ARCADIS Design & Consultancy for natural and built assets

ROMANIAN SECTION OF THE BRUA NATURAL GAS TRANSMISSION CORRIDOR PROJECT

Supplementary Environmental Impact Assessment Report

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Incorporating

EC HARRIS BUILT ASSET CONSULTANCY

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ABREVIATIONS

Abbreviation	Definition
ANRE	Romanian Regulatory Authority for Energy
BAT	Best Available Technique
BCM	Billion Cubic Metres
BURA	Bulgarian-Romanian-Hungarian-Austrian (Natural Gas Transmission Corridor Project)
BVS	Block Valve Station
CBD	Convention on Biological Diversity
CF	Railways
CO_2	Carbon Dioxide
CP	Construction Permit
DC	Communal roads
DDTCE	Development of the European Continent
DJ	County Roads
DN	National Roads
EBRD	European Bank of Reconstruction and Development
EC	European Community
EEC	European Economic Community
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
EU	European Union
EuSSD	European Strategy for Sustainable Development
GCS	Gas Compressor Stations
GD	Governmental Decision
GIP	Good International Practice
HDD	Horizontal Directional Drilling
IGB	Greece-Bulgaria Interconnector
MD	Ministry Decision
MO	Ministry Order
NEPA	National Environmental Protection Agency
PC	Programme of Compliance
PCI	Project of Common Interest
PIG	Pipeline Inspection Gauge
PRs	Performance Requirements
PUG	Local Urban Plans
RoW	Right of Way
SAC	Special Area of Conservation
SCI	Site of Community Importance
SCP	South Caucasus Pipeline
SEA	Strategic Environmental Assessment
SEIA	Supplementary Environmental Impact Assessment
SER	Romania's Energy Strategy
SNDDR	National Strategy for Sustainable Development of Romania
SPA	Special Protection Area
TANAP	Trans-Anatolian Pipeline
TAP	Trans-Adriatic Pipeline
TYNDP	10-year Network Development Plan
UC	Urban Certificate
UPS	Uninterrupted Power Supply
HDPE	High Density Polyethylene
NDT	Non-Destructive Testing
DCVG	Direct Current Voltage Gradient

Abbreviation	Definition
TES	Technical Environmental Study
RSQA	Romanian Society for Quality Assurance
IQNET	International Network of Certification Bodies
KPI	Key Performance Indicator
ESAP	Environmental and Social Action Plan
SEP	Stakeholder Engagement Plan
AoI	Area of Influence
GIS	Geographic Information System
ESRI	Environmental Systems Research Institute
ESAP	Environmental and Social Action Plan
NGO	Non-Governmental Organisation
AGI	Above Ground Installation
WFD	Water Framework Directive
HD	Horizontal Drilling
PVC	Polyvinyl Chloride
NO_2	Nitrogen Dioxide
CO	Carbon Monoxide
VOC	Volatile Organic Compound
PM_{10}	Particulate Matter of 10 Micrometres in diameter or Less
GHG	Greenhouse Gases
HGV	Heavy Goods Vehicle
NOx	Nitrogen Oxides
SOx	Sulphur Oxides
SO_2	Sulphur Dioxide
$PM_{2.5}$	Particulate Matter 2.5 Micrometres in diameter or Less
EPUK	Environmental Protection UK
DMRB	Design Manual for Roads and Bridges
DPM	Diesel Particulate Matter
CH_4	Methane
N_2O	Nitrous Oxide
O_3	Ozone
CFC	Chlorofluorocarbon
SCADA	Supervisory Control and Data Acquisition
dB	Decibels
VDV	Vibration Dose Value
PPV	Peak Particle Velocity
CNVMP	Construction Noise and Vibration Management Plan
LA_{eq}	Equivalent Sound Level
LA_{90}	The noise level exceeded for 90% of the measurement period
LA_{10}	The noise level exceeded for 10% of the measurement period
LA_{1}	The noise level exceeded for 1% of the measurement period
LA_{Max}	Maximum sound level
CH	Critical Habitat
PBF	Priority Biodiversity Features
RTA	Road Traffic Accident
IUCN	International Union for Conservation of Nature
NFF	National Forestry Fund
ECoW	Ecological Clerk of Works
HDV	Heavy Duty Vehicle
BAP	Biodiversity Action Plan
CESMP	Construction Environmental and Social Management Plan
HSE-MP	Health, Safety and Environmental Management Plan

1 Introduction

1.1 Introduction

This document summarises the results of the Supplementary Environmental Impact Assessment (SEIA) for the Romanian section of the Bulgarian-Romanian-Hungarian-Austrian (BRUA) Natural Gas Transmission Corridor Project. It describes recent work undertaken to address potential environmental impacts associated with the construction and operation of the pipeline and is intended to supplement, rather than duplicate, the regulatory Environmental Impact Assessment (EIA) undertaken in 2016 on behalf of Transgaz as part the regulatory permitting process. The information reported here builds on that of the Romanian regulatory EIA but, unless particularly relevant, that earlier information is not repeated here. Potential social impacts are addressed in the Supplementary Social Impact Assessment document, with cross reference made between the two where appropriate.

The SEIA covers those elements of the corridor to be developed in Romania as part of Phase 1 of the pipeline construction between Podisor (22km west of Bucharest) and Recas in the west of the country ("the Project"). Phase 2 of the Project (the 50km from Recas-Horia) is addressed in the context of potential cumulative impacts, but is not yet at the same stage of engineering design and is not included within the currently proposed European Bank for Reconstruction and Development (EBRD) financing.

The pipeline will connect the Romanian gas transmission system with the European "Southern Gas Corridor" as well as to potential offshore sources in the Black Sea. The Project is being constructed on behalf of Societatea Națională de Transport de Gaze Naturale (SNNTGN) Transgaz SA Medias (Transgaz), the licensed operator of the Romanian National Gas Transmission System.

The Environmental and Social Impact Assessment (ESIA) has been prepared by Arcadis, an international consulting firm, and builds on local work undertaken by SC Unitatea de Suport pentru Integrare SRL (USI - a Romanian environmental consultancy) and Green Partners (an international social consultancy based in Romania), as well as Transgaz themselves. It includes an assessment of, and mitigation to address, potential environmental impacts associated primarily with the construction and operation of the pipeline and the temporary and permanent infrastructure needed to support it. Issues regarding other project phases (including emergency conditions) are dealt with as described subsequently and outlined in the Project Scoping Report. Supply chain issues will be dealt with through operational management systems once information is known.

This document should be read in conjunction with the following Project documents:

- Scoping Report
- Regulatory EIA and Appropriate Assessments
- Supplementary Social Impact Assessment (SSIA)
- Environmental and Social Management Plans (ESMPs)

Further information on the project itself can be obtained from Transgaz. Relevant contact details are provided at the end of this Chapter.

1.2 Project Overview

Europe is currently dependent on the transport of large supplies of gas from Russia, Africa and the North Sea primarily through a limited number of strategic pipelines. To ensure greater energy security it is now seeking to diversify its gas supply through the development of a "Southern Gas Corridor", of which the BRUA Project forms a part. As such the Project is included within the larger European Union (EU) Energy Security Strategy (aimed at diversifying both regional energy sources and their associated transport routes) and is designated as an EU "Project of Common Interest" (PCI).

Romania is also the largest gas producer in Central and Eastern Europe with proven reserves of around 100 billion cubic metres (bcm). Although the majority of national gas consumption is covered by domestic production, it remains, however, a net importer of gas, and reliance on imports is expected to grow over the next 10 years. The BRUA pipeline will help provide both short and long-term solutions to these issues and will provide reverse flow to both Bulgaria and Hungary to help meet market demands. Potential additional off-take points may also be provided along its route if required.

The 32" buried pipeline (Phase 1 and 2) will cover approximately 528km, across 79 administrative units (municipalities) and 11 counties and will connect the existing Romanian transmission system with the Bulgarian and Hungarian transmission systems at Giurgiu interconnection point (IP) and Csanadpalota respectively. Three new Gas Compressor Stations (GCS) will also be built along the pipeline at Podisor, Bibesti and Jupa. Further information on the Project, including a breakdown of each section and alternatives is provided in Chapter 3 (Project Overview), whilst Chapter 4 (Construction Approach and Methodology) includes details on the construction methods.

BRUA will be developed in 2 Phases. Phase 1 will enable a reverse flow of some 1.5 billion m3/year at the Bulgarian border and 1.75 billion m3/year at the Hungarian border and is planned to be operational by the end of 2019. Phase 2, is planned to be in place by late 2022, this should enable an increase incapacity to 4.4 billion m3/year at the Hungarian border.

The proposed BRUA pipeline route across Romania, including the location of the three GCS's, is shown in Figure 1.1 in the SEIA Figures Document.

1.3 Need for the Project

Given the importance of energy security outlined above, the development of the BRUA Project is considered a major priority for Transgaz, and is included in the organisations 10-year network development plan (TYNDP). The option of not constructing the project was considered but was rejected because it would result in missed opportunities for:

- Regional **economic development** and diversification associated with the use of gas resources including significant development of certain industries;
- Reducing the national **dependence on imported natural gas** from Russia and enhancing European energy security;
- The **generation of jobs** during both construction and operation of the pipeline (see SSIA). The total number of jobs to be created will be available once the contractors are established; and
- **Replacement of existing power sources** with natural gas which is considered a relatively clean fuel regarding emissions use.

1.4 The Project Proponents

The beneficiary for this project is the Romanian national gas transmission company, Transgaz, established through Governmental Decision (GD) no. 334/28 April 2000. Transgaz is majority state-owned company and as such is tasked with providing and managing the infrastructure necessary for efficient gas transmission in Romania at a national level. This includes international and national transmission, natural gas dispatching and research and development in the field of natural gas. With Transgaz acting as the technical operator of the national gas transmission system within Romania, the company is also responsible for its operation under quality, safety, efficiency and environmental conditions. Whilst BRUA also connects to existing pipelines residing in Bulgaria, Hungary and Austria, the proponents involved in the construction of the other three sections are not considered as proponents for this project due to their completion prior to the Romanian segment of the pipeline.

1.5 Connected Pipeline Projects

As an extension of the Southern Gas Corridor, originating from Shah Deniz gas field in Azerbaijan, there are multiple projects that are loosely connected to this Project, albeit not so closely that they should be considered associated facilities. These include:

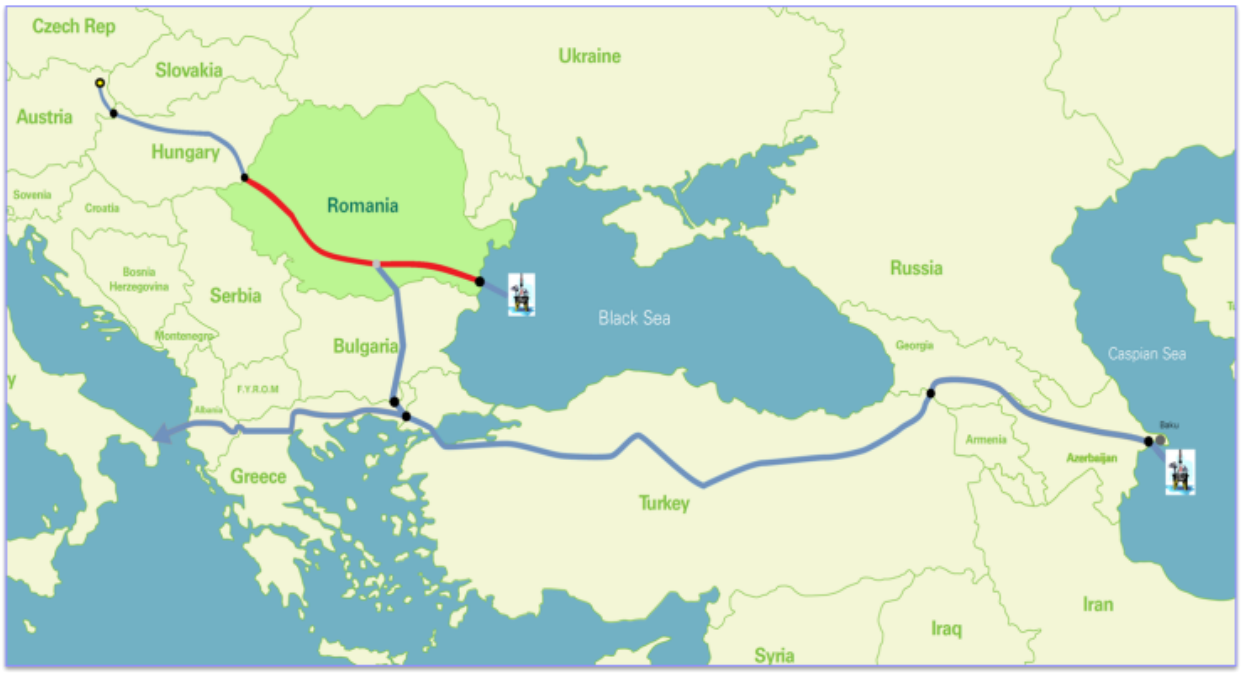
- South Caucasus Pipeline (SCP), which is the first pipeline in the southern gas corridor transporting gas from source at the Shah Deniz gas field to Türkgözü in Turkey via Georgia and was completed in 2006;
- Trans-Anatolian Pipeline (TANAP) which connects to the SCP at Türkgözü and is currently under construction, with the estimation for completion being in 2018. TANAP will run from some 1,850km from the Georgia-Turkey boarder to Ipsala where Turkey borders Greece. This project will allow for 16bcm of gas to southern Europe upon completion, with upgrades to the pipeline already scheduled to increase this supply to 60bcm by final stage; and
- Trans-Adriatic Pipeline (TAP) which connects to TANAP at the Turkish border then runs through Greece, Albania and into Italy for 878km and will enable 20bcm of gas transport per year.

The most important connection for the BRUA pipeline is made within the Greek section of the TAP pipeline where the Greece-Bulgaria Interconnector (IGB) will enable transport of gas into Bulgaria and thus the start of the pipeline infrastructure for BRUA.

One further pipeline that may connect to the BRUA pipeline has been proposed to run from the recently found gas reserves located offshore in the Black Sea. If plans go ahead to build offshore gas wells the transportation of this gas will be carried via a new pipeline running from Constana to the BRUA GCS at Podisor. The bi-directional ability of the Project will allow for Black Sea gas to be quickly distributed to both northern and southern Europe.

Figure 1.2 illustrates the pipeline routing of the Southern Gas Corridor with the Romanian developments, including the proposed Black Sea pipeline, displayed in red.

Figure 1.2 Continental Gas Supply



1.6 Requirements for a Supplementary Environmental Impact

In September of 2016 the construction of the Romanian segment of the BRUA pipeline was permitted at a national level, with the proposal that construction would begin in the 4th quarter of 2017. The Project aims for the construction phase to be finalised by 2019 and the pipeline to be operational by 2020, linking most notably with the Black Sea offshore development.

Since the Project is now being considered for financing by the European Bank of Reconstruction and Development (EBRD), it is also required to demonstrate that it will be constructed and operated in line with the EBRD's Environmental and Social Policy (2014) and associated Performance Requirements (PRs). The following PRs are considered relevant to the Project:

- PR 1: Assessment and Management of Environmental and Social Impacts and Issues;
- PR 2: Labour and Working Conditions;
- PR 3: Resource Efficiency and Pollution Prevention and Control;
- PR 4: Health and Safety;
- PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement;
- PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- PR 8: Cultural Heritage; and
- PR 10: Information Disclosure and Stakeholder Engagement1.

Additionally, the Project falls into the EBRD category of 'pipelines...for the large-scale transport of gas....' which requires it to undergo a detailed ESIA process with the resulting reports available for a minimum 120 days public disclosure and consultation period. The disclosure documents (including this report) must include:

1. An accurate description and delineation of the project and the client's associated activities;
2. Social and environmental baseline data at an appropriate level of detail;
3. Details of applicable environmental and social laws and regulatory requirements of the jurisdictions in which the project operates, including laws implementing host country obligations under international law; and
4. Applicable requirements under the PRs, including application of the mitigation hierarchy and Good International Practice (GIP)2.

This SEIA document seeks to build on the regulatory EIA Report to address the environmental elements of the statutory requirements listed above. Social elements, related to PRs 2, 4, 5 and 10, are addressed in the accompanying Supplementary Social Impact Assessment (SSIA). The Project must implement a plan for engaging with the stakeholders in a meaningful manner in accordance with PR10. Further details of this are also included in the SIA Report and Stakeholder Engagement Plan.

This SEIA has been prepared by Arcadis, the international consultancy, based on information provided by Transgaz, UIS and Green Partners. The work has involved a multi-disciplinary project team and has sought, where practical, to integrate environmental, social and cultural aspects into the project design and delivery. Both international and local consultants and specialists have been involved in the evaluation including technical specialists on each of the topics addressed in the report.

1.7 Limitations of this Report

1 PR 7 (Indigenous Peoples) and PR 9 (Financial Intermediaries) are not considered relevant in the context of this Project.

2 Good international practice refers to the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally or regionally. The outcome of such exercise should be that the project employs the most appropriate technologies in the project-specific circumstances.

Arcadis is aware that there have been a number of limitations in developing this report, specifically with regard to having to frequently use third party data. The conclusions drawn have therefore been based on the best information available, and specific recommendations are included in key areas regarding additional work required. Overall, however, a precautionary approach has been taken to the assessment and an “adaptive” approach has been adopted to mitigation, for example through the use of Contractor Biodiversity Specialists to assess and revise mitigation as necessary once they have collected more accurate baseline data. This process will be monitored by the Project, its regulators and its lenders. A more in-depth account of the limitations to this SEIA is provided in section 6.11 of this document.

1.8 Report Structure

The SEIA is composed of 14 chapters and supporting Appendices and Figures Documents. The main chapters are divided into the following groups:

- Chapters 1-6: Project and Assessment Overview. This includes information on the project description, construction methodology, generic mitigation proposed, SEIA approach and legal setting;
- Chapters 7 - 11: Management of Pollution. This addresses PR3 related impacts and mitigation on the physical environment, namely geology, soils, water resources, air quality and noise; and
- Chapter 12: Ecology and Nature Conservation. This addresses PR6 related elements associated with sensitive ecological receptors; and
- Chapters 13 and 14: Human Environment. This addresses issues related to PR8 including cultural heritage, traffic and transport.

1.9 Associated Documentation

This report should be read in conjunction with:

- Scoping Report: Address the preliminary issues associated with the Project, and scopes impacts to be address in or out depending on their risk to the to the Project
- Supplementary Social Impact Assessment (SSIA): Authored by Green Partners, this document addresses all potential social impacts to the project, including issue such as, non-tangible cultural heritage, land use and vulnerable groups
- Non-technical summary (NTS): This document summaries the findings and conclusions of the SEIA
- Environmental and Social Action Plan: Highlights the actions agreed upon between Transgaz and the EBRD that Transgaz will commit themselves to as part of the loan agreement
- SEIA Figures Document: This document includes all figures referenced to through the SEIA chapters and should be read in conjunction with this report.
- SEIA Appendices Document: This document includes all appendices referenced to through the SEIA chapters and should be read in conjunction with this report.

1.10 Report Access

For full access to this report and all other associated documentation please visit www.ebrd.com.

2 Project Regulatory Regime

This Chapter provides a brief overview of key elements of the international and national environmental and social regulatory framework that is considered relevant to this Project. It also provides an outline of the applicable EBRDs Environmental and Social PRs. Specific regulations and PRs associated with each of the technical disciplines addressed in the SEIA are included in detail in the Regulatory EIA.

2.1 The Romanian Environmental Regulatory Process

2.1.1 Overview of the National Planning Process

Under Romanian planning and permitting regulations, an Urban Certificate is needed to initiate the environmental permitting procedure for a project. The Urban Certificate defines the required technical parameters to be considered within an EIA and lists the approvals that are required for the project. To date Transgaz have obtained 14 UCs, of which three are for the GCSs and 11 of which were issued by each of the local councils through whose administrative area the pipeline will pass. Each Urban Certificate specifies the types of the approvals to be obtained from the various authorities, utilities providers etc. in order to obtain the construction permit. In total Transgaz has had to obtain 423 approvals and agreements, including permits issued at local level required as precondition to obtaining the Environmental Agreement and then the construction permit. Existing and outstanding permits are included in Table 2.4.

Following the Urban Certificates, there are three further environmental stages in the Romanian permitting system, the first two of which relate to the construction stage and the third relates to the project operational stage. The stages are as follows:

- **Stage 1 - Environmental Approvals/Strategic Environmental Assessments (SEA)** for plans and programs (*aviz de mediu pentru planuri si programme*). These are granted in line with GD no. 1076/2004, which transposes the SEA Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of plans and programmes on the environment. The BRUA Project is part of the “Romanian Energy Strategy for 2016-2030, with perspectives for 2050”, for which the Romanian Government has begun the process of completing an SEA. As such it is not expected that an SEA will be required for the Project itself.
- **Stage 2 - Environmental Agreement** (*Acord de mediu*). This is granted in line with the GD no. 445/2009, which transposes the EIA Directive (no. 85/337/EEC) and with subsequent amendments and Ministry Order (MO) No. 135/2010, which describes the EIA permitting procedure. In accordance with the EIA Directive, the BRUA Project falls under *Annex 1 - Pipelines for the transport of natural gas, oil or chemicals with a diameter of more than 800 mm and a length of more than 40 km*, for which EIA is mandatory. The Guidelines for preparation of the EIA are detailed in MO No. 863/2002. The environmental agreement (in addition to permits issued by other authorities) is a pre-condition for obtaining the construction permit. Whenever projects have a potential impact on a Natura 2000 site, an Appropriate Assessment must also be undertaken in line with the EU Habitats Directive. The required EIA and Appropriate Assessments have been completed for the project and the associated permits issued by the Romanian authorities;
- **Stage 3 - Environmental Permit for Operation** (*Autorizatie de mediu*), in line with national requirements (MO no. 1798/2007 on approval of the environmental permitting procedure), Nomenclature of Economic Activities (NACE) code revision 2 – 4095 - transport of gas through the pipelines. This will be achieved before operations commence.

The process is described in more detail in the Regulatory EIA.

2.2 Law 185/2016

Whilst the above describes the general national planning process, BRUA is specifically subject to a new national infrastructure law (185/2016) which has been introduced to facilitate the development of such nationally important projects which should not be held up by local planning decisions. Law 185/2016 streamlines the national permitting process and provides specific measures that help to both reduce the time for permit approvals and provide clarifications where the legislative framework is unclear. Examples of general environmental elements included within the law are to allow that:

- Forestry lands owned by the state can be temporarily removed from forestry use and made available to the Project;
- Construction is allowed in national and natural parks with the favourable opinion of the Ministry of Environment;
- With the exception of the construction Environmental Agreement, all approvals, agreements, permissions and permits requested through the Urban Certificate (including the main construction permit) will be issued in maximum 15 days from submittal of the request, except regarding cultural protection (under art. 22 (4) k) of Law 185/2016) and water management (under art. 22 (2) k) of Law 185/2016) for which 45 days are provided.
- In case of emergency situation (e.g. for environment, public safety etc.) Transgaz has the right to intervene immediately, without waiting to obtain any permits. The construction permit for emergency repairs works will be issued immediately.

The Law also includes the following specific archaeological measures:

- For cultural heritage, the environmental agreement and construction permit will be issued based on the approval from the Ministry of Culture and National Identity (for cultural heritage). This will be issued in 45 days following the submittal of the request. Where necessary, this will be followed by an action plan for mitigation measures on archaeological heritage, within 30 days of the management plan request.
- The approval from the Ministry of Culture and National Identity may include requirements for preventive archaeological research and archaeological discharge which will take place after issuance of the environmental agreement and construction permit but before starting the construction works in that area;
- In case of intervention on historical monuments or their protection zone and in protected constructed areas, the construction permit will be issued based on the positive approval from the Ministry of Culture and National Identity or, by case, by the relevant County Culture Directions under Ministry guidance;
- The preventive archaeological research and the archaeological discharge will be performed gradually, for each part of the land, before starting the construction works and based on the works execution schedule communicated to the County Culture Directions. The certificate for archaeological discharge will be issued for each part of the land which can brought into construction3 ;
- Suspension of the construction works for land with archaeological value discovered by chance does not lead automatically to the suspension of the construction permit;
- The archaeological heritage area is delimited around the archaeological discovery with consideration of the land affected by the discovery. This will not prejudice the right to use, exploit or start /continue the construction works for the rest of the land area which is subject to the construction permit; and
- A simplified procedure for conducting archaeological research, for the issuance of the required permits and for issuance of the certificate for archaeological discharge will be prepared by the Ministry of Culture and National Identity and approved by MO in 30 days after BRUA Law enters in force.

2.3 International Conventions

Romania is a signatory to a number of international conventions including those shown in Table 2.1 overleaf. Further information is provided within the regulatory EIA.

3 This is a reflection of the specification of Regulation GD 43/2000 and is determined in the management plans

Table 2.1 Key Conventions

Diploma	Summary	Applicability to the Project
Convention on the Conservation of European Wildlife and Natural Habitats, adopted at Bern on 19 September 1979	Created on the 19th of September but only signed by Romania on the 18th of May 1993 (and coming into force on the 1st of September) the Convention on the Conservation of European Wildlife and Natural Habitats is a binding legal instrument focusing on the conservation of natural heritage in Europe, with particular focus on protecting natural habitats and endangered species. This imposes legal obligations to protect over 500 wild plant species and more than 1,000 wild animal species.	As a result of signing up to this convention Romania must abide by a specific set of obligations ensuring the protection of fauna and flora. For the BRUA pipeline the implications are that no aspect of construction or operational impacts should be deemed to break any of the obligations laid out by the convention.
Convention on the Biological Diversity from Rio de Janeiro, 5th June 1992 (specifically Council Directive 92/43/EEC)	This multilateral convention held in 1992 and adopted by Romania upon joining the EU in 2007 is aimed at the conservation of biological diversity, sustainable use of biological diversity and the equal sharing of genetic resources. Signing up to the convention commits members to certain practice standards when undergoing potentially evasive activities that may affect biological diversity, for example abiding by a National Biodiversity Strategies and Action Plans (NBSAP).	A specific obligation of the Convention on Biological Diversity is to meet a standard for impact assessment of biological diversity, thus committing BRUA to conduct a thorough impact assessment for this topic to meet the standards set out.
Convention on the protection and use of transboundary watercourses and international lakes, Helsinki, 17 March 1992	One of five of the United Nations Economic Commission for Europe (UNECE) environmental treaties, directed at the protection and management of surface and ground waters. The convention signs countries up to meeting general practice standards for water resource management including monitoring, research and exchanging information. Romania signed up to the convention on joining the EU, adopting all legislation and obligations involved.	The implications of signing up to the convention designed in Helsinki means that when assessing the impacts that BRUA may have on water resources, specific focus much be noted as to meet the protocol established by the treaty. Most notably issues that may be presented in transboundary effects on water resources.
European Convention on the Protection of the Archaeological Heritage (Revised), Valletta, 16 January 1992	European Convention on the Protection of the Archaeological Heritage or the Valletta Treaty was designed in 1992 to create a legally binding standard for European archaeological protection. It tackles issues such as illicit and unscientific excavation methods and lack of public awareness of archaeological heritage by enacting legal parameters to establish practices such as making professional consultation a requirement for project developments and promotion public awareness.	Due to the archaeological significance of many Romanian territories this treaty has vast implications for the BRUA pipeline as it must ensure that its construction abides by the practice standards set out by the convention and avoid poor excavation methods.
The Carpathian Convention adopted to Kiev, 22 of May 2003	This convention has been designed to ensure the sustainable development of the Carpathian Mountains. It not only focuses on the protection of the rare natural complexes that can be found without the mountain range but also to enable the sustainable growth of local economies and communities located within the Carpathian region.	As a consequence of the BRUA route passing through the Carpathian mountain range, the development of the project must ensure that it does not break any of the obligations set out by the Carpathian convention and safeguard local economies.
Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects, done at Lisbon, 17 December 1994	This charter acts as an international agreement to implement a multilateral framework of guidelines and best practice in regard to the energy industry. It has a particular focus upon cooperative trade and establishes the trade tariffs members are subject to.	Due to the BRUA pipeline being a multinational project, each nation involved with the Project must ensure it abides with the obligations presented by the energy charter

Diploma	Summary	Applicability to the Project
The Bonn Convention 1979	The Convention on the Conservation of Migratory Species of Wild Animals aims to conserve terrestrial, marine and avian migratory species throughout their range. Migratory species threatened with extinction are listed on Appendix 1 of the Convention, whilst migratory species that need or would significantly benefit from international co-operation are listed in Appendix 2 of the Convention.	See regulatory EIA and Ecology Chapter (12).
The Ramsar Convention 1971	The Ramsar Convention of Wetlands of International Importance Especially as Wildfowl Habitat was adopted in Ramsar, Iran in February 1971 and entered into force in December 1975. The Convention covers all aspects of wetland conservation and comprises three elements of activity: the designation of wetlands of international importance as Ramsar sites; the promotion of the wise use of all wetlands in the territory of each country; and international co-operation with other countries to further the wise use of wetlands and their resources.	

2.4 EU Directives

Romania is subject to a range of EU Directives as described earlier. Specific directives of greatest important to the technical areas of this Project include the following:

- **Habitats Directive 1992:** Directive 92/43/EEC of the European Union on the Conservation of natural habitats and of wild fauna and flora is the means by which the community meets its obligations as a signatory of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). The Directive introduces a range of measures including the protection and surveillance of habitats and species. The main aim of the Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species at a favourable conservation status, introducing robust protection for those habitats and species of European importance. The 189 habitats listed in Annex I of the Directive and the 788-species listed in Annex II are to be protected by means of a network of sites. Each Member State is required to prepare and propose a national list of sites for evaluation in order to form a European network of Sites of Community Importance (SCIs). Once adopted, these are designated by Member States as Special Areas of Conservation (SACs) and, along with Special Protection Areas (SPAs) classified under the EC Birds Directive, form a network of protected areas known as Natura 2000;
- **The Birds Directive 1979:** Directive 79/409/EEC on the conservation of wild birds was adopted in 1979. The Birds Directive is a primary tool for delivering EU obligations under the Convention on Biological Diversity (Rio de Janeiro , 1992) and the Ramsar and Bonn Conventions. The Birds and Habitats Directives require Member States to take a number of measures/actions in order to protect all bird species, their sites and their habitats; these include measures to conserve and maintain all naturally occurring bird species across the EU through the designation of SPAs for species listed on Annex I of the Directive and migratory species;
- **Water Framework Directive 2000:** Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the community action in the field of water policy (EU Water Framework Directive (WFD)). The WFD places an emphasis upon the Government to enhance the status and prevent further degradation of our aquatic ecosystems and associated wetlands and promotes the sustainable use of water; to this end a number of targets need to be reached by 2015. It requires that all designated inland and coastal waters within defined river basin districts must reach at least good status by 2015 and defines how this should be achieved through the establishment of environmental objectives and ecological targets for surface waters. The result will be a healthy water environment achieved by taking due account of environmental, economic and social considerations; and
- **Environmental Liability Directive 2004:** Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage known as the Environmental Liability Directive seeks to achieve the prevention and remedying of environmental damage - specifically, damage to habitats and species protected by EC law, damage to species or habitats on a site of special scientific interest for which the site has been notified, damage to water resources and land contamination which presents a threat to human health. It reinforces the “polluter pays” principle - making operators financially liable for threats of or actual damage.

Further information on relevant Directives is included in Table 2.2 below

2.5 Romanian National Planning Policy Context

The Project is part of a Ten Year National Gas Transmission System Development Plan, which comprises additional major investment projects by Transgaz to ensure the strategic and sustainable development of the natural gas transmission infrastructure in Romania and its compliance with the applicable European regulations. The Ten Year National Gas Transmission System Development Plan was approved by the Romanian Regulatory Authority for Energy (ANRE) through the Decision no. 2819/17.12.2014, without obtaining the prior approval from the environmental authorities. Further information on national policy is provided in Table 2.3 below.

