Zahtjev za slobodan pristup informacijama

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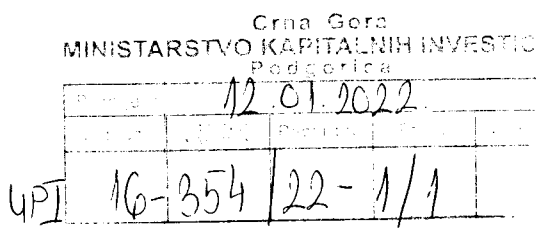
Tue 1/11/2022 5:49 PM

To:Arhiva Ministarstva kapitalnih investicija <arhiva@mki.gov.me>;



1 attachments (916 KB)

Zahtjev za slobodan pristup informacijama sa prilozima.pdf;

Poštovani,

U prilogu je zahtjev za slobodan pristup informacijama na temu Jonsko-jadranskog gasovoda.

Molim da me obavijestite o djelovodnom broju pod kojim je zahtjev zaveden.

Srdačan pozdrav,

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069193371

MINISTARSTVO KAPITALNIH INVESTICIJA
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Crna Gora
MINISTARSTVO KAPITALNIH INVESTICIJA
Podgorica
Primljeno: 12.01.2022
UPI 16-354/22-1/1

Predmet: Zahtjev za slobodan pristup informaciji

Na osnovu člana 3 i člana 18 stav 1 Zakona o slobodnom pristupu informacijama („Službeni list Crne Gore", broj 44/12) tražim pristup informaciji – dokumentu:

- Preliminarni studijsko tehnički izvještaj odnosno Preliminary technical study report (PTSR) o Jonsko jadranskom gasovodu, vjerovatno iz 2013/2014 god.
- Ukoliko je raspoloživa, zahtjev se odnosi i na drugu dokumentaciju koja obrađuje razmatranje varijanti trase Jonsko-jadranskog gasovoda kroz Crnu Goru

Pojašnjenje: Na linku https://www.gov.me/dokumenta/5034b493-9529-4e90-8a43-cf97e312f428 vlada je objavila „Predlog master plana razvoja gasnog transportnog sistema (gasifikacije) Crne Gore s Izvještajem o strateškoj procjeni uticaja na životnu sredinu i Smjernicama za planiranje prioritetnih investicija u projekte gasovoda". Međutim, na stranama fajla: 299, 497, 498 i 499 master plan se poziva na dokument Preliminarni studijsko tehnički izvještaj odnosno Preliminary technical study report (PTSR) u kojem je obrađen odabir trase Jadransko-jonskog gasovoda kroz Crnu Goru između četiri razmatrane varijante, ali ovaj dokument nije dostupan. Navedene stranice prilažem uz ovaj zahtjev.

(podaci o informaciji kojoj se pristup traži)

Pristup traženoj informaciji želim ostvariti:

1. Neposrednim uvidom u prostorijama organa vlasti
2. Prepisivanjem informacije u prostorijama organa vlasti
3. Dostavljanjem kopije informacije
   - Putem pošte

(naznačiti tačnu adresu na koju se traži dostava)

- Elektronskim putem

marko.krstajic@gmail.com ili presnimavanjem na USB flash ili disk
(e-mail adresa / broj fax-a)

U Podgorici, dana 12.01.2021. godine

Podnosilac zahtjeva:

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069 193 371
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Prethodno sprovedenim aktivnostima odabira najpovoljnije trase IAP-a, u okviru potprojekta: WB5-REG-ENE-03 za IAP, izrađena je sljedeća dokumentacija:

- Preliminarni studijski tehnički izvještaj, januar 2014. god.
- Izvještaj o procjeni uticaja na životnu sredinu i socijalna pitanja (PUŽSSP/ eng. ESIA), mart 2014 – nije prošla službeni postupak PUŽS, pa su sprovedene konsultacije i dogovori između zemalja kroz koje IAP prolazi: Albanija, Crna Gora i Hrvatska.

Iako IAP nije dio MPG-a, u Dodatku A date su njegove osnovne karakteristike i opis pravca, kao i glavni rezultati procjene uticaja na životnu sredinu i socijalna pitanja.

Kao što je već rečeno, transportna mreža gasovoda proteže se od obalnog do krajnjeg sjevernog područja i uključuje povezivanje sa svim glavnim centrima. Dva najveća grada su Podgorica i Nikšić.

S obzirom na položaj IAP-a, obalni dio prenosnog sistema Crne Gore prikazan je s kraćim prenosnim cjevovodima koji se odvajaju direktno iz IAP sistema, kao što su ogranci Ulcinj, Tivat/Kotor i Herceg Novi. Opštine Budva i Bar mogu se snabdijevati iz PRM-ova postavljenih direktno na IAP-ove objekte.

Osim obalnog područja, drugi veliki dio sistema temelji se na velikom ogranku do Podgorice koji vodi preko Crne Gore u sjeveroistočnom smjeru. S tog magistralnog gasovoda gasni se prenos nastavlja prema Nikšiću.

Za navedene djelove transportnog sistema je, tokom izrade Smjernica za planiranje prioritetnih investicija u gasovodne projekte (PIP), napravljena detaljnija razrada planiranih trasa, kao i razrada distributivne mreže za svako distributivno područje. Ova područja čine osnovu sistema gasifikacije Crne Gore (Tabela 1).

Tabela 1. Osnove sistema gasifikacije Crne Gore

	Pritisak (bar)	Prečnik (inč)	Dužina (km)
PRENOSNI GASOVODI			
IAP	70	32	94,70
IAP-Ulcinj	50	8	13,20
IAP-Tivat	16	8	6,48
Ogranak do Kotora	16	8	4,50
IAP-Herceg Novi	16	8	15,8
IAP-Podgorica	50	24	54,53
Podgorica–Nikšić	50	12	40,20
UKUPNO (prenosna mreža)			**229,43**
VISOKOPRITISNI (HP) DISTRIBUTIVNI GASOVOD			
Budva	16	8	5,9
Bar	16	8	7,5
Podgorica	16	8	9,8
Nikšić	16	8	5,9
UKUPNA (visokopritisna distribucija)			**29,10**

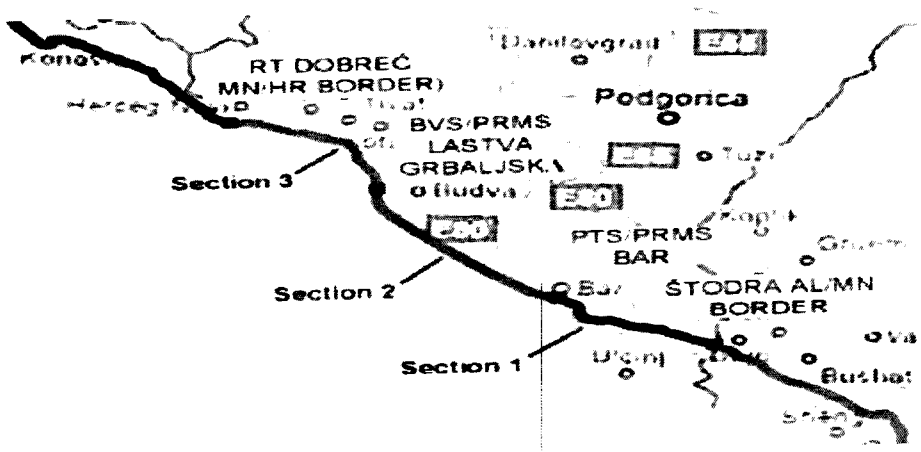
Za gasovod koji povezuje IAP i Podgoricu, MPG-om su predložena tri varijantna rješenja (V1, V2A i V2B).

- U decembru 2013. godine u Bakuu, u Azerbejdžanu, potpisan je Memorandum o razumijevanju između Azerbejdžana, Albanije, Bosne i Hercegovine, Hrvatske i Crne Gore, o saradnji na projektu izgradnje Južnog gasnog koridora u jugoistočnoj Evropi (TAP i IAP).

U sklopu WBIF projekta (pod oznakom WB5-REG-ENE-03) izrađena je Studija izvodljivosti za IAP (izrađivač: COWI i IPF Konzorcijum) i Strareška procjena uticaja projekta na životnu sredinu i socijalna pitanja.

U postupku izrade Studije izvodljivosti, u decembru 2013. godine, u Podgorici je održana prezentacija o procjeni uticaja na životnu sredinu i društvo za projekat IAP-a za Crnu Goru (ESIA). Prezentaciji su prisustvovali predstavnici državnih organa i organa lokalne samouprave. Finalna studija izvodljivosti je predstavljena na sastanku Međudržavne komisije za realizaciju projekta u aprilu 2014. godine u Albaniji.

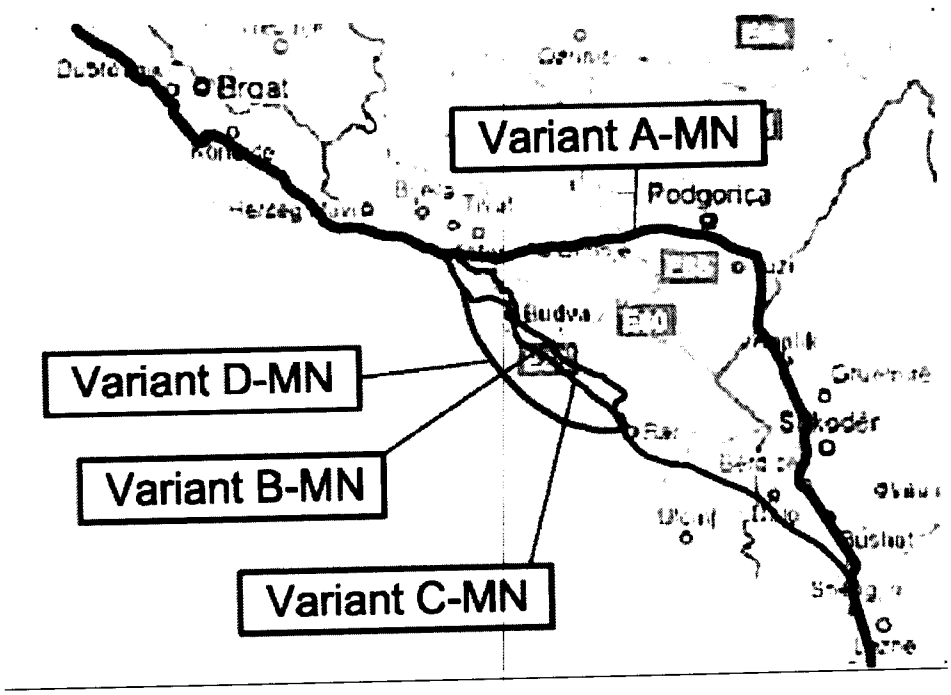
Preliminarnom verzijom Studije analizirane su moguće trase budućeg gasovoda. Trase su analizirane sa aspekata ekonomske opravdanosti, optimalnog prečnika gasovoda, mogućnosti potrošnje gasa i obuhvatile su varijantna rješenja za kompletnu trasu od Fiere do Splita. Za potrebe izrade Studije, Crna Gora je prihvatila varijantno rješenje trase IAP, koje bi trebalo da bude na relaciji Anomalsko polje (Ulcinj)–Bar, odatle podvodnom dionicom do Luštice, zatim preko Luštice ponovo ispod mora ka Hrvatskoj.



Ministarstvo ekonomije informisalo je Ministarstvo održivog razvoja i turizma, sve opštine kroz koje bi trebalo da prođe planirana trasa gasovoda, kao i sve obrađivače opštinskih prostornih planova i prostornog plana za priobalno područje o dostupnim detaljima trase, kako bi ista mogla da bude uvrštena u prostorno-planska dokumenta.

Odabir trase IAP-a

IAP trasa kroz Crnu Goru inicijalno je imala četiri varijante:



Inicijalne varijante IAP trase kroz Crnu Goru	Opis	Debljina stjenske Mase
Varijanta A-MN	Od mjesta Lezha u Albaniji trasa ide u smjeru sjeverozapada, prelazi granicu Crne Gore, sa sjeverne strane zaobilazi Skadarsko jezero i ide prema Podgorici, zatim skreće u smjeru jugozapada i prateći put nastavlja prema Cetinju i Kotoru.	1,4
Varijanta B-MN	Od mjesta Lezha u Albaniji trasa ide u smjeru zapada, prelazi granicu Crne Gore i nastavlja prema Baru. Trasa je postavljena paralelno s obalnom linijom, penje se u planine i ide prema Budvi. Zaobilazeći Budvu sa sjeverne strane, trasa nastavlja prema Kotoru.	1,7
Varijanta C-MN	Ova varijanta slična je varijanti B, s razlikom u tome što prolazi kroz Budvu i pomjerena je bliže obali.	2,0
Varijanta D-MN	Ova varijanta slična je varijantama B i C, s razlikom u tome što nakon Bara ulazi u more i podmorjem dolazi do kopna zapadno od Budve, pa dalje nastavlja prema Kotoru.	2,5
Sve trase nakon Kotora planirane su preko poluostrva Luštica, nakon čega ulaze u Hrvatsku.		

Ove četiri varijante analizirale su se tokom izrade Preliminarnog tehničkog izvještaja (Preliminary Technical Report, January 2013) programskim paketom *DoctuS*, uzevši u obzir tri glavne grupe kriterijuma i njihove potkriterijume:

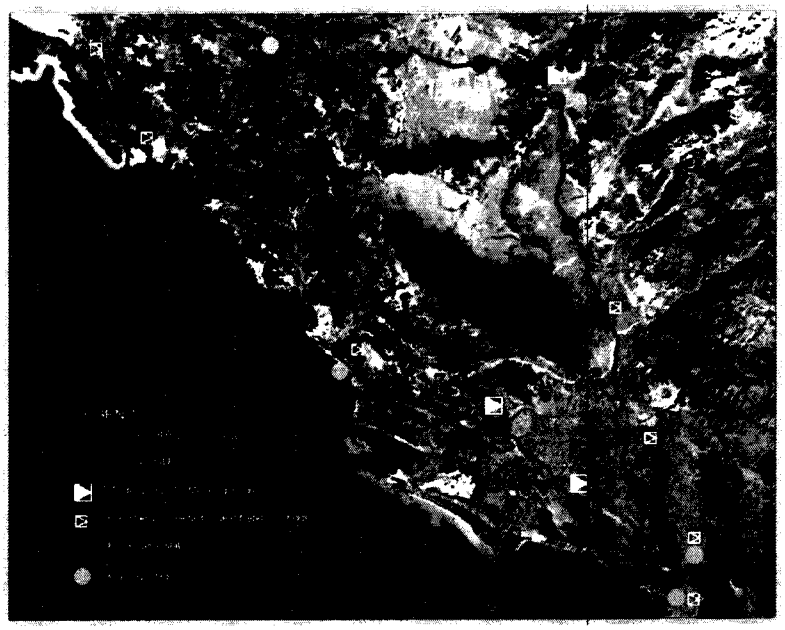
- Kriterijumi okoline
  - Zone sanitarne zaštite (hidrogeologija)
  - Prelasci preko vodotokova
  - Zaštićena područja prirode
  - Korišćenje zemljišta
  - Predio i vizuelni uticaji
  - Kulturna baština

- Socijalni kriterijumi
  - Prolazak kroz naseljena područja i područja velike ekonomske vrijednosti (turističke zone, industrijske zone i dr.)

- Tehnološko-ekonomski kriterijumi
  - Inicijalni troškovi izgradnje
  - Mogućnosti tehničke izvodljivosti izgradnje

Rezultati sprovedene analize pokazali su da su varijante A i D prihvatljivije od varijanti B i C. Rezultati analize prezentovani su dionicima iz energetskog sektora Albanije, Crne Gore, Hrvatske i Bosne i Hecegovine (na radionicama u Podgorici, Sarajevu, Zagrebu i Tirani). Na osnovu dogovora na sastancima, u daljnjim fazama projekta detaljnije su analizirane varijante A-MN i D-MN kroz Crnu Goru, kako bi se odabrala najpovoljnija varijanta.

Na slici u nastavku (Slika 70) prikazane su dvije varijante IAP trase, s obzirom na tačku prelaza iz Crne Gore u Albaniju (varijanta A odnosi se na varijantu A-MN, a varijanta B odnosi se na varijantu D-MN prolaska kroz Crnu Goru) za koje je sprovedena detaljnija analiza, uzevši u obzir gore navedene kriterijume i potkriterijume.



Slika 70. Analiza varijanti IAP trase

Sprovedenom detaljnijom analizom (Preliminary Technical Study Report- Annex II, May 2013) zaključeno je da je varijanta B povoljnija s aspekta tehničke izvodljivosti, ekonomskih kriterijuma, kao i s aspekta životne sredine i socijalnih pitanja. Kao najznačajniji negativan uticaj varijante B s aspekta životne sredine, istaknut je prolazak trase kroz NP "Lovćen". U ovoj fazi nijesu bila izvršena pomorska istraživanja kako bi se dobili kvalitetniji podaci za procjenu i analizu odabira varijanti. Ipak, na osnovu ekspertne ocjene i bez tih istraživanja zaključeno je da je varijanta B povoljnija od varijante A.

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Up. I broj: 16-354/22-1/2 Podgorica, 21.01.2021. godine

Na osnovu člana 30 stav 1 Zakona o slobodnom pristupu informacijama ("Sl.list CG", br.44/12 i 30/17), postupajući po zahtjevu Marka Krstajića, iz Podgorice, od 12.01.2022. godine, Ministarstvo kapitalnih investicija

R J E Š E N J E

I Dozvoljava se pristup informacijama sljedećim dokumentima:
- Preliminarni studijsko tehnički izvještaj – Preliminary technical study report (PTSR), o Jonsko – Jadranskom gasovodu.
- Druga dokumentacija koja obrađuje varijante trase Jonsko – Jadranskog gasovoda.

II Pristup traženoj informaciji ostvariće se elektronskim putem dostavom skeniranih dokumenata na e-mail: marko.krstajić@gmail.com.
III Žalba na rješenje kojim se dozvoljava pristup informaciji ne odlaže izvršenje rješenja.
IV Troškova postupka nije bilo.

O b r a z l o ž e n j e

Marko Krstajić, iz Podgorice, podnio je zahtjev za slobodan pristup informacijama od 12.01.2022. godine, zaveden u Ministarstvo kapitalnih investicija pod Up. I broj: 16-354/22-1/1, kojim je zatražio pristup sljedećim informacijama – dokumentima: Preliminarni studijsko tehnički izvještaj - Preliminary technical study report (PTSR), o Jonsko – Jadranskom gasovodu, i ukoliko je raspoloživa, druga dokumentacija koja obrađuje razmatranje varijanti trase Jonsko – Jadranskog gasovoda kroz Crnu Goru.

Postupajući po predmetnom zahtjevu, Ministarstvo kapitalnih investicija je utvrdilo, da se tražena informacija nalazi u posjedu organa, kao i da se u istoj ne nalaze podacin čijim bi se objelodanjivanjem ugrozio neki interes iz člana 14 Zakona o slobodnom pristupu informacijama. U skladu sa navedenim, predmetni zahtjev se usvaja i podnosiocu zahtjeva se dozvoljava pristup u skladu sa odredbama iz člana 13 istog zakona, kojim je propisano da je organ vlasti dužan da fizičkom i pravnom licu koje traži pristup informaciji ili njenom dijelu koju posjeduju, osim u slučajevima predviđenim zakonom.

Članom 36 Zakona o slobodnom pristupu informacijama, propisano je da žalba na rješenje kojim se dozvoljava pristup informaciji ne odlaže izvršenje rješenja.

Uputstvo o pravnoj zaštiti: Protiv ovog rješenja može se izjasniti žalba Agenciji za zaštitu ličnih podataka i slobodan pristup informacijama, preko ovog organa ili neposredno, u roku od 15 dana od dana prijema rješenja.

Dostavljeno:
-Marko Krstajić
-arhiva

Mladen Bojanić
MINISTAR

Obradio:
Jasmin Krnić, samostalni savjetnik I

Saglasna:
Milena Žižić, sekretarka

The European Union's 2008 IPA Programme for Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo*, Turkey and Iceland

Infrastructure Projects Facility
Technical Assistance Window (IPF TA)

EuropeAid/128073/C/SER/MULTI

Sub Project:
WB5-REG-ENE-03

FS and ESIA for the
Ionian – Adriatic Pipeline (IAP)

Preliminary Technical Study Report
Annex II
Selection of final IAP route

May 2013

This project is funded by the European Union

COWI • IPF CONSORTIUM

*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.

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Annex II
Selection of final IAP route

May 2013

Document no.	WB5-REG-ENE-03 Selection of final IAP route
Version	1
Date of issue	May 2013
Prepared	IAP team
Checked	Eric Balling
Approved	Ole Johansen

*) This designation is without prejudice to positions on status, and is in line with UNHCR 1244 and the ICJ Opinion on Kosovo declaration of independence

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LIST OF ABBREVIATIONS

ALB	Albania
ASA	Archaeological Survey Agency - ALB
asl	above sea level
BiH	Bosnia and Herzegovina
bcm	Billion Cubic Meter
BVS	Block valve station
CTMS	Custody Transfer Metering Station
DCM	Decision of Council of Ministers
EN	Emerald network
EU	European Union
HSSM	Hydrometeorological and Seismological Service of Montenegro
IAP	Ionian-Adriatic Pipeline
IBA	Important Bird Areas
IFI	International Finance Institution
IHM	Institute of Hydrometeorology of Albania
IPA	Important Plant Areas
IPF	Infrastructure Projects Facility
MNE	Montenegro
MNR	Managed Nature Reserve
MoE	Ministry of Economy of Albania
MoEFWA	Ministry of Environment, Forests & Waters Administration- ALB
MPPT	Ministry of Public Works and Transport - ALB
NCL	National Licensing Center of Albania
NM	Nature Monument
NP	National Park
PA	Protected area
PL	Protected Landscape
PP	Physical Plan
PRMS	Gas Pressure Reduction and Metering Station
PTS	Pig Trap Station
PTSR	Preliminary Technical Study Report
SIA	Social Impact Assessment
SoER	State of Environment Report - ALB
TA	Technical Assistance

1 Synopsis

Project Title: Feasibility Study and EIA & SIA Ionian – Adriatic Pipeline

Project Number: WB5-REG-ENE-03

Contractor: COWI-IPF Consortium

Beneficiaries:

Croatia:

Plinacro Ltd and Ministry of Economy.

Bosnia & Herzegovina;

Ministry of Foreign Trade and Economic Relations represented by BH-Gas and Gaspromet.

Montenegro:

Ministry of Economy.

Albania:

Ministry of Economy, Trade and Energy.

Project start date: 08/05/2012

Project Duration: 22 months

Anticipated completion: February 2014

2 Introduction

The Ionian-Adriatic Pipeline Project (IAP) will interconnect the existing and planned gas transmission system of the Republic of Croatia with the Trans Adriatic Pipeline (TAP) or a similar project (Interconnector Turkey – Greece – Italy (ITGI)). The project aims to establish a new supply route for natural gas from the Middle East and Caspian region, northwards along the Adriatic coast. The IAP project is however planned as a bi-directional pipeline, so the possible supply direction could also be north – south, from the strategically planned LNG terminal in Croatia, or other sources.

The construction of this transmission pipeline would enable the gasification of Albania and Montenegro, Bosnia and Herzegovina and southern Croatia, providing a diversified and reliable natural gas supply.

Within the preparation of project documentation for IAP initial investigations and preliminary route selections have already been carried out.

After the presentation of the preliminary analysis it was decided, based on the results, that the IAP route will pass through Albania, Montenegro and Croatia, and branch connections towards BiH will be provided.

For final decision of the IAP route more detailed analysis needed to be carried out in order to establish final IAP route corridor.

The scope of this document is to propose a final solution for the IAP route throughout all three considered countries. As the IAP route is already defined in part of Albania and Montenegro and throughout Croatia, this document will give recommendations for the IAP final/preferred route in the part between Albania and Montenegro.

For ease of reference the variants have been named as follows:

- Variant A – Variant A Montenegro + Variant A Albania (as analysed in PTSR)
- Variant B – Variant D Montenegro + Variant C Albania (as analysed in PTSR)

Figure 1: Pipeline route Variant A and Variant B through Albania and Montenegro

Report structure

The Selection of the final IAP route report is structured as follows:

Chapter 1 – presenting Synopsis of the entire project

Chapter 2 – gives a short introduction of report scope.

Chapter 3 – gives a short description of project and considered IAP routes within each country (the parts already defined and the parts that still need to be defined). it also gives a short explanation of the planned IAP route in accordance with the relevant Strategic planning documentation.

Chapter 4 –presents detailed analysis of observed IAP variants in the trans boundary part between Albania and Montenegro, including technical, economic, environmental and social aspects;

Chapter 5 – presents the final results of the test of the proposed variants, based on valorisation of each aspect.

Chapter 6 – gives final conclusions and recommendations on final IAP routing.

3 Project description

3.1 IAP route description

The route starts near Fier in Albania where it will be connected to the Trans Adriatic Pipeline (TAP). The pipeline runs in northern direction towards Tirana and further on to the border with Montenegro. After passing Montenegro the route crosses the Kotor Bay entering Croatia at Uvala Čipavica. From there the pipeline runs parallel to the coastal line towards Dubrovnik and finally continues in northwest direction to Dugopolje near the city of Split where it interconnects to the gas transmission system of Croatia. The pipeline diameter is 32 inch.

This transmission supply project, of 530 km total length, with nominal diameter 32", would create the preconditions for the development of the natural gas markets of Albania, Montenegro, Bosnia & Herzegovina and Croatia at the estimated annual level of 5 bcm. (for Albania 1bcm + for Montenegro 0.5 bcm + for Bosnia and Herzegovina 1 bcm + for Croatia 2.5 bcm).

The goal of the Preliminary Technical Study Report was to analyse all the possible variants of the IAP route based on techno-economic, environmental and social aspects, and to propose the optimal solution for the entire IAP system. However, members of the Interstate Committee did not agree with the recommendations made by the study team and it was therefore requested that a more detailed analysis of the route in Montenegro and northern part of Albania should be elaborated.

In the present document two route variants through Albania and Montenegro have been subject of such detailed analysis in order to determine the final IAP route (see figure 1).

3.2 IAP route description within each country

3.2.1 Albania

Variant A-ALB

From Balldre the pipeline crosses flat agriculture areas until it reaches Shkodra. The urban area of Shkodra will be passed on the southeast side. The pipeline route crosses river Drin and passes Skadar/Shkodra Lake on the north and runs

into mountainous area towards Hani Hotit (Barlaj) at the border of Albania – Montenegro.

- Total length of section 67.5 km
- Highest point of the pipeline 510 m
- Lowest point of the pipeline -1 m

Variant D-ALB

From Balldre the pipeline runs towards the border of Albania – Montenegro at Dajc (Štodra) runs mostly through flat agriculture areas and it is very suitable for pipeline construction. At the border the pipeline crosses river Bojana.

- Total length of section 29.3 km
- Highest point of the pipeline 100 m
- Lowest point of the pipeline -2 m

3.2.2 Montenegro

Variant A-MN

From Barlaj (Hani Hotit) at Albania – Montenegro border the pipeline runs through mountainous area towards Podgorica passes Podgorica on the south and follows in general the main road in direction to Cetinje. The route passes Cetinje and continues towards Radanovići.

- Total length of section 63.5 km
- Highest point of the pipeline 1360 m
- Lowest point of the pipeline 20 m

Variant D-MN

From Dajc/ Štodra at Albania – Montenegro border towards city of Bar the route runs through flat agriculture terrain occasionally passes few settlements and after that runs through hilly – mountain area. Near the city of Bar, the route enters the sea and is laid down on the seabed. Near the bay of Jaz the route runs on-shore, passes over Quaternary valley and reaches Lastva Grabajska. The route follows the road towards Radanovići, at the edge of a broad valley.

- Total length of section 76.0 km
- Highest point of the pipeline 600 m
- Lowest point of the pipeline -84 m

The offshore section of the route has been changed compared to the PTSR. The route is shorter and closer to the coast in order to achieve uniform depth conditions on the seabed according to the subsea map. Modification of the route has been made based on the preparatory works for the maritime surveys that will be carried out for the proposed offshore section.

3.3 Alignment with Strategic planning documentation

Planning documents regarding spatial planning determine the organization, use and purpose of space, as well as guidelines and measures for organization, protection and development of space. Planning documents are made on state level and at local level.

Albania

The Spatial Planning System

The first efforts to establish a new territory planning system in Albania started in 2006 with the preparation of the "Policy and strategy for the implementation of the new legal framework on spatial planning in Albania" (MPPT, 2007). The objective of this Policy Document is to guide the development of a legal framework for territorial planning in Albania by establishing the basic parameters of the territorial planning system, including scope and content of the process, rules and procedures for implementing the system and assignment of authority for the various phases of this process.

Some of the environmental and social requirements of this Policy and Strategy include:

- Creating a more rational territorial organization of land uses and the linkages between them, to balance demands for development with the need to protect the environment, and to achieve social and economic objectives;

- Increasing attention to the "special areas" that reflect specific environmental, cultural, historic, social or economic concerns;

- The participation of stakeholders provides the opportunity for a more careful identification of key development needs, issues and priorities. This participation must be comprehensive across all planning stages beginning with the study process, which precedes the adoption of any plan or development control.

The law no. 10119 of April 23, 2009: "On the territory Planning", was considered as a framework law whose application would depend completely on bylaws and relevant regulations. There are more than 80 laws that need to be revised to match with this law. There is no full decentralization regarding the territory planning in Albania. Urban planning is a local competence, but territory planning is rather shared between local and central government. According to the "Policy and strategy for the implementation of the new legal framework on spatial planning in Albania", in the case of national infrastructure plans, which include the IAP project, the spatial development plans are adopted by the Ministries of the line, the Council of Ministers, and the parliament of Republic of Albania.

Based on the above mentioned situation, the planning documents regarding the spatial planning of the areas traversed by the proposed pipeline corridors have been extracted from the documentation prepared by the local governments. It should be stressed that the local strategic plans in the north-western part of Albania do not include any pipeline corridor.

Strategic Planning of Shkodra Region

The Strategic Planning of Shkodra Region (Regional Council of Shkodra County, 2012), which includes all the North western part of Albania, aims to propel a balanced and endogenous development of the territory and increase the value of Shkodra region by strengthening its cultural, social, environmental, economic identity, and human resources. Its main topics include:

- Delivery of sites for buildings sufficient to meet anticipated needs;
- Strategic infrastructure, roads, public transport, water, sewerage and power, which serves these sites and connects them together in regional space;
- An economic development strategy which guides and underpins the land and infrastructure proposals by providing an economic rationale for them;
- An environmental strategy which aims to ensure the physical sustainability of the land, infrastructure and economic development proposals;
- Effective implementation proposals concerning organizations of institutions, funding of the necessary financial means and an approach to the management of the plan implementation

A map of the Strategic plan of Shkodra Region is shown in Figure 2 below.

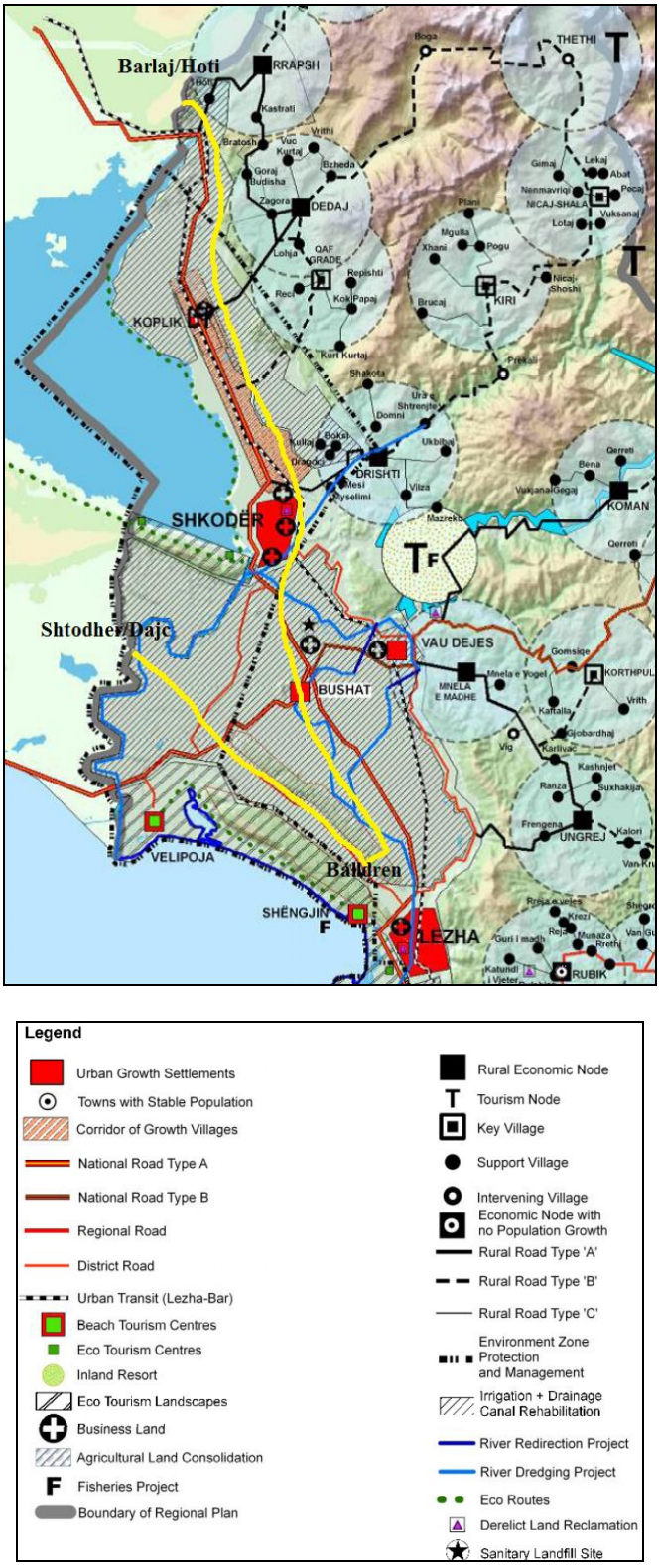


Figure 2 Strategic plan of the Shkodra Region (Shkodra Regional Council, 2012)

In yellow: variants A (Balldren-Hoti/Barlaj) and B (Balldren-Dajc/Shtodher) of the proposed pipeline route.

Variant A

Three zones along Variant A of the proposed pipeline corridor have been extracted from the Shkodra Region Strategic Spatial Plan: Bushat; Shkodra town and its surroundings; and Shkodra-Koplik corridor. These zones cover the main and the most sensitive parts of Variant A of the pipeline corridor, as shown in the following figures.

In the territory of Bushat commune, the pipeline route crosses (Figure 3) the following existing and planned infrastructure areas/objects:

a. a new planned housing zone within the territory of this commune;
b. the planned road to Bar (Montenegro), via the coastline; and
c. the existing urbanized area near Bushat and Melgusha villages.

In the territory of Shkodra and its surroundings, the pipeline route crosses (Figure 4) the following existing/planned infrastructure objects/areas:

a. a planned new business zone in the north of this city;
b. the existing industrial zone of Shkodra;
c. the existing railway connecting Tirana to Shkodra to Montenegro (Podgorica) – two crossings; and
d. the existing district road from Shkodra to Vau Dejes;

Along the corridor Shkodra-Koplik, the pipeline route crosses (Figure 5):

a. two planned new business zones;
b. a planned recreational area in the south of Koplik town;
c. three existing district roads; and
d. a number of existing inhabited rural areas.

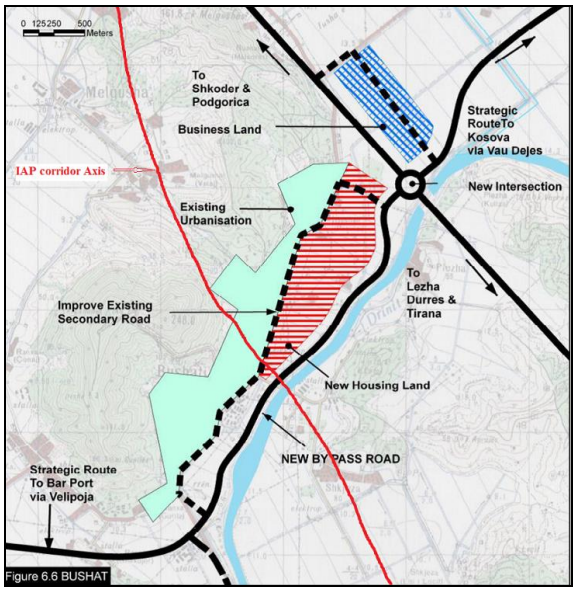


Figure 3 Spatial Plan of Bushat.

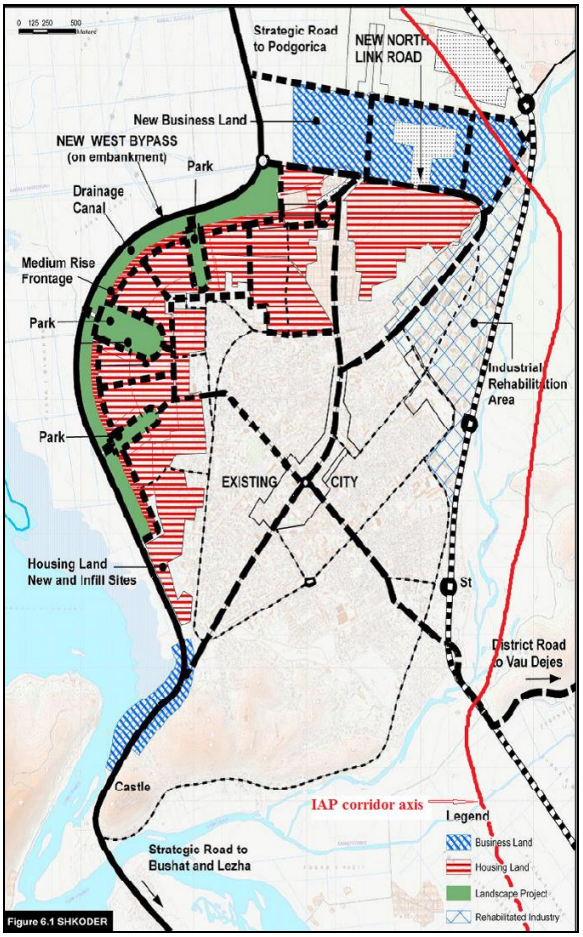


Figure 4 Spatial plan of Shkodra and its surroundings.

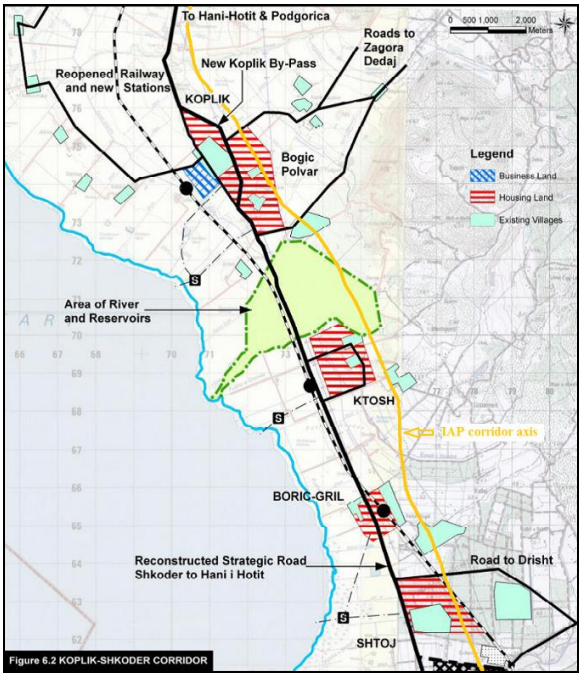


Figure 5 Spatial plan of the corridor Shkodra - Koplik

Variant B

The spatial planning for Variant B of the pipeline route has been extracted from the Strategic Spatial Plan of Dajc Commune, which is more detailed than the regional plan. Since there are no industrial activities in this commune, this Plan aims for the management of agricultural and urban lands.

As shown in following figure, the pipeline corridor runs over agricultural lands only. Close to the state border ALB/MNE, the pipeline traverses the riparian forest of Buna Riverbed that is planned as a green belt.

The other part of Variant B including the pipeline segment from Balldren to the administrative border between Balldren (Lezha district) and Dajc (Shkodra District) communes runs entirely through agricultural lands. There are no other planned infrastructure objects to be found in this segment because it lies in a flood prone area, which requires permanent drainage through a pumping station located near Balldren Village territory.

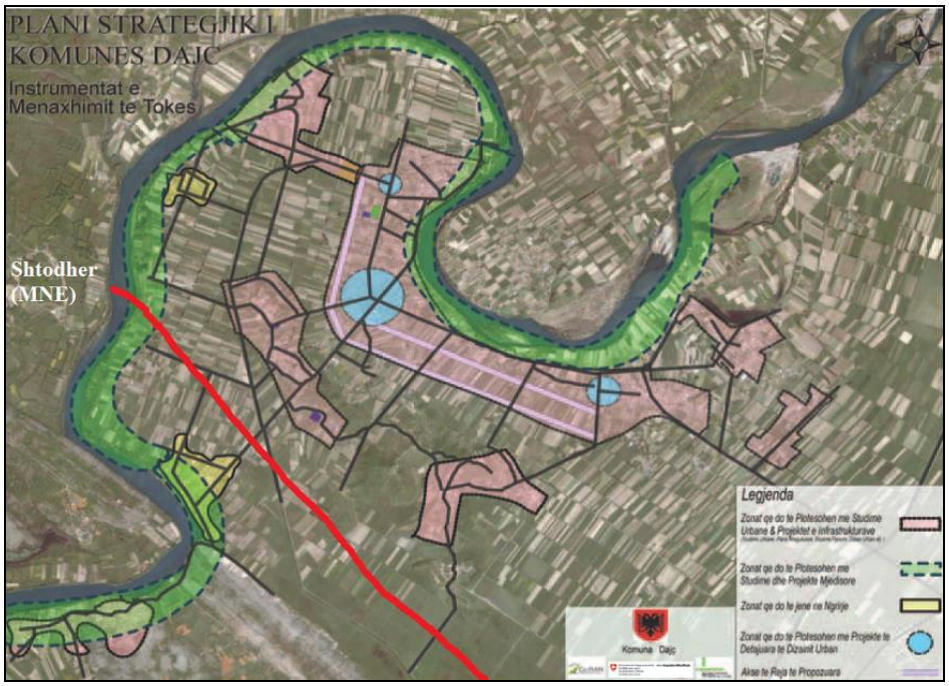


Figure 6 Strategic Spatial Plan of Dajc Commune (2008)

Legend:
-Red line: Variant B of the pipeline route;
-Reddish: areas where urban plans will be improved;
-Yellow: Areas where new housing development is prohibited; and
-Green: Recreational area.

Montenegro

On state level in Montenegro there are four state planning documents:

- Spatial Plan of Montenegro;
- Spatial Plan for Special Purposes;
- Detailed Spatial Plan and
- State Location Study.

The Spatial Plan of Montenegro is a strategic document that sets general conditions for the organization of spatial planning in Montenegro. The Spatial Plan of Montenegro sets state goals and measures for spatial planning development, which is in line with the complete economic, social, ecological and cultural-historical development of Montenegro. In the Spatial Plan of Montenegro the following items are described: policy for use of space, long term policy for organization of space, basic infrastructure systems and basic technical systems and the way of connecting them to infrastructure systems; guidelines for improving energy efficiency and use of renewable energy sources, etc.

In the latest Spatial Plan of Montenegro that covers planning interventions until 2020, the construction of gas pipeline system in Montenegro is envisaged. Until now no gas pipeline network has been built in the territory of Montenegro. It is planned that the foreseen gas system connects with the gas system of Republic of Serbia and with international gas pipeline systems. For that purpose the infrastructure corridor has been reserved within the corridor of a future highway. Nevertheless, the spatial plan also states that these provisions have not yet been realised.

In point 1.3.2.3 “Technical infrastructure systems” of the spatial plan one of the scopes determined by the plan is to include corridors of infrastructure objects within the same routes.

Section 2.6.2 of the spatial plan of Montenegro presents spatial concept of development of energetic infrastructure. In order to create the possibility to improve gas supply network it is necessary to preserve corridors from other requirements and usage that would disturb anticipated purpose, until the final decision upon the gas pipeline network construction, in some of following corridors:

- Niš – Priština – Berane – Podgorica – Bar (“south main gas pipeline”) (within the corridor of planned highway Niš – Podgorica)
- Užice – Prijepolje – Podgorica – Bar (within the corridor of planned highway Beograd – Podgorica - Bar)
- Dubrovnik – Podgorica (within the corridor of planned Adriatic – Ionian highway or alternative, the corridor of the main road along the coast line) the corridor of this gas pipeline should enable connection of gas systems of Croatia and Albania, through Montenegro.

4 Analysis of IAP variants between Albania and Montenegro

4.1 Technical and Technological Gas Pipeline characteristics

4.1.1 General

Gas pipeline system is a closed technological system made of a series connected steel pipes and integrated equipment with the purpose of gas transport at high pressure.

The nominal diameter of pipeline is 32" (DN800). The entire gas pipeline is planned as underground (or sub-sea) installation with the exception of the construction of surface structures on the places of installation of block valve stations (BVS), metering and reduction stations (PRMS) and the pig trap stations (PTS). Variant B is located offshore between Budva and Bar.

Table 1: Technical pipeline characteristics

Section	Length (km)	Diameter (inch)	Pressure (bar)	BVS	BVS +PMRS	BVS +PTS	BVS +CTMS +PRMS (Podgorica)	PRMS +BVS+PTS	CTMS +BVS	CTMS +BVS +PTS
Variant A										
IAP -A - ALB	67.5	32"	85		3			1		1
IAP -A - MN	63.5	32"	75	1	1	1	1			
Total	131. 0			1	4	1	1	1		1
Variant B										
IAP -D- ALB	29.3	32"	85					1	1	
IAP -D- MN	76.0	32"	75	1	2			1	1	
Total	105. 3			1	2			2	2	

Block Valve Station (BVS)

A block valve station (BVS) is a facility on the gas pipeline that enables the closure of each pipe section of the pipeline. The reason for the closure of a pipe section of the gas pipeline can be reconstruction, repair or regular service. If a pipe of the gas pipeline is damaged and there is unexpected gas leakage, the block system shall automatically close the damaged section of the gas pipeline. Unexpected gas leakage is detected because of increased pressure drop in the pipe for example a pressure gradient of 3.5 bar/min.

Block valve device consists of the main in-line ball valve on the gas pipeline, a driver (actuator), control unit (Electronic Line Break Control – ELBC), SCADA system, power-supply, vent and related valves.

Pig Trap Station (PTS)

Pig trap station is the facility on the gas pipeline consisting of a block valve station and the two pig traps. The purpose of the block valve device is the same as in the block valve station stopping of the gas pipeline flow at a certain section. The pig trap enables the reception and sending of the cleaning or intelligent pig from one to another section of the gas pipeline to examine the condition of the gas pipeline. The basic components of the system are the main in-line block valve with control unit, two pig traps with quick closures, SCADA system, vent, power supply and interconnecting piping. Between the two pig traps, each belonging to their own gas pipeline sections, there is a block valve device. In the usual operation gas flows through the block valve the valves at the pig traps are closed.

Gas Pressure Reduction and Metering Station (PRMS)

Metering and reduction stations are the connection points to gas distribution network. Metering and reduction station can be set as a container station with the supply capacity up to 10.000 m^3/h of gas. For bigger gas quantities a solid building shall be provided. The PRMS consists of the metering and reduction part and a boiler-room. In the metering and reduction part there are two or more lines with the regulating, safety and metering equipment that provides safe and uninterrupted operating of the station. In the boiler-room there are gas boilers, of adequate thermal power. The connection of the PMRS and the connections to distribution network will be underground.

The initial gas pressure, at the entrance to the MRS is 85/75 bar and it is lowered by the reduction station system to two or more pressure levels. The common level of reduced gas pressure intended for the industrial consumers is from 3 to 17 bar, while the reduced pressure level intended for the population is 3 to 6 bar.

Custody Transfer Metering Station (CTMS)

At each side of the border, a custody transfer metering station is located with the purpose of measuring quantity of gas that is entering or leaving each country. The container consists of a block valve station, pig station, meter runs, SCADA system, power supply, and interconnecting piping.

Gas Pipeline Construction

The gas pipeline will be designed, constructed and used in accordance with the national and international norms, regulations and laws for that type of structures.

The trench for pipe placement should be made with the depth of 200 to 250 cm, depending on the purpose of land, and the incline of the walls or the insurance system according to geo-mechanical survey. In general the depth should be under the depth of ground freezing and such that it does not obstruct further use of the land for agricultural purposes. Along the entire route of the gas pipeline, two 50 mm HDPE pipes will be installed for the light-wire signal cable. The gas pipeline will be protected by a passive mechanical anticorrosion protection, active cathodic protection and protection from stray currents.

After welding, weld and pressure test should be carried out. After the completion of all works on gas pipe, the construction area should be brought back to its initial state by covering it with soil previously removed.

The Variant A and Variant B pipeline route with pipeline facilities are shown in following figure:

Figure 7: Pipeline route Variant A and Variant B

Defined criteria for technical construction of the pipeline are shown in following Tables:

Valuation factor	Technical construction criteria
1	very difficult
2	difficult
3	moderate
4	easy

4.1.2 Variant A

Total length of pipeline 131km

Highest point of pipeline 1360 m

Lowest point of pipeline -1 m

In its start, the route runs through flat agriculture area that presents easy technical solution. The route occasionally passes near settlements that present moderate technical difficulties. Continuing through flat agriculture area the route crosses a river that presents very difficult technical solution. The route passes the urban area of Shkodra that presents difficult terrain for construction of the pipeline. Again, the pipeline crosses flat agriculture area that presents easy technical solution, and then rocky area that represents moderate technical difficulties. On its way the route has several river crossings that present very difficult technical solution. Through high mountain area very difficult for construction the route reaches the city of Podgorica. This urban area is difficult for construction of the pipeline. From Podgorica the route runs through hilly (difficult) and mountain (very difficult) area, and ends in urban area.

It is considered that the technical solution of the construction of Variant A is difficult (**evaluated 2**).

4.1.3 Variant B

Total length of pipeline of 105.3km

Highest point of the pipeline 600 m

Lowest point of the on-shore pipeline -1 m

The route runs through flat agriculture area that presents easy technical solution. Then it crosses the hill, which is difficult and continues through flat agriculture area that presents easy technical solution. At Albania – Montenegro border the route crosses river Bojana that presents very difficult technical solution. The route runs through flat agriculture area, occasionally passes near settlements which present easy technical solution. The route runs through low hilly rocky terrain that presents moderate technical difficulties. The route passes urban area of Bar through mountain area that present difficult terrain for construction of the pipeline. The pipeline runs offshore from Bar to Budva that

represents moderate technical difficulties. On-shore, pipeline runs partly through flat populated valley, partly through rocky terrain and ends in populated area that presents moderate technical difficulties.

It is considered that the technical solution of the construction of Variant B is moderate (**evaluated 3**).

4.2 Economic calculations

The aim of these analyses was to evaluate the economic effects of detailed Albania and Montenegro routes on the transport tariff tendency for Montenegro.

Analyses are carried out for two routes:

Var. A: Albania-Montenegro Podgorica route

Var. B: Albania -Montenegro coastal route

The economic analyses have been carried out with the following presumptions:

- Investment will be carried out through three years in same yearly amounts.
- Maintenance costs are estimated at 1% of total investment for pipelines and 2% for facilities
- System would be financed from funds obtained on financial markets through long-term borrowing at financial institutions

The price of borrowed capital has been calculated according to the following assumed terms and conditions:

- repayment period: 15 years,
- regular interest rate: 6% per annum
- repayment in equal semi-annual instalments

The operating and maintenance costs include:

- energy costs
- gas transportation system maintenance costs

The quantity of natural gas transported is a business event resulting in an increased financial and economic potential of the project.

The projected provision of natural gas transportation services is based on the assumed gas market build up from the draft gas market forecast. Gas transportation costs are optimized in a way to meet internal rate of return of 7%, the project acceptability criterion. The planned project period of 20 years is taken as one in which the investment project produces acceptable effects. The detailed investment and maintenance cost for pipeline variants are presented in following tables.

Table 2 Route Variant A: Albania-Montenegro Podgorica route - pipeline costs calculation

length	terrain	mechanical works	civil works	Total	TOTAL
km		€/m	€/m	€/m	€
45.2	flat-agricultural	602	208	810	36 593 920
27	urban area	602	630	1 232	33 264 000
8	rocky	632	389	1 021	8 166 400
29	mountainous area	662	817	1 478	42 873 600
21.5	hilly	632	284	915	19 676 800
0.18	river	632	1 368	2 000	360 000
0.07	river	632	1 368	2 000	140 000
0.1	river	632	1 368	2 000	200 000
131.05					141 274 720

Table 3 Route Variant A: Albania-Montenegro Podgorica route - facilities

			Total
Facility	€	Number	€
BVS	350 000	1	350 000
BVS+PRMS	550 000	4	2 200 000
BVS+PTS	800 000	1	800 000
BVS+CTMS+PRMS (Podgorica)	1 700 000	1	1 700 000
PRMS +BVS+PTS	1 000 000	1	1 000 000
CTMS +BVS+PTS	1 200 000	1	1 200 000
		TOTAL:	7 250 000

Legend:
BVS - Block Valve Station
PTS - Pig Trap Station
PRMS - Gas Pressure Reduction and Metering Station
CTMS - Custody Transfer Metering Station

Table 4 Route Variant B: Albania-Montenegro coastal route - pipeline costs calculation

length	terrain	mechanical works	civil works	Total	TOTAL
km		€/m	€/m	€/m	€
38	flat-agricultural	602	314	915	34 777 600
5	flat-populated	602	314	915	4 576 000
5	urban area	602	630	1 232	6 160 000
9	rocky	632	389	1 021	9 187 200
8	mountainous area	662	817	1 478	11 827 200
2	hilly	632	284	915	1 830 400
36	offshore	764	360	1 124	40 473 054
1.5	HDD	650	1 334	1 984	2 976 000
0.2	river	632	1 368	2 000	400 000
0.6	sea entering 2x	602	6 065	6 667	4 000 000
105.3					116 207 454

Legend:
HDD – Horizontal direct drilling

Table 5 Route Variant B: Albania-Montenegro coastal route - facilities

			Total
Facility	€	Number	€
BVS	350 000	1	350 000
BVS+PRMS	550 000	2	1 100 000
PRMS +BVS+PTS	1 000 000	2	2 000 000
CTMS +BVS	750 000	2	1 500 000
		TOTAL:	4 950 000

Legend:
BVS - Block Valve Station
PTS - Pig Trap Station
PRMS - Gas Pressure Reduction and Metering Station
CTMS - Custody Transfer Metering Station

4.2.1 Transport tariff tendency projection

When comparing the Montenegro connection pipeline route options just from the investment point of view the coastal route is much cheaper than the one on the north of the Skadar Lake. Difference in investment costs between the coastal pipeline route and the Podgorica pipeline route toward Croatia is 27.4 million EUR in favour of the costal route, which is 11 mil EUR lower than the difference reported in the Preliminary technical study report.

Shown in continuation is the transport tariff tendency projection for the planned period over which the investment project produces economically acceptable effects.

Table 6 Transport tariff tendency projection Albania-Montenegro routes

MNE			
Period of the project life	**Year**	**20**	
Acceptability criteria of the project			
Internal rate of return (IRR)	**%**	**7.00%**	
Variant		**Var. A**	**Var. B**
Expected volume of transported natural gas, average	**mio m3**	**1 781**	**1 775**
Changes in the volume of transported natural gas	**%**	**0.0%**	**-0.3%**
Investment	**mio €**	**148.5**	**121.2**
Changes in the level of investment	**%**	**0.0%**	**-18.4%**
Operation and maintenance costs	**mio €**	**1.56**	**1.26**
Changes in the level operation and maintenance costs	**%**	**0.0%**	**-19.0%**
Transport tariff	**€cts/m3**	**1.099**	**0.901**
Changes in the level of transports tariffs	**%**	**0.0%**	**-17.9%**

Result of this investment difference is 22% higher transport tariff of the Albania-Montenegro Podgorica route (1.099 €cts/m3) than the more direct Albania -Montenegro coastal route transport tariff (0.901 €cts/m3).

Although 27.4 million EUR relative investment difference allows us to reach potential Podgorica gas power plant consummation sooner; it does not result in smaller transmission tariff.

It should be stressed out that relatively large gas consumption potential in Podgorica area predominantly rely on the expected development of the gas fired power plant after 2025. Uncertainty related to the development of this plant (it is not envisaged in the Montenegro energy sector strategy) has additional negative impact on the already 22% higher transmission tariff of the proposed the Albania-Montenegro Podgorica route.

Taking all that into account the results of the economic study indicate that Variant B (Albania -Montenegro coastal route) can be considered as more favourable solution for the IAP route.

4.3 Preliminary Environmental and Social Impact Assessment for two proposed IAP variants

4.3.1 Environmental and Social baselines

4.3.1.1 Climatic characteristics

Albania

Variant A and Variant B

According to the climate division of the Albanian Territory (IHM, 1984), the project area is located in the Mediterranean Plain Climate Zone. In particular, the segments Balldren – Dajc (border ALB/MNE) and Balldren-Shkodra lie in the Northern Mediterranean Plain Sub-zone, while the segment from Shkodra to the northern part of Hot village (border ALB/MNE) lies in the Northern Mediterranean Hilly Sub-zone.

Mild and wet winters and hot and dry summers characterize the Northern Mediterranean Plain sub-zone, which includes the flat area from Lezha to Shkodra. While the Northern Mediterranean Hilly Sub-zone encompasses the North Albanian low mountain areas whose elevation varies mostly from 200 to 600 m asl. This sub-zone is characterized by relatively warm and wet winter and dry and hot summer.

In order to study the climate characteristics of this particular area, long-term weather data provided by the nearby meteorological stations were collected. These meteorological stations are located in Lezha, Bushat (located between Shkodra and Balldren) and Shkodra.

It is important to note that the entire area of the Western Lowland of Albania is highly influenced by the Adriatic Sea. This influence can be seen by the minimum, maximum and average air temperatures. The most important parameters are the yearly average temperature, the absolute maximum temperature and the absolute minimum temperature. The coldest month is January, whereas the warmest month is July.

Table 7 Annual air temperatures in the northern part of the project area in Albanian territory

Parameter	Station		
	Lezha	Bushat	Shkodra
Annual average	15.4	15.0	14.8
Max abs.	40.0	41.0	41.5
Min. abs.	-10	-11.0	-13.0

Source: Hydro meteorological Institute, Tirana

Typically, the northern part of the study area has high rainfalls, which reach 2000 mm of rain per year. The rainfall is less pronounced in the central and southern part of the northwestern Albania. The maximum daily precipitation in Shkodra is about 200 -240 mm.

Table 8 average yearly precipitations in the northern part of the project area in Albanian territory

Parameter	Station		
	Lezha mm	Bushat mm	Shkodra mm
Annual average precipitation	1325	1640	2070

The quantity of snow varies within a wide range. Snowfalls in the areas Balldren - Dajc and Balldren - Shkodra are rare and of no particular concern. Precipitation in northern part of the project area (from Shkodra to Hot Village) however is approximately 5 to 10% snow; while in areas of elevation higher than 1000m asl; snow constitutes about 20% of winter precipitation.

Storm events are characteristic of the climate of Albania. According to data from the Shkodra Meteorological Station, the 15 minutes precipitation height reaches 30 to 40 mm, the 30 minutes rainfall may reach up to 80 mm, while the rainfall for 1, 2 and 3 hours are registered at respectively 120 mm, 152 mm and 161 mm (all data refers to a repetition probability of one storm event during one year; n = 1).

Conclusion: There are no noticeable differences on climate characteristics. In Variant A rainfalls and snow days are slightly higher, while temperatures slightly lower.

Montenegro

Variant A and Variant B

According to the Köppen climate division, the area of Montenegro is divided into several climatic types with several subtypes. This is due to its geographical location, diverse relief, relocation and confrontation of air masses of different physical properties, surface characteristics and other factors. Major role in modifying the climate in the territory of Montenegro have Atlantic Ocean and the Mediterranean Sea, as well as mainland Europe and Asia, whose vast expanses are regions where centers of cyclones and anticyclones form.

The area of the planned gas pipeline belonging to moderately warm, Mediterranean climate, Cs, (Figure 8) with two subtypes: Csa (Mediterranean climate with hot summers) and Csbx" (Mediterranean climate with warm summers).

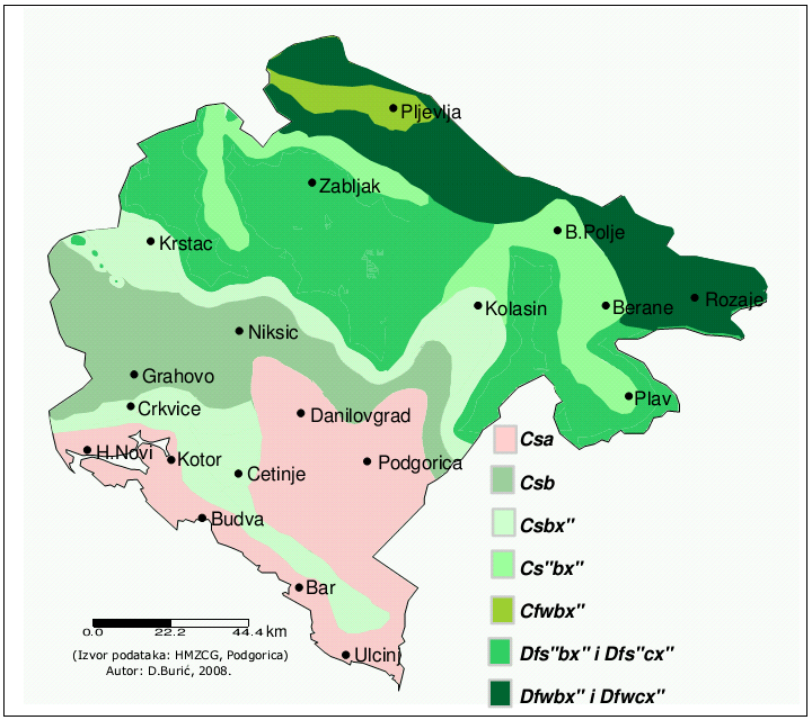


Figure 8 Climatic division of Montenegro according to Köppen in the period 1961-1990.

Csa subtype climate is characterized by bright, dry and bright summers and mild and rainy winters - a typical Mediterranean climate. This subtype has an average air temperature in the coldest month between -3 °C and 18 °C. Summer is the driest time of the year, and the mean temperature of the warmest month is greater than 22 ° C. For the subtypes of Cs-type climate maximum rainfall occurs in November and the lowest in July - littoral and Zeta-bjelopavlići plain.

Csbx" subtype climate is transitional Variant of the Mediterranean climate, which is different than the previous one in that besides the primary secondary (x") maximum precipitation also occurs. At the Csa and Csb subtypes only one, very distinct, maximum and minimum rainfall exists at a time. In this subtype the monthly sum of precipitation decreases from November (primary max.) to early spring, when a secondary maximum occurs (in March or April) - Cetinje.

Depending on their positions in the observed area of the planned pipeline route, stations Ulcinj and Podgorica are the references for the type of climate Csa while Cetinje station represents Csbx" type of climate. According to data from period 1961-1990, the highest average temperature of July of 26.0 °C occurs in Podgorica, where the air temperature extreme of 44.8 °C was recorded. The following table shows an overview of important climatic parameters for the above-mentioned stations.

Table 9 Overview climatological parameters in the observed area

STATION	Altitude [m]	Climate type	Tyr. [°C]	Tmin [°C]	ATmin [°C]	Average annual rainfall [mm]
Cetinje	640	Csbx''	9,8	-4,0	-21,7	3237
Podgorica	49	Csa	15,3	1,4	-9,6	1654
Ulcinj	3,5	Csa	15,5	4,1	-8,4	1258
Tyr. – average yearly temperature Tmin. – average minimal temperature of the coldest month ATmin. – absolute minimal temperature recorded in the observed period						

Table above shows that average air temperatures in Csbx" climate type are considerably lower while average annual rainfall is double.

Conclusion: Given that both variants of the route pass through Csa climate type and only smaller portion through Csbx", impact of climate factors is equal.

4.3.1.2 Geomorphology

Variant A

Albania

The geomorphological characteristics have been described with respect to the proposed pipeline route.

- Balldren to Gocaj

At Balldren Variant A of the pipeline route starts in a narrow and flat valley located between the hilly chains of Rrenci (western part) and Kakarriqi (eastern part) that lie in a southeast to northwest direction. After crossing the Kakarriqi rocky Mountain the pipeline route reaches the Zadrima Plain in the territory of Gocaj Village.

- Gocaj to Drini River

From Gocaj to Drini riverbed the line route traverses from the South to the North the Zadrima Plain, where the line route runs mainly over a flat terrain covered from alluvial deposits, whose upper layers are composed mainly of clays and silts. From the geomorphological point of view, the Zadrima plain consists essentially of two larger units: a- the floodplain alongside the rivers Drini Lezhes and Gjadri, which is situated between the north-eastern slopes of Kakarriqi Mountain and the flysch hills; and b-the large piedmont plain, which extends from the riverside floodplain to mountain chain of Shite-Vela (1,170 m asl) in the East.

In the northern part of Kakarriqi Mountain the pipeline route traverses the hills of Bushat that border the Zadrima Plain from the West. From Bushat to Drini River the pipeline runs again through the flat terrain of Zadrima Plain.

- Drini River to Bajza

From Drini River to the border Albania/Montenegro the pipeline runs through the Malesia Madhe tectonic sub-zone, which is the western periphery of the tectonic zone of the Albanian Alps.

From Drini River to Bajza the pipeline corridor runs in a flat terrain over Quaternary loose deposits of the Pleistocene and Holocene ages. This segment is bordered from the east from the rocky Mountainous area of the Albanian Alps, and from the West from the Shkodra Lake. Along the pipeline route flow a number of small rivers and streams, which originate from the mountainous area in the Eastern part of Shkodra Lake and reach the eastern shoreline of this lake. The direction of these small rivers and streams is from the east to the West, except for the Kiri River which has a north-eastern to south-western direction.

- Bajza to Hoti/Barlaj (km 59.0-67.5)

From Bajza to the border Albania/Montenegro the line route runs through stratified limestone locally dolomitized. The intensive fracturing of the limestone has assisted the high development of the karst that is manifested by the presence of various karst forms like, shallow and deep karren, karst canals and wells, cavities and huge karst springs. The karst springs are mainly located along the Albanian part of the shoreline of Shkodra Lake. In the eastern part of the segment Bajza-Ivanaj the terrain is relatively flat because the karst sinkholes are filled with loose proluvium deposits.

The pipeline segment from Bajza to Hoti/Barlaj follows, in a south to north direction, the foot of the western slope of the rocky mountainous area of the Albanian Alps (shown on following figure). At the border Albania/Montenegro the pipeline route crosses an area of approximately 500 m asl quota.

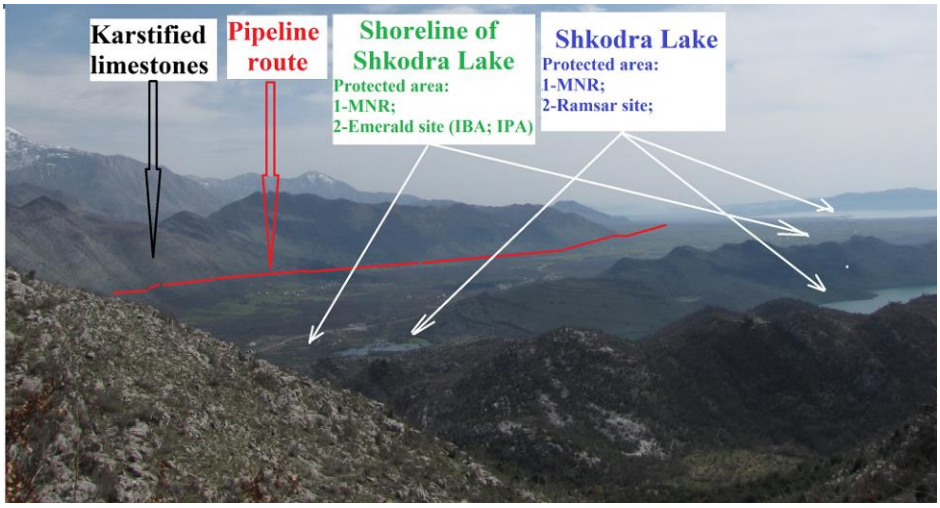


Figure 9 Overview of the main geomorphological units along the segment Bajza-Hoti/Barlaj

Montenegro

Variant A of the planned pipeline route crosses over Albania – Montenegro border south of the Barlaj settlement. The greater area encompasses several mountains. It is a hilly area with extremely indented and dissected relief. Slope terrain is classified as steep and very steep. Planned pipeline route crosses over lowland. After crossing, slope terrain increases again.

Topography of this area is characterized by processes and forms characteristic for glacial and fluvial erosion. North of the planned pipeline route there is a river Cijevna and its terrace surrounded with very dynamic relief characteristics. Route crosses over the valley that is on south side surrounded by middle high hills with the peaks Dečić (650 m) and Đelevik (494 m).

10 km from Albania – Montenegro border near D. Mileš settlement relief the whole geomorphological area becomes completely different. After extremely indented, high-elevated hills with steep slopes the relief becomes lowland (flat surface). The planned pipeline route crosses over the stream Urelja and karst field Rogamsko polje, which is not so high elevated (approximately 60m high) surrounded by middle high hills Šipčanička gora (135 m), Bukovči (88m), Rogamsko brdo (130 m) and Kećeva (146 m). On the south side after Cijevna river karst field Rogamsko polje becomes karst field Ćemovsko polje. This area is not high-elevated, approximately 50 m above sea level.

After crossing Sitnica, stream that flows to the river Morača, relief again becomes high elevated, indented and with steep slopes. Intense denudation processes created this area. The terrain consists of indented ridges, peaks and ditches. The greatest elevation of this whole area is 300 m and is decreasing until it becomes karst field with huge number of karst micro-relief forms (sinkholes).

After passing by Grubani settlement, planned pipeline route crosses through valley between high hill Zlogora with well-expressed peaks Crna Glavica (337 m), Orlić (245 m) and Leperić (425m), which are forming steep ridge from the east to the west, Gomila (252 m), V. Drač (282 m), Pasja glavica (300 m) and Milostojska glavica (305 m).

From Dobrska Župa to Dobrsko Selo planned pipeline route is touching edges of high elevated and well-indented hills. Occasionally crosses through the walley between surrounding middle high mountains and peaks (Vjetuš 639 m, Golo brdo 517 m, Lipovo Korito 495 m, etc.). This valley is classified as lowland (flat surface). High mountains with extremely steep slopes surround the valley. Planned pipeline route occasionally intersects the peaks of small hills. The mountain Ceklinštak (845 m) with steep slope and well-defined ridges is located south from the planned pipeline route.

The last segment of the planned pipeline route passes through the area of Lovćen National park.

Variant A of the planned pipeline ends when entering into Soliotsko polje karst field which is located west from high elevated, well indented hills striated by numerous ditches.

Variant B

Albania

From Balldren to Dajc/Shtodher (Albania/Montenegro border) the proposed pipeline corridor runs entirely in flat terrain.

From Balldren to Torovica embankment the proposed corridor runs along the Balldren Field (Torovica field), which is approximately 1 km wide and 20 km long. This field is bordered from the rocky hills of Rrenci and Kakarriqi (Figure 10) that lie in a Southeast to northwest direction.

From Torovica embankment to the border Albania/ Montenegro the pipeline corridor turns over the flat terrain of the Bregu Bunes Plain, which is bordered from the west from the Kolaj Mountain (545 m asl) and Mali Belaj (Belaj Mountain) hilly chain (Figure 11), which lie in a southeast to northwest direction.

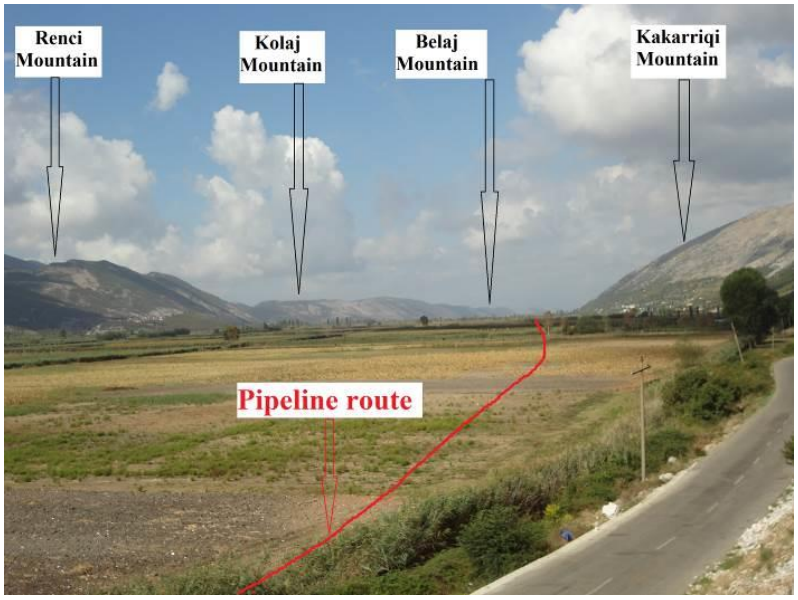


Figure 10 Main geomorphological units along the first 20 km of Variant B of the pipeline route in Albanian territory

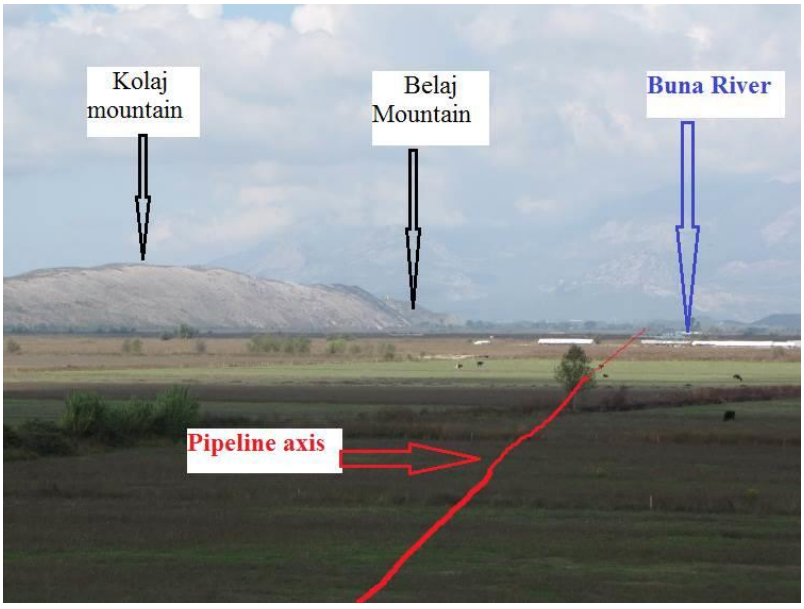


Figure 11 Main geomorphological units of along the last 10 km of Variant B of the pipeline route in Albanian territory

Montenegro

Variant B of the planned pipeline route crosses over Albania – Montenegro border on the Bojana River. The route crosses through the Anamalsko polje karst field, which is elevated approximately 30 m high. The field is surrounded by hills with steep slopes, which are at 70 m of elevation. The route also crosses Miđanska, right stream of Bojana river.

Middle segment of Variant B of the planned pipeline route crosses through the walley between steep slopes of surrounding hills (Gora Kručanska/Vranje gnijezdo 631 m, Povara 319.5 m). The route intersects karst field Mrkovsko polje and Mrkovska River.

After Mrkovsko polje karst field Variant B of the planned pipeline turns to the north and crosses near very steep and well indented mountain Lisinj with well-defined NW-SE ridge and numerous ditches on the west side. There are several high elevated peaks: Treštenik (1090 m), Debetin (1262 m), Ranga (981 m), Loška (1353 m), etc.

Before going through submarin the route climbes over indented karst terrain with steep slopes south from City of Bar. It crosses through well-indented Volujica Mountain. The mountain has well defined ridge with NW-SE direction. The route goes sub-sea near cape Bigovica.

After leaving the submarine course, Variant B of the planned pipeline route enters Mrčevo Polje karst field and goes forward through well-defined walley surrounded with high slopes of Donja Gora, Kalimanica and Bregovi hills. Numerous ditches striate this hilly, steep area. Variant B of the planned pipeline route ends when entering into Soliotsko polje karst field.

4.3.1.3 Geology and hydrogeology

Variant A

Overview of lithostratigraphic units

Albania

At Balldren the line route runs over marshy and marine deposits. From Balldren to Gocaj village the pipeline route traverses the Cretaceous limestone formations of the Kakarriqi Mountain.

From Gocaj to the eastern part of Shkodra town the line route traverses the Zadrima Plain, which has a tectonic origin and has been developed as a result of local subsidence at the end of the Early Pleistocene age (Aliaj et al., 2001). Subsequently, this area was filled in with alluvial deposits by the rivers Drini, Gjadri and numerous streams.

Throughout Zadrima Plain the pipeline route runs through a flat terrain that is covered with alluvium deposits, whose upper layers are composed mainly of clays and silts. This section crosses the main rivers of Drini Lezhes (four times), Drini, and Kiri, as well as two small rivers (Vraka and Rrjolli) and numerous perennial and seasonal streams. On both sides of the river crossings the line route generally runs over gravelly deposits that belong to the Lower Shkodra and Upper Shkodra Quaternary gravel aquifers.

From Shkodra to the border ALB/MNE the pipeline runs through the Malesia Madhe tectonic sub-zone, which represents the western periphery of the tectonic zone of the Mountainous area of the Albanian Alps. The Malesia Madhe sub-zone represents a large monocline split by faults into separate blocks with 20° to 25° dip angles inclining in the northern or north-eastern direction. In the western periphery this monocline bends by dipping south-west at an angle of 10 to 15° under Pliocene to Quaternary molasses and the Shkodra Lake. Stratigraphically, the profile of Malesia Madhe Sub-Zone started in the Upper Triassic with intercalated dolomites and limestone.

From Shkodra to Bajza along the pipeline corridor outcrops in surface Quaternary loose deposits of the Pleistocene and Holocene ages. The segment Shkodra-Gruda Field runs over clayey-sandy deposits. From Palvar to Bajza outcrop in surface alluvium and prolluvium deposits of Rrjolli River and of the Perroi Thate ("Dry Stream") stream that are composed of weakly cemented gravel and sands of high permeability.

From Bajza to the border ALB/MNE the line route runs through stratified Upper Jurassic limestone locally dolomitized which provides well developed bedding fissures interconnected by at least two perpendicular or almost perpendicular fractures. In the Malesia Madhe tectonic sub-zone vertical tectonic faults are intensively developed splitting the area into separate big and small blocks. Shkodra Lake is also a big down faulting block which represents a graben (Geology of Albania, 2002). The Bajza-Ivanaj karst plain represents a second order down faulting block. The intensive fracturing of the limestone has assisted the high development of the karst that is manifested by the presence of various karst forms like, shallow and deep karren, karst canals and wells, caves and huge karst springs. The numerous sinkholes developed on the surface of this karst plain are often merged with each other and filled with proluvium deposits. The karst springs located along the Albanian part of the shoreline of Shkodra Lake are fed from the mountainous area located in the east of this segment of the line route.

Montenegro

Variant A crosses over Albania – Montenegro border south of the Barlaj settlement, over the hills built of grey yellowish Lower Cretaceous ($K_{1,2}$) bulky and stratified limestones, dolomites and dolomitic limestones. The route goes westward and passes over Upper Jurassic (Dogger - $J_3^{2,3}$) and Middle Jurassic (Upper Kimmeridgian – Portlandian - $J_{2,3}$) sediment built of limestone – dolomitic facies with abundance of algae. Variant A near the settlement Paskala turns to NW over the Lower Cretaceous (K_1) layers that consist of limestone, dolomitic limestone and dolomite. East of the settlement Mileši, route of the pipeline descends into the Quaternary valley, which consists of three sections of terraces in Zetska valley. In this valley the pipeline passes through deposits of rivers Morača and Cijevna. The third terrace (t_3) is made from gravel, with pebble size that ranges from 2 to 8 cm, alternating with sands that differ in thickness. Relative height of the third terrace in the Morača canyon is approximately 20 m, and in Zestka valley it varies from 3 to 6 m. The second

terrace (t_2) has small spreading area and is made from the same materials as the third terrace. Forming of the first terrace (t_1) did not have greater significance in forming of accumulations, it reflected only in the riverbed. Sediments of the first and second terrace are partially covered with loess. The route passes South of Podgorica, and near the settlement Lekići it ascends over the hill, which is built of Lower Cretaceous (K_1, $K_{1,2}$) and Middle Cretaceous (K_2^2) sediments, limestones, dolomitic limestones and dolomites. The route near Krincka Kamenica passes over Upper Jurassic ($J_3^{2,3}$) limestone – dolomitic layers with abundance of algae, and Middle Jurassic ($J_{2,3}$) bright grey limestones that alternate in lateral and vertical directions with Lower Jurassic (liass ,dogger - $^2J_1$) bulky limestones with a small share of dolomite and dolomitic limestone. The route in the W direction crosses over Upper Triassic (T_3) deposits that were developed in facies of dolomite and dolomitic limestone and rarely limestone. Northeast of Šišići route passes through the valley built of diluvia deposits (d) presented with disintegrated material and breccia, then route passes over Middle Eocene (E_2) deposits built of flysch sediments and descends into Soliotsko polje that is built of alluvial deposits, sands, gravels and clays. In the Soliotsko polje the route Variant A comes to the route junction.

Tectonic relations and seismic features

Albania

According to the tectonic map of Albania (shown on following figure), from Balldren to Shkodra, the line route runs through the tectonic zones of Kruja and Krasta-Cukali (Meco & Aliaj, 2000).

Figure 12 Tectonic Map of Albania (Meco & Aliaj, 2000)

From Balldren to Hoti/Barlaj (border ALB/MNE), the pipeline route traverses a territory of high seismic activity due to active tectonic faults and to the soil category. Along Variant A seven tectonic faults are crossed from the pipeline route (shown on following figure).

According to the seismic intensity map of Albanian territory (Map of Seismic Regionalization of Albania, Scale. 1:500.000, Tirana 1980; approved by the DCM No 371, of December 20, 1979), the wide project area is situated on the seismic intensity VII, VIII, and IX degree MSK-64 (fig. 13), estimated for 100 year (with 70% probability), for an average soil category (2nd Soil Category, according to the technical condition KTP-N.2-89). The expected maximal earthquake magnitude is Ms=7.2.

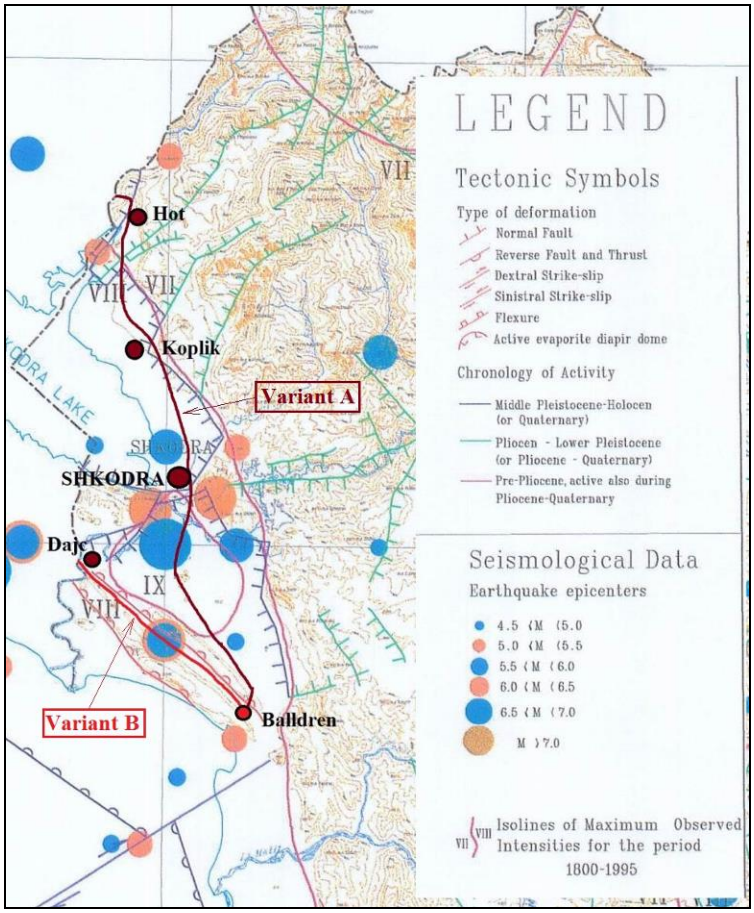


Figure 13 Seismotectonic map of the project area

Source: Seismotectonic Map of Albania, 1:500,000, Academy of Sciences, Institute of Seismology, Tirana 2000.

Montenegro

Variant A enters Montenegro in the area of geotectonic unit called Starocrnogorska ljuska. Stratigraphic series of formations exposed on these terrains start from the Upper Triassic and end with Eocene sediments. Under fluvio – glacial deposits of Zestke ravnice, exploration drilling has identified Neogene marine deposits. On this terrain short discontinuation in sedimentation is identified, which is marked with presence of bauxite.

Within this structural unit is distinctive NE wing of Crnogorski anticlinorium and SW wing of Zeta valley synclinorium. In this structural unit plicative and disjunctive tectonics are expressed. Axis direction is NW-SE, and in the wider area of Tuzi turning of axis elements towards NE is expressed.

Unit Starocrnogorski anticlinorium is part of the tectonic unit Visoki krš in which another structural form - orijensko – bjelogorski syclinorium is distinguished. It is located in the NW part of the terrain overthrusted on Budva-

bar zone along the reverse dislocation Morin – Lepetić. Within this complex structure linear, incline and overturned folds are developed with SW vergence as well as smaller brachystructures.

Variant A in Montenegro part passes through Quaternary valleys Morače and Cijevna near Podgorica which are according to engineering – geological classification of the maximum level of seismicity classified as 8 - 9° of MCS scale. Area of the geoteconic unit Visoki krš according to the same classification is classified as area with maximum extent of seismicity - 6° of MCS scale.

Hydrogeological features

Albania

According to the hydrogeological map of Albania (Eftimi et. Al., 1985), from Balldren to Hoti/Barlaj (border ALB/MNE), the main water resources, over which runs Variant A of the proposed pipeline route, are represented from the following aquifers:

1-Lower Shkodra Quaternary gravel aquifer, which has a local importance for the water supply of the local population;

2-Upper Shkodra Quaternary gravel aquifer that has a national importance, because of the high number of the population supplied with drinking water;

3-Koplik Quaternary Aquifer, which is important in local level for the drinking water supply; and

4-The karst aquifer of Malesia Madhe, from where waters drain to the Shkodra Lake (Ramsar site). This aquifer serves to supply drinking waters to the local population.

Below follows a description of the ground waters over which runs the proposed pipeline route Variant A.

Balldren to Gocaj

At Balldren plain the pipeline route runs over marshy and marine deposits, which overlie the limestone formations of the Torovica syncline from Balldren to the foot of Kakarriqi Mountain. Groundwater along this segment of the pipeline route does not supply drinking water to the villages of the area. A number of karst springs exist on both sides of the Kakarriqi Mountain foots. These springs contain good quality water, which may be used as drinking water. Along the Kakarriqi mountain range, water belonging to limestone rocks can be found at approximately 4-5 m bsl. These waters are of good quality, low mineral content, and suitable for use as drinking water. The well's importance however is to serve solely as individual wells for the villages located on the footings of Kakarriqi Mountain.

Gocaj (Lezha District) to Pacram (Shkodra District) to Drini riverbed

Between Gocaj and the village of Pacram, the pipeline route runs over the Zadrima Plain. The latter is filled with Quaternary loose deposits. The sub clayey and sub sandy cover, which outcrops on the surface, has a thickness that varies between 6 to 40 m. The lower thickness touches in close proximity to the Drini Lezhes riverbed. The water of the underlying Quaternary gravelly aquifer (4-10m thick), has high mineralization and consequently it is not suitable for use as drinking water. The proposed pipeline routes passes over the Nenshkodra aquifer from Pacram to the Drini riverbed. This is an aquifer of regional importance as it supplies drinking water to all villages in this area. The recharge area of this Quaternary gravel aquifer is the Drini riverbed.

Drini riverbed to Gruda field

The pipeline route runs over the Mbishkodra Quaternary gravel aquifer of thickness over 70 m between the Drini river bed and the Gruda field. This aquifer is fed from the karst formations, the Drini and Kiri rivers, and from rainfall. The water table is dependent on the elevation and on the water level of the Shkodra Lake. The clayey sandy cover is only a few meters thick in the western part of this aquifer and inexistent in its eastern part. Thus the eastern portion serves as a recharge area. The quality of the ground waters is very good, and the water wells are characterized by a high discharge. Located in Dobrac (northeast surrounding Shkodra) are waterworks, which supply this city and its surroundings (more than 150,000 inhabitants) with 500 l/s.

Palvar to Bajza

From Palvar to Bajza, the pipeline runs over the Koplik aquifer created from the alluvium and prolluvium deposits of Rrjolli River and of the Perroi Thate (“Dry Stream”) stream. This aquifer is composed of weakly cemented gravel and sands, which are generally characterized by a high permeability, and is fed from the karst formations to the east and rainfalls. The water table is dependent on the elevation and on the water level of Shkodra Lake, which serves as drainage area. The thickness of the aquifer varies from 14 m (Koplik) to 40m (south of Bajza). These water-bearing deposits have very good hydraulic connection with the underlying karstified limestone.

Bajza to Ivanaj to Hoti/Barlaj (border ALB/MNE)

From Bajza to Ivanaj and further to the south of Hoti, the pipeline route runs mainly over a karst plain (Figure 14), as there are no significant Quaternary deposits located in this area. Ground waters flowing from the mountainous area in the east and from rainfalls drain in the Shkodra Lake. A number of perennial and temporary karst lakes and karst springs can be found in the shores of this lake. Hydro-geological studies (Kalaja, 2000; Eftimi, 2008) show that the karst lakes, karst springs, and dug wells communicate with each other from east to west direction, which is the assumed direction of groundwater flow (figures 17, 18, 19, 20). The water of the karst lakes, karst springs, and dug wells is of good

quality. Some dug wells have historical and cultural values (Figure 15). In addition, the karst lakes and springs have high landscape values. The karst springs appear as small round lakes with a diameter of about 15 - 20 m, which by the local population are called “Syri” which means “Eye”. On the shores of Lake Shkodra many temporary karst springs and lakes can be found as well. These are only active during the periods of rainfalls or during the snow melting period.

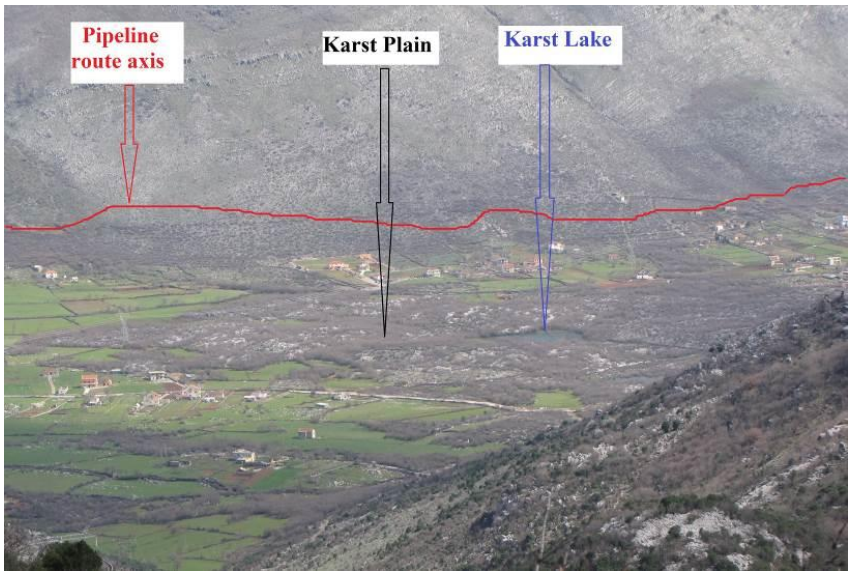


Figure 14 Karst lake on the karst plain in the segment Ivanaj-Hoti/Barlaj

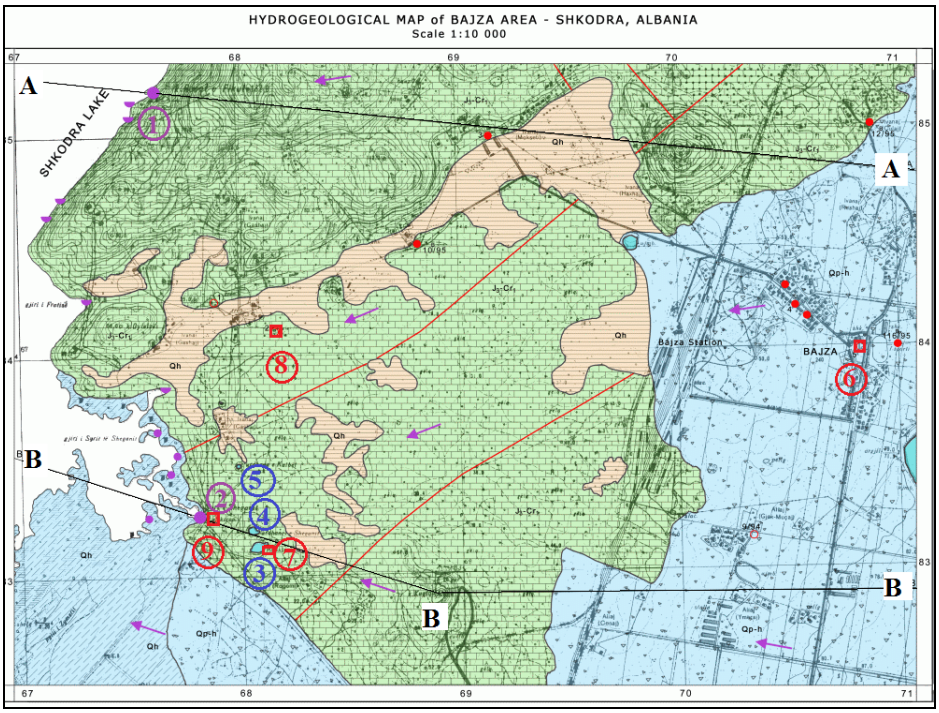
Figure 15 The historical dug well “Shpella Frasherit” (“Cave of ash”) in the centre of Bajza village.

Three small karst lakes (Hurdhana 1, Hurdhana 2, and Hurdhana Kalbet) communicate through karst canals with the Lake Shkodra as well as with Syri Sheganit Spring (Nature Monument). This hydraulic connection is the reason why the water level in the karst lakes varies accordingly to the variation of the Shkodra Lake level; therefore the yearly amplitude of the lake’s level variation is about 5 m. Urdhana Lake 1 and Syri Sheganit spring are used for the

irrigation of the surrounding cultivated lands through pumping stations with a capacity of about 200 -250 l/s.

Figure 16 Bajza Bay where are located numerous karst springs

A detailed investigation has been performed in the framework of the hydrogeological study for the preparation of the report on the "Preliminary Environmental Assessment, Risk Assessment and Preparation of Bidding Documents and Action Plan for Repackaging and Temporary Store of Hazardous Chemicals - Bajza Hot-Spot" (Mon Tec, Tirana, 2008).



Legend:

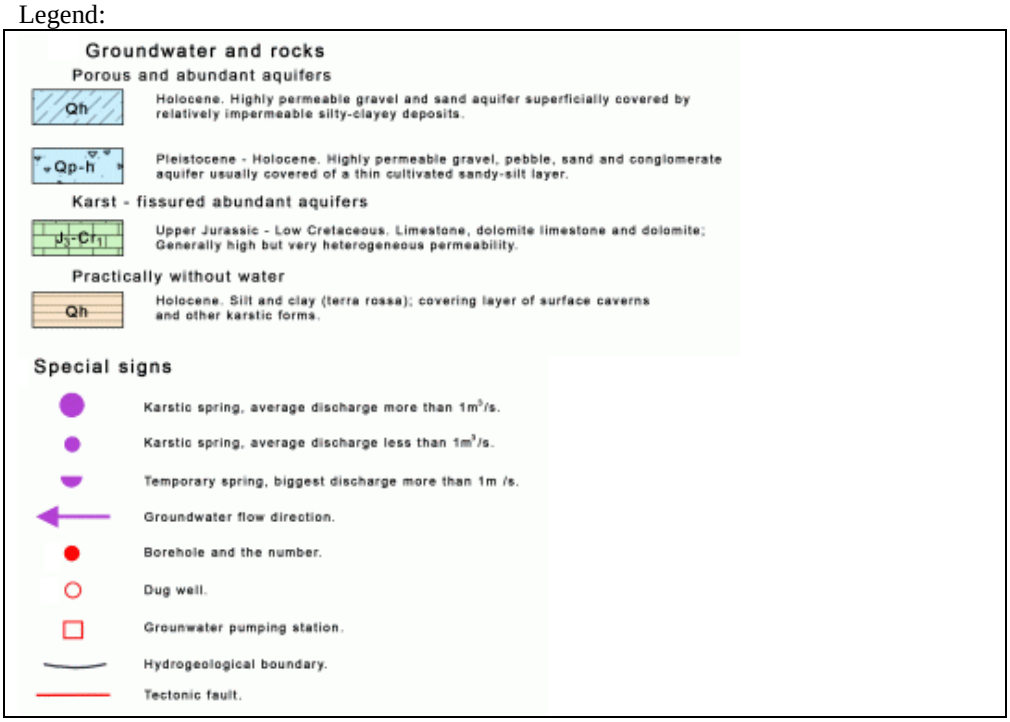


Figure 17 Hydrogeological Map of Bajza area (Eftimi R., 2008)

Source: Based on Eftimi R. in "Preliminary Environmental Assessment, Risk Assessment and Preparation of Bidding Documents and Action Plan for Repackaging and Temporary Store of Hazardous Chemicals - Bajza Hot-Spot" (Mon Tec, Tirana, 2008).
Note: 1-Syri Zi Karst Spring; 2-Syri Sheganit Karst Spring (NM); 3-Hurdhana 1 Karst Lake; 4-Hurdhana 2 Karst Lake; 5-Hurdhana Kalbet karst Lake; 6,8-Dug wells and pumping stations; 7,9-Pumping stations.

The hydrogeological cross-sections A-A and B-B (figures 18, 19, 20) of the above hydrogeological map (fig. 18), show in detail the hydraulic connections between Shkodra Lake and the Karst Springs, Karst Lakes and dug wells in the karstic plain of Bajza that is traversed by Variant A of the proposed pipeline corridor.

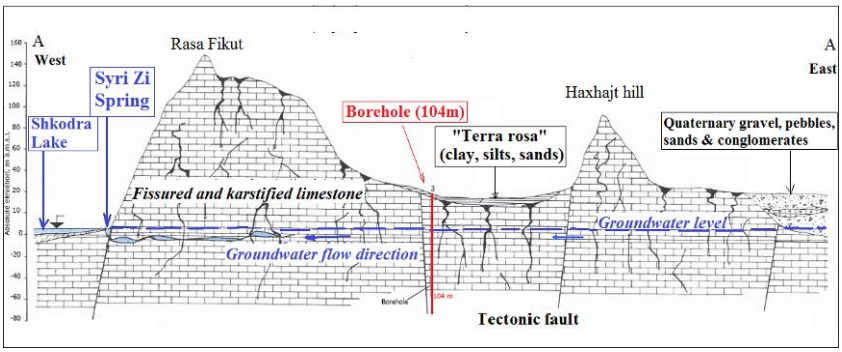


Figure 18 Hydrogeological cross-section (A-A) and hydraulic connections between the Quaternary loose deposits (east of Bajza), Syri Zi karst Spring and Shkodra Lake

Source: Kalaja & Rudi, 1996; and Eftimi R., 2008

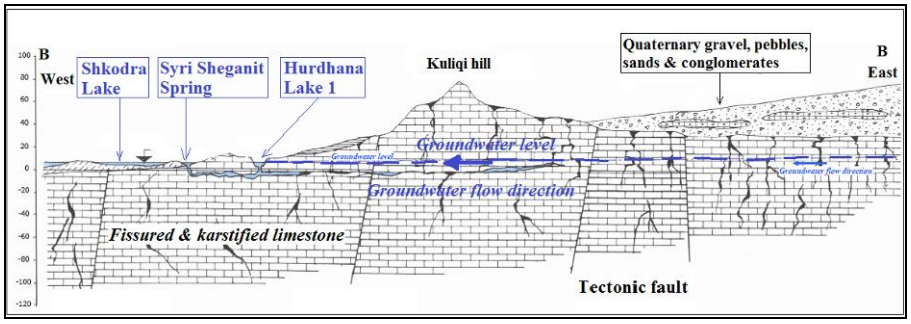


Figure 19 Hydrogeological cross-section (B-B) and hydraulic connections between the Quaternary loose deposits, dug wells, karst lakes, karst springs, and Shkodra Lake

Source: Kalaja & Rudi, 1996; and Eftimi R., 2008

In the figure below are shown in detail the hydraulic connections between the Syri Sheganit Karst Spring and Hurdhana 1 and 2 Karst Lakes.

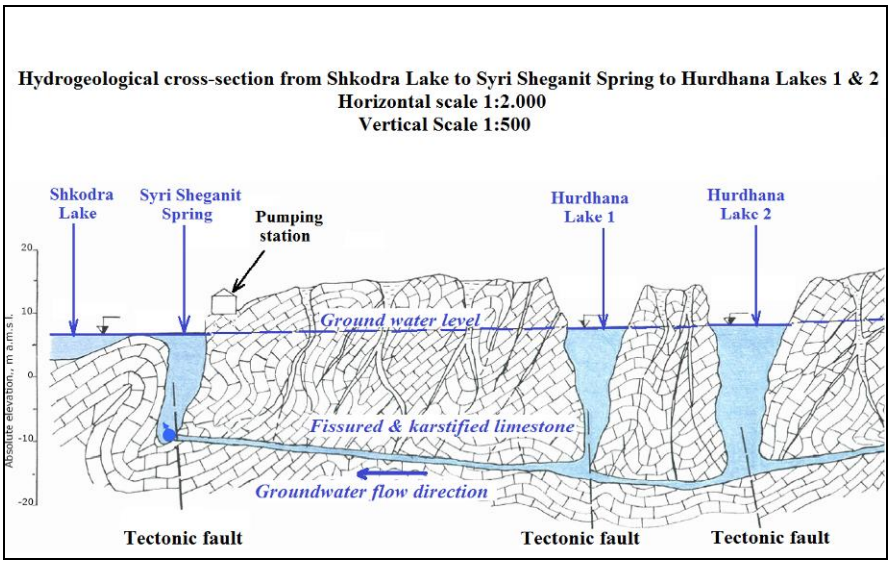


Figure 20 Detailed hydrogeological cross-section near Syri Sheganit Karst Spring
Source: Kalaja & Rudi, 1996

Montenegro

Pipeline route enters Montenegro through Jurassic and Lower Cretaceous limestones, which are mainly intensely karstified with high permeability. Near D. Mileš pipeline route descends to Quaternary valley of rivers Cijevna and Morača whose deposits have different range of yield from high to low. Near Lekići pipeline route ascends over Lower Cretaceous highly karstified rocks with high permeability. Near the settlement Krincka Kamenica Variant A crosses over Upper Cretaceous deposits with medium karstification and high permeability. Near Meterizi pipeline route crosses over Lower Cretaceous intensely karstified deposits with high permeability. In the vicinity of G. Ulici Variant A crosses over Upper Triassic deposits with yield that range from small

to none. In some places pipeline route crosses over smaller diluvial fields with low yield. From the settlement Poda, pipeline route passes mainly through large diluvial fields with various yields, which are separated with Cretaceous and Jurassic deposits. Pipeline route ends at the routes junction in alluvial valley of predominantly high yield.

Variant B

Overview of lithostratigraphic units

Albania

Based on the tectonic map of Albania this section lays in the tectonic zone of Kruja. From Balldren to Dajc the line route runs in a completely flat terrain, over Quaternary marshy and alluvium deposits. The marshy deposits fill the Balldren Plain (Torovica plain), which lies in a southeast to northwest direction, parallel to the hills of Renci (545 m asl at Mali Kolaj peak) and Kakarriqi (383 m asl) that border this plain. From the north-western edge of Kakarriqi hills to the border ALB/MNE the line route runs over the alluvial plain of Buna River, which sediments are composed mainly of clayey-silty deposits.

The Balldreni plain overlies a narrow syncline between the hilly ridges of Rrenci and Kakarriqi that are composed of Cretaceous limestone. The syncline is accentuated by a graben-like structure due to the tectonic activities. Its maximum width is 1 km, while the length is about 20 km.

Montenegro

Variant B crosses over Albania – Montenegro border near the settlement Rusuli, from there the route is heading in NW direction through alluvial valley, built mostly of sands and gravels, rarely clay deposits. West of Vladimir route turns W over Upper Cretaceous (senonian - K_2^3) bulky dolomites, which are alternating with detrital limestones and dolomitized limestones. Near the settlement Kamenički most Variant B passes through Mrkovsko polje that is built of alluvial deposits, and then route crosses over Upper Cretaceous deposits. Near the settlement Pećurice route turns N across dilluvial deposits (d) which are consisted of disintegrated flysch material and fragments of limestone, and in some places are related with slope breccia. After transition through dilluvial deposits, route in NW direction passes over Upper Eocene (E_3) flysch deposits, and S of Zaljevo route passes onto Cape Volujica, that is built of Upper Cretaceous bulky dolomites (senonian - K_2^3), which are alternating with detrital limestones and dolomitizied limestones. In the Bigovica bay the pipeline route Variant B enters the sea.

Geological composition and lithostratigraphy of the seabed is not known. The route exits the sea in the Trsteno bay near Budva and is heading N over Upper Cretaceous ($^3{}_4K_2^3$) white and grey limestones, dolomitic limestones and Upper Cretaceous ($^2{}_4K_2^3$) bulky grey dolomites that are partly bituminous. About one

km from Trsteno bay route crosses into alluvial valley built from sands, gravel and some clay, near Lukavci the route crosses over hill slope that is built of Middle Eocene (E_2) sediments, which are represented with claystone, marl and sandstones with intercalations of breccia and conglomerate. Near Radanovići the route turns along the W edge of Soliotsko polje that is built of alluvial deposits and near Pelinovo comes to the route junction.

Tectonic relations and seismic features

Albania

According to the seismic intensity map of Albanian territory (Map of Seismic Regionalization of Albania, Scale. 1:500.000, Tirana 1980; approved by DCM no 371, of 12.20.1979), the pipeline route runs over a territory situated on the seismic intensity VIII degree MSK-64 (fig. 13), estimated for 100 year (with 70% probability), for an average soil category (2nd Soil Category, according to the technical condition KTP-N.2-89). The expected maximal earthquake magnitude is Ms=7.2.

Variant B does not cross any tectonic fault, while crossing through Albania (Figure 13).

Montenegro

Variant B enters Montenegro in the area of geotectonic unit called Para-autochthon, which is situated between the sea, Cukali zone, Visoki krš and Albanian border. Para-autochthon is built of Upper Cretaceous and Middle Eocene carbonate rocks and Upper Eocene flysch. Because of the distinctive rock plasticity and strong thrusts that acted from NE direction this terrain is abundant with folded structural units – anticlines and synclines.

The route of Varian B exits the sea in the Trsteno bay near Budva and passes through geotectonic unit called Budva-bar zone. This zone is overthrusted over Para-autochthon along reverse dislocation that stretches from Jaz bay near Budva, over Bratešić to Igala.

The geological structure of this geotectonic unit involves various Mesozoic carbonate sediments, Anisian and Paleogene flysch. Budva – Bar set is highly complex, this is the area of intense tectonic narrowing. Around Budva, Mesozoic and Paleogene sediments are folded in multiple parallel overturned anticline and syncline, which are also deformed by breaking.

Variant B passes through geotectonic unit Para-autochthon and partly through Budva-Bar zone which according to engineering – geology classification of the maximum level of seismicity is classified as 9° of the MCS scale.

The area through which Variant B passes, from Bar to Albanian border belongs to 8 - 9° degree of MCS scale according to engineering – geological classification.

Hydrogeological features

Albania

From Balldren to Torovica embankment, the proposed pipeline route runs over recent marshy deposits, which overlie Quaternary marine deposits that fill the Torovica syncline. The water bearing and the permeability of the above deposits are very low. The marine deposits overlie the dolomitized limestone formations of the Rrenci and Kakarriqi anticlines.

Both sides of the Balldren field, in the Renci and Kakarriqi hilly foots, there are numerous karst springs. Springs arising southeast of Renci Mountain do not contain good quality waters; while those of Kakarriqi Mountain are characterized by good quality waters and can be used as drinking water. Along the Kakarriqi mountain range, waters belonging to limestone rocks meet at a depth of about 4-5m bsl. Drilling performed for individual wells along the western mountain range of Kakarriqi Mountain provide good quality waters and low mineral content, suitable for use as drinking water. Nevertheless, these wells are of importance solely for the village of Torovica, which is the only village located in the western side of Kakarriqi Mountain. From Torovica embankment to the Buna River (Albania/ Montenegro border) the Variant B of the proposed pipeline route runs over the alluvium plain of Bregu Bunes ("Buna Riverside Plain"), which lies over a Quaternary gravel aquifer 6-8 m thick. Impermeable sub-clays, which thickness varies from 17 to 25m, cover this aquifer. The villages of the commune of Dajc are supplied with drinking water from individual hydro-geological wells.

In the segment, 20 km long, from Balldren to Torovica Embankment, the pipeline route does not pass on any significant aquifer. However, it is suggested to place the pipeline at a respectable distance from the Kakarriqi mountain foot, in order to avoid the limestone, which underlies in the marshy and marine Quaternary deposits.

From Torovica embankment to Buna River (border ALB/MNE), the pipeline route runs over the Quaternary gravel aquifer of "Buna Riverside Plain", which has a local importance. The impermeable sub-clayey cover is 17-25m thick. Thus there is no risk of groundwater pollution from project activities.

Montenegro

Pipeline route, Variant B, entering Montenegrin territory from the direction of Albania crosses over alluvial valley built of deposits with high yield. Near the settlement, Vladimir the pipeline route crosses Lower Cretaceous sediments with medium karstification and high permeability. Near Kamenički bridge pipeline route passes through peripheral part of alluvial valley and near Pečurice crosses over diluvial deposits with various yields onto Middle Triassic deposits with low permeability. Variant B crosses over deposits with medium karstification and permeability and near the city of Bar enters the sea where is laid on the seabed. In Trsteno bay pipeline route exits the sea where it crosses

over Upper Cretaceous deposits into alluvial valley with predominantly high yield, and partly over the edge of Upper Eocene deposits with yield that range from small to none and then Variant B comes to the routes junction.

4.3.1.4 Land Use and Pedology

Variant A

Albania

Land use

From Balldren to the east of Shkodra the proposed pipeline corridor runs mainly over a flat agricultural lands used mainly for crops, vineyards, olive-trees and other fruit-trees. In this segment the pipeline route traverses three main rivers [Drini-Lezhes (four times), Drini and Kiri], as well as a number of streams. The Drini Lezhes, Drini and Kiri riverbeds are covered of riparian forests.

From the East of Shkodra to Koplik the pipeline route runs over agricultural lands and farmhouse spread everywhere in the agricultural lands. Because of unplanned internal migration during the last 20 years, many arable lands are converted into residential lands. Many rural roads, transmission and telecommunication lines, and poorly maintained irrigation and drainage channels crisscross now the agricultural plots.

From Koplik to Ivanaj, the pipeline traverses agricultural lands of low quality that are partly cultivated and partly abandoned. The abandoned agricultural lands serve as pastures.

From Ivanaj to the border ALB/MNE the pipeline runs mainly over scarce lands that are partly covered from shrubs and partly from rocky patches. The shrubs lie over karstic dolomitised limestones that outcrop in surface in this area.

Pedology

The pedologic assessment of the project area is based on the “World Reference Base for Soil Resources Classification”, whereas the agro production land assessment is dependent on the particle size, nutritional elements, and soil depth.

Figure 21 Map of soil classification (World Reference Base for Soil Resources) on the project area (according to Zdruli et al., 2001)

The topographic relief that pipeline corridor Variant A passes through is generally flat with slight steep hills. Land use throughout the length of the relief varies. Over 80% of its length passes on agricultural land, which intertwines with urban land; while the other 20% passes in non-agricultural land (grassland, shrubs, and soil characteristic of riverbeds).

Pedologic assessment: Based on the "World Reference Base for Soil Resources Classification" the soils along this section belong to the following soil types: Luvic Phaeozem (PHlv) – approx. 43 %; Eutric Fluvisol (PLeu)-31%; Molic Cambisol (CMmo)-14%; Calcaric Regosol (RGca)-6%; and Vertic Luvisol (LVvc) – 6% (fig. 21).

Agro production land assessment: Throughout the length of this segment, beginning from Balldren towards Hoti, land quality varies. Thus, organic matter in the soils of the Zadrima field varies from 3.7 up to 3.9 %, for soils in proximity to Kosmac its 2.9%, and in Koplik 2.1%. Stone makeup in the depths of the soils varies from 0 to 130 cm in Balldren, 0 to 120 cm for the segment Between Drini River and Koplik, and 100 cm up to 110 cm following up to Hoti.

Voluminous density of lands throughout the segment varies from 1.24 to 1.58gr/cm3. These lands have average total porosity indicators, high water field capacity, and high coefficient of water usage.

The table below shows the land quality, for a 400m land strip along the line route, from the agro-pedological point of view, without taking in consideration the land use.

Table 10 Agropedological land quality along Variant A of the pipeline corridor

No	Section Balldren – Hoti/Barlaj (Variant A)			
	Segment	Approximate length (km)	Land surface (ha)	Land quality
1	Balldren-Gocaj	1.2 (km 0.0 - 1.2)	48.0	Not suitable for agricultural purposes
2	Balldren - Trush	20.0 (km 1.2 – 21.2)	800.0	Very good
3	Trush - Vrake	20.0 (km 21.2 - 41.2)	800.0	Good
4	Vrake - Palvar	7.8 (km 41.2 – 49)	312.0	Medium
5	Palvar - Ivanaj	10.0 (km 49 – 59)	400.0	Low
6	Ivanaj – Hoti	8.5 (km 59 – 67.5)	340.00	Not suitable for agricultural purposes

The land requirement for a 400m wide strip along the Variant A of the pipeline route is provided in the table below.

Table 11 Agropedological land quantity and quality along Variant A of the pipeline corridor

No	Section Balldren – Hoti/Barlaj (Variant A)	
	Land quality	Land requirement (ha)
1	Very good	800
2	Good	800
3	Medium	312
4	Low	400
5	Not suitable for agricultural purposes	388
Total		2700

As Variant A crosses numerous villages, rivers, and infrastructure objects, the final table of the land quantity and quality, and land use, is shown in the table

below, which also includes the results of the land occupied from inhabited areas and industrial and military infrastructures (see also the paragraph on social issues).

Table 12 Land use along Variant A of the pipeline corridor

No	Land use (ha)	Land surface occupied (ha)
1	Agricultural land	1,686
2	Broad-leaved oak forests & shrubs	388
3	River & stream beds & riparian areas	80
4	Road and drainage & irrigation infrastructure	50
5	Inhabited rural areas	400
6	Military areas	88
7	Industrial areas	8
Total		2,700

Montenegro

Assessment of land use in two variants was performed by using available Corine Land Cover dataset (CLC) for the year 2006, obtained from European Environmental Agency. CLC identifies hierarchically three different land use category levels inside each of the main group such as artificial surfaces, agricultural areas, forest and semi natural areas etc. For the purpose of impact assessment of two variants, the buffer area of 400 m (200 m on both sides of the pipeline) was taken into consideration.

According to performed analysis it was estimated that Variant A occupies 2534.2 ha in total.

The most abundant land use type in Variant A presents Forest and semi natural areas with 1754.0 ha (69.2 %), Agricultural areas constitute 769.2 ha (30.4 %) and artificial surfaces constitute 11.0 ha (0.4 %).

Table 13 CLC categories for Variant A

Land use category	Area (ha)	Area (%)
Industrial or commercial units	6.0	54.6
Road and rail networks and associated land	5.0	45.4
Artificial surfaces	*11.0*	*100. 0*
Non-irrigated arable land	95.7	12.4
Vineyards	119.8	15.6
Pastures	132.9	17.3
Complex cultivation patterns	123.8	16.1
Land principally occupied by agriculture, with significant areas of natural vegetation	297.0	38.6
Agricultural areas	*769.2*	*100.00*
Broad-leaved forest	532.6	30.4
Coniferous forest	32.2	1.8

Natural grasslands	106.7	6.1
Transitional woodland-shrub	1015.9	57.9
Sparsely vegetated areas	66.6	3.8
Forest and semi natural areas	*1754.0*	*100.00*
Total	2534.2	

Variant B

Albania

Land use

From Balldren to Dajc (Albania/ Montenegro border) the proposed pipeline corridor runs entirely in flat agricultural lands, which are used mainly for crops, vineyards and other fruit trees. Numerous drainage and irrigation channels cross the study area. The villages are rare and far from each-other.

Pedology Assessment: Based on the World Reference Base for Soil Resources classification, soils included in this segment belong to the following types: Eutric Fluvisol (FLeu) approximately 12%, Luvic Kastanozem (KSly) with 12%, Eutric Histisol (HSeu) with 33%, Calcaric Cambisol (CLca) with 20 % and Gleyic Fluvisol (Flgl) with 23% (fig. 21).

Agro production land assessment: Throughout the length of the segment, starting from Balldren towards Buna River, land quality varies. Significant differences are observed on orphic lands along the Torovica valley and following on continuing land mass. Differences in the content of organic matter are extremely high. Lands along the Torovica field have high fertility indicators. The value of organic matter in this region ranges from 3.8% to 4.5% or more. Voluminous density varies from 1.2 to 1.4gr/cm3, while total porosity is average. Soils have high flat-water capacity and simultaneously high water usage coefficient.

Table below shows the land quality along the line route, from the agropedological point of view, without taking in consideration the land use.

Table 14 Land quality along Variant B of the pipeline corridor

No	Section Balldren – Dajc/Shtodher (Variant B)		
	Segment	Approximate length (km)	Land Quality
1	Balldren – Torovica embankment	19.2 (km 0.0-19.2)	Very Good
2	Torovica embankment - Buna River	10.1 (km 19.2-29.3)	Good

The land requirement for a 400m wide strip along the pipeline route is given in the table below.

Table 15 Land quantity and quality along Variant B of the pipeline corridor

No	Section Balldren – Dajc/Shtodher (Variant B)	
	Land quality	Land requirement (ha)
1	Very good	768
2	Good	404
Total		1,172

As Variant B crosses one village only (Torovica) along a segment of 50 m length, the final table of the land quantity and quality, and land use, is shown in the table below.

Table 16 Land use along Variant B of the pipeline corridor

No	Section Balldren –Dajc/Shtodher (Variant B)			
	Land use (ha)	Land quality	Land surface (ha)	Total surface (ha)
1	Agricultural land	Very good	762	1,164
		Good	402	
		Medium	-	
		Low	-	
	Inhabited rural areas		2	2
	Road and drainage/irrigation infrastructure		4	4
	River beds & riparian areas		2	2
2	Total			1,172

Montenegro

According to performed analysis it was estimated that Variant B occupies 3057.6 ha in total.

In Variant B, dominant category is Water bodies (sea) with 1343.1 ha (43.9 %) then Forest and semi natural areas with 868.8 ha (28.4 %), Agricultural areas with 798.2 ha (28.3 %) and Artificial surfaces with 47.5 ha (1.6 %).

Table 17 CLC categories for Variant B

Land use category	Area (ha)	Area (%)
Discontinuous urban fabric	29.3	61.7
Port areas	18.2	38.3
Artificial surfaces	*47.5*	*100.00*
Pastures	64.6	7.5
Complex cultivation patterns	445.0	51.5
Land principally occupied by agriculture, with significant areas of natural vegetation	288.6	33.4
Agricultural areas	*798.2*	*92.4*
Broad-leaved forest	425.8	49.0
Coniferous forest	52.5	6.0

Natural grasslands	109.0	12.5
Sclerophyllous vegetation	204.8	23.6
Transitional woodland-shrub	76.7	8.9
Forest and semi natural areas	*868.8*	*100.00*
Water courses	7.1	0.5
Sea and ocean	1336.0	99.5
Water bodies	*1343.1*	*100.00*
Total	3057.6	

The dominant soil type in the area of consideration presents Leptosols, shallow, often gravelly and erosion-prone soils, with limited soil volume and therefore subject to both drought and waterlogging. In sourounding area of Lake Skadar/Shkodra soils such as Acrisols and Fluvisols are also common. Acrisols are highly weathered soils developed under moist aggressive leaching conditions, with an argilic horizon and a base saturation below 50%, probably paleosols inside the present Mediterranean environment. Fluvisols are lowland soils developed in recent fluviatile, lacustrine or marine deposits, showing commonly stratified layers and an irregular distribution of organic matter with depth.

Erosion processes are mostly related to Variant A. Very high erosion risk exists at only 2.2% of the area, moderate risk at 37.7%, weak at 45.1% and very weak at 15.0 %.

4.3.1.5 Analysis of social issues

Albania

During the last 20 years the population has moved out of the rural areas due to the lack of sustainable economic resources and the lack of service delivery networks. The tendency to migrate is higher in the rural mountainous areas, moderate in the hilly areas and more stable in the municipality of Shkodra.

The lack of urban plans has entailed a situation of chaotic buildings spread out irregularly and in such a way that increases the cost of service delivery (health, education, building roads, sewage and water pipes, etc.). The spread of settlements has already caused the defragmentation of the agricultural land, and the procurement of drinking water through pumping wells.

Variant A

Population – demographic indicators

The intense growth of the informal settlements during the last 20 years, has led to a drastic increase of the urban and sub-urban population as well as of the population of the flat areas. Because of the lack of urban planning and of the informal settlements, an important part of the agricultural land has turned into

inhabited areas. Within the proposed pipeline corridor Variant A, the informal settlements have been developed mainly nearby the towns of Shkodra and Koplik, as well as in the flat terrains on both sides of the highway Shkodra-Koplik. This drastic change on land use and population increase is mainly due to the internal migration from the mountainous areas of Shkodra, Malesia Madhe, Lezha and Puka districts.

The table below shows the data on the population of the districts traversed from Variant A of the proposed pipeline route.

Table 18: Affected districts, including respective population in 2009

No	Province (county)	Affected Districts	Population (2009)*		
			Urban	Rural	Total
1	Shkodra	Malesi Madhe	3,606	32,479	36,085
2		Shkodra	86,222	99,390	185,612
3	Lezha	Lezha	21,369	55,801	77,170
	Total Albania**		1,573,431	1,620,986	3,194,417

**Source: Ministry of Interior, 2010*
***Source: Institute of Statistics, 2009*

The projection on the population changes shows a high trend for the municipalities of Shkodra and Lezha, as well as for the communes situated in lowland and close to the national roads, or to the seaside and to the Shkodra Lakeshore.

Table 19 Projected population changes for 2020 in some dwelling areas along the Variant A of the pipeline corridor*

Administrative units	District	Year 2003*	Year 2010**	Projection for 2020*
Commune of Balldren	Lezha	9.939	10.279	15.316
Commune of Dajç, Lezha		7.011	6.921	14.584
Commune of Barbullush	Shkodra	4.759	4.910	5.542
Commune of Bushat		17.087	23.140	28.250
Commune of Berdice		9.123	8.975	12.911
Commune of Guri i Zi		11.730	11.209	15.202
Municipality of Shkodra		81.994	114.219	138.433
Commune of Rrethina			23.418	
Commune of Gruemire			12.800	
Commune of Qender	Malesia Madhe		6.180	
Municipality of Koplik			11.007	
Commune of Kastrat			12.205	

**Source: Regional Environmental Action Plan on the basin of the Drin River, the area of Shkodra Depression and the Area of Lezha)*
*** Source: Ministry of Interior, 2010*

Economic activities

The area traversed by Variant A of the proposed pipeline route is rich in natural resources, like fertile plains, wetlands, water resources etc. The favourable geographical position, climate, soil quality, water resources, etc. create conditions for a sustainable economic development.

The notable improvement of the national and rural road infrastructure, power and drinking water supply infrastructure and services; tourist infrastructure and services, etc., have led to improvements of the economic and social indicators, and consequently to unemployment and poverty reduction.

The industrial activities are mainly concentrated in Shkodra town and its neighbourhood. In the whole flat area of the Shkodra and Malesia Madhe Districts there are numerous animal farms of national importance for milk and meat production.

Distance from populated areas

Variant A

The field investigations and the study of the recent aerial maps illustrate that Variant A traverses numerous dwelling centres (following figure). Due to the high number of the villages in proximity to the proposed pipeline route corridor, the table below includes only the dwelling centres crossed from the axis of this corridor. The distance from the pipeline axis and the length of crossings have been calculated based on the orthophoto supplied by GIS Albania that gives a snapshot of the dwelling areas in year 2007.

Table 20 Affected villages and their respective distances from the axis of the proposed pipeline corridor

No	Province (county)	Affected District	Affected town	Affected commune	Affected Village	Distance from the pipeline axis	Length of crossings (m)
1	Lezha	Lezha	-	Balldren	Gocaj	crossed	2,000
2			-	Dajc	Mabe	crossed	100
3					Lisi Locit (Mabe)	crossed	300
4	Shkodra	Shkodra	-	Bushat	Shkjeze	crossed	50
5			-		Bushat	crossed	200
6					Velaj (Melgusha)	crossed	700
7			-		Melgusha	crossed	700
8			-		Melgusha	crossed	800
9				Gur i Zi	Renc	crossed	250
10					Bleran	crossed	1,500
11			Shkodra	-	-	crossed	200
12			-	Rrethina	Golem	crossed	800
13					Grude e Re	crossed	500
14					Guci e Re	crossed	1,000

15					Shtoji Vjeter	crossed	200
16		Malesia Madhe		Gruemire	Grude Fushe	crossed	200
17					Pjetroshan	crossed	50
18				Kastrat	Bajza	crossed	300
19					Vukpalaj	crossed	150
		Total					10,000

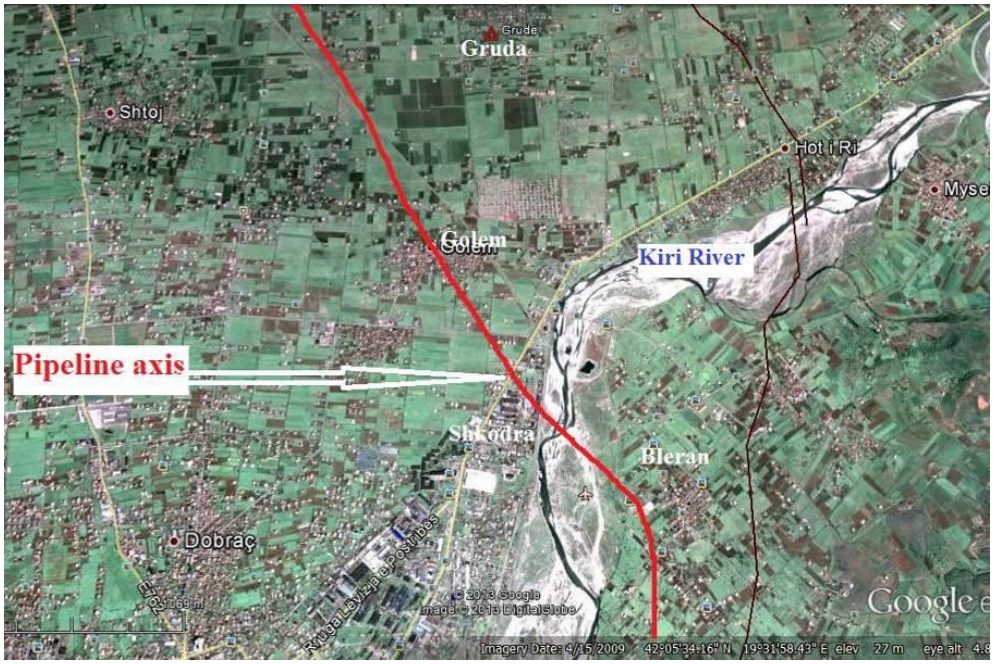


Figure 22 Overview of the crossed inhabited area in the northeast of Shkodra (Google map)

Other infrastructure objects crossed from the proposed pipeline route.

In the territory of Dajc Commune (Lezha District) the axis of the proposed pipeline route runs over the landing strep of the Gjadri air military base. The total length of this landing strep is approximately 3.2 km, from which 2.2 km are crossed from the pipeline axis.

Furthermore, the pipeline crosses the industrial area of Shkodra in the north eastern part of this town.

The table below gives the results of the settlements and industrial and military infrastructure crossed from the axis of the pipeline. The buffer area has been taken 400m wide (200m both sides of the pipeline axis).

Table 21 Crossed settlements/ infrastructure from Variant A of the pipeline route

No	Crossed settlements / infrastructure	Length of crossing	Land surface required (ha)	Comment
1	Settlements	10.0 km	400.0	Inhabited rural areas
2	Military areas	2.2 km	88.0	Landing strip of Gjadri air base
3	Industrial areas	0.2 km	8.0	Northeast of Shkodra surroundings
4	Total	12.4 km	496.0	

Variant B

From Balldren to Dajc (ALB/MNE border) the proposed pipeline corridor runs entirely in flat agricultural terrain. The villages areas are rare and far from each other. Demographic trends show a slight decrease of the population due to the internal migration towards Lezha and Shkodra cities, as well as to the immigration towards other countries like Italy, Germany, etc. The only economic activity in this area is agriculture, which is favoured by the high quality of the land, especially in the Balldren Field.

The projection on the population changes shows a high trend for the municipalities of Shkodra and Lezha, as well as for the communes situated in lowland and close to the national roads or to the seaside and to the Shkodra Lakeshore.

*Table 22 Projected population changes for 2020**

Administrative units	District	Year 2003*	Year 2010**	Projection for 2020*
Balldren Commune	Lezha	9939	10.279	15316
Dajç Commune	Shkodra	8520	8.718	14.584

**Source: Regional Environmental Action Plan on the basin of the Drin River, the area of Shkodra Depression and the Area of Lezha)*
*** Source: Ministry of Interior, 2010*
The projected population increase in these communes affects mostly the villages close to the national roads. Thus, it is not expected any population growth in Torovica, which is the nearest village of Balldren Commune affected from the Variant B of the pipeline route.

The map prepared in the framework of the Strategic Plan for the Development of Dajc Commune (fig. 5) shows that the proposed pipeline route corridor runs in an area planned for agricultural purposes. Thus, the IAP project does not interfere with any infrastructure project within Dajc Commune territory. In addition, the projected growth of the dwelling areas is planned to occur far from this corridor.

From Balldren to the border ALB/MNE, the proposed Variant B of the pipeline route traverses the territories of the following dwelling centres:

Table 23 Villages located less than 500m from the axis of the Variant B of the pipeline corridor

Province (county)	Affected District	Affected Commune	Affected Village	Distance from the pipeline axis	Length of the crossing
Lezha	Lezha	Balldren	Balldren	500m	-
			Torovica	crossed	50m
Shkodra	Shkodra	Bushat	Fshat i Ri	300m	-
		Dajc	Malecaj	100m	-
			Dajc i Ri	400m	-
			Belaj	400m	-
Total					50m

It should be stressed that the pipeline route can completely avoid the dwelling areas because there is enough free space through arable lands, and the villages are far from each other.

Montenegro

General overview – population and economy

Montenegro is an Adriatic-Mediterranean and Dinaric country, covering a land area of 13,812 km2 and having about 625,000 inhabitants (2011 census). It shares borders with Albania, Serbia, Bosnia and Herzegovina and Croatia (only 14 km wide coastal strip). Its relief, mostly mountainous, is dominated by the Dinaric mountain system, stretching parallel to the coastline and with peaks above 2500 m. Northern and central parts of Montenegro are made of high mountain ridges and plateaus, intersecting deep and narrow river valleys. Relatively large plains expand in its central part, and in the area of the Lake of Skadar/Shkodra and Zeta River. Approximately half of the territory belongs to the Sava basin and the other half to the Adriatic Sea basin. The most important rivers of the Sava basin within Montenegro are rivers Piva, Tara, Ćehotina and Lim. These rivers are tributaries of Drina River and Ibar River are tributaries of Morava River. The major river of the Adriatic Sea basin in Montenegro is Morača River with its tributaries Zeta, Cijevna, Rijeka Crnojevića and Orahovštica. Morača flows into Skadar/Shkodra Lake, and from there to the Adriatic Sea through the Bojana River. Montenegro is rich in water resources.

Prior to the war 1991-1995 that ravaged the Dinaric region, the government of Yugoslavia directed the development of the Dinaric region towards mass tourism along the coastal areas, and stimulation of the agricultural production in the interior part of the region by construction of appropriate infrastructure intended for flood protection, irrigation, water supply and hydropower production activities that may impact the quality of the freshwater resources contained in the Dinaric Karstic Aquifer System, and the integrity of its dependent ecosystems. Today, while the region is on a fast track of economic growth, spurred, at least for some of the countries by the opening of EU accession discussions, countries are determined to move towards more

sustainable development models and to deal with many difficulties in the longer run.

Administrative boundaries, general population data and economy

Population density is rather low in Montenegro (50/km^2), in comparison to Croatia with an average population density of 75.8/km^2.

The population growth rate is low or negative and across the region, there is a trend of migration from remote, rural areas towards urban areas and industrialized zones. The settlements are extremely dispersed, and some of them in rural areas are almost completely abandoned. Major and biggest towns and cities are located in the hinterland, in the mountainous areas, but the development of smaller sized cities occurred along the coastline, mostly due to the tourist development. Due to that development of tourism, population numbers in certain subareas may vary considerably across the year, with peaks in the summer season where seasonal working force usually is in need. Most touristic centres are situated along the coast while off the summer season is not yet developed; even if there are fantastic possibilities to do that (mountainous, 5 national park areas, beautiful nature for hiking walking and staying). Taking into account these possibilities it could be expected that in the future tourism including camping on the mountains, along the lakes etc. will be much more developed. That might give an opportunity to change the touristic pattern that is presently organized mostly along the coastline.

In Montenegro the iron works, aluminium industry, mining industry, pharmaceutical industry and food-processing industry represent major industries. Most of the industries are operating now with limited capacities (regarding to the projected capacities) or have been closed.

Employment

Agricultural area in Montenegro occupies 38% of the total surface area (2009). The total agricultural land represents 516,404 ha. The sector of agriculture in Montenegro presents 9% of GDP. During the period between 1992 and 2003 the annual growth in total production increased on average +2.8%. The most important growth was achieved in crop production (annual growth rate +4.7%), while livestock production showed significantly smaller rates of growth at +0.8%.

The contribution of Travel & Tourism to Gross Domestic Product is expected to rise from 20.8% (EUR730.0 mn or US$1,018.0 mn) in 2009 to 25.6% (EUR 1,791.5 mn or US$ 2,290.9 mn) by 2019. (http://www.usmnebc.org/node/22). The economic importance of tourism is great and the country is doing a lot to improve the conditions. Tourism is of a seasonal nature (summer months), and located mostly at the coastal areas. The areas to be activated as tourist destinations – in the future developments - are mountainous tourism as well as rural tourism.

As it could be seen from these data and the description of the situation, Montenegrin economy is shifting from the primary type industrial production country to the service economy with an emphasis on tourism and other connected service economies.

Potential benefits of the pipeline

The total number of dams is four in Montenegro with total installed capacity of 658 MW and with the percentage of 62.2 for energy needs in the country, which means that the country relies mostly on the hydropower energy capacities.

Potential users and benefits from the pipeline:

- Gas supply as a major energy resource of tourist centres, including hotels, smaller apartments as well as restaurants and other tourist service centres – smaller towns and cities along the coastline
- Gas supply as a major energy resource of the households along the coastline and in the hinterland in major settlements (Cetinje, Podgorica, Nikšić) as well as the centres along the coastline – Herceg Novi, Budva, Bar, Ulcinj…
- Gas supply as a major energy resource of industrial capacities and factories, mostly located in the hinterland, mountainous areas
- Gas supply as a major energy resource for the shipyard capacity in Bijela in Boka Kotor Bay
- Gas supply of households along the pipeline route, more or less within the range of bigger or small sized towns and cities to be dependent on the overall economic situation and the rise of the standard of living of local population and the country in general

Less clear benefits of the introduction of the gas as an energy source to be selected by different users will also depend on:

- the price of gas
- availability of other alternative energy resources
- availability of gas supply
- problems connected to the price of distribution of gas to the dispersed households in smaller settlements and villages, especially in the SE areas, towards the Albanian border

Research strategies and methods

This report is based on the findings gathered through the use of the *method of interviews* of the people living along the pipeline route, *with the officials* at the level of counties and municipalities and cities as well on the use of the method of observation.

Variant A

Variant A enters from Albania to Montenegro near the villages Baraj and Skorač and then continues in the same NW direction passing the Tuzi village located to the South of the projected pipeline route. The route then continues towards Ćemovsko polje (Ćemovo field), with one of the biggest coherent vineyards in the world. Here the pipeline is on the nearest point to the capitol of Montenegro, the city of Podgorica. The city of Podgorica with a population of 151.312 (census 2011.) is situated within the Municipality of Podgorica (187.085 inhabitants, census 2011.). This part of Montenegro is very mountainous, so it could be easily supposed that the realization of the pipeline route in this area could be much more difficult in technical terms. However, here will be many more potential consumers of the gas in this area (bigger cities) than in the Variant B of the pipeline route that goes subsea along the shoreline.

After passing the area of Municipality of Podgorica, the route continues to the west towards the Municipality of Cetinje (16.757 inhabitants, Census 2011.) and Lovćen mountain.

It should also be mentioned that this, northern Variant A of the pipeline route goes right through to the National Park Lovćen, categorized in the 2nd category of national parks in the country, proclaimed to be a national park in 1952. Also, it touches the northern part of the National Park Skadarsko jezero (Skadar/Shkodra Lake). It should be emphasized also that there are no permanent population in the Lovćen National Park, apart from the sub-Lovćen villages like Njeguši and the like that lies below the mountain.

Two major infrastructure projects are planned and approved by the State Spatial Plan – one, high voltage power line that should go across Lovćen mountain connecting Italy and Montenegro as well as a cable car (funicular) for tourist reasons from Kotor to Lovćen mountain and further. It is interesting to note that the Government of Montenegro has changed the route of the electric power line at the beginning of April 2013 to protect the area of the National park Lovćen and to inflict less harm to the nature.

Concerning the Park of Nature Skadarsko Jezero (Skadar/Shkodra Lake), it should be mentioned that Albania protected this area in the category Park of Nature as well as the river Bojana that goes into to the Skadar/Shkodra Lake. It might be that the Montenegro government will soon do the same, for the Montenegro part of the lake.

Most economic activities along the corridor are concentrated along the small sized agriculture, and some commerce and service activities. Some people are

employed in the centres of National parks, and some in (rural) tourism. The gas to be provided could be received as an advantage of the existing economic activities.

Variant B

The whole area from the border Albania/Montenegro, till the town of Stari Bar in the NW direction of the country seems to be much less developed than the rest of Montenegro. The area is mostly populated with Muslim –Albanian population. In other words, it represents a rather neglected area yet not developed, and in a way "set a side".

Pipeline route, after the Albania/Montenegro border, enters the Municipality of Ulcinj, passing close to village Ambula and continues to the west passing close to the villages Vladimir, Krute, Grdovići and Dobra voda. Then it continues towards NW direction and reaches the Municipality of Bar. In the area of Volujica the route enters into the sea.

The pipeline comes from the sea again in the Municipality of Budva, and after the city of Budva in heads in the direction of the Kotor Bay. It continues to the Bigovica bay and through the Grbalj valley into the direction of the Municipalities of Kotor and Herceg Novi.

For this social and environmental impact assessment it is not necessary to list all settlements and specified social elements that will be potentially impacted by the pipeline route especially due to the fact that the route goes close to the very small settlements, mostly villages where there is even little agriculture and very small population – usually up to 100-200 inhabitants. In this sense, when the pipeline route comes to the area of the State of Montenegro, it passes many villages having at maximum between 100-500 inhabitants. Due to the present types of economic activities in this area, it could be predicted that no major interest of the local population will be expressed for the use of gas as an energy source. .

The pipeline route is passing through the area of several municipalities:

- The Municipality of Ulcinj (20.265 inhabitants, census 2011)
- The Municipality of Bar (42.368 inhabitants, census 2011)
- The Municipality of Budva (19.170 inhabitants, census 2011.)
- The Municipality of Kotor (22.799 inhabitants, census 2011.)
- The Municipality of Tivat (14.111 inhabitants, census 2011.)
- The Municipality of Herceg Novi (30.992 inhabitants, census 2011.)

4.3.1.6 Hydrology/ Marine areas

Variant A

Hydrology

From Balldren to Hot/Barlaj (border ALB/MNE), Variant A of the pipeline route passes near Shkodra Lake and crosses three (3) main rivers (6 crossings), two small rivers (Vraka and Rrjolli), and a number of streams. The traversed main rivers are: Drini Lezhes (4 times); Drini and Kiri.

Shkodra Lake is the largest one in the Balkan Peninsula. Its area varies from 353 km^2 at a minimum lake level (4.6 m asl) to 500 km^2 at a maximum lake level (9.8 m asl). It has an average depth of 5-6 m, a maximal length of 44 km and a maximal width of 14 km. Its drainage area is about 5,500 km^2, from which 4,470 km^2 in Montenegro and 1,030 km^2 in Albania.

In the segment Ivanaj-Hot, the distance of Shkodra Lake from the axis of the proposed pipeline corridor is approximately 1.5 km.

Drini River is the longest river of Albania (283 km). At Vau i Dejes it enters the lowlands of Shkodra and splits into two distributaries; the Drini, which flows towards Buna River, and the Lezha Drini River that continues to the south, passing through the plain of Zadrima and further one to the west of Lezha, where it reaches the Adriatic sea at the Drini Bay. The average annual discharge of Drini River at Shkodra (including Kiri River discharge) is approx 360 m^3/s. The Drini of Lezha, which is 22 km long, originates at Mjeda Village. It has an annual discharge of 120 m^3/s at Lezha Bridge.

Variant A in Montenegro crosses several streams: stream Urelja south of D. Mileš, streams Koložun and Suvi potok west of Nalježići and stream Petelj south of Sutvara. Pipeline route crosses Koložun stream in western part of Soliotsko polje.

Variant A crosses: east of D. Kokoti, rivers Morača and Cijevna in Čemovsko polje and river Sitnica southwest of Lekići.

River Sitnica is the most downstream right tributary of river Morača. It rises from the karst springs called Vučji studenci.

River Morača originates in northern Montenegro, under Rzača Mountain. It generally flows southwards for some 113 km, before emptying into Lake Skadar.

River Cijevna rises in Albania, and flows into river Morača in Montenegro (south of the town of Podgorica). The river is 64,7 km long.

Variant B

Hydrology

Variant B in Albania crosses once the Buna River at the state border Dajc/Shtodher.

Buna River, which is 44 km long, originates at the southeastern part of Shkodra Lake and discharges its water at the Buna delta in Velipoja into the Adriatic Sea. The Buna joins the Drini River just 1.3 km downstream of Shkodra Lake, resulting in a doubling in water flow from 320 m^3/s to 680 m^3/s. The maximal flow of the Buna has in the past occasionally reached up to 7500 m^3/s, leading to flooding of the wide plain area. The situation changed after 1970 with the reclaiming process of most of the Shkodra plains and the construction of the three big dams in the Drini River.

This pipeline Variant B in Montenegro crosses several streams: south of Pečurice the pipeline route crosses Mali potok. Pipeline route crosses several times stream Lukavci northwest and southeast of Radanovići and Koložun stream in western part of Soliotsko polje.

Variant B crosses south of Shkodra, river Miđanska and river Bojana that presents natural border between Albania and Montenegro. Pipeline route crosses river Mrkovska northwest of Vukići, and river Jaška in Mrčevo polje.

Marine areas

Variant B passes through marine habitats along on the part between Bigovica Bay and Trsteno Bay.

List of marine habitats that are present along the route and will be affected during construction phase are presented in following table.

Table 24 List of marine habitats that are presented along marine part of the route

List of marine habitats present on Varian B - marine area
A1. 1 High energy littoral rocks
A1.13 Mediterranean and Black Sea communities of upper mediolittoral rock A1.14 Mediterranean and Black Sea communities of lower mediolittoral rock very exposed to wave action
A3.1. Atlantic and Mediterranean high energy infralittoral rock
A4.56 Posidonia beds (*Posidonion oceanicae*)
A5.23 Infralittoral fine sand
A4.76 Sublittoral mixed sediments

EUNIS CLASSIFICATION

A1. 1 High energy littoral rocks - The boulders and cliffs rising above high tide and exposed to the splash and spray of sea waves are all encompassed within the definition of this habitat. The habitat is characterized by extreme environmental conditions (lack of moisture, extreme temperature fluctuations and salinity, waves) so the biological diversity of species is low. In the Bigovica Bay and in the Trsteno Bay the upper white belt of rocks is mostly

without vegetation or with rare halophytes, sharply separated from the well-developed terrestrial vegetation. This zone is rarely exposed to the spraying waves, but well enough to prevent the development of terrestrial plants that cannot tolerate siltation.

A1.13 Mediterranean and Black Sea communities of upper mediolittoral rock

A1.14 Mediterranean and Black Sea communities of lower mediolittoral rock very exposed to wave action

The distribution and type of the populations of the solid substratum in the mediolittoral stage are profoundly marked by the submersion variability due to waves and to the irregular rise in the sea level caused by atmospheric pressure and wind. Two horizons corresponding to different average values of the dominant factors (humectation, light, nutrients, topography and type of substratum) can be made out. The upper horizon corresponds to the area that is only moistened by the tops of the waves and spray. The upper mediolittoral is the horizon where the environmental conditions are most restrictive. According to the hydrodynamics and the local topography (Bigovica Bay and in the Trsteno Bay), it can extend over a vertical area of a 50 centimetres. The area of mediolittoral rocks is dominated with development of endolithic Cyanobacteria (Cyanophyceae). The lower horizon of the mediolittoral rock results from the coming together of three essential factors: presence of waves, irregular variations in atmospheric pressure, and wind and tide when present. The constant humiliation greater than in the higher horizon is the dominant factor, followed by light.

A3.1. Atlantic and Mediterranean high energy infralittoral rock - in deeper parts, the infralittoral stage extends from tidal areas to the survival limit of the marine phanerogams and the photophilous algae. This lower limit depends on the penetration of light, and thus varies greatly with the topography where in case of the Bigovica Bay and in the Trsteno Bay the lower limit of this habitat is determinated with sediment substrate. The most dominant genus is brown algae *Cystoseira* that forms large settlements.

In the area of Bigovica Bay the significant impact of sea urchin *Paracentrotus lividus* is present whose grazing diet influences settlements of infralittoral algae, resulting in coverage loss.

A4.56 Posidonia beds (Posidonion oceanicae)

Posidonia oceanica (L.) Delil - seagrass is an endemic species to the Mediterranean Sea and plays an important role in the Mediterranean Sea ecosystem. Along the Montenegro coast it usually forms dense and extensive underwater meadows. These meadows provide important ecological functions and services and support a highly diverse community, including species of economic interest. The thicket of leaves provides excellent conditions for settlement of a number of epiphyte algae, as well as for a shelter, habitation and spawning of numerous animals. *P. oceanica* is present in a narrow coastal strip,

on beds of soft sediment, and in the Bigovica bay and in the Trsteno bay forms tick zone at on depths between 10 and 25 meters.

A5.23 Infralittoral fine sand - In the Bigovica bay and in the Trsteno bay this habitat occurs in very shallow water with sea bottoms characterised by fine sands, usually with homogenous granulometry and of terrigenous origin. Fine sand has occurrence from the lower tide level to 2.5 meters. In deeper parts of bays fine sand is replaced with well sorted sand.

A4.76 Sublittoral mixed sediments - Stretches of organogenous gravels and coarse sands, more or less filled in with sandy and muddy sediment and usually to an extension at depth well sorted fine sands which is case in the Bigovica Bay and in the Trsteno Bay. The sediment is of heterogeneous granulometry and of mixed origin: terrigenous and organogenous. The gravels and sands may come from the neighbouring (infralittoral and circalittoral) rocks, or be made up of fragments of mollusc shells, big calcified bryozoans, or tests of echinoderms. The distribution of this habitat is from 20 to 60 meters depth.

Along the marine part of the pipeline route construction works will affect protected marine species. These species are shown in following table.

Table 25 Protected marine species along marine part of the pipeline route - Variant B

Group	Name (in Latin)
Sponges	*Aplysina aerophoba*
	Axinella cannabina
	Axinella damicornis
	Axinella polypoides
	Axinella verrucosa
	Spongia officinalis
	Tethya aurantium
	7
Cnidarians	*Madrepora oculata*
	Cladocora caespitosa
	Eunicella cavolinii
	Eunicela stricta
	4
Mollusks	*Lithiphaga lithophaga*
	Pinna nobilis
	2
Echinoderms	*Centrostephanus longispinus*
	Ophidiaster ophidianus
	Holothuria forskali
	Holothuria impatiens
	Holothuria polii
	Holothuria tubulosa
	6
Reptiles	*Caretta caretta*
	Chelonia mydas
	2
Mammals	*Delphinus delphis*
	Stenella coeruleoalba
	Stenella frontalis

	Tursiops truncatus
	Grampus griseus
	Balaenoptera physalus
	Delphinus delphis
	Stenella coeruleoalba
	8
Sea grass	*Posidonia oceanica*
	1
Algae	*Cystoseira mediterranea*
	Cystoseira mediterranea (Ag.) Sauv. var. stricta
	Cystoseira mediterranea (Ag.) Sauv. var. spicata
	Cystoseira amentacea
	Cystoseira amentacea var. adriatica
	4
Total	34

**The decision of placing certain plant and animal species under protection (Official Journal of the Republic of Montenegro; no. 76/06; 12 December 2006)*

4.3.1.7 Biological environment (Flora and fauna)

Albania

Variant A

The pipeline in Balldren – Hot alternative (Variant A-Albania) starts at Balldren village and runs through hilly areas covered by degraded Maquis of the Kakariqi Mountain. The pipeline then follows arable land and many other more or less transformed areas used mainly for crops, vineyards and other fruit trees of the Balldren, Gjader, Blinisht, Dajc, Bushat, Melgushe, Ashte, and Renci villages. Further north, near Shkodra city, the route joins Drini and Kiri Rivers. The junction is the site of the best riparian forest of the region.

From this area, not far away from the shore of trans-boundary Skadar/Shkodra Lake the route goes towards the Kopliku, Bajza, Ivanaj and Hot villages. It goes mostly through arable land used mainly for crops, vineyards and other fruit trees and hills covered by Macchia or degraded forests dominated by mixed deciduous oak.

The Drini, Drini Lezhes (Lezha's Drini) and Kiri Rivers are the site of the riparian forest of the region. Variant A of the proposed pipeline route has six main rivers crossings [Drini Lezhes (four crossings), Drini (1 crossing), and Kiri (1 crossing)]. This is considered a relevant number of river crossings because river and riparian environments by nature are highly valuable sites. Numerous drainage and irrigation channels characterize the study area.

The following sections provide a description of the main vegetation types and habitats occurring along the pipeline.

Vegetation types and habitats

Arable lands

The pipeline route follows arable land and many other more or less transformed areas used mainly for crops, vineyards and other fruit trees of the Balldren, Gjader, Blinisht, Dajc, Bushat, Melgushe, Ashte, Renci, Kopliku, Bajza, Ivanaj and Hot villages. Arable lands and their associated irrigation systems constitute the majority of the habitats present within the study area. The most widely cultivated crops in these areas are: bread cereals, vegetables, potatoes, animal fodder, fruit trees, olives, grapes and others (beans, tobacco, etc.). This habitat supports high bird species abundance, which are mostly passerines. In winter, flocks of finches in company of other small passerines use the open fields. In summer, the open fields provide breeding grounds for the common quail. Robin, house sparrow, wren, larks and many species of finches visit hedges and various fruit trees of the open terrains. The most characteristic mammal species are rodents, both voles and mice, such as Thomas's pine vole, the Macedonian mouse, the common house mouse and the common wood mouse. The most common insectivores are the white-toothed shrew, and Balkan blind mole. The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Macchia vegetation

Macchia and all other derived degradation stages within this series occupy a small surface in the study area mostly in Kakariqi Mountain and Shkodra - Koplik segment. The human impact in this area is significant, mainly through agriculture development, illegal forest logging, intentional forest fires, extensive overgrazing, etc. Beside the above damages, the erosion of the land causes another factor with very big impact for these zones. In some areas the soil is eroded so much as bedrock is almost visible. Therefore, the degradation process had started quite a long time ago, as featured by various types of vegetation that appear. The Macchia is representing a stage of degraded evergreen Mediterranean forest or old forests of *Quercus ilex*. The most important species that give the physiognomy to this formation are the evergreen shrubs such as *Phillyrea angustifolia, Punica granatum, Juniperus oxycedrus, Spartium junceum, Cercis siliquastrum, Paliurus spina-christi, Pyrus amygdaliformis, and Cotinus coggygria*. *Quercus ilex* adapted to grow for a long period in hot weather and lack of rain.

Avifauna of the Mediterranean macchia found in the study area supports a wide range of bird species including many passerines. Scrublands provide an important wintering habitat for many bird species, which breed at higher altitudes and move down to scrublands to escape bad weather. The most typical birds of such vegetation are warblers. During spring-summer seasons, the macchia supports a range of species of birds, such as subalpine warbler, *Olivaceous warbler*, etc. During migration, Mediterranean shrubs especially near the coastal area are used as stop-over grounds for other species such as hoopoe, wryneck, blackbird, etc. A range of mammals also exploits the macchia habitat during different periods of the year. The tracks of the weasel, European polecat, fox and badger, as well as of different species of mice and voles were commonly observed during the field survey. Other species such as

lesser white toothed shrew and bicoloured shrew and eastern European hedgehog are reported to this type of habitat. Various bat species hunt for food over the Mediterranean macchia.

In Albania, this type of vegetation has broader extent, in almost half of the country's surface. But generally this type of vegetation is very damaged by exploitation. The value of the vegetation and habitats encountered within the site is generally medium, due to the presence of species that are considered to be threatened in a local or national context, such as *Quercus ilex, Salvia officinalis* (an important medicinal plant harvested in the area).

Forest formations dominated by a mix of deciduous oak species

Forest formations mostly dominated by *Quercus pubescens, Quercus cerris* and *Quercus frainetto* are found across small parts of the study area in the hilly areas of the segment between Kopliku and Hot village. The main elements of these forests are *Quercus pubescens*, *Quercus frainetto, Fraxinus ornus*, *Juniperus oxycedrus*, etc. They represent degraded forest treated as coppice, used by the local population for firewood and for grazing (especially goats) and branch cutting for livestock food basis during the winter.

Fauna of this type of habitat is a mixture of species linked with forests and shrubs. Avifauna is rich and dominated by passerines. A number of bird species visit the area during winter and summer time. The most commonly present include warblers, robin, wren, hoopoe, buntings, goldcrest and firecrest, blackbird, and jay. Common mammals found in this habitat include wood mice and dormice. Other mammals recorded in this type of habitats are foxes, badger, weasel, and white tooth shrews.

Plant species present in this habitat type are for the most part commonly occurring throughout the country. The value of the vegetation and habitats encountered within the pipeline line route is generally Low.

Figure 23 Forest formations dominated by a mix of deciduous oaks along Ivanaj – Hot segment

Riparian vegetation

Alongside Variant A of the proposed pipeline corridor, there is a number of riparian vegetation as follows.

a Riverbeds

The Drini, Drini Lezhes and Kiri Rivers are the site of the riparian forest of the region. Variant A of the pipeline route has 6 main river crossings that are considered a relevant number because river and riparian environments by nature are highly valuable sites. The presence of these rivers, aquatic habitats, freshwater marshes and riparian forests supporting high floral and faunal biodiversity give to the region a high importance. Patches or narrow belts of this habitat type we can found following these rivers on alluvial especially basic lands, with a higher level of underground waters. This habitat type, colonizing poorly stabilized alluvial deposits periodically flooded, is characterized by dominance of the *Salix alba, Alnus glutinosa, Platanus orientalis, Tamarix parviflora*. The accompanying flora include *S. elaeagnos, S. purpurea, Populus nigra, Phragmites australis, Typha latifolia, Lythrum salicaria, Mentha aquatica, Rubus ulmifolius, Populus alba, Arum italicum, Hedera helix, Calamintha grandiflora* etc. Among mosses, lichens and ferns, *Pteridium aquilinum* is often abundant.

At the merging point between Drini and Kiri Rivers, the pipeline route crosses a riparian area in the Drini riverbed (shown on following figure). This is the best riparian area crossed from Variant A of the pipeline route. The small islands are considered as very special and attractive.

Figure 24 Drini River (on the right) by the conflux with Kiri River (on the left);

This is the best riparian area crossed by the pipeline. The small islands are considered as very special and attractive.

Other different independent studies classify this part of the Drini riverbed as more rich in biological values compared to other segments of this riverbed. For the purposes of the construction of Ashta HPP over Drini River, Lahmayer International (2001) and SNC Lavalin (2008) have studied in detail the

biodiversity along the Drini River. As a result, the riverbed from Vau Dejes to Buna River has been split into three segments of different biotic activity (A: low; B: medium; and C: high). As shown in the sketch below (next figure), the river segment crossed by Variant A of the pipeline route has a higher biotic activity compared to the other segments.

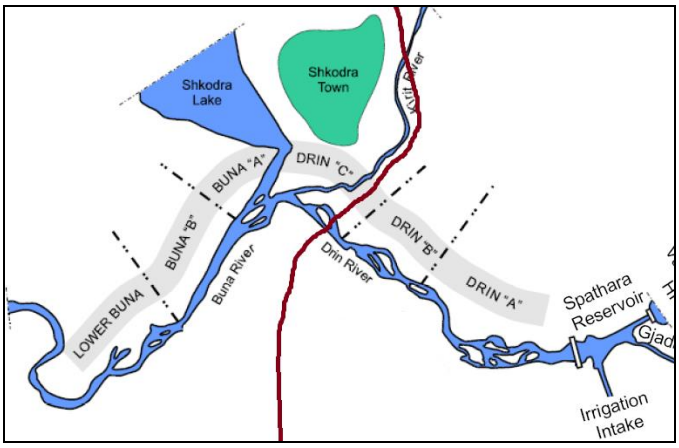


Figure 25 Section C – high biotic activity along the Drini riverbed crossed by the pipeline route (red line)

Source: Lahmayer International, 2001; SNC Lavalin, 2008.

Streams and rivers are important habitat for animal species linked with running freshwater habitats, such as dragonflies, fish (i.e. Barbus meridionalis, Barbus graecus, Cobitis tenia and Chondrostoma nasus), and amphibians. Fresh water streams and rivers provide an important habitat for a range of bird species including kingfisher and wagtails. Herons also frequent this habitat. Some sections of the Drini, Drini Lezhes and Kiri Rivers are also important for otter (Lutra lutra) globally threatened species, whose presence has been verified. Drainage and irrigation channels provides suitable conditions for a number of freshwater insects (dragonflies), fish (especially eel, (Anguilla Anguilla), amphibians, reptiles, and birds. Sometimes, the otter may visit drainage channels.

Riparian vegetation on the riverbeds, although small and patchy is of more significance in terms of habitat, particularly for the fauna. These species-rich habitats add much to the botanical diversity of the site.

b-Drainage and irrigation channels

Numerous drainage and irrigation channels characterize the study area. The formation of reed-beds is more wide spread in these channels. High trunk helophytes, as: *Phragmites australis*, *Typha angustifolia*, *Scirpus lacustris*, participate in its basal composition. These are more frequently accompanied by the species: *Sparganium erectum*, *Alisma plantago-aquatica*, *Eleocharis palustris*, *Lythrum salicaria*, *Veronica anagallis-aquatica*, *Mentha aquatica*.

c Shoreline of Shkodra Lake

The pipeline is located close to the shore of the trans-boundary Shkodra/Skadar Lake - the largest lake on the Balkan Peninsula that both Albania and Montenegro have officially designated as a cross-border protected area. In Albania the actual protection status of the Albanian part of Shkodra Lake is "Managed Nature Reserve" (IUCN Category IV), declared by the Albanian Government with the DCM No. 684, of November 02, 2005. The Ramsar Secretariat and the DCM No. 683, of November 02, 2005, have also declared the Albanian part of the Lake area as a Ramsar site (Ramsar Convention "On internationally important wetlands, especially as waterfowl habitats").

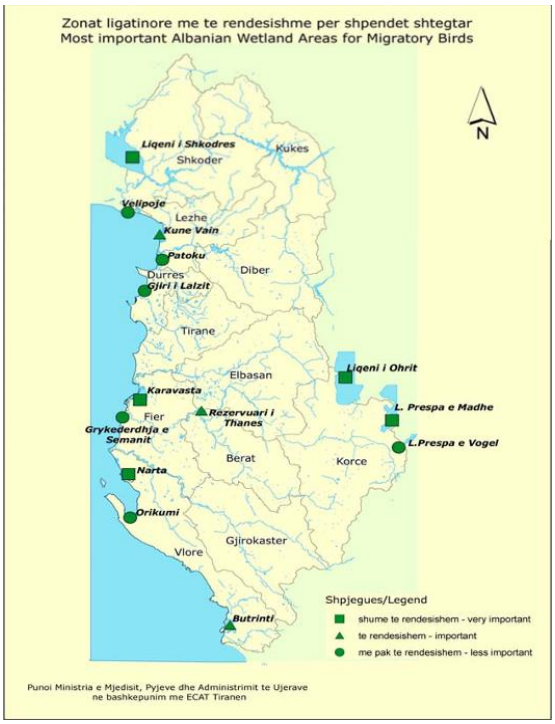


Figure 26 Most important Albanian Wetlands for Migratory Birds

Source: MoEFWA

Shkodra Lake and its watershed represent a complexity of habitats with a high diversity of living organisms. It encompasses several types, subtypes and many smaller classification units of habitats, such as lacustrin, palustrine, riverin, limnetic, litoral, open water areas, vegetated and unvegetated, floating, emergent and submerging vegetation, hard and soft bottom, forest, shrub and herb vegetation etc. This diversity of habitats shelters a high diversity of plants and animals.

Figure 27 Shoreline of Shkodra Lake near Bajza Bay

The total number of aquatic macrophytes for the whole area of Shkodra Lake is 164 species belonging to 66 genera and 43 families. At the northern shore of the lake dominant plant species include *Phragmites communis, Scirpus lacuster, Typha angustipholia, Nuphar lutea, Nymphaea alba, Ceratophyllum demersum, Trapa natans* and *Potamogeton spp*. are represented. Around the lake stands of white willow (*Salix alba*) are the most abundant forests, mainly in the flooding area.

Besides biodiversity values, reed beds and other macrophytes are also important for their purification capacities through nutrient retention and transformation (nitrogen, phosphor), and binding of pollutants.

Twenty vascular plant species, most of them macrophytes, are endangered in the Shkodra Lake and its coasts. The most threatened are considered *Marsilea quadrifolia*, *Hydrocotile vulgaris*, *Hidrocharis morsus* – ranae, *Butomus umbellatus*, *Cladium mariscus*, *Nuphar luteum*, *Nymphaea alba*, *Nymphoides peltata*, *Sagittaria sagittifolia* and *Trapa natans*.

Several aquatic and wetland habitats of the Albanian part of Shkodra Lake are considered as endangered. These includes: Syri Sheganit and Hurdhana Kosanit; Forest areas of Shegan, Kamica, Vraka etc., The most important areas in biodiversity aspect, such as Shegani coast (north-east of the Albanian part).

One hundred and thirty three European threatened habitats (from the EU Habitat Directive and the Bern Convention annexes) are found in Albania and have been used alongside threatened species to identify Albania Important Plant Areas (IPA) under criterion C. The MNR of Shkodra Lake and Buna Riverbed wetland complex has been categorized as an IPA.

Figure 28 Map of the most Important Plant Areas (IPAs) in Albania

Shkodra Lake and its watershed area has a high number of endangered animals, of which many species have regional or international (European and global) threatening status. This is another reason for the international importance of the Skadar/Shkodra Lake. Dhora & Sokoli (2000) have published a list with 124 endangered aquatic animal species of the lake. If considering the terrestrial species, too, the list of endangered fauna of the lake watershed would be much longer. From these 124 endangered aquatic animals, 9 are molluscs, 33 are fishes, 12 are amphibians, 4 are reptiles, 65 are birds and 1 is mammal.

Figure 29 Water snake photographed during field investigations at (Hurdhana 1 Karst Lake)

Variant B

The study area supports a range of natural, semi-natural and artificial vegetation types and habitats. The natural vegetation in these areas is very changed and reduced due to agricultural activities. Semi-natural and artificial or modified

habitats, especially those intensively used for arable lands, constitute the majority of the habitats present, while natural habitats represented mostly by riparian vegetation by the side of the Buna River and degraded Macchia on the Kakarriqi, Rrenci, Gjymti and Kolaj Mountains, away from the pipeline and not affected by the project.

The following sections provide a description of the main vegetation types and habitats occurring inside the 3 km buffer areas along the pipeline listing key species, abundance and distribution within the study area and its sensitivity.

Arable lands

Arable lands and their associated irrigation systems constitute the majority of the habitats present within the study area. Torovica field with an area of more than 2200 ha represent major field of the area. The most widely cultivated crops in these areas are: bread cereals, vegetables, potatoes, animal fodder, fruit trees, olives, vineyards and others (beans, tobacco, etc.).

Figure 30. Torovica field where pipeline passes (direction NE – SW). In the front Renci Mountain

This habitat supports high bird species abundance, which are mostly passerines. In winter, flocks of finches in company of other small passerines use the open fields. In summer, the open fields provide breeding grounds for the common quail. Robin, house sparrow, wren, larks and many species of finches visit hedges and various fruit trees of the open terrains. The most characteristic mammal species are rodents, both voles and mice, such as Thomas's pine vole, the Macedonian mouse, the common house mouse and the common wood mouse. The most common insectivores are the white-toothed shrew, and Balkan blind mole.

The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Macchia vegetation

Cretaceous limestone form hills and mountains, which surround the Torovica field plain, like the Kakarriqi (altitude of 398 m), Rrenci (561 m), Kolaj, Gjymti, Suka and Reçi. Makia and all other derived degradation stages within this series occupy a large surface in the study area. The human impact in this area is significant, mainly through agriculture development, illegal forest logging, intentional forest fires, extensive overgrazing, etc. Beside the above damages, the erosion of the land causes another factor with very big impact for these zones. In some areas the soil is eroded so much as bed rock is almost visible.

The Macchia is representing a stage of degraded evergreen Mediterranean forest or old forests of *Quercus ilex*. The most important species who give the physiognomy to this formation are the evergreen shrubs such as *Arbutus unedo, Punica granatum, Phillyrea angustifolia, Erica arborea, Juniperus oxycedrus, Spartium junceum, Paliurus spina-christi, Pyrus amygdaliformis, Myrtus communis,* adapted to grow for a long period in hot weather and lacking of rain. In many cases the vegetation of these habitats is characterized by dominance of *Paliurus spina – christi* where it forms patches of characteristic physiognomy. In a small part of the territory, in Eastern part of the Renci Mountain areas, mainly in slopes very exposed to erosion, are evident fragments of Mediterranean Coniferous forest formations with dominant species Alepo Pine trees (*Pinus halepensis*).

Scrublands provide an important wintering habitat for many bird species which breed at higher altitudes and move down to scrublands to escape bad weather. The most typical birds of such vegetation are warblers. During spring-summer seasons the macchia supports a range of species of birds, such as subalpine warbler, *Olivaceous warbler*, etc. During migration, Mediterranean shrubs especially near the coastal area are used as stop-over grounds for other species such as hoopoe, wryneck, blackbird, etc. A range of mammals also exploits the macchia habitat during different periods of the year. The tracks of the weasel, European polecat, fox and badger, as well as of different species of mice and voles were commonly observed during the field survey. Other species such as lesser white toothed shrew and bicoloured shrew and eastern European hedgehog are reported to this type of habitat. Various bat species hunt for food over the Mediterranean macchia.

Figure 31 Left: Fragments of Mediterranean coniferous forests, Renci Mountain; and Right: In some areas in the Kakariqi Mountain the soil is eroded so much as bed rock is almost visible.

In Albania, this type of vegetation has broader extent, in almost half the country's surface. But generally this type of vegetation is very damaged by exploitation. The value of the vegetation and habitats encountered within the site is generally medium, due to the presence of species that are considered to be threatened in a local or national context, such as *Quercus ilex, Salvia officinalis* (an important medicinal plant harvested in the area).

The macchia vegetation and the Mediterranean coniferous forest formations lay in the mountainous area both sides of the pipeline route corridor. They are not affected directly from the project activities, because the line route runs in flat agricultural area, parallel to the hilly chains.