Table 2.2 Key applicable regulations embodied or becoming adopted in the national legal system

Regulation	Summary	Applicability to the Project
Environmental regulation of constitutional character		
Emergency Ordinance no 195/2005 regarding environmental protection	The object of the emergency ordinance is a set of legal regulations on environmental protection, an objective of major public interest, based on the principles and strategic elements that lead to sustainable development. The principles and strategic elements underlying this Emergency Ordinance are: A) the principle of integrating environmental requirements into other sectoral policies; B) the precautionary principle in making the decision; C) the principle of preventive action; D) the principle of retaining pollutants at source; E) the "polluter pays" principle; F) the principle of biodiversity conservation and ecosystems specific to the natural biogeographical framework; G) the sustainable use of natural resources; H) informing and public participation in decision-making, as well as access to justice in environmental matters; I) development of international collaboration for environmental protection.	The implications of this environmental act for Transgaz and the BRUA pipeline is to understand the responsibilities they have as the financier and thus take the appropriate action to ensure that the policies put in place by the environmental agreement are met.
General Environmental Policy		
European Parliament and Council Directive 2004/35/CE from Apr 21st 2004 regarding the responsibility for the environment in terms of prevention and reparation of damages brought to the environment	The Directive is transposed in the Romanian legislation via Emergency Ordinance 68/2007 regarding the responsibility for the environment in terms of prevention and reparation of damages brought to the environment, as subsequently amended. The emergency ordinance establishes the legal framework for environmental responsibility based on the principle “polluter pays”, with the aim of preventing and repairing damages brought onto the environment. The emergency ordinance applies to: a) damage to the environment caused by any kind of professional activity provided in Annex no. 3, and any imminent threat of such damage caused by any of these activities; b) damage to protected natural species and habitats and any imminent threat of such damage caused by any professional activity, other than those specified in Annex no. 3, whenever the operator acts intently or intentionally.	The results of this Directive should be understood by Transgaz to exemplify their responsibilities as the lead company and the potential financial implications they are subject to if the project leads to excessive pollution. Further it should help guide their construction methodology to meet standard practice protocol.
Council Directive 85/337/EEC - Environmental Impact Assessment	The Council Directive 58/337 EEC are transposed in national legislation via Governmental Decision no 445/2009 regarding the evaluation of the impact of certain private and public projects on the environment. The list of projects subject to environmental impact assessment is presented in Annex 1 of the governmental decision and Annex 2 contains the list of project for which the need for an environmental impact assessment is still to be determined. Ordinance no 135/2010 approves the methodology applicable for the environmental impact assessment for private and public projects. Ordinance no 863/2002 approves the methodological guides applicable to the stages of the evaluation framework for the environmental impact assessment.	This council directive highlights the responsibility through law and legislation for companies to conduct thorough environmental impact assessments and the minimum standard they must meet, thus BRUA’s environmental impact assessment must be cross referenced with the standards implied by this legislation to ensure the standards are met.

Regulation	Summary	Applicability to the Project
European Parliament and Council Directive no. 2003/4 / EC on public access to environmental information	Directive 2003/4/CE is transposed in national legislation via Government Decision no 878/2005 on public access to environmental information. The Decision ensures the right of access to environmental information owned by or for public authorities and established the conditions, terms and ways in which this right can be exercised. Environmental information is disseminated in a progressive fashion and made available to the public in order to allow for the widest reach of this information. In order to reach this objective, the use of electronic information and computerised telecommunications is encouraged.	Highlights that all environmental information in regard to BRUA's impact should be made publicly available.
Regulation of the European Parliament and Council no 66/2010/CE regarding the EU eco-label	The Regulation is directly applicable to EU member states. With regards to the Romanian legislation, Government Decision no 661/2001 regarding measures to be taken to ensure the application at national level of the Regulation of the European Parliament and Council no 66/2010/CE from Nov 25th 2009 regarding the EU eco-label.	The implications of this regulation highlights that the products used and produced by BRUA should have their own eco-label
Regulation (CE) no 1221/2009 of the European parliament and Council from Nov 25th 2009 regarding the voluntary participation of organisations to an EU wide system of environmental management and audit (EMAS)	The Regulation is directly applicable to member states of the EU. With regards to the Romanian legislation, Government Decision no 57/2011 was adopted regarding the establishment of measures to ensure the application of Regulation (CE) no 1221/2009 of the European Parliament and Council from Nov 25th 2009 2009 regarding the voluntary participation of organisations to an EU wide system of environmental management and audit (EMAS) and the repeal of Regulation (CE) no 761/2001 and of decisions 2001/681/CE and 2006/193/CE of the Commission.	
Air		
Ordinance no 1798/2007	The Ordinance approves the procedure to issue the environmental permit. This procedure regulates the conditions regarding the request, issuance and revision of the environmental permit.	Identifies the necessary procedure BRUA will have to undertake when obtaining the required environmental permits in order to operate the site.
MWFEP Order Nr.462/1993	Concerns the technical conditions to achieve atmospheric protection, the methodology to measure emissions, and the required maximum emission levels which generally correspond to the values indicated by the standards of EU countries. The range of emission sources covered by the limits provided (by concentration of pollutants and by gas flow) is: combustion sources (suspended matter, carbon monoxide, Sulphur oxides, nitrogen oxides), e.g., power plants and cogeneration, heating plants, municipal solid waste incineration plants; volatile organic carbon emission sources, e.g. chemical plants; sources of suspended matter (e.g. heavy metals) emissions. This order provides for, inter alia: the obligation of self-monitoring (Art.13); the embodying of EU regulations concerning vehicle emissions (Art.17 and Art.18); Emitters requiring to be licensed (listed in Annex 3 of the report) must evaluate their discharges and present these data to the relevant environmental authority.	This order influences the protocol that must be put in place in regard to air emission during construction and operation.

Regulation	Summary	Applicability to the Project
Law no 104/2011 regarding air quality	Transposes in the national legislation Directive 2008/50/CE of the European parliament and Council from May 21st 2008 regarding air quality for Europe and the Directive 2004/107/CE pf the European parliament and the Council from Dec 15th 2004 regarding arsenic, cadmium, mercury, polycyclic aromatic hydrocarbons in ambient air. Law no 104/2011 contains measures to be taken at a national level regarding: a) Defining and setting objectives for air quality aimed at avoiding and preventing harmful events and reduce their effects on human health and the overall environment; b) Evaluating the air quality throughout the whole country based on common criteria and methods, established at European level; c) Obtaining information on air quality to support combatting air pollution and the discomfort this causes as well as to monitor in the long-run the tendencies and improvements resulting from the measures taken at national and European level; d) Guaranteeing that the information regarding air quality is available to the public; e) Maintaining the air quality where this is conforming to the respective standards and improving it in the other cases. f) Promoting an enhanced cooperation with the other EU member states in order to reduce air pollution; g) Fulfilling the commitment undertaken under the international accords, conventions and treaties to which Romania is a party.	The national standards which BRUA has to abide by are established, with regards to the maximum permitted air pollutants
National Standards (STAS Nr.12574/1987)	Concerns the maximum allowable limits of pollutant concentrations in protected zones (e.g., residential areas). Compliance with national standards is an obligation of all natural and legal persons in Romania.	Demonstrates the national standards that BRUA will have to meet in regard to maximum allowable limits of pollutants.
Regulation (EU) no 601/2012 of the Comission regarding the monitoring and reporting of greenhouse gas emissions according to Directive 2003/87/CE of the European parliament and the Council		
European Parliament and Council Directive 97/68/CE from Dec 16th	The Directive is transposed in national legislation bia the Government Ordinance no 332/2007 regarding the establishment of procedures for the approval of engines to be mounted on non-road mobile machinery and secondary engines for vehicles for road passenger and freight transportation and to establish the	Although not currently incorporated in Romania legislation, Transgaz should remain conscious of this directive and seek

Regulation	Summary	Applicability to the Project
1997 regarding measures against gas pollutant particles emissions from internal combustion engines of non-road mobile machinery	measures to limit the gas and pollutant particles emissions coming from these vehicles, in order to protect the environment.	to limit the emissions from vehicles involve in the project.
Noise		
General noise regulation	SR 10009:2017 Acoustics: Permissible limits of ambient noise level. The standard establishes admissible limits of ambient noise levels, differentiated by areas and functioning spaces as they are defined in the technical regulation regarding the systematization of locations and environmental protection. Ordinance 119/2014 for the approval of the Hygiene and public health regarding the population's living environment norms establish that in protected areas the following maximum limits for noise will be assured and abided by: a) During the day, the weighted equivalent continuous acoustic pressure level A (AeqT), measure outside the house according to standard SR ISO 1996/2-08, at 1.5m above the ground should not exceed 55 dB and the sound curve Cz 50; b) During the night, between the hours of 23:00-7:00, the weighted equivalent continuous acoustic pressure level A (L(AeqT)), measured outside of the house according to standard SR ISO 1996/2-08, at 1.5m above the ground should not exceed 45 dB and the sound curve Cx 40.	The summation of these regulations indicates the limits that the BRUA pipeline must not exceed in regard to noise pollution
Waste		
Directive 2008/98/CE of the European parliament and of the Council from Nov 19th 2008 regarding waste and reapealing certain directives published in the Official Journal of the European Union (JOUE) series L no 312 from Nov 22nd 2008	The Directive was transposed in the Romanian legislation via Law no. 211 from Nov 15th 2011 regarding the status of waste. The law establishes necessary measures for protecting the environment and the health of the population through prevention or reduction of adverse effects determined by the generation and management of waste and through the reduction of the general effects of using resources and increasing the efficiency of their use.	This directive demonstrates the existing legislative framework to which BRUA must comply with, explicitly highlighting the maximum waste limits and disposal practices.
Natural Calamities and Dangerous Substances		

Regulation	Summary	Applicability to the Project
Regulation (CE) no. 1907/2006 (REACH) regarding the registration, evaluation, authorisation and restricting chemical substances (REACH), for the establishment of the European Agency for Chemical Products, to modify the Directive 1999/45/CE and to repeal the Regulation (CEE) no 793/93 of the Council and the Regulation (CE) no 1488/94 of the Commission as well as the Directive 76/769/CEE of the Council and the Directives 91/155/CEE, 93/67/CEE. 93/105/CE and 2000/21/CE of the Commission Regulation (CE) no 1272/2008 of the European parliament and of the Council from Dec 16th 2008 regarding the classification, labelling and packaging of substances and mixes, of modifying and repealing of Directives 67/548/CEE and 1999/45/CE as well as modifying the Regulation (CE) no 1907/2006	This Regulation applies directly in EU member states. Law no 360/2003 (republished) regatding the status of dangerous substances and mixes, with subsequent ammendments, establishes a general framework for the effective control and efficient monitoring of dangerous substances and mixes, regarding the protection of the health of the population against the negative actions of dangerous substances and mixes.	For the use of any hazardous material in BRUA construction or operation, the packaging and labelling standards outline by this directive must be abided by.

Table 2.3 National policy

Diploma	Summary	Applicability to the Project
National Interconnection Strategy for the National Gas Transmission System	The Interconnection Strategy seeks to link Romania's gas transmission system with that of the neighbouring countries. This has been part of a Europe-wide program adopted in 2009 to help promote the post-recession regional economic recovery by securing energy resources. At the same time the EU Cohesion Policy has sought to pursue convergence, by providing an atmosphere of competition and creating conditions for the regional-level cooperation across the whole European area.	The BRUA Project actively supports such regional plans and programs.
European Strategy for Sustainable Development (EuSSD)	This strategy focuses on addressing unsustainable trends related to: climate change and energy consumption and associated threats to public health, poverty and social exclusion, management of natural resources, loss of biodiversity, land use and transportation. EuSSD identifies key challenges, targets, operational objectives and corresponding actions. According to EuSSD emphasis is the use of on sustainable resources, their turning into value at a large scale, assurance of access on a large scale, and diversification of gas supplies, the interconnection of national systems and assurance of an extensive network in Europe aiming to avoid discontinuity of supply.	BRUA intends to put into practice the provisions of this strategy.
The guiding principles for Sustainable Spatial Development of the European continent (DDTCE)	These outline the measures through which citizens of the EU can achieve standards of modern living that guarantee and reflect a high standard of living	Focus was on the exploitation of natural resources and on the development (diversification) of energy resources as a factor that assures socio-economic development and guarantees constant security. One can notice thus BRUA congruence with DDTCE elements.
Green Book on security of energy supply	Through the document "A European strategy for sustainable, competitive and secure energy" an appeal has been launched to support and commit all Member States in the inclusion of "energy security" clauses in trade agreements, in association and cooperation agreements with producer countries and transit countries establishing a conduct style that eliminates any disruption of energy circuits because of commercial disputes, and additionally outlined the measures to be adopted in the event of unilateral disruption.	In this context focus is on diversification of energy supplies with priority on routes coming from the SE. One can notice thus BRUA congruence with the Green Paper elements on security of energy supplies and the significant contribution to the diversification of supply solutions and the contribution to European energy security by the creation of a new transmission corridor.
Other Government Programs	The Romanian government recognises the need to diversify energy sources and diversification as a priority while maintaining the interest towards committed actions through which the geostrategic position to be turned into an advantage, and Romania to become a pivotal point in the common European energy strategy. Thus, such Government Programmes facilitated both the European dimension of projects aimed to turn into value the energy resources and of national approaches aimed to expand the distribution networks. In this regard consideration was paid to concrete solutions on enhancing energy security by upgrading national transmission and distribution systems and increasing the share of electricity production, while reducing consumption of conventional resources instead.	Again, these Government Programs have highlighted the need to strengthen Romania's energy independence by diversification of supply sources, by increase of interconnection degree of energy networks and by encouraging inter-related projects that enhance gas storage capacities. Attention was also paid to preparations for energy emergency situations with focus on the development of the transmission and storage infrastructure. Thus, BRUA

Diploma	Summary	Applicability to the Project
	Special attention was paid to projects that ensure future network services and a greater flexibility in energy management and energy production. From this point of view, projects involving the development of production capacities that use natural gas are back in focus.	represents the materialization of these elements that reflect the common interests, consensual accepted by the political class irrespective of their doctrinal orientation, due to the commitment to the principles relating to national interest.
Romania's energy strategy for 2007-2020 (SER)	The SER is aimed at developing long-term socio-economic energy resources, and at providing energy sources and resources representing a fundamental, basic element, that need to be integrated in the economic sector. The principles SER is based on are designed to assure the energy security, sustainable development and competitiveness of the energy sector.	Even a cursory analysis of the elements related to BRUA show Project's convergence with SER.
National Strategy for Sustainable Development of Romania (SNDDR)	This document proposes and analyses the strategic planning and development of Romania, including forecasted financial support solutions so that the theoretical elements can be enforced. SNDDR includes several related priorities to secure the energy sources, and to this end the natural targets consisting of the use of natural resources, diversification of supply and assurance of a better interconnection with neighbouring countries are a must.	It is therefore obvious that BRUA should become an item of high priority not only in terms of its approach as a major infrastructure investment, but also from the point of view of its operation.

Table 2.4 Additional permits required

Topic	Regulator	Status
Natura 2000 sites	The approvals from Custodians /administrators of the Natura2000 sites crossed by the Project	Current status is: • **Approved**: i) Nordul Gorjului de Vest; ii) Defileul Jiului National Park. Ongoing: iii) Padurea Bolintin iv) Defileul Jiului, v) Lunca Timisului, vi) Parcul National Gradistea Muncelului – Cioclovina; Not started yet: vii) Valea Oltului Inferior;, , • **Ongoing**:, viii) Parcul National Geoparcul Dinozaurilor Tara Hategului, ix) Strei – Hateg; x) Rusca Monata - Tarcul Retezat; xi) Dealurile Dragasanului; xii) Raul Timis between Rusca and Prisaca.
Water Management	Water Management local / regional authorities	Reportedly already obtained by Transgaz
Forestry approvals	Forestry authorities and public companies	Ongoing process
Cultural Heritage	Permit from national cultural heritage authority, based on county approvals.	A common approach for the type of the archaeological works (intrusive or non-intrusive prior construction) was not yet defined and agreed at national level and this situation may cause delays in overall Project schedule. More details are provided under PR8 below. As for the cultural heritage approvals, a contract was recently signed by Transgaz for elaboration of the theoretical and field observations studies for the rest of the five counties where these studies are still missing. According to our understanding of the situation, theoretical studies would probably not be sufficient in this stage and intrusive works may be also required.

3 Project Overview

3.1 Route Overview

The 32" buried pipeline will ultimately be 528km long (478km in Phase 1, 50 km in Phase 2) and will cross some 79 administrative units (municipalities) and 11 counties. Ultimately it will also link into the existing Romanian transmission system with the Bulgarian and Hungarian transmission systems via interconnectors at Giurgiu and Csanadpalota respectively. Three new GCS will also be built at Podisor, Bibesti and Jupa. Most of the pipeline will follow existing infrastructure routes, although approximately 134km will follow new routes, often for environmental or social reasons as detailed below. An overview of the route is shown in Figures 3.1 and 3.2 (found in the Figures Document). The 1Giurgiu (21.6 km); Teleorman (19.9 km); Dambovita (3.1 km); Arges (35.1 km); Olt (49.4 km); Valcea (56.5 km); Gorj (98.6 km); Hunedoara (78.8 km); Caras-Severin (58.8 km); Timis (80.1 km) and Arad (26.7 km).

Existing land categories for each administrative unit to be crossed have been determined through an appropriate soil survey and classification quality classes prepared by the Office of Soil Survey and Agrochemistry of each county as described further in Chapter 8.

The pipeline will generally run parallel to the existing pipeline sections belonging to the National Gas Transmission System. In some places deviations from these paths have been designed for safety reasons or to reduce environmental and social impacts (e.g. to avoid areas of conservation interest, environmentally sensitive areas or residential areas). This is discussed further under project alternatives below.

- Land temporarily occupied by the pipeline is approximately 1,081ha; and
- Permanent above ground land associated with the pipeline (i.e. Above Ground Installations) is approximately. 19.8 ha, consisting of 12.6 ha for gas compressor stations and 2.2 ha for valve stations and adjacent access roads.

The land is generally either in the ownership of municipalities or is state owned, although some is the property of individuals / businesses. The vast majority (~93%) of the land is outside of areas designated for building by the local municipalities (i.e. communes, towns, cities) and even for the 7% of the land that does overlap with such "buildable areas" the route has been selected to avoid inhabited areas wherever possible.

The majority of the land to be affected (either temporarily or permanently) is arable, orchards, meadows, forests, or unproductive land. The proposed pipeline will however cross a number of features including:

- Communication routes (communication routes of public utility: national roads (DN), county roads (DJ), communal roads (DC), railways (CF) or roads of private use);
- Bodies of water registered or unregistered in the Land Register, valleys and channels;
- Oil pipelines, gas pipelines, water pipelines; and
- Telecommunications networks (fibre optic).

Construction of the pipeline will be undertaken in two phases and four sections (3 in Phase 1 and 1 in Phase 2) as shown in Table 3.1 below, and based on appropriate project lengths for EPC contractors to bid on. Each section is then expected to be constructed using a number of operational spreads (typically expected to be 5 spreads per section).

Table 3.1 Pipeline division summary

Section	Distance	Description of route	Number of Crossings	Valves	CPS
Phase 1					
Podișor-Zatreni	180km	The proposed pipeline will start at the new Podisor GCS located 22km to the west of Bucharest. The predominant land use within this entire section is agricultural (mainly arable farming). The section crosses two major rivers, the Olt (119km) and Cotmeana (75km).	104	5 R 1 RRl	3
Zatreni-Pui	140km	This section predominately crosses the Carpathian Mountains and thus will require more specialist construction techniques, such as increases in the frequency of hammering and reductions in the working strip to accommodate for the terrain. The land traversed will be heavily forested areas, with relatively little agriculture throughout.	214	8 R 1 RR	5
Pui-Recas	159km	*The pipeline continues through the Carpathian Mountains for approximately 20km before passing into the Caransebes corridor for a further 40km. After this it leaves the mountains and heads towards the western plains following the Timis River corridor up to Recas for another 70km. The predominant land use in the first half of this section is woodland and pasture with orchards and meadows. Further west the landscape becomes dominated by agroecosystems.*	261	13 R	5
Phase 2					
Recaș – Horia	50km	The route of this section will generally follow parallel to the existing pipeline Vest I and Vest II. The pipeline will cross the counties of Timiş and Arad.	54	5 R	2

Further details on each of the gas pipeline sections are provided in Section 3.4 - Section 3.7.

3.2 Design Philosophy

3.2.1 General Design Requirements

The BRUA Project has been designed to meet the requirements of Romanian ANRE Order no. 118/2013: "*Technical regulations for design and execution of gas transmission pipelines*". This defines a number of key elements with environmental implications such as:

- Pipeline depth of 1.00m below ground level to be below frost level, except for under-crossings where the pipeline will be buried at a depth of at least 1.50m;
- Requirements for cleaning and Pipeline Inspection Gauge (PIG) inspection;
- Design for seismic risk (based on the Code for Seismic Design: P 100 - 1/2013); and
- Use of a digital data teletransmission system (with communication via a fibre optic route parallel to and of the same length as the pipeline within the pipeline working strip).
- Use of a well-functioning Supervisory control and data acquisition (SCADA) to help identify potential disruptions in normal operations and help manage associated Environment, Health and Safety (EHS) issues.

In addition, and in accordance with *Regulation GD 766/1997* which establishes the categories of construction importance, the pipeline is considered to fall within the "normal construction importance". This is reflected in the design of the proposed construction approach and mitigation.

A number of specific design requirements are also required as a result of the Project Environmental Agreement and other permits which, for example, define specific working strip widths of:

- 21m in agricultural land, pastures, hayfields, unproductive lands;
- 14m in vineyards, orchards, forests and difficult areas; and
- 10m in areas with cross slopes of over 5o where terraces will be constructed.

The proposed pipeline will include a range of technological elements including three GCS (Podişor, Bibeşti and Jupa); 43 line valves; 20 cathodic protection stations and a central dispatching centre for data acquisition, control and surveying. Further details are provided later in this chapter.

In addition, the following design parameters have been taken into consideration for the project:

1. **Safety and security:** Given both the strategic importance of this investment, and the risks inherent in natural gas transport, the design has sought to apply the best practice in pipeline safety and technical quality wherever practical;
2. **Economic criteria**: the design has considered the most effective solutions and methodologies to ensure a long-life span whilst also assume an easy approach to minimise construction costs;
3. **Social criteria**: the routes were selected to minimise effects on local communities during construction and operations (including any necessary activity restrictions). This means, where possible, avoiding sensitive housing areas, transport routes and networks.

3.3 Major Route Selection Considerations

A number of major route options were considered for the pipeline, with the key criteria being to identify a route that was both as short as practical and followed as far as possible existing infrastructure so that at least some elements can be reused. Other criteria included the following:

- Minimising overlap with natural interest objectives, tourism and related economic and social sphere, so that the environmental costs are minimized;
- Ensuring that the best available techniques (BAT) were a part of the Project design up for both construction and operational phases
- Use of precautionary principle to avoid and minimise environmental impact;
- Seek to minimise the amount of land acquisition and physical displacement necessary.

Additional considerations were made for how the construction of the pipeline is to be divided between contractors. A decision to divide construction into four distinct sections (described in sections 3.4, 3.5, 3.6 and 3.7) was made on a technical-economical basis, with sections requiring more specialist methods of construction (e.g. whilst the pipeline crosses the Carpathian Mountains) being shorter in length. Note that the last of these sections will be delivered in Phase 2 of the Project.

3.3.1 Crossing the Carpathian Mountains

The crossing of the Carpathian Mountains is the most sensitive and technically challenging area of the route and was extensively assessed. A number of alternative routes were considered including options around Vulcan and options from Baia-de-Arama - Cornereva – Caransebeş and Motru - Topleţ – Caransebes. Whilst the last two routes were 25-30% shorter than the final selected route they would have had a more significant environmental footprint as they would have required access roads and development sites in pristine natural areas including protected areas.

The chosen route option, which followed an older existing route, was preferred because it:

- Would mostly require an upgrade of existing route and replacement of existing pipes and thus pre-functionalization of transport infrastructure by revamping;
- Went through an area with a low density of protected areas so it only overlapped a small number of protected areas; and
- Could use the existing DC 664 road for access, which currently carries little traffic, reducing both cost and impact.

Once the preferred route was chosen, further design changes were necessary to avoid areas of risk of subsidence due to underground mining. Figure 3.2 (in the figures document) shows the initial design route (red line) and the final modified alternative (yellow line).

3.3.2 **Natura 2000 Site Crossings**

The preferred route has also specifically sought to avoid the many Natura 2000 sites within the Carpathian Mountains, as shown in Figure 3.3 (in the Figures Document). Despite this, it does still cross a number of designated sites for around 25km in total, as shown in Table 3.2 below and described further in Chapter 12 Ecology and Nature Conservation.

Table 3.2 Route overview

Site Name	Chainage	Distance	Site Description / Habitats
Pădurea Bolintin (ROSCI0138)	2-4	2km	The route crosses this site designated for groves with white willow (Salix alba) and white poplar (*Populus alba*); and oak (*Quercus*) species and hornbeam. European pond turtle, otter and fire bellied toad are also present.
Valea Oltului Inferior (ROSPA0106)	119	1.3km	The River Olt, which is crossed here, and its surroundings are an important area for resident and migratory birds. During the migration season, around 20,000 water birds inhabit the region.
Nordul Gorjului de Vest (ROSCI0129)	270-284	13.7km	The route passes for 13.7km along the edge of this site which supports beech forest, alpine meadows, cliffs, caves, steep slopes, alpine scrub and gorges. It is also designated for numerous species including large carnivores such as bear, wolf and lynx, bats, amphibians, invertebrates and alpine plants. It also supports 873ha of natural, sweet chestnut forest - one of only two such areas in the country.
Defileul Jiului (ROSCI0063)	282-284	740m	The route passes along the edge of this site (adjacent to the previous site) which supports old stands of beech Fagus sylvatica and oak *Quercus petraea* woodlands with areas of hornbeam and lime within the gorge associated with cliffs and caves. There are also areas of smaller tree and shrub species and it is also designated for bats, amphibians, invertebrates and the Carpathian *tozzia* plant.
Strei – Haţeg (ROSCI0236)	314-318	3.6km	The route passes along the edge of this site (and slightly inland for engineering purposes) for 3.6km. The site supports notable habitats including steppe grasslands, caves and beech, oak and hornbeam forests. The site is also designated for the golden eagle (*Aquila chrysaetos*), collared flycatcher (*Ficedula albicolis*), red-breasted flycatcher (*Ficedula parva*), and the European honey buzzard (*Pernis apivorus*) as well as bear, otter, wolf, bats, amphibians, invertebrates and plants.
Coridorul Rusca Montană - Ţarcu – Retezat (ROSCI0292)	360-363	2.9km	The route crosses this site at the narrowest point where it follows a road for approximately 2.9km. The site includes beech, oak and hornbeam woodlands and spruce forests, but also present are juniper shrubs and rhododendron. It is also important for large carnivores, namely wolf, bear and lynx. Otter and the fire-bellied toad are also present.
Râul Timis între Rusca şi Prisaca (ROSCI0385)	406	740m	Where the route crosses the Timis River it passes through an area of riparian habitat designated for otter, bats, amphibians, reptiles and fish. (including the Hermann's tortoise Testudo hermanni)

* All km distances quoted are taken from the EIA and should be considered approximate.

Despite the crossing noted in Table 3.2, the pipeline route has sought to cross designated sites over as short a distance as practical, this shown as an overview in Figure 3.4. and in more detail in Figure 3.5 (in the Figures Document)

3.4 Section 1: Podișor-Bibești (km 0-180)

3.4.1 Overview

The proposed pipeline will start at the new Podisor GCS, located 22km to the west of Bucharest. The predominant land use within this section is agricultural (mainly arable farming). From Corbu the pipeline continues for the first 40km or so through relatively flat agricultural land before passing into the foothills of the Carpathian Mountains. Here the landscape changes to young, sparse woodland on the hills and villages in the valleys. The section crosses two major rivers, the Olt (119km) and Cotmeana (75km).

Figure 3.6 (found in the figures document) shows the map for this section of the route.

3.4.2 Settlements

This section passes immediately adjacent, or near to, a number of villages as shown in Table 3.3.

Table 3.3 Podisor-Bibesti Settlements

Settlement	Approximate Chainage	Distance to pipeline at nearest point (m)
Dealu	4	0
Marsa	12	136
Poeni	30	210
Purcareni	47	68
Palanga	51	99
Adunati	56	104
Caldararu	61	165
Strambeni	61	131
Urlueni	76	127
Afrimesti	77	0
Zuvelcati	77	152
Corbu	81	0
Chiteasca	95	5
Negreni	96	124
Cherlestii Mosteni	119	0
Mamura	121	144
Valea Caselor	138	154
Mazili	139	88
Sutesti	140	53
Streminoasa	143	0
Magureni	146	47
Gusoieni	147	0
Burdalesti	150	196
Maciuceni	161	115
Oveselu	162	144
Unamed	163	10

Settlement	Approximate Chainage	Distance to pipeline at nearest point (m)
Dancai	166	0
Tetoiu	170	25
Tetoiu	171	64
Zatreni	178	62
Otetu	180	0

3.4.3 Compressor Stations

The Podisor GCS will receive natural gas from Bulgaria and will be constructed on (and surrounded by) agricultural land. There are no villages within 2km of this site which will be accessed via an existing small road leading from the 412DC communal road.

3.4.4 Other Notable Features

Section 1 includes a number of notable features and requires crossings of 43 main watercourses most notably the Rivers Cotmeana and Olt via executing Horizontal Directional Drilling (HDD). Three rivers in this section shall be crossed via the use of cofferdams.

Table 3.4 Other Notable Features

Chainage (km)	Feature	Description
Worksites and Pipeyards		
0	GCS / worksite	
28	Pipeyard	Pipeyard on agricultural fields to north-east of Poeni
61	Worksite & pipeyard	Worksite to the north of Caldararu on agricultural fields
81	Pipeyard	Pipeyard on agricultural fields to east of Corbu
118	Pipeyard	Pipe storage site on arable land south of Cherlestii Mosteni and near to the reservoir and River Olt crossing point.
150	Worksite	The second worksite, including workers' accommodation will be located on existing arable land south of Gusoieni.
176	Pipeyard	Pipe storage site located east of Zatreni (next to an industrial site).
Open crossing of sensitive sites and main watercourses		
2-4	Conservation Area	The Padurea Bolintin Natura 2000 site (SAC) is designated under the Habitats Directive for three habitats (wetland and two types of forest) and four species of wetland fauna
146	Conservation Area	The route passes within 1km to the north of the Dealurile Dragasaniului Natura 2000 site at Magureni (km 146).
HDD and Other Special Methods		
4	National Road	The pipeline will cross national road 61 at Dealu,
61	National Road	The pipeline will cross national road 65A at Caldararu
75	Major River	The River Cotmeana will be crossed using HDD, crossing length 416m
119	Major River & Conservation	Olt River crossing immediately adjacent to the Mosteni hydroelectric dam and downstream of the Strejesti reservoir, crossing length 475m. This is located within the Valea Oltului Inferior Natura 2000 site (SPA) designated under the Birds Directive.

3.4.5 **Access Roads**

In addition to the national roads 61 and 65A, the route will require fifteen access roads to be constructed or upgraded to facilitate construction.

3.5 Section 2: Bibesti –Pui (km 180-320)

3.5.1 Overview

Section 2 predominately crosses the Carpathian Mountains and thus will require more specialist construction techniques, such as increases in the frequency of hammering and reductions in the working strip to accommodate for the terrain. The majority of land traversed is heavily forested, with relatively little agriculture throughout. Additional to the route entering the Carpathian region Section 2 of the Project will cross the River Jui via HDD and enter multiple conservation areas, most notably entering the geo park from km 311. The Bibesti GCS shall also be built to regulate flow and pressure requirements for throughout the section transitioning the Carpathian Mountains.

The route for Section 2 is shown in Figure 3.7 (in the figures document).

3.5.2 Settlements

This section passes immediately adjacent or near some 19 settlements as shown in table 3.5.

Table 3.5 Bibesti-Pui Settlements

Settlement	Approximate Chainage (Km)	Distance from pipeline (m)
Halangesti	187	0
Stejari	192	0
Hurezani	196.	0
Andreesti	207	0
Frasin	210	0
Viersani	215-218	37
Vidin	224	148
Pojogeni	229 - 231	66
Budieni	238	171
Ungureni	238	137
Balanesti	250	0
Tetila	257	0
Sambotin	262	92
Arsura	266	0
Schela	268	0
Lupeni	293	157
Vulcan	297	26
Dealu Babii	298	0
Baru	314	0

3.5.3 Compressor Stations, Worksites and Pipeyards

The Bibesti GCS will be located on land to the east of the village that is currently used for arable farming. The site is bordered to the north and east by residential properties and woodland and a River to the west. Access will be via the existing local road network. Locations of worksites and pipeyards are shown in Table 3.6.

Table 3.6 Locations of Worksites and Pipeyards

Chainage (km)	Feature	Description
212	Pipeyard	This storage site will be located between the villages of Mucsculesti to the west and Frasin to the south-east, on agricultural land. There are no properties within 700m of this site.
262	Worksite and pipeyard	The third worksite, including workers' accommodation will be located between the villages of Turcinesti and Sambotin. The nearest properties are located to the east within 30m. The land is currently used for agriculture and access will be via the existing road network. There is also a storage site for pipelines near to the worksite described above (between the villages of Turcinesti and Sambotin) immediately next to the worksite.
293	Pipeyard	Storage area in Vulcan on a former industrial site, mainly surrounded by agricultural land with the nearest property being 60m away.

3.5.4 Other Notable Features

Table 3.7 Other Notable Features

Chainage (km)	Feature	Description
268	Cultural site	A church located at the village of Schela, which is located ~700m from the pipeline.
270-284	Conservation Area	the Nordul Gorjului De Vest Natura 2000 Site (SCI) designated for 24 different types of habitat, and 34 species of flora and fauna.
282-284	Conservation Area	The Defieul Jiului Natural 200 Site (SCI) is designated for the protection of 21 habitats and 26 species of flora and fauna
311-342	Geological Park	Dinosaur Geo-Park
314-318	Conservation Area	The Strei-Hateg Natura 2000 Site (SCI), is designated for 5 types of habitat and 25 species of fauna. The pipeline also passes within ~80 m of the Gradistea Muncelului-Ciclovina Natura 2000 site.
261	River	River Jiu to be crossed using HDD with length of 424m

3.5.5 Access Roads

The pipeline will also cross 5 national roads (the DN67B will be crossed twice). Eighteen access roads will either need to be constructed or upgraded to facilitate construction.

3.6 Section 3: Pui– Recaș (km 320-479)

3.6.1 Overview

The pipeline continues through the Carpathian Mountains for a further 20km before passing into the Caransebes corridor for approximately 40km. After this it leaves the Mountains and heads towards the western plains following the Timis River corridor up to Recas for another 70km. The predominant land use in the first half of this section is woodland and pasture with orchards and meadows. Further west the landscape becomes dominated by agroecosystems.

The map for Section 3 is included in Figure 3.8 (found in the Figures Document).

3.6.2 Settlements

This section passes immediately adjacent or near some 24 settlements as shown in Table 3.8 below.

Table 3.8 Pui- Recaș Settlements

Settlements	Approximate Chainage	Distance to pipeline at nearest point (m)
Rau Alb	330	51
Barastii Hategului	337	0
Nalatvad	340	130
Totesti	344	206
Breazova	353	246
Sarmizegetusa	354	34
Zeicani	359	119
Bucova	364	0
Unamed	371	0
Valea Bistrei	384	68
Otelu Rosu	391	95
Glimboca	394	56
Obreja	401	78
Iaz	403	87
Jupa	407	216
Prisaca	412	138
Jena	425	141
Gavojdia	428	217
Lugojel	434	209
Lugoj	443	0
Costeiu	451	4
Gruni	455	0
Sanovita	462	203
Petrovaselo	475	162

3.6.3 Compressor Stations, Worksites and Pipeyards

The regulation of flow and pressure requirements will be controlled in this 150km section via the construction of the Jupa GCS at 409km along the route. Worksites and Pipeyards are included in Table 3.9.

Table 3.9 Worksites and Pipeyards

Chainage (km)	Feature	Description
368	Worksite & pipe storage	The fourth worksite including workers' accommodation will be located approximately 500m south of the nearest properties that make up the village of Bucova. The site will be at a high elevation, uphill from the village on land currently used for agriculture.
404	Pipe storage	Located on agricultural land approximately 1.5km from the nearest property in the village of Iaz, the work site will be accessed using existing road infrastructure.
439	Pipe storage	The second storage area is located to the east of the town of Lugoj and north of the River Timis and is also on agricultural land. The site is accessed via an existing road. There are no properties within 1.3 km.

Chainage (km)	Feature	Description
470	Worksite	The fifth worksite including worker accommodation is located 4.8km to the north-east of Recas city and 300m north of Petrovaselo village. The site is currently arable farmland.

3.6.4 **Other Notable Features**

Within Section 3, the route will require HDD to facilitate the crossing of 50 main watercourses and six rivers, including the Rivers Mare, Timis (twice), Spaia, Glavita, Bega and Chizdia. Table 3.10 lists the notable features to be crossed in Section 3.

Table 3.10 Other Notable Features

Chainage (km)	Feature	Description
342-364	GeoPark	The pipeline continues through the Dinosaur Geo-Park from km 342 to 364.
354	Cultural Heritage	The historic capital of Dacia (the town of Sarmizegetusa). The route is diverted at this point by approximately 3,500m to the north of the existing village to avoid this site
360-363	Conservation Area	Coridorul Rusca Montana – Tarcu - Retezat Natura 2000 site (SCI), designated for 6 habitats and 6 species of fauna.
406	Cultural Heritage	Dacian site of Tibiscum covering 17 hectares, resides next to the River Timis with HDD being used to cross both of them in one drilling
450	Conservation Area	The pipeline also passes within ~700m of the Lunca Timisului Natura 2000 site (SCI).
338	Major River	HDD of River Mare, crossing length 457m.
406 & 437	Major River	HDD of Rivers Raul Timis, crossing length 867m and 384 respectively
429	Major River	HDD of River Spaia, crossing length 323m
465	Major River	HDD of River Glavita, crossing length 326m
459	Major River	HDD of River Bega, crossing length 375m
460	Major River	HDD of River Chizdia, crossing length 325m

3.6.5 **Access Roads**

Fourteen access roads will either need to be constructed or upgraded to facilitate construction.

3.7 Section 4, Phase 2: Recaș-Horia (km 479-528)

3.7.1 Overview

The final 50km of the pipeline (to be developed in Phase 2), will head northwards across the western planes. The dominant land use is agriculture (arable farming) although from approximately km 488 to 493, the route passes through forested land. There are no designated sites within this section. The Route Map is shown in Figure 3.9 (in the figures document).

3.7.2 Settlements

This section is expected to pass near five settlements, but only two, Herneacova (481km) and Remetea Mica (494km), are expected to be within 50m of the route.

Table 3.11 Recaș-Horia Settlements

Settlements	Around Km Point (as per BRUA point marker)	Distance to pipeline at nearest point (m)
Herneacova	481	44
Salciua Noua	487	230
Remetea Mica	494	28
Masloc	499	152
Fantanele	514	208

3.7.3 Other Notable Features

No GCS are proposed for Section 4 of the pipeline. The pipeline will cross five main watercourses, with only the River Mures requiring HDD. HDD approaches are proposed where the pipeline will cross seven national roads and two highways. At this stage, there is no need for any additional access roads to be either constructed or upgraded to facilitate construction within this section. Table 3.12 lists the notable feature of Section 4.

Table 3.12 Notable features of Section 4 of the route

Chainage (km)	Feature	Description
470	Worksite	The fifth worksite including worker accommodation is located 4.8km to the north-east of Recas city and 300m north of Petrovaselo village. The site is currently arable farmland
513	Pipeyard	A second pipe storage area is located approximately 1.5km to the south of the village of Fantanele, also on existing arable farmland.
517	Major River	HDD will be used to cross the River Mares, crossing length 411m

3.8 Other Alternatives Assessed

3.8.1 Local Diversions

In general, the pipeline will run parallel with the existing pipeline transportation systems of south-west Oltenia (two pipelines) and/or the National Gas Transmission System (three pipelines). In a limited number of sites the pipeline will deviate from the existing routes in order to meet safety or environmental requirements. Local routing alternatives where the pipeline will deviate from existing Rights of Way (RoW) are listed in the Table 3.13

Table 3.13 Alternative Deviations

Section	Chainage (km)	Scale of deviation
Section 1	15 - 16	Slight deviation (max 0.5 km south)
	57 – 63	Slight deviation (max 400m south)
	75-76	Slight deviation (max 0.25km north)
	82-85	Slight deviation (max 0.4km north)
	87-106	**Major deviation (max 4.8km north east)**
	106-137	Pipeline follows a new route to avoid clustering all the pipelines in one section when crossing the River Olt.
	155-156	Slight deviation (max 0.7km north)
Section 2	180-184	Slight deviation (max 0.6 km north)
	185-186	Slight deviation (max 0.2 km north)
	196-198	Slight deviation (max 0.5 km south)
	200-202	Slight deviation (max 0.5 km south)
	209-261	**Major deviation to locate route nearer to the main transport network.**
	263-281	**Major deviation to locate route nearer to the main transport network.**
	292-295	Slight deviation (max 1.3km west)
	313-318	**Major deviation to avoid the village of Baru.**
Section 3	364-377	**Major deviation (max 1.4km south) to avoid Bucova village.**
	386-387	Slight deviation (max 0.5km south) to avoid Otelul Rosu city.
	390-391	Slight deviation (max 0.5km east) to avoid Otelul Rosu city
	408-409	Slight deviation (max 0.25km west)
	411-413	Slight deviation (max 0.25km west)
	413-423	Slight deviation (max 0.7km west)
	429-433	Slight deviation (max 0.25km north-east)
	435-438	Slight deviation (max 0.5km south) to avoid the city of Lugojel
	443-448	Slight deviation (max 0.65km north-east)
	449-452	Slight deviation (max 0.8km north-east)
Section 4	494-498	Slight deviation (max 0.4km west)
	515-525	**Major deviation to facilitate crossing the River Mures (max 1km).**

Examples of deviations from existing pipeline infrastructure are shown in Figure 3.10

3.8.2 Construction Alternatives

Two key alternatives were considered i.e. use of surface or buried pipelines as shown in the table below.

Table 3.14 Alternative construction approaches

	Surface Pipeline	Buried pipeline
Advantages	• Lower construction effort and cost.	• Lower impacts over the operational lifetime.
Disadvantages	• Greater social impact and fragmentation of crossed areas. • Additional long-term compensation costs for property rights. • Pipeline needs to include expansion curves and access to adjacent structures. • Safety implications in operational phase. • Greater operational impacts on landscape. • Greater operational impacts on loss of functions (agricultural, natural, etc.) and biodiversity: creating a major artificial barrier.	• Construction requires more financial logistical and human effort.

Overall, whilst the financial resources required for a below ground pipeline were greater, this solution was preferred as it has a reduced environmental impact (especially regarding habitat fragmentation) over the lifetime of the project. Regarding construction alternatives, the project does not involve complicated techniques or technologies so standard practices will be employed, unless otherwise highlighted below or elsewhere in this document. HDD has been specified for crossing of sensitive water courses or major communication routes where constraints have required it.

3.9 Specific Design for Sensitive and Hazardous Areas

3.9.1 Natural Hazards

The pipeline has been designed to meet all national codes regarding hazardous areas such as seismic activity, karst areas, landslip and quicksand. This is discussed further in Chapter 7: Geology and Geomorphology.

3.9.2 Crossings of Watercourses and Infrastructure

The majority of rivers will be crossed at times of low flow, with wet cut methods generally used (only 10 rivers to be crossed by HDD) as outlined further in Chapter 9 Water Resources. Hydrological studies of these water courses have been done previously and BRUA has access to these studies. Table 3.15 lists the watercourses crossed by the entire pipeline route.

National roads, county roads, local roads and railways will be crossed by HDD and only private roads (27 in total) will be crossed using an open cut approach, with the permission of the owner. All other roads will be crossed by HDD, to avoid road closures, under an appropriate permit (national county and highway roads are under national administration; other roads are administered by local councils). In order to obtain permission, a design must be submitted and approved by the relevant authority and police department. It will take a maximum of three days to cross the road (e.g. in the case of a highway).

Further information on crossings methodologies is included under Chapter 4: Construction Approach and Methodology.

Table 3.15 List of watercourse crossings across the entire pipeline route

Section	Chainage (km)	River	Crossing Length (m)	Description
Section 1	76	Cotmeana	416	A tributary of the river Vedea in Romania and discharges into the Vedea in Bădești.
	119	Olt	475	Longest river flowing exclusively through Romania. Its source is in the Hășmaș Mountains of the eastern Carpathian Mountains, near Bălan
Section 2	261	Jiu	424	formed south of Petroșani, with headstreams rising in the Vâlcan and Parâng mountains. It then flows south, cutting, deep gorge, the Surduc Pass in the Transylvanian Alps (Southern Carpathians), before flowing onto the Danube Plain and into the Danube River.
Section 3	338	Raul Mare	457	The Râul Mare is a left tributary of the river Strei
	406	Timis la Jupa	867	A 359 km long river originating from the Semenic Mountains in the southern Carpathian Mountains, Caraș-Severin County, Romania. It flows through the Banat region and flows into the Danube near Pančevo, in northern Serbia.
	429	Spaia	323	Tributary of the river Timiș. It discharges into the Timiș in Gavojdia.
	437	Timis la Lugojel	384	BRUA crosses the Timis the second time to the south-east of Lugoj.
	465	Glavita	326	Tributary of the river Bega and discharges into the Bega near Chizătău. Its lower course is part of the Coșteiu-Chizătău Canal between the Timiș and the Bega
	459	Bega	375	A 254km long river in Romania and Serbia. It rises in the Poiana Ruscă Mountains in Romania, part of the Carpathian Mountains, and it flows into the Tisa river near Titel, Vojvodina, Serbia
	460	Chizdia	325	Right tributary of the river Bega in Romania. It discharges into the Bega near Chizătău
Section 4	517	Mures	411	The Mureș is a 789km river in Eastern Europe. It originates in the Hășmașu Mare Range in the Eastern Carpathian Mountains, Romania, rising close to the headwaters of the Olt River, and joins the Tisza at Szeged in southeastern Hungary.

3.10 Above Ground Installations

3.10.1 Interconnection Points

The following interconnection points are proposed:

Table 3.16 Interconnector Points

Interconnection points	• NT Podișor: by Podișor – Giurgiu pipeline and a control valve; • NT Corbu: by Line III Corbu-Hurezani pipeline and a control valve; • NT Hurezani: by contol valve; and • NT Recaș: by control valve.
Upgrading of Horia Gas Metering Station	Addition of a supplementary metering line. This upgrade leads to a metering capacity of the station of 500,000 Smc/h.

3.10.2 GCS

Three GCS will be built at Podișor, Bibesti and Jupa. The GCSs are located where additional pressure is required following pressure drops along the pipeline. Each Compressor Station will contain eight main buildings: Compressor Building A, Compressor Building B, Fuel Gas Building, Oil Building, Workshop and Warehouse Building, Administration Building, Electric Building, and Firewater Pumps Building. Further for Stage 1, each GCS will have a total installed power of 10 MW (1 x 5 MW active compressor + 1 x 5MW compressor idle as backup). During Stage 2, a supplementary compressor group will be added at each GCS, thus for each GCS will end up with three compression groups, two in permanently active and one as backup. Each GCS will therefore have a total installed power of 15MW (2 x 5 MW active compressors + 1 x 5 MW compressors idle as backup). Detailed technical specifications for the compressor groups had not been finalised by the time of drafting the SEIA, however, given new compressors / turbines will be used, emissions are expected to be low and well within legal limits.

The following technical details are available for the GCSs:

- **Manning**: The GCS's have been designed for its control unit to be operated by 6 personnel during the Operational Phase. Only during maintenance periods will people will be expected at the GCSs. Although this may vary, maintenance periods (which take approximately one month) are anticipated at each GCS once every two years. During these periods, approximately 20 people are expected to be working / using the facilities at the GCSs (using electricity, water / producing wastewater etc.). During the rest of the time, during the operations phase, 6 people are expected to be able to operate each GCSs.
- **Power**: The GCSs will not use electrical power from the grid for the functioning of the compressors because transmission demands safe supply, which cannot be ensured in Romania, and could become extremely expensive. Therefore, the most appropriate alternative is the installation of centrifugal turbo-compressors, powered by gas-turbine engines. These turbines will have a 30% efficiency, which is considered good considering the range of power necessary. A fraction of the gas flowing through the pipeline, estimated to be between 20000 and 400000 Sm3/day (most likely around 30000 Sm3/day), will be diverted and directed to the gas-turbine engines, which will produce energy for the functioning of the centrifugal turbo-compressors. The gas from the pipeline will be used exclusively for this purpose, and electricity to satisfy all other needs within the GCSs will be provided from the grid, as per further described below. Although still in study, it does not seem feasible to re-use the heat from the exhaust gases for any purpose (e.g. combined cycle or heating). For Jupa's GCS, however, an electric gas fired generator will be installed that will be capable of providing the necessary power for normal operation of the compressor station if primary power goes off. No water is expected to be used as cooling system for the gas turbines, but rather air cooling systems, for what no issues are expected related with the use and discharges of cooling water.
- **Utilities**: As mentioned above, in order to meet the electrical power requirements for the operation of each GCS (except for the functioning of the compressors themselves), these will be connected to the power network. This will require the construction (extension) of new overhead electricity transmission lines and Transformers. Regarding Jupa GCS, a small 10m overhead line extension will be enough. However, with regards to Podișor and Bibesti GCSs, approximately 1,000m long overhead power lines (16 poles) will be necessary. For each GCS, two alternative lines will necessary, one active and one backup, the latter to ensure the necessary power to the GCSs in the case there is a power failure. If it is not possible to have two alternative lines, there will be one line and a gas power generator. Each of these lines will connect to a Transformer located in the limits of the GCSs, which will transform power from 20kV to 0.4 kV. Overhead lines and Transformers will be built by the electricity provider, not by the BRUA Project. However, it is not clear at this point whether this will be financed by the BRUA Project or by the electricity provider (in which case these could be considered associated facilities).
- **Uninterrupted Power Supply**: All compression stations are also equipped with uninterrupted power supply that assures power supply to stations when the automatic transfer switch of power generators assuring (redundant) alternative power supply to stations is off. Redundant power supply to stations is ensured by electric gas fired generators, sized so that when power is off there is the ability to provide the necessary power for normal operation of the compressor station. In addition, for each compressor station there are two electric diesels fired generators installed that may be put into operation in extreme cases such as major breakdowns, when there's no electrical

connection anymore, and gas pressure for said section is insufficient, or the gas turbine is out of order. Diesel fired electric generators (one active and a backup) will be sized so as to ensure on their own the operation of the entire plant.

- **PIG stations**: As a minimum, PIG Stations would be located in each of the GCSs (there could be more). The use of these stations is associated with the cleaning / maintenance of the pipeline. The frequency of cleaning depends on the operation, quality of the gas, etc. Maintenance uses a piston within the pipeline which will move along the pipeline cleaning it as the pipe remains operational. The piston is collected at the following Station.
- **Water supply**: The GCSs are designed to account for 20 people, which is considered the maximum number of people at the GCS during maintenance periods. The water requirements to Bibesti GCS will be satisfied though the connection to the existing water supply network from Hurezani and will be used for firefighting, hygiene and consumption. With regards to Podisor Jupa GCSs, local solutions for water supply (for drinking water and firefighting water) have been designed, and water from boreholes is expected to be used. Water taken from the boreholes will be treated via an onsite water treatment plant and then pumped into water tanks for use.
- **Wastewater**: The GCSs will utilise local wastewater treatment plants. After treatment, the water is directed to a reservoir, which will allow for the possibility of collecting water samples for analysis before discharge. If the water quality is not good (results are not compliant), the water will go back to the treatment plant, and only if all is good the water will be discharged to sewerage system / rivers: Bibesti GCS: Amaradia sewerage system; Jupa GCS: Timis river; Podisor GCS: Ilfovăţu – already existing channel.
- **Hydrotesting** will not be carried out at the GCSs, as the water can damage the compressors. Nitrogen is expected to be used to test those sections of the pipeline.

For each GCS, the detailed solutions are summarised within Table 3.17.

Table 3.17 Access, Drinking Water and Power options for the 3 GCS's

	Podisor	Bibesti	Jupa
Chainage	Km 0	Km 196	Km 409
Size (m2)	40808	42770	42775
Access	From county road DJ 412 B from Podişor by creating a derivation, to be asphalted for the entire length of the compressor station	From a technological road, 285m length, emerging from DJ661 or the existing local road East of the station site	From a paved road leading to Tehnocer SA Caransebes gravel pit, related to DN6 (about 550m) or direct connection to the national road DN 6
Drinking Water	Water will be taken from localised boreholes to meet the Plants water demand	From the existing local network of Bibeşti village at a distance of approx. 420 m.	Water will be taken from localised boreholes to meet the Plants water demand
Power	From the existing medium voltage 20 kV network; at a distance of 2,100m or 1200m away	From the existing medium voltage 20 kV network. 600 m or 1,320 m from Hurezani gas compressor station	From the existing medium voltage 20 kV network at a distance of about 550m.

The layout is shown in Figure 3.51 (in the figures document)

3.10.3 **Valve and CP Stations**

A number of block valve stations (BVSs) will be required for the Project. At this stage of engineering it is envisaged that there be approximately 22 BVSs with a maximum distance of 30 km between them, although details will be finalised once the pipeline Preliminary Risk Assessment, and operation and maintenance are agreed. For the BVS with cathodic protection we have a maximum surface of 320 m2, and for the simple BVS is maximum 70 m2, including the adjacent access roads. A total of 2.17 ha will be required for BVS's and their associated access roads. The valves will be remotely operated and fenced, and above ground components are limited to some monitoring components and energy supply equipment (diesel emergency generators and solar panels).

Gas taken over through Podişor GCS from the pipeline systems that will make the connection with the Romania-Bulgaria Interconnector, will be transported through the pipeline system to SC Bibeşti where transportation will continue to SC Jupa, which in turn will manage the volumes to the pipeline systems that will assure the connection with the Romania-Hungary Interconnector. Please note that the entire system will be bidirectional. BRUA will assure bi-directional gas flow helping thus balance the regional gas consumption. Figure 3.11 (found in the Figures Document) demonstrates the layout of the GSC at Bibeşti.

3.11 Pipeline Operation

The proposed pipeline has a design life of a minimum of 40 years of safe and technologically efficient operation with no overhauling and major maintenance works. Some maintenance and upgrading works for ancillary components (valves, compressor stations, etc.) will be needed according to the technical prescriptions, aimed to extend the safe operation of BRUA.

3.12 Pipeline Decommissioning

At the end of its life the pipeline will be decommissioned in accordance with national requirements and good international industry practice (GIIP) in place at the time. Such works are expected to include the demolition / dismantling of above ground installations (buildings, platforms, technological enclosures, etc.) and the reinstatement of land to its original state unless another use is preferred. The pipelines are also expected to be removed if no longer required and the land returned to its original state, in line with the approach taken during construction (see Chapter 4). Impacts are expected to be similar to those identified for the construction works. In some areas (e.g. within Natura 2000 sites) it may be preferable to leave the pipeline in situ, but this will be agreed at the time of decommissioning.

3.13 Project Timeframe

Construction of the Phase 1 Project is planned to run from Q3 2017 to Q4 2019, with commissioning planned for December 2019. The operational phase is expected to be at least 40 years without any requirement for major overhaul or maintenance works for BRUA.

4 Construction Approach and Methodology

4.1 Introduction

This Chapter outlines the approach and methodology to be adopted by the construction teams during the project implementation. This information has been used to indicate the likely nature and extent of the main environmental and social impacts associated with the pipeline construction, and will inform the codes of practice that contractors will be required to use in order to avoid, reduce or compensate for such impacts. Common practices regarding such mitigation are outlined in Chapter 5 (Project Approach to Environmental Protection) with specific mitigation included in the relevant specialist chapters. The mitigation measures will be incorporated into bidding documents and the contractual conditions for construction, although successful bidders will have some leeway in determining how the mitigation is delivered.

4.2 Pipelaying Methodology

4.2.1 Overview

Pipelaying will be undertaken through a series of processes as outlined in the "Technical rules for design and execution of gas pipelines", as approved by A.N.R.E. Order no. 118/2013. Permits will be obtained for all works on the working strip, including for natural and public obstacles crossings. The proposed working strip width is 21m (Figure 4.1). Where the pipeline route enters forests, orchards and difficult areas, the working strip will be narrowed to a minimum of 10m.

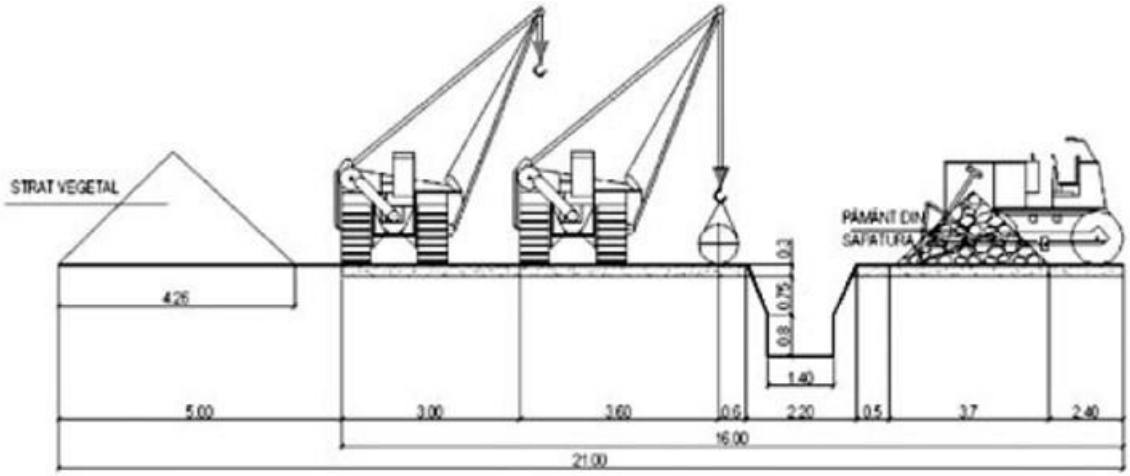


Figure 4.1 Arrangement of working strip, 21m width

An indicative list of the expected working strip widths throughout the project is given below (Table 4.1), however these figures are maximum widths and are changeable to protect receptors throughout the route.

Table 4.1 Expected working strip widths throughout the project

Sensitive Area	Working strip Size (m)
Orchards	14
Vineyards	14
Forested Areas	14
Natura 2000 sites	21 and 14 forest areas
Geo Park	21 and 14 forest areas
Urban Areas	14 to 10

Sensitive Area	Working strip Size (m)
Steep inclines	21/14
Water Crossing	21 on river banks

The pipeline will be installed to a depth of 1.0m below surface level (assumed to be frost depth), except where the route intersects communication channels, where the depth will meet the requirements of STAS 9312/88 (at least 1.5m). Watercourse crossings will be performed either by digging an open trench or by HDD (Chapter 9 Water Resources). Where the pipeline crosses water courses that are not registered in the Land Register, the depth of the pipeline will be below the scouring quotas established by the hydrological study to be presented in alignment sheets. Exterior corrosion protection will be made by isolating corrosive polyethylene HDPE grade B2 and B3 according to EN ISO 21809-1 for the entire route. The route by-passes built up areas, except in areas where for technical and economic reasons by-pass is not possible, where the pipe will be placed along the existing pipelines route.

4.2.2 Overview of Construction Methods

Construction will involve a series of general activities as described below, together with specialised techniques that will be used to cross sensitive features such as roads and watercourses. Pipeline construction is a sequential process and comprises a number of distinct operations, as shown in Figure 4.2 and Figure 4.3. Whilst final construction techniques will be determined during the detailed design they can be broadly categorised under the following five headings:

- **Team 1:** Route surveying, preparation of the working strip, top soil stripping and grading.
- **Team 2:** Pipe stringing, bending and welding.
- **Team 3:** Trench digging.
- **Team 4:** Pipe laying, installation and backfilling.
- **Team 5:** Site clean-up and restoration.

The works to construct the pipeline will be broken down into manageable lengths called “spreads”, and will utilise highly specialised and qualified work groups. The overall construction period is estimated as 31 months, including detailed engineering and pipe laying. The estimated laying rate ranges from 72m per day in mountainous terrain to up to 600m per day in flat terrain. There will be several working teams at the same time along the route. A detailed working schedule will be developed in line with the tendering procedure.

Each of the spreads will consist of five work teams carrying out a number of different activities that will operate along a rolling work front approximately 25km in length. Figure 4.2 and Figure 4.3 show how the work teams will be broadly organised and the equipment that will be used for each of the activities carried out within each of the spreads. Figure 4.4 and Figure 4.5 show examples of photos of the typical equipment that will be used during construction and a schematic diagram that illustrates the rolling sequence of operations that will be carried out by each work team.

4.2.3 Pre-Construction Works

Before construction commences a number of activities will be undertaken. The first of these is land acquisition requires for permanent Project structures and to allow for operations, maintenance and emergency access throughout the operational life of the pipeline. A major criterion of the project design has been that, as far as is practical, permanent infrastructure should be sited on unused land of no particular ecological or cultural value. Where this has not been possible, effort has still been made to avoid land on which there are dwellings or public infrastructure, or which is of high value as a habitat or for agriculture.

In parallel with land acquisition, and before starting any construction work, topographic and photographic records will be made of the existing condition of the pipeline route and the access roads. These records will be used as the standards against which the quality of the restoration work will be judged following completion of construction. The exact pipeline route will first be pegged out, while simultaneously staking out the width of the working strip on both sides of the route. Obstructions such as walls, fences and paths will be disturbed by the minimum amount necessary for safe working. Wall

material will be carefully dismantled and stored for reuse. Records of buried facilities such as drains and irrigation pipe locations will be prepared and verified with the landowner/user to prevent accidental damage during pipeline construction. Existing third-party services will be located, marked, and either safeguarded or diverted. Warning posts will be erected for overhead cables, and temporary crossing points clearly identified. Other pre-construction site activities will include assessment of construction material quantities; assessment of specific construction methods; and installation of construction site and worksites. Environmental and archaeological specialists will accompany the survey crews to clearly mark/flag sensitive environmental and archaeological sites.

4.2.4 Clearance of the Right of Way (RoW)

Following the pipeline route survey, pipe centreline (typically offset to one side of the working strip) and boundary mark out and survey, the RoW will be cleared and levelled. This will involve removal of structures and vegetation from the RoW and then stripping of topsoil (and associated plant life and seed stock) from the working strip by suitable earth moving equipment. The topsoil will be stockpiled in the form of a continuous ridge along the edge of the strip typically no higher than 2m to prevent degradation of the soil and will be kept free from disturbance to reduce the possibility of physical damage and compaction. The working strip will then be levelled, using typical construction site machinery, to eliminate irregularities, large stones, tree stumps and other features. All timber gathered as a result of RoW clearance will be passed on to local forestry authorities.

The topsoil will be deposited on one side of the working corridor where it will be stored in such a way that it is not mixed with other trenched materials or driven over by vehicles. If the topsoil requires long-term storage, then aeration and raking up will be carried out regularly to avoid compaction. The works to this stage can be summarised as in Table 4.2.

Table 4.2 Summary of Works

Activity	Description
Access to work fronts by making temporary ways (technological);	Using existing road networks, a brief systematisation and (where necessary) improvement will be assumed in order to ensure access to working areas. Where such access routes cannot be identified, temporary access routes to the working areas will be created
Site organisation and ensuring the appropriate technical and urban amenities:	Along BRUA five site organisations were defined, to be located in close proximity to roads (DN, DJ, DC), so as to efficiently solve logistic issues. Within these perimeters in the area of about 10.000sqm temporary structures (containers) and storage shelters for equipment, machinery and materials (pipes, sand, etc.) will be installed.
Delineation of working areas, providing temporary protection regimes and their corresponding signalling;	Transposition in site of demarcations corresponding to the fronts of work, the site organisation and technological perimeters will be achieved by field measurement (metal poles painted in contrasting colours, with warning inscriptions) demarcation with plastic strips (nylon) and signalling by means of informative panels; points with higher levels of risk shall be signalled accordingly, limiting the access as stated by legal provisions and technical security standards.
Area clearance within the working area;	Within the targeted perimeter, a brief inventory of pre-existing elements (temporary/artificial structures, fencing etc.) will be carried out, and proper solutions (relocation, financial compensation, etc.) will be adopted in order to clear the way for the works and to avoid all litigation with owners / managers of land.
Removal of vegetal cover, including deforestation works where necessary;	Depending on the structure of the vegetation, removal actions (mowing, clearance deforestation, etc.) will be initiated. Herbaceous vegetation will be mowed, dried and stored in haystacks and vegetation shrubs and woody plants will be grinded and the resulting material will be stored temporarily in the immediate proximity in stacks of compost (mixed with topsoil or deep-soil). When works are finalised, the organic material will be used in order to recover the topsoil level, accelerating the process of ecological restoration.