Riparian vegetation - Buna riverbed

The pipeline corridor traverses only one river; the Buna River at the state border ALB/MNE. The presence of Buna River, aquatic habitats, freshwater marshes and riparian forests supporting high floral and faunal biodiversity give to the region a moderately importance. The Buna River crossing is included within the Protected Area “Shkodra Lake and Buna River Wetland Complex”. Patches or narrow belts of this habitat type we can found following the Buna River on alluvial especially basic lands, with a higher level of underground waters. This habitat type, colonizing poorly stabilized alluvial deposits periodically flooded, is characterized by dominance of the *Salix alba, Alnus glutinosa, Platanus orientalis, Tamarix parviflora.* The accompanying flora include *S. elaeagnos, S. purpurea, Populus nigra, Phragmites australis, Typha latifolia, Lythrum salicaria, Mentha aquatica, Rubus ulmifolius, Populus alba, Arum italicum, Hedera helix, Calamintha grandiflora* etc. Among mosses, lichens and ferns, *Pteridium aquilinum* is often abundant.

Figure 32 Riparian vegetation of the Buna Riverbed

Buna is an ideal case, which connects not only the waters, but especially the ichthiofaunas of some ecosystems of regional importance. Among them, we distinguish the sturgeon *Acipenser sturio*, which is a globally threatened species. The most important migratory fish are: *Alosa falax nilotica, Anguilla anguilla, Dicentrarchus labrax, Mugil cephalus* and *Liza ramada*. Up to now, in the water of Buna are found three species of reptilians: *Emys orbicularis, Natrix natrix persa and Natrix tessellata*.

Buna River with marshes, ponds and channels nearby, are suitable habitats for the amphibian fauna. This field area is characterized by an abundance of amphibians. The most predominant species are *Bufo viridis, Rana lessonae* and *Rana balcanica*. The total number of individuals of bird counted in winter aspect in river sides is 8.000. Referring to the counting of the years 1993 and 1995 in the Albanian part of the river, results that some bird species, despite their low number of individuals, represent an importance of regional scale. For example, 19 individuals of *Larus miutus* counted in Buna are 11% of the total number of this species in all Mediterranean. Buna is the only found location of this species in Albania. Also, 51 individuals of Sterna sandvicensis are 4.2% of the total number of this species in Mediterranean and 85% in Albania.

For other species, such as *Anas penelope*, *Anas clypeata*, *Bucephala clangula* and *Phalacrocorax pygmeus*, comparing the small area of Buna sides with the total distribution area of these species, we can say that the individuals counted in Buna have a percentage, which is of interest in global or regional scale. Over 76% of species of Buna are migratory. This area has an important biogeographical position. It is an important station in one of the three migratory roads of the birds of Europe, the road passing over Balkan. Otter (*Lutra lutra*) is a rare mammal of Buna River. This globally threatened species has been found several times last decades in Buna. On both river sides, as terrestrial mammals are found *Lepus capensis, Vulpes vulpes, Canis aureus, Meles meles, Mustela nivalis, Sus scrofa* and some species of rats and bats.

Riparian vegetation – Drainage and irrigation channels

Numerous drainage and irrigation channels characterize the study area. The formation of reed-beds is more wide spread in these channels. High trunk helophytes, as: *Phragmites australis, Typha angustifolia, Scirpus lacustris,* participate in its basal composition. These are more frequently accompanied by the species: *Sparganium erectum, Alisma plantago-aquatica, Eleocharis palustris, Lythrum salicaria, Veronica anagallis-aquatica, Mentha aquatica.*

Riparian vegetation, although small and patchy is of more significance in terms of habitat, particularly for the fauna. These species-rich habitats add much to the botanical diversity of the site. Most of the species recorded are relatively frequent in Stream/river habitat elsewhere in Albania. The value of the vegetation and habitats encountered within the site is generally medium.

Montenegro

Due to its geographical position, heterogeneity of habitats, topography, geological past and climate variations, Montenegro has high biodiversity in most taxonomic groups, but many are poorly studied in Montenegro. Since 100 % surface of Montenegro is a part of Dinaric Arc Ecoregion (DAE), we were able to use spatial information from Protected Area Gap Analysis (WWF Project Reference No 9Z1387.05; 2009).

Flora

Variant A

In the vicinity of Podgorica the vegetation has more eu-Mediteranean character. In this area the vegetation are predominantly grasslands and scrubs.

On the highest altitudes of Variant A in the NP Lovćen, the Variant A passes through thermophilous beech forests. Moderately thermophilous, beech-dominated forests are transitional between thermophilous and supra-Mediterranean oak woods and montane beech forests. Thermophilous beech forests dominate on sun exposed steep slopes. *Fagus sylvatica* is intermixed with *Quercus petraea, Q. pubescens Ostrya carpinifolia, Acer obtusatum,* etc.

At boundaries of NP Lovćen thermophilous beech forests are mixed with thermophilous and supra-mediterranean oak woods. Along the pipeline route, south from Cetinje, oriental hornbean forests are dominating the area.

Most of the Variant A passes through areas with the vegetation of the thermophilous and supra-Mediterranean oak woods. The term ‘karst-woods’ has been applied to this transitional vegetation that is frequently developed as low, degraded forest, dominated by *Quercus pubescens, Fraxinus ornus, Carpinus orientalis* at lower and *Ostrya carpinifolia* at higher altitudes. Throughout the area, *Quercus pubescens* is often replaced by *Quercus cerris, Quercus virgiliana, Quercus trojana* and *Quercus frainetto*.

Around Soliotsko polje, the eu-Mediterranean vegetation is present. Climazonal vegetation is eu-Mediteranean evergreen forests and scrubs. Most of the area is degraded to tall (*maquis, macchia*) and low scrubs (garrigue). The vegetation is mainly composed of conifers (*Pinus halepensis, Juniperus oxycedrus, Juniperus phoenicea*), sclerophylous evergreen trees and scrubs (*Quercus ilex, Olea europaea, Pistacia lentiscus, Ceratonia siliqua, Arbutus unedo,* etc.) with the occasional admixture of termophylous deciduous taxa (*Ostrya carpinifolia, Fraxinus ornus,* etc.). Also, in this area the vegetation is mixed with sub-Mediterranean vegetation of the oriental hornbean forests. This sub-Mediterranean forest is a transition to continental forests with typical vegetation: *Carpinus orientalis, Ostrya carpinifolia, Quercus pubescens, Celtis australis, Acer monspessulanum, Pistacia terebinthus, Pyrus amigdaliformis, Sorbus domestica, Phillyrea latifolia, Fraxinus ornus*, etc. Distribution of eu-mediteranean and sub-mediterannean forest and scrubs vegetation depends on the orientation of the slopes (topography of particular microlocation).

Variant B

Most of the onshore route of Variant B passes through the eu-Mediterranean vegetation of evergreen forests and scrubs. Surrounding area of the pipeline is mostly degraded to tall (*maquis*) and low scrubs (garrigue). The vegetation is mainly composed of conifers (*Pinus halepensis, Juniperus oxycedrus, Juniperus phoenicea*), sclerophylous evergreen trees and scrubs (*Quercus ilex, Olea europaea, Pistacia lentiscus, Ceratonia siliqua, Arbutus unedo,* etc.) with the occasional admixture of termophylous deciduous taxa (*Ostrya carpinifolia, Fraxinus ornus,* etc.). There are also some parts of Variant B that passes through eu-Mediterranean grasslands.

Closer to the Albanian border most of the Variant B passes though agricultural area, hygrophilic and mesophilic hay meadows.

In the foothill of Rumija Mountain, Variant B passes through the thermophilous and supra-Mediterranean oak woods like the ‘karst-woods’ described for Variant A above.

The Variant B passes through marine area where protected species of seagrass *Posidonia oceanica* and several species of genus *Cystoseira* are present.

Table 26 List of protected marine species that are presented along marine part of the pipeline route

Seagrass	*Posidonia oceanica*
Algae	*Cystoseira mediterranea*
	Cystoseira mediterranea (Ag.) Sauv. var. stricta
	Cystoseira mediterranea (Ag.) Sauv. var. spicata
	Cystoseira amentacea
	Cystoseira amentacea var. adriatica

Fauna

Using spatial data from Protected Area Gap Analysis (WWF Project Reference No 9Z1387.05; 2009), a fauna comparison of the two variants was performed, as presented in following table. Their potential protection derives from "The decision on placing certain plant and animal species under protection" (Official Journal of the Republic of Montenegro; no. 76/06; 12 December 2006)

Table 27 Animal species present in the area of Variant A and Variant B

Group	Name (in Latin)	Variant A	Variant B	Protection
Fish	*Cobitis ohridana*	+		
	Rutilus karamani	+		
	Salaria fluviatilis	+	+	
	Salmothymus obtusirostris	+	+	
	Pachychilon pictum	+	+	
	Telestes montenigrinus	+		
	TOTAL	6	3	0
Amphibians	*Hyla arborea*	+	+	+
	Rana graeca	+	+	+
	Rana ridibunda	+	+	+
	Triturus alpestris	+		+
	Triturus carnifex	+	+	+
	TOTAL	5	4	5
Reptiles	*Algyroides nigropunctatus*	+	+	+
	Elaphe quatorlineata	+	+	+
	Hemidactylus turcicus	+	+	
	Hierophis gemonensis	+	+	
	Hierophis caspius	+	+	
	Lacerta mosorensis	+	+	+
	Lacerta oxycephala	+	+	+
	Lacerta trilineata	+	+	+
	Lacerta viridis	+	+	+
	Malpolon monspessulanus	+	+	+
	Mauremys rivulata	+	+	+
	Platyceps najadum	+	+	
	Podarcis muralis	+	+	+
	Pseudapus apodus	+	+	+
	Telescopus fallax	+	+	
	Testudo hermanni	+	+	+
	Typhlops vermicularis	+	+	
	Vipera berus	+		
	Zamenis situla	+	+	+
	Zootoca vivipara	+		+
	TOTAL	20	18	13
Mammals	*Apodemus epimelas*	+	+	
	Apodemus flavicollis	+		
	Arvicola terrestris	+		
	Canis lupus	+	+	
	Dinaromys bogdanov	+	+	
	Dryomys nitedula	+	+	
	Micromys minutus	+	+	
	Microtus subterraneus	+		
	Microtus thomasi	+		

	Mus spicilegus		+	
	Suncus etruscus	+	+	
	Talpa caeca	+		
	TOTAL	11	7	0
TOTAL		42	32	18

Both variants go through similar habitats, although in different extent, so it is expected for them to have similar animal species, as it is seen from the Table 27. The higher number of species in Variant A could be explained by the fact that this Variant goes through NP Lovćen that has high biodiversity. This is the reason why faunistic biodiversity of NP is discussed in further text. On the other hand, Variant B goes through Adriatic Sea; so marine biodiversity is discussed separately for this Variant.

Variant A

Variant A passes through the mountain region of Lovćen, which is a hot spot of biodiversity due to its contact zone position of Mediterranean and Continental climate. NP Lovćen has many animal species, among which many are relict and endemic species. Furthermore, large mammals are recorded for NP Lovćen, such as *Canis lupus, Ursus arctos, Sus scrofa, Vulpes vulpes, Capreolus capreolus* and *Lepus europaeus*. Also, small mammals are known, such as *Erinaceus concolor, Talpa caeca, Sciurus vulgaris, Dryomys nitedula*, etc.

Around 200 bird species visits and/or breeds inside the Park. Also, in NP Lovćen live other animal groups: 11 species of reptiles, 16 species of amphibians, 85 species of butterflies, 100 species of ants, 45 species of hoverflies etc.

Variant A passes through karst area with numerous caves (e.g. „Duboki do“ in Lovćen and Lipska cave). In many cases, they have an exceptionally complex and high biodiversity, with many endemic and relict forms.

In areas Goljemadi and Kokoti where Variant A passes, an endemic slug *Limax wohlberedti* is registered according to Protection of rare plant and animal species; Official Gazette of Republic of Montenegro No. 76/06.

Variant B

Variant B passes through marine habitats. Data on marine invertebrates suggest relatively high diversity, but also a low degree of endemic species. The diversity of fauna of saltwater fish in the Adriatic Sea includes 117 recorded families, but a low level of endemism. Until now for Montenegro 40 742 species of saltwater fish have been recorded, which represent around 70 % of the species recorded in the Mediterranean.

Along the marine part of the pipeline route several marine protected species are present, as shown in table below.

Table 28 Protected marine species along the route*

Group	Name (in Latin)
Sponges	*Aplysina aerophoba*
	Axinella cannabina
	Axinella damicornis
	Axinella polypoides
	Axinella verrucosa
	Spongia officinalis
	Tethya aurantium
	7
Cnidarians	*Madrepora oculata*
	Cladocora caespitosa
	Eunicella cavolinii
	Eunicela stricta
	4
Mollusks	*Lithiphaga lithophaga*
	Pinna nobilis
	2
Echinoderms	*Centrostephanus longispinus*
	Ophidiaster ophidianus
	Holothuria forskali
	Holothuria impatiens
	Holothuria polii
	Holothuria tubulosa
	6
Reptiles	*Caretta caretta*
	Chelonia mydas
	2
Mammals	*Delphinus delphis*
	Stenella coeruleoalba
	Stenella frontalis
	Tursiops truncatus
	Grampus griseus
	Balaenoptera physalus
	Delphinus delphis
	Stenella coeruleoalba
	8
Total	*29*

**The decision on placing certain plant and animal species under protection (Official Journal of the Republic of Montenegro; no. 76/06; 12 December 2006)*

4.3.1.8 Natural heritage and protected areas

Albania

Variant A

a-Protected areas

4 (four) protected areas are likely to be affected from Variant A of the pipeline route corridor, as follows:

1- MNR of "Shkodra Lake and Buna River wetland complex";

2- MNR of "Riparian area of the Albanian part of Shkodra Lake":

3-NM of "Syri Sheganit" Karst Spring; and

4-NM of "Syri Gjonit" Karst Spring.

Table below shows the main data on these PAs and on the proposed emerald sites likely to be affected from Variant A of the pipeline route.

Table 29 Protected areas and emerald sites along Variant A in Albanian territory

No	Existing Protected Areas			International context/designation			
	National context / designation				EU ecological networks context (Emerald Network / Natura 2000 Network)		Other status
			Protection status				
	Code	-Name of PA; -Sub-legal act	National	IUCN Cat.	Code (Al00000x)	Type of Emerald site	
1	50	-Shkodra Lake & Buna River wetland complex; -DCM No. 683, Nov.02, 2005	MNR; Cat.IV	IV	-	-	1-Ramsar area (Feb., 2006); 2-Cross-border PA (ALB/MNE)
2	127	-Riparian area of the Albanian part of Shkodra Lake; -DCM No. 684, Nov.02, 2005	MNR; Cat.IV	V	09	IBA; IPA	Cross-border PA (ALB/MNE)
3	N/A	-Syri Sheganit Karst Spring -DCM No. 676, Dec. 20, 2002	NM; Cat.III	IV	-	N/A	-
4	N/A	-Syri Zi Karst Spring -DCM No. 676, Dec. 20, 2002	NM; Cat.III	IV	-	-	-

1- Shkodra Lake and Buna River wetland complex

According to the Albanian legislation through DCM No. 683 of February 02, 2005 the Albanian part of the aquatic zone of Shkodra Lake and Buna River wetland complex is asserted as Natural Managed Reserve, which under the Law No. 8906 of June 06, 2002 as amended with the Law No. 9868, of February 04, 2008: "On Protected Areas" falls under Category 4 of the protected areas.

Under Albanian law, for the Category 4 it is applied the third level of protection while under the same law the National Parks fall under Category 2 that implies the second level of protection. The level of category and the

level of protection relate directly to the importance of a given zone, the list of prohibited activities, the list of activities that require the advanced issuance of an environmental permit and other delineations.

In February 02, 2006, by Ramsar Convention on Wetlands, the aquatic zone including the Shkodra Lake and Buna River, Albanian part, was included in the Ramsar list of wetlands of international importance. Wetlands included in that list acquire a new status at the national level and are recognized by the international community as being of significant value not only for the country, or the countries, in which they are located, but for humanity as a whole.

From Shkodra to Bajza the pipeline route runs over permeable Quaternary loose deposit (Shkodra-Bajza segment), which overlie karst limestone, while from Bajza to Hoti/Barlaj (border ALB/MNE) the pipeline route runs traverse karstified limestone formations. The surface and ground waters of both Quaternary and limestone formations drain to the Shkodra Lake. The nearest distance between the axis of the pipeline corridor and this PA is less than 1km (in the territory of Hoti Village).

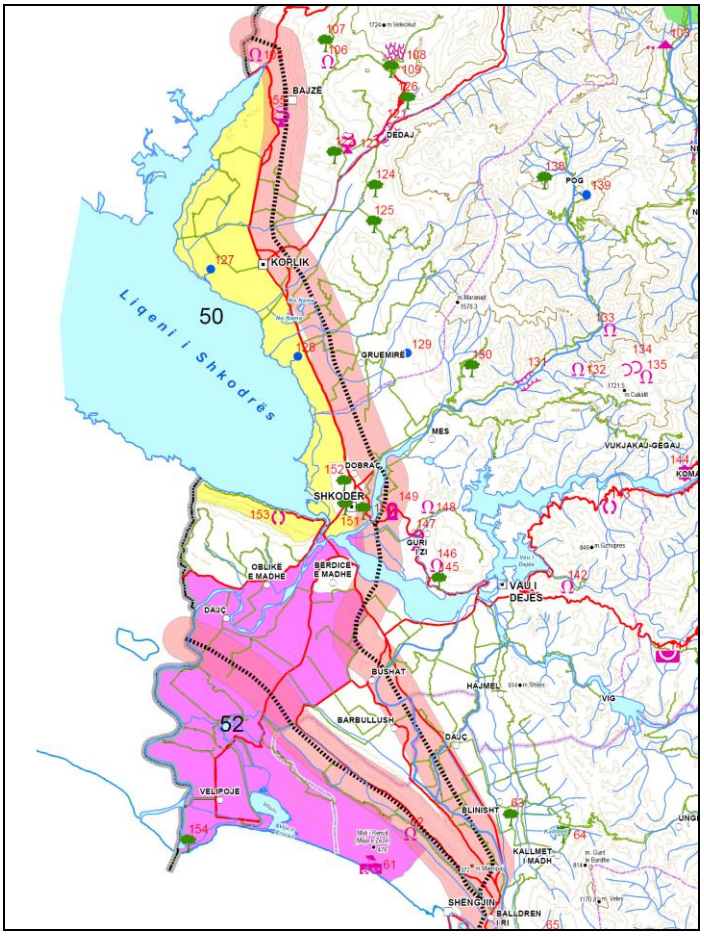


Figure 33 Map of the protected areas in the northwest of Albania and proposed variants of the pipeline route corridors

(Based on the Map of Protected Areas of Albania; MoEFWA, 2012)

2.- Managed Nature Reserve of the Riparian area of Shkodra Lake (Shoreline of Shkodra Lake).

The riparian area of Shkodra Lake also enjoys the status as a protected area. Under DCM No. 684 of November 02, 2005, the Albania government has declared as a "Managed Natural Reserve" the Albanian side of Shkodra Lake shoreline.

The zonation of this PA shows that the crossing corridor falls under level IV of protection (IUCN Category IV).

Similar to the case of Shkodra Lake, From Shkodra to the border ALB/MNE, all the surface and ground waters of both Quaternary and limestone formations drain to this PA.

Over the karst formations along the segment Bajza-Hoti (8.5 km long), this MNR is situated within the proposed pipeline corridor. The nearest distance between the axis of the pipeline corridor and this PA is less than 1km (in the territory of Hoti Village).

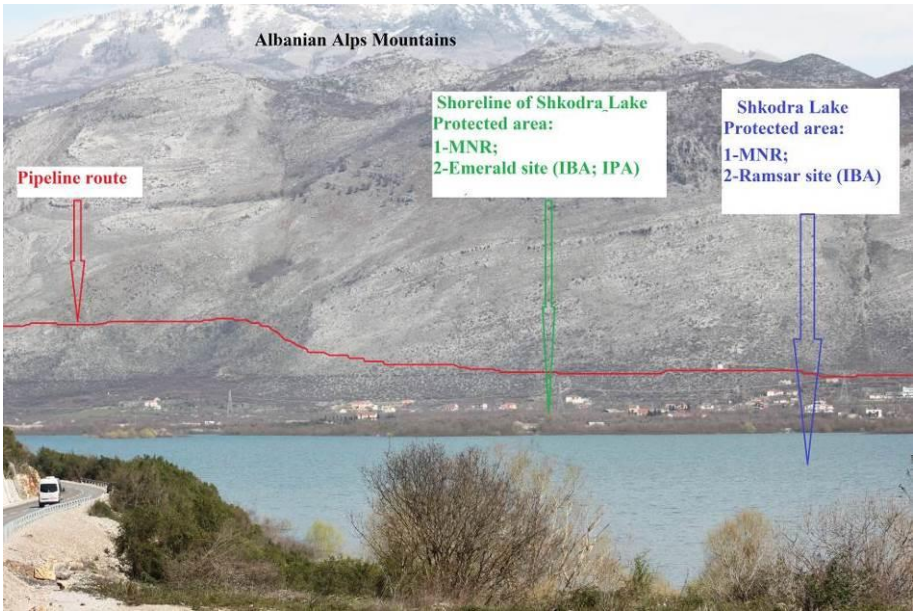


Figure 34 Protected areas near the pipeline route in the segment Bajza-Hoti/Barlaj

The DCM No. 676 of December 20, 2002 has declared the Nature Monuments as Protected Areas (Category IV of protection). According to the above DCM, there are two Nature Monuments near the Variant A of the pipeline route corridor, namely the Syri Sheganit and Syri Gjonit Karst Springs.

3- Syri Sheganit Karst Spring (hydro-monument)

Syri Sheganit ("Shegani's eye"), which is located at the Bajza Bay, is the largest vauclusian karst spring (1000 l/sec) in tectonic-karst fissures, arising from a chimney vertically karst depth of 22-28 m and width 3-5 m. It relates to

two water sources (Hurdhana 1 and 2 Karst Lakes). Water comes from the Western Alps karst areas of Albania. It is rich in fish and other aquatic species. Sources create attractive environment with scientific, hydrological, didactic, aesthetic and tourism values.

Figure 35 Syri Sheganit Karst Spring (Nature Monument; 1000 l/s)

All the surface and ground waters of Bajza karst plain, over which runs the pipeline route, drain to this PA.

4- Syri Gjonit Karst Spring (hydro-monument)

This karst spring is located near Grude Fushe village, near the pipeline route corridor. It emerges as karst source in the contact molasses- limestone deposits. It has a 60-65 m^2 area and a great flow; this is used to supply the population or irrigation. Sources create attractive environment with scientific, hydrological, didactic, aesthetic and tourism values.

b-Emerald sites

There is 1 (one) Emerald site affected from the Variant A of the proposed pipeline corridor, as follows:

1-"The MNR of the Riparian Area of the Albanian part of Shkodra Lake" that is also called "Shoreline of the Albanian part of Shkodra Lake"; Site code: AL0000009; Area covered: 26.535 ha.

This MNR (IUCN Category IV), which is established by the DCM No. 684, of November 02, 2005, is an important area for trans-boundary biodiversity protection. The site that includes a variety of habitats is an Important Bird Area for Europe hosting about 40 bird species, including the globally endangered species of *Phalacrocorax pygmeus*. The Shkodra Lake is home for some 45 fish species including the endangered species of *Acipenser sturio*. The area is rich in aquatic vegetation including some rare and endangered species like *Nymphaea alba*, *Nuphar luteum*, *Nymphoides peltata*, and *Trapa natans*.

Albania as a party to the Bern Convention from 1999 has continued the work for the setting-up of the Emerald network of the Areas of Special Conservation

interest. In the development of the Emerald network in Albania "Managed Nature Reserve of the Albanian part of Shkodra Lake Shoreline" were selected based on the criteria listed in the Resolution no.16 (1989).

This site is located within the pipeline route corridor in the section Bajza-Hoti/Barlaj (figures 33, 34).

c- Natural heritage or habitats of particular interest

Between the pipeline route and the Shkodra Lake there are some small temporary and permanent karst lakes: Urdhana Lake 1, Urdhana Lake 2 (fig. 36), and Hurdhana e Kalbet Lake, which ara fed from ground waters. While in the border of Shkodra Lake, within the Bajza Bay, there are numerous permanent karstic springs of high natural and landscape values. The most important of them are: Syri i Virit; Syri i Franit; Vau i Mullirit; Syri i Zi (fig. 37, left); etc. In total, 18 karst springs (or "eyes") are located the eastern shoreline of Shkodra Lake. Within the pipeline corridor, between Ivanaj and Hoti, are located two other Karst Lakes (fig. 37, right). In the villages located over the karst plain of Bajza there are some dug wells that have natural and historical values (fig. 15).

Figure 36 Hurdhana 1 (left) and 2 (right) karst Lakes in spring time

Figure 37 Left: Syri Zi karst spring and Shkodra Lake; Right: Karst Lake in the karst plain close to Hoti Village.

The karst Lakes Hurdhna 1 and 2, and Hurdhana Kalbet, the karst springs situated near Shkodra Lake, as well as some dug wells can be adversely

affected from the project activities because of the direction of the groundwater flow.

Variant B

a-Protected areas

Variant B of the pipeline route corridor runs across the MNR of Shkodra Lake & Buna River wetland complex". Among the other protected areas in the wide project region, the nearest one to Variant B of the pipeline route is the "Wetland/Terrestrial Protected Landscape of Buna River Mouth-Velipoja" that is located 1.3 km from the proposed pipeline axis.

Table 30 Protected areas and emerald sites along Variant B in Albanian territory

No	Existing Protected Areas			International context/designation			
	National context / designation				EU ecological networks context[1)] (Emerald Network / Natura 2000 Network)		Other status
	Code	-Name of PA; -Sub-legal act	Category of Protection	IUCN Category	Code Al00000x	Type of Emerald site[1,2)]	
1	50	-Shkodra Lake & Buna River wetland complex; -DCM No. 683, Nov.02, 2005	MNR; category IV	IV	-	-	1-Ramsar area (Feb., 2006); IBA & IPA 2-Cross-border PA (ALB/MNE)
2	52	-Wetland/Terrestrial Protected Landscape of Buna River Mouth-Velipoja; -DCM No. 682, Nov.02, 2005	PL; category V	V	21	IBA; IPA	Cross-border PA (ALB/MNE)

1- Shkodra Lake and Buna River wetland complex

This PA (MNR) is crossed from Variant B of the pipeline at Buna/Bojana River (border ALB/MNE) near the territories of Dajc/Shtodher villages (border ALB/MNE). Most of the area where the line crosses this PA belongs to agricultural lands of this village and only in a short segment of approximately 50m passes on natural habitats mostly dominated by riparian vegetation.

It should be stressed that across this protected area the pipeline runs over impermeable sub-clayey deposits, 17-25 m thick. Thus there is no expected any adverse impact of the project activities on the ground waters in this PA.

2- Wetland/Terrestrial Protected Landscape of Buna River Mouth-Velipoja.

Between Rrenci and Kolaj Mountains, the axis of the pipeline route (Variant B) runs approximately 1.3 km from the protected area of "Buna River Mouth - Velipoja Protected Landscape". According to the DCM No. 682, of November 02, 2005, the Buna River Mouth area together with its estuary and the Island of Franc Joseph, Velipoja Reserve, Viluni lagoon, Baks-Rrjolli Beach, Domni Marsh, as well as the surrounding territories, have been designated as Protected Aquatic and Terrestrial Landscape (IUCN Category IV).

The closest point (1.3 km) of the pipeline axis to this site is the Murtenza Marsh. At this point, the axis of the pipeline runs through flat agricultural lands, which lie over a thick impermeable clayey-silty cover. Consequently, no significant adverse impacts are expected on the aquatic and terrestrial parts of this emerald site.

Figure 38 The freshwater marshes of Domni and Murtenza

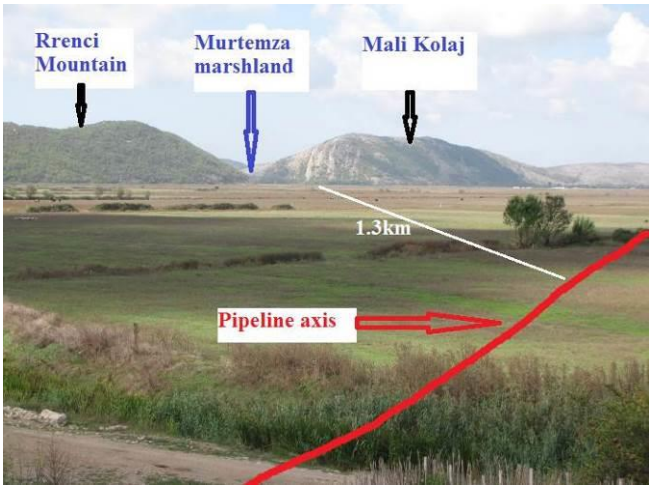


Figure 39 Pipeline and the Murtenza marshland

b - Emerald sites

"Buna River Mouth -Velipoja Protected Landscape" area is identified as an Emerald site (Site code: AL0000021), while its wider area as IBA (Important Birds Area). This aquatic/terrestrial protected landscape has an overall area of 23,027 ha.

As mentioned above, the pipeline axis passes 1.3 from this emerald site.

c- Natural heritage or habitats of particular interest

Field surveys have not identified any other area of particular interest.

Montenegro

Protected areas in the region (buffer distance of 1 km) of the proposed corridors of IAP are presented in Table 31 (for Variant A) and Table 32 (for Variant B), and also in the map of protected areas (Figure 40). Montenegro does not have a proclaimed ecological network, but there is proposal for Emerald network, which will be further developed, to Natura 2000 proposal. There are possible adverse effects to the Emerald network sites, which should be studied in details. In addition, to Emerald network sites Important Plant Areas (IPA) and Important Bird Areas (IBA) are analysed as areas with potential to become Natura 2000 proposals as well.

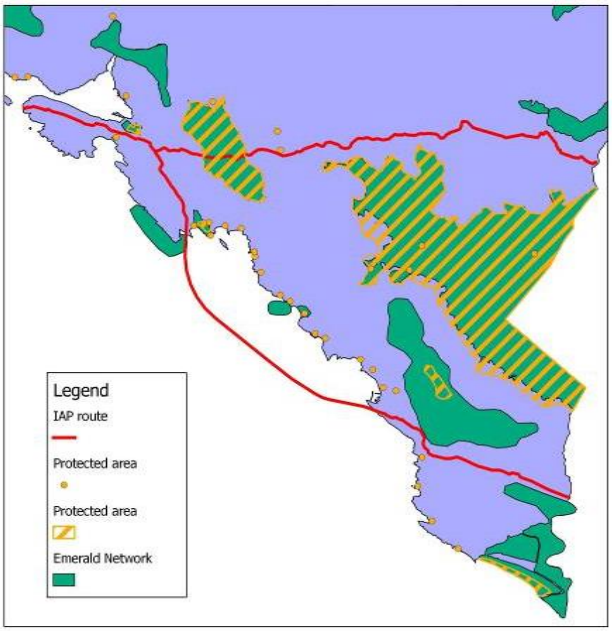


Figure 40 Map of protected areas and biodiversity important areas, Montenegro

Variant A

Variant A passes through National park Lovćen and in the vicinity of protected area Lipska Pećina (Lipska cave) and biodiversity important area Cijevna.

Cijevna River flows through Albania and Montenegro for 64.7 kilometres before merging with Morača River in vicinity of Podgorica and only upstream is proposed as Emerald site and Important Plant Area. In the vicinity of Podgorica Variant A is passing over the Cijevna River. The area of transition over the Cijevna River is downstream from the Emerald and IPA site. Consequently, the Variant A will not have any effect on this protected area.

Monument of Nature Lipska Pecina is a cave on the south of Cetinje. Variant A is passing 800 m from the entrance of Lipska Pecina.

National Park Lovćen encompasses the central and the highest part of Lovćen mountain massif and covers an area of 62.20 km². Due to its position in the joint of Mediterranean and Continental climate, NP Lovćen has rich biodiversity with numerous endemic species present. The area of NP Lovćeni is proposed as Emerald network site and as IPA site. Besides Lovćen's natural beauties, the national park was established to protect rich historical, cultural and architectural heritage of the area. The Spatial Plan of Montenegro defines two protection zones in the NP Lovćen for the period until 2020. Within the Park borders, the first zone of protection unites five nature reserves with the strict level of protection. The second protection zone presents the rest of the park area. Also, around the Park the protection buffer zone is defined. The Variant A is passing in the middle part of the Park from west to east that goes through the second protection zone in a length of around 6.5 km. This part pipeline route is mainly passing through the forest habitats. Also, the Variant is passing through the buffer zone around the park in a length of around 6 km. The new Spatial Plan of the National Park Lovćen (the Spatial plan is in final phase - public debate was in autumn 2012) proposes new zonation of the Park.

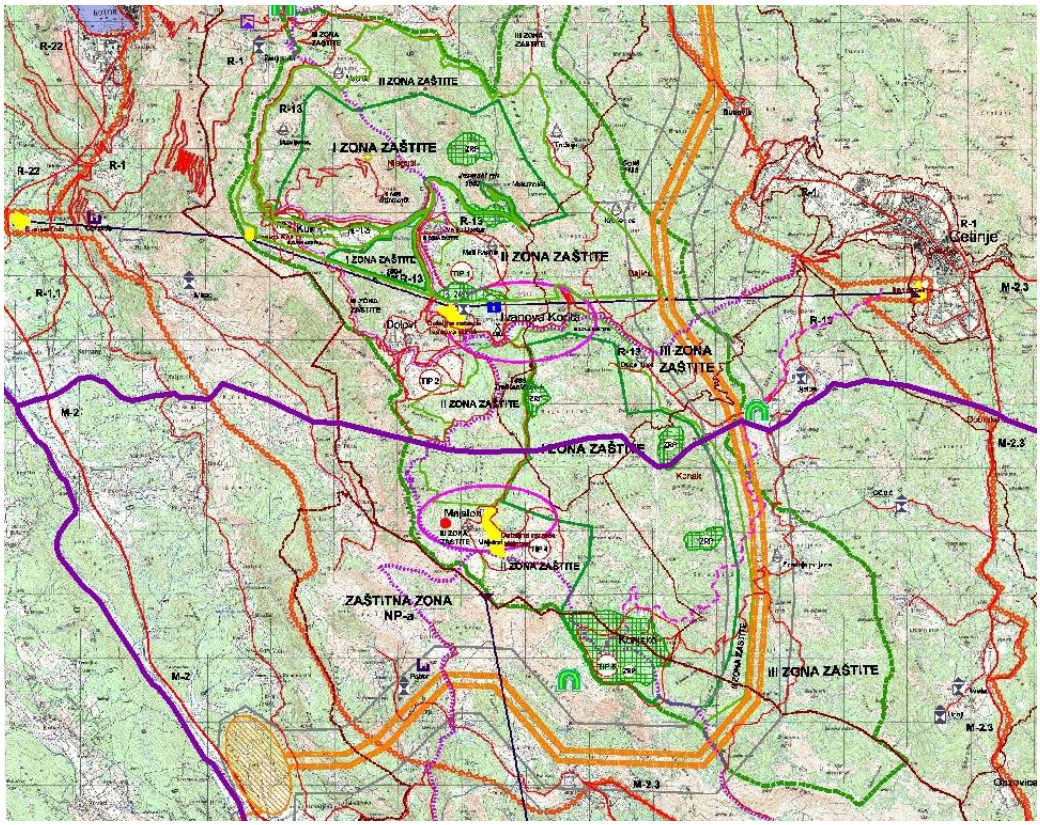


Figure 41. Map of land use and spatial organization from the proposed Spatial Plan of the National Park Lovćen with the IAP route – both variants (dark purple line)

According to the proposed spatial plan of the National Park Lovćen, the pipeline route is passing through 3 km of the first protection zone and 3 km through second protection zone.

The first protection zone is characterised by the areas with the highest functional ecological importance and consequently with the highest level of protection. Along this protection zone it is forbidden to construct any objects and exploit natural resources. The planned pipeline route is predominantly passing through the forest vegetation of the area (in buffer, first and second protection zone, respectively). In the first and second protection zone high natural value of the forest habitats (in particular beech forest) is recognised as important Emerald and Habitat Directive habitat. In this area the pipeline route is passing through rough terrain without settlement. Therefore, the new corridor in this area will cause the removal of important habitats (along ca 20 m of the route and other engineering surfaces) resulting direct loss and habitat fragmentation and might adversely affect the ecological functionality of important habitats. Cutting of forest vegetation in the construction phase might be considered as exploitation of natural resources and may not be approved according to the proposed Spatial Plan.

In addition, in eastern part of the Park the pipeline route is planned through the Special Nature Reserve Sokol (20.6 ha). Consequently, the construction of the planned pipeline will have significant effect on the conservation of the natural values of the Special Nature Reserve Sokol.

Table 31. Protected areas and biodiversity important areas inside 1 km buffer from Variant A

Name of the protected area (Montenegrin)	Name of the protected area (English)	Category of Protection (Montenegrin Law on Nature Protection)	IUCN Category	Other international importance status	Emerald site (potential Natura 2000 sites)	Distance from corridor
Lovćen	Lovćen	National Park	II	IPA	Yes	Passing through
Lipska Pećina	Lipska cave	Monuments of Nature	III/V		No	800 m
Cijevna (rijeka i kanjon)	Cijevna (river and canyon)			IPA - Cijevna Canyon and Hum Orahovski	Yes	820 m

Variant B

Variant B passes ca. 530 m north of Šasko Lake and protected part of river Bojana, Kneta, Ada (IBA – Ulcinj saltpans and Šasko jezero; IPA -Long beach - Ulcinj and Ada Bojana; Emerald site).

Variant B passes through the Emerald network site Platamuni and in the vicinity of two protected areas and three important biodiversity areas. On the northwest of Budva, there are two protected areas and an Emerald network. "Spas" above Budva is the hill on the north of Budva. It is protected as Special Natural Site because of its specific Mediterranean sclerophyllous vegetation. On the north of Budva is Jaz beach, which is protected as Monument of Nature. The Variant B is passing on the northwest of the Beach Jaz and the Spas Hill above Budva.

Marine biodiversity important area Platamuni is recognized as IPA and Emerald site. The Variant B is passing in its marginal marine part of protected area for a length of around 1.7 km. Marine part of Platamuni is proposed because of *Posidonia oceanica* seagrass. This protected area is characterised by high marine biodiversity where there is no presence of anthropogenic impact mainly caused by marine transportation and touristic activities.

Variant B also passes around 190 km south of Rumija (IPA and Emerald site) at its foothill. Rumija has the best developed beech forest on the coastal Montenegro's Dinarids and has also communities of *Pinus heldreichii*, being the southeast location of this halfendemic *Pinus*. Mentioned habitat types are specific for higher parts of the mountain.

Table 32. Protected areas and biodiversity important areas inside 1 km buffer from Variant B

Name of the protected area (Montenegrin)	Name of the protected area (English)	Category of Protection (Montenegrin Law on Nature Protection)	IUCN Category	Other international importance status (IBA or IPA site)	Emerald site (potential Natura 2000 sites)	Distance from corridor
Brdo Spas iznad Budve	Spas Hill above Budva	Special Natural Sites	III		Yes	810 m
Plaža Jaz	Beach Jaz	Monuments of Nature	III/V		No	300 m
Platamuni	Platamuni			IPA	Yes	Passing through
Rumija	Rumija			IPA	Yes	190 m

Šasko j. rijeka Bojana, Kneta, Ada	Šasko lake Bojana river, Kneta, Ada			IBA – Ulcinj saltpans and Sasko jezero IPA -Long beach - Ulcinj and Ada Bojana	Yes	530 m

4.3.1.9 Landscape and Visual Issues

Albania

Variant A

Beginning in Balldren to the state border ALB/MNE at Hot/Barlaj (northeast of Skadar/Shkodra Lake), the proposed pipeline corridor runs mainly over a flat terrain. This area is composed of the plains of Zadrima, Lower Shkodra, Upper Shkodra, Malesia Madhe, and of the karstic field of Bajza-Ivanaj area. The last segment of the pipeline route traverses a rocky mountainous area in the territory of Hot village.

In the segment Ivanaj-Hot the pipeline route passes close to the Skadar/Shkodra Lake (Ramsar site), which shoreline (Protected Landscape) is covered from dense vegetation.

From Balldren to the border ALB/MNE the proposed pipeline corridor traverses four rivers [Drini-Lezhes (four times), Drini, Kiri and Vraka], as well as a number of streams. The Drini Lezhes, Drini and Kiri riverbeds are covered of riparian forests. The Riparian area at the merging point between Drini and Kiri rivers has special landscape value.

With respect to the pipeline route, the main elements of the landscape along the section Balldren-border ALB/MNE, as follows:

From Balldren to the east of Shkodra the landscape is dominated by agricultural lands and the Drini riverbed (Protected Landscape); From Shkodra to Koplik the landscape is dominated by agricultural lands and farmhouse spread everywhere in the agricultural lands; and From Koplik (north of Shkodra city) to Hot Village, the landscape is dominated from five main elements: 1-Skadar/Shkodra Lake (PA-Ramsar site) from the west; 2-the steep western slopes of Albanian Alps Mountains; 3-the karst plain in the territories of Bajza, Ivanaj and Hot villages. In the territory of Bajza village, close to the lake shore, numerous karstic springs come in surface. Two of these springs (Syri Sheganit and Syri Gjonit) are Natural Monuments; 4–The vegetation habitats of the shoreline of Skadar/Shkodra Lake (Managed Nature Reserve); and 5-numerous farmhouses dispersed in the flat land without any criterion of spatial planning.

Because of unplanned internal migration during the last 20 years, many arable lands are converted into residential lands. Many rural roads, transmission and

telecommunication lines, and poorly maintained irrigation and drainage channels crisscross now the agricultural plots.

The most scenic landscapes, along and near this section are:

- Drini River at the location where merges with Kiri River riparian area This riverbed is quite large and is covered by a riparian forest;
- Skadar/Shkodra Lake (Ramsar site);
- The Albanian side of Skadar/Shkodra Lake shore (Managed Nature Reserve);
- The flat karst area in the segment Bajza-Hot Village;
- Numerous karst lakes and karst springs, among which the Syri Sheganit and Syri Gjonit Springs are Nature Monuments; and
- A number of land forms in karst area;

Variant B

From Balldren to Dajc (ALB/MNE border) the proposed pipeline corridor runs entirely in flat terrain. The landscape within this corridor and its proximity is dominated by agricultural lands, which are used mainly for crops, vineyards and other fruit trees. Numerous drainage and irrigation channels cross the study area. The villages are rare and far from each other.

From Balldren to Torovica Village the proposed corridor runs along the Balldren Field, which is approximately 1 km wide and 20 km long. This field is bordered from the rocky hills of Rrenci and Kakarriqi that lie in a Southeast to northwest direction. The eastern slope of the Rrenci hill is covered from bushes and pine forest, while the western slope of Kakarriqi hill is covered partly by maccia. The other part of his surface is composed from denuded limestone rocks.

From Torovica village to the border ALB/MNE the pipeline corridor traverses the Bregu Bunes Plain, which is bordered from the west from the Mali Kolaj (545 m asl) and Mali Belaj hilly chain, which lie in a southeast to northwest direction.

The only scenic landscape along the section Balldren-Dajc (border ALB/MNE) is the protected landscape of Buna River, which is confined by a narrow strip of riparian forest. The proposed pipeline corridor runs across this forest.

Montenegro

In order to estimate the impact of the pipeline route in the landscape features flows of the gas pipeline variants are divided into several smaller landscape

units. The criteria for defining landscape units are features of natural and anthropogenic landscape: relief, surface cover, settlements, infrastructure, rural areas and water flows. A reference area is the zone 1 km wide on each side of the centre of the pipeline. Narrow area is the zone 50 m wide on each side of the gas pipeline.

According to the above criteria the following sections were selected:

K01-*predominantly anthropogenic landscape* - ensembles in which are dominant anthropogenic landscape elements: residential buildings, roads, power lines and agricultural areas. To a lesser size are represented the natural features of the landscape: the high and low vegetation and natural watercourses.

K02-*agricultural landscape* - the landscape is dominated by agricultural areas, roads, residential and commercial buildings. Agricultural areas (meadows and pastures) are small sized and divided with vegetation or stonewalls. To a lesser extent in the area are forest areas.

K03-*intensive agriculture landscape* - the landscape is almost entirely dominated by large size and rectangular shape agricultural land. Roads and anthropogenic streams are large scale and rectilinear direction. Natural surface cover and quality elements of rural landscape in most cases do not exist.

K04-*high value rural landscape* - arable land and pastures, combined with forests are the dominant landscape element. In smaller villages are scattered buildings build in traditional architecture style. Roads and paths are small traffic intensity. Fields, vineyards and pastures are surrounded by stonewalls or tall vegetation and irregular in shape, which is adapted to the terrain.

K05-*industrial landscape* - industrial systems, factories, exploited areas and roads of high intensity are the dominant element of the landscape. This type of landscape is considered to have a very low value.

K06-*landscape of antopogenic flattened fields* - flat surface under grass cover or low vegetation clearly divided into rectangular of large dimensions. The elements of natural or cultural landscape do not exist.

K07-*mosaic landscape* - forests, meadows and karst rockery are dominant element of mosaic landscape structure. To a lesser extent are represented waterways and roads. That high value landscape is determinate with a clearly defined relationship between: contrasting volumes and surfaces, light and dark colours and rough and soft texture. Visual exposure varies depending of the position on the indented relief.

K08-*mountainous forest landscape* - the landscape is dominated by forest area in indented relief. To a lesser extent are represented roads, individual buildings and the rural areas. Visual exposure is large and a dark forest volume dominates the structure. Due to the high level of naturalness the landscape is defined as valuable.

K09-*steep slopes and colluvial drifts landscape* - on very steep slopes mountain ranges dominate the bright tones of rocks and colluvial drifts contrasted with low vegetation surface cover and the occasional occurrence of high vegetation. Anthropogenic elements are not present because of inaccessibility of terrain.

K10-*karst and rockery landscape* - the landscape is dominated by rockeries covered with rare underbrush on relatively steep terrain. Occasionally occurs smaller sized agricultural land, buildings and roads. The structure of the landscape was reduced to contrast of light rockery tones and dark tones of the surface cover.

Variant A

The path of the pipeline route Variant A goes through several ambient landscapes (According to PP Montenegro, 2008). The pipeline route direction is east - west. Extreme eastern point of Variant A, near the border with Albania, is the zone of economic forests and pastures. In further movement to the west, the gas pipeline is going downhill to the river valley landscapes. Continuing to the west, the route passes through the landscape of karst basins and plateaus and comes in subalpine and alpine mountains. At the end of the route, Variant A is going downhill to the landscape of coastal mountains and coastal zone.

Flow route Variant A is divided into segments according to the defined landscape sections (kilometres are calculated from the Albania/ Montenegro border to the end of Variant A):

0-8.7 km: The first segment of the route variants A is 8.7 km long. Within the area of this route segment, there is a constant change in K04-high value rural landscape and K07-mosaic landscape. Landscape features are based on the structure of groves, small villages, and pastures fenced with tall vegetation. Near the border with Albania are visible dominant characteristics of the mountain landscape, which is composed of rocks, mountain pastures and forests.

8.7-10.2 km: On the low slope, the dominant is K02-agricultural landscape. It is characterized by agricultural fields with relatively regular shape separated by tall vegetation. In this segment, small watercourse cuts the route of Variant A.

10.2.-23.6 km: A significant change in landscape characteristics, occurs when the route enters in Ćemovsko field. Space is dominated by anthropogenic landscape elements. Because of the proximity of Podgorica, the number of residential and industrial buildings increases, within large areas of intensive agriculture. The pipeline route in this area passes through suburban areas, crosses roads, railways, industrial areas and rivers Morača and Cijevna. River Cijevna is characterized by extremely dynamic landscape characteristics. The space of the route, in length of 13.6 km, contains types: K01-predominantly anthropogenic landscape, K03-intensive agriculture landscape and K05-industrial landscape. Except of the landscape of the River Cijevna, others are

not very valuable elements of the landscape. Relief is completely flat and the visual exposure is low.

23.6-26.9 km: On steeper slopes and peaks, 3.3 km in length, dominant is K07-mosaic landscape. It is characterized by the dominance of the natural landscape elements with intermittent traffic and the elements of the agrarian landscape.

26.9-57 km: Landscape characteristics are partially changed in the space. It is noticeable a significant higher proportion of the elements of the agrarian landscape in the valleys between the hills; K04-high value rural landscape. The dominant are rural landscape elements: terraced fields on the slopes and agricultural areas in the valleys. Roads are more noticeable while the natural landscape elements are represented with low and high vegetation on the rocks. In the further course of direction, Variant A extends along the direction of the road that connects Podgorica and Cetinje. Route moves along the ridge of the hill to the west. At half of its length, the route passes close to northern border of National Park Skadar Lake, which is protected area with valuable landscape elements. Karst mountain landscape is in contrary relation to strong horizontal water surface surrounded by green vegetation. Besides the natural landscape features within the boundaries of the national park, about 1 km south of the pipeline route, terraced fields along the small villages in the valley can be found. In furthered movement to the west Variant A passes flattened valley on whose northern part is the village surrounded with terraced fields. Steep slopes characterize environment basin. In lower part of the route, landscape is dominated with elements of the natural landscape - trees, bushes and rocky with significant number of traditional anthropogenic units - small villages with associated terraced fields. At a distance of 47.7 km from its beginning, the route crosses the road E80. Characteristics of this part of the area belong to K01-predominantly anthropogenic landscape. Roads and other elements of the urban environment define them. Further on, the route passes slopes and mountain peaks and is visually exposed from surrounding areas. Southern boundary of the National Park Lovcen is located at a distance of 700 m from the pipeline route. Approaching the edge of the plateau the number of anthropogenic elements decreases and the last anthropogenic landscape element is a small village with surrounding fields at distance of a 5.5 km from the west edge of the plateau. Overall, second half of Variant A, route passes through K07-mosaic landscape for about 30 km, with distinct characteristics of natural Mediterranean and sub-Mediterranean landscape: mosaic system groves, rocky terrain and grassland. Area is dominated by high contrast ratio bright tones of stone and darker tones of vegetation.

57-58.2 km: In the last part of the route, it rapidly descends to the coastal zone. Dominated landscape type is K09-steep slopes, colluvial drifts landscape, and the space is characterized by extremely steep terrain elevation (altitude difference of about 1 km). This terrain can be described as a mosaic system of high vegetation and grasslands with the occasional appearance of colluvial drifts. Anthropogenic elements that are present in surroundings, are small villages associated with low-grade roads that are surrounded by terraced agricultural areas.

58.2-62.4 km: In this segment dominates K08- mountainous forest landscape. Exception is the area that is located between 2.1 -2.9 km that contains fragments of the agricultural landscape.

62.4-63.6 km: The end of the route variants A passes through K01-predominantly anthropogenic landscape, which is situated in a valley between two mountain ranges.

Variant B

The path of the gas pipeline route Variant B goes through several ambient landscapes (According to PP Montenegro, 2008).

The route direction is from the southeast to the northwest. The route in most of its course passes through combination of coastal mountains and coastal zone units, and only at its beginning passes through the river valley landscapes.

Variant B is divided into segments according to the defined landscape sections (kilometres are calculated from the Albania/ Montenegro border to the end of Variant B):

0-25.5 km: The beginning of the route entirely passes through K02-agricultural landscape. In the first and central part, the route occasionally touches parts of K07-mosaic landscape. In the landscape, dominate agricultural land, roads, residential and commercial buildings surrounded by hilly area covered with natural and agricultural landscape elements. Structure of the landscape is reduced to a flat regularly shaped fields and the voluminous surrounding of the hills covered with mosaic landscape.

25.5-28.7 km: Beneath the City of Bar, route enters in K10-karst and rockery landscape. As opposed to natural landscape of coastal rocks, parts of the observed territory occupy industrial fragments. In the middle of the area route passes directly through attractive sinkhole with agricultural surface.

28.7-62.0 km: Pipeline is placed offshore.

62.0-63.2 km: After returning onshore, the route climbs to the mountain terrain in which are the dominant characteristics of K08-mountainous forest landscape and K10-karst and rockery landscape.

63.2-64.8 km: K06-landscape of anthropogenic flattened fields is flat grassy area divided into squares. Flattened fields end with campsite and beach. Dimensions and orthogonal distribution of grasslands are in contrast relation with the characteristics of a natural mountain environment.

64.8-68.8 km: In the Mrčevo field increases the share of anthropogenic landscape elements especially roads and residential buildings (K01-predominantly anthropogenic landscape). Agricultural fields with proper form and shape and a small number of objects dominate over the flattened part of the

landscape. East and west from the locations there are hills covered with rocks, macchia and tall vegetation (K08-mountainous forest landscape).

68.8-71.8 km: K08-mountainous forest landscape. Characteristic ribbed relief forms on the slopes are covered with vegetation. Strong and dark volumes of vegetation dominate landscape.

71.8-73.7 km: The final course of the route passes through the area where landscape units K01-predominantly anthropogenic landscape and K08-mountainous forest landscape, overlap. The most dominant feature of the area is land depression that northern part is rich with anthropogenic landscape elements. The shape and arrangement of agricultural areas is based on the irregular rectangular shapes, which are separated with lines of high and low vegetation. Steeper slopes that are surrounding anthropogenic landscape are covered with tall vegetation and therefore give more natural and visually more attractive landscape character.

4.3.1.10 Air Quality and Existing Emissions Load

Albania

Variant A

Though there are no data to monitor the air quality in the rural parts of the project area, it is believed that the air quality, including the suspended particulate matters, is within the acceptable parameters set by the Albanian legislation. The data from air monitoring during 2010 (SoER, MoEFWA, Tirana, 2012) show that typical air polluting substances like SO_2 and NO_x are at acceptable levels (DCM. No. 803, of December 04, 2003; “On air quality standards”).

Meanwhile the suspended particulate matters, in the city of Shkodra are above the acceptable limits. The main reasons for high particulate matters in these cities are; vehicular traffic, poor quality of roads, environmentally non-compliant construction activities, and low quality of vehicular fuels (particularly that of diesel fuel, which is the most common vehicular fuel in Albania). In recent years, air quality with regard to suspended particulate matters and PM_{10} has improved. This improvement is a consequence of increased quality of road infrastructure, which has brought down dust levels. Nevertheless, there is still concern about the levels of the pollutants in the air, as long as they are above the allowed standards.

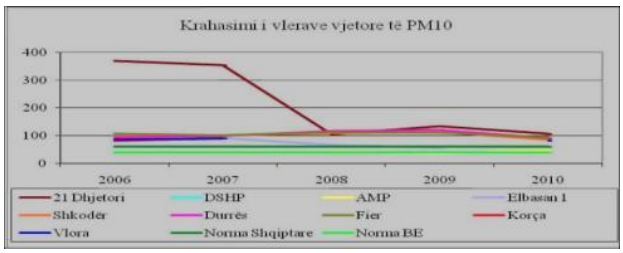


Figure 42 Data on PM10 from 2006 to 2010. In dark green: the Albanian norm; In light green: the EU norm (Source: State of Environment Report, MoEFWA, 2012)

The table below indicates the levels of eight indicators of air pollution in some Albanian cities during 2010.

Table 33 Average level of eight indicators of air monitoring during 2010

Monitoring Station	SO_2	NO_2	LNP	PM10	PM2.5	O_3	Pb	CO	Benzene
21 Dhjetori	24.07	46.08	1967	106.5		55.69	0.069		
DSHP (Tirana)	15.23	24.73		81.55		44.15	0.055	0.453	0.492
AMP (Tirana)	9.88	17.41	74.01	44.81		43.35	0.042	0.38	0.629
Alba 1 (Tirana)	4.77	27.27			27.17	49.13			
Alba 2 (Tirana)	9.66	46.9		58.5	34.73	92.58			
Elbasan 1	18.4	29.39		116.5				0.515	0.453
Shkodra	17	26.5	182	86		70.6	0.22		
Durres	20.1	28.1	192	91		67.4	0.25		
Fier	26.7	31	195	93		62.6	0.24		
Korça	19.9	24.6	186	85		62.3	0.22		
Vlora	21.8	26	176	80		68.1	0.21		
Albanian norm	60	60	140	60	15	65	1	2	5
EU norm		40		40	25		0.5		5

Source: SoER, MoEFWA, 2012.

Several villages and Shkodra town are likely to be adversely affected with regard to air quality by project's activities: Eighteen villages are traversed by the proposed Variant A, which also runs close to the peripheral East of Shkodra city.

The table shows that PM10 concentration in Shkodra is superior to the European standards. It should be stressed that the monitoring points are located in places with heavy traffic. There are no air quality data for the villages crossed by the axis of the pipeline route.

Variant B

Within the Albanian territory, this Variant of the pipeline route corridor runs entirely through agricultural areas, without any industrial activity and far from the heavy traffic of the main roads. Even though there are no data to monitor

the air quality in the rural parts of the project area, it is believed that the air quality, including the suspended particulate matters, is within the acceptable parameters set by the Albanian legislation and the EU norms.

Montenegro

Variant A and Variant B

Air quality

Territory of Montenegro was designated to three zones according to the air quality assessment, taking into account the lower and the upper assessment thresholds of pollutants assessed through analysis and modelling of existing data for pollutants. The borders of air quality zones coincide with administrative borders of municipalities included in these zones.

Table 34 Air quality zones in Montenegro

Air quality zone	**Municipalities included in zone**
Zone of maintaining existing air quality	Andrijevica, Budva, Danilovgrad, Herceg Novi, Kolašin, Kotor, Mojkovac, Plav, Plužine, Rožaje, Šavnik, Tivat, Ulcinj and Žabljak
North Critical Zone Improvement of the air quality required	Berane, Bijelo Polje and Pljevlja
South Critical Zone Improvement of the air quality required	Bar, Cetinje, Nikšić and Podgorica

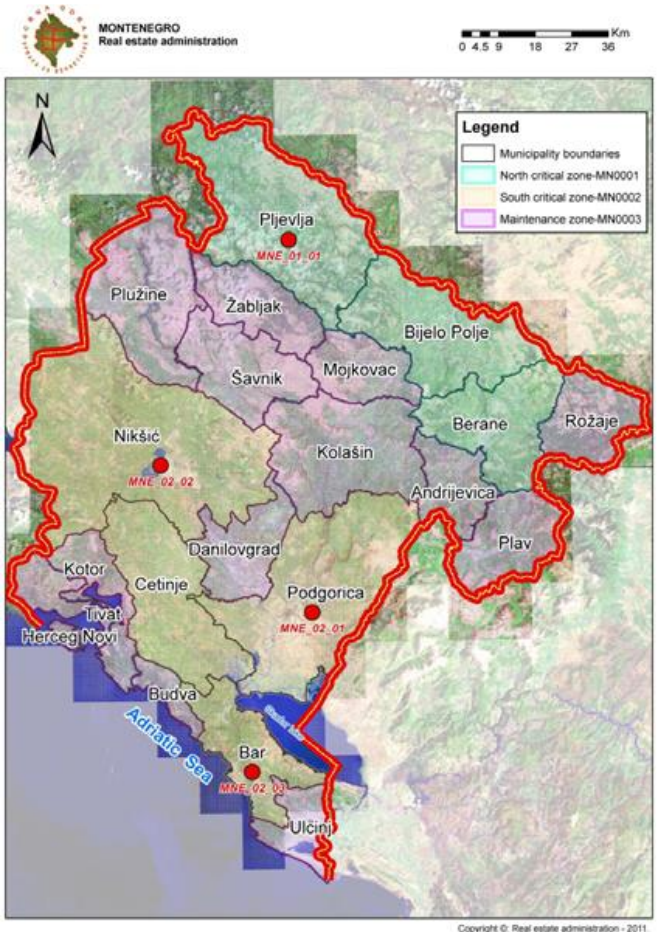


Figure 43: Air quality zones and monitoring stations in Montenegro

Source: State of the Environment Report for Montenegro for 2011, Environmental Protection Agency of Montenegro, 2012.

Systematic ambient air quality monitoring in Montenegro is performed at automatic stations placed in Podgorica, Nikšić, Pljevlja and Bar.

Measuring parameters are: sulphur dioxide (SO_2), nitrogen monoxide (NO), nitrogen dioxide (NO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), methane (CH_4), particulate matter PM10, ground level ozone (O_3), and content of lead Pb, benzo(a)pyrene (BaP), relevant PAU and total PAU in PM10. Continuous monitoring included meteorological parameters as well: air temperature, wind speed and directions and air humidity.

Basic air quality monitoring was conducted at 17 stations.

According to the planned pipeline routes (Variant A and Variant B), only results on air quality monitoring at automatic station and HSSM stations (HSSM building and building of Faculty of Biotchnology) situated in urban area of Podgorica and at automatic station and HMZ station situated in urban area of Bar were consider in this further analysis. For other HSSM's stations

situated in Golubovci, Tivat and Herceg Novi, and Mendra and Ulcinj detailed air quality monitoring results were not available.

Podgorica

Automatic measuring station in Podgorica is located at Bulevar Svetog Petra Cetinjskog – "Nova Varoš". According to the air quality monitoring results, in 2011, the air quality in urban area of Podgorica in relation to sulphur dioxide (SO_2), oxides of nitrogen (NO_x) and content of heavy metals and benzo[a]pyrene in PM10 was very good. However, the air was loaded with particulate matter. Those results indicate that the major source of air pollution were industry and traffic as well as fuel combustion from residential heating installations during heating season.

Bar

Automatic measuring station in Bar is located at Bulevar dinastije Petrovića - "Centar". In 2011, according to the air quality monitoring results, the air quality in urban area of Bar in relation to sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) was very good. However, higher concentrations of ozone, especially during September were detected and the air was loaded with particulate matter, as well. Those results indicate that the major source of air pollution were industry and traffic as well as fuel combustion from residential heating installations during heating season.

Other monitoring stations

Available air quality monitoring results at all other stations (HMZ's stations) indicate that the air quality at these locations was very good.

Emission load

According to the *Regulation on limit values for pollutant emissions from stationary sources into the air (Official Gazette of Montenegro 10/11)*, operators are obliged to conduct monitoring of pollutant emissions from the plants and stationary sources into the air, depending on the type of plant. No data on these emissions were available.

According to *National Greenhouse Gas Inventory 1990-2009*, Energy sector (fossil fuel combustion for electricity or/and heat production) is the largest contributor to greenhouse gas emissions in Montenegro. Industrial Processes Sector is the second largest contributor. The most important sources of CH_4 emission are Agricultural Sector (purple) and Waste Disposal on Landfills (green).

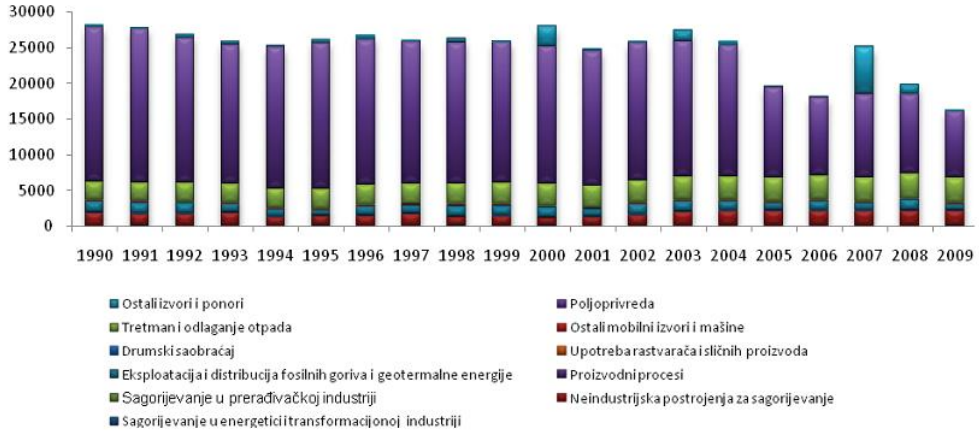


Figure 44. Emission trend of CH4 (in tons) by Sectors for the period 1990-2009

Source: State of the Environment Report for Montenegro for 2011, Environmental Protection Agency of Montenegro, 2012

4.3.1.11 Noise and Vibration

Albania

Variant A

Apart from Tirana and Durres, where noises are above the acceptable levels cities in Albania including Shkodra and Fier, have low levels of noise, due to lower intensity of economic activities. Tirana and Durres had noise levels up to 70 dB (A) or higher during the day. At night, their level of noise falls down to 40 dB (A). The other cities have noise levels up to 62 – 65 dB (A) during the day and 30 – 34 dB (A) during the night. Despite the fact that the law on urban noise entered into force in 2007, Albania still lacks proper standards for the noise levels at various locations. The MoEFWA and the MH issued the Ordinance No. 8 of November 27, 2007 "On maximal levels of noises in the environment". This sub-legal act, which relies on the WHO recommendations, asserts that the acceptable levels shall be up to 50 -55 dB outside the residential dwellings, 35 dB (A) within the residential dwellings, and 30 dB (A) at night. Comparing the recorded data, it can be seen that noises are at acceptable levels during the night, but during the day, there is a sharp rise of up to 15 dB (A).

Numerous villages and Shkodra town are likely to be adversely affected with regard to noise and vibration by project's activities: Eighteen villages are traversed by the proposed Variant A, which also runs close to the peripheral East of Shkodra city.

The following table shows that noise levels in Shkodra are superior to the European standards. It should be stressed that the monitoring points are located in places with heavy traffic. There are no noise data for the villages crossed by the axis of the pipeline route.

Figure 45 Data on noise, in the principal cities of Albania compared to EU standards
Source: State of Environment Report, MoEFWA, 2010 (red: night time, blue: day time)

Noise levels in the rural parts of the study area, which are far from the influence of urban, transport, and industrial activities, is low. Even though there is no monitoring of noise levels in the residential areas, it is estimated that noises in these environments are within the acceptable limits.

Variant B

Within the Albanian territory, Variant B of the pipeline route corridor runs entirely through agricultural areas, without any industrial activity and far from the heavy traffic of the main roads. Even though there are no data to monitor the noise and vibrations quality in the rural parts of the project area, it is believed that they are within the acceptable parameters set by the Albanian legislation and the EU norms.

Montenegro

Variant A and Variant B

Both routes will pass through the sparsely populated areas. At certain areas both routes pass close to existing roads, and in these places the environment is burdened by noise from traffic, while in other places sources of noise are of lower intensity, caused mainly by population activities.

The pipeline is not the source of the noise, except at special facilities, Gas Pressure Reduction and Metering Stations, which serve to reduce the gas pressure by switching from a high-pressure system to a lower pressure system. Therefore, environment around these objects will be observed because of the expected changes in noise levels.

At the observed section, the route Variant A will have two Gas Pressure Reduction and Metering Stations while on route Variant B three Gas Pressure Reduction and Metering Stations are planned to be built. This makes Variant A somewhat more favourable, but it goes through slightly more populated areas.

Therefore, the final location of the Gas Pressure Reduction and Metering Stations will have a key role in the selection of more favourable Variant due to the noise impact on the nearest populated areas.

4.3.1.12 Cultural Heritage

Variant A

Albania

Along the alternatives or the corridors running from Balldren to the North-western part of Albania, many known archaeological sites and monuments have been identified and are listed in the protected monuments. The mountainous areas in the eastern part of the section Shkodra-Hot are rich in intangible cultural heritage components. Some of the most valuable sites from the cultural heritage point of view within or near the proposed Variant A of the pipeline corridor that date from 1000 BC until AD 0 (Galaty et. Al, 2008) are provided in the following map:

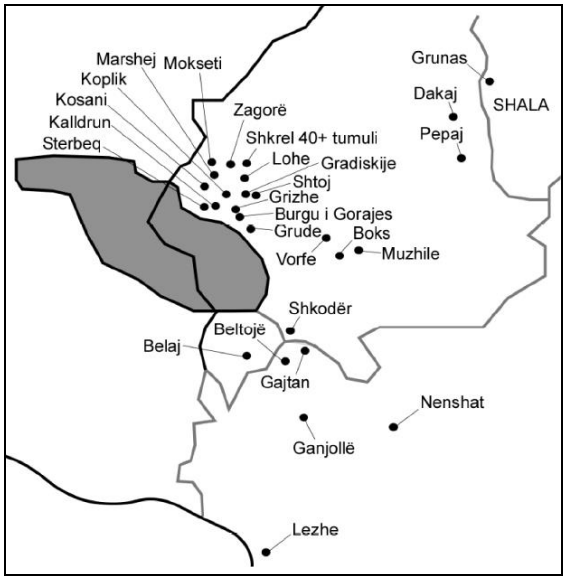


Figure 46 Map of northern Albania with sites 1000 BC-AD 0 (Galaty, 20008).

Source: Michael Galaty et al, in "L'Illyrie Meridionale et L'epire dans l'Antiquite", 5e colloque internationale, 10-12 Octobre 2008, Grenoble, France

Additional studies and a more thorough location assessment of the previously mentioned archaeological sites have led to the following map.

Figure 47 Indicative map of the nearest cultural sites to the pipeline corridor (According to Galaty et al., 2008).

Among the sites shown in the above map, the most proximate to the proposed pipeline route, from south to north, are, Ganjolla are Belan (Belaj), Beltoje, Shkodra (Archaeological Park); Gajtan, Grude, Mes, Boks, Shtoj (Burial Mouds), Marshej, Zagore, and Mokset. The red triangles in the above map (Google, 2013) illustrate mainly sites from 10th century BC to the first century AD. Some of these sites (Gajtan cavern) are much older.

As shown in the map below, the Burial Tumulis of Shtoj are located approximately less than 1.5 km from the axis of the proposed pipeline corridor.

One of the most sensitive areas along the proposed Variant A of the pipeline corridor is the zone between Shkodra city and the ancient Drivastum town (Drishti) that include the following cultural sites:

- Gruda village territory, which archaeological findings date from the first millennium BC until the first century AD (Galaty et. Al., 2008);

- The tumuli burials of Shtoj. On the plain of Shtoj, which is situated about 5 km to the northeast of the city of Shkodra, between the villages of Boks, Dragoc and the Bridge of Mesi, on the western side of the Kiri River, are located 160 tumuli. The excavated tumuli date from the Early Bronze Age until the Late Iron Age. The most representative period of funerary activities dates in the Iron Age, especially between the 7th-5th centuries B.C (Galaty et. Al., 2008);

- Boks village territory, where is located the Kratul fortification, which is situated on the homonymous hill, 143 m above the sea level, 6 km to the northeast of Shkodra and 600 m distant from the Mesi Bridge, a cultural monument of the middle age. The archaeological material indicates that life at the settlement is active from the Early Iron Age until the 1st century A.D. (Galaty et al., 2008);

- Mesi Bridge ("*bridge in the middle*") is a bridge in the village of Mes, located about five kilometres in straight line from the northeast of Shkodra city. It spans along the Kiri River is 108 m long, and represent one of the longest Ottoman bridges in the region; and

- Drishti Castle. The ancient town of Drivastium was founded in Illyrian or Roman times to protect the Kosovo trade route. The large castle from the 12th century was part of a chain of fortifications around Shkodra.

Furthermore, the area around the Archaeological Park of Shkodra that is situated around the Rozafa castle (4th century BC) is very rich in cultural heritage sites/objects.

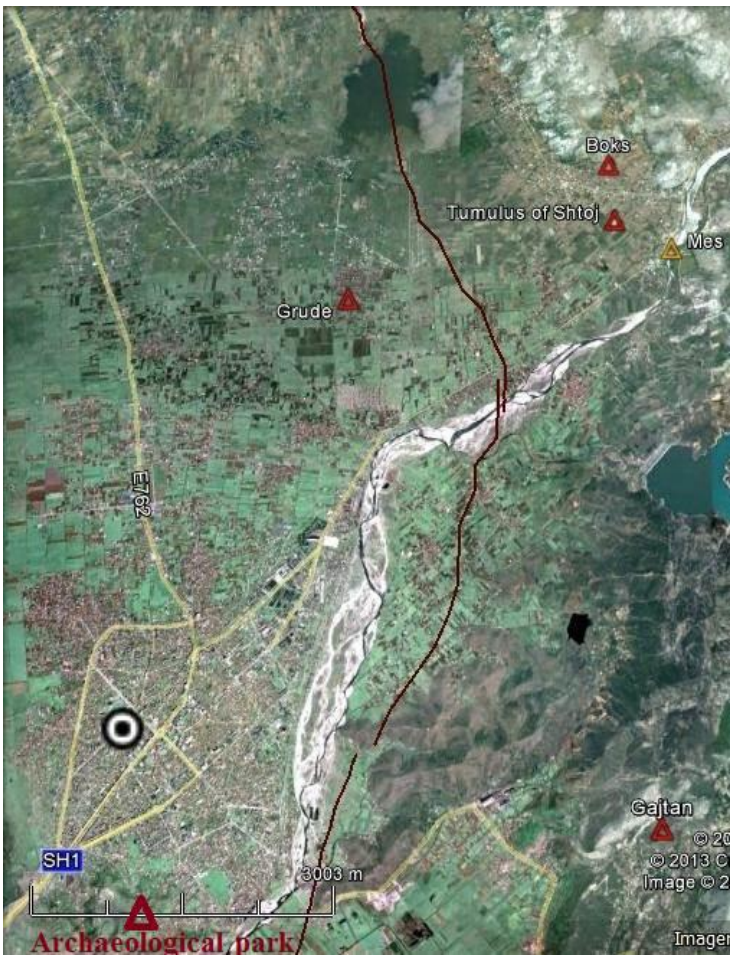


Figure 48 Pipeline route and cultural sites in the northeast of Shkodra City

According to the Law No. 9882 of February 28, 2008 "On the Cultural Heritage", the "Archaeological Survey Agency (ASA) through its structures and in collaboration with legal and physical persons with license to operate in this field follow up the chance of archaeological finds, which come to light during agricultural, building, engineering, and construction activities, and operate in order to preserve these findings (art.26)". For every project that can affect the cultural heritage, "a written approval of The National Council of Restoration and of the National Council of Archaeology is obligatory" (art. 27).

Montenegro

Variant A of the gas pipeline passes through mountainous areas with an occasional appearance of villages. In line with this, elements of cultural heritage are preserved villages with agricultural areas. Agricultural areas are terraced small sized fields and vineyards enclosed with drywalls. Beside the villages there is a significant number monasteries and monuments as elements of historical and cultural heritage.

In the lowland area of Ćemovsko field Variant A passes through the area dominated by anthropogenic structures: settlements, industry and agriculture.

Since the listed elements do not present any value as cultural heritage sites, there is no opportunity of greater impact. Nevertheless, in the wider area of the gas pipeline, elements of cultural heritage of great value are perceptible. This specially refers to archaeological sites and historic buildings around the city of Podgorica. Because of the distance from the pipeline route, there is no possibility of direct influence. In the immediate vicinity of the pipeline (village Dajbabe) is monastery with a church of the Virgin ascendance.

In the middle of its length, Variant A passes from the north by the border of Skadar lake area, which is protected in the category of national park. Besides the natural values, Skadar Lake contains a large number of cultural and historical monuments from different historical periods, mostly located on the islands and peninsulas around the lake. Although the route of the pipeline passes at one point very close to the edge of the park, there is no danger of an impact on cultural heritage.

After 47 km from the beginning, Variant A, passes about 1 km south of the town of Cetinje with numerous elements of cultural heritage. Because the distance to pipeline is relatively large, there is no danger of negative impacts.

About 11 km from the end of the Variant A is the southern boundary of the National Park Lovcen located about 700 m from the planned pipeline. The Park covers the central and the highest part of Lovcen range area, 6220 acres. Characteristic numerous and diverse forms of relief with numerous gullies, pits and deep depressions are intertwined with natural surface cover dominated by tall vegetation and grasslands on the rocks.

Variant B

Albania

Along Variant B in Albania, the proposed pipeline route does not cross any known site/object of significant cultural value, because in the past this territory has been flood prone due to Buna River.

However, according to the Law “On the Cultural Heritage”, a written approval of The National Council of Restoration and of the National Council of Archaeology is obligatory” prior to the construction phase.

Montenegro

In Montenegro, the route of Variant B passes through area with relatively dense network of villages and settlements. In a few cases, some villages could be considered as a valuable element of cultural heritage due to its ambient values, traditional building methods and traditional methods soil treatment and pasturing.

Monasteries, monuments and other individual elements of cultural heritage, according to available data, are not located directly on the route.

Variant B passes close to important historical structure of the Old Bar and surrounding archaeological sites, religious and cultural facilities. Due to the relatively long distance, the route does not have significant effect on the elements of cultural heritage.

Variant B also passes near the town of Budva. In centre of town and surrounding area there are a large number of elements of cultural heritage. Since all elements are at a distance of about 3 km from the route, there is no direct impact of the route on the elements of Budva's cultural heritage.

4.3.1.13 Occupational Health and Safety

Variant A and Variant B

A company for pipeline construction will be contracted. The construction period is estimated to one year and will require the engagement of about a few hundred people.

Operating with the heavy machinery equipment and also contingent blasting through hard rocks presents serious hazards. Based on the geological study for Albanian parts of proposed variants, Variant B of the pipeline route does not traverse any area composed of hard rocks, while Variant A should pass over hard limestone and dolomites across Kakarriqi Mountain (1.2 km long), and along the section from Bajza to the border ALB/MNE (8.5 km long).

During the construction works, workers at the construction site will have to follow and comply with the prescribed principles and regulations on occupational safety (from Council Directive 92/57/EEC of 24 June 1992):

- keeping the construction site in good order and maintaining a satisfactory state of cleanliness;
- choosing the locations of workstations with regard to the easy access to these locations and determining routes or areas for the passage and movement of equipment;
- the conditions under which various materials are handled;
- technical maintenance, pre-commissioning checks and regular checks on installations and equipment with emphasis of correcting any faults which might affect the safety and health of workers;
- the demarcation and laying-out of areas for the storage of various materials, in particular where dangerous materials or substances are involved;
- the conditions under which the used dangerous materials are removed;
- the storage and disposal or removal of waste and debris;

- the adaptation, based on progress made with the site, of the actual period to be allocated for the various types of work or work stages;
- cooperation between employers and self-employed persons;
- interaction with industrial activities on the place within which or in the vicinity of which the construction site is located

When performing the installation works and works related to the operation of pipelines, the following hazards can occur: dangers of electricity, inadequate lighting, dangers in case of maintenance and operation of shut-off systems, deficiencies of warning signs, hazards if prescribed personal protective equipment is not used, hazards in case of working with hazardous materials, hazards in case of dangers during movements, work on heights etc. Zones of explosions danger must be identified on the construction site. Evacuation plan for employees has to be created (in case of accidents that could endanger the life and health of employees - natural disasters, fires, explosions, etc.). All work has to be conducted in accordance with the Occupational Health and Safety Plan that will introduce every worker to the hazards of every job and methods to avoid any dangers. All workers also have to receive proper training.

4.3.1.14 Waste

Variant A and Variant B

During construction phase – earthworks, on Variant A, large quantities of non-hazardous construction waste, mainly waste concrete, will occur. All of the construction waste should be temporarily disposed on site and then transported by officially authorized companies/utilities on final disposal. Some small quantities of hazardous waste could occur (e.g. oily materials) during construction works. That waste should be collected separately and disposed of by officially authorized companies/utilities. In case of accidents like oil/fuel spillage, contaminated soil and material should be immediately disposed of by officially authorized companies/utilities. Lastly it should be noted that the quantity of generated waste from project activities is dependent on the length of the pipeline route. During operation and maintenance of the pipeline some small quantities of non-hazardous waste will be generated by pigging operations (tailings, sludge).

4.3.1.15 Infrastructure

Variant A and Variant B

Various infrastructure objects like; roads, railways, embankments against floods and river erosion, water supply facilities, drainage and irrigation works, military areas, industrial objects/areas, etc., are considered as sensitive installations in respect to the proposed gas pipeline.

In cases where the pipeline intersects the infrastructure constructions (traffic: roads, railways, etc., water management: water supply pipelines and sewage

system, electricity: power lines, cables, etc.) all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual institutions when obtaining certain licenses). All potential adverse impacts can be avoided through proper organization of the construction site and compliance with all applicable laws and regulations respecting the rules of traffic, electrical and civil engineering.

During construction, due to increased frequency of materials and techniques transportation, the traffic situation can change - delays may occur that will require special attention and support services (in transportation of special cargo). Possible accidental damage to public roads can be expected.

In addition to all stated that relates for both variants, Variant B will have an additional impact on maritime traffic, during the construction of the pipeline, as follows:

- Traffic of ships for transport of liquid cargo
- Traffic of passenger ships
- Traffic of yachts and boats for sport and leisure
- Traffic of smaller local vessels and boats for daily trips
- Traffic of fishing boats.

Considered ships will intersect corridor of subsea pipeline during sailing, mooring or anchoring. After the construction of the subsea pipeline (with respect to sea depth in this area - over 200 m) the pipeline will not in any case interfere with the movement of ships, which takes place in the Montenegrin part of the Adriatic Sea.

4.3.1.16 Accident situations

Natural gas is a mixture of different hydrocarbons. Almost 95% of natural gas is methane (CH_4), a greenhouse gas. Natural gas belongs to the group of highly flammable substances.

A general overview of the possible scenarios when an accident occurs on the pipeline:

- Leakage without ignition or explosion, in which natural gas relatively quickly disperses to the upper layers of the atmosphere. In this case, there is little possibility of poisoning people near the site of the accident, and there is no danger to the environment;
- Leakage with the occurrence of fire;

- Leakage with the occurrence of an explosion;
- Leaking gas and inflammation in the leakage, which produces a fiery jet.

In the vicinity of the damaged pipe (radius approx. 200 m) a temporary hazard warning is introduced (be it on land or sea area) and evacuation of people is conducted. The fire brigade is summoned.

Variant A

The European Gas Pipeline Incident Data Group (EGIG) in its document "Gas Pipeline Incidents, 2008", provides an overview of statistical data on the frequency of accident occurrence on land main gas in the period since 1970 to 2007.

In the period since of 1970 to 2007, the total exposure of gas pipeline systems (length x length of pipeline facilities), which are recorded in database EGIG, is 3.15 million km × y. The total number of reported accidents in the same period amounted to 1172, where in the period of 2004 to 2007 there were 49 accidents reported.

Table 35: Overview of accident frequency on land pipelines

Time period	Number of accidents	Total exposure to gas system [km × year]	Accident frequency [(1,000 km × yr) $^{-1}$]
1970-2007	1172	$3{,}15\times10^{6}$	0,37
1970-2004	1123	$2{,}77\times10^{6}$	0,40
2003-2007	88	$0{,}62\times10^{6}$	0,14
2007	14	$0{,}13\times10^{6}$	0,11

Source: 7th EGIG-report 1970-2007, December 2008

Frequency of accident occurrence in the period from 2003 to 2007 is less than a third of the value of the frequency for the entire period of observation, which indicates an increase in security in recent years.

Accident causes on the pipeline can be grouped into six major categories. Table 2 gives an overview of the causes of accidents with their distribution.

Table 36: Summary accident causes on land pipelines

Cause	Contribution [%]
External influence	49,6
Structural error / defect in material	16,5
Corrosion	15,4
Seismic activity	7,3
Performance compound with an error	4,6
Other	6,7

Source: 7th EGIG-report 1970-2007, December 2008

Variant B

In the risk analysis of subsea pipeline, coastal areas so called "landfall zones" differentiate, where the pipeline is under changing conditions (dry, wet - the area under influence of waves, tides) and sea areas. An overview of the accident frequency on underwater pipelines (pipeline) is given in following table (it refers to the coastal area and the open sea area).

Table 37 Frequency of accident occurrence in the subsea pipelines

Type of pipe	Frequency of accident occurrence [(1000 km × yr) $^{-1}$]
Pipeline diameter ≤ 600 mm	0,051
Pipeline diameter > 600 mm	0,014

Source: Riser and pipeline release frequencies, International Association of Oil and Gas Producers, March 2010

The main causes of accidents in subsea pipelines are fishing, anchoring, unknown / unfavourable configuration of the seabed, ocean currents. The table below shows the distribution of the accident causes.

Table 38 Overview of accident causes on underwater pipelines

Cause	Contribution [%]
External influence	38
Corrosion	36
Defect materials	13
Structural error	2
Other	11

Source: Riser and pipeline release frequencies, International Association of Oil and Gas Producers, March 2010

4.3.2 The description of likely significant effects of the project on the environment and social issues and characterization of the impacts

Effects (impacts) are demonstrated in tables, separate for each Variant except for components where the impacts are the same for both considered variants.

For each recognized possible effect the valorisation has been made, using a scale from -2 to +2, where numbers stand for following:

-2 = very negative impact
-1 = negative impact
0 = without impact
+1 = positive impact
+2 = very positive impact

4.3.2.1 Climatic characteristics

Variant A and Variant B

Description of likely significant effects of the project *Effects during construction* Since it is an area with moderately warm climate without significant extremes, pipeline construction will be possible almost all year round. *Effects during pipeline usage* Climatic factors will not affect the operation of the pipeline as it will go through the soil and thus be protected from external influences.
Effects' characteristic Impact during construction is direct since the construction will be carried out in the open. Impact during use is indirect since gas pipes will be buried in the ground.
Effects' significance Impacts during the construction and use are acceptable given the moderately warm climate of the studied area.
Effects' valorisation 0 = without impact

4.3.2.2 Geomorphology

Impacts of both variants (A and B) are possible in the case of pipeline crossing certain characteristic karst micro-relief forms – sinkholes and other gentle karst elements. The impact is manifested as degradation and backfilling. Erosion is also possible while digging canals for pipeline, backfilling due to the stabilization of the terrain and construction of ground elements of the planned pipeline.

Albania

Variant A

Description of likely significant effects of the project Likely adverse impacts on geomorphology because of: -Irreversible changes in geomorphology across karst areas (section Bajza-Hoti) from earth works; -Possible geological risks (landslides, subsidence, erosion) from: a-selection of the pipeline route over loose deposits (South of Shkodra) and in the contact surface between dissimilar geological formations; b-tectonic faults crossing (pipeline route crosses more than 7 tectonic faults); and c-areas of high seismic risk crossing (pipeline crosses an area of seismic intensity IX degree MSK-64). -Erosion in riverbeds from earthworks and vegetation clearing (more than 6 river crossings); -Riversides erosion from selection of the pipeline route alongside the riverbeds (6 km along

the Kiri riverbed in the eastern part of Shkodra).
Effects' characteristic Negative; Direct, Permanent over karst areas; and temporary over loose deposits
Effects' significance With medium significance but acceptable.
Effects' valorisation -1

Variant B

Description of likely significant effects of the project Likely adverse impacts on geomorphology because of: -Possible geological risks (subsidence) from selection of the pipeline route over loose deposits. -Erosion in riverbeds from earthworks and vegetation clearing (1 river crossing at the border ALB/MNE);
Effects' characteristic Negative; Direct, Temporary; With local geographical extension
Effects' significance Acceptable because the effects are of low significance
Effects' valorisation 0

Montenegro

Variant A and B

Description of likely significant effects of the project Possible impact in the case of overlapping pipeline with certain characteristic karst micro-relief forms – sink holes and other gentle karst elements. The impact is manifested as degradation and backfilling. Erosion is also possible while digging canals for pipeline, backfilling due to the stabilization of the terrain and construction of ground elements of the planned pipeline.
Effects' characteristic Negative, temporary effect but with local character.
Effects' significance With medium significance but acceptable
Effects' valorisation -1

4.3.2.3 Land Use and Pedology

Variant A

Albania

Description of likely significant effects of the project
– Permanent land take (67.5 ha) along a narrow strip of 10m wide (5m both sides of the pipeline axis), as follows: 1-Agricultural land: 57.8 ha, from which: a-land of very good agricultural quality: 20.0 ha; b-land of good agricultural quality: 20.0 ha; c-land of medium agricultural quality: 7.8 ha; d-land of low agricultural quality: 10.0ha. 2-Forest and shrubby areas: 9.7 ha. 3- Permanent land take (more than 2.0 ha) near and through the riparian forests (more than 6 river crossings) along the main riverbeds. 4- Temporary land take, changes on land use, and land disturbance that affects a land strip 400m wide (200m both sides of the pipeline axis), as follows: a-Agricultural land: 1,686.0 ha; b-Forest and shrubby areas: 388.0 ha; c-Riparian forests along the river and stream beds: 80.0 ha; and d- Road and drainage & irrigation infrastructure: 50ha The land use changes and the land disturbance includes: Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops; Permanent land take at above ground facilities; Changes to and disturbance of land and associated impacts upon existing land use and users; Temporary land take in agricultural areas; Temporary loss of the agricultural productivity of the land; Damage to agricultural features such as irrigation and drain systems, fences etc.; Contamination of soil by solid and liquid wastes; Disturbance and degradation of soil due to erosion, compaction, removal, modification of morphology, collapse and sinkhole formation processes; etc.
Effects' characteristic
Negative; Direct; Partly reversible because the land cover can be rehabilitated; and irreversible because the riparian forest at the Drini River crossing (1.5 km long) has special values in terms of biodiversity.
Effects' significance
With negative significance but acceptable compared to the importance of the project regarding the gas supply.
Effects' valorisation
-1

Description of likely significant effects of the project
Permanent and temporary land take (buffer area of 400m wide) across inhabited areas and industrial and military infrastructure, as follows: a-Inhabited areas: 400 ha;

b-industrial areas: 8.0 ha; c-military infrastructure: 88.0 ha;
Effect's characteristic Negative; Direct; Irreversible because of the crossing of: a-a great number of inhabited areas; b-the industrial zone of Shkodra; and c-the landing strip of Gjadri air base.
Effect's significance Very high negative impact
Effect's valorization -2

Montenegro

Description of likely significant effects of the project Soil degradation caused by installation of the pipeline, change in land cover characteristics, changes in agricultural production on 30.36% area, changes in forest production on 69.21% area. Very high erosion risk on 2.23% and moderate on 37.66% of total area.
Effects' characteristic Negative effect of disturbance but reversible i.e. previous land cover could be re-established.
Effects' significance With great significance but conditionally acceptable
Effects' valorisation -2

Variant B

Albania

Description of likely significant effects of the project – Permanent land take (29.3 ha) along a narrow strip of 10m wide (5m both sides of the pipeline axis), as follows: 1-Agricultural land: 29.3 ha, from which: a-land of very good agricultural quality: 29.3 ha; and b-land of good agricultural quality: 19.2 ha. 2-Permanent land take (0.05 ha) through the riparian forest of Buna riverbed (1 river crossing)

– Temporary land take, changes on land use, and land disturbance that affects a land strip 400m wide along the pipeline, as follows: a-Agricultural land: 1,164.0 ha; b-Forest and shrubby areas: 388.0 ha; c-Riparian forest across Buna riverbed: 2.0 ha; and d- Road and drainage & irrigation infrastructure: 4.0ha The land use changes and the land disturbance includes: Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops; Permanent land take at above ground facilities; Changes to and disturbance of land and associated impacts upon existing land use and users; Temporary land take in agricultural areas; Temporary loss of the agricultural productivity of the land; Damage to agricultural features such as irrigation and drain systems, fences etc.; Contamination of soil by solid and liquid wastes; Disturbance and degradation of soil due to erosion, compaction, removal, modification of morphology, collapse and sinkhole formation processes; etc.
Effects' characteristic Negative; Direct, and Reversible because the land cover over arable lands can be rehabilitated and the riparian forest at the Buna River crossing has no special biodiversity values.
Effects' significance With low significance; Acceptable
Effects' valorisation 0

Description of likely significant effects of the project Permanent and temporary land take (buffer area of 400m wide) across inhabited area of Torovica village as follows: -Inhabited rural area: 2.0 ha;
Effect's characteristic Negative; Direct; Avoidable because there is enough free space to avoid the Torovica village.
Effect's significance With low significance; Acceptable
Effect's valorization 0

Montenegro

Description of likely significant effects of the project Soil degradation caused by installation of the pipeline, changes in land cover characteristics, changes in agricultural production on 28,25% area, changes in forest production on 28,41% area. Significantly smaller land area under the direct impact than in Variant A. Erosion risk is not very significant.

Effects' characteristic Negative effect of disturbance but reversible i.e. previous land cover could be re-established.
Effects' significance With great significance but conditionally acceptable
Effects' valorisation -1

4.3.2.4 Analysis of social issues

Variant A

Albania

Description of likely significant effects of the project – Permanent land take through highly urbanised areas in Lezha, Shkodra and Malesia Madhe Districts (Pipeline crosses 18 villages and the town of Shkodra). The total length of the pipeline crossing the inhabited centres is 10.0 km; – The disturbance of the life conditions and the cost of the recompensation will increase drastically, because the construction of the pipeline will require the destruction of a very high number of: a- farm houses across 18 villages; b-individual houses in the north eastern surroundings of Shkodra town; and c-industrial objects in the north eastern part of Shkodra town.
Effects' characteristic Very negative; Direct; Irreversible
Effects' significance Unacceptable because of the high number of settlements and other objects crossed from the pipeline. The resettlement of this large population would drastically disturb its life conditions and will increase the cost of the project.
Effects' valorisation -2

Description of likely significant effects of the project Direct and cumulative adverse impacts through disturbance of the life conditions of a large population (more than 150,000 inhabitants) from permanent and temporary impacts on: a-the tourist assets of Shkodra and Malesia Madhe Districts (permanent indirect adverse impacts on the shoreline of Shkodra Lake; temporary frequentation of the cultural heritage sites; etc.); b-the recreational areas near and across the riverbeds and the karst plain of Malesia Madhe District (permanent and temporary impacts on karstic lakes, springs, and wells; etc.); c-The quality of the drinking waters, which can be temporarily polluted from project activities because of the lack of impermeable clayey cover over the Quaternary aquifers along the corridor Shkodra-Koplik; d-The quantity and the quality of the drinking waters in the dug wells over the karst plain of Malesia Madhe (permanent changes in ground waters regime); etc.

Effect's characteristic Very negative; Direct and indirect; Irreversible (quality of quantity of drinking waters, tourists assets and recreational areas).
Effect's significance Unacceptable, because of the high significance due to the likely permanent changes in ground waters regime and consequently negative impacts on: a-drinking waters quantity and quality through the karst plain of Malesia Madhe; b-quality and quantity of waters in the recreational areas (karst springs, lakes and dug wells); and c-tourist assets along the Shoreline of Shkodra Lake.
Effect's valorization -2

Description of likely significant effects of the project Direct and cumulative adverse impacts through disturbance of the life conditions of a large population (more than 150,000 inhabitants) from temporary adverse impacts on: a-the international, national, district, communal, and rural road network, and on the international and national railway; b-numerous water pipelines, sewage and sewerage objects, etc.
Effect's characteristic Negative; Direct; Reversible (transport network; water pipelines and sewage and sewerage infrastructure, etc.).
Effect's significance Acceptable, because of the positive effects of the project through gas supply.
Effect's valorization -1

Montenegro

Description of likely significant effects of the project *Insignificant* to the existing, local population, which is itself rather small in size except for the major cities (Podgorica, Cetinje, Nikšić), but *significant* for the natural areas, especially for the nature protected areas (Lovćen, Rumija (to be protected), Skadar/Shkodra Lake)
Effects' characteristic Due to the scarcity of population in general on the way of the Variant A, except major settlements, cities and towns, *negative* effects could be foreseen for the protected natural areas; *positive and cumulative* effects could be foreseen for the cities and settlements along the pipeline route due to the benefits of this energy source; *direct* consequences might be the reorientation of the use of energy resources in cities - from wood, coal, and electricity to gas; *indirect* benefits might be the overall improvement of the environment and pollution especially in cities; *cumulative* - all of the mentioned could bring to the better environmental situation, with smaller degradation of the nature along the route;

Effects' significance It could be predicted that all effects might be *acceptable* due to the fact that no major degradation is expected as a result of the construction of the pipeline route; In the Variant A *an important effects* could be the degradation of nature in the nature protected areas, but with careful planning and realization of construction, these potentially "important effects" could be almost completely avoided. In the case of the "no harm" realization of the project, no important effects could be predicted
Effects' valorisation +1

Variant B

Albania

Description of likely significant effects of the project – Permanent land take through the inhabited rural area of Torovica village, which is crossed along 50 m from the pipeline axis; and – Adverse impact from earthworks to the recreational area at the Buna riverbed.
Effects' characteristic Negative; Direct, Almost avoidable
Effects' significance Acceptable, because: a- the crossing of the inhabited rural area at Torovica village can be easily avoided by tuning the axis of the pipeline some 100m in the west of this village, over agricultural lands; and b-the recreational area at the Buna riverbed is composed of vegetation that can be easily rehabilitated.
Effects' valorization 0

Montenegro

Description of likely significant effects of the project Impact description- mostly *weak*, to the agriculture that is scattered in smaller pieces of arable land; the gas could *improve* everyday conditions of life of local population and visitors (tourists).
Effects' characteristic Potentially *positive* due to the effect of the introduction of new energy source, depending on the price of gas, availability. It could be predicted that effects of the new energy source would be *positive* especially for tourist development in the areas. No negative effects could be foreseen as well as *negative and indirect (negative) effects*. The effect that could be predicted could be the *direct improvement* of the environmental conditions, better and more efficient use of energy resources, less pollution. A *cumulative* effect will be overall environmental positive effect. *An indirect* effect will be the enlargement of tourist activities also in the hinterland areas as well as the rise of the existing tourist industries in numbers and sizes.

Effects' significance The significance of the effects of the introduction of the pipeline in the areas might be only *acceptable* due to the positive effects that are expected for the people living in these areas. These effects will be *important* for the economy of the country if the conditions for introduction of the gas into everyday life will be favourable. If not, then the gas could be perceived and evaluated as less *important* and less *acceptable*.
Effects' valorisation +1

4.3.2.5 Hydrology/ Groundwaters/ Marine areas

Variant A

Hydrology/ Groundwaters

Albania

Description of likely significant effects of the project Possible contamination (from solid and liquid waste) and changes in quality and quantity on the ground waters, as follows: a-Possible contamination of 3 Quaternary porous aquifers (Lower Shkodra, Upper Shkodra, and Koplik) of high permeability that are not overlaid by impermeable clayey-silty cover. The Quaternary aquifer of Upper Shkodra supplies with drinking water more than 150.000 inhabitants. b-Possible contamination of the karst aquifer of Malesia e Madhe District which is traversed from the pipeline; c-Possible adverse impacts on the quantity and quality of the drinking waters in the karst area of Malesia Madhe District, because the local population is partly supplied in drinking water from dug wells. d-Possible contamination of the karst Springs, karst Lakes, and dug wells that are located over the karst aquifer of Malesia Madhe that have very good hydraulic connections, especially in the karst plain of Bajza; Changes in ground waters regime (flow direction, discharge, etc.) from earthworks in the karst plain of Bajza. These changes can affect the karst Springs, karst lakes, and the dug wells.
Effect's characteristic Very negative; Direct; and with difficulty avoidable because of the very good hydraulic connection between the aquifers and the overlaid geological formations, over which runs the proposed pipeline.
Effect's significance Unacceptable because of the likely adverse effects on the highly permeable aquifers of this region, and consequently on the quality and quantity of the drinking waters of a large population.
Effect's valorization -2

Description of likely significant effects of the project Possible contamination (from solid and liquid waste) and changes in quality and quantity on the surface waters, because of: a-Possible contamination of the waters of Shkodra Lake (Ramsar site, IBA), where drain 3 Quaternary permeable aquifers (Lower Shkodra, Upper Shkodra, and Koplik), and the karst aquifer of Malesia Madhe that are not overlaid by impermeable cover layers; b-Possible contamination of the karst Springs and karst Lakes that are located over the karst aquifer of Malesia Madhe, especially in the Shoreline of Shkodra Lake (MNR, IPA); and The changes in ground waters regime (flow direction, discharge, etc.) from earthworks in the karst plain of Bajza can affect adversely the quality and the quantity of the waters in the karst lakes; Effects on surface water from sediment plumes caused by watercourse crossings (more than 6 river crossings), trenching, etc.
Effect's characteristic Negative; Direct; Unavoidable
Effect's significance Unacceptable, because the adverse effects on the surface waters (Shkodra Lake, karst lakes), where drain the ground waters can last for a long time due to the very good hydraulic connections between the water bearing layers and the overlaid geological formations, over which runs the surface waters.
Effect's valorization -2

Montenegro

Description of likely significant effects of the project *Effects during construction* Because the route of the gas pipeline passes through areas of karst with surface water, negative impact on the quality of surface water and groundwater is possible. Potential impacts: devastation of rivers natural flow due to pipeline construction; contamination due to inadequate waste management; increasing the turbidity level in watercourses during construction phase; contamination and thus reduce of water quality is expected only in case of accidental situations during construction and operation phase. *Effects during pipeline usage* Once construction is complete a structure such as a pipeline does not have a negative impact on surface and ground waters.
Effects' characteristic Direct and possible effects on water quality during operation phase are negative but short-term and localised during construction.
Effects' significance Construction effects are not significant and are acceptable.

Effects' valorisation (weight factor)
-1 moderately negative

Variant B

Hydrology/ Groundwaters

Albania

Description of likely significant effects of the project
Ground waters: Pipeline route runs over 1 Quaternary aquifer (south-western part of Lower Shkodra aquifer) of local importance that is overlaid by an impermeable sub-clayey cover 17-25m thick. Thus, this aquifer is protected from any possible accidental pollution.
Effect's characteristic
Negative; Direct; Temporary; Avoidable because the local aquifer is overlaid by an impermeable sub-clayey cover
Effect's significance
Acceptable
Effect's valorization
0

Description of likely significant effects of the project
Surface waters: Pipeline route crosses one river (Buna/Bojana River), which runs over an impermeable sub-clayey cover 17-25m thick. Thus, there are no hydraulic connections between ground and surface waters. Effects on surface water from: a-liquid and solid waste and from construction works; and b-sediment plumes caused by watercourse crossings (one river crossing), trenching, etc.
Effect's characteristic
Negative; Direct; temporary and partly avoidable
Effect's significance
Acceptable
Effect's valorization
0

Montenegro

Description of likely significant effects of the project
Effects during construction Because the route of the gas pipeline passes through areas of karst with surface water,

negative impact on the quality of surface water and groundwater is possible. Potential impacts: – devastation of rivers natural flow due to pipeline construction; – contamination due to inadequate waste management; – increasing the turbidity level in watercourses during construction phase; – contamination and thus reduce of water quality is expected only in case of accidental situations during construction and operation phase. *Effects during pipeline usage* Once construction is complete a structure such as a pipeline does not have a negative impact on surface and ground waters.
Effects' characteristic Direct and possible effects on water quality during operation phase are negative but short-term and localised during construction
Effects' significance Construction effects are not significant and are acceptable.
Effects' valorisation (weight factor) -1 moderately negative

Marine areas

Description of likely significant effects of the project Loss of marine habitats along the pipeline route Impact zone of laying procedure is divided in to two sub-zones: direct impact zone (area under pipe) and working zone. The working zone is divided into narrow working belt (5 meters in both directions from the route of the pipe) and expanded working belt (100 meters in both directions from the route of the pipe - anchoring area of construction vessels).
Effects' characteristic: Negative / direct Within the direct impact zone loss of marine habitats is direct and permanent. Within the narrow working area, during laying procedure localized damage of marine habitats will be caused by stabilization chains within width of 5 meters on both sides of the pipe. Intensity of the impact in this zone will depend on weather conditions and lateral movements of the pipe during laying process. Along expanded working belt anchoring systems of construction vessels will cause localized damage of marine habitats. Along the coast and up to a certain depth in the costal waters (depending on the topology of the coast) construction trench will dragged which will have negative permanent impact to costal and marine habitats in direct impact zone.
Effects' significance Acceptable / significant
Effects' valorisation -2

Description of likely significant effects of the project Disturbance of sea-fish and other animals associated with seabed (noise, suspended sediments etc.)
Effects' characteristic The pipe will permanently cover slightly movable or immovable organisms (sedentary and sessile), which live on the surface of the seabed (shellfish, gastropods, echinoderms, sponges). Stabilization chains will interact with a surface of the seabed, which will drive away vagile organisms (mainly fish, crustaceans and cephalopods) during working period.
Effects' significance Acceptable / not significant
Effects' valorisation -1

4.3.2.6 Biological environment (Flora and fauna)

Variant A

Albania

Description of likely significant effects of the project – Loss of habitats in the riparian area of Shkodra Lake. Pipeline route axis passes near the shoreline of Shkodra Lake, which riparian area has high biodiversity values in national, trans-boundary, and international level (IBA &IPA); – Loss of habitats in the riparian area of Drini Riverbed; – Loss of habitats in the forested area over the Bajza karst plain, where it is difficult to rehabilitate the forest resources; – Irreversible adverse impacts on endangered plant and fauna species; – Temporary changes on freshwater habitats (Shkodra Lake, karst Springs and karst Lakes) due to work in karst areas; – Possible permanent changes on karst Springs and karst Lakes habitats due to possible changes in ground waters regime (flow direction, water discharge, hydraulic connections, etc.) due to earth works in karst areas; – Temporary changes on river from suspended sediments due to work in river beds; – Changes on structure of grassland habitats; – Potential spread of invasive species; – Animal disturbance – temporary during building of pipeline (noise, dust, air emissions, humane disturbance) and permanent for block-station and measuring-reduction stations (i.e. noise); – Disturbance of river and lake fish and other pelagic animals (noise, suspended sediments etc.) – Accidental release of chemicals, fuel to rivers, lakes or karst areas; – Accident: Emission of bigger amount of gas with possible explosion or fire; and Potential direct longer period changes of habitats in the riparian areas of Drini Lezhes, Drini, and Kiri riverbeds, and of the shoreline of Shkodra Lake.
Effect's characteristic

Negative; Direct; and Indirect; Partly avoidable (the temporary changes) and partly unavoidable (permanent changes on: a- karst springs and karst lakes habitats; b-habitats in the forested areas in karst plains; c-habitats in the IBA and IPA of the Riparian area of Shkodra Lake).
Effect's significance Unacceptable
Effect's valorisation -2

Montenegro

Description of likely significant effects of the project ***Loss and degradation of habitats*** Through the construction of the pipeline some parts of natural vegetation will be lost, which will directly impact some habitat types and plant specimens. In the construction area (cca 20 m) all vegetation will be removed and the terrain will be flattened, which will have effect on the change and degradation of habitats. Moreover, since during the pipeline usage shortgrowing vegetation will be maintained (without the deep routes) the effect of loss of forest and scrub habitat types will be permanent (cca 20 m along the route and other engineering surfaces). In addition to change of habitat types, the construction of the pipeline will have significant impact on habitat fragmentation as well. After the construction of the pipeline inland unvegetated or sparsely vegetated habitats will be developed on the engineering surfaces. It is expected that after some time the grassland habitat type species will develop on the engineering surfaces along the pipeline route. The revegetation of the sparely vegetated engineering surfaces will depend on the soil structure of the primary soil structure. The areas with shallow soil layer will need more time for recovery, as new soil needs to be developed. Grassland habitat types will be changed due to the temporal removal of soil and afterwards changes in soil composition. This construction work will affect the ecological conditions (e.g. change of soil structure) and the plant composition in the construction area. It is expected that grassland habitat types will be reconstructed after some period. The period of vegetation and habitat recovery will depend on the soil type and grassland habitat type, respectively. The areas with dry calcareous grasslands, which have shallow soil layer, will need more time for recovery, as new soil structure needs to be developed. In the engineering surfaces of Variant A (cca 20 m along the pipeline route, gas pressure recustion and metering station, pig trap station, block valve station) will reduce and fragment following forest and shrub habitats: eu-Mediterranean evergreen forests and scrubs, thermophilous and supra-Mediterranean oak woods and thermophilous beech forests. Along the Variant A predominantly are spread dry calcareous grassland habitat type. After the construction of the pipeline and during the usage of the pipeline, along the pipeline route the invasive species could be spread. The new disturbed soil structure could be beneficial for some invasive species and suppress the development of natural vegetation. In addition, the spread of invasive species along the pipeline corridor could affect the structure of surrounding habitats. In order to suppress the development of invasive species regular botanical monitoring of the engineering surfaces will need to be conducted and applied accordingly the environmental protection measures. It is assumed that possible impact can be mitigated by some environmental protection measures. Consequently, the impact is assessed as not significant.
Effects' characteristic Negative, Direct, Permanent for forest and shrub habitats, temporal for grassland and

riparian habitats
Effects' significance Acceptable, less significant
Effects' valorisation -2

Description of likely significant effects of the project ***Temporary deterioration of habitats - Noise, dust, air emissions and humane disturbance*** During the construction of the pipeline the temporary deterioration of habitats will occur. Noise, dust, air emissions and humane disturbance during the construction work will disturb some animal species and deteriorate the habitat quality. This impact is temporary and limited to relatively small area in surrounding of the construction zone. During the pipeline usage the permanent disturbance around the block valve station, the gas pressure reduction and metering stations and the pig trap station might occur because of the of the noise. The noise will be related to small surrounding area of above mentioned objects. During the work of pig trap station higher levels of noise could occur, but the impact is limited to short time, approximately 2 hours. In addition, occasional disturbance of habitats will occur during the maintenance along the pipeline route (e.g. mowing, regular survey of the route). The impact is temporary only during the maintenance work. As above mentioned impacts are spatially narrow or/and temporarily short, it can be concluded that the impact of disturbance and noise during the pipeline usage has minor significance.
Effects' characteristic Negative, temporary, direct
Effects' significance Not significant
Effects' valorisation -1

Description of likely significant effects of the project ***Temporary change of freshwater habitats due to work in river bed and on banks (suspended sediments)*** South of Podgorica Variant A passes over several rivers - Sitnica, Morača and Cijevna. Sitnica and Morača are rivers with gravel and sand watersides in the area of the crossing over. Also, riparian vegetation is present in these sites. Cijevna River has, on the other hand, a canyon-like riverbed with rocky shores. There are several techniques for crossing over the watercourses. As it is not clear in this phase of the project which techniques will be used, the impacts will be assessed for the method of digging in the pipeline into the river bed. The river banks and river bed riparian vegetation will be permanently changed by the construction of pipeline. This impact will be reduced to narrow part of engineering surfaces (cca 20 m). During the construction work minor changes of the river flow might be needed. Due to the possible negative impacts, the construction work on watercourses should be conducted during the low water level. The engineering work in river bed will change physical and chemical properties of river water downstream from the working area. Firstly, the digging and similar construction work will

affect the sediment and impact the physical properties of water (mudding) . The impact will be diluted downstream from the engineering work area and it will not have high magnitude of impact on long length of watercourse. The mudding of water flow might locally affect some animal freshwater species and their distribution. Since engineering work period is short the impact is acceptable, with application of environmental protection measures.
Effects' characteristic negative, direct, temporary
Effects' significance Less significant
Effects' valorisation -1

Description of likely significant effects of the project ***Accidental release of chemicals and fuel to rivers, sea or karstic areas is possible during the construction works*** Contamination of rivers, sea or kartic area can deteriorate habitat quality and have an adverse impact on individual wildlife specimens. With the application of environmental management plan during the construction period (i.e. usual environmental protection precautionary measures for the construction sites, appropriate waste and oil management, use of approved equipment etc.) accident possibility will be significantly reduced.
Effects' characteristic Accidental
Effects' significance Not significant
Effects' valorisation -1

Description of likely significant effects of the project ***Emission of bigger amounts of gas with possible explosion, fire or fire blast are possible as accidents*** This accidental impact could cause direct longer period of habitat changes. Moreover, in some circumstances the fire could be spread to a broader region and affect habitats on broader distance from the Variant. The magnitude of the impact will depend on the temporal meteorological conditions. With appropriate maintenance and survey of the pipeline infrastructure the probability of this kind of accidental impact should be low.
Effects' characteristic Negative, Accidental
Effects' significance Significant
Effects' valorisation -2

Description of likely significant effects of the project ***Degradation of terrestrial underground caves, cave systems, passages and water bodies*** Variant A is dominantly passing through the karst region, with numerous but not completely known caves and pits. Although the construction work is relatively shallow (around 2 m deep), there is still high possibility of coming across a new cave entrance or cave systems. Construction of the pipeline might cause physical changes of the object and could change cave habitat conditions during the construction period. The magnitude of the impact on the caves and cave systems dependes on the size of the undeground habitat. The newly discovered caves could be a habitat for some endemic species. Since the underground fauna is mostly endemic and rare, any disturbance of its habitats should be avoided. Due to that, more detail research of known cave habitats and species should be conducted. In addition, survey of the cave habitats should be conducted and according to results the pipeline route should be diverted.
Effects' characteristic Negative, Accidental
Effects' significance Significant
Effects' valorisation -2

Variant B

Albania

Description of likely significant effects of the project – Loss of habitats in the riparian area of Buna riverbed; – Temporary changes on river from suspended sediments due to work in Buna riverbed; – Changes on structure of grassland habitats; – Potential spread of invasive species; – Animal disturbance – temporary during building of pipeline (noise, dust, air emissions, humane disturbance) and permanent for block-station and measuring-reduction stations (i.e. noise); – Disturbance of river fish and other pelagic animals (noise, suspended sediments etc.); – Accidental release of chemicals, fuel, etc. to Buna River; – Accident - Emission of bigger amount of gas with possible explosion or fire – Potential direct longer period changes of habitats in the riparian area of Buna riverbed
Effect's characteristic Negative; Direct;
Effect's significance Acceptable because the pipeline runs through agricultural lands, except for the Buna riverbed, along a segment of approximately 50m long. At the river crossing the riparian

forest of Buna River is composed of vegetation of common values in terms of biodiversity. In addition, this vegetation has a high potential of rehabilitation.
Effect's valorisation 0

Montenegro

Description of likely significant effects of the project ***Loss and degradation of habitats*** Through the construction of the pipeline some parts of natural vegetation will be lost , which will directly impact some habitat types and plant specimens. In the construction area (cca 20 m) all vegetation will be removed and the terrain will be flattened, which will have effect on the change and degradation of habitats. Moreover, since during the pipeline usage shortgrowing vegetation will be maintained (without the deep routes) the effect of loss of forest and scrub habitat types will be premanent (cca 20 m along the route and other engeneering surfaces). In addtion to change of habitat types, the construction of the pipeline will have significant impact on habitat fragmenatation as well. After the construction of the pipeline inland unvegetated or sparsely vegetated habitats will be developed on the engeneering surfaces . It is expected that after some time the grassland habitat type species will develope on the engenieering surfaces along the pipeline route. The revegetation of the sparecly vegetated engenieering surfaces will depend on the soil structure of the primary soil structure. The areas with shallow soil layer will need more time for recovery, as new soil needs to be developed. Grassland habitat types will be changed due to the temporal removal of soil and afterwards changes in soil composition. This construction work will affect the ecological conditions (e.g. change of soil structure) and the plant composition in the construction area. It is expected that grassland habitat types will be reconstructed after some period. The period of vegetation and habitat recovery will depend on the soil type and grassland habitat type, respectively. The areas with dry calcareous grasslands, which have shallow soil layer, will need more time for recovery, as new soil structure needs to be developed. In the engeneering surfaces of Variant B (cca 20 m along the pipeline route, gass presusure recustion and metering station, pig trap station, block valve station) will reduce and fragment following forest and shrub habitats: eu-Mediteranean evergreen forests and scrubs and thermophilous and supra-Mediterranean oak woods. Along the Variant A predominantly are spread dry calcareous grassland habitat type. After the construction of the pipeline and during the usage of the pipeline, along the pipeline route the invasive species could be spread. The new disturbed soil structure could be beneficial for some invasive species and suppress the development of natural vegetation. In addition, the spread of invasive species along the pipeline corridore could affect the structure of surrounding habitats. In order to suppress the development of invasive species regular botanical monitoring of the engeneering sufaces will need to be conducted and applied accordingly the environmental protection measures. It is assumed that possible impact can be mitigated by some environmental protection measures. Conseqeuntly, the impact is assessed as not significant.
Effects' characteristic Negative, Direct, Permanent for forest and shrub habitats, temporal for grassland and riparian habitats
Effects' significance Acceptable, less significant

Effects' valorisation -2

Description of likely significant effects of the project ***Temporary deterioration of habitats - Noise, dust, air emissions and humane disturbance*** During the construction of the pipeline the temporary deterioration of habitats will occur. Noise, dust, air emissions and humane disturbance during the construction work will disturb some animal species and deteriorate the habitat quality. This impact is temporary and limited to relatively small area in surrounding of the construction zone. During the pipeline usage the permanent disturbance around the block valve station, the gas pressure reduction and metering stations and the pig trap station might occur because of the of the noise. The noise will be related to small surrounding area of above mentioned objects. During the work of pig trap station higher levels of noise could occur, but the impact is limited to short time, approximately 2 hours. In addition, occasional disturbance of habitats will occur during the maintenance along the pipeline route (e.g. mowing, regular survey of the route). The impact is temporary only during the maintenance work. As above mentioned impacts are spatially narrow or/and temporarily short, it can be concluded that the impact of disturbance and noise during the pipeline usage has minor significance.
Effects' characteristic Negative, temporary, direct
Effects' significance Not significant
Effects' valorisation -1

Description of likely significant effects of the project Temp***orary change of freshwater habitats due to work in river bed and on banks (suspended sediments)*** In the foothill of Vranja gnijezdo Hill, Variant B passes through the riverbed of Mrkovska River. There are several techniques for crossing over the watercourses. As it is not clear in this phase of the project which techniques will be used, the impacts will be assessed for the method of digging in the pipeline into the river bed. The river banks and river bed riparian vegetation will be permanently changed by the construction of pipeline (cca 20 m). During the construction work minor changes of the river flow might be needed. Due to the possible negative impacts, the construction work on watercourses should be conducted during the low water level. The engineering work in river bed will change physical and chemical properties of river water downstream from the working area. Firstly, the digging and similar construction work will affect the sediment and impact the physical properties of water (mudding). The impact will be diluted downstream from the engineering work area and it will not have high magnitude of impact on long length of watercourse. The mudding of water flow might locally affect some animal freshwater species and their distribution. Since engineering work period is short the impact is acceptable, with application of environmental protection measures. But since Variant B is not just crossing over the Mrkovska river once, but is also going either in the riverbed or repeatedly crossing over for a certain length of about 1,7 km, this part of the route should be shifted away from the Mrkovska River.

Effects' characteristic negative, direct, temporary
Effects' significance Less significant
Effects' valorisation -1

Description of likely significant effects of the project ***Accidental release of chemicals and fuel to rivers, sea or karstic areas is possible during the construction works*** Contamination of rivers, sea or kartic area can deteriorate habitat quality and have an adverse impact on individual wildlife specimens. With the application of environmental management plan during the construction period (i.e. usual environmental protection precautionary measures for the construction sites, appropriate waste and oil management, use of approved equipment etc.) accident possibility will be significantly reduced.
Effects' characteristic Accidental
Effects' significance Not significant
Effects' valorisation -1

Description of likely significant effects of the project ***Emission of bigger amounts of gas with possible explosion, fire or fire blast are possible as accidents*** This accidental impact could cause direct longer period of habitat changes. Moreover, in some circumstances the fire could be spread to a broader region and affect habitats on broader distance from the Variant. The magnitude of the impact will depend on the temporal meteorological conditions. With appropriate maintenance and survey of the pipeline infrastructure the probability of this kind of accidental impact should be low.
Effects' characteristic Negative, Accidental
Effects' significance Significant
Effects' valorisation -2

4.3.2.7 Natural heritage and protected areas

Variant A

Albania

Description of likely significant effects of the project. ***Impacts on protected areas*** 1-The axis of the pipeline corridor runs less than 1km from the MNR (IUCN category IV) of "Shkodra Lake – Buna River wetland complex" (Ramsar site). Likely impacts: Potential adverse impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Migration of animal populations due to disturbance from project activities (noise from blasting through karst limestones, degradation of the quality of the Lake's waters, etc.). 2-Pipeline route crosses the MNR of the "Riparian Area of the Shkodra Lake", Albanian part (IUCN category IV). Impacts: Destruction of riparian forest and vegetation; Potential impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Migration of animal populations due to disturbance from project activities (noise from blasting through karst limestones, degradation of the quality of the Lake's waters, etc.). 3-Pipeline route runs near the Syri Sheganit and Syri Gjonit Karst Springs (Nature Monuments, IUCN category IV). Potential impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Possible permanent adverse impacts due to possible changes in ground waters regime (flow direction, water discharge, hydraulic connections, etc.) from earth works in karst areas.
Effect's characteristic Negative; Direct and Indirect; Partly temporary and partly permanent; and Likely unavoidable adverse impacts.
Effect's significance Unacceptable, because of the high national and international importance of the PAs.
Effect's valorisation -2

Description of likely significant effects of the project ***Impacts on emerald sites*** Pipeline route axis runs across the Emerald network site "MNR of the Riparian Area of Shkodra Lake", Albanian part that is important as an IBA and IPA. The main potential adverse impacts on this site are: Destruction of riparian forest and vegetation; Potential impacts through direct and indirect impacts to water regime, water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Migration of animal populations due to disturbance from construction activities, etc.
Effect's characteristic Negative; Direct and Indirect; With difficulty avoidable

Effect's significance Unacceptable, because of the high national and international importance of this Emerald site.
Effect's valorisation -2

Description of likely significant effects of the project ***Impacts to Natural heritage or habitats of particular interest:*** -Pipeline route runs near some beautiful karst Lakes (Urdhana Lake 1, Urdhana Lake 2, Hurdhana e Kalbet Lake, etc.), near approximately18 karst springs of high natural and landscape, and biodiversity values (Syri Virit, Syri Franit, Vau Mullirit, Syri Zi, etc.), near some dug wells of historical values like the Shpella Frasherit (Ash cave) dug well, etc.). Potential impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Possible permanent adverse impacts due to possible changes in ground waters regime (flow direction, water discharge, hydraulic connections, etc.) from earth works in karst areas.
Effect's characteristic Negative; Direct and Indirect; with difficulty avoidable
Effect's significance Unacceptable, because of the permanent adverse changes and of the national and regional importance of these sites.
Effect's valorisation -2

Montenegro

Description of likely significant effects of the project ***Passing through protected area or important biodivesity area*** Variant A is passing through National park Lovćen, that is also an Important Plant Area (IPA) and an Emerald site. According to existing zonation the pipeline is passing through the second protection and buffer zone. New zonation of the National park is proposed by the proposed Spatial Plan of the National Park Lovćen (the Spatial plan is in final phase - public debate was in autumn 2012) the pipeline route is passing through 3 km of the first protection zone and 3 km of second protection zone. In the first protection zone are the areas with the highest functional ecological importance, and consequently with the highest level of protection. In this zone it is forbidden to construct any objects and usage of natural resources. The planned pipeline route is predominantly passing through the forest vegetation of the area (in buffer, first and second protection zone, respectively). High natural value of the forest habitats (in particular beech forest) in the first and second protection zone is recognised as important Emerald and Habitat Directive habitat. In this section the pipeline route is passing through rough terrain without settlement. Therefore, the new corridor in this area will cause the removal of important habitats (along cca 20 m of the route and other engineering surfaces) resulting direct loss and habitat fragmentation and might adversely effect the ecological functionality of important habitats. In addition, according to the proposed Spatial Plan cutting of forest vegetation in the construction phase might be considered as the exploitation of natural resources and not be approved. In addition, in eastern part of Park the pipeline route is planned through the Special Nature Reserve Sokol (20,6 ha). Consequently, the construction of planned pipeline route will have

significant effect on the conservation of the natural values of the Special Nature Reserve Sokol. National Park Lovćen is popular tourist area with nice touristic viewpoints. In addition to ecological value of the National Park Lovćen it should be evaluated the impact on visual landscape values. Especially in respect to the visibility of the route from the important touristic viewpoints. During and after construction of the pipeline the construction area will be noticeable as the route pass through karst area with shallow soil layer. Consequently, the construction area will be noticeable as white stripe in the surrounding vegetation. Moreover, the route might be seen like bright line from some touristic hotspots. This effect will be temporal as after some time the construction area will become greener and less obvious. Pipeline route is passing 800 m from the entrance of Lipska cave (Monument of Nature), but since the cave's plan is not available, it is not possible to determine significance of the effect. The part of Cijevna river where Variant A is passing through is downstream from the Emerald site and IPA. Consequently, the Variant A will not have any effect on this protected area.
Effects' characteristic Negative, permanent
Effects' significance Significant
Effects' valorisation -2

Description of likely significant effects of the project ***Loss of protected wildlife species and habitat type*** Through the construction of the pipeline there is a possibility of loss of individual specimen of protected wildlife species. Removal of vegetation might directly affect some specimens of plant species and accompanied slowly moving fauna. In addition, certain amount of direct destruction of bird nests and other protected animal habitats and also direct animal deaths (cca 20 m along the route and other engineering surfaces). Death is largely related to poorly mobile species and those that have a life cycle related to the soil, particularly during sensitive life stages, such as hibernation stage, eggs, etc. Since this is a temporary and relatively short-term negative impact of which is limited to relatively small area, it is estimated that the project would not have a significant impact on the population of the endangered or protected species.
Effects' characteristic Negative, Direct
Effects' significance Not significant
Effects' valorisation -1

Variant B

Albania

Description of likely significant effects of the project
Impacts on protected areas: 1-At Buna riverbed the pipeline route crosses the MNR of the "Shkodra Lake - Buna River wetland complex" (IUCN category IV) at Buna riverbed. Impacts: Destruction of riparian forest and vegetation; Potential impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase.
Effect's characteristic
Negative; Direct.
Effect's significance
Acceptable, because this PA is crossed at Buna riverbed, along a segment of approximately 50m long. At the river crossing the riparian forest of Buna River is composed of vegetation of common values in terms of biodiversity.
Effect's valorisation
0

Description of likely significant effects of the project
Impacts on emerald sites: -The axis of the Pipeline route passes 1.3 km far from the emerald site "Buna River Mouth-Velipoja Protected Landscape". The closest point (1.3 km) to this site is the Murtenza Marsh. At this point the axis of the pipeline runs through flat agricultural lands, which lie over a thick impermeable clayey-silty cover. Consequently, no adverse impact is expected on the aquatic and terrestrial parts of this site. The only possible impacts are the temporary ones that can be caused by noise from truck circulation and digging works.
Effect's characteristic
Negative; Direct; and Indirect; Temporary
Effect's significance
Acceptable; Low significance;
Effect's valorisation
0

Description of likely significant effects of the project
Impacts to Natural heritage or habitats of particular interest: -Pipeline route does not run near any natural heritage or habitat of particular interests.
Effect's characteristic
-
Effect's significance
-
Effect's valorisation
0

Montenegro

Description of likely significant effects of the project
Loss of protected wildlife species and habitat type Through the construction of the pipeline there is a possibility of loss of individual specimen of protected wildlife species. Removal of vegetation might directly affect some specimens of plant species and accompanied slowly moving fauna. In addition, certain amount of direct destruction of bird nests and other protected animal habitats and also direct animal deaths (cca 20 m along the route and other engineering surfaces). Death is largely related to poorly mobile species and those that have a life cycle related to the soil, particularly during sensitive life stages, such as hibernation stage, eggs, etc. Since this is a temporary and relatively short-term negative impact of which is limited to relatively small area, it is estimated that the project would not have a significant impact on the population of the endangered or protected species.
Effects' characteristic
Negative, Direct
Effects' significance
Not significant
Effects' valorisation
-1

Description of likely significant effects of the project
Passing through protected area or important biodiversity area Pipeline route passes through marine area on south-east side of protected area. The pipeline route is passing in its marginal marine part for a length of around 1,7 km. Marine part of Platamuni is proposed because of *Posidonia oceanica* seagrass. Laying procedure will have negative and permanent impact on marine habitats. Impact zone will mainly affect habitats associated with sandy and muddy sediments at depth grater the 30 meters.
Effects' characteristic
Negative
Effects' significance
Significant
Effects' valorisation
-1

4.3.2.8 Landscape and Visual Issues

Variant A

Albania

Description of likely significant effects of the project
– Adverse permanent impact from earth works on the characteristic karst micro relief forms in the Kakarriqi mountain and Bajza-Hoti segments;

– Likely permanent negative impact from ROW presence across the karst area (Kakarriqi Mountain and Bajza-Hoti segments); and – Temporary negative visual impact by earth works, access roads, etc., during construction phase.
Effect's characteristic Negative; Direct; Partly temporary and partly permanent; Unavoidable
Effect's significance Important, because unavoidable impacts through karst areas
Effect's valorisation -2

Description of likely significant effects of the project Pipeline route runs near some beautiful karst Lakes (Urdhana Lake 1, Urdhana Lake 2, Hurdhana e Kalbet Lake, etc.), and near approximately18 karst springs of high landscape and visual values. Over the karst area of Malesia Madhe District there are also some temporary karst lakes that have water only during rainfall months. All the karst lakes and springs are surrounded by dense and rich vegetation. – Possible permanent adverse impacts from earth works due to possible changes in ground waters regime (flow direction, water discharge, hydraulic connections, etc.) from earth works in karst areas. Thus, it exists the possibility that some of these karst spring and lakes disappear definitively; and – Potential impacts through direct and indirect impacts from earth works to water quantity and quality and aquatic ecology (siltation, spills/leaks) during the construction phase.
Effect's characteristic Negative; Direct and indirect; Unavoidable if changes in ground water regime occur.
Effect's significance Less Acceptable
Effect's valorisation -2

Description of likely significant effects of the project – Adverse temporary impact on landscape and visual amenity from earth works and vegetation clearing on the riparian areas in the riverbeds (6 river crossings); and – Likely permanent negative impact from ROW presence across the riparian forests on the riverbeds (6 main rivers crossings), etc.
Effect's characteristic Negative; Direct; Partly avoidable
Effect's significance Acceptable
Effect's valorisation -1

Montenegro

Description of likely significant effects of the project
Impact on the characteristic karst micro-relief forms – sink holes and karst pools is manifested as degradation and backfilling in case of overlapping with pipeline flow. The cause of degradation is digging of pipe trench, backfilling due the stabilization and the construction of aboveground pipeline elements. This influence is strongly emphasized in groups of sensitive and valuable landscapes (K07-*mosaic landscape*, K08-*mountainous forest landscape*, K09-*steep slopes and colluvial drifts landscape*). In groups of landscapes with low and lower landscape values (all other defined groups) influence on the characteristic karst micro-relief forms is negligible.
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
-2

Description of likely significant effects of the project
The visual impact of ground pipeline elements is most pronounced in areas that contain high natural or anthropogenic landscape values. These areas are: K04-*high value rural landscape,* K07-*mosaic landscape,* K08-*mountainous forest landscape,* K09-*steep slopes and colluvial drifts landscape*. Since the ground pipeline elements are very small spatial and volumetric forms effect is not strong. In groups of low landscape value visual effects ground parts of the pipeline are small.
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
0

Description of likely significant effects of the project
Gas pipe imposition
After excavation and backfilling canals remains barren soil changed color and texture in relation to the natural state. Over time, influenced by the succession and atmospheric conditions, it is possible that the space above the gas pipeline again takes the natural characteristics of the environment. Impact is pronounced in areas with high vegetation, and areas with agricultural surfaces enclosed with drywalls: K04-*high value rural landscape,* K07-*mosaic landscape,* K08-*mountainous forest landscape*
Effects' characteristic
Negative; Direct

Effects' significance
Acceptable
Effects' valorisation
0

Description of likely significant effects of the project
Removing or damaging of drywalls is possible during the construction time. They are integral elements of the rural landscape K04-*high value rural landscape,* K02-*agricultural landscape*.
Effects' characteristic
Negative; Direct
Effects' significance
Unacceptable
Effects' valorisation
-2

Description of likely significant effects of the project
During the construction works corridor width, within it is necessary to remove high vegetation, is about 13-16 m wide from both sides of pipeline axis. During the gas pipeline, operation low vegetation is possible to plant within 5 m corridor from each side of pipeline axis, while growth of high vegetation is disabled. These influence is strongest in relation to all other listed influences which is especialy evident in areas of landscape value defines high vegetation combined with other elements of natural and anthropogenic landscape: K04-*high value rural landscape,* K07-*mosaic landscape,* K08-*mountainous forest landscape*. Other defined groups of landscapes are not significantly threatened because the high vegetation is not important element of landscape characteristics.
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
-1

Variant B

Albania

Description of likely significant effects of the project
– Adverse temporary impact on landscape and visual amenity from earth works and vegetation clearing on the riparian area of the Buna/Bojana riverbed (1 river crossing); and – Likely permanent negative impact from ROW presence across the riparian forest (50m wide) of the Albanian part of the Buna/Bojana riverbed

Effect's characteristic Negative; Direct
Effect's significance Acceptable
Effect's valorisation -1

Montenegro

Description of likely significant effects of the project Impact on the characteristic karst micro-relief forms – sinkholes and karst pools is manifested as degradation and backfilling in case of overlapping with the flow pipeline. The cause of degradation is digging of pipe trench, backfilling due the stabilization and the construction of aboveground pipeline elements. This influence is strongly emphasized in groups of sensitive and valuable landscapes, especially in K10-*karst and rockery landscape* then in K07-*mosaic landscape* and K08-*mountainous forest landscape*. In groups of landscapes with low and lower landscape values (all other defined groups) influence on the characteristic karst micro-relief forms is negligible.
Effects' characteristic Negative; Direct
Effects' significance Acceptable
Effects' valorisation -2

Description of likely significant effects of the project The visual impact of ground pipeline elements is most pronounced in areas that contains high natural or anthropogenic landscape values. These areas are K08-*mountainous forest landscape and* K10-*karst and rockery landscape*. Since the above-ground pipeline elements are very small spatial and volumetric forms effect is not strong. In groups of low landscape value visual effects ground parts of the pipeline are small.
Effects' characteristic Negative; Direct
Effects' significance Acceptable
Effects' valorisation 0

Description of likely significant effects of the project
Gas pipe imposition After excavation and backfilling canals remains barren soil changed color and texture in relation to the natural state. Over time, influenced by the succession and atmospheric conditions, it is possible that the space above the gas pipeline again takes the natural characteristics of the environment. Impact is pronounced in areas with high vegetation, and areas with agricultural surfaces enclosed with drywalls: K07-*mosaic landscape,* K08-*mountainous forest landscape.*
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
0

Description of likely significant effects of the project
Removing or damaging of drywalls is possible during the construction time. They are integral elements of the K02-*agricultural landscape*.
Effects' characteristic
Negative; Direct
Effects' significance
Unacceptable
Effects' valorisation
-2

Description of likely significant effects of the project
During the construction works corridor width, within it is necessary to remove high vegetation, is about 13-16 m wide from both sides of pipeline axis. During the gas pipeline, operation low vegetation is possible to plant within 5 m corridor from each side of pipeline axis, while growth of high vegetation is disabled. This influence is strongest in relation to all other listed influences which is especially evident in areas of landscape value defines high vegetation combined with other elements of natural and anthropogenic landscape: K07-*mosaic landscape,* K08-*mountainous forest landscape*. Other defined groups of landscapes are not significantly threatened because the high vegetation is not important element of landscape characteristics.
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
-1

4.3.2.9 Air Quality and Existing Emissions Load

Albania

Variant A

Description of likely significant effects of the project
Temporary impact on local air quality from: – Dust emissions from earthworks, blasting, excavation, cofferdam construction, vehicle movements, etc.; – Temporary construction vehicles exhaust gases emissions (i.e. excavators, bulldozers, trucks, cars). Variant A will be affected more intensively because: – Pipeline route runs partly over hard rocks (Kakarriqi Mountain and Bajza Karst Plain) through which blasting is required; and – Pipeline runs through inhabited areas and crosses 18 villages and Shkodra town. Variant B runs through flat agricultural lands and over loose deposits, and far from inhabited areas.
Effect's characteristic
Temporary direct negative effects
Effect's significance
Acceptable
Effect's valorisation
-1

Variant B

Description of likely significant effects of the project
Variant B runs far from inhabited areas, and through flat agricultural lands and over loose deposits, where blasting is not required. Temporary impact on local air quality from: – Dust emissions from earthworks, excavation, cofferdam construction, vehicle movements; – Temporary construction vehicles exhaust gases emissions (i.e. excavators, bulldozers, trucks, cars).
Effect's characteristic
Temporary direct negative effects
Effect's significance
Acceptable and of low significance.
Effect's valorisation
0

Montenegro

Variant A and Variant B

Description of likely significant effects of the project *Effects during construction* Construction effects of a pipeline and associated facilities include temporary and localised air emissions of dust generated from earth movements, excavation, unpaved surfaces, vehicles movement along the working area and access roads. The area of influence comprise agricultural land and fauna and flora species as well as workers and residential population in the vicinity of these locations, usually up to 100 m. Intensity and area of influence of construction effects depend on meteorological conditions. Higher intensity and larger area of influence could be expected during unfavourable meteorological situations (dry weather, strong wind). Construction effects also include the emissions of exhaust gases from vehicles and equipment with internal combustion engines used for construction (i.e. generators, excavators, bulldozers, trucks, cars etc.). Both of these types of impacts are temporary in nature and localised. *Effects during pipeline usage* Operation effects include fugitive emissions of gas (mostly consisting of methane (CH4), 98%), emissions from cleaning/purging operations and as a result of non-routine events such as pipeline failure or even accidental situations. Fugitive emissions are usually results of leakage through venting parts in aboveground facilities: block valve stations, pig trap stations or gas pressure reduction and metering stations. Air emissions occur as a result of cleaning/purging operation usually performed by passing pigs through completed sections of the pipeline. Non-routine events such as pipe failure can cause significant air emissions. The other emissions are emissions from small combustion installations (usually a boiler with thermal capacity of 100 – 200 kW) intended for gas heating in Gas pressure reduction and metering stations. The fuel used is gas. Relevant pollutants from combustion process are oxides of nitrogen (NOx), carbon monoxide (CO) and carbon dioxide (CO2).
Effects' characteristic Construction effects on air quality are negative but temporary in nature and localised. Operation effects are negative and will be both temporary (cleaning/purging operation) and long term/permanent (fugitive emission of gas and emissions from fuel combustion in gas pressure reduction and metering station).
Effects' significance Construction effects are not significant and are acceptable. Operation effects are not significant on local and regional level. These effects are acceptable.
Effects' valorisation Construction and operation effects: - 1 negative impact

4.3.2.10 Noise and Vibration

Albania

Variant A

Description of likely significant effects of the project
Increase in noise level during the construction phase: in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna. Periodical increase in noise level during the operation phase - in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna. Variant A will be affected more intensively because: Pipeline route runs partly over hard rocks (Kakarriqi Mountain and Bajza Karst Plain) through which blasting is required; and Pipeline runs through inhabited areas (18 villages, and Shkodra town); and Pipeline runs through or near areas rich en fauna (Riparian area of Shkodra Lake, Kakarriqi Mountain)
Effect's characteristic
Negative; Direct; Temporary; Unavoidable; Partly mitigable
Effect's significance
Acceptable
Effect's valorisation
-1

Variant B

Description of likely significant effects of the project
Increase in noise level during the construction phase: – in the vicinity and throughout the dwelling areas; and – in the vicinity and throughout the areas rich in fauna. Periodical increase in noise level during the operation phase - in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna. Variant B runs far from inhabited areas and through flat agricultural lands, as well as over loose deposits, where blasting is not required.
Effect's characteristic
Negative; Direct; Temporary;
Effect's significance
Low significance; Acceptable
Effect's valorisation
0

Montenegro

Variant A and Variant B

Description of likely significant effects of the project
Effects during construction During the pipeline construction additional noise will be broadcast in the environment as a result of construction work. This noise is temporary and will depend on the type and arrangement of sound sources (construction machinery and vehicles), and the intensity and type of construction, as well as an appropriate selection of transport routes. If technological discipline is respected negative impact on the surrounding residential areas is not expected *Effects during pipeline usage* Working pipeline is not a source of noise, except at special facilities, Gas Pressure Reduction and Metering Stations, which serve to reduce the gas pressure by switching from higher pressure system to lower pressure system. Route Variant A (land) of the observed section, will have two Gas Pressure Reduction and Metering Stations while on route Variant B (coastal) there will be three Gas Pressure Reduction and Metering Stations. Sources of noise in the Gas Pressure Reduction and Metering Stations are reduction valves, which should be equipped with silencers which reduce noise. Nearest settlements will be most vulnerable to potential noise from planned Gas Pressure Reduction and Metering Stations. However, significant impact on noise levels is not expected at a sufficient distance of Gas Pressure Reduction and Metering Stations from existing settlements. The practice has shown that the pipelines cause negligible increase in noise at settlements more than 100 meters away, which the population rarely notices.
Effects' characteristic
Noise during construction is temporary and if technological discipline is respected it is not expected to have negative impact. At a sufficient distance of Gas Pressure Reduction and Metering Stations from existing settlements any significant impact on noise levels is not expected.
Effects' significance
Construction impacts are not significant and are acceptable. Impacts during pipline usage are not significant and are acceptable.
Effects' valorisation
-1 moderately negative impact

4.3.2.11 Cultural Heritage

Variant A

Albania

Description of likely significant effects of the project
Likely high adverse impacts, because the proposed pipeline route runs throughout the territories of Shkodra, and Malesia Madhe Districts, which are very rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian-Roman-Byzantine-Medieval ages.

– Direct physical disturbance of or damage to the archaeological sites from construction activities; – Degradation of or damage to aboveground structures due to pollution or vibration; – Blockage of user access to cultural heritage sites; – Negative effects on the setting or ambience of cultural heritage sites.
Effects' characteristic Negative; Direct and Indirect, difficult to avoid
Effects' significance Unacceptable
Effects' valorisation -2

Montenegro

Description of likely significant effects of the project Impacts are possible in the case of overlapping pipeline with certain elements of cultural heritage. The destruction of farm buildings, drywall structures, fields and pastures it is very possible in that case. Intensity of the impact is characterized as a large. Indirect cultural heritage impacts are possible as negative perceptions of cultural heritage connection with the proximity to the gas pipeline infrastructure.
Effects' characteristic negative, direct, indirect
Effects' significance unacceptable, important
Effects' valorisation -1

Variant B

Albania

Description of likely significant effects of the project Likely moderate adverse impacts, because the proposed pipeline route runs throughout an area that has been flood prone, and consequently there is no high probability of finding non-discovered cultural heritage.
Effects' characteristic Negative, direct
Effects' significance Acceptable
Effects' valorisation

0

Montenegro

Description of likely significant effects of the project Impacts are possible in the case of overlapping pipeline with certain elements of cultural heritage. The destruction of farm buildings, drywall structures, fields and pastures it is very possible in that case. Intensity of the impact is characterized as a large. Indirect cultural heritage impacts are possible as a negative perceptions of cultural heritage connection with the proximity to the gas pipeline infrastructure.
Effects' characteristic negative, direct, indirect
Effects' significance unacceptable, important
Effects' valorisation -1

4.3.2.12 Occupational Health and Safety

Variant A and Variant B

Description of likely significant effects of the project When conducting the engineering and installation works and works related to operation of pipelines the following hazards can occur: dangers of electricity, inadequate lighting, dangers in case of maintenance and operation of shut-off systems, deficiencies of warning signs, hazards if prescribed personal protective equipment is not used, hazards in case of working with hazardous materials, hazards in case of dangers during movements, work on heights etc.
Effects' characteristic Direct and possible negative impact to occupational health and safety, mainly during construction.
Effects' significance Acceptable, if all works comply with the Occupational Health and Safety Plan which will introduce every worker to the hazards of every job and methods to avoid any dangers.
Effects' valorisation 0

4.3.2.13 Waste

Variant A and Variant B

Description of likely significant effects of the project *During construction* Inadequate waste management (accumulations of waste, use of unsuitable/sensitive locations for temporary disposal etc.) during construction phase could result in soil

contamination and even in surface-water or seawater pollution. *During operation* Inadequate management of waste generated by pigging operations (tailings, sludge) during maintenance of the pipeline could result in soil contamination and even in air pollution. These possible impacts are not significant due to the fact that such waste generates in small quantities.
Effects' characteristic Effects during construction phase are negative and direct due to the large quantities of waste generated from earthworks. Because of the type and characteristics of construction works, effects are short-term and localised. Possible effects during operation phase are negative but short-term and localised.
Effects' significance Effects during construction phase are significant but acceptable. Effects during operation phase are not significant and are acceptable.
Effects' valorisation Construction effects are -1 (negative)

4.3.2.14 Infrastructure

Variant A

Albania

Description of likely significant effects of the project – Pipeline route affects the landing strip of the Gjadri Air Base (3km long, from which 2.2 km are crossed from the axis of the pipeline); – Possible damages to infrastructure (farm houses, water pipelines, telecommunication cables, sewage and sewerage network, and other urban infrastructure), overall along the corridor Shkodra-Koplik; – Damages to the international and national railway, and to the international, national, district, and rural road network; – Damages to the industrial area in the north eastern surroundings of Shkodra; – Damage to the embankment for protection from river erosion (Drini, Gjadri Rivers, etc.) and to the irrigation and drainage network through the flat agricultural area;
Effects' characteristic Negative; Direct, Reversible but with high cost
Effects' significance Important, but acceptable if damages are repaired or recompensed.
Effects' valorisation -2

Montenegro

Description of likely significant effects of the project
In cases where the pipeline intersects the infrastructure constructions (traffic: roads, railways, etc., water management: water supply pipelines and sewage system, electricity: power lines, cables, etc.) all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual institutions when obtaining certain licenses). During the construction, due to increased frequency of materials and equipment transportation, the traffic situation can change - delays may occur that will require special attention and support services (in transportation of special cargo). Possible accidental damage to public roads can be expected.
Effects' characteristic
Direct and possible negative impact on traffic, water management and energy infrastructure, mainly during construction.
Effects' significance
Acceptable, if all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual institutions when obtaining certain licenses).
Effects' valorisation
0

Variant B

Albania

Description of likely significant effects of the project
– Possible damage to Torovica embankment and to the irrigation and drainage network through the flat agricultural area; – Effects on the district road Bushat-Velipoje.
Effects' characteristic
Negative; direct
Effects' significance
Acceptable and remediable with low cost
Effects' valorisation
0

Montenegro

Description of likely significant effects of the project
In cases where the pipeline intersects the infrastructure constructions (traffic: roads, railways, etc., water management: water supply pipelines and sewage system, electricity: power lines, cables, etc.) all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual

institutions when obtaining certain licenses). During the construction, due to increased frequency of materials and equipment transportation, the traffic situation can change - delays may occur that will require special attention and support services (in transportation of special cargo). Possible accidental damage to public roads can be expected. Various types of ships will intersect the subsea pipeline corridor during sailing, mooring or anchoring.
Effects' characteristic Direct and possible negative impact on traffic, water management and energy infrastructure, mainly during construction.
Effects' significance Acceptable, if all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual institutions when obtaining certain licenses).
Effects' valorisation -1

4.3.2.15 Accident situations

Variant A and Variant B

Description of likely significant effects of the project *Effects during construction* During project construction, there may be unforeseen spills of fuel, lubricants and other fluids from machinery and equipment for construction, be it on land or the underwater section of the pipeline. A majority of possible contamination depends primarily on the organization of the site, and the potential amount of substance on the construction site that may cause pollution. Since quantities of substances that will be used on construction sites are not known at this stage of project development it is not possible to estimate the level of potential contamination as well as the cost of remediation of contamination. *Effects during pipeline usage* During project duration, there may be leaks of natural gas from the system, during which, if there is no ignition or explosion environmental pollution does not occur, other than greenhouse gases, and there is no need for remediation. Costs consequences of such an event, or remediation and removal of contamination depends on the mechanism of the origin and course of the accident, as well as the environment in which the accident occurred.
Effects' characteristics Risk was assessed as moderately negative for the precautionary principle. Key performance impact on the environment as a result of an accident takes place during the accident (fire, explosion, poisoning), and after the accident no further pollution is expected. Constant application of new methods in pipeline construction and its appropriate maintenance contributes to reducing the risk of adverse events.
Effects' significance Acceptable, provided that the design, construction, operation and maintenance of the pipeline and all ancillary facilities apply modern methods, well-established systems of quality assurance and control, and good engineering practice based on current experience at one million kilometres of main gas pipelines in the world.

Effects' valorisation
-1 moderately negative

4.3.3 The description of measures envisaged to prevent, reduce and, if possible, eliminate any significant adverse effects on the environment and social components

4.3.3.1 Variant A and Variant B

During preparatory works and construction

Hydrology/ Groundwaters

1. During the construction and other works on the route section in contact with ground waters, necessary measures shall be taken to protect the watercourse.

2. Excavation material, waste material and other obstacles produced during the pipeline construction shall be removed from the crossing in order to allow for normal watercourse flow without threat to the normal functioning of such canals, streams and rivers.

3. Fuel and lubricant tanks used by construction equipment shall be deposited in waterproof protective basins (retention basins).

4.3.3.2 Variant A

During preparatory works and construction

Climate

1. Crossing the riverbeds in areas of poor vegetation, as well as in the narrowest places;

2. Avoid/minimize the pipeline crossing through forested areas or areas of dense vegetation;

3. Avoid/minimize erosion and sedimentation;

4. Avoid changes on river morphology;

5. Avoid/minimize air pollution from dust and gases;

Geomorphology and geology/hydrology

1. Avoid changes in geomorphology in karst areas (section Bajza-Hoti) from earth works;

2. Avoid the forested areas. Special attention should be paid in the karst areas (segment Bajza-Hoti), where it is difficult to rehabilitate the forest resources;

3. Crossing the rivers in the narrowest places to minimize erosion in riverbeds;

4. Avoid riversides erosion by avoiding the selection of the pipeline route alongside the riverbeds (Kiri riverbed in the eastern part of Shkodra);

5. Avoid/minimize geological risks by avoiding the selection of the pipeline route along the contact surface between dissimilar geological formations (quaternary deposits-limestone; or molassic deposits-limestone).

Land use and pedology

1. Plan the pipeline route as much as possible over lands of low pedologic values;

2. Necessary re-routing within the highly urbanised territory of Shkodra surroundings;

3. Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.);

4. Avoid as much as possible the areas of high urban, industrial and tourist values.

Social issues

1. Necessary re-routing within the highly urbanised surroundings of Shkodra, as well as in the villages where the pipeline runs across inhabited centres;

2. During route selection process use as much as possible the main existing/planned longitudinal infrastructure (national road Lezha-Shkodra-Hani Hotit/Barlaj (border; ALB/MNE);

3. Make use of land boundaries;

4. Avoid wherever possible the settlements;

5. Minimize the adverse impacts on the tourist values by avoiding/minimizing adverse impacts on the biodiversity, the landscape, and the quality, quantity and the regime of the ground waters (Skadar/Shkodra Lake and Lakeshore; karst lakes; dug wells in karst area; etc.);

6. Avoid or minimise involuntary resettlement of communities and households through re-routing;

7. Minimise economic displacement through: routing to avoid structures and permanent crops; restricting working streeps; and sitting lay-down areas on scarce or unused land;

8. Provide compensation for loss of assets, and ensuring that resettlement restores livelihoods and standards of living of displaced persons to pre-Project levels;

9. Consultation with the appropriate authorities and affected persons to minimise and mitigate any adverse impact on affected inhabitants.

Water resources

1. Avoid/minimize impacts on aquifers from pollution of the ground waters. Special attention should be paid along the following sections of the pipeline route:

a. Across Drini riverbed, which serves as a recharge area for the Quaternary gravel aquifer of Lower Shkodra that supplies with drinking water the whole population of this area;

b. Section Kiri River- Grude Village that runs over the Quaternary gravel aquifer of Upper Shkodra which supplies with drinking water Shkodra and its surroundings (more than 150,000 inhabitants). There is no clayey-silty-sandy cover along this section, and all of the eastern part of this aquifer is a recharge area;

c. Section Palvar-Bajza, which runs over alluvium and prolluvium deposits of the Quaternary aquifer of Koplik and has very good hydraulic connection with the under-lying karstified limestone. The Koplik aquifer supplies drinking water to the local population;

d. Section Baja-Ivan-Hot, which runs over Bajza Karst Plain, where the rainfalls and groundwaters drain to some small karst lakes (natural heritage and PA) and further on to Shkodra Lake. The locals are partly supplied with drinking water from dug wells.

Biological environment (flora and fauna)

1. Avoid of sensitive areas (forest on karst areas) and habitats (Drini riverbed, Shkodra lakeshore);

2. Minimize the impact on the Riparian area of Drini Lezhes, Drini and Kiri Rivers by crossing through areas of low values of vegetation;

3. Avoid/minimize the adverse impacts on the biodiversity of the Shkodra Lake by not polluting the ground waters that drain in this lake (section Shkodra-border ALB/MNE);

4. Avoid/minimize impacts on the flora and fauna in sensitive areas along Shkodra Lakeshore. Special attention should be paid to Shkodra lakeshore, Drini riverbed, and to the karst plain in the section Bajza-Ivanaj-Hoti.

5. Construction of the pipeline over the watercourses should be conducted during period of low water levels

6. Before the preparation of the Main project, speleological survey of the route should be conducted within range of construction working area.

7. If during the construction of pipeline, new cave or cave system would be discovered, the construction works need to be stopped and relevant Ministry should be informed.

8. After finalization of the construction work of the pipeline over the watercourses, effected river banks should be restored and cultivated as close as possible to initial conditions

Natural heritage and protected areas

1. Avoid/minimize the adverse impacts on the small karst lakes in the section Shkodra-Hani Hotit by not changing groundwater regime and not polluting groundwaters that drain in these lakes. Special attention should be paid to the karst plain of Bajza (section Bajze-Ivanaj), as well as to the Syri Sheganit and Syri Gjonit karst springs (Nature Monuments);

2. Minimize impact on the Riparian area of Drini Riverbed (Protected Area) by passing through the narrowest place and through areas of low values of vegetation;

3. Avoid/minimize the adverse impacts on the quality of the waters of the Shkodra Lake (Ramsar Site) by not polluting groundwaters that drain in this lake (section Shkodra-border ALB/MNE);

4. Avoid/minimize the adverse impacts on the Shkodra Lake shore (Protected Landscape) by not disturbing the flora and fauna in this PA. Special attention should be paid in the section Bajze-Hot;

5. Preparatory work, including cutting shrubs and trees along the pipeline route, do not conduct in the nesting season of endangered species of birds between beginning of April and end of September to prevent the destruction of their nests and young birds.

6. Pipeline route of Variant A should be re-planned in the way which will bypass boundaries of National Park Lovćen. If the National park Lovćen could not be bypassed the Variant B needs to be considered as only solution.

Landscape and Visual Issues

1. Make use of land boundaries, and existing or planned infrastructure objects (Lezha-Shkodra-Hani Hotit highway);

2. Crossing the Drini Lezhes, Drini and Kiri riverbeds in areas of poor vegetation, as well as in the narrowest places;

3. Avoid the pipeline route through karst areas (Bajze-Ivanaj segment) as much as as it is practical;

4. Where it is possible preserve karst and micro-relief forms with the relocation of the route. That action is needed in cases when it is determined that the area contains very valuable pieces.

5. The visual impact of ground pipeline elements should be mitigated or eliminated with planting vegetation that serves as visual barrier.

6. Visual degradation caused by digging gas pipe trenches can be reduced or eliminated with sowing or hydrosowing autochthonous perennial and herbaceous plants. The reference species for sowing are plants in the immediate vicinity.

7. Vegetation removed during pipeline construction, should be re-plant with the same or similar species.

Cultural heritage

1. Special attention should be paid in the south-eastern and north-eastern parts of Shkodra, where numerous archaeological sites can be found which are crossed by the pipeline corridor;

2. Preliminary archaeological pipeline route survey, in accord with the Albanian Law on Cultural heritage, in order to determine exact positions of cultural heritage sites in relation to pipeline route;

3. Archaeological site supervision during construction works, in accordance with the relevant Laws on Cultural heritage.

4. In the case of overlapping pipeline and highly valuable element of cultural heritage relocation of the gas pipeline is method to avoid impacts.

5. Aboveground parts of the pipeline near the cultural heritage should be visually hidden by planting vegetation or build them in materials adapted to local area. Thus above-ground infrastructure can be contextually integrated into the surrounding area.

Air quality

1. Good construction site management practices such as covering of dusty materials, watering dusty surfaces in dry weather, sheeting of trucks, vehicle speed limits, etc.

2. Maintenance of used equipment and vehicles

3. Training of operators and drivers

Noise and Vibration

1. At Gas Pressure Reduction and Metering Station install silencers on reduction valves which reduce noise emission levels.

2. Respect technical and technological discipline, which is particularly applicable to the use of machines in order that are regularly controlled for malfunctions and their parts are regularly fixed.

3. Harmonize construction periods in the vicinity of residential objects with legislation.

4. For heavy vehicle traffic choose roads already burdened by traffic noise with minimal number of objects potentially at risk.

5. For heavy vehicle parking choose locations removed from objects potentially at risk, and turn off engines of parked vehicles.

Infrastructure

1. Avoid the landing trip of the Gjadri Air Base;

2. Minimize damages to infrastructure objects by using as much as possible the Lezha-Shkodra-Hani Hotit/Barlaj (border ALB/MNE) highway;

3. Before the beginning of ground works, traffic regulation project has to be created and applied for the period of construction works execution. This project shall be used for avoiding all possible conflict points between the planned pipeline and the existing traffic system.

Waste Management

1. Design of appropriate location for temporary disposal of waste

2. Organizing waste transport depending on generation of waste

3. Separate collection of all types of waste, and organizing disposal in the prescribed manner

Accident situations

1. Provide adequate equipment and resources for the recovery of any leakage of fuel or oil from the machinery and equipment used in construction.

2. Maintenance of used equipment and vehicles

3. Created evacuation plan for employees (in case of accidents that could endanger the life and health of employees - natural disasters, fires, explosions, etc.).

4. Training of all workers

During pipeline usage

Biological environment (flora and fauna)

1. During usage period of pipeline, regular removal of invasive alochtonous species should be conducted.

Air quality

1. Regular maintenance of pipeline operation, especially valves and fittings, in comply with internationally accepted standards and guidelines

2. Equipping pipeline with monitoring system connected to blocking and safety valves

3. Regular maintenance of combustion installations in gas pressure reduction and metering stations

4. To ensure reliable and proper operation of combustion installation in Gas pressure reduction and metering station after its start-up, a test monitoring of pollutants emission should be performed

Waste Management

1. Regular unloading of the container on the Pig Trap Station, and delivery of waste to the authorized person

Accident situations

1. Regular maintenance of pipeline operation, especially valves and fittings, in compliance with internationally accepted standards and guidelines

2. Regular maintenance of combustion installations in gas pressure reduction and metering stations

4.3.3.3 Variant B

During preparatory works and construction

Marine areas

1. Regular maintenance of equipment, machinery and equipment should be conducted.

2. Provide adequate facilities and equipment for the repair of any leaking of fuel or oil equipment and machinery used during construction period

Biological environment (flora and fauna)

1. Minimize the adverse impact on biodiversity by crossing the riparian forest of the Buna riverbed at the narrowest place and where the biodiversity values are lower.

2. Construction of the pipeline over the watercourses should be conducted during period of low water levels

3. Before the preparation of the Main project, speleological survey of the route should be conducted within range of construction working area.

4. If during the construction of pipeline, new cave or cave system would be discovered, the construction works need to be stopped and relevant Ministry should be informed

5. After finalization of the construction work of the pipeline over the watercourses, effected river banks should be restored and cultivated as close as possible to initial conditions.

Natural heritage and protected areas

1. Traverse the riparian forest of Buna riverbed at the narrowest place in order to damage it as less as possible this PA.

2. Preparatory work, including cutting shrubs and trees along the pipeline route, do not conduct in the nesting season of endangered species of birds between beginning of April and end of September to prevent the destruction of their nests and young birds.

Landscape and Visual Issues

1. Traverse the riparian forest of Buna riverbed at the narrowest place in order to damage it as less as possible this PA.

2. It is possible to preserve karst and micro-relief forms with the relocation of the route. That action is needed in cases when it is determined that the area contains very valuable pieces.

3. The visual impact of ground elements pipeline should be mitigated or eliminated with planting vegetation that serves as visual barrier.

4. Visual degradation caused by digging gas pipe trenches can be reduced or eliminated with sowing or hydrosowing autochthonous perennial and herbaceous plants. The reference speices for sowing are plants in the immediate vicinity.

5. Vegetation removed during pipeline construction, should be re-plant with the same or similar species.

Cultural heritage

1. Preliminary archaeological pipeline route survey, in accord with the Albanian Law on Cultural heritage, in order to determine if there is any archaeological site within the area of the project activities;

2. Archaeological site supervision during construction works, in accordance with the Laws on Cultural heritage.

3. In the case of overlapping pipeline and highly valuable element of cultural heritage in places relocation of the gas pipeline is method to avoid impacts.

4. Aboveground parts of the pipeline near the cultural heritage should be visually hidden by planting vegetation or build them in materials adapted to local area. Thus above-ground infrastructure can be contextually integrated into the surrounding area.

Air quality

1. Good construction site management practices such as covering of dusty materials, watering dusty surfaces in dry weather, sheeting of trucks, vehicle speed limits, etc.

2. Maintenance of equipment and vehicles

3. Training of operators and drivers

Noise and Vibration

1. At Gas Pressure Reduction and Metering Station install silencers on reduction valves, which reduce noise emission levels.

2. Respect technical and technological discipline, which is particularly applicable to the use of machines in order that are regularly controlled for malfunctions and their parts are regularly fixed.

3. Harmonize construction periods in the vicinity of residential objects with legislation.

4. For heavy vehicle traffic choose roads already burdened by traffic noise with minimal number of objects potentially at risk.

5. For heavy vehicle parking choose locations removed from objects potentially at risk, and turn off engines of parked vehicles.

Infrastructure

1. Before the beginning of ground works, traffic regulation project has to be created and applied for the period of construction works execution. This project shall be used for avoiding all possible conflict points between the planned pipeline and the existing traffic system.

2. Before the beginning of maritime works, a separate maritime safety study has to be created and applied during the execution of works which must define the regime of navigation of ships and other vessels, fishing regime, the regime of anchoring, marking of construction area and labelling of specific vessels participating in the works. This document has to be approved by the competent port authority prior to the commencement of works.

3. Marking of respective areas during maritime works execution is required.

4. Avoid the damage to Torovica embankment.

Waste Management

1. When designing the appropriate location for temporary disposal of waste, avoid proximity to the sea coast

2. Organizing waste transport depending on generation of waste

3. Separate collection of all types of waste, and organizing disposal in the prescribed manner

Accident situations

1. Provide adequate equipment and resources for the recovery of any leakage of fuel or oil from the machinery and equipment used in construction.

2. Maintenance of used equipment and vehicles

3. Created evacuation plan for employees (in case of accidents that could endanger the life and health of employees - natural disasters, fires, explosions, etc.).

4. Training of all workers

During pipeline usage

Air quality

1. Regular maintenance of pipeline operation, especially valves and fittings, in comply with internationally accepted standards and guidelines

2. Equipping pipeline with monitoring system connected to blocking and safety valves

3. Regular maintenance of combustion installations in gas pressure reduction and metering stations

4. To ensure reliable and proper operation of combustion installation in Gas pressure reduction and metering station after its start-up, a test monitoring of pollutants emission should be performed

Biological environment (flora and fauna)

1. During usage period of pipeline, regular removal of invasive alochtonous species should be conducted.

Infrastructure

1. Upon completion of works, mark the pipeline at the entry/exit points to/from the sea, where tags should be set informing that anchoring is prohibited.

Waste Management

1. Regular unloading of the container on the Pig Trap Station, and delivery of waste to the authorized person

Accident situations

1. Regular maintenance of pipeline operation, especially valves and fittings, in compliance with internationally accepted standards and guidelines

2. Regular maintenance of combustion installations in gas pressure reduction and metering stations

4.3.4 The programme of monitoring impact on the environment and social components

4.3.4.1 Variant A and Variant B

During pipeline usage

Biological environment (flora and fauna)

1. During the maintenance of the pipeline, monitoring of the appearance and dispersal of alochtonous invasive species should be conducted. According to the results of monitoring, the invasive species should be removed.

4.3.4.2 Variant A

During pipeline usage

Air quality

1. To ensure reliable and proper operation of combustion installation in gas pressure reduction and metering station after its start-up, a test monitoring of pollutants emission should be performed

Noise and Vibration

1. After the construction of Gas Pressure Reduction and Metering Stations at predicted locations and putting pipeline into operation, measure noise levels at the nearest residential objects or the closest edge of construction areas.

Accident situations

1. Operational safety of the pipeline maintained by the prescribed inspection and maintenance, and in accordance with recognized professional standards. Gas pipeline monitoring includes the following:

    a. monitoring of corrosion

    b. monitoring of damage

c. monitoring of leakage

4.3.4.3 Variant B

During pipeline usage

Maritime areas

1. During first two years after finalization of construction works monitoring of invasive species should be conducted to determinate the possible presence of invasive species specially genus *Caulerpa.*

Air quality

1. To ensure reliable and proper operation of combustion installation in gas pressure reduction and metering station after its start-up, a test monitoring of pollutants emission should be performed

Noise and Vibration

1. After the construction of Gas Pressure Reduction and Metering Stations at predicted locations and putting pipeline into operation, measure noise levels at the nearest residential objects or the closest edge of construction areas.

Accident situations

1. Operational safety of the pipeline maintained by the prescribed inspection and maintenance, and in accordance with recognized professional standards. Gas pipeline monitoring includes the following:

    a. monitoring of corrosion

    b. monitoring of damage

    c. monitoring of leakage

5 Final recommendations

Based on presented analysis of the ***technical*** solutions for both considered variants, it is evaluated that Variant A is difficult to construct whereas Variant B is considered moderate for construction.

Results of the ***economic*** study, as shown in this Report, indicate that Albania - Montenegro coastal route Variant B presents the most favourable solution as a part of the final IAP route.

Environmental and social issues have been more detailed elaborated within the chapter 4.3 Preliminary ESIA for two proposed IAP variants. Within this chapter, analysis of the baseline situation of each environmental and social component has been presented, as well as identification of possible impacts, mitigation measures and monitoring program.

In order to propose for final IAP route in section between Albania and Montenegro, all identified effects have been valorised numerically.

Overall analysis of conducted valorisation has shown that the more negatively has been scored byVariant A, for most of identified effects. These include impacts on geomorphological characteristics, impacts on land use and pedology, impacts on social issues, impacts on biological environment, impacts on natural heritage and protected areas, landscape and visual impacts, impacts on air quality, impacts caused by noise and vibration, impacts on cultural heritage sites and near-by infrastructure objects.

The most negative impact that has been identified for Variant A is its crossing in the middle of the area of National Park Lovćen in Montenegro. From a nature protection, biological, cultural heritage and social point of view this is considered unacceptable. Also, part of the Variant A route in Albania, passes very near or even through the settlements in the area of Shkodra district.

Even though the maritime surveys for the offshore section of proposed Variant B have not yet been carried out, it is considered, based on results presented in this report, that the Variant B is a better solution for the final IAP route.

The European Union's 2008 IPA Programme for Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo*, Turkey and Iceland

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Preliminary Technical Study Report
Annex I

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COWI • IPF CONSORTIUM

*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.

COWI • IPF CONSORTIUM

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*) This designation is without prejudice to positions on status, and is in line with UNHCR 1244 and the ICJ Opinion on Kosovo declaration of independence

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LIST OF ABBREVIATIONS

€cts	EURO cents
IAP	Ionian – Adriatic pipeline
METE	Ministry of Economy, Trade and Energy of Albania
MoEFWA	Ministry of Environment, Forests and Waters Administration (Albania)
PA	Protected Area
TAP CS	Trans Adriatic Pipeline Compressor Station

1. Synopsis

Project Title: Feasibility Study and EIA & SIA Ionian – Adriatic Pipeline

Project Number: WB5-REG-ENE-03

Contractor: COWI-IPF Consortium

Beneficiaries:

Croatia:
Plinacro Ltd and Ministry of Economy.

Bosnia & Herzegovina;
Ministry of Foreign Trade and Economic Relations represented by BH-Gas and Gaspromet.

Montenegro:
Ministry of Economy.

Albania:
Ministry of Economy, Trade and Energy.

Project start date: 08/05/2012

Project Duration: 22 months

Anticipated completion: February 2014

2. Introduction

In December 2012 METE suggested including in the technical study the variant of the pipeline route sections passing from the town of Fier to Tirana via Elbasan. The Interstate Committee supported this proposal

Based on this four different route options connecting the towns of Fier and Elbasan were drafted by the Consultant and at a meeting with METE in February 2013 the most favourable option was selected to be analysed in more details.

The results of this analysis and results of comparison between two possible IAP pipeline routes between Fier and Tirana (Ahmetaq) are presented in this Annex I.

3. Routes description

3.1. Description of considered pipeline variants in Albania: section Fier – Ahmetaq

The two route options considered in this document are shown in the map below

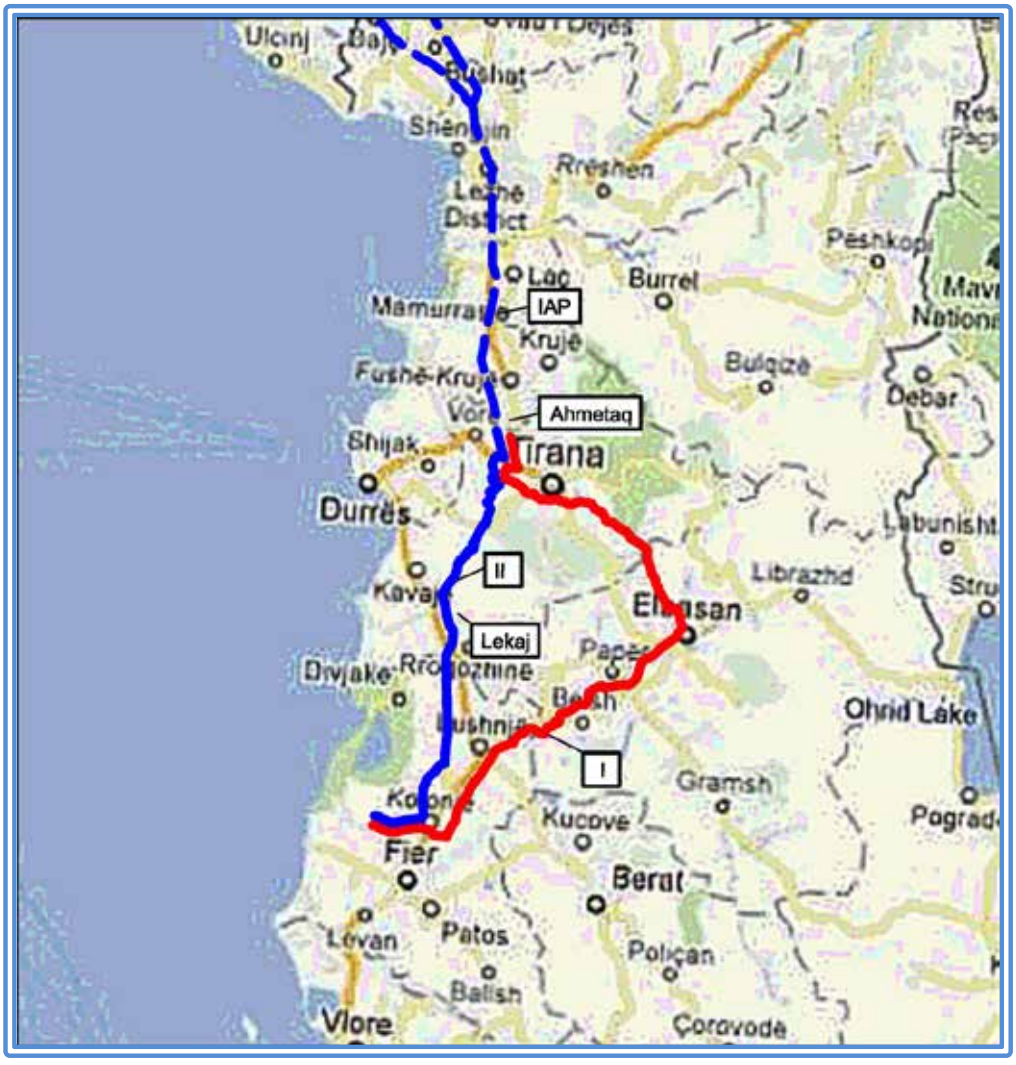


Figure 1: Route section I and II

Section I (Fier – Elbasan - Ahmetaq)

The route starts at compressor station on the TAP system near Fier and runs to east toward Mbrostar. In its route pipeline crosses river. From Mbrostar parallel to the road the route runs toward Lushnja. The pipeline runs mostly through flat agriculture areas. In north - east direction of Lushnja the route runs toward Elbasan through a hilly terrain crossing the flat valleys between hills. In the Elbasan area the route runs through urban area and reaches the route of the new road between Elbasan and Tirana. Parallel to the new road the pipeline route runs toward Tirana through hilly terrain. The route passes Tirana from the south parallel to the river and runs toward Ahmetaq in north direction.

In this section no major problems for construction of pipeline are to be expected.

Total length of section I	124 km
Highest point of the pipeline	630 m
Lowest point of the pipeline	10 m
Maximal operating pressure	85 bar

Section II (Fier –Ahmetaq, via Lekaj)

The route starts at compressor station on the TAP system near Fier and runs to east then turns toward north. The route crosses river and runs in northern direction parallel to the costal line to the Staravec village. The pipeline crosses agriculture areas, mainly flat terrain which is not difficult for construction. From Staravec the route runs in northern direction toward Ahmetaq. The pipeline crosses flat agriculture areas and then south – west of Tirana crosses a hilly terrain, and reaches Tirana area west of the city. In this section no major problems for construction of the pipeline are to be expected.

Total length of section II	88 km
Highest point of the pipeline	320 m
Lowest point of the pipeline	10 m
Maximal operating pressure	85 bar

4. Economic calculations

The aim of these analyses was to evaluate the economic effects of new Fier – Elbasan – Ahmetaq transmission and more detailed Fier – Ahmetaq route on the transport tariff tendency for Albania taking into account expected gas market build up for each country.

The combinations of two Fier-Ahmetaq and two Albania-Montenegro connection routes resulted with economic analysis in four route options:

Var. A-II: Fier - Lekaj- Ahmetaq -Montenegro Podgorica route
Var. D-II: Fier - Lekaj - Ahmetaq -Montenegro coastal route
Var. A-I: Fier-Elbasan - Ahmetaq -Montenegro Podgorica route
Var. D-I: Fier-Elbasan - Ahmetaq -Montenegro coastal route

The economic analyses have been carried out with the following presumptions:

- Investment will be carried out through three years in same yearly amounts.
- System would be financed from funds obtained on financial markets through long-term borrowing at financial institutions

The price of borrowed capital has been calculated according to the following assumed terms and conditions:

- repayment period: 15 years,
- regular interest rate: 6% per annum
- repayment in equal semi-annual instalments

The operating and maintenance costs include:

- energy costs
- gas transportation system maintenance costs

The quantity of natural gas transported is a business event resulting in an increased financial and economic potential of the project.

The projected provision of natural gas transportation services is based on the assumed gas market build up from the draft gas market forecast. The new Elbasan gas pipeline route will supply gas to the potential gas power plant in Elbasan two years earlier than it is envisaged in the case of the coastal route development. The result of that is 1,2% higher project time average gas consumption.
Gas transportation costs are optimized in a way to meet internal rate of return of 7%, the project acceptability criterion.

The planned project period of 20 years is taken as one in which the investment project produces acceptable effects.
The investment and maintenance cost per pipeline section are taken from the Preliminary technical study presented in the following tables.

Table 1 Route variant IAP Albania – pipeline costs calculation

		Investment costs			Maintenance costs		
		Pipeline length	Specific investment cost pipeline	**Investment costs pipeline**	Annual fraction of investment	Total investment costs	**Annual maintenance costs**
Section		km	€/"m	**Mio €**	-	Mio €	**Mio €/a**
1	Fier - Staravec	38.1	26.84	**32.7**	1.00%	32.7	**0.33**
2	Staravec - Ahmetaq	54.3	31.79	**55.2**	1.00%	55.2	**0.55**
3	Staravec - Ahmetaq	63.2	30.03	**60.7**	1.00%	60.7	**0.61**
4	Ahmetaq - Balldre	45	27.83	**40.1**	1.00%	40.1	**0.40**
5	Balldre - Barlaj	66.5	33.22	**70.7**	1.00%	70.7	**0.71**
6	Balldre - Shtodher	27.6	30.14	**26.6**	1.00%	26.6	**0.27**

The route sections 1 Fier – Staravec, 2 Staravec- Ahmetaq and 3 Staravec-Ahmetaq are replaced with two new Fier-Ahmetaq route options and presented in the following table.

Table 2 New Fier-Ahmetaq route variants– pipeline costs calculation

		Investment costs			Maintenance costs		
		Pipeline length	Specific investment cost pipeline	**Investment costs pipeline**	Annual fraction of investment	Total investment costs	**Annual maintenance costs**
Section		km	€/"m	**Mio €**	-	Mio €	**Mio €/a**
I	Fier - Elbasan - Ahmetaq	124	30.25	**120.0**	1.00%	120.0	**1.20**
II	Fier- Ahmetaq	88	30.36	**85.5**	1.00%	85.5	**0.85**

Note: In the above table, Fier-Ahmetaq (88 km long) means Fier-Lekaj-Ahmetaq (Section II)

4.1. Transport tariff tendency projection

Shown in continuation is the transport tariff tendency projection for the planned period over which the investment project produces economically acceptable effects.

Table 3 Transport tariff tendency projection Albania

ALB

Period of the project life	**Year**	**20**			
Acceptability criteria of the project					
Internal rate of return (IRR)	**%**	**7.00%**			
Variant		**Var. A-II**	**Var. D-II**	**Var. A-I**	**Var. D-I**
Expected volume of transported natural gas, average	**mio m3**	**3 508**	**3 502**	**3 551**	**3 551**
Changes in the volume of transported natural gas	**%**	**0.0%**	**-0.2%**	**1.2%**	**1.2%**
Investment	**mio €**	**196.3**	**152.2**	**230.8**	**186.7**
Changes in the level of investment	**%**	**0.0%**	**-22.5%**	**17.6%**	**-4.9%**
Operation and maintenance costs	**mio €**	**2.0**	**1.5**	**2.3**	**1.9**
Changes in the level operation and maintenance costs	**%**	**0.0%**	**-25.0%**	**15.0%**	**-5.0%**
Transport costs	**€cts/m3**	**0.754**	**0.585**	**0.862**	**0.699**
Changes in the level of transports tariffs	**%**	**0.0%**	**-22.5%**	**14.3%**	**-7.4%**

The Albania-Montenegro route economic optimisation issues were presented in details in the Preliminary technical study, so in this material more focus will be given to the new Elbasan route economic optimization results.

When developing pipeline route options then the criterion is that the pipeline should pass near the centre of the future consumption if that is more feasible than some other more direct route.

If we follow this criterion then route to Tirana should pass near the city of Elbasan. Nevertheless, the Section I (Fier – Elbasan – Ahmetaq) route is 34.5 million EUR more expensive than Section II (Fier – Lekaj - Ahmetaq) route.

Result of this investment difference is 14.3% higher transport tariff of the Fier – Elbasan – Ahmetaq + Montenegro Podgorica route (0.862 €cts/m^3) than the more direct Fier – Lekaj – Ahmetaq + Montenegro Podgorica route transport tariff (0.754 €cts/m^3).

The difference between Fier – Ahmetaq + Montenegro coastal route tariff (0.585 €cts/m^3) and Fier – Elbasan – Ahmetaq +Montenegro coastal route tariff (0.699 €cts/m^3) is even higher by19.5%.

If we decide on direct Fier – Lekaj - Ahmetaq route through Albania, then connection pipeline branch toward Elbasan should be developed. Tirana-Elbasan pipeline branch development cost is estimated at 19 million EUR. Even if we add this cost to the investment costs for Section II (Fier – Lekaj – Ahmetaq) the total cost is still 15.5 million EUR less than the cost of Section I (Fier – Elbasan –Ahmetaq).

Although 15.5 million EUR relative investment difference allows us to reach potential Elbasan gas power plant consummation sooner; it does not result in smaller transmission tariff.

It should be stressed out that relatively large gas consumption potential in Elbasan area predominantly rely on the expected development of the gas fired power plant. Uncertainty related to the development of this plant has additional negative impact on the already 14% to 19% higher transmission tariff of the proposed Fier-Elbasan-Ahmetaq route.

Taking all that into account the results of the economic study indicate that Section II (Fier - Lekaj - Ahmetaq) is a more favourable solution for the IAP route.

However, this recommendation should be tested with the social and environmental impacts together with the technical aspects in the Doctus evaluation presented in chapter 6 of this Annex.

5. Potential environmental and social impacts

5.1. Description of environmental and social baseline conditions

5.1.1. Project location and pipeline corridor variants

The project area is located in the Western Lowland of Albania. The sections of the proposed pipeline corridor alternatives start at Fier District, at the potential site of TAP compressor station, and continue east to Lushnja town. METE has proposed two alternative corridor sections from Fier to Rinas/Ahmetaq (NW of Tirana): Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq; and Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq.

In the environmental study, the pipeline route Fier- Grabian – Lekaj – Tirana Rians/Ahmetaq is the direct route Fier-Ahmetaq of the technical study. Rinas is often used instead of Ahmetaq, because this location (Rinas) is more known than the little village of Ahmetaq.

Table 4 Sections of the pipeline corridor variants between Fier and Ahmetaq/Rinas

Section	Description
I	Fier- Lushnja- Elbasan – Tirana- Rinas/Ahmetaq
II	Fier- Grabian-Lekaj - Tirana – Rinas/Ahmetaq

Both these pipeline route variants merge at Vaqarr Village territory (west of Tirana), from which to Rinas/Ahmetaq they runs in the same route.

The table below indicates the names of the geographical locations traversed from the proposed sections of the pipeline corridor alternatives.

Table 5 Geographical locations traversed by the proposed pipeline corridor alternatives between Fier and Rinas/Ahmetaq

Section	Section's name	Detailed description of the pipeline route
1	Fier- Lushnja-Elbasan-Tirana – Rinas/Ahmetaq	From the TAP's compressor station, which is the starting point of the IAP projet, the pipeline route goes toward the east and crosses Semani River at Mojalli village. From Mojalli to Mbrostar the line route runs over the southern part of the Ardenica hill. Starting from Mbrostar, the pipeline route continues northeast following the new highway Fier-Lushnja. From Lushnja the pipeline route runs throughout a

		narrow hilly valley at Karbunara Village territory and then traverses the hilly area of Dumrea region (Elbasan County); From the northe-astern part of Dumrea the pipeline route runs through the flat terrain of Pazhok plain and then continues toward the East alongside the Shkumbini riverbed, which is crossed at the southern part of Elbasan town; After crossing a populated area in the western part of this town, the pipeline route runs along a narrow hilly valley (the Kushe stream valley), alongside to the new highway (under construction) Elbasan-Tirana; From the upper course of Kushe stream to Krraba village (Tirana District) the pipeline route runs over the top of a hilly terrain because of two tunnels of the highway Elbasan-Tirana; From Krraba tunnel to Mullet village the pipeline runs alongside the highway Tirana-Elbasan, which, in this segment, lies entirely in the Erzeni river valley; From Mullet to Vaqarr and further on to Kashar the pipeline route runs alongside the Tirana by-pass highway (under feasibility study); From Kashar to Rinas, the pipeline route runs in flat area, parallel to the highway Tirana – Lezha.
2	Fier- Grabian-Lekaj-Tirana - Rinas	From the TAP's compressor station, which is the starting point of the IAP projet, the pipeline route goes toward the Northeast following the western foot of Ardenica hill. At Fier Seman Village territory the line route traverses the narrow valley between Ardenica and Divjaka hills. Starting from the south-eastern edge of Divjaka hills, the pipeline route continues north following the eastern side of Divjaka hills through Terbufi Field. The pipeline traverses Shkumbini River in the northern part of Terbufi Village. From Shkumbini River the pipeline runs parallel to the highway till Lekaj (Kavaja District). From Lekaj to Vaqarr and further on to Kashar (West of Tirana) the pipeline route traverses a steep hilly area, which belongs to Kavaja and Tirana Districts; From Kashar (Tirana District) to Rinas, the pipeline route runs in flat area, almost parallel to the highway Tirana – Lezha.

The indicative map below shows the above proposed pipeline route alternatives from Fier to Ahmetaq/Rinas.

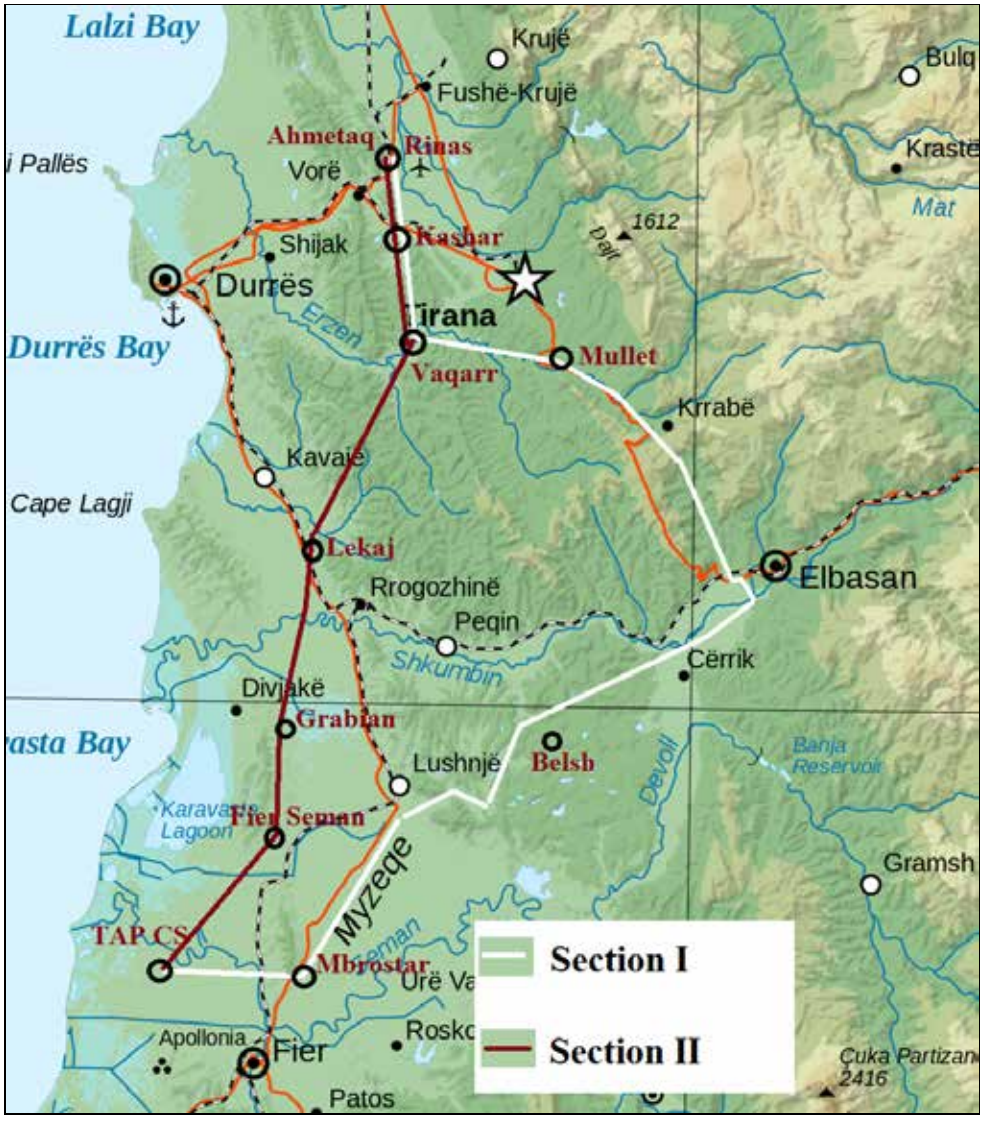


Figure 2: Proposed pipeline route alternative sections (I and II) from Fier to Tirana

To provide an improved description of the baseline environmental and socioeconomic conditions along the pipeline route, the proposed sections I and II of the pipeline corridor alternatives will be divided into segments of different lengths, which are linked to the landscape, land use, morphology of the terrain, geological settings, tectonic characteristics, ground and surface waters, soil category, geological hazards/risks, cultural heritage, etc.

The following table indicates the segments that belong to sections I and II of the proposed pipeline corridor options.

Section	*Segment*
I	TAP CS - Mbrostar
	Mbrostar – Lushnja
	Lushnja-Elbasan
	Elbasan city
	Elbasan-Mullet
	Mullet-Vaqarr-Kashar (West of Tirana)
	Kashar-Ahmetaq/Rinas
II	TAP's CS* - Fier Seman
	Fier Seman-Grabian-Shkumbini River
	Shkumbini River- Lekaj
	Lekaj- Vaqarr-Kashar (West of Tirana City)
	Kashar-Ahmetaq/Rinas

Table 6 Segments of the Sections I and II of the proposed pipeline route

5.1.2. Climatic characteristics

Based on the climatic division of the Albanian Territory, the project area is part of the Mediterranean Plain Climatic Zone. More particularly, both sections are part of the Central Mediterranean Sub-zone, which is characterized by mild and wet winters and hot and dry summers. It is important to note that the entire area of the Western Lowland of Albania is highly influenced by the Adriatic Sea. This influence can be seen by the minimum, maximum and average air temperatures.

In order to study the climatic characteristics of this particular area the long-term weather data provided by the nearby meteorological stations were collected. These meteorological stations are located in Fier, Lushnja, Kavaja, Elbasan and Tirana. The most important parameters are the yearly average temperature, the absolute maximum temperature and the absolute minimum temperature. The coldest month is January, whereas the warmest month is July. In the table below the temperatures measured at the above-mentioned meteorological stations are shown.

Table 7 Annual air temperature in the project area

Parameter	***Weather Station***				
Temperature (^{o}C)	Fier	Kavaja	Lushnja	Elbasan	Tirana
Annual average	16	14.8	15.9	15.1	15.1
Max abs.	39.5	39.8	39.7	42.2	41.5
Min. abs.	-7.0	-11.6	-8.2	-7.5	-10.4

Source: Hydro meteorological Institute, Tirana

The rainfall data are shown in the table below.

Table 8 Average yearly precipitation

	Weather station				
Rainfall mm	Fier	Kavaja	Lushnja	Elbasan	Tirana
Annual average rainfall	932	1050	980	1200	1210

Meanwhile, snowfalls are rare events in this area and are of no particular concern.
As a conclusion, the climate characteristics in the areas traversed from sections I and II of the proposed pipeline corridor, are similar.

5.1.3. Geomorphology and Geology

5.1.3.1. Overview of the geological settings

According to the geological map of Albania, the proposed pipeline corridor/sub-corridors traverse an area where outcrop en surface Quaternary, Molassic and flysch deposits, as well as limestone geological formations.

The wide study area is affected from geological hazards, which include: active tectonic faults (all the wide study area); small landslides; rock falls; erosion phenomena; and possible soil liquefaction (deposits within the wide study area).

Section 1: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

Fier-Mbrostar-Lushnja

From TAP CS to the western flank of Ardenica hill, the pipeline route runs over the clayey-silty-sandy quaternary deposits of the Fier Coastal Plain, with thickness of more than 100 m. The composition of the upper geological layers that outcrop in surface in the hilly terrain of Ardenica is made of clayey deposits of the Helmasi (N21h) geological unit, which is slightly affected from the erosion phenomena. No ground waters are expected in this hilly terrain.

From Mbrostar to Lushnja the pipeline route runs over the clayey-silty-sandy quatenary deposits of the Lushnja Plain, which thickness is between 100 and 200 m.

From Lushnja to Dumrea region (Elbasan District)

This segment of the proposed pipeline route runs throughout a hilly valley in the Karbunara Village territory. The hilly slopes are gentle. The upper geological layers that outcrop in surface in the hilly terrain are represented from clayey-sandy deposits of the Tortonian (N13t), age and from clayey-sandy-evaporite deposits of the Messinian age (N13m). Small landslides and mud flows affect the hilly slopes. It seems these geological hazards affect the top cover only, and are stimulated from the transformation of the shrubby areas in agricultural lands. No ground waters are expected in this area.

Figure 3: Left: South-North view:Small landslide in the hilly area in the eastern part of Lushnja town, within the territory of Karbunara village; Right: South-North view:Mud flow in the hilly area in the eastern part of Lushnja town, within the territory of Karbunara village

Dumrea to Elbasan

The Dumrea region, which lies mainly in Elbasan district, represents a sensitive area along the proposed pipeline corridor section Lushnja-Elbasan. It is composed by rolling hills with gentle slopes. All the 85 karstic lakes of this region lie over evaporite deposits of the Messinian age (N13m), which are composed mainly from gypsum and anhydrite layers. The evaporite deposits contain small quantities of highly solvable salts as Halite (NaCl/sodium chloride) and Sylvinite (KCl/potassium chloride). It seems that the presence of these solvable salt deposits is the main cause of the formation of the karstic lakes, as well as of numerous karstic holes and sink holes throughout the Dumrea karstic plateau.

The geological hazards are represented from the formation of karstic holes (fig. 3) and sinkholes, and from tectonic lines, which runs around the salty diapir of Dumrea region. In order to avoid as much as possible these tectonic lines, it is suggested to not pass the pipeline route along the contact surface between the clayey-sandy-evaporite deposits of the Mesinian age (N13m) and the clayey-sandy deposits of the Tortonian (N13t) age.

The top cover may also be affected from geological risks like small landslides because of the massive deforestation of this region for agricultural purposes.

Figure 4: Left: East-West view. Karstic sink hole in Dumrea region, within the territory of Gradishta village; Right: East-West view; Small landslide in the hilly area in northern part of Dumrea region, close to the proposed pipeline corridor, within the territory of Shales village

Figure 5: Norh-South view; Typical landscape in Dumrea region, in the territories of Shales and Gradishta villages. The lowest flat terrain is prone to possible creation of karstic holes because of the presence of highly solvable salt deposits

Northeast of Dumrea the pipeline route runs over the Pazhok field (Cerrik Field), which is composed of clay-silty-sandy quatenary deposits of low permeability. Their thickness is more than 10m.

Elbasan town

Within the territory of this town the pipeline route runs over quatenary clayey-silty deposits, with thickness varying from 15 to 20m.

Elbasan-Tirana

From Elbasan to Mullet (southwest of Tirana city) the terrain is rather mountainous and steep. The mountain chains, which lie mainly in a south-north direction, are formed from molassic, flysch and limestone formations. The mollasic and flysch deposits often are prone to erosion.

From Mullet to Vaqarr, where the pipeline route should follow the Tirana by-pass road (under feasibility study), the proposed pipeline route runs over the quatenary deposits of Erzeni River. While from Vaqarr to Kashar, the pipeline route traverses molassic and flysch deposits.

While from Kashar to Rinas/Ahmetaq the pipeline route runs over clayey-silty-sandy quatenary deposits.

Section 2: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

Fier-Grabian-Lekaj

From TAP CS to Fier Seman the pipeline route runs over the clayey-silty-sandy quatenary deposits of the Fier Coastal Plain, which thickness is more than 100m.

From Fier Seman to Grabian to Shkumbini River and further on to Lekaj the proposed pipeline route runs entirely in flat terrain over clayey-silty-sandy quatenary deposits that have a low water bearing capacity. The lowland is bordered from the west by the Ardenica-Divjaka-Kryevidhi hilly chain and from the east by the Lushnja-Dushku-Rrogozhina-Kavaja hills. The main geological structures, with northwest-southeast direction, are clearly outcropped on the existing relief. The upper part of the geological section in the hilly areas is represented by Pliocene (N2) and quatenary (Q) deposits.

Lekaj to Tirana

From Lekaj to Vaqarr and further on to Kashar (west of Tirana city) the terrain is rather high and steep. The hills, which lie mainly in a south-north direction, are formed from molassic and flysch formations that often are prone to erosion. Near Vaqarr Village territory (Tirana District) the proposed pipeline route runs over the quaternary gravel aquifer of Erzeni River, which has a local importance for the villages of this area.

From Kashar to Rinas/Ahmetaq the pipeline route runs over the clayey-silty-sandy quaternary deposits of the Tirana-Ishmi depression.

5.1.3.2. Tectonics and seismicity

Albania is one of the most seismically active countries in Europe (Meco & Aliai, 2000). The interaction between the Adriatic and the Albanian micro plate is the main reason for seismic activity in Albania. The study area is affected from numerous active tectonic faults. Among the ten identified earthquake source zones, the Lezha-Ulqini (LU), the Shkodra-Tropoje (ST), The Elbasan-Dibra-Tetova (EDT) and the Preadriatic Lowland (PL) ones are of importance for the project region.

According to the seismic intensity map of Albanian territory (Map of Seismic Regionalization of Albania, Scale. 1:500.000, Tirana 1980; approved by DCM no 371, of 12.20.1979), the wide project area is situated on the seismic intensity VII and VIII degree MSK-64, estimated for 100 year (with 70% probability), for an average soil category (2nd Soil Category, according to the technical condition KTP-N.2-89), while the sections 5 and 6 lies partly on IX degree. The expected maximal earthquake magnitude is Ms=7.2.

With respect to the sections I and II of the proposed pipeline route, the seismic intensity and the crossed active neo-tectonic faults, are as follows:

Section I: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq :

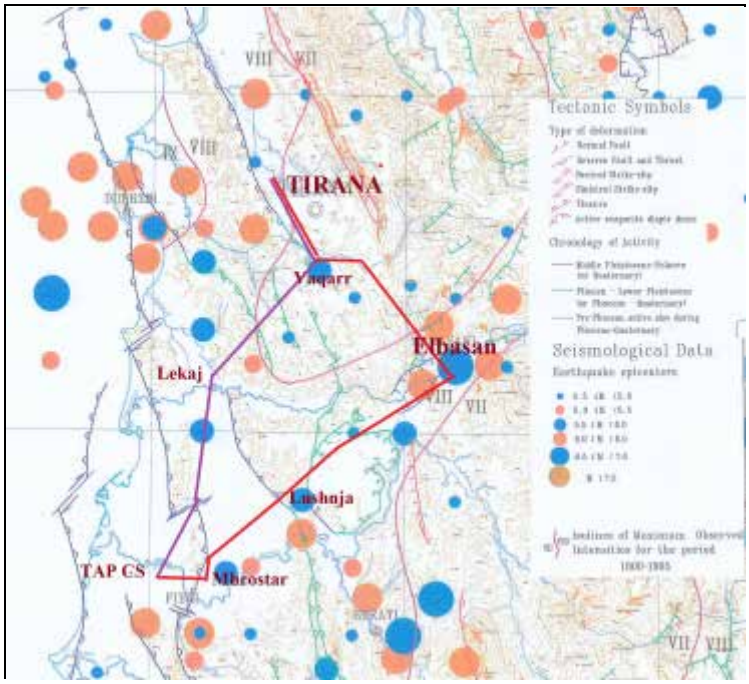
a. Seismic intensity: VII and VIII degree MSK-64; and
b. 6-7 tectonic faults crossings.

According to the Seismo tectonic map of Albania (Academy of Sciences, Seismological Institute, Tirana 2000), the earthquakes which have occurred along Section I are stronger than those which have occurred along section II

because of the important tectonic faults Vlora-Lushnja-Elbasa-Dibra-Tetove, along which runs the biggest part of the Section II of the proposed pipeline route.

Section II: Fier -Grabian-Lekaj-Tirana-Rinas/Ahmetaq :

a. Seismic intensity: VII and VIII degree MSK-64; and
b. 3-4 tectonic faults crossings.



Source: Seismotectonic map of Albania, Scale 1; 500,000 (Academy of Sciences, Seismological Institute, Tirana 2000),

Figure 6: Seismotectonic map of the project area.

5.1.4. Land Use and Settlement Patterns

5.1.4.1. Land Use

The Western Lowland of Albania, where the main part of the pipeline route is located, is distinguished by intense agricultural activities. It is also the most densely populated region of Albania, and an area of economic, touristic, and ecological value. Some of the highest land values in Albania are evident within this important region. Higher land values are encountered near the coastline and the major cities of Albania (Fier, Elbasan, Tirana).

The sections I and II of the proposed pipeline corridors pass through agricultural lands and to a lesser scale through forests, shrubs, pastures, scarce lands, and populated areas.

From Fier to Tirana, there are the following important areas of ecological, economical, or touristic values:

Section 1: Fier-Mbrostar-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

There are some areas of high economic and touristic values within this section. These are as follows:

-Karstic plateau of Dumrea, which is crossed by the pipeline route segment Lushnja-Elbasan. This plateau has high tourist values because of the presence of 85 karstic lakes and of some archaeological sites;

-Elbasan town, whose territory has high land prices because of: a- the opportunity for building individual houses and industrial objects; b-presence of cultural heritage sites/objects. This town has a favourable geographical location (in the crossroads north-south and east-west) and an existing industrial infrastructure (numerous buildings of the former Elbasan big steel factory); and

-Erzeni River Valley in the southern part of Tirana city (from Krraba to Mullet-to Vaqarr), where the price of land is high because of the opportunity to build individual houses in an area of high landscape values and of clean air.

Section 2: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

The proposed pipeline route does not cross any areas of significant ecological, economical, or touristic values in this section.

The proposed pipeline route runs through flat and hilly agricultural lands and shrubby/degraded forests areas, as well as through urban centres. The table below shows approximately the land use along the buffer area (10m wide) of the proposed pipeline route variants from Fier to Vaqarr (west of Tirana), where both these variants merge and continue towards Kashar and further on to Rinas/Ahmetaq.

Table 9 Land use along the pipeline route variants from Fier to Vaqarr

Section		Agricultural land			Shrubs & degraded forests (ha)	Inhabited areas (ha)	Total land required (ha)
		Flat agr. land (ha)	Hilly agr. land (ha)	Total. agr. land (ha)			
1	Fier-Lushnja-Elbasan-Vaqarr	45.5	46.5	92.0	16.2	1.8	110.0
2	Fier-Grabian-Lekas-Vaqarr	51.7	9.8	61.5	12.2	-	74.0

While the land use along the segment Vaqarr- Rinas/Ahmetaq (approximately 14 km long) that is common for both pipeline route alternatives, is shown in the table below:

Table 10 Land use along the common segment (Vaqarr-Rinas/Ahmetaq) for both pipeline route variants

Segment	Agricultural land			Shrubs & degraded forests (ha)	Inhabited areas (ha)	Total land required (ha)
Vaqarr-Rinas/Ahmetaq	Flat agr. Land (ha)	Hilly agr. Land (ha)	Total. agr. land (ha)			
	7.7	2.3	10.0	4.0	-	14.0

The results of the Table 9 and Table 10 lead to the table Table 11, which shows the land use along the sections Fier-Lekaj-Tirana-Rinas/Ahmetaq and Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq.

Table 11 Land use along the pipeline route variants from Fier to Rinas/Ahmetaq

Section		Agricultural land			Shrubs & degraded forests (ha)	Inhabited areas (ha)	Total land required (ha)
		Flat agr. land (ha)	Hilly agr. land (ha)	Total. agr. land (ha)			
1	Fier-Lushnja-Elbasan-Vaqarr-Rinas/Ahmetaq	53.2	48.8	102.0	20.2	1.8	124.0
2	Fier-Grabian-Lekas-Vaqarr-Rinas/Ahmetaq	59.4	12.1	71.5	16.2	-	88.0

5.1.4.2. Settlement Patterns in the Project Area

The proposed pipeline sections I and II passes through the territories of five Albanian districts (Fier, Lushnja, Kavaja, Tirana and Elbasan). Within the above districts, the line route passes through or in vicinity of some cities (Lushnja, Elbasan and Tirana).

Table 12 Affected districts and respective population in 2009, Albania

No	***Province (county)***	***Districts affected***	***Population***		
			Urban	***Rural***	***Total***
1	Fier	Lushnja	37,445	105,805	143,250
2		Fier	76,925	122,479	199,404
3	Tirana	Tirana	550,670	166,621	717,291
4		Kavaje	37,980	44,926	82,906
5	Elbasan	Elbasan	154,435	124,013	278,448
	Total Albania		1,573,431	1,620,986	3,194,417

Source: Institute of Statistic, Tirana

The intense growth of the informal settlements during the last 20 years, has led to a drastic increase of the urban population. Within the proposed pipeline corridor variants, the informal settlements have been developed overall nearby the towns of Elbasan (section 1) and Tirana (section 1).

With respect to sections I and II of the proposed pipeline route, the populated area affected adversely and directly from the construction activities are as follows:

Section 1: (Fier-Lushnja-Elbasan-Tirana--Rinas/Ahmetaq

Along this section, the proposed pipeline route traverses the following populated areas:

The city of Elbasan (154,435 inhabitants); and
The southern neighbouring of Tirana (Mullet area), where the new constructions are growing quickly.

Section 2: (Fier-Grabian-Lekaj-Tirana- -Rinas/Ahmetaq

From TAP CS to Tirana to Rinas there is no any important settlement traversed from the proposed pipeline route.

5.1.5. Socioeconomic baseline

The population in the Albanian part of the project area is distributed widely over the entire region's territory. The region of the Western Plains of Albania is rich in natural resources such as fertile plains, wetlands, water resources, beaches etc. Between the period of 1989 to 2012, the population of this area

had the highest growth rate in the country. This growth was mainly due to migration of population into this region because of its favourable conditions such as geographical position, climate, soil quality, employment possibilities, better infrastructure network (roads, railways, power and electricity supply, etc.)

Meanwhile, during the same period, the population in the rural areas has decreased due to the high rate of internal migration from the mountainous regions towards the urban areas, coastal areas, and good agricultural lands. Thus, within the Albanian part of the project area, the population of the towns and cities of the Western Plains has increased drastically.

The highest migration rates towards other countries (Italy, Germany, USA, Greece, etc.) are recorded in the coastal urban centres (Fier, Durres, Tirana, Lezha, Shkodra, Koplik, etc.) and some rural communes.

The unemployment rate is comparatively lower than other regions of Albania, but it is relatively high compared to other countries. This is an indication of the high level of poverty in the greater part of the project region, especially within the rural areas, which is also due to the small quantity of the agricultural land per capita.

During the last decades, a notable improvement of the national and rural road infrastructure has been recorded. Additional improvements have been recorded on other facilities like Durres and Shengjini ports and; drainage and irrigation networks; educational and health infrastructure and services; power and drinking water supply infrastructure and services; tourist infrastructure and services; creation of small and medium industrial, agricultural, artisanal, and service enterprises; etc. Thus, the local population of the project area and the central and local state institutions are making considerable efforts to improve the economic and social indicators, and consequently lower the unemployment and poverty rate.

The project region between Fier and Tirana also has valuable cultural resources and tourist attractions. Among the natural resources are Divjaka Pine Forest (National Park and proposed Emerald site), and Karavasta Lagoon (Ramsa site and proposed emerald site). In the karstic Plateau of Dumrea there ara approximately 85 big and small karstic lakes. This Plateau, composed of rolling hills, has special landscape and tourist values. Meanwhile, riparian forests surround the Semani, Shkumbini and riverbeds. Lastly, there are numerous protected areas that are distinguished in a national and regional scale as IPAs (Important plant area) and IBAs (Important Bird Area).

Among the cultural resources of the project area are many castles dated from Illyrian to medieval periods. Meanwhile, in the territories of Elbasan and Fier counties, there are a great number of archaeological sites and objects.

Some of the most environmentally and socioeconomic valuable sites within the proposed pipeline corridor are:

Section I (Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq)

Along this section, the proposed pipeline route traverses some sites of significant environmental and socioeconomic values. These are as follows:

-the Karstic Plateau of Dumrea (segment from Lushnja to Elbasan), which has approximately 85 big and small karstic lakes and some archaeological sites, and consists of special tourist values;

-the territory of Elbasan town, where the pipeline route traverses numerous settlements, as well as infrastructure areas/objects such as railways, power cables, industrial objects, etc. The underground areas of this town are also very rich in archaeological heritage; and

-The southern neighbouring of Tirana city, from Krraba to Mullet to Vaqarr where new constructions are growing quickly because of: a-the construction of the new road network; b-the construction of the big trade centers (Carrefour, etc) and recreational objects; and c- the construction of new dwelling centers in the beautiful landscape and far from the polluted and noisiest city of Tirana.

Section II (Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq):

Along this section, the proposed pipeline route does not cross any site of significant socioeconomic value.

From TAP CS to Lekaj, the proposed pipeline route runs through flat agricultural lands, while from Lekaj to Vaqarr (West of Tirana) through shrubs, degraded oak forests, scarce lands and some small parcels of hilly agricultural lands.

The Divjaka Pine Forest (National Park and proposed Emerald site) and Karavasta Lagoon (Ramsar site and proposed emerald site) are located more than 5 km far from the proposed pipeline route (segment TAP CS – Grabian).

5.1.6. Water Resources and quality

The whole project area lies in the Western Lowland of Albania, which is traversed from all the most important Albanian rivers, which run over and through the most important Quaternary gravel aquifers of the country. These aquifers serve to supply with drinking water the majority of the principal Albanian urban centres that are located mainly within the Western Lowland of the country.

5.1.6.1. Ground waters

Section 1: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

From TAP CS to Mbrostar to the western flank of Ardenica hills the proposed pipeline route does not run over any aquifer. The water bearing of the

traversed Quaternary deposits (mainly clays, silts, and sands) is low and without any practical importance for the local population. The ground waters of these clayey-silty-sandy deposits are of bad quality. The villages located in the northern part of this plain are supplied with drinking water from water pipelines, which are supplied from the hydrological wells drilled in the molassic geological formations located within the Radostina village territory, which lies in the hilly area situated in the east of the above-mentioned coastal plain

Across the Ardenica hill, which is traversed by the pipeline route, the composition of the upper geological layers that outcrop in surface is made of clayey deposits of the Helmasi (N_2^1h) geological unit (fig. 3), which is slightly affected from the erosion phenomena. No ground waters are expected in this hilly terrain.

From Mbrostar to Lushnja, the proposed line route runs over the southern part of the important aquifer of Lushnja, which water bearing layers are composed of gravels and sands. Along this pipeline route segment the thickness of the impermeable clayey-silty cover, which overlies the Southern edge of Lushnja aquifer, is more than 100 m thick. Thus, this aquifer in this area may not be affected from the project activities.

The segment from Lushnja to the eastern edge of Dumrea karstic plateau runs over geological formations without waterbearing capacity and permeability.

At Pazhoku field and throughout Elbasan town the proposed pipeline route runs over the Shkumbini quaternary gravel aquifer, which is one of the most important in national scale. The thickness of the clayey-silty cover in Pazhok field is more than 10m.

Further investigations are necessary to know the recharge areas of this aquifer, in order to not pollute the ground waters during construction activities.

From Elbasan to Mullet the pipeline route runs over molassic and flysch formations, which has a low water bearing capacity. In the southern part of Mullet, at Iba village territory, the highway under construction runs in the Erzeni riverbed. Since the pipeline should run along this highway, it a risk for groundwaters pollution because this segment of the Erzeni riverbed is a recharge area.

From Mullet to Vaqarr the proposed pipeline route should follow the Tirana by-pass road, which lies over the quatenary Gravel aquifer of Erzeni River. This aquifer has only a local importance, but still it remains the risk of groundwater pollution at the river crossings.

From Vaqarr to Kashar (West of Tirana), the geological deposits have a low water bearing capacity, while from Kashar to Rinas/Ahmetaq the proposed line route runs over the south-western part of the important quatenary gravel aquifer of Tirana-Ishmi.

Conclusion: Along the section 1, the pipeline route runs over the following quatenary gravel aquifers:
-the Lushnja Aquifer (important in national level);
-the Elbasani Aquifer (important in national level);
-the Erzeni River Aquifer (important in local level); and
-the Tirana-Ishmi Aquifer (important in national level).

Section 2: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

Segment TAP CS – Fier Seman Village

In the Coastal Plain located in the western part of Ardenica hills the proposed pipeline route does not run over any aquifer. The water bearing of the traversed quatenary deposits (mainly clays, silts, and sands) is low and without any practical importance for the local population. The ground waters of these clayey-silty-sandy deposits are of bad quality. The villages, which territories should be traversed by the proposed pipeline route are supplied in drinking water from water pipelines that are supplied from the hydrological wells drilled in the molassic geological formations located within the Radostina village territory, which lies in the hilly area situated in the east of the above-mentioned coastal plain

Segment Fier Seman-Grabian-Shkumbini River

From Lushnja to Shkumbini River the proposed line route runs over the eastern edge of the Lushnja aquifer, which is classified among the seven most important quaternary gravel aquifers of Albania. The thickness of the gravel layer that comprises this aquifer generally ranges from 7 to 25 m; in some locations near the Shkumbin River, its thickness is more than 35 m. The overlying quatenary (Q) deposits, which consist mostly of clayey-silty-sandy sediments, have a thickness from 30 m in the north to 200 m in the south.

Segment Shkumbini River – Lekaj

From Shkumbini River to Lekaj (hilly foot of Rrogozhina-Kavaja hills) the proposed line route runs over quatenary sediments composed mainly of clays, silts, and sands that have a low water bearing capacity.

Segment Lekaj-Tirana

From Lekaj to Kashar (West of Tirana), the proposed pipeline route runs over molassic and flysch deposits, which have a low water bearing capacity and permeability. This segment does not represent- any importance from the ground waters standpoint.
From Kashar to Rinas the pipeline route runs over the Tirana-Ishmi quatenary gravel aquifer, which is important in national level.

Conclusion: Along the section 1, the pipeline route runs over the following quatenary gravel aquifers:
-the Lushnja Aquifer (important in national level);

-the Erzeni River Aquifer (important in local level); and
-the Tirana-Ishmi Aquifer (important in national level).

5.1.6.2. Surface waters

Section I: Fier-Lushnja-Elbasani-Tirana-Rinas/Ahmetaq

This section of the pipeline route traverses three important rivers (more than 8 crossings), as follows:
-Semani River: Crossed once at the territory of Mujalli Village, west of Ardenica hill;
-Shkumbini River: One crossing at the southern part of Elbasan city; and
-Erzeni: more than 6 crossings at Ibe (1-2 crossings), Berzhite (1 crossings), Petrele (1 crossing) and Vaqarr (3 crossings) villages territories.

In addition, in the territory of Berzhita commune (Tirana District) the new highway Elbasan-Tirana, alongside which the pipeline route lies, runs alongside and joint to the Erzeni River.

Figure 7: The new highway Elbasan-Tirana (under construction) at Berzhita Village territory (Tirana District) and the Erzeni River. At this location, the highway runs between the river and a hilly steep terrain.

Section II: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

From TAP CS to Tirana, the pipeline route traverses three important Rivers, as follows:

-Semani River (between TAP CS and Grabian);
-Shkumbini River (in the segment Grabian-Lekaj, close to Rrogozhina Bridge);
-Erzeni River (in the territory of Vaqarr Village).

This section of the pipeline route traverses three important rivers (3 crossings): Semani (near TAP CS), Semani (near Rrogozhina Bridge) and Erzeni (near Vaqarr Village).

5.1.7. Biological environment

5.1.7.1. Biodiversity

General overview

Within the project area the landscape consists of flat lands covered from agricultural lands and inhabited areas and of hills covered by Macchia, degraded forests dominated by mixed deciduous oak, and partly covered by olive trees and almost totally in urban and suburban areas, arable land and many other more or less transformed areas used mainly for crops, vineyards and other fruit trees. The study area is characterized by numerous drainage and irrigation channels. The Semani, Shkumbini and Erzeni Rivers are the sites of the riparian vegetation of the region.

Biodiversity along the sections of the proposed pipeline corridors

The following sections provide a short description of the main vegetation types and habitats occurring along the proposed pipeline corridors, listing key species, abundance and distribution within the study area and its sensitivity.

Section I: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

Fier-Mbrostar

From Fier to Mbrostar, the pipeline route runs in a west-east direction. The terrain is flat and lies west of Ardenica hills. The pipeline route traverses also the Ardenica hills. Olive groves and agricultural lands are one of the most typical landscape units of the area. Patches or small areas of the riparian vegetation can be found following the River crossings of Semani River. This very open vegetation, colonizing poorly stabilized alluvial deposits periodically flooded, is characterized by dominance of the Salix alba, Alnus glutinosa, Platanus orientalis,etc.

Mbrostar-Lushnja

From Mbrostar to Lushnja, the proposed sub corridor passes in flat terrain. Arable lands and their associated irrigation systems constitute the majority of the habitats present within the study area. The most important crops cultivated in these areas are Corn, Barley and Alfa-Alfa. Horticulture in the study area is mostly presented by olive trees, vineyards and other fruit trees.

Lushnja to Cerrik Field (Pazhok field)

From Lushnja to Cerriku field the pipeline route traverses the rolling hills of Lushnja and Dumrea. Olive groves and agricultural lands are one of the most typical landscape units of the area. Forest formations dominated by a mix of deciduous oak species including Quercus pubescens, Quercus cerris and Quercus frainetto are found across small parts of the study area in the hilly areas. Besides Carpinus orientalis forms patches of almost pure forest throughout the area. This shrubby formation represents degraded stage of

former forests mainly dominated by Quercus cerris, associated by Quercus pubescens or Quercus frainetto. They generally represent degraded forest treated as coppice, used by the local population for fire wood and for grazing and branch cutting for livestock food basis during the winter.

Natural eutrophic lakes are found in different parts of area. These lakes are characterized by common plant species typical of the fresh water habitats. Most of the species recorded such as Phragmites australis, Typha angustifolia, Juncus bulbosus, Eleocharis acicularis, Cyperus fuscus, C. flavescens, Scirpus setaceus, Salix alba, Tamarix parviflora etc, are relatively frequent in wetland habitats elsewhere. Although wetland itself is of high ecological interest, these lakes occurring in the Transmission line area are of little botanical interest. They are considered to be common on both a local and national scale.

The Cerriku field (Pazhoku field).
Arable lands and their associated irrigation systems constitute the majority of the habitats present within the Pazhoku field. The most important crops cultivated in these areas are Corn, Barley and Alfa- alfa. Horticulture in the study area is mostly presented by olive trees, vineyards and other fruit trees. Weeds are a common element or constitutes in a different scale vegetation of these cultivated areas.

Patches or small areas of the riparian vegetation can be found following the River crossings of Shkumbini River in southern part of Elbasani city. This very open vegetation, colonizing poorly stabilized alluvial deposits periodically flooded, is characterized by dominance of the Salix alba, Alnus glutinosa, Platanus orientalis,etc.

In general the value of habitats encountered within the pipeline area from Fier to Elbasan is Low. The vegetation is dominated by common plant species, with low plant species diversity, low value and the absence of species that are considered to be rare in a local or national context.

Elbasan to Krraba tunnel
From Elbasan to the northern entrance of Krraba tunnel (under construction) the pipeline route runs mainly along the narrow hilly valley of Kushe stream, which traverses a steep mountainous terrain. Patches or narrow belts of riparian vegetation dominated by Tamarix parviflora, Salix alba, Alnus glutinosa, Platanus orientalis,etc. can be found following the Kushe stream. This very sparse vegetation periodically flooded is poor in species and reaches its optimum development during the summer. Macchie and forest formations dominated by a mix of deciduous oak species very degraded are found across small parts in this hilly area. Actually these formations, mostly in vicinity of the villages have a strong human impact: cuttings, intensive grazing, and deforestations in some places with aim to profit arable land for cultivation of agricultural plants. Beside the above damages another factor with very big impact for these zones is caused by the erosion of the land.

The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Krraba tunnel to Mullet
From the northern entrance of Krraba tunnel to Mullet, the proposed pipeline route runs along the Erzeni River, parallel to the new highway.

Macchie or maquis is found fragmentary in the hilly areas of the pipeline route from Krraba tunnel to Mullet village. The Macchie is representing a stage of degraded evergreen Mediterranean forest or old forests of Quercus ilex. Climax formation or old forests of Quercus ilex, is almost fully extinct in this area. The most important species who give the physiognomy to this formation are the evergreen shrubs such as Arbutus unedo, Phillyrea angustifolia, Erica arborea,etc.

Forest formations dominated by a mix of deciduous oak species including Quercus pubescens, Quercus cerris and Quercus frainetto are found across small parts of the hills in the study area.

The Erzeni River is the site of the riparian vegetation characterized by dominance of the Salix alba, Alnus glutinosa, Platanus orientalis, Tamarix parviflora.

Actually, these habitat types, especially in vicinity of the villages have a strong human impact: cuttings, intensive grazing, and deforestations in some places with aim to profit arable land for cultivation of agricultural plants. In Albania, this type of vegetation has broader extent. The value of the vegetation and habitats encountered within the site is generally low.

From Mullet to Vaqarr to Kashar
Arable lands and their associated irrigation systems constitute the majority of the habitats from Mullet to Vaqarr. The most important crops cultivated in these areas are Corn, Barley and Alfa-alfa. Horticulture in the study area is mostly presented by olive trees, vineyards and other fruit trees. Weeds are a common element or constitutes in differ scale vegetation of these cultivated areas. In general the value of these habitats encountered within the pipeline area is low. The vegetation is dominated by common plant species typical of cultivated lands, with low plant species diversity and low value.

Patches and narrow belts of the riparian vegetation can be found following the Erzeni River. This very sparse vegetation periodically flooded is poor in species and reaches its optimum development during the summer. Tamarix parviflora formation accompanied by the species Salix alba, Alnus glutinosa, Phragmites australis, Typha latifolia, Lythrum salicaria, Mentha aquatica, Populus nigra, Populus alba, Dittrichia viscosa dominates the area.

The formations of degraded macchia, give the dominant aspect and cover of the hilly areas. But generally this type of vegetation is very damaged by exploitation. The value of the vegetation and habitats encountered within the

site is generally low, due to the absence of species that are considered to be rare or threatened in a local or national context.

From Kashar to Rinas/Ahmetaq the pipeline route traverses mainly mixed mosaic agricultural areas, which represent insignificant biological values.

Section II: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

TAP CS to Grabian
From Fier (TAP CS) to Grabian, the pipeline route runs in a south-north direction. The terrain is flat and lies west of the hilly ranges of Ardenica. This route passes through two types of habitats including:

Mixed mosaic and recently abandoned agricultural areas; and
River habitat (running water at Semani riverbed).

Grabian to Lekaj
From Grabian to Lekaj, the pipeline runs totally through the flat agricultural lands. The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

The botanical value of the areas from Fier to Lekaj are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Lekaj to Vaqarr to Kashar
From Lekaj (Kavaja District) towards Tirana, the pipeline route traverses a hilly and steep terrain. Macchie and Forest formations dominated by a mix of deciduous oak species are found across small parts in this hilly area. Actually these formations, mostly in vicinity of the villages have a strong human impact: cuttings, intensive grazing, and deforestations in some places with aim to profit arable land for cultivation of agricultural plants. Beside the above damages another factor with very big impact for these zones is caused by the erosion of the land.

The route passes through several types of habitats including:

Degraded forest formations dominated by a mix of deciduous oak species;
Maccchie on hilly ranges between Tirana and Lekaj;
Mixed mosaic and recently abandoned agricultural areas; and
Stream/river habitat (running water).

The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Conclusion

Within the area of the pipe route, no protected area and endemic, rare or endangered species were identified. Habitats were in general of low importance from a nature conservation perspective.

5.1.7.2. Natural heritage and protected areas

The nearest protected areas to the proposed pipeline route are given in the following table:

Table 13 Existing Protected Areas in the Fier-Tirana Pipeline Project area

Name of the Protected area	Category of Protection (Albanian Law on Protected areas)	IUCN Category	International importance	District	Distance from the proposed pipeline route
Divjake-Karavasta	NationalPark;category II	II	Ramsar Site	Lushnja	5-6 km
Seferan Lake	Nature Monument (NM); category IV	IV	-	Elbasan	2 km
Dega Lake	Nature Monument (NM); category IV	IV	-	Elbasan	2.5 km

Source: MoEFWA, 2012

From the above table it is noted that the proposed pipeline route goes far from any area of conservation concern already part of the network of Protected Areas. Thus no adverse impact of the project activities upon these areas is expected.

Figure 8: Indicative Map of Protected areas in the project region and the proposed pipeline route alternatives between Fier and Tirana (Source: MoEFWA, 2012)

5.1.7.3. Emerald Network in the Study Area

In 2008, in the framework of the Emerald Network development, 25 potential sites have been identified for inclusion in the Emerald Network in Albania (Council of Europe 2009). The list of proposed sites includes some sites within the wide study area, which are listed in the table below.

Table 14 Proposed Emerald Sites in Project area

No	***Emerald Sites in Albania***	***Site Code***
1	Divjaka Pine National Park	AL0000002
2	Shkodra lake Managed Nature Reserve (Albanian part)	AL0000009
3	Karavasta (proposed National Park)	AL0000016
4	Shengjin-Ishem (proposed Managed Nature Reserve)	AL0000017
5	Buna River-Velipoja Protected Landscape	AL0000021
6	Rrushkulli-Ishem Managed Nature Reserve (proposed)	AL0000024
7	Berzane Managed Nature Reserve	AL0000025

Among the proposed emerald sites, the nearest to the pipeline route are the Divjaka Pine National Park (AL0000002) and the Divjaka pine forest and the proposed national park of Karavasta (AL00000016). The Karavasta Lagoon is located approximately 5.5 km far from the pipeline route (segment TAP CS – Fier Seman), whilst Divjaka Pine National park is more than 6 km far from the pipeline route in the segment Grabian-Shkumbini River. Thus, none of the proposed emerald sites are affected from the proposed project activities.

5.1.8. Landscape and Visual Issues

Section I: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

Coastal plain between TAP's Compressor station and Mbrostar (Segment TAP-Mbrostar)

The IAP pipeline should join the Trans Adriatic Pipeline (TAP) in the coastal plain located between the Ardenica hills (in the east) and the Adriatic Sea (in the west), as well as between the river mouths of Vjosa (in the south) and Semani (in the north). This plain is represented by a flat terrain covered from agricultural lands. The Ardenica and Libofsha hilly chain, which is avoided by the pipeline route, lies in a south-north direction, in the middle of a flat agricultural terrain. The hills are covered mainly with olive trees, arable lands, and in a smaller scale with pine trees.

Figure 9: East-West view; Coastal plain between the Ardenica hill and the Adriatic Sea

Mbrostar-Lushnja

The section Lushnja-Mbrostar runs in a flat terrain, through arable lands along the Lushnja-Fier highway. The clayey-silty cover, which overlies the southern part of the Lushnja aquifer, seems to be thick. On both sides of the highway there are a number of small businesses (gas stations, bar-restaurants, etc.)

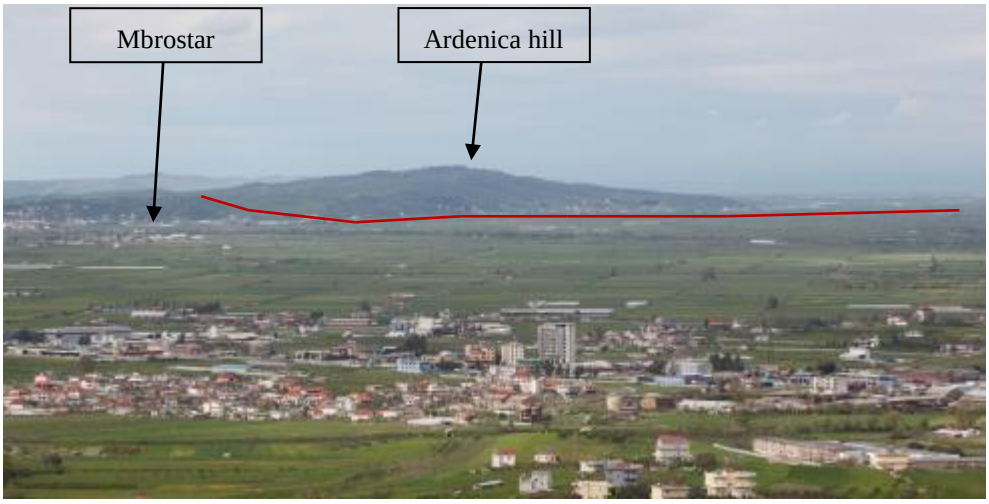


Figure 10: SE-NW view of the area between Lushnja town and Mbrostar (administrative border Lushnja/Fier districts)

Lushnja-Elbasan

From Lushnja, the proposed pipeline route runs along a narrow hilly Valley in the territory of Karbunara Village. The landscape is characterised by a rolling hilly terrain covered mainly by agricultural lands. The hilly slopes are gentle. Small landslides and mud flows affect the hilly slopes.

Figure 11: East-West view; Landscape in the Karbunara Village territory

From the northeastern part of Karbunara Village to Shkumbini River, the pipeline route traverses the Dumrea region (Elbasan District)

The Dumrea region, which lies mainly in Elbasan district, represents a sensitive area along the proposed pipeline corridor segment Lushnja-Elbasan. It is composed by rolling hills, covered mainly by agricultural lands, and in a lesser scale from shrubs.

There are approximately 85 small and big karstic lakes within Dumrea region (Elbasan County). Approximately 20 of them do not have water in the summer time. All these lakes, which are of natural origin, do not communicate with each-other. The proposed pipeline corridor section Lushnja-Elbasan runs along the northern part of Dumrea region, avoiding the most important karstic lakes.

Figure 12: East-West view; The western part of Dumrea region viewed from Gradishta hill.

Figure 13: South-North; The Northern part of Dumrea region viewed from Gradishta hill.

From the north eastern part of Dumrea, the pipeline route runs through aricultural lands towards the flat terrain of Pazhok field (Cerrik field) and then continues toward the North-East alongside the Shkumbini riverbed, which crosses at the southern part of Elbasan town.

Figure 14: SW-NE view; Pazhoku field (called also Cerrik Field)

Figure 15: SE-NW view; Shkumbini River close to the crossing point, southeast of the steel plant.

Elbasan town

From Shkumbini River to the north of Elbasan town, the pipeline route runs across the flat and densely populated area of Elbasan town. The landscape is dominated by individual houses, industrial objects (steel factory, power stations, etc.) and by transport infrastructure (roads, railway, etc.).

Figure 16: Northwestern-Southeastern view; Overview of the proposed pipeline route within the territory of Elbasan town

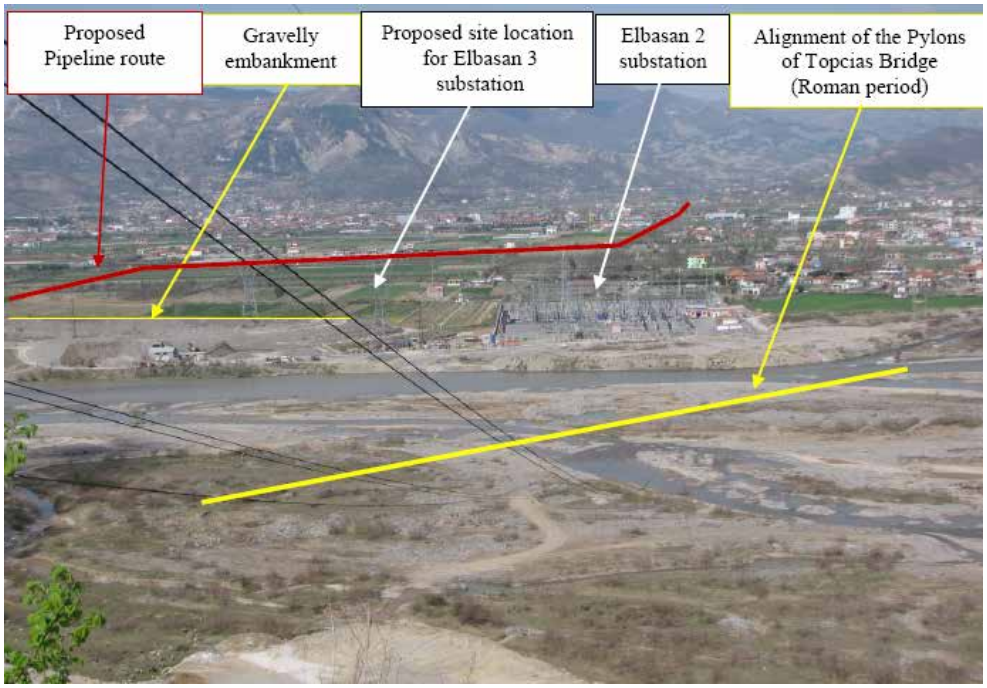


Figure 17: South-North view: Proposed pipeline route and landscape in the southern part of Elbasan

Elbasan-Mullet (Tirana district)
In the north-western part of Elbasan, the pipeline route runs along a narrow hilly valley (the Kushe stream valley), alongside the new highway (under construction). From the upper course of Kushe stream to Krraba village the pipeline route runs over the top of a hilly terrain because of two tunnels of the highway Elbasan-Tirana; From Krraba tunnel to Mullet village the pipeline runs alongside the highway Tirana-Elbasan, which, in this segment, lies entirely in the Erzeni river valley.

On both sides of the pipeline route the terrain is hilly and very steep and heavily affected from erosion and small landslides. The hilly relief is transversally interrupted by a series of small stream valleys. There are a few agricultural lands spread in the hilly area. The main part of the landcover is represented by shrubs, degraded oak forests and scarce lands. From Elbasan to Krraba Village territory (Tirana District) the inhabited areas are represented by rare and very small villages. From Krraba to Mullet the main watercourse is the Erzeni River, alongside which runs the new Elbasan-Tirana highway (under construction). It can be stressed that the Erzeni riverbed in this segment is rich in riparian forests and consequently represents special landscape value.

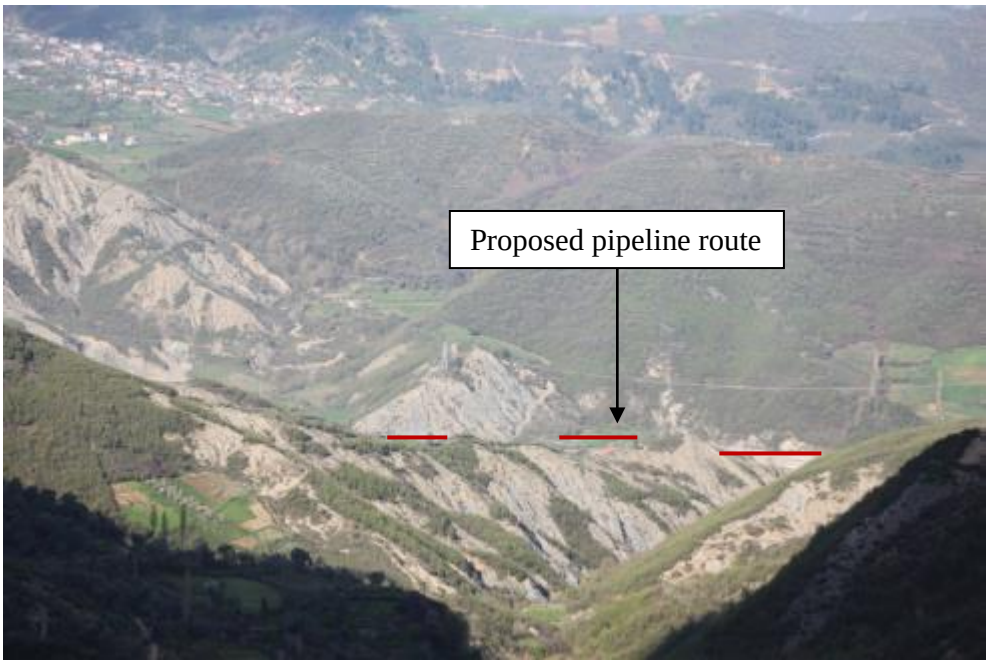


Figure 18: West-East view; Typical landscape in the segment Elbasan-Tirana; The proposed pipeline route runs alongside the new highway Elbasan-Tirana (under construction), which traverses the narrow valley of Kushe stream

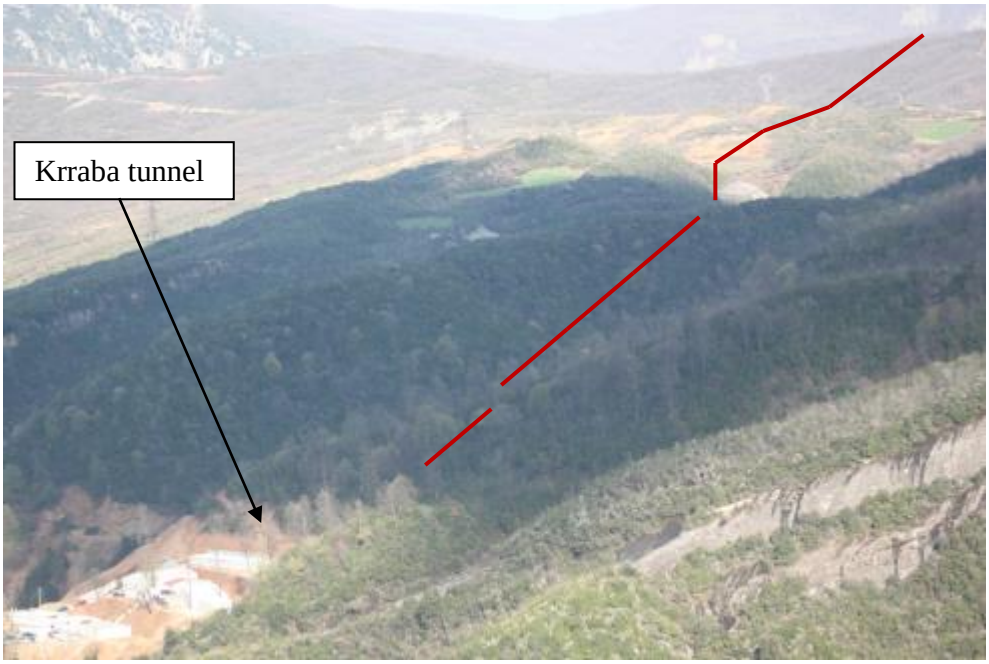


Figure 19: Potential pipeline route at Krraba tunnel. At this place the new highway traverses 2 tunnels. Consequently the pipeline route runs on the top of a mountainous terrain composed of hard rocks (mainly sandstones).

Mullet-Vaqarr-Kashar

From Mullet to Vaqarr and further on to Kashar the pipeline route runs alongside the Tirana by-pass highway (under feasibility study), which should follow the Erzeni River valley. The landscape is dominated by this river valley, which is bordered from the south and the north by hilly chains

Figure 20: SE_NW view; Eastern part of Mullet-Vaqarr area viewed from Petrela castle. The Tirana by-pass, along which the pipeline route runs next to the Erzeni River valley.

Kashar-Rinas/Ahmetaq
From Kashar to Rinas/Ahmetaq the landscape is dominated by agricultural lands and individual houses spread in the lowland on both sides of Tirana-Durres highway.

Section II: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

Coastal plain between TAP's Compressor station and Fier Seman village (Segment TAP CS-Fier Seman)

The IAP pipeline should join the Trans Adriatic Pipeline (TAP) in the coastal plain located between the Ardenica hills (in the east) and the Adriatic Sea, as well as between the river mouths of Vjosa (in the south) and Semani (in the north). This plain is represented by a flat terrain covered from agricultural lands. The Ardenica and Libofsha hilly chain, which is avoided by the pipeline route, lies in a south-north direction, in the middle of a flat agricultural terrain. The hills are covered mainly with olive trees, arable lands, and in a smaller scale with pine trees.

Figure 21: SW-NE view; Coastal plain between the Ardenica hills and the Adriatic Sea

Fier Seman-Grabian-Shkumbini River

The segment Fier Seman-Grabian-Shkumbini River runs in a flat terrain, through arable lands along the Lushnja-Fier highway. The clayey-silty cover, which overlies the central and northern part of the Lushnja aquifer, seems to be thick.

This segment runs entirely through flat agricultural lands in the Terbufi Plain, which is bordered from the west by the Ardenica-Divjaka hilly chain and from the east by the Lushnja-Dushku-Rrogozhina hills. The pipeline route crosses the Shkumbini River close to the Rrogozhina Bridge, where the riverbed does not have any special landscape value due to the lack of riparian forests.

Figure 22: East-West view; Typical landscape in the segment Fier Seman-Grabian-Shkumbini River viewed from Dushku Village hills.

Shkumbini River - Lekaj

This segment, which runs almost parallel to the highway Lushnja-Kavaja, traverses the flat agricultural terrain of Kavaja field. In proximity to Gosa Village (Kavaja District) and on both sides of the highway, there are a number of small businesses (gas stations, bar-restaurants, etc.).

Figure 23: East-West view; Landscape in the western part of Lekaj

Lekaj-Kashar (west of Tirana)

From Lekaj to the western part of Tirana City, the pipeline route traverses a hilly and steep terrain, which is heavily affected from erosion and small landslides (fig. 2). The hilly relief is transversally interrupted by a series of small stream valleys. There are a few agricultural lands dispersed in the hilly area. The main part of the land cover is represented by shrubs, degraded oak forests and scarce lands. The inhabited areas are represented by rare and small villages. The main watercourse in this area is the Erzeni River, which is traversed by the proposed pipeline route in the Vaqarr Village territory. It can be stressed that this riverbed in this area does not represents any special landscape value.

Figure 24: East-West view of the Lekaj-Tirana hilly area, viewed from the Ramushi Mountain Pass.

Figure 25: NE-SW view; Typical landscape at the southern part of Kashar area. The hills lie mainly in a south-north direction.

Kashar-Rinas/Ahmetaq
From Kashar to Rinas/Ahmetaq the landscape is dominated by agricultural lands and individual houses spread in the lowland both sides of Tirana-Durres highway.

5.1.9. Air Quality and Existing Emissions Load

Even though there are no data to monitor the air quality in the rural parts of the project area, it is believed that the air quality, including the suspended particulate matters, is within the acceptable parameters set by the Albanian legislation. The data from air monitoring during 2010 (SoER, MoEFWA, Tirana, 2012) show that typical air polluting substances like SO_2 and NO_x are at acceptable levels (DCM. No. 803, of December 04, 2003; "On air quality standards").

Meanwhile the suspended particulate matters, in the cities of Fier, Elbasan, and Tirana are above the acceptable limits. The main reasons for high particulate matters in these cities are vehicular traffic, poor quality of roads, environmentally non-compliant construction activities, and low quality of vehicular fuels (particularly that of diesel fuel, which is the most common vehicular fuel in this country).

In recent years, the air quality with regard to suspended particulate matters and PM_{10} has improved. This improvement is a consequence of increased quality of the road infrastructure, which has brought down the dust levels. Nevertheless, there is still concern about the levels of the pollutants in the air as long as they are above the allowed standards.

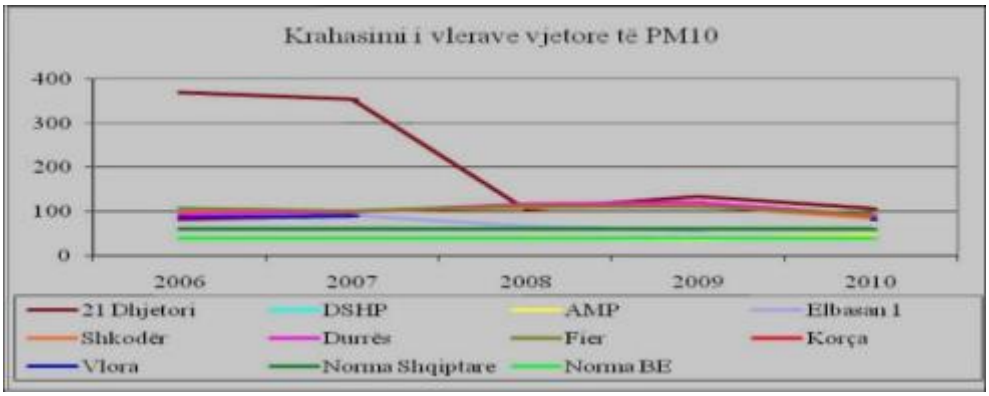


Figure 26: Data on PM10 from 2006 to 2010 for some Albanian cities.

In dark green: the Albanian norm; In light green: the EU norm (Source: State of Environment Report, MoEFWA, 2012)

The table below indicates the levels of eight indicators of air pollution in some Albanian cities during 2010.

Table 15 Average level of eight indicators of air monitoring during 2010

(Source: SoER, MoEFWA, 2012)

Monitoring Station	**SO_2**	**NO_2**	**LNP**	**PM 10**	**PM 2.5**	**O_3**	**Pb**	**CO**	**Benzene**
21 Dhjetori	24.07	46.08	1967	106.		55.69	0.069		
DSHP (Tirana)	15.23	24.73		81.5		44.15	0.055	0.45	0.49
AMP (Tirana)	9.88	17.41	74.0	44.8		43.35	0.042	0.38	0.62
Alba 1 (Tirana)	4.77	27.27			27.17	49.13			
Alba 2 (Tirana)	9.66	46.9		58.5	34.73	92.58			
Elbasan 1	18.4	29.39		116.				0.51	0.45
Shkodra	17	26.5	182	86		70.6	0.22		
Durrës	20.1	28.1	192	91		67.4	0.25		
Fier	26.7	31	195	93		62.6	0.24		
Korça	19.9	24.6	186	85		62.3	0.22		
Vlora	21.8	26	176	80		68.1	0.21		
Albanian norm	60	60	140	60	15	65	1	2	5
EU norm		40		40	25		0.5		5

Two Albanian urban centres are directly affected by the proposed pipeline corridor: Elbasan and Tirana. Elbasan town is traversed by Section I, which also runs close to the peripheral south of Tirana city.

5.1.10. Noise and Vibration

The level of the noise in the rural parts of the study area, which are far from the influence of urban, transport, and industrial activities, is low. Even though there is no monitoring of the noise levels in the residential areas, it is estimated that noises in these environments are within the acceptable limits.

Meanwhile, a monitoring of the noise levels was conducted by the Public Health Institute of Albania (PHI) for 7 cities in Albania. Apart from Tirana and

Durres, where noises are above the acceptable levels, the other cities including Shkodra and Fier have low levels of noise, due to lower intensity of economic activities. Tirana and Durres had noise levels up to 70 dB (A) or higher during the day. At night, their level of noise falls down to 40 dB (A). The other cities have noise levels up to 62 – 65 dB (A) during the day and 30 – 34 dB (A) during the night.

Despite the fact that the law on urban noise entered into force in 2007, Albania still lacks proper standards for the noise levels at various locations. The MoEFWA and the MH issued the Ordinance No. 8 of November 27, 2007 "On maximal levels of noises in the environment". This sub-legal act, which relies on the WHO recommendations, asserts that the acceptable levels shall be up to 50 -55 dB outside the residential dwellings, 35 dB (A) within the residential dwellings, and 30 dB (A) at night. Comparing the recorded data, it can be seen that noises are at acceptable levels during the night, but during the day, there is a sharp rise of up to 15 dB (A).

Two Albanian urban centres are likely to be adversely affected with regard to noise and vibration by project's activities: Elbasan and the southern neighbouring of Tirana. Elbasan town is traversed from the proposed Section I, which also runs close to the peripheral South of Tirana city. Section I does not traverse any important urban centre.

The following table shows that noise levels in Elbasan and Tirana are superior to the European standards. It should be stressed that the monitoring points are located in places with heavy traffic.

*Figure 27: Data on noise, in the principal cities of Albania compared to EU standards (in red: during **N**ight time, in blue: during **D**ay time)*

Source: State of Environment Report, MoEFWA, 2010

5.1.11. Cultural Heritage

Among the cultural resources in the area between Fier and Tirana, are many castles dated from Illyrian to medieval periods. Meanwhile in the territories of Elbasan and Fier counties there are a great number of archaeological sites and objects.

Some of the most valuable sites from the cultural heritage point of view within the proposed pipeline corridor are listed below.

Section I (Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq):

Along this section the proposed pipeline route traverses some sites of significant cultural values, as follows:

In Dumrea region (part of the segment Lushnja-Elbasan):

a-Archaeological site of Gradishta, located at the top of Gradishta hill that is rich in archaeological findings;
b-Ruins of the castles of Dragot and Kajan which are located more than 5 km from the proposed pipeline corridor;
c-Tumuli of Kajan Village, located approximately 5 km from the axis of the proposed pipeline corridor;

From Dumrea to the southern part of Elbasan town the closest cultural sites/objects to the axis of the proposed pipeline route are:

-Tumuli of Pazhok (early Bronze Age), located in Pazhok/Cerrik field, approximately 3 km southeast of the pipeline axis;
-Castle of Hidra, located 5 km south of the pipeline axis;
-Station of the Egnatia Road (Roman period), located less than 1km northwest of the proposed pipeline axis;
-Pylons of the Topcias bridge (Roman period), located approximately 700m from the axis of the proposed pipeline corridor;
-Station of the Egnatia Road (Roman period) in Bradashesh Village territory, located less than 1km from the proposed pipeline axis;

Figure 28: View of a pylon of the Topcias Bridge of the Roman period.

From Elbasan to Kashar (Tirana District) there is no known significant cultural site/object in the vicinity of the proposed pipeline corridor

Section II (Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq):

Along this section, the proposed pipeline route does not cross any site of significant cultural value. The national Archaeological Park of Apollonia is

located approximately 5 km from the TAP CS, south of the starting point of the proposed IAP project.

The nearest cultural object from the proposed pipeline route is the Castle of Ndroq (Tirana District), which is located less than 1km west of the axis of the pipeline segment Lekaj-Vaqarr; While the castle of Dorez (Tirana District) is located approximately 5.5 km east of this axis

Figure 29: Remnants of Ndroqi castle, located approximately 1km west of the proposed axis of the pipeline corridor

5.1.12. Occupational Health and Safety

When the company for pipeline construction will be contracted it will need a few hundred people for the period of construction, of at least 1 year.

Working with heavy equipment and also eventual use of blasting through hard rocks present serious hazards. Based on the geological study the Section I should pass over hard sandstones in the southern part of Krraba tunnel (segment Elbasan-Tirana).

During construction works, workers at the construction site will have to respect and implement the required principles and regulations on occupational safety (from Council Directive 92/57/EEC of 24 June 1992):

- keeping the construction site in good order and in a satisfactory state of cleanliness;
- choosing the location of workstations bearing in mind how access to these workplaces is obtained, and determining routes or areas for the passage and movement and equipment;
- the conditions under which various materials are handled;
- technical maintenance, pre-commissioning checks and regular checks on installations and equipment with a view to correcting any faults which might affect the safety and health of workers;
- the demarcation and laying-out of areas for the storage of various materials, in particular where dangerous materials or substances are concerned;
- the conditions under which the dangerous materials used are removed;
- the storage and disposal or removal of waste and debris;
- the adaptation, based on progress made with the site, of the actual period to be allocated for the various types of work or work stages;
- cooperation between employers and self-employed persons; and

- interaction with industrial activities at the place within which or in the vicinity of which the construction site is located

When performing the engineering and installation works and works related to operation of pipelines it is necessary to pay respect to dangers of electricity, dangers of inadequate lighting, dangers in case of maintenance and operation of shut-off systems, deficiencies of warning signs, hazards if prescribed personal protective equipment is not used, hazards in case of working with hazardous materials, hazards in case of dangers during movements, height work etc. Danger zones of explosion must be identified on the construction site. Evacuation plan for employees have to be created (in case of accidents that could endanger the life and health of employees - natural disasters, fires, explosions, etc.). All work has to follow an Occupational Health and Safety Plan which will help every worker to know the hazards of every job and how to avoid any dangers. All workers also have to receive proper training.

5.1.13. Waste

During construction works of the pipeline, construction waste will comprise mainly soil and rocks from excavation. Except these types of waste, during installation of the pipeline the packaging waste (plastic and cardboard) will occur. Also small quantities of household waste will emerge. It is supposed that some minor quantities of waste oils and oily materials will result from transport and operation activities of the machinery.

During maintenance of the pipeline in operation, small quantities of hazardous waste will occur. These waste may affect adversely the soil, the ground waters and the surface waters. The most sensible environments are the recharge areas of the rivers aquifers, as well as the permeable geological layers that outcrop in surface. That will be waste from cleaning the transport system. In case of decommissioning of the pipeline some types of reconstruction waste like metal, plastics and isolation materials will emerge.

5.2. Environmental and Socioeconomic impacts

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
Landscape and visual issues	Section I	Regional	Adverse impact on the landscape from construction activities from excavation of pipe trenches, backfill due to the stabilization processes and the construction of ground pipeline elements; The adverse visual impact of ground pipeline elements is most pronounced in areas with significant natural or anthropogenic landscape values which are in opponent status with out of context modern technological elements; Temporary negative visual impact created by digging trenches or clearing of vegetation caused by the gas pipeline construction technology. It is expected that it will be reduced during the time under the influence of natural succession and atmospheric conditions; Likely adverse impact on the characteristic karst micro relief forms - sinkholes and pools (Dumrea region) is reflected in the form of degradation during the pipeline construction; Positive visual impact through the densely populated areas (Elbasan city and south western neighbouring of Tirana) by the ROW.	Landscape project to be prepared within the main design. Landscape project should pay special care to ground infrastructure facilities of the pipeline (planting high vegetation in their immediate surroundings); Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); Avoid PAs, or minimize, impacts, as practical as possible, by crossing through areas of low values of vegetation; Avoid as much as practicable the areas covered from forests and permanent crops during the design stage; Traverses the riverbeds in areas of poor vegetation, as well as in the narrowest places; Minimize the working strip through forested areas as much as practicable; Avoid the pipeline route through karstic areas (Dumrea region) as much as practicable; Avoid the pipeline route through areas susceptible to be affected from geological risks (landslides, erosion, soil subsidence, etc.). Develop a communication strategy with stakeholders.

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
	Section II	Local	Adverse impact on the landscape from construction activities from excavation of pipe trenches, backfill due to the stabilization processes and the construction of ground pipeline elements; The adverse visual impact of ground pipeline elements is most pronounced in areas with significant natural or anthropogenic landscape values which are in opponent status with out of context modern technological elements; Temporary negative visual impact created by digging a trenches or clearing of vegetation caused by the gas pipeline construction technology. It is expected that it will be reduced during the time under the influence of natural succession and atmospheric conditions; Positive visual impact through the densely populated areas by the ROW.	Landscape project to be prepared within the main design. Landscape project should pay special care to ground infrastructure facilities of the pipeline (planting high vegetation in their immediate surroundings); Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); Avoid PAs, or minimize, impacts, as practical as possible, by crossing through areas of low values of vegetation; Avoid as much as practicable the areas covered from forests and permanent crops during the design stage; Traverses the riverbeds in areas of poor vegetation, as well as in the narrowest places; Minimize the working strip through forested areas as much as practicable; Avoids the pipeline route through areas susceptible to be affected from geological risks (landslides, erosion, soil subsidence, etc.). Develop a communication strategy with relevant stakeholders.
Groundwater	Section I	Regional	The pipeline route runs over 3 of the most important Quaternary gravel aquifers of national importance (Lushnja, Elbasani and Tirana-Ishmi), as well as over 1 aquifer of local importance (Erzeni River aquifer); Contamination of groundwater is expected only in case of	Select the pipeline route at the peripherals of the aquifers; Overlie the aquifers where the impermeable clay cover is the most thick; Avoid the recharge areas of the aquifers; Construction and operation equipment maintenance;

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			accidental situations during construction and operation phase; Unregulated waste disposal during the construction phase.	Waste management plans for construction site; Waste management plans for operation period; Develop a communication strategy with relevant stakeholders.
	Section II	Regional	The pipeline route runs over 2 of the most important Quaternary gravel aquifers of national importance (Lushnja and Tirana-Ishmi), as well as over 1 aquifer of local importance (Erzeni River aquifer); Contamination of groundwater is expected only in case of accidental situations during construction and operation phase; Unregulated waste disposal during the construction phase.	Select the pipeline route at the peripherals of the aquifers; Overlie the aquifers where the impermeable clay cover is the most thick; Avoid the recharged areas of the aquifers; Construction and operation equipment maintenance; Waste management plans for construction site; Waste management plans for operation period; Develop a communication strategy with relevant stakeholders.
Surface waters	Section I	Regional	Passes in the vicinity of some karstic lakes in Dumrea region. Traverses numerous streams, small rivers, as well as 3 of the most important rivers of the country, namely: Semani (once crossing), Shkumbini (once crossing) and Erzeni (6 crossings); Passes in the Erzeni Riverbed at the southern part of Tirana territory; Devastation of rivers natural flow due to pipeline construction; Increasing the turbidity level in watercourses during	Select pipeline route in the narrowest places of the riverbeds; Select pipeline route in due distance from the Karstic lakes of Dumrea region; Avoids the pipeline route in the riverbeds; To restrict impacts to the work belt (organization of construction site and working area according to high professional standards); Construction and operation equipment maintenance; Waste management plans for construction stage; Waste management plans for operation period.

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			construction phase; Contamination and thus reduce of water quality is expected only in case of accidental situations during construction and operation phase.	
	Section II	Regional	Traverses numerous streams, small rivers, as well as 3 of the most important rivers of the country, namely: Semani, Shkumbini and Erzeni; Devastation of rivers natural flow due to pipeline construction Increasing the turbidity level in watercourses during construction phase Contamination and thus reduce of water quality is expected only in case of accidental situations during construction and operation phase	Select pipeline route in the narrowest places of the riverbeds; To restrict impacts to the work belt (organization of construction site and working area according to high professional standards) Construction and operation equipment maintenance Waste management plans for construction site Waste management plans for operation period
Biological and Ecological Resources	Section I	Local	Loss of habitats - temporary (in working area) and permanent for forest & shrub habitats; change of structure of grassland habitats; Potential spread of invasive species on terrestrial part and sea (brought with ballast waters from working platforms) ; Animal disturbance – temporary during building of pipeline (noise, dust, air emissions, humane disturbance) and permanent for block-station, measuring-reduction stations and compressor station (i.e. noise); Temporary change of freshwater habitats due to work in	Selection of route and related working areas which will avoid sensitive and rare habitats; Minimization of working area; Restoration of grassland habitats after construction; Avoidance of karstic holes in Dumrea region; Preparation of habitat/vegetation restoration plan; Avoidance of building work in sensitive part of year (i.e. Avoidance of nesting season); Avoidance of building of block-station, measuring-reduction stations and compressor station in sensitive areas;

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			river bed and on banks (suspended sediments); Disturbance of river-fish and other aquatic animals (noise, suspended sediments etc.) Accidental release of chemicals, fuel to rivers, water reservoirs, lakes or karstic areas; Passing through or near protected area or important biodiversity area; Accident - Emission of bigger amount of gas with possible explosion or fire. Potential direct longer period changes of habitats (forest fire).	Avoidance of work during the high water period and period of spawning of sensitive species; Avoidance of sensitive and rare habitats; Avoidance of work in spawning time for sensitive species; Environmental plan for construction work; Avoidance of protected area and/or avoidance of negative impact to conservation objectives of other areas important for biodiversity; Operational plan with environmental protection plan; Develop a communication strategy with relevant stakeholders.
	Section II	Local	Loss of habitats - temporary (in working area) and permanent for forest & shrub habitats; change of structure of grassland habitats; Potential spread of invasive species on terrestrial part and sea (brought with ballast waters from working platforms) ; Animal disturbance – temporary during building of pipeline (noise, dust, air emissions, humane disturbance) and permanent for block-station, measuring-reduction stations and compressor station (i.e. noise); Temporary change of freshwater habitats due to work in river bed and on banks (suspended sediments); Disturbance of river-fish and other aquatic animals (noise, suspended sediments etc.)	Selection of route and related working areas which will avoid sensitive and rare habitats; Minimization of working area; Restoration of grassland habitats after construction; Preparation of habitat/vegetation restoration plan; Avoidance of building work in sensitive part of year (i.e. Avoidance of nesting season); Avoidance of building of block-station, measuring-reduction stations and compressor station in sensitive areas; Avoidance of work during the high water period and period of spawning of sensitive species; Avoidance of sensitive and rare habitats; Avoidance of work in spawning time for sensitive species;

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			Accidental release of chemicals, fuel to rivers or water reservoirs; Passing through or near important biodiversity area; Accident - Emission of bigger amount of gas with possible explosion or fire. Potential direct longer period changes of habitats (forest fire).	Environmental plan for construction work; Avoidance of protected area and/or avoidance of negative impact to conservation objectives of other areas important for biodiversity; Operational plan with environmental protection plan; Develop a communication strategy with relevant stakeholders.
Land use	Section I	Regional	Changes to and disturbance of land and associated impacts upon existing land use and users; Temporary land take in agricultural areas; Temporary loss of the agricultural productivity of the land; Possible damage to agricultural features such as irrigation systems or drain tiles, fences etc.; Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops; Permanent land take at above ground facilities, such as pump stations, pressure reduction stations and block valves; Permanent land take near and through numerous urban and suburban areas in section I (Elbasan city and south western neighbouring of Tirana); Likely permanent land take near and through the tourist areas of the Dumrea Karstic Plateau; Permanent land take near and through the riparian forests along the riverbeds, as well as near the karstic Lakes of	Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); During route selection process use as practical as possible the existing/planned longitudinal infrastructure (national roads Fier-Lushnja, Elbasan-Tirana, and Tirana by-pass); Avoid as much as possible the settlements, especially in Elbasan city and in the south western neighbouring of Tirana); Avoid as much as possible the areas of high tourist values in Dumrea region; Avoid PAs, or minimize, impacts, as practical as possible, by crossing through areas of low values of biodiversity; Avoid the permanent crops during the design stage. During design phase traverses the riverbeds at the narrowest places; Any drainages systems crossed by the pipeline and disturbed during construction would be maintained to the

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			Dega and Seferan (Nature Monuments).	extent practicable; Compensate the land holders and owners of the restrictions originating from construction of pipeline.
	Section II	Local	Changes to and disturbance of land and associated impacts upon existing land use and users; Temporary land take in agricultural areas; Temporary loss of the agricultural productivity of the land; Possible damage to agricultural features such as irrigation systems or drain tiles, fences etc.; Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops; Permanent land take at above ground facilities, such as pump stations, pressure reduction stations and block valves; Permanent land take near and through the riparian forests along the riverbeds.	Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); During route selection process use as practical as possible the existing/planned longitudinal infrastructure (national roads Fier-Lushnja-Kavaja, and Tirana by-pass); Avoid as much as possible the settlements; Minimize impacts, as practical as possible, by crossing through areas of low values of biodiversity; Avoid the permanent crops during the design stage. During design phase traverses the riverbeds at the narrowest places; Any drainage systems crossed by the pipeline and disturbed during construction would be maintained to the extent practicable; Compensate the land holders and owners of the restrictions originating from construction of pipeline.
Socioeconomic baseline	Section I	Regional to National	Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops. Permanent land take at above ground facilities, such as pump stations, pressure reduction stations and block valves; Permanent land take near and through numerous urban and	Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); During route selection process use as practical as possible the existing/planned longitudinal infrastructure (national roads Fier-Lushnja, Elbasan-Tirana, and Tirana by-pass);

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			suburban areas in section I (Elbasan city and south western neighbouring of Tirana); Likely permanent land take near and through the tourist areas of the Karstic Plateau of Dumrea; Permanent land take near and through the riparian forests along the riverbeds, as well as near the karstic Lakes of Dega and Seferan (Nature Monuments). Likely adverse impact on the industrial area of Elbasan.	Avoid as much as possible the settlements, especially in Elbasan city and in the south western neighbouring of Tirana); Avoid as much as possible the areas of high tourist values in Dumrea region; Compensate the owners of the restrictions originating from construction of pipeline; Develop a communication strategy with relevant stakeholders.
	Section II	Local to Regional	Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops. Permanent land take at above ground facilities, such as pump stations, pressure reduction stations and block valves; Permanent land take near and through the riparian forests along the riverbeds.	Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); During route selection process use as practical as possible the existing/planned longitudinal infrastructure (national roads Fier-Lushnja-Kavaja, and Tirana by-pass); Avoid as much as possible the settlements; Compensate the owners of the restrictions originating from construction of pipeline; Develop a communication strategy with relevant stakeholders.
Cultural Heritage	Section I	National	Likely high adverse impacts, because the proposed pipeline route runs throughout the territories of Dumrea region and Elbasan, which are rich in discovered and non-discovered cultural heritage.	During route selection process use as practical as possible the existing/planned longitudinal infrastructure; Preliminary archaeological pipeline route survey in order to determine exact positions of cultural heritage sites in relation to pipeline route;

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
				Archaeological site supervision during construction works; Develop a communication strategy with relevant stakeholders.
	Section II	National	Likely moderate adverse impacts, because the proposed pipeline route runs throughout areas which have been flood prone (Coastal Plain of Fier, Terbufi field) or are characterised by a hilly steep terrain (Lekaj-Vaqarr pipeline segment) located far from the roads, and consequently there is no high probability of finding non-discovered cultural heritage.	During route selection process use as practical as possible the existing/planned longitudinal infrastructure; Preliminary archaeological pipeline route survey in order to determine exact positions of cultural heritage sites in relation to pipeline route; Archaeological site supervision during construction works; Develop a communication strategy with relevant stakeholders.
Air Quality and Existing Emissions Load	Section I Section II	Local	In the vicinity and throughout the dwelling areas; In the vicinity of block-station, measuring-reduction stations and compressor station due to fugitive emissions; In the vicinity and throughout the areas rich in fauna.	Apply appropriate mitigation measures; Develop a communication strategy with relevant stakeholders..
Noise and Vibration	Section I Section II	Local	Increase in noise level during the construction phase: in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna; Periodical increase in noise level during the operation phase: in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna.	Apply appropriate mitigation measures; Respect working hours of construction sites; Plan periodical works on above–ground objects and inform on time local community; Develop a communication strategy with relevant stakeholders.

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
Occupational Health and Safety	Section I Section II	Local	It is not expected presence of serious work injuries, only minor injuries at work (regarding non-compliance with the rules of safe work, not using personal protective equipment).	All work has to follow an Occupational Health and Safety Plan; Respect and implement the required principles and regulations on occupational safety; All workers have to receive proper training; Danger zones of explosion must be identified on the construction site; Evacuation plan for employees has to be created; Develop a communication strategy with relevant stakeholders.
Waste	Section I Section II	Local	During construction works of the pipeline, construction waste will comprise mainly soil and rocks from excavation. Except these types of waste, during installation of the pipeline the packaging waste (plastic and cardboard) will occur. Also small quantities of household waste will emerge. It is supposed that some minor quantities of waste oils and oily materials will result from transport and operation activities of the machinery. During maintenance of the pipeline in operation, small quantities of hazardous waste will occur. In case of decommissioning of the pipeline some types of reconstruction waste like metal, plastics and isolation materials will emerge.	Develop and implement waste management plans; Develop a communication strategy with relevant stakeholders.

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
Accidents	Section I Section II	Local	Accidents during ROW clearance throughout dwelling areas; Pipeline leakages; Leakage at ground infrastructure pipeline facilities inlet and outlet (MS, BS, etc.); Fire during construction phase; Explosions;	Safety measures during ROW clearance throughout inhabited areas; Monitoring of process parameters (flow, pressure, temperature…) Safety pressure valves; Fire fighting equipment; Develop a communication strategy with relevant stakeholders.

6. Selection of IAP variants

6.1. Test of proposed options

Albania

Defined criteria for IAP route variants in Albania are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant selection	less acceptable	acceptable	most acceptable
Environmental criteria	negative impact	moderate impact	slight impact
Social criteria	very negative impact	negative impact	moderate impact
Techno - economic criteria	negative	acceptable	positive
Impacts on waters	negative	moderate	none
Impacts on surface waters	negative	moderate	none
Watercourses crossing (larger rivers)	7 and more crossings	1 to 7 crossings	does not cross
Impact on groundwaters	negative	moderate	none
Water protection zones crossing	existing probability	moderate probability	small probability
Land use impact	negative	moderate	slight
Impact on nature and cultural heritage	very negative/ negative	moderate	none
Impact on nature heritage	very negative/ negative	moderate	none
Impact on nature protected areas and Emerald network	negative (more than 5 EN/PA/nature protected sites ir	moderate (1 to 5 EN/PA/nature protected sites	slight (1 or none EN/PA/nature protected
Impact on biodiversity	negative	moderate	slight
Impact on cultural heritage	very negative/ negative	moderate	slight
Impact on landscape values	negative	moderate	none
Corridor crosses populated areas	very negative	negative	moderate
Corridor crosses areas of economic/ turistic activities value	negative	moderate	slight
Total construction cost	up to 40% from the most cheapest	up to 30% from the most cheapest	up to 15% from the cheapest
Technical difficulties of pipeline construction	very difficult	moderate	slight
Impact on forestry and forests	negative	moderate	slight
Economic value of the forests	great	small	none
Impact on forest land	negative	moderate	slight
Forest land crossing	50ha and more	10 - 50ha	less than 10ha
Impact on agriculture and agriculture land	negative	moderate	slight
Impact on agriculture land	negative	moderate	slight
Agriculture land crossing	more than 100ha	50-100ha	less than 50ha
Impact on agriculture	negative	moderate	slight

Figure 30: Defined criteria for IAP route variants in Albania

Considered Variants description based on Environmental Criteria

Environmental Criteria	***Weight factor 1 – 5***	***Section I Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq***	***Section II Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq***
Hydrogeology/ Water protection zones	4	The pipeline route runs over 3 (three) Quaternary gravel aquifers of national importance, as follows: 1-Lushnja aquifer (sect.1); 2-Elbasani aquifer; and 3-Tirana-Ishmi aquifer (sect.4); There is possibility that route passes through water protection zone. **(Existing probability)**	The pipeline route runs over 2 (two) Quaternary gravel aquifers of national importance, as follows: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); There is possibility that route passes through water protection zone. **(Existing probability)**
Water Resources	3	-The pipeline route traverses 3 (three) important rivers (8 crossings), as follows: 1-Semani; 2-Shkumbini; 3-Erzeni (6 crossings); -The pipeline route often runs in the Erzeni riverbed from Krraba to Vaqarr. **(Route considered as less acceptable)**	The pipeline route traverses 3 (three) important rivers (3 crossings), as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; **(Route considered as acceptable)**
Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)	4	Runs near 2 (two) PA: 1-Seferan Karstic Lake; & 2-Dega Karstic Lake (Hydro-monuments). **(Moderate impact)**	The pipeline route do not run across or in vicinity to any EN/PA **(Slight impact)**
Landscape and Visual	3	-20.2 km route runs through steep hilly area covered from shrubs	-16.2 km runs through steep hilly area, mainly over flysch

Issues		and degraded forests that lie mainly over flysch and molassic deposits, which are prone to erosion; -48.8 km route runs through hilly agricultural area, which is prone to erosion; -17.2 km route runs across the rolling hills of the Karstic Plateau of Dumre, which is very sensitive against erosion; -In the karstic plateau of Dumrea region (85 karstic lakes) the pipeline route runs near some karstic lakes; Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes, and from soil subsidence in the Dumrea karstic Plateau; -Likely adverse visual impact on the tourist area of Dumrea (85 karstic lakes). **(Negative)**	and molassic deposits, which are prone to erosion. The hilly area is covered from degraded forests and shrubs; -12.1 km route runs through hilly agricultural area, which is prone to erosion; Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; **(Moderate)**
Land use	4	-The pipeline buffer area (10m wide) lies through **20.2 ha** of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; -The pipeline buffer area occupies **102 ha of agricultural land**	-The pipeline buffer area (10m wide) lies over 16.2 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; -The pipeline buffer area occupies **71.5 ha of agricultural**

		and has a negative impact on agriculture and agricultural land.	**land** and has a negative impact on agriculture and agricultural land.
Cultural Heritage	4	Section I runs throughout the territory of Dumrea region and of the Elbasan County, which are rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian- Roman-Byzantine-Medieval ages. Likely high adverse impact on the elements of cultural heritage. **(Negative)**	Section II runs throughout a territory, which is not very rich in discovered cultural heritage. Likely moderate adverse impact on the elements of cultural heritage. **(Moderate)**

Considered Variants description based on Social Criteria

Social Criteria	***Weight factor 1 – 5***	***Section I***	***Section II***
Pipeline corridor crosses populated areas	4	Pipeline route runs near and throughout populated areas in Elbasan city and in the south-eastern neighbouring of Tirana. **(Negative)**	Pipeline route does not run through any densely populated area. **(Moderate)**
Pipeline corridor crosses areas of economic/touristic activities values	3	-Pipeline route runs through Elbasan town territory, where are located important economic activities (industry-national importance); -Pipeline runs through the touristic area of Dumrea region (Karstic Plateau; 85 karstic lakes). **(Negative)**	Pipeline route runs mainly through agricultural and shrubby areas. It does not cross any zone of important economic activities. **(Moderate)**

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	***Weight factor 1 – 5***	***Section I***	***Section II***
Cost of construction	4	120.0 EUR	85.5 EUR
Technical solution of pipeline construction	2	In his first part Section I pass through flat agriculture areas that present slight technical difficult. In north - east direction of the Lushnja route runs toward Elbasan through a hilly terrain crossing the flat valleys between hills - that presents moderate technical difficult. In the Elbasan area route runs through urban area and reaches the route of new road from Elbasan to Tirana. Parallel to the new road route, pipeline route runs toward Tirana through hilly terrain that presents moderate technical difficult. The Route passes Tirana from the south follow the Erzeni River valley than runs toward Ahmetaq in north direction through flat urban valley that presents **moderate technical difficulties**.	From Fier toward north direction, Section II crosses agriculture areas, mainly flat terrain that presents slight technical difficult. In the south – west of Tirana route crosses a hilly terrain that presents difficult technical solution. The route runs toward Ahmetaq in north direction through flat urban valley that presents **moderate technical difficulties**.

Results gained by DoctuS software are shown on following figure.

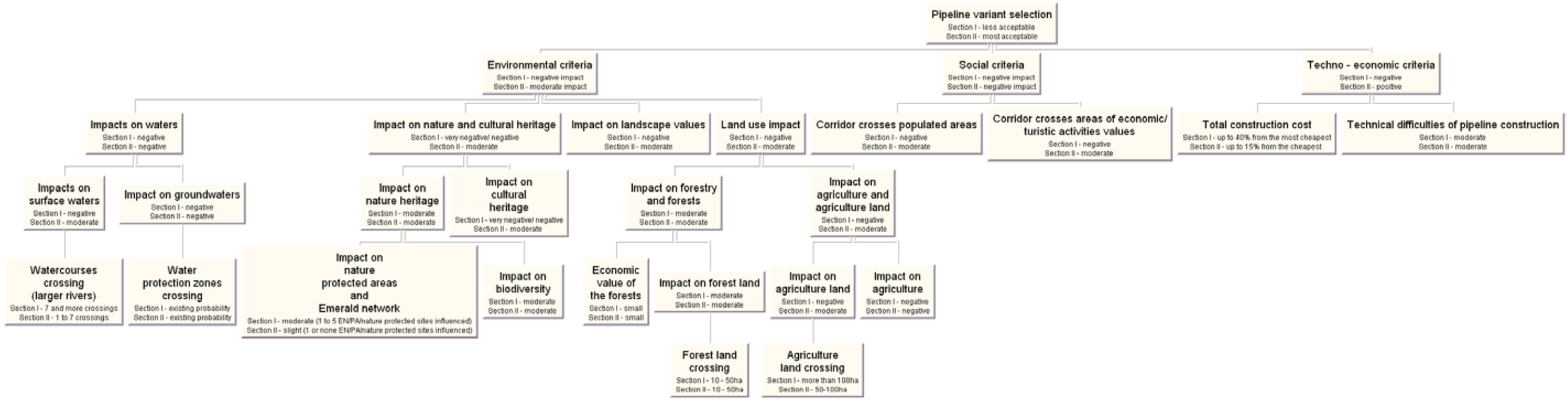


Figure 31: IAP route variants selection for section Fier –Tirana in Albania

As more acceptable Section II is recommended.

7. Recommendations

The analysis consisted of evaluation of environmental, social and techno – economic parameters, for that the criteria have been set.

Based on conducted analysis in Doctus Section II (Fier – Lekaj - Ahmetaq) is recommended as more acceptable.

The European Union's 2008 IPA Programme for Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo*, Turkey and Iceland

Infrastructure Projects Facility
Technical Assistance Window (IPF TA)

EuropeAid/128073/C/SER/MULTI

Sub Project:
WB5-REG-ENE-03

FS and ESIA for the
Ionian – Adriatic Pipeline (IAP)

Preliminary Technical Study Report

January 2013

This project is funded by
the European Union

COWI • IPF CONSORTIUM

*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.

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Infrastructure Projects Facility

Technical Assistance Window (IPF TA)

Western Balkans

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*) This designation is without prejudice to positions on status, and is in line with UNHCR 1244 and the ICJ Opinion on Kosovo declaration of independence

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LIST OF ABBREVIATIONS

ANSI	American National Standards Institute
bcm	Billion Cubic Meter
BiH	Bosnia and Herzegovina
CO_2	Carbon dioxide
EBRD	European Bank for Reconstruction and Development
EBRD PR	EBRD Performance Requirements EC
EC	European Commission
ECS	Energy Community Secretariat
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EU	European Union
FS	Feasibility Study
IAP	Ionian-Adriatic Pipeline
IFI	International Finance Institution
IMF	International Monetary Fund
IPF	Infrastructure Projects Facility
IRR	Internal Rate of Return
ITGI	Interconnector Turkey – Greece – Italy
LNG	Liquefied natural gas
LPG	Liquid petroleum gas
M Nm^3	million normal cubic meters
Mtoe	mega tons of oil equivalent
MW	Megawatt
NPP	Nuclear Power Plant
NPV	Net Present Value
PFS	Pre-Feasibility Study
RS	Republic of Srpska
SEE	South East Europe
SIA	Social Impact Assessment
TA	Technical Assistance
TAP	Trans-Adriatic Pipeline
ToR	Terms of Reference
TSO	Transmission System Operator
UN	United Nations

1 Synopsis

Project Title: Feasibility Study and EIA & SIA Ionian – Adriatic Pipeline

Project Number: WB5-REG-ENE-03

Contractor: COWI-IPF Consortium

Beneficiaries:

Croatia:
Plinacro Ltd and Ministry of Economy.

Bosnia & Herzegovina;
Ministry of Foreign Trade and Economic Relations represented by BH-Gas and Gaspromet.

Montenegro:
Ministry of Economy.

Albania:
Ministry of Economy, Trade and Energy.

Project start date: 08/05/2012

Project Duration: 22 months

Anticipated completion: February 2014

2 Introduction

2.1 Background

The Ionian-Adriatic Pipeline Project (IAP) will interconnect the existing and planned gas transmission system of the Republic of Croatia with the Trans Adriatic Pipeline (TAP) or a similar project (Interconnector Turkey – Greece – Italy (ITGI)). The project aims to establish a new supply route for natural gas from the Middle East and Caspian region, northwards along the Adriatic coast. The IAP project is however planned as a bi-directional pipeline, so the possible supply direction could also be north – south, from the strategically planned LNG terminal in Croatia, or other sources.

The construction of this transmission pipeline would enable the gasification of Albania and Montenegro, Bosnia and Herzegovina and southern Croatia, providing a diversified and reliable natural gas supply. This transmission supply project, of 540 km total length, would create the preconditions for the development of the natural gas markets of Albania, Montenegro, Bosnia & Herzegovina and Croatia in the estimated annual level of 5 bcm. (for Albania 1bcm + for Montenegro 0.5 bcm + for Bosnia and Herzegovina 1 bcm + for Croatia 2.5 bcm).

2.2 Scope of work

The scope of work consists of the following main activities:

- Infrastructure and market background analysis (in a separate report)
  - describing the existing gas transmission systems
  - identifying the major objectives the project will achieve
- Route selection and layout optimization
  - The examination of topography and overview of ground conditions and other potential key technical issues
  - The characterisation of traversed territories: urban area, agricultural areas, forests, etc.
  - The review of routing options and recommendation for a preferred route corridor (geographical coordinates and altitudes of key reference pipeline segments)
  - The identification and the location of main difficulties to be addressed during the project design and implementation: roads, rail tracks, rivers, swamp lands, built areas, mountainous areas, significant environmental and social impacts, etc.
  - The identification of potential entry points on each territory and the evaluation of relevant alternatives

- Analysis of technical options
  - The diameter of the gas pipeline and the design pressure will be harmonised
  - Exploration of several options related to planned transit flows, capital expenditures and interconnection arrangements between the gas transmission networks in Croatia and Bosnia & Herzegovina
- Cost estimates
  - Cost estimates covers the main CAPEX components associated to the project completion
- Financial and economic analysis
  - Evaluate the financial and economic sustainability conditions for the identified scenarios through comprehensive analysis

2.3 Summary[1]

The goal of the Preliminary Technical Study Report was to analyze all the possible variants of the route of the IAP system with techno-economic, environmental and social aspects, and to determine the optimal solution for the entire IAP system. Selected and proposed options of IAP pipeline, with included chosen variant in each country, represent unique IAP pipeline corridor, which will be subsequently detailed and planed in the next phase of Project, in scale 1: 25000 with all necessary facilities included.

To create PTSR, previous research and studies have been used, such as the Ionian Adriatic Pipeline Pre-Feasibility Study, prepared by ILF in 2009, then other routing, engineering, geodetic and environmental documentation of the main gas pipeline Split - Ploče - Dubrovnik - Prevlaka – Dobreč provided by Plinacro. Also, all documents on which Plinacro obtained the necessary permits have been taken into account in this study.

To determine the optimal pipeline diameter, hydraulic calculations were carried out for all possible diameters and possible directions of gas transport. The basic economic analysis of all variants of IAP system was done, in a way to determine transportation tariff. On this basis, the most acceptable variant of the basic system is determined. The result of this analysis was that the pipeline diameter of 32" meets all the criteria for all possible variants of the pipeline. This selection includes a compressor station in Split which is used in both directions of gas transport. In direction A: Fier-Split, it is used to raise the pressure from the IAP system to the required pressure in the Croatian gas transmission system, and in the direction B: Split - Fier to achieve the pressure required to be able to transport gas through the IAP system in opposite direction from north to south.

Also, the basic economic parameters were determined for the route variants of the individual countries, which are used as input parameters for Doctus program. Final version of entire IAP route was chosen accordingly.

The selection of the most suitable choice in a particular country is carried out by the IT system Doctus. Selection is based on three criteria: environmental, social and techno-economic. The three variants through Croatia, four variants through Montenegro and four variants through Albania have been analysed. In compliance with all of the selection criteria the following variants were chosen:

[1] See comment in beginning of Chapter 6

Variant A-HR
Variant A-MNE
Variant A- AL

As a result of the above conducted analysis, final unique IAP pipeline route is determined.

The route starts in Fier in Albania, runs in northern direction reaching Tirana, continuing toward border to Montenegro. At the border the pipeline crosses river Bojana. Route passes Skadar Lake on the northern side then runs toward Podgorica in Montenegro. Following the main road the pipeline passes Cetinje continuing toward border to Croatia, crossing the Bokokotorska bay and reaches the peninsular of Croatian territory. Parallel to the coastal line the route runs toward Dubrovnik across Konavli field. After Dubrovnik the route is crossing the bay of Rijeka dubrovačka reaching Dubrovačko primorje and via peninsula Pelješac crossing the sea toward Ploče. The route passes the city of Ploče on the west side. Finally from Ploče the route runs north-west and reaches Dugopolje near the city of Split.

The route is shown in following figure.

Figure 1: IAP gas system final route

Pipeline:	
Total length of final route	530 km
Investment costs pipeline	610.56 Mio €
Annual maintenance costs	6.1 Mio €/year
Compressor station:	
Compression power	1425 kW
Specific performance related cost	1500 €/kW
Investment costs compressor station	35.9 Mio €
Annual energy costs	0.5 Mio €/year
Annual maintenance costs	1.0 Mio €/year

Activities conducted in Preliminary Technical Study Report, are the basis for the next step of optimizing IAP system, which will be implemented in the Feasibility Study.

3 Basic data

3.1 Infrastructure analysis

The gas transmission system of Croatia consists of a 2,113 km long network of high pressure main and regional gas pipelines, over 300 over ground objects such as block stations, cathodic protection and blow off stations, 9 in-take measuring stations and 132 off-take measuring-reduction stations.

The Trans Adriatic Pipeline (TAP) is a natural gas pipeline project. The Trans Adriatic Pipeline will transport natural gas from Shah Deniz II development in Azerbaijan, taking it via Greece and Albania, and across the Adriatic Sea to southern Italy, and further into Western Europe. The TAP route will be approximately 800 kilometres in length (Greece 478 km; Albania 204 km; offshore Adriatic Sea 105 km; Italy 5 km).
TAP will initially have a capacity of 10 bcm/year. Two compressor stations, one near Komotini, in Greece, and the other on the Albanian coast near Fier, will be used to ensure gas transportation through the pipeline. Two additional compressor stations can be installed later (one near Thessaloniki, and the other near the Greek-Albanian border) to attain the maximum throughput of 20 bcm/year.
The TAP project is exploring the possibility of developing an underground natural gas storage facility in Albania.
In 2003 the pre-feasibility study for TAP was conducted. The feasibility study for the project was concluded by Axpo's EGL in March 2006, confirming technical, economic and environmental feasibility. TAP's extended basic engineering, including the offshore seabed survey, and preliminary impact assessment surveys were concluded by March 2007. In 2008, TAP entered the front-end engineering detailed design stage (FEED). In February 2012 TAP was selected by Shah Deniz Consortium as the priority route to Italy. In September 2012 Albania, Greece and Italy signed MoU in support of TAP.
TAP's schedule is aligned with developments upstream. The pipeline should be ready to transport natural gas from the Caspian region, when Phase II of Shah Deniz field in Azerbaijan starts production (estimated in 2017/2018).
EGL also signed a gas purchase agreement with Iran for up to 5.5 bcm/year to supply the TAP pipeline. This makes TAP the only pipeline project in the region that has contracted gas volumes to support it.

Figure 2: Planned route of TAP Project
Source: http://www.trans-adriatic-pipeline.com

The IAP project intends to connect the existing and the planned gas transmission system of the Republic of Croatia, via Montenegro, and Albania with the TAP system. The total gas pipeline length from Split (Croatia) to Fier (Albania) is 540 km. Its 5 bcm/year capacity will provide natural gas supply for Albania, Montenegro, Bosnia and Herzegovina and Croatia.

Implementation of the entire Ionian-Adriatic Pipeline project supports opening of the new energy corridor for the SEE region within the fourth EU transmission corridor, and provides a new natural gas supply direction from the Middle East and the Caspian region.

The Ionian-Adriatic Pipeline will be bi-directional, i.e. it will provide SEE region with natural gas also from other sources such as the future LNG Terminal on the island of Krk.

A Ministerial Declaration between Albania, Croatia and Montenegro has been signed for the IAP project in Zagreb, on September 2007 and Bosnia and Herzegovina has co-signed this Declaration, in Tirana, on December 2008. In 2010 an Interstate Committee was established for the support and implementation of the project under the Treaty establishing the Energy Community, with the support and under the coordination of the Secretariat of the Energy Community. In 2011, Plinacro and TAP consortium signed a MoU. Subsequently, TAP consortium has signed a MoU with BH Gas, Ministry of Economy of Montenegro, Ministry of Economy, Trade and Energy of Albania and Slovenian gas transmission system operator, Plinovodi. A Joint Working Group TAP/IAP was established in 2011 and started operations.

3.1.1 Albania

Albania had its National Strategy for Energy approved by the Government in June 2003, and after three years the Action plan for implementation was updated in June 2007. The domestic gas production capacities are in their minimal limits, due to drying up of the reserves and decline of the initial pressure in oil resources. The total proven reserves of natural gas in the country are some 57 million Nm^3.

The existing gas pipeline network has a length of 498 km. Gas infrastructure in many places is out of operation and needs rehabilitation and parts of the network need to be totally substituted. Due to the low level of gas production, some of the pipelines are unable to transport gas due to their continuous corrosion and destruction. Nevertheless, these gas pipeline corridors might be used for future gas transmission and distribution network development options.

Albania has adopted a law on the gas sector, (no. 9946, 30.06.2008 "On the natural gas sector"), in which is not absolutely in line with the Energy Community Treaty requirements. The purpose of the law is to establish the legal and institutional framework for the development and regulation of the natural gas sector and gasification of Albania.

The Energy Sector Policy of Albania provides that the long-term development of energy sector should take into consideration a possible development of the natural gas industry in the future.

The supply of Albania with gas is foreseen to be done by the international gas networks, for which there are three existing options:

1. From neighbouring countries through regional gas pipeline: gas from Macedonia, gas from Greece.
2. From gas pipeline for the supply of Western Europe (”TAP” project).
3. From LNG terminal on the Adriatic coast.

Figure 3: Gas supply options to Albania
Source: Oxford Institute for Energy Studies

According to the The European Waterborne LNG Report the proposed LNG import terminal, which will have an annual receiving capacity of 10 Bcm of LNG per year, will be located by the Seman River in southwest Albania's Fieri district, 100 km southwest of Albania's capital Tirana.

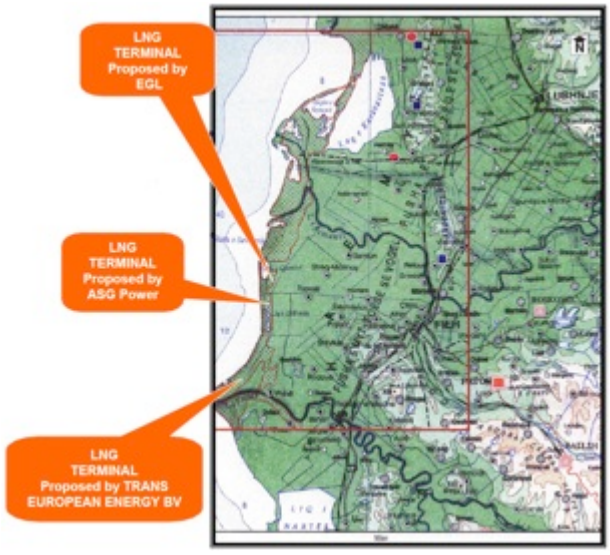


Figure 4: Proposed LNG terminal projects, Fieri region
Source: REPUBLIC OF ALBANIA, MINISTRY OF ECONOMY, TRADE AND ENERGY, Gas Forum Meeting, Gas Supply in Albania, 16 April 2008, Maribor, SLOVENIA

At this point TAP seems to be the optimal option to supply gas to Albania.
In Albania it is possible to supply natural gas from the planned ITGI pipeline, in the southern part of Albania, which connects Greece and Italy. But it seems that the earliest option to supply gas from Greece to Albania in 2017/2018 is the TAP project.
IAP (Ionian-Adriatic Pipeline) would be a transmission pipeline connected to TAP, originating in Albania and passing through Montenegro and along the Adriatic coast towards Croatia.

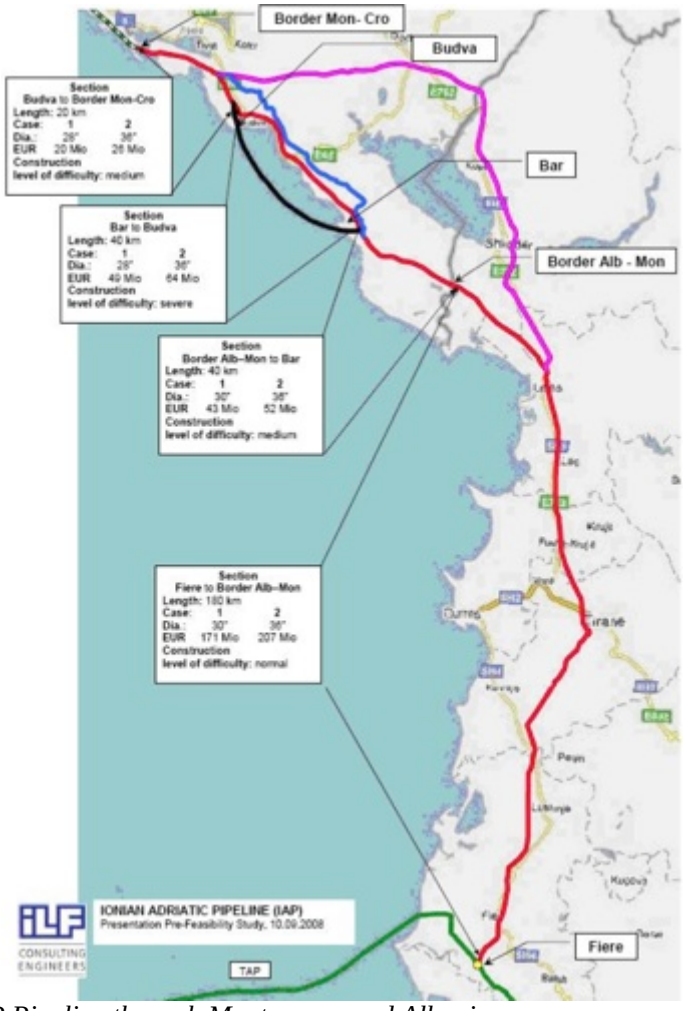


Figure 5: IAP Pipeline through Montenegro and Albania
Source: Presentation, „Ionian - Adriatic pipeline project “, PLINACRO, 4th Gas Forum, Ljubljana 2009

SEE Regional Gasification Study identified and considered two potential UGS locations: Divjaka depleted gas field and Dumrea salt dome. Divjaka was exploited between 1960 and 1980 and is practically empty. In that time period approx. 1.3 bcm natural gas had been produced. The Divjaka field consists of 25 different reservoir layers each 4 to 6 meters thick in the depth interval from 2,000 to 2,600 m, with no water drive. The possibility of gas storage in the Divjaka field had been investigated by a feasibility study.

The salt dome of Dumrea is a large diapir covering a surface area of approximately 250 km². The salt mirror is mostly at depth 2,000 m. The overburden is karstic to a large extent and consists of gypsum and anhydrite. The salt reaches down to 6,000 m. The salt volume is estimated to amount

1,400 km³. The TAP project is investigating the option of developing gas storage facilities in the Dumre underground salt dome formations.

3.1.2 Montenegro

There is no developed market for natural gas, gas transmission or distribution systems in Montenegro. The "Energy Development Strategy of the Republic of Montenegro until 2025 - professional basis - Book C development system of coal, oil and gas from 2006" investigated options for gas supply to Montenegro. Options to supply natural gas to Montenegro from imports, from own production as well as mixed and evaporated LPG was elaborated. According to the study of potential natural gas reserves, there is almost 425 billion m^3 (Pliocene-Miocene-Oligocene submarine complex) of natural gas reserves available in Montenegro Adriatic sea area. Although the study planned activity on the development of mixed and evaporated LPG in the major consumption centres (Podgorica, Nikšić and bigger coastal cities), actions to implement these projects are not initiated, and it is assumed that the competent authorities do not intend to develop this type of energy supply. At the time of the study there was no option to supply gas from the TAP and the IAP project and it was expected to supply gas from Serbia over Kosovo*. A gas transmission, distribution and market development study from 1998 envisaged the development of a gas system in Montenegro in three phases:

- development of gas transmission pipeline Podujevo - Podgorica with Niksic-Podgorica branch ,
- development of the transmission pipeline Podgorica - Cetinje - Budva with the main branches of Budva - Tivat and Budva - Ulcinj,
- development of main branches Berane - Bijelo Polje - Mojkovac, Mateševo - Kolašin and Rožaje - Plav

It is expected that, if Montenegro's own natural gas reserves were developed, gas and oil pipelines should be established in stages, first near the coast and then towards Podgorica and Nikšić.
According to the new Energy strategy of Montenegro (2012 draft) the exploration in the next 5-10 years will answer how big the reserves of oil and gas might be. In case of the positive results, supply with domestic gas cannot be expected before 2020. Due to the big uncertainties the draft 2012 Strategy does not anticipate possibility to use domestically produced natural gas.
A new 2012 draft Energy strategy of Montenegro recognizes IAP as a major gas supply option for Montenegro.

3.1.3 Bosnia and Herzegovina

Bosnia and Herzegovina does not have its own sources of natural gas, hence supply is exclusively based on import. For the time being, gas only arrives from one source and transport is only in one direction, i.e. Beregovo - Horgos - Zvornik.
All natural gas for Bosnia and Herzegovina is imported from the Russia. There is a contract with Gazexport for the delivery of gas, but it is not of a long-term contract due to unsettled war debt with the Russian partner.
The procurement of gas is a complex process. The main supplier is Russia, but gas is transported by several companies from other countries, via gas pipelines to the users.

Bosnia and Herzegovina is served by a 16 inch pipeline which crosses the border at Šepac. This pipeline passes through Zvornik, Kladanj and Sarajevo, terminating in Zenica. Ownership is shared between Gaspromet Pale (22 km from the Srbija border to Zvornik), Sarajevo Gas Lukavica (40 km between Zvornik and Kladanj) and BH Gas Sarajevo (132 km, Zvornik – Sarajevo – Zenica).

Figure 6: Bosnia and Herzegovina: Route of the Existing Gas Pipeline

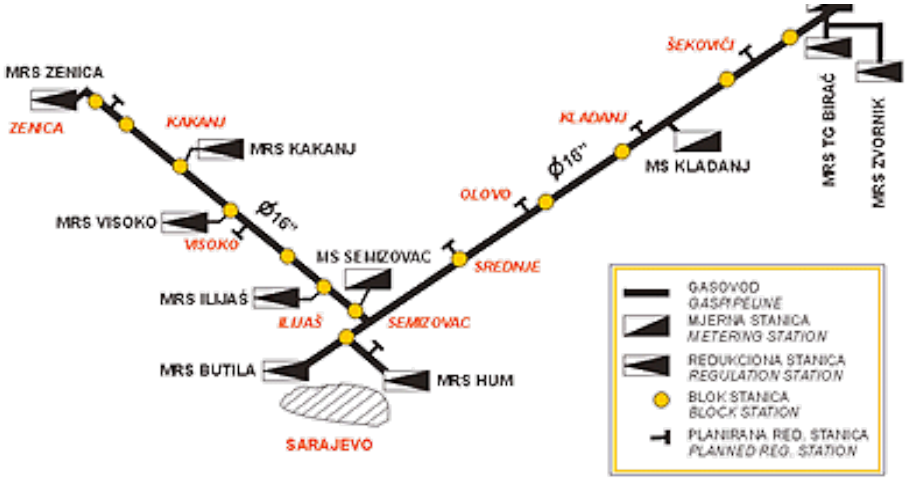


Figure 7: Bosnia and Herzegovina: Details of the existing gas pipeline
Source: BH Gas

Gas is transported along the gas pipeline systems of Ukraine, Hungary and Serbia.
According to available information Bosnia and Herzegovina has long-term contracts for the transport of natural gas concluded with foreign partners, as follows:

- With MOL for transport of natural gas through Hungary for the amounts of 600 M Nm^3/year until 2018
- With Srbijagas for transport of natural gas through Serbia for the amounts of 600 M Nm^3/year until 2019.

The transport system of natural gas in Bosnia and Herzegovina has the following main characteristics:

- Length of the gas pipeline 191 km
- Cross-section of the gas pipeline 406.4 mm (16 “)
- Projected pressure 50 bars
- Projected capacity 1 bcm per year

Current contracted transport capacity to Bosnia and Herzegovina is 750 million m^3/year, while the pressure at the receiver station in Zvornik is 26 bars.
There are 9 metering stations, 12 block stations and 4 cleaning stations on the transport system.
The relationship of different participants in the natural gas sector seems quite complicated. During our investigation we have not been able to clarify the situation completely (other previous reports also display the same difficulty). We believe that the following description is as realistic as possible.
BH Gas and Energoinvest signed a special Agreement under which the Energoinvest is responsible for foreign trade operations related to the gas import. Energoinvest (gas import company in BiH) signed the Contract number 643/00157629/210201 dated 23 January, 1997, with Gazexport of the Russian Federation for the delivery of natural gas to Bosnia and Herzegovina under the condition of repayment of a debt for the delivery of gas in 1996. This is the reason that Gazexport insisted that Energoinvest should remain the contracting party for the delivery of gas.

Energy Development Strategy of the Republika Srpska from 2010 was prepared with a similar methodology as the study of the energy sector in BiH - Module 10 natural gas. Strategy considers two possibilities for the development of the system:

- Alternative 1. - in the first stage Sava (supply route from Serbia along the river Sava) pipeline system will be built to the all consumption centers
- Alternative 2 - ensures the supply of gas to consumption centres to the nearest available gas systems: the connection to the system of Serbia in Bijeljina, and connections to Croatian system in Brod and Gradiška. After the increase of consumption, in the second phase, the backbone of the Sava pipeline, i.e. the pipeline Bijeljina - Banja Luka will be built.

The alternatives are based on the gas transmission system optimisation results and on the strategic interests of the RS concerning the gas market development. Given the stated alternatives, the possibility of gas imports and the results of optimizing the development of gas transmission system in the Republika Srpska conclude the following:

1. Optimum supply points are Gradiška (which is the lowest cost for gasification of the largest consumption point Banja Luka), then Bijeljina from Serbia, and Bosanski Brod from Croatia,
2. First phase of the gas system development are the areas of the following cities:
    - Gradiška, Laktaši and Banja Luka from the Gradiška;
    - Brod, Derventa and Modriča from the Brod;
    - Bijeljina from the Serbia, and
    - Vlasenica and Pale from the existing system,

3. Gas system development in the area of Doboj and Prijedor, then of Prnjavor area, i.e. gasification of Brdsko from direction of Bijeljina will follow
4. Merging of Bijeljina - Banja Luka into the Sava supply system in full.

In September 2012 Republika Srpska and Gazprom signed the Memorandum of Understanding related to the mutually beneficial partnership and cooperation. Construction of a gas lateral from South Stream to Republika Srpska and gasification of the population centres along its route is a part of the Memorandum.

FMERI - Strategic plan and program to develop the energy sector of the Federation BiH from 2009, gas consumption is calculated according to the expected natural gas consumption from the Ramboll study and Energy Sector Study BiH, and states that there are real indications that BiH could increase the share of natural gas.
The strategic plan defines the priority transmission PTG and distribution PGG projects..
As priority projects of the Strategic Plan, gas pipelines PTG1 and PGG1 were determined with a period of realization 2010-2011, pipelines PTG3 and PGG3, PTG4 and PGG4 and PGG5 were determined as the medium-term projects and with a period of construction from 2011-2015, and finally pipelines PTG2 and PGG2 are defined as a medium/long-term projects (long-term development projects after 2015).

Project description:
PTG1: Transmission pipeline Bosanski Brod – Doboj – Maglaj – Zenica
PGG1: Gas distribution development along Bosanski Brod – Zenica pipeline
PTG2: Transmission pipeline Sarajevo – Mostar – Ploce
PGG2: Gas distribution development along Sarajevo – Ploce pipeline
PTG3: Transmission pipelines Zenica – Travnik, Travnik –Gornji Vakuf i Travnik – Jajce
PGG3: Gas distribution development of Central Bosnia Canton
PTG4: Transmission pipelines Tr.Raštela/Šturlic (enterance from Croatia) – Cazin – B. Krupa – S. Most – Kljuc with branch pipeline toward Bihacu, V. Kladuši i B. Petrovcu
PGG4: Gas distribution development of Una-Sana Canton
PGG5: Gas distribution development in city Orašje
PTGS6: Underground gas storage Tetima with transmission pipeline Kladanj – Tuzla – Tetima

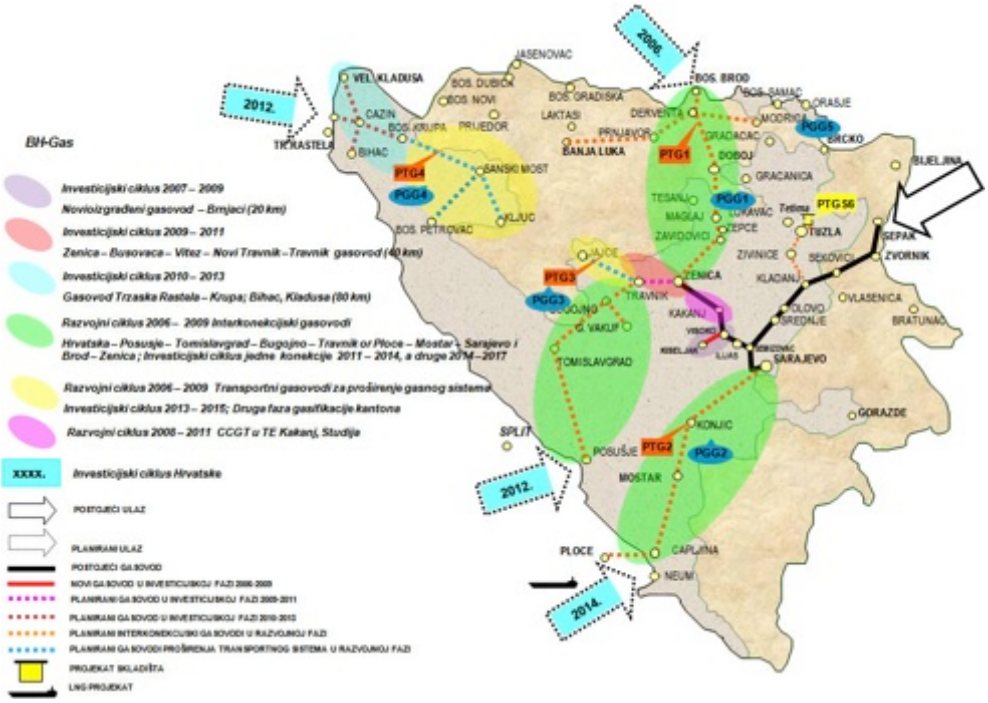


Figure 8: Existing and planned gas transport system of B & H
Source: BH Gas

In the short term, we can most probably expect development of gas system from Croatia in the north toward Republic of Srpska and potentially Sarajevo, and in case the IAP pipeline is developed the connection Ploče-Mostar will be developed. In the case that IAP pipeline system will not be developed, then the pipeline system Zagvozd – Imotski (Croatia) – Posusje (BiH) with branch to Mostar and extension of the main pipeline via Tomislavgrad and Bugojno to Travnik with connection to exiting gas pipeline might be a feasible solution for the gas supply for south and central part of Bosnia and Herzegovina.

3.1.4 Croatia

Natural gas is produced from 16 on-shore and 9 off-shore gas fields meeting 71, 9 percent of total domestic demand. The largest share of gas produced in Panon area is coming from the fields Molve and Kalinovac. They include the units for processing and preparation of gas for transportation – Central gas stations Molve I, II and III.
In the thirty years of its existence, configuration, capacity, and other features of the Croatian gas transportation system were determined and developed as a function of acceptance of gas production from INA gas and oil fields, acceptance of gas imported via Slovakia, Austria and Slovenia and its transport to distribution canters.

The natural gas transport system comprises 2 511 km of pipelines. Gas was delivered to the transmission system through 10 entry measuring stations. Out of them, 8 stations are taking gas from the domestic gas fields while 2 stations have international character as it is the entry station for the imported gas (from Russia, Slovenia, Italy and Hungary). Gas is delivered from the transport system through 193 connections at 157 exit measuring-reduction stations. Out of them, 40 connections function as delivery points for industrial customers on

the transportation system, whereas 151 connections are used for delivery to distribution systems.
Entry capacity to the transmission systems are:

- import route from Slovenia is 210 000 m^3/h,
- import route from Hungary is 800 000 m^3/h,
- supply from Adriatic gas fields 240 000 m^3/h
- supply from Panon gas fields 111 000 m^3/h (depends on the gas production)

The whole system is designed for working pressure 50/75 bar. System is mainly located in the northern part of Croatia. The Istria gas transmission system, pipeline Pula-Karlovac and Bosiljevo-Split are located at the south of Croatia.
Transportation of natural gas is regulated energy activity and is done as a public service and a company's core business of Plinacro Ltd, Zagreb, which is the owner and operator of gas transportation system. Plinacro Ltd manages the system of main and regional gas pipelines which transport natural gas from domestic production (the northern part of the continental and the northern Croatian Adriatic) and imports (supply transport route through the Republic of Slovenia and Hungary) to the distribution systems and (industrial and power plants) customers that are directly connected to the transmission system
One of the fundamental principles of Croatian Energy Strategy from 2009 is the equal quality of energy supply to its entire territory. In particular, it relates to the availability of networked forms of energy (electricity and natural gas). Related to the effective use of energy, Strategy sets the goal to reduce use of electricity for space heating and hot water and replace it with the other forms of energy, including natural gas.
In order to implement the Strategy, an energy reform was carried out in 2002, energy legislation has been passed, and PLINACRO was founded as state-owned company responsible for a project to develop natural gas transmission system.
The basic document that defines the future development of gas transportation system is the "Plan of development, construction and modernization of gas transportation system in the Republic of Croatia from 2002 to 2011", adopted by Government. For the next cycle of development and investment since 2007 to 2011, the Plinacro drafted "Amendments to the Development Plan, the construction and modernization of Croatian gas transmission system from 2002 to 2011 - second investment cycle since 2007 to 2011" and its revisions. Today, development of transmission system in the Republic of Croatia is carried out in accordance with the document “Gas Transmission System Development Plan of the Republic of Croatia 2011-2015”. Development Plan pipeline development obligations are presented in three regional groups of projects;

- gas pipeline system Pula-Karlovac
- gas pipeline system of Lika and Dalmatia, and
- gas pipeline system in Central and Eastern Croatia.

The gas pipeline system Pula-Karlovac was built and it connects Adriatic gas fields with the continental part of gas system through Istria and Gorski Kotar. The backbone of the gas pipeline system Lika and Dalmatia is the pipeline Bosiljevo-Split, which is connected to Pula-Karlovac pipeline in Bosiljevo. The capacity of this pipeline is adapted not only to the needs of distribution

consumers and industry in Dalmatia, but also for the potential needs of gas power plant at the location of Obrovac. This pipeline will enable the development of gas consumption in the southern part of Croatia.
The plan predicts the construction of the pipeline around the end of the year 2012. The pipeline has been completed and in function up to Benkovac town, including the towns Biograd and Zadar. The Benkovac-Split connection is under construction and will be developed on schedule.

The pipeline is/will be constructed of steel pipes DN 500, 75 bar working pressure and the length of 290 km. Regional and major branch pipelines Kaštel Zegarski-Obrovac, Benkovac-Zadar and Benkovac-Biograd already have got the use permit, while for gas pipelines Morpolača-Pirovac, Šibenik-Knin and Jadrići-Trogir the technical inspection is to be carried out. The stated gas pipelines have been built and depend on the construction of the main gas pipeline Benkovac-Split. These pipelines will be smaller in diameter up to (DN 300) and working pressure 75 bar.

The construction of the several measuring-reduction stations is planned on the main gas pipeline: Ogulin, Otočac, Gospić, Gračac, Obrovac, Benkovac, Biograd, Zadar, Pirovac, Šibenik, Drniš, Knin, Trogir and Split.
Investments in gas pipeline system in Central and Eastern Croatia primarily is related to the investments in reconstruction and new facilities on existing systems and the construction of 75 bar backbone of the transport system of Croatia: Zagreb-Slavonski Brod-Donji Miholjac-Hungary. Connection pipeline to Hungary: Slobodnica-Donji Miholjac-Dravaszerdahely DN 800 was built and it is in function since August 2011. Maximum transmission capacity of this interconnection is 6, 5 bcm/year, with a possibility of gas flow and transmission in both directions.

Figure 9: Gas transportation system in Croatia in 2012
Source: Directions of development of the Croatian gas system, Đurovic. HSUP Opatija 2010

After the Second investment cycle ends with its main tasks of gasification of Croatia, the development in the future will be directed to projects which will primarily be focused on the supply of new transit or import routes to Croatia and supply connection toward neighbouring countries. New supply and import routes are: a combination of the Nabucco or South Stream connection from Hungary and Serbia, increase in supply capacity from Slovenia, the pipeline system IAP, pipeline system for receiving and evacuation of LNG from island Krk. Supply connections toward neighbouring countries are primarily to Bosnia and Herzegovina: pipelines Gradiška - Banja Luka, Slobodnica - Bosanski Brod, Ličke Jesenice - Bihać, and pipelines Imotski - Posušje or Ploče-Mostar. For all the aforementioned projects preliminary activities will be performed until and including the preliminary design, while construction will depend on their integration into actual supply and market options.

Figure 10: Development of gas transmission system in Croatia after 2012
Source: PLINACRO Ltd, 5th Gas Forum, 14 September 2010, Brdo, Slovenia

3.2 Pipeline route description

3.2.1 General

The following route description deals with the main route indicated as the longest route from Fier to Split ignoring the most feasible route.
The route starts in Fier in Albania, runs in northern direction reaching Tirana, continuing toward the border to Montenegro. The route passes Skadar lake from the northern side then runs toward Podgorica in Montenegro. Following the main road the pipeline passes the city of Cetinje continuing toward border to Croatia, crossing the Bokokotorska bay and reaches the peninsular of Croatian territory. Parallel to the coastal line pipeline runs toward Dubrovnik, reaching Dubrovačko primorje and via peninsula Pelješac crossing the sea toward Ploče. Finally from Ploče the route runs north-west and reaches the city of Split.
In the following figure the route is shown bold.

Figure 11: Ionian – Adriatic Pipeline

Each country has alternative routes, which are analysed in optimization of the most feasible route. They are described as follows:

3.2.2 Route description Albania

The route starts at compressor station CS3 of the TAP-System near the city of Fier and runs in northern direction parallel to the coastal line and reach Tirana. From Tirana route runs toward Lezhe and continuing toward border of Montenegro. The route has four variants from Fier to border of Montenegro which are shown at figure 12.

Variant A-AL
The route runs from Fier toward Tirana area passes north of Skadar Lake and runs toward Hani Hotit (Barlaj) at Albania – Montenegro border.

Variant B-AL
From Fier route runs to the west, toward the cost and then in northern direction parallel to the costal line toward Skadar Lake, passes north of Skadar Lake and runs toward Hani Hotit (Barlaj) at Albania – Montenegro border.

Variant C-AL
The route runs from Fier toward Tirana area and parallel to the costal line toward Dajc (Štodra) at the Albania – Montenegro border.

Variant D-AL
From Fier the route runs to the west, toward the coast and then in northern direction parallel to the costal line toward Dajc (Štodra) at the Albania – Montenegro border.

Figure 12: The IAP on Albanian territory

3.2.3 Route description Montenegro

Route via Montenegro has four variants. They are described below and shown on figure 13.

Variant A-MN
From Lezhe the route crosses the border of Montenegro, passes Skadar Lake on the northern side then runs toward Podgorica. Following the main road the pipeline passes the city of Cetinje continuing toward Kotor. On IAP route this variant can only be connected with Variant A-AL or Variant B-AL in Albania.

Variant B-MN
From Lezhe the route crosses the border of Montenegro and runs toward Bar. Parallel to the coastal line, up in the mountains the pipeline runs toward Budva, passes Budva on the northern side and reaches Kotor. On IAP route this variant can only be connected with Variant C-AL or Variant D-AL in Albania.

Variant C-MN
From Lezhe the route crosses border of Montenegro and runs toward Bar. Following the route along the coast the pipeline reaches Budva and continues toward Kotor. On IAP route this variant can only be connected with Variant C-AL or Variant D-AL in Albania.

Variant D-MN
From Lezhe the route crosses the border of Montenegro and runs toward Bar. From Bar the route runs offshore, reaches the coast and continues toward Kotor. On IAP route this variant can only be connected with Variant C-AL or Variant D-AL in Albania.

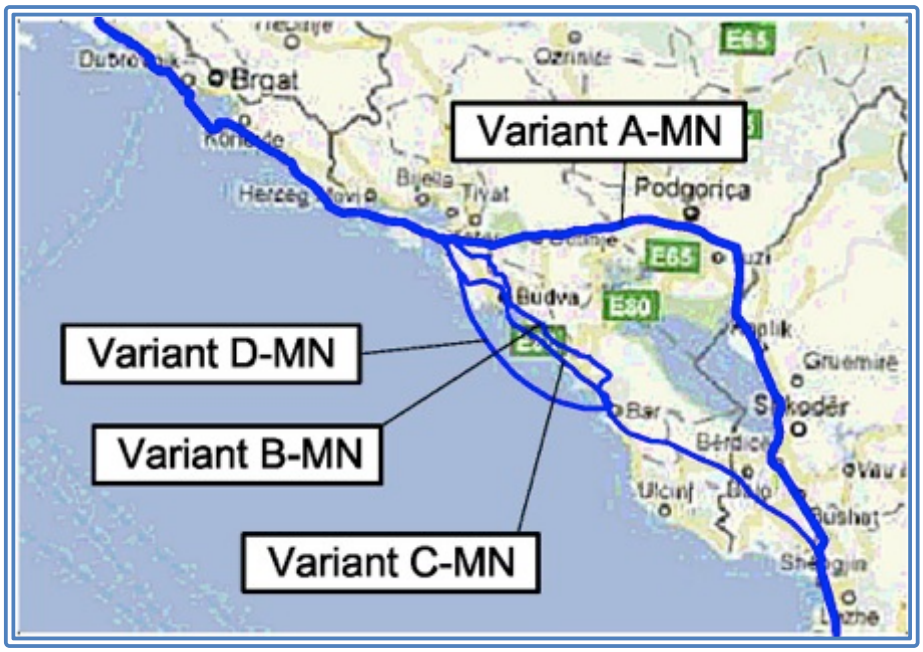


Figure 13: The IAP on Montenegro territory

3.2.4 Route description Croatia

In Croatia the pipeline runs from the border of Montenegro to Split. From section Dubrovačko primorje to Ploče it has three variants, which are shown at figure 14.

Variant A-HR
From Dubrovačko primorje the pipeline route runs via peninsula Pelješac crossing the sea at Osobjava place reaching Ploče north-west of the city.

Variant B-HR
From Dubrovačko primorje the pipeline route runs via peninsula Pelješac crossing the sea at Osobjava place reaching Ploče south of the city.

Variant C-HR
From Dubrovačko primorje to Ploče pipeline route runs parallel to the costal line partly through Bosnia and Herzegovina territory.

Figure 14: the IAP on Croatian territory

3.2.5 Route description Bosnia and Herzegovina

There are two route variants through Bosnia and Herzegovina:

Variant A – BiH
The route starts at Dubrovačko primorje in Croatia and runs in northern direction toward border of Croatia - BiH, passes Hutovo blato lake at the east side runs parallel to the Neretva river and reaches city of Mostar. From Mostar the route runs toward Posušje and continues toward Zagvozd in Croatia. The route is shown on figure 15.
If the pipeline route Variant A-BiH is not acceptable the Bosnia and Herzegovina pipeline system will be connected to IAP system by the branch connections.

Variant C-HR (BiH)
The route starts at the border of Croatia in the east and runs near city of Neum toward the border of Croatia in the west.

There are two variants of the branch connection to Bosnia and Herzegovina pipeline system from the IAP System.

Interconnection variant 1
Zagvozd (HR) – Imotski (HR) – Posušje (BiH)

Interconnection variant 2
Ploče (HR) – Čapljina (BiH).

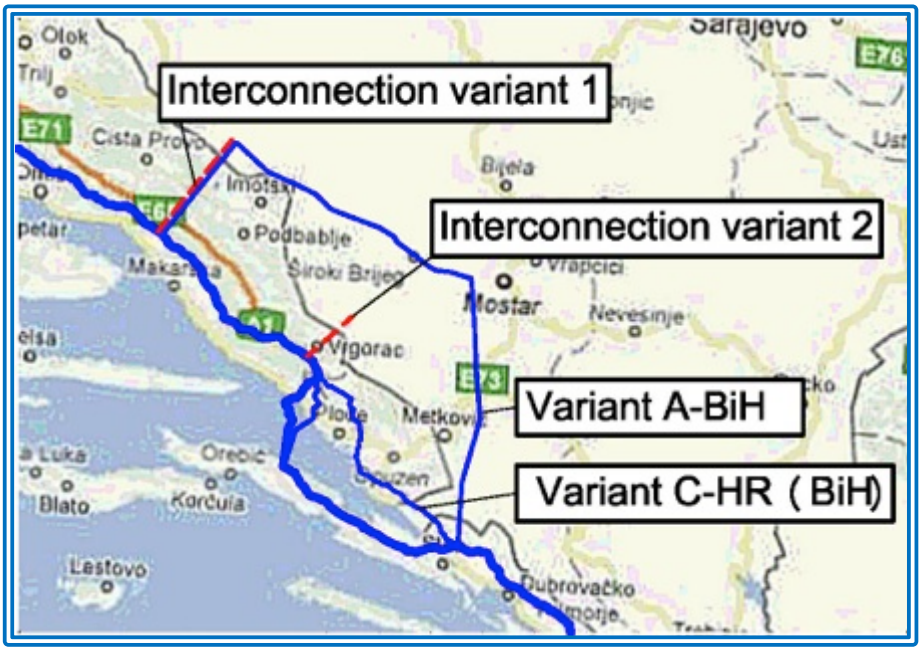


Figure 15: The IAP on Bosnia and Herzegovina territory

3.3 Pipeline Throughput Scenarios

The IAP project is planned as bi-directional pipeline. Possible supply direction could be south – north: (Fier – Split), or north – south: (Split –Fier).

For all Variants it has to be considered that 1.0 bcm/year will have to be supplied to Albania, 0, 5 bcm/year have to be transported to Montenegro and 1.0 bcm/year shall be designated to Bosnia at the branch in the Ploče area.

The quantities for the northern region of Croatia are assumed to be 2,5 bcm/year, so total IAP throughput is 5 bcm/year, for south – north: (Fier – Split) direction.

Therefore for north – south: (Split –Fier) direction the quantities for the southern region of Croatia are assumed to be 0,2 bcm/year, at the first off take at Ploče 0,1 bcm/year, should exit from the system, while the remaining 0.1 bcm/year, should exit at Dubrovnik off take so total IAP throughput is 2,7 bcm/year.

Optimization is carried out including both directions.

3.4 Basic Block Flow Diagram

The following figure shows the basic block flow diagram of the IAP gas pipeline system considered in the calculations.

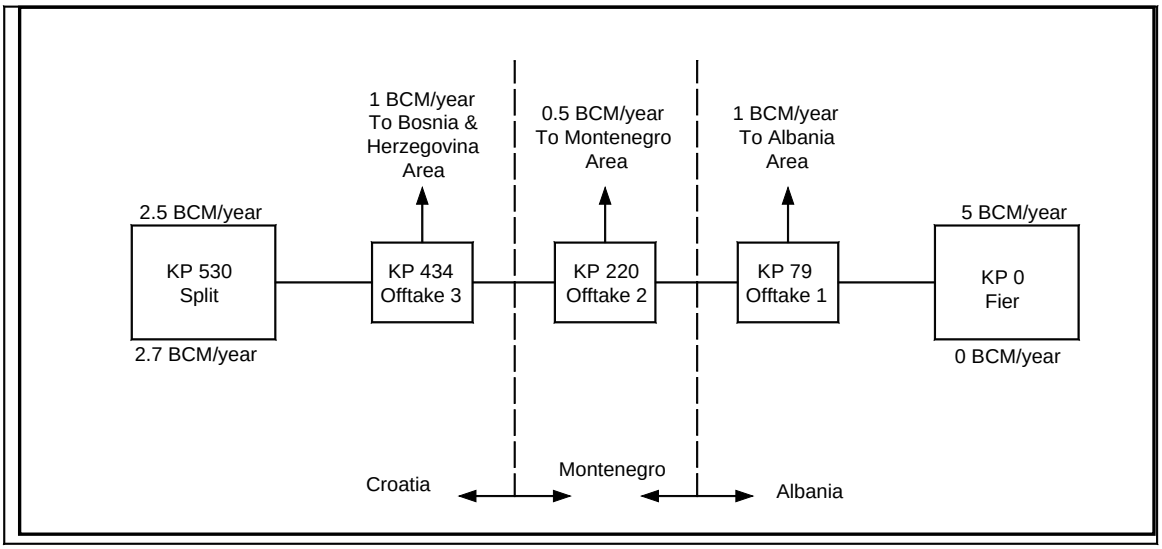


Figure 16: Basic block flow diagram

The following figure shows the block flow diagram of the IAP gas pipeline system with all variants pipeline route. The highlighted variant is considered in the calculations.

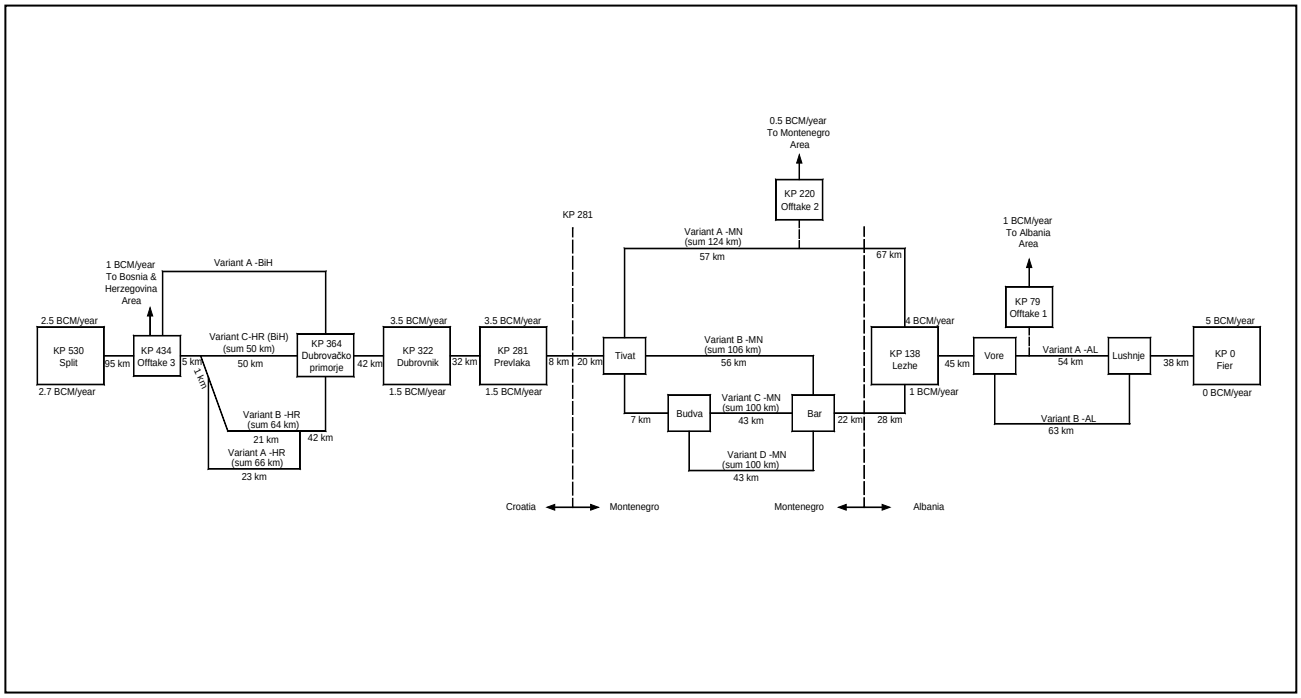


Figure 17: Basic block flow diagram with all variants

3.5 Basic Variants Block Flow Diagram

The following figure shows the basic block flow diagram of route option between Ploče –Dubrovnik (variants A, B or C).

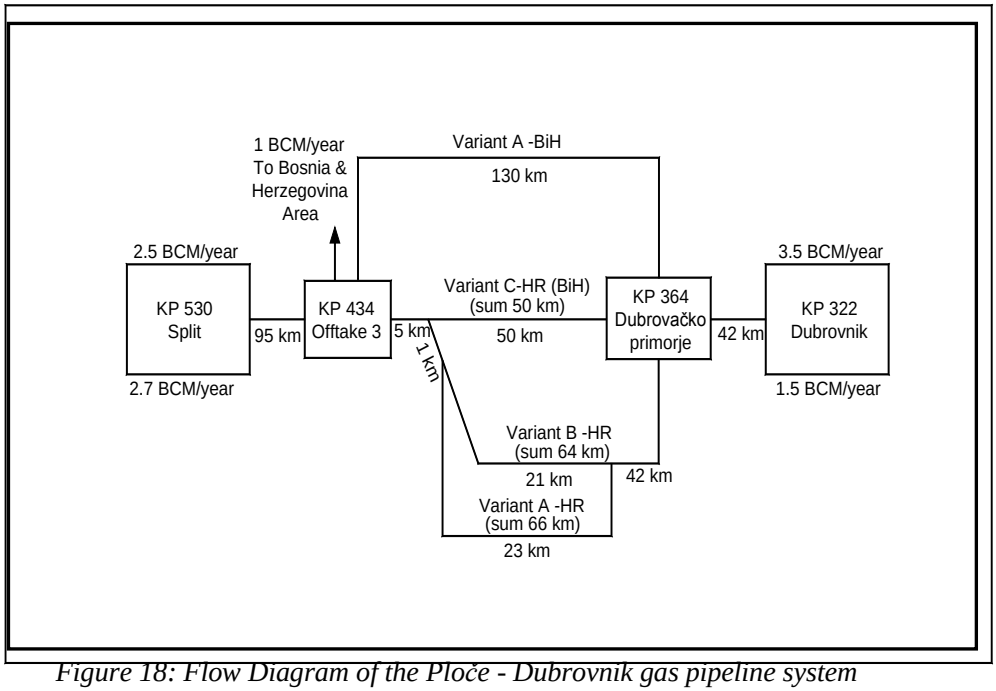


Figure 18: Flow Diagram of the Ploče - Dubrovnik gas pipeline system

The following figure shows the basic block flow diagram of route option between (HR/MNE border - and MNE/ALB border)

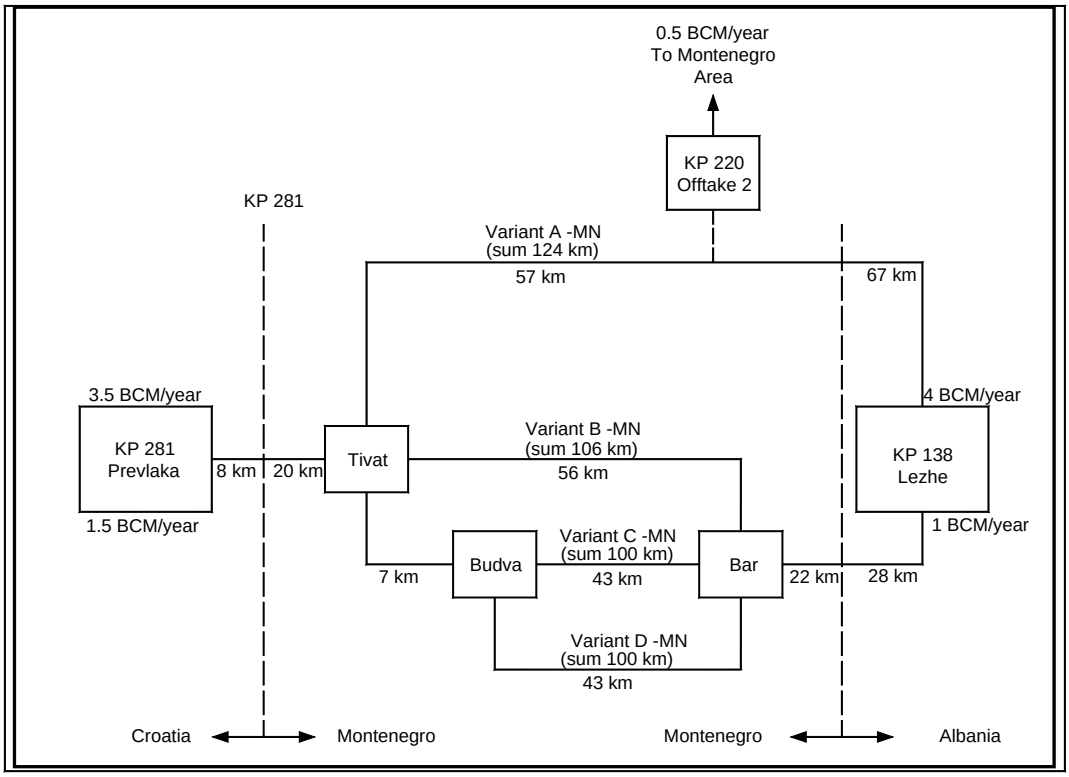


Figure 19: Block Flow Diagram of the Prevlaka - Lezhe gas pipeline system

The following figure shows the basic block flow diagram of route option between (MNE/AL border) and Fier

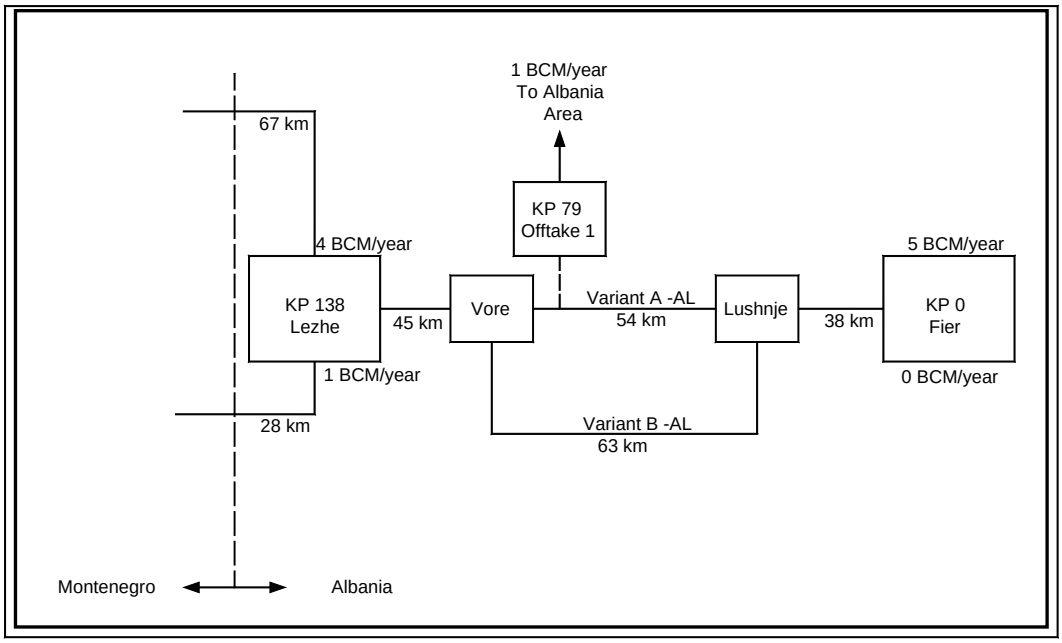


Figure 20: Block Flow Diagram of the Lezhe - Fier gas pipeline system

3.6 Standard Conditions and Operational Availability

For the gas quality and throughput related calculations the following standard conditions were assumed:

Standard Pressure: 1.01325 bar
Standard Temperature: 15°C

The time availability factor has been assumed as 95%, i.e. the annual operating time corresponds to 8322 h per year.

3.7 Gas Quality

Natural gas composition shown in the following table corresponds to the gas composition of the Trans Adriatic Pipeline (TAP) according to C205/ILFM-AD-0000/Rev. B IAP (Ionian Adriatic Pipeline) – Hydraulic study and cost comparison (step 1). The process calculations are based on this composition.

Table 1: Design Gas Composition

Component		**Mole %**
Methane	C1	87.78
Ethane	C2	2.72
Propane	C3	1.54
Iso-Butane	C4	0.50

Component		**Mole %**
N-Butane	C4	0.51
Iso-Pentane	C5	0.24
N-Pentane	C5	0.24
Hexane	C6	0.03
Nitrogen	N2	4.43
Carbon Dioxide	CO2	2.01
Total	-	100.00

3.8 Pipeline Related Data

General Parameters
For the pipeline, the following parameters have been assumed:

- Pipeline Maximum Allowable Operating Pressure: 85 barg
- Pipe Wall Conductivity: 45 W/m/K
- PE Coating Thickness: 3.5 mm
- PE Coating Conductivity: 0.35 W/m/K
- Roughness: 8 μm
- The soil temperature at laying depths: 10°C
- Pipe wall thickness determination as per ASME B31.8.

Heat Transfer related data of the Buried Pipeline
For the hydraulic calculations, the following heat transfer data of the buried pipeline have been considered:

- Soil cover above pipeline top: 1 m
- Soil Heat Conductivity: 1.0 W/m/K
- The soil temperature at laying depths: 10°C

3.9 Compressor Station Related Data

Process Parameters
For estimations regarding the compressor and gas turbine requirements, the following assumptions have been made:

- Adiabatic compression efficiency: 80 %
- Mechanical efficiency: 97 %
- Gas turbine fuel gas efficiency: 33 %
- Gas turbine altitude correction: 0.78 - 1
- Gas turbine Inlet loss correction: 0.952 - 1
- Gas exhaust loss correction: 0.979 - 1
- Gas turbine ambient temperature correction: 0.82 – 1.25

4 Hydraulic calculations

4.1 Simulation Software

The process calculations have been conducted using the GASWorkS software 6.0 by Bradley B. Bean, PE.

GASWorkS™ provides Windows based steady-state network modelling tools. It is designed to assist the engineering professionals analyze and design distribution, gathering, transmission, and plant piping systems containing natural gas or other compressible fluids. Support is provided for systems made up of fittings, compressors, pipes, regulators, valves, and wells. A robust set of import and export routines allows data exchange with a variety of CAD, GIS, and Database applications.

4.2 Methodology

To make decision about optimal pipeline diameter for IAP system the hydraulic calculations have been conducted in two steps:

Step 1
The optimal pipeline diameter is determined while ignoring of the most feasible route option through beneficiary countries. The longest route was taken into account instead.
The hydraulic calculations have been conducted for set of different pipeline diameters in range of 28“, 30“, 32“, 34“ and 36“ for pipeline route Fier – Split. Since the pipeline system is assumed to be bi-directional, the calculations have been conducted for pipeline route Split- Fier as well.
Number and power of compressor stations, along pipeline route is determined based on demanded pressures at the outputs and at the base of inlet pressure at inlet point of pipeline route in either direction. In the final solution, the compressor with higher demanded compression power for both directions at the same site is chosen.

Step 2
The optimal option of the route through beneficiary countries is determined for the pipeline diameter determined in Step 1.
The final solution is based on optimal pipeline diameter in both directions and optimal option of the route through beneficiary countries.

Individual pipeline system configurations are compared to each other with respect to investment cost, fuel gas cost and maintenance cost. The final comparison is performed based on the PDV method.

4.3 Wall thickness calculation

Pipe wall thickness calculations have been performed per ASME B31.8.

4.4 Design Pressure

Design pressure calculation has been performed on the basis of pipeline diameter and throughput of the system and according to inlet and outlet pressure of the system.

For south – north: (Fier – Split) direction the calculations are based on a maximum supply pressure of 82 barg at a temperature of 10°C from TAP pipeline. The minimum delivery pressures are considered as follows:

- To Tirana area is specified with 50barg.
- To Montenegro area is specified with 50barg.
- To Ploče is specified with 50barg.
- To Split is specified with 70 barg.

For north – south: (Split –Fier) direction the calculations are based on a minimum supply pressure of 50 barg at a temperature of 10°C from Bosiljevo – Split pipeline which Plinacro delivers at inlet of IAP system. To transmit 2.7 bcm/year trough the IAP system, minimum design pressure is assumed to be 60 barg which is obtained by compressor at the inlet of IAP system. The minimum delivery pressures are considered as follows:

- To Tirana area is specified with 50barg.
- To Montenegro area is specified with 50barg.
- To Ploče is specified with 50barg.
- To Fier is specified with 50 barg.

4.5 Hydraulics Results

Results of hydraulics calculations for determination of optimal pipeline diameter, as mentioned in methodology chapter are shown below in following figures and table.