Activity	Description
Stripping topsoil layer (on about 30 cm);	Topsoil will be stripped and bulldozed on a depth of up to 30cm. Topsoil will be deposited into stacks located on one edge of the site, and will be used in order to recover the topsoil level after the finalisation of works.

4.2.5 **Excavation of the Trench**

Workmanship of the trench for pipeline mounting will be determined by the characteristics of the terrain, excavation volumes, facilities and constructor equipment. The excavation of the trench will typically be done mechanically by rotary excavators and Castor type excavators, in areas where access is possible, as well as where the movement of large volumes of soil is required. In some cases, it may be done manually, including in areas where the pipeline is to be laid a small distance away from other gas or sewerage pipelines, underground facilities or telecommunications or electricity networks, where there is no access for excavation plant, or where specific requirements are identified regarding archaeological sensitivities.

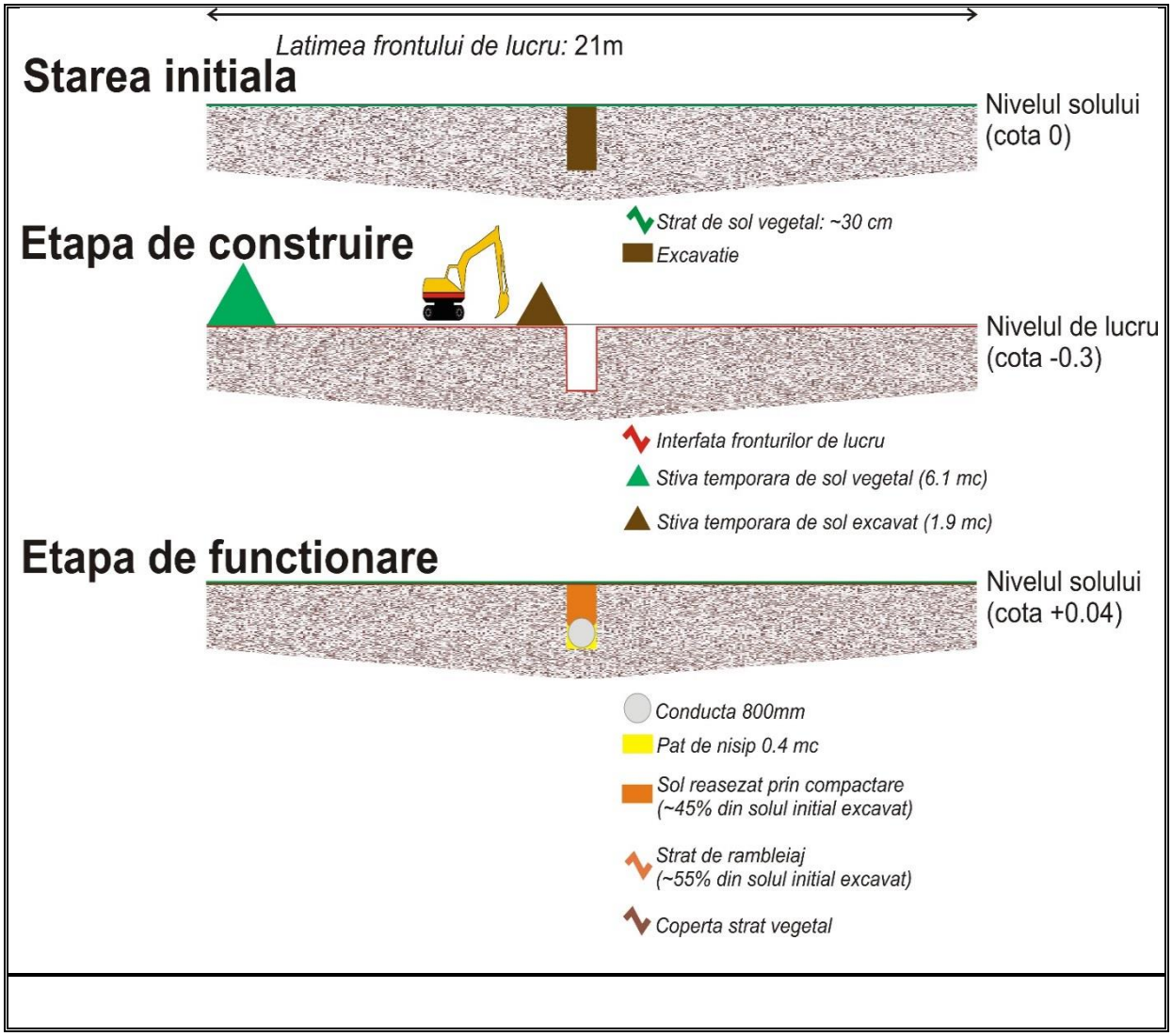


Figure 4.2 Functional scheme of the technological process for pipeline laying

Figure 4.3 Image of a working strip for gas pipeline laying

Trenches will generally be 2m deep, but when determining the depth of the trench consideration will be paid to the fact that pipeline will be permanently laid below frost depth, i.e. at a depth of 1.00 m measured from the ground surface to the upper generatrix of the pipeline, except for crossings of communication channels, where pipeline will be laid at a depth of at least 1.50 m. Also, the depth of pipeline laying will vary from one case to another, but not less than 1.00 m up to pipeline upper generatrix, in cases where it intersects other underground pipelines and equipment (water pipelines, sewers, etc.). The trench will be approximately 1.6m -1.8m wide at the base and will be excavated to the requisite depth by an excavator or specialised trenching equipment. The excavated subsoil will be placed adjacent to the topsoil pile but separated to prevent mixing. A maximum period for leaving trenches open has been set at 30 days for the project.

4.2.6 **Pipe Stringing, Bending and Welding**

The pipeline will be constructed from approximately 12m long sections of steel pipe. The individual sections will be transported to the working strip from the pipe storage yard in the construction site. This activity involves transporting the pipes from the storage areas and positioning them along the RoW. This operation will be carried out using side-booms and tracked vehicles suitable for pipe transportation. The pipe will be unloaded with a mounted pipe-layer crane, and side boom, and placed end-to-end alongside the future trench, taking special care not to damage the pipe.

Pipe bending will generally be done during manufacturing and no specific bending is expected on site. However, should such work be needed, before the pipe is prepared for welding, a bending crew may be used on occasion to bend the pipe in place where necessary to match terrain contours using many small bends along the length of a pipe section until the desired summary bend angle has been achieved.

The pipeline centreline will be surveyed with bending limitations in mind. Where the bend cannot be made gradually enough to meet specific conditions, a prefabricated factory bend will be inserted into the pipeline. These conditions will, however, be identified prior to construction. The individual sections of pipe will be welded together to form the pipeline. The weld will consist of several passes (layers) depending on the pipe wall thickness. The pipes will be joined together using a motor-driven welding machine by a continuous wire arc welding process. Pipes will be connected by electric butt welding by rotation, to create the sections, and on site (in the ditch) to create the line of the pipeline. All full line butt welds and curves will be insulated with heat-shrinking sleeves or cold applied tapes (reinforced insulation). Above-ground parts of plants along the pipeline will be protected by applying a layer of anti-corrosive primer and two coats of paint.

Pipes will be joined by connecting and welding several pipes so that a pipes string is formed and placed on temporary supports along the edge of the trench. The weld will be tested by Non-destructive Testing (NDT) with radio graphic inspection, and any test results of questionable quality will be retaken. Any welds indicating defects will be remedied by repair or replacement. In this eventuality, the weld will be re-tested. After the welds have been checked, tested and approved, the coating crew will clean the exposed steel section at the joint between the pipes, sand-blast the steel, and apply a protective coating to it. The coating will be heat-shrinkable polyethylene sleeves around the pipe. The pipeline will be examined for coating damage after installation. The entire pipeline coating will be electronically inspected, using Direct Current Voltage Gradient (DCVG) or any equivalent technique, to assess the condition of coating to locate and repair any coating faults or voids.

When assembling welded pipes consideration will be paid to EN ISO 9692-1: 2004 and EN ISO 9692-2: 2000. Pipe welding assembly will be made in accordance with API Std. 1104-1105. In order to eliminate surface defects and areas of geometric errors in all phases of execution of welded joints, inspection will be carried out by the following: welder, foreman; QC authorized personnel; welding responsible. All welds will be checked visually and by non-destructive methods (at 100% rate). Weld control will be performed by use of gammagraphy or ultrasound method.

4.2.7 **Pipe Laying, Checking and Backfilling**

Assembly and laying of the pipeline in the trench it’s final position will involve laying sections joined by electric welding in full line on the side of the trench and definitive laying in the trench followed by pipeline assembly in the trench, in final position, will be made by on site by welding performed "in place" in the pits position. Pre-installation operations for the pipeline include:

- Checking and correction of the trench bottom, to be formed only by straight sections between two adjacent pits positions and to contain no hard objects that could damage the pipeline insulation;
- Checking of insulation;
- Arrangement of profiling between pipeline and trench; and
- Checking of launching devices.

The technical solution for pipeline's preparation before lancing requires special devices for anchoring. The pipeline's preparation before lancing will be done on horizontal surfaces. The lancing of the pipe in-trench in slope areas is done starting with the top of the slope.

Pipeline laying will be made in previously dug trench, using launcher type TL.4 mobile cranes. Changes in direction, both horizontally and vertically, will be made through CMF curves (minimum 5 x DN). To avoid exceeding of material elasticity limit during pipeline laying, pipeline will be laid with observance of the following conditions:

- Maximum 15m distance between launchers; and
- Maximum 1.5m lifting height for pipeline during the laying process.

To further reduce tensions and thermal expansion and to avoid damage to the insulation, final pipe fitting and positioning is recommended to be made at an ambient temperature of approximately 10-15°C (in the morning during the summer or midday during winter).

Figure 4.4 Schematic view of gas transmission pipeline laying

Figure 4.5 View from construction site

The welded pipeline will be raised off the skids and lowered into the trench by a team of side boom operators. All rock will be removed from the trench prior to the lowering-in operation. It will be ensured that in any case only stone-free material will be used for bedding the pipe sections. In areas of rocky terrain, sand or sieved backfill material will be placed in the bottom of the trench and on both sides of the pipe for protection purposes.

Before the pipe section is laid in the bottom of the trench, the insulation will be re-tested. Following pipe laying the wooden skids or sand bags will be moved to the next trench section. All other debris will be removed from the site and the trench will be inspected to ensure that no debris has fallen in.

Backfill will normally be placed over the pipeline immediately after the pipe section has been lowered into the trench. Backfill material in the direct vicinity of the pipe will be compacted in layers. A backhoe loader will be used to replace the excavated material into the trench to cover the pipe. Extreme care will be taken with the initial fill to avoid damage to the coating. After the initial layer of screened material is placed into the trench, the remaining soil and rock mixture will be replaced to complete the backfill. In order to avoid any damage to the pipeline coating and the bottom of the trench, the padding material will consist of well graded, sandy material. Trenching material not used for backfilling will be removed and disposed of according to legal requirements.

Post pipeline laying operations include checking and insulation of all welds performed in pit position; and execution of pressure tests after filling of pipeline trench. Resistance test will be done by either pneumatic or hydraulic methods. Details of hydrotesting are provided in Section 4.3.

4.2.8 **Restoration of the RoW**

After completion of backfill, the restoration operation will begin. The removed top soil will be placed back on the working corridor. The original contours of the land will be restored as closely as possible. As part of the restoration process, all equipment access crossings will be removed. Particular care will be taken to ensure that land drainage infrastructure, access roads, other networks and facilities, and vegetation, which were disturbed/ moved during construction, will be reinstated to their former state. Photographic records will be made of the route, where necessary, before and after the works. If required, the final step will be the establishment of access barriers to prevent trespassing on the RoW at appropriate points. All posts and markers will be located to minimise interference with agricultural activities. Cathodic protection system test posts will be installed. The final stage in the pipeline construction process, once reinstatement is established, is the removal of temporary fencing, where it has been installed. Soil quality data has been collected across 500 land plots along the BRUA route, which will help ensure adequate levels are reached in the restoration process.

It should be noted that filling of pipeline trench with soil after laying will be performed manually and mechanically, according to the *"Technical regulations for the design and execution of gas transmission pipelines*", approved by Order A.N.R.E. no. 118/2013. Filling of pipeline trench will only be performed after checking and insulation of all welds performed in pits position; installation of potential outlets and drainage vents (where applicable). Filling the trench will be performed with soil

from excavations that is stored on the side of the trench, and then finally the topsoil, that was stored separately, will be added. In farmland areas after trench filling, the topsoil will be reinstated so that after compacting the land is reinstated to its initial state.

Where there are undercrossings of drainage channels, the pipeline will be casted in concrete in order to compensate for hydrostatic force. The depth of pipeline laying ranges from 1.50 m to 2.0 m from valley floor to the upper limit of the concrete casted pipeline. Where depths are considerable, the pipeline will connect to the crossing section through curves ranging between 5°-45°.

The restoration will be evaluated on two distinct processes: the technical restoration including actions such as backfilling and grading and bio-restoration involving actions such as habitat restoration. The restoration of the RoW will be approved on the basis of monitoring feedback for both processes. Further details for both technical and biological restoration are covered by the supporting Reinstatement and Biodiversity Management Plans

4.3 Pressure Testing during Construction (Hydro-testing)

4.3.1 Overview

Hydrotesting (or hydrostatic testing) is the most common method for testing the integrity of the pipeline and checking for any potential leaks (e.g. from faulty welds or cracked pipe) prior to commissioning. The test involves placing water inside the pipeline at a certain pressure to check the pipeline is not damaged and will not leak during operation. The first step in hydrotesting is pipeline cleaning. This is carried out using a pipeline PIG, which is a tool that is sent down a pipeline and propelled by the pressure of the product in the pipeline itself e.g. the water used for hydrotesting or air used for pipe cleaning. PIGs perform four main activities during hydro-testing:

- Cleaning of the inside of the pipeline, which is performed with a brush-type directional PIG that will be driven along the pipeline by air;
- Testing of the pipe work and the welded joints using a "smart PIG", which will measure pipe thickness, corrosion and the integrity of welds along the pipeline;
- Drying of the pipeline using foam-type swabbing PIGs; and
- Gauge checking of the pipeline using a PIG with a gauge plate attached. This PIG is sent the whole length of the pipeline to check for dents, imperfections and damages. The relevant defect is then located and the damaged pipe section is repaired.

The pipeline is then filled with water, which is pressurised. For this Project, the pipeline will be pressure tested only in areas designated as Class 3 locations under the Romanian national pipeline design standards. Such areas are relatively built up; the classes are determined by the number of buildings located within a 400m corridor of the pipeline. The water used for hydro-testing needs to be free of contaminants, of pH between 5 and 8 and contain no additives, corrosion inhibitors or chemicals. Pressurisation is then carried out with a high-pressure pump. After the pipeline has been filled and pressurised, and all the necessary parameters have been measured, the pipeline is dewatered and dried. Further Information on Hydro-testing is provided in Chapter 9: Water Resources.

4.3.2 Water Supply for Hydro-Testing

Water required for hydro-testing purposes will be obtained in tankers from permitted suppliers and will not be abstracted directly by the Contractor from surface watercourses. There will be four suppliers of the water, all are local water utility companies with no expected issues in meeting the required demand[4,] The wastewater effluent generated following hydro-testing will also be removed from site in tankers to a waste water treatment plant operated by the relevant utility company that supplied the water and will not be discharged directly into local surface watercourses The quantity of water estimated to be required for hydro-testing is 55,000 m3 in total. Where the sections of pipeline to be tested are adjacent to each other and simultaneously ready for testing, water will be re-used to reduce the overall volumes that need to be supplied.

4 If this changed and Contractors did need to use surface water for hydro-testing purposes the required permits must be obtained from the relevant Water Authority.

4.4 Construction Machinery, Equipment, Transportation and Traffic

Although of a very large scale, the Project is a conventional civil engineering project, and will not require unusual or unfamiliar equipment or construction techniques. The major items of construction equipment needed include bulldozers, heavy excavators, spoil removal trucks, large, heavy lift cranes, standby generators, excavators, side booms/pipe layers, rock breakers. Figures 4.4 and 4.5 shows some examples of the typical construction equipment and activities.

Each spread along the pipeline route will however require significant transportation of:

4. Labour, material and equipment;
5. Steel pipelines; and
6. Excavated spoil, although for most of the route this will be stored close to the trench, ready for backfilling.

In order to facilitate the movement of equipment and the construction workforce, a number of road upgrades will be required.

Large earth moving machinery and other special items of equipment will be required to prepare the construction working strip, to excavate the trench and lay the pipeline. The following is an estimate of additional construction traffic (per day). These predictions are indicative only, but are based on experience of other similar pipeline construction projects. This traffic will apply to each appropriate construction spread of the construction working corridor that is being used.

- Approx. 30 two-way light vehicle movements (60 movements) per day to transport workers to site (from the appropriate camp to the construction work area - 15 movements in the morning and 15 movements in the evening);
- Approx. five truck movements per day to move construction equipment (there are fewer movements for construction equipment as these will be transported along the construction working corridor where possible;
- Approx. 50 two-way truck movements (100 movements) per day to bring material to the construction working corridor (pipes, sand for sand bedding, etc.); and
- Approx. 10 two-way truck movements (20 movements) per day to take material away from construction working corridor (e.g. excavated rocks which cannot be backfilled, clearing and grading (timber).

Further details of the equipment that could be used for construction of the main pipeline components and photographs showing examples of some of these major items are shown in Figure 4.4 and 4.5.

Construction traffic will utilise the existing local road network and the new and upgraded roads to access points along the pipeline construction corridor. Traffic will then travel up and down the construction strip. Construction materials such as pre-fabricated pipe joints will be stored at established pipe storage yards which will be located as per agreement with the relevant land owners and/or municipalities. Materials will then be transported on HGVs from these locations to the construction corridor. Each pipe will be around 12 to 18 m long and could weigh between 7 and 12 tonnes. Materials for civil construction will be temporarily stored within the construction corridor. A Traffic Management Plan will be developed with the regulatory authorities and implemented throughout construction.

4.5 Construction Yards and Camps

4.5.1 Construction Camps

Five main construction camps (works organisations) are planned along the proposed pipeline route. The Contractor will have the opportunity to optimise his working concept and operate additional camps if required, with all camps being required to meet EBRD IFC Workers Accommodation Guidelines. Camps will be located along the pipeline route at regular distances, so that long transport time for staff to the work place can be avoided. If possible, camps will be located close to main roads with good connection to larger cities, allowing easy transport of personnel, food and utilities to the camp. Communities will be consulted to identify the best location for the camps. The five potential construction camp locations are as follows:

- Caldararu km 61;
- Guseoeni km 150;
- Turciniesti km 261;
- Bucova km 368; and
- Petrovaselo km 470.

Each site is a square area of land of about 10,000sqm, usually located on agricultural land outside urban areas, close to BRUA and near major roadways, in order to ensure supply of materials, equipment, pipes and the flow of workers. The locations of these sites are shown in Figure 4.6 (in the figures document).

A description of each of the worksites is presented in the Figure 4.7 (in the figures document)

The locations depend on the forecasted work speed and directions. The Primary Contractor will make its own arrangements for the housing and welfare of its employees by the erection, fitting up and maintenance of temporary quarters and camp accommodation, together with all services at the places of work. The camps will be 'open' rather than 'closed' camps, but worker off-time will be carefully managed. Construction camps will be developed for each part of the Project before construction of pipeline and associated facilities begins. There may, however, be a requirement for some small-scale and temporary accommodation in towns outside of the camps during the pre-construction phase, while camps and roads are under construction.

The main camps will not be combined with major pipe yards and bending areas. Mass transport of pipes and other material produce a large quantity of dust and noise; therefore, these areas should be separated from accommodations and offices. The same concept applies for the protection of residential areas. Major pipe yards and bending areas will be located away from these areas as much as practical.

Temporary, self-contained construction camps will be set up and operated during construction. A typical layout of a camp and examples of construction camps are shown on Figure 4.8 (in the figures document). They will have their own water and electrical supply as well as facilities for wastewater and garbage treatment. Camp staff will provide housekeeping, meal services and medical services. Fresh water will be provided from existing water supplies if available or alternatively from springs in the camp surroundings. All wastewater will be treated according to national requirements prior to dewatering in a river or leaching.

Topsoil will be removed and stored during the occupation of land. The surface of all traffic areas will be temporarily covered at least with gravel. All camps will be fenced, lighted and guarded. All installations are of temporary character and will be removed completely (including foundations) after the construction period. The entire area will be vegetated after demobilisation of infrastructure. As the terrain in Romania is predominantly non-mountainous only one type of pipeline construction camp is defined.

Five distinct site organizations will be located on BRUA route. Each site organizations will facilitate the operation of up to four (simultaneous) work fronts. Each site organisation will occupy an area of approx. 10000sqm the situation of these work sites is summarized in Table 4.3.

Table 4.3 Site Organisations

No.	Type of organization	Name	Km pipeline
1.	Site organization and pipe storage	Căldăraru, Argeș county	61+255
2.	Site organization and pipe storage	Gușoeni, Vâlcea county	150+140
3.	Site organization and pipe storage	Turcinești, Gorj county	261+825
4.	Site organization and pipe storage	Bucova, Caraș Severin county	368+413
5.	Site organization and pipe storage	Petrovaselo, Timiș county	470 + 000

Table 4.4 Nearby pipeline sections

No.	Type of organization	Name	Km pipeline
1.	Site organization inside Podișor GCS	Podișor, Giurgiu county	0
2.	Site organization inside Bibești GCS	Hurezani, Gorj county	196+340
3.	Site organization inside Jupa GCS	Zăgujeni, Caraș Severin county	409+186

There will also be additional site organisations and pipe storages in each gas compressor station (approx. 5000 sqm) to serve both the work fronts in the future technological platforms of the GCS, as well as nearby sections of the gas transmission pipeline. At special points (e.g. larger river crossings and BVSs) temporary small camps for construction works will be installed. If possible the teams will not stay in these small camps overnight but be based in nearby hotels or main camps. All construction camps will be fenced, lighted and guarded. All the construction camps are of temporary character and will be removed completely (including foundations) after the construction period. The entire area will be vegetated after demobilisation of infrastructure.

4.5.2 **Storage and Pipe Yards**

All key material such as pipes, components of the GCSs and special construction equipment will be shipped to Romania and stored in an intermediate storage yard before distribution to the pipe yards along the route. The Contractor will have the opportunity to optimize his working concept and operate additional pipe yards if required. The intermediate storage yard will have sufficient pipe storage capacity to provide buffer storage in case of construction delays. This intermediate yard will be used for storage only; there will be no bending, coating or cutting of pipe at this location.

The locations of pipe yards for the intermediate storage of pipes have been selected close to main roads surrounding the pipeline track to provide easy access for long trucks. All methods of storing pipes will be designed to prevent any damage to pipes and/or any coating material at any stage. Storage of the pipes within the construction camps aims to avoid additional areas being affected by Project impacts.

Delivery of the pipes to the pipe yards will be in accordance with the construction time schedule. The concept will be optimised in order to avoid long storage times or supply shortfalls. Transport of pipeline sections will be limited to daylight hours, as much as practicable. The pipe yards will feature enough capacity to serve as a buffer in case of construction delays. During storage, pipes will be protected against corrosion and other degradation. Measures will be taken to prevent rolling and ensure stability of the pipe stacks. Regular pipes of 32” diameter may be stacked in three layers, concrete coated pipes (e.g. for river crossings) may be stacked in two layers’ maximum. All pipe yards will be fenced, lighted and guarded. All installations are of temporary character and will be removed completely (including foundations) after the construction period. The entire area will be vegetated after demobilisation of infrastructure.

4.5.2.1 Logistic warehouses (for temporary storage of the pipe segments)

Distinct pipe storages will be placed strategically on BRUA route so as to ensure a continuous flow of materials required for site organisation. Typically, pipe storages are located between two such work sites so there is the possibility of alternative supply, depending on the workflow. Each logistic warehouse will occupy an area of approx. 1200sqm, to be wire fenced. On the site, modular containers to serve the personnel involved in operational activities will be installed. The locations identified for temporary storage of the pipe segments for BRUA are summarized below in table 4.5:

Table 4.2 Pipe segments for BRUA

No.	Type of organization	Name	Access road surfaces sq.m.	Km pipeline
1.	Pipe storage	Poeni, Teleorman county	250	28+380
2.	Pipe storage	Corbu, Olt county	1151	80+460
3.	Pipe storage	Cherlești, Olt county	528	118+160
4.	Pipe storage	Zătreni, Vâlcea county	724	176+400
5.	Pipe storage	Frasin, Gorj county	238	211+875
6.	Pipe storage	Jiu Paroșeni (Vulcan), Hunedoara county	372	292+800
7.	Pipe storage	Pui, Hunedoara county	187	329+120
8.	Pipe storage	Iaz, Caraș-Severin county	0	404+406
9.	Pipe storage	Lugoj, Timiș county	43	438+950
10.	Pipe storage	Fântânele, Arad county	67	512+600

4.6 Construction of Above-Ground Installations

4.6.1 Compressor Stations

Detailed engineering, levelling and commissioning of the GCS sites is to be finalised. The number of staff that will be required for the construction of each GCS will be decided by the contractor but is estimated to be between 70 and 120. The water supply is estimated to be 3.75m3/h. The average and the maximum sanitary waste water during construction are estimated to be 3.75m3/h and 45.0m3/h respectively. The following construction steps are usually recognised in such facilities:

- Surveying;
- Preparation of temporary facilities such as storage areas, offices and accommodation facilities;
- Preparation of the construction site;
- Earthworks;
- Preparation of foundations (including piling where required);
- Erection of equipment and buildings (installation of underground structures might require the use of sheet piling for stabilisation of construction pits);
- Laying of cables, electrical works;
- Piping and mechanical works;
- Construction of internal roads and areas (if any);
- Installation of operational and instrumentation systems;
- Commissioning; and
- Operation.

For the GCS, there are foreseen standard construction techniques such as:

- Excavation of the trenches for the foundations; in order to ensure a depth that will be under the freezing point and a proper (solid) fundament for the heavy equipment and machineries to be installed, a depth of about 2m will be considered, from the floor to be built;
- The walls will be constructed in sandwich panels which will allow for an easy mounting/demounting procedure in order to facilitate repairs to the heavy equipment or their replacement; these materials are also very good acoustic screens, limiting the noise levels generated upon functioning of the machineries;

- The roof of the main industrial building will be made of light materials in order to be able to discharge the gases and force of the blasts in case of severe malfunction;
- The main support structure of the buildings will be made of steel;
- The floors will be covered in hard antistatic, anti-slip resins provided with drainage systems;
- The administrative buildings will be provided with walls, doors and windows that can withstand at least 90 minutes to open fire;
- Fitting of the equipment inside the buildings;
- Connection of the building to utility networks (water, electricity, waste waters);
- Construction of the roadways, parking areas, sidewalks; and
- Overall works for the ecological restoration of green areas within the precincts of the GCS.

4.6.2 Block Valve Stations

Details for the engineering, construction and commissioning schedule for the BVS needs to be developed in the detail design phase, but will involve standard operations namely:

- Preparation of the construction site;
- Earthworks;
- Preparation of foundations;
- Erection of equipment and building;
- Laying of cables and electrical works;
- Piping and mechanical works; and
- Installation of operational and instrumentation systems.

The compressor stations will be built by a separate Contractor; hence they will install their own camp independent from that of the pipe laying Contractor.

4.7 Construction Access

4.7.1 Overview

Construction access will be determined by the EPC contactor but it is expected that the pipeline will generally be accessed via existing roads or tracks, a number of which may require upgrade to allow passage of construction vehicles. In certain places, new temporary roads may need to be constructed, for example to facilitate access to the HDD sites. Where such works are required they will seek to follow existing tracks where practicable. A traffic management plan will be developed with the objective of keeping existing roads open for public use during the construction period.

4.7.2 Access to Above Ground Installations

Permanent access is required to the GCSs throughout construction and operation/maintenance. The heaviest transport units will be the Turbo Compressors with a total weight of 40-100 tonnes. For the above-mentioned cases, a Technical Environmental Study (TES) will be developed according to Law 4014/2011 art. 7 par.2 and art. 11 par. 11 and MD 167563/2013. TESs may also be completed for any additional facilities that are not included in this SEIA and deemed necessary depending on the final design of the construction of the pipeline.

4.7.3 Access to the Pipeline

The following approaches will be taken to pipeline access:

- **Pipe transportation:** Pipes will be distributed to the pipeline route directly from the designated pipeline storage yards. Transportation is expected be provided by regular trailers as all yards are accessible via national roads. From the pipe yards, further transports will be made by stringing trucks or specialised transport vehicles for mountainous regions.
- **Access to the RoW:** As outlined above a network of access roads will be used to provide access to the pipeline working strip at regular distances. Local access is mostly given by existing roads which is generally considered adequate for the needs of the Project. In difficult topography with lots of ascents and descents, long transports along the working strip shall be avoided as the

slopes are mostly too steep for any transport equipment. In such sections construction equipment will be secured by winches and pipe laying works will be carried out by cableways. On completion of construction new access roads may become public roads or may be decommissioned (e.g. for reasons of protection of habitats or forest resources) by agreement with the authorities. Access roads for pipeline maintenance will be maintained.

- A running strip will be maintained along RoW. This is expected to include the use of temporary flumes for crossing small streams (to minimise time in the water) and or small temporary bridges for larger watercourses. River fording will be avoided where practicable.

4.8 Services and Utilities

Where sites are established close enough, and there is sufficient capacity, services and utilities (i.e., water supply, wastewater and sanitation services, electricity supply, potable water supply, and solid waste management) will be purchased from local suppliers. Local utilities will be commissioned to extend transmission lines or water pipes to worksites. Where local capacity is insufficient, contractors will establish their own site facilities.

4.9 Special Construction Techniques

The pipeline route crosses a number of areas where specialised construction approaches are required. These include areas of infrastructure (roads, railways, pipelines etc.), rivers and streams, areas prone to landslip, elevated sections, areas with high groundwater and areas of particular environmental and/or social sensitivity. Special construction methods will be used in such areas as described below.

Crossings will be installed in parallel with or in front of the mainline working corridor. **Separate crews will install bored crossings for roads and highways along the pipeline corridor**. These crews will perform the excavation, welding, and installation of the crossing pipe. All pipeline crossings will be tested to ensure that there are no leaks. Increased burial depths at important crossings (roads, rivers, railways) and steep slopes will help maintaining the safety and structural integrity of the pipeline. The requirements and technical instructions of the competent authorities will be taken into account in the detailed design and construction of crossings. Crossing techniques can be divided into the following:

- **open cut** (where the trench is dug directly across the feature), and
- **trenchless crossing** methods which prevent surface disturbance.

Trenchless crossing methods include jack and bore, thrust-boring, auger boring, micro-tunnelling and HDD. These methods are used where ground conditions permit, where disruption to others will be unacceptable or where there will be significant damage to the environment by the use of open cut methods. The jack and bore method (also known as augur boring or horizontal boring) is considered the least disruptive method, but cannot be used effectively in areas where boulders or rock are present or for crossings longer than approximately 60m. Jack and bore will require the digging of a pit on one side of the road. The boring machine will be lowered into the pit to begin boring, with the pipe inserted into the hole as it is being drilled. The outside of the pipe will be coated with concrete or abrasion resistant material to protect the pipe coating from being damaged as it is pushed through the bore hole. As each complete joint of pipe is installed another joint of pipe welded to the first joint and boring will continue. This method will continue until the boring machine and the pipe are received in a "capture" pit on the opposite side of the crossing. The integrity of the pipe welds will then be tested to ensure that there are no leaks.

4.9.1 Infrastructure Crossings

The pipeline will cross a number of highways and major roads (22 crossings), as well as secondary roads, unclassified roads, tracks and rail lines. Motorways, national roads, county roads, communal roads, public utility roads and private asphalted roads and railways are undercrossed by horizontal drilling, and pipeline is installed in protection tube. In addition, it requires 25 river crossings, including 18 major rivers, also numerous channel crossings, medium watercourses and smaller streams and creeks. Tables 4.6 and 4.7 provide details of the crossing types required along the proposed pipeline route.