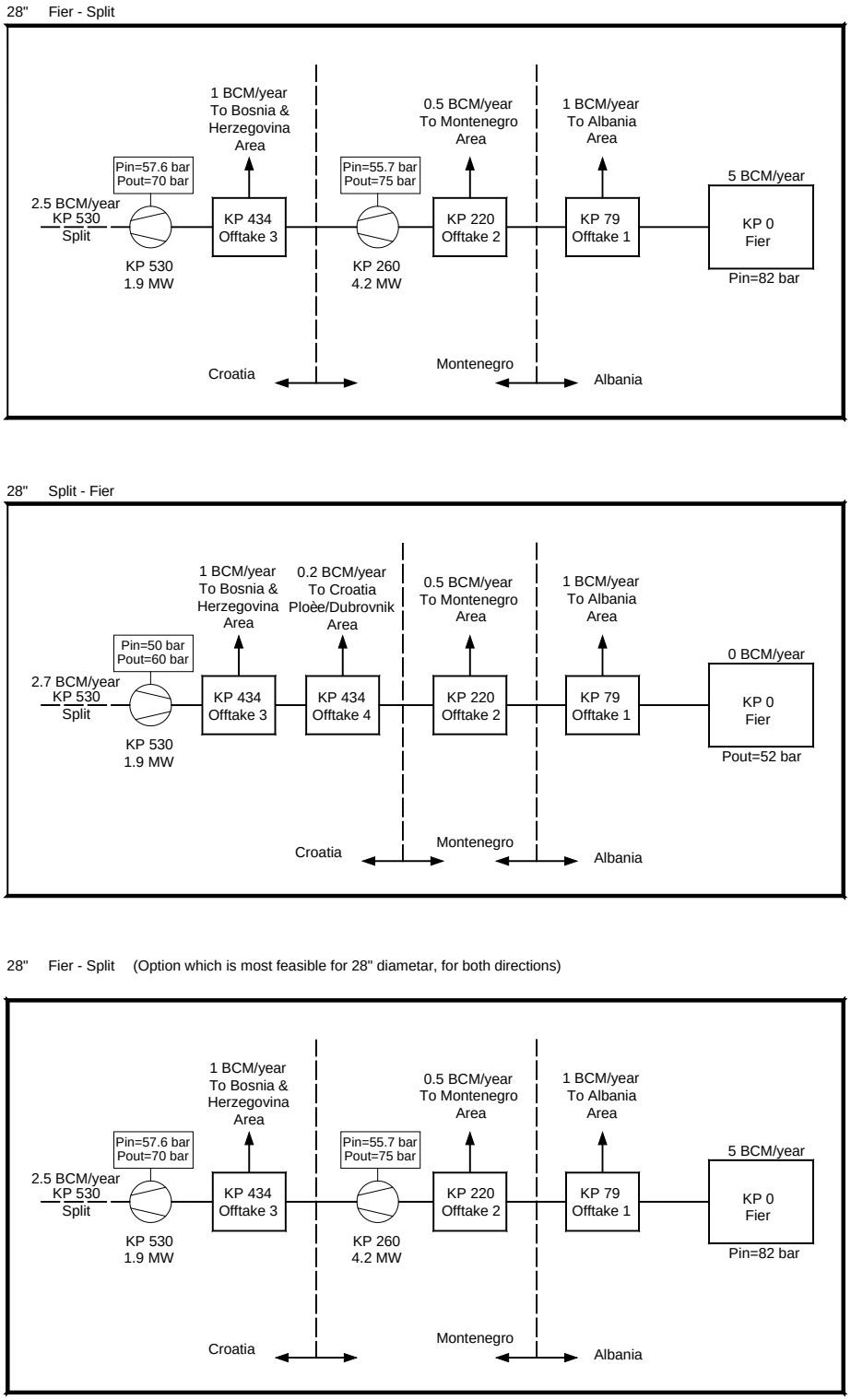


Figure 21: Hydraulic calculation for Option 28"

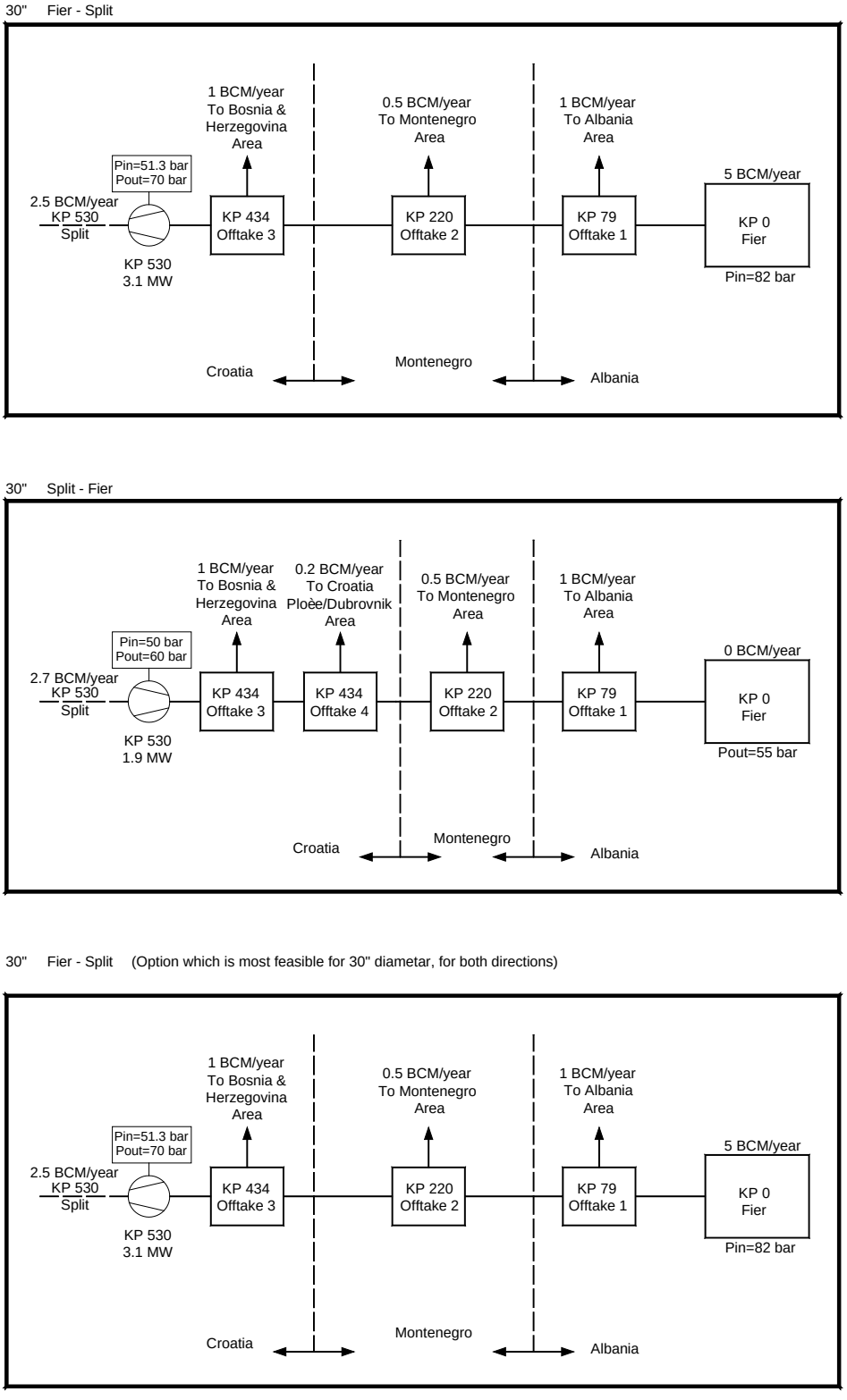


Figure 22: Hydraulic calculation for Option 30”

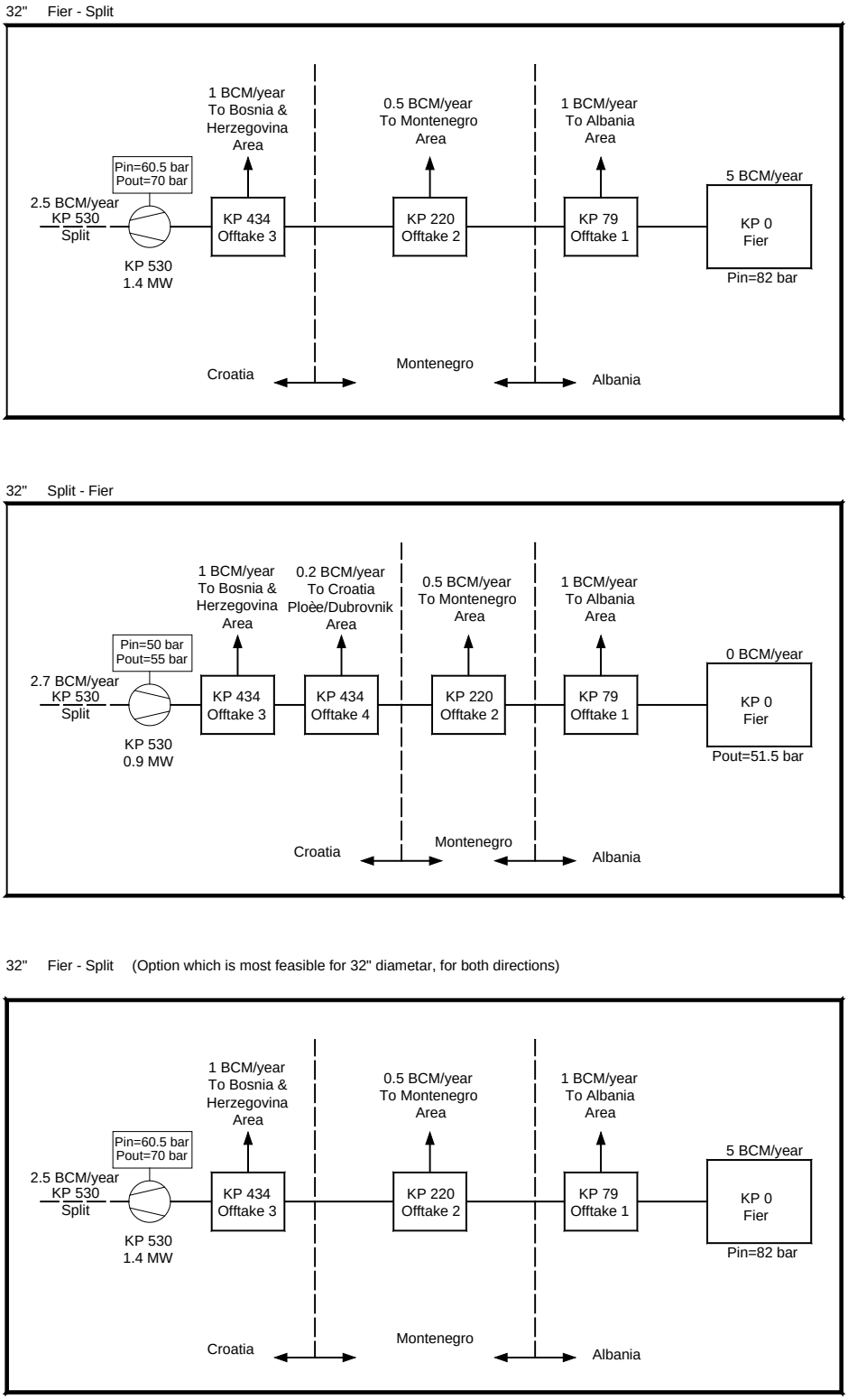


Figure 23: Hydraulic calculation for Option 32"

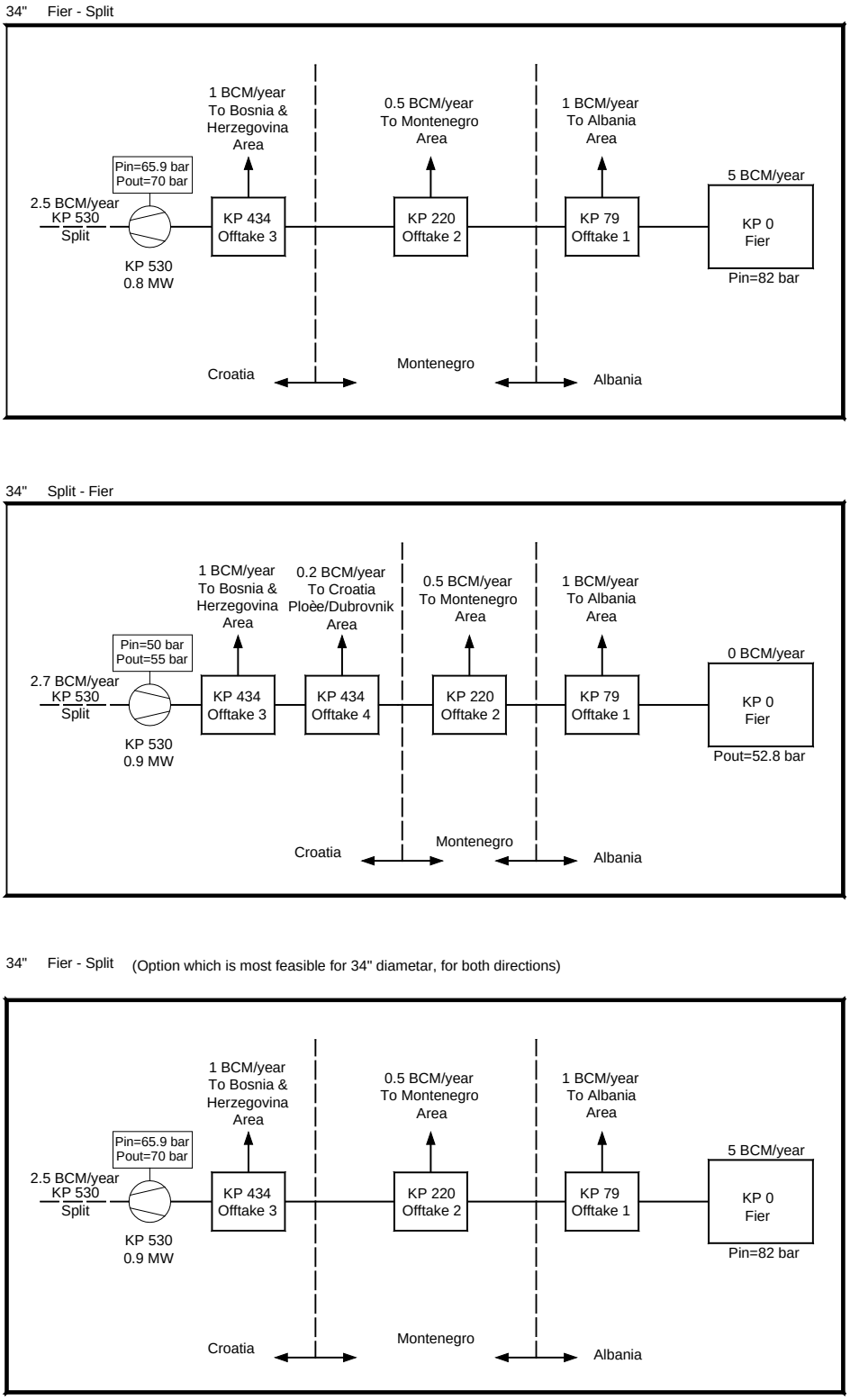


Figure 24: Hydraulic calculation for Option 34"

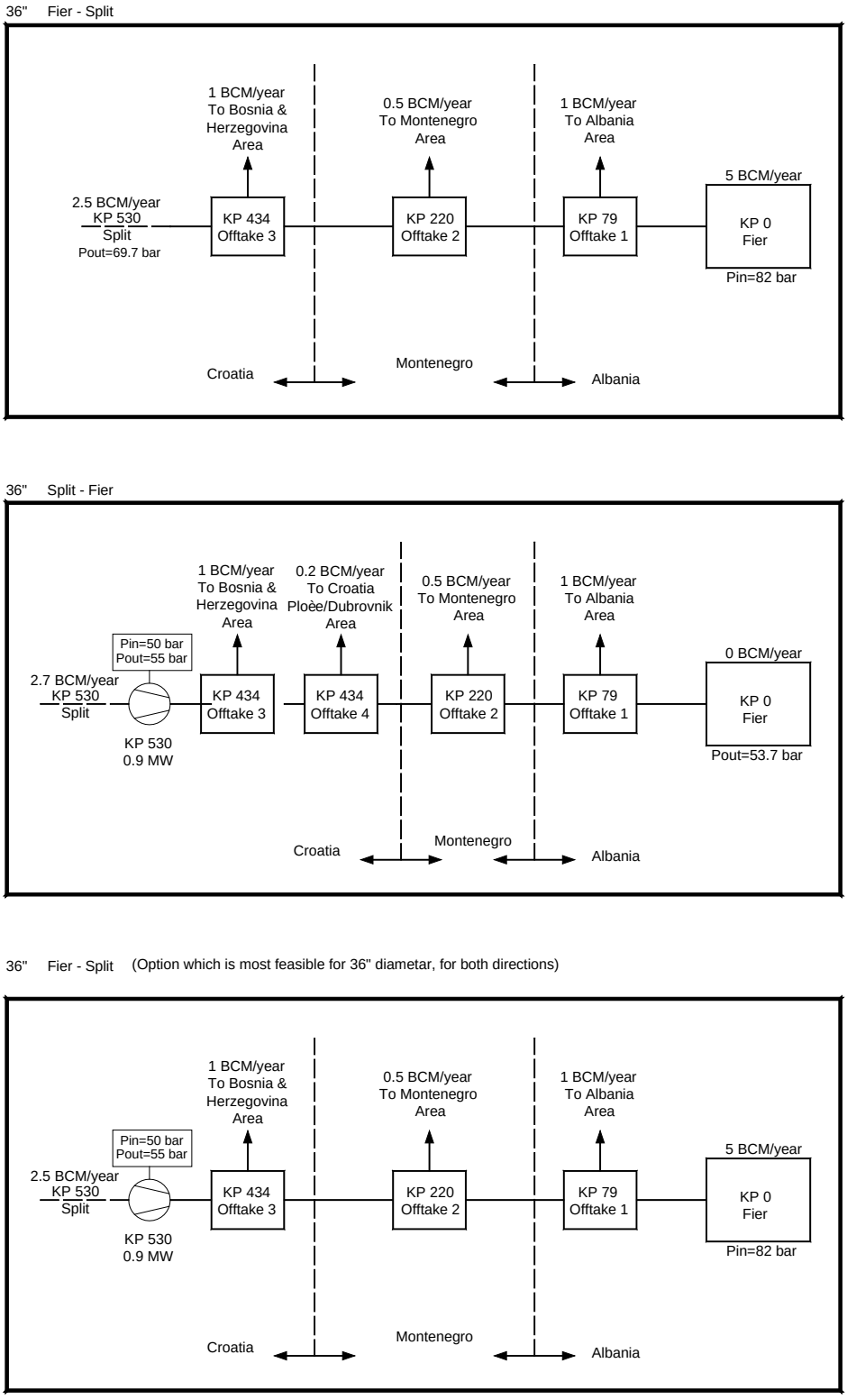


Figure 25: Hydraulic calculation for Option 36"

Hydraulics results are summarized in the following table.

Table 2: Hydraulics results

Option Loop	**Direction** A (Fier - Split) B (Split - Fier)	**Pin** bar	**Pou** bar	**CS** **Split**	**Power** MW	**Additional CS in Montenegro**	**Power** MW
28"	A	82.0	70.0	1.0	1.9	1.0	4.2
28"	B	50.0	52.2	1.0	1.9		
30"	A	82.0	70.0	1.0	3.1		
30"	B	50.0	55.0	1.0	3.1		
32"	A	82.0	70.0	1.0	1.4		
32"	B	50.0	51.5	1.0	1.4		
34"	A	82.0	70.0	1.0	0.9		
34"	B	50.0	52.8	1.0	0.9		
36"	A	82.0	70.0	1.0	-		
36"	B	50.0	53.7	1.0	0.9		

5 Economic calculations

5.1 CAPEX and OPEX Estimate

For each pipeline diameter option considered, the following main items have been estimated:

- For the Pipeline Sections:
  - Pipeline investment cost
  - Pipeline maintenance cost
- For the Compressor Stations:
  - Compressor shaft rated power
  - Compressor station investment cost
  - Compressor station energy cost
  - Compressor station maintenance cost

The following tables show cost evaluation of each pipeline diameter option

Table 3: Cost calculation for Option 28"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**				
1.1	**Investment costs**				
	Nominal diametar	inch	28		
	Pipeline length	km	530		
	Specific investment cost pipeline	€/"m	36.0		
	Investment costs pipeline	**Mio €**	**534.24**		
1.2	**Maintenance costs**				
	Annual fraction of investment	-	1.0%		
	Total investment costs	Mio €	534.24		
	Annual maintenance costs	**Mio €/year**	**5.3**		
2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW	4211	1938	
	Instaled ISO power	MW	7.7	3.5	
	Basis-Investment	Mio €	32	32	
	Specific performance related cost	€/kW	1500	1500	
	Performance Related Costs	Mio €	11.5	5.3	
	Investment costs compressor station	**Mio €**	**43.6**	**37.3**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm	30	30	
	Shaft Power	MW	4.3	2	
	Annual energy costs	**Mio €/year**	**1.4**	**0.7**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-	2.8%	2.8%	
	Investment costs	Mio €	43.6	37.3	
	Annual maintenance costs	**Mio €/year**	**1.2**	**1.0**	
3	**COST COMPOSITION**				
3.1	**Investment costs**				
	Pipeline	Mio €	534.24		
	Compressor station	Mio €	80.8		
	Sum	**Mio €**	**615.04**		
3.2	**Energy costs**				
	Pipeline	Mio €	0		
	Compressor station	Mio €	2.1		
	Sum	**Mio €**	**2.1**		
3.3	**Maintenance costs**				
	Pipeline	Mio €	5.3		
	Compressor station	Mio €	2.3		
	Sum	**Mio €**	**7.6**		

Table 4: Cost calculation for Option 30"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**				
1.1	**Investment costs**				
	Nominal diametar	inch	30		
	Pipeline length	km	530		
	Specific investment cost pipeline	€/"m	36.0		
	Investment costs pipeline	**Mio €**	**572.4**		
1.2	**Maintenance costs**				
	Annual fraction of investment	-	1.0%		
	Total investment costs	Mio €	572.4		
	Annual maintenance costs	**Mio €/year**	**5.7**		
2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		3141	
	Instaled ISO power	MW		5.7	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		8.6	
	Investment costs compressor station	**Mio €**		**40.6**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		3.2	
	Annual energy costs	**Mio €/year**		**1.1**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		40.6	
	Annual maintenance costs	**Mio €/year**		**1.1**	
3	**COST COMPOSITION**				
3.1	**Investment costs**				
	Pipeline	Mio €	572.4		
	Compressor station	Mio €	40.6		
	Sum	**Mio €**	**612.95**		
3.2	**Energy costs**				
	Pipeline	Mio €	0		
	Compressor station	Mio €	1.1		
	Sum	**Mio €**	**1.1**		
3.3	**Maintenance costs**				
	Pipeline	Mio €	5.7		
	Compressor station	Mio €	1.1		
	Sum	**Mio €**	**6.9**		

Table 5: Cost calculation for Option 32"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**				
1.1	**Investment costs**				
	Nominal diametar	inch	32		
	Pipeline length	km	530		
	Specific investment cost pipeline	€/"m	36.0		
	Investment costs pipeline	**Mio €**	**610.56**		
1.2	**Maintenance costs**				
	Annual fraction of investment	-	1.0%		
	Total investment costs	Mio €	610.56		
	Annual maintenance costs	**Mio €/year**	**6.1**		
2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		1425	
	Instaled ISO power	MW		2.6	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		3.9	
	Investment costs compressor station	**Mio €**		**35.9**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		1.5	
	Annual energy costs	**Mio €/year**		**0.5**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		35.9	
	Annual maintenance costs	**Mio €/year**		**1.0**	
3	**COST COMPOSITION**				
3.1	**Investment costs**				
	Pipeline	Mio €	610.56		
	Compressor station	Mio €	35.9		
	Sum	**Mio €**	**646.46**		
3.2	**Energy costs**				
	Pipeline	Mio €	0		
	Compressor station	Mio €	0.5		
	Sum	**Mio €**	**0.5**		
3.3	**Maintenance costs**				
	Pipeline	Mio €	6.1		
	Compressor station	Mio €	1.0		
	Sum	**Mio €**	**7.1**		

Table 6: Cost calculation for Option 34"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**		
1.1	**Investment costs**		
	Nominal diametar	inch	34
	Pipeline length	km	530
	Specific investment cost pipeline	€/"m	36.0
	Investment costs pipeline	**Mio €**	**648.72**
1.2	**Maintenance costs**		
	Annual fraction of investment	-	1.0%
	Total investment costs	Mio €	648.72
	Annual maintenance costs	**Mio €/year**	**6.5**

2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		978	
	Instaled ISO power	MW		1.8	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		2.7	
	Investment costs compressor station	**Mio €**		**34.7**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		1	
	Annual energy costs	**Mio €/year**		**0.3**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		34.7	
	Annual maintenance costs	**Mio €/year**		**1.0**	

3	**COST COMPOSITION**		
3.1	**Investment costs**		
	Pipeline	Mio €	648.72
	Compressor station	Mio €	34.7
	Sum	**Mio €**	**683.42**
3.2	**Energy costs**		
	Pipeline	Mio €	0
	Compressor station	Mio €	0.3
	Sum	**Mio €**	**0.3**
3.3	**Maintenance costs**		
	Pipeline	Mio €	6.5
	Compressor station	Mio €	1.0
	Sum	**Mio €**	**7.5**

Table 7: Cost calculation for Option 36"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**				
1.1	**Investment costs**				
	Nominal diametar	inch	36		
	Pipeline length	km	530		
	Specific investment cost pipeline	€/"m	36.0		
	Investment costs pipeline	**Mio €**	**686.88**		
1.2	**Maintenance costs**				
	Annual fraction of investment	-	1.0%		
	Total investment costs	Mio €	686.88		
	Annual maintenance costs	**Mio €/year**	**6.9**		
2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		978	
	Instaled ISO power	MW		1.8	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		2.7	
	Investment costs compressor station	**Mio €**		**34.7**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		1	
	Annual energy costs	**Mio €/year**		**0.3**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		34.7	
	Annual maintenance costs	**Mio €/year**		**1.0**	
3	**COST COMPOSITION**				
3.1	**Investment costs**				
	Pipeline	Mio €	686.88		
	Compressor station	Mio €	34.7		
	Sum	**Mio €**	**721.58**		
3.2	**Energy costs**				
	Pipeline	Mio €	0		
	Compressor station	Mio €	0.3		
	Sum	**Mio €**	**0.3**		
3.3	**Maintenance costs**				
	Pipeline	Mio €	6.9		
	Compressor station	Mio €	1.0		
	Sum	**Mio €**	**7.8**		

5.2 Economic and financial analysis of the project

The aim of this economic and financial analysis is to express all the effects of the Ionian-Adriatic Gas Pipeline Project in value units and thus provide the documentation and information base for project assessment.
Investments in the construction of the gas transportation system represent a capital allocation for an investment proposal that debits the Investor's current liquid expenditures on account of assured future benefits. Therefore, successful management of capital to be invested in the construction of the Ionian-Adriatic Gas Pipeline system comprises:

- drawing up the investment proposal,
- cash flow estimate for the investment proposal,
- cash flow evaluation,
- project selection based on acceptance criterion.

5.2.1 Options under consideration

Preparations for the Ionian-Adriatic Gas Pipeline Project are still in an early stage where various options are permitted, so the economic and financial analysis will be made for several options involving different pipeline diameters, viz.:

- pipeline diameter 28" (Model 1),
- pipeline diameter 30" (Model 2),
- pipeline diameter 32" (Model 3),
- pipeline diameter 34" (Model 4),
- pipeline diameter 36" (Model 5).

5.2.2 Investment costs

The basic task of the economic and financial analysis of the said investment project in preparing the construction of the Ionian-Adriatic Gas Pipeline includes an information base composed, among other things, of investments in real estate and equipment for natural gas transportation.

The investment proposal (amount and structure) is based on the technological and engineering characteristics of the Ionian-Adriatic Gas transportation system.

Table 8 Investment structure and dynamics

	Investment structure	Total investment 000 €	Dynamics Year 1.	Year 2.	Year 3.
1.	**Model 1 - pipeline diameter 28"**				
	Pipeline	534.200	178.067	178.067	178.067
	Compressor station	80.800	26.933	26.933	26.933
	Total investment	615.000	205.000	205.000	205.000
2.	**Model 2 - pipeline diameter 30"**				
	Pipeline	572.400	190.800	190.800	190.800
	Compressor station	40.600	13.533	13.533	13.533
	Total investment	613.000	204.333	204.333	204.333
3.	**Model 3 - pipeline diameter 32"**				
	Pipeline	610.600	203.533	203.533	203.533
	Compressor station	35.900	11.967	11.967	11.967
	Total investment	646.500	215.500	215.500	215.500
4.	**Model 4 - pipeline diameter 34"**				
	Pipeline	648.700	216.233	216.233	216.233
	Compressor station	34.700	11.567	11.567	11.567
	Total investment	683.400	227.800	227.800	227.800
5.	**Model 5 - pipeline diameter 36"**				
	Pipeline	686.900	228.967	228.967	228.967
	Compressor station	34.700	11.567	11.567	11.567
	Total investment	721.600	240.533	240.533	240.533

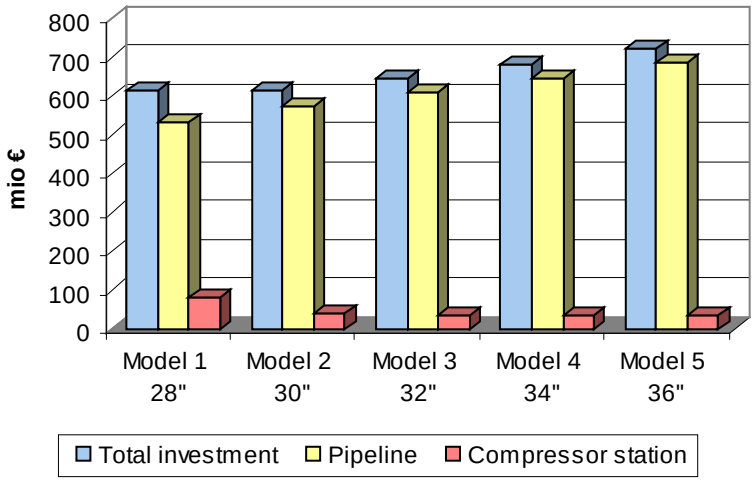


Figure 26: Investments in the gas transportation system

5.2.3 Financing sources

The next important step in the financial analysis of the investment project in preparing the construction of the Ionian-Adriatic Gas Pipeline is selecting the sources of investment financing. The procedure is important not only to complete the financial scheme, but also to assess the financial obligations arising from it.

Within the Financing Plan for this investment project an option has been considered according to which the construction of the Ionian-Adriatic Gas Transportation System would be financed from:

Funds obtained on financial markets through long-term borrowing at financial institutions

The price of borrowed capital has been calculated according to the following assumed terms and conditions:

- repayment period: 15 years,
- regular interest rate: 6% per annum
- repayment in equal semi-annual instalments

5.2.4 Estimate of expenditures

Expenditures include investments, operation and maintenance costs and other outlays related to natural gas transportation, in other words, any expenditure that diminish the economic and financial potential of the Ionian-Adriatic Gas Pipeline project.

Investments in fixed assets

The investment proposal for the analysed options (investment amount and structure) is based on technological and engineering characteristics of the Ionian-Adriatic Gas Pipeline project. The investment level and progress are shown in section Investment Costs.

Business expenditures

This part of financial data processing is tasked to determine the reason and the amount of business expenditures that diminish the economic and financial potential of the investment project, as an important input for the subsequent assessment of liquidity and profitability.
Business expenditures are divided into three groups:

- operating and maintenance costs,
- depreciation, and
- financial expenditures.

Operating and maintenance costs

At this stage of preparations for the Ionian-Adriatic Gas Pipeline project, the operating and maintenance costs include:

- energy costs
- gas transportation system maintenance costs

Table 9 Operating and maintenance costs

Options under consideration	mio €		
	Total costs	Energy costs	Maintenance costs
Model 1 - pipeline diameter 28"	**9,7**	**2,1**	**7,6**
Model 2 - pipeline diameter 30"	**8,0**	**1,1**	**6,9**
Model 3 - pipeline diameter 32"	**7,6**	**0,5**	**7,1**
Model 4 - pipeline diameter 34"	**7,8**	**0,3**	**7,5**
Model 5 - pipeline diameter 36"	**8,1**	**0,3**	**7,8**

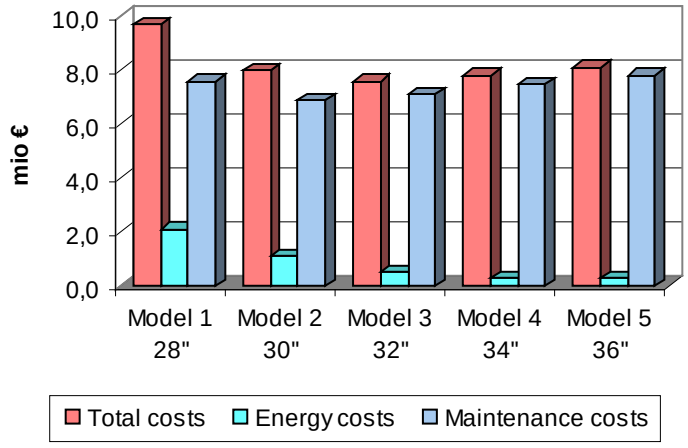


Figure 27: Operating and maintenance cost projection

5.2.5 Assessment of cash inflows

This part of financial data processing is tasked to determine the amount of cash inflows which are expected from the provision of natural gas transportation services and which increase the project's financial and economic potential, as an important input for the subsequent assessment of liquidity and profitability.

The project will earn cash from:

- provision of natural gas transport services
- the project's remaining value.

Income from natural gas transportation services

The quantity of natural gas transported is a business event resulting in an increased financial and economic potential of the project.

The projected provision of natural gas transportation services is based on:

- the expected volume of transported natural gas in the order of **5 billion cubic metres**,
- the amount of transport tariff that meets the set project acceptability criterion, the internal rate of return of 7%.

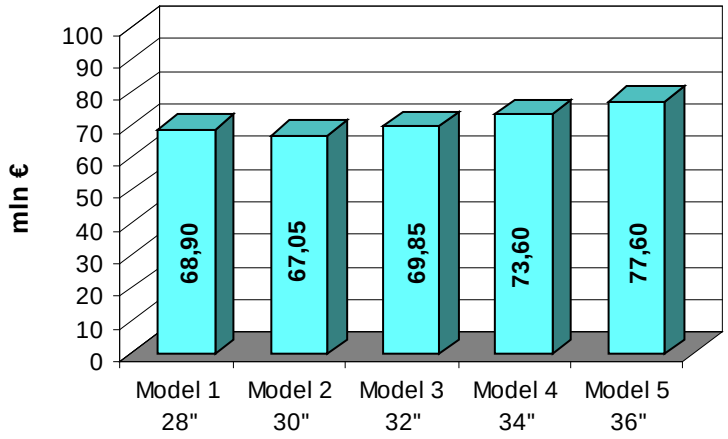


Figure 28: Operating revenue projection

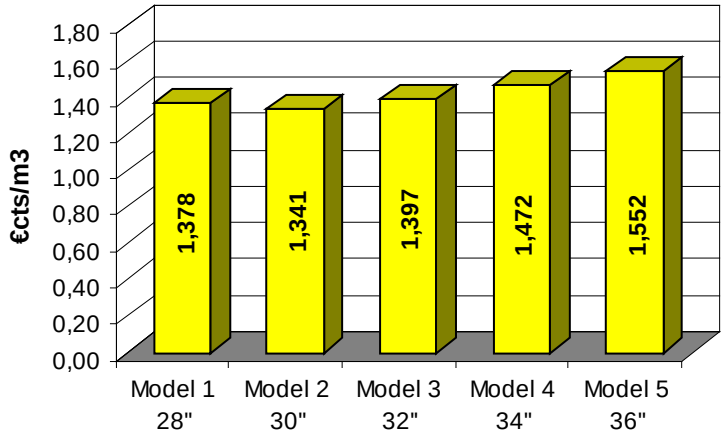


Figure 29: Transport tariff projection

The project's value balance

What also makes the project's cash inflows is the project's value balance that appears in the last year of the project's life, and includes:

- the remaining value of fixed tangible assets
- the remaining value of working capital.

5.2.6 Project profitability assessment

The success of the project will depend on its effects on the energy market, which will determine its economic impact. The economic assessment of the project includes profitability assessment at project level, i.e., the project's contribution to capital accumulation.

The source of information for profitability assessment is the project's economic flow, i.e., the business events determining the development of the project's economic potential.

Economic flow projection

The essence of profitability assessment (economic assessment for the Investor) is to ascertain whether the project's material basis is growing or decreasing, with its entire life taken into consideration.

The source of information for profitability assessment is the project's economic flow, i.e., the business events determining the development of the project's economic potential.

The assessment of future cash flows is based on:

- total investments in the gas pipeline construction project amounting:
  - €615.0 million, Model 1 – 28" pipeline,
  - €613.0 million, Model 2 – 30" pipeline,
  - €646,5 million, Model 3 – 32" pipeline,
  - €683,4 million, Model 4 – 34" pipeline,
  - €721.6 million, Model 5 – 36" pipeline,
- operating and maintenance costs amounting:
  - €9,7 million, Model 1 – 28" pipeline,
  - €8.0 million, Model 2 – 30" pipeline,
  - €7.6 million, Model 3 – 32" pipeline,
  - €7.8 million, Model 4 – 34" pipeline,
  - €8.1 million, Model 5 – 36" pipeline,
- expected volume of transported natural gas amounting
  - 5 billion cubic metres,
- amount of transport tariff that meets the set project acceptability criterion, the internal rate of return of 7%,
- the planned period of 20 years in which the investment project produces acceptable effects

For the investment proposals concerning the Ionian-Adriatic Gas Pipeline Project information has been provided about expected future cash flows. The cash flow estimates have yielded relevant information required for assessing the acceptability of each of the herein analysed solutions.
Described in continuation is the project's economic flow for the assumed management scenarios. Shown in Tables are the basic groups of planned (business and investment) activities impacting the project's cash flow, plus their structure and progress (business events based on planned business and investment activities that increase or decrease the project's economic potential).

Table 10 Economic flow – Model 1 – pipeline diameter 28"

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services				68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700
4.05.	Income tax	0	0	0	0	1.074	1.558	2.043	2.528	3.013	3.498	3.983
4.06.	**Total cash outflows**	**0**	**0**	**0**	**9.700**	**10.774**	**11.258**	**11.743**	**12.228**	**12.713**	**13.198**	**13.683**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**36.932**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**96.132**	**58.126**	**57.642**	**57.157**	**56.672**	**56.187**	**55.702**	**55.217**
	Evaluation of capital expenditure											
4.09.	Investment	205.000	205.000	205.000	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	205.000	410.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000
4.11.	Net cash flow from operating activitis	0	0	0	96.132	58.126	57.642	57.157	56.672	56.187	55.702	55.217
4.12.	**Net cash flow**	**-205.000**	**-205.000**	**-205.000**	**96.132**	**58.126**	**57.642**	**57.157**	**56.672**	**56.187**	**55.702**	**55.217**
4.13.	Cumulative net cash flow	-205.000	-410.000	-615.000	-518.868	-460.742	-403.100	-345.944	-289.272	-233.085	-177.382	-122.165

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	205.000
4.03.	**Total cash inflows**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**273.900**
	Cash outflows												
4.04.	Operation and maintensnce costs	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700
4.05.	Income tax	4.467	4.952	5.437	5.922	6.407	6.892	7.376	7.740	7.740	7.740	7.740	7.740
4.06.	**Total cash outflows**	**14.167**	**14.652**	**15.137**	**15.622**	**16.107**	**16.592**	**17.076**	**17.440**	**17.440**	**17.440**	**17.440**	**17.440**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-41.000**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**54.733**	**54.248**	**53.763**	**53.278**	**52.793**	**52.308**	**51.824**	**10.460**	**51.460**	**51.460**	**51.460**	**256.460**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000
4.11.	Net cash flow from operating activitis	54.733	54.248	53.763	53.278	52.793	52.308	51.824	10.460	51.460	51.460	51.460	256.460
4.12.	**Net cash flow**	**54.733**	**54.248**	**53.763**	**53.278**	**52.793**	**52.308**	**51.824**	**10.460**	**51.460**	**51.460**	**51.460**	**256.460**
4.13.	Cumulative net cash flow	-67.432	-13.184	40.579	93.857	146.650	198.958	250.782	261.242	312.702	364.162	415.622	672.082

Table 11 Economic flow – Model 2 – pipeline diameter 30''

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services	0	0	0	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
4.05.	Income tax	0	0	0	0	1.079	1.562	2.045	2.528	3.012	3.495	3.978
4.06.	**Total cash outflows**	**0**	**0**	**0**	**8.000**	**9.079**	**9.562**	**10.045**	**10.528**	**11.012**	**11.495**	**11.978**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**36.671**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**95.721**	**57.971**	**57.488**	**57.005**	**56.522**	**56.038**	**55.555**	**55.072**
	Evaluation of capital expenditure											
4.09.	Investment	204.333	204.333	204.333	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	204.333	408.667	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000
4.11.	Net cash flow from operating activitis	0	0	0	95.721	57.971	57.488	57.005	56.522	56.038	55.555	55.072
4.12.	**Net cash flow**	**-204.333**	**-204.333**	**-204.333**	**95.721**	**57.971**	**57.488**	**57.005**	**56.522**	**56.038**	**55.555**	**55.072**
4.13.	Cumulative net cash flow	-204.333	-408.667	-613.000	-517.279	-459.308	-401.820	-344.815	-288.293	-232.255	-176.699	-121.627

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	204.333
4.03.	**Total cash inflows**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**271.383**
	Cash outflows												
4.04.	Operation and maintensnce costs	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
4.05.	Income tax	4.461	4.945	5.428	5.911	6.394	6.878	7.361	7.723	7.723	7.723	7.723	7.723
4.06.	**Total cash outflows**	**12.461**	**12.945**	**13.428**	**13.911**	**14.394**	**14.878**	**15.361**	**15.723**	**15.723**	**15.723**	**15.723**	**15.723**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-40.867**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**54.589**	**54.105**	**53.622**	**53.139**	**52.656**	**52.172**	**51.689**	**10.460**	**51.327**	**51.327**	**51.327**	**255.660**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000
4.11.	Net cash flow from operating activitis	54.589	54.105	53.622	53.139	52.656	52.172	51.689	10.460	51.327	51.327	51.327	255.660
4.12.	**Net cash flow**	**54.589**	**54.105**	**53.622**	**53.139**	**52.656**	**52.172**	**51.689**	**10.460**	**51.327**	**51.327**	**51.327**	**255.660**
4.13.	Cumulative net cash flow	-67.039	-12.933	40.689	93.828	146.483	198.656	250.345	260.805	312.131	363.458	414.785	670.445

Table 12 Economic flow – Model 3 – pipeline diameter 32"

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services	0	0	0	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600
4.05.	Income tax	0	0	0	0	1.132	1.642	2.151	2.661	3.171	3.680	4.190
4.06.	**Total cash outflows**	**0**	**0**	**0**	**7.600**	**8.732**	**9.242**	**9.751**	**10.261**	**10.771**	**11.280**	**11.790**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**38.608**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**100.858**	**61.118**	**60.608**	**60.099**	**59.589**	**59.079**	**58.570**	**58.060**
	Evaluation of capital expenditure											
4.09.	Investment	215.500	215.500	215.500	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	215.500	431.000	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500
4.11.	Net cash flow from operating activitis	0	0	0	100.858	61.118	60.608	60.099	59.589	59.079	58.570	58.060
4.12.	**Net cash flow**	**-215.500**	**-215.500**	**-215.500**	**100.858**	**61.118**	**60.608**	**60.099**	**59.589**	**59.079**	**58.570**	**58.060**
4.13.	Cumulative net cash flow	-215.500	-431.000	-646.500	-545.642	-484.524	-423.916	-363.817	-304.228	-245.149	-186.579	-128.519

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	215.500
4.03.	**Total cash inflows**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**285.350**
	Cash outflows												
4.04.	Operation and maintensnce costs	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600
4.05.	Income tax	4.700	5.209	5.719	6.229	6.738	7.248	7.758	8.140	8.140	8.140	8.140	8.140
4.06.	**Total cash outflows**	**12.300**	**12.809**	**13.319**	**13.829**	**14.338**	**14.848**	**15.358**	**15.740**	**15.740**	**15.740**	**15.740**	**15.740**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-43.100**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**57.550**	**57.041**	**56.531**	**56.021**	**55.512**	**55.002**	**54.492**	**11.010**	**54.110**	**54.110**	**54.110**	**269.610**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500
4.11.	Net cash flow from operating activitis	57.550	57.041	56.531	56.021	55.512	55.002	54.492	11.010	54.110	54.110	54.110	269.610
4.12.	**Net cash flow**	**57.550**	**57.041**	**56.531**	**56.021**	**55.512**	**55.002**	**54.492**	**11.010**	**54.110**	**54.110**	**54.110**	**269.610**
4.13.	Cumulative net cash flow	-70.969	-13.929	42.602	98.624	154.135	209.137	263.629	274.639	328.749	382.859	436.969	706.579

Table 13 Economic flow – Model 4 – pipeline diameter 34"

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services	0	0	0	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800
4.05.	Income tax	0	0	0	0	1.196	1.735	2.274	2.812	3.351	3.890	4.429
4.06.	**Total cash outflows**	**0**	**0**	**0**	**7.800**	**8.996**	**9.535**	**10.074**	**10.612**	**11.151**	**11.690**	**12.229**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**40.793**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**106.593**	**64.604**	**64.065**	**63.526**	**62.988**	**62.449**	**61.910**	**61.371**
	Evaluation of capital expenditure											
4.09.	Investment	227.800	227.800	227.800	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	227.800	455.600	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400
4.11.	Net cash flow from operating activitis	0	0	0	106.593	64.604	64.065	63.526	62.988	62.449	61.910	61.371
4.12.	**Net cash flow**	**-227.800**	**-227.800**	**-227.800**	**106.593**	**64.604**	**64.065**	**63.526**	**62.988**	**62.449**	**61.910**	**61.371**
4.13.	Cumulative net cash flow	-227.800	-455.600	-683.400	-576.807	-512.203	-448.138	-384.612	-321.624	-259.175	-197.265	-135.894

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	227.800
4.03.	**Total cash inflows**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**301.400**
	Cash outflows												
4.04.	Operation and maintensnce costs	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800
4.05.	Income tax	4.967	5.506	6.045	6.584	7.122	7.661	8.200	8.604	8.604	8.604	8.604	8.604
4.06.	**Total cash outflows**	**12.767**	**13.306**	**13.845**	**14.384**	**14.922**	**15.461**	**16.000**	**16.404**	**16.404**	**16.404**	**16.404**	**16.404**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-45.560**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**60.833**	**60.294**	**59.755**	**59.216**	**58.678**	**58.139**	**57.600**	**11.636**	**57.196**	**57.196**	**57.196**	**284.996**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400
4.11.	Net cash flow from operating activitis	60.833	60.294	59.755	59.216	58.678	58.139	57.600	11.636	57.196	57.196	57.196	284.996
4.12.	**Net cash flow**	**60.833**	**60.294**	**59.755**	**59.216**	**58.678**	**58.139**	**57.600**	**11.636**	**57.196**	**57.196**	**57.196**	**284.996**
4.13.	Cumulative net cash flow	-75.061	-14.767	44.988	104.204	162.882	221.021	278.621	290.257	347.453	404.649	461.845	746.841

Table 14 Economic flow – Model 5 – pipeline diameter 36"

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services	0	0	0	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100
4.05.	Income tax	0	0	0	0	1.267	1.836	2.405	2.974	3.543	4.112	4.681
4.06.	**Total cash outflows**	**0**	**0**	**0**	**8.100**	**9.367**	**9.936**	**10.505**	**11.074**	**11.643**	**12.212**	**12.781**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**43.060**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**112.560**	**68.233**	**67.664**	**67.095**	**66.526**	**65.957**	**65.388**	**64.819**
	Evaluation of capital expenditure											
4.09.	Investment	240.533	240.533	240.533	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	240.533	481.067	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600
4.11.	Net cash flow from operating activitis	0	0	0	112.560	68.233	67.664	67.095	66.526	65.957	65.388	64.819
4.12.	**Net cash flow**	**-240.533**	**-240.533**	**-240.533**	**112.560**	**68.233**	**67.664**	**67.095**	**66.526**	**65.957**	**65.388**	**64.819**
4.13.	Cumulative net cash flow	-240.533	-481.067	-721.600	-609.040	-540.807	-473.143	-406.049	-339.523	-273.565	-208.177	-143.358

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	240.533
4.03.	**Total cash inflows**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**318.133**
	Cash outflows												
4.04.	Operation and maintensnce costs	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100
4.05.	Income tax	5.249	5.818	6.387	6.956	7.525	8.094	8.663	9.089	9.089	9.089	9.089	9.089
4.06.	**Total cash outflows**	**13.349**	**13.918**	**14.487**	**15.056**	**15.625**	**16.194**	**16.763**	**17.189**	**17.189**	**17.189**	**17.189**	**17.189**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-48.107**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**64.251**	**63.682**	**63.113**	**62.544**	**61.975**	**61.406**	**60.837**	**12.304**	**60.411**	**60.411**	**60.411**	**300.944**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600
4.11.	Net cash flow from operating activitis	64.251	63.682	63.113	62.544	61.975	61.406	60.837	12.304	60.411	60.411	60.411	300.944
4.12.	**Net cash flow**	**64.251**	**63.682**	**63.113**	**62.544**	**61.975**	**61.406**	**60.837**	**12.304**	**60.411**	**60.411**	**60.411**	**300.944**
4.13.	Cumulative net cash flow	-79.107	-15.425	47.687	110.231	172.206	233.613	294.450	306.754	367.165	427.575	487.986	788.930

In the dynamic approach to the assessment of the economic contribution of the project, use has been made of:

- internal rate of return method

Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is defined as a discount rate that makes the present value of the expected cash flows from a particular project equal to the present value of the expected cash flows from the project. IRR is a relative measure of project efficiency that provides information only about the average annual project accumulation rate.

IRR for the Ionian-Adriatic Gas Pipeline Project, based on the analysed technical solutions and the assumed business conditions, amounts to 7% (project acceptability criterion).

Transport tariff tendency projection

Shown in continuation is the transport tariff tendency projection for the planned period over which the investment project produces economically acceptable effects.

Table 15 Transport tariff tendency projection

Period of the project life	**Year**	**20**				
Expected volume of transported natural gas	**mio m3**	**5.000**				
Acceptability criteria of the project						
Internal rate of return (IRR)	**%**	**7,00%**				
		Model 1 28"	**Model 2 30"**	**Model 3 32"**	**Model 4 34"**	**Model 5 36"**
Investment	**mio €**	**615,0**	**613,0**	**646,5**	**683,4**	**721,6**
Changes in the level of investment	**%**	**0,3%**	**0,0%**	**5,5%**	**11,5%**	**17,7%**
Operation and maintenance costs	**mio €**	**9,7**	**8,0**	**7,6**	**7,8**	**8,1**
Changes in the level O&M costs	**%**	**21,3%**	**0,0%**	**-5,0%**	**-2,5%**	**1,3%**
Transport tariff	**€cts/m3**	**1,378**	**1,341**	**1,397**	**1,472**	**1,552**
Changes in the level of transports tariffs	**%**	**2,8%**	**0,0%**	**4,2%**	**9,8%**	**15,7%**

5.2.7 Concluding assessment

Given the investment in question, the expected volume of transported natural gas amounting to 5 billion cubic metres and the planned 20-year life, the Ionian-Adriatic Gas Pipeline project is acceptable up to the minimum transport tariff of:

- 1,341 €cts/m3 for a gas transportation system with pipeline diameter 30" (Model 2),
- 1,378 €cts/m3 for a gas transportation system with pipeline diameter 28" (Model 1),
- 1,397 €cts/m3 for a gas transportation system with pipeline diameter 32" (Model 3),
- 1,472 €cts/m3 for a gas transportation system with pipeline diameter 34" (Model 4),
- 1,552 €cts/m3 for a gas transportation system with pipeline diameter 36" (Model 5).

These are marginal tariffs for the use of the gas transportation system that meet the set minimum project acceptability criterion, the internal rate of return of 7%.

In the final diameter pipeline selecting process, apart from the economic effects of the project it is necessary to examine the function of the pipeline as part of a transport corridor for gas from Shah Deniz II development in Azerbaijan, and in a later stage as part of the EU Southern Gas Corridor. Southern Gas Corridor is an initiative of the European Commission for the gas supply from Caspian and Middle Eastern regions to Europe. In the first phase of the Shah Deniz II development project it will be possible to supply 10 bcm annually for the European market. But with long-term development of Caspian and Middle Eastern gas reserves and with the development of the Trans Caspian gas Pipeline and other gas transmission systems, Southern Corridor projects could provide the necessary transportation capacity to deliver 60 to 120 billion cubic metres per year of Caspian and Central Asian gas, which the European Commission aims to bring directly to Europe. Nabucco, ITGI (Interconnector Turkey-Greece-Italy) and TAP (Trans-Adriatic Pipeline) could transport that gas through this region to Europe.

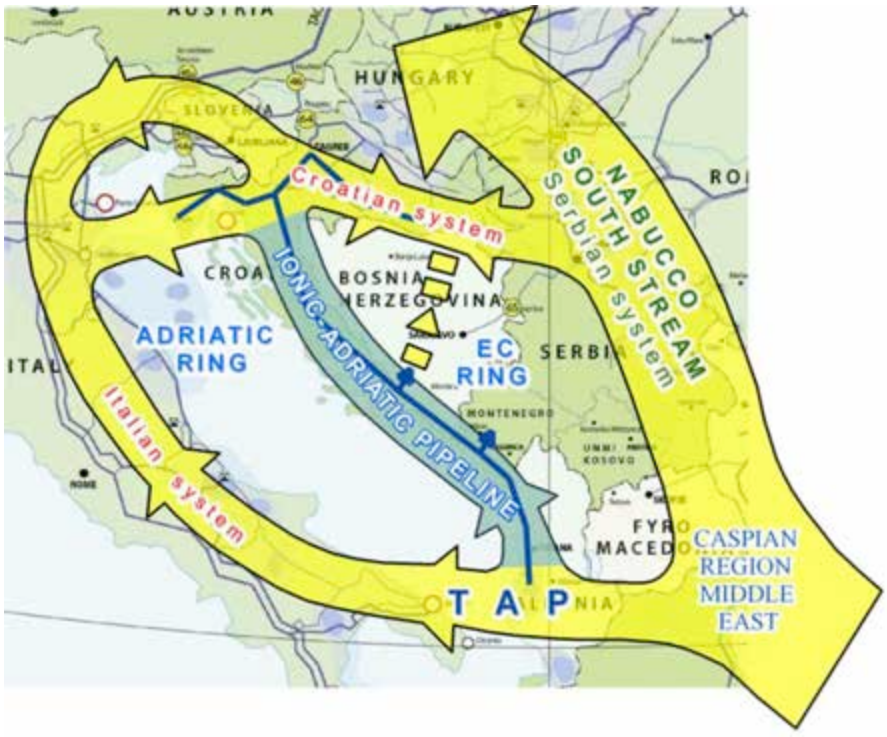


Figure 30: IAP position in future EU Caspian supply routes to Europe

Source: Plinacro, 5th Gas Forum, 14 September 2010, Brdo, Slovenia

IAP's central location between future supply routes to Europe can enable IAP to transit additional gas quantities to the countries in the region and further on to Europe.

Investment for the construction of 32" pipeline is only 6% higher than the solution necessary to develop the economically best option pipeline of 30", but this additional investment will increase the pipeline capacity by about 20 per cent. The larger diameter of 32" and consequently 20% higher pipeline capacity allows for greater flexibility and a greater role of IAP pipeline system in a Southern Gas Corridor.

It is also expected that the total gas consumption in the region will exceed 5 bcm which could be supplied with the 32'' pipeline.

For that reason, we suggest that the transmission system with 32" pipeline diameter (Model 3) is selected as economically and strategically best development option.

6 Selection of IAP variants

The present chapter is in principle unchanged from the first version with exception of specific corrections pointed out by the Stakeholders. The acceptable routes in Albania and Montenegro are presently being subject to detailed analyses that will lead to a more reliable background for arriving at a decision on the optimal IAP route in Albania and Montenegro.

In addition the IAP team has been requested to evaluate a variant in Albania from Lushnje via Elbasan to Tirana.

After completion of these two studies it is the intention to publish the results as an annex to the Preliminary Technical Study Report.

6.1 Methodology

To make decision about optimal variant for IAP system, the pipeline route is divided in sections. The start or the end of each section is either the point of connection of pipeline variants or the state border. Each section is shown on following figures and each section has its unique number. Economic calculations are made for each section and all sections are described below. On following figures are also shown the branch connections toward places and cities that are not part of IAP system. This connection will provide supply of those cities with natural gas.

Figure 31: Sections on IAP gas system

The scoping exercise is conducted by taking into account environmental, social and techno-economic aspects.

By the used methodology within the scoping exercise for every variant in each country passed by the pipeline, the following analysis phases were included:

1. Definition of the criteria for comparison

a. Overview and explanation of each criteria

b. Definition of difficulty factor for each criteria

2. Variants analysis according to defined criteria

The analysis will be conducted with the software program DoctuS – software application for decision-making support.

About DoctuS software

One of the benefits of intelligent systems to support business decisions DoctuS is the ability to process qualitative data due to its ability to process concepts. This is of great importance, since numerous aspects can only be scored based on conceptual scales.

Another important advantage is the possibility to clearly overview the process of decision making. Specialist mathematical knowledge is not needed to understand the reasoning system. The decision-maker can edit their knowledge in several ways. Knowledge acquisition is the process of learning. Through this process concepts are re-defined and studying of their new dependencies or metaphor is done. We can say that there are two groups of implementations of expert systems in business. The first imply that original decisions are made when experience is not enough. Within these business decisions deductive reasoning is used, that is the one of intelligent systems to support business decisions - DoctuS.

Within the analysis, the phase principle is applied, all in order to secure quality of entire process.

At the beginning, the area of interest is detected (all IAP route variants within each related country).

After that the criteria for comparison is defined and according to them all variants have been analysed.

The condition for obtaining the quality of the process is previous definition of comparison criteria and evaluation of the acceptability of pre-defined pipeline route variants.

The result of criteria applying is the decision tree of all considered variants with the demonstration of the most acceptable one.

Three criteria groups have been defined that are going to be sub-divided in more precise criteria within the software program.

A group: Environmental Criteria
B group: Social Criteria
C group: Techno – Economic Criteria

For each criterion the weight factor is defined. It serves to classification of the criteria based on their significance among the others.

Overview of Environmental Criteria

-Hydrogeology/ Water protection zones

Route variants are evaluated according to the probability of water protection zones crossings. The more acceptable route is the one for which the smaller probability has been noticed.

-Water Resources

Route variants are evaluated according to the number of watercourse crossings. The more acceptable route is the one that does not cross watercourses.

Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)

Route variants are evaluated according to their crossings through and vicinity to the protected areas (PA) and Emerald network (EN) sites, respectively. The more acceptable route is the one that crosses fewer and more distant to PA and/or EN sites and has lower impact on biodiversity of the area.

-Land use

Route variants are evaluated according to their impacts to current land use. Within agricultural land uses permanent crops on the area influences by construction works will be permanently changed to other crops and the area with other crops will be temporarily out of production (during construction works). Forest and forest land will be permanently changed. The more acceptable route is the one that does not cross areas of great agriculture or forest value and causes less negative impacts.

-Landscape and Visual Issues

Route variants are evaluated according to their impacts to landscape characteristics. The more acceptable route is the one that does not cross areas of landscape significance, which follows existing infrastructure corridor, follows the relief characteristics, and does not evoke high visual impacts due to land clearing (forests, agriculture land, etc.) for the purpose of pipeline construction and maintenance.

-Cultural Heritage (both physical and intangible as appropriate)

Route variants are evaluated according to crossing cultural areas and their status. The more acceptable route is the one that avoids crossings of the cultural heritage protected areas. In cases where the route crosses these areas, the more acceptable are the crossings in the periphery parts of the areas.

Overview of Social Criteria
Socioeconomic baselines

Route variants are evaluated based on their impacts on settlements, with respect to passing through populated area and also areas of great economic value (tourism, industrial zones, etc.). The more acceptable is the variant that avoid such areas.

Overview of Techno Economic Criteria

- Total cost with expropriation and land use

Route variants are evaluated based on the initial cost for construction. The total cost for construction is calculated based on the length of pipeline route, chosen diameter, type of terrain where the pipeline will be laid down, and also the estimated expropriation costs.

- Technical difficulties of pipeline construction

Description of technical parameters of pipeline, determined and analysed in this stage of project documentation preparation has been described in Preliminary Technical Study Report. As in this stage the total number of ground infrastructure objects has not yet been defined and also not the other infrastructure objects that may result in greater safety aspect of pipeline construction, the main criteria for evaluation is the ground/ terrain condition and the difficulty of its crossing. This also included land access issues, in relation to whether the terrain is accessible or not. The more acceptable is considered the variant that crosses more technically easily crossed terrain and has easier access for construction and further maintenance.

6.2 Economic calculations

The aim of these analyses was to analyse economic effects of each transmission route for each country, taking into account not only maximal expected gas flows, but also expected gas market build up for each country.

At the beginning it is very important to emphasize that the analyses do not take into account any social, environmental or any other technical difficulties that might affect development of any of the proposed routes. These issues and difficulties can in some cases have more impact on project development possibilities than the economics.

The economic analyses have been carried out with the following presumptions:

Investment will be carried out through three years in same yearly amounts.

System would be financed from funds obtained on financial markets through long-term borrowing at financial institutions

The price of borrowed capital has been calculated according to the following assumed terms and conditions:

- repayment period: 15 years,
- regular interest rate: 6% per annum
- repayment in equal semi-annual instalments

The operating and maintenance costs include:

- energy costs
- gas transportation system maintenance costs

The quantity of natural gas transported is a business event resulting in an increased financial and economic potential of the project.

The projected provision of natural gas transportation services is based on the assumed gas market build up from the draft gas market forecast.

Transport tariff is optimized in a way that meets internal rate of return of 7%, the project acceptability criterion.

The planned project period of 20 years is taken as one in which the investment project produces acceptable effects.

The investment and maintenance cost per pipeline sections are presented in the following tables.

Table 16. Route variant – pipeline costs calculation

		Investment costs			Maintenance costs		
		Pipeline length	Specific investment cost pipeline	**Investment costs pipeline**	Annual fraction of investment	Total investment costs	**Annual maintenance costs**
Section		km	€/"m	**Mio €**	-	Mio €	**Mio €/a**
1	Fier - Staravec	38.1	26.84	**32.7**	1.00%	32.7	**0.33**
2	Staravec - Ahmetaq	54.3	31.79	**55.2**	1.00%	55.2	**0.55**
3	Staravec - Ahmetaq	63.2	30.03	**60.7**	1.00%	60.7	**0.61**
4	Ahmetaq - Balldre	45	27.83	**40.1**	1.00%	40.1	**0.40**
5	Balldre - Barlaj	66.5	33.22	**70.7**	1.00%	70.7	**0.71**
6	Balldre - Shtodher	27.6	30.14	**26.6**	1.00%	26.6	**0.27**
7	Barlaj - Nalježići	54.7	36.08	**63.2**	1.00%	63.2	**0.63**
8	Nalježići - Radanovići	2.4	36.63	**2.8**	1.00%	2.8	**0.03**
9	Schodher - Donji Podi	22	35.20	**24.8**	1.00%	24.8	**0.25**
10	Donji Podi - Nalježići	53.6	39.16	**67.2**	1.00%	67.2	**0.67**
11	Donji Podi – Bartula	1	42.90	**1.4**	1.00%	1.4	**0.01**
12	Bartula - Lastva Grbajska	41.6	38.83	**51.7**	1.00%	51.7	**0.52**
13	Lastva Grbajska - Radanovići	7.4	35.64	**8.4**	1.00%	8.4	**0.08**
14	Bartula - Lastva Grbajska	42.3	40.92	**55.4**	1.00%	55.4	**0.55**
15	Radanovići - Vitajina	19.6	36.96	**23.2**	1.00%	23.2	**0.23**
16	Vitajina - Đurinići	8.4	41.14	**11.1**	1.00%	11.1	**0.11**
17	Đurinići - Čibaća	32.4	40.59	**42.1**	1.00%	42.1	**0.42**
18	Čibaća - Podimoć	42.5	38.39	**52.2**	1.00%	52.2	**0.52**
19	Podimoć - Kobiljača	50.2	35.97	**57.8**	1.00%	57.8	**0.58**
20	Podimoć - Osobjava	41.6	39.05	**52.0**	1.00%	52.0	**0.52**
21	Osobjava - Ploče	21.2	44.22	**30.0**	1.00%	30.0	**0.30**
22	Ploče - Kobiljača	0.6	30.80	**0.6**	1.00%	0.6	**0.01**
23	Osobjava - Ploče	22.3	44.00	**31.4**	1.00%	31.4	**0.31**
24	Kobiljača – Otrić seoci	4.8	31.46	**4.8**	1.00%	4.8	**0.05**
25	Otrić seoci - Zagvozd	42.4	35.42	**48.1**	1.00%	48.1	**0.48**
26	Zagvozd - Dugopolje	53	35.86	**60.8**	1.00%	60.8	**0.61**
27	Podimoć - Mostar - Posušje - Imotski - Zagvozd	134.4	38.39	**165.1**	1.00%	165.1	**1.65**

Table 17. Route variant – compressor station costs calculation

2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		1425	
	Instaled ISO power	MW		2.6	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		3.9	
	Investment costs compressor station	**Mio €**		**35.9**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		1.5	
	Annual energy costs	**Mio €/a**		**0.5**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		35.9	
	Annual maintenance costs	**Mio €/a**		**1.0**	

6.2.1 Transport tariff tendency projection

Shown in continuation is the transport tariff tendency projection for the planned period over which the investment project produces economically acceptable effects.

Table 18 Transport tariff tendency projection Albania

ALB					
Period of the project life	**Year**	**20**			
Acceptability criteria of the project					
Internal rate of return (IRR)	**%**	**7,00%**			
Variant		**Var. A-AL**	**Var. D-AL**	**Var. C-AL**	**Var. B-AL**
Expected volume of transported natural gas, average	**mio m3**	**3 508**	**3 502**	**3 502**	**3 508**
Changes in the volume of transported natural gas	**%**	**0,0%**	**-0,2%**	**-0,2%**	**0,0%**
Investment	**mio €**	**198,7**	**160,2**	**154,7**	**204,2**
Changes in the level of investment	**%**	**0,0%**	**-19,4%**	**-22,1%**	**2,8%**
Operation and maintenance costs	**mio €**	**2,0**	**1,6**	**1,5**	**2,0**
Changes in the level operation and maintenance costs	**%**	**0,0%**	**-20,0%**	**-25,0%**	**0,0%**
Transport tariff	**€cts/m3**	**0,760**	**0,614**	**0,592**	**0,779**
Changes in the level of transports tariffs	**%**	**0,0%**	**-19,2%**	**-22,1%**	**2,5%**

When only investment costs and expected gas demand are taken into consideration the results presented are as expected: development of shorter coastal routes results with 20 percent lower transport tariff compared to the northern connection route to Montenegro.
When comparing the coastal and inland near Tirana pipeline route development options then the criterion is that the pipeline should pass near the centre of the

future consumption. In this case Tirana is a centre of the consumption and this pipeline branch is cheaper than the coastal route. Future branch pipeline diameter toward Duress should be of smaller diameter compared to a branch from the coastal route toward Tirana, resulting in the end with the lower investment costs.
When comparing the Montenegro connection pipeline route options just from the investment point of view the coastal route is much cheaper than one on the north of the Skadar Lake. But in this case the development options on the Montenegro side of the border should be taken into account too. Difference in investment costs between the coastal pipeline route and the northern pipeline route toward Montenegro is 44 mil EUR.

Table 19 Transport tariff tendency projection Montenegro

MNE					
Period of the project life	Year	20			
Acceptability criteria of the project					
Internal rate of return (IRR)	%	7,00%			
Variant		Var. A-MN	Var. B-MN	Var. C-MN	Var. D-MN
Expected volume of transported natural gas, average	mio m3	1 781	1 775	1 775	1 775
Changes in the volume of transported natural gas	%	0,0%	-0,3%	-0,3%	-0,3%
Investment	mio €	89,1	119,3	109,5	111,8
Changes in the level of investment	%	0,0%	33,9%	22,9%	25,5%
Operation and maintenance costs	mio €	0,9	1,2	1,1	1,1
Changes in the level operation and maintenance costs	%	0,0%	33,3%	22,2%	22,2%
Transport tariff	€cts/m3	0,655	0,883	0,810	0,826
Changes in the level of transports tariffs	%	0,0%	34,8%	23,7%	26,1%

If we are going to follow the lower investment near the centre of the consumption pipeline route selection criterion it is obvious that the pipeline route A near Podgorica is an optimal solution if only Montenegro pipeline development options should be considered. The optimized transport tariff reflects that and it is about 30 per cent lower than the coastal route variants transmission tariff. The pipeline variant A is about 20 million EUR cheaper than the cheapest coastal pipeline route option.
These results are in direct collision with the Albania tariff optimization results. The difference between coastal and Northern route in Albania was 44 million EUR and when compared to the difference between Montenegro coastal and northern pipeline route amounted 20 mil. EUR it seems that the coastal route has potential for saving 24 mil. EUR.
Nevertheless, if we decide on the coastal route through Montenegro, then connection pipeline branch toward Podgorica and Nikšić should be developed. Their development cost is estimated at 36 mil. EUR. If this branch pipeline cost is taken into the equation, then the northern pipeline route will result with total savings of 12 mil. EUR.
The reason for such a big difference in the pipeline cost between northern and coastal route is a very difficult terrain near the coast. To decrease the coastal investment costs, Montenegrin coastal cities connection pipelines should be developed with the lower pressure pipelines which can be installed in the existing roads. Since the future consumption of the coastal cities is much lower than those from Podgorica area, lower pipeline pressure supply option should be a feasible option.

Table 20 Transport tariff tendency projection Croatia

CRO					
Period of the project life	Year	20			
Acceptability criteria of the project					
Internal rate of return (IRR)	%	7,00%			
Variant		Var. C	Var. B-HR	Var. A-HR	Var. A-BH
Expected volume of transported natural gas, average	mio m3	1 458	1 458	1 458	1 458
Changes in the volume of transported natural gas	%	0,0%	0,0%	0,0%	0,0%
Investment	mio €	312,7	337,5	338,9	367,2
Changes in the level of investment	%	0,0%	7,9%	8,4%	17,4%
Operation and maintenance costs	mio €	4,3	4,5	4,5	4,8
Changes in the level operation and maintenance costs	%	0,0%	4,7%	4,7%	11,6%
Transport tariff	€cts/m3	2,816	3,030	3,041	3,287
Changes in the level of transports tariffs	%	0,0%	7,6%	8,0%	16,7%

When only investment costs and expected gas demand are taken into the consideration the results presented are as expected: development of shorter Variant C have 7 to 8 percent lower transport tariff compared to the variant A and B which are going all the way through the Croatian territory.
But we should have in mind that the pipeline route C is crossing the very difficult Neretva delta marsh and muddy terrain where the development of the pipeline would be almost impossible. Flooding and movement of the Neretva delta terrain can cause big structural damage to the pipeline.
From that reason only supply routes Variant A and Varian B should be taken into consideration. Variant B is a little bit cheaper than Variant A which results in the lower transmission tariff for Variant B.
It should also be taken into account that Location permit for the gas pipeline Split Ploče is already issued, and that decision on acceptance on the EIA for complete Variant A pipeline route is issued also.
Variant A-BH that starts from Dubrovačko primorje in Croatia reaches city of Mostar, then runs toward Posušje and continuing toward Zagvozd in Croatia is most expensive of all investigated pipeline routes. If we take into account that all procedures starting from the physical planning toward location permit (which is almost finished for the Croatian routes) it is obvious that this route is in many aspects in the inferior position when compared with the routes in Croatia.

6.2.2 Concluding remarks

When only investment for main transmission route costs and expected gas demand are taken into consideration then the coastal route through Albania, coastal route through Montenegro and Variant C in Croatia seems as the most favourable pipeline route selection.
But if we take into consideration the additional cost for the main consumption sectors branch connection costs and main technical differences in the pipeline development processes then the supply route Fier-Tirana-Podgorica- Pelješac peninsula-Ploče route seems to be the most favourable.
Taking all that into account the authors of the study recommends Fier-Tirana-Podgorica- Pelješac peninsula-Ploče route as most favourable route.

Nevertheless, this recommendation should be tested with social and environmental requirements that will be tested together with the technical aspects in the Doctus evaluation software which follows in next chapter.

6.3 Test of proposed options

Albania

Defined criteria for IAP route variants in Albania are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant selection	less acceptable	acceptable	most acceptable
Environmental criteria	negative impact	moderate impact	slight impact
Social criteria	great negative impact	negative impact	moderate impact
Techno - economic criteria	negative	acceptable	positive
Impacts on waters	negative	moderate	none
Impacts on surface waters	negative	moderate	none
Watercourses crossing (larger rivers)	7 and more crossings	1 to 7 crossings	does not cross
Impact on groundwaters	negative	moderate	none
Water protection zones crossing	existing probability	moderate probability	small probability
Land use impact	negative	moderate	slight
Impact on nature and cultural heritage	great negative/ negative	moderate	none
Impact on nature heritage	great negative/ negative	moderate	none
Impact on nature protected areas and Emerald network	negative (more then 5 EN/PA/nature protected sites influenced)	moderate (1 to 5 EN/PA/nature protected sit	slight (1 or none EN/PA/nature protected
Impact on biodiversity	negative	moderate	slight
Impact on cultural heritage	great negative/ negative	moderate	slight
Impact on landscape values	negative	moderate	none
Pipeline corridor crosses populated areas	great negative	negative	moderate
Pipeline corridor crosses areas of economic/ turistic activities valu	negative	moderate	slight
Total construction cost	up to 40% from the most cheapest	up to 30% from the most cheapest	up to 15% from the most cheapest
Technical difficulties of pipeline construction	very difficult	moderate	slight
Impact on forestry and forests	negative	moderate	slight
Economic value of the forests	great	small	none
Impact on forest land	negative	moderate	slight
Forest land crossing	50ha and more	10 - 50ha	less then 10ha
Impact on agriculture and agriculture land	negative	moderate	slight
Impact on agriculture land	negative	moderate	slight
Agriculture land crossing	more then 100ha	50-100ha	less then 50ha
Impact on agriculture	negative	moderate	slight

Figure 32: Defined criteria for IAP route variants in Albania

Considered Variants description based on Environmental Criteria

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Hydrogeology/ Water protection zones	4	The pipeline route overlies **5 (five aquifers),** as follows: · 3 (three) Quaternary gravel aquifers of national importance: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); 3-Mati aquifer (sect.4), and · 2 (two) Quaternary gravel aquifers of regional importance: 4-Nenshkodra aquifer (sect.6); 5-Mbishkodra aquifer (sect.6). There is possibility that route passes through water protection zone. **(Existing probability)**	The pipeline route overlies **6 (six aquifers),** as follows: · 3 (three) Quaternary gravel aquifers of national importance: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); 3-Mati aquifer (sect.4), and · 3 (three) Quaternary gravel aquifers of regional importance: 4-Erzeni aquifer (sect.2). 5-Nenshkodra aquifer (sect.6); 6-Mbishkodra aquifer (sect.6). There is possibility that route passes through water protection zone. **(Existing probability)**	The pipeline route overlies **3 (three aquifers)** of national importance as follows: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); and 3-Mati aquifer (sect.4). There is possibility that route passes through water protection zone. **(Existing probability)**	The pipeline route overlies **4 (four aquifers),** as follows: · 3 (three) Quaternary gravel aquifers of national importance: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); 3-Mati aquifer (sect.4), and · 1 (one) Quaternary gravel aquifer of regional importance: 4-Erzeni aquifer (sect.2). There is possibility that route passes through water protection zone. **(Existing probability)**
Water Resources	3	The pipeline route **traverses 9 (nine) important rivers**	The pipeline route **traverses 9 (nine) important rivers**	The pipeline route traverses **6 (six) important rivers**,	The pipeline route traverses **6 (six)**

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		(13 crossings), as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; 4-Ishmi; 5-Mati; 6,7,8,9,10-Drini Lezhes (five times); 11-Drini; 12-Kiri; and 13-Vraka Route considered as **less acceptable**	**(13 crossings)**, as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; 4-Ishmi; 5-Mati; 6,7,8,9,10-Drini Lezhes (five times); 11-Drini; 12-Kiri; and 13-Vraka Route considered as **less acceptable**	as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; 4-Ishmi; 5-Mati; and 6-Drini Lezhes. Route considered as **acceptable**	**important rivers**, as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; 4-Ishmi; 5-Mati; and 6-Drini Lezhes. Route considered as **acceptable**
Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)	4	-Runs in vicinity of **3 (three)** PAs: 1-Skadar lake (Ramsar site); 2-Riparian area of Skadar lake (MNR); 3-Wetland/Terrestrial PL of Buna River; Route considered as **(Moderate impact)**	-Runs in vicinity of **3 (three)** PAs: 1-Skadar lake (Ramsar site); 2-Riparian area of Skadar lake (MNR); 3-Wetland/Terrestrial PL of Buna River; **(Moderate impact)**	-Traverses **1 (one)** PA. The pipeline route crosses a narrow strip of the riparian forest within the Wetland/Terrestrial PL of Buna River. **(Slight to Moderate impact)**	-Traverses **1 (one)** PA. The pipeline route crosses a narrow strip of the riparian forest within the Wetland/Terrestrial PL of Buna River. **(Slight to Moderate impact)**
Landscape and Visual Issues	3	**Medium to high adverse impact**, because: Length 204 km.	**Medium to high adverse impact,** because: Length 213 km.	**Moderate adverse impact**, because: Length 165 km.	**Moderate adverse impact,** because: Length 172 km.

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		-167km runs on lowland, used mainly as agricultural land and cultivated with crops; -35km runs through hilly area, from which: 26 km over flysch formations and 9km over limestones. The hilly area is covered from degraded forests and shrubs; -2 km total width of riverbeds (mainly riparian forest). Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; -Traverses 13 riverbeds, consequently, it is expected negative visual impact on the riparian forests along the	-190km runs on lowland, used mainly as agricultural land and cultivated with crops; - 21 km route runs through hilly area, from which: 12 km over flysch formations and 9km over limestones. The hilly area is covered from degraded forests and shrubs; -2 km total width of riverbeds (mainly riparian forest). Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; -Traverses 13 riverbeds, consequently, it is expected negative visual impact on the	-137km runs on lowland, used mainly as agricultural land and cultivated with crops; -27km route through hilly area, from which: 24 km over flysch formations and 3km over limestones. The hilly area is covered from degraded forests and shrubs; -1km total width of riverbeds (mainly riparian forest). Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; -Traverses 6 riverbeds, consequently, it is expected negative visual impact on	-159 km runs on lowland, used mainly as agricultural land and cultivated with crops; -12 km route through hilly area, from which: 9 km over flysch formations and 3km over limestones. The hilly area is covered from degraded forests and shrubs; -1km total width of the riverbeds (mainly riparian forest). Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; -Traverses 6 riverbeds,

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		riverbeds. **(Negative)**	riparian forests along the riverbeds. **(Negative)**	the riparian forests along the riverbeds. **(Negative)**	consequently, it is expected negative visual impact on the riparian forests along the riverbeds. **(Negative)**
Land use	4	-Crosses 35 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; - Passes through 167 ha of flat agricultural land and has a negative impact on agriculture and agricultural land.	-Crosses 21 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; - Passes through 190 ha of flat agricultural land and has a negative impact on agriculture and agricultural land.	-Crosses 27 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; - Passes through 137 ha of flat agricultural land and has a negative impact on agriculture and agricultural land.	-Crosses 12 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; - Passes through 159 ha of flat agricultural land and has a negative impact on agriculture and agricultural land.
Cultural Heritage		Variant A runs throughout the territories of **2 (two) Districts** (Shkodra, and Lezha), which are very rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian-Roman-	Variant B runs throughout the territory of **3 (three) Districts** (Durresi, Lezha, and Shkodra), which are very rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian-Hellenic-	Variant C: 1-Runs through the territory of **1 (one) District** (Lezha) which is very rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian- Roman-	Variant D: 1-Runs through the territory of **2 (two) Districts** (Durresi and Lezha), which are very rich in discovered and non-discovered cultural heritage dated from the

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		Byzantine-Medieval ages. Likely very high adverse impact on the elements of cultural heritage. **(Negative)**	Roman-Byzantine-Medieval ages. Likely very high adverse impact on the elements of cultural heritage. **(Great Negative)**	Byzantine-Medieval ages; and 2-Runs throughout the Balldren field, which has been flood prone, and consequently there is no high probability of finding non-discovered cultural heritage. Likely high adverse impact on the elements of cultural heritage. (**Moderate)**	Early Bronze to Illyrian-Hellenic-Roman-Byzantine-Medieval ages; and 2-Runs throughout the Balldren field, which has been flood prone, and consequently there is no high probability of finding non-discovered cultural heritage. Likely very high adverse impact on the elements of cultural heritage. **(Negative)**

Considered Variants description based on Social Criteria

Social Criteria	Weight factor 1 – 5	Variant A	Variant B	Variant C	Variant D
Pipeline corridor crosses populated areas	4	Pipeline route runs near and throughout the settlements of many villages within Shkodra district, as well as through Lezha town.	Pipeline route runs near and throughout the settlements of many villages within n Shkodra district, as well as through Lezha town, and	Pipeline route runs throughout settlements within Lezha town. **(Moderate)**	Pipeline route runs through Lezha town, and throughout an urbanised zone within the seaside tourist area

Social Criteria	Weight factor 1 – 5	Variant A	Variant B	Variant C	Variant D
		(Negative)	throughout an urbanised zone within the seaside tourist area (South of Durres). **(Great Negative)**		(South of Durres). **(Great Negative)**
Pipeline corridor crosses areas of economic activities values	3	Pipeline route runs through zones of economic activities such as Shkodra town (industry-regional importance), and the whole flat area of the Shkodra and Malesia Madhe Districts (animal farms for meat production –national importance). **(Negative impact)**	Pipeline route runs through zones of economic activities such as Shkodra town (industry-regional importance), and the whole flat area of the Shkodra and Malesia Madhe Districts (animal farms for meat production –national importance); as well as through Durresi zones of economic activities (transport and tourism), **(Negative impact)**	Pipeline route runs through rural areas. **(Slight impact)**	Pipeline route runs through rural areas, as well as close to Durresi zones of economic activities (transport and tourism South of Durresi). **(Moderate impact)**

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Cost of construction	*4*	198,7 M Euro	204,2 M Euro	154,7 M Euro	160,2 M Euro
Technical solution of pipeline construction	*2*	Variant A passes through mountainous area of Albania, near settlements that presents **moderate** technical difficulties.	Variant B passes through mountainous area of Albania, near settlements that presents **moderate** technical difficulties.	Variant C passes through **slight** technical difficult area.	Variant D passes through hilly part of Albania, near settlements that presents **moderate** technical difficulties.

Results gained by DoctuS software are shown on following figure.

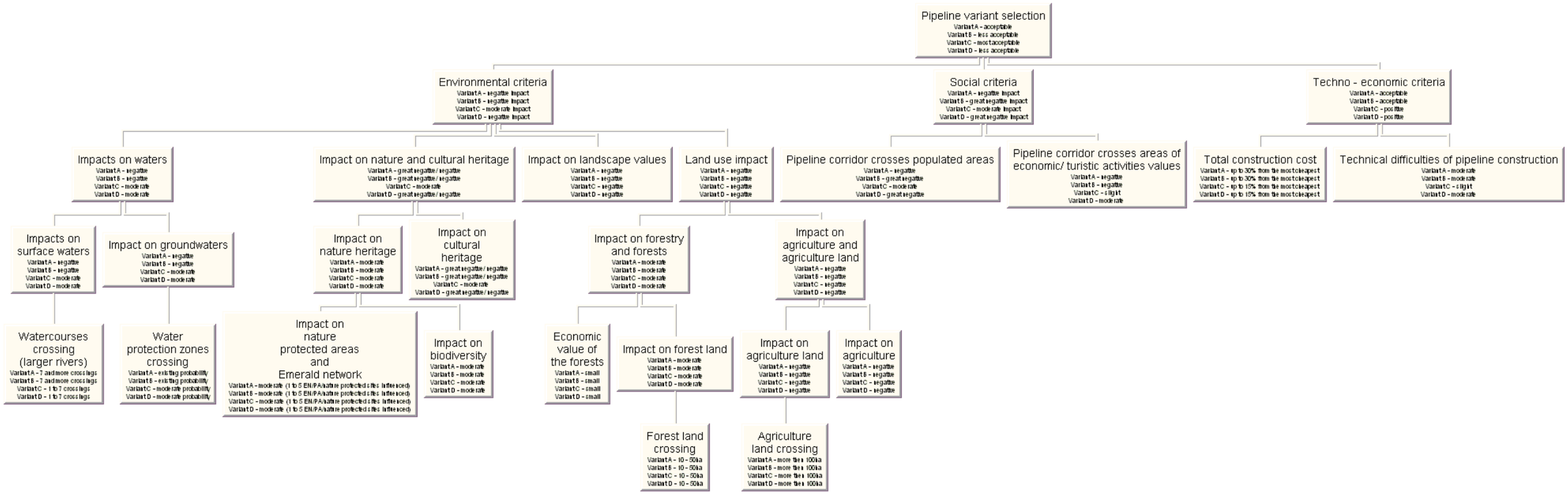


Figure 33: IAP route variants selection for Montenegro

As most acceptable Variant C has been selected, followed by Variant A. Variant B and Variant D are considered less acceptable, mostly due to crossing highly populated area of town of Durres.

Montenegro

Defined criteria for IAP route variants in Montenegro are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant selection	less acceptable	acceptable	most acceptable
Environmental criteria	negative impact	moderate impact	slight impact
Social criteria	negative impact	moderate impact	positive impact
Techno - economic criteria	negative	acceptable	positive
Impacts on waters	negative	moderate	none
Impacts on surface waters	negative	moderate	none
Watercourses crossing (larger rivers)	5 and more crossings	1 to 5 crossings	does not cross
Impact on groundwaters	negative	moderate	none
Water protection zones crossing	existing probability	smaller probability	
Land use impact	negative	moderate	slight
Impact on forestry and forests	negative	moderate	slight
Economic value of the forests	great	small	none
Impact on forest land	negative	moderate	slight
Forest land crossing	50ha and more	10 - 50ha	less then 10ha
Impact on agriculture and agriculture land	negative	moderate	slight
Impact on agriculture land	negative	moderate	slight
Agriculture land crossing	more then 20ha	2-20ha	less then 2ha
Impact on agriculture	negative	moderate	slight
Impact on nature and cultural heritage	great negative/ negative	moderate	none
Impact on nature heritage	great negative/ negative	moderate	none
Impact on nature protected areas and Emerald network	negative (more then 5 EN/PA/nature protected sites influenced)	moderate (1 to 5 EN/PA/nature protected sit	slight (1 or none EN/PA/nature protected
Impact on biodiversity	negative	moderate	slight
Impact on cultural heritage	great negative	moderate	slight
Impact on landscape values	negative	moderate	none
Pipeline corridor crosses populated areas	negative	moderate	slight
Pipeline corridor crosses areas of economic/ turistic activitie	negative	moderate	slight
Total construction cost	up to 40% from the most cheapest	up to 30% from the most cheapest	up to 15% from the most cheapest
Technical difficulties of pipeline construction	very difficult	moderate	slight

Figure 34: Defined criteria for IAP route variants in Montenegro

Considered Variants description based on Environmental Criteria

Environmental Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Hydrogeology / Water protection zones	*4*	- Route probably passes through water protection zone of the water source Topliš - there is possibility that route passes through water protection zone of water source of the river Crnojevica (**existing probability**)	- in the area between Budva-Bar passes near a number of water sources, so there is a significant possibility that the route passes through water protection zones (**existing probability**)	- in the area between Budva-Bar passes near a number of water sources, so there is a significant possibility that the route passes through water protection zones (**existing probability**)	- As the route passes mainly through the sea there is a small possibility of its cross through water protection zones (**small probability**)
Water Resources	*3*	- crosses Morača and Cijevna River The route is considered **acceptable**.	- crosses Bojana River The route is considered **acceptable**.	- crosses Bojana River The route is considered **acceptable**.	- crosses Bojana River The route is considered **acceptable**.
Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)	*4*	Variant A: - Passes through an EN site - Passes in vicinity of four PA (three EN sites) The route is considered **acceptable**.	Variant B: - Passes through two EN sites - Passes in vicinity of two EN sites (one PA) - pass through Rumija (center of biodiversity) The route is considered **less acceptable**	Variant C: - Passes in vicinity of four Emerald sites (two PA) The route is considered **acceptable**.	Variant D: - Passes through Protected area in vicinity of four EN sites (two PA) - Passes through sea habitats The route is considered **acceptable**.
Land use	*4*	Variant A crosses through 35 ha of forest land, and have moderate impact. The economic value of forest in the variant A route area is small. Variant A passes through	Variant B crosses through 39 ha of forest land, and have negative impact on forest land. The economic value of forest in the variant B route area is small. Variant B passes through 10ha	Variant C crosses through 44 ha of forest land, and have negative impact on forest land. The economic value of forest in the variant C route area is small. Variant B passes through 12ha of agriculture land and thus have	Variant D crosses through 20 ha of forest land, and have slight impact on forest land. There is no economic value of forest in the variant D route area. Variant D passes through 12ha of agriculture land and thus have

Environmental Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		20ha of agriculture land and thus have moderate impact on agriculture and agriculture land.	of agriculture land and thus has slight impact on agriculture and agriculture land.	moderate impact on agriculture and slight impact on agriculture land.	slight impact on agriculture and agriculture land.
Landscape and Visual Issues	*3*	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)	Negative impact on the landscape is mostly visualized during construction phase. There is a high probability of damaging dry walls and terraced fields, during Variant B construction. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**negative**)	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)
Cultural Heritage	*4*	In the wider area of the gas pipeline direction are perceptible elements of cultural heritage of great value. Especially archaeological sites and historic buildings mostly around the city of Podgorica. Due to the distance from the route there is no possibility of direct influence. (**moderate**)	There is a strong possibility of an impact on the elements of cultural heritage. This is especially possible in the Old Bar where expectly these elements are numerous discovered and undiscovered archaeological sites. (**great negative**)	Due to large number of valuable cultural heritage elements in the vicinity of the route C there is possible strong impact on cultural heritage. (**great negative**)	None of the cultural heritage areas has been observed in the wider area of route D. But there is a possibility of hydroarchaelogical findings. (**moderate**)

Considered Variants description based on Social Criteria

Social Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Pipeline corridor crosses populated areas	*4*	Variant A is passing near settlements, but avoiding constructed areas. (**moderate**)	Variant B is passing through settlements (**negative**)	Variant C is passing through settlements, (**negative**).	Variant D is passing near settlements, but avoiding constructed areas. (**moderate**)
Pipeline corridor crosses areas of economic activities values	*3*	Variant A passes near zones of economic activities near town of Podgorica but it does not endanger them (**moderate**)	Variant B passes through zones of touristic activities near towns of Budva and Bar, (**negative**)	Variant C passes through zones of touristic activities near towns of Budva and Bar, (**negative**)	Variant D does not pass near zones of economic or touristic activities (**slight**)

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Cost of construction	*4*	89,1 M Euro	119,3 M Euro	109,5 M Euro	111,8 M Euro
Technical solution of pipeline construction	*2*	Variant A passes through mountainous area of Montenegro that presents **moderate** technical difficulties. As it passes near settlements and detected soil excavation types are not technically demanding it is considered that technical solution of this variant construction is **moderate**.	Variant B passes through high mountain area of Montenegro that presents **very difficult** technical solution. Although it passes near settlements and detected soil excavation types are not technically demanding it is considered that technical solution of this variant construction is **very difficult**.	Variant C passes through mountanious area. As it passes through settlements it is considered that technical solution of this variant construction is **very difficult**.	Variant D has longest off-shore section that presents **moderate** technical difficult. It does not pass across very demanding terrain regarding altitude differences and soil excavation types.

Results gained by DoctuS software are shown on following figure.

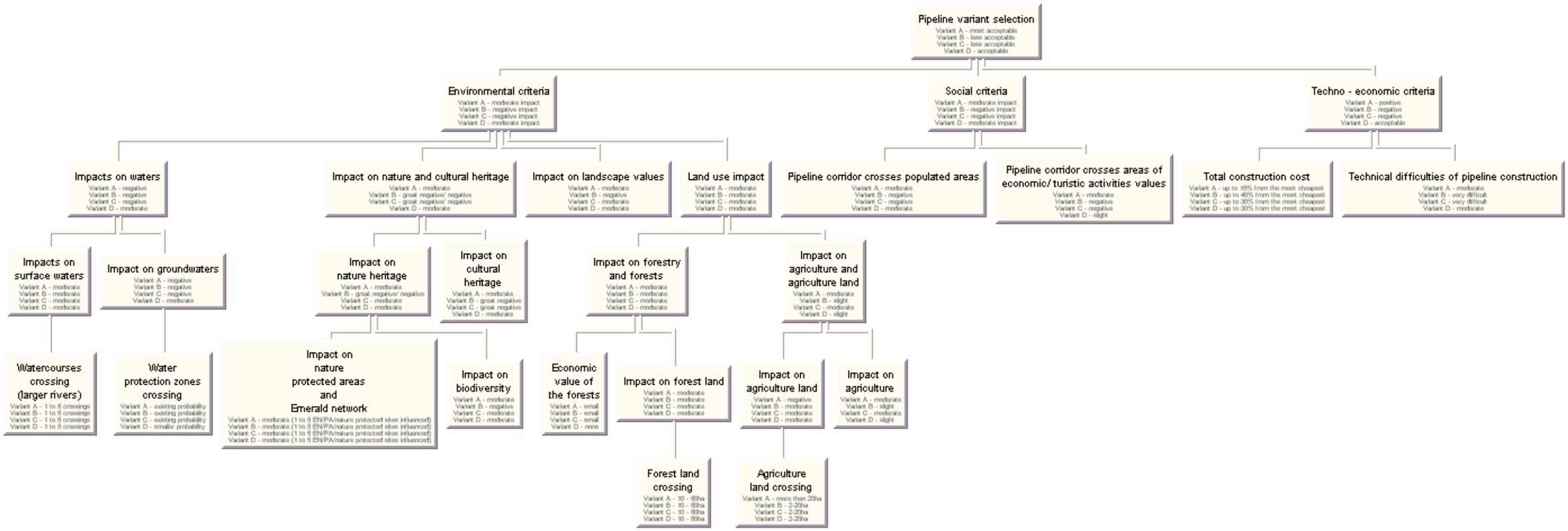


Figure 35: IAP route variants selection for Montenegro

As most acceptable Variant A has been selected, followed by Variant D. Variant B and Variant C are considered less acceptable.

Montenegro and Albania

As the analysis have shown that two potential IAP routes through Montenegro and Albania, that continues on each other, are considered acceptable, evaluation of these two routes have been done.
Considered routes are:

- Variant A (Montenegro) and Variant A (Albania)
- Variant D (Montenegro) and Variant C (Albania)

Also, all possible branch connections to major gas consumers (towns of Nikšić, Podgorica, etc) have been included in techno-economic criteria evaluation.

Defined criteria for IAP route variants in Montenegro and Albania are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant selection	less acceptable	acceptable	most acceptable
Environmental criteria	negative impact	moderate impact	slight impact
Social criteria	negative impact	moderate impact	positive impact
Techno - economic criteria	negative	acceptable	positive
Impacts on waters	negative	moderate	none
Impacts on surface waters	negative	moderate	none
Watercourses crossing (larger rivers)	9 and more crossings	1 to 9 crossings	does not cross
Impact on groundwaters	negative	moderate	none
Water protection zones crossing	existing probability	small probability	
Land use impact	negative	moderate	slight
Impact on nature and cultural heritage	great negative/ negative	moderate	none
Impact on nature heritage	great negative/ negative	moderate	none
Impact on nature protected areas and Emerald network	negative (more then 10 EN/PA/nature protected sites influenced)	moderate (5 to 10 EN/PA/nature protected s	slight (5 to 1 EN/PA/nature protected site
Impact on biodiversity	negative	moderate	slight
Impact on cultural heritage	great negative	moderate	slight
Impact on landscape values	negative	moderate	none
Pipeline corridor crosses populated areas	negative	moderate	slight
Pipeline corridor crosses areas of economic/ turistic activities valu	negative	moderate	slight
Total construction cost	up to 20% from the most cheapest	up to 10% from the most cheapest	the most cheapest togheter with branch c
Technical difficulties of pipeline construction	very difficult	moderate	slight

Figure 36: Defined criteria for IAP route variants in Montenegro and Albania

Considered Variants description based on Environmental Criteria

Environmental Criteria	*Weight factor 1 – 5*	*Variant A (Montenegro) + Variant A (Albania)*	*Variant D (Montenegro) +Variant C (Albania)*
Hydrogeology/ Water protection zones	*4*	- Route probably passes through water protection zone of the water source Topliš - there is possibility that route passes through water protection zone of water source of the river Crnojevica - pipeline route overlies 5 (two) Quaternary gravel aquifers: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); 3-Mati aquifer (sect.4) 4-Mbishkodra aquifer (sect.6); 5-Nenshkodra aquifer (sect.6). (**existing probability**)	- As the route passes mainly through the sea there is a small possibility of its cross through water protection zones - The pipeline route in Albania overlies **3 (three aquifers)** of national importance as follows: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); and 3-Mati aquifer (sect.4). (**existing probability**)
Water Resources	*3*	- crosses Morača and Cijevna River in Montenegro - The pipeline route traverses 9 (six) important rivers in Albania: Kiri; Vraka; Drini River; Drini Lezhes river (five times); Mati; Ishmi; Shkumbini; Semani and Erzeni The route is considered **less acceptable**.	- crosses Bojana River The pipeline route traverses 6 (one) important rivers in Albania:: Erzeni, Drini Lezhes; Mati; Ishmi; Shkumbini; Semani The route is considered **acceptable**.
Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)	*4*	Variant A: - Passes through an EN site in Montenegro - Passes in vicinity of four PA (three EN sites) in Montenegro - Runs in vicinity of 3 (two) PAs in Albania The route is considered **to have moderate impact**.	Variant D: - Passes through Protected area in vicinity of four EN sites (two PA) in Montenegro - Passes through sea habitats in Montenegro - Traverses 1 PAs site in Albania The route is considered t**o have moderate impact**.. The off shore section goes through the sea habitats area with potential high biodiversity value.
Land use	*4*	The route has moderate impact on agriculture and	The route has moderate impact on agriculture and

Environmental Criteria	*Weight factor 1 – 5*	*Variant A (Montenegro) + Variant A (Albania)*	*Variant D (Montenegro) +Variant C (Albania)*
		agriculture land and as well to forest land values.	agriculture land and as well to forest land values.
Landscape and Visual Issues	*3*	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)
Cultural Heritage	*4*	In the wider area of the gas pipeline direction are perceptible elements of cultural heritage of great value. Especially archeological sites and historic buildings mostly around the city of Podgorica, Shkodra, and Lezha Districts. Attention needs to be paid during the tuning of the route. (**moderate**)	None of the cultural heritage areas has been observed in the wider area of route D in Montenegro. But there is a possibility of hydroarchealogical findings. Also, in the wider area of the gas pipeline direction are perceptible elements of cultural heritage of great value. Especially archeological sites and historic buildings mostly around Lezha Districts. Attention needs to be paid during the tuning of the route. (**moderate**)

Considered Variants description based on Social Criteria

Social Criteria	*Weight factor 1 – 5*	*Variant A (Montenegro) + Variant A (Albania)*	*Variant D (Montenegro) +Variant C (Albania)*
Pipeline corridor crosses populated areas	*4*	Variant A is passing near settlements, but avoiding constructed areas (Montenegro). Pipeline route runs near and throughout the settlements of many villages within Shkodra and Lezha districts – this can be avoided in future project preparation phases – route tuning (Albania). (**moderate**)	Variant D is passing near settlements, but avoiding constructed areas (Montenegro). Pipeline route runs near and throughout the settlements of many villages within Lezha district – this can be avoided in future project preparation phases – route tuning (Albania). (**moderate**)
Pipeline corridor crosses areas of economic activities values	*3*	Variant A passes near zones of economic activities near town of Podgorica but it does not endanger them (Montenegro)	Variant D does not pass near zones of economic or touristic activities (Montenegro) Pipeline route runs through rural areas (Albania).

		Pipeline route runs through zones of economic activities near Shkodra and the whole flat area of the Shkodra and Malesia Madhe Districts – this can be avoided in future project preparation phases – route tuning (Albania). **(moderate**)	(**slight impact**)

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	*Weight factor 1 – 5*	*Variant A (Montenegro) + Variant A (Albania)*	*Variant D (Montenegro) +Variant C (Albania)*
Cost of construction	*4*	The difference between coastal and Northern route in Albania was 44 million EUR and when compared to the difference between Montenegro coastal and northern pipeline route amounted 20 mil. EUR it seems that the coastal route has potential for saving 24 mil. EUR. (Variant D in Montenegro and Variant C in Albania) Nevertheless, if we decide on the coastal route through Montenegro, then connection pipeline branch toward Podgorica and Nikšić should be developed. Their development cost is estimated at 36 mil. EUR. If this branch pipeline cost is taken into the equation, then the **northern pipeline route** (Variant A in Montenegro and Variant A in Albania) will result with total savings of 12 mil. EUR.	
Technical solution of pipeline construction	*2*	Variant A passes through mountainous area of Montenegro that presents **moderate** technical difficult. As it pass near settlements and detected soil excavation types are not technically demanding it is considered that technical solution of this variant construction is moderate. The proposed pipeline route runs mainly in flat terrain, except: a-the hilly area South-West of Tirana District, where flysch geological formations outcrop in surface; and b-some small areas within the Malesia Madhe, Shkodra, and Lezha Districts, where outcrop in surface hard rocks limestone formations), and near and throughout many dwelling areas (within Malesia Madhe, Shkodra, and Lezha Districts) that presents **moderate technical difficulties**.	Variant D has longest off-shore section that presents **moderate** technical difficult. It does not pass across very demanding terrain regarding altitude differences and soil excavation types. The proposed pipeline route runs mainly in flat terrain (except the hilly area South-West of Tirana District, where soft rocks composed by flysch geological formations outcrop in surface) and do not affects adversely the settlements that presents **low technical difficulties**.

Results gained by DoctuS software are shown on following figure.

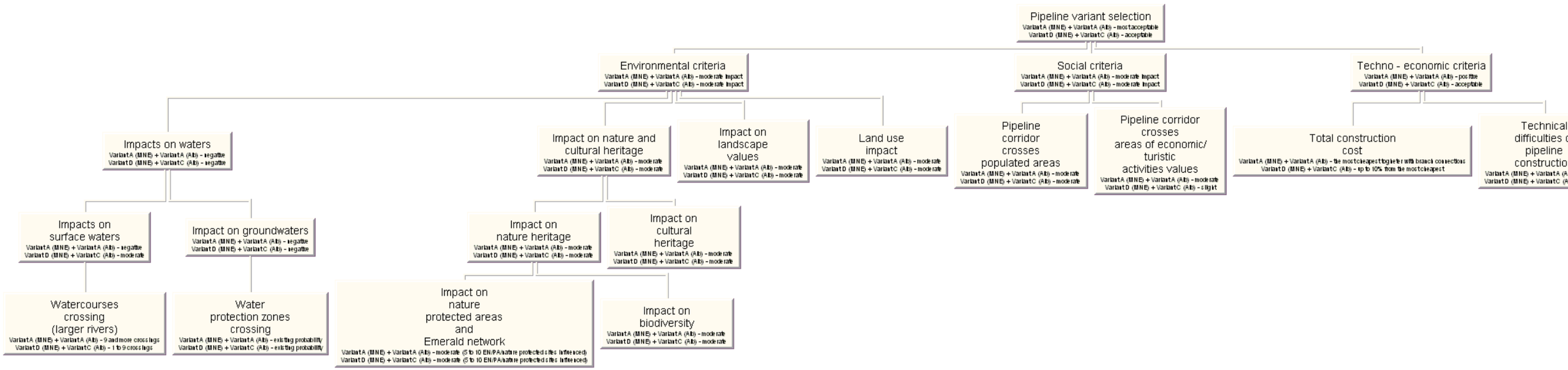


Figure 37: Defined criteria for IAP route variants in Montenegro and Albania

As most acceptable Variant A in Montenegro continuing to Variant A in Albania has been selected.

Croatia and Bosnia and Herzegovina

For Croatian part of the IAP route the EIA procedures have been finished, for separate sections of pipeline route:

- section Split – Ploče
- section Ploče – Dubrovnik – with 3 variants evaluated
- section Dubrovnik – Prevlaka

As most acceptable Variant A has been chosen, for which the authorized Ministry has issued a valid Decision upon the acceptability for the environment.

Defined criteria for IAP route variants in Croatia are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant	less acceptable	acceptable	most acceptable
Environmental criteria	less acceptable	acceptable	most acceptable
Social criteria	negative impact	moderate impact	positive impact
Techno - economic criteria	negative	acceptable	more acceptable
Pipeline corridor crosses populated areas	great negative	moderate	slight
Pipeline corridor crosses areas of economic activiti	great negative	moderate	slight
Total construction cost	up to 20% from the most cheapest	up to 10% from the most cheapest	the most cheapest
Technical difficulties of pipeline construction	very difficult	moderate	slight

Figure 38: Criteria for IAP route variants in Croatia

Considered Variants description based on Social Criteria

Social Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*
Pipeline corridor crosses populated areas	*4*	Variant A is passing near settlements, but avoiding constructed areas. (**moderate**)	Variant B is passing near settlements, but avoiding constructed areas. (**moderate**)	Variant C is passing near settlements, but avoiding constructed areas (**moderate**).
Pipeline corridor crosses areas of economic activities values	*3*	Variant A passes near zones of economic activities on Pelješac peninsula, but it does not endanger them (**moderate**)	Variant B passes near zones of economic activities on Pelješac peninsula, but it does not endanger them. (**moderate**)	Variant C passes through zones of economic activities (agriculture production) in Neretva river delta area. (**great negative**)

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*
Cost of construction	*4*	338,9 M Euro	337,5 M Euro	312,7 M Euro
Technical difficulties of pipeline construction	*2*	Variant A has off-shore section that presents **moderate** technical difficult. It does not pass across very demanding terrain regarding altitude differences and soil excavation types.	Variant B has off-shore section that presents **moderate** technical difficult. It does not pass across very demanding terrain regarding altitude differences and soil excavation types.	Variant C crosses Neretva river delta that present **very difficult** and technically demanding structure. Unstable terrain in Neretva delta area makes pipeline lying very unstable form technical security point.

Results gained by DoctuS software are shown on following figure.

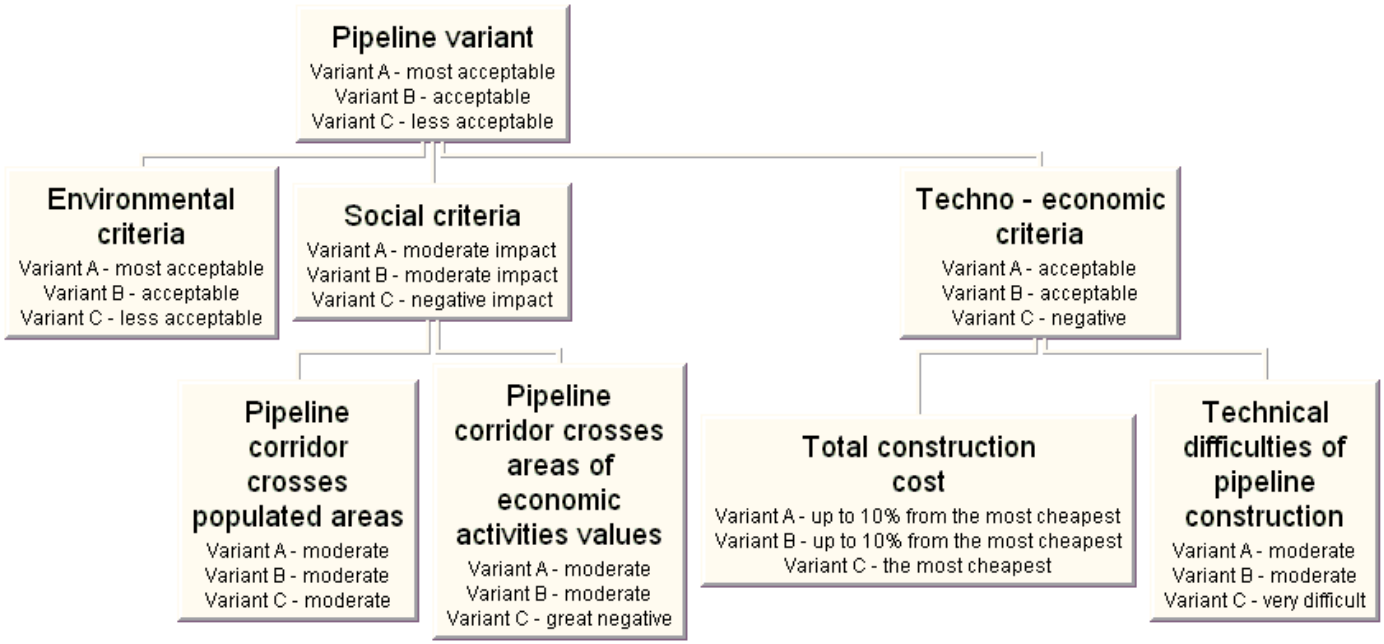


Figure 39: IAP route variants selection for Croatia

As most acceptable Variant A has been selected. Variant B is considered acceptable. Variant C is considered less acceptable.

7 Related documents

For further information and basic data references are made to the following documents:

- WB5-REG-ENE-03 Feasibility Study and EIA&SIA Ionian - Adriatic Pipeline (IAP) – Terms of reference
- C205/AD-0003/Rev.0 IAP Ionian Adriatic Pipeline – Pre- Feasibility Study
- C205/ILFM-AD-0000/Rev. B IAP (Ionian Adriatic Pipeline) – Hydraulic study and cost comparison (step 1)
- C205/ILFM-AD-0001/Rev. A IAP (Ionian Adriatic Pipeline) – Hydraulic study (step 2)
- C205/AD-0001/Rev.0 IAP (Ionian Adriatic Pipeline) – Site visit report, North Albania – Montenegro –
- Conceptual plan gas pipeline system Ploče – Dubrovnik – Prevlaka - Dobreč (Idejne osnove plinovodnog sustava Ploče – Dubrovnik – Prevlaka – Dobreč)
- Conceptual plan of the international gas pipeline system Ploče - Mostar (Idejne osnove međunarodnog plinovoda Ploče – Mostar)
- Conceptual plan of the international gas pipeline system Zagvozd – Imotski - Posušje (Idejne osnove međunarodnog plinovoda Zagvozd – Imotski – Posušje)
- A study of the route of the main gas pipeline Ploče – Dubrovnik (Studija trase za magistralni plinovod Ploče – Dubrovnik)
- A study of the route of the international gas pipeline Dubrovnik – Prevlaka – Dobreč (Studija trase za međunarodni plinovod Dubrovnik – Prevlaka – Dobreč)
- Geodetic (longitudinal profiles, cadastral base) for the main gas pipeline Ploče - Dubrovnik (Geodetske podloge (uzdužni profile, katastarske podloge) za magistralni plinovod Ploče – Dubrovnik)
- Geodetic (DOF, cadastral base and situations, longitudinal profiles) for international gas pipeline Dubrovnik – Prevlaka – Dobreč (Geodetske podloge (DOF, katastarske podloge i situacije, uzdužni profile) za međunarodni plinovod Dubrovnik – Prevlaka – Dobreč)
- Geological study for the main gas pipeline Ploče - Dubrovnik (Geološki elaborat za magistralni plinovod Ploče – Dubrovnik)
- Geological study for the international gas pipeline Dubrovnik – Prevlaka – Dobreč (Geološki elaborat za međunarodni plinovod Dubrovnik – Prevlaka – Dobreč)

- A study on the environmental impact of the main gas pipeline Ploče – Dubrovnik (Studija o utjecaju na okoliš za magistralni plinovod Ploče – Dubrovnik)
- A study on the environmental impact of the international gas pipeline Dubrovnik – Prevlaka – Dobreč (Studija o utjecaju na okoliš za međunarodni plinovod Dubrovnik – Prevlaka – Dobreč)
- Basic design of the mine gas pipeline Split – Ploče (Idejni projekt magistralnog plinovoda Split – Ploče)
- Feasibility study for corridor of IAP underwater route (part of the Croatian territorial sea) (Studija izvodljivosti za koridor podmorskih dionica IAP (dio u hrvatskim teritorijalnim vodama)
- Hydrographic study – geological – magnetometry surveying undersea route of the future IAP gas pipeline (part of the Croatian territorial sea) (Studija hidrografsko – geološko – magnetometrijske izmjere na podmorskim dionicama budućeg plinovoda IAP (dio u hrvatskim teritorijalnim vodama))
- Assessment of potential natural gas in countries that gravitate Adriatic - Ionian pipeline as part of the EC SEE gas ring (Studija ocjene potencijalnog tržišta prirodnog plina u zemljama koje gravitiraju Jadransko – jonskom plinovodu kao dijelu SEE EC plinskog prstena)
- WB5-REG-ENE-03_18-20 June 2012 - Mission Report
- WB5-REG-ENE-03_27-29 June 2012 - Mission Report
- WB5-REG-ENE-03_15-21 July 2012 - Mission Report
- WB5-REG-ENE-03_22-28 July 2012 - Mission Report
- WB5-REG-ENE-03_25_28_September_2012 - Mission Report
- WB5-REG-ENE-03_August 2012 - GAP Analyses Report

Appendix 1 Description of variants

Section 1 (Fier – Staravec)
The route starts at compressor station on the TAP system near Fier and runs in northern direction parallel to the costal line to the Staravec village. The pipeline crosses agriculture areas, mainly flat terrain which is not difficult for construction.

Total length of section 1	38.1 km
Highest point of the pipeline	100 m
Lowest point of the pipeline	10 m
Maximal operating pressure	85 bar

Section 2 (Staravec – Ahmetaq)
From Staravec the route runs in northern direction toward Ahmetaq. The pipeline crosses flat agriculture areas and then south – west of Tirana crosses a hilly terrain, and reaches Tirana area west of the city. In this section no major problems for construction of the pipeline are to be expected.

Total length of section 2	54.3 km
Highest point of the pipeline	320 m
Lowest point of the pipeline	10 m
Maximal operating pressure	85 bar

Section 3 (Staravec – Ahmetaq)
From Staravec the route runs to west toward the cost and then in northern direction parallel to the costal line to the Ahmetaq. The pipeline runs mostly through flat agriculture areas. Near Durres it passes through an urban area, crosses a hilly terrain and reaches Ahmetaq. In this section no major problems for construction of pipeline are to be expected.

Total length of section 3	63.2 km
Highest point of the pipeline	170 m
Lowest point of the pipeline	-2 m
Maximal operating pressure	85 bar

Section 4 (Ahmetaq – Balldre)
From Ahmetaq the route runs in northern direction toward Balldre. The route runs through flat agriculture areas. At his route pipeline crosses two rivers. Pipeline construction is practicable.

Total length of section 4	45.0 km
Highest point of the pipeline	140 m
Lowest point of the pipeline	-2 m
Maximal operating pressure	85 bar

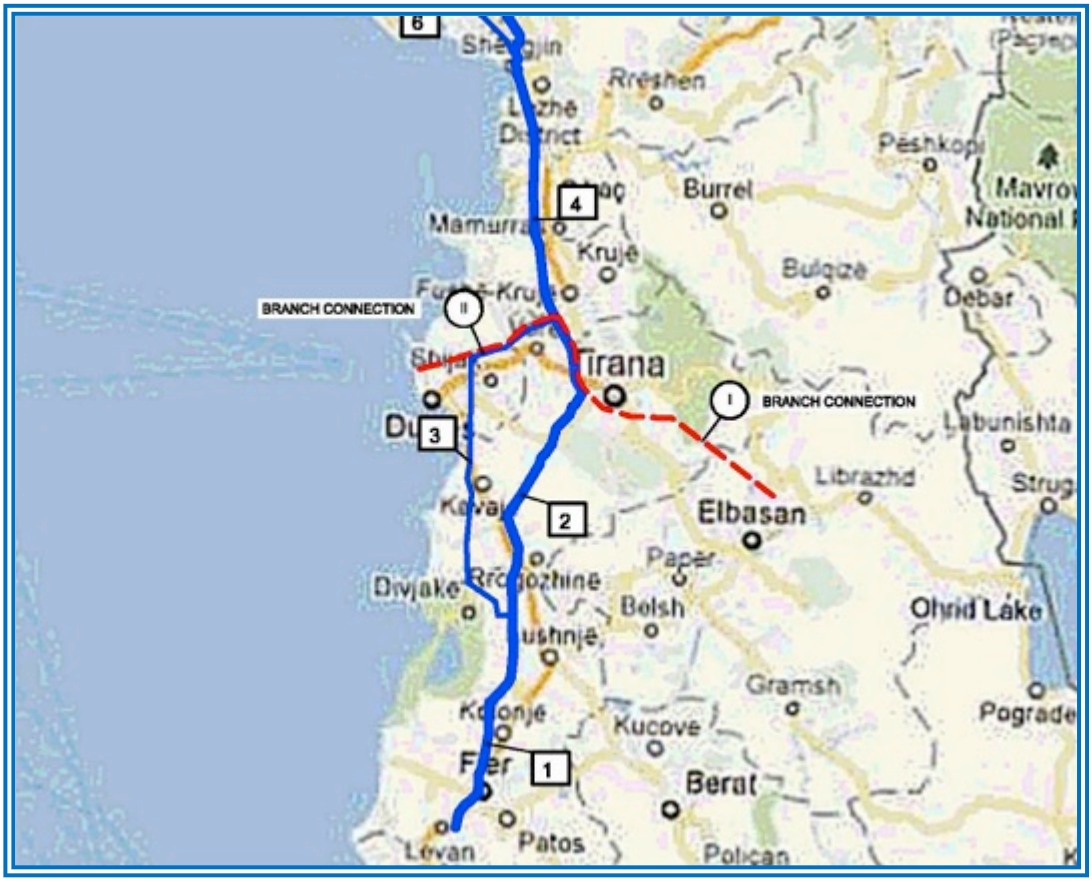


Figure 40: Route section 1 to 4

Section 5 (Balldre – Barlaj)
The pipeline crosses flat agriculture areas until it reaches Skadar. The urban area of Skadar will be passed on the south – east side. The pipeline route crosses river Drin and passes Skadar Lake on the north and runs into mountainous area toward Barlaj at Albania – Montenegro border.

Total length of section 5	66.5 km
Highest point of the pipeline	510 m
Lowest point of the pipeline	-1 m
Maximal operating pressure	85 bar

Section 6 (Balldre – Štodra)
Alternative route from Balldre toward Albania – Montenegro border at Štodra runs mostly through flat agriculture areas and it is very suitable for pipeline construction. At the border pipeline crosses river Bojana.

Total length of section 6	27.6 km
Highest point of the pipeline	100 m
Lowest point of the pipeline	-2 m
Maximal operating pressure	85 bar

Section 7 (Barlaj – Nalježići)
From Albania – Montenegro border the pipeline runs through mountainous area toward Podgorica, passes Podgorica on the south and runs toward Cetinje. From Podgorica the pipeline follows in general the main road in direction to Cetinje. There may be difficulties in construction of the pipeline due to mountainous terrain.

Total length of section 7	54.7 km
Highest point of the pipeline	1360 m
Lowest point of the pipeline	20 m
Maximal operating pressure	75 bar

Section 8 (Nalježići – Radanovići)
This is a short section in hilly terrain. In this section no major problems for construction of pipeline are to be expected.

Total length of section 8	2.4 km
Highest point of the pipeline	420 m
Lowest point of the pipeline	40 m
Maximal operating pressure	75 bar

Section 9 (Štodra – Donji Podi)
From Albania – Montenegro border toward city of Bar the route runs partly through flat terrain and after that through mountainous area. This mountainous terrain is very difficult for construction of the pipeline.

Total length of section 9	22.0 km
Highest point of the pipeline	600 m
Lowest point of the pipeline	5 m
Maximal operating pressure	75 bar

Section 10 (Donji Podi - Nalježići)
From Bar across mountainous area parallel to the coast, route runs toward Nalježići. This mountainous terrain is very difficult for construction of the pipeline.

Total length of section 10	53.6 km
Highest point of the pipeline	1310 m
Lowest point of the pipeline	150 m
Maximal operating pressure	75 bar

Section 11 (Donji Podi – Bartula)
This is a short section in hilly terrain. In this section no major problems for construction of pipeline are to be expected.

Total length of section 11	1.0 km
Highest point of the pipeline	460 m
Lowest point of the pipeline	260 m
Maximal operating pressure	75 bar

Section 12 (Bartula – Lastva Grbajska)
Pipeline route runs along the coast. This is the most critical section of the route. Some parts especially in the vicinity of the cities seems to be not really feasible as the steep mountain slopes are directly starting at the coast and the settlement areas have expanded already to lower parts of the mountain slopes. It seems to make an installation of a large diameter pipeline unrealistic with classical construction methods. In the Bar area no feasible route could be found.

Total length of section 12	41.6 km
Highest point of the pipeline	520 m
Lowest point of the pipeline	40 m
Maximal operating pressure	75 bar

Section 13 (Lastva Grbajska - Radanovići)
The route follows the road toward Radanovići, at the edge of a wide valley. In this section no major problems for construction of pipeline are to be expected.

Total length of section 13	7.4 km
Highest point of the pipeline	160 m
Lowest point of the pipeline	40 m
Maximal operating pressure	75 bar

Section 14 (Bartula - Lastva Grbajska)
The route passes near the city of Bar, enters the sea and is laid down on the seabed. In the bay of Jaz the route runs on-shore, passes over Quaternary valley and reaches Lastva Grabajska.

Total length of section 14	42.3 km
Highest point of the pipeline	200 m
Lowest point of the pipeline	-50 m
Maximal operating pressure	75 bar

Section 15 (Radanovići - Vitajina)
From Budva to Croatia the pipeline runs across the peninsula where a subsea section of the pipeline will lead from Rt. Dobreč through Boka Kotorska to the landing point in Uvala Čipavica on Croatian territory. Offshore section in Bokakotorska bay is included in sections 15 and 16.

Total length of section 15	19.6 km
Highest point of the pipeline	570 m
Lowest point of the pipeline	-20 m
Maximal operating pressure	75 bar

Section 16 (Vitajina - Đurinići)
Pipeline passes through the flat valley of peninsula Prevlaka toward Đurinići. The section covers half of the subsea pipeline in Bokakotorska bay. In this section no major problems for construction of pipeline are to be expected.

Total length of section 16	8.4 km
Highest point of the pipeline	340 m
Lowest point of the pipeline	-20 m
Maximal operating pressure	75 bar

Section 17 (Đurinići - Čibaća)
On shore pipeline route from Đurinići to Čibaća runs mostly across the Field of Konavli, passes Dubrovnik airport and at the Cavtat runs in to the sea. From Cavtat to Čibaća pipeline runs offshore. The place where the pipeline goes under the sea is very steep and construction of the pipeline is highly difficult.

Total length of section 17	32.4 km
Highest point of the pipeline	300 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Figure 41: Route section 5 to 17

Section 18 (Čibaća - Podimoć)
From Ćibaća to Podimoć the route runs in very hilly and rough terrain. The main problem of this section is crossing the bay of Rijeka dubrovačka. The hills on the shores of the bay are very steep and high.

Total length of section 19	42.5 km
Highest point of the pipeline	460 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 19 (Podimoć - Kobiljača)
From Podimoć toward Kobiljača the route runs over the rough rocky terrain and passes through Bosnia and Hezegovina territory near the city of Neum. In Bosnia and Herzegovina the route runs mostly through mountainous terrain and crosses the river of Neretva near city of Opuzen.

Total length of section 20	50.2 km

Highest point of the pipeline	330 m
Lowest point of the pipeline	40 m
Maximal operating pressure	75 bar

Section 20 (Podimoć - Osobjava)

Route runs over peninsula Pelješac through hilly rough terrain. Near Broce, the pipeline crosses the bay of Ston.

Total length of section 21	41.6 km
Highest point of the pipeline	350 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 21 (Osobjava - Ploče)

Near Osobjava the route crosses offshore the Pelješac bay and runs toward the city of Ploče. Route passes the city of Ploče on the east side and through mountainous area runs toward Kobiljača.

Total length of section 22	21.2 km
Highest point of the pipeline	260 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 22 (Ploče - Kobiljača)

This is a short section which descends from the hill and mostly passes through flat agriculture area.

Total length of section 23	0.6 km
Highest point of the pipeline	60 m
Lowest point of the pipeline	20 m
Maximal operating pressure	75 bar

Section 23 (Osobjava - Ploče)
After crossing the Pelješac bay the route passes the city of Ploče on the west side, runs near Bačinsko lake and through mountainous area goes toward Kobiljača.

Total length of section 24	22.3 km
Highest point of the pipeline	300 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 24 (Kobiljača – Otrić seoci)
From Kobiljača to Otrić seoci, pipeline goes along the edge of agriculture field and no major problems for construction of pipeline are to be expected.

Total length of section 25	4.8 km
Highest point of the pipeline	115 m
Lowest point of the pipeline	28 m
Maximal operating pressure	75 bar

Section 25 (Otrić seoci - Zagvozd)
From Otrić seoci to Zagvozd the route goes partly along the edge of agriculture field, but mostly goes through mountainous and hilly area following in general the highway in direction to Split.

Total length of section 26	42.4 km
Highest point of the pipeline	620 m
Lowest point of the pipeline	38 m
Maximal operating pressure	75 bar

Section 26 (Zagvozd - Dugopolje)
The route runs toward Dugopolje through mountainous and hilly area, following in general the highway in direction to Split. In that point IAP gas system will be connected to Croatian gas pipeline system. Before entering in existing Croatian gas system, gas pressure will be increased by a new compressor station.

Total length of section 27	53.0 km
Highest point of the pipeline	300 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 27 (Podimoć – Mostar – Posušje – Imotski - Zagvozd) BiH
This section starts in Croatian territory, runs through territory of Bosnia and Herzegovina in north direction toward city of Mostar, passes Posušje and Imotski, and runs toward Zagvozd in Croatian territory. Pipeline mostly runs through mountainous and hilly areas and at some parts through flat valleys.

Total length of section 28	135.0 km
Highest point of the pipeline	920 m
Lowest point of the pipeline	150 m
Maximal operating pressure	75 bar

Figure 42: Route section 18 to 27

Branch connection I (Ahmetaq – Tirana - Elbasan)
If section 2 will be constructed Elbasan will be connected through Branch connection I from Tirana to Elbasan. The length of branch connection will be 35 km.
If section 3 will be constructed Elbasan will be connected through Branch connection I from Ahmetaq to Elbasan. The length of branch connection will be 50 km.
The route crosses flat agriculture areas near Tirana and then south – east of Tirana crossing a hilly terrain toward Elbasan.

Total length of branch connection I	50.0 km
Highest point of the pipeline	630 m
Lowest point of the pipeline	62 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Branch connection II (Ahmetaq – Durres)
If section 2 from Staravec to Ahmetaq will not be constructed, this branch connection will provide a supply of Durres with natural gas. The route crosses hilly terrain and continues toward Durres through flat agriculture areas.

Total length of branch connection II	22.0 km
Highest point of the pipeline	170 m
Lowest point of the pipeline	1 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Branch connection III (Melgushe – Bartula)
If the pipeline route toward Podgorica will be selected as a pipeline route of IAP, a supply of city of Bar will be provided through branch connection. Toward city of Bar route runs partly through flat terrain and then through mountainous area. Route has to cross the river Bojana.

Total length of branch connection III	35.0 km
Highest point of the pipeline	940 m
Lowest point of the pipeline	4 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Branch connection IV (Majstori – Budva)
If the pipeline route toward Podgorica will be selected as a pipeline route of IAP, a supply of city of Budva will be provided through branch connection. Route runs through mountainous and hilly area whit steep parts.

Total length of branch connection IV	7.8 km
Highest point of the pipeline	1200 m
Lowest point of the pipeline	60 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Branch connection V (Radanovići – Cetinje - Podgorica- Nikšić)
If the IAP pipeline route would not follow Podgorica - Cetinje rout the new branch connection toward Cetinje – Podgorica – Nikšić will be constructed. This branch connection runs through mountainous area toward Podgorica and continues toward Nikšić. The route follows in general the main road in direction Cetinje – Podgorica - Nikšić. There may be difficulties in construction of the pipeline due to mountainous terrain.

Total length of branch connection V	84.0 km
Highest point of the pipeline	1360 m
Lowest point of the pipeline	60 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Interconnection variant 1 (Zagvozd - Vir)
This branch connection is alternative to branch connection VI (Otrić seoci - Vitina) and will also provide a supply of Bosnia and Herzegovina with natural gas if the section 28 (Podimoć – Mostar – Posušje – Imotski - Zagvozd) will not be part of IAP system. Route runs through mountainous and hilly area.

Total length of branch connection VII	23.2 km
Highest point of the pipeline	850 m
Lowest point of the pipeline	260 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	20”

Interconnection variant 2 (Otrić seoci - Vitina)

This branch connection will provide a supply of Bosnia and Herzegovina with natural gas if the section 28 (Podimoć – Mostar – Posušje – Imotski - Zagvozd) will not be part of IAP system. The route crosses flat rocky terrain, passes over flat agriculture area and then ends at the hilly area.

Total length of branch connection VI	12.0 km
Highest point of the pipeline	390 m
Lowest point of the pipeline	70 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	20”

Appendix 2 Technical and environmental explanation of constraints of crossing delta Neretva river (Variant C in Croatia and BiH)

Technical constraints

Route variant of C-HR passes through the valley of the Neretva River delta, and part of the route runs through marshy terrain.
Execution of works for construction of a gas pipeline in marshy terrain is much more demanding, and therefore more expensive than building on clay courts.

Before the transportation of pipes along the route, a working corridor should be established along the entire length. Because of the diameter of the pipeline DN800, the usual width of the corridor is 20-22m, but here it is necessary to provide a greater breadth because of a bigger width of the trench top and larger amounts of material from the excavation, which must be disposed along the trench. The width of the trench in the ground, which is mostly composed of humus and clay, is approx. 3m, and in swampy area approx. 8m. Therefore, the total width of the work corridor is 25-27 m. In addition to higher construction costs it creates higher costs of land use fees.

During construction of gas pipelines it is necessary to enable safe movement of mechanization along the whole route. Given that the ground is swampy it is necessary to substitute the materials, predictably 0,5 – 1 m depth. In order for this to be carried out it is necessary to dig out topsoil and bring it away in a width of approx. 8 – 10 m along the entire length of the pipeline route, and replace it with stone material. Considering the composition of the soil there are no quarries in the Neretva River valley, and therefore it will have to be brought from distant quarries. The cost of transportation is equalized with the cost of the stone if the distance to the quarry is approx. 25 – 30 km. This means that the cost of transportation in this case will be greater than the cost of stone, and this will additionally increase the price of performance.

After completion of the work it is necessary to keep the service road at least 3m wide, the rest of the working corridor in the width of 5 – 7 m on which the substitution of materials has been made should be returned to its original state. This means another substitution of materials.

Since the service road is constructed on marshy terrain it can be assumed that it will sink with time, and therefore further silting of the road will be needed each year in order to remain it in function.

For performance of works in clay terrain usually the trench for the pipe laying is carried out with a gradient of 3:1. In case that the gas pipeline is laid in muddy ground, trench sits should be completed with a slope 1:2. Therefore, in this case it is necessary to perform 2,5 times larger excavation, which further increases the price of works.

After excavation of the trench, due to the large bandwidth of soil, it can be assumed that the entire height of trench will be filled with water which will not

be possible to pump out. This also presents a very serious security problem, because in the event that any of the workers (wearing coveralls, further hampered by tools) falls into the trench it could have unintended consequences.

Once the individual welded sections are laid in the trench, mud would immediately enter the pipes which would later be difficult to remove. Besides, deposited sections should be welded inside the trench that is filled with water, which is not possible. Thus, each prefabricated pit needs to be surrounded with waterproof fence, and the water should be constantly pumped out of the trench.

If the ends of the pipes would be closed so that the mud doesn't enter them, such placed sections would be swimming in the trench because the lift is twice the weight of the pipe. In this way, laid sections would not be able to connect.

After laying and backfilling the trench, it is necessary to perform a pressure test. The gas pipes would be even heavier and there is a risk of further subsidence. Considering that block stations would be performed on solid ground, the indicated subsidence would cause additional unauthorized pipe strain.

Environmental constraints

Possible impacts on biodiversity important areas of Variant C of the pipeline Ploče-Dubrovnik
Pipeline between Ploče and Dubrovnik pass through and in vicinity of several biodiversity important areas. The largest and internationally recognised biodiversity important area is wetland ecosystem of Neretva Delta.

Neretva Delta is protected or planned to be protected in following major categories:

1. Ramsar site
2. Croatian Ecological Network site
3. Proposed Natura 2000 site as Special Protected Area and Special Area of Conservation
4. Nature Park (planned)

Ramsar site
The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The wise use of wetlands is defined as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". Variant C of the pipeline will have negative impact on wetland habitat types of Neretva Delta. Consequently, in regard to Neretva Delta as Ramsar site the variant C is not favourable variant.

Croatian ecological network and NATURA 2000
At the heart of the two EU Directives (the Birds Directive and the Habitats Directive) is the creation of a Europe-wide ecological network of nature conservation sites – the NATURA 2000 Network. This network is designed to

conserve over a thousand rare, threatened and endemic species of wild animals and plants and some 230 natural and semi-natural habitats listed in the annexes of the two EU Directives.

Approximately 25,000 sites around EU have been included in the NATURA 2000 Network. At the time of its accession to the EU, Croatia will also need to implement the Birds and Habitats Directives on its territory.

In addition to NATURA 2000 sites, each country may establish some other features and sites as ecologically important areas. In Croatia these sites are incorporated as part of Croatian ecological network (EN). As part of adaptation to EU legislation Croatia has proclaimed Croatian Ecological Network (CEN) prior to NATURA 2000. The Ordinance on CEN initiated the development of the CEN, which also represents the network of habitats and species of European importance under NATURA 2000. The majority of sites of the CEN and NATURA 2000 cover the same area, although the target features within the same area might be different (different qualifying species and habitats).

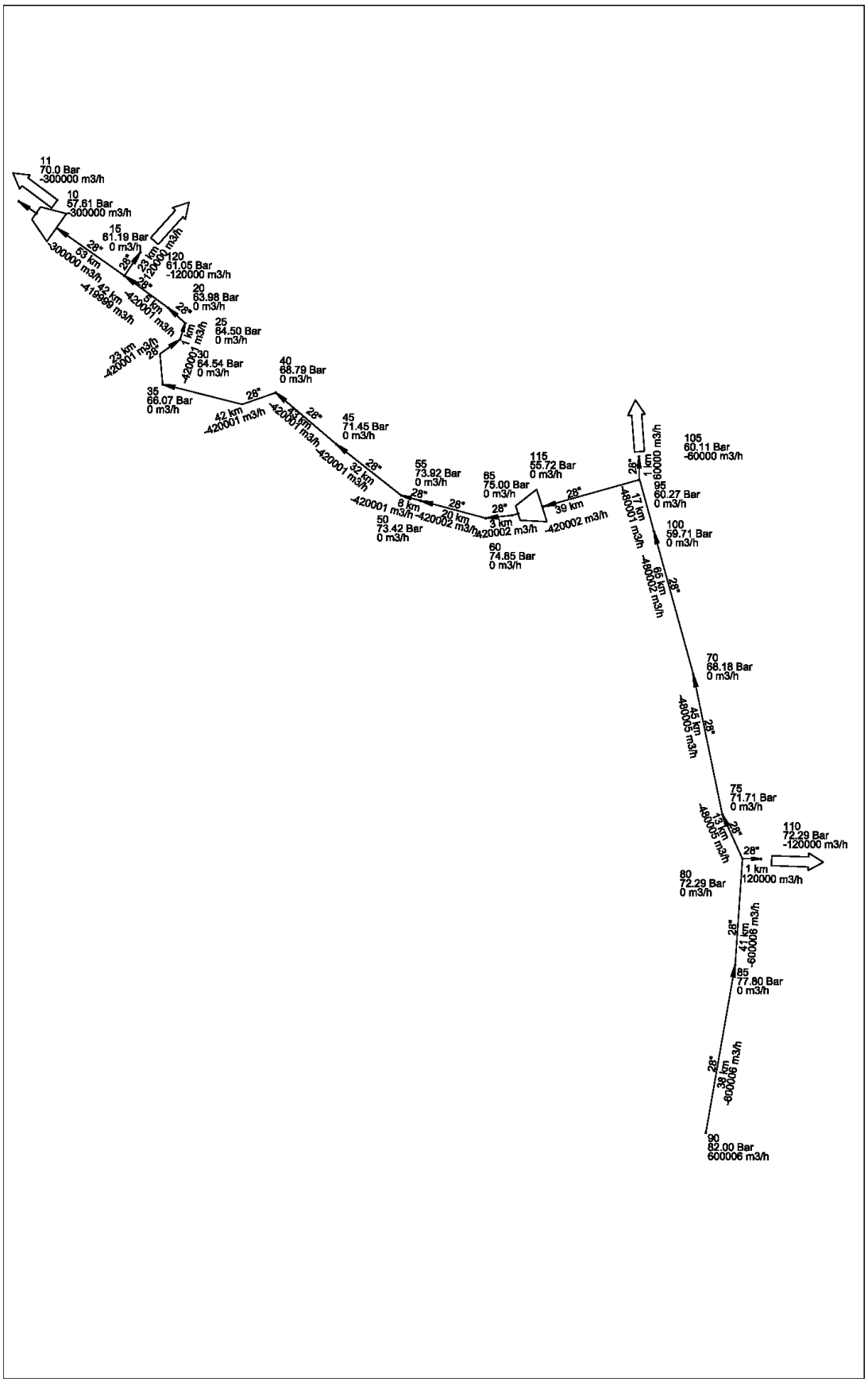
Nature impact assessment is a procedure of assessment of ecological impacts of given plan/ project on ecological network site conservation objectives and their integrity. Nature impact assessment is prescribed by Article 6(3) and 6(4) of Habitat Directive and already implemented in Croatian law. The main principle of nature impact assessment is avoidance of the impacts that might have adverse effect.

Variant A and Variant B avoid Neretva Delta area and only superficially impact Delta in the part where the pipeline pass under the sea. In contrast, Variant C of the pipeline passes through the middle of Neretva Delta and need to cross under the Neretva River and several major canals. The pipeline route is planned through the wetland area with high biodiversity value. Although, the core pipline will not affect big surface the pipeline constructions, supporting roads and construction managing surfaces might have adverse effect on proposed Natura 2000 site. In addition to impacts on Neretva Delta area, the Variant C pass the ecological network HR2000747 Ponor Crni vir and proposed Natura 2000 site HR2001046 Matica – Vrgoračko polje where adverse effects are possible as well.
The significant negative impact on the integrity of the ecological network site that cannot be avoided or mitigated should be approved through the procedure with uncertain outcome: the Imperative Reasons of Overriding Public Interest (IROPI). Moreover, before the implementation of the IROPI there should be aproved that there are no other alternative solutions (variants). In addition, the IROPI for the pipeline construction cannot be approved if there are possible significant impacts on priority species or habitat types.

Nature Park
Nature Park is protected area category designated by Croatian law. Neretva Delta is not jet designated as Nature Park but it is planned to be protected. Study for evaluation of Neretva Delta presents high natural value of the Neretva Delta area.

Appendix 3 Process calculation sheets

1. Process calculation sheet – Option 28”



Header Report: d:\livica\projek~1\2012\aip\pro3\28-3cvv

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 08:47:49 On 09-18-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 50
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

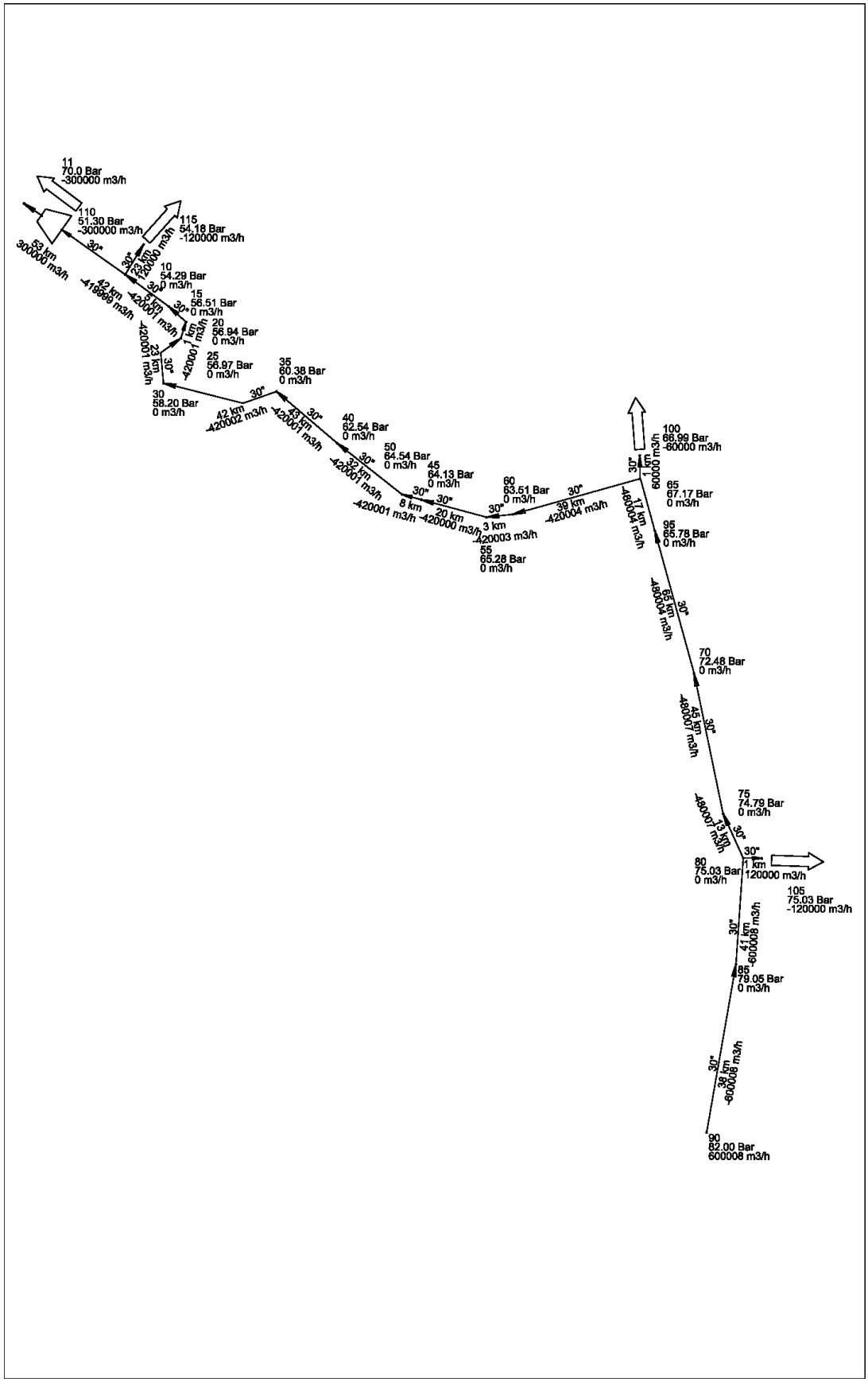
Node Report: d:\livica\projek~1\2012\aip\pro3\28-3cvv

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	57.61	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
15	61.19	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
20	63.98	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
25	64.50	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	64.54	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	66.07	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	68.79	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	71.45	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	73.42	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	73.92	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
60	74.85	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
65	75.00	Bar	YES	0	M^3/hr	FIX	41	Meters	10	Celsius	1.0116	Bar
70	68.18	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
75	71.71	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
80	72.29	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
85	77.80	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
90	82.00	Bar	YES	600006	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
95	60.27	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
100	59.71	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
105	60.11	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
110	72.29	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
115	55.72	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
120	61.05	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\livica\projek~1\2012\aip\pro3\28-3cvv

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETED_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
1	10	15	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	3613.68	436515968.00	Millibar	1.0
3	15	20	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	419999	M^3/hr	2787.38	354545120.00	Millibar	1.0
5	20	25	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	521.59	68070120.00	Millibar	1.0
7	25	30	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	40.87	5356390.50	Millibar	1.0
8	30	35	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1534.51	203542928.00	Millibar	1.0
10	35	40	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	2712.94	371376352.00	Millibar	1.0
11	40	45	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	2666.83	379410944.00	Millibar	1.0
12	45	50	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1968.91	289245088.00	Millibar	1.0
14	50	55	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	502.01	74989448.00	Millibar	1.0
15	60	65	P	Pan-B	28"85bar	Millimeter	0.00179	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	146.95	22318374.00	Millibar	1.0
23	70	75	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480005	M^3/hr	3518.15	499293536.00	Millibar	1.0
24	75	80	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480005	M^3/hr	575.39	84014912.00	Millibar	1.0
26	85	90	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600006	M^3/hr	4199.01	679537664.00	Millibar	1.0
27	95	100	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480001	M^3/hr	615.50	75057464.00	Millibar	1.0
28	95	105	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	168.33	20602812.00	Millibar	1.0
29	80	85	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600006	M^3/hr	5522.84	840084416.00	Millibar	1.0
30	80	110	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	5.21	763900.19	Millibar	1.0
31	100	70	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480002	M^3/hr	8535.96	1108522880.00	Millibar	1.0
32	55	60	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	925.03	139498560.00	Millibar	1.0
33	115	95	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	4589.02	541372032.00	Millibar	1.0
34	115	65	C	Pan-B	EMPIRICA	Millimeter	1.00000	Millimet	25.9	Meters	1.00000	Decimal	ON	YES	420002	M^3/hr	19320.56	2563889152.00	Millibar	1.0
35	15	120	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	141.21	17547682.00	Millibar	1.0

2. Process calculation sheet – Option 30”



Header Report: d:\ivica\projek~1\2012\aip\pro3\30-2c

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 14:30:26 On 10-15-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 50
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

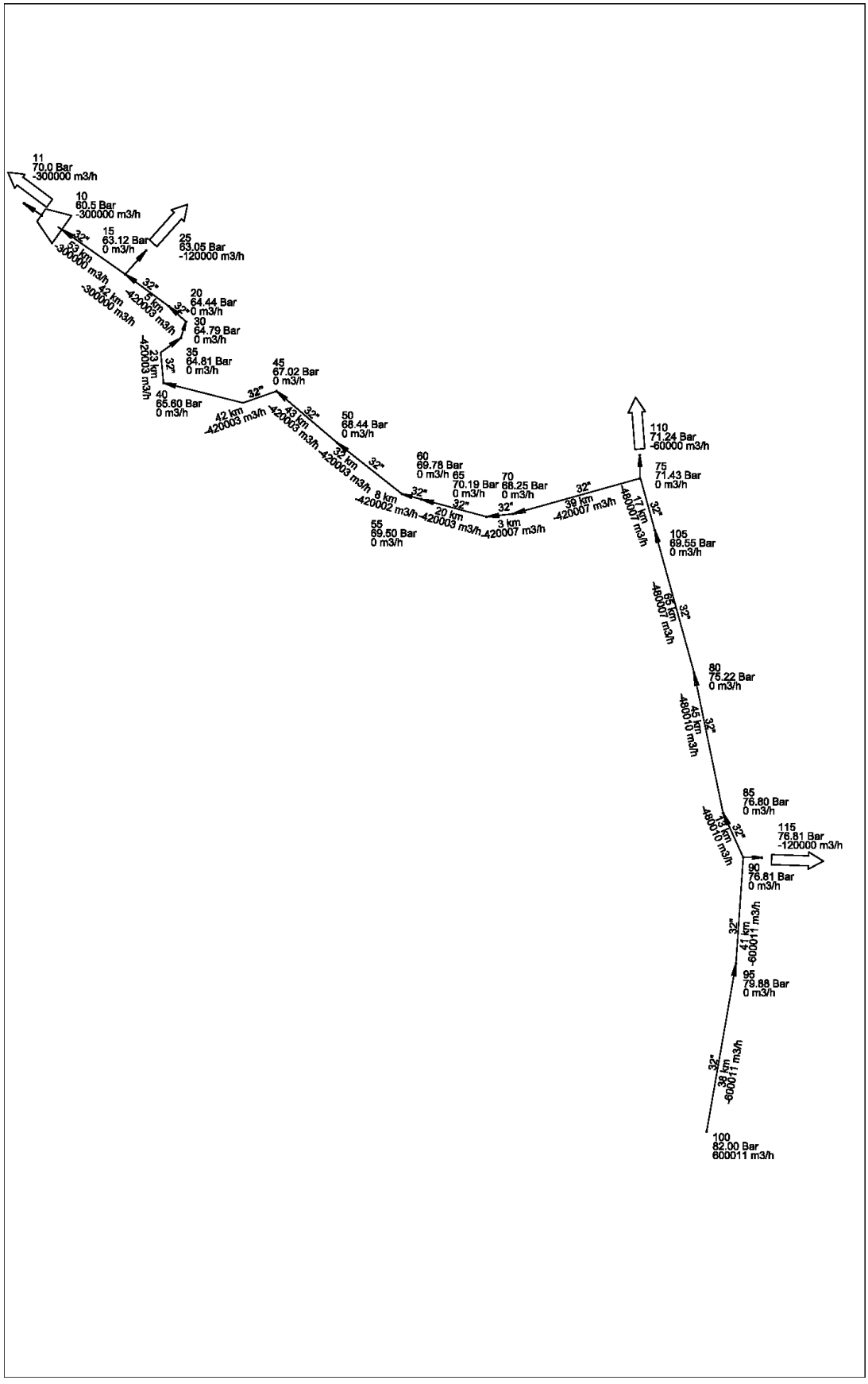
Node Report: d:\ivica\projek~1\2012\aip\pro3\30-2c

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	54.29	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
15	56.51	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
20	56.94	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
25	56.97	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	58.20	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	60.38	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	62.54	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	64.13	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	64.54	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	65.28	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
60	63.51	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
65	67.17	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
70	72.48	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
75	74.79	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
80	75.03	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
85	79.05	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
90	82.00	Bar	YES	600008	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
95	65.78	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
100	66.99	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
105	75.03	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
110	51.30	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
115	54.18	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\ivica\projek~1\2012\aip\pro3\30-2c

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETER	D_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
3	10	15	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	419999	M^3/hr	2212.19	249589632.00	Millibar	1.00
5	15	20	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	434.17	50133540.00	Millibar	1.00
7	20	25	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	32.77	3798808.50	Millibar	1.00
8	25	30	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1231.67	144354720.00	Millibar	1.00
10	30	35	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	2183.64	263385312.00	Millibar	1.00
11	35	40	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	2153.44	269082208.00	Millibar	1.00
12	40	45	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1593.88	205135648.00	Millibar	1.00
14	45	50	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	406.90	53183304.00	Millibar	1.00
15	55	60	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	1808.97	236560464.00	Millibar	1.00
16	60	65	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420004	M^3/hr	3702.01	491124096.00	Millibar	1.00
23	70	75	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480007	M^3/hr	2311.39	345100096.00	Millibar	1.00
24	75	80	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480007	M^3/hr	225.88	34298740.00	Millibar	1.00
26	85	90	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600008	M^3/hr	2945.80	480418400.00	Millibar	1.00
27	65	95	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480004	M^3/hr	1450.99	195760528.00	Millibar	1.00
28	65	100	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	186.54	25402374.00	Millibar	1.00
29	80	85	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600008	M^3/hr	4036.37	630093696.00	Millibar	1.00
30	80	105	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	3.56	541840.31	Millibar	1.00
31	95	70	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480004	M^3/hr	6764.44	948567744.00	Millibar	1.00
32	50	55	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420000	M^3/hr	735.16	96926984.00	Millibar	1.00
34	10	110	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	3028.39	325805664.00	Millibar	1.00
35	10	115	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	112.64	12446707.00	Millibar	1.00

3. Process calculation sheet – Option 32”



Header Report: d:\ivica\projek~1\2012\aip\pro3\32-2c

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 11:50:17 On 09-06-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 50
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

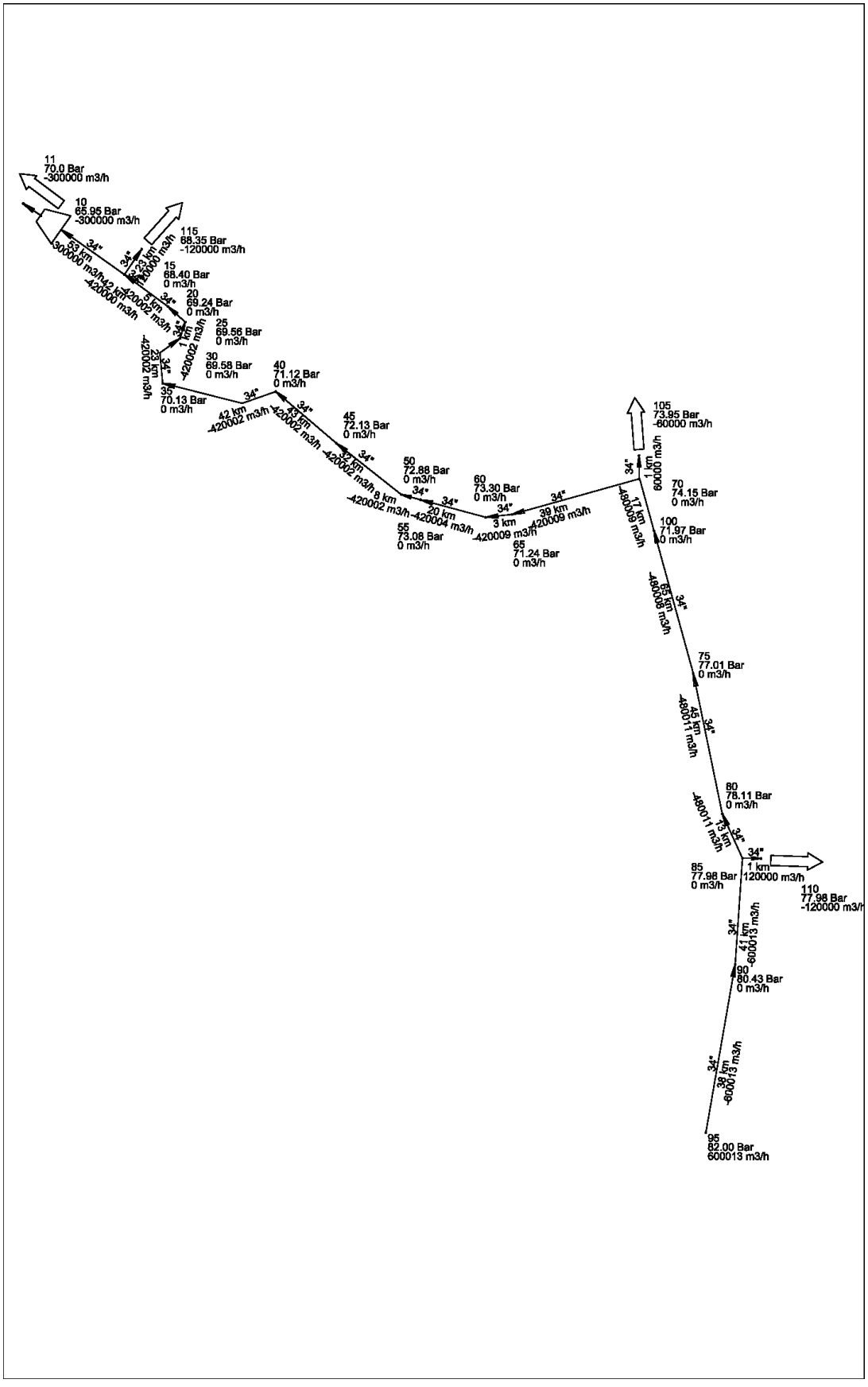
Node Report: d:\ivica\projek~1\2012\aip\pro3\32-2c

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	60.50	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
15	63.12	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
20	64.44	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
25	64.79	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	64.81	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	65.60	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	67.02	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	68.44	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	69.50	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	69.78	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
60	70.19	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
65	68.25	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
70	71.43	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
75	75.22	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
80	76.80	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
85	76.81	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
90	79.88	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
95	82.00	Bar	YES	600010	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
100	69.55	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
105	71.24	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
110	76.81	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
115	63.05	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\ivica\projek~1\2012\aip\pro3\32-2c

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETER	D_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
1	10	15	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	2658.16	333906720.00	Millibar	1.0
3	15	20	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1310.39	169805552.00	Millibar	1.0
5	20	25	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	362.26	47548796.00	Millibar	1.0
7	25	30	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	20.93	2754824.00	Millibar	1.0
8	30	35	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	790.35	104683296.00	Millibar	1.0
10	35	40	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420000	M^3/hr	1418.39	190999824.00	Millibar	1.0
11	40	45	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	1419.18	195133440.00	Millibar	1.0
12	45	50	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	1062.73	148760560.00	Millibar	1.0
14	50	55	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	272.92	38567544.00	Millibar	1.0
15	60	65	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420007	M^3/hr	1990.63	279519328.00	Millibar	1.0
16	65	70	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420006	M^3/hr	3229.26	457444256.00	Millibar	1.0
23	75	80	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480009	M^3/hr	1569.28	241747968.00	Millibar	1.0
24	80	85	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480009	M^3/hr	6.27	975555.88	Millibar	1.0
26	90	95	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600010	M^3/hr	2116.68	346955264.00	Millibar	1.0
27	70	100	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480006	M^3/hr	1935.40	276664672.00	Millibar	1.0
28	70	105	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	197.80	28619370.00	Millibar	1.0
29	85	90	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600010	M^3/hr	3083.15	489343776.00	Millibar	1.0
30	85	110	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	2.53	392981.56	Millibar	1.0
31	100	75	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480006	M^3/hr	5733.34	841355008.00	Millibar	1.0
32	55	60	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420005	M^3/hr	409.91	58206060.00	Millibar	1.0
33	15	115	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	70.41	9027246.00	Millibar	1.0

4. Process calculation sheet – Option 34”



Header Report: d:\livica\projek~1\2012\aip\pro3\34-2c

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 12:08:47 On 09-06-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 50
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

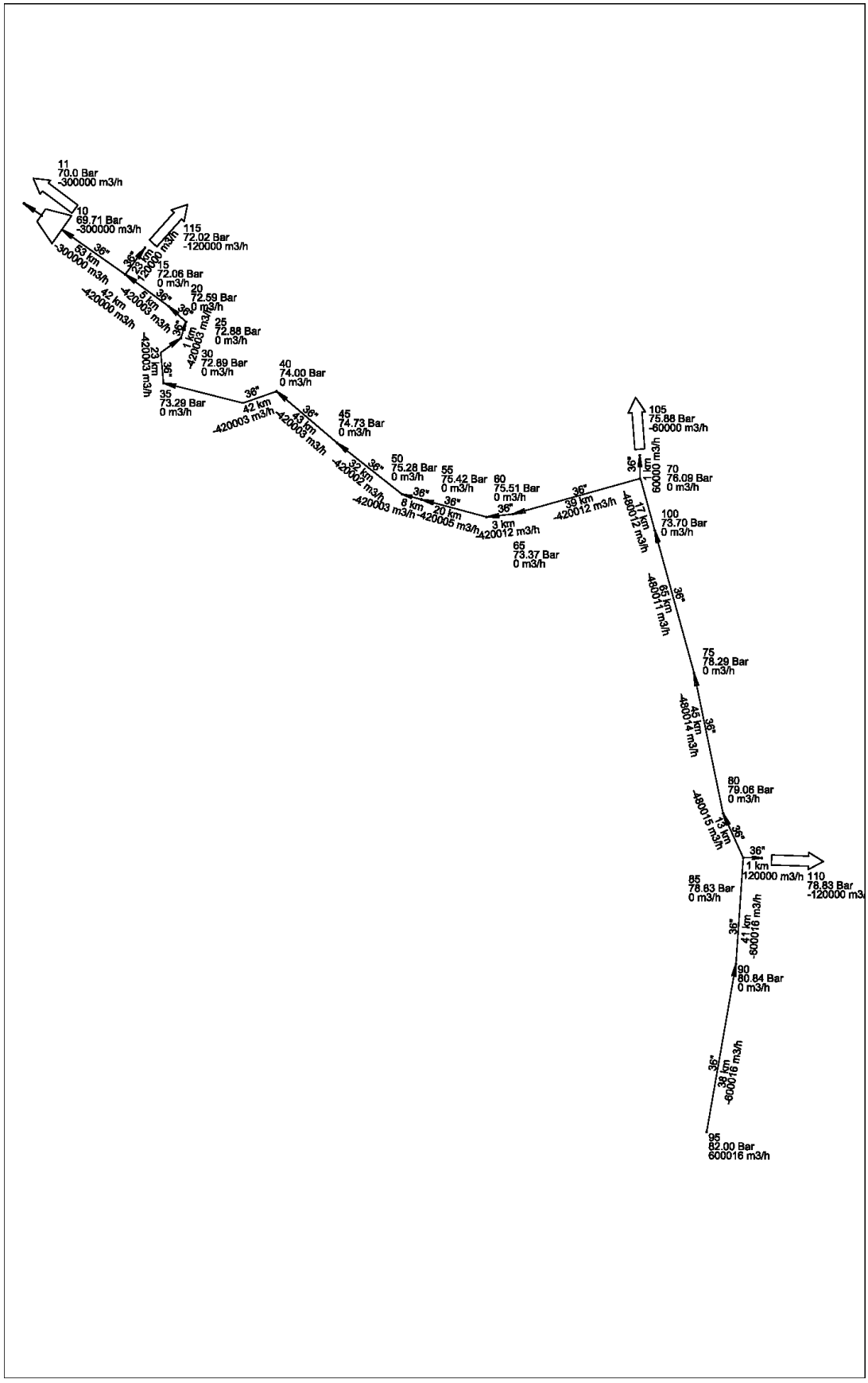
Node Report: d:\livica\projek~1\2012\aip\pro3\34-2c

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	65.95	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
15	68.40	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
20	69.24	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
25	69.56	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	69.58	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	70.13	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	71.12	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	72.13	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	72.88	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	73.08	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
60	73.30	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
65	71.24	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
70	74.15	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
75	77.01	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
80	78.11	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
85	77.98	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
90	80.43	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
95	82.00	Bar	YES	600013	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
100	71.97	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
105	73.95	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
110	77.98	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
115	68.35	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\livica\projek~1\2012\aip\pro3\34-2c

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETER	D_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
1	10	15	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	2488.62	339320896.00	Millibar	1.0
3	15	20	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	420000	M^3/hr	833.71	116445360.00	Millibar	1.0
5	20	25	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	325.36	45820172.00	Millibar	1.0
7	25	30	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	14.57	2056624.75	Millibar	1.0
8	30	35	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	551.39	78151728.00	Millibar	1.0
10	35	40	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	995.18	142592640.00	Millibar	1.0
11	40	45	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	1002.73	145677584.00	Millibar	1.0
12	45	50	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	755.29	111057384.00	Millibar	1.0
14	50	55	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	194.56	28792740.00	Millibar	1.0
15	60	65	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420009	M^3/hr	2103.88	308249632.00	Millibar	1.0
16	65	70	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420009	M^3/hr	2951.37	434919904.00	Millibar	1.0
23	75	80	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480011	M^3/hr	1098.55	172628208.00	Millibar	1.0
24	80	85	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480011	M^3/hr	134.79	21310458.00	Millibar	1.0
26	90	95	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600013	M^3/hr	1566.88	257697456.00	Millibar	1.0
27	70	100	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480009	M^3/hr	2233.74	330772096.00	Millibar	1.0
28	70	105	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	204.99	30770836.00	Millibar	1.0
29	85	90	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600013	M^3/hr	2463.39	395212480.00	Millibar	1.0
30	85	110	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	1.86	293415.13	Millibar	1.0
31	100	75	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480008	M^3/hr	5098.90	769653184.00	Millibar	1.0
32	55	60	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420004	M^3/hr	217.71	32307698.00	Millibar	1.0
33	15	115	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	48.56	6740089.50	Millibar	1.0

5. Process calculation sheet – Option 36”



Header Report: d:\livica\projek~1\2012\aip\pro3\36-2c

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 12:18:08 On 09-06-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 100
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

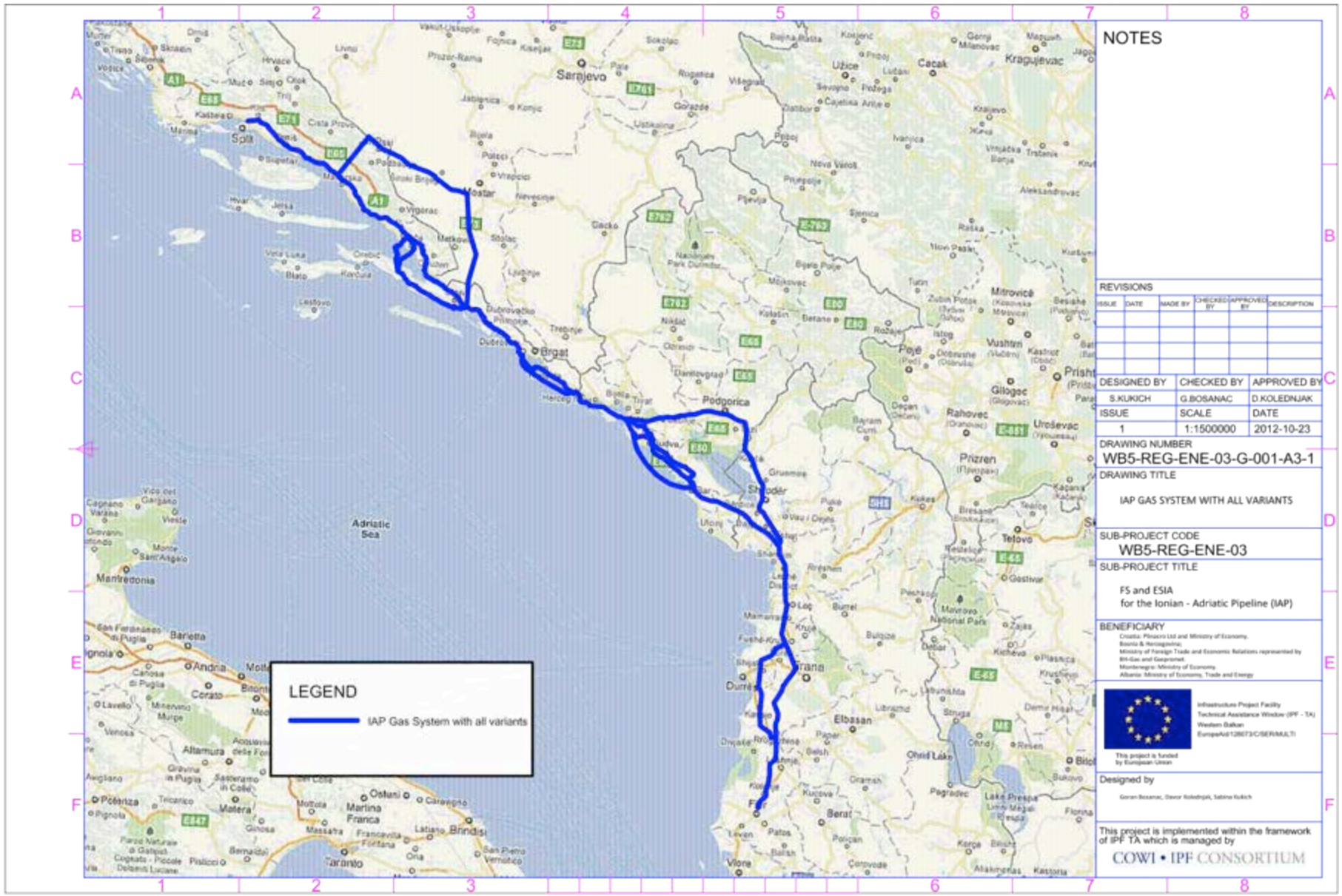
Node Report: d:\livica\projek~1\2012\aip\pro3\36-2c

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	69.71	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
15	72.06	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
20	72.59	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
25	72.88	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	72.89	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	73.29	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	74.00	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	74.73	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	75.28	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	75.42	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
60	75.51	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
65	73.37	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
70	76.09	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
75	78.29	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
80	79.06	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
85	78.83	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
90	80.84	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
95	82.00	Bar	YES	600016	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
100	73.70	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
105	75.88	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
110	78.83	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
115	72.02	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\livica\projek~1\2012\aip\pro3\36-2c

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETE	D_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
1	10	15	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	2388.18	343313248.00	Millibar	1.0
3	15	20	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	420000	M^3/hr	525.48	77071608.00	Millibar	1.0
5	20	25	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	302.00	44544616.00	Millibar	1.0
7	25	30	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	10.43	1541423.13	Millibar	1.0
8	30	35	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	395.20	58574076.00	Millibar	1.0
10	35	40	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	715.70	106871992.00	Millibar	1.0
11	40	45	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	724.20	109184120.00	Millibar	1.0
12	45	50	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	547.47	83236456.00	Millibar	1.0
14	50	55	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	141.30	21579922.00	Millibar	1.0
15	60	65	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420012	M^3/hr	2183.87	329449632.00	Millibar	1.0
16	65	70	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420012	M^3/hr	2762.25	418299168.00	Millibar	1.0
23	75	80	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480014	M^3/hr	763.09	121624888.00	Millibar	1.0
24	80	85	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480015	M^3/hr	236.10	37755296.00	Millibar	1.0
26	90	95	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600016	M^3/hr	1163.56	191834016.00	Millibar	1.0
27	70	100	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480012	M^3/hr	2442.76	370697856.00	Millibar	1.0
28	70	105	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	210.14	32358402.00	Millibar	1.0
29	85	90	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600016	M^3/hr	2014.68	325753056.00	Millibar	1.0
30	85	110	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	1.38	219936.48	Millibar	1.0
31	100	75	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480011	M^3/hr	4655.21	716744384.00	Millibar	1.0
32	55	60	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420005	M^3/hr	86.29	13197945.00	Millibar	1.0
33	15	115	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	34.58	5052198.00	Millibar	1.0

Appendix 4 IAP gas system with all variants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BENEFICIARY
Designed by
This project is implemented within the framework of IPF TA which is managed by
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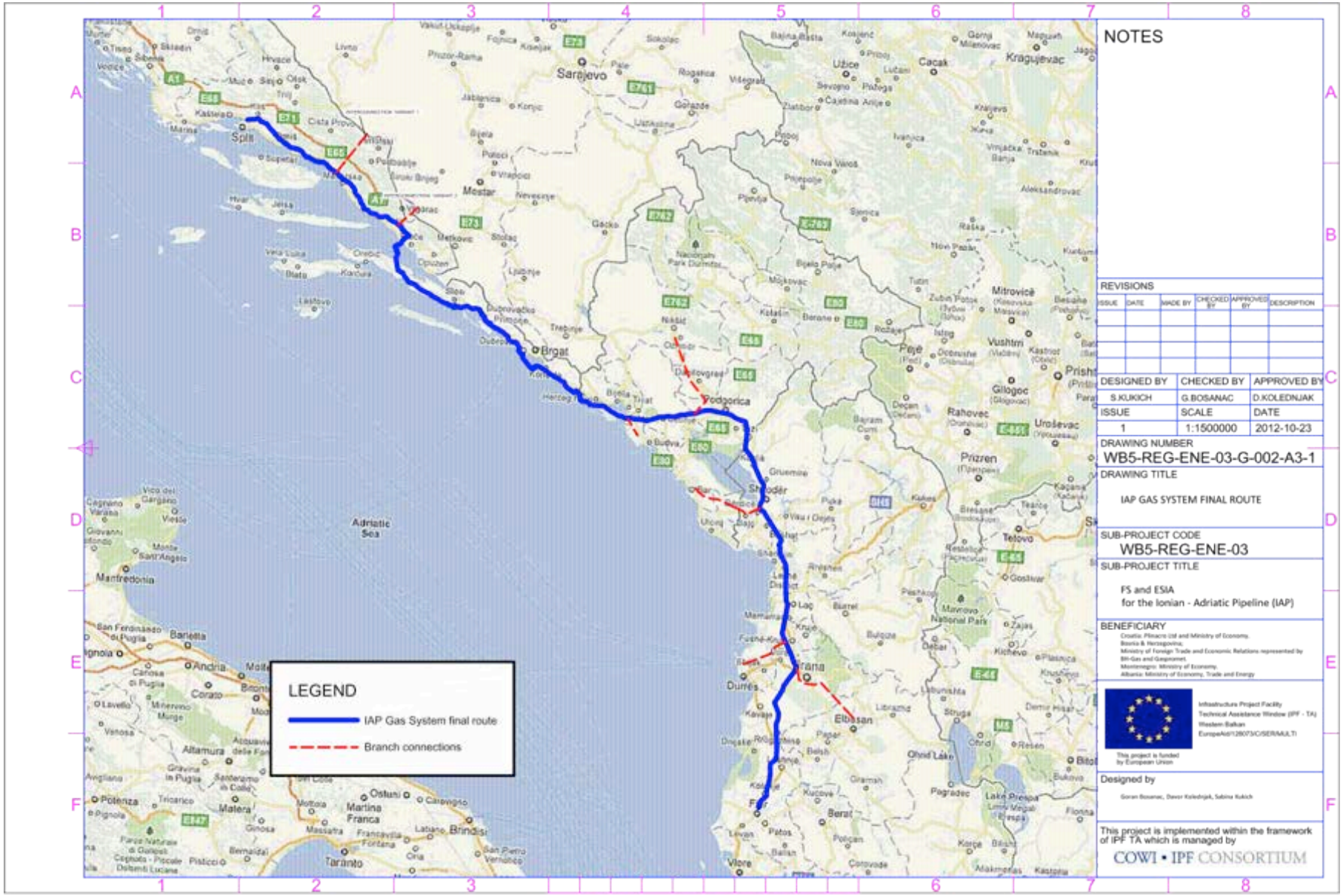
LEGEND
IAP Gas System with all variants
Adriatic Sea
Sarajevo
Split
Mostar
Brgat
Podgorica
Prizren
Tirana
Durrës
Elbasan
Vlore
Berat
Ohrid Lake
Lake Prespa
Mantredonia
Barletta
Andria
Corato
Altamura
Matera
Martina Franca
Ostuni
Brindisi
Taranto

Appendix 5 IAP gas system final route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IAP Gas System final route
Branch connections
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Split
Sarajevo
Mostar
Brgat
Podgorica
Shkodër
Durrës
Tirana
Elbasan
Berat
Vlore
Taranto
Brindisi
Bari
Matera
Potenza
Prizren
Tetovo
Ohrid Lake
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Andria
Barletta
Altamura
Martina Franca
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Peja
Mitrovicë
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SUB-PROJECT CODE
WB5-REG-ENE-03
SUB-PROJECT TITLE
FS and ESIA
for the Ionian - Adriatic Pipeline (IAP)
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The European Union's 2008 IPA Programme for Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo*, Turkey and Iceland

Infrastructure Projects Facility
Technical Assistance Window (IPF TA)

EuropeAid/128073/C/SER/MULTI

Sub Project:
WB5-REG-ENE-03

FS and ESIA for the
Ionian – Adriatic Pipeline (IAP)

Preliminary Technical Study Report

January 2013

This project is funded by
the European Union

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*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.

The European Union's 2008 IPA Programme for Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo*, Turkey and Iceland

Infrastructure Projects Facility

Technical Assistance Window (IPF TA)

Western Balkans

EuropeAid/128073/C/SER/MULTI

Sub project:
WB5-REG-ENE-03

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Ionian – Adriatic Pipeline (IAP)

Preliminary Technical Study Report

January 2013

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LIST OF ABBREVIATIONS

ANSI	American National Standards Institute
bcm	Billion Cubic Meter
BiH	Bosnia and Herzegovina
CO_2	Carbon dioxide
EBRD	European Bank for Reconstruction and Development
EBRD PR	EBRD Performance Requirements EC
EC	European Commission
ECS	Energy Community Secretariat
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EU	European Union
FS	Feasibility Study
IAP	Ionian-Adriatic Pipeline
IFI	International Finance Institution
IMF	International Monetary Fund
IPF	Infrastructure Projects Facility
IRR	Internal Rate of Return
ITGI	Interconnector Turkey – Greece – Italy
LNG	Liquefied natural gas
LPG	Liquid petroleum gas
M Nm^3	million normal cubic meters
Mtoe	mega tons of oil equivalent
MW	Megawatt
NPP	Nuclear Power Plant
NPV	Net Present Value
PFS	Pre-Feasibility Study
RS	Republic of Srpska
SEE	South East Europe
SIA	Social Impact Assessment
TA	Technical Assistance
TAP	Trans-Adriatic Pipeline
ToR	Terms of Reference
TSO	Transmission System Operator
UN	United Nations

1 Synopsis

Project Title: Feasibility Study and EIA & SIA Ionian – Adriatic Pipeline

Project Number: WB5-REG-ENE-03

Contractor: COWI-IPF Consortium

Beneficiaries:

Croatia:
Plinacro Ltd and Ministry of Economy.

Bosnia & Herzegovina;
Ministry of Foreign Trade and Economic Relations represented by BH-Gas and Gaspromet.

Montenegro:
Ministry of Economy.

Albania:
Ministry of Economy, Trade and Energy.

Project start date: 08/05/2012

Project Duration: 22 months

Anticipated completion: February 2014

2 Introduction

2.1 Background

The Ionian-Adriatic Pipeline Project (IAP) will interconnect the existing and planned gas transmission system of the Republic of Croatia with the Trans Adriatic Pipeline (TAP) or a similar project (Interconnector Turkey – Greece – Italy (ITGI)). The project aims to establish a new supply route for natural gas from the Middle East and Caspian region, northwards along the Adriatic coast. The IAP project is however planned as a bi-directional pipeline, so the possible supply direction could also be north – south, from the strategically planned LNG terminal in Croatia, or other sources.

The construction of this transmission pipeline would enable the gasification of Albania and Montenegro, Bosnia and Herzegovina and southern Croatia, providing a diversified and reliable natural gas supply. This transmission supply project, of 540 km total length, would create the preconditions for the development of the natural gas markets of Albania, Montenegro, Bosnia & Herzegovina and Croatia in the estimated annual level of 5 bcm. (for Albania 1bcm + for Montenegro 0.5 bcm + for Bosnia and Herzegovina 1 bcm + for Croatia 2.5 bcm).

2.2 Scope of work

The scope of work consists of the following main activities:

- Infrastructure and market background analysis (in a separate report)
  - describing the existing gas transmission systems
  - identifying the major objectives the project will achieve
- Route selection and layout optimization
  - The examination of topography and overview of ground conditions and other potential key technical issues
  - The characterisation of traversed territories: urban area, agricultural areas, forests, etc.
  - The review of routing options and recommendation for a preferred route corridor (geographical coordinates and altitudes of key reference pipeline segments)
  - The identification and the location of main difficulties to be addressed during the project design and implementation: roads, rail tracks, rivers, swamp lands, built areas, mountainous areas, significant environmental and social impacts, etc.
  - The identification of potential entry points on each territory and the evaluation of relevant alternatives

- Analysis of technical options
  - The diameter of the gas pipeline and the design pressure will be harmonised
  - Exploration of several options related to planned transit flows, capital expenditures and interconnection arrangements between the gas transmission networks in Croatia and Bosnia & Herzegovina
- Cost estimates
  - Cost estimates covers the main CAPEX components associated to the project completion
- Financial and economic analysis
  - Evaluate the financial and economic sustainability conditions for the identified scenarios through comprehensive analysis

2.3 Summary[1]

The goal of the Preliminary Technical Study Report was to analyze all the possible variants of the route of the IAP system with techno-economic, environmental and social aspects, and to determine the optimal solution for the entire IAP system. Selected and proposed options of IAP pipeline, with included chosen variant in each country, represent unique IAP pipeline corridor, which will be subsequently detailed and planed in the next phase of Project, in scale 1: 25000 with all necessary facilities included.

To create PTSR, previous research and studies have been used, such as the Ionian Adriatic Pipeline Pre-Feasibility Study, prepared by ILF in 2009, then other routing, engineering, geodetic and environmental documentation of the main gas pipeline Split - Ploče - Dubrovnik - Prevlaka – Dobreč provided by Plinacro. Also, all documents on which Plinacro obtained the necessary permits have been taken into account in this study.

To determine the optimal pipeline diameter, hydraulic calculations were carried out for all possible diameters and possible directions of gas transport. The basic economic analysis of all variants of IAP system was done, in a way to determine transportation tariff. On this basis, the most acceptable variant of the basic system is determined. The result of this analysis was that the pipeline diameter of 32" meets all the criteria for all possible variants of the pipeline. This selection includes a compressor station in Split which is used in both directions of gas transport. In direction A: Fier-Split, it is used to raise the pressure from the IAP system to the required pressure in the Croatian gas transmission system, and in the direction B: Split - Fier to achieve the pressure required to be able to transport gas through the IAP system in opposite direction from north to south.

Also, the basic economic parameters were determined for the route variants of the individual countries, which are used as input parameters for Doctus program. Final version of entire IAP route was chosen accordingly.

The selection of the most suitable choice in a particular country is carried out by the IT system Doctus. Selection is based on three criteria: environmental, social and techno-economic. The three variants through Croatia, four variants through Montenegro and four variants through Albania have been analysed. In compliance with all of the selection criteria the following variants were chosen:

[1] See comment in beginning of Chapter 6

Variant A-HR
Variant A-MNE
Variant A- AL

As a result of the above conducted analysis, final unique IAP pipeline route is determined.

The route starts in Fier in Albania, runs in northern direction reaching Tirana, continuing toward border to Montenegro. At the border the pipeline crosses river Bojana. Route passes Skadar Lake on the northern side then runs toward Podgorica in Montenegro. Following the main road the pipeline passes Cetinje continuing toward border to Croatia, crossing the Bokokotorska bay and reaches the peninsular of Croatian territory. Parallel to the coastal line the route runs toward Dubrovnik across Konavli field. After Dubrovnik the route is crossing the bay of Rijeka dubrovačka reaching Dubrovačko primorje and via peninsula Pelješac crossing the sea toward Ploče. The route passes the city of Ploče on the west side. Finally from Ploče the route runs north-west and reaches Dugopolje near the city of Split.

The route is shown in following figure.

Figure 1: IAP gas system final route

Pipeline:	
Total length of final route	530 km
Investment costs pipeline	610.56 Mio €
Annual maintenance costs	6.1 Mio €/year
Compressor station:	
Compression power	1425 kW
Specific performance related cost	1500 €/kW
Investment costs compressor station	35.9 Mio €
Annual energy costs	0.5 Mio €/year
Annual maintenance costs	1.0 Mio €/year

Activities conducted in Preliminary Technical Study Report, are the basis for the next step of optimizing IAP system, which will be implemented in the Feasibility Study.

3 Basic data

3.1 Infrastructure analysis

The gas transmission system of Croatia consists of a 2,113 km long network of high pressure main and regional gas pipelines, over 300 over ground objects such as block stations, cathodic protection and blow off stations, 9 in-take measuring stations and 132 off-take measuring-reduction stations.

The Trans Adriatic Pipeline (TAP) is a natural gas pipeline project. The Trans Adriatic Pipeline will transport natural gas from Shah Deniz II development in Azerbaijan, taking it via Greece and Albania, and across the Adriatic Sea to southern Italy, and further into Western Europe. The TAP route will be approximately 800 kilometres in length (Greece 478 km; Albania 204 km; offshore Adriatic Sea 105 km; Italy 5 km).
TAP will initially have a capacity of 10 bcm/year. Two compressor stations, one near Komotini, in Greece, and the other on the Albanian coast near Fier, will be used to ensure gas transportation through the pipeline. Two additional compressor stations can be installed later (one near Thessaloniki, and the other near the Greek-Albanian border) to attain the maximum throughput of 20 bcm/year.
The TAP project is exploring the possibility of developing an underground natural gas storage facility in Albania.
In 2003 the pre-feasibility study for TAP was conducted. The feasibility study for the project was concluded by Axpo's EGL in March 2006, confirming technical, economic and environmental feasibility. TAP's extended basic engineering, including the offshore seabed survey, and preliminary impact assessment surveys were concluded by March 2007. In 2008, TAP entered the front-end engineering detailed design stage (FEED). In February 2012 TAP was selected by Shah Deniz Consortium as the priority route to Italy. In September 2012 Albania, Greece and Italy signed MoU in support of TAP.
TAP's schedule is aligned with developments upstream. The pipeline should be ready to transport natural gas from the Caspian region, when Phase II of Shah Deniz field in Azerbaijan starts production (estimated in 2017/2018).
EGL also signed a gas purchase agreement with Iran for up to 5.5 bcm/year to supply the TAP pipeline. This makes TAP the only pipeline project in the region that has contracted gas volumes to support it.

Figure 2: Planned route of TAP Project
Source: http://www.trans-adriatic-pipeline.com

The IAP project intends to connect the existing and the planned gas transmission system of the Republic of Croatia, via Montenegro, and Albania with the TAP system. The total gas pipeline length from Split (Croatia) to Fier (Albania) is 540 km. Its 5 bcm/year capacity will provide natural gas supply for Albania, Montenegro, Bosnia and Herzegovina and Croatia.

Implementation of the entire Ionian-Adriatic Pipeline project supports opening of the new energy corridor for the SEE region within the fourth EU transmission corridor, and provides a new natural gas supply direction from the Middle East and the Caspian region.

The Ionian-Adriatic Pipeline will be bi-directional, i.e. it will provide SEE region with natural gas also from other sources such as the future LNG Terminal on the island of Krk.

A Ministerial Declaration between Albania, Croatia and Montenegro has been signed for the IAP project in Zagreb, on September 2007 and Bosnia and Herzegovina has co-signed this Declaration, in Tirana, on December 2008. In 2010 an Interstate Committee was established for the support and implementation of the project under the Treaty establishing the Energy Community, with the support and under the coordination of the Secretariat of the Energy Community. In 2011, Plinacro and TAP consortium signed a MoU. Subsequently, TAP consortium has signed a MoU with BH Gas, Ministry of Economy of Montenegro, Ministry of Economy, Trade and Energy of Albania and Slovenian gas transmission system operator, Plinovodi. A Joint Working Group TAP/IAP was established in 2011 and started operations.

3.1.1 Albania

Albania had its National Strategy for Energy approved by the Government in June 2003, and after three years the Action plan for implementation was updated in June 2007. The domestic gas production capacities are in their minimal limits, due to drying up of the reserves and decline of the initial pressure in oil resources. The total proven reserves of natural gas in the country are some 57 million Nm^3.

The existing gas pipeline network has a length of 498 km. Gas infrastructure in many places is out of operation and needs rehabilitation and parts of the network need to be totally substituted. Due to the low level of gas production, some of the pipelines are unable to transport gas due to their continuous corrosion and destruction. Nevertheless, these gas pipeline corridors might be used for future gas transmission and distribution network development options.

Albania has adopted a law on the gas sector, (no. 9946, 30.06.2008 "On the natural gas sector"), in which is not absolutely in line with the Energy Community Treaty requirements. The purpose of the law is to establish the legal and institutional framework for the development and regulation of the natural gas sector and gasification of Albania.

The Energy Sector Policy of Albania provides that the long-term development of energy sector should take into consideration a possible development of the natural gas industry in the future.

The supply of Albania with gas is foreseen to be done by the international gas networks, for which there are three existing options:

1. From neighbouring countries through regional gas pipeline: gas from Macedonia, gas from Greece.
2. From gas pipeline for the supply of Western Europe (”TAP” project).
3. From LNG terminal on the Adriatic coast.

Figure 3: Gas supply options to Albania
Source: Oxford Institute for Energy Studies

According to the The European Waterborne LNG Report the proposed LNG import terminal, which will have an annual receiving capacity of 10 Bcm of LNG per year, will be located by the Seman River in southwest Albania's Fieri district, 100 km southwest of Albania's capital Tirana.

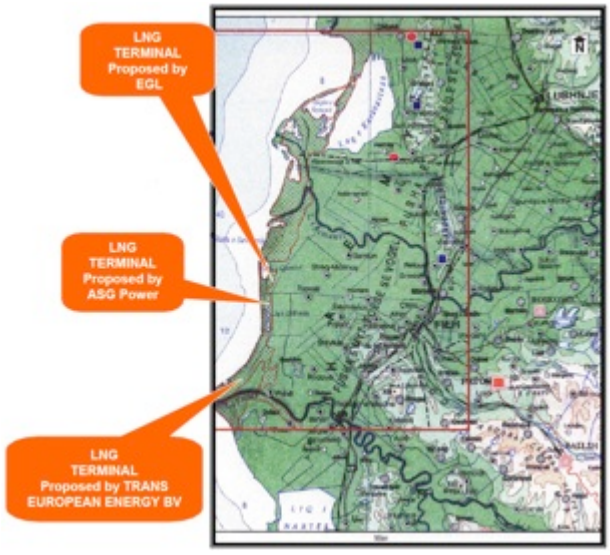


Figure 4: Proposed LNG terminal projects, Fieri region
Source: REPUBLIC OF ALBANIA, MINISTRY OF ECONOMY, TRADE AND ENERGY, Gas Forum Meeting, Gas Supply in Albania, 16 April 2008, Maribor, SLOVENIA

At this point TAP seems to be the optimal option to supply gas to Albania.
In Albania it is possible to supply natural gas from the planned ITGI pipeline, in the southern part of Albania, which connects Greece and Italy. But it seems that the earliest option to supply gas from Greece to Albania in 2017/2018 is the TAP project.
IAP (Ionian-Adriatic Pipeline) would be a transmission pipeline connected to TAP, originating in Albania and passing through Montenegro and along the Adriatic coast towards Croatia.

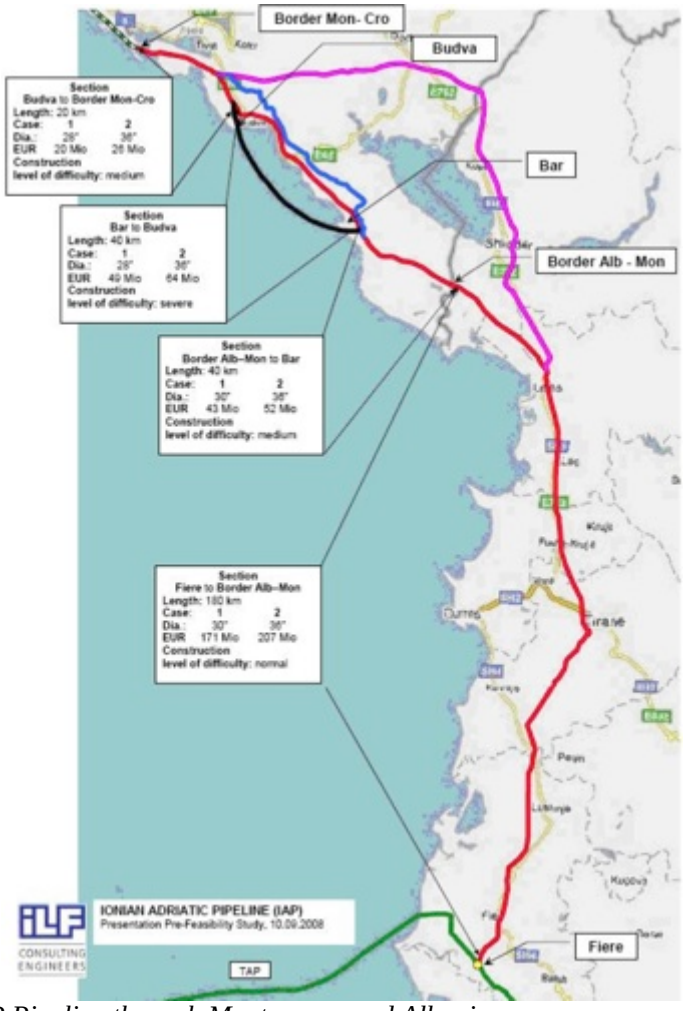


Figure 5: IAP Pipeline through Montenegro and Albania
Source: Presentation, „Ionian - Adriatic pipeline project “, PLINACRO, 4th Gas Forum, Ljubljana 2009

SEE Regional Gasification Study identified and considered two potential UGS locations: Divjaka depleted gas field and Dumrea salt dome. Divjaka was exploited between 1960 and 1980 and is practically empty. In that time period approx. 1.3 bcm natural gas had been produced. The Divjaka field consists of 25 different reservoir layers each 4 to 6 meters thick in the depth interval from 2,000 to 2,600 m, with no water drive. The possibility of gas storage in the Divjaka field had been investigated by a feasibility study.

The salt dome of Dumrea is a large diapir covering a surface area of approximately 250 km². The salt mirror is mostly at depth 2,000 m. The overburden is karstic to a large extent and consists of gypsum and anhydrite. The salt reaches down to 6,000 m. The salt volume is estimated to amount

1,400 km³. The TAP project is investigating the option of developing gas storage facilities in the Dumre underground salt dome formations.

3.1.2 Montenegro

There is no developed market for natural gas, gas transmission or distribution systems in Montenegro. The "Energy Development Strategy of the Republic of Montenegro until 2025 - professional basis - Book C development system of coal, oil and gas from 2006" investigated options for gas supply to Montenegro. Options to supply natural gas to Montenegro from imports, from own production as well as mixed and evaporated LPG was elaborated. According to the study of potential natural gas reserves, there is almost 425 billion m^3 (Pliocene-Miocene-Oligocene submarine complex) of natural gas reserves available in Montenegro Adriatic sea area. Although the study planned activity on the development of mixed and evaporated LPG in the major consumption centres (Podgorica, Nikšić and bigger coastal cities), actions to implement these projects are not initiated, and it is assumed that the competent authorities do not intend to develop this type of energy supply. At the time of the study there was no option to supply gas from the TAP and the IAP project and it was expected to supply gas from Serbia over Kosovo*. A gas transmission, distribution and market development study from 1998 envisaged the development of a gas system in Montenegro in three phases:

- development of gas transmission pipeline Podujevo - Podgorica with Niksic-Podgorica branch ,
- development of the transmission pipeline Podgorica - Cetinje - Budva with the main branches of Budva - Tivat and Budva - Ulcinj,
- development of main branches Berane - Bijelo Polje - Mojkovac, Mateševo - Kolašin and Rožaje - Plav

It is expected that, if Montenegro's own natural gas reserves were developed, gas and oil pipelines should be established in stages, first near the coast and then towards Podgorica and Nikšić.
According to the new Energy strategy of Montenegro (2012 draft) the exploration in the next 5-10 years will answer how big the reserves of oil and gas might be. In case of the positive results, supply with domestic gas cannot be expected before 2020. Due to the big uncertainties the draft 2012 Strategy does not anticipate possibility to use domestically produced natural gas.
A new 2012 draft Energy strategy of Montenegro recognizes IAP as a major gas supply option for Montenegro.

3.1.3 Bosnia and Herzegovina

Bosnia and Herzegovina does not have its own sources of natural gas, hence supply is exclusively based on import. For the time being, gas only arrives from one source and transport is only in one direction, i.e. Beregovo - Horgos - Zvornik.
All natural gas for Bosnia and Herzegovina is imported from the Russia. There is a contract with Gazexport for the delivery of gas, but it is not of a long-term contract due to unsettled war debt with the Russian partner.
The procurement of gas is a complex process. The main supplier is Russia, but gas is transported by several companies from other countries, via gas pipelines to the users.

Bosnia and Herzegovina is served by a 16 inch pipeline which crosses the border at Šepac. This pipeline passes through Zvornik, Kladanj and Sarajevo, terminating in Zenica. Ownership is shared between Gaspromet Pale (22 km from the Srbija border to Zvornik), Sarajevo Gas Lukavica (40 km between Zvornik and Kladanj) and BH Gas Sarajevo (132 km, Zvornik – Sarajevo – Zenica).

Figure 6: Bosnia and Herzegovina: Route of the Existing Gas Pipeline

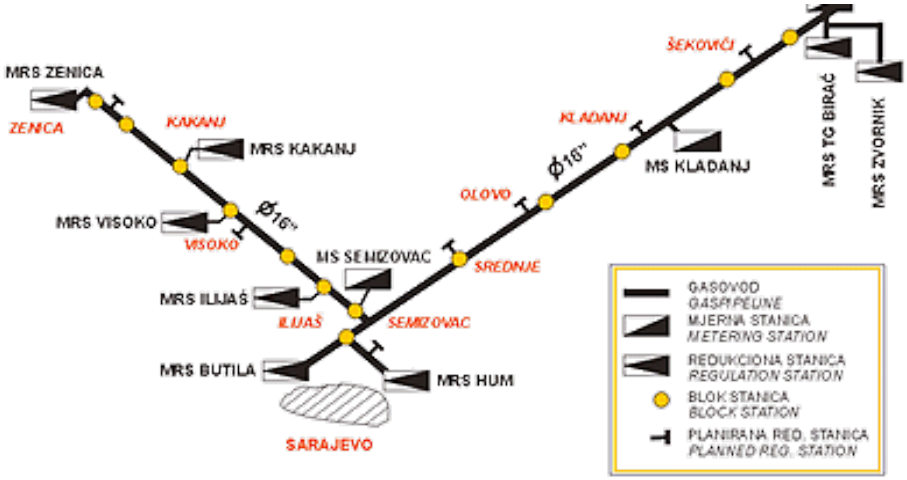


Figure 7: Bosnia and Herzegovina: Details of the existing gas pipeline
Source: BH Gas

Gas is transported along the gas pipeline systems of Ukraine, Hungary and Serbia.
According to available information Bosnia and Herzegovina has long-term contracts for the transport of natural gas concluded with foreign partners, as follows:

- With MOL for transport of natural gas through Hungary for the amounts of 600 M Nm^3/year until 2018
- With Srbijagas for transport of natural gas through Serbia for the amounts of 600 M Nm^3/year until 2019.

The transport system of natural gas in Bosnia and Herzegovina has the following main characteristics:

- Length of the gas pipeline 191 km
- Cross-section of the gas pipeline 406.4 mm (16 “)
- Projected pressure 50 bars
- Projected capacity 1 bcm per year

Current contracted transport capacity to Bosnia and Herzegovina is 750 million m^3/year, while the pressure at the receiver station in Zvornik is 26 bars.
There are 9 metering stations, 12 block stations and 4 cleaning stations on the transport system.
The relationship of different participants in the natural gas sector seems quite complicated. During our investigation we have not been able to clarify the situation completely (other previous reports also display the same difficulty). We believe that the following description is as realistic as possible.
BH Gas and Energoinvest signed a special Agreement under which the Energoinvest is responsible for foreign trade operations related to the gas import. Energoinvest (gas import company in BiH) signed the Contract number 643/00157629/210201 dated 23 January, 1997, with Gazexport of the Russian Federation for the delivery of natural gas to Bosnia and Herzegovina under the condition of repayment of a debt for the delivery of gas in 1996. This is the reason that Gazexport insisted that Energoinvest should remain the contracting party for the delivery of gas.

Energy Development Strategy of the Republika Srpska from 2010 was prepared with a similar methodology as the study of the energy sector in BiH - Module 10 natural gas. Strategy considers two possibilities for the development of the system:

- Alternative 1. - in the first stage Sava (supply route from Serbia along the river Sava) pipeline system will be built to the all consumption centers
- Alternative 2 - ensures the supply of gas to consumption centres to the nearest available gas systems: the connection to the system of Serbia in Bijeljina, and connections to Croatian system in Brod and Gradiška. After the increase of consumption, in the second phase, the backbone of the Sava pipeline, i.e. the pipeline Bijeljina - Banja Luka will be built.

The alternatives are based on the gas transmission system optimisation results and on the strategic interests of the RS concerning the gas market development. Given the stated alternatives, the possibility of gas imports and the results of optimizing the development of gas transmission system in the Republika Srpska conclude the following:

1. Optimum supply points are Gradiška (which is the lowest cost for gasification of the largest consumption point Banja Luka), then Bijeljina from Serbia, and Bosanski Brod from Croatia,
2. First phase of the gas system development are the areas of the following cities:
    - Gradiška, Laktaši and Banja Luka from the Gradiška;
    - Brod, Derventa and Modriča from the Brod;
    - Bijeljina from the Serbia, and
    - Vlasenica and Pale from the existing system,

3. Gas system development in the area of Doboj and Prijedor, then of Prnjavor area, i.e. gasification of Brdsko from direction of Bijeljina will follow
4. Merging of Bijeljina - Banja Luka into the Sava supply system in full.

In September 2012 Republika Srpska and Gazprom signed the Memorandum of Understanding related to the mutually beneficial partnership and cooperation. Construction of a gas lateral from South Stream to Republika Srpska and gasification of the population centres along its route is a part of the Memorandum.

FMERI - Strategic plan and program to develop the energy sector of the Federation BiH from 2009, gas consumption is calculated according to the expected natural gas consumption from the Ramboll study and Energy Sector Study BiH, and states that there are real indications that BiH could increase the share of natural gas.
The strategic plan defines the priority transmission PTG and distribution PGG projects..
As priority projects of the Strategic Plan, gas pipelines PTG1 and PGG1 were determined with a period of realization 2010-2011, pipelines PTG3 and PGG3, PTG4 and PGG4 and PGG5 were determined as the medium-term projects and with a period of construction from 2011-2015, and finally pipelines PTG2 and PGG2 are defined as a medium/long-term projects (long-term development projects after 2015).

Project description:
PTG1: Transmission pipeline Bosanski Brod – Doboj – Maglaj – Zenica
PGG1: Gas distribution development along Bosanski Brod – Zenica pipeline
PTG2: Transmission pipeline Sarajevo – Mostar – Ploce
PGG2: Gas distribution development along Sarajevo – Ploce pipeline
PTG3: Transmission pipelines Zenica – Travnik, Travnik –Gornji Vakuf i Travnik – Jajce
PGG3: Gas distribution development of Central Bosnia Canton
PTG4: Transmission pipelines Tr.Raštela/Šturlic (enterance from Croatia) – Cazin – B. Krupa – S. Most – Kljuc with branch pipeline toward Bihacu, V. Kladuši i B. Petrovcu
PGG4: Gas distribution development of Una-Sana Canton
PGG5: Gas distribution development in city Orašje
PTGS6: Underground gas storage Tetima with transmission pipeline Kladanj – Tuzla – Tetima

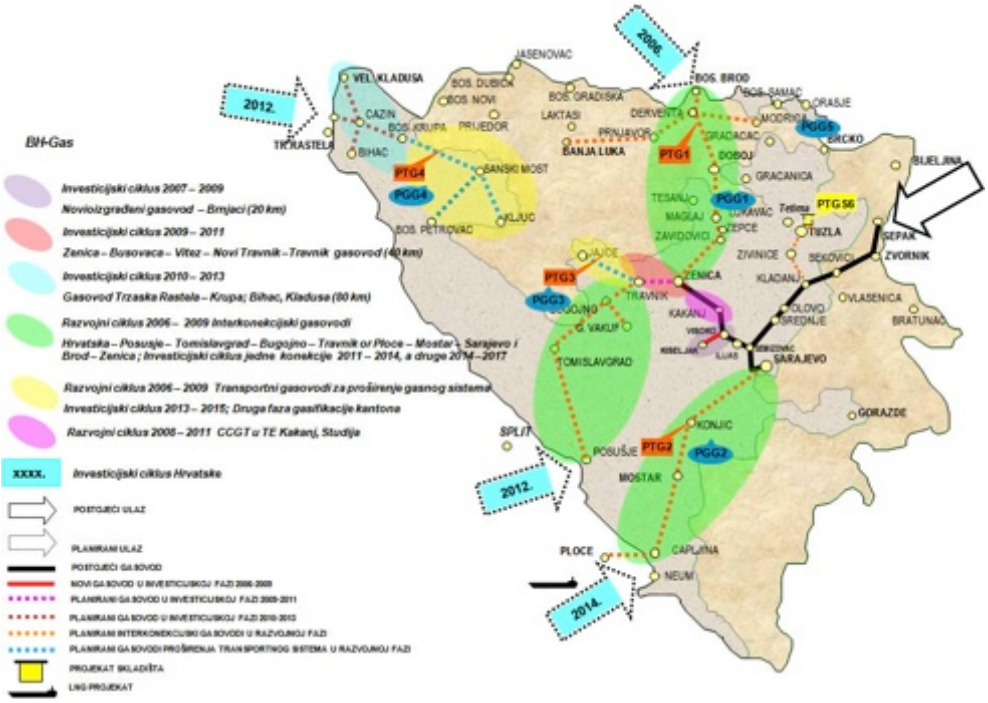


Figure 8: Existing and planned gas transport system of B & H
Source: BH Gas

In the short term, we can most probably expect development of gas system from Croatia in the north toward Republic of Srpska and potentially Sarajevo, and in case the IAP pipeline is developed the connection Ploče-Mostar will be developed. In the case that IAP pipeline system will not be developed, then the pipeline system Zagvozd – Imotski (Croatia) – Posusje (BiH) with branch to Mostar and extension of the main pipeline via Tomislavgrad and Bugojno to Travnik with connection to exiting gas pipeline might be a feasible solution for the gas supply for south and central part of Bosnia and Herzegovina.

3.1.4 Croatia

Natural gas is produced from 16 on-shore and 9 off-shore gas fields meeting 71, 9 percent of total domestic demand. The largest share of gas produced in Panon area is coming from the fields Molve and Kalinovac. They include the units for processing and preparation of gas for transportation – Central gas stations Molve I, II and III.
In the thirty years of its existence, configuration, capacity, and other features of the Croatian gas transportation system were determined and developed as a function of acceptance of gas production from INA gas and oil fields, acceptance of gas imported via Slovakia, Austria and Slovenia and its transport to distribution canters.

The natural gas transport system comprises 2 511 km of pipelines. Gas was delivered to the transmission system through 10 entry measuring stations. Out of them, 8 stations are taking gas from the domestic gas fields while 2 stations have international character as it is the entry station for the imported gas (from Russia, Slovenia, Italy and Hungary). Gas is delivered from the transport system through 193 connections at 157 exit measuring-reduction stations. Out of them, 40 connections function as delivery points for industrial customers on

the transportation system, whereas 151 connections are used for delivery to distribution systems.
Entry capacity to the transmission systems are:

- import route from Slovenia is 210 000 m^3/h,
- import route from Hungary is 800 000 m^3/h,
- supply from Adriatic gas fields 240 000 m^3/h
- supply from Panon gas fields 111 000 m^3/h (depends on the gas production)

The whole system is designed for working pressure 50/75 bar. System is mainly located in the northern part of Croatia. The Istria gas transmission system, pipeline Pula-Karlovac and Bosiljevo-Split are located at the south of Croatia.
Transportation of natural gas is regulated energy activity and is done as a public service and a company's core business of Plinacro Ltd, Zagreb, which is the owner and operator of gas transportation system. Plinacro Ltd manages the system of main and regional gas pipelines which transport natural gas from domestic production (the northern part of the continental and the northern Croatian Adriatic) and imports (supply transport route through the Republic of Slovenia and Hungary) to the distribution systems and (industrial and power plants) customers that are directly connected to the transmission system
One of the fundamental principles of Croatian Energy Strategy from 2009 is the equal quality of energy supply to its entire territory. In particular, it relates to the availability of networked forms of energy (electricity and natural gas). Related to the effective use of energy, Strategy sets the goal to reduce use of electricity for space heating and hot water and replace it with the other forms of energy, including natural gas.
In order to implement the Strategy, an energy reform was carried out in 2002, energy legislation has been passed, and PLINACRO was founded as state-owned company responsible for a project to develop natural gas transmission system.
The basic document that defines the future development of gas transportation system is the "Plan of development, construction and modernization of gas transportation system in the Republic of Croatia from 2002 to 2011", adopted by Government. For the next cycle of development and investment since 2007 to 2011, the Plinacro drafted "Amendments to the Development Plan, the construction and modernization of Croatian gas transmission system from 2002 to 2011 - second investment cycle since 2007 to 2011" and its revisions. Today, development of transmission system in the Republic of Croatia is carried out in accordance with the document “Gas Transmission System Development Plan of the Republic of Croatia 2011-2015”. Development Plan pipeline development obligations are presented in three regional groups of projects;

- gas pipeline system Pula-Karlovac
- gas pipeline system of Lika and Dalmatia, and
- gas pipeline system in Central and Eastern Croatia.

The gas pipeline system Pula-Karlovac was built and it connects Adriatic gas fields with the continental part of gas system through Istria and Gorski Kotar. The backbone of the gas pipeline system Lika and Dalmatia is the pipeline Bosiljevo-Split, which is connected to Pula-Karlovac pipeline in Bosiljevo. The capacity of this pipeline is adapted not only to the needs of distribution

consumers and industry in Dalmatia, but also for the potential needs of gas power plant at the location of Obrovac. This pipeline will enable the development of gas consumption in the southern part of Croatia.
The plan predicts the construction of the pipeline around the end of the year 2012. The pipeline has been completed and in function up to Benkovac town, including the towns Biograd and Zadar. The Benkovac-Split connection is under construction and will be developed on schedule.

The pipeline is/will be constructed of steel pipes DN 500, 75 bar working pressure and the length of 290 km. Regional and major branch pipelines Kaštel Zegarski-Obrovac, Benkovac-Zadar and Benkovac-Biograd already have got the use permit, while for gas pipelines Morpolača-Pirovac, Šibenik-Knin and Jadrići-Trogir the technical inspection is to be carried out. The stated gas pipelines have been built and depend on the construction of the main gas pipeline Benkovac-Split. These pipelines will be smaller in diameter up to (DN 300) and working pressure 75 bar.

The construction of the several measuring-reduction stations is planned on the main gas pipeline: Ogulin, Otočac, Gospić, Gračac, Obrovac, Benkovac, Biograd, Zadar, Pirovac, Šibenik, Drniš, Knin, Trogir and Split.
Investments in gas pipeline system in Central and Eastern Croatia primarily is related to the investments in reconstruction and new facilities on existing systems and the construction of 75 bar backbone of the transport system of Croatia: Zagreb-Slavonski Brod-Donji Miholjac-Hungary. Connection pipeline to Hungary: Slobodnica-Donji Miholjac-Dravaszerdahely DN 800 was built and it is in function since August 2011. Maximum transmission capacity of this interconnection is 6, 5 bcm/year, with a possibility of gas flow and transmission in both directions.

Figure 9: Gas transportation system in Croatia in 2012
Source: Directions of development of the Croatian gas system, Đurovic. HSUP Opatija 2010

After the Second investment cycle ends with its main tasks of gasification of Croatia, the development in the future will be directed to projects which will primarily be focused on the supply of new transit or import routes to Croatia and supply connection toward neighbouring countries. New supply and import routes are: a combination of the Nabucco or South Stream connection from Hungary and Serbia, increase in supply capacity from Slovenia, the pipeline system IAP, pipeline system for receiving and evacuation of LNG from island Krk. Supply connections toward neighbouring countries are primarily to Bosnia and Herzegovina: pipelines Gradiška - Banja Luka, Slobodnica - Bosanski Brod, Ličke Jesenice - Bihać, and pipelines Imotski - Posušje or Ploče-Mostar. For all the aforementioned projects preliminary activities will be performed until and including the preliminary design, while construction will depend on their integration into actual supply and market options.

Figure 10: Development of gas transmission system in Croatia after 2012
Source: PLINACRO Ltd, 5th Gas Forum, 14 September 2010, Brdo, Slovenia

3.2 Pipeline route description

3.2.1 General

The following route description deals with the main route indicated as the longest route from Fier to Split ignoring the most feasible route.
The route starts in Fier in Albania, runs in northern direction reaching Tirana, continuing toward the border to Montenegro. The route passes Skadar lake from the northern side then runs toward Podgorica in Montenegro. Following the main road the pipeline passes the city of Cetinje continuing toward border to Croatia, crossing the Bokokotorska bay and reaches the peninsular of Croatian territory. Parallel to the coastal line pipeline runs toward Dubrovnik, reaching Dubrovačko primorje and via peninsula Pelješac crossing the sea toward Ploče. Finally from Ploče the route runs north-west and reaches the city of Split.
In the following figure the route is shown bold.

Figure 11: Ionian – Adriatic Pipeline

Each country has alternative routes, which are analysed in optimization of the most feasible route. They are described as follows:

3.2.2 Route description Albania

The route starts at compressor station CS3 of the TAP-System near the city of Fier and runs in northern direction parallel to the coastal line and reach Tirana. From Tirana route runs toward Lezhe and continuing toward border of Montenegro. The route has four variants from Fier to border of Montenegro which are shown at figure 12.

Variant A-AL
The route runs from Fier toward Tirana area passes north of Skadar Lake and runs toward Hani Hotit (Barlaj) at Albania – Montenegro border.

Variant B-AL
From Fier route runs to the west, toward the cost and then in northern direction parallel to the costal line toward Skadar Lake, passes north of Skadar Lake and runs toward Hani Hotit (Barlaj) at Albania – Montenegro border.

Variant C-AL
The route runs from Fier toward Tirana area and parallel to the costal line toward Dajc (Štodra) at the Albania – Montenegro border.

Variant D-AL
From Fier the route runs to the west, toward the coast and then in northern direction parallel to the costal line toward Dajc (Štodra) at the Albania – Montenegro border.

Figure 12: The IAP on Albanian territory

3.2.3 Route description Montenegro

Route via Montenegro has four variants. They are described below and shown on figure 13.

Variant A-MN
From Lezhe the route crosses the border of Montenegro, passes Skadar Lake on the northern side then runs toward Podgorica. Following the main road the pipeline passes the city of Cetinje continuing toward Kotor. On IAP route this variant can only be connected with Variant A-AL or Variant B-AL in Albania.

Variant B-MN
From Lezhe the route crosses the border of Montenegro and runs toward Bar. Parallel to the coastal line, up in the mountains the pipeline runs toward Budva, passes Budva on the northern side and reaches Kotor. On IAP route this variant can only be connected with Variant C-AL or Variant D-AL in Albania.

Variant C-MN
From Lezhe the route crosses border of Montenegro and runs toward Bar. Following the route along the coast the pipeline reaches Budva and continues toward Kotor. On IAP route this variant can only be connected with Variant C-AL or Variant D-AL in Albania.

Variant D-MN
From Lezhe the route crosses the border of Montenegro and runs toward Bar. From Bar the route runs offshore, reaches the coast and continues toward Kotor. On IAP route this variant can only be connected with Variant C-AL or Variant D-AL in Albania.

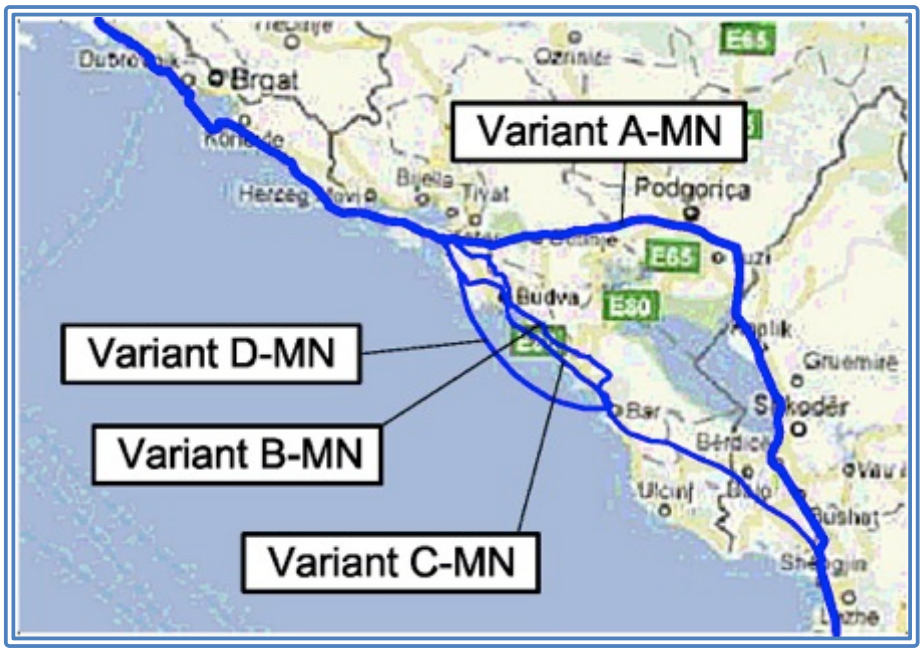


Figure 13: The IAP on Montenegro territory

3.2.4 Route description Croatia

In Croatia the pipeline runs from the border of Montenegro to Split. From section Dubrovačko primorje to Ploče it has three variants, which are shown at figure 14.

Variant A-HR
From Dubrovačko primorje the pipeline route runs via peninsula Pelješac crossing the sea at Osobjava place reaching Ploče north-west of the city.

Variant B-HR
From Dubrovačko primorje the pipeline route runs via peninsula Pelješac crossing the sea at Osobjava place reaching Ploče south of the city.

Variant C-HR
From Dubrovačko primorje to Ploče pipeline route runs parallel to the costal line partly through Bosnia and Herzegovina territory.

Figure 14: the IAP on Croatian territory

3.2.5 Route description Bosnia and Herzegovina

There are two route variants through Bosnia and Herzegovina:

Variant A – BiH
The route starts at Dubrovačko primorje in Croatia and runs in northern direction toward border of Croatia - BiH, passes Hutovo blato lake at the east side runs parallel to the Neretva river and reaches city of Mostar. From Mostar the route runs toward Posušje and continues toward Zagvozd in Croatia. The route is shown on figure 15.
If the pipeline route Variant A-BiH is not acceptable the Bosnia and Herzegovina pipeline system will be connected to IAP system by the branch connections.

Variant C-HR (BiH)
The route starts at the border of Croatia in the east and runs near city of Neum toward the border of Croatia in the west.

There are two variants of the branch connection to Bosnia and Herzegovina pipeline system from the IAP System.

Interconnection variant 1
Zagvozd (HR) – Imotski (HR) – Posušje (BiH)

Interconnection variant 2
Ploče (HR) – Čapljina (BiH).

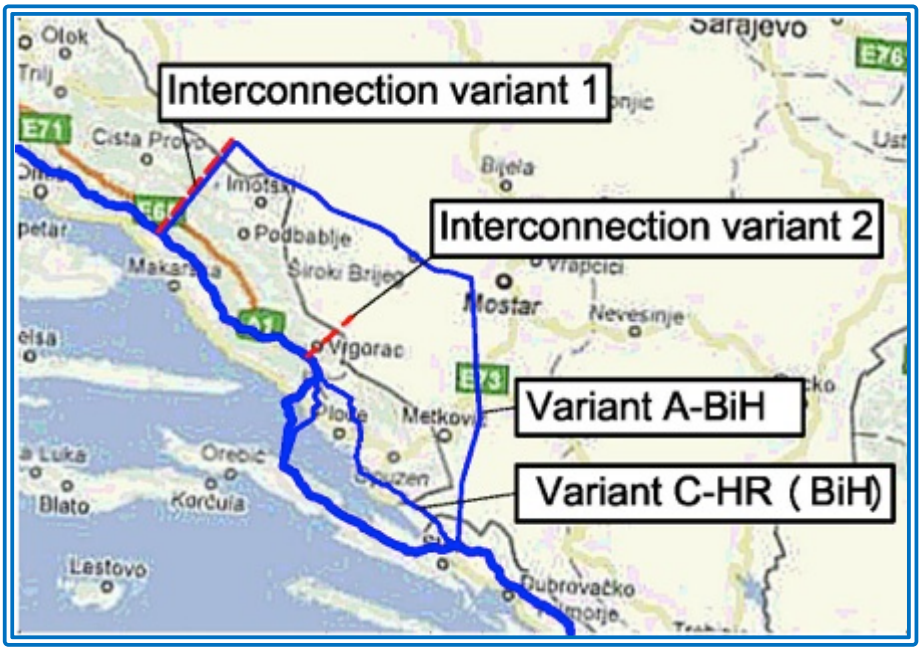


Figure 15: The IAP on Bosnia and Herzegovina territory

3.3 Pipeline Throughput Scenarios

The IAP project is planned as bi-directional pipeline. Possible supply direction could be south – north: (Fier – Split), or north – south: (Split –Fier).

For all Variants it has to be considered that 1.0 bcm/year will have to be supplied to Albania, 0, 5 bcm/year have to be transported to Montenegro and 1.0 bcm/year shall be designated to Bosnia at the branch in the Ploče area.

The quantities for the northern region of Croatia are assumed to be 2,5 bcm/year, so total IAP throughput is 5 bcm/year, for south – north: (Fier – Split) direction.

Therefore for north – south: (Split –Fier) direction the quantities for the southern region of Croatia are assumed to be 0,2 bcm/year, at the first off take at Ploče 0,1 bcm/year, should exit from the system, while the remaining 0.1 bcm/year, should exit at Dubrovnik off take so total IAP throughput is 2,7 bcm/year.

Optimization is carried out including both directions.

3.4 Basic Block Flow Diagram

The following figure shows the basic block flow diagram of the IAP gas pipeline system considered in the calculations.

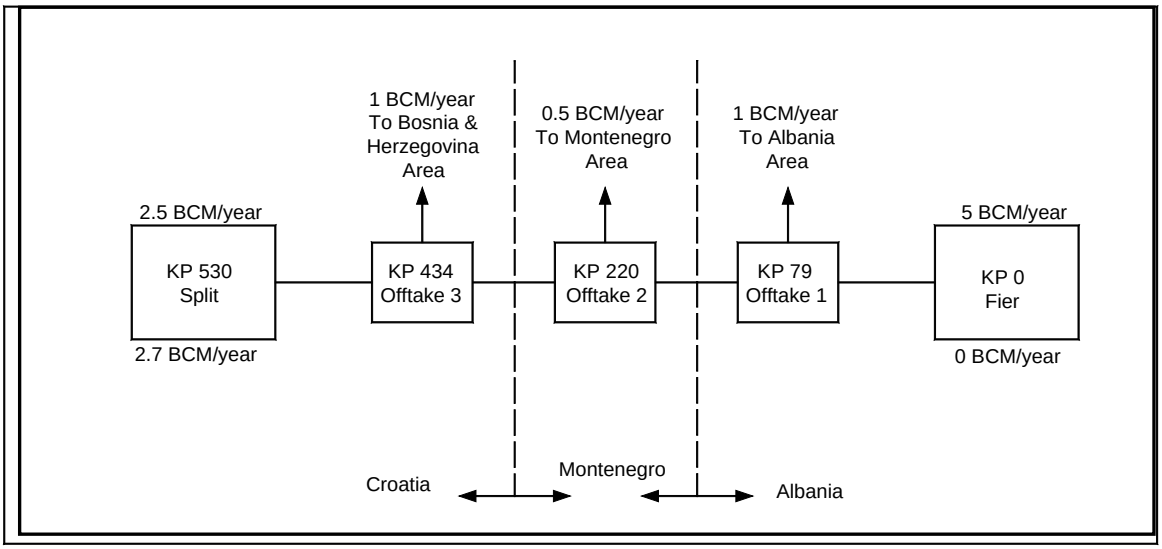


Figure 16: Basic block flow diagram

The following figure shows the block flow diagram of the IAP gas pipeline system with all variants pipeline route. The highlighted variant is considered in the calculations.

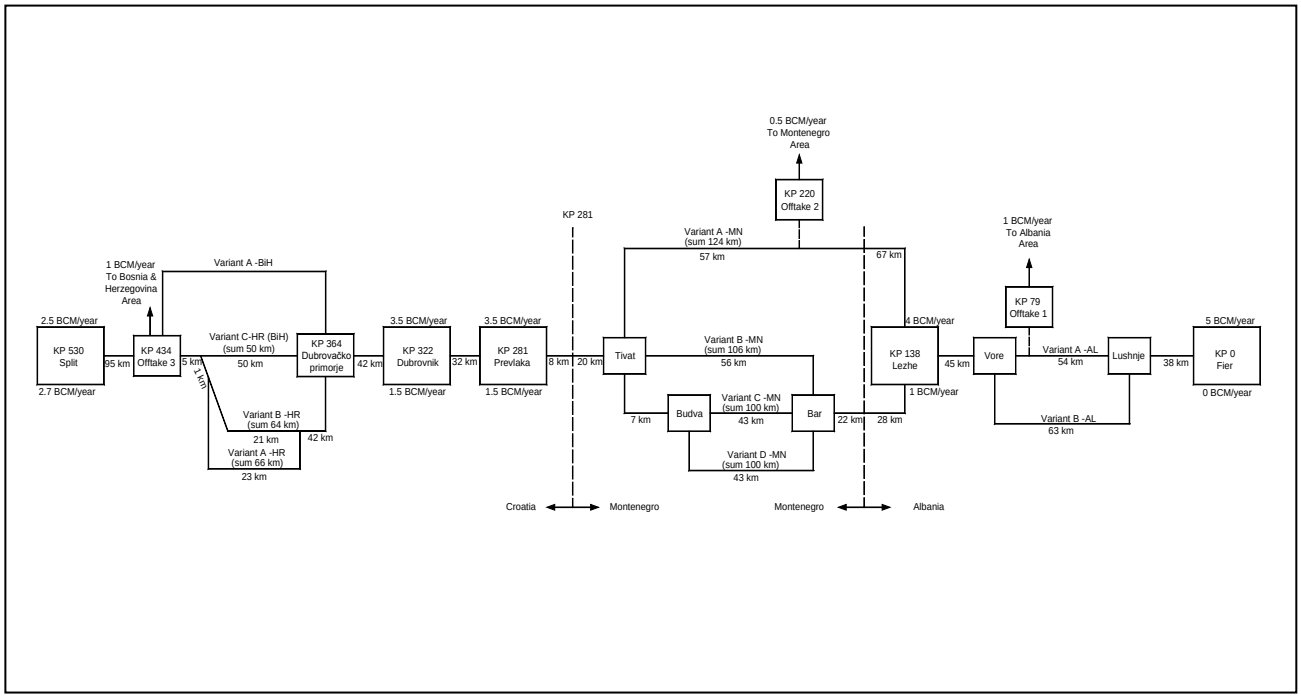


Figure 17: Basic block flow diagram with all variants

3.5 Basic Variants Block Flow Diagram

The following figure shows the basic block flow diagram of route option between Ploče –Dubrovnik (variants A, B or C).

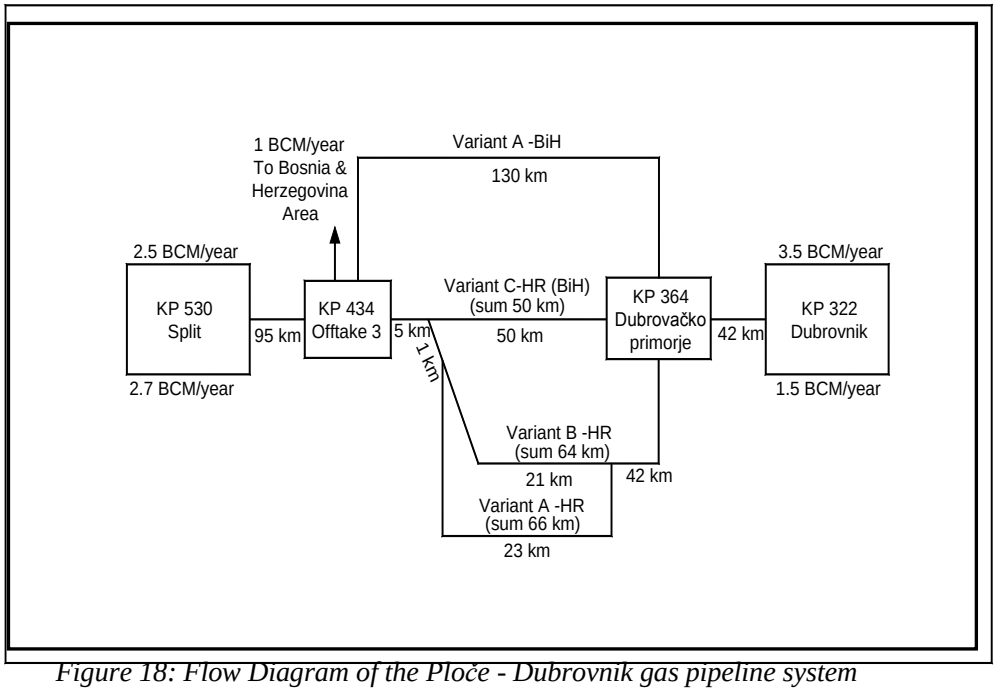


Figure 18: Flow Diagram of the Ploče - Dubrovnik gas pipeline system

The following figure shows the basic block flow diagram of route option between (HR/MNE border - and MNE/ALB border)

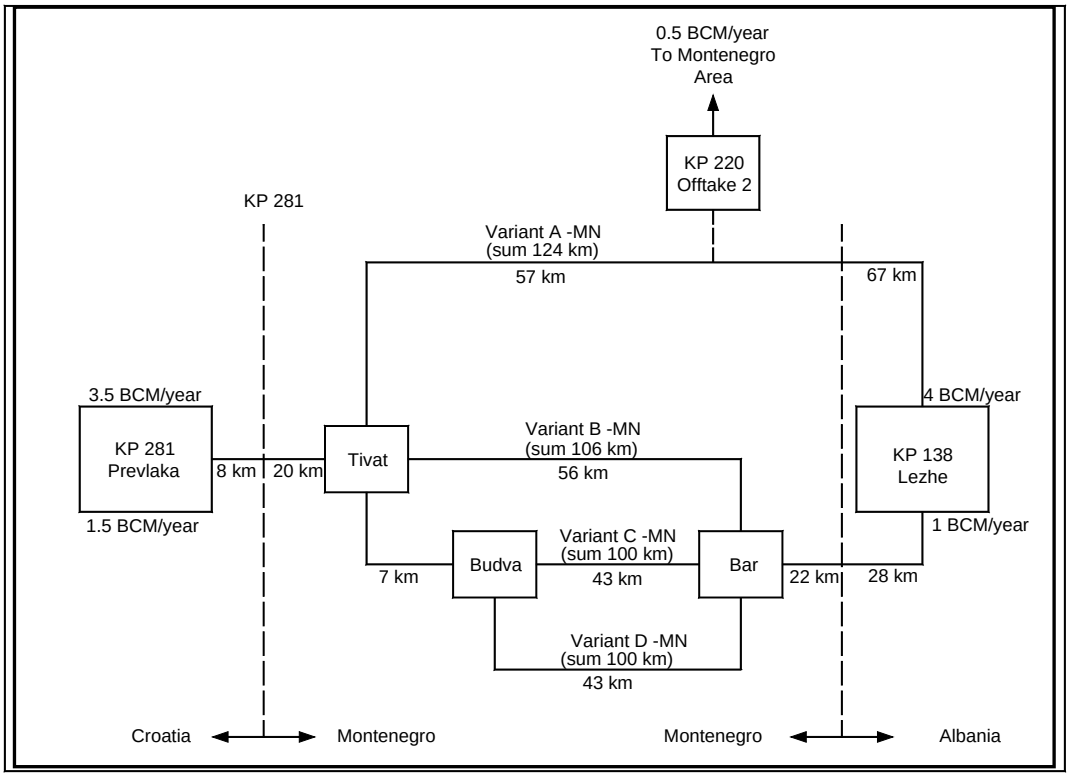


Figure 19: Block Flow Diagram of the Prevlaka - Lezhe gas pipeline system

The following figure shows the basic block flow diagram of route option between (MNE/AL border) and Fier

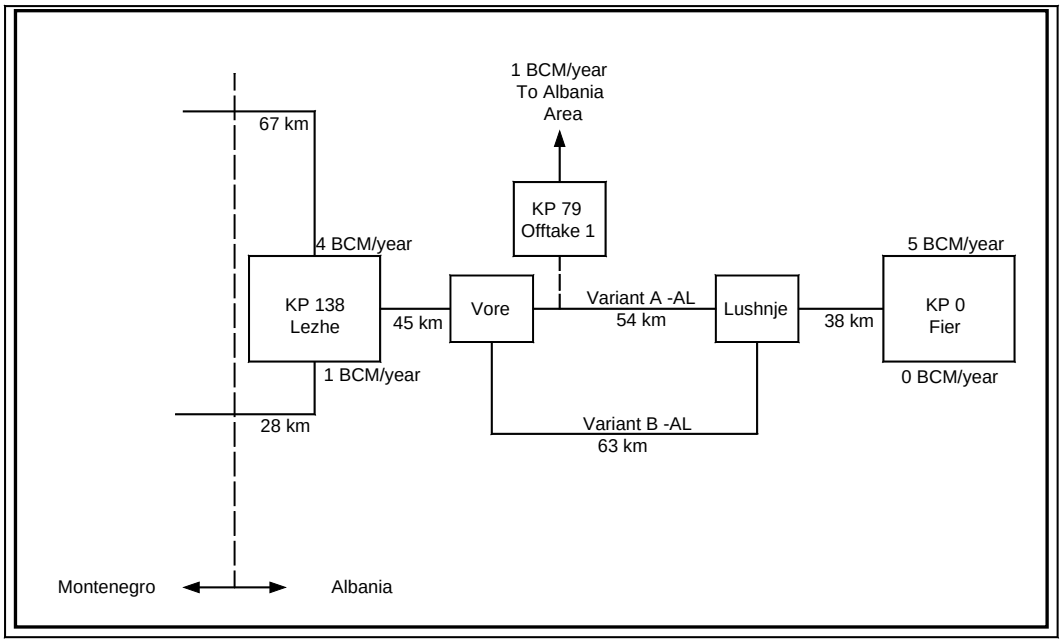


Figure 20: Block Flow Diagram of the Lezhe - Fier gas pipeline system

3.6 Standard Conditions and Operational Availability

For the gas quality and throughput related calculations the following standard conditions were assumed:

Standard Pressure: 1.01325 bar
Standard Temperature: 15°C

The time availability factor has been assumed as 95%, i.e. the annual operating time corresponds to 8322 h per year.

3.7 Gas Quality

Natural gas composition shown in the following table corresponds to the gas composition of the Trans Adriatic Pipeline (TAP) according to C205/ILFM-AD-0000/Rev. B IAP (Ionian Adriatic Pipeline) – Hydraulic study and cost comparison (step 1). The process calculations are based on this composition.

Table 1: Design Gas Composition

Component		**Mole %**
Methane	C1	87.78
Ethane	C2	2.72
Propane	C3	1.54
Iso-Butane	C4	0.50

Component		**Mole %**
N-Butane	C4	0.51
Iso-Pentane	C5	0.24
N-Pentane	C5	0.24
Hexane	C6	0.03
Nitrogen	N2	4.43
Carbon Dioxide	CO2	2.01
Total	-	100.00

3.8 Pipeline Related Data

General Parameters
For the pipeline, the following parameters have been assumed:

- Pipeline Maximum Allowable Operating Pressure: 85 barg
- Pipe Wall Conductivity: 45 W/m/K
- PE Coating Thickness: 3.5 mm
- PE Coating Conductivity: 0.35 W/m/K
- Roughness: 8 μm
- The soil temperature at laying depths: 10°C
- Pipe wall thickness determination as per ASME B31.8.

Heat Transfer related data of the Buried Pipeline
For the hydraulic calculations, the following heat transfer data of the buried pipeline have been considered:

- Soil cover above pipeline top: 1 m
- Soil Heat Conductivity: 1.0 W/m/K
- The soil temperature at laying depths: 10°C

3.9 Compressor Station Related Data

Process Parameters
For estimations regarding the compressor and gas turbine requirements, the following assumptions have been made:

- Adiabatic compression efficiency: 80 %
- Mechanical efficiency: 97 %
- Gas turbine fuel gas efficiency: 33 %
- Gas turbine altitude correction: 0.78 - 1
- Gas turbine Inlet loss correction: 0.952 - 1
- Gas exhaust loss correction: 0.979 - 1
- Gas turbine ambient temperature correction: 0.82 – 1.25

4 Hydraulic calculations

4.1 Simulation Software

The process calculations have been conducted using the GASWorkS software 6.0 by Bradley B. Bean, PE.

GASWorkS™ provides Windows based steady-state network modelling tools. It is designed to assist the engineering professionals analyze and design distribution, gathering, transmission, and plant piping systems containing natural gas or other compressible fluids. Support is provided for systems made up of fittings, compressors, pipes, regulators, valves, and wells. A robust set of import and export routines allows data exchange with a variety of CAD, GIS, and Database applications.

4.2 Methodology

To make decision about optimal pipeline diameter for IAP system the hydraulic calculations have been conducted in two steps:

Step 1
The optimal pipeline diameter is determined while ignoring of the most feasible route option through beneficiary countries. The longest route was taken into account instead.
The hydraulic calculations have been conducted for set of different pipeline diameters in range of 28“, 30“, 32“, 34“ and 36“ for pipeline route Fier – Split. Since the pipeline system is assumed to be bi-directional, the calculations have been conducted for pipeline route Split- Fier as well.
Number and power of compressor stations, along pipeline route is determined based on demanded pressures at the outputs and at the base of inlet pressure at inlet point of pipeline route in either direction. In the final solution, the compressor with higher demanded compression power for both directions at the same site is chosen.

Step 2
The optimal option of the route through beneficiary countries is determined for the pipeline diameter determined in Step 1.
The final solution is based on optimal pipeline diameter in both directions and optimal option of the route through beneficiary countries.

Individual pipeline system configurations are compared to each other with respect to investment cost, fuel gas cost and maintenance cost. The final comparison is performed based on the PDV method.

4.3 Wall thickness calculation

Pipe wall thickness calculations have been performed per ASME B31.8.

4.4 Design Pressure

Design pressure calculation has been performed on the basis of pipeline diameter and throughput of the system and according to inlet and outlet pressure of the system.

For south – north: (Fier – Split) direction the calculations are based on a maximum supply pressure of 82 barg at a temperature of 10°C from TAP pipeline. The minimum delivery pressures are considered as follows:

- To Tirana area is specified with 50barg.
- To Montenegro area is specified with 50barg.
- To Ploče is specified with 50barg.
- To Split is specified with 70 barg.

For north – south: (Split –Fier) direction the calculations are based on a minimum supply pressure of 50 barg at a temperature of 10°C from Bosiljevo – Split pipeline which Plinacro delivers at inlet of IAP system. To transmit 2.7 bcm/year trough the IAP system, minimum design pressure is assumed to be 60 barg which is obtained by compressor at the inlet of IAP system. The minimum delivery pressures are considered as follows:

- To Tirana area is specified with 50barg.
- To Montenegro area is specified with 50barg.
- To Ploče is specified with 50barg.
- To Fier is specified with 50 barg.

4.5 Hydraulics Results

Results of hydraulics calculations for determination of optimal pipeline diameter, as mentioned in methodology chapter are shown below in following figures and table.

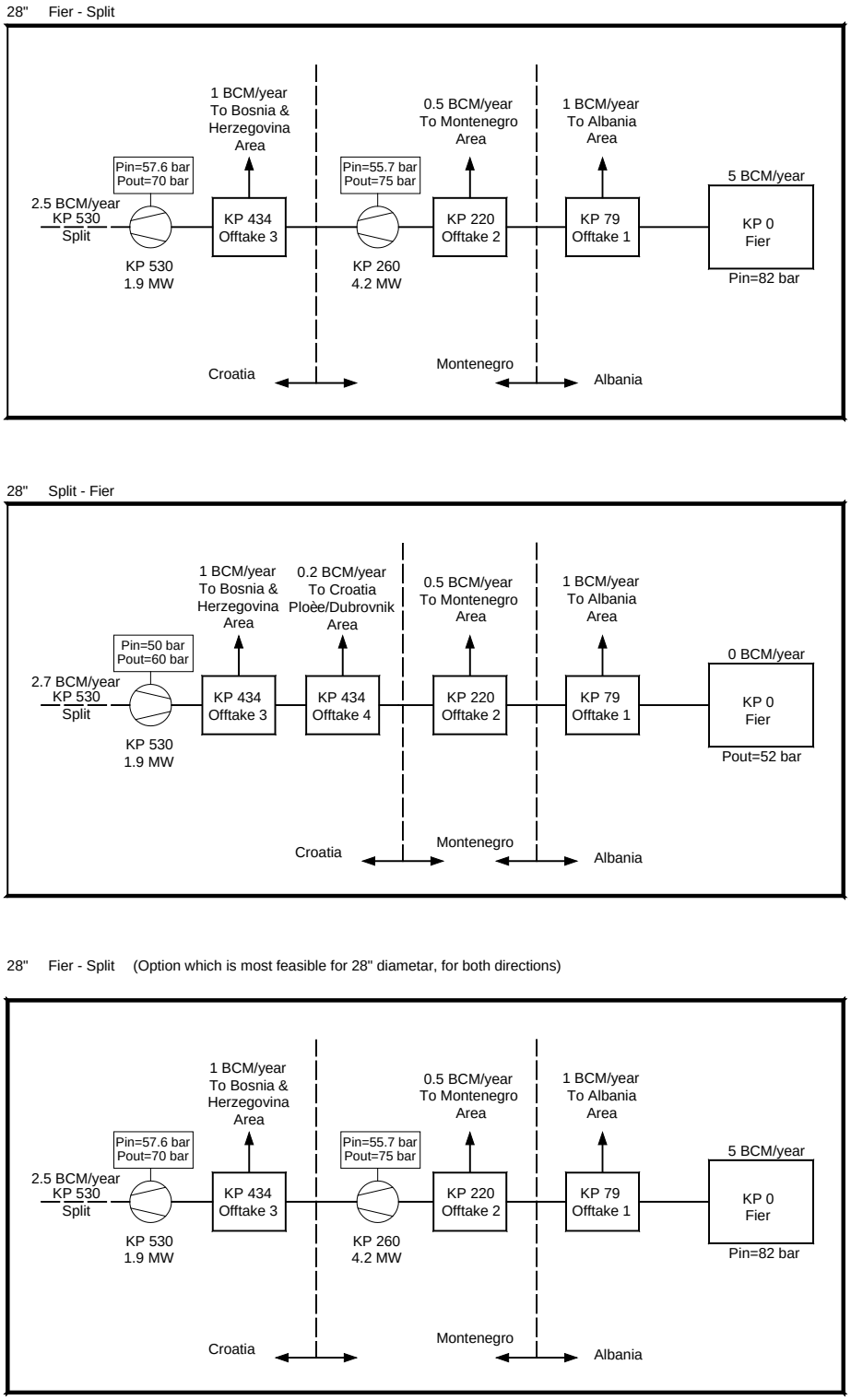


Figure 21: Hydraulic calculation for Option 28"

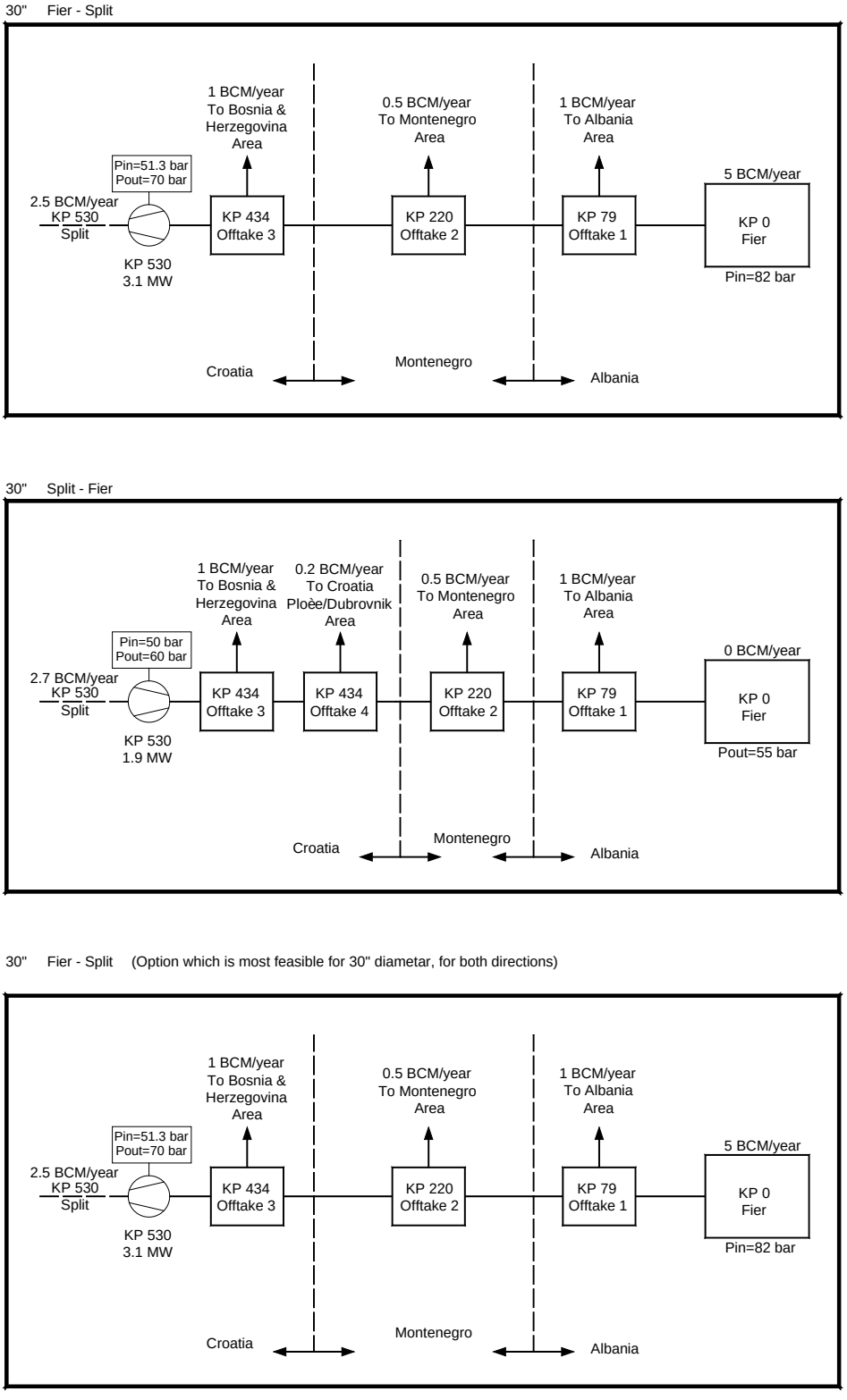


Figure 22: Hydraulic calculation for Option 30”

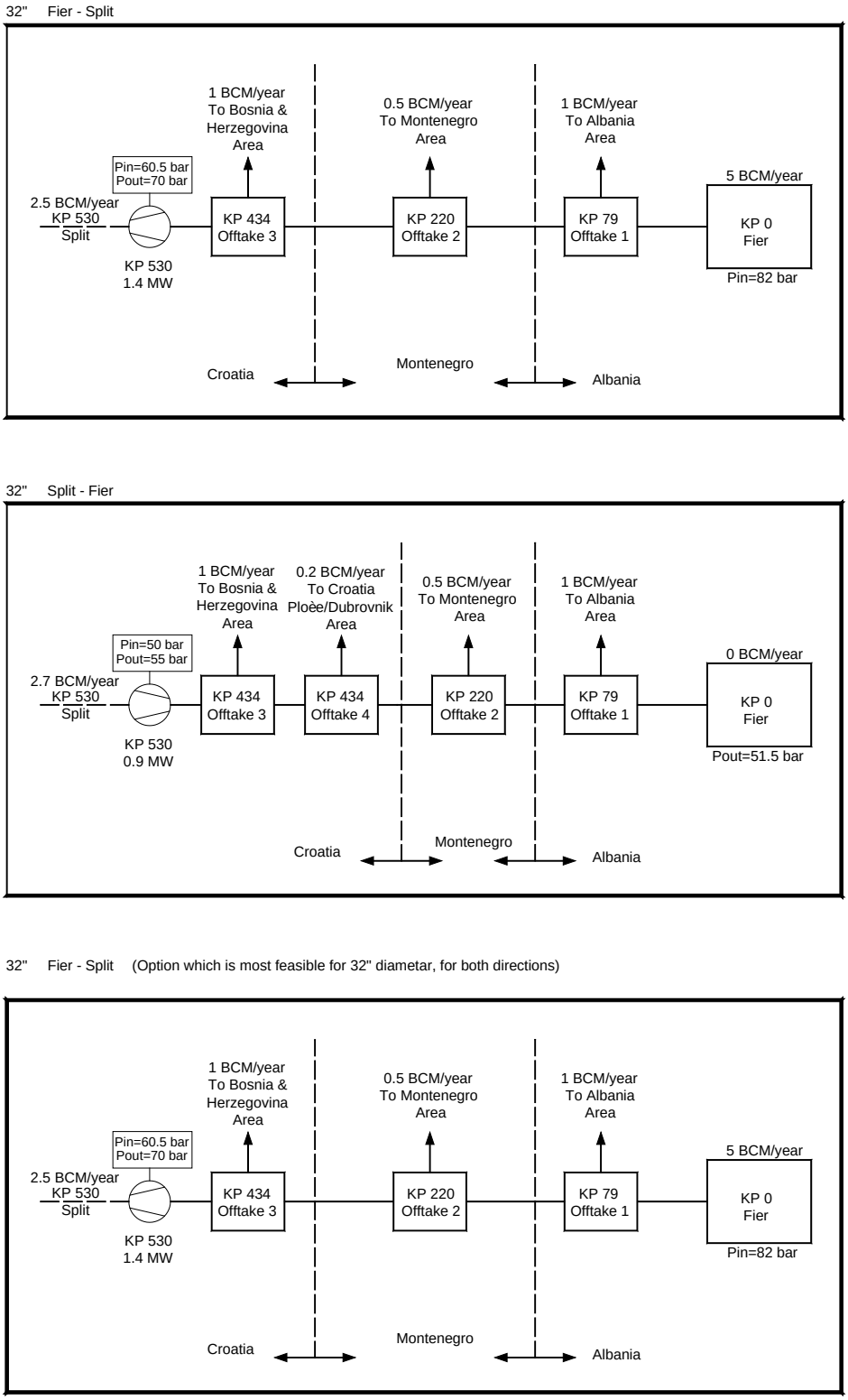


Figure 23: Hydraulic calculation for Option 32"

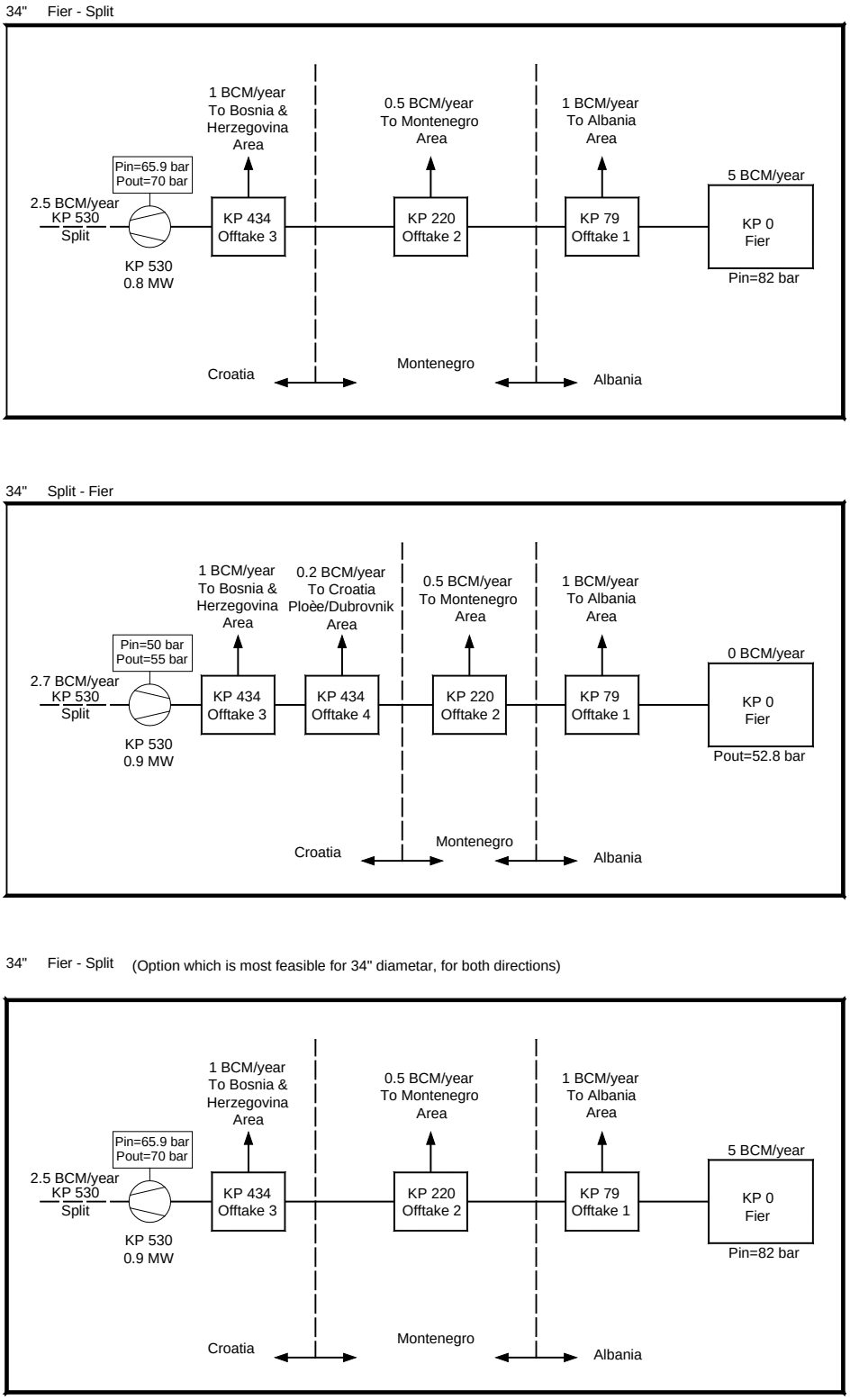


Figure 24: Hydraulic calculation for Option 34"

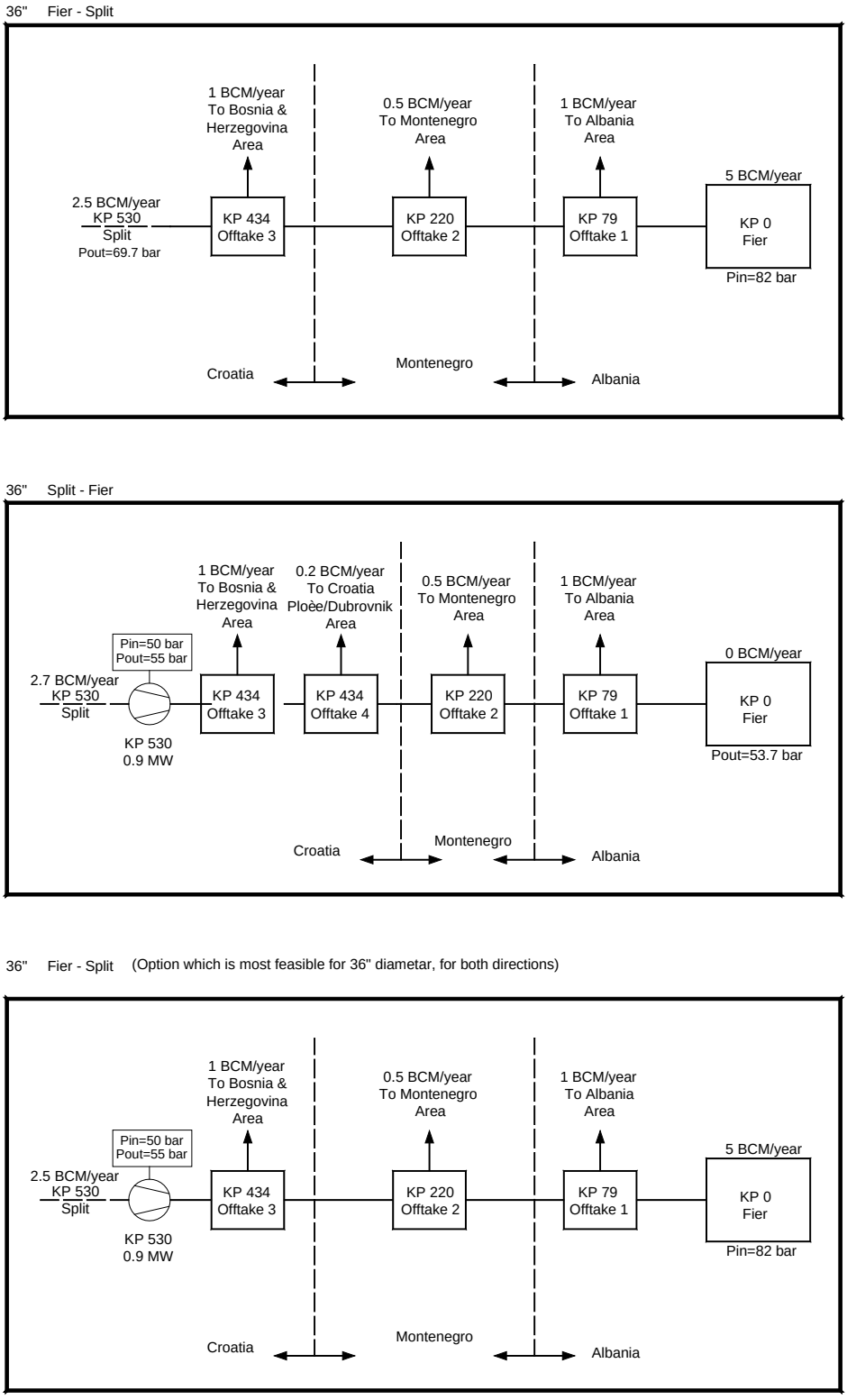


Figure 25: Hydraulic calculation for Option 36"

Hydraulics results are summarized in the following table.

Table 2: Hydraulics results

Option Loop	**Direction** A (Fier - Split) B (Split - Fier)	**Pin** bar	**Pou** bar	**CS** **Split**	**Power** MW	**Additional CS in Montenegro**	**Power** MW
28"	A	82.0	70.0	1.0	1.9	1.0	4.2
28"	B	50.0	52.2	1.0	1.9		
30"	A	82.0	70.0	1.0	3.1		
30"	B	50.0	55.0	1.0	3.1		
32"	A	82.0	70.0	1.0	1.4		
32"	B	50.0	51.5	1.0	1.4		
34"	A	82.0	70.0	1.0	0.9		
34"	B	50.0	52.8	1.0	0.9		
36"	A	82.0	70.0	1.0	-		
36"	B	50.0	53.7	1.0	0.9		

5 Economic calculations

5.1 CAPEX and OPEX Estimate

For each pipeline diameter option considered, the following main items have been estimated:

- For the Pipeline Sections:
  - Pipeline investment cost
  - Pipeline maintenance cost
- For the Compressor Stations:
  - Compressor shaft rated power
  - Compressor station investment cost
  - Compressor station energy cost
  - Compressor station maintenance cost

The following tables show cost evaluation of each pipeline diameter option

Table 3: Cost calculation for Option 28"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**				
1.1	**Investment costs**				
	Nominal diametar	inch	28		
	Pipeline length	km	530		
	Specific investment cost pipeline	€/"m	36.0		
	Investment costs pipeline	**Mio €**	**534.24**		
1.2	**Maintenance costs**				
	Annual fraction of investment	-	1.0%		
	Total investment costs	Mio €	534.24		
	Annual maintenance costs	**Mio €/year**	**5.3**		
2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW	4211	1938	
	Instaled ISO power	MW	7.7	3.5	
	Basis-Investment	Mio €	32	32	
	Specific performance related cost	€/kW	1500	1500	
	Performance Related Costs	Mio €	11.5	5.3	
	Investment costs compressor station	**Mio €**	**43.6**	**37.3**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm	30	30	
	Shaft Power	MW	4.3	2	
	Annual energy costs	**Mio €/year**	**1.4**	**0.7**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-	2.8%	2.8%	
	Investment costs	Mio €	43.6	37.3	
	Annual maintenance costs	**Mio €/year**	**1.2**	**1.0**	
3	**COST COMPOSITION**				
3.1	**Investment costs**				
	Pipeline	Mio €	534.24		
	Compressor station	Mio €	80.8		
	Sum	**Mio €**	**615.04**		
3.2	**Energy costs**				
	Pipeline	Mio €	0		
	Compressor station	Mio €	2.1		
	Sum	**Mio €**	**2.1**		
3.3	**Maintenance costs**				
	Pipeline	Mio €	5.3		
	Compressor station	Mio €	2.3		
	Sum	**Mio €**	**7.6**		

Table 4: Cost calculation for Option 30"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**				
1.1	**Investment costs**				
	Nominal diametar	inch	30		
	Pipeline length	km	530		
	Specific investment cost pipeline	€/"m	36.0		
	Investment costs pipeline	**Mio €**	**572.4**		
1.2	**Maintenance costs**				
	Annual fraction of investment	-	1.0%		
	Total investment costs	Mio €	572.4		
	Annual maintenance costs	**Mio €/year**	**5.7**		
2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		3141	
	Instaled ISO power	MW		5.7	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		8.6	
	Investment costs compressor station	**Mio €**		**40.6**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		3.2	
	Annual energy costs	**Mio €/year**		**1.1**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		40.6	
	Annual maintenance costs	**Mio €/year**		**1.1**	
3	**COST COMPOSITION**				
3.1	**Investment costs**				
	Pipeline	Mio €	572.4		
	Compressor station	Mio €	40.6		
	Sum	**Mio €**	**612.95**		
3.2	**Energy costs**				
	Pipeline	Mio €	0		
	Compressor station	Mio €	1.1		
	Sum	**Mio €**	**1.1**		
3.3	**Maintenance costs**				
	Pipeline	Mio €	5.7		
	Compressor station	Mio €	1.1		
	Sum	**Mio €**	**6.9**		

Table 5: Cost calculation for Option 32"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**				
1.1	**Investment costs**				
	Nominal diametar	inch	32		
	Pipeline length	km	530		
	Specific investment cost pipeline	€/"m	36.0		
	Investment costs pipeline	**Mio €**	**610.56**		
1.2	**Maintenance costs**				
	Annual fraction of investment	-	1.0%		
	Total investment costs	Mio €	610.56		
	Annual maintenance costs	**Mio €/year**	**6.1**		
2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		1425	
	Instaled ISO power	MW		2.6	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		3.9	
	Investment costs compressor station	**Mio €**		**35.9**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		1.5	
	Annual energy costs	**Mio €/year**		**0.5**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		35.9	
	Annual maintenance costs	**Mio €/year**		**1.0**	
3	**COST COMPOSITION**				
3.1	**Investment costs**				
	Pipeline	Mio €	610.56		
	Compressor station	Mio €	35.9		
	Sum	**Mio €**	**646.46**		
3.2	**Energy costs**				
	Pipeline	Mio €	0		
	Compressor station	Mio €	0.5		
	Sum	**Mio €**	**0.5**		
3.3	**Maintenance costs**				
	Pipeline	Mio €	6.1		
	Compressor station	Mio €	1.0		
	Sum	**Mio €**	**7.1**		

Table 6: Cost calculation for Option 34"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**		
1.1	**Investment costs**		
	Nominal diametar	inch	34
	Pipeline length	km	530
	Specific investment cost pipeline	€/"m	36.0
	Investment costs pipeline	**Mio €**	**648.72**
1.2	**Maintenance costs**		
	Annual fraction of investment	-	1.0%
	Total investment costs	Mio €	648.72
	Annual maintenance costs	**Mio €/year**	**6.5**

2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		978	
	Instaled ISO power	MW		1.8	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		2.7	
	Investment costs compressor station	**Mio €**		**34.7**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		1	
	Annual energy costs	**Mio €/year**		**0.3**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		34.7	
	Annual maintenance costs	**Mio €/year**		**1.0**	

3	**COST COMPOSITION**		
3.1	**Investment costs**		
	Pipeline	Mio €	648.72
	Compressor station	Mio €	34.7
	Sum	**Mio €**	**683.42**
3.2	**Energy costs**		
	Pipeline	Mio €	0
	Compressor station	Mio €	0.3
	Sum	**Mio €**	**0.3**
3.3	**Maintenance costs**		
	Pipeline	Mio €	6.5
	Compressor station	Mio €	1.0
	Sum	**Mio €**	**7.5**

Table 7: Cost calculation for Option 36"

1	**PIPELINE - INVESTMENT AND MAINTENANCE COSTS**				
1.1	**Investment costs**				
	Nominal diametar	inch	36		
	Pipeline length	km	530		
	Specific investment cost pipeline	€/"m	36.0		
	Investment costs pipeline	**Mio €**	**686.88**		
1.2	**Maintenance costs**				
	Annual fraction of investment	-	1.0%		
	Total investment costs	Mio €	686.88		
	Annual maintenance costs	**Mio €/year**	**6.9**		
2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		978	
	Instaled ISO power	MW		1.8	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		2.7	
	Investment costs compressor station	**Mio €**		**34.7**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		1	
	Annual energy costs	**Mio €/year**		**0.3**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		34.7	
	Annual maintenance costs	**Mio €/year**		**1.0**	
3	**COST COMPOSITION**				
3.1	**Investment costs**				
	Pipeline	Mio €	686.88		
	Compressor station	Mio €	34.7		
	Sum	**Mio €**	**721.58**		
3.2	**Energy costs**				
	Pipeline	Mio €	0		
	Compressor station	Mio €	0.3		
	Sum	**Mio €**	**0.3**		
3.3	**Maintenance costs**				
	Pipeline	Mio €	6.9		
	Compressor station	Mio €	1.0		
	Sum	**Mio €**	**7.8**		

5.2 Economic and financial analysis of the project

The aim of this economic and financial analysis is to express all the effects of the Ionian-Adriatic Gas Pipeline Project in value units and thus provide the documentation and information base for project assessment.
Investments in the construction of the gas transportation system represent a capital allocation for an investment proposal that debits the Investor's current liquid expenditures on account of assured future benefits. Therefore, successful management of capital to be invested in the construction of the Ionian-Adriatic Gas Pipeline system comprises:

- drawing up the investment proposal,
- cash flow estimate for the investment proposal,
- cash flow evaluation,
- project selection based on acceptance criterion.

5.2.1 Options under consideration

Preparations for the Ionian-Adriatic Gas Pipeline Project are still in an early stage where various options are permitted, so the economic and financial analysis will be made for several options involving different pipeline diameters, viz.:

- pipeline diameter 28" (Model 1),
- pipeline diameter 30" (Model 2),
- pipeline diameter 32" (Model 3),
- pipeline diameter 34" (Model 4),
- pipeline diameter 36" (Model 5).

5.2.2 Investment costs

The basic task of the economic and financial analysis of the said investment project in preparing the construction of the Ionian-Adriatic Gas Pipeline includes an information base composed, among other things, of investments in real estate and equipment for natural gas transportation.

The investment proposal (amount and structure) is based on the technological and engineering characteristics of the Ionian-Adriatic Gas transportation system.

Table 8 Investment structure and dynamics

	Investment structure	Total investment 000 €	Dynamics Year 1.	Year 2.	Year 3.
1.	**Model 1 - pipeline diameter 28"**				
	Pipeline	534.200	178.067	178.067	178.067
	Compressor station	80.800	26.933	26.933	26.933
	Total investment	615.000	205.000	205.000	205.000
2.	**Model 2 - pipeline diameter 30"**				
	Pipeline	572.400	190.800	190.800	190.800
	Compressor station	40.600	13.533	13.533	13.533
	Total investment	613.000	204.333	204.333	204.333
3.	**Model 3 - pipeline diameter 32"**				
	Pipeline	610.600	203.533	203.533	203.533
	Compressor station	35.900	11.967	11.967	11.967
	Total investment	646.500	215.500	215.500	215.500
4.	**Model 4 - pipeline diameter 34"**				
	Pipeline	648.700	216.233	216.233	216.233
	Compressor station	34.700	11.567	11.567	11.567
	Total investment	683.400	227.800	227.800	227.800
5.	**Model 5 - pipeline diameter 36"**				
	Pipeline	686.900	228.967	228.967	228.967
	Compressor station	34.700	11.567	11.567	11.567
	Total investment	721.600	240.533	240.533	240.533

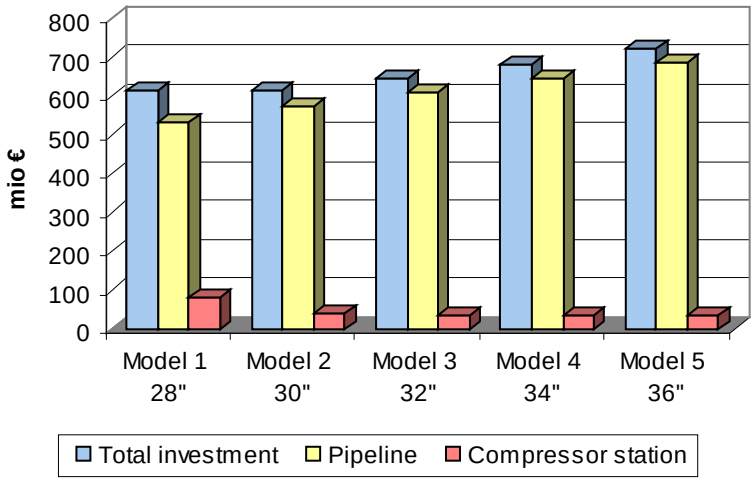


Figure 26: Investments in the gas transportation system

5.2.3 Financing sources

The next important step in the financial analysis of the investment project in preparing the construction of the Ionian-Adriatic Gas Pipeline is selecting the sources of investment financing. The procedure is important not only to complete the financial scheme, but also to assess the financial obligations arising from it.

Within the Financing Plan for this investment project an option has been considered according to which the construction of the Ionian-Adriatic Gas Transportation System would be financed from:

Funds obtained on financial markets through long-term borrowing at financial institutions

The price of borrowed capital has been calculated according to the following assumed terms and conditions:

- repayment period: 15 years,
- regular interest rate: 6% per annum
- repayment in equal semi-annual instalments

5.2.4 Estimate of expenditures

Expenditures include investments, operation and maintenance costs and other outlays related to natural gas transportation, in other words, any expenditure that diminish the economic and financial potential of the Ionian-Adriatic Gas Pipeline project.

Investments in fixed assets

The investment proposal for the analysed options (investment amount and structure) is based on technological and engineering characteristics of the Ionian-Adriatic Gas Pipeline project. The investment level and progress are shown in section Investment Costs.

Business expenditures

This part of financial data processing is tasked to determine the reason and the amount of business expenditures that diminish the economic and financial potential of the investment project, as an important input for the subsequent assessment of liquidity and profitability.
Business expenditures are divided into three groups:

- operating and maintenance costs,
- depreciation, and
- financial expenditures.

Operating and maintenance costs

At this stage of preparations for the Ionian-Adriatic Gas Pipeline project, the operating and maintenance costs include:

- energy costs
- gas transportation system maintenance costs

Table 9 Operating and maintenance costs

Options under consideration	mio €		
	Total costs	Energy costs	Maintenance costs
Model 1 - pipeline diameter 28"	**9,7**	**2,1**	**7,6**
Model 2 - pipeline diameter 30"	**8,0**	**1,1**	**6,9**
Model 3 - pipeline diameter 32"	**7,6**	**0,5**	**7,1**
Model 4 - pipeline diameter 34"	**7,8**	**0,3**	**7,5**
Model 5 - pipeline diameter 36"	**8,1**	**0,3**	**7,8**

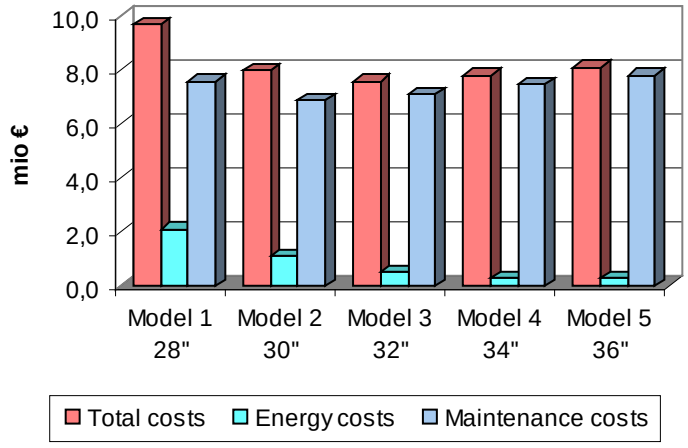


Figure 27: Operating and maintenance cost projection

5.2.5 Assessment of cash inflows

This part of financial data processing is tasked to determine the amount of cash inflows which are expected from the provision of natural gas transportation services and which increase the project's financial and economic potential, as an important input for the subsequent assessment of liquidity and profitability.

The project will earn cash from:

- provision of natural gas transport services
- the project's remaining value.

Income from natural gas transportation services

The quantity of natural gas transported is a business event resulting in an increased financial and economic potential of the project.

The projected provision of natural gas transportation services is based on:

- the expected volume of transported natural gas in the order of **5 billion cubic metres**,
- the amount of transport tariff that meets the set project acceptability criterion, the internal rate of return of 7%.

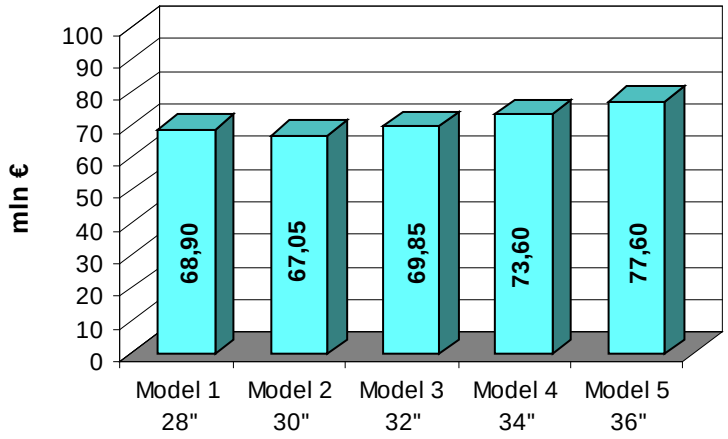


Figure 28: Operating revenue projection

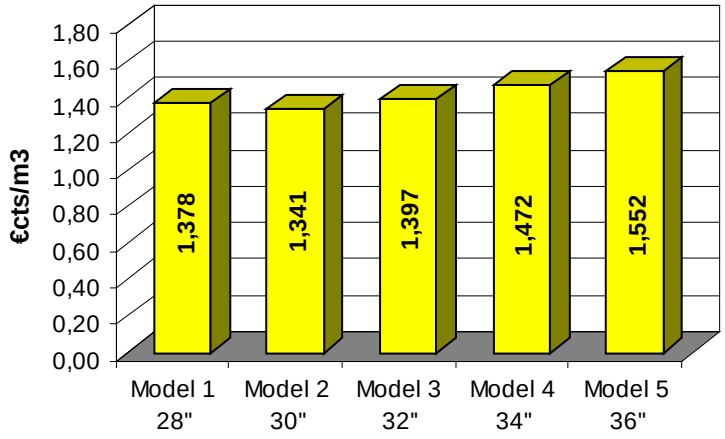


Figure 29: Transport tariff projection

The project's value balance

What also makes the project's cash inflows is the project's value balance that appears in the last year of the project's life, and includes:

- the remaining value of fixed tangible assets
- the remaining value of working capital.

5.2.6 Project profitability assessment

The success of the project will depend on its effects on the energy market, which will determine its economic impact. The economic assessment of the project includes profitability assessment at project level, i.e., the project's contribution to capital accumulation.

The source of information for profitability assessment is the project's economic flow, i.e., the business events determining the development of the project's economic potential.

Economic flow projection

The essence of profitability assessment (economic assessment for the Investor) is to ascertain whether the project's material basis is growing or decreasing, with its entire life taken into consideration.

The source of information for profitability assessment is the project's economic flow, i.e., the business events determining the development of the project's economic potential.

The assessment of future cash flows is based on:

- total investments in the gas pipeline construction project amounting:
  - €615.0 million, Model 1 – 28" pipeline,
  - €613.0 million, Model 2 – 30" pipeline,
  - €646,5 million, Model 3 – 32" pipeline,
  - €683,4 million, Model 4 – 34" pipeline,
  - €721.6 million, Model 5 – 36" pipeline,
- operating and maintenance costs amounting:
  - €9,7 million, Model 1 – 28" pipeline,
  - €8.0 million, Model 2 – 30" pipeline,
  - €7.6 million, Model 3 – 32" pipeline,
  - €7.8 million, Model 4 – 34" pipeline,
  - €8.1 million, Model 5 – 36" pipeline,
- expected volume of transported natural gas amounting
  - 5 billion cubic metres,
- amount of transport tariff that meets the set project acceptability criterion, the internal rate of return of 7%,
- the planned period of 20 years in which the investment project produces acceptable effects

For the investment proposals concerning the Ionian-Adriatic Gas Pipeline Project information has been provided about expected future cash flows. The cash flow estimates have yielded relevant information required for assessing the acceptability of each of the herein analysed solutions.
Described in continuation is the project's economic flow for the assumed management scenarios. Shown in Tables are the basic groups of planned (business and investment) activities impacting the project's cash flow, plus their structure and progress (business events based on planned business and investment activities that increase or decrease the project's economic potential).

Table 10 Economic flow – Model 1 – pipeline diameter 28"

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services				68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700
4.05.	Income tax	0	0	0	0	1.074	1.558	2.043	2.528	3.013	3.498	3.983
4.06.	**Total cash outflows**	**0**	**0**	**0**	**9.700**	**10.774**	**11.258**	**11.743**	**12.228**	**12.713**	**13.198**	**13.683**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**36.932**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**96.132**	**58.126**	**57.642**	**57.157**	**56.672**	**56.187**	**55.702**	**55.217**
	Evaluation of capital expenditure											
4.09.	Investment	205.000	205.000	205.000	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	205.000	410.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000
4.11.	Net cash flow from operating activitis	0	0	0	96.132	58.126	57.642	57.157	56.672	56.187	55.702	55.217
4.12.	**Net cash flow**	**-205.000**	**-205.000**	**-205.000**	**96.132**	**58.126**	**57.642**	**57.157**	**56.672**	**56.187**	**55.702**	**55.217**
4.13.	Cumulative net cash flow	-205.000	-410.000	-615.000	-518.868	-460.742	-403.100	-345.944	-289.272	-233.085	-177.382	-122.165

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900	68.900
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	205.000
4.03.	**Total cash inflows**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**68.900**	**273.900**
	Cash outflows												
4.04.	Operation and maintensnce costs	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700	9.700
4.05.	Income tax	4.467	4.952	5.437	5.922	6.407	6.892	7.376	7.740	7.740	7.740	7.740	7.740
4.06.	**Total cash outflows**	**14.167**	**14.652**	**15.137**	**15.622**	**16.107**	**16.592**	**17.076**	**17.440**	**17.440**	**17.440**	**17.440**	**17.440**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-41.000**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**54.733**	**54.248**	**53.763**	**53.278**	**52.793**	**52.308**	**51.824**	**10.460**	**51.460**	**51.460**	**51.460**	**256.460**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000	615.000
4.11.	Net cash flow from operating activitis	54.733	54.248	53.763	53.278	52.793	52.308	51.824	10.460	51.460	51.460	51.460	256.460
4.12.	**Net cash flow**	**54.733**	**54.248**	**53.763**	**53.278**	**52.793**	**52.308**	**51.824**	**10.460**	**51.460**	**51.460**	**51.460**	**256.460**
4.13.	Cumulative net cash flow	-67.432	-13.184	40.579	93.857	146.650	198.958	250.782	261.242	312.702	364.162	415.622	672.082

Table 11 Economic flow – Model 2 – pipeline diameter 30''

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services	0	0	0	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
4.05.	Income tax	0	0	0	0	1.079	1.562	2.045	2.528	3.012	3.495	3.978
4.06.	**Total cash outflows**	**0**	**0**	**0**	**8.000**	**9.079**	**9.562**	**10.045**	**10.528**	**11.012**	**11.495**	**11.978**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**36.671**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**95.721**	**57.971**	**57.488**	**57.005**	**56.522**	**56.038**	**55.555**	**55.072**
	Evaluation of capital expenditure											
4.09.	Investment	204.333	204.333	204.333	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	204.333	408.667	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000
4.11.	Net cash flow from operating activitis	0	0	0	95.721	57.971	57.488	57.005	56.522	56.038	55.555	55.072
4.12.	**Net cash flow**	**-204.333**	**-204.333**	**-204.333**	**95.721**	**57.971**	**57.488**	**57.005**	**56.522**	**56.038**	**55.555**	**55.072**
4.13.	Cumulative net cash flow	-204.333	-408.667	-613.000	-517.279	-459.308	-401.820	-344.815	-288.293	-232.255	-176.699	-121.627

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050	67.050
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	204.333
4.03.	**Total cash inflows**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**67.050**	**271.383**
	Cash outflows												
4.04.	Operation and maintensnce costs	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
4.05.	Income tax	4.461	4.945	5.428	5.911	6.394	6.878	7.361	7.723	7.723	7.723	7.723	7.723
4.06.	**Total cash outflows**	**12.461**	**12.945**	**13.428**	**13.911**	**14.394**	**14.878**	**15.361**	**15.723**	**15.723**	**15.723**	**15.723**	**15.723**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-40.867**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**54.589**	**54.105**	**53.622**	**53.139**	**52.656**	**52.172**	**51.689**	**10.460**	**51.327**	**51.327**	**51.327**	**255.660**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000	613.000
4.11.	Net cash flow from operating activitis	54.589	54.105	53.622	53.139	52.656	52.172	51.689	10.460	51.327	51.327	51.327	255.660
4.12.	**Net cash flow**	**54.589**	**54.105**	**53.622**	**53.139**	**52.656**	**52.172**	**51.689**	**10.460**	**51.327**	**51.327**	**51.327**	**255.660**
4.13.	Cumulative net cash flow	-67.039	-12.933	40.689	93.828	146.483	198.656	250.345	260.805	312.131	363.458	414.785	670.445

Table 12 Economic flow – Model 3 – pipeline diameter 32"

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services	0	0	0	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600
4.05.	Income tax	0	0	0	0	1.132	1.642	2.151	2.661	3.171	3.680	4.190
4.06.	**Total cash outflows**	**0**	**0**	**0**	**7.600**	**8.732**	**9.242**	**9.751**	**10.261**	**10.771**	**11.280**	**11.790**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**38.608**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**100.858**	**61.118**	**60.608**	**60.099**	**59.589**	**59.079**	**58.570**	**58.060**
	Evaluation of capital expenditure											
4.09.	Investment	215.500	215.500	215.500	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	215.500	431.000	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500
4.11.	Net cash flow from operating activitis	0	0	0	100.858	61.118	60.608	60.099	59.589	59.079	58.570	58.060
4.12.	**Net cash flow**	**-215.500**	**-215.500**	**-215.500**	**100.858**	**61.118**	**60.608**	**60.099**	**59.589**	**59.079**	**58.570**	**58.060**
4.13.	Cumulative net cash flow	-215.500	-431.000	-646.500	-545.642	-484.524	-423.916	-363.817	-304.228	-245.149	-186.579	-128.519

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850	69.850
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	215.500
4.03.	**Total cash inflows**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**69.850**	**285.350**
	Cash outflows												
4.04.	Operation and maintensnce costs	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600	7.600
4.05.	Income tax	4.700	5.209	5.719	6.229	6.738	7.248	7.758	8.140	8.140	8.140	8.140	8.140
4.06.	**Total cash outflows**	**12.300**	**12.809**	**13.319**	**13.829**	**14.338**	**14.848**	**15.358**	**15.740**	**15.740**	**15.740**	**15.740**	**15.740**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-43.100**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**57.550**	**57.041**	**56.531**	**56.021**	**55.512**	**55.002**	**54.492**	**11.010**	**54.110**	**54.110**	**54.110**	**269.610**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500	646.500
4.11.	Net cash flow from operating activitis	57.550	57.041	56.531	56.021	55.512	55.002	54.492	11.010	54.110	54.110	54.110	269.610
4.12.	**Net cash flow**	**57.550**	**57.041**	**56.531**	**56.021**	**55.512**	**55.002**	**54.492**	**11.010**	**54.110**	**54.110**	**54.110**	**269.610**
4.13.	Cumulative net cash flow	-70.969	-13.929	42.602	98.624	154.135	209.137	263.629	274.639	328.749	382.859	436.969	706.579

Table 13 Economic flow – Model 4 – pipeline diameter 34"

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services	0	0	0	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800
4.05.	Income tax	0	0	0	0	1.196	1.735	2.274	2.812	3.351	3.890	4.429
4.06.	**Total cash outflows**	**0**	**0**	**0**	**7.800**	**8.996**	**9.535**	**10.074**	**10.612**	**11.151**	**11.690**	**12.229**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**40.793**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**106.593**	**64.604**	**64.065**	**63.526**	**62.988**	**62.449**	**61.910**	**61.371**
	Evaluation of capital expenditure											
4.09.	Investment	227.800	227.800	227.800	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	227.800	455.600	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400
4.11.	Net cash flow from operating activitis	0	0	0	106.593	64.604	64.065	63.526	62.988	62.449	61.910	61.371
4.12.	**Net cash flow**	**-227.800**	**-227.800**	**-227.800**	**106.593**	**64.604**	**64.065**	**63.526**	**62.988**	**62.449**	**61.910**	**61.371**
4.13.	Cumulative net cash flow	-227.800	-455.600	-683.400	-576.807	-512.203	-448.138	-384.612	-321.624	-259.175	-197.265	-135.894

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600	73.600
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	227.800
4.03.	**Total cash inflows**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**73.600**	**301.400**
	Cash outflows												
4.04.	Operation and maintensnce costs	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800	7.800
4.05.	Income tax	4.967	5.506	6.045	6.584	7.122	7.661	8.200	8.604	8.604	8.604	8.604	8.604
4.06.	**Total cash outflows**	**12.767**	**13.306**	**13.845**	**14.384**	**14.922**	**15.461**	**16.000**	**16.404**	**16.404**	**16.404**	**16.404**	**16.404**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-45.560**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**60.833**	**60.294**	**59.755**	**59.216**	**58.678**	**58.139**	**57.600**	**11.636**	**57.196**	**57.196**	**57.196**	**284.996**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400	683.400
4.11.	Net cash flow from operating activitis	60.833	60.294	59.755	59.216	58.678	58.139	57.600	11.636	57.196	57.196	57.196	284.996
4.12.	**Net cash flow**	**60.833**	**60.294**	**59.755**	**59.216**	**58.678**	**58.139**	**57.600**	**11.636**	**57.196**	**57.196**	**57.196**	**284.996**
4.13.	Cumulative net cash flow	-75.061	-14.767	44.988	104.204	162.882	221.021	278.621	290.257	347.453	404.649	461.845	746.841

Table 14 Economic flow – Model 5 – pipeline diameter 36"

000 €

Item no	Item	Forecast Years of the project life 1	2	3	4	5	6	7	8	9	10	11
	Cash inflows											
4.01.	Income from natural gas transportation services	0	0	0	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0
4.03.	**Total cash inflows**	**0**	**0**	**0**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**
	Cash outflows											
4.04.	Operation and maintensnce costs	0	0	0	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100
4.05.	Income tax	0	0	0	0	1.267	1.836	2.405	2.974	3.543	4.112	4.681
4.06.	**Total cash outflows**	**0**	**0**	**0**	**8.100**	**9.367**	**9.936**	**10.505**	**11.074**	**11.643**	**12.212**	**12.781**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**43.060**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**0**	**0**	**0**	**112.560**	**68.233**	**67.664**	**67.095**	**66.526**	**65.957**	**65.388**	**64.819**
	Evaluation of capital expenditure											
4.09.	Investment	240.533	240.533	240.533	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	240.533	481.067	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600
4.11.	Net cash flow from operating activitis	0	0	0	112.560	68.233	67.664	67.095	66.526	65.957	65.388	64.819
4.12.	**Net cash flow**	**-240.533**	**-240.533**	**-240.533**	**112.560**	**68.233**	**67.664**	**67.095**	**66.526**	**65.957**	**65.388**	**64.819**
4.13.	Cumulative net cash flow	-240.533	-481.067	-721.600	-609.040	-540.807	-473.143	-406.049	-339.523	-273.565	-208.177	-143.358

000 €

Item no	Item	Forecast Years of the project life 12	13	14	15	16	17	18	19	20	21	22	23
	Cash inflows												
4.01.	Income from natural gas transportation services	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600	77.600
4.02.	The project's value balance	0	0	0	0	0	0	0	0	0	0	0	240.533
4.03.	**Total cash inflows**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**77.600**	**318.133**
	Cash outflows												
4.04.	Operation and maintensnce costs	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100	8.100
4.05.	Income tax	5.249	5.818	6.387	6.956	7.525	8.094	8.663	9.089	9.089	9.089	9.089	9.089
4.06.	**Total cash outflows**	**13.349**	**13.918**	**14.487**	**15.056**	**15.625**	**16.194**	**16.763**	**17.189**	**17.189**	**17.189**	**17.189**	**17.189**
4.07.	**Increase (Decrease) in working capital**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-48.107**	**0**	**0**	**0**	**0**
4.08.	**Net cash flow from operating activitis**	**64.251**	**63.682**	**63.113**	**62.544**	**61.975**	**61.406**	**60.837**	**12.304**	**60.411**	**60.411**	**60.411**	**300.944**
	Evaluation of capital expenditure												
4.09.	Investment	0	0	0	0	0	0	0	0	0	0	0	0
4.10.	Cumulative Investment	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600	721.600
4.11.	Net cash flow from operating activitis	64.251	63.682	63.113	62.544	61.975	61.406	60.837	12.304	60.411	60.411	60.411	300.944
4.12.	**Net cash flow**	**64.251**	**63.682**	**63.113**	**62.544**	**61.975**	**61.406**	**60.837**	**12.304**	**60.411**	**60.411**	**60.411**	**300.944**
4.13.	Cumulative net cash flow	-79.107	-15.425	47.687	110.231	172.206	233.613	294.450	306.754	367.165	427.575	487.986	788.930

In the dynamic approach to the assessment of the economic contribution of the project, use has been made of:

- internal rate of return method

Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is defined as a discount rate that makes the present value of the expected cash flows from a particular project equal to the present value of the expected cash flows from the project. IRR is a relative measure of project efficiency that provides information only about the average annual project accumulation rate.

IRR for the Ionian-Adriatic Gas Pipeline Project, based on the analysed technical solutions and the assumed business conditions, amounts to 7% (project acceptability criterion).

Transport tariff tendency projection

Shown in continuation is the transport tariff tendency projection for the planned period over which the investment project produces economically acceptable effects.

Table 15 Transport tariff tendency projection

Period of the project life	**Year**	**20**				
Expected volume of transported natural gas	**mio m3**	**5.000**				
Acceptability criteria of the project						
Internal rate of return (IRR)	**%**	**7,00%**				
		Model 1 28"	**Model 2 30"**	**Model 3 32"**	**Model 4 34"**	**Model 5 36"**
Investment	**mio €**	**615,0**	**613,0**	**646,5**	**683,4**	**721,6**
Changes in the level of investment	**%**	**0,3%**	**0,0%**	**5,5%**	**11,5%**	**17,7%**
Operation and maintenance costs	**mio €**	**9,7**	**8,0**	**7,6**	**7,8**	**8,1**
Changes in the level O&M costs	**%**	**21,3%**	**0,0%**	**-5,0%**	**-2,5%**	**1,3%**
Transport tariff	**€cts/m3**	**1,378**	**1,341**	**1,397**	**1,472**	**1,552**
Changes in the level of transports tariffs	**%**	**2,8%**	**0,0%**	**4,2%**	**9,8%**	**15,7%**

5.2.7 Concluding assessment

Given the investment in question, the expected volume of transported natural gas amounting to 5 billion cubic metres and the planned 20-year life, the Ionian-Adriatic Gas Pipeline project is acceptable up to the minimum transport tariff of:

- 1,341 €cts/m3 for a gas transportation system with pipeline diameter 30" (Model 2),
- 1,378 €cts/m3 for a gas transportation system with pipeline diameter 28" (Model 1),
- 1,397 €cts/m3 for a gas transportation system with pipeline diameter 32" (Model 3),
- 1,472 €cts/m3 for a gas transportation system with pipeline diameter 34" (Model 4),
- 1,552 €cts/m3 for a gas transportation system with pipeline diameter 36" (Model 5).

These are marginal tariffs for the use of the gas transportation system that meet the set minimum project acceptability criterion, the internal rate of return of 7%.

In the final diameter pipeline selecting process, apart from the economic effects of the project it is necessary to examine the function of the pipeline as part of a transport corridor for gas from Shah Deniz II development in Azerbaijan, and in a later stage as part of the EU Southern Gas Corridor. Southern Gas Corridor is an initiative of the European Commission for the gas supply from Caspian and Middle Eastern regions to Europe. In the first phase of the Shah Deniz II development project it will be possible to supply 10 bcm annually for the European market. But with long-term development of Caspian and Middle Eastern gas reserves and with the development of the Trans Caspian gas Pipeline and other gas transmission systems, Southern Corridor projects could provide the necessary transportation capacity to deliver 60 to 120 billion cubic metres per year of Caspian and Central Asian gas, which the European Commission aims to bring directly to Europe. Nabucco, ITGI (Interconnector Turkey-Greece-Italy) and TAP (Trans-Adriatic Pipeline) could transport that gas through this region to Europe.

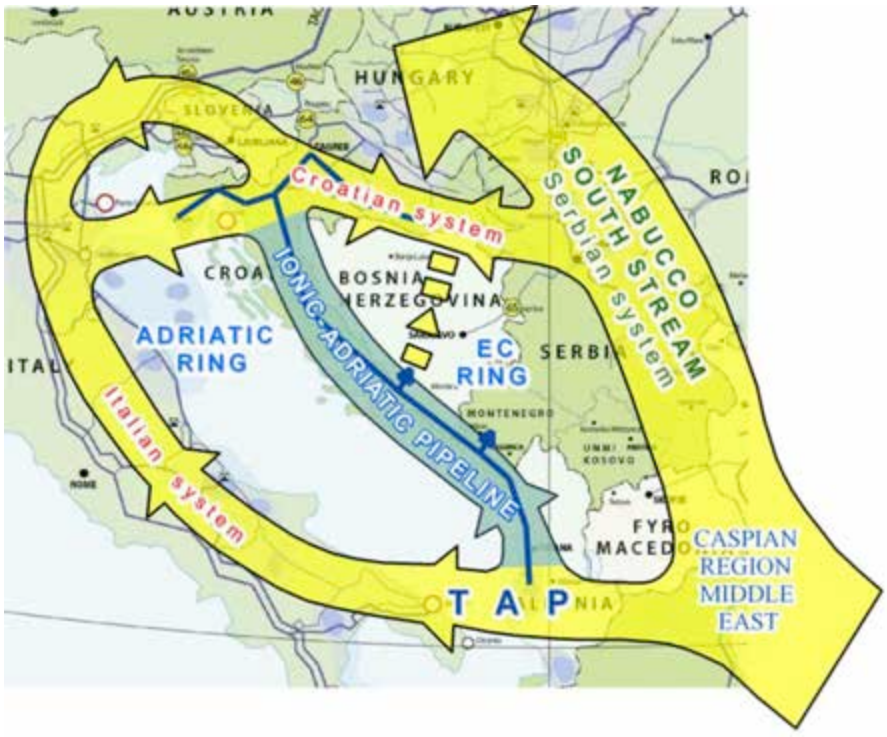


Figure 30: IAP position in future EU Caspian supply routes to Europe

Source: Plinacro, 5th Gas Forum, 14 September 2010, Brdo, Slovenia

IAP's central location between future supply routes to Europe can enable IAP to transit additional gas quantities to the countries in the region and further on to Europe.

Investment for the construction of 32" pipeline is only 6% higher than the solution necessary to develop the economically best option pipeline of 30", but this additional investment will increase the pipeline capacity by about 20 per cent. The larger diameter of 32" and consequently 20% higher pipeline capacity allows for greater flexibility and a greater role of IAP pipeline system in a Southern Gas Corridor.

It is also expected that the total gas consumption in the region will exceed 5 bcm which could be supplied with the 32'' pipeline.

For that reason, we suggest that the transmission system with 32" pipeline diameter (Model 3) is selected as economically and strategically best development option.

6 Selection of IAP variants

The present chapter is in principle unchanged from the first version with exception of specific corrections pointed out by the Stakeholders. The acceptable routes in Albania and Montenegro are presently being subject to detailed analyses that will lead to a more reliable background for arriving at a decision on the optimal IAP route in Albania and Montenegro.

In addition the IAP team has been requested to evaluate a variant in Albania from Lushnje via Elbasan to Tirana.

After completion of these two studies it is the intention to publish the results as an annex to the Preliminary Technical Study Report.

6.1 Methodology

To make decision about optimal variant for IAP system, the pipeline route is divided in sections. The start or the end of each section is either the point of connection of pipeline variants or the state border. Each section is shown on following figures and each section has its unique number. Economic calculations are made for each section and all sections are described below. On following figures are also shown the branch connections toward places and cities that are not part of IAP system. This connection will provide supply of those cities with natural gas.

Figure 31: Sections on IAP gas system

The scoping exercise is conducted by taking into account environmental, social and techno-economic aspects.

By the used methodology within the scoping exercise for every variant in each country passed by the pipeline, the following analysis phases were included:

1. Definition of the criteria for comparison

a. Overview and explanation of each criteria

b. Definition of difficulty factor for each criteria

2. Variants analysis according to defined criteria

The analysis will be conducted with the software program DoctuS – software application for decision-making support.

About DoctuS software

One of the benefits of intelligent systems to support business decisions DoctuS is the ability to process qualitative data due to its ability to process concepts. This is of great importance, since numerous aspects can only be scored based on conceptual scales.

Another important advantage is the possibility to clearly overview the process of decision making. Specialist mathematical knowledge is not needed to understand the reasoning system. The decision-maker can edit their knowledge in several ways. Knowledge acquisition is the process of learning. Through this process concepts are re-defined and studying of their new dependencies or metaphor is done. We can say that there are two groups of implementations of expert systems in business. The first imply that original decisions are made when experience is not enough. Within these business decisions deductive reasoning is used, that is the one of intelligent systems to support business decisions - DoctuS.

Within the analysis, the phase principle is applied, all in order to secure quality of entire process.

At the beginning, the area of interest is detected (all IAP route variants within each related country).

After that the criteria for comparison is defined and according to them all variants have been analysed.

The condition for obtaining the quality of the process is previous definition of comparison criteria and evaluation of the acceptability of pre-defined pipeline route variants.

The result of criteria applying is the decision tree of all considered variants with the demonstration of the most acceptable one.

Three criteria groups have been defined that are going to be sub-divided in more precise criteria within the software program.

A group: Environmental Criteria
B group: Social Criteria
C group: Techno – Economic Criteria

For each criterion the weight factor is defined. It serves to classification of the criteria based on their significance among the others.

Overview of Environmental Criteria

-Hydrogeology/ Water protection zones

Route variants are evaluated according to the probability of water protection zones crossings. The more acceptable route is the one for which the smaller probability has been noticed.

-Water Resources

Route variants are evaluated according to the number of watercourse crossings. The more acceptable route is the one that does not cross watercourses.

Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)

Route variants are evaluated according to their crossings through and vicinity to the protected areas (PA) and Emerald network (EN) sites, respectively. The more acceptable route is the one that crosses fewer and more distant to PA and/or EN sites and has lower impact on biodiversity of the area.

-Land use

Route variants are evaluated according to their impacts to current land use. Within agricultural land uses permanent crops on the area influences by construction works will be permanently changed to other crops and the area with other crops will be temporarily out of production (during construction works). Forest and forest land will be permanently changed. The more acceptable route is the one that does not cross areas of great agriculture or forest value and causes less negative impacts.

-Landscape and Visual Issues

Route variants are evaluated according to their impacts to landscape characteristics. The more acceptable route is the one that does not cross areas of landscape significance, which follows existing infrastructure corridor, follows the relief characteristics, and does not evoke high visual impacts due to land clearing (forests, agriculture land, etc.) for the purpose of pipeline construction and maintenance.

-Cultural Heritage (both physical and intangible as appropriate)

Route variants are evaluated according to crossing cultural areas and their status. The more acceptable route is the one that avoids crossings of the cultural heritage protected areas. In cases where the route crosses these areas, the more acceptable are the crossings in the periphery parts of the areas.

Overview of Social Criteria
Socioeconomic baselines

Route variants are evaluated based on their impacts on settlements, with respect to passing through populated area and also areas of great economic value (tourism, industrial zones, etc.). The more acceptable is the variant that avoid such areas.

Overview of Techno Economic Criteria

- Total cost with expropriation and land use

Route variants are evaluated based on the initial cost for construction. The total cost for construction is calculated based on the length of pipeline route, chosen diameter, type of terrain where the pipeline will be laid down, and also the estimated expropriation costs.

- Technical difficulties of pipeline construction

Description of technical parameters of pipeline, determined and analysed in this stage of project documentation preparation has been described in Preliminary Technical Study Report. As in this stage the total number of ground infrastructure objects has not yet been defined and also not the other infrastructure objects that may result in greater safety aspect of pipeline construction, the main criteria for evaluation is the ground/ terrain condition and the difficulty of its crossing. This also included land access issues, in relation to whether the terrain is accessible or not. The more acceptable is considered the variant that crosses more technically easily crossed terrain and has easier access for construction and further maintenance.

6.2 Economic calculations

The aim of these analyses was to analyse economic effects of each transmission route for each country, taking into account not only maximal expected gas flows, but also expected gas market build up for each country.

At the beginning it is very important to emphasize that the analyses do not take into account any social, environmental or any other technical difficulties that might affect development of any of the proposed routes. These issues and difficulties can in some cases have more impact on project development possibilities than the economics.

The economic analyses have been carried out with the following presumptions:

Investment will be carried out through three years in same yearly amounts.

System would be financed from funds obtained on financial markets through long-term borrowing at financial institutions

The price of borrowed capital has been calculated according to the following assumed terms and conditions:

- repayment period: 15 years,
- regular interest rate: 6% per annum
- repayment in equal semi-annual instalments

The operating and maintenance costs include:

- energy costs
- gas transportation system maintenance costs

The quantity of natural gas transported is a business event resulting in an increased financial and economic potential of the project.

The projected provision of natural gas transportation services is based on the assumed gas market build up from the draft gas market forecast.

Transport tariff is optimized in a way that meets internal rate of return of 7%, the project acceptability criterion.

The planned project period of 20 years is taken as one in which the investment project produces acceptable effects.

The investment and maintenance cost per pipeline sections are presented in the following tables.

Table 16. Route variant – pipeline costs calculation

		Investment costs			Maintenance costs		
		Pipeline length	Specific investment cost pipeline	**Investment costs pipeline**	Annual fraction of investment	Total investment costs	**Annual maintenance costs**
Section		km	€/"m	**Mio €**	-	Mio €	**Mio €/a**
1	Fier - Staravec	38.1	26.84	**32.7**	1.00%	32.7	**0.33**
2	Staravec - Ahmetaq	54.3	31.79	**55.2**	1.00%	55.2	**0.55**
3	Staravec - Ahmetaq	63.2	30.03	**60.7**	1.00%	60.7	**0.61**
4	Ahmetaq - Balldre	45	27.83	**40.1**	1.00%	40.1	**0.40**
5	Balldre - Barlaj	66.5	33.22	**70.7**	1.00%	70.7	**0.71**
6	Balldre - Shtodher	27.6	30.14	**26.6**	1.00%	26.6	**0.27**
7	Barlaj - Nalježići	54.7	36.08	**63.2**	1.00%	63.2	**0.63**
8	Nalježići - Radanovići	2.4	36.63	**2.8**	1.00%	2.8	**0.03**
9	Schodher - Donji Podi	22	35.20	**24.8**	1.00%	24.8	**0.25**
10	Donji Podi - Nalježići	53.6	39.16	**67.2**	1.00%	67.2	**0.67**
11	Donji Podi – Bartula	1	42.90	**1.4**	1.00%	1.4	**0.01**
12	Bartula - Lastva Grbajska	41.6	38.83	**51.7**	1.00%	51.7	**0.52**
13	Lastva Grbajska - Radanovići	7.4	35.64	**8.4**	1.00%	8.4	**0.08**
14	Bartula - Lastva Grbajska	42.3	40.92	**55.4**	1.00%	55.4	**0.55**
15	Radanovići - Vitajina	19.6	36.96	**23.2**	1.00%	23.2	**0.23**
16	Vitajina - Đurinići	8.4	41.14	**11.1**	1.00%	11.1	**0.11**
17	Đurinići - Čibaća	32.4	40.59	**42.1**	1.00%	42.1	**0.42**
18	Čibaća - Podimoć	42.5	38.39	**52.2**	1.00%	52.2	**0.52**
19	Podimoć - Kobiljača	50.2	35.97	**57.8**	1.00%	57.8	**0.58**
20	Podimoć - Osobjava	41.6	39.05	**52.0**	1.00%	52.0	**0.52**
21	Osobjava - Ploče	21.2	44.22	**30.0**	1.00%	30.0	**0.30**
22	Ploče - Kobiljača	0.6	30.80	**0.6**	1.00%	0.6	**0.01**
23	Osobjava - Ploče	22.3	44.00	**31.4**	1.00%	31.4	**0.31**
24	Kobiljača – Otrić seoci	4.8	31.46	**4.8**	1.00%	4.8	**0.05**
25	Otrić seoci - Zagvozd	42.4	35.42	**48.1**	1.00%	48.1	**0.48**
26	Zagvozd - Dugopolje	53	35.86	**60.8**	1.00%	60.8	**0.61**
27	Podimoć - Mostar - Posušje - Imotski - Zagvozd	134.4	38.39	**165.1**	1.00%	165.1	**1.65**

Table 17. Route variant – compressor station costs calculation

2	**COMPRESSOR STATION - INVESTMENT, OPERATIONAL AND MAINTENANCE COSTS**				
	Compressor station		**CS1**	**CS2**	**CS3**
2.1	**Investment costs**				
	Compression power	kW		1425	
	Instaled ISO power	MW		2.6	
	Basis-Investment	Mio €		32	
	Specific performance related cost	€/kW		1500	
	Performance Related Costs	Mio €		3.9	
	Investment costs compressor station	**Mio €**		**35.9**	
2.2	**Energy costs**				
	Specific Energy Costs	€/MWhtherm		30	
	Shaft Power	MW		1.5	
	Annual energy costs	**Mio €/a**		**0.5**	
2.3	**Maintenance costs**				
	Annual fraction of investment	-		2.8%	
	Investment costs	Mio €		35.9	
	Annual maintenance costs	**Mio €/a**		**1.0**	

6.2.1 Transport tariff tendency projection

Shown in continuation is the transport tariff tendency projection for the planned period over which the investment project produces economically acceptable effects.

Table 18 Transport tariff tendency projection Albania

ALB					
Period of the project life	**Year**	**20**			
Acceptability criteria of the project					
Internal rate of return (IRR)	**%**	**7,00%**			
Variant		**Var. A-AL**	**Var. D-AL**	**Var. C-AL**	**Var. B-AL**
Expected volume of transported natural gas, average	**mio m3**	**3 508**	**3 502**	**3 502**	**3 508**
Changes in the volume of transported natural gas	**%**	**0,0%**	**-0,2%**	**-0,2%**	**0,0%**
Investment	**mio €**	**198,7**	**160,2**	**154,7**	**204,2**
Changes in the level of investment	**%**	**0,0%**	**-19,4%**	**-22,1%**	**2,8%**
Operation and maintenance costs	**mio €**	**2,0**	**1,6**	**1,5**	**2,0**
Changes in the level operation and maintenance costs	**%**	**0,0%**	**-20,0%**	**-25,0%**	**0,0%**
Transport tariff	**€cts/m3**	**0,760**	**0,614**	**0,592**	**0,779**
Changes in the level of transports tariffs	**%**	**0,0%**	**-19,2%**	**-22,1%**	**2,5%**

When only investment costs and expected gas demand are taken into consideration the results presented are as expected: development of shorter coastal routes results with 20 percent lower transport tariff compared to the northern connection route to Montenegro.
When comparing the coastal and inland near Tirana pipeline route development options then the criterion is that the pipeline should pass near the centre of the

future consumption. In this case Tirana is a centre of the consumption and this pipeline branch is cheaper than the coastal route. Future branch pipeline diameter toward Duress should be of smaller diameter compared to a branch from the coastal route toward Tirana, resulting in the end with the lower investment costs.
When comparing the Montenegro connection pipeline route options just from the investment point of view the coastal route is much cheaper than one on the north of the Skadar Lake. But in this case the development options on the Montenegro side of the border should be taken into account too. Difference in investment costs between the coastal pipeline route and the northern pipeline route toward Montenegro is 44 mil EUR.

Table 19 Transport tariff tendency projection Montenegro

MNE					
Period of the project life	Year	20			
Acceptability criteria of the project					
Internal rate of return (IRR)	%	7,00%			
Variant		Var. A-MN	Var. B-MN	Var. C-MN	Var. D-MN
Expected volume of transported natural gas, average	mio m3	1 781	1 775	1 775	1 775
Changes in the volume of transported natural gas	%	0,0%	-0,3%	-0,3%	-0,3%
Investment	mio €	89,1	119,3	109,5	111,8
Changes in the level of investment	%	0,0%	33,9%	22,9%	25,5%
Operation and maintenance costs	mio €	0,9	1,2	1,1	1,1
Changes in the level operation and maintenance costs	%	0,0%	33,3%	22,2%	22,2%
Transport tariff	€cts/m3	0,655	0,883	0,810	0,826
Changes in the level of transports tariffs	%	0,0%	34,8%	23,7%	26,1%

If we are going to follow the lower investment near the centre of the consumption pipeline route selection criterion it is obvious that the pipeline route A near Podgorica is an optimal solution if only Montenegro pipeline development options should be considered. The optimized transport tariff reflects that and it is about 30 per cent lower than the coastal route variants transmission tariff. The pipeline variant A is about 20 million EUR cheaper than the cheapest coastal pipeline route option.
These results are in direct collision with the Albania tariff optimization results. The difference between coastal and Northern route in Albania was 44 million EUR and when compared to the difference between Montenegro coastal and northern pipeline route amounted 20 mil. EUR it seems that the coastal route has potential for saving 24 mil. EUR.
Nevertheless, if we decide on the coastal route through Montenegro, then connection pipeline branch toward Podgorica and Nikšić should be developed. Their development cost is estimated at 36 mil. EUR. If this branch pipeline cost is taken into the equation, then the northern pipeline route will result with total savings of 12 mil. EUR.
The reason for such a big difference in the pipeline cost between northern and coastal route is a very difficult terrain near the coast. To decrease the coastal investment costs, Montenegrin coastal cities connection pipelines should be developed with the lower pressure pipelines which can be installed in the existing roads. Since the future consumption of the coastal cities is much lower than those from Podgorica area, lower pipeline pressure supply option should be a feasible option.

Table 20 Transport tariff tendency projection Croatia

CRO					
Period of the project life	Year	20			
Acceptability criteria of the project					
Internal rate of return (IRR)	%	7,00%			
Variant		Var. C	Var. B-HR	Var. A-HR	Var. A-BH
Expected volume of transported natural gas, average	mio m3	1 458	1 458	1 458	1 458
Changes in the volume of transported natural gas	%	0,0%	0,0%	0,0%	0,0%
Investment	mio €	312,7	337,5	338,9	367,2
Changes in the level of investment	%	0,0%	7,9%	8,4%	17,4%
Operation and maintenance costs	mio €	4,3	4,5	4,5	4,8
Changes in the level operation and maintenance costs	%	0,0%	4,7%	4,7%	11,6%
Transport tariff	€cts/m3	2,816	3,030	3,041	3,287
Changes in the level of transports tariffs	%	0,0%	7,6%	8,0%	16,7%

When only investment costs and expected gas demand are taken into the consideration the results presented are as expected: development of shorter Variant C have 7 to 8 percent lower transport tariff compared to the variant A and B which are going all the way through the Croatian territory.
But we should have in mind that the pipeline route C is crossing the very difficult Neretva delta marsh and muddy terrain where the development of the pipeline would be almost impossible. Flooding and movement of the Neretva delta terrain can cause big structural damage to the pipeline.
From that reason only supply routes Variant A and Varian B should be taken into consideration. Variant B is a little bit cheaper than Variant A which results in the lower transmission tariff for Variant B.
It should also be taken into account that Location permit for the gas pipeline Split Ploče is already issued, and that decision on acceptance on the EIA for complete Variant A pipeline route is issued also.
Variant A-BH that starts from Dubrovačko primorje in Croatia reaches city of Mostar, then runs toward Posušje and continuing toward Zagvozd in Croatia is most expensive of all investigated pipeline routes. If we take into account that all procedures starting from the physical planning toward location permit (which is almost finished for the Croatian routes) it is obvious that this route is in many aspects in the inferior position when compared with the routes in Croatia.

6.2.2 Concluding remarks

When only investment for main transmission route costs and expected gas demand are taken into consideration then the coastal route through Albania, coastal route through Montenegro and Variant C in Croatia seems as the most favourable pipeline route selection.
But if we take into consideration the additional cost for the main consumption sectors branch connection costs and main technical differences in the pipeline development processes then the supply route Fier-Tirana-Podgorica- Pelješac peninsula-Ploče route seems to be the most favourable.
Taking all that into account the authors of the study recommends Fier-Tirana-Podgorica- Pelješac peninsula-Ploče route as most favourable route.

Nevertheless, this recommendation should be tested with social and environmental requirements that will be tested together with the technical aspects in the Doctus evaluation software which follows in next chapter.

6.3 Test of proposed options

Albania

Defined criteria for IAP route variants in Albania are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant selection	less acceptable	acceptable	most acceptable
Environmental criteria	negative impact	moderate impact	slight impact
Social criteria	great negative impact	negative impact	moderate impact
Techno - economic criteria	negative	acceptable	positive
Impacts on waters	negative	moderate	none
Impacts on surface waters	negative	moderate	none
Watercourses crossing (larger rivers)	7 and more crossings	1 to 7 crossings	does not cross
Impact on groundwaters	negative	moderate	none
Water protection zones crossing	existing probability	moderate probability	small probability
Land use impact	negative	moderate	slight
Impact on nature and cultural heritage	great negative/ negative	moderate	none
Impact on nature heritage	great negative/ negative	moderate	none
Impact on nature protected areas and Emerald network	negative (more then 5 EN/PA/nature protected sites influenced)	moderate (1 to 5 EN/PA/nature protected sit	slight (1 or none EN/PA/nature protected
Impact on biodiversity	negative	moderate	slight
Impact on cultural heritage	great negative/ negative	moderate	slight
Impact on landscape values	negative	moderate	none
Pipeline corridor crosses populated areas	great negative	negative	moderate
Pipeline corridor crosses areas of economic/ turistic activities valu	negative	moderate	slight
Total construction cost	up to 40% from the most cheapest	up to 30% from the most cheapest	up to 15% from the most cheapest
Technical difficulties of pipeline construction	very difficult	moderate	slight
Impact on forestry and forests	negative	moderate	slight
Economic value of the forests	great	small	none
Impact on forest land	negative	moderate	slight
Forest land crossing	50ha and more	10 - 50ha	less then 10ha
Impact on agriculture and agriculture land	negative	moderate	slight
Impact on agriculture land	negative	moderate	slight
Agriculture land crossing	more then 100ha	50-100ha	less then 50ha
Impact on agriculture	negative	moderate	slight

Figure 32: Defined criteria for IAP route variants in Albania

Considered Variants description based on Environmental Criteria

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Hydrogeology/ Water protection zones	4	The pipeline route overlies **5 (five aquifers),** as follows: · 3 (three) Quaternary gravel aquifers of national importance: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); 3-Mati aquifer (sect.4), and · 2 (two) Quaternary gravel aquifers of regional importance: 4-Nenshkodra aquifer (sect.6); 5-Mbishkodra aquifer (sect.6). There is possibility that route passes through water protection zone. **(Existing probability)**	The pipeline route overlies **6 (six aquifers),** as follows: · 3 (three) Quaternary gravel aquifers of national importance: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); 3-Mati aquifer (sect.4), and · 3 (three) Quaternary gravel aquifers of regional importance: 4-Erzeni aquifer (sect.2). 5-Nenshkodra aquifer (sect.6); 6-Mbishkodra aquifer (sect.6). There is possibility that route passes through water protection zone. **(Existing probability)**	The pipeline route overlies **3 (three aquifers)** of national importance as follows: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); and 3-Mati aquifer (sect.4). There is possibility that route passes through water protection zone. **(Existing probability)**	The pipeline route overlies **4 (four aquifers),** as follows: · 3 (three) Quaternary gravel aquifers of national importance: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); 3-Mati aquifer (sect.4), and · 1 (one) Quaternary gravel aquifer of regional importance: 4-Erzeni aquifer (sect.2). There is possibility that route passes through water protection zone. **(Existing probability)**
Water Resources	3	The pipeline route **traverses 9 (nine) important rivers**	The pipeline route **traverses 9 (nine) important rivers**	The pipeline route traverses **6 (six) important rivers**,	The pipeline route traverses **6 (six)**

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		(13 crossings), as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; 4-Ishmi; 5-Mati; 6,7,8,9,10-Drini Lezhes (five times); 11-Drini; 12-Kiri; and 13-Vraka Route considered as **less acceptable**	**(13 crossings)**, as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; 4-Ishmi; 5-Mati; 6,7,8,9,10-Drini Lezhes (five times); 11-Drini; 12-Kiri; and 13-Vraka Route considered as **less acceptable**	as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; 4-Ishmi; 5-Mati; and 6-Drini Lezhes. Route considered as **acceptable**	**important rivers**, as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; 4-Ishmi; 5-Mati; and 6-Drini Lezhes. Route considered as **acceptable**
Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)	4	-Runs in vicinity of **3 (three)** PAs: 1-Skadar lake (Ramsar site); 2-Riparian area of Skadar lake (MNR); 3-Wetland/Terrestrial PL of Buna River; Route considered as **(Moderate impact)**	-Runs in vicinity of **3 (three)** PAs: 1-Skadar lake (Ramsar site); 2-Riparian area of Skadar lake (MNR); 3-Wetland/Terrestrial PL of Buna River; **(Moderate impact)**	-Traverses **1 (one)** PA. The pipeline route crosses a narrow strip of the riparian forest within the Wetland/Terrestrial PL of Buna River. **(Slight to Moderate impact)**	-Traverses **1 (one)** PA. The pipeline route crosses a narrow strip of the riparian forest within the Wetland/Terrestrial PL of Buna River. **(Slight to Moderate impact)**
Landscape and Visual Issues	3	**Medium to high adverse impact**, because: Length 204 km.	**Medium to high adverse impact,** because: Length 213 km.	**Moderate adverse impact**, because: Length 165 km.	**Moderate adverse impact,** because: Length 172 km.

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		-167km runs on lowland, used mainly as agricultural land and cultivated with crops; -35km runs through hilly area, from which: 26 km over flysch formations and 9km over limestones. The hilly area is covered from degraded forests and shrubs; -2 km total width of riverbeds (mainly riparian forest). Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; -Traverses 13 riverbeds, consequently, it is expected negative visual impact on the riparian forests along the	-190km runs on lowland, used mainly as agricultural land and cultivated with crops; - 21 km route runs through hilly area, from which: 12 km over flysch formations and 9km over limestones. The hilly area is covered from degraded forests and shrubs; -2 km total width of riverbeds (mainly riparian forest). Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; -Traverses 13 riverbeds, consequently, it is expected negative visual impact on the	-137km runs on lowland, used mainly as agricultural land and cultivated with crops; -27km route through hilly area, from which: 24 km over flysch formations and 3km over limestones. The hilly area is covered from degraded forests and shrubs; -1km total width of riverbeds (mainly riparian forest). Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; -Traverses 6 riverbeds, consequently, it is expected negative visual impact on	-159 km runs on lowland, used mainly as agricultural land and cultivated with crops; -12 km route through hilly area, from which: 9 km over flysch formations and 3km over limestones. The hilly area is covered from degraded forests and shrubs; -1km total width of the riverbeds (mainly riparian forest). Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; -Traverses 6 riverbeds,

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		riverbeds. **(Negative)**	riparian forests along the riverbeds. **(Negative)**	the riparian forests along the riverbeds. **(Negative)**	consequently, it is expected negative visual impact on the riparian forests along the riverbeds. **(Negative)**
Land use	4	-Crosses 35 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; - Passes through 167 ha of flat agricultural land and has a negative impact on agriculture and agricultural land.	-Crosses 21 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; - Passes through 190 ha of flat agricultural land and has a negative impact on agriculture and agricultural land.	-Crosses 27 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; - Passes through 137 ha of flat agricultural land and has a negative impact on agriculture and agricultural land.	-Crosses 12 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; - Passes through 159 ha of flat agricultural land and has a negative impact on agriculture and agricultural land.
Cultural Heritage		Variant A runs throughout the territories of **2 (two) Districts** (Shkodra, and Lezha), which are very rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian-Roman-	Variant B runs throughout the territory of **3 (three) Districts** (Durresi, Lezha, and Shkodra), which are very rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian-Hellenic-	Variant C: 1-Runs through the territory of **1 (one) District** (Lezha) which is very rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian- Roman-	Variant D: 1-Runs through the territory of **2 (two) Districts** (Durresi and Lezha), which are very rich in discovered and non-discovered cultural heritage dated from the

Environmental Criteria	Weight factor 1 – 5	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		Byzantine-Medieval ages. Likely very high adverse impact on the elements of cultural heritage. **(Negative)**	Roman-Byzantine-Medieval ages. Likely very high adverse impact on the elements of cultural heritage. **(Great Negative)**	Byzantine-Medieval ages; and 2-Runs throughout the Balldren field, which has been flood prone, and consequently there is no high probability of finding non-discovered cultural heritage. Likely high adverse impact on the elements of cultural heritage. (**Moderate)**	Early Bronze to Illyrian-Hellenic-Roman-Byzantine-Medieval ages; and 2-Runs throughout the Balldren field, which has been flood prone, and consequently there is no high probability of finding non-discovered cultural heritage. Likely very high adverse impact on the elements of cultural heritage. **(Negative)**

Considered Variants description based on Social Criteria

Social Criteria	Weight factor 1 – 5	Variant A	Variant B	Variant C	Variant D
Pipeline corridor crosses populated areas	4	Pipeline route runs near and throughout the settlements of many villages within Shkodra district, as well as through Lezha town.	Pipeline route runs near and throughout the settlements of many villages within n Shkodra district, as well as through Lezha town, and	Pipeline route runs throughout settlements within Lezha town. **(Moderate)**	Pipeline route runs through Lezha town, and throughout an urbanised zone within the seaside tourist area

Social Criteria	Weight factor 1 – 5	Variant A	Variant B	Variant C	Variant D
		(Negative)	throughout an urbanised zone within the seaside tourist area (South of Durres). **(Great Negative)**		(South of Durres). **(Great Negative)**
Pipeline corridor crosses areas of economic activities values	3	Pipeline route runs through zones of economic activities such as Shkodra town (industry-regional importance), and the whole flat area of the Shkodra and Malesia Madhe Districts (animal farms for meat production –national importance). **(Negative impact)**	Pipeline route runs through zones of economic activities such as Shkodra town (industry-regional importance), and the whole flat area of the Shkodra and Malesia Madhe Districts (animal farms for meat production –national importance); as well as through Durresi zones of economic activities (transport and tourism), **(Negative impact)**	Pipeline route runs through rural areas. **(Slight impact)**	Pipeline route runs through rural areas, as well as close to Durresi zones of economic activities (transport and tourism South of Durresi). **(Moderate impact)**

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Cost of construction	*4*	198,7 M Euro	204,2 M Euro	154,7 M Euro	160,2 M Euro
Technical solution of pipeline construction	*2*	Variant A passes through mountainous area of Albania, near settlements that presents **moderate** technical difficulties.	Variant B passes through mountainous area of Albania, near settlements that presents **moderate** technical difficulties.	Variant C passes through **slight** technical difficult area.	Variant D passes through hilly part of Albania, near settlements that presents **moderate** technical difficulties.

Results gained by DoctuS software are shown on following figure.

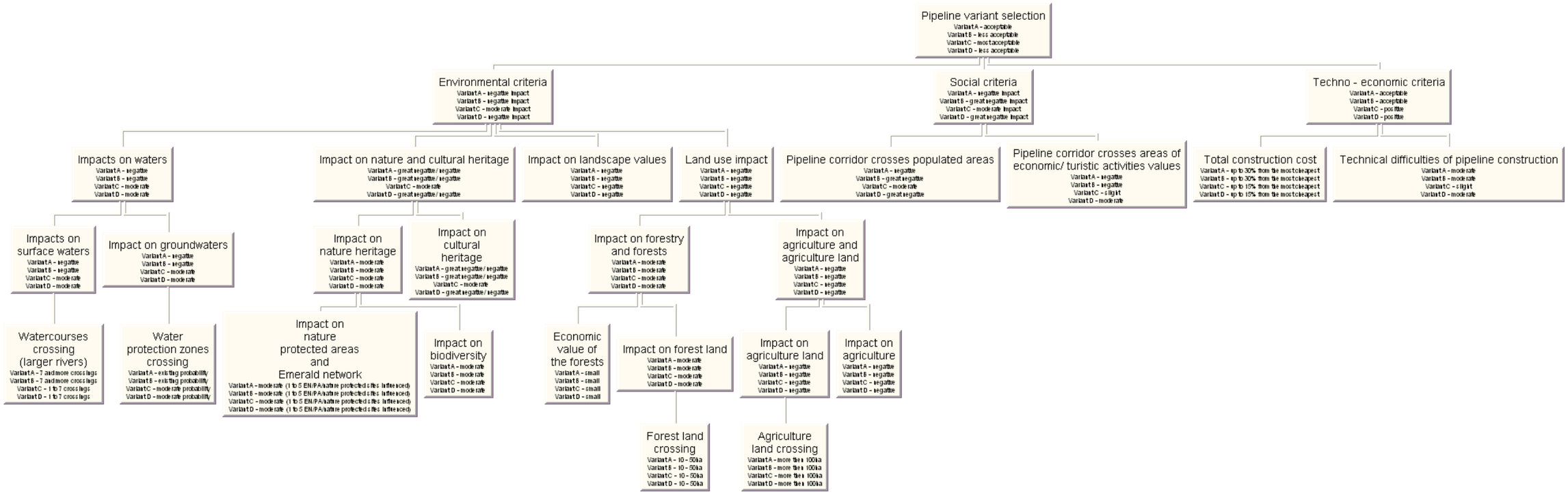


Figure 33: IAP route variants selection for Montenegro

As most acceptable Variant C has been selected, followed by Variant A. Variant B and Variant D are considered less acceptable, mostly due to crossing highly populated area of town of Durres.

Montenegro

Defined criteria for IAP route variants in Montenegro are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant selection	less acceptable	acceptable	most acceptable
Environmental criteria	negative impact	moderate impact	slight impact
Social criteria	negative impact	moderate impact	positive impact
Techno - economic criteria	negative	acceptable	positive
Impacts on waters	negative	moderate	none
Impacts on surface waters	negative	moderate	none
Watercourses crossing (larger rivers)	5 and more crossings	1 to 5 crossings	does not cross
Impact on groundwaters	negative	moderate	none
Water protection zones crossing	existing probability	smaller probability	
Land use impact	negative	moderate	slight
Impact on forestry and forests	negative	moderate	slight
Economic value of the forests	great	small	none
Impact on forest land	negative	moderate	slight
Forest land crossing	50ha and more	10 - 50ha	less then 10ha
Impact on agriculture and agriculture land	negative	moderate	slight
Impact on agriculture land	negative	moderate	slight
Agriculture land crossing	more then 20ha	2-20ha	less then 2ha
Impact on agriculture	negative	moderate	slight
Impact on nature and cultural heritage	great negative/ negative	moderate	none
Impact on nature heritage	great negative/ negative	moderate	none
Impact on nature protected areas and Emerald network	negative (more then 5 EN/PA/nature protected sites influenced)	moderate (1 to 5 EN/PA/nature protected sit	slight (1 or none EN/PA/nature protected
Impact on biodiversity	negative	moderate	slight
Impact on cultural heritage	great negative	moderate	slight
Impact on landscape values	negative	moderate	none
Pipeline corridor crosses populated areas	negative	moderate	slight
Pipeline corridor crosses areas of economic/ turistic activitie	negative	moderate	slight
Total construction cost	up to 40% from the most cheapest	up to 30% from the most cheapest	up to 15% from the most cheapest
Technical difficulties of pipeline construction	very difficult	moderate	slight

Figure 34: Defined criteria for IAP route variants in Montenegro

Considered Variants description based on Environmental Criteria

Environmental Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Hydrogeology / Water protection zones	*4*	- Route probably passes through water protection zone of the water source Topliš - there is possibility that route passes through water protection zone of water source of the river Crnojevica (**existing probability**)	- in the area between Budva-Bar passes near a number of water sources, so there is a significant possibility that the route passes through water protection zones (**existing probability**)	- in the area between Budva-Bar passes near a number of water sources, so there is a significant possibility that the route passes through water protection zones (**existing probability**)	- As the route passes mainly through the sea there is a small possibility of its cross through water protection zones (**small probability**)
Water Resources	*3*	- crosses Morača and Cijevna River The route is considered **acceptable**.	- crosses Bojana River The route is considered **acceptable**.	- crosses Bojana River The route is considered **acceptable**.	- crosses Bojana River The route is considered **acceptable**.
Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)	*4*	Variant A: - Passes through an EN site - Passes in vicinity of four PA (three EN sites) The route is considered **acceptable**.	Variant B: - Passes through two EN sites - Passes in vicinity of two EN sites (one PA) - pass through Rumija (center of biodiversity) The route is considered **less acceptable**	Variant C: - Passes in vicinity of four Emerald sites (two PA) The route is considered **acceptable**.	Variant D: - Passes through Protected area in vicinity of four EN sites (two PA) - Passes through sea habitats The route is considered **acceptable**.
Land use	*4*	Variant A crosses through 35 ha of forest land, and have moderate impact. The economic value of forest in the variant A route area is small. Variant A passes through	Variant B crosses through 39 ha of forest land, and have negative impact on forest land. The economic value of forest in the variant B route area is small. Variant B passes through 10ha	Variant C crosses through 44 ha of forest land, and have negative impact on forest land. The economic value of forest in the variant C route area is small. Variant B passes through 12ha of agriculture land and thus have	Variant D crosses through 20 ha of forest land, and have slight impact on forest land. There is no economic value of forest in the variant D route area. Variant D passes through 12ha of agriculture land and thus have

Environmental Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
		20ha of agriculture land and thus have moderate impact on agriculture and agriculture land.	of agriculture land and thus has slight impact on agriculture and agriculture land.	moderate impact on agriculture and slight impact on agriculture land.	slight impact on agriculture and agriculture land.
Landscape and Visual Issues	*3*	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)	Negative impact on the landscape is mostly visualized during construction phase. There is a high probability of damaging dry walls and terraced fields, during Variant B construction. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**negative**)	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)
Cultural Heritage	*4*	In the wider area of the gas pipeline direction are perceptible elements of cultural heritage of great value. Especially archaeological sites and historic buildings mostly around the city of Podgorica. Due to the distance from the route there is no possibility of direct influence. (**moderate**)	There is a strong possibility of an impact on the elements of cultural heritage. This is especially possible in the Old Bar where expectly these elements are numerous discovered and undiscovered archaeological sites. (**great negative**)	Due to large number of valuable cultural heritage elements in the vicinity of the route C there is possible strong impact on cultural heritage. (**great negative**)	None of the cultural heritage areas has been observed in the wider area of route D. But there is a possibility of hydroarchaelogical findings. (**moderate**)

Considered Variants description based on Social Criteria

Social Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Pipeline corridor crosses populated areas	*4*	Variant A is passing near settlements, but avoiding constructed areas. (**moderate**)	Variant B is passing through settlements (**negative**)	Variant C is passing through settlements, (**negative**).	Variant D is passing near settlements, but avoiding constructed areas. (**moderate**)
Pipeline corridor crosses areas of economic activities values	*3*	Variant A passes near zones of economic activities near town of Podgorica but it does not endanger them (**moderate**)	Variant B passes through zones of touristic activities near towns of Budva and Bar, (**negative**)	Variant C passes through zones of touristic activities near towns of Budva and Bar, (**negative**)	Variant D does not pass near zones of economic or touristic activities (**slight**)

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*	*Variant D*
Cost of construction	*4*	89,1 M Euro	119,3 M Euro	109,5 M Euro	111,8 M Euro
Technical solution of pipeline construction	*2*	Variant A passes through mountainous area of Montenegro that presents **moderate** technical difficulties. As it passes near settlements and detected soil excavation types are not technically demanding it is considered that technical solution of this variant construction is **moderate**.	Variant B passes through high mountain area of Montenegro that presents **very difficult** technical solution. Although it passes near settlements and detected soil excavation types are not technically demanding it is considered that technical solution of this variant construction is **very difficult**.	Variant C passes through mountanious area. As it passes through settlements it is considered that technical solution of this variant construction is **very difficult**.	Variant D has longest off-shore section that presents **moderate** technical difficult. It does not pass across very demanding terrain regarding altitude differences and soil excavation types.

Results gained by DoctuS software are shown on following figure.

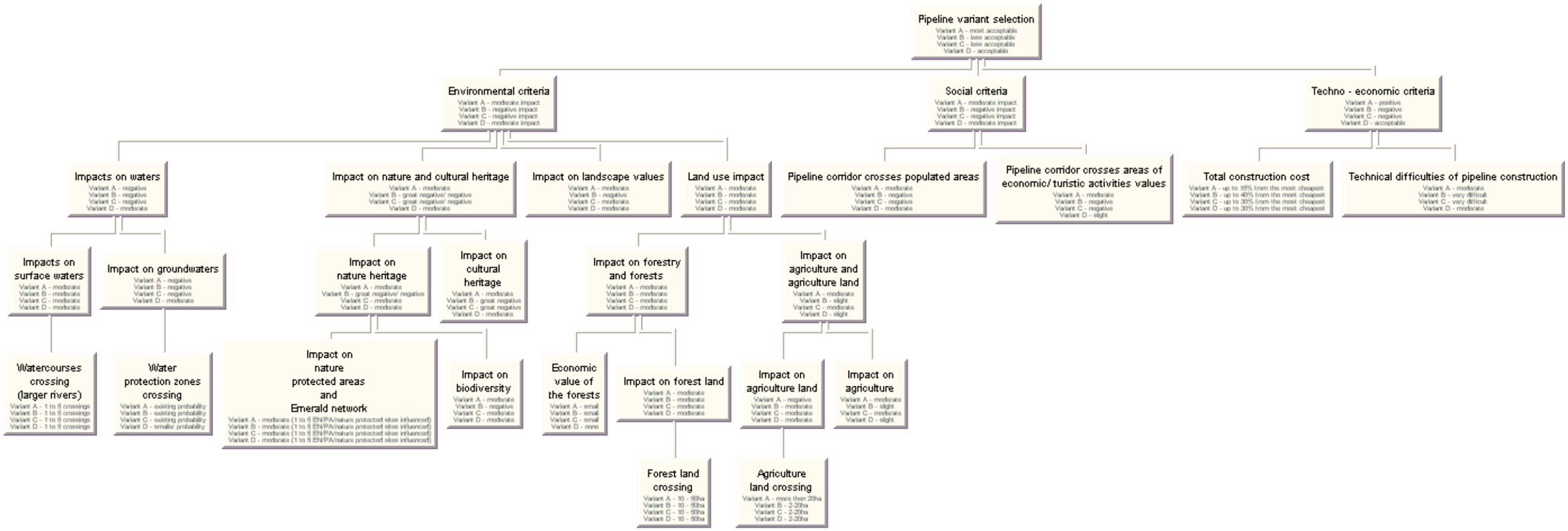


Figure 35: IAP route variants selection for Montenegro

As most acceptable Variant A has been selected, followed by Variant D. Variant B and Variant C are considered less acceptable.

Montenegro and Albania

As the analysis have shown that two potential IAP routes through Montenegro and Albania, that continues on each other, are considered acceptable, evaluation of these two routes have been done.
Considered routes are:

- Variant A (Montenegro) and Variant A (Albania)
- Variant D (Montenegro) and Variant C (Albania)

Also, all possible branch connections to major gas consumers (towns of Nikšić, Podgorica, etc) have been included in techno-economic criteria evaluation.

Defined criteria for IAP route variants in Montenegro and Albania are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant selection	less acceptable	acceptable	most acceptable
Environmental criteria	negative impact	moderate impact	slight impact
Social criteria	negative impact	moderate impact	positive impact
Techno - economic criteria	negative	acceptable	positive
Impacts on waters	negative	moderate	none
Impacts on surface waters	negative	moderate	none
Watercourses crossing (larger rivers)	9 and more crossings	1 to 9 crossings	does not cross
Impact on groundwaters	negative	moderate	none
Water protection zones crossing	existing probability	small probability	
Land use impact	negative	moderate	slight
Impact on nature and cultural heritage	great negative/ negative	moderate	none
Impact on nature heritage	great negative/ negative	moderate	none
Impact on nature protected areas and Emerald network	negative (more then 10 EN/PA/nature protected sites influenced)	moderate (5 to 10 EN/PA/nature protected s	slight (5 to 1 EN/PA/nature protected site
Impact on biodiversity	negative	moderate	slight
Impact on cultural heritage	great negative	moderate	slight
Impact on landscape values	negative	moderate	none
Pipeline corridor crosses populated areas	negative	moderate	slight
Pipeline corridor crosses areas of economic/ turistic activities valu	negative	moderate	slight
Total construction cost	up to 20% from the most cheapest	up to 10% from the most cheapest	the most cheapest togheter with branch c
Technical difficulties of pipeline construction	very difficult	moderate	slight

Figure 36: Defined criteria for IAP route variants in Montenegro and Albania

Considered Variants description based on Environmental Criteria

Environmental Criteria	*Weight factor 1 – 5*	*Variant A (Montenegro) + Variant A (Albania)*	*Variant D (Montenegro) +Variant C (Albania)*
Hydrogeology/ Water protection zones	*4*	- Route probably passes through water protection zone of the water source Topliš - there is possibility that route passes through water protection zone of water source of the river Crnojevica - pipeline route overlies 5 (two) Quaternary gravel aquifers: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); 3-Mati aquifer (sect.4) 4-Mbishkodra aquifer (sect.6); 5-Nenshkodra aquifer (sect.6). (**existing probability**)	- As the route passes mainly through the sea there is a small possibility of its cross through water protection zones - The pipeline route in Albania overlies **3 (three aquifers)** of national importance as follows: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); and 3-Mati aquifer (sect.4). (**existing probability**)
Water Resources	*3*	- crosses Morača and Cijevna River in Montenegro - The pipeline route traverses 9 (six) important rivers in Albania: Kiri; Vraka; Drini River; Drini Lezhes river (five times); Mati; Ishmi; Shkumbini; Semani and Erzeni The route is considered **less acceptable**.	- crosses Bojana River The pipeline route traverses 6 (one) important rivers in Albania:: Erzeni, Drini Lezhes; Mati; Ishmi; Shkumbini; Semani The route is considered **acceptable**.
Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)	*4*	Variant A: - Passes through an EN site in Montenegro - Passes in vicinity of four PA (three EN sites) in Montenegro - Runs in vicinity of 3 (two) PAs in Albania The route is considered **to have moderate impact**.	Variant D: - Passes through Protected area in vicinity of four EN sites (two PA) in Montenegro - Passes through sea habitats in Montenegro - Traverses 1 PAs site in Albania The route is considered t**o have moderate impact**.. The off shore section goes through the sea habitats area with potential high biodiversity value.
Land use	*4*	The route has moderate impact on agriculture and	The route has moderate impact on agriculture and

Environmental Criteria	*Weight factor 1 – 5*	*Variant A (Montenegro) + Variant A (Albania)*	*Variant D (Montenegro) +Variant C (Albania)*
		agriculture land and as well to forest land values.	agriculture land and as well to forest land values.
Landscape and Visual Issues	*3*	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)	Negative impact on the landscape is mostly visualized during construction phase. During operation phase visual impact manifests only with ground pipeline infrastructure facilities. (**moderate**)
Cultural Heritage	*4*	In the wider area of the gas pipeline direction are perceptible elements of cultural heritage of great value. Especially archeological sites and historic buildings mostly around the city of Podgorica, Shkodra, and Lezha Districts. Attention needs to be paid during the tuning of the route. (**moderate**)	None of the cultural heritage areas has been observed in the wider area of route D in Montenegro. But there is a possibility of hydroarchealogical findings. Also, in the wider area of the gas pipeline direction are perceptible elements of cultural heritage of great value. Especially archeological sites and historic buildings mostly around Lezha Districts. Attention needs to be paid during the tuning of the route. (**moderate**)

Considered Variants description based on Social Criteria

Social Criteria	*Weight factor 1 – 5*	*Variant A (Montenegro) + Variant A (Albania)*	*Variant D (Montenegro) +Variant C (Albania)*
Pipeline corridor crosses populated areas	*4*	Variant A is passing near settlements, but avoiding constructed areas (Montenegro). Pipeline route runs near and throughout the settlements of many villages within Shkodra and Lezha districts – this can be avoided in future project preparation phases – route tuning (Albania). (**moderate**)	Variant D is passing near settlements, but avoiding constructed areas (Montenegro). Pipeline route runs near and throughout the settlements of many villages within Lezha district – this can be avoided in future project preparation phases – route tuning (Albania). (**moderate**)
Pipeline corridor crosses areas of economic activities values	*3*	Variant A passes near zones of economic activities near town of Podgorica but it does not endanger them (Montenegro)	Variant D does not pass near zones of economic or touristic activities (Montenegro) Pipeline route runs through rural areas (Albania).