Table 4.6 Infrastructure crossing approaches

Receptor	Details of Crossing Approach
Railways	Will be crossed generally by the jack and bore method. For railway and road crossings where the relevant authority or road owner requests the installation of a casing pipe, the jack and bore method described above will apply to this casing pipe. Following this, the pipe will be pulled into the casing pipe. Spacers will ensure the pipe is separated from the casing pipe wall during the pulling-in operation. In addition, fluid cement such as bentonite will be used to fill the space between the casing and pipe in order to prevent any contact between the gas- and the casing pipe after hardening, thus ensuring proper cathodic protection of the pipe during operation.
Public highways	Crossed using the jack and bore method to avoid disruption of the traffic.
Access roads, and other drives and tracks.	The majority of these are un-surfaced and are likely to be crossed by the open cut method of construction. When the open cut method is used, traffic will be diverted around the crossing via detours or temporary roads. To minimise the duration of traffic disruption, the pipe will be prepared prior to commencement of roadway excavation. Once the pipeline has been installed, the trench will be backfilled and compacted in layers in accordance with relevant agency specifications. The roadway will then be resurfaced over the compacted trench. Final selection of crossing methods will be coordinated with the appropriate road management authority.

Table 4.3 Numbers of crossings

Section	1. Podișor-Bibești	2. Bibesti – Pui	3. Pui–Recaș	4.Hateg-Recas
Chainage	0-180	180-320	320-479	479-529
Distance	180	140	159	50
Main rivers	43	28	50	5
Channels	62	109	138	19
National roads	8	6	8	3
County roads	19	34	10	5
Other Roads	23	24	53	2
Railroads	4	13	5	2
Total	159	214	264	36

4.9.2 **Watercourse Crossings**

As previously described, the vast majority of watercourse crossings are planned using the open-cut technique, unless trenchless techniques, i.e. Horizontal Directional Drilling (HDD) are required due to environmental, technical and engineering constraints. The open-cut method is the preferred option for crossing watercourses for this Project due to economic reasons. A total of 12 crossings of main rivers are proposed to be achieved by HDD. These rivers are listed in Chapter 9, Water Resources. HDD is a technique that avoids any direct impacts to the river itself (i.e. banks, riverbed, water quality) or the loss of riparian vegetation.

At open-cut crossings that are not registered in the Land Register, the pipeline laying depth will be set below the scouring quotas established by the Hydrological Study, which are to be presented in alignment sheets. Most rivers will be crossed by concrete casted pipeline in open trench. After crossing works are completed, the river beds and banks will be restored to their initial state.

Further information on river crossings is covered in Chapter 9 Water Resources.

Table 4.8 River Crossing Techniques

Approach	Description
Open Cut Method for Large River Crossings	Large rivers are generally crossed by excavating an open trench and installing a siphon. The pipe trench is excavated by means of excavators operating from floating pontoons. The defined height and the width of the pipe trench are continuously monitored and documented by means of echo soundings. The excavated material is stored temporarily in designated and approved places. The pipeline section for the river crossing is constructed on the river bank and then pulled into position

Approach	Description
	using a winch located on the opposite river bank. After checking that the pipeline is in the correct position, the pipe trench is backfilled and any sheet piles are removed. Pipes with increased wall thickness and a “reinforced PE coating” are used for the crossings as they will have to withstand the additional weight of the overlying river bed material and water. Buoyancy control is achieved by means of a reinforced concrete coating which also serves to mechanically protect the PE coating during the pulling-in process.
Open Cut Method for Rivers and Streams	In general, a temporary passage is erected across the watercourse after preparing the working strip. This passage principally consists of an earth dam, which, depending on the water level, is equipped with pipes to ensure the unhindered flow of water. This passage is dimensioned for a low to medium water flow and is flooded in case of high water levels. The pipeline section is pre-fabricated on the river bank together with its concrete casing. The trench is then excavated across the watercourse to accommodate the pipeline. Excavation of the trench is likely to make the water turbid. However, in the smaller streams with a surface width of between 3-5m this turbidity will last for approximately half a day only. For bigger crossings sediment curtains can be installed in order to prevent the sediment plume from travelling downstream. Specific measures, such as sediment barriers, and seasonal limitations such as construction only in low flow conditions, are usually implemented to minimise the mobilisation of fine particulate materials downstream. The prefabricated section of pipeline will then be lifted into place and the pipe trench s backfilled using the stored excavation material. This will again make the water turbid, with the duration of the work being limited to a few hours for smaller streams. In streams where an infiltration from the river into the groundwater is possible, clay barriers at the river banks are used to seal the pipeline trench. The river bed is then restored to its original state. The river banks are then restored incorporating stabilisation of the river bank slopes (erosion control systems). Slope stabilisation is dimensioned according to the expected flood runoff, with bank protection being defined as a function of the water depth and the inclination of the water run. In order to construct bank protection in accordance with ecological aspects, natural measures for stabilising the river bank are given preference. When stones are used to stabilise the river bank, they are subsequently covered with humus to facilitate a natural vegetation cover.
Trenchless Method for Rivers and Streams	Although the open cut method is also the preferred method for the larger rivers which have significant width, large water volumes and sensitive ecosystems downstream, if soil conditions allow, HDD will be employed, or alternatively microtunneling which is another trenchless crossing method. HDD is a trenchless crossing method which begins with boring a small diameter, horizontal hole (pilot hole) under the crossing obstacle (e.g. a river) with a steel drill rod. When the steel drill rod emerges on the opposite side of the crossing, a special cutter, called a back reamer, is attached and pulled back through the pilot hole. The reamer bores out the pilot hole so that the pipe can be pulled through. The pipe is usually pulled through from the side of the crossing opposite the drill rig. Usually a drilling mud, such as fluid bentonite clay (an inert, non-toxic substance), is forced down the hole to stabilize the hole and remove soil cuttings. Bentonite provides lubrication to the hole drilling and also provides stability and support for the bored hole.

4.9.3 **Unstable Ground**

The route crosses a number of areas that are challenging for a pipeline due to geo-hazards; particularly landslides, earth flows and erosion gullies following vegetation removal. In such areas, the strip must be prepared by excavation or landfill measures and potentially stabilised and/or drained with a new surface established with gravel sand or stabilised with cement or lime. Adequate protection measures must also be implemented at river banks to prevent instability and erosion of the river bank. This will be implemented upstream and downstream of the river crossings and may include a combination of the installation of vegetation, geotextiles and stones as appropriate.

4.9.4 **Elevated Areas**

In areas with cross-cut slopes along pipeline mounting direction higher than 23^0 , horizontal terraces will be built to allow access to the execution equipment. Works will be similar to the opening of a quarry level, assuming achievement of horizontal surfaces to allow excavation for pipeline laying.

For most of the route, excavated material will be used for refilling the trench, however, as the pipe requires some space in the trench, and, depending on ground conditions, it is likely that at least some bedding and padding material may need to be replaced by suitable filling material. As a result, at least 0.52m³/m of fill material will need to be removed and disposed. In general, all spare material will be disposed permanently away from the pipeline.

In elevated mountain areas, a larger amount of material tends to accumulate. The surface of these will normally be levelled allowing pipelaying works on a limited but flat working strip. Normally this flat strip will be of permanent character in order to provide easier access for later inspections or maintenance works. Sections of construction in elevated areas will be further defined and clearly differentiated from standard working strip (21m) width. The use of the minimum working strip (10m) width will be investigated for each relevant section. Details will be addressed during the next phase of engineering by the contractors who will be tasked with identification of potential deposits. Where excess material is generated it will not be pushed off the ridge but will be transported to a dedicated area(s) as close as possible but at a location where any impact can be minimised. Any disposal will be carried out on stable ground, compacted and re-naturalised (covered with local topsoil and start-up aid for habitat-suitable growth of vegetation) in order to avoid any later landslides or excessive erosion on the deposit. The shape of the spoil deposit will be profiled and landscaped in order to minimise any impact on visual amenity.

4.9.5 High Groundwater Areas

In areas of high groundwater, the pipe trench will require dewatering to ensure a dry work zone. In addition, the new pipeline will be fitted with buoyancy control in the form of either concrete weighting or a piled foundation to prevent the pipeline from floating on the water table during operation.

4.9.6 Construction Schedule

The duration of the Project construction phase is estimated at 31 months and is scheduled to start in 2017, to allow commissioning of the Project to take place during 2019. Work will be sequential and the duration of construction at a specific location will be much shorter than the overall durations indicated. The pipeline has been designed to be used for an unlimited period of time, and the operational phase is expected to be at least 40 years. The duration of safe, technologically efficient operation with no overhauling and major maintenance works for BRUA was estimated at 40 years.

5 Project Approach to Environmental Protection

This Chapter outlines the general approach to be taken by the project to ensure environmental protection requirements are included in both the design and subsequent construction of the project. The approaches highlighted are intended to address a number of technical areas, for example through a clearer definition of Good International Practice (GIP) in general working practices. Approaches to discipline specific environmental protection measures are included in the following chapters. Many of the mitigation measures here will be reflected in the requirements of the BRUA Contractors, who will be expected to implement them as part of their normal construction procedures and practices.

5.1 Transgaz Corporate Commitments

As a national utilities company, Transgaz is fully aware of its environmental and social obligations and the importance of demonstrating its "good citizen" status. To help achieve this it has an internal sustainable development strategy (incorporating a social responsibility policy) that has the objective of ensuring company accountability towards its employees, shareholders, partners, community and environment[5] and actively supports sustainable development of the community, health and the environment, amongst other issues. This approach is captured in the company's policy statement and associated integrated management systems certification as shown in Figure 5.1 below.

Policy statement

TRANSGAZ

POLICY IN THE FIELD OF QUALITY, ENVIRONMENTAL PROTECTION, OCCUPATIONAL HEALTH AND SAFETY STATEMENT – COMMITMENT OF THE DIRECTOR GENERAL

For the National Gas Transmission Company – Transgaz – gaining sustainable success in a complex, challenging and constantly changing environment is a major challenge to be addressed only by continuously improving the Integrated Quality Environment Occupational Health and Safety Management System (IMS – HSSQE) in line with SR EN ISO 9001:2015, SR EN ISO 14001:2015 and SR OHSAS 18001:2008.

As Transgaz' Director - General I undertake to:

- Allocate the necessary resources to meet the requirements applicable to the integrated management system for quality-environment-occupational health and safety and to promote the concept of continuous improvement in all Transgaz' processes;
- Make the personnel at all levels in the organization aware of the importance to know and implement within the organization the management principles set by SR EN ISO 9000:2015;
- Maintain and continuously improve the environmental and occupational health and safety performances

OBJECTIVES OF IMS – HSSQE

QUALITY
- Ensure the transition of the quality management system to the requirements of SR EN ISO 9001:2015;
- Analyze and (re) draw Transgaz' processes;
- Design, document and implement the *continuous improvement* process;
- Design, document and implement the process related to "Transgaz' Employees Satisfaction Evaluation".

ENVIRONMENT
- Pollution prevention;
- Compliance with the environmental regulation;
- Prevention of waste generation from own activities;
- Ensuring the transition of the environmental management system to the requirements of SR EN ISO 14001:2015.

OCCUPATIONAL HEALTH AND SAFETY
- Compliance with the occupational health and safety regulations;
- Prevention of accidents, dangerous incidents and occupational diseases of all persons participating in the working process.

The supervisors of the operating personnel shall make sure that such policy is communicated to and understood by all employees operating within or on behalf of the organization.

This policy is regularly analysed so as to ensure its relevance and adequacy and it is available to the public and to all stakeholders.

DIRECTOR GENERAL
Petru Ion VĂDUVA

TRANSGAZ

Data: 16.02.2016

CERTIFICATE

CERTIFICATE

CERTIFICATE

Figure 5.1 Transgaz policy statement and associated integrated management systems certification

The Transgaz integrated management system is the tool through which the company's management supports the creation of a culture of quality and responsibility towards the health of employees and

5 See http://www.transgaz.ro/en/responsabilitate-sociala/csr-policy for more details

the environment. It incorporates all the processes carried out within the company (quality, environment, occupational health and safety) and address the requirements of the three management systems governed by international standards namely:

- Quality Management ISO 9001:2008
- Environmental Management ISO 14001:2004
- Occupational health and safety Management OHSAS 18001:2007

The Integrated Management System was recertified in 2015 by The Romanian Society for Quality Assurance (RSQA) a member of The International Network of Certification Bodies (IQNET). They agreed that the Integrated Quality, Environment, Occupational Health and Safety System is a logical and systematic managerial approach allowing for optimum strategic and operational decisions taking into account all essential aspects leading to the efficient operation of the company, both from the point of view of quality and of the environment and safety. A process is ongoing related to the transition to ISO 9001:2015 and ISO 14001:2015. This is focusing on more recently included aspects such as understanding the organisation and the context in which it operates; understanding the stakeholders' needs and expectations; actions related to risks and opportunities management; change planning; and the process approach. ~~Figure 5.2 Transgaz policy~~

5.2 Implications for Project Design Philosophy

Transgaz has specifically sought to include a broad range of environmental (and social) protection measures into the Project Design. This has included, but is not limited to, the application of the principles shown in Table 5.1 below as well as the development of a Project Commitments Register containing key Environmental and Social provisions from the Regulatory and Supplementary EIAs and ESMPs which have been included within the EPC tender documents and which forms part of the Project ESMS.

Table 5.1 Key Project Design Principles

Principle	Application
Precautionary principle in decision making	The EIA process was undertaken to inform project design (as well as permitting) including selection of alternative alignment (see Chapter 4) to minimise environmental (and social) impacts. This precautionary approach is also reflected in the commitments register described above.
Preventive action	Where practical best practice solutions are being applied to the project, so that impacts on the environment can be prevented, reduced or mitigated at source. This will be extended into construction through the use of appropriate management plans as well as ongoing contractor monitoring to ensure that the design philosophies are upheld. It has also included specification of the GCS technology to meet national and EU emissions requirements.
Pollutants prevention and management at the source	Where practical emissions associated with the construction and operation of the project will be controlled at source. The principle of 'polluter pays' will be applied during construction to create an environment of high responsibility and awareness of environmental responsibilities, community and common heritage. For example at each site grass soakaway will be used for gradual discharge of rainwater and also to help prevent pollutant run-off to nearby watercourses in the event of a spill.
Conservation of local biodiversity and natural	The requirement of "in situ" biodiversity conservation has been considered as a key mechanism, representing the most viable, cost effective and relevant solution. Where this is not possible measures of ecological restoration have been proposed to provide restoration

Principle	Application
ecosystems	to its original state.

5.3 Application of BAT

As described in Chapters 3 and 4 a number of project alternatives have been reviewed during the development of the BRUA project to ensure that the Project is constructed and operated in accordance with the BATs. These have included both alternative routes (e.g. to minimise impacts on protected areas or avoid areas of known land contamination) and alternative technologies, such as those used within the compressor systems to minimise impacts to noise and air. Wherever practical, and in addition to the application of the mandatory Romanian design standards, this has sought to apply the thinking of BAT (Best Available Techniques) to the Project. Further examples of the application of BAT are provided in the discipline-specific chapters that follow.

5.4 Project Environmental Management System

The BRUA project will have a specific environmental management system in place. This will be aligned with the Transgaz Integrated Management System and will also interface with the Contractor Management Systems. The system will involve a number of specific staff to be employed by BRUA to manage the implementation of the environmental commitments outlined in this document and the accompanying management plans. An overview of the Project Management structure, including the specific environmental functions, is provided in Figure 5.2 (in figures document).

5.5 Construction Environmental Management Plans

The project has created a number of specific management plans which outline general (GIP) mitigation and management requirements or discipline-specific mitigation and management requirements as relevant. The following construction management plans are being produced to accompany this SEIA:

Table 5.2 List of Construction Management plans

Management Plan	Document Number	Description
General Framework Management Plan	**1062-TGN-MNG-PLN-PJM-22-00001**	Provides a general overview of the issues to be addressed through the management plans, the roles and responsibilities of Transgaz and contractors, and the approach to managing the nested hierarchy of plans.
Contractor Management Plan	**1062-TGN-MNG-PLN-PJM-22-00002**	Details the approach to managing the contractors and the key issues around monitoring and feedback to contractors.
Pollution Prevention Management Plan	**1062-TGN-MNG-PLN-PJM-22-00003;**	Provides a series of requirements regarding generic pollution prevention, including use of GIP to avoid emissions to air and water and/or noise emissions.
Hazardous Materials Management Plan	**1062-TGN-MNG-PLN-PJM-22-00004**	Outlines how hazardous materials are to be managed in the context of the project.
Waste Management Plan	**1062-TGN-MNG-PLN-PJM-22-00005**	Outlines how waste is to be managed in the context of the project.
Biodiversity Management Plan	**1062-TGN-MNG-PLN-PJM-22-00006**	Outlines approaches to avoiding and mitigating potential impacts to Biodiversity during construction. Long term management of biodiversity will sit under the Biodiversity Action Plan.
Water Management Plan	**1062-TGN-MNG-PLN-PJM-22-00007**	Outlines approaches to managing impacts on water resources on the project.

Management Plan	Document Number	Description
Water Crossing Management Plan	**1062-TGN-MNG-PLN-PJM-22-00008**	Details approaches to be taken to minimising impact to water quality and flow water crossings.
Health and Safety Management System	**1062-TGN-MNG-PLN-PJM-22-00009**	Describes how health and safety is to be managed during construction works.
Labour and Working Conditions Management Plan	**1062-TGN-MNG-PLN-PJM-22-00010**	Outlines minimum requirements for worker conditions.
Community Health and Safety Management Plan	**1062-TGN-MNG-PLN-PJM-22-00011**	Outlines approaches to be taken to help ensure community health and safety.
Road and Traffic Management Plan	**1062-TGN-MNG-PLN-PJM-22-00012**	Outlines measures to be taken to avoid traffic impacts.
Cultural Heritage Management Plan	**1062-TGN-MNG-PLN-PJM-22-00013**	Describes approaches to be taken to avoid adverse impacts on archaeology and cultural heritage.
Reinstatement Management Plan	**1062-TGN-MNG-PLN-PJM-22-00014**	Includes specific requirements for soil management, physical soil reinstatement and erosion control. Habitat reinstatement is included in the BMP.
Emergency Response Management Plan	**1062-TGN-MNG-PLN-PJM-22-00015**	Addressed approaches to be adopted in the event of an emergency situation and how such situations should be planned for.
Stakeholder Engagement Plan (SEP)	**1062-TGN-MNG-PLN-PJM-22-00016**	Identifies key project stakeholders and outlines how communications with them are to be run.
Hydrotesting Method Statement	**1062-TGN-MNG-PLN-PJM-22-00017**	Outlines how hydrotesting operations are to be. carried out

Additionally, method statements will be produced as required to manage construction through sensitive areas and sites such as water crossings, cultural heritage sites within 500m of Pipeline routing and habitat fragmentation areas. The links between these plans is shown in Figure 5.3 below.

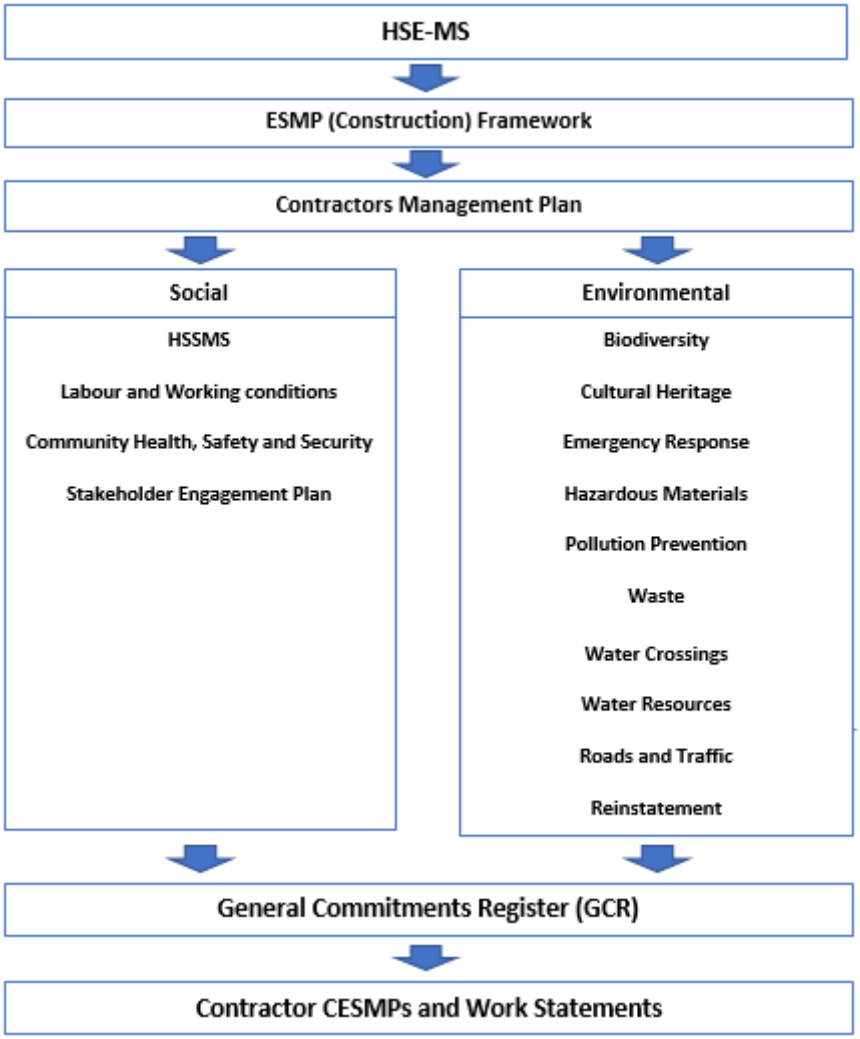


Figure 5.3 HSE-MS and CESMP linkages

The above plans will be shared with the contractors and the embedded actions will need to be incorporated into the contractor management plans. Transgaz will then monitor contractor delivery of the relevant activities included within the Plan, and will advise on corrective actions should any be required. The approach to such monitoring will involve a combination of proactive and reactive key performance indicators (KPIs) with the emphasis being on the former (for example % staff trained, speed of implementation of corrective actions, near miss report frequency etc.). Regulatory monitoring will also occur throughout the project construction works to ensure that they are undertaken in line with the requirements of the Project Environmental Permit (see Chapter 2 and Appendix 5.1 for more detail).

The plans formed a tiered hierarchy as follows:

- **General plans** (such as the Pollution Prevention Plan and the Reinstatement Management Plan) are applicable to all activities across the construction works and all construction staff need to be aware of them
- **Discipline specific plans** (such as Cultural Heritage Management Plan and the Biodiversity Management Plan) will be managed by specialists, but all staff need to be aware of what to look out for and who to contact.
- **Location specific plans** (such as the Water Crossings Management Plan) will be only applicable in certain locations or when certain techniques are to be applied.

Throughout the remainder of this document a number of other specific plans and method statements are also proposed (such as to be applied in the Natura 2000 sites). These will be developed by Transgaz and the contractors once the contractors have been appointed and the working approach has been defined.

5.6 Application of GIP during construction works.

As outlined above, a number of specific issues are raised in these construction management plans that represent good industry practice (GIP) and which may otherwise have been detailed in the following chapters. Examples of such standard pipeline construction techniques are provided in Table 5.3 below to avoid multiple repetition in subsequent chapters.

Table 5.3 Examples of GIP Issues to be applied across the Project through the Management Plans

Reference Management Plan	Specific requirements included in the plan
Pollution Prevention Management Plan	• Addresses such issues as Prevent unauthorised entry to protected areas through fencing or flagging • Ensuring equipment is maintained to manufacturers standards and that noise baffles are fitted • Regular inspections to prevent leakage • Provide secondary spill containment • Installed with automatic alarms and shut off systems • Checked prior to delivery to prevent overfill and spillage; • Properly contained for decanting and fill areas to contain any spillage during transfer.
Hazardous Materials Management Plan	• Hazardous chemicals to be labelled with the appropriate internationally recognised diamond shaped hazard symbol • Chemicals with different hazard symbols should not be stored together • Ensure the storage and operation under safety conditions of dangerous materials • Ensure all chemicals have proof of their pre-registration with the European Chemicals Agency shall be pursued • The storage of the diesel in tanks, the equipment shall be supplied by oil pump, and the reservoirs shall be supplied by auto tanks • The equipment shall be brought to the site in perfect state of operation, the technical revisions and oil exchange being already made • The exchange of oils shall be done after each work season in specialized workshops
Waste Management Plan	• The selective collection of the generated waste, temporary storage in special areas and delivery to the authorized operators for valorisation/elimination • Hazardous waste shall be collected selectively in containers and they shall be temporary deposited in specially arranged places • In order to reduce the volume of waste required to be deposited and transported, the site assemblies shall be equipped with installations for pressing metal boxes and pets, installations for paper cut • The metal containers for the deposit of used oils shall be adequately marked (with the code of the type of used oil) and they shall be located on concreted surrounded areas • Both inside the site organization and in the related stations well defined areas shall be set, having the destination of controlled and safe depositing of the wastes • Waste tyres will be collected separately from other wastes and will be disposed of via licensed transporters in accordance with the regulation • A strict management record shall be maintained by monthly completion of the waste management papers, per types of identified waste.
Biodiversity Management Plan	See Chapter 12

Reference Management Plan	Specific requirements included in the plan
Water Management Plan	• Where water is limited or water minimisation is required, surface binding agents, the sealing of heavily used access ways and the covering of stockpiles should be implemented • Perform the water crossing works during the periods of low waters • During the construction stage, during the stage for testing the sections of the transmission pipe, the tightness shall be tested by filling it with water. After passing the pressure tests, the water volumes temporary deposited in the respective tube segments shall be pumped in the following segments which are to be subject to the technological testing • Perform simulations regarding emergency situations in case that an accidental pollution is caused, having impact on the water resources • Apply the pollution prevention plan to avoid accidental pollution • Set up drainage systems with appropriate silt and oil traps in worksites • Obtain applicable water abstraction permits for surface and groundwater's • Install temporary vehicle crossings/bridges • Undertake Water conservation initiatives to limit the water consumption during construction activities (including dust suppression and careful potable water consumption • Conducting additional hydrogeological and groundwater quality assessments at locations where groundwater is planned to be used as potable water • Monitoring the meteorological bulletins meant to take the equipment outside the areas which could be flooded, in case of high waters
HSSMS	• Reduce exposure times for people working near noisy machinery and provide workers with appropriate hearing protection • In case of using penetrating radiations (radiography) as method for the non-destructive control of the pipes welding, their level is low, being classified within admitted limits, and no additional protection measures being required, except for the ones taken by the specialized laboratory. The owner of the laboratory shall have according to the contract the obligation to manage the radioactive sources according to the legislation in the nuclear activity field
Cultural Heritage Management Plan	• In case of discovery of new artefacts, the excavation works will be done manually • Stopping the works in case of the discovery of new artefacts and archaeological sites; works will be resumed only after that site receives an archaeological discharge • Ensure access to sites during execution of works (e.g. Access to crosses, churches, cemeteries) • Repair / restore any monuments damaged or destroyed • "Map all previously recorded sites of historical or cultural value prior to construction so that approximate locations are known to project contractors and personnel • Ensure that qualified specialist (e.g., archaeologist) are onsite during construction in the vicinity of any previously recorded historically or culturally important sites. Educate project workforce on the recognition of sites with historical or cultural value".
Reinstatement Management Plan	• The excavated material shall be operated and deposited in an adequate manner, in order to be reused when covering the pipe. If the land is deposited for a longer period of time, they shall be protected by erosion and compaction – by grassing • Organize distinct dumps for temporary deposits of the volumes of excavated soil, as follows: for the uncovered vegetal soil, to the extremity of the working platform; for the soil excavated from the trench picturing the pipe, in the immediate vicinity of the excavation area • Compact the layers of covering soil by using a beater (manual); successive layers of 20-30 cm each shall be made which have been moistened in advance and then they will be compacted • Disturb soils only within the designated right of way (ROW) working strip and additional work areas, and new access roads • Incorporate organic material into topsoil which is deficient of organic matter at the time of

Reference Management Plan	Specific requirements included in the plan
	stripping, clearing and stockpiling to limit wind erosion and compaction and to improve water-holding capacity • Minimise double handling of top soil • Use measures to prevent mixing of topsoil with subsoil (including use of geotextile where required e.g. at restricted spaces) • Continuous visual inspection of activity sites for identification of possible soil contamination • The measures required for the prevention of soil pollution with drilling fluid shall be taken.

It should be noted that all management plans include sections on Monitoring, Reporting and Training, and link with the broader management system documentation which describes approaches to Management of Change amongst other issues.

5.7 Operational and Decommissioning Management Plans

In addition to the Construction Management Plans outlined above, a series of operational management plans will also be developed, prior to operations commencing. Likewise, specific decommissioning plans will be developed prior to any such works commencing and in line with GIP prevalent at the time.

6 SEIA Approach and Impact Assessment Methodology

This Chapter summarises the SEIA process undertaken for the Project. It includes a description of the general methodologies that have been used for both the data collection and the assessment of impacts. Where topic specific methodologies have deviated from or added to this generic process they are highlighted in the relevant sections.

6.1 Overview of the Supplementary EIA (SEIA) Process

Environmental and Social Impact Assessment (ESIA) is the process of systematically identifying assessing and mitigating the potential effects of a project on the relevant social, ecological and physical environment (together socio-environmental elements) within which it is to be delivered. In so doing it can act as a planning tool to help developers address significant impacts from (or to) a project early whilst also providing a control framework for impact management during project delivery. This process also builds on the regulatory Environmental Impact Assessment (EIA) framework required by both EU Directives and Romanian law. Since the integration of such considerations into the project cycle is essential to the objectives of sustainable development, the use of ESIA is increasingly accepted around the world. This study specifically applies the European Bank for Reconstruction and Development (EBRD) Performance Requirements (PRs), as the key guidelines for managing or avoiding potential risks associated with significant adverse impacts on people, their rights, livelihoods, culture and the environment.

6.1.1 Objectives of this SEIA

The BRUA SEIA has been developed to help articulate the:

- Legal framework applicable to the project;
- Principal project features and technical specifications; including the approach used to design the pipeline and assessment of alternatives for the project;
- Environmental and cultural heritage baseline of the project in terms of key sensitivities and potential constraints on the construction, operation and maintenance, and decommissioning of the pipeline;
- Potential impacts of the project and project-related activities on this baseline; and
- Mitigation or enhancement measures proposed to avoid, reduce or eliminate negative impacts to the environment.

6.1.2 SEIA Steps

The key steps in the process can be considered in terms of phases as described below:

- Pre-study activities such as screening, preliminary assessment and scoping to help establish key considerations in advance of detailed studies;
- The impact assessment study, which results in the identification and assessment of impacts and the development of measures to mitigate and reduce or eliminate adverse impacts; and
- The post-study stage, which includes steps undertaken for review and monitoring to ensure that mitigation measures are implemented, and are effective during construction and operations.

The overall approach that has been followed for the ESIA is shown schematically in Figure 6.1 below.