		Pipeline route runs through zones of economic activities near Shkodra and the whole flat area of the Shkodra and Malesia Madhe Districts – this can be avoided in future project preparation phases – route tuning (Albania). **(moderate**)	(**slight impact**)

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	*Weight factor 1 – 5*	*Variant A (Montenegro) + Variant A (Albania)*	*Variant D (Montenegro) +Variant C (Albania)*
Cost of construction	*4*	The difference between coastal and Northern route in Albania was 44 million EUR and when compared to the difference between Montenegro coastal and northern pipeline route amounted 20 mil. EUR it seems that the coastal route has potential for saving 24 mil. EUR. (Variant D in Montenegro and Variant C in Albania) Nevertheless, if we decide on the coastal route through Montenegro, then connection pipeline branch toward Podgorica and Nikšić should be developed. Their development cost is estimated at 36 mil. EUR. If this branch pipeline cost is taken into the equation, then the **northern pipeline route** (Variant A in Montenegro and Variant A in Albania) will result with total savings of 12 mil. EUR.	
Technical solution of pipeline construction	*2*	Variant A passes through mountainous area of Montenegro that presents **moderate** technical difficult. As it pass near settlements and detected soil excavation types are not technically demanding it is considered that technical solution of this variant construction is moderate. The proposed pipeline route runs mainly in flat terrain, except: a-the hilly area South-West of Tirana District, where flysch geological formations outcrop in surface; and b-some small areas within the Malesia Madhe, Shkodra, and Lezha Districts, where outcrop in surface hard rocks limestone formations), and near and throughout many dwelling areas (within Malesia Madhe, Shkodra, and Lezha Districts) that presents **moderate technical difficulties**.	Variant D has longest off-shore section that presents **moderate** technical difficult. It does not pass across very demanding terrain regarding altitude differences and soil excavation types. The proposed pipeline route runs mainly in flat terrain (except the hilly area South-West of Tirana District, where soft rocks composed by flysch geological formations outcrop in surface) and do not affects adversely the settlements that presents **low technical difficulties**.

Results gained by DoctuS software are shown on following figure.

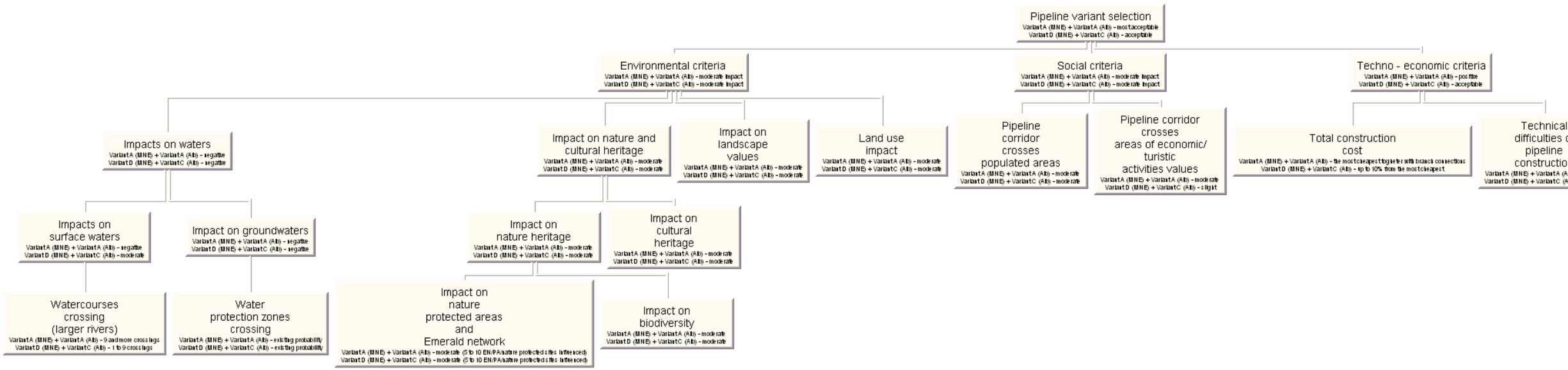


Figure 37: Defined criteria for IAP route variants in Montenegro and Albania

As most acceptable Variant A in Montenegro continuing to Variant A in Albania has been selected.

Croatia and Bosnia and Herzegovina

For Croatian part of the IAP route the EIA procedures have been finished, for separate sections of pipeline route:

- section Split – Ploče
- section Ploče – Dubrovnik – with 3 variants evaluated
- section Dubrovnik – Prevlaka

As most acceptable Variant A has been chosen, for which the authorized Ministry has issued a valid Decision upon the acceptability for the environment.

Defined criteria for IAP route variants in Croatia are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant	less acceptable	acceptable	most acceptable
Environmental criteria	less acceptable	acceptable	most acceptable
Social criteria	negative impact	moderate impact	positive impact
Techno - economic criteria	negative	acceptable	more acceptable
Pipeline corridor crosses populated areas	great negative	moderate	slight
Pipeline corridor crosses areas of economic activiti	great negative	moderate	slight
Total construction cost	up to 20% from the most cheapest	up to 10% from the most cheapest	the most cheapest
Technical difficulties of pipeline construction	very difficult	moderate	slight

Figure 38: Criteria for IAP route variants in Croatia

Considered Variants description based on Social Criteria

Social Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*
Pipeline corridor crosses populated areas	*4*	Variant A is passing near settlements, but avoiding constructed areas. (**moderate**)	Variant B is passing near settlements, but avoiding constructed areas. (**moderate**)	Variant C is passing near settlements, but avoiding constructed areas (**moderate**).
Pipeline corridor crosses areas of economic activities values	*3*	Variant A passes near zones of economic activities on Pelješac peninsula, but it does not endanger them (**moderate**)	Variant B passes near zones of economic activities on Pelješac peninsula, but it does not endanger them. (**moderate**)	Variant C passes through zones of economic activities (agriculture production) in Neretva river delta area. (**great negative**)

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	*Weight factor 1 – 5*	*Variant A*	*Variant B*	*Variant C*
Cost of construction	*4*	338,9 M Euro	337,5 M Euro	312,7 M Euro
Technical difficulties of pipeline construction	*2*	Variant A has off-shore section that presents **moderate** technical difficult. It does not pass across very demanding terrain regarding altitude differences and soil excavation types.	Variant B has off-shore section that presents **moderate** technical difficult. It does not pass across very demanding terrain regarding altitude differences and soil excavation types.	Variant C crosses Neretva river delta that present **very difficult** and technically demanding structure. Unstable terrain in Neretva delta area makes pipeline lying very unstable form technical security point.

Results gained by DoctuS software are shown on following figure.

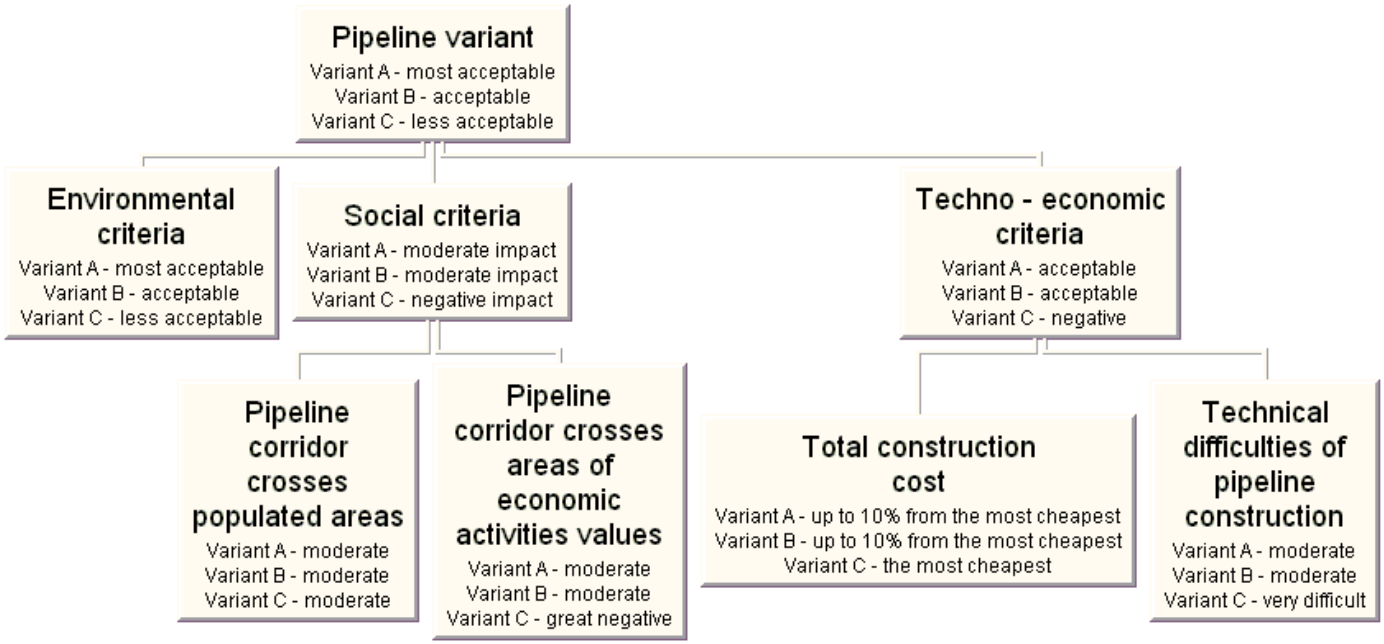


Figure 39: IAP route variants selection for Croatia

As most acceptable Variant A has been selected. Variant B is considered acceptable. Variant C is considered less acceptable.

7 Related documents

For further information and basic data references are made to the following documents:

- WB5-REG-ENE-03 Feasibility Study and EIA&SIA Ionian - Adriatic Pipeline (IAP) – Terms of reference
- C205/AD-0003/Rev.0 IAP Ionian Adriatic Pipeline – Pre- Feasibility Study
- C205/ILFM-AD-0000/Rev. B IAP (Ionian Adriatic Pipeline) – Hydraulic study and cost comparison (step 1)
- C205/ILFM-AD-0001/Rev. A IAP (Ionian Adriatic Pipeline) – Hydraulic study (step 2)
- C205/AD-0001/Rev.0 IAP (Ionian Adriatic Pipeline) – Site visit report, North Albania – Montenegro –
- Conceptual plan gas pipeline system Ploče – Dubrovnik – Prevlaka - Dobreč (Idejne osnove plinovodnog sustava Ploče – Dubrovnik – Prevlaka – Dobreč)
- Conceptual plan of the international gas pipeline system Ploče - Mostar (Idejne osnove međunarodnog plinovoda Ploče – Mostar)
- Conceptual plan of the international gas pipeline system Zagvozd – Imotski - Posušje (Idejne osnove međunarodnog plinovoda Zagvozd – Imotski – Posušje)
- A study of the route of the main gas pipeline Ploče – Dubrovnik (Studija trase za magistralni plinovod Ploče – Dubrovnik)
- A study of the route of the international gas pipeline Dubrovnik – Prevlaka – Dobreč (Studija trase za međunarodni plinovod Dubrovnik – Prevlaka – Dobreč)
- Geodetic (longitudinal profiles, cadastral base) for the main gas pipeline Ploče - Dubrovnik (Geodetske podloge (uzdužni profile, katastarske podloge) za magistralni plinovod Ploče – Dubrovnik)
- Geodetic (DOF, cadastral base and situations, longitudinal profiles) for international gas pipeline Dubrovnik – Prevlaka – Dobreč (Geodetske podloge (DOF, katastarske podloge i situacije, uzdužni profile) za međunarodni plinovod Dubrovnik – Prevlaka – Dobreč)
- Geological study for the main gas pipeline Ploče - Dubrovnik (Geološki elaborat za magistralni plinovod Ploče – Dubrovnik)
- Geological study for the international gas pipeline Dubrovnik – Prevlaka – Dobreč (Geološki elaborat za međunarodni plinovod Dubrovnik – Prevlaka – Dobreč)

- A study on the environmental impact of the main gas pipeline Ploče – Dubrovnik (Studija o utjecaju na okoliš za magistralni plinovod Ploče – Dubrovnik)
- A study on the environmental impact of the international gas pipeline Dubrovnik – Prevlaka – Dobreč (Studija o utjecaju na okoliš za međunarodni plinovod Dubrovnik – Prevlaka – Dobreč)
- Basic design of the mine gas pipeline Split – Ploče (Idejni projekt magistralnog plinovoda Split – Ploče)
- Feasibility study for corridor of IAP underwater route (part of the Croatian territorial sea) (Studija izvodljivosti za koridor podmorskih dionica IAP (dio u hrvatskim teritorijalnim vodama)
- Hydrographic study – geological – magnetometry surveying undersea route of the future IAP gas pipeline (part of the Croatian territorial sea) (Studija hidrografsko – geološko – magnetometrijske izmjere na podmorskim dionicama budućeg plinovoda IAP (dio u hrvatskim teritorijalnim vodama))
- Assessment of potential natural gas in countries that gravitate Adriatic - Ionian pipeline as part of the EC SEE gas ring (Studija ocjene potencijalnog tržišta prirodnog plina u zemljama koje gravitiraju Jadransko – jonskom plinovodu kao dijelu SEE EC plinskog prstena)
- WB5-REG-ENE-03_18-20 June 2012 - Mission Report
- WB5-REG-ENE-03_27-29 June 2012 - Mission Report
- WB5-REG-ENE-03_15-21 July 2012 - Mission Report
- WB5-REG-ENE-03_22-28 July 2012 - Mission Report
- WB5-REG-ENE-03_25_28_September_2012 - Mission Report
- WB5-REG-ENE-03_August 2012 - GAP Analyses Report

Appendix 1 Description of variants

Section 1 (Fier – Staravec)
The route starts at compressor station on the TAP system near Fier and runs in northern direction parallel to the costal line to the Staravec village. The pipeline crosses agriculture areas, mainly flat terrain which is not difficult for construction.

Total length of section 1	38.1 km
Highest point of the pipeline	100 m
Lowest point of the pipeline	10 m
Maximal operating pressure	85 bar

Section 2 (Staravec – Ahmetaq)
From Staravec the route runs in northern direction toward Ahmetaq. The pipeline crosses flat agriculture areas and then south – west of Tirana crosses a hilly terrain, and reaches Tirana area west of the city. In this section no major problems for construction of the pipeline are to be expected.

Total length of section 2	54.3 km
Highest point of the pipeline	320 m
Lowest point of the pipeline	10 m
Maximal operating pressure	85 bar

Section 3 (Staravec – Ahmetaq)
From Staravec the route runs to west toward the cost and then in northern direction parallel to the costal line to the Ahmetaq. The pipeline runs mostly through flat agriculture areas. Near Durres it passes through an urban area, crosses a hilly terrain and reaches Ahmetaq. In this section no major problems for construction of pipeline are to be expected.

Total length of section 3	63.2 km
Highest point of the pipeline	170 m
Lowest point of the pipeline	-2 m
Maximal operating pressure	85 bar

Section 4 (Ahmetaq – Balldre)
From Ahmetaq the route runs in northern direction toward Balldre. The route runs through flat agriculture areas. At his route pipeline crosses two rivers. Pipeline construction is practicable.

Total length of section 4	45.0 km
Highest point of the pipeline	140 m
Lowest point of the pipeline	-2 m
Maximal operating pressure	85 bar

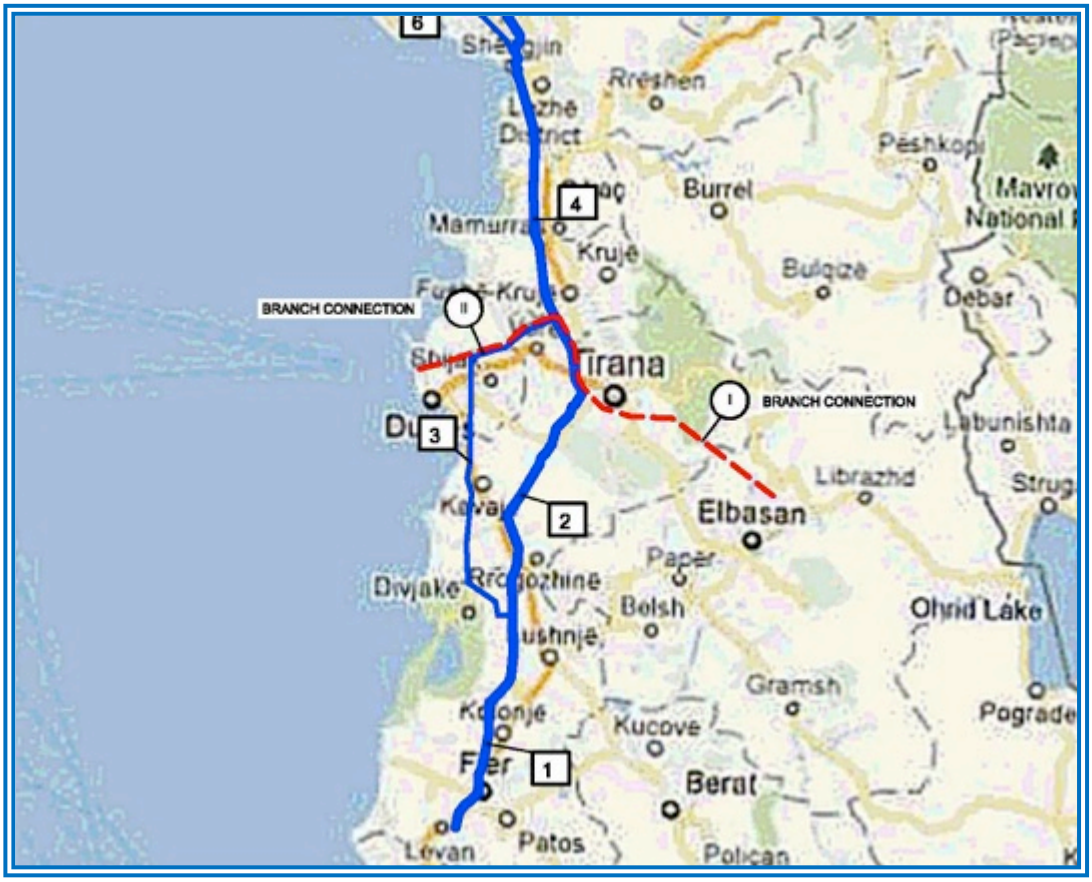


Figure 40: Route section 1 to 4

Section 5 (Balldre – Barlaj)
The pipeline crosses flat agriculture areas until it reaches Skadar. The urban area of Skadar will be passed on the south – east side. The pipeline route crosses river Drin and passes Skadar Lake on the north and runs into mountainous area toward Barlaj at Albania – Montenegro border.

Total length of section 5	66.5 km
Highest point of the pipeline	510 m
Lowest point of the pipeline	-1 m
Maximal operating pressure	85 bar

Section 6 (Balldre – Štodra)
Alternative route from Balldre toward Albania – Montenegro border at Štodra runs mostly through flat agriculture areas and it is very suitable for pipeline construction. At the border pipeline crosses river Bojana.

Total length of section 6	27.6 km
Highest point of the pipeline	100 m
Lowest point of the pipeline	-2 m
Maximal operating pressure	85 bar

Section 7 (Barlaj – Nalježići)
From Albania – Montenegro border the pipeline runs through mountainous area toward Podgorica, passes Podgorica on the south and runs toward Cetinje. From Podgorica the pipeline follows in general the main road in direction to Cetinje. There may be difficulties in construction of the pipeline due to mountainous terrain.

Total length of section 7	54.7 km
Highest point of the pipeline	1360 m
Lowest point of the pipeline	20 m
Maximal operating pressure	75 bar

Section 8 (Nalježići – Radanovići)
This is a short section in hilly terrain. In this section no major problems for construction of pipeline are to be expected.

Total length of section 8	2.4 km
Highest point of the pipeline	420 m
Lowest point of the pipeline	40 m
Maximal operating pressure	75 bar

Section 9 (Štodra – Donji Podi)
From Albania – Montenegro border toward city of Bar the route runs partly through flat terrain and after that through mountainous area. This mountainous terrain is very difficult for construction of the pipeline.

Total length of section 9	22.0 km
Highest point of the pipeline	600 m
Lowest point of the pipeline	5 m
Maximal operating pressure	75 bar

Section 10 (Donji Podi - Nalježići)
From Bar across mountainous area parallel to the coast, route runs toward Nalježići. This mountainous terrain is very difficult for construction of the pipeline.

Total length of section 10	53.6 km
Highest point of the pipeline	1310 m
Lowest point of the pipeline	150 m
Maximal operating pressure	75 bar

Section 11 (Donji Podi – Bartula)
This is a short section in hilly terrain. In this section no major problems for construction of pipeline are to be expected.

Total length of section 11	1.0 km
Highest point of the pipeline	460 m
Lowest point of the pipeline	260 m
Maximal operating pressure	75 bar

Section 12 (Bartula – Lastva Grbajska)
Pipeline route runs along the coast. This is the most critical section of the route. Some parts especially in the vicinity of the cities seems to be not really feasible as the steep mountain slopes are directly starting at the coast and the settlement areas have expanded already to lower parts of the mountain slopes. It seems to make an installation of a large diameter pipeline unrealistic with classical construction methods. In the Bar area no feasible route could be found.

Total length of section 12	41.6 km
Highest point of the pipeline	520 m
Lowest point of the pipeline	40 m
Maximal operating pressure	75 bar

Section 13 (Lastva Grbajska - Radanovići)
The route follows the road toward Radanovići, at the edge of a wide valley. In this section no major problems for construction of pipeline are to be expected.

Total length of section 13	7.4 km
Highest point of the pipeline	160 m
Lowest point of the pipeline	40 m
Maximal operating pressure	75 bar

Section 14 (Bartula - Lastva Grbajska)
The route passes near the city of Bar, enters the sea and is laid down on the seabed. In the bay of Jaz the route runs on-shore, passes over Quaternary valley and reaches Lastva Grabajska.

Total length of section 14	42.3 km
Highest point of the pipeline	200 m
Lowest point of the pipeline	-50 m
Maximal operating pressure	75 bar

Section 15 (Radanovići - Vitajina)
From Budva to Croatia the pipeline runs across the peninsula where a subsea section of the pipeline will lead from Rt. Dobreč through Boka Kotorska to the landing point in Uvala Čipavica on Croatian territory. Offshore section in Bokakotorska bay is included in sections 15 and 16.

Total length of section 15	19.6 km
Highest point of the pipeline	570 m
Lowest point of the pipeline	-20 m
Maximal operating pressure	75 bar

Section 16 (Vitajina - Đurinići)
Pipeline passes through the flat valley of peninsula Prevlaka toward Đurinići. The section covers half of the subsea pipeline in Bokakotorska bay. In this section no major problems for construction of pipeline are to be expected.

Total length of section 16	8.4 km
Highest point of the pipeline	340 m
Lowest point of the pipeline	-20 m
Maximal operating pressure	75 bar

Section 17 (Đurinići - Čibaća)
On shore pipeline route from Đurinići to Čibaća runs mostly across the Field of Konavli, passes Dubrovnik airport and at the Cavtat runs in to the sea. From Cavtat to Čibaća pipeline runs offshore. The place where the pipeline goes under the sea is very steep and construction of the pipeline is highly difficult.

Total length of section 17	32.4 km
Highest point of the pipeline	300 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Figure 41: Route section 5 to 17

Section 18 (Čibaća - Podimoć)
From Ćibaća to Podimoć the route runs in very hilly and rough terrain. The main problem of this section is crossing the bay of Rijeka dubrovačka. The hills on the shores of the bay are very steep and high.

Total length of section 19	42.5 km
Highest point of the pipeline	460 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 19 (Podimoć - Kobiljača)
From Podimoć toward Kobiljača the route runs over the rough rocky terrain and passes through Bosnia and Hezegovina territory near the city of Neum. In Bosnia and Herzegovina the route runs mostly through mountainous terrain and crosses the river of Neretva near city of Opuzen.

Total length of section 20	50.2 km

Highest point of the pipeline	330 m
Lowest point of the pipeline	40 m
Maximal operating pressure	75 bar

Section 20 (Podimoć - Osobjava)

Route runs over peninsula Pelješac through hilly rough terrain. Near Broce, the pipeline crosses the bay of Ston.

Total length of section 21	41.6 km
Highest point of the pipeline	350 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 21 (Osobjava - Ploče)

Near Osobjava the route crosses offshore the Pelješac bay and runs toward the city of Ploče. Route passes the city of Ploče on the east side and through mountainous area runs toward Kobiljača.

Total length of section 22	21.2 km
Highest point of the pipeline	260 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 22 (Ploče - Kobiljača)

This is a short section which descends from the hill and mostly passes through flat agriculture area.

Total length of section 23	0.6 km
Highest point of the pipeline	60 m
Lowest point of the pipeline	20 m
Maximal operating pressure	75 bar

Section 23 (Osobjava - Ploče)
After crossing the Pelješac bay the route passes the city of Ploče on the west side, runs near Bačinsko lake and through mountainous area goes toward Kobiljača.

Total length of section 24	22.3 km
Highest point of the pipeline	300 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 24 (Kobiljača – Otrić seoci)
From Kobiljača to Otrić seoci, pipeline goes along the edge of agriculture field and no major problems for construction of pipeline are to be expected.

Total length of section 25	4.8 km
Highest point of the pipeline	115 m
Lowest point of the pipeline	28 m
Maximal operating pressure	75 bar

Section 25 (Otrić seoci - Zagvozd)
From Otrić seoci to Zagvozd the route goes partly along the edge of agriculture field, but mostly goes through mountainous and hilly area following in general the highway in direction to Split.

Total length of section 26	42.4 km
Highest point of the pipeline	620 m
Lowest point of the pipeline	38 m
Maximal operating pressure	75 bar

Section 26 (Zagvozd - Dugopolje)
The route runs toward Dugopolje through mountainous and hilly area, following in general the highway in direction to Split. In that point IAP gas system will be connected to Croatian gas pipeline system. Before entering in existing Croatian gas system, gas pressure will be increased by a new compressor station.

Total length of section 27	53.0 km
Highest point of the pipeline	300 m
Lowest point of the pipeline	0 m
Maximal operating pressure	75 bar

Section 27 (Podimoć – Mostar – Posušje – Imotski - Zagvozd) BiH
This section starts in Croatian territory, runs through territory of Bosnia and Herzegovina in north direction toward city of Mostar, passes Posušje and Imotski, and runs toward Zagvozd in Croatian territory. Pipeline mostly runs through mountainous and hilly areas and at some parts through flat valleys.

Total length of section 28	135.0 km
Highest point of the pipeline	920 m
Lowest point of the pipeline	150 m
Maximal operating pressure	75 bar

Figure 42: Route section 18 to 27

Branch connection I (Ahmetaq – Tirana - Elbasan)
If section 2 will be constructed Elbasan will be connected through Branch connection I from Tirana to Elbasan. The length of branch connection will be 35 km.
If section 3 will be constructed Elbasan will be connected through Branch connection I from Ahmetaq to Elbasan. The length of branch connection will be 50 km.
The route crosses flat agriculture areas near Tirana and then south – east of Tirana crossing a hilly terrain toward Elbasan.

Total length of branch connection I	50.0 km
Highest point of the pipeline	630 m
Lowest point of the pipeline	62 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Branch connection II (Ahmetaq – Durres)
If section 2 from Staravec to Ahmetaq will not be constructed, this branch connection will provide a supply of Durres with natural gas. The route crosses hilly terrain and continues toward Durres through flat agriculture areas.

Total length of branch connection II	22.0 km
Highest point of the pipeline	170 m
Lowest point of the pipeline	1 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Branch connection III (Melgushe – Bartula)
If the pipeline route toward Podgorica will be selected as a pipeline route of IAP, a supply of city of Bar will be provided through branch connection. Toward city of Bar route runs partly through flat terrain and then through mountainous area. Route has to cross the river Bojana.

Total length of branch connection III	35.0 km
Highest point of the pipeline	940 m
Lowest point of the pipeline	4 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Branch connection IV (Majstori – Budva)
If the pipeline route toward Podgorica will be selected as a pipeline route of IAP, a supply of city of Budva will be provided through branch connection. Route runs through mountainous and hilly area whit steep parts.

Total length of branch connection IV	7.8 km
Highest point of the pipeline	1200 m
Lowest point of the pipeline	60 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Branch connection V (Radanovići – Cetinje - Podgorica- Nikšić)
If the IAP pipeline route would not follow Podgorica - Cetinje rout the new branch connection toward Cetinje – Podgorica – Nikšić will be constructed. This branch connection runs through mountainous area toward Podgorica and continues toward Nikšić. The route follows in general the main road in direction Cetinje – Podgorica - Nikšić. There may be difficulties in construction of the pipeline due to mountainous terrain.

Total length of branch connection V	84.0 km
Highest point of the pipeline	1360 m
Lowest point of the pipeline	60 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	12”

Interconnection variant 1 (Zagvozd - Vir)
This branch connection is alternative to branch connection VI (Otrić seoci - Vitina) and will also provide a supply of Bosnia and Herzegovina with natural gas if the section 28 (Podimoć – Mostar – Posušje – Imotski - Zagvozd) will not be part of IAP system. Route runs through mountainous and hilly area.

Total length of branch connection VII	23.2 km
Highest point of the pipeline	850 m
Lowest point of the pipeline	260 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	20”

Interconnection variant 2 (Otrić seoci - Vitina)

This branch connection will provide a supply of Bosnia and Herzegovina with natural gas if the section 28 (Podimoć – Mostar – Posušje – Imotski - Zagvozd) will not be part of IAP system. The route crosses flat rocky terrain, passes over flat agriculture area and then ends at the hilly area.

Total length of branch connection VI	12.0 km
Highest point of the pipeline	390 m
Lowest point of the pipeline	70 m
Maximal operating pressure	50 bar
Pipeline nominal diameter	20”

Appendix 2 Technical and environmental explanation of constraints of crossing delta Neretva river (Variant C in Croatia and BiH)

Technical constraints

Route variant of C-HR passes through the valley of the Neretva River delta, and part of the route runs through marshy terrain.
Execution of works for construction of a gas pipeline in marshy terrain is much more demanding, and therefore more expensive than building on clay courts.

Before the transportation of pipes along the route, a working corridor should be established along the entire length. Because of the diameter of the pipeline DN800, the usual width of the corridor is 20-22m, but here it is necessary to provide a greater breadth because of a bigger width of the trench top and larger amounts of material from the excavation, which must be disposed along the trench. The width of the trench in the ground, which is mostly composed of humus and clay, is approx. 3m, and in swampy area approx. 8m. Therefore, the total width of the work corridor is 25-27 m. In addition to higher construction costs it creates higher costs of land use fees.

During construction of gas pipelines it is necessary to enable safe movement of mechanization along the whole route. Given that the ground is swampy it is necessary to substitute the materials, predictably 0,5 – 1 m depth. In order for this to be carried out it is necessary to dig out topsoil and bring it away in a width of approx. 8 – 10 m along the entire length of the pipeline route, and replace it with stone material. Considering the composition of the soil there are no quarries in the Neretva River valley, and therefore it will have to be brought from distant quarries. The cost of transportation is equalized with the cost of the stone if the distance to the quarry is approx. 25 – 30 km. This means that the cost of transportation in this case will be greater than the cost of stone, and this will additionally increase the price of performance.

After completion of the work it is necessary to keep the service road at least 3m wide, the rest of the working corridor in the width of 5 – 7 m on which the substitution of materials has been made should be returned to its original state. This means another substitution of materials.

Since the service road is constructed on marshy terrain it can be assumed that it will sink with time, and therefore further silting of the road will be needed each year in order to remain it in function.

For performance of works in clay terrain usually the trench for the pipe laying is carried out with a gradient of 3:1. In case that the gas pipeline is laid in muddy ground, trench sits should be completed with a slope 1:2. Therefore, in this case it is necessary to perform 2,5 times larger excavation, which further increases the price of works.

After excavation of the trench, due to the large bandwidth of soil, it can be assumed that the entire height of trench will be filled with water which will not

be possible to pump out. This also presents a very serious security problem, because in the event that any of the workers (wearing coveralls, further hampered by tools) falls into the trench it could have unintended consequences.

Once the individual welded sections are laid in the trench, mud would immediately enter the pipes which would later be difficult to remove. Besides, deposited sections should be welded inside the trench that is filled with water, which is not possible. Thus, each prefabricated pit needs to be surrounded with waterproof fence, and the water should be constantly pumped out of the trench.

If the ends of the pipes would be closed so that the mud doesn't enter them, such placed sections would be swimming in the trench because the lift is twice the weight of the pipe. In this way, laid sections would not be able to connect.

After laying and backfilling the trench, it is necessary to perform a pressure test. The gas pipes would be even heavier and there is a risk of further subsidence. Considering that block stations would be performed on solid ground, the indicated subsidence would cause additional unauthorized pipe strain.

Environmental constraints

Possible impacts on biodiversity important areas of Variant C of the pipeline Ploče-Dubrovnik
Pipeline between Ploče and Dubrovnik pass through and in vicinity of several biodiversity important areas. The largest and internationally recognised biodiversity important area is wetland ecosystem of Neretva Delta.

Neretva Delta is protected or planned to be protected in following major categories:

1. Ramsar site
2. Croatian Ecological Network site
3. Proposed Natura 2000 site as Special Protected Area and Special Area of Conservation
4. Nature Park (planned)

Ramsar site
The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The wise use of wetlands is defined as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". Variant C of the pipeline will have negative impact on wetland habitat types of Neretva Delta. Consequently, in regard to Neretva Delta as Ramsar site the variant C is not favourable variant.

Croatian ecological network and NATURA 2000
At the heart of the two EU Directives (the Birds Directive and the Habitats Directive) is the creation of a Europe-wide ecological network of nature conservation sites – the NATURA 2000 Network. This network is designed to

conserve over a thousand rare, threatened and endemic species of wild animals and plants and some 230 natural and semi-natural habitats listed in the annexes of the two EU Directives.

Approximately 25,000 sites around EU have been included in the NATURA 2000 Network. At the time of its accession to the EU, Croatia will also need to implement the Birds and Habitats Directives on its territory.

In addition to NATURA 2000 sites, each country may establish some other features and sites as ecologically important areas. In Croatia these sites are incorporated as part of Croatian ecological network (EN). As part of adaptation to EU legislation Croatia has proclaimed Croatian Ecological Network (CEN) prior to NATURA 2000. The Ordinance on CEN initiated the development of the CEN, which also represents the network of habitats and species of European importance under NATURA 2000. The majority of sites of the CEN and NATURA 2000 cover the same area, although the target features within the same area might be different (different qualifying species and habitats).

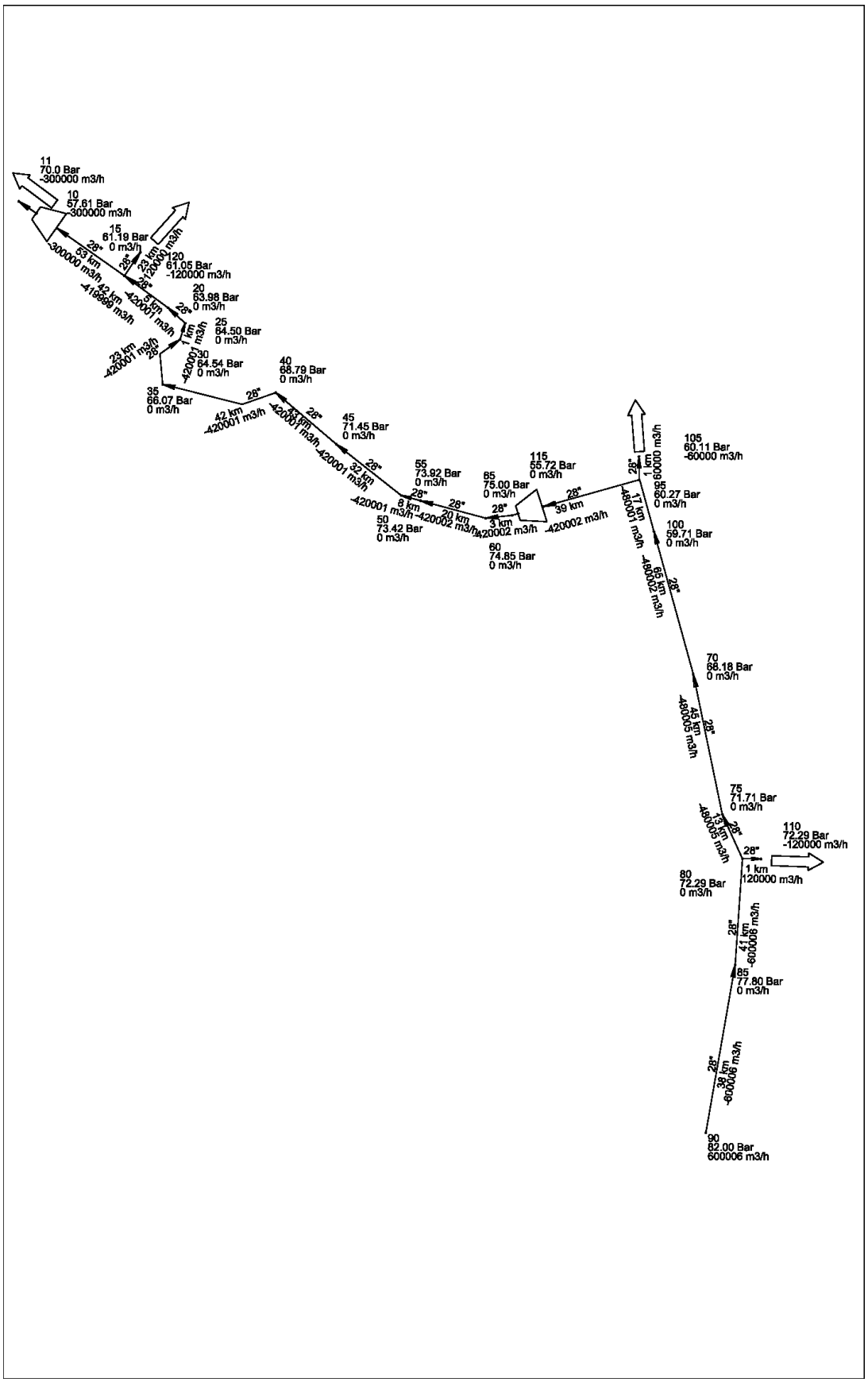
Nature impact assessment is a procedure of assessment of ecological impacts of given plan/ project on ecological network site conservation objectives and their integrity. Nature impact assessment is prescribed by Article 6(3) and 6(4) of Habitat Directive and already implemented in Croatian law. The main principle of nature impact assessment is avoidance of the impacts that might have adverse effect.

Variant A and Variant B avoid Neretva Delta area and only superficially impact Delta in the part where the pipeline pass under the sea. In contrast, Variant C of the pipeline passes through the middle of Neretva Delta and need to cross under the Neretva River and several major canals. The pipeline route is planned through the wetland area with high biodiversity value. Although, the core pipline will not affect big surface the pipeline constructions, supporting roads and construction managing surfaces might have adverse effect on proposed Natura 2000 site. In addition to impacts on Neretva Delta area, the Variant C pass the ecological network HR2000747 Ponor Crni vir and proposed Natura 2000 site HR2001046 Matica – Vrgoračko polje where adverse effects are possible as well.
The significant negative impact on the integrity of the ecological network site that cannot be avoided or mitigated should be approved through the procedure with uncertain outcome: the Imperative Reasons of Overriding Public Interest (IROPI). Moreover, before the implementation of the IROPI there should be aproved that there are no other alternative solutions (variants). In addition, the IROPI for the pipeline construction cannot be approved if there are possible significant impacts on priority species or habitat types.

Nature Park
Nature Park is protected area category designated by Croatian law. Neretva Delta is not jet designated as Nature Park but it is planned to be protected. Study for evaluation of Neretva Delta presents high natural value of the Neretva Delta area.

Appendix 3 Process calculation sheets

1. Process calculation sheet – Option 28”



Header Report: d:\livica\projek~1\2012\aip\pro3\28-3cvv

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 08:47:49 On 09-18-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 50
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

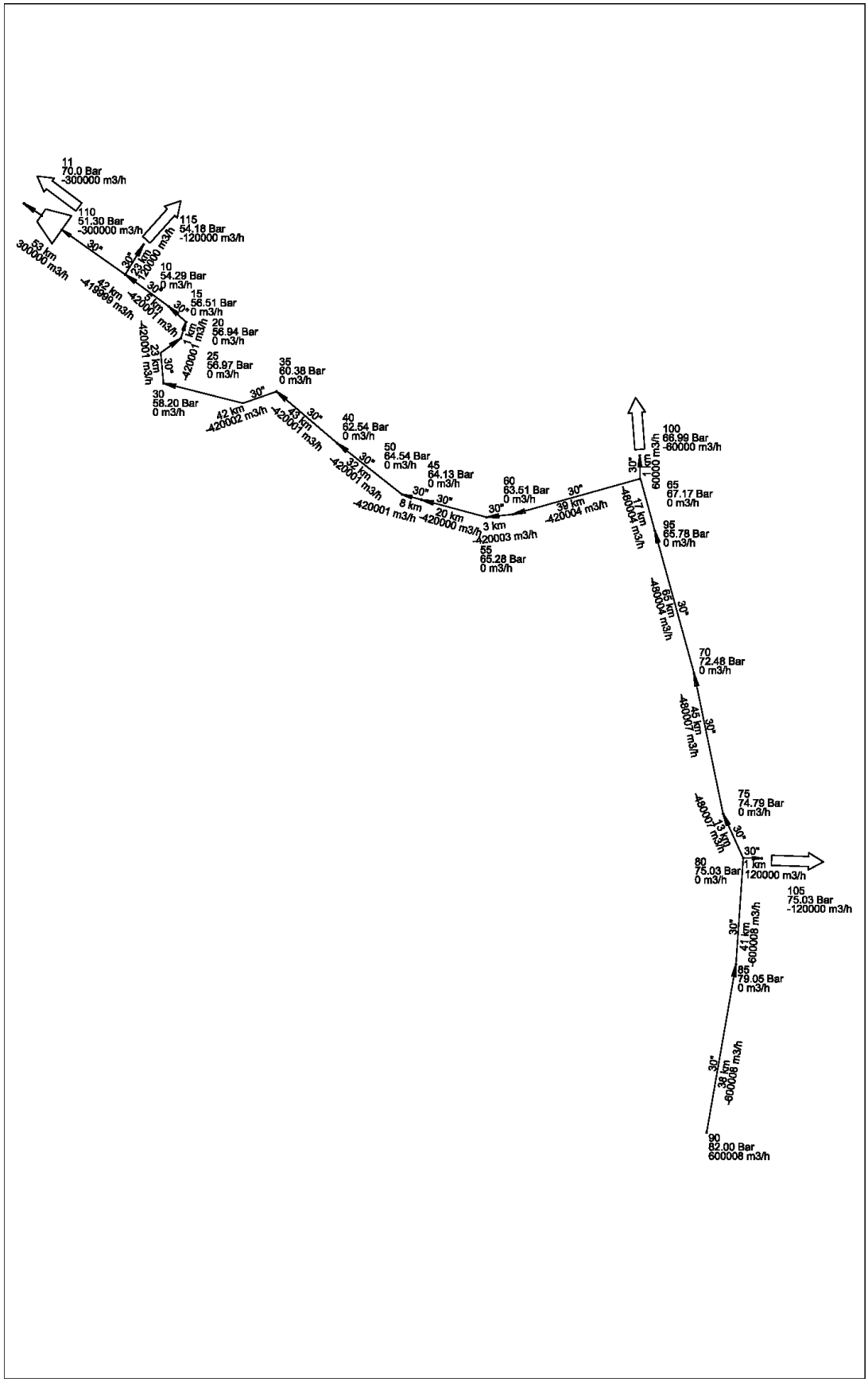
Node Report: d:\livica\projek~1\2012\aip\pro3\28-3cvv

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	57.61	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
15	61.19	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
20	63.98	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
25	64.50	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	64.54	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	66.07	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	68.79	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	71.45	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	73.42	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	73.92	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
60	74.85	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
65	75.00	Bar	YES	0	M^3/hr	FIX	41	Meters	10	Celsius	1.0116	Bar
70	68.18	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
75	71.71	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
80	72.29	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
85	77.80	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
90	82.00	Bar	YES	600006	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
95	60.27	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
100	59.71	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
105	60.11	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
110	72.29	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
115	55.72	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
120	61.05	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\livica\projek~1\2012\aip\pro3\28-3cvv

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETED_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
1	10	15	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	3613.68	436515968.00	Millibar	1.0
3	15	20	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	419999	M^3/hr	2787.38	354545120.00	Millibar	1.0
5	20	25	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	521.59	68070120.00	Millibar	1.0
7	25	30	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	40.87	5356390.50	Millibar	1.0
8	30	35	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1534.51	203542928.00	Millibar	1.0
10	35	40	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	2712.94	371376352.00	Millibar	1.0
11	40	45	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	2666.83	379410944.00	Millibar	1.0
12	45	50	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1968.91	289245088.00	Millibar	1.0
14	50	55	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	502.01	74989448.00	Millibar	1.0
15	60	65	P	Pan-B	28"85bar	Millimeter	0.00179	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	146.95	22318374.00	Millibar	1.0
23	70	75	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480005	M^3/hr	3518.15	499293536.00	Millibar	1.0
24	75	80	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480005	M^3/hr	575.39	84014912.00	Millibar	1.0
26	85	90	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600006	M^3/hr	4199.01	679537664.00	Millibar	1.0
27	95	100	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480001	M^3/hr	615.50	75057464.00	Millibar	1.0
28	95	105	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	168.33	20602812.00	Millibar	1.0
29	80	85	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600006	M^3/hr	5522.84	840084416.00	Millibar	1.0
30	80	110	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	5.21	763900.19	Millibar	1.0
31	100	70	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480002	M^3/hr	8535.96	1108522880.00	Millibar	1.0
32	55	60	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	925.03	139498560.00	Millibar	1.0
33	115	95	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	4589.02	541372032.00	Millibar	1.0
34	115	65	C	Pan-B	EMPIRICA	Millimeter	1.00000	Millimet	25.9	Meters	1.00000	Decimal	ON	YES	420002	M^3/hr	19320.56	2563889152.00	Millibar	1.0
35	15	120	P	Pan-B	28"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	141.21	17547682.00	Millibar	1.0

2. Process calculation sheet – Option 30”



Header Report: d:\ivica\projek~1\2012\aip\pro3\30-2c

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 14:30:26 On 10-15-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 50
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

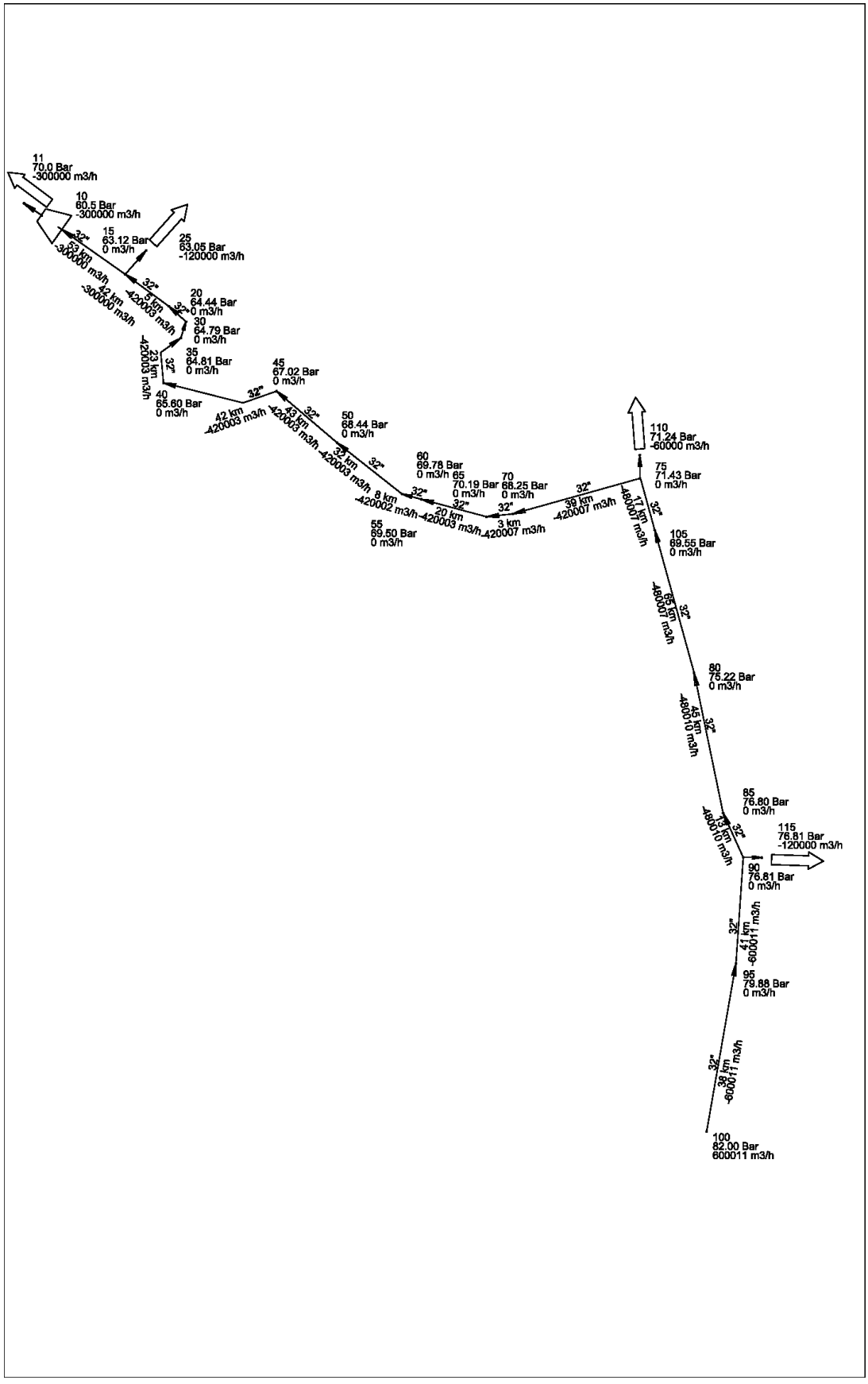
Node Report: d:\ivica\projek~1\2012\aip\pro3\30-2c

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	54.29	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
15	56.51	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
20	56.94	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
25	56.97	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	58.20	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	60.38	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	62.54	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	64.13	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	64.54	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	65.28	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
60	63.51	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
65	67.17	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
70	72.48	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
75	74.79	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
80	75.03	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
85	79.05	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
90	82.00	Bar	YES	600008	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
95	65.78	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
100	66.99	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
105	75.03	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
110	51.30	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
115	54.18	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\ivica\projek~1\2012\aip\pro3\30-2c

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETER	D_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
3	10	15	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	419999	M^3/hr	2212.19	249589632.00	Millibar	1.00
5	15	20	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	434.17	50133540.00	Millibar	1.00
7	20	25	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	32.77	3798808.50	Millibar	1.00
8	25	30	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1231.67	144354720.00	Millibar	1.00
10	30	35	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	2183.64	263385312.00	Millibar	1.00
11	35	40	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	2153.44	269082208.00	Millibar	1.00
12	40	45	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1593.88	205135648.00	Millibar	1.00
14	45	50	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	406.90	53183304.00	Millibar	1.00
15	55	60	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	1808.97	236560464.00	Millibar	1.00
16	60	65	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420004	M^3/hr	3702.01	491124096.00	Millibar	1.00
23	70	75	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480007	M^3/hr	2311.39	345100096.00	Millibar	1.00
24	75	80	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480007	M^3/hr	225.88	34298740.00	Millibar	1.00
26	85	90	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600008	M^3/hr	2945.80	480418400.00	Millibar	1.00
27	65	95	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480004	M^3/hr	1450.99	195760528.00	Millibar	1.00
28	65	100	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	186.54	25402374.00	Millibar	1.00
29	80	85	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600008	M^3/hr	4036.37	630093696.00	Millibar	1.00
30	80	105	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	3.56	541840.31	Millibar	1.00
31	95	70	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480004	M^3/hr	6764.44	948567744.00	Millibar	1.00
32	50	55	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420000	M^3/hr	735.16	96926984.00	Millibar	1.00
34	10	110	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	3028.39	325805664.00	Millibar	1.00
35	10	115	P	Pan-B	30"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	112.64	12446707.00	Millibar	1.00

3. Process calculation sheet – Option 32”



Header Report: d:\ivica\projek~1\2012\aip\pro3\32-2c

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 11:50:17 On 09-06-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 50
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

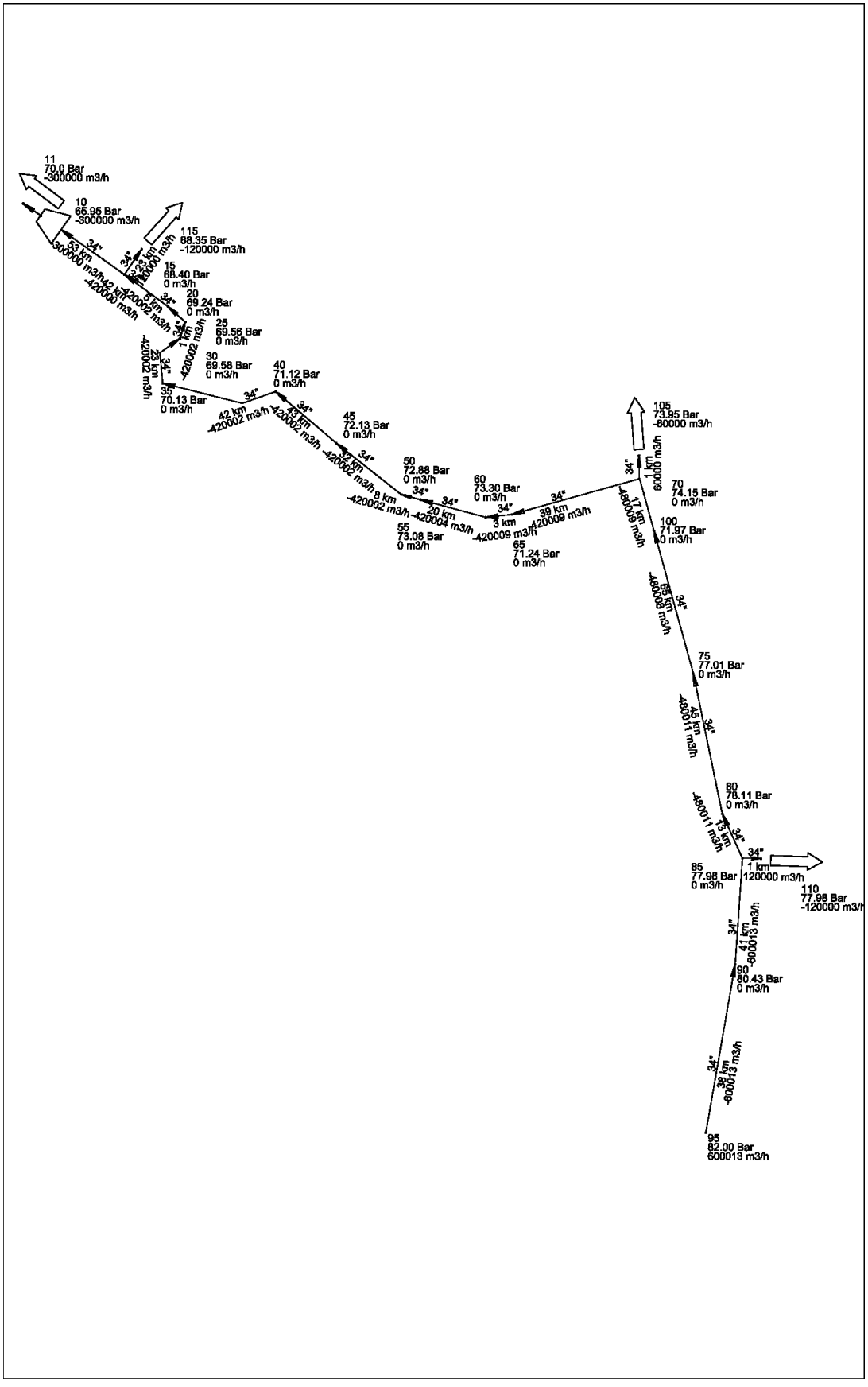
Node Report: d:\ivica\projek~1\2012\aip\pro3\32-2c

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	60.50	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
15	63.12	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
20	64.44	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
25	64.79	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	64.81	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	65.60	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	67.02	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	68.44	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	69.50	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	69.78	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
60	70.19	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
65	68.25	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
70	71.43	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
75	75.22	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
80	76.80	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
85	76.81	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
90	79.88	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
95	82.00	Bar	YES	600010	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
100	69.55	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
105	71.24	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
110	76.81	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
115	63.05	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\ivica\projek~1\2012\aip\pro3\32-2c

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETER	D_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
1	10	15	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	2658.16	333906720.00	Millibar	1.0
3	15	20	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	1310.39	169805552.00	Millibar	1.0
5	20	25	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420001	M^3/hr	362.26	47548796.00	Millibar	1.0
7	25	30	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	20.93	2754824.00	Millibar	1.0
8	30	35	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	790.35	104683296.00	Millibar	1.0
10	35	40	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420000	M^3/hr	1418.39	190999824.00	Millibar	1.0
11	40	45	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	1419.18	195133440.00	Millibar	1.0
12	45	50	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	1062.73	148760560.00	Millibar	1.0
14	50	55	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	272.92	38567544.00	Millibar	1.0
15	60	65	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420007	M^3/hr	1990.63	279519328.00	Millibar	1.0
16	65	70	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420006	M^3/hr	3229.26	457444256.00	Millibar	1.0
23	75	80	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480009	M^3/hr	1569.28	241747968.00	Millibar	1.0
24	80	85	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480009	M^3/hr	6.27	975555.88	Millibar	1.0
26	90	95	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600010	M^3/hr	2116.68	346955264.00	Millibar	1.0
27	70	100	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480006	M^3/hr	1935.40	276664672.00	Millibar	1.0
28	70	105	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	197.80	28619370.00	Millibar	1.0
29	85	90	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600010	M^3/hr	3083.15	489343776.00	Millibar	1.0
30	85	110	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	2.53	392981.56	Millibar	1.0
31	100	75	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480006	M^3/hr	5733.34	841355008.00	Millibar	1.0
32	55	60	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420005	M^3/hr	409.91	58206060.00	Millibar	1.0
33	15	115	P	Pan-B	32"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	70.41	9027246.00	Millibar	1.0

4. Process calculation sheet – Option 34”



Header Report: d:\livica\projek~1\2012\aip\pro3\34-2c

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 12:08:47 On 09-06-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 50
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

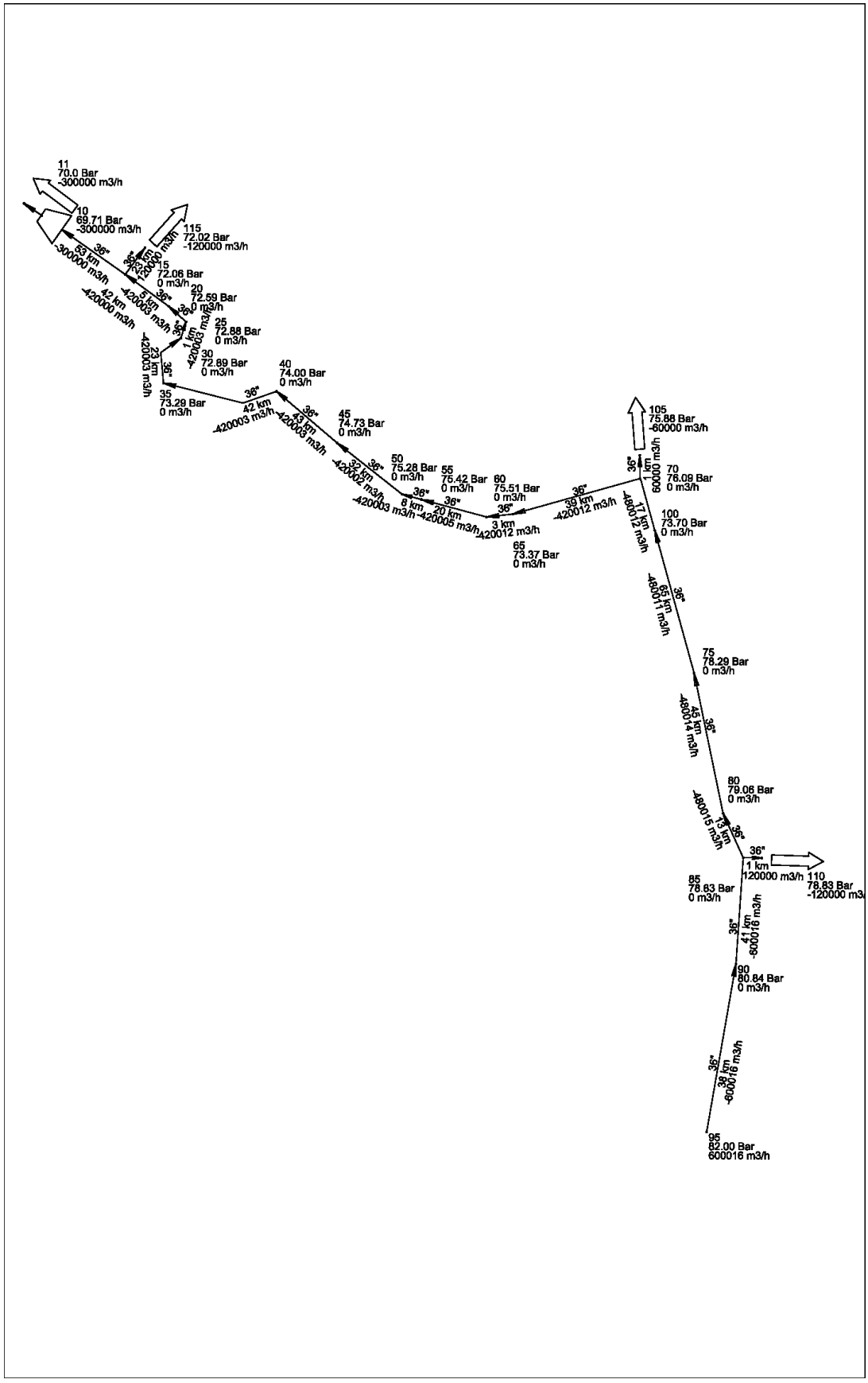
Node Report: d:\livica\projek~1\2012\aip\pro3\34-2c

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	65.95	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
15	68.40	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
20	69.24	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
25	69.56	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	69.58	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	70.13	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	71.12	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	72.13	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	72.88	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	73.08	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
60	73.30	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
65	71.24	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
70	74.15	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
75	77.01	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
80	78.11	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
85	77.98	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
90	80.43	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
95	82.00	Bar	YES	600013	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
100	71.97	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
105	73.95	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
110	77.98	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
115	68.35	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\livica\projek~1\2012\aip\pro3\34-2c

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETER	D_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
1	10	15	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	2488.62	339320896.00	Millibar	1.0
3	15	20	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	420000	M^3/hr	833.71	116445360.00	Millibar	1.0
5	20	25	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	325.36	45820172.00	Millibar	1.0
7	25	30	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	14.57	2056624.75	Millibar	1.0
8	30	35	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	551.39	78151728.00	Millibar	1.0
10	35	40	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	995.18	142592640.00	Millibar	1.0
11	40	45	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	1002.73	145677584.00	Millibar	1.0
12	45	50	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	755.29	111057384.00	Millibar	1.0
14	50	55	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	194.56	28792740.00	Millibar	1.0
15	60	65	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420009	M^3/hr	2103.88	308249632.00	Millibar	1.0
16	65	70	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420009	M^3/hr	2951.37	434919904.00	Millibar	1.0
23	75	80	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480011	M^3/hr	1098.55	172628208.00	Millibar	1.0
24	80	85	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480011	M^3/hr	134.79	21310458.00	Millibar	1.0
26	90	95	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600013	M^3/hr	1566.88	257697456.00	Millibar	1.0
27	70	100	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480009	M^3/hr	2233.74	330772096.00	Millibar	1.0
28	70	105	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	204.99	30770836.00	Millibar	1.0
29	85	90	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600013	M^3/hr	2463.39	395212480.00	Millibar	1.0
30	85	110	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	1.86	293415.13	Millibar	1.0
31	100	75	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480008	M^3/hr	5098.90	769653184.00	Millibar	1.0
32	55	60	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420004	M^3/hr	217.71	32307698.00	Millibar	1.0
33	15	115	P	Pan-B	34"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	48.56	6740089.50	Millibar	1.0

5. Process calculation sheet – Option 36”



Header Report: d:\livica\projek~1\2012\aip\pro3\36-2c

Base Pressure: 1.01325 Bar
Base Temperature: 15 Celsius
Specific Gravity: 0.644
Viscosity: 0.0000074 Lbm/Ft-sec

Last Solved: At 12:18:08 On 09-06-2012
Largest Node Error: 0 Mcfh At Node 55
Design Factor: 1
Convergence Tolerance: .1 Mcfh
Maximum Iteratins: 100
Upper Dampening Factor: 10
Lower Dampening Factor: .01
Compressibility Calculated: No

Condition Node:
Condition Pressure: 0 Bar
Minimum System Pressure: 0 Bar
Optimized By: Cost

Model Notes...
New GASWorkS File...

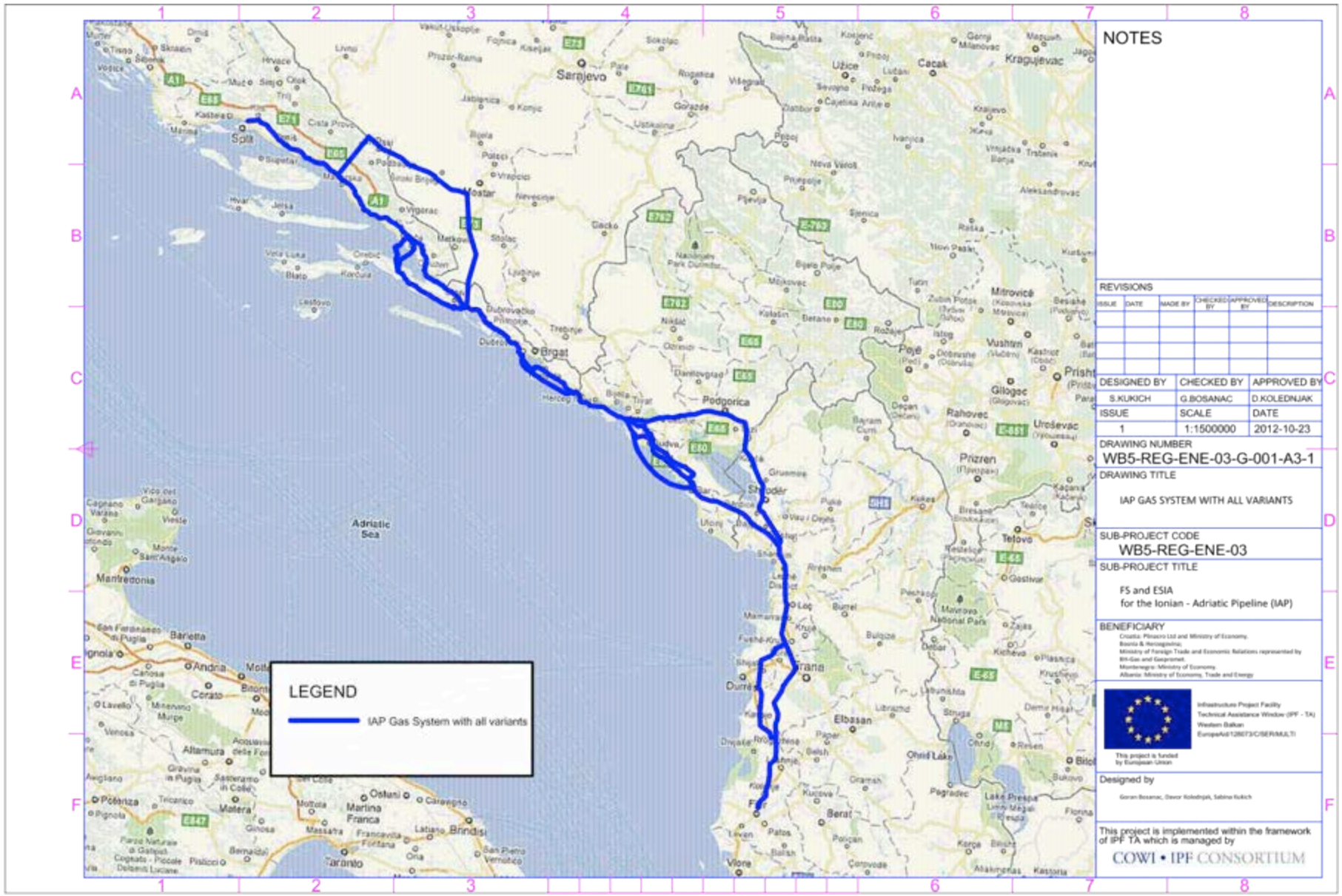
Node Report: d:\livica\projek~1\2012\aip\pro3\36-2c

NODENAM	PRESSURE	P_UNIT	PKNOLOAD	Q_UNIT	QKNOWN	ELEVATION	Z_UNIT	TEMP	T_UNIT	P_ATM	PA_UNIT
10	69.71	Bar	NO	-300000	M^3/hr	FIX	340	Meters	10	Celsius	0.9767	Bar
15	72.06	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
20	72.59	Bar	NO	0	M^3/hr	YES	38	Meters	10	Celsius	1.0120	Bar
25	72.88	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
30	72.89	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
35	73.29	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
40	74.00	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
45	74.73	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
50	75.28	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
55	75.42	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
60	75.51	Bar	NO	0	M^3/hr	YES	41	Meters	10	Celsius	1.0116	Bar
65	73.37	Bar	NO	0	M^3/hr	YES	421	Meters	10	Celsius	0.9675	Bar
70	76.09	Bar	NO	0	M^3/hr	YES	64	Meters	10	Celsius	1.0089	Bar
75	78.29	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
80	79.06	Bar	NO	0	M^3/hr	YES	29	Meters	10	Celsius	1.0130	Bar
85	78.83	Bar	NO	0	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
90	80.84	Bar	NO	0	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar
95	82.00	Bar	YES	600016	M^3/hr	NO	5	Meters	10	Celsius	1.0159	Bar
100	73.70	Bar	NO	0	M^3/hr	YES	543	Meters	10	Celsius	0.9537	Bar
105	75.88	Bar	NO	-60000	M^3/hr	YES	99	Meters	10	Celsius	1.0047	Bar
110	78.83	Bar	NO	-120000	M^3/hr	YES	111	Meters	10	Celsius	1.0033	Bar
115	72.02	Bar	NO	-120000	M^3/hr	YES	0	Meters	10	Celsius	1.0165	Bar

Pipe Report: d:\livica\projek~1\2012\aip\pro3\36-2c

GW_ID	FROMNODE	TONODE	TYPE	EQUATIO	DIAMETE	D_UNIT	ROUGHNESS	R_UNIT	GWLENGTH	L_UNIT	EFFICIENCY	E_UNIT	STATUS	SERVICES	FLOW	Q_UNIT	DP	DP2	P_UNIT	Z_FACTOR
1	10	15	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	53.0	Kilometers	0.98000	Decimal	ON	YES	300000	M^3/hr	2388.18	343313248.00	Millibar	1.0
3	15	20	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	42.4	Kilometers	0.98000	Decimal	ON	YES	420000	M^3/hr	525.48	77071608.00	Millibar	1.0
5	20	25	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	4.8	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	302.00	44544616.00	Millibar	1.0
7	25	30	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	0.6	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	10.43	1541423.13	Millibar	1.0
8	30	35	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	22.8	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	395.20	58574076.00	Millibar	1.0
10	35	40	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	41.6	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	715.70	106871992.00	Millibar	1.0
11	40	45	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	42.5	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	724.20	109184120.00	Millibar	1.0
12	45	50	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	32.4	Kilometers	0.98000	Decimal	ON	YES	420002	M^3/hr	547.47	83236456.00	Millibar	1.0
14	50	55	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	8.4	Kilometers	0.98000	Decimal	ON	YES	420003	M^3/hr	141.30	21579922.00	Millibar	1.0
15	60	65	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	2.5	Kilometers	0.98000	Decimal	ON	YES	420012	M^3/hr	2183.87	329449632.00	Millibar	1.0
16	65	70	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	39.0	Kilometers	0.98000	Decimal	ON	YES	420012	M^3/hr	2762.25	418299168.00	Millibar	1.0
23	75	80	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	45.0	Kilometers	0.98000	Decimal	ON	YES	480014	M^3/hr	763.09	121624888.00	Millibar	1.0
24	80	85	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	13.1	Kilometers	0.98000	Decimal	ON	YES	480015	M^3/hr	236.10	37755296.00	Millibar	1.0
26	90	95	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	38.1	Kilometers	0.98000	Decimal	ON	YES	600016	M^3/hr	1163.56	191834016.00	Millibar	1.0
27	70	100	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	17.4	Kilometers	0.98000	Decimal	ON	YES	480012	M^3/hr	2442.76	370697856.00	Millibar	1.0
28	70	105	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	60000	M^3/hr	210.14	32358402.00	Millibar	1.0
29	85	90	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	41.2	Kilometers	0.98000	Decimal	ON	YES	600016	M^3/hr	2014.68	325753056.00	Millibar	1.0
30	85	110	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	1.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	1.38	219936.48	Millibar	1.0
31	100	75	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	64.8	Kilometers	0.98000	Decimal	ON	YES	480011	M^3/hr	4655.21	716744384.00	Millibar	1.0
32	55	60	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	19.7	Kilometers	0.98000	Decimal	ON	YES	420005	M^3/hr	86.29	13197945.00	Millibar	1.0
33	15	115	P	Pan-B	36"85bar	Millimeter	0.00800	Millimet	23.0	Kilometers	0.98000	Decimal	ON	YES	120000	M^3/hr	34.58	5052198.00	Millibar	1.0

Appendix 4 IAP gas system with all variants


NOTES
REVISIONS
ISSUE
DATE
MADE BY
CHECKED BY
APPROVED BY
DESCRIPTION
DESIGNED BY
S.KUKICH
CHECKED BY
G.BOSANAC
APPROVED BY
D.KOLEDNJAK
ISSUE
1
SCALE
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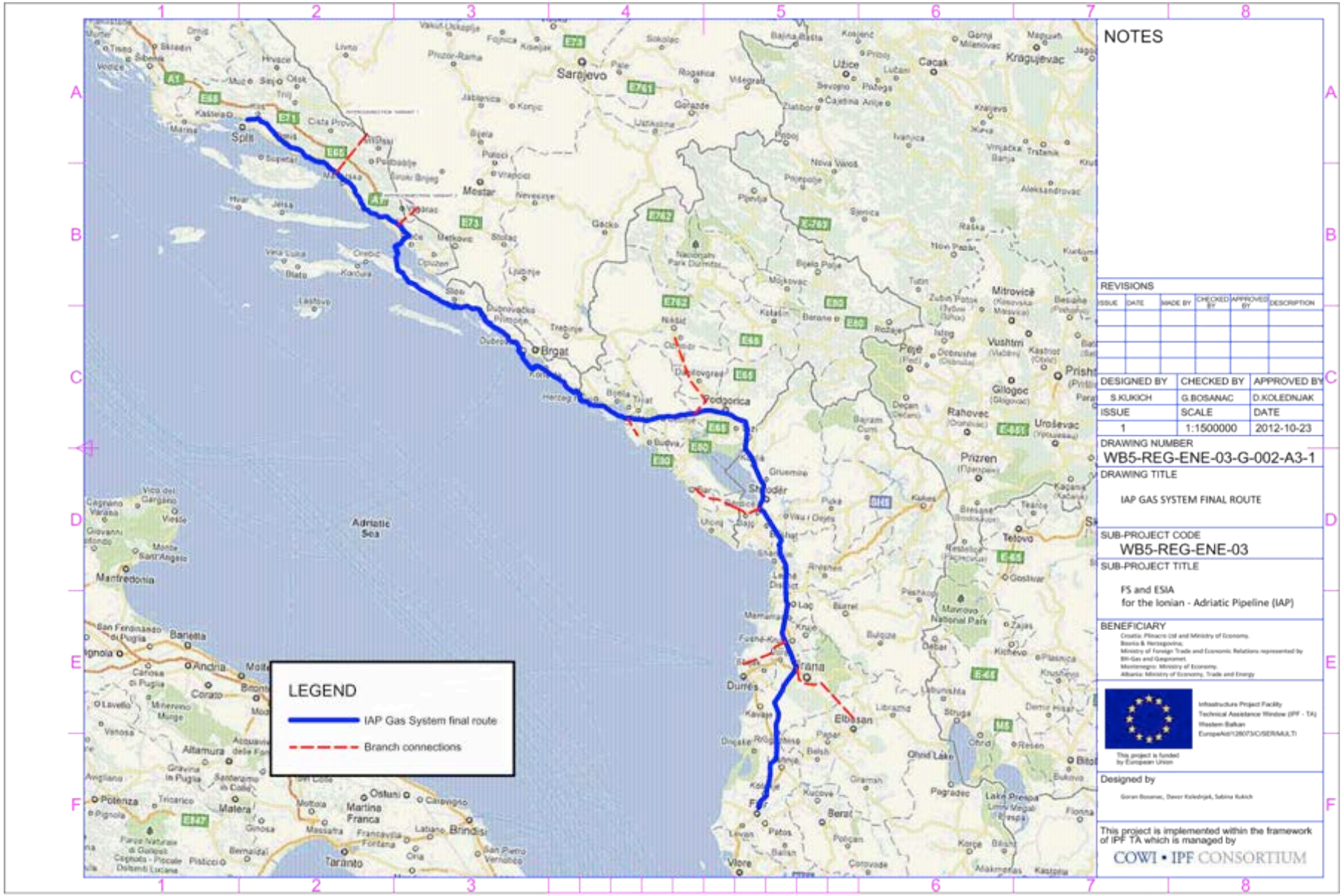
DATE
2012-10-23
DRAWING NUMBER
WB5-REG-ENE-03-G-001-A3-1
DRAWING TITLE
IAP GAS SYSTEM WITH ALL VARIANTS
SUB-PROJECT CODE
WB5-REG-ENE-03
SUB-PROJECT TITLE
FS and ESIA
for the Ionian - Adriatic Pipeline (IAP)
BENEFICIARY
Designed by
This project is implemented within the framework of IPF TA which is managed by
COWI • IPF CONSORTIUM
LEGEND
IAP Gas System with all variants
Adriatic Sea
Sarajevo
Split
Mostar
Brgat
Podgorica
Prizren
Tirana
Durrës
Elbasan
Vlore
Berat
Ohrid Lake
Lake Prespa
Mantredonia
Barletta
Andria
Corato
Altamura
Matera
Martina Franca
Ostuni
Brindisi
Taranto

Appendix 5 IAP gas system final route


LEGEND
IAP Gas System final route
Branch connections
Adriatic Sea
Split
Sarajevo
Mostar
Brgat
Podgorica
Shkodër
Durrës
Tirana
Elbasan
Berat
Vlore
Taranto
Brindisi
Bari
Matera
Potenza
Prizren
Tetovo
Ohrid Lake
Lake Prespa
Mantredonia
Andria
Barletta
Altamura
Martina Franca
Ostuni
Peja
Mitrovicë
Kragujevac
NOTES
REVISIONS
ISSUE
DATE
MADE BY
CHECKED BY
APPROVED BY
DESCRIPTION
DESIGNED BY
S.KUKICH
CHECKED BY
G.BOSANAC
APPROVED BY
D.KOLEDNJAK
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DATE
2012-10-23
DRAWING NUMBER
WB5-REG-ENE-03-G-002-A3-1
DRAWING TITLE
IAP GAS SYSTEM FINAL ROUTE
SUB-PROJECT CODE
WB5-REG-ENE-03
SUB-PROJECT TITLE
FS and ESIA
for the Ionian - Adriatic Pipeline (IAP)
BENEFICIARY
Designed by
This project is implemented within the framework of IPF TA which is managed by
COWI • IPF CONSORTIUM

The European Union's 2008 IPA Programme for Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo*, Turkey and Iceland

Infrastructure Projects Facility
Technical Assistance Window (IPF TA)

EuropeAid/128073/C/SER/MULTI

Sub Project:
WB5-REG-ENE-03

FS and ESIA for the
Ionian – Adriatic Pipeline (IAP)

Preliminary Technical Study Report
Annex I

April 2013

This project is funded by the European Union

COWI • IPF CONSORTIUM

*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.

COWI • IPF CONSORTIUM

The European Union's 2008 IPA Programme for Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo*, Turkey and Iceland

Infrastructure Projects Facility

Technical Assistance Window (IPF TA)

Western Balkans

EuropeAid/128073/C/SER/MULTI

Sub project:
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FS and ESIA for the
Ionian – Adriatic Pipeline (IAP)

Preliminary Technical Study Report
Annex I

April 2013

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*) This designation is without prejudice to positions on status, and is in line with UNHCR 1244 and the ICJ Opinion on Kosovo declaration of independence

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LIST OF ABBREVIATIONS

€cts	EURO cents
IAP	Ionian – Adriatic pipeline
METE	Ministry of Economy, Trade and Energy of Albania
MoEFWA	Ministry of Environment, Forests and Waters Administration (Albania)
PA	Protected Area
TAP CS	Trans Adriatic Pipeline Compressor Station

1. Synopsis

Project Title: Feasibility Study and EIA & SIA Ionian – Adriatic Pipeline

Project Number: WB5-REG-ENE-03

Contractor: COWI-IPF Consortium

Beneficiaries:

Croatia:
Plinacro Ltd and Ministry of Economy.

Bosnia & Herzegovina;
Ministry of Foreign Trade and Economic Relations represented by BH-Gas and Gaspromet.

Montenegro:
Ministry of Economy.

Albania:
Ministry of Economy, Trade and Energy.

Project start date: 08/05/2012

Project Duration: 22 months

Anticipated completion: February 2014

2. Introduction

In December 2012 METE suggested including in the technical study the variant of the pipeline route sections passing from the town of Fier to Tirana via Elbasan. The Interstate Committee supported this proposal

Based on this four different route options connecting the towns of Fier and Elbasan were drafted by the Consultant and at a meeting with METE in February 2013 the most favourable option was selected to be analysed in more details.

The results of this analysis and results of comparison between two possible IAP pipeline routes between Fier and Tirana (Ahmetaq) are presented in this Annex I.

3. Routes description

3.1. Description of considered pipeline variants in Albania: section Fier – Ahmetaq

The two route options considered in this document are shown in the map below

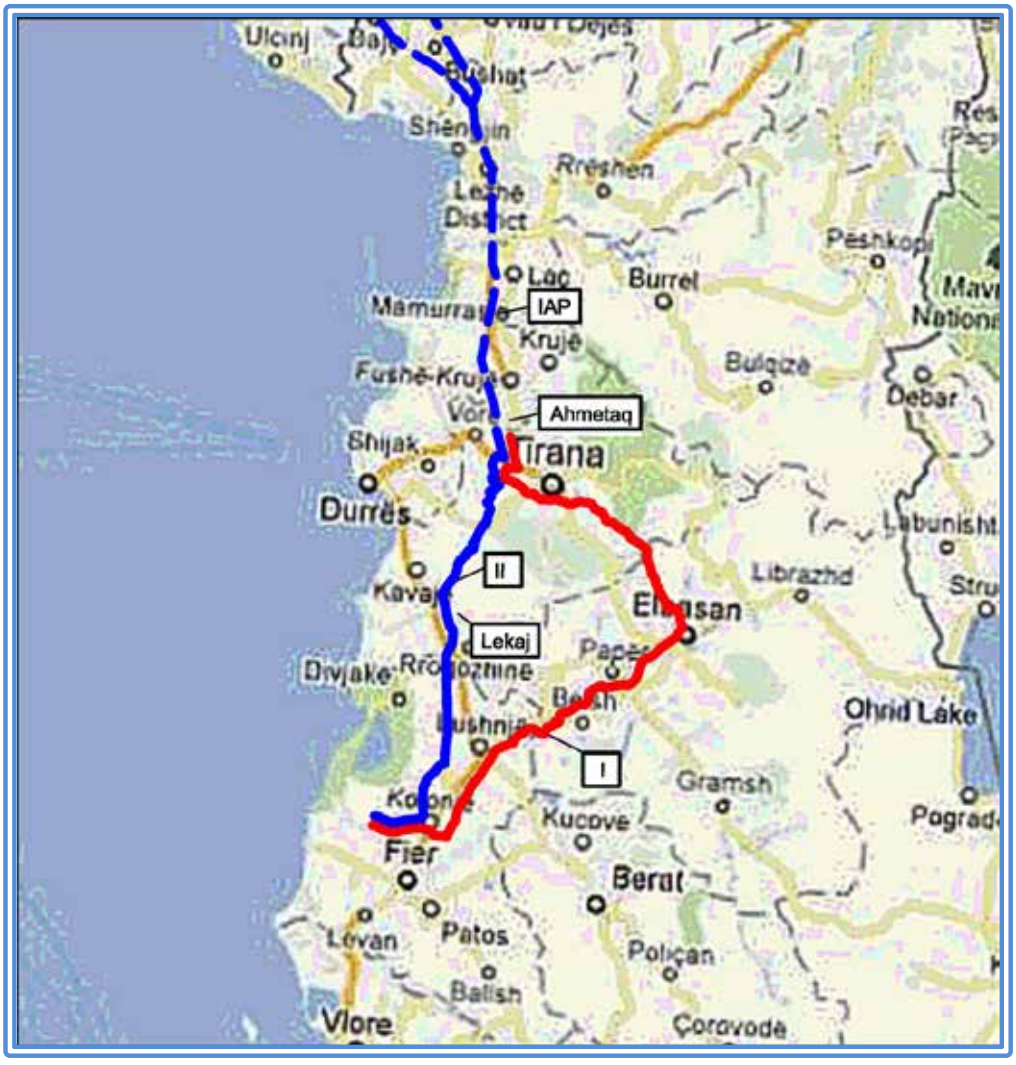


Figure 1: Route section I and II

Section I (Fier – Elbasan - Ahmetaq)

The route starts at compressor station on the TAP system near Fier and runs to east toward Mbrostar. In its route pipeline crosses river. From Mbrostar parallel to the road the route runs toward Lushnja. The pipeline runs mostly through flat agriculture areas. In north - east direction of Lushnja the route runs toward Elbasan through a hilly terrain crossing the flat valleys between hills. In the Elbasan area the route runs through urban area and reaches the route of the new road between Elbasan and Tirana. Parallel to the new road the pipeline route runs toward Tirana through hilly terrain. The route passes Tirana from the south parallel to the river and runs toward Ahmetaq in north direction.

In this section no major problems for construction of pipeline are to be expected.

Total length of section I	124 km
Highest point of the pipeline	630 m
Lowest point of the pipeline	10 m
Maximal operating pressure	85 bar

Section II (Fier –Ahmetaq, via Lekaj)

The route starts at compressor station on the TAP system near Fier and runs to east then turns toward north. The route crosses river and runs in northern direction parallel to the costal line to the Staravec village. The pipeline crosses agriculture areas, mainly flat terrain which is not difficult for construction. From Staravec the route runs in northern direction toward Ahmetaq. The pipeline crosses flat agriculture areas and then south – west of Tirana crosses a hilly terrain, and reaches Tirana area west of the city. In this section no major problems for construction of the pipeline are to be expected.

Total length of section II	88 km
Highest point of the pipeline	320 m
Lowest point of the pipeline	10 m
Maximal operating pressure	85 bar

4. Economic calculations

The aim of these analyses was to evaluate the economic effects of new Fier – Elbasan – Ahmetaq transmission and more detailed Fier – Ahmetaq route on the transport tariff tendency for Albania taking into account expected gas market build up for each country.

The combinations of two Fier-Ahmetaq and two Albania-Montenegro connection routes resulted with economic analysis in four route options:

Var. A-II: Fier - Lekaj- Ahmetaq -Montenegro Podgorica route
Var. D-II: Fier - Lekaj - Ahmetaq -Montenegro coastal route
Var. A-I: Fier-Elbasan - Ahmetaq -Montenegro Podgorica route
Var. D-I: Fier-Elbasan - Ahmetaq -Montenegro coastal route

The economic analyses have been carried out with the following presumptions:

- Investment will be carried out through three years in same yearly amounts.
- System would be financed from funds obtained on financial markets through long-term borrowing at financial institutions

The price of borrowed capital has been calculated according to the following assumed terms and conditions:

- repayment period: 15 years,
- regular interest rate: 6% per annum
- repayment in equal semi-annual instalments

The operating and maintenance costs include:

- energy costs
- gas transportation system maintenance costs

The quantity of natural gas transported is a business event resulting in an increased financial and economic potential of the project.

The projected provision of natural gas transportation services is based on the assumed gas market build up from the draft gas market forecast. The new Elbasan gas pipeline route will supply gas to the potential gas power plant in Elbasan two years earlier than it is envisaged in the case of the coastal route development. The result of that is 1,2% higher project time average gas consumption.
Gas transportation costs are optimized in a way to meet internal rate of return of 7%, the project acceptability criterion.

The planned project period of 20 years is taken as one in which the investment project produces acceptable effects.
The investment and maintenance cost per pipeline section are taken from the Preliminary technical study presented in the following tables.

Table 1 Route variant IAP Albania – pipeline costs calculation

		Investment costs			Maintenance costs		
		Pipeline length	Specific investment cost pipeline	**Investment costs pipeline**	Annual fraction of investment	Total investment costs	**Annual maintenance costs**
Section		km	€/"m	**Mio €**	-	Mio €	**Mio €/a**
1	Fier - Staravec	38.1	26.84	**32.7**	1.00%	32.7	**0.33**
2	Staravec - Ahmetaq	54.3	31.79	**55.2**	1.00%	55.2	**0.55**
3	Staravec - Ahmetaq	63.2	30.03	**60.7**	1.00%	60.7	**0.61**
4	Ahmetaq - Balldre	45	27.83	**40.1**	1.00%	40.1	**0.40**
5	Balldre - Barlaj	66.5	33.22	**70.7**	1.00%	70.7	**0.71**
6	Balldre - Shtodher	27.6	30.14	**26.6**	1.00%	26.6	**0.27**

The route sections 1 Fier – Staravec, 2 Staravec- Ahmetaq and 3 Staravec-Ahmetaq are replaced with two new Fier-Ahmetaq route options and presented in the following table.

Table 2 New Fier-Ahmetaq route variants– pipeline costs calculation

		Investment costs			Maintenance costs		
		Pipeline length	Specific investment cost pipeline	**Investment costs pipeline**	Annual fraction of investment	Total investment costs	**Annual maintenance costs**
Section		km	€/"m	**Mio €**	-	Mio €	**Mio €/a**
I	Fier - Elbasan - Ahmetaq	124	30.25	**120.0**	1.00%	120.0	**1.20**
II	Fier- Ahmetaq	88	30.36	**85.5**	1.00%	85.5	**0.85**

Note: In the above table, Fier-Ahmetaq (88 km long) means Fier-Lekaj-Ahmetaq (Section II)

4.1. Transport tariff tendency projection

Shown in continuation is the transport tariff tendency projection for the planned period over which the investment project produces economically acceptable effects.

Table 3 Transport tariff tendency projection Albania

ALB

Period of the project life	**Year**	**20**			
Acceptability criteria of the project					
Internal rate of return (IRR)	**%**	**7.00%**			
Variant		**Var. A-II**	**Var. D-II**	**Var. A-I**	**Var. D-I**
Expected volume of transported natural gas, average	**mio m3**	**3 508**	**3 502**	**3 551**	**3 551**
Changes in the volume of transported natural gas	**%**	**0.0%**	**-0.2%**	**1.2%**	**1.2%**
Investment	**mio €**	**196.3**	**152.2**	**230.8**	**186.7**
Changes in the level of investment	**%**	**0.0%**	**-22.5%**	**17.6%**	**-4.9%**
Operation and maintenance costs	**mio €**	**2.0**	**1.5**	**2.3**	**1.9**
Changes in the level operation and maintenance costs	**%**	**0.0%**	**-25.0%**	**15.0%**	**-5.0%**
Transport costs	**€cts/m3**	**0.754**	**0.585**	**0.862**	**0.699**
Changes in the level of transports tariffs	**%**	**0.0%**	**-22.5%**	**14.3%**	**-7.4%**

The Albania-Montenegro route economic optimisation issues were presented in details in the Preliminary technical study, so in this material more focus will be given to the new Elbasan route economic optimization results.

When developing pipeline route options then the criterion is that the pipeline should pass near the centre of the future consumption if that is more feasible than some other more direct route.

If we follow this criterion then route to Tirana should pass near the city of Elbasan. Nevertheless, the Section I (Fier – Elbasan – Ahmetaq) route is 34.5 million EUR more expensive than Section II (Fier – Lekaj - Ahmetaq) route.

Result of this investment difference is 14.3% higher transport tariff of the Fier – Elbasan – Ahmetaq + Montenegro Podgorica route (0.862 €cts/m^3) than the more direct Fier – Lekaj – Ahmetaq + Montenegro Podgorica route transport tariff (0.754 €cts/m^3).

The difference between Fier – Ahmetaq + Montenegro coastal route tariff (0.585 €cts/m^3) and Fier – Elbasan – Ahmetaq +Montenegro coastal route tariff (0.699 €cts/m^3) is even higher by19.5%.

If we decide on direct Fier – Lekaj - Ahmetaq route through Albania, then connection pipeline branch toward Elbasan should be developed. Tirana-Elbasan pipeline branch development cost is estimated at 19 million EUR. Even if we add this cost to the investment costs for Section II (Fier – Lekaj – Ahmetaq) the total cost is still 15.5 million EUR less than the cost of Section I (Fier – Elbasan –Ahmetaq).

Although 15.5 million EUR relative investment difference allows us to reach potential Elbasan gas power plant consummation sooner; it does not result in smaller transmission tariff.

It should be stressed out that relatively large gas consumption potential in Elbasan area predominantly rely on the expected development of the gas fired power plant. Uncertainty related to the development of this plant has additional negative impact on the already 14% to 19% higher transmission tariff of the proposed Fier-Elbasan-Ahmetaq route.

Taking all that into account the results of the economic study indicate that Section II (Fier - Lekaj - Ahmetaq) is a more favourable solution for the IAP route.

However, this recommendation should be tested with the social and environmental impacts together with the technical aspects in the Doctus evaluation presented in chapter 6 of this Annex.

5. Potential environmental and social impacts

5.1. Description of environmental and social baseline conditions

5.1.1. Project location and pipeline corridor variants

The project area is located in the Western Lowland of Albania. The sections of the proposed pipeline corridor alternatives start at Fier District, at the potential site of TAP compressor station, and continue east to Lushnja town. METE has proposed two alternative corridor sections from Fier to Rinas/Ahmetaq (NW of Tirana): Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq; and Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq.

In the environmental study, the pipeline route Fier- Grabian – Lekaj – Tirana Rians/Ahmetaq is the direct route Fier-Ahmetaq of the technical study. Rinas is often used instead of Ahmetaq, because this location (Rinas) is more known than the little village of Ahmetaq.

Table 4 Sections of the pipeline corridor variants between Fier and Ahmetaq/Rinas

Section	Description
I	Fier- Lushnja- Elbasan – Tirana- Rinas/Ahmetaq
II	Fier- Grabian-Lekaj - Tirana – Rinas/Ahmetaq

Both these pipeline route variants merge at Vaqarr Village territory (west of Tirana), from which to Rinas/Ahmetaq they runs in the same route.

The table below indicates the names of the geographical locations traversed from the proposed sections of the pipeline corridor alternatives.

Table 5 Geographical locations traversed by the proposed pipeline corridor alternatives between Fier and Rinas/Ahmetaq

Section	Section's name	Detailed description of the pipeline route
1	Fier- Lushnja-Elbasan-Tirana – Rinas/Ahmetaq	From the TAP's compressor station, which is the starting point of the IAP projet, the pipeline route goes toward the east and crosses Semani River at Mojalli village. From Mojalli to Mbrostar the line route runs over the southern part of the Ardenica hill. Starting from Mbrostar, the pipeline route continues northeast following the new highway Fier-Lushnja. From Lushnja the pipeline route runs throughout a

		narrow hilly valley at Karbunara Village territory and then traverses the hilly area of Dumrea region (Elbasan County); From the northe-astern part of Dumrea the pipeline route runs through the flat terrain of Pazhok plain and then continues toward the East alongside the Shkumbini riverbed, which is crossed at the southern part of Elbasan town; After crossing a populated area in the western part of this town, the pipeline route runs along a narrow hilly valley (the Kushe stream valley), alongside to the new highway (under construction) Elbasan-Tirana; From the upper course of Kushe stream to Krraba village (Tirana District) the pipeline route runs over the top of a hilly terrain because of two tunnels of the highway Elbasan-Tirana; From Krraba tunnel to Mullet village the pipeline runs alongside the highway Tirana-Elbasan, which, in this segment, lies entirely in the Erzeni river valley; From Mullet to Vaqarr and further on to Kashar the pipeline route runs alongside the Tirana by-pass highway (under feasibility study); From Kashar to Rinas, the pipeline route runs in flat area, parallel to the highway Tirana – Lezha.
2	Fier- Grabian-Lekaj-Tirana - Rinas	From the TAP's compressor station, which is the starting point of the IAP projet, the pipeline route goes toward the Northeast following the western foot of Ardenica hill. At Fier Seman Village territory the line route traverses the narrow valley between Ardenica and Divjaka hills. Starting from the south-eastern edge of Divjaka hills, the pipeline route continues north following the eastern side of Divjaka hills through Terbufi Field. The pipeline traverses Shkumbini River in the northern part of Terbufi Village. From Shkumbini River the pipeline runs parallel to the highway till Lekaj (Kavaja District). From Lekaj to Vaqarr and further on to Kashar (West of Tirana) the pipeline route traverses a steep hilly area, which belongs to Kavaja and Tirana Districts; From Kashar (Tirana District) to Rinas, the pipeline route runs in flat area, almost parallel to the highway Tirana – Lezha.

The indicative map below shows the above proposed pipeline route alternatives from Fier to Ahmetaq/Rinas.

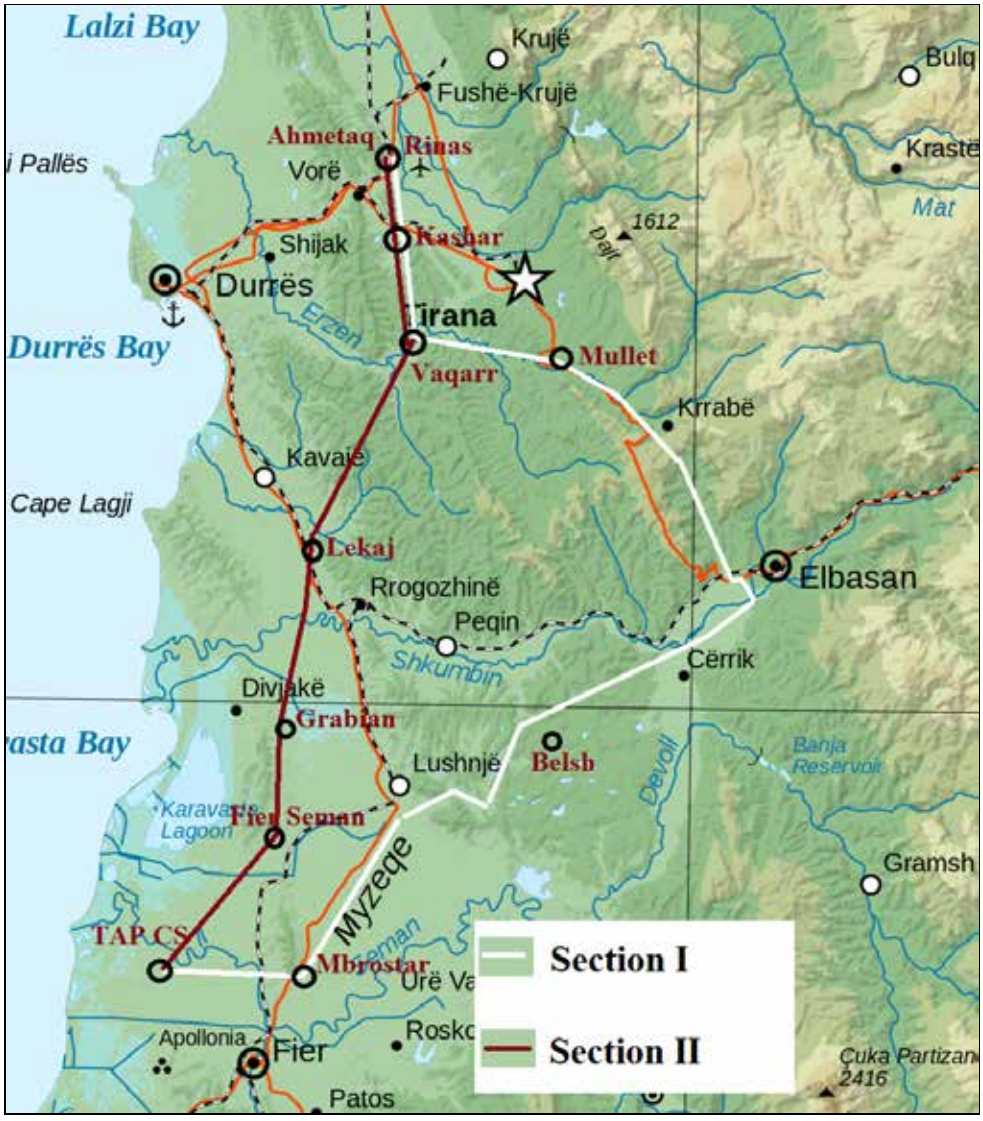


Figure 2: Proposed pipeline route alternative sections (I and II) from Fier to Tirana

To provide an improved description of the baseline environmental and socioeconomic conditions along the pipeline route, the proposed sections I and II of the pipeline corridor alternatives will be divided into segments of different lengths, which are linked to the landscape, land use, morphology of the terrain, geological settings, tectonic characteristics, ground and surface waters, soil category, geological hazards/risks, cultural heritage, etc.

The following table indicates the segments that belong to sections I and II of the proposed pipeline corridor options.

Section	*Segment*
I	TAP CS - Mbrostar
	Mbrostar – Lushnja
	Lushnja-Elbasan
	Elbasan city
	Elbasan-Mullet
	Mullet-Vaqarr-Kashar (West of Tirana)
	Kashar-Ahmetaq/Rinas
II	TAP's CS* - Fier Seman
	Fier Seman-Grabian-Shkumbini River
	Shkumbini River- Lekaj
	Lekaj- Vaqarr-Kashar (West of Tirana City)
	Kashar-Ahmetaq/Rinas

Table 6 Segments of the Sections I and II of the proposed pipeline route

5.1.2. Climatic characteristics

Based on the climatic division of the Albanian Territory, the project area is part of the Mediterranean Plain Climatic Zone. More particularly, both sections are part of the Central Mediterranean Sub-zone, which is characterized by mild and wet winters and hot and dry summers. It is important to note that the entire area of the Western Lowland of Albania is highly influenced by the Adriatic Sea. This influence can be seen by the minimum, maximum and average air temperatures.

In order to study the climatic characteristics of this particular area the long-term weather data provided by the nearby meteorological stations were collected. These meteorological stations are located in Fier, Lushnja, Kavaja, Elbasan and Tirana. The most important parameters are the yearly average temperature, the absolute maximum temperature and the absolute minimum temperature. The coldest month is January, whereas the warmest month is July. In the table below the temperatures measured at the above-mentioned meteorological stations are shown.

Table 7 Annual air temperature in the project area

Parameter	***Weather Station***				
Temperature (^{o}C)	Fier	Kavaja	Lushnja	Elbasan	Tirana
Annual average	16	14.8	15.9	15.1	15.1
Max abs.	39.5	39.8	39.7	42.2	41.5
Min. abs.	-7.0	-11.6	-8.2	-7.5	-10.4

Source: Hydro meteorological Institute, Tirana

The rainfall data are shown in the table below.

Table 8 Average yearly precipitation

	Weather station				
Rainfall mm	Fier	Kavaja	Lushnja	Elbasan	Tirana
Annual average rainfall	932	1050	980	1200	1210

Meanwhile, snowfalls are rare events in this area and are of no particular concern.
As a conclusion, the climate characteristics in the areas traversed from sections I and II of the proposed pipeline corridor, are similar.

5.1.3. Geomorphology and Geology

5.1.3.1. Overview of the geological settings

According to the geological map of Albania, the proposed pipeline corridor/sub-corridors traverse an area where outcrop en surface Quaternary, Molassic and flysch deposits, as well as limestone geological formations.

The wide study area is affected from geological hazards, which include: active tectonic faults (all the wide study area); small landslides; rock falls; erosion phenomena; and possible soil liquefaction (deposits within the wide study area).

Section 1: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

Fier-Mbrostar-Lushnja

From TAP CS to the western flank of Ardenica hill, the pipeline route runs over the clayey-silty-sandy quaternary deposits of the Fier Coastal Plain, with thickness of more than 100 m. The composition of the upper geological layers that outcrop in surface in the hilly terrain of Ardenica is made of clayey deposits of the Helmasi (N21h) geological unit, which is slightly affected from the erosion phenomena. No ground waters are expected in this hilly terrain.

From Mbrostar to Lushnja the pipeline route runs over the clayey-silty-sandy quatenary deposits of the Lushnja Plain, which thickness is between 100 and 200 m.

From Lushnja to Dumrea region (Elbasan District)

This segment of the proposed pipeline route runs throughout a hilly valley in the Karbunara Village territory. The hilly slopes are gentle. The upper geological layers that outcrop in surface in the hilly terrain are represented from clayey-sandy deposits of the Tortonian (N13t), age and from clayey-sandy-evaporite deposits of the Messinian age (N13m). Small landslides and mud flows affect the hilly slopes. It seems these geological hazards affect the top cover only, and are stimulated from the transformation of the shrubby areas in agricultural lands. No ground waters are expected in this area.

Figure 3: Left: South-North view:Small landslide in the hilly area in the eastern part of Lushnja town, within the territory of Karbunara village; Right: South-North view:Mud flow in the hilly area in the eastern part of Lushnja town, within the territory of Karbunara village

Dumrea to Elbasan

The Dumrea region, which lies mainly in Elbasan district, represents a sensitive area along the proposed pipeline corridor section Lushnja-Elbasan. It is composed by rolling hills with gentle slopes. All the 85 karstic lakes of this region lie over evaporite deposits of the Messinian age (N13m), which are composed mainly from gypsum and anhydrite layers. The evaporite deposits contain small quantities of highly solvable salts as Halite (NaCl/sodium chloride) and Sylvinite (KCl/potassium chloride). It seems that the presence of these solvable salt deposits is the main cause of the formation of the karstic lakes, as well as of numerous karstic holes and sink holes throughout the Dumrea karstic plateau.

The geological hazards are represented from the formation of karstic holes (fig. 3) and sinkholes, and from tectonic lines, which runs around the salty diapir of Dumrea region. In order to avoid as much as possible these tectonic lines, it is suggested to not pass the pipeline route along the contact surface between the clayey-sandy-evaporite deposits of the Mesinian age (N13m) and the clayey-sandy deposits of the Tortonian (N13t) age.

The top cover may also be affected from geological risks like small landslides because of the massive deforestation of this region for agricultural purposes.

Figure 4: Left: East-West view. Karstic sink hole in Dumrea region, within the territory of Gradishta village; Right: East-West view; Small landslide in the hilly area in northern part of Dumrea region, close to the proposed pipeline corridor, within the territory of Shales village

Figure 5: Norh-South view; Typical landscape in Dumrea region, in the territories of Shales and Gradishta villages. The lowest flat terrain is prone to possible creation of karstic holes because of the presence of highly solvable salt deposits

Northeast of Dumrea the pipeline route runs over the Pazhok field (Cerrik Field), which is composed of clay-silty-sandy quatenary deposits of low permeability. Their thickness is more than 10m.

Elbasan town

Within the territory of this town the pipeline route runs over quatenary clayey-silty deposits, with thickness varying from 15 to 20m.

Elbasan-Tirana

From Elbasan to Mullet (southwest of Tirana city) the terrain is rather mountainous and steep. The mountain chains, which lie mainly in a south-north direction, are formed from molassic, flysch and limestone formations. The mollasic and flysch deposits often are prone to erosion.

From Mullet to Vaqarr, where the pipeline route should follow the Tirana by-pass road (under feasibility study), the proposed pipeline route runs over the quatenary deposits of Erzeni River. While from Vaqarr to Kashar, the pipeline route traverses molassic and flysch deposits.

While from Kashar to Rinas/Ahmetaq the pipeline route runs over clayey-silty-sandy quatenary deposits.

Section 2: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

Fier-Grabian-Lekaj

From TAP CS to Fier Seman the pipeline route runs over the clayey-silty-sandy quatenary deposits of the Fier Coastal Plain, which thickness is more than 100m.

From Fier Seman to Grabian to Shkumbini River and further on to Lekaj the proposed pipeline route runs entirely in flat terrain over clayey-silty-sandy quatenary deposits that have a low water bearing capacity. The lowland is bordered from the west by the Ardenica-Divjaka-Kryevidhi hilly chain and from the east by the Lushnja-Dushku-Rrogozhina-Kavaja hills. The main geological structures, with northwest-southeast direction, are clearly outcropped on the existing relief. The upper part of the geological section in the hilly areas is represented by Pliocene (N2) and quatenary (Q) deposits.

Lekaj to Tirana

From Lekaj to Vaqarr and further on to Kashar (west of Tirana city) the terrain is rather high and steep. The hills, which lie mainly in a south-north direction, are formed from molassic and flysch formations that often are prone to erosion. Near Vaqarr Village territory (Tirana District) the proposed pipeline route runs over the quaternary gravel aquifer of Erzeni River, which has a local importance for the villages of this area.

From Kashar to Rinas/Ahmetaq the pipeline route runs over the clayey-silty-sandy quaternary deposits of the Tirana-Ishmi depression.

5.1.3.2. Tectonics and seismicity

Albania is one of the most seismically active countries in Europe (Meco & Aliai, 2000). The interaction between the Adriatic and the Albanian micro plate is the main reason for seismic activity in Albania. The study area is affected from numerous active tectonic faults. Among the ten identified earthquake source zones, the Lezha-Ulqini (LU), the Shkodra-Tropoje (ST), The Elbasan-Dibra-Tetova (EDT) and the Preadriatic Lowland (PL) ones are of importance for the project region.

According to the seismic intensity map of Albanian territory (Map of Seismic Regionalization of Albania, Scale. 1:500.000, Tirana 1980; approved by DCM no 371, of 12.20.1979), the wide project area is situated on the seismic intensity VII and VIII degree MSK-64, estimated for 100 year (with 70% probability), for an average soil category (2nd Soil Category, according to the technical condition KTP-N.2-89), while the sections 5 and 6 lies partly on IX degree. The expected maximal earthquake magnitude is Ms=7.2.

With respect to the sections I and II of the proposed pipeline route, the seismic intensity and the crossed active neo-tectonic faults, are as follows:

Section I: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq :

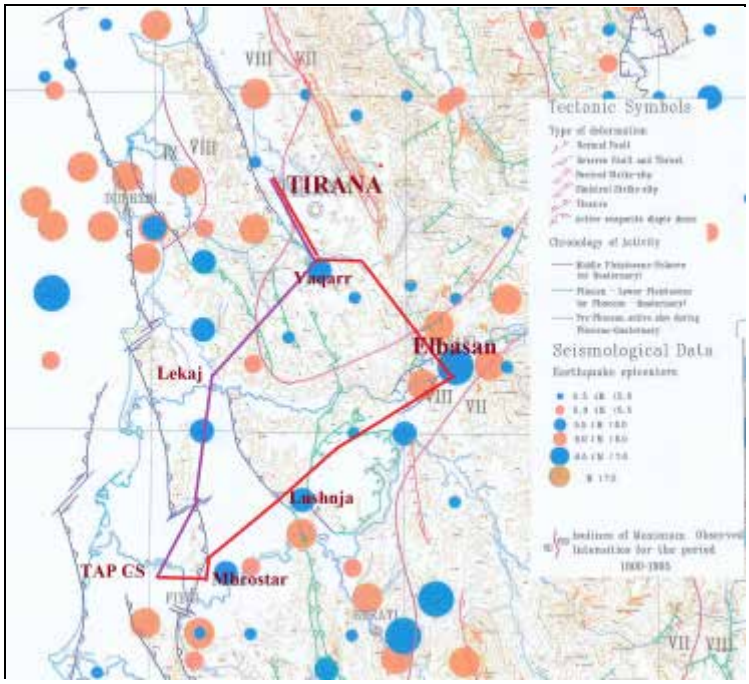
a. Seismic intensity: VII and VIII degree MSK-64; and
b. 6-7 tectonic faults crossings.

According to the Seismo tectonic map of Albania (Academy of Sciences, Seismological Institute, Tirana 2000), the earthquakes which have occurred along Section I are stronger than those which have occurred along section II

because of the important tectonic faults Vlora-Lushnja-Elbasa-Dibra-Tetove, along which runs the biggest part of the Section II of the proposed pipeline route.

Section II: Fier -Grabian-Lekaj-Tirana-Rinas/Ahmetaq :

a. Seismic intensity: VII and VIII degree MSK-64; and
b. 3-4 tectonic faults crossings.



Source: Seismotectonic map of Albania, Scale 1; 500,000 (Academy of Sciences, Seismological Institute, Tirana 2000),

Figure 6: Seismotectonic map of the project area.

5.1.4. Land Use and Settlement Patterns

5.1.4.1. Land Use

The Western Lowland of Albania, where the main part of the pipeline route is located, is distinguished by intense agricultural activities. It is also the most densely populated region of Albania, and an area of economic, touristic, and ecological value. Some of the highest land values in Albania are evident within this important region. Higher land values are encountered near the coastline and the major cities of Albania (Fier, Elbasan, Tirana).

The sections I and II of the proposed pipeline corridors pass through agricultural lands and to a lesser scale through forests, shrubs, pastures, scarce lands, and populated areas.

From Fier to Tirana, there are the following important areas of ecological, economical, or touristic values:

Section 1: Fier-Mbrostar-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

There are some areas of high economic and touristic values within this section. These are as follows:

-Karstic plateau of Dumrea, which is crossed by the pipeline route segment Lushnja-Elbasan. This plateau has high tourist values because of the presence of 85 karstic lakes and of some archaeological sites;

-Elbasan town, whose territory has high land prices because of: a- the opportunity for building individual houses and industrial objects; b-presence of cultural heritage sites/objects. This town has a favourable geographical location (in the crossroads north-south and east-west) and an existing industrial infrastructure (numerous buildings of the former Elbasan big steel factory); and

-Erzeni River Valley in the southern part of Tirana city (from Krraba to Mullet-to Vaqarr), where the price of land is high because of the opportunity to build individual houses in an area of high landscape values and of clean air.

Section 2: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

The proposed pipeline route does not cross any areas of significant ecological, economical, or touristic values in this section.

The proposed pipeline route runs through flat and hilly agricultural lands and shrubby/degraded forests areas, as well as through urban centres. The table below shows approximately the land use along the buffer area (10m wide) of the proposed pipeline route variants from Fier to Vaqarr (west of Tirana), where both these variants merge and continue towards Kashar and further on to Rinas/Ahmetaq.

Table 9 Land use along the pipeline route variants from Fier to Vaqarr

Section		Agricultural land			Shrubs & degraded forests (ha)	Inhabited areas (ha)	Total land required (ha)
		Flat agr. land (ha)	Hilly agr. land (ha)	Total. agr. land (ha)			
1	Fier-Lushnja-Elbasan-Vaqarr	45.5	46.5	92.0	16.2	1.8	110.0
2	Fier-Grabian-Lekas-Vaqarr	51.7	9.8	61.5	12.2	-	74.0

While the land use along the segment Vaqarr- Rinas/Ahmetaq (approximately 14 km long) that is common for both pipeline route alternatives, is shown in the table below:

Table 10 Land use along the common segment (Vaqarr-Rinas/Ahmetaq) for both pipeline route variants

Segment	Agricultural land			Shrubs & degraded forests (ha)	Inhabited areas (ha)	Total land required (ha)
Vaqarr-Rinas/Ahmetaq	Flat agr. Land (ha)	Hilly agr. Land (ha)	Total. agr. land (ha)			
	7.7	2.3	10.0	4.0	-	14.0

The results of the Table 9 and Table 10 lead to the table Table 11, which shows the land use along the sections Fier-Lekaj-Tirana-Rinas/Ahmetaq and Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq.

Table 11 Land use along the pipeline route variants from Fier to Rinas/Ahmetaq

Section		Agricultural land			Shrubs & degraded forests (ha)	Inhabited areas (ha)	Total land required (ha)
		Flat agr. land (ha)	Hilly agr. land (ha)	Total. agr. land (ha)			
1	Fier-Lushnja-Elbasan-Vaqarr-Rinas/Ahmetaq	53.2	48.8	102.0	20.2	1.8	124.0
2	Fier-Grabian-Lekas-Vaqarr-Rinas/Ahmetaq	59.4	12.1	71.5	16.2	-	88.0

5.1.4.2. Settlement Patterns in the Project Area

The proposed pipeline sections I and II passes through the territories of five Albanian districts (Fier, Lushnja, Kavaja, Tirana and Elbasan). Within the above districts, the line route passes through or in vicinity of some cities (Lushnja, Elbasan and Tirana).

Table 12 Affected districts and respective population in 2009, Albania

No	***Province (county)***	***Districts affected***	***Population***		
			Urban	***Rural***	***Total***
1	Fier	Lushnja	37,445	105,805	143,250
2		Fier	76,925	122,479	199,404
3	Tirana	Tirana	550,670	166,621	717,291
4		Kavaje	37,980	44,926	82,906
5	Elbasan	Elbasan	154,435	124,013	278,448
	Total Albania		1,573,431	1,620,986	3,194,417

Source: Institute of Statistic, Tirana

The intense growth of the informal settlements during the last 20 years, has led to a drastic increase of the urban population. Within the proposed pipeline corridor variants, the informal settlements have been developed overall nearby the towns of Elbasan (section 1) and Tirana (section 1).

With respect to sections I and II of the proposed pipeline route, the populated area affected adversely and directly from the construction activities are as follows:

Section 1: (Fier-Lushnja-Elbasan-Tirana--Rinas/Ahmetaq

Along this section, the proposed pipeline route traverses the following populated areas:

The city of Elbasan (154,435 inhabitants); and
The southern neighbouring of Tirana (Mullet area), where the new constructions are growing quickly.

Section 2: (Fier-Grabian-Lekaj-Tirana- -Rinas/Ahmetaq

From TAP CS to Tirana to Rinas there is no any important settlement traversed from the proposed pipeline route.

5.1.5. Socioeconomic baseline

The population in the Albanian part of the project area is distributed widely over the entire region's territory. The region of the Western Plains of Albania is rich in natural resources such as fertile plains, wetlands, water resources, beaches etc. Between the period of 1989 to 2012, the population of this area

had the highest growth rate in the country. This growth was mainly due to migration of population into this region because of its favourable conditions such as geographical position, climate, soil quality, employment possibilities, better infrastructure network (roads, railways, power and electricity supply, etc.)

Meanwhile, during the same period, the population in the rural areas has decreased due to the high rate of internal migration from the mountainous regions towards the urban areas, coastal areas, and good agricultural lands. Thus, within the Albanian part of the project area, the population of the towns and cities of the Western Plains has increased drastically.

The highest migration rates towards other countries (Italy, Germany, USA, Greece, etc.) are recorded in the coastal urban centres (Fier, Durres, Tirana, Lezha, Shkodra, Koplik, etc.) and some rural communes.

The unemployment rate is comparatively lower than other regions of Albania, but it is relatively high compared to other countries. This is an indication of the high level of poverty in the greater part of the project region, especially within the rural areas, which is also due to the small quantity of the agricultural land per capita.

During the last decades, a notable improvement of the national and rural road infrastructure has been recorded. Additional improvements have been recorded on other facilities like Durres and Shengjini ports and; drainage and irrigation networks; educational and health infrastructure and services; power and drinking water supply infrastructure and services; tourist infrastructure and services; creation of small and medium industrial, agricultural, artisanal, and service enterprises; etc. Thus, the local population of the project area and the central and local state institutions are making considerable efforts to improve the economic and social indicators, and consequently lower the unemployment and poverty rate.

The project region between Fier and Tirana also has valuable cultural resources and tourist attractions. Among the natural resources are Divjaka Pine Forest (National Park and proposed Emerald site), and Karavasta Lagoon (Ramsa site and proposed emerald site). In the karstic Plateau of Dumrea there ara approximately 85 big and small karstic lakes. This Plateau, composed of rolling hills, has special landscape and tourist values. Meanwhile, riparian forests surround the Semani, Shkumbini and riverbeds. Lastly, there are numerous protected areas that are distinguished in a national and regional scale as IPAs (Important plant area) and IBAs (Important Bird Area).

Among the cultural resources of the project area are many castles dated from Illyrian to medieval periods. Meanwhile, in the territories of Elbasan and Fier counties, there are a great number of archaeological sites and objects.

Some of the most environmentally and socioeconomic valuable sites within the proposed pipeline corridor are:

Section I (Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq)

Along this section, the proposed pipeline route traverses some sites of significant environmental and socioeconomic values. These are as follows:

-the Karstic Plateau of Dumrea (segment from Lushnja to Elbasan), which has approximately 85 big and small karstic lakes and some archaeological sites, and consists of special tourist values;

-the territory of Elbasan town, where the pipeline route traverses numerous settlements, as well as infrastructure areas/objects such as railways, power cables, industrial objects, etc. The underground areas of this town are also very rich in archaeological heritage; and

-The southern neighbouring of Tirana city, from Krraba to Mullet to Vaqarr where new constructions are growing quickly because of: a-the construction of the new road network; b-the construction of the big trade centers (Carrefour, etc) and recreational objects; and c- the construction of new dwelling centers in the beautiful landscape and far from the polluted and noisiest city of Tirana.

Section II (Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq):

Along this section, the proposed pipeline route does not cross any site of significant socioeconomic value.

From TAP CS to Lekaj, the proposed pipeline route runs through flat agricultural lands, while from Lekaj to Vaqarr (West of Tirana) through shrubs, degraded oak forests, scarce lands and some small parcels of hilly agricultural lands.

The Divjaka Pine Forest (National Park and proposed Emerald site) and Karavasta Lagoon (Ramsar site and proposed emerald site) are located more than 5 km far from the proposed pipeline route (segment TAP CS – Grabian).

5.1.6. Water Resources and quality

The whole project area lies in the Western Lowland of Albania, which is traversed from all the most important Albanian rivers, which run over and through the most important Quaternary gravel aquifers of the country. These aquifers serve to supply with drinking water the majority of the principal Albanian urban centres that are located mainly within the Western Lowland of the country.

5.1.6.1. Ground waters

Section 1: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

From TAP CS to Mbrostar to the western flank of Ardenica hills the proposed pipeline route does not run over any aquifer. The water bearing of the

traversed Quaternary deposits (mainly clays, silts, and sands) is low and without any practical importance for the local population. The ground waters of these clayey-silty-sandy deposits are of bad quality. The villages located in the northern part of this plain are supplied with drinking water from water pipelines, which are supplied from the hydrological wells drilled in the molassic geological formations located within the Radostina village territory, which lies in the hilly area situated in the east of the above-mentioned coastal plain

Across the Ardenica hill, which is traversed by the pipeline route, the composition of the upper geological layers that outcrop in surface is made of clayey deposits of the Helmasi (N_2^1h) geological unit (fig. 3), which is slightly affected from the erosion phenomena. No ground waters are expected in this hilly terrain.

From Mbrostar to Lushnja, the proposed line route runs over the southern part of the important aquifer of Lushnja, which water bearing layers are composed of gravels and sands. Along this pipeline route segment the thickness of the impermeable clayey-silty cover, which overlies the Southern edge of Lushnja aquifer, is more than 100 m thick. Thus, this aquifer in this area may not be affected from the project activities.

The segment from Lushnja to the eastern edge of Dumrea karstic plateau runs over geological formations without waterbearing capacity and permeability.

At Pazhoku field and throughout Elbasan town the proposed pipeline route runs over the Shkumbini quaternary gravel aquifer, which is one of the most important in national scale. The thickness of the clayey-silty cover in Pazhok field is more than 10m.

Further investigations are necessary to know the recharge areas of this aquifer, in order to not pollute the ground waters during construction activities.

From Elbasan to Mullet the pipeline route runs over molassic and flysch formations, which has a low water bearing capacity. In the southern part of Mullet, at Iba village territory, the highway under construction runs in the Erzeni riverbed. Since the pipeline should run along this highway, it a risk for groundwaters pollution because this segment of the Erzeni riverbed is a recharge area.

From Mullet to Vaqarr the proposed pipeline route should follow the Tirana by-pass road, which lies over the quatenary Gravel aquifer of Erzeni River. This aquifer has only a local importance, but still it remains the risk of groundwater pollution at the river crossings.

From Vaqarr to Kashar (West of Tirana), the geological deposits have a low water bearing capacity, while from Kashar to Rinas/Ahmetaq the proposed line route runs over the south-western part of the important quatenary gravel aquifer of Tirana-Ishmi.

Conclusion: Along the section 1, the pipeline route runs over the following quatenary gravel aquifers:
-the Lushnja Aquifer (important in national level);
-the Elbasani Aquifer (important in national level);
-the Erzeni River Aquifer (important in local level); and
-the Tirana-Ishmi Aquifer (important in national level).

Section 2: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

Segment TAP CS – Fier Seman Village

In the Coastal Plain located in the western part of Ardenica hills the proposed pipeline route does not run over any aquifer. The water bearing of the traversed quatenary deposits (mainly clays, silts, and sands) is low and without any practical importance for the local population. The ground waters of these clayey-silty-sandy deposits are of bad quality. The villages, which territories should be traversed by the proposed pipeline route are supplied in drinking water from water pipelines that are supplied from the hydrological wells drilled in the molassic geological formations located within the Radostina village territory, which lies in the hilly area situated in the east of the above-mentioned coastal plain

Segment Fier Seman-Grabian-Shkumbini River

From Lushnja to Shkumbini River the proposed line route runs over the eastern edge of the Lushnja aquifer, which is classified among the seven most important quaternary gravel aquifers of Albania. The thickness of the gravel layer that comprises this aquifer generally ranges from 7 to 25 m; in some locations near the Shkumbin River, its thickness is more than 35 m. The overlying quatenary (Q) deposits, which consist mostly of clayey-silty-sandy sediments, have a thickness from 30 m in the north to 200 m in the south.

Segment Shkumbini River – Lekaj

From Shkumbini River to Lekaj (hilly foot of Rrogozhina-Kavaja hills) the proposed line route runs over quatenary sediments composed mainly of clays, silts, and sands that have a low water bearing capacity.

Segment Lekaj-Tirana

From Lekaj to Kashar (West of Tirana), the proposed pipeline route runs over molassic and flysch deposits, which have a low water bearing capacity and permeability. This segment does not represent- any importance from the ground waters standpoint.
From Kashar to Rinas the pipeline route runs over the Tirana-Ishmi quatenary gravel aquifer, which is important in national level.

Conclusion: Along the section 1, the pipeline route runs over the following quatenary gravel aquifers:
-the Lushnja Aquifer (important in national level);

-the Erzeni River Aquifer (important in local level); and
-the Tirana-Ishmi Aquifer (important in national level).

5.1.6.2. Surface waters

Section I: Fier-Lushnja-Elbasani-Tirana-Rinas/Ahmetaq

This section of the pipeline route traverses three important rivers (more than 8 crossings), as follows:
-Semani River: Crossed once at the territory of Mujalli Village, west of Ardenica hill;
-Shkumbini River: One crossing at the southern part of Elbasan city; and
-Erzeni: more than 6 crossings at Ibe (1-2 crossings), Berzhite (1 crossings), Petrele (1 crossing) and Vaqarr (3 crossings) villages territories.

In addition, in the territory of Berzhita commune (Tirana District) the new highway Elbasan-Tirana, alongside which the pipeline route lies, runs alongside and joint to the Erzeni River.

Figure 7: The new highway Elbasan-Tirana (under construction) at Berzhita Village territory (Tirana District) and the Erzeni River. At this location, the highway runs between the river and a hilly steep terrain.

Section II: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

From TAP CS to Tirana, the pipeline route traverses three important Rivers, as follows:

-Semani River (between TAP CS and Grabian);
-Shkumbini River (in the segment Grabian-Lekaj, close to Rrogozhina Bridge);
-Erzeni River (in the territory of Vaqarr Village).

This section of the pipeline route traverses three important rivers (3 crossings): Semani (near TAP CS), Semani (near Rrogozhina Bridge) and Erzeni (near Vaqarr Village).

5.1.7. Biological environment

5.1.7.1. Biodiversity

General overview

Within the project area the landscape consists of flat lands covered from agricultural lands and inhabited areas and of hills covered by Macchia, degraded forests dominated by mixed deciduous oak, and partly covered by olive trees and almost totally in urban and suburban areas, arable land and many other more or less transformed areas used mainly for crops, vineyards and other fruit trees. The study area is characterized by numerous drainage and irrigation channels. The Semani, Shkumbini and Erzeni Rivers are the sites of the riparian vegetation of the region.

Biodiversity along the sections of the proposed pipeline corridors

The following sections provide a short description of the main vegetation types and habitats occurring along the proposed pipeline corridors, listing key species, abundance and distribution within the study area and its sensitivity.

Section I: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

Fier-Mbrostar

From Fier to Mbrostar, the pipeline route runs in a west-east direction. The terrain is flat and lies west of Ardenica hills. The pipeline route traverses also the Ardenica hills. Olive groves and agricultural lands are one of the most typical landscape units of the area. Patches or small areas of the riparian vegetation can be found following the River crossings of Semani River. This very open vegetation, colonizing poorly stabilized alluvial deposits periodically flooded, is characterized by dominance of the Salix alba, Alnus glutinosa, Platanus orientalis,etc.

Mbrostar-Lushnja

From Mbrostar to Lushnja, the proposed sub corridor passes in flat terrain. Arable lands and their associated irrigation systems constitute the majority of the habitats present within the study area. The most important crops cultivated in these areas are Corn, Barley and Alfa-Alfa. Horticulture in the study area is mostly presented by olive trees, vineyards and other fruit trees.

Lushnja to Cerrik Field (Pazhok field)

From Lushnja to Cerriku field the pipeline route traverses the rolling hills of Lushnja and Dumrea. Olive groves and agricultural lands are one of the most typical landscape units of the area. Forest formations dominated by a mix of deciduous oak species including Quercus pubescens, Quercus cerris and Quercus frainetto are found across small parts of the study area in the hilly areas. Besides Carpinus orientalis forms patches of almost pure forest throughout the area. This shrubby formation represents degraded stage of

former forests mainly dominated by Quercus cerris, associated by Quercus pubescens or Quercus frainetto. They generally represent degraded forest treated as coppice, used by the local population for fire wood and for grazing and branch cutting for livestock food basis during the winter.

Natural eutrophic lakes are found in different parts of area. These lakes are characterized by common plant species typical of the fresh water habitats. Most of the species recorded such as Phragmites australis, Typha angustifolia, Juncus bulbosus, Eleocharis acicularis, Cyperus fuscus, C. flavescens, Scirpus setaceus, Salix alba, Tamarix parviflora etc, are relatively frequent in wetland habitats elsewhere. Although wetland itself is of high ecological interest, these lakes occurring in the Transmission line area are of little botanical interest. They are considered to be common on both a local and national scale.

The Cerriku field (Pazhoku field).
Arable lands and their associated irrigation systems constitute the majority of the habitats present within the Pazhoku field. The most important crops cultivated in these areas are Corn, Barley and Alfa- alfa. Horticulture in the study area is mostly presented by olive trees, vineyards and other fruit trees. Weeds are a common element or constitutes in a different scale vegetation of these cultivated areas.

Patches or small areas of the riparian vegetation can be found following the River crossings of Shkumbini River in southern part of Elbasani city. This very open vegetation, colonizing poorly stabilized alluvial deposits periodically flooded, is characterized by dominance of the Salix alba, Alnus glutinosa, Platanus orientalis,etc.

In general the value of habitats encountered within the pipeline area from Fier to Elbasan is Low. The vegetation is dominated by common plant species, with low plant species diversity, low value and the absence of species that are considered to be rare in a local or national context.

Elbasan to Krraba tunnel
From Elbasan to the northern entrance of Krraba tunnel (under construction) the pipeline route runs mainly along the narrow hilly valley of Kushe stream, which traverses a steep mountainous terrain. Patches or narrow belts of riparian vegetation dominated by Tamarix parviflora, Salix alba, Alnus glutinosa, Platanus orientalis,etc. can be found following the Kushe stream. This very sparse vegetation periodically flooded is poor in species and reaches its optimum development during the summer. Macchie and forest formations dominated by a mix of deciduous oak species very degraded are found across small parts in this hilly area. Actually these formations, mostly in vicinity of the villages have a strong human impact: cuttings, intensive grazing, and deforestations in some places with aim to profit arable land for cultivation of agricultural plants. Beside the above damages another factor with very big impact for these zones is caused by the erosion of the land.

The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Krraba tunnel to Mullet
From the northern entrance of Krraba tunnel to Mullet, the proposed pipeline route runs along the Erzeni River, parallel to the new highway.

Macchie or maquis is found fragmentary in the hilly areas of the pipeline route from Krraba tunnel to Mullet village. The Macchie is representing a stage of degraded evergreen Mediterranean forest or old forests of Quercus ilex. Climax formation or old forests of Quercus ilex, is almost fully extinct in this area. The most important species who give the physiognomy to this formation are the evergreen shrubs such as Arbutus unedo, Phillyrea angustifolia, Erica arborea,etc.

Forest formations dominated by a mix of deciduous oak species including Quercus pubescens, Quercus cerris and Quercus frainetto are found across small parts of the hills in the study area.

The Erzeni River is the site of the riparian vegetation characterized by dominance of the Salix alba, Alnus glutinosa, Platanus orientalis, Tamarix parviflora.

Actually, these habitat types, especially in vicinity of the villages have a strong human impact: cuttings, intensive grazing, and deforestations in some places with aim to profit arable land for cultivation of agricultural plants. In Albania, this type of vegetation has broader extent. The value of the vegetation and habitats encountered within the site is generally low.

From Mullet to Vaqarr to Kashar
Arable lands and their associated irrigation systems constitute the majority of the habitats from Mullet to Vaqarr. The most important crops cultivated in these areas are Corn, Barley and Alfa-alfa. Horticulture in the study area is mostly presented by olive trees, vineyards and other fruit trees. Weeds are a common element or constitutes in differ scale vegetation of these cultivated areas. In general the value of these habitats encountered within the pipeline area is low. The vegetation is dominated by common plant species typical of cultivated lands, with low plant species diversity and low value.

Patches and narrow belts of the riparian vegetation can be found following the Erzeni River. This very sparse vegetation periodically flooded is poor in species and reaches its optimum development during the summer. Tamarix parviflora formation accompanied by the species Salix alba, Alnus glutinosa, Phragmites australis, Typha latifolia, Lythrum salicaria, Mentha aquatica, Populus nigra, Populus alba, Dittrichia viscosa dominates the area.

The formations of degraded macchia, give the dominant aspect and cover of the hilly areas. But generally this type of vegetation is very damaged by exploitation. The value of the vegetation and habitats encountered within the

site is generally low, due to the absence of species that are considered to be rare or threatened in a local or national context.

From Kashar to Rinas/Ahmetaq the pipeline route traverses mainly mixed mosaic agricultural areas, which represent insignificant biological values.

Section II: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

TAP CS to Grabian
From Fier (TAP CS) to Grabian, the pipeline route runs in a south-north direction. The terrain is flat and lies west of the hilly ranges of Ardenica. This route passes through two types of habitats including:

Mixed mosaic and recently abandoned agricultural areas; and
River habitat (running water at Semani riverbed).

Grabian to Lekaj
From Grabian to Lekaj, the pipeline runs totally through the flat agricultural lands. The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

The botanical value of the areas from Fier to Lekaj are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Lekaj to Vaqarr to Kashar
From Lekaj (Kavaja District) towards Tirana, the pipeline route traverses a hilly and steep terrain. Macchie and Forest formations dominated by a mix of deciduous oak species are found across small parts in this hilly area. Actually these formations, mostly in vicinity of the villages have a strong human impact: cuttings, intensive grazing, and deforestations in some places with aim to profit arable land for cultivation of agricultural plants. Beside the above damages another factor with very big impact for these zones is caused by the erosion of the land.

The route passes through several types of habitats including:

Degraded forest formations dominated by a mix of deciduous oak species;
Maccchie on hilly ranges between Tirana and Lekaj;
Mixed mosaic and recently abandoned agricultural areas; and
Stream/river habitat (running water).

The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Conclusion

Within the area of the pipe route, no protected area and endemic, rare or endangered species were identified. Habitats were in general of low importance from a nature conservation perspective.

5.1.7.2. Natural heritage and protected areas

The nearest protected areas to the proposed pipeline route are given in the following table:

Table 13 Existing Protected Areas in the Fier-Tirana Pipeline Project area

Name of the Protected area	Category of Protection (Albanian Law on Protected areas)	IUCN Category	International importance	District	Distance from the proposed pipeline route
Divjake-Karavasta	NationalPark;category II	II	Ramsar Site	Lushnja	5-6 km
Seferan Lake	Nature Monument (NM); category IV	IV	-	Elbasan	2 km
Dega Lake	Nature Monument (NM); category IV	IV	-	Elbasan	2.5 km

Source: MoEFWA, 2012

From the above table it is noted that the proposed pipeline route goes far from any area of conservation concern already part of the network of Protected Areas. Thus no adverse impact of the project activities upon these areas is expected.

Figure 8: Indicative Map of Protected areas in the project region and the proposed pipeline route alternatives between Fier and Tirana (Source: MoEFWA, 2012)

5.1.7.3. Emerald Network in the Study Area

In 2008, in the framework of the Emerald Network development, 25 potential sites have been identified for inclusion in the Emerald Network in Albania (Council of Europe 2009). The list of proposed sites includes some sites within the wide study area, which are listed in the table below.

Table 14 Proposed Emerald Sites in Project area

No	***Emerald Sites in Albania***	***Site Code***
1	Divjaka Pine National Park	AL0000002
2	Shkodra lake Managed Nature Reserve (Albanian part)	AL0000009
3	Karavasta (proposed National Park)	AL0000016
4	Shengjin-Ishem (proposed Managed Nature Reserve)	AL0000017
5	Buna River-Velipoja Protected Landscape	AL0000021
6	Rrushkulli-Ishem Managed Nature Reserve (proposed)	AL0000024
7	Berzane Managed Nature Reserve	AL0000025

Among the proposed emerald sites, the nearest to the pipeline route are the Divjaka Pine National Park (AL0000002) and the Divjaka pine forest and the proposed national park of Karavasta (AL00000016). The Karavasta Lagoon is located approximately 5.5 km far from the pipeline route (segment TAP CS – Fier Seman), whilst Divjaka Pine National park is more than 6 km far from the pipeline route in the segment Grabian-Shkumbini River. Thus, none of the proposed emerald sites are affected from the proposed project activities.

5.1.8. Landscape and Visual Issues

Section I: Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq

Coastal plain between TAP's Compressor station and Mbrostar (Segment TAP-Mbrostar)

The IAP pipeline should join the Trans Adriatic Pipeline (TAP) in the coastal plain located between the Ardenica hills (in the east) and the Adriatic Sea (in the west), as well as between the river mouths of Vjosa (in the south) and Semani (in the north). This plain is represented by a flat terrain covered from agricultural lands. The Ardenica and Libofsha hilly chain, which is avoided by the pipeline route, lies in a south-north direction, in the middle of a flat agricultural terrain. The hills are covered mainly with olive trees, arable lands, and in a smaller scale with pine trees.

Figure 9: East-West view; Coastal plain between the Ardenica hill and the Adriatic Sea

Mbrostar-Lushnja

The section Lushnja-Mbrostar runs in a flat terrain, through arable lands along the Lushnja-Fier highway. The clayey-silty cover, which overlies the southern part of the Lushnja aquifer, seems to be thick. On both sides of the highway there are a number of small businesses (gas stations, bar-restaurants, etc.)

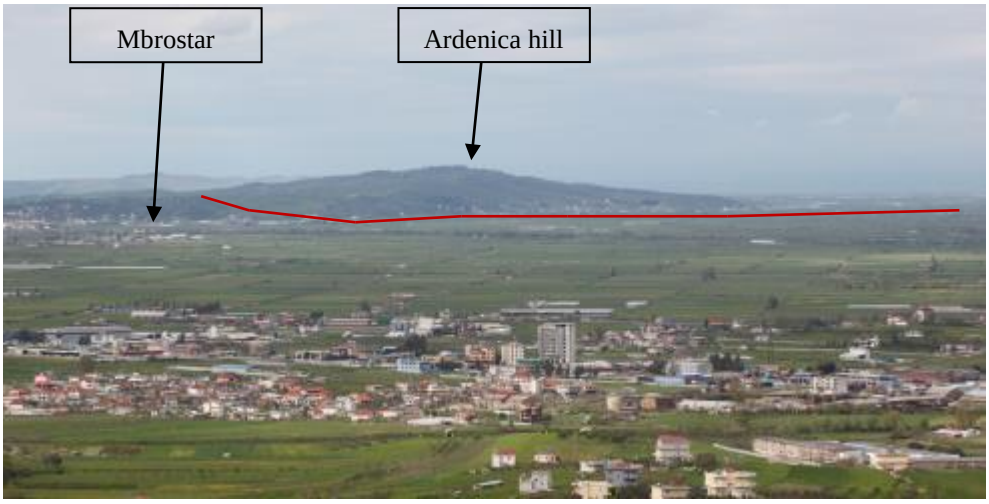


Figure 10: SE-NW view of the area between Lushnja town and Mbrostar (administrative border Lushnja/Fier districts)

Lushnja-Elbasan

From Lushnja, the proposed pipeline route runs along a narrow hilly Valley in the territory of Karbunara Village. The landscape is characterised by a rolling hilly terrain covered mainly by agricultural lands. The hilly slopes are gentle. Small landslides and mud flows affect the hilly slopes.

Figure 11: East-West view; Landscape in the Karbunara Village territory

From the northeastern part of Karbunara Village to Shkumbini River, the pipeline route traverses the Dumrea region (Elbasan District)

The Dumrea region, which lies mainly in Elbasan district, represents a sensitive area along the proposed pipeline corridor segment Lushnja-Elbasan. It is composed by rolling hills, covered mainly by agricultural lands, and in a lesser scale from shrubs.

There are approximately 85 small and big karstic lakes within Dumrea region (Elbasan County). Approximately 20 of them do not have water in the summer time. All these lakes, which are of natural origin, do not communicate with each-other. The proposed pipeline corridor section Lushnja-Elbasan runs along the northern part of Dumrea region, avoiding the most important karstic lakes.

Figure 12: East-West view; The western part of Dumrea region viewed from Gradishta hill.

Figure 13: South-North; The Northern part of Dumrea region viewed from Gradishta hill.

From the north eastern part of Dumrea, the pipeline route runs through aricultural lands towards the flat terrain of Pazhok field (Cerrik field) and then continues toward the North-East alongside the Shkumbini riverbed, which crosses at the southern part of Elbasan town.

Figure 14: SW-NE view; Pazhoku field (called also Cerrik Field)

Figure 15: SE-NW view; Shkumbini River close to the crossing point, southeast of the steel plant.

Elbasan town

From Shkumbini River to the north of Elbasan town, the pipeline route runs across the flat and densely populated area of Elbasan town. The landscape is dominated by individual houses, industrial objects (steel factory, power stations, etc.) and by transport infrastructure (roads, railway, etc.).

Figure 16: Northwestern-Southeastern view; Overview of the proposed pipeline route within the territory of Elbasan town

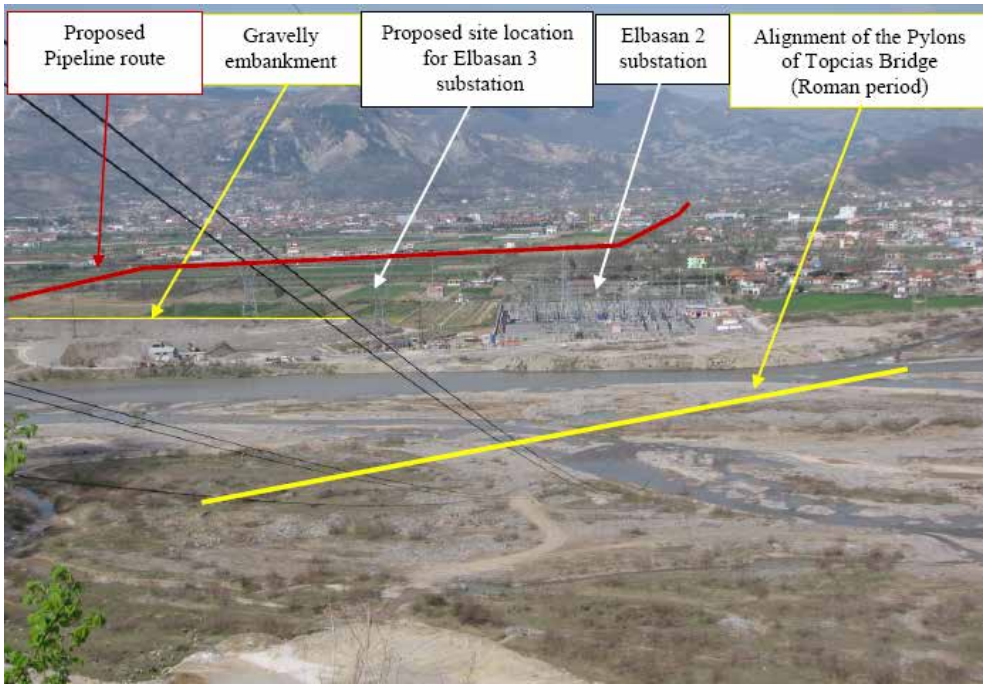


Figure 17: South-North view: Proposed pipeline route and landscape in the southern part of Elbasan

Elbasan-Mullet (Tirana district)
In the north-western part of Elbasan, the pipeline route runs along a narrow hilly valley (the Kushe stream valley), alongside the new highway (under construction). From the upper course of Kushe stream to Krraba village the pipeline route runs over the top of a hilly terrain because of two tunnels of the highway Elbasan-Tirana; From Krraba tunnel to Mullet village the pipeline runs alongside the highway Tirana-Elbasan, which, in this segment, lies entirely in the Erzeni river valley.

On both sides of the pipeline route the terrain is hilly and very steep and heavily affected from erosion and small landslides. The hilly relief is transversally interrupted by a series of small stream valleys. There are a few agricultural lands spread in the hilly area. The main part of the landcover is represented by shrubs, degraded oak forests and scarce lands. From Elbasan to Krraba Village territory (Tirana District) the inhabited areas are represented by rare and very small villages. From Krraba to Mullet the main watercourse is the Erzeni River, alongside which runs the new Elbasan-Tirana highway (under construction). It can be stressed that the Erzeni riverbed in this segment is rich in riparian forests and consequently represents special landscape value.

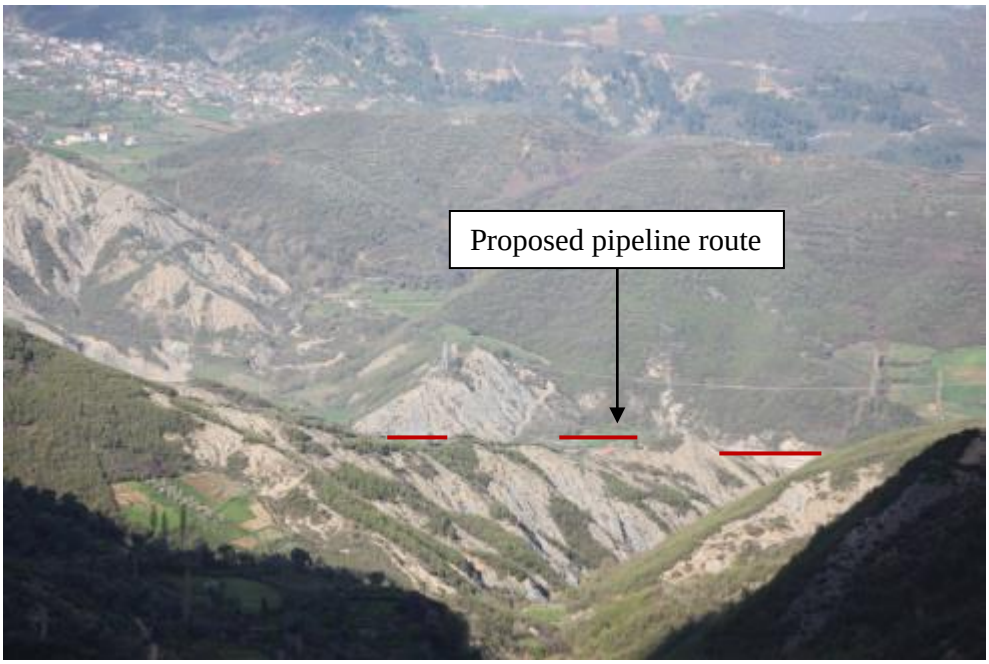


Figure 18: West-East view; Typical landscape in the segment Elbasan-Tirana; The proposed pipeline route runs alongside the new highway Elbasan-Tirana (under construction), which traverses the narrow valley of Kushe stream

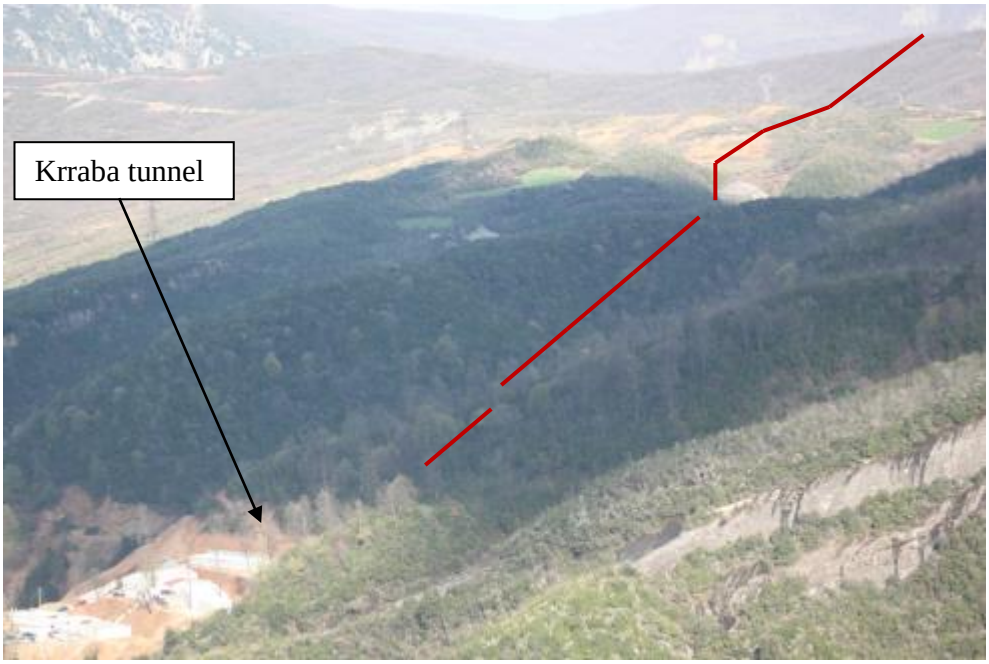


Figure 19: Potential pipeline route at Krraba tunnel. At this place the new highway traverses 2 tunnels. Consequently the pipeline route runs on the top of a mountainous terrain composed of hard rocks (mainly sandstones).

Mullet-Vaqarr-Kashar

From Mullet to Vaqarr and further on to Kashar the pipeline route runs alongside the Tirana by-pass highway (under feasibility study), which should follow the Erzeni River valley. The landscape is dominated by this river valley, which is bordered from the south and the north by hilly chains

Figure 20: SE_NW view; Eastern part of Mullet-Vaqarr area viewed from Petrela castle. The Tirana by-pass, along which the pipeline route runs next to the Erzeni River valley.

Kashar-Rinas/Ahmetaq
From Kashar to Rinas/Ahmetaq the landscape is dominated by agricultural lands and individual houses spread in the lowland on both sides of Tirana-Durres highway.

Section II: Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq

Coastal plain between TAP's Compressor station and Fier Seman village (Segment TAP CS-Fier Seman)

The IAP pipeline should join the Trans Adriatic Pipeline (TAP) in the coastal plain located between the Ardenica hills (in the east) and the Adriatic Sea, as well as between the river mouths of Vjosa (in the south) and Semani (in the north). This plain is represented by a flat terrain covered from agricultural lands. The Ardenica and Libofsha hilly chain, which is avoided by the pipeline route, lies in a south-north direction, in the middle of a flat agricultural terrain. The hills are covered mainly with olive trees, arable lands, and in a smaller scale with pine trees.

Figure 21: SW-NE view; Coastal plain between the Ardenica hills and the Adriatic Sea

Fier Seman-Grabian-Shkumbini River

The segment Fier Seman-Grabian-Shkumbini River runs in a flat terrain, through arable lands along the Lushnja-Fier highway. The clayey-silty cover, which overlies the central and northern part of the Lushnja aquifer, seems to be thick.

This segment runs entirely through flat agricultural lands in the Terbufi Plain, which is bordered from the west by the Ardenica-Divjaka hilly chain and from the east by the Lushnja-Dushku-Rrogozhina hills. The pipeline route crosses the Shkumbini River close to the Rrogozhina Bridge, where the riverbed does not have any special landscape value due to the lack of riparian forests.

Figure 22: East-West view; Typical landscape in the segment Fier Seman-Grabian-Shkumbini River viewed from Dushku Village hills.

Shkumbini River - Lekaj

This segment, which runs almost parallel to the highway Lushnja-Kavaja, traverses the flat agricultural terrain of Kavaja field. In proximity to Gosa Village (Kavaja District) and on both sides of the highway, there are a number of small businesses (gas stations, bar-restaurants, etc.).

Figure 23: East-West view; Landscape in the western part of Lekaj

Lekaj-Kashar (west of Tirana)

From Lekaj to the western part of Tirana City, the pipeline route traverses a hilly and steep terrain, which is heavily affected from erosion and small landslides (fig. 2). The hilly relief is transversally interrupted by a series of small stream valleys. There are a few agricultural lands dispersed in the hilly area. The main part of the land cover is represented by shrubs, degraded oak forests and scarce lands. The inhabited areas are represented by rare and small villages. The main watercourse in this area is the Erzeni River, which is traversed by the proposed pipeline route in the Vaqarr Village territory. It can be stressed that this riverbed in this area does not represents any special landscape value.

Figure 24: East-West view of the Lekaj-Tirana hilly area, viewed from the Ramushi Mountain Pass.

Figure 25: NE-SW view; Typical landscape at the southern part of Kashar area. The hills lie mainly in a south-north direction.

Kashar-Rinas/Ahmetaq
From Kashar to Rinas/Ahmetaq the landscape is dominated by agricultural lands and individual houses spread in the lowland both sides of Tirana-Durres highway.

5.1.9. Air Quality and Existing Emissions Load

Even though there are no data to monitor the air quality in the rural parts of the project area, it is believed that the air quality, including the suspended particulate matters, is within the acceptable parameters set by the Albanian legislation. The data from air monitoring during 2010 (SoER, MoEFWA, Tirana, 2012) show that typical air polluting substances like SO_2 and NO_x are at acceptable levels (DCM. No. 803, of December 04, 2003; "On air quality standards").

Meanwhile the suspended particulate matters, in the cities of Fier, Elbasan, and Tirana are above the acceptable limits. The main reasons for high particulate matters in these cities are vehicular traffic, poor quality of roads, environmentally non-compliant construction activities, and low quality of vehicular fuels (particularly that of diesel fuel, which is the most common vehicular fuel in this country).

In recent years, the air quality with regard to suspended particulate matters and PM_{10} has improved. This improvement is a consequence of increased quality of the road infrastructure, which has brought down the dust levels. Nevertheless, there is still concern about the levels of the pollutants in the air as long as they are above the allowed standards.

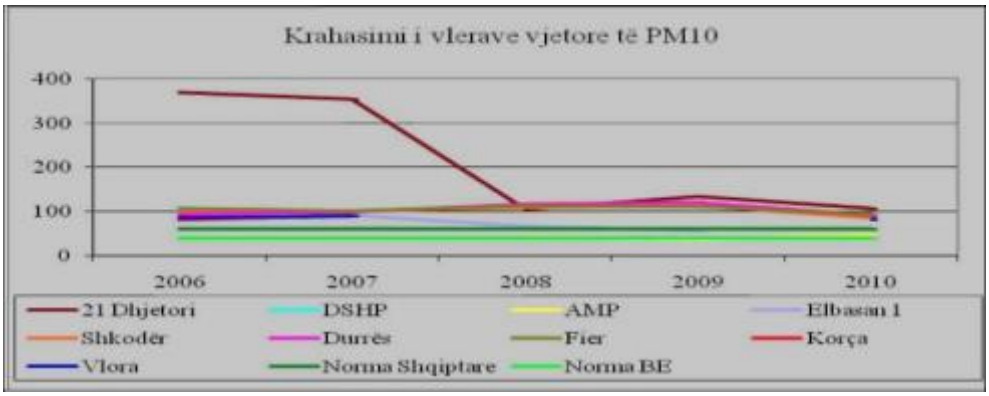


Figure 26: Data on PM10 from 2006 to 2010 for some Albanian cities.

In dark green: the Albanian norm; In light green: the EU norm (Source: State of Environment Report, MoEFWA, 2012)

The table below indicates the levels of eight indicators of air pollution in some Albanian cities during 2010.

Table 15 Average level of eight indicators of air monitoring during 2010

(Source: SoER, MoEFWA, 2012)

Monitoring Station	**SO_2**	**NO_2**	**LNP**	**PM 10**	**PM 2.5**	**O_3**	**Pb**	**CO**	**Benzene**
21 Dhjetori	24.07	46.08	1967	106.		55.69	0.069		
DSHP (Tirana)	15.23	24.73		81.5		44.15	0.055	0.45	0.49
AMP (Tirana)	9.88	17.41	74.0	44.8		43.35	0.042	0.38	0.62
Alba 1 (Tirana)	4.77	27.27			27.17	49.13			
Alba 2 (Tirana)	9.66	46.9		58.5	34.73	92.58			
Elbasan 1	18.4	29.39		116.				0.51	0.45
Shkodra	17	26.5	182	86		70.6	0.22		
Durrës	20.1	28.1	192	91		67.4	0.25		
Fier	26.7	31	195	93		62.6	0.24		
Korça	19.9	24.6	186	85		62.3	0.22		
Vlora	21.8	26	176	80		68.1	0.21		
Albanian norm	60	60	140	60	15	65	1	2	5
EU norm		40		40	25		0.5		5

Two Albanian urban centres are directly affected by the proposed pipeline corridor: Elbasan and Tirana. Elbasan town is traversed by Section I, which also runs close to the peripheral south of Tirana city.

5.1.10. Noise and Vibration

The level of the noise in the rural parts of the study area, which are far from the influence of urban, transport, and industrial activities, is low. Even though there is no monitoring of the noise levels in the residential areas, it is estimated that noises in these environments are within the acceptable limits.

Meanwhile, a monitoring of the noise levels was conducted by the Public Health Institute of Albania (PHI) for 7 cities in Albania. Apart from Tirana and

Durres, where noises are above the acceptable levels, the other cities including Shkodra and Fier have low levels of noise, due to lower intensity of economic activities. Tirana and Durres had noise levels up to 70 dB (A) or higher during the day. At night, their level of noise falls down to 40 dB (A). The other cities have noise levels up to 62 – 65 dB (A) during the day and 30 – 34 dB (A) during the night.

Despite the fact that the law on urban noise entered into force in 2007, Albania still lacks proper standards for the noise levels at various locations. The MoEFWA and the MH issued the Ordinance No. 8 of November 27, 2007 "On maximal levels of noises in the environment". This sub-legal act, which relies on the WHO recommendations, asserts that the acceptable levels shall be up to 50 -55 dB outside the residential dwellings, 35 dB (A) within the residential dwellings, and 30 dB (A) at night. Comparing the recorded data, it can be seen that noises are at acceptable levels during the night, but during the day, there is a sharp rise of up to 15 dB (A).

Two Albanian urban centres are likely to be adversely affected with regard to noise and vibration by project's activities: Elbasan and the southern neighbouring of Tirana. Elbasan town is traversed from the proposed Section I, which also runs close to the peripheral South of Tirana city. Section I does not traverse any important urban centre.

The following table shows that noise levels in Elbasan and Tirana are superior to the European standards. It should be stressed that the monitoring points are located in places with heavy traffic.

*Figure 27: Data on noise, in the principal cities of Albania compared to EU standards (in red: during **N**ight time, in blue: during **D**ay time)*

Source: State of Environment Report, MoEFWA, 2010

5.1.11. Cultural Heritage

Among the cultural resources in the area between Fier and Tirana, are many castles dated from Illyrian to medieval periods. Meanwhile in the territories of Elbasan and Fier counties there are a great number of archaeological sites and objects.

Some of the most valuable sites from the cultural heritage point of view within the proposed pipeline corridor are listed below.

Section I (Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq):

Along this section the proposed pipeline route traverses some sites of significant cultural values, as follows:

In Dumrea region (part of the segment Lushnja-Elbasan):

a-Archaeological site of Gradishta, located at the top of Gradishta hill that is rich in archaeological findings;
b-Ruins of the castles of Dragot and Kajan which are located more than 5 km from the proposed pipeline corridor;
c-Tumuli of Kajan Village, located approximately 5 km from the axis of the proposed pipeline corridor;

From Dumrea to the southern part of Elbasan town the closest cultural sites/objects to the axis of the proposed pipeline route are:

-Tumuli of Pazhok (early Bronze Age), located in Pazhok/Cerrik field, approximately 3 km southeast of the pipeline axis;
-Castle of Hidra, located 5 km south of the pipeline axis;
-Station of the Egnatia Road (Roman period), located less than 1km northwest of the proposed pipeline axis;
-Pylons of the Topcias bridge (Roman period), located approximately 700m from the axis of the proposed pipeline corridor;
-Station of the Egnatia Road (Roman period) in Bradashesh Village territory, located less than 1km from the proposed pipeline axis;

Figure 28: View of a pylon of the Topcias Bridge of the Roman period.

From Elbasan to Kashar (Tirana District) there is no known significant cultural site/object in the vicinity of the proposed pipeline corridor

Section II (Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq):

Along this section, the proposed pipeline route does not cross any site of significant cultural value. The national Archaeological Park of Apollonia is

located approximately 5 km from the TAP CS, south of the starting point of the proposed IAP project.

The nearest cultural object from the proposed pipeline route is the Castle of Ndroq (Tirana District), which is located less than 1km west of the axis of the pipeline segment Lekaj-Vaqarr; While the castle of Dorez (Tirana District) is located approximately 5.5 km east of this axis

Figure 29: Remnants of Ndroqi castle, located approximately 1km west of the proposed axis of the pipeline corridor

5.1.12. Occupational Health and Safety

When the company for pipeline construction will be contracted it will need a few hundred people for the period of construction, of at least 1 year.

Working with heavy equipment and also eventual use of blasting through hard rocks present serious hazards. Based on the geological study the Section I should pass over hard sandstones in the southern part of Krraba tunnel (segment Elbasan-Tirana).

During construction works, workers at the construction site will have to respect and implement the required principles and regulations on occupational safety (from Council Directive 92/57/EEC of 24 June 1992):

- keeping the construction site in good order and in a satisfactory state of cleanliness;
- choosing the location of workstations bearing in mind how access to these workplaces is obtained, and determining routes or areas for the passage and movement and equipment;
- the conditions under which various materials are handled;
- technical maintenance, pre-commissioning checks and regular checks on installations and equipment with a view to correcting any faults which might affect the safety and health of workers;
- the demarcation and laying-out of areas for the storage of various materials, in particular where dangerous materials or substances are concerned;
- the conditions under which the dangerous materials used are removed;
- the storage and disposal or removal of waste and debris;
- the adaptation, based on progress made with the site, of the actual period to be allocated for the various types of work or work stages;
- cooperation between employers and self-employed persons; and

- interaction with industrial activities at the place within which or in the vicinity of which the construction site is located

When performing the engineering and installation works and works related to operation of pipelines it is necessary to pay respect to dangers of electricity, dangers of inadequate lighting, dangers in case of maintenance and operation of shut-off systems, deficiencies of warning signs, hazards if prescribed personal protective equipment is not used, hazards in case of working with hazardous materials, hazards in case of dangers during movements, height work etc. Danger zones of explosion must be identified on the construction site. Evacuation plan for employees have to be created (in case of accidents that could endanger the life and health of employees - natural disasters, fires, explosions, etc.). All work has to follow an Occupational Health and Safety Plan which will help every worker to know the hazards of every job and how to avoid any dangers. All workers also have to receive proper training.

5.1.13. Waste

During construction works of the pipeline, construction waste will comprise mainly soil and rocks from excavation. Except these types of waste, during installation of the pipeline the packaging waste (plastic and cardboard) will occur. Also small quantities of household waste will emerge. It is supposed that some minor quantities of waste oils and oily materials will result from transport and operation activities of the machinery.

During maintenance of the pipeline in operation, small quantities of hazardous waste will occur. These waste may affect adversely the soil, the ground waters and the surface waters. The most sensible environments are the recharge areas of the rivers aquifers, as well as the permeable geological layers that outcrop in surface. That will be waste from cleaning the transport system. In case of decommissioning of the pipeline some types of reconstruction waste like metal, plastics and isolation materials will emerge.

5.2. Environmental and Socioeconomic impacts

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
Landscape and visual issues	Section I	Regional	Adverse impact on the landscape from construction activities from excavation of pipe trenches, backfill due to the stabilization processes and the construction of ground pipeline elements; The adverse visual impact of ground pipeline elements is most pronounced in areas with significant natural or anthropogenic landscape values which are in opponent status with out of context modern technological elements; Temporary negative visual impact created by digging trenches or clearing of vegetation caused by the gas pipeline construction technology. It is expected that it will be reduced during the time under the influence of natural succession and atmospheric conditions; Likely adverse impact on the characteristic karst micro relief forms - sinkholes and pools (Dumrea region) is reflected in the form of degradation during the pipeline construction; Positive visual impact through the densely populated areas (Elbasan city and south western neighbouring of Tirana) by the ROW.	Landscape project to be prepared within the main design. Landscape project should pay special care to ground infrastructure facilities of the pipeline (planting high vegetation in their immediate surroundings); Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); Avoid PAs, or minimize, impacts, as practical as possible, by crossing through areas of low values of vegetation; Avoid as much as practicable the areas covered from forests and permanent crops during the design stage; Traverses the riverbeds in areas of poor vegetation, as well as in the narrowest places; Minimize the working strip through forested areas as much as practicable; Avoid the pipeline route through karstic areas (Dumrea region) as much as practicable; Avoid the pipeline route through areas susceptible to be affected from geological risks (landslides, erosion, soil subsidence, etc.). Develop a communication strategy with stakeholders.