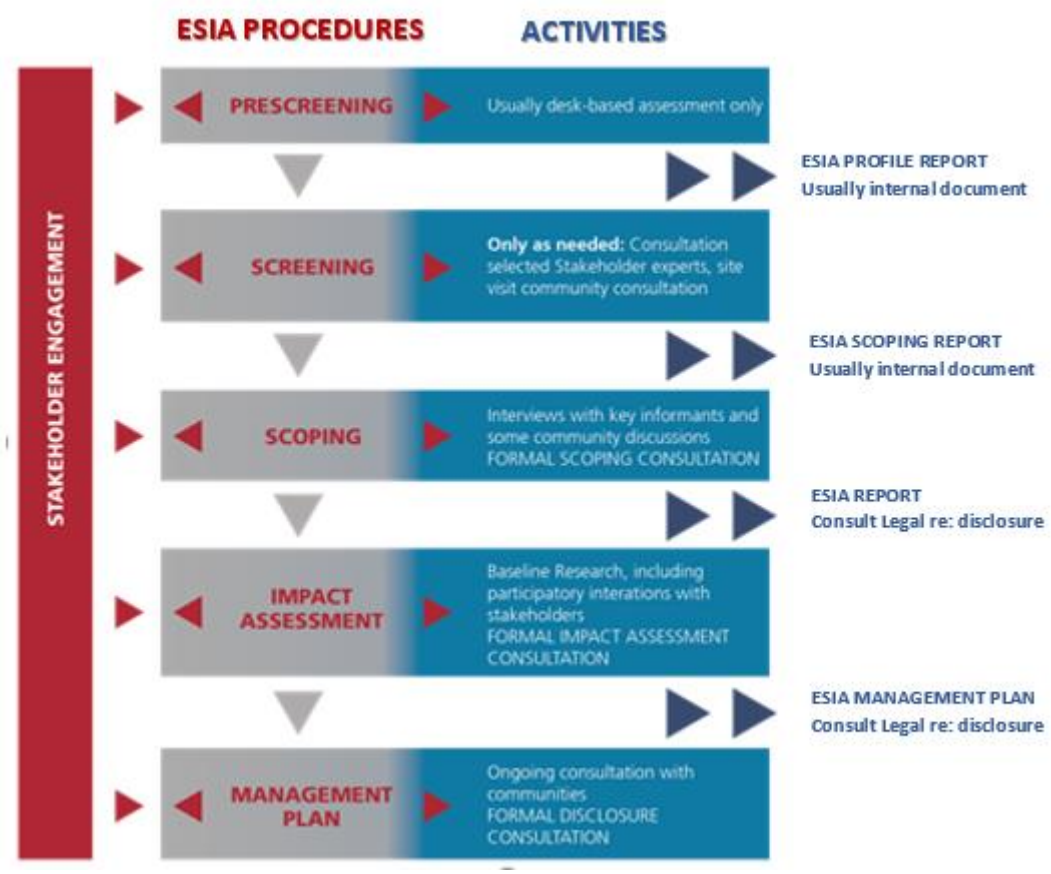


Figure 6.1 – The ESIA Process

6.2 Key Standards and Requirements

As outlined in Chapter 2, this Project has been designed to be in compliance with the EBRD's 2014 Environmental and Social Policy. This Policy is implemented by the EBRD to help ensure that they finance projects that are socially and environmentally sustainable; respectful of the rights of affected workers and communities; and designed and operated in compliance with both applicable regulatory requirements and good international practice.

Under the Bank's E&S Policy, and bearing in mind the requirement to take a precautionary approach to project development, the BRUA Project has been classified as a "Category A" project. As such it is required to undergo a comprehensive Environmental and Social Impact Assessment (ESIA) process with priority actions and measures to safeguard key social and environment sensitivities set out in a Project Environmental and Social Action Plan (ESAP).

In line with the EBRD requirements, a Project must be compliant with both national and local regulations (ensured via BRUAs overall programme of assessment and permitting work) and compliant with the internal Bank Performance Requirements (PRs). The ESP and PRs have been addressed via the combination of this SEIA, Green Partners SIA, Transgaz ESMPs and the ESAP, formulating the Supplementary Lenders Information Package (SLIP). For this Project, the PR's that were deemed necessary to address in the SLIP package are as follows:

- PR 1: Assessment and Management of Environmental and Social Impacts and Issues
- PR 2: Labour and Working Conditions
- PR 3: Resource Efficiency and Pollution Prevention and Control
- PR 4: Health and Safety

- PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement
- PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- PR 8: Cultural Heritage
- PR 10: Information Disclosure and Stakeholder Engagement

In addition to the EBRD PRs, pertinent national, EU and international legislation and standards for the protection of the environment and people have been applied during the SEIA, and have been used to inform the significance criteria used for the study. Any breach of a law would be regarded as a significant impact, requiring the Project to take action to avoid or mitigate to a legally acceptable level.

6.3 Stakeholder Engagement

As part of the SEIA, a series of stakeholder engagements have been undertaken in line with the requirements of both Romanian EIA legislation and EBRD PR10 'Information Disclosure and Stakeholder Engagement' and to address this requirement Transgaz has developed a Stakeholder Engagement Plan (SEP) that provides a framework for stakeholder interaction. This is described further in the Project SSIA.

6.4 Project Scoping

6.4.1 Overview

Defining the scope of the SEIA and the "Area of Influence" (AoI) of the project are critical for an effective impact assessment process. To this extent, a scoping workshop was held on Cluj, Romania from 8-10 November 2016. The workshop involved a range of key project stakeholders and was set up with the objective of determining potentially significant impacts requiring further study/mitigation. The Scoping Report is available as a standalone report and provides further details on the:

- Scope and content of the SEIA to be undertaken;
- Regulations and guidelines to be considered in the SEIA process;
- Description of the alternatives reviewed and selected options;
- Key potential impacts; and
- Terms of Reference for the SEIA.

For the purposes of this SEIA "the Project" is considered as including all those actions and activities that are a necessary part of the development, including ancillary facilities without which the Project cannot proceed. These activities are described further in Chapters 4 and 5 of this report. Activities which are induced by the Project but which are not essential to its development and are undertaken by others are addressed in section 6.9 on cumulative and transboundary impacts.

6.4.2 The Project Area of Influence

The 'spatial scope', 'study area' or 'area of influence (AoI)' for the Project is used to describe the extent over which project impacts will be realised. The AoI to be assessed can vary depending upon the type of impact being considered and the attributes of the potentially affected receptors[6] and may also extend across administrative or national boundaries. In each case, however, the AoI includes all areas within which significant impacts are likely to occur taking into account the:

- Physical extent of the proposed works, defined by the limits of land to be acquired or used (temporarily or permanently) by the Project; and
- Nature of the baseline environment and manner in which impacts are likely to be propagated beyond the Project boundary.

[6] For example, effects on archaeological features are typically confined to those areas physically disturbed by the construction works, whilst the effects of noise or visual intrusion can be experienced at some distance, and air pollution may be dispersed over long distances or even contribute to regional/global impacts (where relevant such changes are described in each section as appropriate)

For the proposed BRUA project, the Project Area includes the footprint of all project activities[7] and a larger working strip typically of 150m either side of the pipeline to include the areas in which a direct or indirect impact on the physical, biological, social or cultural environment might occur. Where different areas are used, this is discussed in the respective Baseline Sections.

6.4.3 Associated Facilities

The ESIA process also typically seeks to identify and characterise, to the extent practical, any material potentially significant environmental and social issues associated with activities or facilities which, whilst not directly part of the project, are intimately associated with or could present a risk to the project. For BRUA, and as described in the Project Scoping Report, such associated facilities are considered to include the Bulgarian and Hungarian elements of the BRUA project, although the discrete national processes being undertaken for these separate projects mean that no material environmental or social risks that could affect the BRUA project have been identified to date. The other major associated facility of relevance to this Project is the proposed BRUA Phase 2 construction (Recas – Horia) and this has been addressed throughout these works.

6.4.4 Temporal Scope

The SEIA process takes into account all phases of Project development from initial site preparation, including any advance works, through construction, commissioning and operation, to decommissioning, restoration and after use (to the extent to which these can be envisaged). Since the design lifetime of the Project is considered to be at least 40 years[8], where appropriate the assessment also considers the development of pertinent aspects of the baseline over this time and assesses the extent to which projected changes and trends influence impacts.

6.5 Baseline Study Methodologies

Baseline information was collected using a wide range of methodologies for the BRUA Project as outlined below.

6.5.1 Desk Studies

Existing information from a range of studies was evaluated as an initial review to identify areas for further focussed studies to be undertaken.

6.5.2 Route "Walkover"

For the regulatory impact assessment, the existing land-uses along the proposed pipeline route were then verified through directly walking (or driving) the entire route supplemented by using drones to take digital high-resolution pictures (min. 10MPx) and/or surveyor photographs. Examples of the aerial photographs taken by drones (prototype 4qrs, DJI Phantom II and DJI Phantom III Advanced) are shown in Figure 6.2. The walkover studies were used to categorize land uses into the following categories: Cultivated land; Agricultural land used as pasture; Watercourses; Residential zones; Forests and Roads.

[7] This includes the pipeline working strip (which has a width of approximately 21 m and includes room for pipeline fabrication and for simultaneous vehicle movements), access roads, Compressor Stations, Construction Yards, laydown areas, work sites and other related facilities

[8] The proposed pipeline facilities (compressor stations, equipment etc.) will be designed for a lifetime of 25 years, while the pipeline itself is designed for a technical lifetime of 40 years. For the purposes of this ESIA the design life of the project has been considered to be 50 years, although it should be noted that after 25 years the Compressor equipment would be replaced by BAT at that time.

Figure 6.2 Phantom II Drone Advanced ready to fly (left) and aerial photographs (right)

Figure 6.3 Aerial photos merged (stitched) used for the overall analysis, large-scale land us

6.5.3 **Site / Topic specific studies**

A good understanding of the baseline is the key factor to comprehend the nature and importance of project impacts and in feeding back to project design and routing / sitting decisions. Where specific methodologies have been used to develop the baseline data for the different disciplines, detailed information on these is provided within each Chapter.

6.6 GIS, Mapping and Indicators

The use of a Geographical Information System (GIS) is important both in interpreting the data collected and in analysing and presenting relevant information on maps and charts of the study area Information collected during the field survey, together with the result of the intensive desktop analysis based on high resolution satellite imagery and official sources (official GIS data and thematic maps), was integrated into a geographic database developed according with the most recent standards and accepted formats (ESRI geodatabase, ESRI Grid and shapefiles). This project GIS (Geographic Information System) allowed for the findings of the different disciplines to be integrated and for maps and figures to be created showing different combinations of relevant data. All the information for each site of interest have been included, such as information on the relevance of the site, specific metadata (source, year etc.) and when available also associated photographs have been linked. The data collected should be viewed as a snapshot in time. In some areas, there will be additional data collection to resolve uncertainties/gaps and to feed into future management plans in a later stage of the Project.

6.7 SEIA Considerations in Project Planning and Design

The proposed pipeline route has been selected following an extensive alternatives route assessment (see “Project Alternatives” Section in Chapter 4). This included an initial identification of macro-corridors, followed by progressively accurate delineation of the RoW to optimize the Project footprint (including pipeline start and end points) based around limiting the environmental, social and cultural constraints and impacts. Interaction between the SEIA and design teams and BRUA AG decision-makers included structured workshops focused around mitigation assumed to be built into design and good construction practice, as well as the need for additional mitigation and options for addressing some of the key issues for the Project as outlined in this Although this SEIA Report.

The SEIA process will continue to influence the management of project design, implementation, commissioning and operation, and the Project management of Change procedures will be used to enable an adaptive management approach can be taken should previously unforeseen environmental or social issues be identified. A key element in achieving the Project's environmental and social management obligations will be this on-going interaction between design, construction, commissioning and operating engineers, as well as contractors and environmental and social specialists. Key to the management of this interaction will be the suite of management plans, provisions and guidelines to be contained within the Transgaz's Environmental and Social Management Systems (ESMS), General Commitments Register (GCR) and framework CESMPs.

6.8 Impact Assessment Methodology

6.8.1 General Considerations

The assessment of impacts is an iterative process that considers several key questions:

- Identification – how can the BRUA Project interfere with the environment and people, considering both the specific project-related activities that will be carried out, and existing baseline conditions;
- Prediction – what will happen to the environment and people as a consequence of the potential impacts associated to the BRUA Project?
- Evaluation – does this impact matter? How important or significant is it?
- Mitigation – if it is significant can anything be done about it?
- Residual Impact – is it still significant?

Where significant residual impacts remain further options for mitigation may be considered and impacts re-assessed until they are as low as is technically and financially feasible for the Project and would be deemed to be within acceptable levels.

This section describes the general approach followed in the SEIA to address the above-mentioned questions, which will be adopted for the assessment of impacts related with the several disciplines. Further detailed information on specific methodologies, in particular with regards to the significance criteria (and their derivation) applied for the assessment of impacts, is specified in the "Methodology" section of each technical sections.

6.8.1.1 Impact Identification

A logical and systematic approach needs to be undertaken to impact identification, in order to ensure that the key issues are identified and classified into impact categories for further study. It aims to take account of all of the important environmental/project impacts and interactions, making sure that indirect and cumulative effects, which may be potentially significant, are not inadvertently omitted.

For the BRUA project, impact identification was carried out, as described above, during the screening workshop, as per the following approach which relied mostly on the professional judgement of the people involved:

7. The specific project-related activities that will be carried out in order to build and operate the BRUA Project were reviewed and **potential sources of impact** on each environmental compartment were identified:
8. Taking into consideration the existing baseline conditions and the potential presence of sensitive receptors within the project's Area of Influence, an evaluation was carried out of how the BRUA Project will be likely to interfere with the environment and people, and a number of potential impacts were identified (impact identification) for each environmental compartment;
9. A preliminary assessment was carried out in order to decide, for each impact, whether:
    - it has the potential to cause important consequences, in which case such impact was "scoped in", and will be further assessed in the respective technical sections ahead in the SEIA; or
    - it is deemed minor or insignificant, in which case such impact was "scope out" from further assessment in the SEIA, although an explanation of the reasoning around

"scoping out" such impacts will still be included in the respective technical sections ahead in the SEIA.

In the next phase, the "scoped in" impacts were analysed in greater detail in accordance with terms of reference specifically established for this purpose, and presented in the Scoping Report.

6.8.1.2 Impact Prediction

For all "scoped in" impacts, the SEIA seeks to predict what will happen, i.e., what changes (impacts) the BRUA project-related activities will induce and to assess in further detail the potential size and characteristics of those impacts. Impact prediction or forecasting is a technical exercise. It utilises physical, biological, socio-economic and cultural data to estimate the likely characteristics and parameters of impacts. Project impacts can be classified according to the "direction of the impact", that's to say, whether the interference produced by the Project actions on the environment and/or society is:

- **Negative**: the impact factor causes a worsening of the environmental or socio-economic state or quality; or
- **Positive**: the impact factor causes an improvement of the environmental or socio-economic state or quality.

The SEIA then describes the predicted impacts (and quantifies these to the extent practicable, which varies depending on the topic being assessed) according to a series of criteria / impact-related features (i.e. related with the interferences produced by the project-related actions on the environment and/or society), such as:

- **Magnitude:** Extent of the impact, generally in terms of a quantifiable measure (its size, scale or intensity);
- **Geographic extent and distribution:** Area where the impact exerts its influence (i.e. site specific, local, regional, national, global);
- **Duration:** Length of time when the impact occurs (short term, intermittent, long term, continuous);
- **Reversibility:** Possibility to restore the qualitative state of the component following the modifications occurred: reversible (sort-, mid-, or long-term) or irreversible;
- **Frequency**: How often the potential impact occurs / how frequently the receptor will experience the impact (rare, infrequent, intermittent, occasional, frequent);
- **Probability of occurrence**: Likelihood of the impact occurring or probability of a specified outcome (chance of something happening): related with the uncertainty or confidence in the prediction.

Given that the sensitivity of the receptors is also critical for the definition of the significance of each impact, there must be a way to account for this feature. Indeed, the environmental and social components are characterized by their **sensitivity** (receptor sensitivity: presence of stressor and resilience to the stressor) to the presence of a "stressor", as well as by their "propensity to change". This is function of one or more intrinsic features of the receptors/components, such as the presence of elements of particular value or vulnerability, or function of already existing high levels of environmental degradation. **Sensitivity** is therefore the summary of the conditions which characterize the present quality and/or trends of specific environmental and social components and/or of their resources. The sensitivity of environmental and social components / receptors is therefore assessed on the basis of the presence/absence of some features, which define both the current degree of quality, and the component's susceptibility to environmental changes. The quality or importance of a resource or receptor has been judged taking into account, for example, its local, regional, national or international designation, its importance to the local or wider community, its ecosystem function or its economic value.

Finally, the prediction takes account of mitigation measures that are already an integral part of design. It also takes into consideration any uncertainty about the occurrence of the impact, expressed as its likelihood.

6.8.1.3 Impact Significance

The next step in the assessment is to explain what the impact means in terms of its importance to the natural, social and cultural society and the environment, so that stakeholders understand how much weight should be given to the particular issue in determining their view of the Project. This step is referred to as the 'evaluation of significance'. If an impact is judged as significant, in isolation or in combination with other impacts, it is reported in the SEIA Impact Assessment Sections so that it can be taken into account by others in making decisions on the Project. This recognises that evaluation requires an exercise of judgement and that judgements may vary between parties involved in the process. The evaluation of impacts presented in the SEIA Report is based on the judgement of the SEIA team, informed by reference to legal standards, national and regional government policy, lenders' requirements, current international good practice/standards and the views of stakeholders.

In order to maximise the transparency of the SEIA process, criteria for assessing the significance of impacts are defined for each particular "scoped in" impact. Typically, these criteria take into account whether the Project will:

- Cause legal or accepted environmental standards to be exceeded, e.g. air, water or soil quality, noise levels, or make a substantial contribution to the likelihood of exceedance;
- Adversely affect protected areas or features, or valuable resources, e.g. nature conservation areas, rare or protected species, protected landscapes, historic features, high quality agricultural land, important sources of water supply, other key ecosystem services; and
- Conflict with established government policy e.g. to reduce CO_2 emissions, recycle waste, regenerate deprived urban areas, protect human rights.

As insufficient quantitative information was generally available to allow a quantitative classification of significance, a qualitative evaluation was generated aiming to classify it in one of the following five categories: "very low", "low", "medium", "high", and "very high".

The term 'significance' is used here as shorthand to include and encompass all the dimensions of the predicted impacts, as described above.

However, the parameters used for the description of the impacts and the receptor sensitivity are deeply related with each specific environmental compartment. Therefore, no single classification system could be defined that would be suitable to classify all impacts. For this reason, a specific classification system was developed for each "scoped in" impact, to allow its classification in each or the above-mentioned significance categories. Also, when defining the five significance categories to classify each impact, all or part of the parameters / dimensions (amongst those indicated above) were used, as considered relevant for the classification of significance of that particular impact.

The classification systems developed for the classification of impact significance are presented in the methodology section of the respective environmental compartment. This means that, in order to define each of the classification criteria for the classification of a specific impact, all or part of the parameters / dimensions described above were used, as considered relevant for the classification of significance for that particular impact.

This means that, in order to define each of the classification criteria for the classification of a specific impact, all or part of the parameters / dimensions described above were used, as considered relevant for the classification of significance for that particular impact. Any negative impacts classified as "Very low", "Low" or "Moderate" are considered not to be significant, and shall be managed according to GIP/generic mitigation, not requiring further specific mitigation. Any negative impacts classified as "High" or "Very high" are considered to be significant and require additional targeted/specific mitigation, management and inspection/monitoring to verify the efficacy of the mitigation in place and/or the need for additional mitigation to address such impacts.

6.8.2 **Mitigation**

Impact assessment is designed to ensure that decisions on projects are made in full knowledge of their likely impacts on the environment and society. A vital step within the process is the identification of measures that will be taken by a project to mitigate its impacts. In some instances, mitigation will be inherent in design and in others mitigation measures will need to be identified during the SEIA process. The on-going SEIA process has therefore involved identifying where significant impacts could occur and then working with the Project team to identify and develop technically and financially

feasible and cost-effective means of mitigating those impacts to levels that are deemed acceptable. These measures have then been agreed with the Project team and integrated into the Project proposals and the ESAP as clear unambiguous commitments.

Where a significant impact is identified, the following hierarchy of options for mitigation was typically explored:

- Avoid at source – remove the source of the impact;
- Abate at source – reduce the source of the impact
- Attenuate – reduce the impact between the source and the receptor;
- Abate at the receptor – reduce the impact at the receptor;
- Remedy – repair the damage caused by the impact after it has occurred; and
- Compensate / Offset – replace in kind or with a different resource of equal value.

Compensation/offset is typically seen as a last resort but may be required in terms of Local legislation (sometimes also independent of the significance of an impact). Compensation or offset does not, however, automatically make an impact 'acceptable' or excuse the need to consider other forms of mitigation as discussed in the hierarchy.

6.8.3 Assessing Residual Impacts

Following agreement on technically and financially feasible and cost-effective mitigation, the SEIA team has, where necessary, re-assessed the impacts taking into account the further mitigation commitments integrated into design and operation of the Project. This iterative process continued until an impact was deemed acceptable within the confines of what was regarded to be technically and financially feasible and cost-effective. All residual significant impacts are described in the SEIA Report in terms of their overall significance. Where an impact is of more than minor significance the SEIA explains in greater detail how the mitigation hierarchy has been applied (and where appropriate the other mitigation options considered in the assessment and the reasons for their rejection) to reduce an impact to a level that is deemed to be acceptable. The degree of significance attributed to residual impacts is related to the weight the SEIA team considers should be given to them in making decisions on the Project and developing conditions. Any residual major impacts, whether positive or negative, are considered to warrant substantial weight, when compared with other environmental, social or economic costs and benefits, for those making decisions on the Project; conditions will be expected to be imposed to ensure adverse impacts are strictly controlled and monitored and beneficial impacts are fully delivered. Residual moderate impacts are considered to be of lesser importance to making decisions, but still warranting careful attention to conditions regarding mitigation and monitoring, to ensure best available techniques are used to keep adverse impacts within levels deemed to be acceptable and to ensure beneficial impacts are delivered. Minor impacts are brought to the attention of decision-makers but are identified as warranting little if any weight in the decision; mitigation will be achieved using normal good practice and monitoring will be expected to be carried out to confirm that impacts do not exceed predicted levels

6.9 Cumulative and Transboundary Impacts

In the context of the BRUA Project, cumulative impacts can potentially occur from the combined effects of the BRUA Project with other presently on-going or reasonably foreseeable future activities in the project area. No detailed cumulative impact assessment has yet been undertaken for the project, but the project has specifically sought to use rights of way and routes which have been previously used for linear infrastructure project to reduce levels of cumulative impact to the greatest extent possible.

The term Trans-boundary impacts are impacts which occur across political boundaries, be it because of the movement of an impacting item (such as waste); or because of a medium, which in itself is of a trans-boundary nature, (such as atmospheric emissions). For this BRUA the potential for trans-boundary impacts related to impacts on water resources; biological resources (primarily migratory bird populations); social aspects and climate change have been reviewed, but no material Trans Boundary impacts have been identified as the entire project route remains within the Romanian national boundaries and off-site impacts are not expected to be Signficant.

6.10 Management and Monitoring

A wide range of different measures to mitigate impacts have been identified in the SEIA Report and the Project is committed to their implementation. These measures are set out in the Project Description and other Chapters of the report and, to assist the reader, they have been brought together in an Impact summary table. In addition, an ESAP for the Project will be prepared which describes how the mitigation commitments will actually be delivered, together with the role of monitoring, inspection, audit and reporting. The ESAP will be in line with EBRD's Performance Requirements. Where necessary, additional details in the form of outline topic-specific plans (e.g. for waste management) will be provided for issues of critical importance.

6.11 Limitations of the Study

Like most SEIAs, the BRUA SEIA faced a number of challenges in terms of the accuracy of predicting impacts, and developing appropriate mitigation. Furthermore, even with a firm Project design and an unchanging environment, predictions are by definition uncertain. In order to facilitate decision-making, areas of uncertainty, data gaps and deficiencies, and additional work required during further stages of Project development have been highlighted within the SEIA report and mainly stem from the issues discussed below.

- **Accuracy, Depth of Detail and Gaps in Knowledge of the Existing Conditions**. Although a good deal of information was already available for Romania, various physical, geophysical, biological and archaeological surveys were carried out in the study area; the field surveys were performed by established scientists with a detailed knowledge of the Region. There has also been substantial data gathering on socioeconomic conditions in the area. The surveys and data gathering were planned in such a manner so as to satisfy any specific local information needs. All surveys complied with Romanian standards for baseline data collection and relevant scientific protocols, but were also designed and undertaken with supporting an international SEIA in mind. The information gathering was not limited to the surveys, but also researched the extensive body of information available in the scientific literature, grey literature and NGO and government documents. Despite the extensive effort put into baseline data collection, it is unavoidable that some gaps in knowledge remain. In such cases, use has been made of information on similar environments or expert judgment, together with the application of a conservative approach to evaluating impact significance where appropriate. The extent to which such uncertainty influenced the impact assessment is addressed in the relevant sections of the SEIA Report.
- **Developing Design** While SEIA is generally a process that interacts with design, it relies on design for certain data to provide the basis for impact assessment. In this respect, it ideally has also to follow design, as well as interface with it. In a project of the scale and complexity of the BRUA there were inevitably issues that have yet to be fully resolved in terms of the precise nature of project activities. The majority of these are construction related. Uncertainty has therefore arisen as a result of the stage that has been reached in the design process at the time of preparation of the SEIA Report. Where the stage in design process results in uncertainty that is material to the findings of the SEIA, this is clearly stated and in some instances more than one option has been assessed. The general approach has been to take a conservative view of the likely residual impacts, to identify standards of performance that the Project will meet where firm predictions cannot be made, and to propose monitoring and further contingency measures.
- **Accuracy of Impact Prediction and Effectiveness of Mitigation.** The accuracy of impact prediction is affected by both the issues discussed above, together with the prediction technique used. This is in part because SEIA predictions are made using methods ranging from qualitative assessment and expert judgement to quantitative modelling. The accuracy of predictions depended on the assessment method and the quality of the input data on the Project and its environmental and social context. Where assumptions have been made, the natures of any uncertainties that stem from these have been presented in the topic specific sections of the SEIA Report. In all instances, the significance criteria have been applied conservatively to ensure that the effectiveness of mitigation is not overestimated.
- **Managing Uncertainty.** Managing residual uncertainty is a key role of the ESMPs and the overall management approach. The ESMPs must have a formalised and adaptive approach to management to allow for both Transgaz and project Contractors to effectively implement changes

to mitigation and management procedures. Impacts will be monitored, as will the effectiveness of mitigation. Where residual impacts are found to be unacceptably high and/or mitigation fails to achieve its objectives, corrective actions will be implemented.

7 Geology and Geomorphology

This Chapter summarises potential project impacts on, or arising from, the underlying geology and geomorphology of the proposed pipeline route. Whilst the pipeline will be located only 1-1.5m below the ground surface, avoidance of geological risks are important to ensure safe construction and operational integrity as well as to avoid adversely affecting infrastructure, human settlements and the broader environment.

7.1 Relevant legislation and Guidance

The key regulations relevant to this section are the Romanian pipeline design regulations as outlined in Sections 2 and 4. In terms of design for seismic risk, the most important regulation is the Romanian *Code for Seismic Design: P 100 - 1/2013* which has been applied to the Project design.

7.2 Key Issues from Scoping

The scoping assessment identified the following issues that could present hazards to the proposed pipeline:

Table 7.1 Issues from Scoping

Hazard	Implications
Earthquakes and Faults	Earthquakes that result in surface fault rupture are an important consideration for buried pipelines. Pipelines crossing fault zones must be able to deform longitudinally and flex to accommodate ground surface offsets. Faults can be categorised as follows: • Class 1: Seismic faults. Faults that are associated with a known historical or paleoseismological earthquake; • Class 2: Possibly active faults. Faults that have sufficient geological and geomorphological evidence to suggest activation since Upper Pleistocene; • Class 3: Neotectonic faults. Faults that affect post-Alpine and pre-Pleistocene rocks, but there are no indications that they have been activated since; • Class 4: Faults with unknown activity. They are mainly basement faults that have no characteristics that can be used to date their recent activity.
Landslides	Landslides are generally unpredictable in behaviour i.e. the frequency/magnitude of movement episodes and the style of ground disturbance that can be expected changes making it difficult to achieve significant engineered risk reduction. Avoidance is considered to be the most appropriate strategy for route selection.
Soil Liquefaction	Soil liquefaction is a secondary earthquake phenomenon which can endanger pipeline integrity. The potential for soil liquefaction is site dependent but is most likely to occur in water saturated, relatively uniform fine sands or coarse silts in a loose state. Such underground conditions are not expected to occur in the vicinity of BRUA in Romania. *Following the scoping study, Transgaz studies have determined that there is no evidence for such conditions along the proposed route.*
Karst Areas	Karst areas are found where soluble rocks are eroded by the action of groundwater to form caves. In well-developed karst, the voids and caves can be large and wide enough to carry all the natural drainage. Most karst in the world is formed in limestone rocks and marble (its metamorphic equivalent). Gypsum is much more soluble than limestone, and karst will therefore develop more rapidly on gypsum than on limestone. The major engineering significance of karst is the existence of underground cavities, which can cause ground subsidence or sudden collapse. *Following the scoping study, Transgaz studies have determined that there is no evidence for such conditions along the proposed route.*

The assessment also considers issues associated with impacts on designated sites of geological interest, and the potential for creation of erosion and landslides as a result of hammering of rock during construction. Table 7.2 highlights the sources of impacts identified in the scoping report and whether the impact was scoped in or out.

Table 7.2 Geology and Geomorphology scoping issues

Source of Impact	Receptor(s)	Impact	Key Receptor Sensitivities	Scoped In/Out	Justification for Scoped In/Out
Landslides	Surrounding environment and construction workers	Physical harm to workers or destruction of surrounding habitat or infrastructure (including the pipeline)	In areas identified as high risk of landslides extra precautionary measures to be taken during construction	In	Scoped in with regards to identifying high risk areas
Faults	Surrounding environment and construction workers	Physical harm to workers or destruction of surrounding habitat or infrastructure (including the pipeline)	High risk in areas exhibiting seismic activity	In	Scoped in because of known earthquake risk in Romania although it is noted that the route follows existing infrastructure which hasn't experienced seismic activity
Soil Liquefaction	Pipeline	Destruction of pipeline integrity	Areas of seismic activity with high soil saturation levels	Out	Scoped out following information from Transgaz
Karst Areas	Pipeline	Destruction of pipeline integrity	Areas with a high proportion of soluble rocks	Out	Scoped out following information from Transgaz

7.3 Existing Conditions

7.3.1 Baseline Studies

The baseline conditions reported are based on the results of a series of geological/ geotechnical studies carried out along the proposed pipeline route as part of the engineering design and as reported in the regulatory EIA. These include the following "Geotechnical studies for natural gas pipeline transport" carried out in 2014:

Phase 1:

- Plateau sector Corbu (jud. GR, TL, DB AG, OT, and the crossing Cotmeana and DJ679 - SC Mistar Project SRL;
- Plateau-sector Corbu (jud. GR, TL, DB AG, OT – UTCB;
- Corbu-Hurezani sector (jud. OT, VL, GJ) - SC Mistar Project SRL;

Phase 2:

- Hurezani-sector Haţeg (jud. GJ, HD) - SC Mistar Project SRL;
- Hurezani-sector Haţeg (jud. HD, CS, TM, AR) - SC Mistar Project SRL;

7.3.2 **Regional Overview**

7.3.2.1 Plate Tectonics and Seismology

Romania is located in an area with active tectonic movements and the proposed pipeline crosses a number of areas of known current or historic seismic activity, including the arc shaped mountain ranges of the Carpathian Mountains which form the northern branch of an Alpine-Himalayan fold and thrust system called the Alpide belt, which evolved during the Alpine orogeny as a result of interactions between the Eurasian, Anatolian and African plates. Figure 7.1 (found in the Figures Document) shows the seismic plate composition in the EMEA Region. The complex geological evolution of the Carpathians is very similar to that of the nearby Eastern Alps (which have more recent seismic activity). They have arisen through strong tectonic processes (folding, thrusting) accompanied by the formation of the sedimentary basins, with associated plutonic and volcanic activity. Whilst earthquake activity is reported by the Romanian authorities as low in the Southern Carpathians (which the project crosses), more activity is present to the east, with the Vrancea region near the southern end of the Eastern Carpathians experiencing the following significant (Magnitude 6 and above) earthquakes recorded in the last 50 years:

- A 1977 quake (M7.2) at a depth of 100 km which resulted in 1528 deaths, 11,300 injuries and 35,000 buildings severely damaged (Zimnicea town was completely destroyed)
- More recent non-fatal earthquakes in 1986 (M 7.1, depth 130 km); 1990 (M 6.7/6.2 - Depth 90/ 79 km) and 2004 (M 6.0 - Depth 98,6 km).

An overall seismic risk map for the country is shown in the Figure 7.1 (found in the Figures Document)

7.3.2.2 Regional Geology

The proposed pipeline route passes over a range of geological strata as shown in the Figure 7.2, which are generally divided into three sub zones as follows:

- The plains around Bucharest which are characterized by marine sediments and are mostly flat with occasional terrace deposits.
- The Carpathian Mountains which form a complicated tectonic structure of folding and subsequent thrusts and faulting as well as historic volcanic activity.
- The plains of the Pannonian Basin which are again made of marine sediments.

Within the southern Carpathians there are three structural and paleogeographic units, namely the Danubian terrane, Severin nappe, and Getic terrane (late Cretaceous to early Tertiary). Of these the

- Danubian and Getic terranes consist of shallow-water, non-marine Mesozoic rocks that overlie Paleozoic and Precambrian sedimentary and crystalline rocks. Rocks of the Getic terrane have been thrust eastward over rocks of the Danubian terrane along the Getic thrust fault. Some Late Jurassic to Late Cretaceous flysch-type rocks occurs between the Getic and Danubian rocks.
- Severin nappe represent remnant oceanic deposits that probably extended eastward into the flysch terrane of the eastern Carpathians.