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
	Section II	Local	Adverse impact on the landscape from construction activities from excavation of pipe trenches, backfill due to the stabilization processes and the construction of ground pipeline elements; The adverse visual impact of ground pipeline elements is most pronounced in areas with significant natural or anthropogenic landscape values which are in opponent status with out of context modern technological elements; Temporary negative visual impact created by digging a trenches or clearing of vegetation caused by the gas pipeline construction technology. It is expected that it will be reduced during the time under the influence of natural succession and atmospheric conditions; Positive visual impact through the densely populated areas by the ROW.	Landscape project to be prepared within the main design. Landscape project should pay special care to ground infrastructure facilities of the pipeline (planting high vegetation in their immediate surroundings); Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); Avoid PAs, or minimize, impacts, as practical as possible, by crossing through areas of low values of vegetation; Avoid as much as practicable the areas covered from forests and permanent crops during the design stage; Traverses the riverbeds in areas of poor vegetation, as well as in the narrowest places; Minimize the working strip through forested areas as much as practicable; Avoids the pipeline route through areas susceptible to be affected from geological risks (landslides, erosion, soil subsidence, etc.). Develop a communication strategy with relevant stakeholders.
Groundwater	Section I	Regional	The pipeline route runs over 3 of the most important Quaternary gravel aquifers of national importance (Lushnja, Elbasani and Tirana-Ishmi), as well as over 1 aquifer of local importance (Erzeni River aquifer); Contamination of groundwater is expected only in case of	Select the pipeline route at the peripherals of the aquifers; Overlie the aquifers where the impermeable clay cover is the most thick; Avoid the recharge areas of the aquifers; Construction and operation equipment maintenance;

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			accidental situations during construction and operation phase; Unregulated waste disposal during the construction phase.	Waste management plans for construction site; Waste management plans for operation period; Develop a communication strategy with relevant stakeholders.
	Section II	Regional	The pipeline route runs over 2 of the most important Quaternary gravel aquifers of national importance (Lushnja and Tirana-Ishmi), as well as over 1 aquifer of local importance (Erzeni River aquifer); Contamination of groundwater is expected only in case of accidental situations during construction and operation phase; Unregulated waste disposal during the construction phase.	Select the pipeline route at the peripherals of the aquifers; Overlie the aquifers where the impermeable clay cover is the most thick; Avoid the recharged areas of the aquifers; Construction and operation equipment maintenance; Waste management plans for construction site; Waste management plans for operation period; Develop a communication strategy with relevant stakeholders.
Surface waters	Section I	Regional	Passes in the vicinity of some karstic lakes in Dumrea region. Traverses numerous streams, small rivers, as well as 3 of the most important rivers of the country, namely: Semani (once crossing), Shkumbini (once crossing) and Erzeni (6 crossings); Passes in the Erzeni Riverbed at the southern part of Tirana territory; Devastation of rivers natural flow due to pipeline construction; Increasing the turbidity level in watercourses during	Select pipeline route in the narrowest places of the riverbeds; Select pipeline route in due distance from the Karstic lakes of Dumrea region; Avoids the pipeline route in the riverbeds; To restrict impacts to the work belt (organization of construction site and working area according to high professional standards); Construction and operation equipment maintenance; Waste management plans for construction stage; Waste management plans for operation period.

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			construction phase; Contamination and thus reduce of water quality is expected only in case of accidental situations during construction and operation phase.	
	Section II	Regional	Traverses numerous streams, small rivers, as well as 3 of the most important rivers of the country, namely: Semani, Shkumbini and Erzeni; Devastation of rivers natural flow due to pipeline construction Increasing the turbidity level in watercourses during construction phase Contamination and thus reduce of water quality is expected only in case of accidental situations during construction and operation phase	Select pipeline route in the narrowest places of the riverbeds; To restrict impacts to the work belt (organization of construction site and working area according to high professional standards) Construction and operation equipment maintenance Waste management plans for construction site Waste management plans for operation period
Biological and Ecological Resources	Section I	Local	Loss of habitats - temporary (in working area) and permanent for forest & shrub habitats; change of structure of grassland habitats; Potential spread of invasive species on terrestrial part and sea (brought with ballast waters from working platforms) ; Animal disturbance – temporary during building of pipeline (noise, dust, air emissions, humane disturbance) and permanent for block-station, measuring-reduction stations and compressor station (i.e. noise); Temporary change of freshwater habitats due to work in	Selection of route and related working areas which will avoid sensitive and rare habitats; Minimization of working area; Restoration of grassland habitats after construction; Avoidance of karstic holes in Dumrea region; Preparation of habitat/vegetation restoration plan; Avoidance of building work in sensitive part of year (i.e. Avoidance of nesting season); Avoidance of building of block-station, measuring-reduction stations and compressor station in sensitive areas;

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			river bed and on banks (suspended sediments); Disturbance of river-fish and other aquatic animals (noise, suspended sediments etc.) Accidental release of chemicals, fuel to rivers, water reservoirs, lakes or karstic areas; Passing through or near protected area or important biodiversity area; Accident - Emission of bigger amount of gas with possible explosion or fire. Potential direct longer period changes of habitats (forest fire).	Avoidance of work during the high water period and period of spawning of sensitive species; Avoidance of sensitive and rare habitats; Avoidance of work in spawning time for sensitive species; Environmental plan for construction work; Avoidance of protected area and/or avoidance of negative impact to conservation objectives of other areas important for biodiversity; Operational plan with environmental protection plan; Develop a communication strategy with relevant stakeholders.
	Section II	Local	Loss of habitats - temporary (in working area) and permanent for forest & shrub habitats; change of structure of grassland habitats; Potential spread of invasive species on terrestrial part and sea (brought with ballast waters from working platforms) ; Animal disturbance – temporary during building of pipeline (noise, dust, air emissions, humane disturbance) and permanent for block-station, measuring-reduction stations and compressor station (i.e. noise); Temporary change of freshwater habitats due to work in river bed and on banks (suspended sediments); Disturbance of river-fish and other aquatic animals (noise, suspended sediments etc.)	Selection of route and related working areas which will avoid sensitive and rare habitats; Minimization of working area; Restoration of grassland habitats after construction; Preparation of habitat/vegetation restoration plan; Avoidance of building work in sensitive part of year (i.e. Avoidance of nesting season); Avoidance of building of block-station, measuring-reduction stations and compressor station in sensitive areas; Avoidance of work during the high water period and period of spawning of sensitive species; Avoidance of sensitive and rare habitats; Avoidance of work in spawning time for sensitive species;

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			Accidental release of chemicals, fuel to rivers or water reservoirs; Passing through or near important biodiversity area; Accident - Emission of bigger amount of gas with possible explosion or fire. Potential direct longer period changes of habitats (forest fire).	Environmental plan for construction work; Avoidance of protected area and/or avoidance of negative impact to conservation objectives of other areas important for biodiversity; Operational plan with environmental protection plan; Develop a communication strategy with relevant stakeholders.
Land use	Section I	Regional	Changes to and disturbance of land and associated impacts upon existing land use and users; Temporary land take in agricultural areas; Temporary loss of the agricultural productivity of the land; Possible damage to agricultural features such as irrigation systems or drain tiles, fences etc.; Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops; Permanent land take at above ground facilities, such as pump stations, pressure reduction stations and block valves; Permanent land take near and through numerous urban and suburban areas in section I (Elbasan city and south western neighbouring of Tirana); Likely permanent land take near and through the tourist areas of the Dumrea Karstic Plateau; Permanent land take near and through the riparian forests along the riverbeds, as well as near the karstic Lakes of	Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); During route selection process use as practical as possible the existing/planned longitudinal infrastructure (national roads Fier-Lushnja, Elbasan-Tirana, and Tirana by-pass); Avoid as much as possible the settlements, especially in Elbasan city and in the south western neighbouring of Tirana); Avoid as much as possible the areas of high tourist values in Dumrea region; Avoid PAs, or minimize, impacts, as practical as possible, by crossing through areas of low values of biodiversity; Avoid the permanent crops during the design stage. During design phase traverses the riverbeds at the narrowest places; Any drainages systems crossed by the pipeline and disturbed during construction would be maintained to the

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			Dega and Seferan (Nature Monuments).	extent practicable; Compensate the land holders and owners of the restrictions originating from construction of pipeline.
	Section II	Local	Changes to and disturbance of land and associated impacts upon existing land use and users; Temporary land take in agricultural areas; Temporary loss of the agricultural productivity of the land; Possible damage to agricultural features such as irrigation systems or drain tiles, fences etc.; Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops; Permanent land take at above ground facilities, such as pump stations, pressure reduction stations and block valves; Permanent land take near and through the riparian forests along the riverbeds.	Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); During route selection process use as practical as possible the existing/planned longitudinal infrastructure (national roads Fier-Lushnja-Kavaja, and Tirana by-pass); Avoid as much as possible the settlements; Minimize impacts, as practical as possible, by crossing through areas of low values of biodiversity; Avoid the permanent crops during the design stage. During design phase traverses the riverbeds at the narrowest places; Any drainage systems crossed by the pipeline and disturbed during construction would be maintained to the extent practicable; Compensate the land holders and owners of the restrictions originating from construction of pipeline.
Socioeconomic baseline	Section I	Regional to National	Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops. Permanent land take at above ground facilities, such as pump stations, pressure reduction stations and block valves; Permanent land take near and through numerous urban and	Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); During route selection process use as practical as possible the existing/planned longitudinal infrastructure (national roads Fier-Lushnja, Elbasan-Tirana, and Tirana by-pass);

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
			suburban areas in section I (Elbasan city and south western neighbouring of Tirana); Likely permanent land take near and through the tourist areas of the Karstic Plateau of Dumrea; Permanent land take near and through the riparian forests along the riverbeds, as well as near the karstic Lakes of Dega and Seferan (Nature Monuments). Likely adverse impact on the industrial area of Elbasan.	Avoid as much as possible the settlements, especially in Elbasan city and in the south western neighbouring of Tirana); Avoid as much as possible the areas of high tourist values in Dumrea region; Compensate the owners of the restrictions originating from construction of pipeline; Develop a communication strategy with relevant stakeholders.
	Section II	Local to Regional	Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops. Permanent land take at above ground facilities, such as pump stations, pressure reduction stations and block valves; Permanent land take near and through the riparian forests along the riverbeds.	Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.); During route selection process use as practical as possible the existing/planned longitudinal infrastructure (national roads Fier-Lushnja-Kavaja, and Tirana by-pass); Avoid as much as possible the settlements; Compensate the owners of the restrictions originating from construction of pipeline; Develop a communication strategy with relevant stakeholders.
Cultural Heritage	Section I	National	Likely high adverse impacts, because the proposed pipeline route runs throughout the territories of Dumrea region and Elbasan, which are rich in discovered and non-discovered cultural heritage.	During route selection process use as practical as possible the existing/planned longitudinal infrastructure; Preliminary archaeological pipeline route survey in order to determine exact positions of cultural heritage sites in relation to pipeline route;

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
				Archaeological site supervision during construction works; Develop a communication strategy with relevant stakeholders.
	Section II	National	Likely moderate adverse impacts, because the proposed pipeline route runs throughout areas which have been flood prone (Coastal Plain of Fier, Terbufi field) or are characterised by a hilly steep terrain (Lekaj-Vaqarr pipeline segment) located far from the roads, and consequently there is no high probability of finding non-discovered cultural heritage.	During route selection process use as practical as possible the existing/planned longitudinal infrastructure; Preliminary archaeological pipeline route survey in order to determine exact positions of cultural heritage sites in relation to pipeline route; Archaeological site supervision during construction works; Develop a communication strategy with relevant stakeholders.
Air Quality and Existing Emissions Load	Section I Section II	Local	In the vicinity and throughout the dwelling areas; In the vicinity of block-station, measuring-reduction stations and compressor station due to fugitive emissions; In the vicinity and throughout the areas rich in fauna.	Apply appropriate mitigation measures; Develop a communication strategy with relevant stakeholders..
Noise and Vibration	Section I Section II	Local	Increase in noise level during the construction phase: in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna; Periodical increase in noise level during the operation phase: in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna.	Apply appropriate mitigation measures; Respect working hours of construction sites; Plan periodical works on above–ground objects and inform on time local community; Develop a communication strategy with relevant stakeholders.

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
Occupational Health and Safety	Section I Section II	Local	It is not expected presence of serious work injuries, only minor injuries at work (regarding non-compliance with the rules of safe work, not using personal protective equipment).	All work has to follow an Occupational Health and Safety Plan; Respect and implement the required principles and regulations on occupational safety; All workers have to receive proper training; Danger zones of explosion must be identified on the construction site; Evacuation plan for employees has to be created; Develop a communication strategy with relevant stakeholders.
Waste	Section I Section II	Local	During construction works of the pipeline, construction waste will comprise mainly soil and rocks from excavation. Except these types of waste, during installation of the pipeline the packaging waste (plastic and cardboard) will occur. Also small quantities of household waste will emerge. It is supposed that some minor quantities of waste oils and oily materials will result from transport and operation activities of the machinery. During maintenance of the pipeline in operation, small quantities of hazardous waste will occur. In case of decommissioning of the pipeline some types of reconstruction waste like metal, plastics and isolation materials will emerge.	Develop and implement waste management plans; Develop a communication strategy with relevant stakeholders.

Environmental and Social component	IAP pipeline route	Area of impact	Potential impacts of significance	Mitigation options
Accidents	Section I Section II	Local	Accidents during ROW clearance throughout dwelling areas; Pipeline leakages; Leakage at ground infrastructure pipeline facilities inlet and outlet (MS, BS, etc.); Fire during construction phase; Explosions;	Safety measures during ROW clearance throughout inhabited areas; Monitoring of process parameters (flow, pressure, temperature…) Safety pressure valves; Fire fighting equipment; Develop a communication strategy with relevant stakeholders.

6. Selection of IAP variants

6.1. Test of proposed options

Albania

Defined criteria for IAP route variants in Albania are shown on following figure.

Name	Value 1	Value 2	Value 3
Pipeline variant selection	less acceptable	acceptable	most acceptable
Environmental criteria	negative impact	moderate impact	slight impact
Social criteria	very negative impact	negative impact	moderate impact
Techno - economic criteria	negative	acceptable	positive
Impacts on waters	negative	moderate	none
Impacts on surface waters	negative	moderate	none
Watercourses crossing (larger rivers)	7 and more crossings	1 to 7 crossings	does not cross
Impact on groundwaters	negative	moderate	none
Water protection zones crossing	existing probability	moderate probability	small probability
Land use impact	negative	moderate	slight
Impact on nature and cultural heritage	very negative/ negative	moderate	none
Impact on nature heritage	very negative/ negative	moderate	none
Impact on nature protected areas and Emerald network	negative (more than 5 EN/PA/nature protected sites ir	moderate (1 to 5 EN/PA/nature protected sites	slight (1 or none EN/PA/nature protected
Impact on biodiversity	negative	moderate	slight
Impact on cultural heritage	very negative/ negative	moderate	slight
Impact on landscape values	negative	moderate	none
Corridor crosses populated areas	very negative	negative	moderate
Corridor crosses areas of economic/ turistic activities value	negative	moderate	slight
Total construction cost	up to 40% from the most cheapest	up to 30% from the most cheapest	up to 15% from the cheapest
Technical difficulties of pipeline construction	very difficult	moderate	slight
Impact on forestry and forests	negative	moderate	slight
Economic value of the forests	great	small	none
Impact on forest land	negative	moderate	slight
Forest land crossing	50ha and more	10 - 50ha	less than 10ha
Impact on agriculture and agriculture land	negative	moderate	slight
Impact on agriculture land	negative	moderate	slight
Agriculture land crossing	more than 100ha	50-100ha	less than 50ha
Impact on agriculture	negative	moderate	slight

Figure 30: Defined criteria for IAP route variants in Albania

Considered Variants description based on Environmental Criteria

Environmental Criteria	***Weight factor 1 – 5***	***Section I Fier-Lushnja-Elbasan-Tirana-Rinas/Ahmetaq***	***Section II Fier-Grabian-Lekaj-Tirana-Rinas/Ahmetaq***
Hydrogeology/ Water protection zones	4	The pipeline route runs over 3 (three) Quaternary gravel aquifers of national importance, as follows: 1-Lushnja aquifer (sect.1); 2-Elbasani aquifer; and 3-Tirana-Ishmi aquifer (sect.4); There is possibility that route passes through water protection zone. **(Existing probability)**	The pipeline route runs over 2 (two) Quaternary gravel aquifers of national importance, as follows: 1-Lushnja aquifer (sect.1); 2-Tirana-Ishmi aquifer (sect.4); There is possibility that route passes through water protection zone. **(Existing probability)**
Water Resources	3	-The pipeline route traverses 3 (three) important rivers (8 crossings), as follows: 1-Semani; 2-Shkumbini; 3-Erzeni (6 crossings); -The pipeline route often runs in the Erzeni riverbed from Krraba to Vaqarr. **(Route considered as less acceptable)**	The pipeline route traverses 3 (three) important rivers (3 crossings), as follows: 1-Semani; 2-Shkumbini; 3-Erzeni; **(Route considered as acceptable)**
Biological and Ecological Resources (Terrestrial and Aquatic environment; Nature protected areas)	4	Runs near 2 (two) PA: 1-Seferan Karstic Lake; & 2-Dega Karstic Lake (Hydro-monuments). **(Moderate impact)**	The pipeline route do not run across or in vicinity to any EN/PA **(Slight impact)**
Landscape and Visual	3	-20.2 km route runs through steep hilly area covered from shrubs	-16.2 km runs through steep hilly area, mainly over flysch

Issues		and degraded forests that lie mainly over flysch and molassic deposits, which are prone to erosion; -48.8 km route runs through hilly agricultural area, which is prone to erosion; -17.2 km route runs across the rolling hills of the Karstic Plateau of Dumre, which is very sensitive against erosion; -In the karstic plateau of Dumrea region (85 karstic lakes) the pipeline route runs near some karstic lakes; Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes, and from soil subsidence in the Dumrea karstic Plateau; -Likely adverse visual impact on the tourist area of Dumrea (85 karstic lakes). **(Negative)**	and molassic deposits, which are prone to erosion. The hilly area is covered from degraded forests and shrubs; -12.1 km route runs through hilly agricultural area, which is prone to erosion; Impacts: -Likely negative impact on hilly area because of the permanent ROW in an area covered from shrubs and degraded forests; -Likely negative impact on landscape from erosion on the steep slopes; **(Moderate)**
Land use	4	-The pipeline buffer area (10m wide) lies through **20.2 ha** of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; -The pipeline buffer area occupies **102 ha of agricultural land**	-The pipeline buffer area (10m wide) lies over 16.2 ha of degraded forests and shrubs and has a moderate impact; -The economic value of the forest is small; -The pipeline buffer area occupies **71.5 ha of agricultural**

		and has a negative impact on agriculture and agricultural land.	**land** and has a negative impact on agriculture and agricultural land.
Cultural Heritage	4	Section I runs throughout the territory of Dumrea region and of the Elbasan County, which are rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian- Roman-Byzantine-Medieval ages. Likely high adverse impact on the elements of cultural heritage. **(Negative)**	Section II runs throughout a territory, which is not very rich in discovered cultural heritage. Likely moderate adverse impact on the elements of cultural heritage. **(Moderate)**

Considered Variants description based on Social Criteria

Social Criteria	***Weight factor 1 – 5***	***Section I***	***Section II***
Pipeline corridor crosses populated areas	4	Pipeline route runs near and throughout populated areas in Elbasan city and in the south-eastern neighbouring of Tirana. **(Negative)**	Pipeline route does not run through any densely populated area. **(Moderate)**
Pipeline corridor crosses areas of economic/touristic activities values	3	-Pipeline route runs through Elbasan town territory, where are located important economic activities (industry-national importance); -Pipeline runs through the touristic area of Dumrea region (Karstic Plateau; 85 karstic lakes). **(Negative)**	Pipeline route runs mainly through agricultural and shrubby areas. It does not cross any zone of important economic activities. **(Moderate)**

Considered Variants description based on Techno Economic Criteria

Techno Economic Criteria	***Weight factor 1 – 5***	***Section I***	***Section II***
Cost of construction	4	120.0 EUR	85.5 EUR
Technical solution of pipeline construction	2	In his first part Section I pass through flat agriculture areas that present slight technical difficult. In north - east direction of the Lushnja route runs toward Elbasan through a hilly terrain crossing the flat valleys between hills - that presents moderate technical difficult. In the Elbasan area route runs through urban area and reaches the route of new road from Elbasan to Tirana. Parallel to the new road route, pipeline route runs toward Tirana through hilly terrain that presents moderate technical difficult. The Route passes Tirana from the south follow the Erzeni River valley than runs toward Ahmetaq in north direction through flat urban valley that presents **moderate technical difficulties**.	From Fier toward north direction, Section II crosses agriculture areas, mainly flat terrain that presents slight technical difficult. In the south – west of Tirana route crosses a hilly terrain that presents difficult technical solution. The route runs toward Ahmetaq in north direction through flat urban valley that presents **moderate technical difficulties**.

Results gained by DoctuS software are shown on following figure.

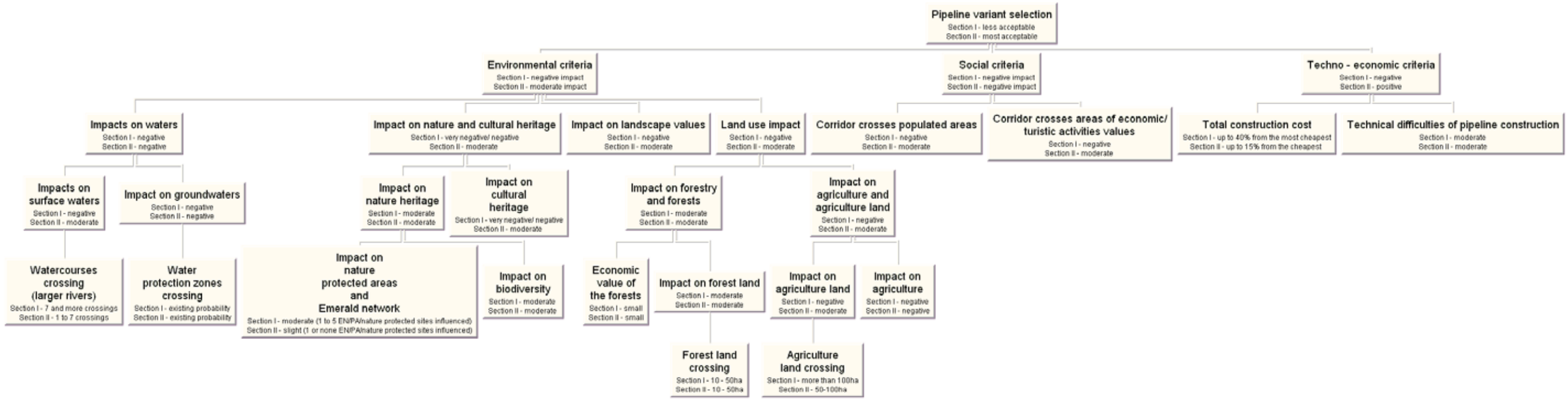


Figure 31: IAP route variants selection for section Fier –Tirana in Albania

As more acceptable Section II is recommended.

7. Recommendations

The analysis consisted of evaluation of environmental, social and techno – economic parameters, for that the criteria have been set.

Based on conducted analysis in Doctus Section II (Fier – Lekaj - Ahmetaq) is recommended as more acceptable.

The European Union's 2008 IPA Programme for Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo*, Turkey and Iceland

Infrastructure Projects Facility
Technical Assistance Window (IPF TA)

EuropeAid/128073/C/SER/MULTI

Sub Project:
WB5-REG-ENE-03

FS and ESIA for the
Ionian – Adriatic Pipeline (IAP)

Preliminary Technical Study Report
Annex II
Selection of final IAP route

May 2013

This project is funded by the European Union

COWI • IPF CONSORTIUM

*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.

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LIST OF ABBREVIATIONS

ALB	Albania
ASA	Archaeological Survey Agency - ALB
asl	above sea level
BiH	Bosnia and Herzegovina
bcm	Billion Cubic Meter
BVS	Block valve station
CTMS	Custody Transfer Metering Station
DCM	Decision of Council of Ministers
EN	Emerald network
EU	European Union
HSSM	Hydrometeorological and Seismological Service of Montenegro
IAP	Ionian-Adriatic Pipeline
IBA	Important Bird Areas
IFI	International Finance Institution
IHM	Institute of Hydrometeorology of Albania
IPA	Important Plant Areas
IPF	Infrastructure Projects Facility
MNE	Montenegro
MNR	Managed Nature Reserve
MoE	Ministry of Economy of Albania
MoEFWA	Ministry of Environment, Forests & Waters Administration- ALB
MPPT	Ministry of Public Works and Transport - ALB
NCL	National Licensing Center of Albania
NM	Nature Monument
NP	National Park
PA	Protected area
PL	Protected Landscape
PP	Physical Plan
PRMS	Gas Pressure Reduction and Metering Station
PTS	Pig Trap Station
PTSR	Preliminary Technical Study Report
SIA	Social Impact Assessment
SoER	State of Environment Report - ALB
TA	Technical Assistance

1 Synopsis

Project Title: Feasibility Study and EIA & SIA Ionian – Adriatic Pipeline

Project Number: WB5-REG-ENE-03

Contractor: COWI-IPF Consortium

Beneficiaries:

Croatia:

Plinacro Ltd and Ministry of Economy.

Bosnia & Herzegovina;

Ministry of Foreign Trade and Economic Relations represented by BH-Gas and Gaspromet.

Montenegro:

Ministry of Economy.

Albania:

Ministry of Economy, Trade and Energy.

Project start date: 08/05/2012

Project Duration: 22 months

Anticipated completion: February 2014

2 Introduction

The Ionian-Adriatic Pipeline Project (IAP) will interconnect the existing and planned gas transmission system of the Republic of Croatia with the Trans Adriatic Pipeline (TAP) or a similar project (Interconnector Turkey – Greece – Italy (ITGI)). The project aims to establish a new supply route for natural gas from the Middle East and Caspian region, northwards along the Adriatic coast. The IAP project is however planned as a bi-directional pipeline, so the possible supply direction could also be north – south, from the strategically planned LNG terminal in Croatia, or other sources.

The construction of this transmission pipeline would enable the gasification of Albania and Montenegro, Bosnia and Herzegovina and southern Croatia, providing a diversified and reliable natural gas supply.

Within the preparation of project documentation for IAP initial investigations and preliminary route selections have already been carried out.

After the presentation of the preliminary analysis it was decided, based on the results, that the IAP route will pass through Albania, Montenegro and Croatia, and branch connections towards BiH will be provided.

For final decision of the IAP route more detailed analysis needed to be carried out in order to establish final IAP route corridor.

The scope of this document is to propose a final solution for the IAP route throughout all three considered countries. As the IAP route is already defined in part of Albania and Montenegro and throughout Croatia, this document will give recommendations for the IAP final/preferred route in the part between Albania and Montenegro.

For ease of reference the variants have been named as follows:

- Variant A – Variant A Montenegro + Variant A Albania (as analysed in PTSR)
- Variant B – Variant D Montenegro + Variant C Albania (as analysed in PTSR)

Figure 1: Pipeline route Variant A and Variant B through Albania and Montenegro

Report structure

The Selection of the final IAP route report is structured as follows:

Chapter 1 – presenting Synopsis of the entire project

Chapter 2 – gives a short introduction of report scope.

Chapter 3 – gives a short description of project and considered IAP routes within each country (the parts already defined and the parts that still need to be defined). it also gives a short explanation of the planned IAP route in accordance with the relevant Strategic planning documentation.

Chapter 4 –presents detailed analysis of observed IAP variants in the trans boundary part between Albania and Montenegro, including technical, economic, environmental and social aspects;

Chapter 5 – presents the final results of the test of the proposed variants, based on valorisation of each aspect.

Chapter 6 – gives final conclusions and recommendations on final IAP routing.

3 Project description

3.1 IAP route description

The route starts near Fier in Albania where it will be connected to the Trans Adriatic Pipeline (TAP). The pipeline runs in northern direction towards Tirana and further on to the border with Montenegro. After passing Montenegro the route crosses the Kotor Bay entering Croatia at Uvala Čipavica. From there the pipeline runs parallel to the coastal line towards Dubrovnik and finally continues in northwest direction to Dugopolje near the city of Split where it interconnects to the gas transmission system of Croatia. The pipeline diameter is 32 inch.

This transmission supply project, of 530 km total length, with nominal diameter 32", would create the preconditions for the development of the natural gas markets of Albania, Montenegro, Bosnia & Herzegovina and Croatia at the estimated annual level of 5 bcm. (for Albania 1bcm + for Montenegro 0.5 bcm + for Bosnia and Herzegovina 1 bcm + for Croatia 2.5 bcm).

The goal of the Preliminary Technical Study Report was to analyse all the possible variants of the IAP route based on techno-economic, environmental and social aspects, and to propose the optimal solution for the entire IAP system. However, members of the Interstate Committee did not agree with the recommendations made by the study team and it was therefore requested that a more detailed analysis of the route in Montenegro and northern part of Albania should be elaborated.

In the present document two route variants through Albania and Montenegro have been subject of such detailed analysis in order to determine the final IAP route (see figure 1).

3.2 IAP route description within each country

3.2.1 Albania

Variant A-ALB

From Balldre the pipeline crosses flat agriculture areas until it reaches Shkodra. The urban area of Shkodra will be passed on the southeast side. The pipeline route crosses river Drin and passes Skadar/Shkodra Lake on the north and runs

into mountainous area towards Hani Hotit (Barlaj) at the border of Albania – Montenegro.

- Total length of section 67.5 km
- Highest point of the pipeline 510 m
- Lowest point of the pipeline -1 m

Variant D-ALB

From Balldre the pipeline runs towards the border of Albania – Montenegro at Dajc (Štodra) runs mostly through flat agriculture areas and it is very suitable for pipeline construction. At the border the pipeline crosses river Bojana.

- Total length of section 29.3 km
- Highest point of the pipeline 100 m
- Lowest point of the pipeline -2 m

3.2.2 Montenegro

Variant A-MN

From Barlaj (Hani Hotit) at Albania – Montenegro border the pipeline runs through mountainous area towards Podgorica passes Podgorica on the south and follows in general the main road in direction to Cetinje. The route passes Cetinje and continues towards Radanovići.

- Total length of section 63.5 km
- Highest point of the pipeline 1360 m
- Lowest point of the pipeline 20 m

Variant D-MN

From Dajc/ Štodra at Albania – Montenegro border towards city of Bar the route runs through flat agriculture terrain occasionally passes few settlements and after that runs through hilly – mountain area. Near the city of Bar, the route enters the sea and is laid down on the seabed. Near the bay of Jaz the route runs on-shore, passes over Quaternary valley and reaches Lastva Grabajska. The route follows the road towards Radanovići, at the edge of a broad valley.

- Total length of section 76.0 km
- Highest point of the pipeline 600 m
- Lowest point of the pipeline -84 m

The offshore section of the route has been changed compared to the PTSR. The route is shorter and closer to the coast in order to achieve uniform depth conditions on the seabed according to the subsea map. Modification of the route has been made based on the preparatory works for the maritime surveys that will be carried out for the proposed offshore section.

3.3 Alignment with Strategic planning documentation

Planning documents regarding spatial planning determine the organization, use and purpose of space, as well as guidelines and measures for organization, protection and development of space. Planning documents are made on state level and at local level.

Albania

The Spatial Planning System

The first efforts to establish a new territory planning system in Albania started in 2006 with the preparation of the "Policy and strategy for the implementation of the new legal framework on spatial planning in Albania" (MPPT, 2007). The objective of this Policy Document is to guide the development of a legal framework for territorial planning in Albania by establishing the basic parameters of the territorial planning system, including scope and content of the process, rules and procedures for implementing the system and assignment of authority for the various phases of this process.

Some of the environmental and social requirements of this Policy and Strategy include:

- Creating a more rational territorial organization of land uses and the linkages between them, to balance demands for development with the need to protect the environment, and to achieve social and economic objectives;

- Increasing attention to the "special areas" that reflect specific environmental, cultural, historic, social or economic concerns;

- The participation of stakeholders provides the opportunity for a more careful identification of key development needs, issues and priorities. This participation must be comprehensive across all planning stages beginning with the study process, which precedes the adoption of any plan or development control.

The law no. 10119 of April 23, 2009: "On the territory Planning", was considered as a framework law whose application would depend completely on bylaws and relevant regulations. There are more than 80 laws that need to be revised to match with this law. There is no full decentralization regarding the territory planning in Albania. Urban planning is a local competence, but territory planning is rather shared between local and central government. According to the "Policy and strategy for the implementation of the new legal framework on spatial planning in Albania", in the case of national infrastructure plans, which include the IAP project, the spatial development plans are adopted by the Ministries of the line, the Council of Ministers, and the parliament of Republic of Albania.

Based on the above mentioned situation, the planning documents regarding the spatial planning of the areas traversed by the proposed pipeline corridors have been extracted from the documentation prepared by the local governments. It should be stressed that the local strategic plans in the north-western part of Albania do not include any pipeline corridor.

Strategic Planning of Shkodra Region

The Strategic Planning of Shkodra Region (Regional Council of Shkodra County, 2012), which includes all the North western part of Albania, aims to propel a balanced and endogenous development of the territory and increase the value of Shkodra region by strengthening its cultural, social, environmental, economic identity, and human resources. Its main topics include:

- Delivery of sites for buildings sufficient to meet anticipated needs;
- Strategic infrastructure, roads, public transport, water, sewerage and power, which serves these sites and connects them together in regional space;
- An economic development strategy which guides and underpins the land and infrastructure proposals by providing an economic rationale for them;
- An environmental strategy which aims to ensure the physical sustainability of the land, infrastructure and economic development proposals;
- Effective implementation proposals concerning organizations of institutions, funding of the necessary financial means and an approach to the management of the plan implementation

A map of the Strategic plan of Shkodra Region is shown in Figure 2 below.

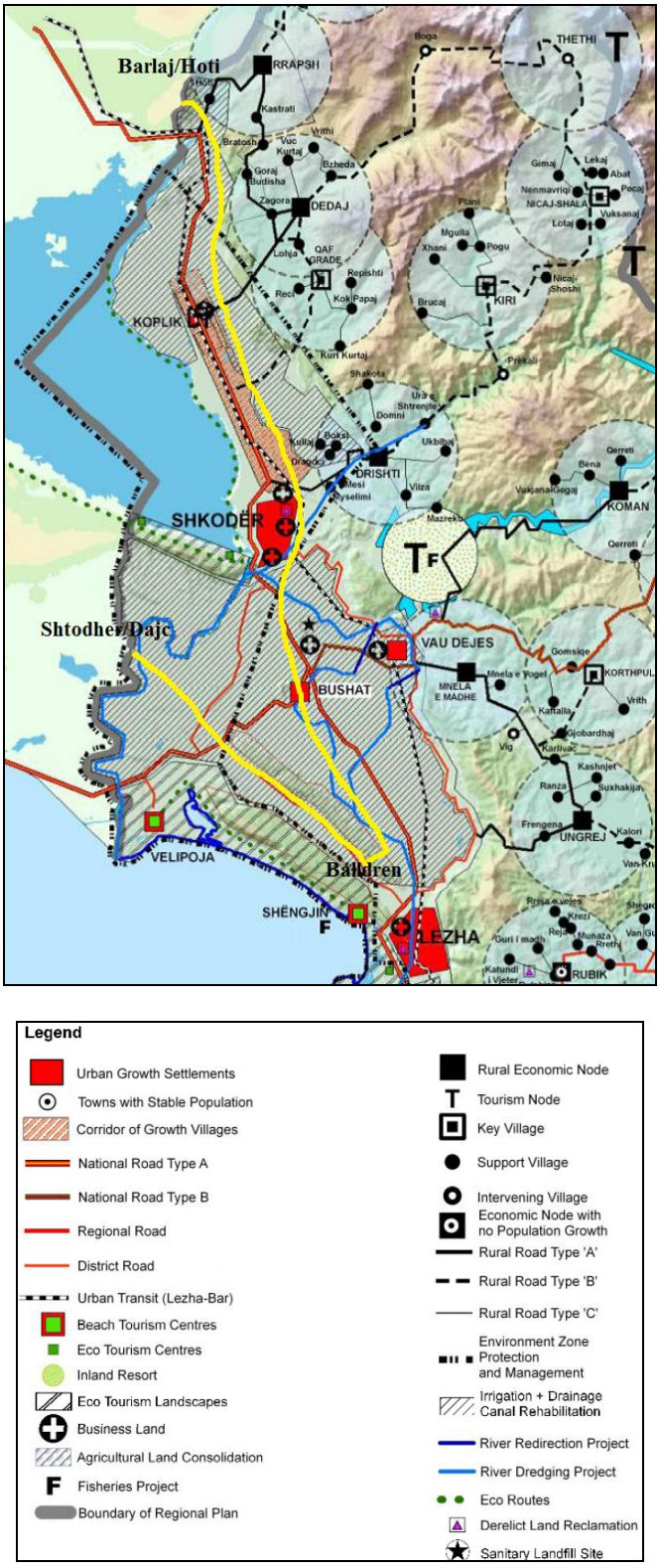


Figure 2 Strategic plan of the Shkodra Region (Shkodra Regional Council, 2012)

In yellow: variants A (Balldren-Hoti/Barlaj) and B (Balldren-Dajc/Shtodher) of the proposed pipeline route.

Variant A

Three zones along Variant A of the proposed pipeline corridor have been extracted from the Shkodra Region Strategic Spatial Plan: Bushat; Shkodra town and its surroundings; and Shkodra-Koplik corridor. These zones cover the main and the most sensitive parts of Variant A of the pipeline corridor, as shown in the following figures.

In the territory of Bushat commune, the pipeline route crosses (Figure 3) the following existing and planned infrastructure areas/objects:

a. a new planned housing zone within the territory of this commune;
b. the planned road to Bar (Montenegro), via the coastline; and
c. the existing urbanized area near Bushat and Melgusha villages.

In the territory of Shkodra and its surroundings, the pipeline route crosses (Figure 4) the following existing/planned infrastructure objects/areas:

a. a planned new business zone in the north of this city;
b. the existing industrial zone of Shkodra;
c. the existing railway connecting Tirana to Shkodra to Montenegro (Podgorica) – two crossings; and
d. the existing district road from Shkodra to Vau Dejes;

Along the corridor Shkodra-Koplik, the pipeline route crosses (Figure 5):

a. two planned new business zones;
b. a planned recreational area in the south of Koplik town;
c. three existing district roads; and
d. a number of existing inhabited rural areas.

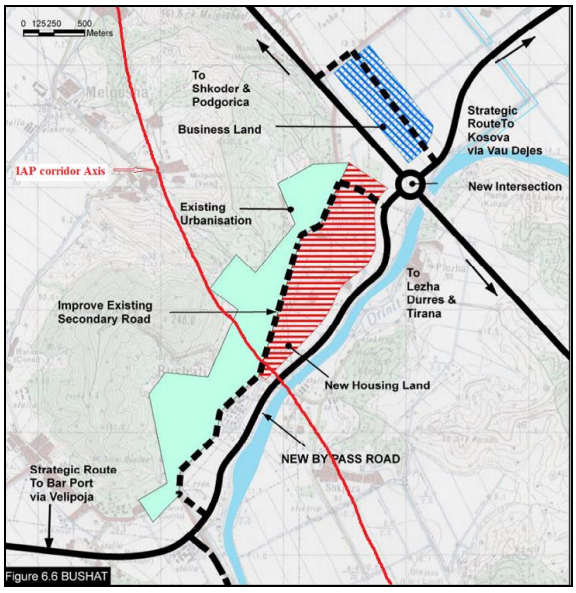


Figure 3 Spatial Plan of Bushat.

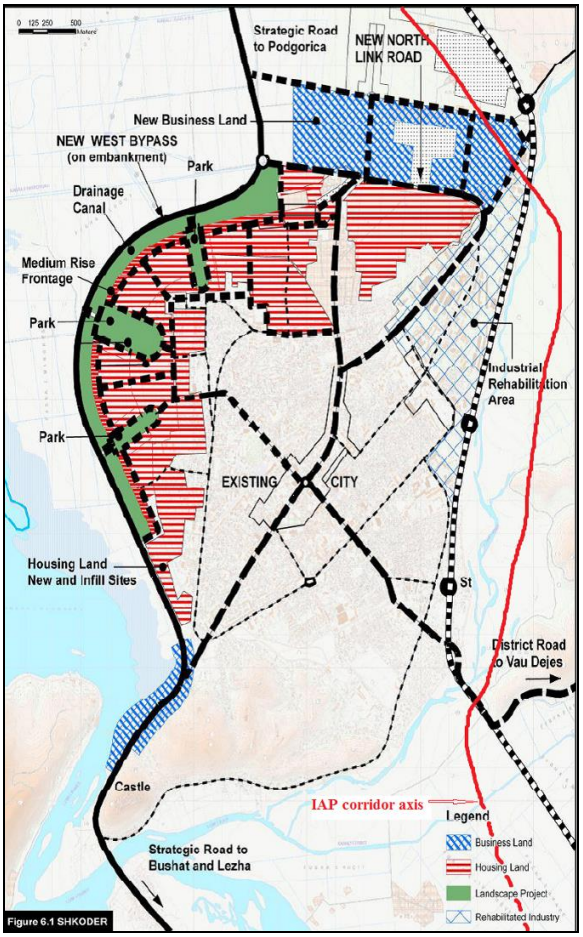


Figure 4 Spatial plan of Shkodra and its surroundings.

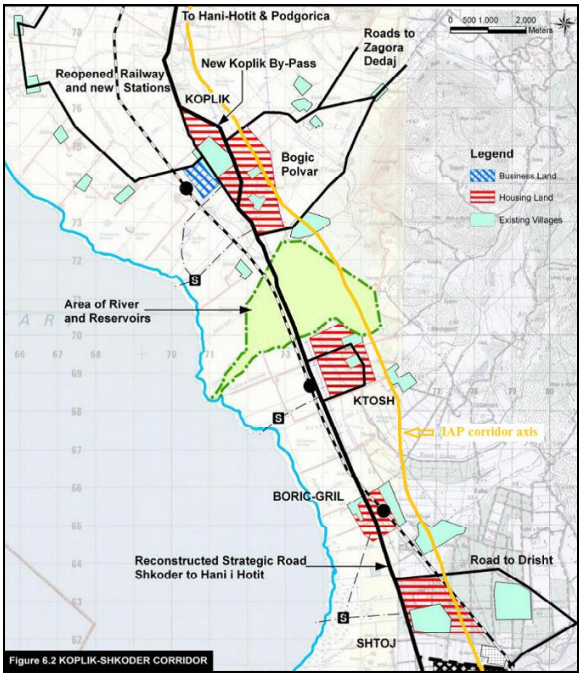


Figure 5 Spatial plan of the corridor Shkodra - Koplik

Variant B

The spatial planning for Variant B of the pipeline route has been extracted from the Strategic Spatial Plan of Dajc Commune, which is more detailed than the regional plan. Since there are no industrial activities in this commune, this Plan aims for the management of agricultural and urban lands.

As shown in following figure, the pipeline corridor runs over agricultural lands only. Close to the state border ALB/MNE, the pipeline traverses the riparian forest of Buna Riverbed that is planned as a green belt.

The other part of Variant B including the pipeline segment from Balldren to the administrative border between Balldren (Lezha district) and Dajc (Shkodra District) communes runs entirely through agricultural lands. There are no other planned infrastructure objects to be found in this segment because it lies in a flood prone area, which requires permanent drainage through a pumping station located near Balldren Village territory.

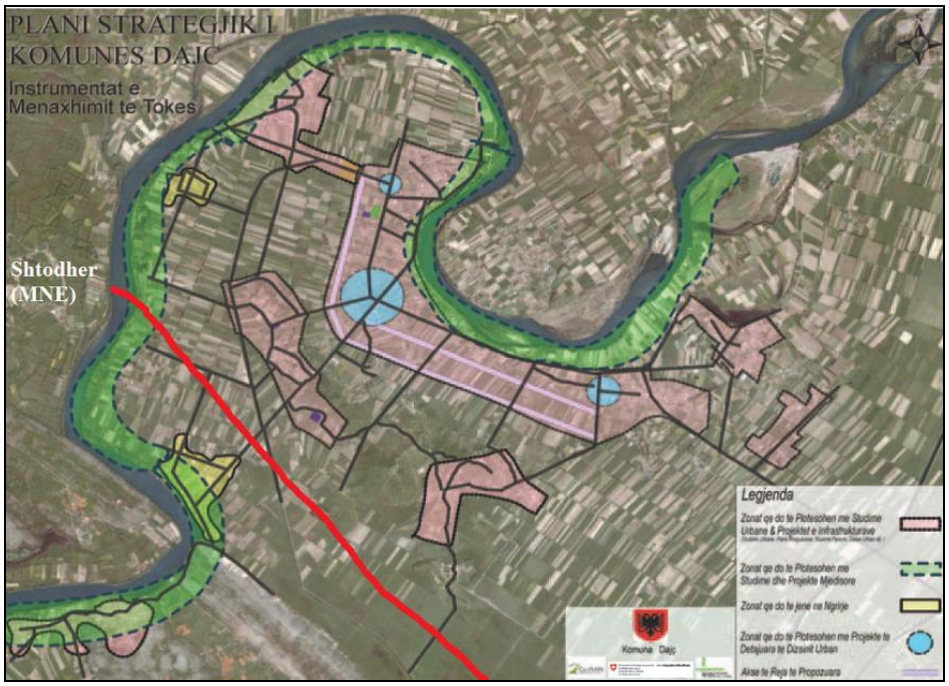


Figure 6 Strategic Spatial Plan of Dajc Commune (2008)

Legend:
-Red line: Variant B of the pipeline route;
-Reddish: areas where urban plans will be improved;
-Yellow: Areas where new housing development is prohibited; and
-Green: Recreational area.

Montenegro

On state level in Montenegro there are four state planning documents:

- Spatial Plan of Montenegro;
- Spatial Plan for Special Purposes;
- Detailed Spatial Plan and
- State Location Study.

The Spatial Plan of Montenegro is a strategic document that sets general conditions for the organization of spatial planning in Montenegro. The Spatial Plan of Montenegro sets state goals and measures for spatial planning development, which is in line with the complete economic, social, ecological and cultural-historical development of Montenegro. In the Spatial Plan of Montenegro the following items are described: policy for use of space, long term policy for organization of space, basic infrastructure systems and basic technical systems and the way of connecting them to infrastructure systems; guidelines for improving energy efficiency and use of renewable energy sources, etc.

In the latest Spatial Plan of Montenegro that covers planning interventions until 2020, the construction of gas pipeline system in Montenegro is envisaged. Until now no gas pipeline network has been built in the territory of Montenegro. It is planned that the foreseen gas system connects with the gas system of Republic of Serbia and with international gas pipeline systems. For that purpose the infrastructure corridor has been reserved within the corridor of a future highway. Nevertheless, the spatial plan also states that these provisions have not yet been realised.

In point 1.3.2.3 “Technical infrastructure systems” of the spatial plan one of the scopes determined by the plan is to include corridors of infrastructure objects within the same routes.

Section 2.6.2 of the spatial plan of Montenegro presents spatial concept of development of energetic infrastructure. In order to create the possibility to improve gas supply network it is necessary to preserve corridors from other requirements and usage that would disturb anticipated purpose, until the final decision upon the gas pipeline network construction, in some of following corridors:

- Niš – Priština – Berane – Podgorica – Bar (“south main gas pipeline”) (within the corridor of planned highway Niš – Podgorica)
- Užice – Prijepolje – Podgorica – Bar (within the corridor of planned highway Beograd – Podgorica - Bar)
- Dubrovnik – Podgorica (within the corridor of planned Adriatic – Ionian highway or alternative, the corridor of the main road along the coast line) the corridor of this gas pipeline should enable connection of gas systems of Croatia and Albania, through Montenegro.

4 Analysis of IAP variants between Albania and Montenegro

4.1 Technical and Technological Gas Pipeline characteristics

4.1.1 General

Gas pipeline system is a closed technological system made of a series connected steel pipes and integrated equipment with the purpose of gas transport at high pressure.

The nominal diameter of pipeline is 32" (DN800). The entire gas pipeline is planned as underground (or sub-sea) installation with the exception of the construction of surface structures on the places of installation of block valve stations (BVS), metering and reduction stations (PRMS) and the pig trap stations (PTS). Variant B is located offshore between Budva and Bar.

Table 1: Technical pipeline characteristics

Section	Length (km)	Diameter (inch)	Pressure (bar)	BVS	BVS +PMRS	BVS +PTS	BVS +CTMS +PRMS (Podgorica)	PRMS +BVS+PTS	CTMS +BVS	CTMS +BVS +PTS
Variant A										
IAP -A - ALB	67.5	32"	85		3			1		1
IAP -A - MN	63.5	32"	75	1	1	1	1			
Total	131. 0			1	4	1	1	1		1
Variant B										
IAP -D- ALB	29.3	32"	85					1	1	
IAP -D- MN	76.0	32"	75	1	2			1	1	
Total	105. 3			1	2			2	2	

Block Valve Station (BVS)

A block valve station (BVS) is a facility on the gas pipeline that enables the closure of each pipe section of the pipeline. The reason for the closure of a pipe section of the gas pipeline can be reconstruction, repair or regular service. If a pipe of the gas pipeline is damaged and there is unexpected gas leakage, the block system shall automatically close the damaged section of the gas pipeline. Unexpected gas leakage is detected because of increased pressure drop in the pipe for example a pressure gradient of 3.5 bar/min.

Block valve device consists of the main in-line ball valve on the gas pipeline, a driver (actuator), control unit (Electronic Line Break Control – ELBC), SCADA system, power-supply, vent and related valves.

Pig Trap Station (PTS)

Pig trap station is the facility on the gas pipeline consisting of a block valve station and the two pig traps. The purpose of the block valve device is the same as in the block valve station stopping of the gas pipeline flow at a certain section. The pig trap enables the reception and sending of the cleaning or intelligent pig from one to another section of the gas pipeline to examine the condition of the gas pipeline. The basic components of the system are the main in-line block valve with control unit, two pig traps with quick closures, SCADA system, vent, power supply and interconnecting piping. Between the two pig traps, each belonging to their own gas pipeline sections, there is a block valve device. In the usual operation gas flows through the block valve the valves at the pig traps are closed.

Gas Pressure Reduction and Metering Station (PRMS)

Metering and reduction stations are the connection points to gas distribution network. Metering and reduction station can be set as a container station with the supply capacity up to 10.000 m^3/h of gas. For bigger gas quantities a solid building shall be provided. The PRMS consists of the metering and reduction part and a boiler-room. In the metering and reduction part there are two or more lines with the regulating, safety and metering equipment that provides safe and uninterrupted operating of the station. In the boiler-room there are gas boilers, of adequate thermal power. The connection of the PMRS and the connections to distribution network will be underground.

The initial gas pressure, at the entrance to the MRS is 85/75 bar and it is lowered by the reduction station system to two or more pressure levels. The common level of reduced gas pressure intended for the industrial consumers is from 3 to 17 bar, while the reduced pressure level intended for the population is 3 to 6 bar.

Custody Transfer Metering Station (CTMS)

At each side of the border, a custody transfer metering station is located with the purpose of measuring quantity of gas that is entering or leaving each country. The container consists of a block valve station, pig station, meter runs, SCADA system, power supply, and interconnecting piping.

Gas Pipeline Construction

The gas pipeline will be designed, constructed and used in accordance with the national and international norms, regulations and laws for that type of structures.

The trench for pipe placement should be made with the depth of 200 to 250 cm, depending on the purpose of land, and the incline of the walls or the insurance system according to geo-mechanical survey. In general the depth should be under the depth of ground freezing and such that it does not obstruct further use of the land for agricultural purposes. Along the entire route of the gas pipeline, two 50 mm HDPE pipes will be installed for the light-wire signal cable. The gas pipeline will be protected by a passive mechanical anticorrosion protection, active cathodic protection and protection from stray currents.

After welding, weld and pressure test should be carried out. After the completion of all works on gas pipe, the construction area should be brought back to its initial state by covering it with soil previously removed.

The Variant A and Variant B pipeline route with pipeline facilities are shown in following figure:

Figure 7: Pipeline route Variant A and Variant B

Defined criteria for technical construction of the pipeline are shown in following Tables:

Valuation factor	Technical construction criteria
1	very difficult
2	difficult
3	moderate
4	easy

4.1.2 Variant A

Total length of pipeline 131km

Highest point of pipeline 1360 m

Lowest point of pipeline -1 m

In its start, the route runs through flat agriculture area that presents easy technical solution. The route occasionally passes near settlements that present moderate technical difficulties. Continuing through flat agriculture area the route crosses a river that presents very difficult technical solution. The route passes the urban area of Shkodra that presents difficult terrain for construction of the pipeline. Again, the pipeline crosses flat agriculture area that presents easy technical solution, and then rocky area that represents moderate technical difficulties. On its way the route has several river crossings that present very difficult technical solution. Through high mountain area very difficult for construction the route reaches the city of Podgorica. This urban area is difficult for construction of the pipeline. From Podgorica the route runs through hilly (difficult) and mountain (very difficult) area, and ends in urban area.

It is considered that the technical solution of the construction of Variant A is difficult (**evaluated 2**).

4.1.3 Variant B

Total length of pipeline of 105.3km

Highest point of the pipeline 600 m

Lowest point of the on-shore pipeline -1 m

The route runs through flat agriculture area that presents easy technical solution. Then it crosses the hill, which is difficult and continues through flat agriculture area that presents easy technical solution. At Albania – Montenegro border the route crosses river Bojana that presents very difficult technical solution. The route runs through flat agriculture area, occasionally passes near settlements which present easy technical solution. The route runs through low hilly rocky terrain that presents moderate technical difficulties. The route passes urban area of Bar through mountain area that present difficult terrain for construction of the pipeline. The pipeline runs offshore from Bar to Budva that

represents moderate technical difficulties. On-shore, pipeline runs partly through flat populated valley, partly through rocky terrain and ends in populated area that presents moderate technical difficulties.

It is considered that the technical solution of the construction of Variant B is moderate (**evaluated 3**).

4.2 Economic calculations

The aim of these analyses was to evaluate the economic effects of detailed Albania and Montenegro routes on the transport tariff tendency for Montenegro.

Analyses are carried out for two routes:

Var. A: Albania-Montenegro Podgorica route

Var. B: Albania -Montenegro coastal route

The economic analyses have been carried out with the following presumptions:

- Investment will be carried out through three years in same yearly amounts.
- Maintenance costs are estimated at 1% of total investment for pipelines and 2% for facilities
- System would be financed from funds obtained on financial markets through long-term borrowing at financial institutions

The price of borrowed capital has been calculated according to the following assumed terms and conditions:

- repayment period: 15 years,
- regular interest rate: 6% per annum
- repayment in equal semi-annual instalments

The operating and maintenance costs include:

- energy costs
- gas transportation system maintenance costs

The quantity of natural gas transported is a business event resulting in an increased financial and economic potential of the project.

The projected provision of natural gas transportation services is based on the assumed gas market build up from the draft gas market forecast. Gas transportation costs are optimized in a way to meet internal rate of return of 7%, the project acceptability criterion. The planned project period of 20 years is taken as one in which the investment project produces acceptable effects. The detailed investment and maintenance cost for pipeline variants are presented in following tables.

Table 2 Route Variant A: Albania-Montenegro Podgorica route - pipeline costs calculation

length	terrain	mechanical works	civil works	Total	TOTAL
km		€/m	€/m	€/m	€
45.2	flat-agricultural	602	208	810	36 593 920
27	urban area	602	630	1 232	33 264 000
8	rocky	632	389	1 021	8 166 400
29	mountainous area	662	817	1 478	42 873 600
21.5	hilly	632	284	915	19 676 800
0.18	river	632	1 368	2 000	360 000
0.07	river	632	1 368	2 000	140 000
0.1	river	632	1 368	2 000	200 000
131.05					141 274 720

Table 3 Route Variant A: Albania-Montenegro Podgorica route - facilities

			Total
Facility	€	Number	€
BVS	350 000	1	350 000
BVS+PRMS	550 000	4	2 200 000
BVS+PTS	800 000	1	800 000
BVS+CTMS+PRMS (Podgorica)	1 700 000	1	1 700 000
PRMS +BVS+PTS	1 000 000	1	1 000 000
CTMS +BVS+PTS	1 200 000	1	1 200 000
		TOTAL:	7 250 000

Legend:
BVS - Block Valve Station
PTS - Pig Trap Station
PRMS - Gas Pressure Reduction and Metering Station
CTMS - Custody Transfer Metering Station

Table 4 Route Variant B: Albania-Montenegro coastal route - pipeline costs calculation

length	terrain	mechanical works	civil works	Total	TOTAL
km		€/m	€/m	€/m	€
38	flat-agricultural	602	314	915	34 777 600
5	flat-populated	602	314	915	4 576 000
5	urban area	602	630	1 232	6 160 000
9	rocky	632	389	1 021	9 187 200
8	mountainous area	662	817	1 478	11 827 200
2	hilly	632	284	915	1 830 400
36	offshore	764	360	1 124	40 473 054
1.5	HDD	650	1 334	1 984	2 976 000
0.2	river	632	1 368	2 000	400 000
0.6	sea entering 2x	602	6 065	6 667	4 000 000
105.3					116 207 454

Legend:
HDD – Horizontal direct drilling

Table 5 Route Variant B: Albania-Montenegro coastal route - facilities

			Total
Facility	€	Number	€
BVS	350 000	1	350 000
BVS+PRMS	550 000	2	1 100 000
PRMS +BVS+PTS	1 000 000	2	2 000 000
CTMS +BVS	750 000	2	1 500 000
		TOTAL:	4 950 000

Legend:
BVS - Block Valve Station
PTS - Pig Trap Station
PRMS - Gas Pressure Reduction and Metering Station
CTMS - Custody Transfer Metering Station

4.2.1 Transport tariff tendency projection

When comparing the Montenegro connection pipeline route options just from the investment point of view the coastal route is much cheaper than the one on the north of the Skadar Lake. Difference in investment costs between the coastal pipeline route and the Podgorica pipeline route toward Croatia is 27.4 million EUR in favour of the costal route, which is 11 mil EUR lower than the difference reported in the Preliminary technical study report.

Shown in continuation is the transport tariff tendency projection for the planned period over which the investment project produces economically acceptable effects.

Table 6 Transport tariff tendency projection Albania-Montenegro routes

MNE			
Period of the project life	**Year**	**20**	
Acceptability criteria of the project			
Internal rate of return (IRR)	**%**	**7.00%**	
Variant		**Var. A**	**Var. B**
Expected volume of transported natural gas, average	**mio m3**	**1 781**	**1 775**
Changes in the volume of transported natural gas	**%**	**0.0%**	**-0.3%**
Investment	**mio €**	**148.5**	**121.2**
Changes in the level of investment	**%**	**0.0%**	**-18.4%**
Operation and maintenance costs	**mio €**	**1.56**	**1.26**
Changes in the level operation and maintenance costs	**%**	**0.0%**	**-19.0%**
Transport tariff	**€cts/m3**	**1.099**	**0.901**
Changes in the level of transports tariffs	**%**	**0.0%**	**-17.9%**

Result of this investment difference is 22% higher transport tariff of the Albania-Montenegro Podgorica route (1.099 €cts/m3) than the more direct Albania -Montenegro coastal route transport tariff (0.901 €cts/m3).

Although 27.4 million EUR relative investment difference allows us to reach potential Podgorica gas power plant consummation sooner; it does not result in smaller transmission tariff.

It should be stressed out that relatively large gas consumption potential in Podgorica area predominantly rely on the expected development of the gas fired power plant after 2025. Uncertainty related to the development of this plant (it is not envisaged in the Montenegro energy sector strategy) has additional negative impact on the already 22% higher transmission tariff of the proposed the Albania-Montenegro Podgorica route.

Taking all that into account the results of the economic study indicate that Variant B (Albania -Montenegro coastal route) can be considered as more favourable solution for the IAP route.

4.3 Preliminary Environmental and Social Impact Assessment for two proposed IAP variants

4.3.1 Environmental and Social baselines

4.3.1.1 Climatic characteristics

Albania

Variant A and Variant B

According to the climate division of the Albanian Territory (IHM, 1984), the project area is located in the Mediterranean Plain Climate Zone. In particular, the segments Balldren – Dajc (border ALB/MNE) and Balldren-Shkodra lie in the Northern Mediterranean Plain Sub-zone, while the segment from Shkodra to the northern part of Hot village (border ALB/MNE) lies in the Northern Mediterranean Hilly Sub-zone.

Mild and wet winters and hot and dry summers characterize the Northern Mediterranean Plain sub-zone, which includes the flat area from Lezha to Shkodra. While the Northern Mediterranean Hilly Sub-zone encompasses the North Albanian low mountain areas whose elevation varies mostly from 200 to 600 m asl. This sub-zone is characterized by relatively warm and wet winter and dry and hot summer.

In order to study the climate characteristics of this particular area, long-term weather data provided by the nearby meteorological stations were collected. These meteorological stations are located in Lezha, Bushat (located between Shkodra and Balldren) and Shkodra.

It is important to note that the entire area of the Western Lowland of Albania is highly influenced by the Adriatic Sea. This influence can be seen by the minimum, maximum and average air temperatures. The most important parameters are the yearly average temperature, the absolute maximum temperature and the absolute minimum temperature. The coldest month is January, whereas the warmest month is July.

Table 7 Annual air temperatures in the northern part of the project area in Albanian territory

Parameter	Station		
	Lezha	Bushat	Shkodra
Annual average	15.4	15.0	14.8
Max abs.	40.0	41.0	41.5
Min. abs.	-10	-11.0	-13.0

Source: Hydro meteorological Institute, Tirana

Typically, the northern part of the study area has high rainfalls, which reach 2000 mm of rain per year. The rainfall is less pronounced in the central and southern part of the northwestern Albania. The maximum daily precipitation in Shkodra is about 200 -240 mm.

Table 8 average yearly precipitations in the northern part of the project area in Albanian territory

Parameter	Station		
	Lezha mm	Bushat mm	Shkodra mm
Annual average precipitation	1325	1640	2070

The quantity of snow varies within a wide range. Snowfalls in the areas Balldren - Dajc and Balldren - Shkodra are rare and of no particular concern. Precipitation in northern part of the project area (from Shkodra to Hot Village) however is approximately 5 to 10% snow; while in areas of elevation higher than 1000m asl; snow constitutes about 20% of winter precipitation.

Storm events are characteristic of the climate of Albania. According to data from the Shkodra Meteorological Station, the 15 minutes precipitation height reaches 30 to 40 mm, the 30 minutes rainfall may reach up to 80 mm, while the rainfall for 1, 2 and 3 hours are registered at respectively 120 mm, 152 mm and 161 mm (all data refers to a repetition probability of one storm event during one year; n = 1).

Conclusion: There are no noticeable differences on climate characteristics. In Variant A rainfalls and snow days are slightly higher, while temperatures slightly lower.

Montenegro

Variant A and Variant B

According to the Köppen climate division, the area of Montenegro is divided into several climatic types with several subtypes. This is due to its geographical location, diverse relief, relocation and confrontation of air masses of different physical properties, surface characteristics and other factors. Major role in modifying the climate in the territory of Montenegro have Atlantic Ocean and the Mediterranean Sea, as well as mainland Europe and Asia, whose vast expanses are regions where centers of cyclones and anticyclones form.

The area of the planned gas pipeline belonging to moderately warm, Mediterranean climate, Cs, (Figure 8) with two subtypes: Csa (Mediterranean climate with hot summers) and Csbx" (Mediterranean climate with warm summers).

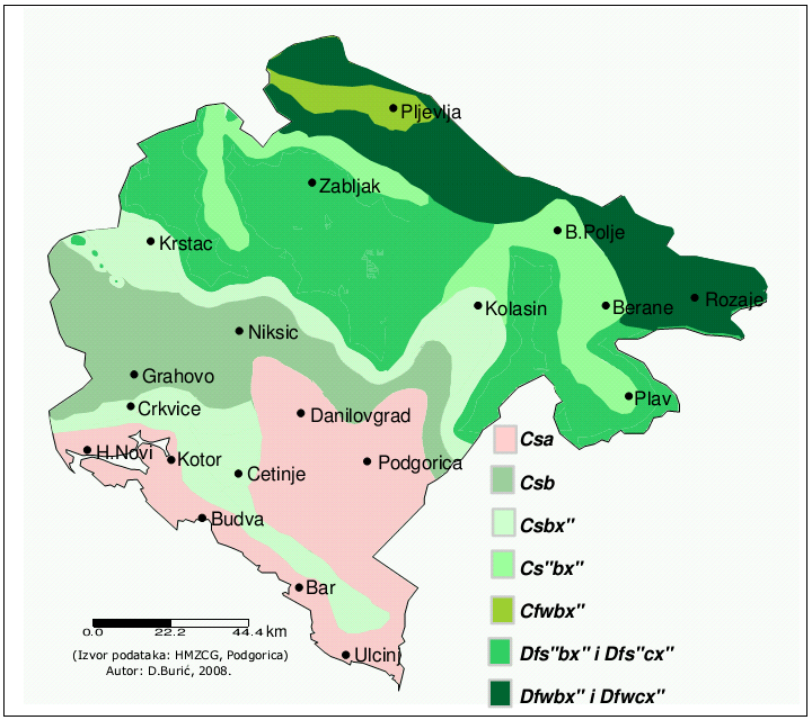


Figure 8 Climatic division of Montenegro according to Köppen in the period 1961-1990.

Csa subtype climate is characterized by bright, dry and bright summers and mild and rainy winters - a typical Mediterranean climate. This subtype has an average air temperature in the coldest month between -3 °C and 18 °C. Summer is the driest time of the year, and the mean temperature of the warmest month is greater than 22 ° C. For the subtypes of Cs-type climate maximum rainfall occurs in November and the lowest in July - littoral and Zeta-bjelopavlići plain.

Csbx" subtype climate is transitional Variant of the Mediterranean climate, which is different than the previous one in that besides the primary secondary (x") maximum precipitation also occurs. At the Csa and Csb subtypes only one, very distinct, maximum and minimum rainfall exists at a time. In this subtype the monthly sum of precipitation decreases from November (primary max.) to early spring, when a secondary maximum occurs (in March or April) - Cetinje.

Depending on their positions in the observed area of the planned pipeline route, stations Ulcinj and Podgorica are the references for the type of climate Csa while Cetinje station represents Csbx" type of climate. According to data from period 1961-1990, the highest average temperature of July of 26.0 °C occurs in Podgorica, where the air temperature extreme of 44.8 °C was recorded. The following table shows an overview of important climatic parameters for the above-mentioned stations.

Table 9 Overview climatological parameters in the observed area

STATION	Altitude [m]	Climate type	Tyr. [°C]	Tmin [°C]	ATmin [°C]	Average annual rainfall [mm]
Cetinje	640	Csbx''	9,8	-4,0	-21,7	3237
Podgorica	49	Csa	15,3	1,4	-9,6	1654
Ulcinj	3,5	Csa	15,5	4,1	-8,4	1258
Tyr. – average yearly temperature Tmin. – average minimal temperature of the coldest month ATmin. – absolute minimal temperature recorded in the observed period						

Table above shows that average air temperatures in Csbx" climate type are considerably lower while average annual rainfall is double.

Conclusion: Given that both variants of the route pass through Csa climate type and only smaller portion through Csbx", impact of climate factors is equal.

4.3.1.2 Geomorphology

Variant A

Albania

The geomorphological characteristics have been described with respect to the proposed pipeline route.

- Balldren to Gocaj

At Balldren Variant A of the pipeline route starts in a narrow and flat valley located between the hilly chains of Rrenci (western part) and Kakarriqi (eastern part) that lie in a southeast to northwest direction. After crossing the Kakarriqi rocky Mountain the pipeline route reaches the Zadrima Plain in the territory of Gocaj Village.

- Gocaj to Drini River

From Gocaj to Drini riverbed the line route traverses from the South to the North the Zadrima Plain, where the line route runs mainly over a flat terrain covered from alluvial deposits, whose upper layers are composed mainly of clays and silts. From the geomorphological point of view, the Zadrima plain consists essentially of two larger units: a- the floodplain alongside the rivers Drini Lezhes and Gjadri, which is situated between the north-eastern slopes of Kakarriqi Mountain and the flysch hills; and b-the large piedmont plain, which extends from the riverside floodplain to mountain chain of Shite-Vela (1,170 m asl) in the East.

In the northern part of Kakarriqi Mountain the pipeline route traverses the hills of Bushat that border the Zadrima Plain from the West. From Bushat to Drini River the pipeline runs again through the flat terrain of Zadrima Plain.

- Drini River to Bajza

From Drini River to the border Albania/Montenegro the pipeline runs through the Malesia Madhe tectonic sub-zone, which is the western periphery of the tectonic zone of the Albanian Alps.

From Drini River to Bajza the pipeline corridor runs in a flat terrain over Quaternary loose deposits of the Pleistocene and Holocene ages. This segment is bordered from the east from the rocky Mountainous area of the Albanian Alps, and from the West from the Shkodra Lake. Along the pipeline route flow a number of small rivers and streams, which originate from the mountainous area in the Eastern part of Shkodra Lake and reach the eastern shoreline of this lake. The direction of these small rivers and streams is from the east to the West, except for the Kiri River which has a north-eastern to south-western direction.

- Bajza to Hoti/Barlaj (km 59.0-67.5)

From Bajza to the border Albania/Montenegro the line route runs through stratified limestone locally dolomitized. The intensive fracturing of the limestone has assisted the high development of the karst that is manifested by the presence of various karst forms like, shallow and deep karren, karst canals and wells, cavities and huge karst springs. The karst springs are mainly located along the Albanian part of the shoreline of Shkodra Lake. In the eastern part of the segment Bajza-Ivanaj the terrain is relatively flat because the karst sinkholes are filled with loose proluvium deposits.

The pipeline segment from Bajza to Hoti/Barlaj follows, in a south to north direction, the foot of the western slope of the rocky mountainous area of the Albanian Alps (shown on following figure). At the border Albania/Montenegro the pipeline route crosses an area of approximately 500 m asl quota.

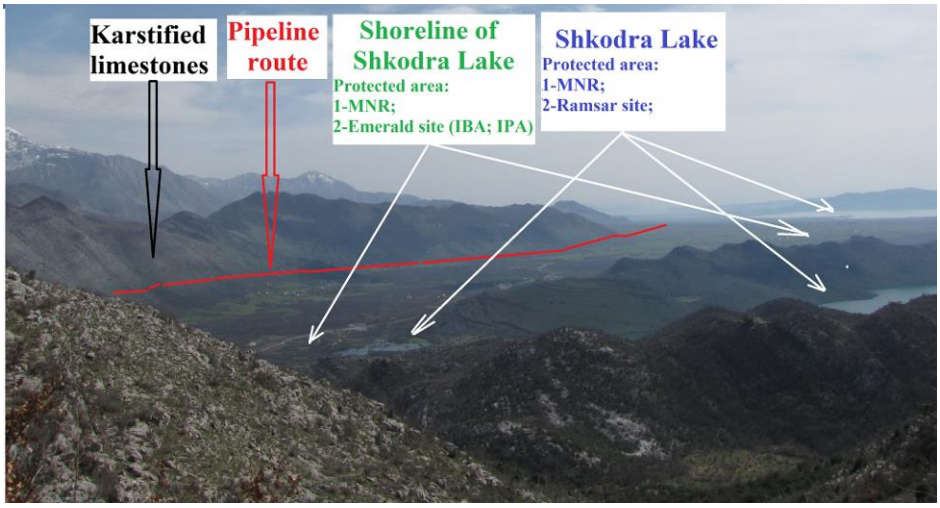


Figure 9 Overview of the main geomorphological units along the segment Bajza-Hoti/Barlaj

Montenegro

Variant A of the planned pipeline route crosses over Albania – Montenegro border south of the Barlaj settlement. The greater area encompasses several mountains. It is a hilly area with extremely indented and dissected relief. Slope terrain is classified as steep and very steep. Planned pipeline route crosses over lowland. After crossing, slope terrain increases again.

Topography of this area is characterized by processes and forms characteristic for glacial and fluvial erosion. North of the planned pipeline route there is a river Cijevna and its terrace surrounded with very dynamic relief characteristics. Route crosses over the valley that is on south side surrounded by middle high hills with the peaks Dečić (650 m) and Đelevik (494 m).

10 km from Albania – Montenegro border near D. Mileš settlement relief the whole geomorphological area becomes completely different. After extremely indented, high-elevated hills with steep slopes the relief becomes lowland (flat surface). The planned pipeline route crosses over the stream Urelja and karst field Rogamsko polje, which is not so high elevated (approximately 60m high) surrounded by middle high hills Šipčanička gora (135 m), Bukovči (88m), Rogamsko brdo (130 m) and Kećeva (146 m). On the south side after Cijevna river karst field Rogamsko polje becomes karst field Ćemovsko polje. This area is not high-elevated, approximately 50 m above sea level.

After crossing Sitnica, stream that flows to the river Morača, relief again becomes high elevated, indented and with steep slopes. Intense denudation processes created this area. The terrain consists of indented ridges, peaks and ditches. The greatest elevation of this whole area is 300 m and is decreasing until it becomes karst field with huge number of karst micro-relief forms (sinkholes).

After passing by Grubani settlement, planned pipeline route crosses through valley between high hill Zlogora with well-expressed peaks Crna Glavica (337 m), Orlić (245 m) and Leperić (425m), which are forming steep ridge from the east to the west, Gomila (252 m), V. Drač (282 m), Pasja glavica (300 m) and Milostojska glavica (305 m).

From Dobrska Župa to Dobrsko Selo planned pipeline route is touching edges of high elevated and well-indented hills. Occasionally crosses through the walley between surrounding middle high mountains and peaks (Vjetuš 639 m, Golo brdo 517 m, Lipovo Korito 495 m, etc.). This valley is classified as lowland (flat surface). High mountains with extremely steep slopes surround the valley. Planned pipeline route occasionally intersects the peaks of small hills. The mountain Ceklinštak (845 m) with steep slope and well-defined ridges is located south from the planned pipeline route.

The last segment of the planned pipeline route passes through the area of Lovćen National park.

Variant A of the planned pipeline ends when entering into Soliotsko polje karst field which is located west from high elevated, well indented hills striated by numerous ditches.

Variant B

Albania

From Balldren to Dajc/Shtodher (Albania/Montenegro border) the proposed pipeline corridor runs entirely in flat terrain.

From Balldren to Torovica embankment the proposed corridor runs along the Balldren Field (Torovica field), which is approximately 1 km wide and 20 km long. This field is bordered from the rocky hills of Rrenci and Kakarriqi (Figure 10) that lie in a Southeast to northwest direction.

From Torovica embankment to the border Albania/ Montenegro the pipeline corridor turns over the flat terrain of the Bregu Bunes Plain, which is bordered from the west from the Kolaj Mountain (545 m asl) and Mali Belaj (Belaj Mountain) hilly chain (Figure 11), which lie in a southeast to northwest direction.

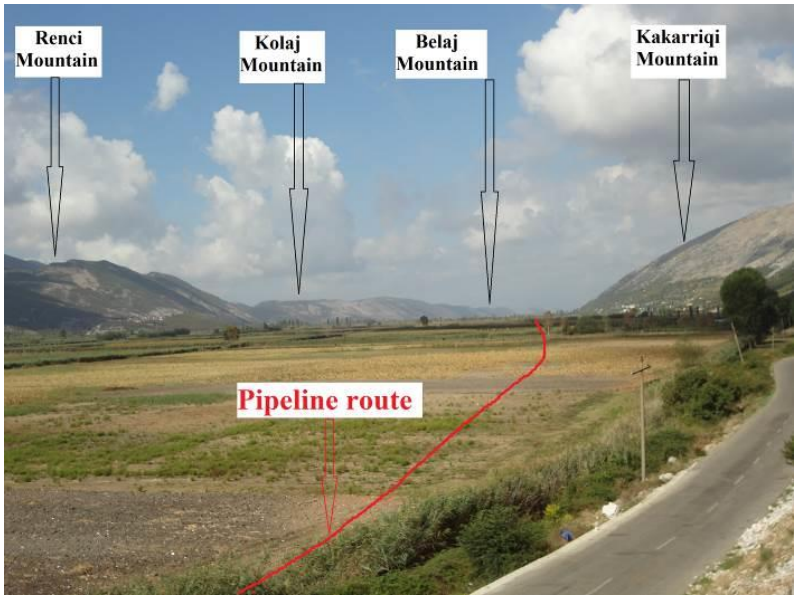


Figure 10 Main geomorphological units along the first 20 km of Variant B of the pipeline route in Albanian territory

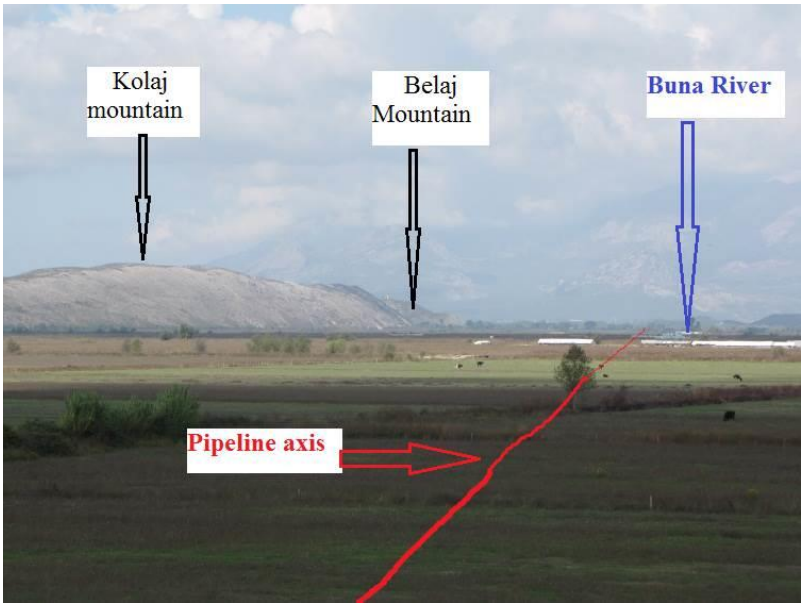


Figure 11 Main geomorphological units of along the last 10 km of Variant B of the pipeline route in Albanian territory

Montenegro

Variant B of the planned pipeline route crosses over Albania – Montenegro border on the Bojana River. The route crosses through the Anamalsko polje karst field, which is elevated approximately 30 m high. The field is surrounded by hills with steep slopes, which are at 70 m of elevation. The route also crosses Miđanska, right stream of Bojana river.

Middle segment of Variant B of the planned pipeline route crosses through the walley between steep slopes of surrounding hills (Gora Kručanska/Vranje gnijezdo 631 m, Povara 319.5 m). The route intersects karst field Mrkovsko polje and Mrkovska River.

After Mrkovsko polje karst field Variant B of the planned pipeline turns to the north and crosses near very steep and well indented mountain Lisinj with well-defined NW-SE ridge and numerous ditches on the west side. There are several high elevated peaks: Treštenik (1090 m), Debetin (1262 m), Ranga (981 m), Loška (1353 m), etc.

Before going through submarin the route climbes over indented karst terrain with steep slopes south from City of Bar. It crosses through well-indented Volujica Mountain. The mountain has well defined ridge with NW-SE direction. The route goes sub-sea near cape Bigovica.

After leaving the submarine course, Variant B of the planned pipeline route enters Mrčevo Polje karst field and goes forward through well-defined walley surrounded with high slopes of Donja Gora, Kalimanica and Bregovi hills. Numerous ditches striate this hilly, steep area. Variant B of the planned pipeline route ends when entering into Soliotsko polje karst field.

4.3.1.3 Geology and hydrogeology

Variant A

Overview of lithostratigraphic units

Albania

At Balldren the line route runs over marshy and marine deposits. From Balldren to Gocaj village the pipeline route traverses the Cretaceous limestone formations of the Kakarriqi Mountain.

From Gocaj to the eastern part of Shkodra town the line route traverses the Zadrima Plain, which has a tectonic origin and has been developed as a result of local subsidence at the end of the Early Pleistocene age (Aliaj et al., 2001). Subsequently, this area was filled in with alluvial deposits by the rivers Drini, Gjadri and numerous streams.

Throughout Zadrima Plain the pipeline route runs through a flat terrain that is covered with alluvium deposits, whose upper layers are composed mainly of clays and silts. This section crosses the main rivers of Drini Lezhes (four times), Drini, and Kiri, as well as two small rivers (Vraka and Rrjolli) and numerous perennial and seasonal streams. On both sides of the river crossings the line route generally runs over gravelly deposits that belong to the Lower Shkodra and Upper Shkodra Quaternary gravel aquifers.

From Shkodra to the border ALB/MNE the pipeline runs through the Malesia Madhe tectonic sub-zone, which represents the western periphery of the tectonic zone of the Mountainous area of the Albanian Alps. The Malesia Madhe sub-zone represents a large monocline split by faults into separate blocks with 20° to 25° dip angles inclining in the northern or north-eastern direction. In the western periphery this monocline bends by dipping south-west at an angle of 10 to 15° under Pliocene to Quaternary molasses and the Shkodra Lake. Stratigraphically, the profile of Malesia Madhe Sub-Zone started in the Upper Triassic with intercalated dolomites and limestone.

From Shkodra to Bajza along the pipeline corridor outcrops in surface Quaternary loose deposits of the Pleistocene and Holocene ages. The segment Shkodra-Gruda Field runs over clayey-sandy deposits. From Palvar to Bajza outcrop in surface alluvium and prolluvium deposits of Rrjolli River and of the Perroi Thate ("Dry Stream") stream that are composed of weakly cemented gravel and sands of high permeability.

From Bajza to the border ALB/MNE the line route runs through stratified Upper Jurassic limestone locally dolomitized which provides well developed bedding fissures interconnected by at least two perpendicular or almost perpendicular fractures. In the Malesia Madhe tectonic sub-zone vertical tectonic faults are intensively developed splitting the area into separate big and small blocks. Shkodra Lake is also a big down faulting block which represents a graben (Geology of Albania, 2002). The Bajza-Ivanaj karst plain represents a second order down faulting block. The intensive fracturing of the limestone has assisted the high development of the karst that is manifested by the presence of various karst forms like, shallow and deep karren, karst canals and wells, caves and huge karst springs. The numerous sinkholes developed on the surface of this karst plain are often merged with each other and filled with proluvium deposits. The karst springs located along the Albanian part of the shoreline of Shkodra Lake are fed from the mountainous area located in the east of this segment of the line route.

Montenegro

Variant A crosses over Albania – Montenegro border south of the Barlaj settlement, over the hills built of grey yellowish Lower Cretaceous ($K_{1,2}$) bulky and stratified limestones, dolomites and dolomitic limestones. The route goes westward and passes over Upper Jurassic (Dogger - $J_3^{2,3}$) and Middle Jurassic (Upper Kimmeridgian – Portlandian - $J_{2,3}$) sediment built of limestone – dolomitic facies with abundance of algae. Variant A near the settlement Paskala turns to NW over the Lower Cretaceous (K_1) layers that consist of limestone, dolomitic limestone and dolomite. East of the settlement Mileši, route of the pipeline descends into the Quaternary valley, which consists of three sections of terraces in Zetska valley. In this valley the pipeline passes through deposits of rivers Morača and Cijevna. The third terrace (t_3) is made from gravel, with pebble size that ranges from 2 to 8 cm, alternating with sands that differ in thickness. Relative height of the third terrace in the Morača canyon is approximately 20 m, and in Zestka valley it varies from 3 to 6 m. The second

terrace (t_2) has small spreading area and is made from the same materials as the third terrace. Forming of the first terrace (t_1) did not have greater significance in forming of accumulations, it reflected only in the riverbed. Sediments of the first and second terrace are partially covered with loess. The route passes South of Podgorica, and near the settlement Lekići it ascends over the hill, which is built of Lower Cretaceous (K_1, $K_{1,2}$) and Middle Cretaceous (K_2^2) sediments, limestones, dolomitic limestones and dolomites. The route near Krincka Kamenica passes over Upper Jurassic ($J_3^{2,3}$) limestone – dolomitic layers with abundance of algae, and Middle Jurassic ($J_{2,3}$) bright grey limestones that alternate in lateral and vertical directions with Lower Jurassic (liass ,dogger - $^2J_1$) bulky limestones with a small share of dolomite and dolomitic limestone. The route in the W direction crosses over Upper Triassic (T_3) deposits that were developed in facies of dolomite and dolomitic limestone and rarely limestone. Northeast of Šišići route passes through the valley built of diluvia deposits (d) presented with disintegrated material and breccia, then route passes over Middle Eocene (E_2) deposits built of flysch sediments and descends into Soliotsko polje that is built of alluvial deposits, sands, gravels and clays. In the Soliotsko polje the route Variant A comes to the route junction.

Tectonic relations and seismic features

Albania

According to the tectonic map of Albania (shown on following figure), from Balldren to Shkodra, the line route runs through the tectonic zones of Kruja and Krasta-Cukali (Meco & Aliaj, 2000).

Figure 12 Tectonic Map of Albania (Meco & Aliaj, 2000)

From Balldren to Hoti/Barlaj (border ALB/MNE), the pipeline route traverses a territory of high seismic activity due to active tectonic faults and to the soil category. Along Variant A seven tectonic faults are crossed from the pipeline route (shown on following figure).

According to the seismic intensity map of Albanian territory (Map of Seismic Regionalization of Albania, Scale. 1:500.000, Tirana 1980; approved by the DCM No 371, of December 20, 1979), the wide project area is situated on the seismic intensity VII, VIII, and IX degree MSK-64 (fig. 13), estimated for 100 year (with 70% probability), for an average soil category (2nd Soil Category, according to the technical condition KTP-N.2-89). The expected maximal earthquake magnitude is Ms=7.2.

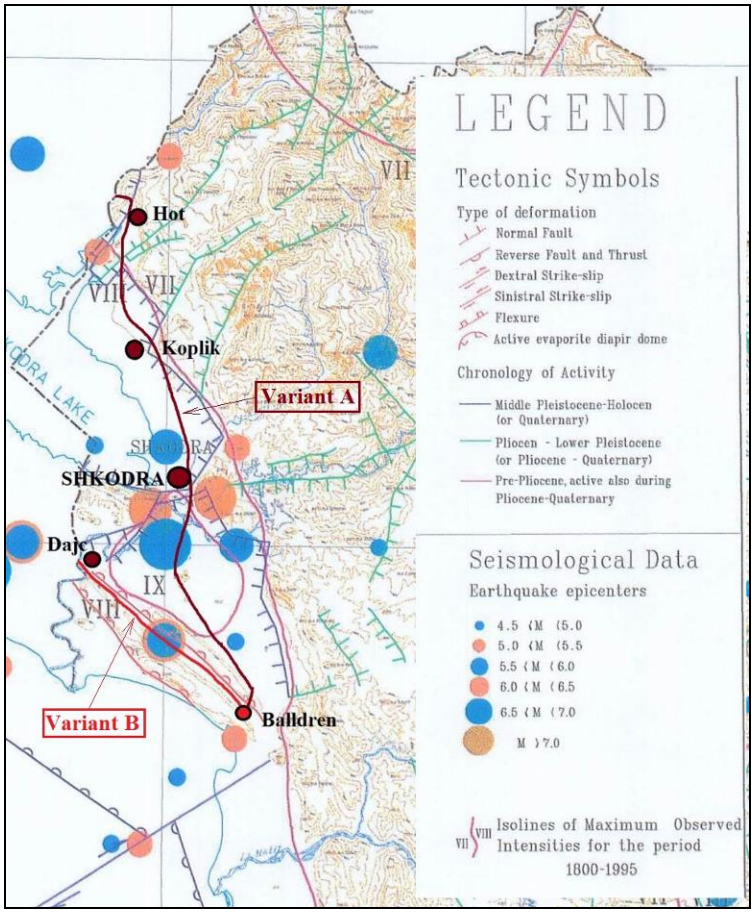


Figure 13 Seismotectonic map of the project area

Source: Seismotectonic Map of Albania, 1:500,000, Academy of Sciences, Institute of Seismology, Tirana 2000.

Montenegro

Variant A enters Montenegro in the area of geotectonic unit called Starocrnogorska ljuska. Stratigraphic series of formations exposed on these terrains start from the Upper Triassic and end with Eocene sediments. Under fluvio – glacial deposits of Zestke ravnice, exploration drilling has identified Neogene marine deposits. On this terrain short discontinuation in sedimentation is identified, which is marked with presence of bauxite.

Within this structural unit is distinctive NE wing of Crnogorski anticlinorium and SW wing of Zeta valley synclinorium. In this structural unit plicative and disjunctive tectonics are expressed. Axis direction is NW-SE, and in the wider area of Tuzi turning of axis elements towards NE is expressed.

Unit Starocrnogorski anticlinorium is part of the tectonic unit Visoki krš in which another structural form - orijensko – bjelogorski syclinorium is distinguished. It is located in the NW part of the terrain overthrusted on Budva-

bar zone along the reverse dislocation Morin – Lepetić. Within this complex structure linear, incline and overturned folds are developed with SW vergence as well as smaller brachystructures.

Variant A in Montenegro part passes through Quaternary valleys Morače and Cijevna near Podgorica which are according to engineering – geological classification of the maximum level of seismicity classified as 8 - 9° of MCS scale. Area of the geoteconic unit Visoki krš according to the same classification is classified as area with maximum extent of seismicity - 6° of MCS scale.

Hydrogeological features

Albania

According to the hydrogeological map of Albania (Eftimi et. Al., 1985), from Balldren to Hoti/Barlaj (border ALB/MNE), the main water resources, over which runs Variant A of the proposed pipeline route, are represented from the following aquifers:

1-Lower Shkodra Quaternary gravel aquifer, which has a local importance for the water supply of the local population;

2-Upper Shkodra Quaternary gravel aquifer that has a national importance, because of the high number of the population supplied with drinking water;

3-Koplik Quaternary Aquifer, which is important in local level for the drinking water supply; and

4-The karst aquifer of Malesia Madhe, from where waters drain to the Shkodra Lake (Ramsar site). This aquifer serves to supply drinking waters to the local population.

Below follows a description of the ground waters over which runs the proposed pipeline route Variant A.

Balldren to Gocaj

At Balldren plain the pipeline route runs over marshy and marine deposits, which overlie the limestone formations of the Torovica syncline from Balldren to the foot of Kakarriqi Mountain. Groundwater along this segment of the pipeline route does not supply drinking water to the villages of the area. A number of karst springs exist on both sides of the Kakarriqi Mountain foots. These springs contain good quality water, which may be used as drinking water. Along the Kakarriqi mountain range, water belonging to limestone rocks can be found at approximately 4-5 m bsl. These waters are of good quality, low mineral content, and suitable for use as drinking water. The well's importance however is to serve solely as individual wells for the villages located on the footings of Kakarriqi Mountain.

Gocaj (Lezha District) to Pacram (Shkodra District) to Drini riverbed

Between Gocaj and the village of Pacram, the pipeline route runs over the Zadrima Plain. The latter is filled with Quaternary loose deposits. The sub clayey and sub sandy cover, which outcrops on the surface, has a thickness that varies between 6 to 40 m. The lower thickness touches in close proximity to the Drini Lezhes riverbed. The water of the underlying Quaternary gravelly aquifer (4-10m thick), has high mineralization and consequently it is not suitable for use as drinking water. The proposed pipeline routes passes over the Nenshkodra aquifer from Pacram to the Drini riverbed. This is an aquifer of regional importance as it supplies drinking water to all villages in this area. The recharge area of this Quaternary gravel aquifer is the Drini riverbed.

Drini riverbed to Gruda field

The pipeline route runs over the Mbishkodra Quaternary gravel aquifer of thickness over 70 m between the Drini river bed and the Gruda field. This aquifer is fed from the karst formations, the Drini and Kiri rivers, and from rainfall. The water table is dependent on the elevation and on the water level of the Shkodra Lake. The clayey sandy cover is only a few meters thick in the western part of this aquifer and inexistent in its eastern part. Thus the eastern portion serves as a recharge area. The quality of the ground waters is very good, and the water wells are characterized by a high discharge. Located in Dobrac (northeast surrounding Shkodra) are waterworks, which supply this city and its surroundings (more than 150,000 inhabitants) with 500 l/s.

Palvar to Bajza

From Palvar to Bajza, the pipeline runs over the Koplik aquifer created from the alluvium and prolluvium deposits of Rrjolli River and of the Perroi Thate (“Dry Stream”) stream. This aquifer is composed of weakly cemented gravel and sands, which are generally characterized by a high permeability, and is fed from the karst formations to the east and rainfalls. The water table is dependent on the elevation and on the water level of Shkodra Lake, which serves as drainage area. The thickness of the aquifer varies from 14 m (Koplik) to 40m (south of Bajza). These water-bearing deposits have very good hydraulic connection with the underlying karstified limestone.

Bajza to Ivanaj to Hoti/Barlaj (border ALB/MNE)

From Bajza to Ivanaj and further to the south of Hoti, the pipeline route runs mainly over a karst plain (Figure 14), as there are no significant Quaternary deposits located in this area. Ground waters flowing from the mountainous area in the east and from rainfalls drain in the Shkodra Lake. A number of perennial and temporary karst lakes and karst springs can be found in the shores of this lake. Hydro-geological studies (Kalaja, 2000; Eftimi, 2008) show that the karst lakes, karst springs, and dug wells communicate with each other from east to west direction, which is the assumed direction of groundwater flow (figures 17, 18, 19, 20). The water of the karst lakes, karst springs, and dug wells is of good

quality. Some dug wells have historical and cultural values (Figure 15). In addition, the karst lakes and springs have high landscape values. The karst springs appear as small round lakes with a diameter of about 15 - 20 m, which by the local population are called “Syri” which means “Eye”. On the shores of Lake Shkodra many temporary karst springs and lakes can be found as well. These are only active during the periods of rainfalls or during the snow melting period.

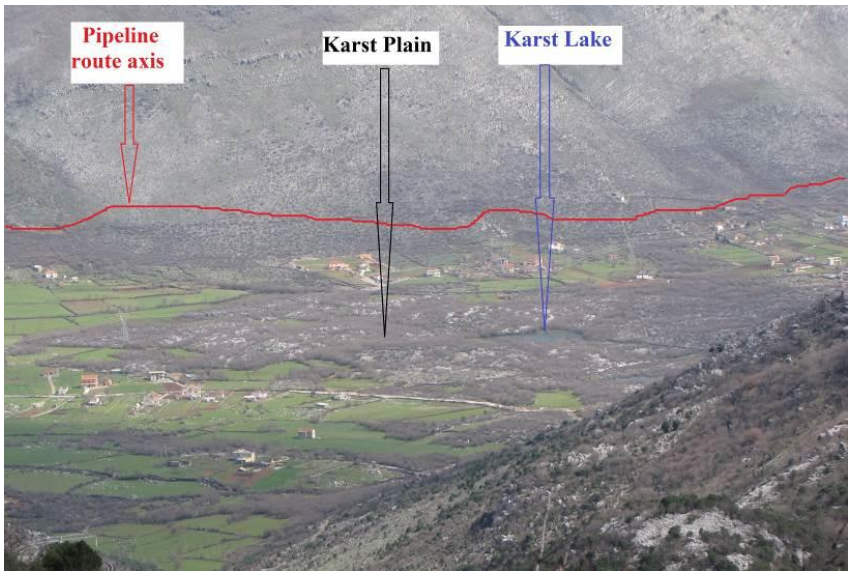


Figure 14 Karst lake on the karst plain in the segment Ivanaj-Hoti/Barlaj

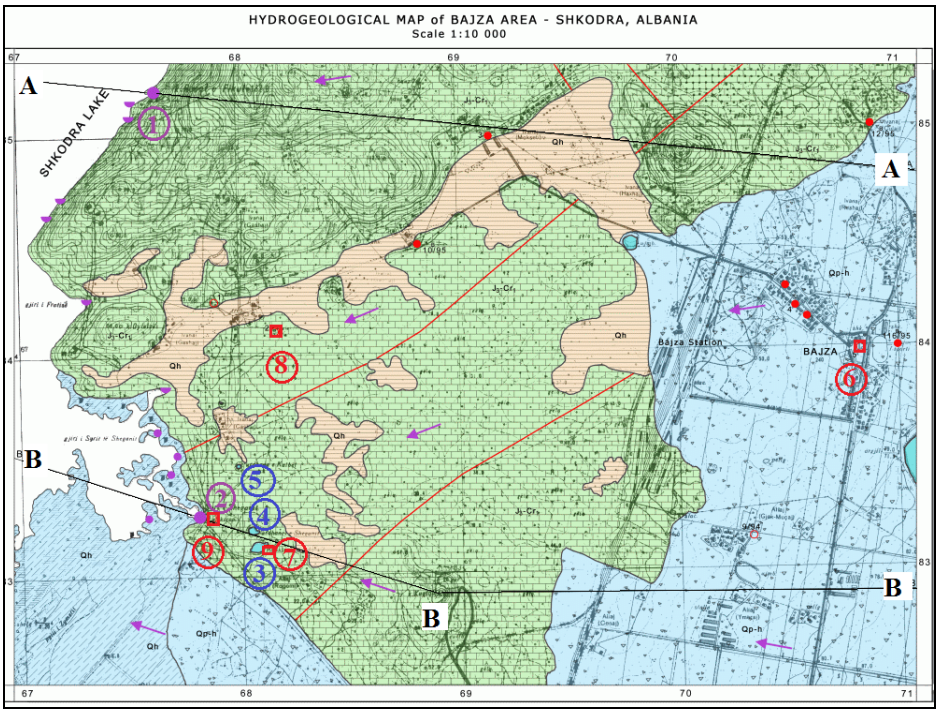
Figure 15 The historical dug well “Shpella Frasherit” (“Cave of ash”) in the centre of Bajza village.

Three small karst lakes (Hurdhana 1, Hurdhana 2, and Hurdhana Kalbet) communicate through karst canals with the Lake Shkodra as well as with Syri Sheganit Spring (Nature Monument). This hydraulic connection is the reason why the water level in the karst lakes varies accordingly to the variation of the Shkodra Lake level; therefore the yearly amplitude of the lake’s level variation is about 5 m. Urdhana Lake 1 and Syri Sheganit spring are used for the

irrigation of the surrounding cultivated lands through pumping stations with a capacity of about 200 -250 l/s.

Figure 16 Bajza Bay where are located numerous karst springs

A detailed investigation has been performed in the framework of the hydrogeological study for the preparation of the report on the "Preliminary Environmental Assessment, Risk Assessment and Preparation of Bidding Documents and Action Plan for Repackaging and Temporary Store of Hazardous Chemicals - Bajza Hot-Spot" (Mon Tec, Tirana, 2008).



Legend:

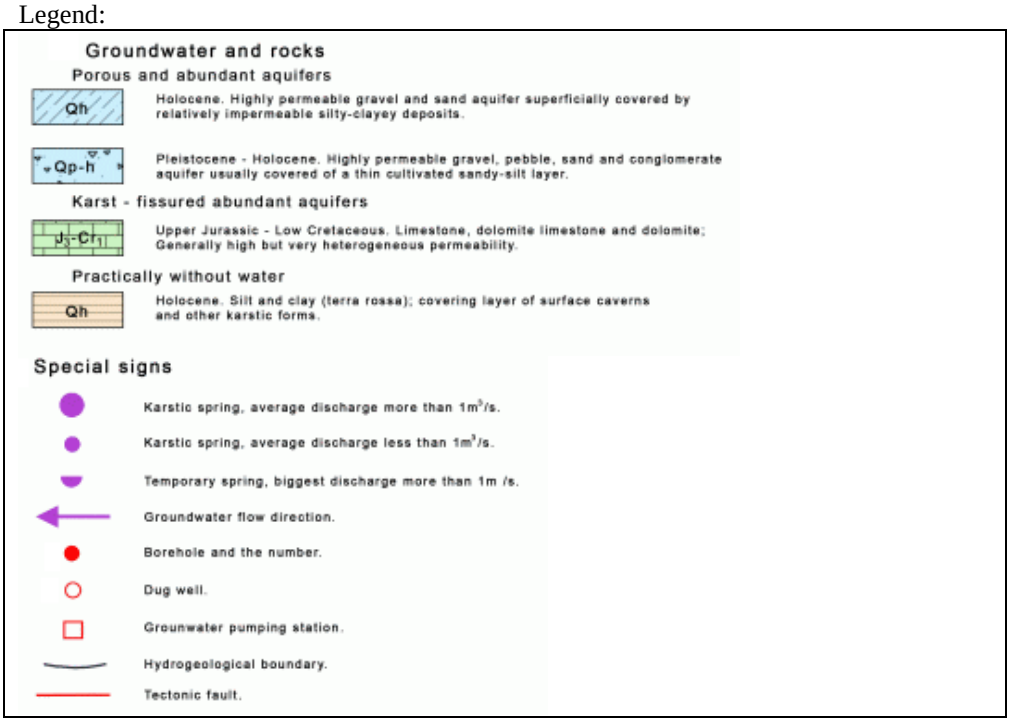


Figure 17 Hydrogeological Map of Bajza area (Eftimi R., 2008)

Source: Based on Eftimi R. in "Preliminary Environmental Assessment, Risk Assessment and Preparation of Bidding Documents and Action Plan for Repackaging and Temporary Store of Hazardous Chemicals - Bajza Hot-Spot" (Mon Tec, Tirana, 2008).
Note: 1-Syri Zi Karst Spring; 2-Syri Sheganit Karst Spring (NM); 3-Hurdhana 1 Karst Lake; 4-Hurdhana 2 Karst Lake; 5-Hurdhana Kalbet karst Lake; 6,8-Dug wells and pumping stations; 7,9-Pumping stations.

The hydrogeological cross-sections A-A and B-B (figures 18, 19, 20) of the above hydrogeological map (fig. 18), show in detail the hydraulic connections between Shkodra Lake and the Karst Springs, Karst Lakes and dug wells in the karstic plain of Bajza that is traversed by Variant A of the proposed pipeline corridor.

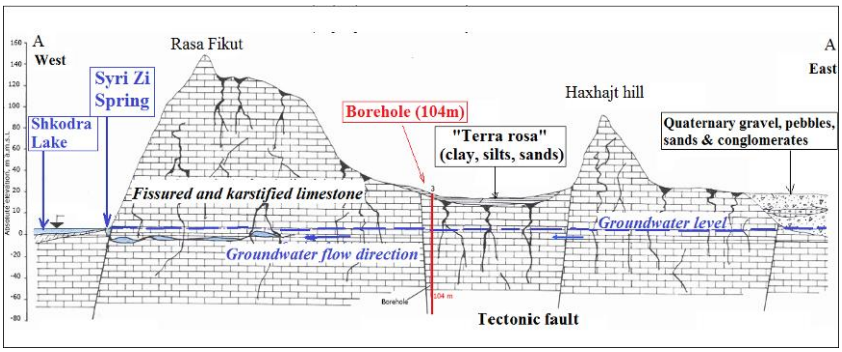


Figure 18 Hydrogeological cross-section (A-A) and hydraulic connections between the Quaternary loose deposits (east of Bajza), Syri Zi karst Spring and Shkodra Lake

Source: Kalaja & Rudi, 1996; and Eftimi R., 2008

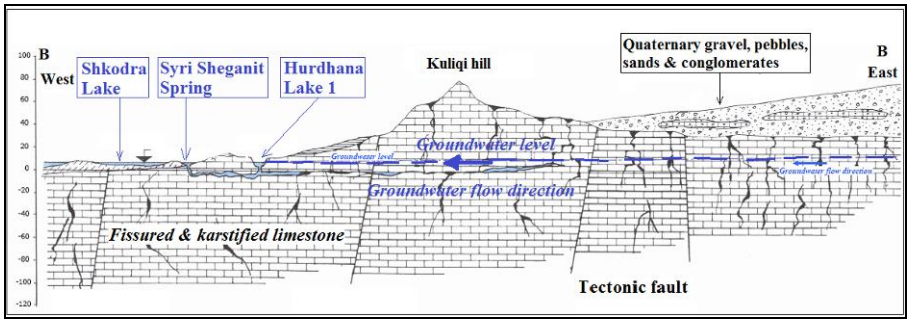


Figure 19 Hydrogeological cross-section (B-B) and hydraulic connections between the Quaternary loose deposits, dug wells, karst lakes, karst springs, and Shkodra Lake

Source: Kalaja & Rudi, 1996; and Eftimi R., 2008

In the figure below are shown in detail the hydraulic connections between the Syri Sheganit Karst Spring and Hurdhana 1 and 2 Karst Lakes.

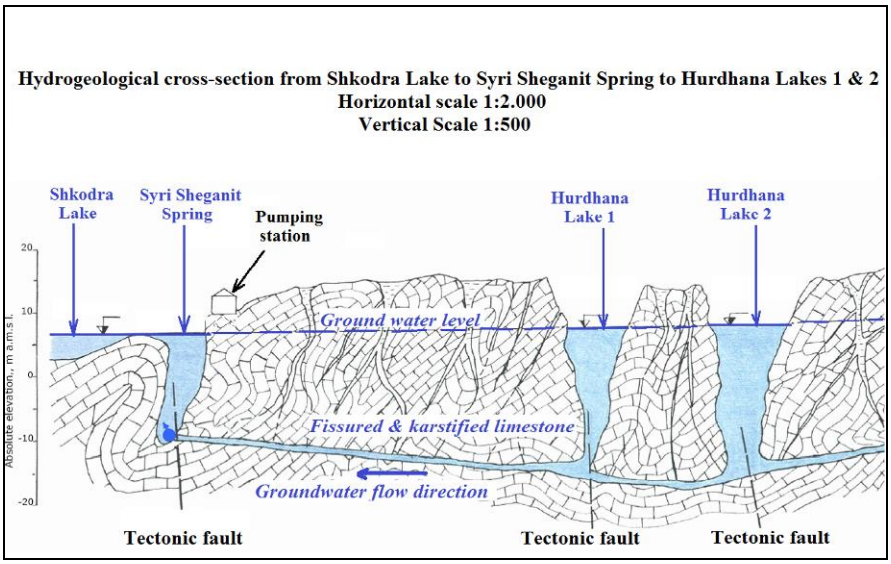


Figure 20 Detailed hydrogeological cross-section near Syri Sheganit Karst Spring
Source: Kalaja & Rudi, 1996

Montenegro

Pipeline route enters Montenegro through Jurassic and Lower Cretaceous limestones, which are mainly intensely karstified with high permeability. Near D. Mileš pipeline route descends to Quaternary valley of rivers Cijevna and Morača whose deposits have different range of yield from high to low. Near Lekići pipeline route ascends over Lower Cretaceous highly karstified rocks with high permeability. Near the settlement Krincka Kamenica Variant A crosses over Upper Cretaceous deposits with medium karstification and high permeability. Near Meterizi pipeline route crosses over Lower Cretaceous intensely karstified deposits with high permeability. In the vicinity of G. Ulici Variant A crosses over Upper Triassic deposits with yield that range from small

to none. In some places pipeline route crosses over smaller diluvial fields with low yield. From the settlement Poda, pipeline route passes mainly through large diluvial fields with various yields, which are separated with Cretaceous and Jurassic deposits. Pipeline route ends at the routes junction in alluvial valley of predominantly high yield.

Variant B

Overview of lithostratigraphic units

Albania

Based on the tectonic map of Albania this section lays in the tectonic zone of Kruja. From Balldren to Dajc the line route runs in a completely flat terrain, over Quaternary marshy and alluvium deposits. The marshy deposits fill the Balldren Plain (Torovica plain), which lies in a southeast to northwest direction, parallel to the hills of Renci (545 m asl at Mali Kolaj peak) and Kakarriqi (383 m asl) that border this plain. From the north-western edge of Kakarriqi hills to the border ALB/MNE the line route runs over the alluvial plain of Buna River, which sediments are composed mainly of clayey-silty deposits.

The Balldreni plain overlies a narrow syncline between the hilly ridges of Rrenci and Kakarriqi that are composed of Cretaceous limestone. The syncline is accentuated by a graben-like structure due to the tectonic activities. Its maximum width is 1 km, while the length is about 20 km.

Montenegro

Variant B crosses over Albania – Montenegro border near the settlement Rusuli, from there the route is heading in NW direction through alluvial valley, built mostly of sands and gravels, rarely clay deposits. West of Vladimir route turns W over Upper Cretaceous (senonian - K_2^3) bulky dolomites, which are alternating with detrital limestones and dolomitized limestones. Near the settlement Kamenički most Variant B passes through Mrkovsko polje that is built of alluvial deposits, and then route crosses over Upper Cretaceous deposits. Near the settlement Pećurice route turns N across dilluvial deposits (d) which are consisted of disintegrated flysch material and fragments of limestone, and in some places are related with slope breccia. After transition through dilluvial deposits, route in NW direction passes over Upper Eocene (E_3) flysch deposits, and S of Zaljevo route passes onto Cape Volujica, that is built of Upper Cretaceous bulky dolomites (senonian - K_2^3), which are alternating with detrital limestones and dolomitizied limestones. In the Bigovica bay the pipeline route Variant B enters the sea.

Geological composition and lithostratigraphy of the seabed is not known. The route exits the sea in the Trsteno bay near Budva and is heading N over Upper Cretaceous ($^3{}_4K_2^3$) white and grey limestones, dolomitic limestones and Upper Cretaceous ($^2{}_4K_2^3$) bulky grey dolomites that are partly bituminous. About one

km from Trsteno bay route crosses into alluvial valley built from sands, gravel and some clay, near Lukavci the route crosses over hill slope that is built of Middle Eocene (E_2) sediments, which are represented with claystone, marl and sandstones with intercalations of breccia and conglomerate. Near Radanovići the route turns along the W edge of Soliotsko polje that is built of alluvial deposits and near Pelinovo comes to the route junction.

Tectonic relations and seismic features

Albania

According to the seismic intensity map of Albanian territory (Map of Seismic Regionalization of Albania, Scale. 1:500.000, Tirana 1980; approved by DCM no 371, of 12.20.1979), the pipeline route runs over a territory situated on the seismic intensity VIII degree MSK-64 (fig. 13), estimated for 100 year (with 70% probability), for an average soil category (2nd Soil Category, according to the technical condition KTP-N.2-89). The expected maximal earthquake magnitude is Ms=7.2.

Variant B does not cross any tectonic fault, while crossing through Albania (Figure 13).

Montenegro

Variant B enters Montenegro in the area of geotectonic unit called Para-autochthon, which is situated between the sea, Cukali zone, Visoki krš and Albanian border. Para-autochthon is built of Upper Cretaceous and Middle Eocene carbonate rocks and Upper Eocene flysch. Because of the distinctive rock plasticity and strong thrusts that acted from NE direction this terrain is abundant with folded structural units – anticlines and synclines.

The route of Varian B exits the sea in the Trsteno bay near Budva and passes through geotectonic unit called Budva-bar zone. This zone is overthrusted over Para-autochthon along reverse dislocation that stretches from Jaz bay near Budva, over Bratešić to Igala.

The geological structure of this geotectonic unit involves various Mesozoic carbonate sediments, Anisian and Paleogene flysch. Budva – Bar set is highly complex, this is the area of intense tectonic narrowing. Around Budva, Mesozoic and Paleogene sediments are folded in multiple parallel overturned anticline and syncline, which are also deformed by breaking.

Variant B passes through geotectonic unit Para-autochthon and partly through Budva-Bar zone which according to engineering – geology classification of the maximum level of seismicity is classified as 9° of the MCS scale.

The area through which Variant B passes, from Bar to Albanian border belongs to 8 - 9° degree of MCS scale according to engineering – geological classification.

Hydrogeological features

Albania

From Balldren to Torovica embankment, the proposed pipeline route runs over recent marshy deposits, which overlie Quaternary marine deposits that fill the Torovica syncline. The water bearing and the permeability of the above deposits are very low. The marine deposits overlie the dolomitized limestone formations of the Rrenci and Kakarriqi anticlines.

Both sides of the Balldren field, in the Renci and Kakarriqi hilly foots, there are numerous karst springs. Springs arising southeast of Renci Mountain do not contain good quality waters; while those of Kakarriqi Mountain are characterized by good quality waters and can be used as drinking water. Along the Kakarriqi mountain range, waters belonging to limestone rocks meet at a depth of about 4-5m bsl. Drilling performed for individual wells along the western mountain range of Kakarriqi Mountain provide good quality waters and low mineral content, suitable for use as drinking water. Nevertheless, these wells are of importance solely for the village of Torovica, which is the only village located in the western side of Kakarriqi Mountain. From Torovica embankment to the Buna River (Albania/ Montenegro border) the Variant B of the proposed pipeline route runs over the alluvium plain of Bregu Bunes ("Buna Riverside Plain"), which lies over a Quaternary gravel aquifer 6-8 m thick. Impermeable sub-clays, which thickness varies from 17 to 25m, cover this aquifer. The villages of the commune of Dajc are supplied with drinking water from individual hydro-geological wells.

In the segment, 20 km long, from Balldren to Torovica Embankment, the pipeline route does not pass on any significant aquifer. However, it is suggested to place the pipeline at a respectable distance from the Kakarriqi mountain foot, in order to avoid the limestone, which underlies in the marshy and marine Quaternary deposits.

From Torovica embankment to Buna River (border ALB/MNE), the pipeline route runs over the Quaternary gravel aquifer of "Buna Riverside Plain", which has a local importance. The impermeable sub-clayey cover is 17-25m thick. Thus there is no risk of groundwater pollution from project activities.

Montenegro

Pipeline route, Variant B, entering Montenegrin territory from the direction of Albania crosses over alluvial valley built of deposits with high yield. Near the settlement, Vladimir the pipeline route crosses Lower Cretaceous sediments with medium karstification and high permeability. Near Kamenički bridge pipeline route passes through peripheral part of alluvial valley and near Pečurice crosses over diluvial deposits with various yields onto Middle Triassic deposits with low permeability. Variant B crosses over deposits with medium karstification and permeability and near the city of Bar enters the sea where is laid on the seabed. In Trsteno bay pipeline route exits the sea where it crosses

over Upper Cretaceous deposits into alluvial valley with predominantly high yield, and partly over the edge of Upper Eocene deposits with yield that range from small to none and then Variant B comes to the routes junction.

4.3.1.4 Land Use and Pedology

Variant A

Albania

Land use

From Balldren to the east of Shkodra the proposed pipeline corridor runs mainly over a flat agricultural lands used mainly for crops, vineyards, olive-trees and other fruit-trees. In this segment the pipeline route traverses three main rivers [Drini-Lezhes (four times), Drini and Kiri], as well as a number of streams. The Drini Lezhes, Drini and Kiri riverbeds are covered of riparian forests.

From the East of Shkodra to Koplik the pipeline route runs over agricultural lands and farmhouse spread everywhere in the agricultural lands. Because of unplanned internal migration during the last 20 years, many arable lands are converted into residential lands. Many rural roads, transmission and telecommunication lines, and poorly maintained irrigation and drainage channels crisscross now the agricultural plots.

From Koplik to Ivanaj, the pipeline traverses agricultural lands of low quality that are partly cultivated and partly abandoned. The abandoned agricultural lands serve as pastures.

From Ivanaj to the border ALB/MNE the pipeline runs mainly over scarce lands that are partly covered from shrubs and partly from rocky patches. The shrubs lie over karstic dolomitised limestones that outcrop in surface in this area.

Pedology

The pedologic assessment of the project area is based on the “World Reference Base for Soil Resources Classification”, whereas the agro production land assessment is dependent on the particle size, nutritional elements, and soil depth.

Figure 21 Map of soil classification (World Reference Base for Soil Resources) on the project area (according to Zdruli et al., 2001)

The topographic relief that pipeline corridor Variant A passes through is generally flat with slight steep hills. Land use throughout the length of the relief varies. Over 80% of its length passes on agricultural land, which intertwines with urban land; while the other 20% passes in non-agricultural land (grassland, shrubs, and soil characteristic of riverbeds).

Pedologic assessment: Based on the "World Reference Base for Soil Resources Classification" the soils along this section belong to the following soil types: Luvic Phaeozem (PHlv) – approx. 43 %; Eutric Fluvisol (PLeu)-31%; Molic Cambisol (CMmo)-14%; Calcaric Regosol (RGca)-6%; and Vertic Luvisol (LVvc) – 6% (fig. 21).

Agro production land assessment: Throughout the length of this segment, beginning from Balldren towards Hoti, land quality varies. Thus, organic matter in the soils of the Zadrima field varies from 3.7 up to 3.9 %, for soils in proximity to Kosmac its 2.9%, and in Koplik 2.1%. Stone makeup in the depths of the soils varies from 0 to 130 cm in Balldren, 0 to 120 cm for the segment Between Drini River and Koplik, and 100 cm up to 110 cm following up to Hoti.

Voluminous density of lands throughout the segment varies from 1.24 to 1.58gr/cm3. These lands have average total porosity indicators, high water field capacity, and high coefficient of water usage.

The table below shows the land quality, for a 400m land strip along the line route, from the agro-pedological point of view, without taking in consideration the land use.

Table 10 Agropedological land quality along Variant A of the pipeline corridor

No	Section Balldren – Hoti/Barlaj (Variant A)			
	Segment	Approximate length (km)	Land surface (ha)	Land quality
1	Balldren-Gocaj	1.2 (km 0.0 - 1.2)	48.0	Not suitable for agricultural purposes
2	Balldren - Trush	20.0 (km 1.2 – 21.2)	800.0	Very good
3	Trush - Vrake	20.0 (km 21.2 - 41.2)	800.0	Good
4	Vrake - Palvar	7.8 (km 41.2 – 49)	312.0	Medium
5	Palvar - Ivanaj	10.0 (km 49 – 59)	400.0	Low
6	Ivanaj – Hoti	8.5 (km 59 – 67.5)	340.00	Not suitable for agricultural purposes

The land requirement for a 400m wide strip along the Variant A of the pipeline route is provided in the table below.

Table 11 Agropedological land quantity and quality along Variant A of the pipeline corridor

No	Section Balldren – Hoti/Barlaj (Variant A)	
	Land quality	Land requirement (ha)
1	Very good	800
2	Good	800
3	Medium	312
4	Low	400
5	Not suitable for agricultural purposes	388
Total		2700

As Variant A crosses numerous villages, rivers, and infrastructure objects, the final table of the land quantity and quality, and land use, is shown in the table

below, which also includes the results of the land occupied from inhabited areas and industrial and military infrastructures (see also the paragraph on social issues).

Table 12 Land use along Variant A of the pipeline corridor

No	Land use (ha)	Land surface occupied (ha)
1	Agricultural land	1,686
2	Broad-leaved oak forests & shrubs	388
3	River & stream beds & riparian areas	80
4	Road and drainage & irrigation infrastructure	50
5	Inhabited rural areas	400
6	Military areas	88
7	Industrial areas	8
Total		2,700

Montenegro

Assessment of land use in two variants was performed by using available Corine Land Cover dataset (CLC) for the year 2006, obtained from European Environmental Agency. CLC identifies hierarchically three different land use category levels inside each of the main group such as artificial surfaces, agricultural areas, forest and semi natural areas etc. For the purpose of impact assessment of two variants, the buffer area of 400 m (200 m on both sides of the pipeline) was taken into consideration.

According to performed analysis it was estimated that Variant A occupies 2534.2 ha in total.

The most abundant land use type in Variant A presents Forest and semi natural areas with 1754.0 ha (69.2 %), Agricultural areas constitute 769.2 ha (30.4 %) and artificial surfaces constitute 11.0 ha (0.4 %).

Table 13 CLC categories for Variant A

Land use category	Area (ha)	Area (%)
Industrial or commercial units	6.0	54.6
Road and rail networks and associated land	5.0	45.4
Artificial surfaces	*11.0*	*100. 0*
Non-irrigated arable land	95.7	12.4
Vineyards	119.8	15.6
Pastures	132.9	17.3
Complex cultivation patterns	123.8	16.1
Land principally occupied by agriculture, with significant areas of natural vegetation	297.0	38.6
Agricultural areas	*769.2*	*100.00*
Broad-leaved forest	532.6	30.4
Coniferous forest	32.2	1.8

Natural grasslands	106.7	6.1
Transitional woodland-shrub	1015.9	57.9
Sparsely vegetated areas	66.6	3.8
Forest and semi natural areas	*1754.0*	*100.00*
Total	2534.2	

Variant B

Albania

Land use

From Balldren to Dajc (Albania/ Montenegro border) the proposed pipeline corridor runs entirely in flat agricultural lands, which are used mainly for crops, vineyards and other fruit trees. Numerous drainage and irrigation channels cross the study area. The villages are rare and far from each-other.

Pedology Assessment: Based on the World Reference Base for Soil Resources classification, soils included in this segment belong to the following types: Eutric Fluvisol (FLeu) approximately 12%, Luvic Kastanozem (KSly) with 12%, Eutric Histisol (HSeu) with 33%, Calcaric Cambisol (CLca) with 20 % and Gleyic Fluvisol (Flgl) with 23% (fig. 21).

Agro production land assessment: Throughout the length of the segment, starting from Balldren towards Buna River, land quality varies. Significant differences are observed on orphic lands along the Torovica valley and following on continuing land mass. Differences in the content of organic matter are extremely high. Lands along the Torovica field have high fertility indicators. The value of organic matter in this region ranges from 3.8% to 4.5% or more. Voluminous density varies from 1.2 to 1.4gr/cm3, while total porosity is average. Soils have high flat-water capacity and simultaneously high water usage coefficient.

Table below shows the land quality along the line route, from the agropedological point of view, without taking in consideration the land use.

Table 14 Land quality along Variant B of the pipeline corridor

No	Section Balldren – Dajc/Shtodher (Variant B)		
	Segment	Approximate length (km)	Land Quality
1	Balldren – Torovica embankment	19.2 (km 0.0-19.2)	Very Good
2	Torovica embankment - Buna River	10.1 (km 19.2-29.3)	Good

The land requirement for a 400m wide strip along the pipeline route is given in the table below.

Table 15 Land quantity and quality along Variant B of the pipeline corridor

No	Section Balldren – Dajc/Shtodher (Variant B)	
	Land quality	Land requirement (ha)
1	Very good	768
2	Good	404
Total		1,172

As Variant B crosses one village only (Torovica) along a segment of 50 m length, the final table of the land quantity and quality, and land use, is shown in the table below.

Table 16 Land use along Variant B of the pipeline corridor

No	Section Balldren –Dajc/Shtodher (Variant B)			
	Land use (ha)	Land quality	Land surface (ha)	Total surface (ha)
1	Agricultural land	Very good	762	1,164
		Good	402	
		Medium	-	
		Low	-	
	Inhabited rural areas		2	2
	Road and drainage/irrigation infrastructure		4	4
	River beds & riparian areas		2	2
2	Total			1,172

Montenegro

According to performed analysis it was estimated that Variant B occupies 3057.6 ha in total.

In Variant B, dominant category is Water bodies (sea) with 1343.1 ha (43.9 %) then Forest and semi natural areas with 868.8 ha (28.4 %), Agricultural areas with 798.2 ha (28.3 %) and Artificial surfaces with 47.5 ha (1.6 %).

Table 17 CLC categories for Variant B

Land use category	Area (ha)	Area (%)
Discontinuous urban fabric	29.3	61.7
Port areas	18.2	38.3
Artificial surfaces	*47.5*	*100.00*
Pastures	64.6	7.5
Complex cultivation patterns	445.0	51.5
Land principally occupied by agriculture, with significant areas of natural vegetation	288.6	33.4
Agricultural areas	*798.2*	*92.4*
Broad-leaved forest	425.8	49.0
Coniferous forest	52.5	6.0

Natural grasslands	109.0	12.5
Sclerophyllous vegetation	204.8	23.6
Transitional woodland-shrub	76.7	8.9
Forest and semi natural areas	*868.8*	*100.00*
Water courses	7.1	0.5
Sea and ocean	1336.0	99.5
Water bodies	*1343.1*	*100.00*
Total	3057.6	

The dominant soil type in the area of consideration presents Leptosols, shallow, often gravelly and erosion-prone soils, with limited soil volume and therefore subject to both drought and waterlogging. In sourounding area of Lake Skadar/Shkodra soils such as Acrisols and Fluvisols are also common. Acrisols are highly weathered soils developed under moist aggressive leaching conditions, with an argilic horizon and a base saturation below 50%, probably paleosols inside the present Mediterranean environment. Fluvisols are lowland soils developed in recent fluviatile, lacustrine or marine deposits, showing commonly stratified layers and an irregular distribution of organic matter with depth.

Erosion processes are mostly related to Variant A. Very high erosion risk exists at only 2.2% of the area, moderate risk at 37.7%, weak at 45.1% and very weak at 15.0 %.

4.3.1.5 Analysis of social issues

Albania

During the last 20 years the population has moved out of the rural areas due to the lack of sustainable economic resources and the lack of service delivery networks. The tendency to migrate is higher in the rural mountainous areas, moderate in the hilly areas and more stable in the municipality of Shkodra.

The lack of urban plans has entailed a situation of chaotic buildings spread out irregularly and in such a way that increases the cost of service delivery (health, education, building roads, sewage and water pipes, etc.). The spread of settlements has already caused the defragmentation of the agricultural land, and the procurement of drinking water through pumping wells.

Variant A

Population – demographic indicators

The intense growth of the informal settlements during the last 20 years, has led to a drastic increase of the urban and sub-urban population as well as of the population of the flat areas. Because of the lack of urban planning and of the informal settlements, an important part of the agricultural land has turned into

inhabited areas. Within the proposed pipeline corridor Variant A, the informal settlements have been developed mainly nearby the towns of Shkodra and Koplik, as well as in the flat terrains on both sides of the highway Shkodra-Koplik. This drastic change on land use and population increase is mainly due to the internal migration from the mountainous areas of Shkodra, Malesia Madhe, Lezha and Puka districts.

The table below shows the data on the population of the districts traversed from Variant A of the proposed pipeline route.

Table 18: Affected districts, including respective population in 2009

No	Province (county)	Affected Districts	Population (2009)*		
			Urban	Rural	Total
1	Shkodra	Malesi Madhe	3,606	32,479	36,085
2		Shkodra	86,222	99,390	185,612
3	Lezha	Lezha	21,369	55,801	77,170
	Total Albania**		1,573,431	1,620,986	3,194,417

**Source: Ministry of Interior, 2010*
***Source: Institute of Statistics, 2009*

The projection on the population changes shows a high trend for the municipalities of Shkodra and Lezha, as well as for the communes situated in lowland and close to the national roads, or to the seaside and to the Shkodra Lakeshore.

Table 19 Projected population changes for 2020 in some dwelling areas along the Variant A of the pipeline corridor*

Administrative units	District	Year 2003*	Year 2010**	Projection for 2020*
Commune of Balldren	Lezha	9.939	10.279	15.316
Commune of Dajç, Lezha		7.011	6.921	14.584
Commune of Barbullush	Shkodra	4.759	4.910	5.542
Commune of Bushat		17.087	23.140	28.250
Commune of Berdice		9.123	8.975	12.911
Commune of Guri i Zi		11.730	11.209	15.202
Municipality of Shkodra		81.994	114.219	138.433
Commune of Rrethina			23.418	
Commune of Gruemire			12.800	
Commune of Qender	Malesia Madhe		6.180	
Municipality of Koplik			11.007	
Commune of Kastrat			12.205	

**Source: Regional Environmental Action Plan on the basin of the Drin River, the area of Shkodra Depression and the Area of Lezha)*
*** Source: Ministry of Interior, 2010*

Economic activities

The area traversed by Variant A of the proposed pipeline route is rich in natural resources, like fertile plains, wetlands, water resources etc. The favourable geographical position, climate, soil quality, water resources, etc. create conditions for a sustainable economic development.

The notable improvement of the national and rural road infrastructure, power and drinking water supply infrastructure and services; tourist infrastructure and services, etc., have led to improvements of the economic and social indicators, and consequently to unemployment and poverty reduction.

The industrial activities are mainly concentrated in Shkodra town and its neighbourhood. In the whole flat area of the Shkodra and Malesia Madhe Districts there are numerous animal farms of national importance for milk and meat production.

Distance from populated areas

Variant A

The field investigations and the study of the recent aerial maps illustrate that Variant A traverses numerous dwelling centres (following figure). Due to the high number of the villages in proximity to the proposed pipeline route corridor, the table below includes only the dwelling centres crossed from the axis of this corridor. The distance from the pipeline axis and the length of crossings have been calculated based on the orthophoto supplied by GIS Albania that gives a snapshot of the dwelling areas in year 2007.

Table 20 Affected villages and their respective distances from the axis of the proposed pipeline corridor

No	Province (county)	Affected District	Affected town	Affected commune	Affected Village	Distance from the pipeline axis	Length of crossings (m)
1	Lezha	Lezha	-	Balldren	Gocaj	crossed	2,000
2			-	Dajc	Mabe	crossed	100
3					Lisi Locit (Mabe)	crossed	300
4	Shkodra	Shkodra	-	Bushat	Shkjeze	crossed	50
5			-		Bushat	crossed	200
6					Velaj (Melgusha)	crossed	700
7			-		Melgusha	crossed	700
8			-		Melgusha	crossed	800
9				Gur i Zi	Renc	crossed	250
10					Bleran	crossed	1,500
11			Shkodra	-	-	crossed	200
12			-	Rrethina	Golem	crossed	800
13					Grude e Re	crossed	500
14					Guci e Re	crossed	1,000

15					Shtoji Vjeter	crossed	200
16		Malesia Madhe		Gruemire	Grude Fushe	crossed	200
17					Pjetroshan	crossed	50
18				Kastrat	Bajza	crossed	300
19					Vukpalaj	crossed	150
		Total					10,000

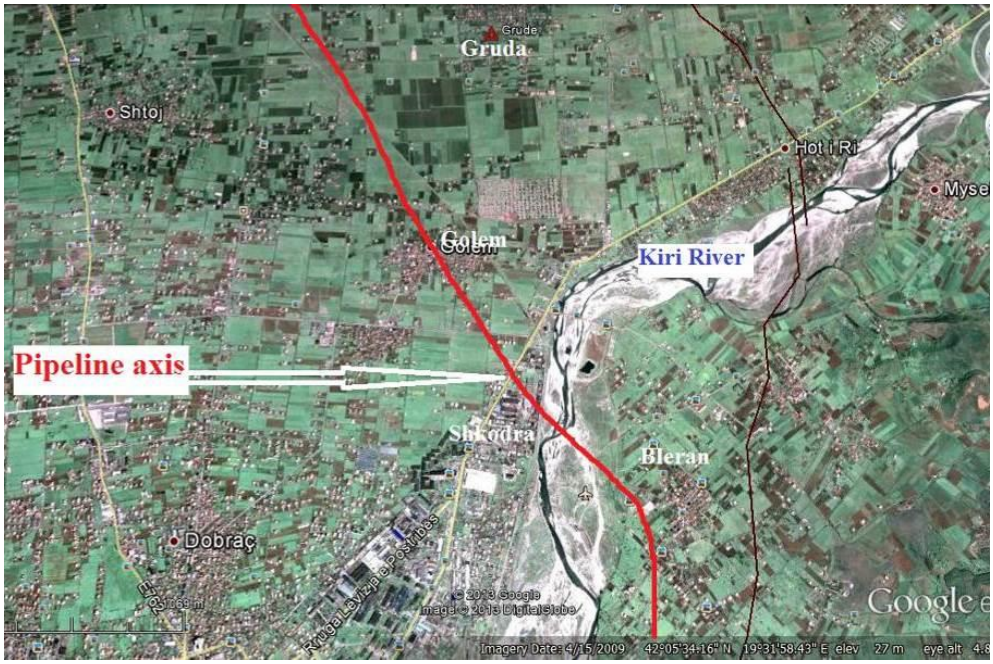


Figure 22 Overview of the crossed inhabited area in the northeast of Shkodra (Google map)

Other infrastructure objects crossed from the proposed pipeline route.

In the territory of Dajc Commune (Lezha District) the axis of the proposed pipeline route runs over the landing strep of the Gjadri air military base. The total length of this landing strep is approximately 3.2 km, from which 2.2 km are crossed from the pipeline axis.

Furthermore, the pipeline crosses the industrial area of Shkodra in the north eastern part of this town.

The table below gives the results of the settlements and industrial and military infrastructure crossed from the axis of the pipeline. The buffer area has been taken 400m wide (200m both sides of the pipeline axis).

Table 21 Crossed settlements/ infrastructure from Variant A of the pipeline route

No	Crossed settlements / infrastructure	Length of crossing	Land surface required (ha)	Comment
1	Settlements	10.0 km	400.0	Inhabited rural areas
2	Military areas	2.2 km	88.0	Landing strip of Gjadri air base
3	Industrial areas	0.2 km	8.0	Northeast of Shkodra surroundings
4	Total	12.4 km	496.0	

Variant B

From Balldren to Dajc (ALB/MNE border) the proposed pipeline corridor runs entirely in flat agricultural terrain. The villages areas are rare and far from each other. Demographic trends show a slight decrease of the population due to the internal migration towards Lezha and Shkodra cities, as well as to the immigration towards other countries like Italy, Germany, etc. The only economic activity in this area is agriculture, which is favoured by the high quality of the land, especially in the Balldren Field.

The projection on the population changes shows a high trend for the municipalities of Shkodra and Lezha, as well as for the communes situated in lowland and close to the national roads or to the seaside and to the Shkodra Lakeshore.

*Table 22 Projected population changes for 2020**

Administrative units	District	Year 2003*	Year 2010**	Projection for 2020*
Balldren Commune	Lezha	9939	10.279	15316
Dajç Commune	Shkodra	8520	8.718	14.584

**Source: Regional Environmental Action Plan on the basin of the Drin River, the area of Shkodra Depression and the Area of Lezha)*
*** Source: Ministry of Interior, 2010*
The projected population increase in these communes affects mostly the villages close to the national roads. Thus, it is not expected any population growth in Torovica, which is the nearest village of Balldren Commune affected from the Variant B of the pipeline route.

The map prepared in the framework of the Strategic Plan for the Development of Dajc Commune (fig. 5) shows that the proposed pipeline route corridor runs in an area planned for agricultural purposes. Thus, the IAP project does not interfere with any infrastructure project within Dajc Commune territory. In addition, the projected growth of the dwelling areas is planned to occur far from this corridor.

From Balldren to the border ALB/MNE, the proposed Variant B of the pipeline route traverses the territories of the following dwelling centres:

Table 23 Villages located less than 500m from the axis of the Variant B of the pipeline corridor

Province (county)	Affected District	Affected Commune	Affected Village	Distance from the pipeline axis	Length of the crossing
Lezha	Lezha	Balldren	Balldren	500m	-
			Torovica	crossed	50m
Shkodra	Shkodra	Bushat	Fshat i Ri	300m	-
		Dajc	Malecaj	100m	-
			Dajc i Ri	400m	-
			Belaj	400m	-
Total					50m

It should be stressed that the pipeline route can completely avoid the dwelling areas because there is enough free space through arable lands, and the villages are far from each other.

Montenegro

General overview – population and economy

Montenegro is an Adriatic-Mediterranean and Dinaric country, covering a land area of 13,812 km2 and having about 625,000 inhabitants (2011 census). It shares borders with Albania, Serbia, Bosnia and Herzegovina and Croatia (only 14 km wide coastal strip). Its relief, mostly mountainous, is dominated by the Dinaric mountain system, stretching parallel to the coastline and with peaks above 2500 m. Northern and central parts of Montenegro are made of high mountain ridges and plateaus, intersecting deep and narrow river valleys. Relatively large plains expand in its central part, and in the area of the Lake of Skadar/Shkodra and Zeta River. Approximately half of the territory belongs to the Sava basin and the other half to the Adriatic Sea basin. The most important rivers of the Sava basin within Montenegro are rivers Piva, Tara, Ćehotina and Lim. These rivers are tributaries of Drina River and Ibar River are tributaries of Morava River. The major river of the Adriatic Sea basin in Montenegro is Morača River with its tributaries Zeta, Cijevna, Rijeka Crnojevića and Orahovštica. Morača flows into Skadar/Shkodra Lake, and from there to the Adriatic Sea through the Bojana River. Montenegro is rich in water resources.

Prior to the war 1991-1995 that ravaged the Dinaric region, the government of Yugoslavia directed the development of the Dinaric region towards mass tourism along the coastal areas, and stimulation of the agricultural production in the interior part of the region by construction of appropriate infrastructure intended for flood protection, irrigation, water supply and hydropower production activities that may impact the quality of the freshwater resources contained in the Dinaric Karstic Aquifer System, and the integrity of its dependent ecosystems. Today, while the region is on a fast track of economic growth, spurred, at least for some of the countries by the opening of EU accession discussions, countries are determined to move towards more

sustainable development models and to deal with many difficulties in the longer run.

Administrative boundaries, general population data and economy

Population density is rather low in Montenegro (50/km^2), in comparison to Croatia with an average population density of 75.8/km^2.

The population growth rate is low or negative and across the region, there is a trend of migration from remote, rural areas towards urban areas and industrialized zones. The settlements are extremely dispersed, and some of them in rural areas are almost completely abandoned. Major and biggest towns and cities are located in the hinterland, in the mountainous areas, but the development of smaller sized cities occurred along the coastline, mostly due to the tourist development. Due to that development of tourism, population numbers in certain subareas may vary considerably across the year, with peaks in the summer season where seasonal working force usually is in need. Most touristic centres are situated along the coast while off the summer season is not yet developed; even if there are fantastic possibilities to do that (mountainous, 5 national park areas, beautiful nature for hiking walking and staying). Taking into account these possibilities it could be expected that in the future tourism including camping on the mountains, along the lakes etc. will be much more developed. That might give an opportunity to change the touristic pattern that is presently organized mostly along the coastline.

In Montenegro the iron works, aluminium industry, mining industry, pharmaceutical industry and food-processing industry represent major industries. Most of the industries are operating now with limited capacities (regarding to the projected capacities) or have been closed.

Employment

Agricultural area in Montenegro occupies 38% of the total surface area (2009). The total agricultural land represents 516,404 ha. The sector of agriculture in Montenegro presents 9% of GDP. During the period between 1992 and 2003 the annual growth in total production increased on average +2.8%. The most important growth was achieved in crop production (annual growth rate +4.7%), while livestock production showed significantly smaller rates of growth at +0.8%.

The contribution of Travel & Tourism to Gross Domestic Product is expected to rise from 20.8% (EUR730.0 mn or US$1,018.0 mn) in 2009 to 25.6% (EUR 1,791.5 mn or US$ 2,290.9 mn) by 2019. (http://www.usmnebc.org/node/22). The economic importance of tourism is great and the country is doing a lot to improve the conditions. Tourism is of a seasonal nature (summer months), and located mostly at the coastal areas. The areas to be activated as tourist destinations – in the future developments - are mountainous tourism as well as rural tourism.

As it could be seen from these data and the description of the situation, Montenegrin economy is shifting from the primary type industrial production country to the service economy with an emphasis on tourism and other connected service economies.

Potential benefits of the pipeline

The total number of dams is four in Montenegro with total installed capacity of 658 MW and with the percentage of 62.2 for energy needs in the country, which means that the country relies mostly on the hydropower energy capacities.

Potential users and benefits from the pipeline:

- Gas supply as a major energy resource of tourist centres, including hotels, smaller apartments as well as restaurants and other tourist service centres – smaller towns and cities along the coastline
- Gas supply as a major energy resource of the households along the coastline and in the hinterland in major settlements (Cetinje, Podgorica, Nikšić) as well as the centres along the coastline – Herceg Novi, Budva, Bar, Ulcinj…
- Gas supply as a major energy resource of industrial capacities and factories, mostly located in the hinterland, mountainous areas
- Gas supply as a major energy resource for the shipyard capacity in Bijela in Boka Kotor Bay
- Gas supply of households along the pipeline route, more or less within the range of bigger or small sized towns and cities to be dependent on the overall economic situation and the rise of the standard of living of local population and the country in general

Less clear benefits of the introduction of the gas as an energy source to be selected by different users will also depend on:

- the price of gas
- availability of other alternative energy resources
- availability of gas supply
- problems connected to the price of distribution of gas to the dispersed households in smaller settlements and villages, especially in the SE areas, towards the Albanian border

Research strategies and methods

This report is based on the findings gathered through the use of the *method of interviews* of the people living along the pipeline route, *with the officials* at the level of counties and municipalities and cities as well on the use of the method of observation.

Variant A

Variant A enters from Albania to Montenegro near the villages Baraj and Skorač and then continues in the same NW direction passing the Tuzi village located to the South of the projected pipeline route. The route then continues towards Ćemovsko polje (Ćemovo field), with one of the biggest coherent vineyards in the world. Here the pipeline is on the nearest point to the capitol of Montenegro, the city of Podgorica. The city of Podgorica with a population of 151.312 (census 2011.) is situated within the Municipality of Podgorica (187.085 inhabitants, census 2011.). This part of Montenegro is very mountainous, so it could be easily supposed that the realization of the pipeline route in this area could be much more difficult in technical terms. However, here will be many more potential consumers of the gas in this area (bigger cities) than in the Variant B of the pipeline route that goes subsea along the shoreline.

After passing the area of Municipality of Podgorica, the route continues to the west towards the Municipality of Cetinje (16.757 inhabitants, Census 2011.) and Lovćen mountain.

It should also be mentioned that this, northern Variant A of the pipeline route goes right through to the National Park Lovćen, categorized in the 2nd category of national parks in the country, proclaimed to be a national park in 1952. Also, it touches the northern part of the National Park Skadarsko jezero (Skadar/Shkodra Lake). It should be emphasized also that there are no permanent population in the Lovćen National Park, apart from the sub-Lovćen villages like Njeguši and the like that lies below the mountain.

Two major infrastructure projects are planned and approved by the State Spatial Plan – one, high voltage power line that should go across Lovćen mountain connecting Italy and Montenegro as well as a cable car (funicular) for tourist reasons from Kotor to Lovćen mountain and further. It is interesting to note that the Government of Montenegro has changed the route of the electric power line at the beginning of April 2013 to protect the area of the National park Lovćen and to inflict less harm to the nature.

Concerning the Park of Nature Skadarsko Jezero (Skadar/Shkodra Lake), it should be mentioned that Albania protected this area in the category Park of Nature as well as the river Bojana that goes into to the Skadar/Shkodra Lake. It might be that the Montenegro government will soon do the same, for the Montenegro part of the lake.

Most economic activities along the corridor are concentrated along the small sized agriculture, and some commerce and service activities. Some people are

employed in the centres of National parks, and some in (rural) tourism. The gas to be provided could be received as an advantage of the existing economic activities.

Variant B

The whole area from the border Albania/Montenegro, till the town of Stari Bar in the NW direction of the country seems to be much less developed than the rest of Montenegro. The area is mostly populated with Muslim –Albanian population. In other words, it represents a rather neglected area yet not developed, and in a way "set a side".

Pipeline route, after the Albania/Montenegro border, enters the Municipality of Ulcinj, passing close to village Ambula and continues to the west passing close to the villages Vladimir, Krute, Grdovići and Dobra voda. Then it continues towards NW direction and reaches the Municipality of Bar. In the area of Volujica the route enters into the sea.

The pipeline comes from the sea again in the Municipality of Budva, and after the city of Budva in heads in the direction of the Kotor Bay. It continues to the Bigovica bay and through the Grbalj valley into the direction of the Municipalities of Kotor and Herceg Novi.

For this social and environmental impact assessment it is not necessary to list all settlements and specified social elements that will be potentially impacted by the pipeline route especially due to the fact that the route goes close to the very small settlements, mostly villages where there is even little agriculture and very small population – usually up to 100-200 inhabitants. In this sense, when the pipeline route comes to the area of the State of Montenegro, it passes many villages having at maximum between 100-500 inhabitants. Due to the present types of economic activities in this area, it could be predicted that no major interest of the local population will be expressed for the use of gas as an energy source. .

The pipeline route is passing through the area of several municipalities:

- The Municipality of Ulcinj (20.265 inhabitants, census 2011)
- The Municipality of Bar (42.368 inhabitants, census 2011)
- The Municipality of Budva (19.170 inhabitants, census 2011.)
- The Municipality of Kotor (22.799 inhabitants, census 2011.)
- The Municipality of Tivat (14.111 inhabitants, census 2011.)
- The Municipality of Herceg Novi (30.992 inhabitants, census 2011.)

4.3.1.6 Hydrology/ Marine areas

Variant A

Hydrology

From Balldren to Hot/Barlaj (border ALB/MNE), Variant A of the pipeline route passes near Shkodra Lake and crosses three (3) main rivers (6 crossings), two small rivers (Vraka and Rrjolli), and a number of streams. The traversed main rivers are: Drini Lezhes (4 times); Drini and Kiri.

Shkodra Lake is the largest one in the Balkan Peninsula. Its area varies from 353 km^2 at a minimum lake level (4.6 m asl) to 500 km^2 at a maximum lake level (9.8 m asl). It has an average depth of 5-6 m, a maximal length of 44 km and a maximal width of 14 km. Its drainage area is about 5,500 km^2, from which 4,470 km^2 in Montenegro and 1,030 km^2 in Albania.

In the segment Ivanaj-Hot, the distance of Shkodra Lake from the axis of the proposed pipeline corridor is approximately 1.5 km.

Drini River is the longest river of Albania (283 km). At Vau i Dejes it enters the lowlands of Shkodra and splits into two distributaries; the Drini, which flows towards Buna River, and the Lezha Drini River that continues to the south, passing through the plain of Zadrima and further one to the west of Lezha, where it reaches the Adriatic sea at the Drini Bay. The average annual discharge of Drini River at Shkodra (including Kiri River discharge) is approx 360 m^3/s. The Drini of Lezha, which is 22 km long, originates at Mjeda Village. It has an annual discharge of 120 m^3/s at Lezha Bridge.

Variant A in Montenegro crosses several streams: stream Urelja south of D. Mileš, streams Koložun and Suvi potok west of Nalježići and stream Petelj south of Sutvara. Pipeline route crosses Koložun stream in western part of Soliotsko polje.

Variant A crosses: east of D. Kokoti, rivers Morača and Cijevna in Čemovsko polje and river Sitnica southwest of Lekići.

River Sitnica is the most downstream right tributary of river Morača. It rises from the karst springs called Vučji studenci.

River Morača originates in northern Montenegro, under Rzača Mountain. It generally flows southwards for some 113 km, before emptying into Lake Skadar.

River Cijevna rises in Albania, and flows into river Morača in Montenegro (south of the town of Podgorica). The river is 64,7 km long.

Variant B

Hydrology

Variant B in Albania crosses once the Buna River at the state border Dajc/Shtodher.

Buna River, which is 44 km long, originates at the southeastern part of Shkodra Lake and discharges its water at the Buna delta in Velipoja into the Adriatic Sea. The Buna joins the Drini River just 1.3 km downstream of Shkodra Lake, resulting in a doubling in water flow from 320 m^3/s to 680 m^3/s. The maximal flow of the Buna has in the past occasionally reached up to 7500 m^3/s, leading to flooding of the wide plain area. The situation changed after 1970 with the reclaiming process of most of the Shkodra plains and the construction of the three big dams in the Drini River.

This pipeline Variant B in Montenegro crosses several streams: south of Pečurice the pipeline route crosses Mali potok. Pipeline route crosses several times stream Lukavci northwest and southeast of Radanovići and Koložun stream in western part of Soliotsko polje.

Variant B crosses south of Shkodra, river Miđanska and river Bojana that presents natural border between Albania and Montenegro. Pipeline route crosses river Mrkovska northwest of Vukići, and river Jaška in Mrčevo polje.

Marine areas

Variant B passes through marine habitats along on the part between Bigovica Bay and Trsteno Bay.

List of marine habitats that are present along the route and will be affected during construction phase are presented in following table.

Table 24 List of marine habitats that are presented along marine part of the route

List of marine habitats present on Varian B - marine area
A1. 1 High energy littoral rocks
A1.13 Mediterranean and Black Sea communities of upper mediolittoral rock A1.14 Mediterranean and Black Sea communities of lower mediolittoral rock very exposed to wave action
A3.1. Atlantic and Mediterranean high energy infralittoral rock
A4.56 Posidonia beds (*Posidonion oceanicae*)
A5.23 Infralittoral fine sand
A4.76 Sublittoral mixed sediments

EUNIS CLASSIFICATION

A1. 1 High energy littoral rocks - The boulders and cliffs rising above high tide and exposed to the splash and spray of sea waves are all encompassed within the definition of this habitat. The habitat is characterized by extreme environmental conditions (lack of moisture, extreme temperature fluctuations and salinity, waves) so the biological diversity of species is low. In the Bigovica Bay and in the Trsteno Bay the upper white belt of rocks is mostly

without vegetation or with rare halophytes, sharply separated from the well-developed terrestrial vegetation. This zone is rarely exposed to the spraying waves, but well enough to prevent the development of terrestrial plants that cannot tolerate siltation.

A1.13 Mediterranean and Black Sea communities of upper mediolittoral rock

A1.14 Mediterranean and Black Sea communities of lower mediolittoral rock very exposed to wave action

The distribution and type of the populations of the solid substratum in the mediolittoral stage are profoundly marked by the submersion variability due to waves and to the irregular rise in the sea level caused by atmospheric pressure and wind. Two horizons corresponding to different average values of the dominant factors (humectation, light, nutrients, topography and type of substratum) can be made out. The upper horizon corresponds to the area that is only moistened by the tops of the waves and spray. The upper mediolittoral is the horizon where the environmental conditions are most restrictive. According to the hydrodynamics and the local topography (Bigovica Bay and in the Trsteno Bay), it can extend over a vertical area of a 50 centimetres. The area of mediolittoral rocks is dominated with development of endolithic Cyanobacteria (Cyanophyceae). The lower horizon of the mediolittoral rock results from the coming together of three essential factors: presence of waves, irregular variations in atmospheric pressure, and wind and tide when present. The constant humiliation greater than in the higher horizon is the dominant factor, followed by light.

A3.1. Atlantic and Mediterranean high energy infralittoral rock - in deeper parts, the infralittoral stage extends from tidal areas to the survival limit of the marine phanerogams and the photophilous algae. This lower limit depends on the penetration of light, and thus varies greatly with the topography where in case of the Bigovica Bay and in the Trsteno Bay the lower limit of this habitat is determinated with sediment substrate. The most dominant genus is brown algae *Cystoseira* that forms large settlements.

In the area of Bigovica Bay the significant impact of sea urchin *Paracentrotus lividus* is present whose grazing diet influences settlements of infralittoral algae, resulting in coverage loss.

A4.56 Posidonia beds (Posidonion oceanicae)

Posidonia oceanica (L.) Delil - seagrass is an endemic species to the Mediterranean Sea and plays an important role in the Mediterranean Sea ecosystem. Along the Montenegro coast it usually forms dense and extensive underwater meadows. These meadows provide important ecological functions and services and support a highly diverse community, including species of economic interest. The thicket of leaves provides excellent conditions for settlement of a number of epiphyte algae, as well as for a shelter, habitation and spawning of numerous animals. *P. oceanica* is present in a narrow coastal strip,

on beds of soft sediment, and in the Bigovica bay and in the Trsteno bay forms tick zone at on depths between 10 and 25 meters.

A5.23 Infralittoral fine sand - In the Bigovica bay and in the Trsteno bay this habitat occurs in very shallow water with sea bottoms characterised by fine sands, usually with homogenous granulometry and of terrigenous origin. Fine sand has occurrence from the lower tide level to 2.5 meters. In deeper parts of bays fine sand is replaced with well sorted sand.

A4.76 Sublittoral mixed sediments - Stretches of organogenous gravels and coarse sands, more or less filled in with sandy and muddy sediment and usually to an extension at depth well sorted fine sands which is case in the Bigovica Bay and in the Trsteno Bay. The sediment is of heterogeneous granulometry and of mixed origin: terrigenous and organogenous. The gravels and sands may come from the neighbouring (infralittoral and circalittoral) rocks, or be made up of fragments of mollusc shells, big calcified bryozoans, or tests of echinoderms. The distribution of this habitat is from 20 to 60 meters depth.

Along the marine part of the pipeline route construction works will affect protected marine species. These species are shown in following table.

Table 25 Protected marine species along marine part of the pipeline route - Variant B

Group	Name (in Latin)
Sponges	*Aplysina aerophoba*
	Axinella cannabina
	Axinella damicornis
	Axinella polypoides
	Axinella verrucosa
	Spongia officinalis
	Tethya aurantium
	7
Cnidarians	*Madrepora oculata*
	Cladocora caespitosa
	Eunicella cavolinii
	Eunicela stricta
	4
Mollusks	*Lithiphaga lithophaga*
	Pinna nobilis
	2
Echinoderms	*Centrostephanus longispinus*
	Ophidiaster ophidianus
	Holothuria forskali
	Holothuria impatiens
	Holothuria polii
	Holothuria tubulosa
	6
Reptiles	*Caretta caretta*
	Chelonia mydas
	2
Mammals	*Delphinus delphis*
	Stenella coeruleoalba
	Stenella frontalis

	Tursiops truncatus
	Grampus griseus
	Balaenoptera physalus
	Delphinus delphis
	Stenella coeruleoalba
	8
Sea grass	*Posidonia oceanica*
	1
Algae	*Cystoseira mediterranea*
	Cystoseira mediterranea (Ag.) Sauv. var. stricta
	Cystoseira mediterranea (Ag.) Sauv. var. spicata
	Cystoseira amentacea
	Cystoseira amentacea var. adriatica
	4
Total	34

**The decision of placing certain plant and animal species under protection (Official Journal of the Republic of Montenegro; no. 76/06; 12 December 2006)*

4.3.1.7 Biological environment (Flora and fauna)

Albania

Variant A

The pipeline in Balldren – Hot alternative (Variant A-Albania) starts at Balldren village and runs through hilly areas covered by degraded Maquis of the Kakariqi Mountain. The pipeline then follows arable land and many other more or less transformed areas used mainly for crops, vineyards and other fruit trees of the Balldren, Gjader, Blinisht, Dajc, Bushat, Melgushe, Ashte, and Renci villages. Further north, near Shkodra city, the route joins Drini and Kiri Rivers. The junction is the site of the best riparian forest of the region.

From this area, not far away from the shore of trans-boundary Skadar/Shkodra Lake the route goes towards the Kopliku, Bajza, Ivanaj and Hot villages. It goes mostly through arable land used mainly for crops, vineyards and other fruit trees and hills covered by Macchia or degraded forests dominated by mixed deciduous oak.

The Drini, Drini Lezhes (Lezha's Drini) and Kiri Rivers are the site of the riparian forest of the region. Variant A of the proposed pipeline route has six main rivers crossings [Drini Lezhes (four crossings), Drini (1 crossing), and Kiri (1 crossing)]. This is considered a relevant number of river crossings because river and riparian environments by nature are highly valuable sites. Numerous drainage and irrigation channels characterize the study area.

The following sections provide a description of the main vegetation types and habitats occurring along the pipeline.

Vegetation types and habitats

Arable lands

The pipeline route follows arable land and many other more or less transformed areas used mainly for crops, vineyards and other fruit trees of the Balldren, Gjader, Blinisht, Dajc, Bushat, Melgushe, Ashte, Renci, Kopliku, Bajza, Ivanaj and Hot villages. Arable lands and their associated irrigation systems constitute the majority of the habitats present within the study area. The most widely cultivated crops in these areas are: bread cereals, vegetables, potatoes, animal fodder, fruit trees, olives, grapes and others (beans, tobacco, etc.). This habitat supports high bird species abundance, which are mostly passerines. In winter, flocks of finches in company of other small passerines use the open fields. In summer, the open fields provide breeding grounds for the common quail. Robin, house sparrow, wren, larks and many species of finches visit hedges and various fruit trees of the open terrains. The most characteristic mammal species are rodents, both voles and mice, such as Thomas's pine vole, the Macedonian mouse, the common house mouse and the common wood mouse. The most common insectivores are the white-toothed shrew, and Balkan blind mole. The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Macchia vegetation

Macchia and all other derived degradation stages within this series occupy a small surface in the study area mostly in Kakariqi Mountain and Shkodra - Koplik segment. The human impact in this area is significant, mainly through agriculture development, illegal forest logging, intentional forest fires, extensive overgrazing, etc. Beside the above damages, the erosion of the land causes another factor with very big impact for these zones. In some areas the soil is eroded so much as bedrock is almost visible. Therefore, the degradation process had started quite a long time ago, as featured by various types of vegetation that appear. The Macchia is representing a stage of degraded evergreen Mediterranean forest or old forests of *Quercus ilex*. The most important species that give the physiognomy to this formation are the evergreen shrubs such as *Phillyrea angustifolia, Punica granatum, Juniperus oxycedrus, Spartium junceum, Cercis siliquastrum, Paliurus spina-christi, Pyrus amygdaliformis, and Cotinus coggygria*. *Quercus ilex* adapted to grow for a long period in hot weather and lack of rain.

Avifauna of the Mediterranean macchia found in the study area supports a wide range of bird species including many passerines. Scrublands provide an important wintering habitat for many bird species, which breed at higher altitudes and move down to scrublands to escape bad weather. The most typical birds of such vegetation are warblers. During spring-summer seasons, the macchia supports a range of species of birds, such as subalpine warbler, *Olivaceous warbler*, etc. During migration, Mediterranean shrubs especially near the coastal area are used as stop-over grounds for other species such as hoopoe, wryneck, blackbird, etc. A range of mammals also exploits the macchia habitat during different periods of the year. The tracks of the weasel, European polecat, fox and badger, as well as of different species of mice and voles were commonly observed during the field survey. Other species such as

lesser white toothed shrew and bicoloured shrew and eastern European hedgehog are reported to this type of habitat. Various bat species hunt for food over the Mediterranean macchia.

In Albania, this type of vegetation has broader extent, in almost half of the country's surface. But generally this type of vegetation is very damaged by exploitation. The value of the vegetation and habitats encountered within the site is generally medium, due to the presence of species that are considered to be threatened in a local or national context, such as *Quercus ilex, Salvia officinalis* (an important medicinal plant harvested in the area).

Forest formations dominated by a mix of deciduous oak species

Forest formations mostly dominated by *Quercus pubescens, Quercus cerris* and *Quercus frainetto* are found across small parts of the study area in the hilly areas of the segment between Kopliku and Hot village. The main elements of these forests are *Quercus pubescens*, *Quercus frainetto, Fraxinus ornus*, *Juniperus oxycedrus*, etc. They represent degraded forest treated as coppice, used by the local population for firewood and for grazing (especially goats) and branch cutting for livestock food basis during the winter.

Fauna of this type of habitat is a mixture of species linked with forests and shrubs. Avifauna is rich and dominated by passerines. A number of bird species visit the area during winter and summer time. The most commonly present include warblers, robin, wren, hoopoe, buntings, goldcrest and firecrest, blackbird, and jay. Common mammals found in this habitat include wood mice and dormice. Other mammals recorded in this type of habitats are foxes, badger, weasel, and white tooth shrews.

Plant species present in this habitat type are for the most part commonly occurring throughout the country. The value of the vegetation and habitats encountered within the pipeline line route is generally Low.

Figure 23 Forest formations dominated by a mix of deciduous oaks along Ivanaj – Hot segment

Riparian vegetation

Alongside Variant A of the proposed pipeline corridor, there is a number of riparian vegetation as follows.

a Riverbeds

The Drini, Drini Lezhes and Kiri Rivers are the site of the riparian forest of the region. Variant A of the pipeline route has 6 main river crossings that are considered a relevant number because river and riparian environments by nature are highly valuable sites. The presence of these rivers, aquatic habitats, freshwater marshes and riparian forests supporting high floral and faunal biodiversity give to the region a high importance. Patches or narrow belts of this habitat type we can found following these rivers on alluvial especially basic lands, with a higher level of underground waters. This habitat type, colonizing poorly stabilized alluvial deposits periodically flooded, is characterized by dominance of the *Salix alba, Alnus glutinosa, Platanus orientalis, Tamarix parviflora*. The accompanying flora include *S. elaeagnos, S. purpurea, Populus nigra, Phragmites australis, Typha latifolia, Lythrum salicaria, Mentha aquatica, Rubus ulmifolius, Populus alba, Arum italicum, Hedera helix, Calamintha grandiflora* etc. Among mosses, lichens and ferns, *Pteridium aquilinum* is often abundant.

At the merging point between Drini and Kiri Rivers, the pipeline route crosses a riparian area in the Drini riverbed (shown on following figure). This is the best riparian area crossed from Variant A of the pipeline route. The small islands are considered as very special and attractive.

Figure 24 Drini River (on the right) by the conflux with Kiri River (on the left);

This is the best riparian area crossed by the pipeline. The small islands are considered as very special and attractive.

Other different independent studies classify this part of the Drini riverbed as more rich in biological values compared to other segments of this riverbed. For the purposes of the construction of Ashta HPP over Drini River, Lahmayer International (2001) and SNC Lavalin (2008) have studied in detail the

biodiversity along the Drini River. As a result, the riverbed from Vau Dejes to Buna River has been split into three segments of different biotic activity (A: low; B: medium; and C: high). As shown in the sketch below (next figure), the river segment crossed by Variant A of the pipeline route has a higher biotic activity compared to the other segments.

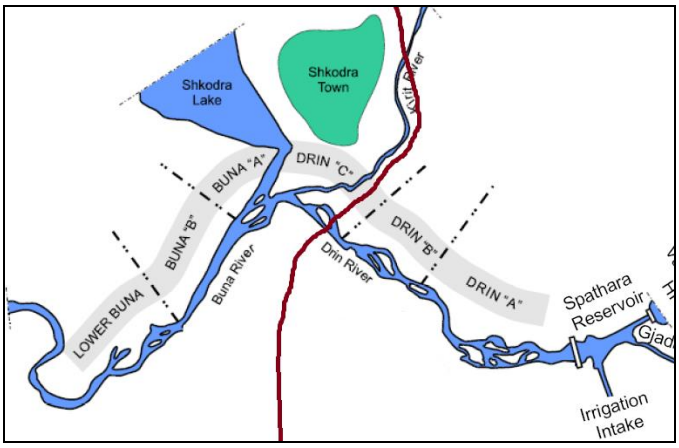


Figure 25 Section C – high biotic activity along the Drini riverbed crossed by the pipeline route (red line)

Source: Lahmayer International, 2001; SNC Lavalin, 2008.

Streams and rivers are important habitat for animal species linked with running freshwater habitats, such as dragonflies, fish (i.e. Barbus meridionalis, Barbus graecus, Cobitis tenia and Chondrostoma nasus), and amphibians. Fresh water streams and rivers provide an important habitat for a range of bird species including kingfisher and wagtails. Herons also frequent this habitat. Some sections of the Drini, Drini Lezhes and Kiri Rivers are also important for otter (Lutra lutra) globally threatened species, whose presence has been verified. Drainage and irrigation channels provides suitable conditions for a number of freshwater insects (dragonflies), fish (especially eel, (Anguilla Anguilla), amphibians, reptiles, and birds. Sometimes, the otter may visit drainage channels.

Riparian vegetation on the riverbeds, although small and patchy is of more significance in terms of habitat, particularly for the fauna. These species-rich habitats add much to the botanical diversity of the site.

b-Drainage and irrigation channels

Numerous drainage and irrigation channels characterize the study area. The formation of reed-beds is more wide spread in these channels. High trunk helophytes, as: *Phragmites australis*, *Typha angustifolia*, *Scirpus lacustris*, participate in its basal composition. These are more frequently accompanied by the species: *Sparganium erectum*, *Alisma plantago-aquatica*, *Eleocharis palustris*, *Lythrum salicaria*, *Veronica anagallis-aquatica*, *Mentha aquatica*.

c Shoreline of Shkodra Lake

The pipeline is located close to the shore of the trans-boundary Shkodra/Skadar Lake - the largest lake on the Balkan Peninsula that both Albania and Montenegro have officially designated as a cross-border protected area. In Albania the actual protection status of the Albanian part of Shkodra Lake is "Managed Nature Reserve" (IUCN Category IV), declared by the Albanian Government with the DCM No. 684, of November 02, 2005. The Ramsar Secretariat and the DCM No. 683, of November 02, 2005, have also declared the Albanian part of the Lake area as a Ramsar site (Ramsar Convention "On internationally important wetlands, especially as waterfowl habitats").

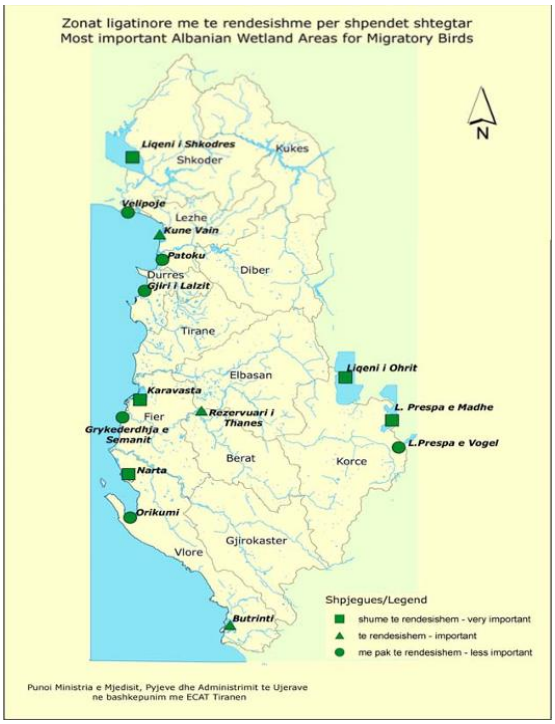


Figure 26 Most important Albanian Wetlands for Migratory Birds

Source: MoEFWA

Shkodra Lake and its watershed represent a complexity of habitats with a high diversity of living organisms. It encompasses several types, subtypes and many smaller classification units of habitats, such as lacustrin, palustrine, riverin, limnetic, litoral, open water areas, vegetated and unvegetated, floating, emergent and submerging vegetation, hard and soft bottom, forest, shrub and herb vegetation etc. This diversity of habitats shelters a high diversity of plants and animals.

Figure 27 Shoreline of Shkodra Lake near Bajza Bay

The total number of aquatic macrophytes for the whole area of Shkodra Lake is 164 species belonging to 66 genera and 43 families. At the northern shore of the lake dominant plant species include *Phragmites communis, Scirpus lacuster, Typha angustipholia, Nuphar lutea, Nymphaea alba, Ceratophyllum demersum, Trapa natans* and *Potamogeton spp*. are represented. Around the lake stands of white willow (*Salix alba*) are the most abundant forests, mainly in the flooding area.

Besides biodiversity values, reed beds and other macrophytes are also important for their purification capacities through nutrient retention and transformation (nitrogen, phosphor), and binding of pollutants.

Twenty vascular plant species, most of them macrophytes, are endangered in the Shkodra Lake and its coasts. The most threatened are considered *Marsilea quadrifolia*, *Hydrocotile vulgaris*, *Hidrocharis morsus* – ranae, *Butomus umbellatus*, *Cladium mariscus*, *Nuphar luteum*, *Nymphaea alba*, *Nymphoides peltata*, *Sagittaria sagittifolia* and *Trapa natans*.

Several aquatic and wetland habitats of the Albanian part of Shkodra Lake are considered as endangered. These includes: Syri Sheganit and Hurdhana Kosanit; Forest areas of Shegan, Kamica, Vraka etc., The most important areas in biodiversity aspect, such as Shegani coast (north-east of the Albanian part).

One hundred and thirty three European threatened habitats (from the EU Habitat Directive and the Bern Convention annexes) are found in Albania and have been used alongside threatened species to identify Albania Important Plant Areas (IPA) under criterion C. The MNR of Shkodra Lake and Buna Riverbed wetland complex has been categorized as an IPA.

Figure 28 Map of the most Important Plant Areas (IPAs) in Albania

Shkodra Lake and its watershed area has a high number of endangered animals, of which many species have regional or international (European and global) threatening status. This is another reason for the international importance of the Skadar/Shkodra Lake. Dhora & Sokoli (2000) have published a list with 124 endangered aquatic animal species of the lake. If considering the terrestrial species, too, the list of endangered fauna of the lake watershed would be much longer. From these 124 endangered aquatic animals, 9 are molluscs, 33 are fishes, 12 are amphibians, 4 are reptiles, 65 are birds and 1 is mammal.

Figure 29 Water snake photographed during field investigations at (Hurdhana 1 Karst Lake)

Variant B

The study area supports a range of natural, semi-natural and artificial vegetation types and habitats. The natural vegetation in these areas is very changed and reduced due to agricultural activities. Semi-natural and artificial or modified

habitats, especially those intensively used for arable lands, constitute the majority of the habitats present, while natural habitats represented mostly by riparian vegetation by the side of the Buna River and degraded Macchia on the Kakarriqi, Rrenci, Gjymti and Kolaj Mountains, away from the pipeline and not affected by the project.

The following sections provide a description of the main vegetation types and habitats occurring inside the 3 km buffer areas along the pipeline listing key species, abundance and distribution within the study area and its sensitivity.

Arable lands

Arable lands and their associated irrigation systems constitute the majority of the habitats present within the study area. Torovica field with an area of more than 2200 ha represent major field of the area. The most widely cultivated crops in these areas are: bread cereals, vegetables, potatoes, animal fodder, fruit trees, olives, vineyards and others (beans, tobacco, etc.).

Figure 30. Torovica field where pipeline passes (direction NE – SW). In the front Renci Mountain

This habitat supports high bird species abundance, which are mostly passerines. In winter, flocks of finches in company of other small passerines use the open fields. In summer, the open fields provide breeding grounds for the common quail. Robin, house sparrow, wren, larks and many species of finches visit hedges and various fruit trees of the open terrains. The most characteristic mammal species are rodents, both voles and mice, such as Thomas's pine vole, the Macedonian mouse, the common house mouse and the common wood mouse. The most common insectivores are the white-toothed shrew, and Balkan blind mole.

The botanical value of these areas are generally low due to the low diversity of plant species and the absence of species that are considered to be rare in a local or national context.

Macchia vegetation

Cretaceous limestone form hills and mountains, which surround the Torovica field plain, like the Kakarriqi (altitude of 398 m), Rrenci (561 m), Kolaj, Gjymti, Suka and Reçi. Makia and all other derived degradation stages within this series occupy a large surface in the study area. The human impact in this area is significant, mainly through agriculture development, illegal forest logging, intentional forest fires, extensive overgrazing, etc. Beside the above damages, the erosion of the land causes another factor with very big impact for these zones. In some areas the soil is eroded so much as bed rock is almost visible.

The Macchia is representing a stage of degraded evergreen Mediterranean forest or old forests of *Quercus ilex*. The most important species who give the physiognomy to this formation are the evergreen shrubs such as *Arbutus unedo, Punica granatum, Phillyrea angustifolia, Erica arborea, Juniperus oxycedrus, Spartium junceum, Paliurus spina-christi, Pyrus amygdaliformis, Myrtus communis,* adapted to grow for a long period in hot weather and lacking of rain. In many cases the vegetation of these habitats is characterized by dominance of *Paliurus spina – christi* where it forms patches of characteristic physiognomy. In a small part of the territory, in Eastern part of the Renci Mountain areas, mainly in slopes very exposed to erosion, are evident fragments of Mediterranean Coniferous forest formations with dominant species Alepo Pine trees (*Pinus halepensis*).

Scrublands provide an important wintering habitat for many bird species which breed at higher altitudes and move down to scrublands to escape bad weather. The most typical birds of such vegetation are warblers. During spring-summer seasons the macchia supports a range of species of birds, such as subalpine warbler, *Olivaceous warbler*, etc. During migration, Mediterranean shrubs especially near the coastal area are used as stop-over grounds for other species such as hoopoe, wryneck, blackbird, etc. A range of mammals also exploits the macchia habitat during different periods of the year. The tracks of the weasel, European polecat, fox and badger, as well as of different species of mice and voles were commonly observed during the field survey. Other species such as lesser white toothed shrew and bicoloured shrew and eastern European hedgehog are reported to this type of habitat. Various bat species hunt for food over the Mediterranean macchia.

Figure 31 Left: Fragments of Mediterranean coniferous forests, Renci Mountain; and Right: In some areas in the Kakariqi Mountain the soil is eroded so much as bed rock is almost visible.

In Albania, this type of vegetation has broader extent, in almost half the country's surface. But generally this type of vegetation is very damaged by exploitation. The value of the vegetation and habitats encountered within the site is generally medium, due to the presence of species that are considered to be threatened in a local or national context, such as *Quercus ilex, Salvia officinalis* (an important medicinal plant harvested in the area).

The macchia vegetation and the Mediterranean coniferous forest formations lay in the mountainous area both sides of the pipeline route corridor. They are not affected directly from the project activities, because the line route runs in flat agricultural area, parallel to the hilly chains.

Riparian vegetation - Buna riverbed

The pipeline corridor traverses only one river; the Buna River at the state border ALB/MNE. The presence of Buna River, aquatic habitats, freshwater marshes and riparian forests supporting high floral and faunal biodiversity give to the region a moderately importance. The Buna River crossing is included within the Protected Area “Shkodra Lake and Buna River Wetland Complex”. Patches or narrow belts of this habitat type we can found following the Buna River on alluvial especially basic lands, with a higher level of underground waters. This habitat type, colonizing poorly stabilized alluvial deposits periodically flooded, is characterized by dominance of the *Salix alba, Alnus glutinosa, Platanus orientalis, Tamarix parviflora.* The accompanying flora include *S. elaeagnos, S. purpurea, Populus nigra, Phragmites australis, Typha latifolia, Lythrum salicaria, Mentha aquatica, Rubus ulmifolius, Populus alba, Arum italicum, Hedera helix, Calamintha grandiflora* etc. Among mosses, lichens and ferns, *Pteridium aquilinum* is often abundant.

Figure 32 Riparian vegetation of the Buna Riverbed

Buna is an ideal case, which connects not only the waters, but especially the ichthiofaunas of some ecosystems of regional importance. Among them, we distinguish the sturgeon *Acipenser sturio*, which is a globally threatened species. The most important migratory fish are: *Alosa falax nilotica, Anguilla anguilla, Dicentrarchus labrax, Mugil cephalus* and *Liza ramada*. Up to now, in the water of Buna are found three species of reptilians: *Emys orbicularis, Natrix natrix persa and Natrix tessellata*.

Buna River with marshes, ponds and channels nearby, are suitable habitats for the amphibian fauna. This field area is characterized by an abundance of amphibians. The most predominant species are *Bufo viridis, Rana lessonae* and *Rana balcanica*. The total number of individuals of bird counted in winter aspect in river sides is 8.000. Referring to the counting of the years 1993 and 1995 in the Albanian part of the river, results that some bird species, despite their low number of individuals, represent an importance of regional scale. For example, 19 individuals of *Larus miutus* counted in Buna are 11% of the total number of this species in all Mediterranean. Buna is the only found location of this species in Albania. Also, 51 individuals of Sterna sandvicensis are 4.2% of the total number of this species in Mediterranean and 85% in Albania.

For other species, such as *Anas penelope*, *Anas clypeata*, *Bucephala clangula* and *Phalacrocorax pygmeus*, comparing the small area of Buna sides with the total distribution area of these species, we can say that the individuals counted in Buna have a percentage, which is of interest in global or regional scale. Over 76% of species of Buna are migratory. This area has an important biogeographical position. It is an important station in one of the three migratory roads of the birds of Europe, the road passing over Balkan. Otter (*Lutra lutra*) is a rare mammal of Buna River. This globally threatened species has been found several times last decades in Buna. On both river sides, as terrestrial mammals are found *Lepus capensis, Vulpes vulpes, Canis aureus, Meles meles, Mustela nivalis, Sus scrofa* and some species of rats and bats.

Riparian vegetation – Drainage and irrigation channels

Numerous drainage and irrigation channels characterize the study area. The formation of reed-beds is more wide spread in these channels. High trunk helophytes, as: *Phragmites australis, Typha angustifolia, Scirpus lacustris,* participate in its basal composition. These are more frequently accompanied by the species: *Sparganium erectum, Alisma plantago-aquatica, Eleocharis palustris, Lythrum salicaria, Veronica anagallis-aquatica, Mentha aquatica.*

Riparian vegetation, although small and patchy is of more significance in terms of habitat, particularly for the fauna. These species-rich habitats add much to the botanical diversity of the site. Most of the species recorded are relatively frequent in Stream/river habitat elsewhere in Albania. The value of the vegetation and habitats encountered within the site is generally medium.

Montenegro

Due to its geographical position, heterogeneity of habitats, topography, geological past and climate variations, Montenegro has high biodiversity in most taxonomic groups, but many are poorly studied in Montenegro. Since 100 % surface of Montenegro is a part of Dinaric Arc Ecoregion (DAE), we were able to use spatial information from Protected Area Gap Analysis (WWF Project Reference No 9Z1387.05; 2009).

Flora

Variant A

In the vicinity of Podgorica the vegetation has more eu-Mediteranean character. In this area the vegetation are predominantly grasslands and scrubs.

On the highest altitudes of Variant A in the NP Lovćen, the Variant A passes through thermophilous beech forests. Moderately thermophilous, beech-dominated forests are transitional between thermophilous and supra-Mediterranean oak woods and montane beech forests. Thermophilous beech forests dominate on sun exposed steep slopes. *Fagus sylvatica* is intermixed with *Quercus petraea, Q. pubescens Ostrya carpinifolia, Acer obtusatum,* etc.

At boundaries of NP Lovćen thermophilous beech forests are mixed with thermophilous and supra-mediterranean oak woods. Along the pipeline route, south from Cetinje, oriental hornbean forests are dominating the area.

Most of the Variant A passes through areas with the vegetation of the thermophilous and supra-Mediterranean oak woods. The term ‘karst-woods’ has been applied to this transitional vegetation that is frequently developed as low, degraded forest, dominated by *Quercus pubescens, Fraxinus ornus, Carpinus orientalis* at lower and *Ostrya carpinifolia* at higher altitudes. Throughout the area, *Quercus pubescens* is often replaced by *Quercus cerris, Quercus virgiliana, Quercus trojana* and *Quercus frainetto*.

Around Soliotsko polje, the eu-Mediterranean vegetation is present. Climazonal vegetation is eu-Mediteranean evergreen forests and scrubs. Most of the area is degraded to tall (*maquis, macchia*) and low scrubs (garrigue). The vegetation is mainly composed of conifers (*Pinus halepensis, Juniperus oxycedrus, Juniperus phoenicea*), sclerophylous evergreen trees and scrubs (*Quercus ilex, Olea europaea, Pistacia lentiscus, Ceratonia siliqua, Arbutus unedo,* etc.) with the occasional admixture of termophylous deciduous taxa (*Ostrya carpinifolia, Fraxinus ornus,* etc.). Also, in this area the vegetation is mixed with sub-Mediterranean vegetation of the oriental hornbean forests. This sub-Mediterranean forest is a transition to continental forests with typical vegetation: *Carpinus orientalis, Ostrya carpinifolia, Quercus pubescens, Celtis australis, Acer monspessulanum, Pistacia terebinthus, Pyrus amigdaliformis, Sorbus domestica, Phillyrea latifolia, Fraxinus ornus*, etc. Distribution of eu-mediteranean and sub-mediterannean forest and scrubs vegetation depends on the orientation of the slopes (topography of particular microlocation).

Variant B

Most of the onshore route of Variant B passes through the eu-Mediterranean vegetation of evergreen forests and scrubs. Surrounding area of the pipeline is mostly degraded to tall (*maquis*) and low scrubs (garrigue). The vegetation is mainly composed of conifers (*Pinus halepensis, Juniperus oxycedrus, Juniperus phoenicea*), sclerophylous evergreen trees and scrubs (*Quercus ilex, Olea europaea, Pistacia lentiscus, Ceratonia siliqua, Arbutus unedo,* etc.) with the occasional admixture of termophylous deciduous taxa (*Ostrya carpinifolia, Fraxinus ornus,* etc.). There are also some parts of Variant B that passes through eu-Mediterranean grasslands.

Closer to the Albanian border most of the Variant B passes though agricultural area, hygrophilic and mesophilic hay meadows.

In the foothill of Rumija Mountain, Variant B passes through the thermophilous and supra-Mediterranean oak woods like the ‘karst-woods’ described for Variant A above.

The Variant B passes through marine area where protected species of seagrass *Posidonia oceanica* and several species of genus *Cystoseira* are present.

Table 26 List of protected marine species that are presented along marine part of the pipeline route

Seagrass	*Posidonia oceanica*
Algae	*Cystoseira mediterranea*
	Cystoseira mediterranea (Ag.) Sauv. var. stricta
	Cystoseira mediterranea (Ag.) Sauv. var. spicata
	Cystoseira amentacea
	Cystoseira amentacea var. adriatica

Fauna

Using spatial data from Protected Area Gap Analysis (WWF Project Reference No 9Z1387.05; 2009), a fauna comparison of the two variants was performed, as presented in following table. Their potential protection derives from "The decision on placing certain plant and animal species under protection" (Official Journal of the Republic of Montenegro; no. 76/06; 12 December 2006)

Table 27 Animal species present in the area of Variant A and Variant B

Group	Name (in Latin)	Variant A	Variant B	Protection
Fish	*Cobitis ohridana*	+		
	Rutilus karamani	+		
	Salaria fluviatilis	+	+	
	Salmothymus obtusirostris	+	+	
	Pachychilon pictum	+	+	
	Telestes montenigrinus	+		
	TOTAL	6	3	0
Amphibians	*Hyla arborea*	+	+	+
	Rana graeca	+	+	+
	Rana ridibunda	+	+	+
	Triturus alpestris	+		+
	Triturus carnifex	+	+	+
	TOTAL	5	4	5
Reptiles	*Algyroides nigropunctatus*	+	+	+
	Elaphe quatorlineata	+	+	+
	Hemidactylus turcicus	+	+	
	Hierophis gemonensis	+	+	
	Hierophis caspius	+	+	
	Lacerta mosorensis	+	+	+
	Lacerta oxycephala	+	+	+
	Lacerta trilineata	+	+	+
	Lacerta viridis	+	+	+
	Malpolon monspessulanus	+	+	+
	Mauremys rivulata	+	+	+
	Platyceps najadum	+	+	
	Podarcis muralis	+	+	+
	Pseudapus apodus	+	+	+
	Telescopus fallax	+	+	
	Testudo hermanni	+	+	+
	Typhlops vermicularis	+	+	
	Vipera berus	+		
	Zamenis situla	+	+	+
	Zootoca vivipara	+		+
	TOTAL	20	18	13
Mammals	*Apodemus epimelas*	+	+	
	Apodemus flavicollis	+		
	Arvicola terrestris	+		
	Canis lupus	+	+	
	Dinaromys bogdanov	+	+	
	Dryomys nitedula	+	+	
	Micromys minutus	+	+	
	Microtus subterraneus	+		
	Microtus thomasi	+		

	Mus spicilegus		+	
	Suncus etruscus	+	+	
	Talpa caeca	+		
	TOTAL	11	7	0
TOTAL		42	32	18

Both variants go through similar habitats, although in different extent, so it is expected for them to have similar animal species, as it is seen from the Table 27. The higher number of species in Variant A could be explained by the fact that this Variant goes through NP Lovćen that has high biodiversity. This is the reason why faunistic biodiversity of NP is discussed in further text. On the other hand, Variant B goes through Adriatic Sea; so marine biodiversity is discussed separately for this Variant.

Variant A

Variant A passes through the mountain region of Lovćen, which is a hot spot of biodiversity due to its contact zone position of Mediterranean and Continental climate. NP Lovćen has many animal species, among which many are relict and endemic species. Furthermore, large mammals are recorded for NP Lovćen, such as *Canis lupus, Ursus arctos, Sus scrofa, Vulpes vulpes, Capreolus capreolus* and *Lepus europaeus*. Also, small mammals are known, such as *Erinaceus concolor, Talpa caeca, Sciurus vulgaris, Dryomys nitedula*, etc.

Around 200 bird species visits and/or breeds inside the Park. Also, in NP Lovćen live other animal groups: 11 species of reptiles, 16 species of amphibians, 85 species of butterflies, 100 species of ants, 45 species of hoverflies etc.

Variant A passes through karst area with numerous caves (e.g. „Duboki do“ in Lovćen and Lipska cave). In many cases, they have an exceptionally complex and high biodiversity, with many endemic and relict forms.

In areas Goljemadi and Kokoti where Variant A passes, an endemic slug *Limax wohlberedti* is registered according to Protection of rare plant and animal species; Official Gazette of Republic of Montenegro No. 76/06.

Variant B

Variant B passes through marine habitats. Data on marine invertebrates suggest relatively high diversity, but also a low degree of endemic species. The diversity of fauna of saltwater fish in the Adriatic Sea includes 117 recorded families, but a low level of endemism. Until now for Montenegro 40 742 species of saltwater fish have been recorded, which represent around 70 % of the species recorded in the Mediterranean.

Along the marine part of the pipeline route several marine protected species are present, as shown in table below.

Table 28 Protected marine species along the route*

Group	Name (in Latin)
Sponges	*Aplysina aerophoba*
	Axinella cannabina
	Axinella damicornis
	Axinella polypoides
	Axinella verrucosa
	Spongia officinalis
	Tethya aurantium
	7
Cnidarians	*Madrepora oculata*
	Cladocora caespitosa
	Eunicella cavolinii
	Eunicela stricta
	4
Mollusks	*Lithiphaga lithophaga*
	Pinna nobilis
	2
Echinoderms	*Centrostephanus longispinus*
	Ophidiaster ophidianus
	Holothuria forskali
	Holothuria impatiens
	Holothuria polii
	Holothuria tubulosa
	6
Reptiles	*Caretta caretta*
	Chelonia mydas
	2
Mammals	*Delphinus delphis*
	Stenella coeruleoalba
	Stenella frontalis
	Tursiops truncatus
	Grampus griseus
	Balaenoptera physalus
	Delphinus delphis
	Stenella coeruleoalba
	8
Total	*29*

**The decision on placing certain plant and animal species under protection (Official Journal of the Republic of Montenegro; no. 76/06; 12 December 2006)*

4.3.1.8 Natural heritage and protected areas

Albania

Variant A

a-Protected areas

4 (four) protected areas are likely to be affected from Variant A of the pipeline route corridor, as follows:

1- MNR of "Shkodra Lake and Buna River wetland complex";

2- MNR of "Riparian area of the Albanian part of Shkodra Lake":

3-NM of "Syri Sheganit" Karst Spring; and

4-NM of "Syri Gjonit" Karst Spring.

Table below shows the main data on these PAs and on the proposed emerald sites likely to be affected from Variant A of the pipeline route.

Table 29 Protected areas and emerald sites along Variant A in Albanian territory

No	Existing Protected Areas			International context/designation			
	National context / designation				EU ecological networks context (Emerald Network / Natura 2000 Network)		Other status
			Protection status				
	Code	-Name of PA; -Sub-legal act	National	IUCN Cat.	Code (Al00000x)	Type of Emerald site	
1	50	-Shkodra Lake & Buna River wetland complex; -DCM No. 683, Nov.02, 2005	MNR; Cat.IV	IV	-	-	1-Ramsar area (Feb., 2006); 2-Cross-border PA (ALB/MNE)
2	127	-Riparian area of the Albanian part of Shkodra Lake; -DCM No. 684, Nov.02, 2005	MNR; Cat.IV	V	09	IBA; IPA	Cross-border PA (ALB/MNE)
3	N/A	-Syri Sheganit Karst Spring -DCM No. 676, Dec. 20, 2002	NM; Cat.III	IV	-	N/A	-
4	N/A	-Syri Zi Karst Spring -DCM No. 676, Dec. 20, 2002	NM; Cat.III	IV	-	-	-

1- Shkodra Lake and Buna River wetland complex

According to the Albanian legislation through DCM No. 683 of February 02, 2005 the Albanian part of the aquatic zone of Shkodra Lake and Buna River wetland complex is asserted as Natural Managed Reserve, which under the Law No. 8906 of June 06, 2002 as amended with the Law No. 9868, of February 04, 2008: "On Protected Areas" falls under Category 4 of the protected areas.

Under Albanian law, for the Category 4 it is applied the third level of protection while under the same law the National Parks fall under Category 2 that implies the second level of protection. The level of category and the

level of protection relate directly to the importance of a given zone, the list of prohibited activities, the list of activities that require the advanced issuance of an environmental permit and other delineations.

In February 02, 2006, by Ramsar Convention on Wetlands, the aquatic zone including the Shkodra Lake and Buna River, Albanian part, was included in the Ramsar list of wetlands of international importance. Wetlands included in that list acquire a new status at the national level and are recognized by the international community as being of significant value not only for the country, or the countries, in which they are located, but for humanity as a whole.

From Shkodra to Bajza the pipeline route runs over permeable Quaternary loose deposit (Shkodra-Bajza segment), which overlie karst limestone, while from Bajza to Hoti/Barlaj (border ALB/MNE) the pipeline route runs traverse karstified limestone formations. The surface and ground waters of both Quaternary and limestone formations drain to the Shkodra Lake. The nearest distance between the axis of the pipeline corridor and this PA is less than 1km (in the territory of Hoti Village).

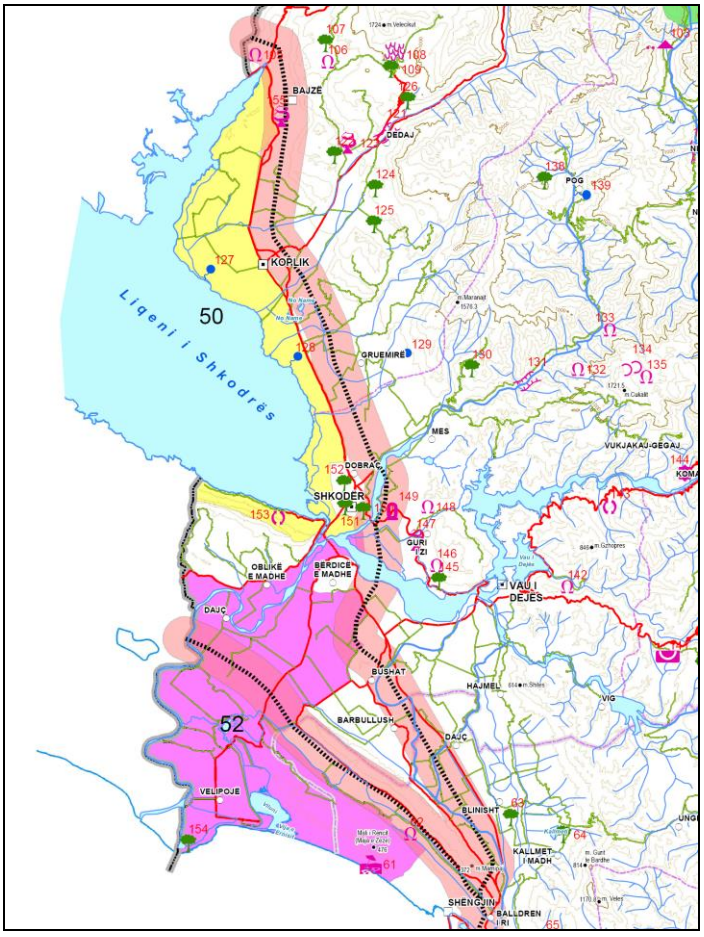


Figure 33 Map of the protected areas in the northwest of Albania and proposed variants of the pipeline route corridors

(Based on the Map of Protected Areas of Albania; MoEFWA, 2012)

2.- Managed Nature Reserve of the Riparian area of Shkodra Lake (Shoreline of Shkodra Lake).

The riparian area of Shkodra Lake also enjoys the status as a protected area. Under DCM No. 684 of November 02, 2005, the Albania government has declared as a "Managed Natural Reserve" the Albanian side of Shkodra Lake shoreline.

The zonation of this PA shows that the crossing corridor falls under level IV of protection (IUCN Category IV).

Similar to the case of Shkodra Lake, From Shkodra to the border ALB/MNE, all the surface and ground waters of both Quaternary and limestone formations drain to this PA.

Over the karst formations along the segment Bajza-Hoti (8.5 km long), this MNR is situated within the proposed pipeline corridor. The nearest distance between the axis of the pipeline corridor and this PA is less than 1km (in the territory of Hoti Village).

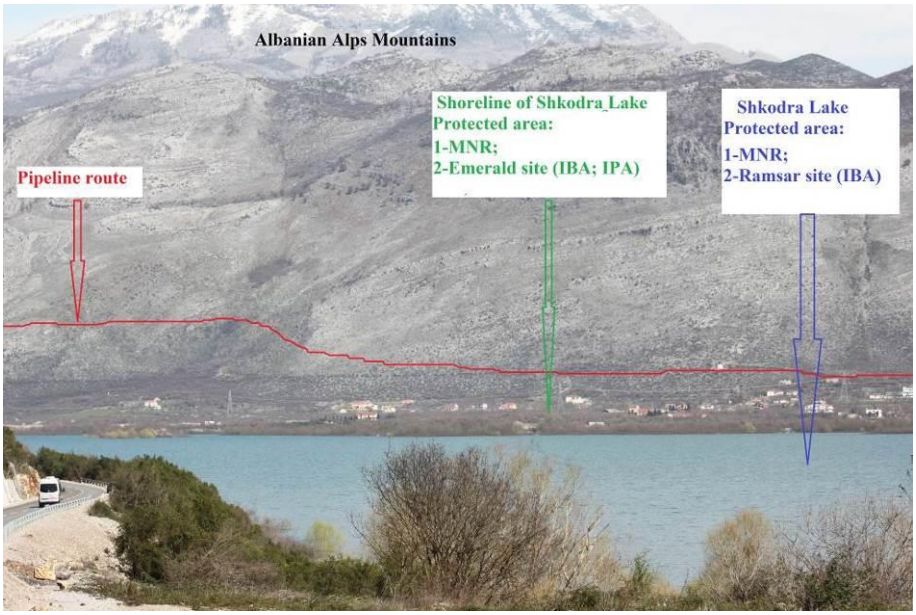


Figure 34 Protected areas near the pipeline route in the segment Bajza-Hoti/Barlaj

The DCM No. 676 of December 20, 2002 has declared the Nature Monuments as Protected Areas (Category IV of protection). According to the above DCM, there are two Nature Monuments near the Variant A of the pipeline route corridor, namely the Syri Sheganit and Syri Gjonit Karst Springs.

3- Syri Sheganit Karst Spring (hydro-monument)

Syri Sheganit ("Shegani's eye"), which is located at the Bajza Bay, is the largest vauclusian karst spring (1000 l/sec) in tectonic-karst fissures, arising from a chimney vertically karst depth of 22-28 m and width 3-5 m. It relates to

two water sources (Hurdhana 1 and 2 Karst Lakes). Water comes from the Western Alps karst areas of Albania. It is rich in fish and other aquatic species. Sources create attractive environment with scientific, hydrological, didactic, aesthetic and tourism values.

Figure 35 Syri Sheganit Karst Spring (Nature Monument; 1000 l/s)

All the surface and ground waters of Bajza karst plain, over which runs the pipeline route, drain to this PA.

4- Syri Gjonit Karst Spring (hydro-monument)

This karst spring is located near Grude Fushe village, near the pipeline route corridor. It emerges as karst source in the contact molasses- limestone deposits. It has a 60-65 m^2 area and a great flow; this is used to supply the population or irrigation. Sources create attractive environment with scientific, hydrological, didactic, aesthetic and tourism values.

b-Emerald sites

There is 1 (one) Emerald site affected from the Variant A of the proposed pipeline corridor, as follows:

1-"The MNR of the Riparian Area of the Albanian part of Shkodra Lake" that is also called "Shoreline of the Albanian part of Shkodra Lake"; Site code: AL0000009; Area covered: 26.535 ha.

This MNR (IUCN Category IV), which is established by the DCM No. 684, of November 02, 2005, is an important area for trans-boundary biodiversity protection. The site that includes a variety of habitats is an Important Bird Area for Europe hosting about 40 bird species, including the globally endangered species of *Phalacrocorax pygmeus*. The Shkodra Lake is home for some 45 fish species including the endangered species of *Acipenser sturio*. The area is rich in aquatic vegetation including some rare and endangered species like *Nymphaea alba*, *Nuphar luteum*, *Nymphoides peltata*, and *Trapa natans*.

Albania as a party to the Bern Convention from 1999 has continued the work for the setting-up of the Emerald network of the Areas of Special Conservation

interest. In the development of the Emerald network in Albania "Managed Nature Reserve of the Albanian part of Shkodra Lake Shoreline" were selected based on the criteria listed in the Resolution no.16 (1989).

This site is located within the pipeline route corridor in the section Bajza-Hoti/Barlaj (figures 33, 34).

c- Natural heritage or habitats of particular interest

Between the pipeline route and the Shkodra Lake there are some small temporary and permanent karst lakes: Urdhana Lake 1, Urdhana Lake 2 (fig. 36), and Hurdhana e Kalbet Lake, which ara fed from ground waters. While in the border of Shkodra Lake, within the Bajza Bay, there are numerous permanent karstic springs of high natural and landscape values. The most important of them are: Syri i Virit; Syri i Franit; Vau i Mullirit; Syri i Zi (fig. 37, left); etc. In total, 18 karst springs (or "eyes") are located the eastern shoreline of Shkodra Lake. Within the pipeline corridor, between Ivanaj and Hoti, are located two other Karst Lakes (fig. 37, right). In the villages located over the karst plain of Bajza there are some dug wells that have natural and historical values (fig. 15).

Figure 36 Hurdhana 1 (left) and 2 (right) karst Lakes in spring time

Figure 37 Left: Syri Zi karst spring and Shkodra Lake; Right: Karst Lake in the karst plain close to Hoti Village.

The karst Lakes Hurdhna 1 and 2, and Hurdhana Kalbet, the karst springs situated near Shkodra Lake, as well as some dug wells can be adversely

affected from the project activities because of the direction of the groundwater flow.

Variant B

a-Protected areas

Variant B of the pipeline route corridor runs across the MNR of Shkodra Lake & Buna River wetland complex". Among the other protected areas in the wide project region, the nearest one to Variant B of the pipeline route is the "Wetland/Terrestrial Protected Landscape of Buna River Mouth-Velipoja" that is located 1.3 km from the proposed pipeline axis.

Table 30 Protected areas and emerald sites along Variant B in Albanian territory

No	Existing Protected Areas			International context/designation			
	National context / designation				EU ecological networks context[1)] (Emerald Network / Natura 2000 Network)		Other status
	Code	-Name of PA; -Sub-legal act	Category of Protection	IUCN Category	Code Al00000x	Type of Emerald site[1,2)]	
1	50	-Shkodra Lake & Buna River wetland complex; -DCM No. 683, Nov.02, 2005	MNR; category IV	IV	-	-	1-Ramsar area (Feb., 2006); IBA & IPA 2-Cross-border PA (ALB/MNE)
2	52	-Wetland/Terrestrial Protected Landscape of Buna River Mouth-Velipoja; -DCM No. 682, Nov.02, 2005	PL; category V	V	21	IBA; IPA	Cross-border PA (ALB/MNE)

1- Shkodra Lake and Buna River wetland complex

This PA (MNR) is crossed from Variant B of the pipeline at Buna/Bojana River (border ALB/MNE) near the territories of Dajc/Shtodher villages (border ALB/MNE). Most of the area where the line crosses this PA belongs to agricultural lands of this village and only in a short segment of approximately 50m passes on natural habitats mostly dominated by riparian vegetation.

It should be stressed that across this protected area the pipeline runs over impermeable sub-clayey deposits, 17-25 m thick. Thus there is no expected any adverse impact of the project activities on the ground waters in this PA.

2- Wetland/Terrestrial Protected Landscape of Buna River Mouth-Velipoja.

Between Rrenci and Kolaj Mountains, the axis of the pipeline route (Variant B) runs approximately 1.3 km from the protected area of "Buna River Mouth - Velipoja Protected Landscape". According to the DCM No. 682, of November 02, 2005, the Buna River Mouth area together with its estuary and the Island of Franc Joseph, Velipoja Reserve, Viluni lagoon, Baks-Rrjolli Beach, Domni Marsh, as well as the surrounding territories, have been designated as Protected Aquatic and Terrestrial Landscape (IUCN Category IV).

The closest point (1.3 km) of the pipeline axis to this site is the Murtenza Marsh. At this point, the axis of the pipeline runs through flat agricultural lands, which lie over a thick impermeable clayey-silty cover. Consequently, no significant adverse impacts are expected on the aquatic and terrestrial parts of this emerald site.

Figure 38 The freshwater marshes of Domni and Murtenza

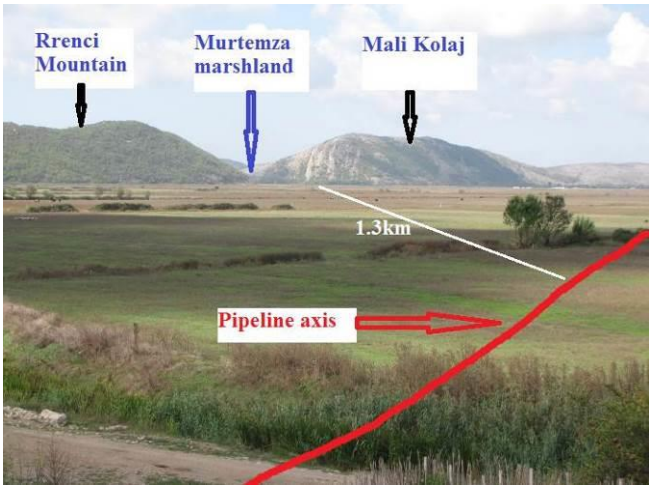


Figure 39 Pipeline and the Murtenza marshland

b - Emerald sites

"Buna River Mouth -Velipoja Protected Landscape" area is identified as an Emerald site (Site code: AL0000021), while its wider area as IBA (Important Birds Area). This aquatic/terrestrial protected landscape has an overall area of 23,027 ha.

As mentioned above, the pipeline axis passes 1.3 from this emerald site.

c- Natural heritage or habitats of particular interest

Field surveys have not identified any other area of particular interest.

Montenegro

Protected areas in the region (buffer distance of 1 km) of the proposed corridors of IAP are presented in Table 31 (for Variant A) and Table 32 (for Variant B), and also in the map of protected areas (Figure 40). Montenegro does not have a proclaimed ecological network, but there is proposal for Emerald network, which will be further developed, to Natura 2000 proposal. There are possible adverse effects to the Emerald network sites, which should be studied in details. In addition, to Emerald network sites Important Plant Areas (IPA) and Important Bird Areas (IBA) are analysed as areas with potential to become Natura 2000 proposals as well.

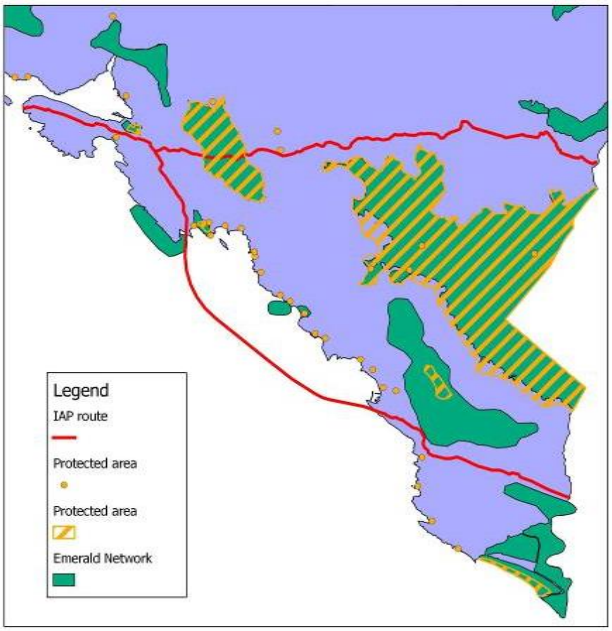


Figure 40 Map of protected areas and biodiversity important areas, Montenegro

Variant A

Variant A passes through National park Lovćen and in the vicinity of protected area Lipska Pećina (Lipska cave) and biodiversity important area Cijevna.

Cijevna River flows through Albania and Montenegro for 64.7 kilometres before merging with Morača River in vicinity of Podgorica and only upstream is proposed as Emerald site and Important Plant Area. In the vicinity of Podgorica Variant A is passing over the Cijevna River. The area of transition over the Cijevna River is downstream from the Emerald and IPA site. Consequently, the Variant A will not have any effect on this protected area.

Monument of Nature Lipska Pecina is a cave on the south of Cetinje. Variant A is passing 800 m from the entrance of Lipska Pecina.

National Park Lovćen encompasses the central and the highest part of Lovćen mountain massif and covers an area of 62.20 km². Due to its position in the joint of Mediterranean and Continental climate, NP Lovćen has rich biodiversity with numerous endemic species present. The area of NP Lovćeni is proposed as Emerald network site and as IPA site. Besides Lovćen's natural beauties, the national park was established to protect rich historical, cultural and architectural heritage of the area. The Spatial Plan of Montenegro defines two protection zones in the NP Lovćen for the period until 2020. Within the Park borders, the first zone of protection unites five nature reserves with the strict level of protection. The second protection zone presents the rest of the park area. Also, around the Park the protection buffer zone is defined. The Variant A is passing in the middle part of the Park from west to east that goes through the second protection zone in a length of around 6.5 km. This part pipeline route is mainly passing through the forest habitats. Also, the Variant is passing through the buffer zone around the park in a length of around 6 km. The new Spatial Plan of the National Park Lovćen (the Spatial plan is in final phase - public debate was in autumn 2012) proposes new zonation of the Park.

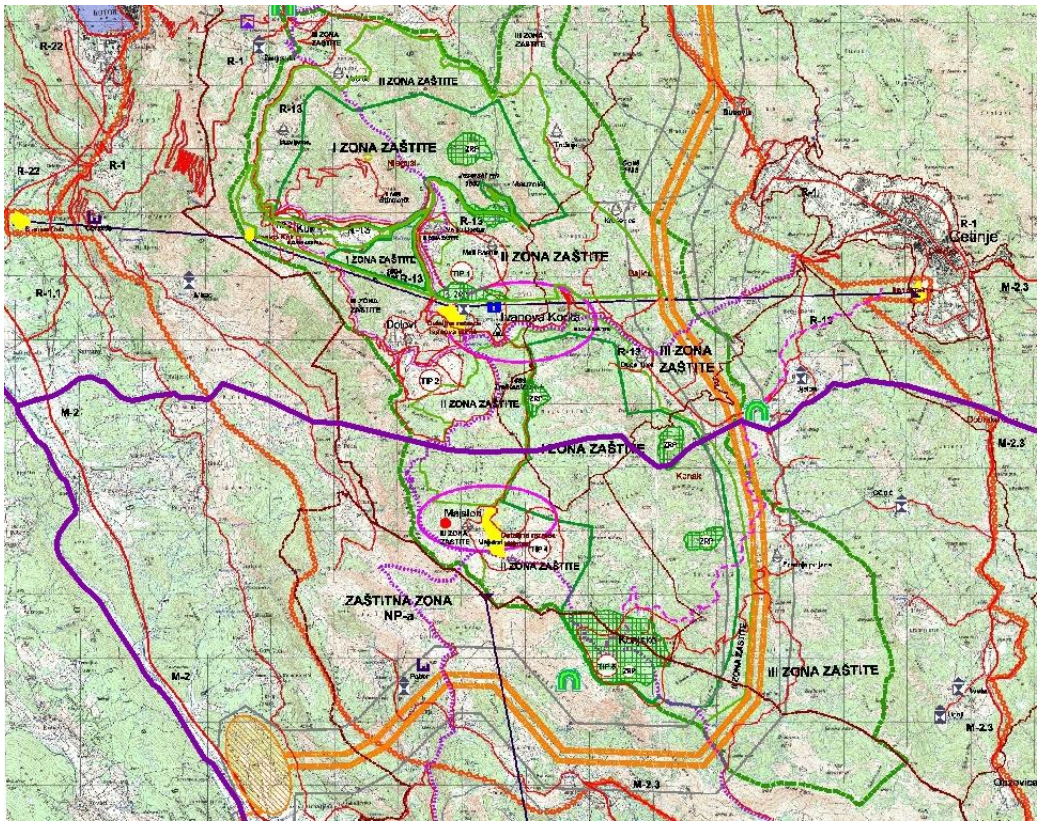


Figure 41. Map of land use and spatial organization from the proposed Spatial Plan of the National Park Lovćen with the IAP route – both variants (dark purple line)

According to the proposed spatial plan of the National Park Lovćen, the pipeline route is passing through 3 km of the first protection zone and 3 km through second protection zone.

The first protection zone is characterised by the areas with the highest functional ecological importance and consequently with the highest level of protection. Along this protection zone it is forbidden to construct any objects and exploit natural resources. The planned pipeline route is predominantly passing through the forest vegetation of the area (in buffer, first and second protection zone, respectively). In the first and second protection zone high natural value of the forest habitats (in particular beech forest) is recognised as important Emerald and Habitat Directive habitat. In this area the pipeline route is passing through rough terrain without settlement. Therefore, the new corridor in this area will cause the removal of important habitats (along ca 20 m of the route and other engineering surfaces) resulting direct loss and habitat fragmentation and might adversely affect the ecological functionality of important habitats. Cutting of forest vegetation in the construction phase might be considered as exploitation of natural resources and may not be approved according to the proposed Spatial Plan.

In addition, in eastern part of the Park the pipeline route is planned through the Special Nature Reserve Sokol (20.6 ha). Consequently, the construction of the planned pipeline will have significant effect on the conservation of the natural values of the Special Nature Reserve Sokol.

Table 31. Protected areas and biodiversity important areas inside 1 km buffer from Variant A

Name of the protected area (Montenegrin)	Name of the protected area (English)	Category of Protection (Montenegrin Law on Nature Protection)	IUCN Category	Other international importance status	Emerald site (potential Natura 2000 sites)	Distance from corridor
Lovćen	Lovćen	National Park	II	IPA	Yes	Passing through
Lipska Pećina	Lipska cave	Monuments of Nature	III/V		No	800 m
Cijevna (rijeka i kanjon)	Cijevna (river and canyon)			IPA - Cijevna Canyon and Hum Orahovski	Yes	820 m

Variant B

Variant B passes ca. 530 m north of Šasko Lake and protected part of river Bojana, Kneta, Ada (IBA – Ulcinj saltpans and Šasko jezero; IPA -Long beach - Ulcinj and Ada Bojana; Emerald site).

Variant B passes through the Emerald network site Platamuni and in the vicinity of two protected areas and three important biodiversity areas. On the northwest of Budva, there are two protected areas and an Emerald network. "Spas" above Budva is the hill on the north of Budva. It is protected as Special Natural Site because of its specific Mediterranean sclerophyllous vegetation. On the north of Budva is Jaz beach, which is protected as Monument of Nature. The Variant B is passing on the northwest of the Beach Jaz and the Spas Hill above Budva.

Marine biodiversity important area Platamuni is recognized as IPA and Emerald site. The Variant B is passing in its marginal marine part of protected area for a length of around 1.7 km. Marine part of Platamuni is proposed because of *Posidonia oceanica* seagrass. This protected area is characterised by high marine biodiversity where there is no presence of anthropogenic impact mainly caused by marine transportation and touristic activities.

Variant B also passes around 190 km south of Rumija (IPA and Emerald site) at its foothill. Rumija has the best developed beech forest on the coastal Montenegro's Dinarids and has also communities of *Pinus heldreichii*, being the southeast location of this halfendemic *Pinus*. Mentioned habitat types are specific for higher parts of the mountain.

Table 32. Protected areas and biodiversity important areas inside 1 km buffer from Variant B

Name of the protected area (Montenegrin)	Name of the protected area (English)	Category of Protection (Montenegrin Law on Nature Protection)	IUCN Category	Other international importance status (IBA or IPA site)	Emerald site (potential Natura 2000 sites)	Distance from corridor
Brdo Spas iznad Budve	Spas Hill above Budva	Special Natural Sites	III		Yes	810 m
Plaža Jaz	Beach Jaz	Monuments of Nature	III/V		No	300 m
Platamuni	Platamuni			IPA	Yes	Passing through
Rumija	Rumija			IPA	Yes	190 m

Šasko j. rijeka Bojana, Kneta, Ada	Šasko lake Bojana river, Kneta, Ada			IBA – Ulcinj saltpans and Sasko jezero IPA -Long beach - Ulcinj and Ada Bojana	Yes	530 m

4.3.1.9 Landscape and Visual Issues

Albania

Variant A

Beginning in Balldren to the state border ALB/MNE at Hot/Barlaj (northeast of Skadar/Shkodra Lake), the proposed pipeline corridor runs mainly over a flat terrain. This area is composed of the plains of Zadrima, Lower Shkodra, Upper Shkodra, Malesia Madhe, and of the karstic field of Bajza-Ivanaj area. The last segment of the pipeline route traverses a rocky mountainous area in the territory of Hot village.

In the segment Ivanaj-Hot the pipeline route passes close to the Skadar/Shkodra Lake (Ramsar site), which shoreline (Protected Landscape) is covered from dense vegetation.

From Balldren to the border ALB/MNE the proposed pipeline corridor traverses four rivers [Drini-Lezhes (four times), Drini, Kiri and Vraka], as well as a number of streams. The Drini Lezhes, Drini and Kiri riverbeds are covered of riparian forests. The Riparian area at the merging point between Drini and Kiri rivers has special landscape value.

With respect to the pipeline route, the main elements of the landscape along the section Balldren-border ALB/MNE, as follows:

From Balldren to the east of Shkodra the landscape is dominated by agricultural lands and the Drini riverbed (Protected Landscape); From Shkodra to Koplik the landscape is dominated by agricultural lands and farmhouse spread everywhere in the agricultural lands; and From Koplik (north of Shkodra city) to Hot Village, the landscape is dominated from five main elements: 1-Skadar/Shkodra Lake (PA-Ramsar site) from the west; 2-the steep western slopes of Albanian Alps Mountains; 3-the karst plain in the territories of Bajza, Ivanaj and Hot villages. In the territory of Bajza village, close to the lake shore, numerous karstic springs come in surface. Two of these springs (Syri Sheganit and Syri Gjonit) are Natural Monuments; 4–The vegetation habitats of the shoreline of Skadar/Shkodra Lake (Managed Nature Reserve); and 5-numerous farmhouses dispersed in the flat land without any criterion of spatial planning.

Because of unplanned internal migration during the last 20 years, many arable lands are converted into residential lands. Many rural roads, transmission and

telecommunication lines, and poorly maintained irrigation and drainage channels crisscross now the agricultural plots.

The most scenic landscapes, along and near this section are:

- Drini River at the location where merges with Kiri River riparian area This riverbed is quite large and is covered by a riparian forest;
- Skadar/Shkodra Lake (Ramsar site);
- The Albanian side of Skadar/Shkodra Lake shore (Managed Nature Reserve);
- The flat karst area in the segment Bajza-Hot Village;
- Numerous karst lakes and karst springs, among which the Syri Sheganit and Syri Gjonit Springs are Nature Monuments; and
- A number of land forms in karst area;

Variant B

From Balldren to Dajc (ALB/MNE border) the proposed pipeline corridor runs entirely in flat terrain. The landscape within this corridor and its proximity is dominated by agricultural lands, which are used mainly for crops, vineyards and other fruit trees. Numerous drainage and irrigation channels cross the study area. The villages are rare and far from each other.

From Balldren to Torovica Village the proposed corridor runs along the Balldren Field, which is approximately 1 km wide and 20 km long. This field is bordered from the rocky hills of Rrenci and Kakarriqi that lie in a Southeast to northwest direction. The eastern slope of the Rrenci hill is covered from bushes and pine forest, while the western slope of Kakarriqi hill is covered partly by maccia. The other part of his surface is composed from denuded limestone rocks.

From Torovica village to the border ALB/MNE the pipeline corridor traverses the Bregu Bunes Plain, which is bordered from the west from the Mali Kolaj (545 m asl) and Mali Belaj hilly chain, which lie in a southeast to northwest direction.

The only scenic landscape along the section Balldren-Dajc (border ALB/MNE) is the protected landscape of Buna River, which is confined by a narrow strip of riparian forest. The proposed pipeline corridor runs across this forest.

Montenegro

In order to estimate the impact of the pipeline route in the landscape features flows of the gas pipeline variants are divided into several smaller landscape

units. The criteria for defining landscape units are features of natural and anthropogenic landscape: relief, surface cover, settlements, infrastructure, rural areas and water flows. A reference area is the zone 1 km wide on each side of the centre of the pipeline. Narrow area is the zone 50 m wide on each side of the gas pipeline.

According to the above criteria the following sections were selected:

K01-*predominantly anthropogenic landscape* - ensembles in which are dominant anthropogenic landscape elements: residential buildings, roads, power lines and agricultural areas. To a lesser size are represented the natural features of the landscape: the high and low vegetation and natural watercourses.

K02-*agricultural landscape* - the landscape is dominated by agricultural areas, roads, residential and commercial buildings. Agricultural areas (meadows and pastures) are small sized and divided with vegetation or stonewalls. To a lesser extent in the area are forest areas.

K03-*intensive agriculture landscape* - the landscape is almost entirely dominated by large size and rectangular shape agricultural land. Roads and anthropogenic streams are large scale and rectilinear direction. Natural surface cover and quality elements of rural landscape in most cases do not exist.

K04-*high value rural landscape* - arable land and pastures, combined with forests are the dominant landscape element. In smaller villages are scattered buildings build in traditional architecture style. Roads and paths are small traffic intensity. Fields, vineyards and pastures are surrounded by stonewalls or tall vegetation and irregular in shape, which is adapted to the terrain.

K05-*industrial landscape* - industrial systems, factories, exploited areas and roads of high intensity are the dominant element of the landscape. This type of landscape is considered to have a very low value.

K06-*landscape of antopogenic flattened fields* - flat surface under grass cover or low vegetation clearly divided into rectangular of large dimensions. The elements of natural or cultural landscape do not exist.

K07-*mosaic landscape* - forests, meadows and karst rockery are dominant element of mosaic landscape structure. To a lesser extent are represented waterways and roads. That high value landscape is determinate with a clearly defined relationship between: contrasting volumes and surfaces, light and dark colours and rough and soft texture. Visual exposure varies depending of the position on the indented relief.

K08-*mountainous forest landscape* - the landscape is dominated by forest area in indented relief. To a lesser extent are represented roads, individual buildings and the rural areas. Visual exposure is large and a dark forest volume dominates the structure. Due to the high level of naturalness the landscape is defined as valuable.

K09-*steep slopes and colluvial drifts landscape* - on very steep slopes mountain ranges dominate the bright tones of rocks and colluvial drifts contrasted with low vegetation surface cover and the occasional occurrence of high vegetation. Anthropogenic elements are not present because of inaccessibility of terrain.

K10-*karst and rockery landscape* - the landscape is dominated by rockeries covered with rare underbrush on relatively steep terrain. Occasionally occurs smaller sized agricultural land, buildings and roads. The structure of the landscape was reduced to contrast of light rockery tones and dark tones of the surface cover.

Variant A

The path of the pipeline route Variant A goes through several ambient landscapes (According to PP Montenegro, 2008). The pipeline route direction is east - west. Extreme eastern point of Variant A, near the border with Albania, is the zone of economic forests and pastures. In further movement to the west, the gas pipeline is going downhill to the river valley landscapes. Continuing to the west, the route passes through the landscape of karst basins and plateaus and comes in subalpine and alpine mountains. At the end of the route, Variant A is going downhill to the landscape of coastal mountains and coastal zone.

Flow route Variant A is divided into segments according to the defined landscape sections (kilometres are calculated from the Albania/ Montenegro border to the end of Variant A):

0-8.7 km: The first segment of the route variants A is 8.7 km long. Within the area of this route segment, there is a constant change in K04-high value rural landscape and K07-mosaic landscape. Landscape features are based on the structure of groves, small villages, and pastures fenced with tall vegetation. Near the border with Albania are visible dominant characteristics of the mountain landscape, which is composed of rocks, mountain pastures and forests.

8.7-10.2 km: On the low slope, the dominant is K02-agricultural landscape. It is characterized by agricultural fields with relatively regular shape separated by tall vegetation. In this segment, small watercourse cuts the route of Variant A.

10.2.-23.6 km: A significant change in landscape characteristics, occurs when the route enters in Ćemovsko field. Space is dominated by anthropogenic landscape elements. Because of the proximity of Podgorica, the number of residential and industrial buildings increases, within large areas of intensive agriculture. The pipeline route in this area passes through suburban areas, crosses roads, railways, industrial areas and rivers Morača and Cijevna. River Cijevna is characterized by extremely dynamic landscape characteristics. The space of the route, in length of 13.6 km, contains types: K01-predominantly anthropogenic landscape, K03-intensive agriculture landscape and K05-industrial landscape. Except of the landscape of the River Cijevna, others are

not very valuable elements of the landscape. Relief is completely flat and the visual exposure is low.

23.6-26.9 km: On steeper slopes and peaks, 3.3 km in length, dominant is K07-mosaic landscape. It is characterized by the dominance of the natural landscape elements with intermittent traffic and the elements of the agrarian landscape.

26.9-57 km: Landscape characteristics are partially changed in the space. It is noticeable a significant higher proportion of the elements of the agrarian landscape in the valleys between the hills; K04-high value rural landscape. The dominant are rural landscape elements: terraced fields on the slopes and agricultural areas in the valleys. Roads are more noticeable while the natural landscape elements are represented with low and high vegetation on the rocks. In the further course of direction, Variant A extends along the direction of the road that connects Podgorica and Cetinje. Route moves along the ridge of the hill to the west. At half of its length, the route passes close to northern border of National Park Skadar Lake, which is protected area with valuable landscape elements. Karst mountain landscape is in contrary relation to strong horizontal water surface surrounded by green vegetation. Besides the natural landscape features within the boundaries of the national park, about 1 km south of the pipeline route, terraced fields along the small villages in the valley can be found. In furthered movement to the west Variant A passes flattened valley on whose northern part is the village surrounded with terraced fields. Steep slopes characterize environment basin. In lower part of the route, landscape is dominated with elements of the natural landscape - trees, bushes and rocky with significant number of traditional anthropogenic units - small villages with associated terraced fields. At a distance of 47.7 km from its beginning, the route crosses the road E80. Characteristics of this part of the area belong to K01-predominantly anthropogenic landscape. Roads and other elements of the urban environment define them. Further on, the route passes slopes and mountain peaks and is visually exposed from surrounding areas. Southern boundary of the National Park Lovcen is located at a distance of 700 m from the pipeline route. Approaching the edge of the plateau the number of anthropogenic elements decreases and the last anthropogenic landscape element is a small village with surrounding fields at distance of a 5.5 km from the west edge of the plateau. Overall, second half of Variant A, route passes through K07-mosaic landscape for about 30 km, with distinct characteristics of natural Mediterranean and sub-Mediterranean landscape: mosaic system groves, rocky terrain and grassland. Area is dominated by high contrast ratio bright tones of stone and darker tones of vegetation.

57-58.2 km: In the last part of the route, it rapidly descends to the coastal zone. Dominated landscape type is K09-steep slopes, colluvial drifts landscape, and the space is characterized by extremely steep terrain elevation (altitude difference of about 1 km). This terrain can be described as a mosaic system of high vegetation and grasslands with the occasional appearance of colluvial drifts. Anthropogenic elements that are present in surroundings, are small villages associated with low-grade roads that are surrounded by terraced agricultural areas.

58.2-62.4 km: In this segment dominates K08- mountainous forest landscape. Exception is the area that is located between 2.1 -2.9 km that contains fragments of the agricultural landscape.

62.4-63.6 km: The end of the route variants A passes through K01-predominantly anthropogenic landscape, which is situated in a valley between two mountain ranges.

Variant B

The path of the gas pipeline route Variant B goes through several ambient landscapes (According to PP Montenegro, 2008).

The route direction is from the southeast to the northwest. The route in most of its course passes through combination of coastal mountains and coastal zone units, and only at its beginning passes through the river valley landscapes.

Variant B is divided into segments according to the defined landscape sections (kilometres are calculated from the Albania/ Montenegro border to the end of Variant B):

0-25.5 km: The beginning of the route entirely passes through K02-agricultural landscape. In the first and central part, the route occasionally touches parts of K07-mosaic landscape. In the landscape, dominate agricultural land, roads, residential and commercial buildings surrounded by hilly area covered with natural and agricultural landscape elements. Structure of the landscape is reduced to a flat regularly shaped fields and the voluminous surrounding of the hills covered with mosaic landscape.

25.5-28.7 km: Beneath the City of Bar, route enters in K10-karst and rockery landscape. As opposed to natural landscape of coastal rocks, parts of the observed territory occupy industrial fragments. In the middle of the area route passes directly through attractive sinkhole with agricultural surface.

28.7-62.0 km: Pipeline is placed offshore.

62.0-63.2 km: After returning onshore, the route climbs to the mountain terrain in which are the dominant characteristics of K08-mountainous forest landscape and K10-karst and rockery landscape.

63.2-64.8 km: K06-landscape of anthropogenic flattened fields is flat grassy area divided into squares. Flattened fields end with campsite and beach. Dimensions and orthogonal distribution of grasslands are in contrast relation with the characteristics of a natural mountain environment.

64.8-68.8 km: In the Mrčevo field increases the share of anthropogenic landscape elements especially roads and residential buildings (K01-predominantly anthropogenic landscape). Agricultural fields with proper form and shape and a small number of objects dominate over the flattened part of the

landscape. East and west from the locations there are hills covered with rocks, macchia and tall vegetation (K08-mountainous forest landscape).

68.8-71.8 km: K08-mountainous forest landscape. Characteristic ribbed relief forms on the slopes are covered with vegetation. Strong and dark volumes of vegetation dominate landscape.

71.8-73.7 km: The final course of the route passes through the area where landscape units K01-predominantly anthropogenic landscape and K08-mountainous forest landscape, overlap. The most dominant feature of the area is land depression that northern part is rich with anthropogenic landscape elements. The shape and arrangement of agricultural areas is based on the irregular rectangular shapes, which are separated with lines of high and low vegetation. Steeper slopes that are surrounding anthropogenic landscape are covered with tall vegetation and therefore give more natural and visually more attractive landscape character.

4.3.1.10 Air Quality and Existing Emissions Load

Albania

Variant A

Though there are no data to monitor the air quality in the rural parts of the project area, it is believed that the air quality, including the suspended particulate matters, is within the acceptable parameters set by the Albanian legislation. The data from air monitoring during 2010 (SoER, MoEFWA, Tirana, 2012) show that typical air polluting substances like SO_2 and NO_x are at acceptable levels (DCM. No. 803, of December 04, 2003; “On air quality standards”).

Meanwhile the suspended particulate matters, in the city of Shkodra are above the acceptable limits. The main reasons for high particulate matters in these cities are; vehicular traffic, poor quality of roads, environmentally non-compliant construction activities, and low quality of vehicular fuels (particularly that of diesel fuel, which is the most common vehicular fuel in Albania). In recent years, air quality with regard to suspended particulate matters and PM_{10} has improved. This improvement is a consequence of increased quality of road infrastructure, which has brought down dust levels. Nevertheless, there is still concern about the levels of the pollutants in the air, as long as they are above the allowed standards.

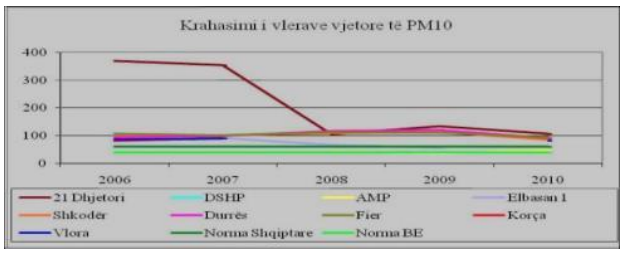


Figure 42 Data on PM10 from 2006 to 2010. In dark green: the Albanian norm; In light green: the EU norm (Source: State of Environment Report, MoEFWA, 2012)

The table below indicates the levels of eight indicators of air pollution in some Albanian cities during 2010.

Table 33 Average level of eight indicators of air monitoring during 2010

Monitoring Station	SO_2	NO_2	LNP	PM10	PM2.5	O_3	Pb	CO	Benzene
21 Dhjetori	24.07	46.08	1967	106.5		55.69	0.069		
DSHP (Tirana)	15.23	24.73		81.55		44.15	0.055	0.453	0.492
AMP (Tirana)	9.88	17.41	74.01	44.81		43.35	0.042	0.38	0.629
Alba 1 (Tirana)	4.77	27.27			27.17	49.13			
Alba 2 (Tirana)	9.66	46.9		58.5	34.73	92.58			
Elbasan 1	18.4	29.39		116.5				0.515	0.453
Shkodra	17	26.5	182	86		70.6	0.22		
Durres	20.1	28.1	192	91		67.4	0.25		
Fier	26.7	31	195	93		62.6	0.24		
Korça	19.9	24.6	186	85		62.3	0.22		
Vlora	21.8	26	176	80		68.1	0.21		
Albanian norm	60	60	140	60	15	65	1	2	5
EU norm		40		40	25		0.5		5

Source: SoER, MoEFWA, 2012.

Several villages and Shkodra town are likely to be adversely affected with regard to air quality by project's activities: Eighteen villages are traversed by the proposed Variant A, which also runs close to the peripheral East of Shkodra city.

The table shows that PM10 concentration in Shkodra is superior to the European standards. It should be stressed that the monitoring points are located in places with heavy traffic. There are no air quality data for the villages crossed by the axis of the pipeline route.

Variant B

Within the Albanian territory, this Variant of the pipeline route corridor runs entirely through agricultural areas, without any industrial activity and far from the heavy traffic of the main roads. Even though there are no data to monitor

the air quality in the rural parts of the project area, it is believed that the air quality, including the suspended particulate matters, is within the acceptable parameters set by the Albanian legislation and the EU norms.

Montenegro

Variant A and Variant B

Air quality

Territory of Montenegro was designated to three zones according to the air quality assessment, taking into account the lower and the upper assessment thresholds of pollutants assessed through analysis and modelling of existing data for pollutants. The borders of air quality zones coincide with administrative borders of municipalities included in these zones.

Table 34 Air quality zones in Montenegro

Air quality zone	**Municipalities included in zone**
Zone of maintaining existing air quality	Andrijevica, Budva, Danilovgrad, Herceg Novi, Kolašin, Kotor, Mojkovac, Plav, Plužine, Rožaje, Šavnik, Tivat, Ulcinj and Žabljak
North Critical Zone Improvement of the air quality required	Berane, Bijelo Polje and Pljevlja
South Critical Zone Improvement of the air quality required	Bar, Cetinje, Nikšić and Podgorica

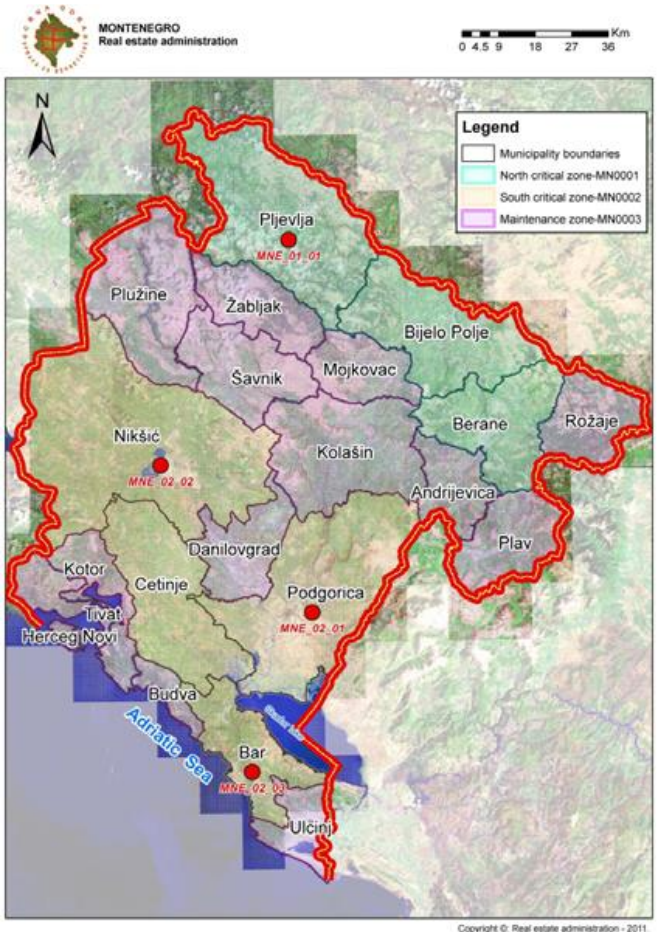


Figure 43: Air quality zones and monitoring stations in Montenegro

Source: State of the Environment Report for Montenegro for 2011, Environmental Protection Agency of Montenegro, 2012.

Systematic ambient air quality monitoring in Montenegro is performed at automatic stations placed in Podgorica, Nikšić, Pljevlja and Bar.

Measuring parameters are: sulphur dioxide (SO_2), nitrogen monoxide (NO), nitrogen dioxide (NO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), methane (CH_4), particulate matter PM10, ground level ozone (O_3), and content of lead Pb, benzo(a)pyrene (BaP), relevant PAU and total PAU in PM10. Continuous monitoring included meteorological parameters as well: air temperature, wind speed and directions and air humidity.

Basic air quality monitoring was conducted at 17 stations.

According to the planned pipeline routes (Variant A and Variant B), only results on air quality monitoring at automatic station and HSSM stations (HSSM building and building of Faculty of Biotchnology) situated in urban area of Podgorica and at automatic station and HMZ station situated in urban area of Bar were consider in this further analysis. For other HSSM's stations

situated in Golubovci, Tivat and Herceg Novi, and Mendra and Ulcinj detailed air quality monitoring results were not available.

Podgorica

Automatic measuring station in Podgorica is located at Bulevar Svetog Petra Cetinjskog – "Nova Varoš". According to the air quality monitoring results, in 2011, the air quality in urban area of Podgorica in relation to sulphur dioxide (SO_2), oxides of nitrogen (NO_x) and content of heavy metals and benzo[a]pyrene in PM10 was very good. However, the air was loaded with particulate matter. Those results indicate that the major source of air pollution were industry and traffic as well as fuel combustion from residential heating installations during heating season.

Bar

Automatic measuring station in Bar is located at Bulevar dinastije Petrovića - "Centar". In 2011, according to the air quality monitoring results, the air quality in urban area of Bar in relation to sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) was very good. However, higher concentrations of ozone, especially during September were detected and the air was loaded with particulate matter, as well. Those results indicate that the major source of air pollution were industry and traffic as well as fuel combustion from residential heating installations during heating season.

Other monitoring stations

Available air quality monitoring results at all other stations (HMZ's stations) indicate that the air quality at these locations was very good.

Emission load

According to the *Regulation on limit values for pollutant emissions from stationary sources into the air (Official Gazette of Montenegro 10/11)*, operators are obliged to conduct monitoring of pollutant emissions from the plants and stationary sources into the air, depending on the type of plant. No data on these emissions were available.

According to *National Greenhouse Gas Inventory 1990-2009*, Energy sector (fossil fuel combustion for electricity or/and heat production) is the largest contributor to greenhouse gas emissions in Montenegro. Industrial Processes Sector is the second largest contributor. The most important sources of CH_4 emission are Agricultural Sector (purple) and Waste Disposal on Landfills (green).

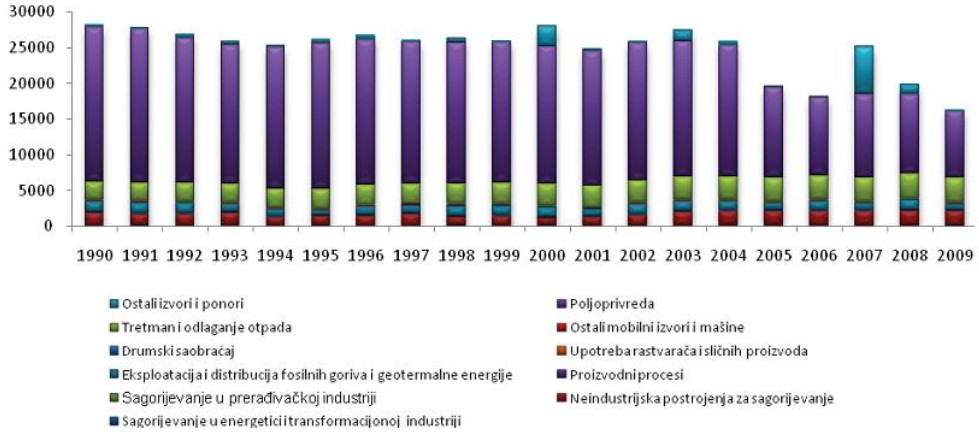


Figure 44. Emission trend of CH4 (in tons) by Sectors for the period 1990-2009

Source: State of the Environment Report for Montenegro for 2011, Environmental Protection Agency of Montenegro, 2012

4.3.1.11 Noise and Vibration

Albania

Variant A

Apart from Tirana and Durres, where noises are above the acceptable levels cities in Albania including Shkodra and Fier, have low levels of noise, due to lower intensity of economic activities. Tirana and Durres had noise levels up to 70 dB (A) or higher during the day. At night, their level of noise falls down to 40 dB (A). The other cities have noise levels up to 62 – 65 dB (A) during the day and 30 – 34 dB (A) during the night. Despite the fact that the law on urban noise entered into force in 2007, Albania still lacks proper standards for the noise levels at various locations. The MoEFWA and the MH issued the Ordinance No. 8 of November 27, 2007 "On maximal levels of noises in the environment". This sub-legal act, which relies on the WHO recommendations, asserts that the acceptable levels shall be up to 50 -55 dB outside the residential dwellings, 35 dB (A) within the residential dwellings, and 30 dB (A) at night. Comparing the recorded data, it can be seen that noises are at acceptable levels during the night, but during the day, there is a sharp rise of up to 15 dB (A).

Numerous villages and Shkodra town are likely to be adversely affected with regard to noise and vibration by project's activities: Eighteen villages are traversed by the proposed Variant A, which also runs close to the peripheral East of Shkodra city.

The following table shows that noise levels in Shkodra are superior to the European standards. It should be stressed that the monitoring points are located in places with heavy traffic. There are no noise data for the villages crossed by the axis of the pipeline route.

Figure 45 Data on noise, in the principal cities of Albania compared to EU standards
Source: State of Environment Report, MoEFWA, 2010 (red: night time, blue: day time)

Noise levels in the rural parts of the study area, which are far from the influence of urban, transport, and industrial activities, is low. Even though there is no monitoring of noise levels in the residential areas, it is estimated that noises in these environments are within the acceptable limits.

Variant B

Within the Albanian territory, Variant B of the pipeline route corridor runs entirely through agricultural areas, without any industrial activity and far from the heavy traffic of the main roads. Even though there are no data to monitor the noise and vibrations quality in the rural parts of the project area, it is believed that they are within the acceptable parameters set by the Albanian legislation and the EU norms.

Montenegro

Variant A and Variant B

Both routes will pass through the sparsely populated areas. At certain areas both routes pass close to existing roads, and in these places the environment is burdened by noise from traffic, while in other places sources of noise are of lower intensity, caused mainly by population activities.

The pipeline is not the source of the noise, except at special facilities, Gas Pressure Reduction and Metering Stations, which serve to reduce the gas pressure by switching from a high-pressure system to a lower pressure system. Therefore, environment around these objects will be observed because of the expected changes in noise levels.

At the observed section, the route Variant A will have two Gas Pressure Reduction and Metering Stations while on route Variant B three Gas Pressure Reduction and Metering Stations are planned to be built. This makes Variant A somewhat more favourable, but it goes through slightly more populated areas.

Therefore, the final location of the Gas Pressure Reduction and Metering Stations will have a key role in the selection of more favourable Variant due to the noise impact on the nearest populated areas.

4.3.1.12 Cultural Heritage

Variant A

Albania

Along the alternatives or the corridors running from Balldren to the North-western part of Albania, many known archaeological sites and monuments have been identified and are listed in the protected monuments. The mountainous areas in the eastern part of the section Shkodra-Hot are rich in intangible cultural heritage components. Some of the most valuable sites from the cultural heritage point of view within or near the proposed Variant A of the pipeline corridor that date from 1000 BC until AD 0 (Galaty et. Al, 2008) are provided in the following map:

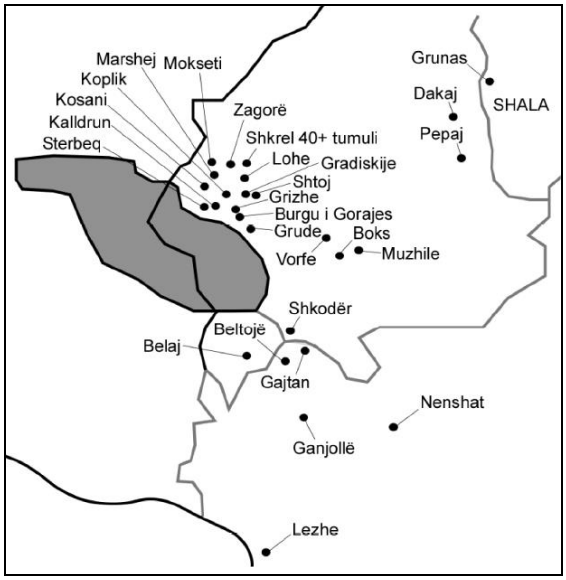


Figure 46 Map of northern Albania with sites 1000 BC-AD 0 (Galaty, 20008).

Source: Michael Galaty et al, in "L'Illyrie Meridionale et L'epire dans l'Antiquite", 5e colloque internationale, 10-12 Octobre 2008, Grenoble, France

Additional studies and a more thorough location assessment of the previously mentioned archaeological sites have led to the following map.

Figure 47 Indicative map of the nearest cultural sites to the pipeline corridor (According to Galaty et al., 2008).

Among the sites shown in the above map, the most proximate to the proposed pipeline route, from south to north, are, Ganjolla are Belan (Belaj), Beltoje, Shkodra (Archaeological Park); Gajtan, Grude, Mes, Boks, Shtoj (Burial Mouds), Marshej, Zagore, and Mokset. The red triangles in the above map (Google, 2013) illustrate mainly sites from 10th century BC to the first century AD. Some of these sites (Gajtan cavern) are much older.

As shown in the map below, the Burial Tumulis of Shtoj are located approximately less than 1.5 km from the axis of the proposed pipeline corridor.

One of the most sensitive areas along the proposed Variant A of the pipeline corridor is the zone between Shkodra city and the ancient Drivastum town (Drishti) that include the following cultural sites:

- Gruda village territory, which archaeological findings date from the first millennium BC until the first century AD (Galaty et. Al., 2008);

- The tumuli burials of Shtoj. On the plain of Shtoj, which is situated about 5 km to the northeast of the city of Shkodra, between the villages of Boks, Dragoc and the Bridge of Mesi, on the western side of the Kiri River, are located 160 tumuli. The excavated tumuli date from the Early Bronze Age until the Late Iron Age. The most representative period of funerary activities dates in the Iron Age, especially between the 7th-5th centuries B.C (Galaty et. Al., 2008);

- Boks village territory, where is located the Kratul fortification, which is situated on the homonymous hill, 143 m above the sea level, 6 km to the northeast of Shkodra and 600 m distant from the Mesi Bridge, a cultural monument of the middle age. The archaeological material indicates that life at the settlement is active from the Early Iron Age until the 1st century A.D. (Galaty et al., 2008);

- Mesi Bridge ("*bridge in the middle*") is a bridge in the village of Mes, located about five kilometres in straight line from the northeast of Shkodra city. It spans along the Kiri River is 108 m long, and represent one of the longest Ottoman bridges in the region; and

- Drishti Castle. The ancient town of Drivastium was founded in Illyrian or Roman times to protect the Kosovo trade route. The large castle from the 12th century was part of a chain of fortifications around Shkodra.

Furthermore, the area around the Archaeological Park of Shkodra that is situated around the Rozafa castle (4th century BC) is very rich in cultural heritage sites/objects.

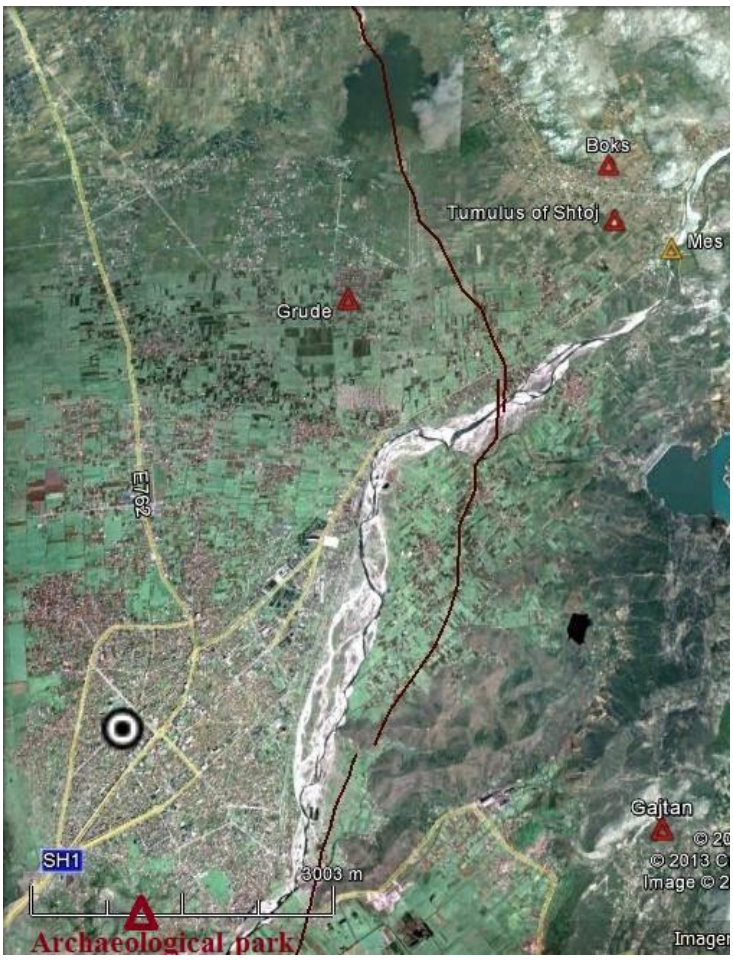


Figure 48 Pipeline route and cultural sites in the northeast of Shkodra City

According to the Law No. 9882 of February 28, 2008 "On the Cultural Heritage", the "Archaeological Survey Agency (ASA) through its structures and in collaboration with legal and physical persons with license to operate in this field follow up the chance of archaeological finds, which come to light during agricultural, building, engineering, and construction activities, and operate in order to preserve these findings (art.26)". For every project that can affect the cultural heritage, "a written approval of The National Council of Restoration and of the National Council of Archaeology is obligatory" (art. 27).

Montenegro

Variant A of the gas pipeline passes through mountainous areas with an occasional appearance of villages. In line with this, elements of cultural heritage are preserved villages with agricultural areas. Agricultural areas are terraced small sized fields and vineyards enclosed with drywalls. Beside the villages there is a significant number monasteries and monuments as elements of historical and cultural heritage.

In the lowland area of Ćemovsko field Variant A passes through the area dominated by anthropogenic structures: settlements, industry and agriculture.

Since the listed elements do not present any value as cultural heritage sites, there is no opportunity of greater impact. Nevertheless, in the wider area of the gas pipeline, elements of cultural heritage of great value are perceptible. This specially refers to archaeological sites and historic buildings around the city of Podgorica. Because of the distance from the pipeline route, there is no possibility of direct influence. In the immediate vicinity of the pipeline (village Dajbabe) is monastery with a church of the Virgin ascendance.

In the middle of its length, Variant A passes from the north by the border of Skadar lake area, which is protected in the category of national park. Besides the natural values, Skadar Lake contains a large number of cultural and historical monuments from different historical periods, mostly located on the islands and peninsulas around the lake. Although the route of the pipeline passes at one point very close to the edge of the park, there is no danger of an impact on cultural heritage.

After 47 km from the beginning, Variant A, passes about 1 km south of the town of Cetinje with numerous elements of cultural heritage. Because the distance to pipeline is relatively large, there is no danger of negative impacts.

About 11 km from the end of the Variant A is the southern boundary of the National Park Lovcen located about 700 m from the planned pipeline. The Park covers the central and the highest part of Lovcen range area, 6220 acres. Characteristic numerous and diverse forms of relief with numerous gullies, pits and deep depressions are intertwined with natural surface cover dominated by tall vegetation and grasslands on the rocks.

Variant B

Albania

Along Variant B in Albania, the proposed pipeline route does not cross any known site/object of significant cultural value, because in the past this territory has been flood prone due to Buna River.

However, according to the Law “On the Cultural Heritage”, a written approval of The National Council of Restoration and of the National Council of Archaeology is obligatory” prior to the construction phase.

Montenegro

In Montenegro, the route of Variant B passes through area with relatively dense network of villages and settlements. In a few cases, some villages could be considered as a valuable element of cultural heritage due to its ambient values, traditional building methods and traditional methods soil treatment and pasturing.

Monasteries, monuments and other individual elements of cultural heritage, according to available data, are not located directly on the route.

Variant B passes close to important historical structure of the Old Bar and surrounding archaeological sites, religious and cultural facilities. Due to the relatively long distance, the route does not have significant effect on the elements of cultural heritage.

Variant B also passes near the town of Budva. In centre of town and surrounding area there are a large number of elements of cultural heritage. Since all elements are at a distance of about 3 km from the route, there is no direct impact of the route on the elements of Budva's cultural heritage.

4.3.1.13 Occupational Health and Safety

Variant A and Variant B

A company for pipeline construction will be contracted. The construction period is estimated to one year and will require the engagement of about a few hundred people.

Operating with the heavy machinery equipment and also contingent blasting through hard rocks presents serious hazards. Based on the geological study for Albanian parts of proposed variants, Variant B of the pipeline route does not traverse any area composed of hard rocks, while Variant A should pass over hard limestone and dolomites across Kakarriqi Mountain (1.2 km long), and along the section from Bajza to the border ALB/MNE (8.5 km long).

During the construction works, workers at the construction site will have to follow and comply with the prescribed principles and regulations on occupational safety (from Council Directive 92/57/EEC of 24 June 1992):

- keeping the construction site in good order and maintaining a satisfactory state of cleanliness;
- choosing the locations of workstations with regard to the easy access to these locations and determining routes or areas for the passage and movement of equipment;
- the conditions under which various materials are handled;
- technical maintenance, pre-commissioning checks and regular checks on installations and equipment with emphasis of correcting any faults which might affect the safety and health of workers;
- the demarcation and laying-out of areas for the storage of various materials, in particular where dangerous materials or substances are involved;
- the conditions under which the used dangerous materials are removed;
- the storage and disposal or removal of waste and debris;

- the adaptation, based on progress made with the site, of the actual period to be allocated for the various types of work or work stages;
- cooperation between employers and self-employed persons;
- interaction with industrial activities on the place within which or in the vicinity of which the construction site is located

When performing the installation works and works related to the operation of pipelines, the following hazards can occur: dangers of electricity, inadequate lighting, dangers in case of maintenance and operation of shut-off systems, deficiencies of warning signs, hazards if prescribed personal protective equipment is not used, hazards in case of working with hazardous materials, hazards in case of dangers during movements, work on heights etc. Zones of explosions danger must be identified on the construction site. Evacuation plan for employees has to be created (in case of accidents that could endanger the life and health of employees - natural disasters, fires, explosions, etc.). All work has to be conducted in accordance with the Occupational Health and Safety Plan that will introduce every worker to the hazards of every job and methods to avoid any dangers. All workers also have to receive proper training.

4.3.1.14 Waste

Variant A and Variant B

During construction phase – earthworks, on Variant A, large quantities of non-hazardous construction waste, mainly waste concrete, will occur. All of the construction waste should be temporarily disposed on site and then transported by officially authorized companies/utilities on final disposal. Some small quantities of hazardous waste could occur (e.g. oily materials) during construction works. That waste should be collected separately and disposed of by officially authorized companies/utilities. In case of accidents like oil/fuel spillage, contaminated soil and material should be immediately disposed of by officially authorized companies/utilities. Lastly it should be noted that the quantity of generated waste from project activities is dependent on the length of the pipeline route. During operation and maintenance of the pipeline some small quantities of non-hazardous waste will be generated by pigging operations (tailings, sludge).

4.3.1.15 Infrastructure

Variant A and Variant B

Various infrastructure objects like; roads, railways, embankments against floods and river erosion, water supply facilities, drainage and irrigation works, military areas, industrial objects/areas, etc., are considered as sensitive installations in respect to the proposed gas pipeline.

In cases where the pipeline intersects the infrastructure constructions (traffic: roads, railways, etc., water management: water supply pipelines and sewage

system, electricity: power lines, cables, etc.) all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual institutions when obtaining certain licenses). All potential adverse impacts can be avoided through proper organization of the construction site and compliance with all applicable laws and regulations respecting the rules of traffic, electrical and civil engineering.

During construction, due to increased frequency of materials and techniques transportation, the traffic situation can change - delays may occur that will require special attention and support services (in transportation of special cargo). Possible accidental damage to public roads can be expected.

In addition to all stated that relates for both variants, Variant B will have an additional impact on maritime traffic, during the construction of the pipeline, as follows:

- Traffic of ships for transport of liquid cargo
- Traffic of passenger ships
- Traffic of yachts and boats for sport and leisure
- Traffic of smaller local vessels and boats for daily trips
- Traffic of fishing boats.

Considered ships will intersect corridor of subsea pipeline during sailing, mooring or anchoring. After the construction of the subsea pipeline (with respect to sea depth in this area - over 200 m) the pipeline will not in any case interfere with the movement of ships, which takes place in the Montenegrin part of the Adriatic Sea.

4.3.1.16 Accident situations

Natural gas is a mixture of different hydrocarbons. Almost 95% of natural gas is methane (CH_4), a greenhouse gas. Natural gas belongs to the group of highly flammable substances.

A general overview of the possible scenarios when an accident occurs on the pipeline:

- Leakage without ignition or explosion, in which natural gas relatively quickly disperses to the upper layers of the atmosphere. In this case, there is little possibility of poisoning people near the site of the accident, and there is no danger to the environment;
- Leakage with the occurrence of fire;

- Leakage with the occurrence of an explosion;
- Leaking gas and inflammation in the leakage, which produces a fiery jet.

In the vicinity of the damaged pipe (radius approx. 200 m) a temporary hazard warning is introduced (be it on land or sea area) and evacuation of people is conducted. The fire brigade is summoned.

Variant A

The European Gas Pipeline Incident Data Group (EGIG) in its document "Gas Pipeline Incidents, 2008", provides an overview of statistical data on the frequency of accident occurrence on land main gas in the period since 1970 to 2007.

In the period since of 1970 to 2007, the total exposure of gas pipeline systems (length x length of pipeline facilities), which are recorded in database EGIG, is 3.15 million km × y. The total number of reported accidents in the same period amounted to 1172, where in the period of 2004 to 2007 there were 49 accidents reported.

Table 35: Overview of accident frequency on land pipelines

Time period	Number of accidents	Total exposure to gas system [km × year]	Accident frequency [(1,000 km × yr) $^{-1}$]
1970-2007	1172	$3{,}15\times10^{6}$	0,37
1970-2004	1123	$2{,}77\times10^{6}$	0,40
2003-2007	88	$0{,}62\times10^{6}$	0,14
2007	14	$0{,}13\times10^{6}$	0,11

Source: 7th EGIG-report 1970-2007, December 2008

Frequency of accident occurrence in the period from 2003 to 2007 is less than a third of the value of the frequency for the entire period of observation, which indicates an increase in security in recent years.

Accident causes on the pipeline can be grouped into six major categories. Table 2 gives an overview of the causes of accidents with their distribution.

Table 36: Summary accident causes on land pipelines

Cause	Contribution [%]
External influence	49,6
Structural error / defect in material	16,5
Corrosion	15,4
Seismic activity	7,3
Performance compound with an error	4,6
Other	6,7

Source: 7th EGIG-report 1970-2007, December 2008

Variant B

In the risk analysis of subsea pipeline, coastal areas so called "landfall zones" differentiate, where the pipeline is under changing conditions (dry, wet - the area under influence of waves, tides) and sea areas. An overview of the accident frequency on underwater pipelines (pipeline) is given in following table (it refers to the coastal area and the open sea area).

Table 37 Frequency of accident occurrence in the subsea pipelines

Type of pipe	Frequency of accident occurrence [(1000 km × yr) $^{-1}$]
Pipeline diameter ≤ 600 mm	0,051
Pipeline diameter > 600 mm	0,014

Source: Riser and pipeline release frequencies, International Association of Oil and Gas Producers, March 2010

The main causes of accidents in subsea pipelines are fishing, anchoring, unknown / unfavourable configuration of the seabed, ocean currents. The table below shows the distribution of the accident causes.

Table 38 Overview of accident causes on underwater pipelines

Cause	Contribution [%]
External influence	38
Corrosion	36
Defect materials	13
Structural error	2
Other	11

Source: Riser and pipeline release frequencies, International Association of Oil and Gas Producers, March 2010

4.3.2 The description of likely significant effects of the project on the environment and social issues and characterization of the impacts

Effects (impacts) are demonstrated in tables, separate for each Variant except for components where the impacts are the same for both considered variants.

For each recognized possible effect the valorisation has been made, using a scale from -2 to +2, where numbers stand for following:

-2 = very negative impact
-1 = negative impact
0 = without impact
+1 = positive impact
+2 = very positive impact

4.3.2.1 Climatic characteristics

Variant A and Variant B

Description of likely significant effects of the project *Effects during construction* Since it is an area with moderately warm climate without significant extremes, pipeline construction will be possible almost all year round. *Effects during pipeline usage* Climatic factors will not affect the operation of the pipeline as it will go through the soil and thus be protected from external influences.
Effects' characteristic Impact during construction is direct since the construction will be carried out in the open. Impact during use is indirect since gas pipes will be buried in the ground.
Effects' significance Impacts during the construction and use are acceptable given the moderately warm climate of the studied area.
Effects' valorisation 0 = without impact

4.3.2.2 Geomorphology

Impacts of both variants (A and B) are possible in the case of pipeline crossing certain characteristic karst micro-relief forms – sinkholes and other gentle karst elements. The impact is manifested as degradation and backfilling. Erosion is also possible while digging canals for pipeline, backfilling due to the stabilization of the terrain and construction of ground elements of the planned pipeline.

Albania

Variant A

Description of likely significant effects of the project Likely adverse impacts on geomorphology because of: -Irreversible changes in geomorphology across karst areas (section Bajza-Hoti) from earth works; -Possible geological risks (landslides, subsidence, erosion) from: a-selection of the pipeline route over loose deposits (South of Shkodra) and in the contact surface between dissimilar geological formations; b-tectonic faults crossing (pipeline route crosses more than 7 tectonic faults); and c-areas of high seismic risk crossing (pipeline crosses an area of seismic intensity IX degree MSK-64). -Erosion in riverbeds from earthworks and vegetation clearing (more than 6 river crossings); -Riversides erosion from selection of the pipeline route alongside the riverbeds (6 km along

the Kiri riverbed in the eastern part of Shkodra).
Effects' characteristic Negative; Direct, Permanent over karst areas; and temporary over loose deposits
Effects' significance With medium significance but acceptable.
Effects' valorisation -1

Variant B

Description of likely significant effects of the project Likely adverse impacts on geomorphology because of: -Possible geological risks (subsidence) from selection of the pipeline route over loose deposits. -Erosion in riverbeds from earthworks and vegetation clearing (1 river crossing at the border ALB/MNE);
Effects' characteristic Negative; Direct, Temporary; With local geographical extension
Effects' significance Acceptable because the effects are of low significance
Effects' valorisation 0

Montenegro

Variant A and B

Description of likely significant effects of the project Possible impact in the case of overlapping pipeline with certain characteristic karst micro-relief forms – sink holes and other gentle karst elements. The impact is manifested as degradation and backfilling. Erosion is also possible while digging canals for pipeline, backfilling due to the stabilization of the terrain and construction of ground elements of the planned pipeline.
Effects' characteristic Negative, temporary effect but with local character.
Effects' significance With medium significance but acceptable
Effects' valorisation -1

4.3.2.3 Land Use and Pedology

Variant A

Albania

Description of likely significant effects of the project
– Permanent land take (67.5 ha) along a narrow strip of 10m wide (5m both sides of the pipeline axis), as follows: 1-Agricultural land: 57.8 ha, from which: a-land of very good agricultural quality: 20.0 ha; b-land of good agricultural quality: 20.0 ha; c-land of medium agricultural quality: 7.8 ha; d-land of low agricultural quality: 10.0ha. 2-Forest and shrubby areas: 9.7 ha. 3- Permanent land take (more than 2.0 ha) near and through the riparian forests (more than 6 river crossings) along the main riverbeds. 4- Temporary land take, changes on land use, and land disturbance that affects a land strip 400m wide (200m both sides of the pipeline axis), as follows: a-Agricultural land: 1,686.0 ha; b-Forest and shrubby areas: 388.0 ha; c-Riparian forests along the river and stream beds: 80.0 ha; and d- Road and drainage & irrigation infrastructure: 50ha The land use changes and the land disturbance includes: Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops; Permanent land take at above ground facilities; Changes to and disturbance of land and associated impacts upon existing land use and users; Temporary land take in agricultural areas; Temporary loss of the agricultural productivity of the land; Damage to agricultural features such as irrigation and drain systems, fences etc.; Contamination of soil by solid and liquid wastes; Disturbance and degradation of soil due to erosion, compaction, removal, modification of morphology, collapse and sinkhole formation processes; etc.
Effects' characteristic
Negative; Direct; Partly reversible because the land cover can be rehabilitated; and irreversible because the riparian forest at the Drini River crossing (1.5 km long) has special values in terms of biodiversity.
Effects' significance
With negative significance but acceptable compared to the importance of the project regarding the gas supply.
Effects' valorisation
-1

Description of likely significant effects of the project
Permanent and temporary land take (buffer area of 400m wide) across inhabited areas and industrial and military infrastructure, as follows: a-Inhabited areas: 400 ha;

b-industrial areas: 8.0 ha; c-military infrastructure: 88.0 ha;
Effect's characteristic Negative; Direct; Irreversible because of the crossing of: a-a great number of inhabited areas; b-the industrial zone of Shkodra; and c-the landing strip of Gjadri air base.
Effect's significance Very high negative impact
Effect's valorization -2

Montenegro

Description of likely significant effects of the project Soil degradation caused by installation of the pipeline, change in land cover characteristics, changes in agricultural production on 30.36% area, changes in forest production on 69.21% area. Very high erosion risk on 2.23% and moderate on 37.66% of total area.
Effects' characteristic Negative effect of disturbance but reversible i.e. previous land cover could be re-established.
Effects' significance With great significance but conditionally acceptable
Effects' valorisation -2

Variant B

Albania

Description of likely significant effects of the project – Permanent land take (29.3 ha) along a narrow strip of 10m wide (5m both sides of the pipeline axis), as follows: 1-Agricultural land: 29.3 ha, from which: a-land of very good agricultural quality: 29.3 ha; and b-land of good agricultural quality: 19.2 ha. 2-Permanent land take (0.05 ha) through the riparian forest of Buna riverbed (1 river crossing)

– Temporary land take, changes on land use, and land disturbance that affects a land strip 400m wide along the pipeline, as follows: a-Agricultural land: 1,164.0 ha; b-Forest and shrubby areas: 388.0 ha; c-Riparian forest across Buna riverbed: 2.0 ha; and d- Road and drainage & irrigation infrastructure: 4.0ha The land use changes and the land disturbance includes: Permanent changes of land use in forests, olive yards, vineyards, and other permanent crops; Permanent land take at above ground facilities; Changes to and disturbance of land and associated impacts upon existing land use and users; Temporary land take in agricultural areas; Temporary loss of the agricultural productivity of the land; Damage to agricultural features such as irrigation and drain systems, fences etc.; Contamination of soil by solid and liquid wastes; Disturbance and degradation of soil due to erosion, compaction, removal, modification of morphology, collapse and sinkhole formation processes; etc.
Effects' characteristic Negative; Direct, and Reversible because the land cover over arable lands can be rehabilitated and the riparian forest at the Buna River crossing has no special biodiversity values.
Effects' significance With low significance; Acceptable
Effects' valorisation 0

Description of likely significant effects of the project Permanent and temporary land take (buffer area of 400m wide) across inhabited area of Torovica village as follows: -Inhabited rural area: 2.0 ha;
Effect's characteristic Negative; Direct; Avoidable because there is enough free space to avoid the Torovica village.
Effect's significance With low significance; Acceptable
Effect's valorization 0

Montenegro

Description of likely significant effects of the project Soil degradation caused by installation of the pipeline, changes in land cover characteristics, changes in agricultural production on 28,25% area, changes in forest production on 28,41% area. Significantly smaller land area under the direct impact than in Variant A. Erosion risk is not very significant.

Effects' characteristic Negative effect of disturbance but reversible i.e. previous land cover could be re-established.
Effects' significance With great significance but conditionally acceptable
Effects' valorisation -1

4.3.2.4 Analysis of social issues

Variant A

Albania

Description of likely significant effects of the project – Permanent land take through highly urbanised areas in Lezha, Shkodra and Malesia Madhe Districts (Pipeline crosses 18 villages and the town of Shkodra). The total length of the pipeline crossing the inhabited centres is 10.0 km; – The disturbance of the life conditions and the cost of the recompensation will increase drastically, because the construction of the pipeline will require the destruction of a very high number of: a- farm houses across 18 villages; b-individual houses in the north eastern surroundings of Shkodra town; and c-industrial objects in the north eastern part of Shkodra town.
Effects' characteristic Very negative; Direct; Irreversible
Effects' significance Unacceptable because of the high number of settlements and other objects crossed from the pipeline. The resettlement of this large population would drastically disturb its life conditions and will increase the cost of the project.
Effects' valorisation -2

Description of likely significant effects of the project Direct and cumulative adverse impacts through disturbance of the life conditions of a large population (more than 150,000 inhabitants) from permanent and temporary impacts on: a-the tourist assets of Shkodra and Malesia Madhe Districts (permanent indirect adverse impacts on the shoreline of Shkodra Lake; temporary frequentation of the cultural heritage sites; etc.); b-the recreational areas near and across the riverbeds and the karst plain of Malesia Madhe District (permanent and temporary impacts on karstic lakes, springs, and wells; etc.); c-The quality of the drinking waters, which can be temporarily polluted from project activities because of the lack of impermeable clayey cover over the Quaternary aquifers along the corridor Shkodra-Koplik; d-The quantity and the quality of the drinking waters in the dug wells over the karst plain of Malesia Madhe (permanent changes in ground waters regime); etc.

Effect's characteristic Very negative; Direct and indirect; Irreversible (quality of quantity of drinking waters, tourists assets and recreational areas).
Effect's significance Unacceptable, because of the high significance due to the likely permanent changes in ground waters regime and consequently negative impacts on: a-drinking waters quantity and quality through the karst plain of Malesia Madhe; b-quality and quantity of waters in the recreational areas (karst springs, lakes and dug wells); and c-tourist assets along the Shoreline of Shkodra Lake.
Effect's valorization -2

Description of likely significant effects of the project Direct and cumulative adverse impacts through disturbance of the life conditions of a large population (more than 150,000 inhabitants) from temporary adverse impacts on: a-the international, national, district, communal, and rural road network, and on the international and national railway; b-numerous water pipelines, sewage and sewerage objects, etc.
Effect's characteristic Negative; Direct; Reversible (transport network; water pipelines and sewage and sewerage infrastructure, etc.).
Effect's significance Acceptable, because of the positive effects of the project through gas supply.
Effect's valorization -1

Montenegro

Description of likely significant effects of the project *Insignificant* to the existing, local population, which is itself rather small in size except for the major cities (Podgorica, Cetinje, Nikšić), but *significant* for the natural areas, especially for the nature protected areas (Lovćen, Rumija (to be protected), Skadar/Shkodra Lake)
Effects' characteristic Due to the scarcity of population in general on the way of the Variant A, except major settlements, cities and towns, *negative* effects could be foreseen for the protected natural areas; *positive and cumulative* effects could be foreseen for the cities and settlements along the pipeline route due to the benefits of this energy source; *direct* consequences might be the reorientation of the use of energy resources in cities - from wood, coal, and electricity to gas; *indirect* benefits might be the overall improvement of the environment and pollution especially in cities; *cumulative* - all of the mentioned could bring to the better environmental situation, with smaller degradation of the nature along the route;

Effects' significance It could be predicted that all effects might be *acceptable* due to the fact that no major degradation is expected as a result of the construction of the pipeline route; In the Variant A *an important effects* could be the degradation of nature in the nature protected areas, but with careful planning and realization of construction, these potentially "important effects" could be almost completely avoided. In the case of the "no harm" realization of the project, no important effects could be predicted
Effects' valorisation +1

Variant B

Albania

Description of likely significant effects of the project – Permanent land take through the inhabited rural area of Torovica village, which is crossed along 50 m from the pipeline axis; and – Adverse impact from earthworks to the recreational area at the Buna riverbed.
Effects' characteristic Negative; Direct, Almost avoidable
Effects' significance Acceptable, because: a- the crossing of the inhabited rural area at Torovica village can be easily avoided by tuning the axis of the pipeline some 100m in the west of this village, over agricultural lands; and b-the recreational area at the Buna riverbed is composed of vegetation that can be easily rehabilitated.
Effects' valorization 0

Montenegro

Description of likely significant effects of the project Impact description- mostly *weak*, to the agriculture that is scattered in smaller pieces of arable land; the gas could *improve* everyday conditions of life of local population and visitors (tourists).
Effects' characteristic Potentially *positive* due to the effect of the introduction of new energy source, depending on the price of gas, availability. It could be predicted that effects of the new energy source would be *positive* especially for tourist development in the areas. No negative effects could be foreseen as well as *negative and indirect (negative) effects*. The effect that could be predicted could be the *direct improvement* of the environmental conditions, better and more efficient use of energy resources, less pollution. A *cumulative* effect will be overall environmental positive effect. *An indirect* effect will be the enlargement of tourist activities also in the hinterland areas as well as the rise of the existing tourist industries in numbers and sizes.

Effects' significance The significance of the effects of the introduction of the pipeline in the areas might be only *acceptable* due to the positive effects that are expected for the people living in these areas. These effects will be *important* for the economy of the country if the conditions for introduction of the gas into everyday life will be favourable. If not, then the gas could be perceived and evaluated as less *important* and less *acceptable*.
Effects' valorisation +1

4.3.2.5 Hydrology/ Groundwaters/ Marine areas

Variant A

Hydrology/ Groundwaters

Albania

Description of likely significant effects of the project Possible contamination (from solid and liquid waste) and changes in quality and quantity on the ground waters, as follows: a-Possible contamination of 3 Quaternary porous aquifers (Lower Shkodra, Upper Shkodra, and Koplik) of high permeability that are not overlaid by impermeable clayey-silty cover. The Quaternary aquifer of Upper Shkodra supplies with drinking water more than 150.000 inhabitants. b-Possible contamination of the karst aquifer of Malesia e Madhe District which is traversed from the pipeline; c-Possible adverse impacts on the quantity and quality of the drinking waters in the karst area of Malesia Madhe District, because the local population is partly supplied in drinking water from dug wells. d-Possible contamination of the karst Springs, karst Lakes, and dug wells that are located over the karst aquifer of Malesia Madhe that have very good hydraulic connections, especially in the karst plain of Bajza; Changes in ground waters regime (flow direction, discharge, etc.) from earthworks in the karst plain of Bajza. These changes can affect the karst Springs, karst lakes, and the dug wells.
Effect's characteristic Very negative; Direct; and with difficulty avoidable because of the very good hydraulic connection between the aquifers and the overlaid geological formations, over which runs the proposed pipeline.
Effect's significance Unacceptable because of the likely adverse effects on the highly permeable aquifers of this region, and consequently on the quality and quantity of the drinking waters of a large population.
Effect's valorization -2

Description of likely significant effects of the project Possible contamination (from solid and liquid waste) and changes in quality and quantity on the surface waters, because of: a-Possible contamination of the waters of Shkodra Lake (Ramsar site, IBA), where drain 3 Quaternary permeable aquifers (Lower Shkodra, Upper Shkodra, and Koplik), and the karst aquifer of Malesia Madhe that are not overlaid by impermeable cover layers; b-Possible contamination of the karst Springs and karst Lakes that are located over the karst aquifer of Malesia Madhe, especially in the Shoreline of Shkodra Lake (MNR, IPA); and The changes in ground waters regime (flow direction, discharge, etc.) from earthworks in the karst plain of Bajza can affect adversely the quality and the quantity of the waters in the karst lakes; Effects on surface water from sediment plumes caused by watercourse crossings (more than 6 river crossings), trenching, etc.
Effect's characteristic Negative; Direct; Unavoidable
Effect's significance Unacceptable, because the adverse effects on the surface waters (Shkodra Lake, karst lakes), where drain the ground waters can last for a long time due to the very good hydraulic connections between the water bearing layers and the overlaid geological formations, over which runs the surface waters.
Effect's valorization -2

Montenegro

Description of likely significant effects of the project *Effects during construction* Because the route of the gas pipeline passes through areas of karst with surface water, negative impact on the quality of surface water and groundwater is possible. Potential impacts: devastation of rivers natural flow due to pipeline construction; contamination due to inadequate waste management; increasing the turbidity level in watercourses during construction phase; contamination and thus reduce of water quality is expected only in case of accidental situations during construction and operation phase. *Effects during pipeline usage* Once construction is complete a structure such as a pipeline does not have a negative impact on surface and ground waters.
Effects' characteristic Direct and possible effects on water quality during operation phase are negative but short-term and localised during construction.
Effects' significance Construction effects are not significant and are acceptable.

Effects' valorisation (weight factor)
-1 moderately negative

Variant B

Hydrology/ Groundwaters

Albania

Description of likely significant effects of the project
Ground waters: Pipeline route runs over 1 Quaternary aquifer (south-western part of Lower Shkodra aquifer) of local importance that is overlaid by an impermeable sub-clayey cover 17-25m thick. Thus, this aquifer is protected from any possible accidental pollution.
Effect's characteristic
Negative; Direct; Temporary; Avoidable because the local aquifer is overlaid by an impermeable sub-clayey cover
Effect's significance
Acceptable
Effect's valorization
0

Description of likely significant effects of the project
Surface waters: Pipeline route crosses one river (Buna/Bojana River), which runs over an impermeable sub-clayey cover 17-25m thick. Thus, there are no hydraulic connections between ground and surface waters. Effects on surface water from: a-liquid and solid waste and from construction works; and b-sediment plumes caused by watercourse crossings (one river crossing), trenching, etc.
Effect's characteristic
Negative; Direct; temporary and partly avoidable
Effect's significance
Acceptable
Effect's valorization
0

Montenegro

Description of likely significant effects of the project
Effects during construction Because the route of the gas pipeline passes through areas of karst with surface water,

negative impact on the quality of surface water and groundwater is possible. Potential impacts: – devastation of rivers natural flow due to pipeline construction; – contamination due to inadequate waste management; – increasing the turbidity level in watercourses during construction phase; – contamination and thus reduce of water quality is expected only in case of accidental situations during construction and operation phase. *Effects during pipeline usage* Once construction is complete a structure such as a pipeline does not have a negative impact on surface and ground waters.
Effects' characteristic Direct and possible effects on water quality during operation phase are negative but short-term and localised during construction
Effects' significance Construction effects are not significant and are acceptable.
Effects' valorisation (weight factor) -1 moderately negative

Marine areas

Description of likely significant effects of the project Loss of marine habitats along the pipeline route Impact zone of laying procedure is divided in to two sub-zones: direct impact zone (area under pipe) and working zone. The working zone is divided into narrow working belt (5 meters in both directions from the route of the pipe) and expanded working belt (100 meters in both directions from the route of the pipe - anchoring area of construction vessels).
Effects' characteristic: Negative / direct Within the direct impact zone loss of marine habitats is direct and permanent. Within the narrow working area, during laying procedure localized damage of marine habitats will be caused by stabilization chains within width of 5 meters on both sides of the pipe. Intensity of the impact in this zone will depend on weather conditions and lateral movements of the pipe during laying process. Along expanded working belt anchoring systems of construction vessels will cause localized damage of marine habitats. Along the coast and up to a certain depth in the costal waters (depending on the topology of the coast) construction trench will dragged which will have negative permanent impact to costal and marine habitats in direct impact zone.
Effects' significance Acceptable / significant
Effects' valorisation -2

Description of likely significant effects of the project Disturbance of sea-fish and other animals associated with seabed (noise, suspended sediments etc.)
Effects' characteristic The pipe will permanently cover slightly movable or immovable organisms (sedentary and sessile), which live on the surface of the seabed (shellfish, gastropods, echinoderms, sponges). Stabilization chains will interact with a surface of the seabed, which will drive away vagile organisms (mainly fish, crustaceans and cephalopods) during working period.
Effects' significance Acceptable / not significant
Effects' valorisation -1

4.3.2.6 Biological environment (Flora and fauna)

Variant A

Albania

Description of likely significant effects of the project – Loss of habitats in the riparian area of Shkodra Lake. Pipeline route axis passes near the shoreline of Shkodra Lake, which riparian area has high biodiversity values in national, trans-boundary, and international level (IBA &IPA); – Loss of habitats in the riparian area of Drini Riverbed; – Loss of habitats in the forested area over the Bajza karst plain, where it is difficult to rehabilitate the forest resources; – Irreversible adverse impacts on endangered plant and fauna species; – Temporary changes on freshwater habitats (Shkodra Lake, karst Springs and karst Lakes) due to work in karst areas; – Possible permanent changes on karst Springs and karst Lakes habitats due to possible changes in ground waters regime (flow direction, water discharge, hydraulic connections, etc.) due to earth works in karst areas; – Temporary changes on river from suspended sediments due to work in river beds; – Changes on structure of grassland habitats; – Potential spread of invasive species; – Animal disturbance – temporary during building of pipeline (noise, dust, air emissions, humane disturbance) and permanent for block-station and measuring-reduction stations (i.e. noise); – Disturbance of river and lake fish and other pelagic animals (noise, suspended sediments etc.) – Accidental release of chemicals, fuel to rivers, lakes or karst areas; – Accident: Emission of bigger amount of gas with possible explosion or fire; and Potential direct longer period changes of habitats in the riparian areas of Drini Lezhes, Drini, and Kiri riverbeds, and of the shoreline of Shkodra Lake.
Effect's characteristic

Negative; Direct; and Indirect; Partly avoidable (the temporary changes) and partly unavoidable (permanent changes on: a- karst springs and karst lakes habitats; b-habitats in the forested areas in karst plains; c-habitats in the IBA and IPA of the Riparian area of Shkodra Lake).
Effect's significance Unacceptable
Effect's valorisation -2

Montenegro

Description of likely significant effects of the project ***Loss and degradation of habitats*** Through the construction of the pipeline some parts of natural vegetation will be lost, which will directly impact some habitat types and plant specimens. In the construction area (cca 20 m) all vegetation will be removed and the terrain will be flattened, which will have effect on the change and degradation of habitats. Moreover, since during the pipeline usage shortgrowing vegetation will be maintained (without the deep routes) the effect of loss of forest and scrub habitat types will be permanent (cca 20 m along the route and other engineering surfaces). In addition to change of habitat types, the construction of the pipeline will have significant impact on habitat fragmentation as well. After the construction of the pipeline inland unvegetated or sparsely vegetated habitats will be developed on the engineering surfaces. It is expected that after some time the grassland habitat type species will develop on the engineering surfaces along the pipeline route. The revegetation of the sparely vegetated engineering surfaces will depend on the soil structure of the primary soil structure. The areas with shallow soil layer will need more time for recovery, as new soil needs to be developed. Grassland habitat types will be changed due to the temporal removal of soil and afterwards changes in soil composition. This construction work will affect the ecological conditions (e.g. change of soil structure) and the plant composition in the construction area. It is expected that grassland habitat types will be reconstructed after some period. The period of vegetation and habitat recovery will depend on the soil type and grassland habitat type, respectively. The areas with dry calcareous grasslands, which have shallow soil layer, will need more time for recovery, as new soil structure needs to be developed. In the engineering surfaces of Variant A (cca 20 m along the pipeline route, gas pressure recustion and metering station, pig trap station, block valve station) will reduce and fragment following forest and shrub habitats: eu-Mediterranean evergreen forests and scrubs, thermophilous and supra-Mediterranean oak woods and thermophilous beech forests. Along the Variant A predominantly are spread dry calcareous grassland habitat type. After the construction of the pipeline and during the usage of the pipeline, along the pipeline route the invasive species could be spread. The new disturbed soil structure could be beneficial for some invasive species and suppress the development of natural vegetation. In addition, the spread of invasive species along the pipeline corridor could affect the structure of surrounding habitats. In order to suppress the development of invasive species regular botanical monitoring of the engineering surfaces will need to be conducted and applied accordingly the environmental protection measures. It is assumed that possible impact can be mitigated by some environmental protection measures. Consequently, the impact is assessed as not significant.
Effects' characteristic Negative, Direct, Permanent for forest and shrub habitats, temporal for grassland and

riparian habitats
Effects' significance Acceptable, less significant
Effects' valorisation -2

Description of likely significant effects of the project ***Temporary deterioration of habitats - Noise, dust, air emissions and humane disturbance*** During the construction of the pipeline the temporary deterioration of habitats will occur. Noise, dust, air emissions and humane disturbance during the construction work will disturb some animal species and deteriorate the habitat quality. This impact is temporary and limited to relatively small area in surrounding of the construction zone. During the pipeline usage the permanent disturbance around the block valve station, the gas pressure reduction and metering stations and the pig trap station might occur because of the of the noise. The noise will be related to small surrounding area of above mentioned objects. During the work of pig trap station higher levels of noise could occur, but the impact is limited to short time, approximately 2 hours. In addition, occasional disturbance of habitats will occur during the maintenance along the pipeline route (e.g. mowing, regular survey of the route). The impact is temporary only during the maintenance work. As above mentioned impacts are spatially narrow or/and temporarily short, it can be concluded that the impact of disturbance and noise during the pipeline usage has minor significance.
Effects' characteristic Negative, temporary, direct
Effects' significance Not significant
Effects' valorisation -1

Description of likely significant effects of the project ***Temporary change of freshwater habitats due to work in river bed and on banks (suspended sediments)*** South of Podgorica Variant A passes over several rivers - Sitnica, Morača and Cijevna. Sitnica and Morača are rivers with gravel and sand watersides in the area of the crossing over. Also, riparian vegetation is present in these sites. Cijevna River has, on the other hand, a canyon-like riverbed with rocky shores. There are several techniques for crossing over the watercourses. As it is not clear in this phase of the project which techniques will be used, the impacts will be assessed for the method of digging in the pipeline into the river bed. The river banks and river bed riparian vegetation will be permanently changed by the construction of pipeline. This impact will be reduced to narrow part of engineering surfaces (cca 20 m). During the construction work minor changes of the river flow might be needed. Due to the possible negative impacts, the construction work on watercourses should be conducted during the low water level. The engineering work in river bed will change physical and chemical properties of river water downstream from the working area. Firstly, the digging and similar construction work will

affect the sediment and impact the physical properties of water (mudding) . The impact will be diluted downstream from the engineering work area and it will not have high magnitude of impact on long length of watercourse. The mudding of water flow might locally affect some animal freshwater species and their distribution. Since engineering work period is short the impact is acceptable, with application of environmental protection measures.
Effects' characteristic negative, direct, temporary
Effects' significance Less significant
Effects' valorisation -1

Description of likely significant effects of the project ***Accidental release of chemicals and fuel to rivers, sea or karstic areas is possible during the construction works*** Contamination of rivers, sea or kartic area can deteriorate habitat quality and have an adverse impact on individual wildlife specimens. With the application of environmental management plan during the construction period (i.e. usual environmental protection precautionary measures for the construction sites, appropriate waste and oil management, use of approved equipment etc.) accident possibility will be significantly reduced.
Effects' characteristic Accidental
Effects' significance Not significant
Effects' valorisation -1

Description of likely significant effects of the project ***Emission of bigger amounts of gas with possible explosion, fire or fire blast are possible as accidents*** This accidental impact could cause direct longer period of habitat changes. Moreover, in some circumstances the fire could be spread to a broader region and affect habitats on broader distance from the Variant. The magnitude of the impact will depend on the temporal meteorological conditions. With appropriate maintenance and survey of the pipeline infrastructure the probability of this kind of accidental impact should be low.
Effects' characteristic Negative, Accidental
Effects' significance Significant
Effects' valorisation -2

Description of likely significant effects of the project ***Degradation of terrestrial underground caves, cave systems, passages and water bodies*** Variant A is dominantly passing through the karst region, with numerous but not completely known caves and pits. Although the construction work is relatively shallow (around 2 m deep), there is still high possibility of coming across a new cave entrance or cave systems. Construction of the pipeline might cause physical changes of the object and could change cave habitat conditions during the construction period. The magnitude of the impact on the caves and cave systems dependes on the size of the undeground habitat. The newly discovered caves could be a habitat for some endemic species. Since the underground fauna is mostly endemic and rare, any disturbance of its habitats should be avoided. Due to that, more detail research of known cave habitats and species should be conducted. In addition, survey of the cave habitats should be conducted and according to results the pipeline route should be diverted.
Effects' characteristic Negative, Accidental
Effects' significance Significant
Effects' valorisation -2

Variant B

Albania

Description of likely significant effects of the project – Loss of habitats in the riparian area of Buna riverbed; – Temporary changes on river from suspended sediments due to work in Buna riverbed; – Changes on structure of grassland habitats; – Potential spread of invasive species; – Animal disturbance – temporary during building of pipeline (noise, dust, air emissions, humane disturbance) and permanent for block-station and measuring-reduction stations (i.e. noise); – Disturbance of river fish and other pelagic animals (noise, suspended sediments etc.); – Accidental release of chemicals, fuel, etc. to Buna River; – Accident - Emission of bigger amount of gas with possible explosion or fire – Potential direct longer period changes of habitats in the riparian area of Buna riverbed
Effect's characteristic Negative; Direct;
Effect's significance Acceptable because the pipeline runs through agricultural lands, except for the Buna riverbed, along a segment of approximately 50m long. At the river crossing the riparian

forest of Buna River is composed of vegetation of common values in terms of biodiversity. In addition, this vegetation has a high potential of rehabilitation.
Effect's valorisation 0

Montenegro

Description of likely significant effects of the project ***Loss and degradation of habitats*** Through the construction of the pipeline some parts of natural vegetation will be lost , which will directly impact some habitat types and plant specimens. In the construction area (cca 20 m) all vegetation will be removed and the terrain will be flattened, which will have effect on the change and degradation of habitats. Moreover, since during the pipeline usage shortgrowing vegetation will be maintained (without the deep routes) the effect of loss of forest and scrub habitat types will be premanent (cca 20 m along the route and other engeneering surfaces). In addtion to change of habitat types, the construction of the pipeline will have significant impact on habitat fragmenatation as well. After the construction of the pipeline inland unvegetated or sparsely vegetated habitats will be developed on the engeneering surfaces . It is expected that after some time the grassland habitat type species will develope on the engenieering surfaces along the pipeline route. The revegetation of the sparecly vegetated engenieering surfaces will depend on the soil structure of the primary soil structure. The areas with shallow soil layer will need more time for recovery, as new soil needs to be developed. Grassland habitat types will be changed due to the temporal removal of soil and afterwards changes in soil composition. This construction work will affect the ecological conditions (e.g. change of soil structure) and the plant composition in the construction area. It is expected that grassland habitat types will be reconstructed after some period. The period of vegetation and habitat recovery will depend on the soil type and grassland habitat type, respectively. The areas with dry calcareous grasslands, which have shallow soil layer, will need more time for recovery, as new soil structure needs to be developed. In the engeneering surfaces of Variant B (cca 20 m along the pipeline route, gass presusure recustion and metering station, pig trap station, block valve station) will reduce and fragment following forest and shrub habitats: eu-Mediteranean evergreen forests and scrubs and thermophilous and supra-Mediterranean oak woods. Along the Variant A predominantly are spread dry calcareous grassland habitat type. After the construction of the pipeline and during the usage of the pipeline, along the pipeline route the invasive species could be spread. The new disturbed soil structure could be beneficial for some invasive species and suppress the development of natural vegetation. In addition, the spread of invasive species along the pipeline corridore could affect the structure of surrounding habitats. In order to suppress the development of invasive species regular botanical monitoring of the engeneering sufaces will need to be conducted and applied accordingly the environmental protection measures. It is assumed that possible impact can be mitigated by some environmental protection measures. Conseqeuntly, the impact is assessed as not significant.
Effects' characteristic Negative, Direct, Permanent for forest and shrub habitats, temporal for grassland and riparian habitats
Effects' significance Acceptable, less significant

Effects' valorisation -2

Description of likely significant effects of the project ***Temporary deterioration of habitats - Noise, dust, air emissions and humane disturbance*** During the construction of the pipeline the temporary deterioration of habitats will occur. Noise, dust, air emissions and humane disturbance during the construction work will disturb some animal species and deteriorate the habitat quality. This impact is temporary and limited to relatively small area in surrounding of the construction zone. During the pipeline usage the permanent disturbance around the block valve station, the gas pressure reduction and metering stations and the pig trap station might occur because of the of the noise. The noise will be related to small surrounding area of above mentioned objects. During the work of pig trap station higher levels of noise could occur, but the impact is limited to short time, approximately 2 hours. In addition, occasional disturbance of habitats will occur during the maintenance along the pipeline route (e.g. mowing, regular survey of the route). The impact is temporary only during the maintenance work. As above mentioned impacts are spatially narrow or/and temporarily short, it can be concluded that the impact of disturbance and noise during the pipeline usage has minor significance.
Effects' characteristic Negative, temporary, direct
Effects' significance Not significant
Effects' valorisation -1

Description of likely significant effects of the project Temp***orary change of freshwater habitats due to work in river bed and on banks (suspended sediments)*** In the foothill of Vranja gnijezdo Hill, Variant B passes through the riverbed of Mrkovska River. There are several techniques for crossing over the watercourses. As it is not clear in this phase of the project which techniques will be used, the impacts will be assessed for the method of digging in the pipeline into the river bed. The river banks and river bed riparian vegetation will be permanently changed by the construction of pipeline (cca 20 m). During the construction work minor changes of the river flow might be needed. Due to the possible negative impacts, the construction work on watercourses should be conducted during the low water level. The engineering work in river bed will change physical and chemical properties of river water downstream from the working area. Firstly, the digging and similar construction work will affect the sediment and impact the physical properties of water (mudding). The impact will be diluted downstream from the engineering work area and it will not have high magnitude of impact on long length of watercourse. The mudding of water flow might locally affect some animal freshwater species and their distribution. Since engineering work period is short the impact is acceptable, with application of environmental protection measures. But since Variant B is not just crossing over the Mrkovska river once, but is also going either in the riverbed or repeatedly crossing over for a certain length of about 1,7 km, this part of the route should be shifted away from the Mrkovska River.

Effects' characteristic negative, direct, temporary
Effects' significance Less significant
Effects' valorisation -1

Description of likely significant effects of the project ***Accidental release of chemicals and fuel to rivers, sea or karstic areas is possible during the construction works*** Contamination of rivers, sea or kartic area can deteriorate habitat quality and have an adverse impact on individual wildlife specimens. With the application of environmental management plan during the construction period (i.e. usual environmental protection precautionary measures for the construction sites, appropriate waste and oil management, use of approved equipment etc.) accident possibility will be significantly reduced.
Effects' characteristic Accidental
Effects' significance Not significant
Effects' valorisation -1

Description of likely significant effects of the project ***Emission of bigger amounts of gas with possible explosion, fire or fire blast are possible as accidents*** This accidental impact could cause direct longer period of habitat changes. Moreover, in some circumstances the fire could be spread to a broader region and affect habitats on broader distance from the Variant. The magnitude of the impact will depend on the temporal meteorological conditions. With appropriate maintenance and survey of the pipeline infrastructure the probability of this kind of accidental impact should be low.
Effects' characteristic Negative, Accidental
Effects' significance Significant
Effects' valorisation -2

4.3.2.7 Natural heritage and protected areas

Variant A

Albania

Description of likely significant effects of the project. ***Impacts on protected areas*** 1-The axis of the pipeline corridor runs less than 1km from the MNR (IUCN category IV) of "Shkodra Lake – Buna River wetland complex" (Ramsar site). Likely impacts: Potential adverse impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Migration of animal populations due to disturbance from project activities (noise from blasting through karst limestones, degradation of the quality of the Lake's waters, etc.). 2-Pipeline route crosses the MNR of the "Riparian Area of the Shkodra Lake", Albanian part (IUCN category IV). Impacts: Destruction of riparian forest and vegetation; Potential impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Migration of animal populations due to disturbance from project activities (noise from blasting through karst limestones, degradation of the quality of the Lake's waters, etc.). 3-Pipeline route runs near the Syri Sheganit and Syri Gjonit Karst Springs (Nature Monuments, IUCN category IV). Potential impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Possible permanent adverse impacts due to possible changes in ground waters regime (flow direction, water discharge, hydraulic connections, etc.) from earth works in karst areas.
Effect's characteristic Negative; Direct and Indirect; Partly temporary and partly permanent; and Likely unavoidable adverse impacts.
Effect's significance Unacceptable, because of the high national and international importance of the PAs.
Effect's valorisation -2

Description of likely significant effects of the project ***Impacts on emerald sites*** Pipeline route axis runs across the Emerald network site "MNR of the Riparian Area of Shkodra Lake", Albanian part that is important as an IBA and IPA. The main potential adverse impacts on this site are: Destruction of riparian forest and vegetation; Potential impacts through direct and indirect impacts to water regime, water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Migration of animal populations due to disturbance from construction activities, etc.
Effect's characteristic Negative; Direct and Indirect; With difficulty avoidable

Effect's significance Unacceptable, because of the high national and international importance of this Emerald site.
Effect's valorisation -2

Description of likely significant effects of the project ***Impacts to Natural heritage or habitats of particular interest:*** -Pipeline route runs near some beautiful karst Lakes (Urdhana Lake 1, Urdhana Lake 2, Hurdhana e Kalbet Lake, etc.), near approximately18 karst springs of high natural and landscape, and biodiversity values (Syri Virit, Syri Franit, Vau Mullirit, Syri Zi, etc.), near some dug wells of historical values like the Shpella Frasherit (Ash cave) dug well, etc.). Potential impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase; Possible permanent adverse impacts due to possible changes in ground waters regime (flow direction, water discharge, hydraulic connections, etc.) from earth works in karst areas.
Effect's characteristic Negative; Direct and Indirect; with difficulty avoidable
Effect's significance Unacceptable, because of the permanent adverse changes and of the national and regional importance of these sites.
Effect's valorisation -2

Montenegro

Description of likely significant effects of the project ***Passing through protected area or important biodivesity area*** Variant A is passing through National park Lovćen, that is also an Important Plant Area (IPA) and an Emerald site. According to existing zonation the pipeline is passing through the second protection and buffer zone. New zonation of the National park is proposed by the proposed Spatial Plan of the National Park Lovćen (the Spatial plan is in final phase - public debate was in autumn 2012) the pipeline route is passing through 3 km of the first protection zone and 3 km of second protection zone. In the first protection zone are the areas with the highest functional ecological importance, and consequently with the highest level of protection. In this zone it is forbidden to construct any objects and usage of natural resources. The planned pipeline route is predominantly passing through the forest vegetation of the area (in buffer, first and second protection zone, respectively). High natural value of the forest habitats (in particular beech forest) in the first and second protection zone is recognised as important Emerald and Habitat Directive habitat. In this section the pipeline route is passing through rough terrain without settlement. Therefore, the new corridor in this area will cause the removal of important habitats (along cca 20 m of the route and other engineering surfaces) resulting direct loss and habitat fragmentation and might adversely effect the ecological functionality of important habitats. In addition, according to the proposed Spatial Plan cutting of forest vegetation in the construction phase might be considered as the exploitation of natural resources and not be approved. In addition, in eastern part of Park the pipeline route is planned through the Special Nature Reserve Sokol (20,6 ha). Consequently, the construction of planned pipeline route will have

significant effect on the conservation of the natural values of the Special Nature Reserve Sokol. National Park Lovćen is popular tourist area with nice touristic viewpoints. In addition to ecological value of the National Park Lovćen it should be evaluated the impact on visual landscape values. Especially in respect to the visibility of the route from the important touristic viewpoints. During and after construction of the pipeline the construction area will be noticeable as the route pass through karst area with shallow soil layer. Consequently, the construction area will be noticeable as white stripe in the surrounding vegetation. Moreover, the route might be seen like bright line from some touristic hotspots. This effect will be temporal as after some time the construction area will become greener and less obvious. Pipeline route is passing 800 m from the entrance of Lipska cave (Monument of Nature), but since the cave's plan is not available, it is not possible to determine significance of the effect. The part of Cijevna river where Variant A is passing through is downstream from the Emerald site and IPA. Consequently, the Variant A will not have any effect on this protected area.
Effects' characteristic Negative, permanent
Effects' significance Significant
Effects' valorisation -2

Description of likely significant effects of the project ***Loss of protected wildlife species and habitat type*** Through the construction of the pipeline there is a possibility of loss of individual specimen of protected wildlife species. Removal of vegetation might directly affect some specimens of plant species and accompanied slowly moving fauna. In addition, certain amount of direct destruction of bird nests and other protected animal habitats and also direct animal deaths (cca 20 m along the route and other engineering surfaces). Death is largely related to poorly mobile species and those that have a life cycle related to the soil, particularly during sensitive life stages, such as hibernation stage, eggs, etc. Since this is a temporary and relatively short-term negative impact of which is limited to relatively small area, it is estimated that the project would not have a significant impact on the population of the endangered or protected species.
Effects' characteristic Negative, Direct
Effects' significance Not significant
Effects' valorisation -1

Variant B

Albania

Description of likely significant effects of the project
Impacts on protected areas: 1-At Buna riverbed the pipeline route crosses the MNR of the "Shkodra Lake - Buna River wetland complex" (IUCN category IV) at Buna riverbed. Impacts: Destruction of riparian forest and vegetation; Potential impacts through direct and indirect impacts to water quality and aquatic ecology (siltation, spills/leaks) during the construction phase.
Effect's characteristic
Negative; Direct.
Effect's significance
Acceptable, because this PA is crossed at Buna riverbed, along a segment of approximately 50m long. At the river crossing the riparian forest of Buna River is composed of vegetation of common values in terms of biodiversity.
Effect's valorisation
0

Description of likely significant effects of the project
Impacts on emerald sites: -The axis of the Pipeline route passes 1.3 km far from the emerald site "Buna River Mouth-Velipoja Protected Landscape". The closest point (1.3 km) to this site is the Murtenza Marsh. At this point the axis of the pipeline runs through flat agricultural lands, which lie over a thick impermeable clayey-silty cover. Consequently, no adverse impact is expected on the aquatic and terrestrial parts of this site. The only possible impacts are the temporary ones that can be caused by noise from truck circulation and digging works.
Effect's characteristic
Negative; Direct; and Indirect; Temporary
Effect's significance
Acceptable; Low significance;
Effect's valorisation
0

Description of likely significant effects of the project
Impacts to Natural heritage or habitats of particular interest: -Pipeline route does not run near any natural heritage or habitat of particular interests.
Effect's characteristic
-
Effect's significance
-
Effect's valorisation
0

Montenegro

Description of likely significant effects of the project
Loss of protected wildlife species and habitat type Through the construction of the pipeline there is a possibility of loss of individual specimen of protected wildlife species. Removal of vegetation might directly affect some specimens of plant species and accompanied slowly moving fauna. In addition, certain amount of direct destruction of bird nests and other protected animal habitats and also direct animal deaths (cca 20 m along the route and other engineering surfaces). Death is largely related to poorly mobile species and those that have a life cycle related to the soil, particularly during sensitive life stages, such as hibernation stage, eggs, etc. Since this is a temporary and relatively short-term negative impact of which is limited to relatively small area, it is estimated that the project would not have a significant impact on the population of the endangered or protected species.
Effects' characteristic
Negative, Direct
Effects' significance
Not significant
Effects' valorisation
-1

Description of likely significant effects of the project
Passing through protected area or important biodiversity area Pipeline route passes through marine area on south-east side of protected area. The pipeline route is passing in its marginal marine part for a length of around 1,7 km. Marine part of Platamuni is proposed because of *Posidonia oceanica* seagrass. Laying procedure will have negative and permanent impact on marine habitats. Impact zone will mainly affect habitats associated with sandy and muddy sediments at depth grater the 30 meters.
Effects' characteristic
Negative
Effects' significance
Significant
Effects' valorisation
-1

4.3.2.8 Landscape and Visual Issues

Variant A

Albania

Description of likely significant effects of the project
– Adverse permanent impact from earth works on the characteristic karst micro relief forms in the Kakarriqi mountain and Bajza-Hoti segments;

– Likely permanent negative impact from ROW presence across the karst area (Kakarriqi Mountain and Bajza-Hoti segments); and – Temporary negative visual impact by earth works, access roads, etc., during construction phase.
Effect's characteristic Negative; Direct; Partly temporary and partly permanent; Unavoidable
Effect's significance Important, because unavoidable impacts through karst areas
Effect's valorisation -2

Description of likely significant effects of the project Pipeline route runs near some beautiful karst Lakes (Urdhana Lake 1, Urdhana Lake 2, Hurdhana e Kalbet Lake, etc.), and near approximately18 karst springs of high landscape and visual values. Over the karst area of Malesia Madhe District there are also some temporary karst lakes that have water only during rainfall months. All the karst lakes and springs are surrounded by dense and rich vegetation. – Possible permanent adverse impacts from earth works due to possible changes in ground waters regime (flow direction, water discharge, hydraulic connections, etc.) from earth works in karst areas. Thus, it exists the possibility that some of these karst spring and lakes disappear definitively; and – Potential impacts through direct and indirect impacts from earth works to water quantity and quality and aquatic ecology (siltation, spills/leaks) during the construction phase.
Effect's characteristic Negative; Direct and indirect; Unavoidable if changes in ground water regime occur.
Effect's significance Less Acceptable
Effect's valorisation -2

Description of likely significant effects of the project – Adverse temporary impact on landscape and visual amenity from earth works and vegetation clearing on the riparian areas in the riverbeds (6 river crossings); and – Likely permanent negative impact from ROW presence across the riparian forests on the riverbeds (6 main rivers crossings), etc.
Effect's characteristic Negative; Direct; Partly avoidable
Effect's significance Acceptable
Effect's valorisation -1

Montenegro

Description of likely significant effects of the project
Impact on the characteristic karst micro-relief forms – sink holes and karst pools is manifested as degradation and backfilling in case of overlapping with pipeline flow. The cause of degradation is digging of pipe trench, backfilling due the stabilization and the construction of aboveground pipeline elements. This influence is strongly emphasized in groups of sensitive and valuable landscapes (K07-*mosaic landscape*, K08-*mountainous forest landscape*, K09-*steep slopes and colluvial drifts landscape*). In groups of landscapes with low and lower landscape values (all other defined groups) influence on the characteristic karst micro-relief forms is negligible.
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
-2

Description of likely significant effects of the project
The visual impact of ground pipeline elements is most pronounced in areas that contain high natural or anthropogenic landscape values. These areas are: K04-*high value rural landscape,* K07-*mosaic landscape,* K08-*mountainous forest landscape,* K09-*steep slopes and colluvial drifts landscape*. Since the ground pipeline elements are very small spatial and volumetric forms effect is not strong. In groups of low landscape value visual effects ground parts of the pipeline are small.
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
0

Description of likely significant effects of the project
Gas pipe imposition
After excavation and backfilling canals remains barren soil changed color and texture in relation to the natural state. Over time, influenced by the succession and atmospheric conditions, it is possible that the space above the gas pipeline again takes the natural characteristics of the environment. Impact is pronounced in areas with high vegetation, and areas with agricultural surfaces enclosed with drywalls: K04-*high value rural landscape,* K07-*mosaic landscape,* K08-*mountainous forest landscape*
Effects' characteristic
Negative; Direct

Effects' significance
Acceptable
Effects' valorisation
0

Description of likely significant effects of the project
Removing or damaging of drywalls is possible during the construction time. They are integral elements of the rural landscape K04-*high value rural landscape,* K02-*agricultural landscape*.
Effects' characteristic
Negative; Direct
Effects' significance
Unacceptable
Effects' valorisation
-2

Description of likely significant effects of the project
During the construction works corridor width, within it is necessary to remove high vegetation, is about 13-16 m wide from both sides of pipeline axis. During the gas pipeline, operation low vegetation is possible to plant within 5 m corridor from each side of pipeline axis, while growth of high vegetation is disabled. These influence is strongest in relation to all other listed influences which is especialy evident in areas of landscape value defines high vegetation combined with other elements of natural and anthropogenic landscape: K04-*high value rural landscape,* K07-*mosaic landscape,* K08-*mountainous forest landscape*. Other defined groups of landscapes are not significantly threatened because the high vegetation is not important element of landscape characteristics.
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
-1

Variant B

Albania

Description of likely significant effects of the project
– Adverse temporary impact on landscape and visual amenity from earth works and vegetation clearing on the riparian area of the Buna/Bojana riverbed (1 river crossing); and – Likely permanent negative impact from ROW presence across the riparian forest (50m wide) of the Albanian part of the Buna/Bojana riverbed

Effect's characteristic Negative; Direct
Effect's significance Acceptable
Effect's valorisation -1

Montenegro

Description of likely significant effects of the project Impact on the characteristic karst micro-relief forms – sinkholes and karst pools is manifested as degradation and backfilling in case of overlapping with the flow pipeline. The cause of degradation is digging of pipe trench, backfilling due the stabilization and the construction of aboveground pipeline elements. This influence is strongly emphasized in groups of sensitive and valuable landscapes, especially in K10-*karst and rockery landscape* then in K07-*mosaic landscape* and K08-*mountainous forest landscape*. In groups of landscapes with low and lower landscape values (all other defined groups) influence on the characteristic karst micro-relief forms is negligible.
Effects' characteristic Negative; Direct
Effects' significance Acceptable
Effects' valorisation -2

Description of likely significant effects of the project The visual impact of ground pipeline elements is most pronounced in areas that contains high natural or anthropogenic landscape values. These areas are K08-*mountainous forest landscape and* K10-*karst and rockery landscape*. Since the above-ground pipeline elements are very small spatial and volumetric forms effect is not strong. In groups of low landscape value visual effects ground parts of the pipeline are small.
Effects' characteristic Negative; Direct
Effects' significance Acceptable
Effects' valorisation 0

Description of likely significant effects of the project
Gas pipe imposition After excavation and backfilling canals remains barren soil changed color and texture in relation to the natural state. Over time, influenced by the succession and atmospheric conditions, it is possible that the space above the gas pipeline again takes the natural characteristics of the environment. Impact is pronounced in areas with high vegetation, and areas with agricultural surfaces enclosed with drywalls: K07-*mosaic landscape,* K08-*mountainous forest landscape.*
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
0

Description of likely significant effects of the project
Removing or damaging of drywalls is possible during the construction time. They are integral elements of the K02-*agricultural landscape*.
Effects' characteristic
Negative; Direct
Effects' significance
Unacceptable
Effects' valorisation
-2

Description of likely significant effects of the project
During the construction works corridor width, within it is necessary to remove high vegetation, is about 13-16 m wide from both sides of pipeline axis. During the gas pipeline, operation low vegetation is possible to plant within 5 m corridor from each side of pipeline axis, while growth of high vegetation is disabled. This influence is strongest in relation to all other listed influences which is especially evident in areas of landscape value defines high vegetation combined with other elements of natural and anthropogenic landscape: K07-*mosaic landscape,* K08-*mountainous forest landscape*. Other defined groups of landscapes are not significantly threatened because the high vegetation is not important element of landscape characteristics.
Effects' characteristic
Negative; Direct
Effects' significance
Acceptable
Effects' valorisation
-1

4.3.2.9 Air Quality and Existing Emissions Load

Albania

Variant A

Description of likely significant effects of the project
Temporary impact on local air quality from: – Dust emissions from earthworks, blasting, excavation, cofferdam construction, vehicle movements, etc.; – Temporary construction vehicles exhaust gases emissions (i.e. excavators, bulldozers, trucks, cars). Variant A will be affected more intensively because: – Pipeline route runs partly over hard rocks (Kakarriqi Mountain and Bajza Karst Plain) through which blasting is required; and – Pipeline runs through inhabited areas and crosses 18 villages and Shkodra town. Variant B runs through flat agricultural lands and over loose deposits, and far from inhabited areas.
Effect's characteristic
Temporary direct negative effects
Effect's significance
Acceptable
Effect's valorisation
-1

Variant B

Description of likely significant effects of the project
Variant B runs far from inhabited areas, and through flat agricultural lands and over loose deposits, where blasting is not required. Temporary impact on local air quality from: – Dust emissions from earthworks, excavation, cofferdam construction, vehicle movements; – Temporary construction vehicles exhaust gases emissions (i.e. excavators, bulldozers, trucks, cars).
Effect's characteristic
Temporary direct negative effects
Effect's significance
Acceptable and of low significance.
Effect's valorisation
0

Montenegro

Variant A and Variant B

Description of likely significant effects of the project *Effects during construction* Construction effects of a pipeline and associated facilities include temporary and localised air emissions of dust generated from earth movements, excavation, unpaved surfaces, vehicles movement along the working area and access roads. The area of influence comprise agricultural land and fauna and flora species as well as workers and residential population in the vicinity of these locations, usually up to 100 m. Intensity and area of influence of construction effects depend on meteorological conditions. Higher intensity and larger area of influence could be expected during unfavourable meteorological situations (dry weather, strong wind). Construction effects also include the emissions of exhaust gases from vehicles and equipment with internal combustion engines used for construction (i.e. generators, excavators, bulldozers, trucks, cars etc.). Both of these types of impacts are temporary in nature and localised. *Effects during pipeline usage* Operation effects include fugitive emissions of gas (mostly consisting of methane (CH4), 98%), emissions from cleaning/purging operations and as a result of non-routine events such as pipeline failure or even accidental situations. Fugitive emissions are usually results of leakage through venting parts in aboveground facilities: block valve stations, pig trap stations or gas pressure reduction and metering stations. Air emissions occur as a result of cleaning/purging operation usually performed by passing pigs through completed sections of the pipeline. Non-routine events such as pipe failure can cause significant air emissions. The other emissions are emissions from small combustion installations (usually a boiler with thermal capacity of 100 – 200 kW) intended for gas heating in Gas pressure reduction and metering stations. The fuel used is gas. Relevant pollutants from combustion process are oxides of nitrogen (NOx), carbon monoxide (CO) and carbon dioxide (CO2).
Effects' characteristic Construction effects on air quality are negative but temporary in nature and localised. Operation effects are negative and will be both temporary (cleaning/purging operation) and long term/permanent (fugitive emission of gas and emissions from fuel combustion in gas pressure reduction and metering station).
Effects' significance Construction effects are not significant and are acceptable. Operation effects are not significant on local and regional level. These effects are acceptable.
Effects' valorisation Construction and operation effects: - 1 negative impact

4.3.2.10 Noise and Vibration

Albania

Variant A

Description of likely significant effects of the project
Increase in noise level during the construction phase: in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna. Periodical increase in noise level during the operation phase - in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna. Variant A will be affected more intensively because: Pipeline route runs partly over hard rocks (Kakarriqi Mountain and Bajza Karst Plain) through which blasting is required; and Pipeline runs through inhabited areas (18 villages, and Shkodra town); and Pipeline runs through or near areas rich en fauna (Riparian area of Shkodra Lake, Kakarriqi Mountain)
Effect's characteristic
Negative; Direct; Temporary; Unavoidable; Partly mitigable
Effect's significance
Acceptable
Effect's valorisation
-1

Variant B

Description of likely significant effects of the project
Increase in noise level during the construction phase: – in the vicinity and throughout the dwelling areas; and – in the vicinity and throughout the areas rich in fauna. Periodical increase in noise level during the operation phase - in the vicinity and throughout the dwelling areas; and in the vicinity and throughout the areas rich in fauna. Variant B runs far from inhabited areas and through flat agricultural lands, as well as over loose deposits, where blasting is not required.
Effect's characteristic
Negative; Direct; Temporary;
Effect's significance
Low significance; Acceptable
Effect's valorisation
0

Montenegro

Variant A and Variant B

Description of likely significant effects of the project
Effects during construction During the pipeline construction additional noise will be broadcast in the environment as a result of construction work. This noise is temporary and will depend on the type and arrangement of sound sources (construction machinery and vehicles), and the intensity and type of construction, as well as an appropriate selection of transport routes. If technological discipline is respected negative impact on the surrounding residential areas is not expected *Effects during pipeline usage* Working pipeline is not a source of noise, except at special facilities, Gas Pressure Reduction and Metering Stations, which serve to reduce the gas pressure by switching from higher pressure system to lower pressure system. Route Variant A (land) of the observed section, will have two Gas Pressure Reduction and Metering Stations while on route Variant B (coastal) there will be three Gas Pressure Reduction and Metering Stations. Sources of noise in the Gas Pressure Reduction and Metering Stations are reduction valves, which should be equipped with silencers which reduce noise. Nearest settlements will be most vulnerable to potential noise from planned Gas Pressure Reduction and Metering Stations. However, significant impact on noise levels is not expected at a sufficient distance of Gas Pressure Reduction and Metering Stations from existing settlements. The practice has shown that the pipelines cause negligible increase in noise at settlements more than 100 meters away, which the population rarely notices.
Effects' characteristic
Noise during construction is temporary and if technological discipline is respected it is not expected to have negative impact. At a sufficient distance of Gas Pressure Reduction and Metering Stations from existing settlements any significant impact on noise levels is not expected.
Effects' significance
Construction impacts are not significant and are acceptable. Impacts during pipline usage are not significant and are acceptable.
Effects' valorisation
-1 moderately negative impact

4.3.2.11 Cultural Heritage

Variant A

Albania

Description of likely significant effects of the project
Likely high adverse impacts, because the proposed pipeline route runs throughout the territories of Shkodra, and Malesia Madhe Districts, which are very rich in discovered and non-discovered cultural heritage dated from the Early Bronze to Illyrian-Roman-Byzantine-Medieval ages.

– Direct physical disturbance of or damage to the archaeological sites from construction activities; – Degradation of or damage to aboveground structures due to pollution or vibration; – Blockage of user access to cultural heritage sites; – Negative effects on the setting or ambience of cultural heritage sites.
Effects' characteristic Negative; Direct and Indirect, difficult to avoid
Effects' significance Unacceptable
Effects' valorisation -2

Montenegro

Description of likely significant effects of the project Impacts are possible in the case of overlapping pipeline with certain elements of cultural heritage. The destruction of farm buildings, drywall structures, fields and pastures it is very possible in that case. Intensity of the impact is characterized as a large. Indirect cultural heritage impacts are possible as negative perceptions of cultural heritage connection with the proximity to the gas pipeline infrastructure.
Effects' characteristic negative, direct, indirect
Effects' significance unacceptable, important
Effects' valorisation -1

Variant B

Albania

Description of likely significant effects of the project Likely moderate adverse impacts, because the proposed pipeline route runs throughout an area that has been flood prone, and consequently there is no high probability of finding non-discovered cultural heritage.
Effects' characteristic Negative, direct
Effects' significance Acceptable
Effects' valorisation

0

Montenegro

Description of likely significant effects of the project Impacts are possible in the case of overlapping pipeline with certain elements of cultural heritage. The destruction of farm buildings, drywall structures, fields and pastures it is very possible in that case. Intensity of the impact is characterized as a large. Indirect cultural heritage impacts are possible as a negative perceptions of cultural heritage connection with the proximity to the gas pipeline infrastructure.
Effects' characteristic negative, direct, indirect
Effects' significance unacceptable, important
Effects' valorisation -1

4.3.2.12 Occupational Health and Safety

Variant A and Variant B

Description of likely significant effects of the project When conducting the engineering and installation works and works related to operation of pipelines the following hazards can occur: dangers of electricity, inadequate lighting, dangers in case of maintenance and operation of shut-off systems, deficiencies of warning signs, hazards if prescribed personal protective equipment is not used, hazards in case of working with hazardous materials, hazards in case of dangers during movements, work on heights etc.
Effects' characteristic Direct and possible negative impact to occupational health and safety, mainly during construction.
Effects' significance Acceptable, if all works comply with the Occupational Health and Safety Plan which will introduce every worker to the hazards of every job and methods to avoid any dangers.
Effects' valorisation 0

4.3.2.13 Waste

Variant A and Variant B

Description of likely significant effects of the project *During construction* Inadequate waste management (accumulations of waste, use of unsuitable/sensitive locations for temporary disposal etc.) during construction phase could result in soil

contamination and even in surface-water or seawater pollution. *During operation* Inadequate management of waste generated by pigging operations (tailings, sludge) during maintenance of the pipeline could result in soil contamination and even in air pollution. These possible impacts are not significant due to the fact that such waste generates in small quantities.
Effects' characteristic Effects during construction phase are negative and direct due to the large quantities of waste generated from earthworks. Because of the type and characteristics of construction works, effects are short-term and localised. Possible effects during operation phase are negative but short-term and localised.
Effects' significance Effects during construction phase are significant but acceptable. Effects during operation phase are not significant and are acceptable.
Effects' valorisation Construction effects are -1 (negative)

4.3.2.14 Infrastructure

Variant A

Albania

Description of likely significant effects of the project – Pipeline route affects the landing strip of the Gjadri Air Base (3km long, from which 2.2 km are crossed from the axis of the pipeline); – Possible damages to infrastructure (farm houses, water pipelines, telecommunication cables, sewage and sewerage network, and other urban infrastructure), overall along the corridor Shkodra-Koplik; – Damages to the international and national railway, and to the international, national, district, and rural road network; – Damages to the industrial area in the north eastern surroundings of Shkodra; – Damage to the embankment for protection from river erosion (Drini, Gjadri Rivers, etc.) and to the irrigation and drainage network through the flat agricultural area;
Effects' characteristic Negative; Direct, Reversible but with high cost
Effects' significance Important, but acceptable if damages are repaired or recompensed.
Effects' valorisation -2

Montenegro

Description of likely significant effects of the project
In cases where the pipeline intersects the infrastructure constructions (traffic: roads, railways, etc., water management: water supply pipelines and sewage system, electricity: power lines, cables, etc.) all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual institutions when obtaining certain licenses). During the construction, due to increased frequency of materials and equipment transportation, the traffic situation can change - delays may occur that will require special attention and support services (in transportation of special cargo). Possible accidental damage to public roads can be expected.
Effects' characteristic
Direct and possible negative impact on traffic, water management and energy infrastructure, mainly during construction.
Effects' significance
Acceptable, if all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual institutions when obtaining certain licenses).
Effects' valorisation
0

Variant B

Albania

Description of likely significant effects of the project
– Possible damage to Torovica embankment and to the irrigation and drainage network through the flat agricultural area; – Effects on the district road Bushat-Velipoje.
Effects' characteristic
Negative; direct
Effects' significance
Acceptable and remediable with low cost
Effects' valorisation
0

Montenegro

Description of likely significant effects of the project
In cases where the pipeline intersects the infrastructure constructions (traffic: roads, railways, etc., water management: water supply pipelines and sewage system, electricity: power lines, cables, etc.) all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual

institutions when obtaining certain licenses). During the construction, due to increased frequency of materials and equipment transportation, the traffic situation can change - delays may occur that will require special attention and support services (in transportation of special cargo). Possible accidental damage to public roads can be expected. Various types of ships will intersect the subsea pipeline corridor during sailing, mooring or anchoring.
Effects' characteristic Direct and possible negative impact on traffic, water management and energy infrastructure, mainly during construction.
Effects' significance Acceptable, if all intersections with the installations will be resolved with the consent of their owners (taking into account the special conditions provided by the individual institutions when obtaining certain licenses).
Effects' valorisation -1

4.3.2.15 Accident situations

Variant A and Variant B

Description of likely significant effects of the project *Effects during construction* During project construction, there may be unforeseen spills of fuel, lubricants and other fluids from machinery and equipment for construction, be it on land or the underwater section of the pipeline. A majority of possible contamination depends primarily on the organization of the site, and the potential amount of substance on the construction site that may cause pollution. Since quantities of substances that will be used on construction sites are not known at this stage of project development it is not possible to estimate the level of potential contamination as well as the cost of remediation of contamination. *Effects during pipeline usage* During project duration, there may be leaks of natural gas from the system, during which, if there is no ignition or explosion environmental pollution does not occur, other than greenhouse gases, and there is no need for remediation. Costs consequences of such an event, or remediation and removal of contamination depends on the mechanism of the origin and course of the accident, as well as the environment in which the accident occurred.
Effects' characteristics Risk was assessed as moderately negative for the precautionary principle. Key performance impact on the environment as a result of an accident takes place during the accident (fire, explosion, poisoning), and after the accident no further pollution is expected. Constant application of new methods in pipeline construction and its appropriate maintenance contributes to reducing the risk of adverse events.
Effects' significance Acceptable, provided that the design, construction, operation and maintenance of the pipeline and all ancillary facilities apply modern methods, well-established systems of quality assurance and control, and good engineering practice based on current experience at one million kilometres of main gas pipelines in the world.

Effects' valorisation
-1 moderately negative

4.3.3 The description of measures envisaged to prevent, reduce and, if possible, eliminate any significant adverse effects on the environment and social components

4.3.3.1 Variant A and Variant B

During preparatory works and construction

Hydrology/ Groundwaters

1. During the construction and other works on the route section in contact with ground waters, necessary measures shall be taken to protect the watercourse.

2. Excavation material, waste material and other obstacles produced during the pipeline construction shall be removed from the crossing in order to allow for normal watercourse flow without threat to the normal functioning of such canals, streams and rivers.

3. Fuel and lubricant tanks used by construction equipment shall be deposited in waterproof protective basins (retention basins).

4.3.3.2 Variant A

During preparatory works and construction

Climate

1. Crossing the riverbeds in areas of poor vegetation, as well as in the narrowest places;

2. Avoid/minimize the pipeline crossing through forested areas or areas of dense vegetation;

3. Avoid/minimize erosion and sedimentation;

4. Avoid changes on river morphology;

5. Avoid/minimize air pollution from dust and gases;

Geomorphology and geology/hydrology

1. Avoid changes in geomorphology in karst areas (section Bajza-Hoti) from earth works;

2. Avoid the forested areas. Special attention should be paid in the karst areas (segment Bajza-Hoti), where it is difficult to rehabilitate the forest resources;

3. Crossing the rivers in the narrowest places to minimize erosion in riverbeds;

4. Avoid riversides erosion by avoiding the selection of the pipeline route alongside the riverbeds (Kiri riverbed in the eastern part of Shkodra);

5. Avoid/minimize geological risks by avoiding the selection of the pipeline route along the contact surface between dissimilar geological formations (quaternary deposits-limestone; or molassic deposits-limestone).

Land use and pedology

1. Plan the pipeline route as much as possible over lands of low pedologic values;

2. Necessary re-routing within the highly urbanised territory of Shkodra surroundings;

3. Make use of land boundaries, and existing or planned infrastructure objects (roads, etc.);

4. Avoid as much as possible the areas of high urban, industrial and tourist values.

Social issues

1. Necessary re-routing within the highly urbanised surroundings of Shkodra, as well as in the villages where the pipeline runs across inhabited centres;

2. During route selection process use as much as possible the main existing/planned longitudinal infrastructure (national road Lezha-Shkodra-Hani Hotit/Barlaj (border; ALB/MNE);

3. Make use of land boundaries;

4. Avoid wherever possible the settlements;

5. Minimize the adverse impacts on the tourist values by avoiding/minimizing adverse impacts on the biodiversity, the landscape, and the quality, quantity and the regime of the ground waters (Skadar/Shkodra Lake and Lakeshore; karst lakes; dug wells in karst area; etc.);

6. Avoid or minimise involuntary resettlement of communities and households through re-routing;

7. Minimise economic displacement through: routing to avoid structures and permanent crops; restricting working streeps; and sitting lay-down areas on scarce or unused land;

8. Provide compensation for loss of assets, and ensuring that resettlement restores livelihoods and standards of living of displaced persons to pre-Project levels;

9. Consultation with the appropriate authorities and affected persons to minimise and mitigate any adverse impact on affected inhabitants.

Water resources

1. Avoid/minimize impacts on aquifers from pollution of the ground waters. Special attention should be paid along the following sections of the pipeline route:

a. Across Drini riverbed, which serves as a recharge area for the Quaternary gravel aquifer of Lower Shkodra that supplies with drinking water the whole population of this area;

b. Section Kiri River- Grude Village that runs over the Quaternary gravel aquifer of Upper Shkodra which supplies with drinking water Shkodra and its surroundings (more than 150,000 inhabitants). There is no clayey-silty-sandy cover along this section, and all of the eastern part of this aquifer is a recharge area;

c. Section Palvar-Bajza, which runs over alluvium and prolluvium deposits of the Quaternary aquifer of Koplik and has very good hydraulic connection with the under-lying karstified limestone. The Koplik aquifer supplies drinking water to the local population;

d. Section Baja-Ivan-Hot, which runs over Bajza Karst Plain, where the rainfalls and groundwaters drain to some small karst lakes (natural heritage and PA) and further on to Shkodra Lake. The locals are partly supplied with drinking water from dug wells.

Biological environment (flora and fauna)

1. Avoid of sensitive areas (forest on karst areas) and habitats (Drini riverbed, Shkodra lakeshore);

2. Minimize the impact on the Riparian area of Drini Lezhes, Drini and Kiri Rivers by crossing through areas of low values of vegetation;

3. Avoid/minimize the adverse impacts on the biodiversity of the Shkodra Lake by not polluting the ground waters that drain in this lake (section Shkodra-border ALB/MNE);

4. Avoid/minimize impacts on the flora and fauna in sensitive areas along Shkodra Lakeshore. Special attention should be paid to Shkodra lakeshore, Drini riverbed, and to the karst plain in the section Bajza-Ivanaj-Hoti.

5. Construction of the pipeline over the watercourses should be conducted during period of low water levels

6. Before the preparation of the Main project, speleological survey of the route should be conducted within range of construction working area.

7. If during the construction of pipeline, new cave or cave system would be discovered, the construction works need to be stopped and relevant Ministry should be informed.

8. After finalization of the construction work of the pipeline over the watercourses, effected river banks should be restored and cultivated as close as possible to initial conditions

Natural heritage and protected areas

1. Avoid/minimize the adverse impacts on the small karst lakes in the section Shkodra-Hani Hotit by not changing groundwater regime and not polluting groundwaters that drain in these lakes. Special attention should be paid to the karst plain of Bajza (section Bajze-Ivanaj), as well as to the Syri Sheganit and Syri Gjonit karst springs (Nature Monuments);

2. Minimize impact on the Riparian area of Drini Riverbed (Protected Area) by passing through the narrowest place and through areas of low values of vegetation;

3. Avoid/minimize the adverse impacts on the quality of the waters of the Shkodra Lake (Ramsar Site) by not polluting groundwaters that drain in this lake (section Shkodra-border ALB/MNE);

4. Avoid/minimize the adverse impacts on the Shkodra Lake shore (Protected Landscape) by not disturbing the flora and fauna in this PA. Special attention should be paid in the section Bajze-Hot;

5. Preparatory work, including cutting shrubs and trees along the pipeline route, do not conduct in the nesting season of endangered species of birds between beginning of April and end of September to prevent the destruction of their nests and young birds.

6. Pipeline route of Variant A should be re-planned in the way which will bypass boundaries of National Park Lovćen. If the National park Lovćen could not be bypassed the Variant B needs to be considered as only solution.

Landscape and Visual Issues

1. Make use of land boundaries, and existing or planned infrastructure objects (Lezha-Shkodra-Hani Hotit highway);

2. Crossing the Drini Lezhes, Drini and Kiri riverbeds in areas of poor vegetation, as well as in the narrowest places;

3. Avoid the pipeline route through karst areas (Bajze-Ivanaj segment) as much as as it is practical;

4. Where it is possible preserve karst and micro-relief forms with the relocation of the route. That action is needed in cases when it is determined that the area contains very valuable pieces.

5. The visual impact of ground pipeline elements should be mitigated or eliminated with planting vegetation that serves as visual barrier.

6. Visual degradation caused by digging gas pipe trenches can be reduced or eliminated with sowing or hydrosowing autochthonous perennial and herbaceous plants. The reference species for sowing are plants in the immediate vicinity.

7. Vegetation removed during pipeline construction, should be re-plant with the same or similar species.

Cultural heritage

1. Special attention should be paid in the south-eastern and north-eastern parts of Shkodra, where numerous archaeological sites can be found which are crossed by the pipeline corridor;

2. Preliminary archaeological pipeline route survey, in accord with the Albanian Law on Cultural heritage, in order to determine exact positions of cultural heritage sites in relation to pipeline route;

3. Archaeological site supervision during construction works, in accordance with the relevant Laws on Cultural heritage.

4. In the case of overlapping pipeline and highly valuable element of cultural heritage relocation of the gas pipeline is method to avoid impacts.

5. Aboveground parts of the pipeline near the cultural heritage should be visually hidden by planting vegetation or build them in materials adapted to local area. Thus above-ground infrastructure can be contextually integrated into the surrounding area.

Air quality

1. Good construction site management practices such as covering of dusty materials, watering dusty surfaces in dry weather, sheeting of trucks, vehicle speed limits, etc.

2. Maintenance of used equipment and vehicles

3. Training of operators and drivers

Noise and Vibration

1. At Gas Pressure Reduction and Metering Station install silencers on reduction valves which reduce noise emission levels.

2. Respect technical and technological discipline, which is particularly applicable to the use of machines in order that are regularly controlled for malfunctions and their parts are regularly fixed.

3. Harmonize construction periods in the vicinity of residential objects with legislation.

4. For heavy vehicle traffic choose roads already burdened by traffic noise with minimal number of objects potentially at risk.

5. For heavy vehicle parking choose locations removed from objects potentially at risk, and turn off engines of parked vehicles.

Infrastructure

1. Avoid the landing trip of the Gjadri Air Base;

2. Minimize damages to infrastructure objects by using as much as possible the Lezha-Shkodra-Hani Hotit/Barlaj (border ALB/MNE) highway;

3. Before the beginning of ground works, traffic regulation project has to be created and applied for the period of construction works execution. This project shall be used for avoiding all possible conflict points between the planned pipeline and the existing traffic system.

Waste Management

1. Design of appropriate location for temporary disposal of waste

2. Organizing waste transport depending on generation of waste

3. Separate collection of all types of waste, and organizing disposal in the prescribed manner

Accident situations

1. Provide adequate equipment and resources for the recovery of any leakage of fuel or oil from the machinery and equipment used in construction.

2. Maintenance of used equipment and vehicles

3. Created evacuation plan for employees (in case of accidents that could endanger the life and health of employees - natural disasters, fires, explosions, etc.).

4. Training of all workers

During pipeline usage

Biological environment (flora and fauna)

1. During usage period of pipeline, regular removal of invasive alochtonous species should be conducted.

Air quality

1. Regular maintenance of pipeline operation, especially valves and fittings, in comply with internationally accepted standards and guidelines

2. Equipping pipeline with monitoring system connected to blocking and safety valves

3. Regular maintenance of combustion installations in gas pressure reduction and metering stations

4. To ensure reliable and proper operation of combustion installation in Gas pressure reduction and metering station after its start-up, a test monitoring of pollutants emission should be performed

Waste Management

1. Regular unloading of the container on the Pig Trap Station, and delivery of waste to the authorized person

Accident situations

1. Regular maintenance of pipeline operation, especially valves and fittings, in compliance with internationally accepted standards and guidelines

2. Regular maintenance of combustion installations in gas pressure reduction and metering stations

4.3.3.3 Variant B

During preparatory works and construction

Marine areas

1. Regular maintenance of equipment, machinery and equipment should be conducted.

2. Provide adequate facilities and equipment for the repair of any leaking of fuel or oil equipment and machinery used during construction period

Biological environment (flora and fauna)

1. Minimize the adverse impact on biodiversity by crossing the riparian forest of the Buna riverbed at the narrowest place and where the biodiversity values are lower.

2. Construction of the pipeline over the watercourses should be conducted during period of low water levels

3. Before the preparation of the Main project, speleological survey of the route should be conducted within range of construction working area.

4. If during the construction of pipeline, new cave or cave system would be discovered, the construction works need to be stopped and relevant Ministry should be informed

5. After finalization of the construction work of the pipeline over the watercourses, effected river banks should be restored and cultivated as close as possible to initial conditions.

Natural heritage and protected areas

1. Traverse the riparian forest of Buna riverbed at the narrowest place in order to damage it as less as possible this PA.

2. Preparatory work, including cutting shrubs and trees along the pipeline route, do not conduct in the nesting season of endangered species of birds between beginning of April and end of September to prevent the destruction of their nests and young birds.

Landscape and Visual Issues

1. Traverse the riparian forest of Buna riverbed at the narrowest place in order to damage it as less as possible this PA.

2. It is possible to preserve karst and micro-relief forms with the relocation of the route. That action is needed in cases when it is determined that the area contains very valuable pieces.

3. The visual impact of ground elements pipeline should be mitigated or eliminated with planting vegetation that serves as visual barrier.

4. Visual degradation caused by digging gas pipe trenches can be reduced or eliminated with sowing or hydrosowing autochthonous perennial and herbaceous plants. The reference speices for sowing are plants in the immediate vicinity.

5. Vegetation removed during pipeline construction, should be re-plant with the same or similar species.

Cultural heritage

1. Preliminary archaeological pipeline route survey, in accord with the Albanian Law on Cultural heritage, in order to determine if there is any archaeological site within the area of the project activities;

2. Archaeological site supervision during construction works, in accordance with the Laws on Cultural heritage.

3. In the case of overlapping pipeline and highly valuable element of cultural heritage in places relocation of the gas pipeline is method to avoid impacts.

4. Aboveground parts of the pipeline near the cultural heritage should be visually hidden by planting vegetation or build them in materials adapted to local area. Thus above-ground infrastructure can be contextually integrated into the surrounding area.

Air quality

1. Good construction site management practices such as covering of dusty materials, watering dusty surfaces in dry weather, sheeting of trucks, vehicle speed limits, etc.

2. Maintenance of equipment and vehicles

3. Training of operators and drivers

Noise and Vibration

1. At Gas Pressure Reduction and Metering Station install silencers on reduction valves, which reduce noise emission levels.

2. Respect technical and technological discipline, which is particularly applicable to the use of machines in order that are regularly controlled for malfunctions and their parts are regularly fixed.

3. Harmonize construction periods in the vicinity of residential objects with legislation.

4. For heavy vehicle traffic choose roads already burdened by traffic noise with minimal number of objects potentially at risk.

5. For heavy vehicle parking choose locations removed from objects potentially at risk, and turn off engines of parked vehicles.

Infrastructure

1. Before the beginning of ground works, traffic regulation project has to be created and applied for the period of construction works execution. This project shall be used for avoiding all possible conflict points between the planned pipeline and the existing traffic system.

2. Before the beginning of maritime works, a separate maritime safety study has to be created and applied during the execution of works which must define the regime of navigation of ships and other vessels, fishing regime, the regime of anchoring, marking of construction area and labelling of specific vessels participating in the works. This document has to be approved by the competent port authority prior to the commencement of works.

3. Marking of respective areas during maritime works execution is required.

4. Avoid the damage to Torovica embankment.

Waste Management

1. When designing the appropriate location for temporary disposal of waste, avoid proximity to the sea coast

2. Organizing waste transport depending on generation of waste

3. Separate collection of all types of waste, and organizing disposal in the prescribed manner

Accident situations

1. Provide adequate equipment and resources for the recovery of any leakage of fuel or oil from the machinery and equipment used in construction.

2. Maintenance of used equipment and vehicles

3. Created evacuation plan for employees (in case of accidents that could endanger the life and health of employees - natural disasters, fires, explosions, etc.).

4. Training of all workers

During pipeline usage

Air quality

1. Regular maintenance of pipeline operation, especially valves and fittings, in comply with internationally accepted standards and guidelines

2. Equipping pipeline with monitoring system connected to blocking and safety valves

3. Regular maintenance of combustion installations in gas pressure reduction and metering stations

4. To ensure reliable and proper operation of combustion installation in Gas pressure reduction and metering station after its start-up, a test monitoring of pollutants emission should be performed

Biological environment (flora and fauna)

1. During usage period of pipeline, regular removal of invasive alochtonous species should be conducted.

Infrastructure

1. Upon completion of works, mark the pipeline at the entry/exit points to/from the sea, where tags should be set informing that anchoring is prohibited.

Waste Management

1. Regular unloading of the container on the Pig Trap Station, and delivery of waste to the authorized person

Accident situations

1. Regular maintenance of pipeline operation, especially valves and fittings, in compliance with internationally accepted standards and guidelines

2. Regular maintenance of combustion installations in gas pressure reduction and metering stations

4.3.4 The programme of monitoring impact on the environment and social components

4.3.4.1 Variant A and Variant B

During pipeline usage

Biological environment (flora and fauna)

1. During the maintenance of the pipeline, monitoring of the appearance and dispersal of alochtonous invasive species should be conducted. According to the results of monitoring, the invasive species should be removed.

4.3.4.2 Variant A

During pipeline usage

Air quality

1. To ensure reliable and proper operation of combustion installation in gas pressure reduction and metering station after its start-up, a test monitoring of pollutants emission should be performed

Noise and Vibration

1. After the construction of Gas Pressure Reduction and Metering Stations at predicted locations and putting pipeline into operation, measure noise levels at the nearest residential objects or the closest edge of construction areas.

Accident situations

1. Operational safety of the pipeline maintained by the prescribed inspection and maintenance, and in accordance with recognized professional standards. Gas pipeline monitoring includes the following:

    a. monitoring of corrosion

    b. monitoring of damage

c. monitoring of leakage

4.3.4.3 Variant B

During pipeline usage

Maritime areas

1. During first two years after finalization of construction works monitoring of invasive species should be conducted to determinate the possible presence of invasive species specially genus *Caulerpa.*

Air quality

1. To ensure reliable and proper operation of combustion installation in gas pressure reduction and metering station after its start-up, a test monitoring of pollutants emission should be performed

Noise and Vibration

1. After the construction of Gas Pressure Reduction and Metering Stations at predicted locations and putting pipeline into operation, measure noise levels at the nearest residential objects or the closest edge of construction areas.

Accident situations

1. Operational safety of the pipeline maintained by the prescribed inspection and maintenance, and in accordance with recognized professional standards. Gas pipeline monitoring includes the following:

    a. monitoring of corrosion

    b. monitoring of damage

    c. monitoring of leakage

5 Final recommendations

Based on presented analysis of the ***technical*** solutions for both considered variants, it is evaluated that Variant A is difficult to construct whereas Variant B is considered moderate for construction.

Results of the ***economic*** study, as shown in this Report, indicate that Albania - Montenegro coastal route Variant B presents the most favourable solution as a part of the final IAP route.

Environmental and social issues have been more detailed elaborated within the chapter 4.3 Preliminary ESIA for two proposed IAP variants. Within this chapter, analysis of the baseline situation of each environmental and social component has been presented, as well as identification of possible impacts, mitigation measures and monitoring program.

In order to propose for final IAP route in section between Albania and Montenegro, all identified effects have been valorised numerically.

Overall analysis of conducted valorisation has shown that the more negatively has been scored byVariant A, for most of identified effects. These include impacts on geomorphological characteristics, impacts on land use and pedology, impacts on social issues, impacts on biological environment, impacts on natural heritage and protected areas, landscape and visual impacts, impacts on air quality, impacts caused by noise and vibration, impacts on cultural heritage sites and near-by infrastructure objects.

The most negative impact that has been identified for Variant A is its crossing in the middle of the area of National Park Lovćen in Montenegro. From a nature protection, biological, cultural heritage and social point of view this is considered unacceptable. Also, part of the Variant A route in Albania, passes very near or even through the settlements in the area of Shkodra district.

Even though the maritime surveys for the offshore section of proposed Variant B have not yet been carried out, it is considered, based on results presented in this report, that the Variant B is a better solution for the final IAP route.