The Pannonian and Transylvanian basins are superimposed on these structural elements of the Carpathians and represent post-tectonic basins, created partly by extension in middle and late Tertiary time.

Further information on the deeper geology is provided in the Regulatory EIA. Shallow geology along the route is summarised in Table 7.3 below.

Table 7.3 Summary of shallower geological characteristics of the pipeline route

Section	Landform and underlying geology
Phase 1	
Section 1: Podișor-Corbu (km 0-80km)	The route passes through flat agricultural land underlain by deposits of sands, gravel and clay.
Section 2: Corbu – Hurezani (km 80-196km)	The route continues through relatively flat agricultural land for the first 35km or so, passing along the plains between the Rivers Vedita-Vedea and River Vedea- Plapcea where the top 5-20m of geology consists of mid-Pleistocene loess deposits including the floodplains and

Section	Landform and underlying geology
	loess deposits of the Vedea river terraces. At about km 115 the pipelines starts to climb out of the Moseian Platform and towards Jitaru it enters the Carpathian depression. Between Jitaru and Hurezani the Carpathian depression is known locally as the “Getic Depression”. Here upper horizons are composed of sandy clay, sands and loamy sands with lignite layers. In places this geology outcrops and in areas of erosion deep valleys have revealed the sands, gravel and clay horizons of the lower Pleocene.
Section 3: Hurezani – Hațeg (km 196-342)	From km 196-244 the route continues through the foothills of the Carpathian Mountains before passing into the mountains themselves. From ~ km 311 the route passes through the Dinosaur Geo-Park. In the early stages, between Hurezani and Sambotin, there has been hetrogenous and discontinuous deposition of gravel, sand, and clay although the predominantly sandy formations are increasingly replaced by clay formations as the route heads north. The oldest deposits along the route are found in the “Dac region” and are made up of marl and clays with thin areas of sands and coal strata. From Sambotin the route starts to climb into the Carpathian Mountains to the south of Vulcan region. Here the rocks include the indigenous Danubian formations and are traversed by massive bodies of igneous rocks: granite, granodiorite with areas of basalt also present further north. The Petrosani Depression here partially overlaps the indigenous Danubian as a result of a tectonic overthrust and the basalts are mixed with massive limestone sediments from the upper Jurassic stratigraphic interval. In the western basin conglomerates contain insertions plus sandy marl, limestone, marl, green clay, and yellow slightly cemented sands. The thickness of these deposits reached about 300 m. In the Badenian basin at Petrosani are horizons of gravel and sands with intercalations of sandy clay and coal layers from the eastern basin
Section 4: Hațeg – Recaș (km 342 - 478)	From km 342 the route passes through the Hateg depression of the Carpathian Mountains (and leaving the Dinosaur Geo-Park at km 364). From there is passes into the Caransebes corridor for approximately 40km before leaving the mountains around km 402 and heading towards the western plains following the Timis River corridor up to Recas for another 70km. Initially, between Dalu Sajen and Dacidelor Deva the geology is dominated by further conglomerates represented by the cristalofiliene formations over which sedimentary formations feature including limestone, sandstone, conglomerate, and clays. Leaving the mountains, towards the Pannonian Basin, the route passes over a pool of sedimentary deposits which show great lithological variability both horizontally and vertically. The geology here includes deposits from the Quaternary Badenian-stratigrafic range, composed of sand, clay, limestone, and sandstone with marl and partially eroded sands Quaternary surface deposits here are alluvial in nature and consist of sands, gravels and clays with loessoid type deposits consisting of sands and clay powders. Deposit thickness varies between 5-15 m, sometimes reaching up to 30 m. Generally, the Arad deposits (2-5 meters thick) overlie the West Loessurile and loess formations of the Nădlacului deposits (10-20 m) and he cobbles, gravel, sand, clays, charcoal of the Cuatemarul deposits (30 -100 m thick) Between Hateg and Caransebes the route passes west through the Culoarul Caransebes valley past the towns of Bucova and Marga. Here it passes over the early “Dacidele” formation of shale with crystalline granitoide and old mezzo-metamorphic rock. This is overlain near Bucova with layers of coarse sandstone and brecii, microconglomerate with lots of limestone, sandstone, from the paleocene age. *A number of West-East faults are found here*. Further west is well developed terrace with gravels, sands belonging "Strata of Candeşti", present in the frame of the basin area; Late Pleistocene age with gravels and sands to clays plus; Late Pleistocene age lower terrace representing higher silt composed of gravels and sands and a red clay.
Phase 2	
Section 5: Recaș – Horia (km 478 - 528)	From Recaş towards Habib the pipeline passes through the Banat Plain which represents one of the eastern portions of the large sedimentary Pannonian Basin. This area “sank” on the alignments of “pannonic” faults oriented roughly N-S and increasingly westward and away from the Carpathian Mountains. The foundation is divided into blocks bounded by faults. The geology here is composed of sand, clay, limestone, and sandstone, but is often eroded leaving underlying marl and clay.

7.3.3 **Designated Site: The Hateg Country Dinosaurs Geopark**

Romania does not have many designated geologically sensitive areas, but one of the few, the Hateg Country Dinosaurs Geopark, is crossed by the route between km 311-364. This Geopark covers an area of in excess of 100,000 hectares and includes the town of Hațeg, as well as 10 other communes. The Park, which contains a mix of deep gorges, caves, and mountain areas, as well as several areas

of cultural and archaeological importance, is known world-wide known for the fossils of “dwarf dinosaurs” found here and dating back to the Cretaceous Period, some 72-65 million years ago.

Fifteen dinosaur species, both herbivorous and carnivorous have been described based on skeletal remains found in fossil fluvial and lake deposits. Dinosaur eggs and hatchlings were also discovered in the same deposits, as well as many non-dinosaur species, representing all the classes of vertebrates, from fishes to mammals. Included in this assemblage is a huge pterosaur (flying reptile), named Hatzegopteryx, which had a wingspan of 12 m. Another geologic feature that is well documented in the Geopark are the volcanic rocks - tuffs, lavas and volcanic bombs marking the volcanic eruptions that took place in the region during the dinosaurs’ existence. All the natural, historical and cultural sites from the Hațeg region are integrated within the management plan of the Geopark.

7.4 Impact Assessment

7.4.1 Significance Criteria

Geohazards have the potential to have a range of impacts on the pipeline including:

- Lateral pipe displacement;
- Pipe settlement or uplift (heave) of pipe
- Significant plastic deformation of the pipe wall material (due to compression, tension or shear strain)
- Spanning (i.e. the loss of ground support if a landslide removes the ground material over a significant length of the pipe trench)
- Increase of the static load upon the pipe (i.e. pipe is buried under landslide debris)
- Temporary increase of the dynamic load upon the pipe (i.e. is imposed by falling rocks).

The likelihood of such effects is determined by a range of geological, geomorphological and geotechnical factors[9], which have been taken into account in the project design (including the seismic history of the area crossed) and the location of the GCS sites.

Beside engineering and construction considerations, safe construction and operation are considered important from an environmental and social point of view. Proposed significance criteria associated with these interactions are shown in the tables below.

Table 7.4 Impact assessment criteria for geology and geomorphology

Assessment endpoint	Negligible Risk/Impact	Low risk/impact	Medium risk/impact	High risk/impact	Very High risk/impact
Crossing areas of faults and seismic activity	RoW or AGIs in areas classified as seismic zone V.	RoW or AGIs in areas classified as seismic zone IV.	RoW or AGIs in areas classified as seismic zone III.	RoW or AGIs in areas classified as seismic zone II.	RoW or AGIs in areas classified as seismic zone I.
Crossing of geohazards: (landslides, rock fall)	RoW or AGIs in areas with no history of specific geohazards	RoW or AGIs in areas with few examples of specific geohazards.	RoW or AGIs in areas with some examples of specific geohazards.	RoW or AGIs in areas with many examples of specific geohazards.	RoW or AGIs in areas with regular examples of specific geohazards.
Excavation techniques	Normal construction methods	Ripping and some hammering	Moderate levels of hammering	Major hammering and some blasting	Significant blasting

9 These include for example, soil types and grain sizes, mineral composition and stratification of rock formations, rock weathering process, slope angles of terrain surfaces, presence of groundwater in sediment deposits, rain fall characteristics or soil freezing, etc.

7.4.2 Seismic Risks and Geohazards

As outlined above, Transgaz has undertaken a large number of Seismic Risk and Geohazard Studies to inform the routing and design of the proposed pipeline. As a result the pipeline is considered to be at a low risk of seismic activity. Based on the preliminary information available to date (and to be further developed before construction commences) the following potential levels of unmitigated risk have been identified regarding geohazards:

Table 7.5 Geohazard significant criteria

Sector	Landslides	Rockfall	Karst formations	Volcanic formations	Soil Liquefaction
1	Low	Negligible	Negligible	Negligible	Negligible
2	Medium	Medium	Negligible	Low	Negligible
3	Medium	Medium	Negligible	Medium	Negligible
4	Medium	Medium	Negligible	Low	Negligible
5	Low	Low	Negligible	Negligible	Negligible

As shown in the table the greatest risks are associated with landslides and rockfalls in mountainous areas, and specific measures are proposed to address these as outlined in Chapters 3 and 4.

7.4.3 Excavation Techniques

Whilst the generic construction methodology is considered appropriate for areas with unconsolidated deposits, where more solid geology/ bedrock is present specific approaches involving hammering and ripping of the rock may be required. Such situations can be grouped into the following classes:

10. Unconsolidated deposits, excavation with light tracked excavation machinery possible (negligible-low risk)
11. Coarse or consolidated sedimentary rock weathered rock, ripping necessary, excavation with heavy excavation machinery possible (medium - high risk).
12. Blasting required (very high risk)

The geotechnical studies undertaken to date indicate that as no “Class 3” ground is expected to be encountered no blasting will be required. Some areas of “Class 2” ground are present where the route crosses the Carpathian Mountains between km 271-301 and 309-311as shown in Figure 7.5. Implications of this are discussed further in the sections on ecology, waste, traffic, noise and air quality.

7.5 Proposed Mitigation

In addition to the generic construction mitigation outlined earlier the project has specifically included a range of mitigation into its design as outlined below.

7.5.1 Geohazards

Impacts associated with geohazards will be finalised in the detailed design stages pre-construction. Overall, however, the pipeline design meets the national specifications required for managing seismic risk which includes specific criteria regarding pipe thickness, coating, and backfill/bedding material.. Impacts from rockfall and landslides will be mitigated by reducing the potential for project-induced earth movements, by following GIIP for construction sites and implementing Health and Safety Management Plans and specific working activities instructions for geohazard areas. These will be included the following:

- **Landslides.** Use of embankments at the base of slopes or retaining structures, reducing the slope inclination with additional soil materials or lowering groundwater levels, or replacing or reinforcing sensitive soil layers to minimise causation.
- **Rockfall.** Use of stoppers, barriers and/or wire fences to minimise impact.

7.5.2 Designated Sites

Transgaz will develop and agree a specific management plan to address impacts to the Geopark.

7.5.3 Non-designated geology

Given that the pipeline is generally within the superficial strata and soil, to a depth of about 2m, deeper bedrock layers are generally not affected by the proposed project. A greater depth of excavation may be required where terracing is proposed (totalling 11km), especially in the area of the crossing of the Transylvanian Alps (between Truss and the volcano). Specific techniques are proposed for this as described in Chapter 4.

7.6 Monitoring

Monitoring will be mainly focussed on areas where there is potential for erosion, rockfall and landslides as part of the ongoing engineering design, construction delivery and operational maintenance. A check sheet will be developed to cover recoding of potential ground movements, slope instability and erosion during checks on the RoW. These checks will detail triggers for further on the ground investigations where required in order to determine if any remedial actions are required.For the Geopark an archaeological watching brief will be developed, together with a chance find procedure and this will be applied as for other areas of archaeological interest.

7.7 Residual Impacts

Following the implementation of the mitigation proposed above, the project is not expected to result in any material residual impacts associated with geology and geohazards.

8 Soils

This Chapter summarises the proposals for managing potential impacts on soils affected by the proposed project. Soil is considered a particularly sensitive resource in Romania and the preservation of soil quality is a key objective of Romanian legislation as well as a target for the BRUA project, whilst disturbance of areas with existing soil contamination pose potential project risks. The general approach to managing soils is further considered in Chapter 5: General Construction Mitigation.

8.1 Relevant legislation and Guidance

The key Romanian regulations relevant to this Chapter are summarised in Chapter 2 and covered in more detailed in the Regulatory EIA. Issues around prevention of pollution to soil are covered under EBRD PR3.

8.2 Scoping Assessment

Pipeline projects can have major impacts on soil by causing temporary increased exposure to wind and water erosion following vegetation removal, creating changes in physical properties through compaction, and changes in chemical properties through fertilization, discharge of wastewater and deposition of air pollutants, etc. The following specific issues were identified for further evaluation:

- Loss of soil, including removal, erosion and surface sealing
- Disturbance and degradation effects on soil quality and productivity, including land use,
- Impacts from compaction and erosion of sensitive soils, especially along elevated areas
- Existing contamination and potential for contamination from split solid and liquid material

Table 8.1 highlights the sources of impacts identified in the scoping report and whether the impact was scoped in or out.

Table 8.1 Soils Scoping Report impacts

Source of Impact	Receptor(s)	Impact	Key Receptor Sensitivities	Scoped In/Out	Justification for Scoped In/Out
Clearance of the working strip, excavation of the pipeline trench and reinstatement activities	Geological and soil resources	Deterioration in soil grade/quality and productivity	Careful soil handling is required to enable effective vegetation re-instatement and/or re-use of soils for agriculture.	In	Scoped in with regard to particularly high grade agricultural soils.
Use of/construction of access roads	Geological and soil resources	Compaction of soils by construction plant and vehicles	Reduced aeration, permeability and water-holding capacity of soils. Increased susceptibility of soils to wind and water erosion	Out	Scoped out with regard to additional studies, however GIP mitigation measures to be incorporated into the SLIP.
Accidental spills of oils or chemicals due to poor pollution prevention and control measures.	Geological and soil resources	Localised contamination of soil	N/A	Out	It is understood that Transgaz will be applying Good International Practice (GIP) to their construction activities as part of their HSE-MS.
Contaminated Land	Construction Workers	Exposure to contaminants present in soils via acute exposure scenarios such as inhalation of dust or	Construction workers could develop health problems as a result of exposure.	In	Scoped in for any known areas of significant land contamination.

Source of Impact	Receptor(s)	Impact	Key Receptor Sensitivities	Scoped In/Out	Justification for Scoped In/Out
		vapour or ingestion			
Contaminated Land	Surface and Groundwater	Mobilisation of contaminants in the soil that would otherwise be immobile (e.g. from historic landfill sites) and the creation of new pathways for contamination to reach groundwater and surface water resources i.e. via leaching and run-off.	A reduction in water quality could further impact users of water resources (for agriculture or potable supply) and aquatic flora/fauna.	Out	Scoped out with regard to additional studies, however GIP mitigation measures to be incorporated into the SLIP. NB: water quality issues are covered in the Groundwater and Surface Water Sections.

8.3 Existing Conditions

8.3.1 Baseline Studies

The baseline data presented here has been acquired through a combination of desk study and a comprehensive soil sampling programme undertaken by Transgaz as part of the construction planning and permitting process. The latter included analysis of over 500 soil samples by qualified agronomists to understand soil conditions (notably in agricultural areas) to enable appropriate compensation regimes to be developed and the samples have been verified by the local authorities as part of the permitting process. This is discussed further in the Regulatory EIA.

8.3.2 Conditions along the Route

Soil resources in Romania are an important resource, especially given the high (>60%) agricultural land use in the country. Nationally, soils are classified into 12 classes and 32 types, differentiated by structure and productive capacity (see Figure 8.1 in the Figures Document). Key soil characteristics are presented below.

Table 8.2 Key soil characteristics along the Phase 1 of the proposed pipeline route

Sector	Description of soils
Section 1: Podisor - Bibesti	Soils in the relatively flat agricultural areas are dominated by luvisoils with lenses of highly productive regosols and aluvisoils (especially in the meadow terraces of the Carpathian foothills).
Section 2: Bibesti - Pui	Leaving the meadows podzols become dominant together with pre-podzols and other shallower soils. In the valleys, the productive luvisols and gleio soils remain.
Section 3 Pui - Recas	Returning to the valleys and plains soil quality improves with luvisols and gleio soils still dominant in the valleys.

8.3.3 Susceptibility to Erosion and Compaction

For most of the proposed route, the soils are reported to be in relatively good condition with fairly good cohesion and a soil structure that provides for aggregate stability and reduces the likelihood of soil erosion. Much of the region has, however, been experiencing accelerated soil degradation and erosion as a result of both urban development and deforestation. Where the ground is already saturated, during periods of high intensity rainfall flash flooding is also a concern with negative impacts for both agricultural land and settlements (greater slope instability, landslides and erosion).

A number of sections have been identified where the erosion risk is particular high due to the soil properties and topography as illustrated in Figure 8.1.

8.3.4 Existing Soil Contamination

Most of the proposed pipeline route passes through agricultural land or other non-urban land uses such as forest land, grasslands and vineyards. Land uses within the AoI are summarized below:

Table 8.3 Land use in the 300-m corridor

Landuse	Road	Atrophic	Agricultural	Meadow	Forest	Riparian	Scrub	Other
Ha	371	218	10870	1722	2048	299	210	41
%	2.4	1.4	68.9	10.9	13	1.9	1.3	0.3

Source: EIA report

Given this profile the majority of the route is expected to be relatively free from areas of contamination. Whist limited information is currently available on land contamination the following have been identified:

Table 8.4 Potential Soil Pollutants

Source	Status
Industrial Pollution	In a limited number of areas, the pipeline will pass through towns and urban areas. The regions of Drăgăşani, Târgu Cărbuneşti, and Lugoj are mostly industrial areas, and mining is an economic activity specific for Vulcan. The route has already been designed to avoid known areas of major industrial/mining contamination but further characterisation of contamination is likely to be required here.
Nitrates	Elevated nitrate concentrations may be present in soils associated with more intensive agriculture (for example under corn, cotton and tobacco crops. Typically elevated concentrations occur in the upper 30 cm of a soil profile. Where these soils are disturbed there is a risk the nitrate could be subsequently leached into the groundwater at a faster rate.
Agro-chemicals	Perennial crops (fruit orchards) and grapes are not characterized as heavily fertilized crops but the amount of chemical inputs they receive are diverse, based on spray programs applied, season and year, weather conditions and the type of fruit trees. Over-use of agricultural chemicals in the area is reported but not quantified, particularly those used for plant protection purposes. Pasture lands tend to receive comparatively lower chemical inputs compared with more intensively cultivated crops elsewhere along the corridor. The most intensively irrigated crops that also receive high agri-chemical inputs are field vegetables.

BRUA route was also overlaid with maps of areas vulnerable to nitrate pollution (historical pollution or nitrites) as shown in Figure 8.2 (in the Figures Document).

8.4 Impact Assessment and Mitigation

8.4.1 Methodology

Impacts on soils have been assessed based on the following criteria

Table 8.5 Soil related impacts and mitigation

Issue	Negligible Impact	Low impact	Medium impact	High Impact	**Very** High Impact
Degradation of soil with high agricultural potential	No detectable effect on soils or ground conditions	Minor effects expected to last for up to three months after reinstatement	Minor losses of productivity expected to last up to six months after reinstatement.	Moderate losses of productivity predicted to last more than one year after reinstatement	Major losses of productivity predicted to last more than one year after reinstatement
Erosion in areas high erosion potential	No detectable soil erosion, soil creep.	Minor or localised soil erosion, soil creep.	Soil erosion evident and potentially leading to some rill or shallow gulley erosion.	Rill and gully formation predicted to be extensive enough to impacts on neighbouring land and pipe integrity.	Major rill and gully formation predicted with significant potential impacts on neighbouring land and pipe integrity.

Issue	Negligible Impact	Low impact	Medium impact	High Impact	**Very** High Impact
Contamination of soils	Areas with low likelihood of existing contamination	Areas with some potential contamination exposure which may require some mitigation/management measures	Areas with medium potential exposure to existing contamination, which may require mitigation/management measures	Areas with high potential exposure to contamination which will require site specific mitigation/ management measures and/or further in-depth studies	Areas with potentially very high exposure to existing contamination which will require site specific mitigation/management measures and/or further in-depth studies

8.4.2 Disturbance and Land take

Contractors will be required to adhere to the general mitigation outlined in Chapter 5 and the specific requirements of the Project "Soil Management Plan". However, the following impacts of Medium Significance are envisaged:

- Temporary disturbance of some 1083 ha of soil across the working strip,
- Temporary loss of further land resulting from the establishment of the construction camps, pipe yards, compressor stations and ancillary facilities.
- Permanent loss of a further 12 ha of land at the compressor stations.

As the sites of BVS and the Compressor Stations will be permanently sealed the excavated soil is to be reused elsewhere as described in the Reinstatement Management Plan.

8.4.3 Impacts on Soil Quality and Productivity

Soil quality is affected by a range of factors, such as its biological activity, the quantity of soil organic matter, chemical composition, texture and structure. Despite the application of the measures outlined in the Soil Management Plan, the construction works are expected to have at least some effects on soil productivity across the route, although these will mostly be temporary. Such impacts are expected to be greatest in areas where soil has previously been undisturbed but could also affects areas of high agricultural value. Whilst such impacts will only affect the working strip they are still considered of **Medium significance** because:

- Soil will be temporarily disturbed by the works and be unavailable for agricultural production, but the timeframe for this disturbance prior to restoration remains limited to about 30 days, longer in exceptional circumstances but not exceeding 5 months;
- Where land is left fallow there is a risk of growth of ruderal, alien or invasive species that will require additional management;
- Disturbed soils are potentially at risk from erosion (see below) which can result in decreased fertility and structural stability.

8.4.4 Soil Compaction

Construction activities, including stripping, excavation and transport could potentially lead to soil compaction along the working strip This will especially affect the A and B soil horizons and leads to an increased risk of surface runoff (due to reduced storage capacity) and erosion. This can result in diminished fertility, limited root growth and increased exposure to the effects of drought. In the absence of appropriate and prompt interventions the affected areas can expand and persist. Overall, unmitigated impacts arising from compaction are considered to represent a **medium significant impact.** Figures 8.3 and 8.4 demonstrate the potential the effect of construction equipment on soil along the project route.

Figure 8.3 Effect of tracked machines

Figure 8.4 Effect of Wheels

~~*Appearance of a grassy field affected by the use of tracked machines (left) and Wheel (right)*~~

8.4.5 Soil Erosion

For most of the proposed route, the soils have fairly good cohesion and structure, providing aggregate stability and reducing the likelihood of soil erosion resulting in a low-medium significance impact. Where soils are regularly mobilized (e.g. cultivated soils) impacts are not as great as in the case of soils from the natural systems (stands, natural meadows, etc.). However, a number of sections have been identified where the soil erosion risk is considered high due to the soil properties and topography. The table below shows the potential sensitivity of the 9 major land uses recognised to soil erosion. Unmitigated Impacts are expected to be a **medium level impact** with the exception of some of the more mountainous areas where they could represent a **high-level impact.**

Table 8.6 The situation at BRUA sectors and their exposure to factors that encourage erosion

Land use	Length (km)	Impact level	Description
Agro-ecosystems	363.45	1	Considered relatively stable
Anthropic areas	19.25	1	Considered relatively stable
Grassy areas	58.26	3	Neutral impact
Nude areas	0.1	2	Limited impact as soil layers lack cohesions
Forests	70.03	5	Significant impact, mitigation required including careful ecological restoration
Riparian	10.84	5	Significant impact, mitigation required including careful ecological restoration
Bush / shrub	6.68	4	Impact within acceptable limits, the expected cancellation under its brief interventions;
TOTAL	528.51		

8.4.6 Soil Pollution

Accidental pollution of soil during construction of the pipeline (along the construction corridor) and the above ground facilities could occur through direct spillage of materials such as oils or hydraulic fluids from vehicles and machinery and surface runoff and sanitary waste from construction sites. However, this has been scoped out as any potential spillages will generally be of small quantities and localized in nature and will be managed through GIP in line with the pollution prevention management plan. Should any pollution occur, the land will be immediately excavated, removed and processed as a dangerous/ hazardous waste from an authorised contractor according to the Site Waste Management Plan.

8.4.6.1 Impacts from existing contamination

The route as designed is not intended to pass through any contaminated sites, waste dumps or uncontrolled waste landfills. However, along the construction corridor, undiscovered pollutants that may already be present in the soil from current or historical sources and may be encountered during excavations. This could potentially impact the construction workers' health via inhalation of dust or direct ingestion, the land drainage network and then groundwater via rain water surface runoff from stockpiles.

However, given the agricultural nature of the majority of the study area, it is very unlikely that contamination due to industrial activities will be encountered along the route. Any that exist are likely to relate to agrochemical use or inputs of contaminants from upstream in floodplain areas.

Based on the baseline data available it is considered unlikely that any significant existing soil contamination will be encountered during the excavation of the pipeline trench. However, if potential contamination is encountered, the following measures will be taken:

- An assessment of the potential risks will be undertaken, including soil sampling if necessary;
- Appropriate Personal Protective Equipment will be used to protect the construction workers;
- The excavated contaminated soil will be segregated from the main stockpiles (in order to minimise the potential to impact the surrounding land and the potential for run-off to reach the land drainage network) and will be disposed of through a licensed waste contractor;
- In the vicinity of any contamination, the pipeline trench will either be lined with impermeable materials or will be backfilled with low permeability materials such as clay; and
- Overall, impacts of **low significance** are anticipated to arise from existing contamination.

8.5 Proposed Mitigation

The majority of the mitigation outlined below will be delivered through the physical soils reinstatement and biorestoration (biodiversity management) plans and will be applied generically across the project in line with other plans outlined in Chapter 5. This includes minimising duration of stockpiling, managing open ground to reduce erosion and sediment runoff and special techniques in areas with thin topsoil. Transgaz and the contactors will develop dedicated teams with a specific remit regarding erosion and sediment control implementation (EPC) and monitoring (Transgaz).

8.5.1 Soil Quality and Productivity

The reinstatement measures described in Chapter 5 (e.g. careful handling and storage of topsoil, limiting soil compaction risk and surface protection from erosion) will enable the successful reinstatement of the soils. In addition, the following will be applied:

- Identification and mapping of areas with soils of high sensitivity;
- Where appropriate composted plant material collected from the areas cleared of vegetation will be used as a soil amendment to increase soil organic matter levels.
- All areas to be stripped will be cleared of surface vegetation prior to stripping. This will not be mixed with the topsoil but will be composted (see above).
- In general topsoil will only be stored for 30 days. Where the topsoil will be stockpiled for durations exceeding 30 days, the stockpiles will be assessed to determine if additional remedial measures are required. These could include the turning of stockpiled material or the installation of ventilation pipes. Stockpiles will generally be sited to ensure they do not become waterlogged and the surfaces will be smoothed to ensure they shed water.
- Given the thickness of soil (30 cm) approximately and 4 million m3 of topsoil will be disturbed. All materials will be re-used during the land restoration phase ensuring no material is required to be disposed of.
- From the outset, topsoil will be separated to protect it from compaction, risk of pollution by oil products, etc. Topsoil stockpiles will be stored at one side of the work area and will take the form of berms with triangular form, slope inclination will reach 45 °and a maximum height of 2.5m and a width of 2.5m.

8.5.2 **Soil Compaction**

Physical impacts on soil will occur during construction due to movement of heavy machinery. The following mitigation measures are proposed to minimise potential soil compaction impacts:

- Project vehicles and heavy machinery will use only the construction corridor and the access roads.
- For soils of high sensitivity to compaction (e.g. clayey soils, Luvisols) soil handling will be undertaken only during dry periods.
- Where significant loading of soils will take place, temporary surface stabilisation materials will be used such as geotextiles with a gravel layer on top to distribute the ground pressure.
- Deep ploughing to 60 cm in multiple directions (subsoil de-compaction) will be undertaken prior to reinstatement of topsoil layers.

8.5.3 **Soil Erosion**

Soil restoration and land reclamation techniques will be applied to control erosion, especially in areas of high risk. These methods will include seeding, hydroseeding, other soil revegetation practices and silt fences. In particular, the following will be applied:

- Using the hydroseeding method, seed mixtures of endemic species and varieties already present in the section (fescue grass and legume seeds), mulch, fertilizer, tackifier and water are applied as a slurry mix. It is the most effective (optimum) method of obtaining growth on steep or difficult sites;
- The seed mixtures which will be used by hydroseeding method are not the same for all the sections along the pipeline corridor. Different seed mixtures for each section are presented in *Chapter 12*;
- Shrubs planting will be undertaken as appropriate at the sections with high precipitation, moderate – steep slopes and weak soil structure or structureless soils. Those techniques reduce the risk of soil erosion and assist the reinstatement;
- Silt fencing will be used during construction to limit the spread of silt-laden runoff. Where required these will remain in place post-construction until vegetation has established. They will then be carefully removed without damaging the reinstated soils or establishing vegetation;
- Where feasible, pipeline construction activities shall avoid the months of highest precipitation, because the risks of soil structure destruction and soil compaction is extremely high;
- The construction strip reinstatement will take place immediately following pipeline installation, especially in the sites that have high or medium erosion sensitivity according to the international best practice, in order to reduce erosion risk; and
- All grade cuts will be replaced to their original contours and the work area will be seeded, fertilized and mulched to restore ground cover and to minimize erosion.

In areas of steep slopes and high erosion risk geotextiles will be used to limit the risk of erosion, example shown in Figure 8.4.

Figure 8.6 Amass of plant and rockfill material to form terraces on a high slope

8.5.4 Pollution mitigation

Appropriate training programs will be put in place for personnel involved in BRUA construction activities regarding pollution prevention and minimisation in line with the general pollution prevention plan. In addition, storage of materials will be done to avoid pollution, and measures will be taken to reduce waste and ensure it is not stored in sensitive areas. Excess clean spoil will be disposed of as part of the land reclamation and is not expected to contribute a significant impact.

8.5.5 Impacts from Operations

No significant impacts to soil and subsoil are envisaged during Project operations. Agricultural soil can continue to be used with a ploughing depth to 30 cm. As part of the pipeline route management, the pipeline protection strip (8 m width) will be kept free from any deep rooting vegetation. In order to protect the soil and surface and groundwater, this will be achieved by physical means (i.e. no application of herbicides, defoliant etc. will be allowed).

The Pipeline Route Maintenance Plan will include periodic checks for surface erosion and remedial actions will be taken where this is noted.

If external pipeline maintenance becomes necessary, i.e. excavation of a pipeline section for repair (which will be an exceptional case), impacts and mitigation at the particular location will be similar to those of the construction stage.

8.5.6 Impacts from Decommissioning

Depending on the approach and technologies available at decommissioning stage, the pipeline may either stay in the ground or will be taken out partly or completely. Regarding soil impacts, in the case of taking the pipeline out, impacts will be similar to construction stage. Soil profiles will be disturbed, but as BRUA will follow the international best practice during the construction and decommissioning phase (diligent care in excavation, separation and appropriate storage of topsoil and subsoil, de-compaction of working strip, etc.) this will ensure that soils will be reinstated to their previous conditions, as close as technically feasible. This way, soils will be available again for agricultural use and re-vegetation in non-agricultural areas. Mitigation measures will be planned according to the best practice available at the time of decommissioning (i.e. in 40 years).

8.6 Monitoring

Details of monitoring to be undertaken are provided in the BRUA Construction Environmental Management Plans. This will include specific monitoring regarding:

- Stripping, storage and reinstatement of soils;
- Decompaction of subsoil;
- Pollution and spill prevention;
- Habitat reinstatement and erosion prevention; and
- Soil quality reinstatement (to be specifically monitored by the regulatory authorities).

Further details are provided in the management plans.

8.7 Residual Impacts:

The effectiveness of the soil reinstatement will be carefully monitored by the regulators, and with the implementation of the proposed mitigation, residual impacts are expected to be reduced to the permanent loss of the 12ha of land of land to the compressor stations. Whilst there will be a lag in soil productivity being regained overall residual impacts are expected to be of only low-medium significance.

9 Water Resources

This Chapter addresses potential project impacts on local water resources. As such it includes an assessment of impacts on hydrology, hydrogeology and water quality during both the construction and operation phases of the proposed project. Information regarding the ecological importance of the water resources is covered in Chapter 12: Ecology and Nature Conservation.

9.1 Relevant legislation and Guidance

Protection of the water environment is a target of Romanian, European and international legislation as well as a requirement of the EBRD's Performance Requirements (PR3), both for the protection of water users and the preservation of ecosystem integrity. The key Romanian and international regulations relevant to this Chapter are summarised in Chapter 2 and covered in more detailed in the Regulatory EIA. Issues around prevention of pollution to soil are also covered under EBRD PR3 (PR3: Resource Efficiency and Pollution Prevention and Control).

9.2 Scoping Assessment

Water resources are critical to a wide range of human and ecological functions, and are increasingly under threat from pollution and abstraction, as well as impacts of climate change. Impacts may affect both the water resources themselves (primary receptors) and users of those water resources (secondary receptors). Examples of such sensitive receptors identified during the Scoping Process that could be affected by changes in water quality, flows and levels as a result of project construction or operation include:

- Abstractors of surface water or groundwater (for e.g. potable water or irrigation purposes);
- Aquatic flora/fauna; and
- Water level dependant habitats e.g. wetlands.

Construction activities that can contribute to impacts on the water environment include abstraction (from surface water courses or groundwater), de-watering, wastewater discharge, excavations and the operation of machinery or vehicles that could result in oil/chemical spills. During project operation abstraction (demand for water), wastewater discharges and run-off from areas of hardstanding (which could contain mobilised contaminants) could all contribute to impacts on water resources. Key potential sources of impact are shown in Tables 9.1 and 9.2 below as included in the scoping report. Issues that were "scoped out' are included within the scoping report provided as a separate document.

Table 9.1 Water Resource Impacts during Construction – Scoped In

Source of Impact	Receptor(s)	Impact	Key Receptor Sensitivities	Justification for being Scoped In
Groundwaters				
Contaminated soil	Groundwater quality; users	Mobilisation of soil contaminants and subsequent leaching into the groundwater	Reduced groundwater quality could impact users of water e.g. for agriculture or potable supply	Scoped in with regard to groundwater abstractions from shallow aquifers, in areas of significant contamination.
Installation of the pipeline and above ground infrastructure e.g. the GCS	Groundwater levels, users; dependent water bodies	Introduction of a below ground obstruction (i.e. the pipeline). Reduction in infiltration.	Groundwater recharge/flows may be impeded within any underlying shallow aquifers.	Scoped in with regard to groundwater abstractions from shallow aquifers and water level dependent sensitive wetlands.
Surface Waters				
Effluents from hydro-testing, accommodation	Surface Water quality	Direct discharges of polluted effluent into water courses.	Water users; aquatic flora/fauna	Scoped in because the proposed treatment of discharges is not yet

Source of Impact	Receptor(s)	Impact	Key Receptor Sensitivities	Justification for being Scoped In
camps, de-watering etc.				clear.
Abstraction from water courses for hydro-testing and dust suppression.	Surface Water quality	Temporary reductions in flows and water levels	Water users; aquatic flora/fauna.	Requires confirmation of abstraction rates, durations and volumes as well as existing flow regimes within water courses.
Dams during pipeline laying	Surface Water flows	Temporary reduction in flows downstream.	Water users; aquatic flora/fauna.	Scoped in for sensitive watercourses, otherwise managed through GIP.
In stream construction activities (excavations etc.)	Surface Water quality; water users; aquatic flora/fauna quality.	Disturbance to and alteration of the structure and nature of the river bed.	Increased turbidity downstream, release of nutrients, eutrophication and deoxygenation of water	Scoped in for sensitive watercourses, otherwise managed through GIP.

Table 9.2 Water Resource Impacts during Operation – Scoped In

Source of Impact	Receptor(s)	Impact	Key Receptor Sensitivities	Justification for being Scoped In
Groundwater abstraction	Groundwater levels; users; dependent waterbodies	Abstractions of groundwater to supply the GCSs. A localised lowering of groundwater levels (a cone of depression)	Lower groundwater levels will reduce the ability of other groundwater users to access supply. Any groundwater dependent water bodies could suffer from a reduced base flow.	The volumes of water required to supply the GCSs and the locations of any existing abstractions are not known at this stage.

9.3 Existing Conditions

9.3.1 **Baseline Data** Collection

This Chapter has been developed based primarily on desk study information, as no specific water quality monitoring was undertaken to inform the regulatory EIA. To rectify this proposals for monitoring during construction are included within the mitigation section. For this assessment, the Project Area of Influence (AoI) is considered to extend up to 2km downstream within a surface watercourse directly affected by a construction activity.

9.3.2 **Hydrogeology**

In general, given the shallow depth of the proposed pipeline, hydrogeological resources used for potable drinking are not expected to be adversely affected by the proposed pipeline construction or operation. The exception to this is where boreholes are to be sunk to access such resources and this is discussed in the impacts section. Shallow groundwater does however have the potential to impact on the construction methodology (i.e. requirements for dewatering) and hydrogeological surveys have been undertaken along the proposed route involving drilling boreholes to 6m depth at 500m intervals. As a result, the route has been designed to avoid areas of shallow groundwater, as well as any designated Sanitary Protection Areas. Figure 9.1 shows (found in the Figures Document) the main groundwater zones underlying the BRUA pipeline route.

9.3.3 **Hydrology**

The pipeline will run through 12 administrative hydrological catchment areas (water basins), including the main 5 catchments of Argeş-Vedea; Olt; Jiu; Mureş; and Banat as shown in Figure 9.2.

The pipeline route will also cross 7 main watercourses within these catchment areas, namely the Rivers Bega, Chizdia, Cotmeana Jiu, Mureș River, Great River and Timiș, as illustrated in Figure 9.3.

It will also cross some 246 minor watercourses, irrigation channels and drainage ditches, such as the example of an irrigation channel shown in Figure 9.4 below.

Figure 9.4 Example Irrigation Channel

Approximately 70% of water supply for domestic use is sourced from surface waters in Romania, and 95% for industrial supply[10]. Some key river basins, including the Jiu, Argeş-Ve de and Olt are facing increasing water scarcity based on the per-capita water availability, during dry periods.

9.3.4 Rivers to be crossed by HDD

Twelve major rivers crossings will be achieved using horizontal directional drilling (HDD) as shown in Table 9.3 below. These locations have been chosen based on consultations with the National Waters Administration (the administrator and issuer of permits for water crossings) as follows:

- Width and/or depth of the river channels prevent standard construction approaches;
- Avoid damaging existing flood defence infrastructure/ because there are existing dams; or
- Due to other geotechnical considerations (presence of off-takes, land configuration etc.).

The total length of the crossings (also shown) are selected so that the entry and exit points for drilling will be a considerable distance away from the left and right river banks. Drilling depths will be determined by the curvature that is required to pass beneath the river at these distances.

Table 9.3 Crossings by horizontal drilling beneath watercourses

River	Chainage (km)	Length of crossing (m)	
Cotmeana	84	416	The channel here is not very wide, around 5m and both banks are heavily vegetated. The area immediately surrounding the river at this point is a mixture of agricultural land and woodland.
Olt	120	475	The crossing is immediately downstream of a hydroelectric dam and the acumularea Strejesti Reservoir. The channel here is approximately 200m wide and the banks are re-inforced with concrete.

10 Technical report 'Water Balanace, National Administration of Romania Water, 2011'

River	Chainage (km)	Length of crossing (m)	
Torrent (of the River Gilort)	225	455	The crossing is downstream of the town of Carbunesti. The river at this point is approximately 60m wide and is surrounded by agricultural land and woodland
Jiu	261	424	The river at this point is approximately 234m wide and is braided, splitting into two main channels that flow around a central island and other smaller islands within the channel. The river banks are reinforced and sloping.
Râul Mare	339	457	This is around 250m downstream of a small hydroelectric dam, where the river is raised upstream and culverted under a road prior to passing through the turbines. The river banks are reinforced concrete.
Timiș (at Jupa)	406	867	The channel here is approximately 20m wide and the banks are vegetated and sloping. The river at this point is surrounded by agricultural land but there is an access road that runs down to the left bank.
Spaia	429	323	This is around 1km upstream of its confluence with the River Timis. The river banks have been reinforced with concrete. A minor road runs adjacent to the left bank and there is main road bridge just upstream of the pipeline crossing point. The surrounding area is agricultrual land.
Timiș (at Lugojel)	438	384	This is immediately upstream of the town of Lugojel. The channel is approximately 70m wide at this point. An access road leads down to the left bank but both banks are vegetated.
Glavița	456	326	This is a few km upstream of its confluence with the River Bega. There is a clear river corridor that is vegetated, which is bordered by worked agricultural land. The channel at this point is only a few m wide.
Chizdia	459	325	This is just upstream of the confluence with the R. Bega. The river here flows through agricultural land and is surrounded by fields. There is dense vegetation on both the left and right banks.
Bega	461	375	The river at this point flows through agricultural land and is surrounded by fields. Both banks are vegetated. The channel here is approximately 15m wide.
Mureș	517	411	This is approximately 8 km east of SPA ROSPA0069. The River at this point is approximately 140m wide with existing access roads on each bank. The surrounding area is agricultural land.

These watercourses are illustrated in Figure 9.5 (found in Figures document).

9.3.5 Surface Water Quality

Romanian watercourses have been classified in accordance with the EU Water Framework Directive (WFD) which is intended to promote the development of a minimum of 'good' quality status (based on both good ecological status and good chemical status)11 for surface waterbodies. In Romania watercourses are typically classified as Very Good, Good, Moderate, Satisfactory or Unsatisfactory.

11 Good ecological status is defined in Annex V of the Water Framework Proposal, in terms of the quality of the biological community, the hydrological characteristics and the chemical characteristics (water temperature, pH, dissolved oxygen and nutrients levels (N and P)). Good chemical status is defined in terms of compliance with all the quality standards established for chemical substances at European level. Ecological status is expressed in terms of five classes (high, good, moderate, poor or bad).

Figure 9.6 (from the Romanian Waters National Administration and found in the Figures Document represents the most recent water quality data available (2009). The BRUA Project crosses water courses of varying water quality but none that were categorised of less than 'moderate' quality. In the eastern and western lowlands water quality was typically 'moderate' to 'good' but in the foothills of the Carpathian Mountains and the mountains themselves, the watercourses were mainly of 'very good' quality.

9.3.6 Water Abstractions

Abstraction permits in Romania are required under legislative Order 662 2006, which regulates the issuing of permits and licenses for water management. Activities that require a permit include:

works of water use, with buildings and related facilities: drinking water supply including those in rural areas, where must be guaranteed the gradual sewerage and wastewater treatment, industrial water and irrigation facilities fisheries hydroelectric, uses hydro, facilities for sailing, rafting, floating bridges, spa facilities, tourist or recreational, other works of this kind;

Works and categories of activities that do not require approval include water supply for uses designed to meet household needs, with capacity up to 0.21 litres/second and works abstraction if flow does not exceed 2 litres/second and the resulting effluents do not influence the quality of water resources.

Whilst it has not been possible to obtain a comprehensive list of all permitted abstractions within the Project AoI, during the social impact assessment residents living on affected land plots located along the pipeline route were asked where they sourced water from (i.e. a borehole or a water course) for which they would not legally require a permit. In total, 444 questionnaires were issued in 26 out of the 79 municipalities. The responses received are summarised in Table 9.4 below.

Table 9.4 Sources of Water

Sources of water (on affected land plots)	Number	%
Public irrigation system	8	1.8
Borehole/well	18	4.1
Other sources (river, channel etc.)	22	5.0
No water source	327	73.6
No answer	69	15.5

It should be noted that public irrigation systems are remnants of the communist system in Romania and in the vast majority of cases are no longer functional. The "no answer" responses were typically from questionnaires performed at households within 250m of the AoI but which don't own the land being crossed by the pipeline, so felt that this question did not apply to them. It is unclear at this stage where the "no water source" obtained their supplies from, this may be public utilities.

9.4 Impact Assessment

9.4.1 Approach and Methodology

Significance criteria for the assessment of impacts on water resources are outlined in Table 9.5 below.

Table 9.5 Significance Criteria Water Resources Impacts

#5 Assessment endpoint: Reduction in downstream flow volumes				
Negligible Impact	Low Impact	Medium Impact	High Impact	Very high Impact
Reduction in water flow				
Minor decrease in downstream flow volume for no more than 1 day. **No impact on availability of surface water for abstraction.**	Minor decrease in downstream flow volume for no more than 3 days. No impact on availability of surface water for abstraction.	Moderate decrease in downstream flow volume for no more than one week. Possible, temporary direct impact on the availability of surface water for abstraction.	Moderate decrease in downstream river flow volume for more than one week and up to 2 weeks. Likely direct, temporary impact on the availability of surface water for abstraction.	Major decrease in downstream river flow volume for up to one week. Definite direct, temporary impact on the availability of surface water for abstraction.
Reduction in water quality				
Visible increase in turbidity of watercourse observed for up to 1 day. **No impact on suitability of surface water for the purpose of its abstraction.** **Rapid return to baseline conditions on completion of construction activities.**	Visible increase in turbidity of watercourse observed for up to 3 days. Minor, temporary impact on suitability of surface water for the purpose of its abstraction. Quick return to baseline conditions; within 1 week.	Visible turbidity increase in watercourse observed for up to 1 week after completion of construction. Moderate, temporary impact on suitability of surface water for the purpose of its abstraction. Return to baseline conditions; within 2 weeks.	Visible turbidity increase in watercourse observed for up to 2 weeks after completion of construction. Major, temporary impact on suitability of surface water for the purpose of its abstraction. Return to baseline conditions within one month	Visible turbidity increase in watercourse observed for up to 1 month after completion of construction. Major, temporary impact on suitability of surface water for the purpose of its abstraction. Return to baseline conditions between one and six months
Reduction in groundwater levels and availability				
Minor decrease in groundwater levels for no more than 1 day. **No impact on availability of groundwater for abstraction.**	Minor decrease in groundwater levels for no more than 3 days. No impact on availability of groundwater for abstraction.	Moderate decrease in groundwater levels for no more than one week. Possible, temporary direct impact on the availability of groundwater for abstraction.	Moderate decrease in groundwater levels for more than one week and up to 2 weeks. Likely direct, temporary impact on the availability of groundwater for abstraction.	Major decrease in groundwater levels for up to one week. Definite direct, temporary impacts on the availability of groundwater for abstraction.

9.4.2 **Groundwater Use and Interaction**

9.4.2.1 Potable groundwater

The pipeline trench is anticipated to be excavated to a depth of approximately 2m and the excavation works will not extend to depths where deep groundwater is encountered. As a result, there is no

pathway for the direct ingress of any contaminants mobilised within run-off. Such impacts are therefore considered to be of **negligible risk/impact.** The exception is the locations where boreholes will be drilled for the compressor stations. These are to be located on Greenfield sites and soil surveys will be undertaken before drilling commences. They are considered to represent a **negligible** level of risk/impact.

9.4.2.2 Shallow Groundwater

The hydrogeological surveys undertaken to date indicate that there will be no need for significant de-watering activities during pipeline construction. However, should a contractor encounter shallow groundwater during excavations, any de-watering effluent will be disposed of in accordance with the Water Management Plan, either by discharge under permit and/or the landowners consent to the ground or, into a surface water course, or taken away by tanker according to its quality and the agreed approaches within the Water Management Plan. The project has also been designed to avoid areas of known historic soil contamination, with the nearest location being a former industrial site at km 313 located approximately 300m from the pipeline. Impacts associated with shallow water discharges are therefore considered to represent a **negligible** level of risk/impact.

9.4.2.3 Groundwater recharge

For most of the pipeline route, natural soil cover will be restored over the works and infiltration rates are not expected to be affected. The exception is the three GCSs where the introduction of hard standing/buildings will reduce infiltration from rain water into the ground. Whilst the specific footprint of each GCS is still being finalised , up to 50% of the total surface area is expected to be retained as 'green space' to limit the extant of hardstanding. Even in these areas rainwater will be collected by a network of gutters and drains and directed to a soakaway to enable groundwater recharge. In other areas where temporary construction yards and pipe storage sites are required, barriers to groundwater recharge will only be present in the short term. As a result, these impacts are expected to represent only a **low** level of impact.

9.4.3 **Hydro-testing**

The pipeline will be pressure tested with water (hydro-testing) to confirm its structural integrity in areas designated as Class 3 locations under the Romanian national pipeline design standards. Such areas are relatively built up (the classes are determined by the number of buildings located within a 400m corridor of the pipeline) and the volume of water required is calculated at 0.49m^3 per metre of pipe (55,000m^3 in total). This water will be obtained by tanker from permitted suppliers and will not be abstracted directly from surface water courses or groundwater. There will be four suppliers of this water, all are local water utility companies and there are no expected issues in meeting the demand for water required. This is a project change from the assumed abstraction outlined in the Regulatory EIA.

During hydro-testing, where the sections of pipeline to be tested are adjacent to each other and simultaneously ready for testing, water will also be re-used to reduce the overall volumes that need to be supplied. Water will be supplied in tankers by the utility companies and stored on site until it is used. The wastewater effluent following hydro-testing will also be removed from site in tankers to a waste water treatment plant operated by the relevant utility company that supplied the water and will not be discharged directly into local surface watercourses. Consequently, impacts on water resources as a result of hydro-testing are considered to be **negligible.**

9.4.4 **Dust Suppression**

Water will be used to damp down roads during construction for dust suppression purposes. It is estimated that approximately 30 litres of water will be needed for every 10m of road and that around 8,300m^3 of water will be required in total for this purpose during the Project construction phase. Water required for dust suppression will not be abstracted directly from surface water courses or groundwater but will be supplied by municipal water companies and delivered by tanker to the locations where it is needed. There will be four suppliers of water, all are local water utility companies and there are no expected issues in meeting the demand for water required. Consequently, impacts on water resources as a result of dust suppression are considered to be **low**. In the event that Contractors need to abstract water from surface water courses for the purpose of dust suppression,

the appropriate permits will be obtained from the relevant authorities prior to any abstraction taking place.

9.4.5 Construction Compound Water Use and Discharges

During construction works there is the potential for adverse impacts on surface water quality as a result of water use and effluent discharges, including sanitary effluents and rainwater run-off. During the construction phase, there are expected to be approximately 680 workers across the 5 construction sites and 10 pipe storage sites. They will be supplied with potable water in reusable polyethylene containers, not from direct abstraction from watercourses. Sanitary effluents will not be discharged directly into surface water courses, but instead portable chemical toilets will be installed at construction sites/worksites along with showers that have wastewater tanks as shown in Figure 9.7and Figure 9.8. Sanitary wastewater and chemical toilet waste will be collected by specialist waste contractors and taken for treatment and disposal.

Figure 9.7: Portable chemical toilets and wash basins with sealed water collection tanks

Figure 9.8: Portable shower with wastewater collection tanks

Rainwater and run off will be managed initially through a drainage system that will incorporate oil separators. The water will then pass into a soakaway (referred to in the EIA as a grassy polder) that will act to gradually filter the water and capture contaminants. Overall impacts on water resources as a result of construction compounds are considered to be **low**.

9.4.6 Water Crossings

The greatest potential impact from the proposed pipeline construction is from water crossings. In addition to the HDD techniques described earlier in Chapter 4, the pipeline will cross some 115 rivers and 319 irrigation channels, drainage channels and tributaries where horizontal drilling (HD) will not be used and open-cut excavations will be performed instead. A list of all the rivers and channels that will be crossed by the pipeline and the approach that will be taken (open-cut excavation or HD/HDD) to performing the crossings is provided in Appendix 9.1 and 9.2.

Crossing a waterbody by way of open-cut involves the physical removal of surface materials to achieve the required burial depth of the pipeline and can be performed in both wet and dry conditions. There are two general approaches for crossing watercourses using open-cut excavations that will be employed for the Project, as detailed in Chapter 4 (Construction Methodology) and outlined below. The duration of each river crossing is given in Appendix 9.1.The total duration of water crossings using open-cut techniques is on average 8.6 days, with actual work within the river bed taking on average 4.1 days, and ranging from 1 to 14 days for larger rivers. In most cases, the larger rivers will be crossed using coffer dams to divert the flow and create dry working conditions and only 17 rivers will take over 5 days of working within the river bed without the use of a coffer dam. Four river

crossings using open-cut excavations without a coffer dam are expected to take 14 days work in the river bed. HDD will not be used for the longer duration water crossings for economic reasons.

In all cases, access to the watercourse will necessitate equipment and personnel being able to cross the watercourse. This is intended to be achieved using existing roads and bridges only, so that there will be no requirement to construct bridges or culverts across any watercourse. The Water Crossing Construction Environmental & Social Management Plan will enforce this by including a requirement for fording rivers to be avoided by Contractors wherever possible.

9.4.6.1 Open-Cut Excavation with Coffer Dam

The 5 rivers listed in Table 9.6 below will be crossed using open-cut excavation with coffer dam. The dam, constructed from sandbags, will be used to redirect the flow and create a working area around the excavation of the trench in one section of the watercourse at a time (starting from one bank). The sandbags help prevent sediment from entering the watercourse. A drainage system will be installed within the cofferdam wall to allow the water levels to drain naturally prior to work commencing. Water crossings with cofferdams will be undertaken during periods of low flows to make it easier to achieve drier conditions behind the cofferdam (i.e. when precipitation levels and snow melt are low). By not damming the whole channel in one go some downstream flow can be maintained. The excavated material from the bed of the watercourse will be temporarily stored on the river banks, in a designated dry area. Once the initial trench has been excavated, pre-cast concrete blocks will be installed around the pipeline on the bank of the watercourse, and after that the pipeline will be launched into the trench. In order to complete the trench, the remaining section of the channel will be isolated with a coffer dam and the process repeated. The excavated material will then be used to backfill the trench prior to the cofferdam being removed.

Table 9.6 Rivers to be crossed using open-cut with coffer dam

River	Location (km, m)	Duration of works in the River bed (days)
River Cainelui Stauleni lake	58,832	14
River Cerna	162,763	5
River Oltet	175,287	8
River Amaradia	196,663	10
River Gilort	225,32	10

Whilst installation of a coffer dam may have a temporary impact on the downstream flow regimes in these rivers, it is not expected that the volumes of water downstream of the dam will be significantly decreased, as some flow will be maintained at all times as only up to half of the channel will be dammed at one time. There will be some “shadow” effect from the dam but the greater impact is expected to be on flow velocity near the dam, rather than volume. For the Cainelui river where works in the river bed could take up to 14 days this could result in an impact of **medium significance** albeit the expected low flow conditions may reduce this. For the other rivers, the low duration of the work means that impacts are considered to be of only **Low to Medium** significance depending on the duration of the construction activities and the prevailing flow regime of the watercourse.

9.4.6.2 Open-Cut Excavation without Coffer Dam

The remaining 110 rivers and channels will be crossed using the open-cut excavation approach but without a coffer dam approach. In these cases, a trench will be excavated across the bed of the watercourse using specialised cable dredger and telescopic excavator. The pipe is then pulled into position through the trench and a pre-cast concrete cover is used to maintain the pipe’s stability. The excavated bed material will be temporarily stored on both river banks, in a designated dry area, before being used to backfill the trench (starting from the banks, towards the centre of the channel). Impacts from open cut excavations without coffer dam are unlikely to have any impact on downstream flow volumes, as there will be no major impediment to flow within the channel. They do however have the potential to affect water quality, albeit that as shown in appendix 9.2, many of the channels that will be crossed using this approach contain no water at times of low flow and there are not expected to be any downstream abstractions that could be impacted. Overall impacts are considered to be of

Low to Medium significance depending on the duration of the construction activities and the prevailing flow regime of the watercourse.

9.4.6.3 Ecological Implications of Increased Turbidity

As outlined above, there are a large number of water courses (including 115 rivers) to be crossed by open-cut excavations, with works lasting up to 14 days in the most extreme case. Whether or not coffer dams are used, trench excavation activities will result in major disturbance of the river bed and the release of sediments (and any contamination) into the water at levels potentially many times greater than background levels. This could adversely affect downstream water quality, which could in turn have an impact on the use of surface water abstracted and on biodiversity receptors. Typical impacts of turbidity on biodiversity receptors (as discussed further in Chapter 12) include the following:

- Reduction in the depth of light penetration into the water column affecting photosynthetic activity and thus primary productivity in submerged plants (a basic food source for aquatic animals);
- Physical damage to leaf surfaces by abrasion and by smothering;
- Adversely affecting invertebrate populations, interfere with the behaviour, feeding and growth of fish species. It can also cause damage to fish gills by abrasion (hyperplasia), and clogging; and
- Increase the susceptibility of fish to disease. Mucus secreted by fish in response to high concentrations of suspended solids attracts bacteria and fungus.

Streams and rivers have different levels of sensitivity to increases in suspended sediment concentrations, depending on the natural background levels and their seasonal use by certain animals. Other factors are gradient of channel-bed, the adaptability of the flora and fauna and the particle size distribution of the sediment. Occasional periodic increases in both suspended and deposited sediment are a natural phenomenon, and stream and river habitats have adapted to cope with a range of sediment concentrations resulting from natural events. However, if the frequency and/or magnitude of sediment loading resulting from construction activities exceeds those of natural events, this can put serious stresses on watercourses and associated habitats. Where there are high flows in a watercourse, the suspended sediments are likely to be diluted relatively quickly. However, where the watercourses are slow flowing or have limited flow it may take longer for sediments to be diluted/deposited and for baseline conditions to be restored. It is intended to undertake works in watercourses during periods of low flow and therefore turbidity could take longer to return to baseline levels. Impact significance from turbidity can therefore range from **Low to Very High** depending on the duration of the construction activities and the prevailing flow regime of the river and this is discussed further in Chapter 12.

9.4.7 **Operational Impacts**

9.4.7.1 GCS Effluent

Impacts during pipeline operation are generally expected to be restricted to wastewater discharges (including sanitary effluents) and rainwater run-off from areas of hard standing (parking areas and walkways) within the GCS compounds. On-site facilities for the collection, treatment and discharge of wastewater/rain water at each of the GCS will include separate collection and treatment facilities for domestic wastewater (a biological treatment plant), rain water (drainage network and soakaways) and industrial wastewater. Treated domestic wastewater and rain water will be directed through a PVC sewerage network to an underground pumping station. At each GCS, the pumping station will also be connected to an underground retention basin (designed to hold rain water run-off). Following treatment, the effluent will be temporarily stored in the retention basin to enable water quality samples to be taken to ensure that national water quality standards (NTPA001) are being achieved prior to discharge into the relevant local surface water course. If the required standards are not met, the water will be returned to the treatment plant for further treatment. The GCSs are being designed to accommodate up to 20 staff during periods of maintenance (approximately one month every two years), but are expected for the most part to be unmanned. Consequently, as the overall volumes of effluent will be relatively low and treatment to national quality standards will be undertaken there are not expected to be any significant effects on water resources as a result of wastewater discharges during operation and impacts are therefore considered **low**.

9.4.7.2 GCS Water Use

Potable and firefighting water for the Bibesti GCS will be supplied by connection to the existing municipal drinking water network in Hurezani. Both Jupa and Podisor GCSs will be supplied with potable and firefighting water from boreholes that will be drilled within the compound upon receipt of the necessary permits from the relevant authority. No direct abstraction from surface watercourses will be required.

During the operational phase, the water for Bibesti GCS will be supplied by the local water utility company in Hurezani. Only Jupa and Podisor GCSs will be supplied by groundwater abstractions from boreholes. Given the infrequent and limited demand for groundwater, it is not expected that this will result in a significant impact on local groundwater levels or any other abstractors of groundwater. Impacts on water resources as a result of operational requirements are therefore considered **negligible**.

9.5 Mitigation

Given the impact assessment outlined above, most impacts can be managed through GIP (see chapter 5) and potentially significant impacts are considered to be restricted to those associated with downstream impacts from watercourse crossings. The Water Crossings Construction Environmental & Social Management Plan includes a range of requirements (including those from the regulatory Environmental Agreement), which must be implemented to ensure minimal impacts from interrupting river flow or affecting water quality.

All rivers have different characteristics. Therefore, if the Biodiversity Specialist on-site determines that a watercourse is ecologically sensitive to changes in flow or water quality (especially turbidity (NTU)), they will direct the Contractors to undertake water quality, turbidity and flow monitoring according to GIP 12. Monitoring should be undertaken both immediately upstream of the works (to establish natural baseline levels) and then at intervals up to 2km downstream of the construction site, to determine the extent of any impacts and the need for any intervention (e.g. temporary cessation of works) or other application of GIP mitigation. Equally, where human receptors are identified that are located within 2km of the water crossing site, monitoring should also be undertaken as directed by the Biodiversity Specialist and according to GIP.

When working within watercourses, where there are known sensitive receptors located downstream (permitted abstractions or sensitive biodiversity receptors) **Silt fences** (or curtains) will be considered to provide specific protection against sediment movement whilst letting water through the silt fences shall be installed in the watercourse in the direction of water flow to ensure the most effective filtration and sediment retention. Once filled with silt or damaged, the fenced will be replaced. Another method that may be used for sediment control is placing **straw bales** wrapped in terram within the watercourse, to trap the suspended sediment while allowing water through the bales. The straw bales should be placed into the river bed and stabilised with stakes or can be placed into a cage or net to keep them together and then placed downstream of the works. They should also be replaced if damaged or they have become ineffective. These shall be used as advised by the Biodiversity Specialist. Both of these techniques will also provide a certain level of mitigation in the event of small scale and localised hydrocarbon spills (i.e. oily sheens on water).

In addition to the above, contractors will be required to develop and implement appropriate pollution prevention and emergency response management plans in accordance with the requirements of the BRUA Construction Environmental and Social Management Plans.

9.6 Monitoring

Monitoring of water quality, flow and turbidity levels will be undertaken during the crossing of watercourses as directed by the Biodiversity Specialist, as outlined in section 9.5 above and in accordance with GIP. Visual observations will also be undertaken at water crossings for any hydro-carbon sheens and appropriate action taken if required (see above). In addition, the Water and Water Crossings CESMPs will contain specific management actions and monitoring measures that will be included within the Contractors Management Plans to avoid or limit risks and impacts to watercourses.

12 For example, the Canadian Water Quality Guidelines for the Protection of Aquatic Life, which give guideline values for NTU under various flow conditions.

Additional monitoring will specifically be undertaken with regard to dewatering of trenches ~~(as per section 9.5.2),~~ operation at the GCSs ~~(as per section 9.5.7)~~ and otherwise as detailed in the Environmental Agreement (see Regulatory EIA). This will be undertaken in accordance with GIP and will be detailed in the Contractors Management Plans.

9.7 Residual Impacts

If the relevant mitigation measures outlined above are implemented during the construction phase, no significant residual impacts are expected on Water Resources from the project.

10 Air Quality and Greenhouse Gas Emissions

This Chapter summarises the potential impacts on ambient air quality as a result of the Project activities and presents an initial calculation of the of Project's Greenhouse Gas emissions (both construction and operational phases). Whilst potential impacts on ambient air quality may affect both human and ecological receptors this section focuses on the human aspects. Ecological issues are addressed in Chapter 12. Issues regarding worker exposure to air pollutants are addressed under application of GIP and Romanian regulatory health and safety requirements.

10.1 Relevant legislation and Guidance

The key Romanian and international regulations relevant to this Chapter are summarised in Chapter 2 and covered in more detailed in the Regulatory EIA. Issues around prevention of pollution to air are covered under EBRD PR3.

10.2 Scoping Assessment

Key issues addressed in this Chapter are outlined in Table 10.1 (construction) and 10.2 (operations) below. Further information on scoping is provided in the Scoping Assessment Report.

Table 10.1 Scoping Matrix - Project Construction Phase

Source of Impact	Receptor(s)	Impact
Construction activities: earthworks, excavation, vehicle movement, stockpiles, unpaved surfaces, cement production, etc.	Human receptors: workers and residential population living near the construction sites;	Increase in the concentration of dust in the atmosphere due to fugitive dust emissions along the working strip, and work sites – pollutant of concern: construction dust Particulates will deposit 10-20m from source in sensitive areas.
Construction activities: construction machinery / equipment and movement of vehicles involved in construction (i.e. generators, excavators, bulldozers, side booms, trucks, cars)	Human receptors: workers and residential population living near the construction sites;	Increase in the concentration of gaseous pollutants in the atmosphere due to emissions of exhaust gases along the working strip, and work sites – main pollutants of concern: NO2 and CO.
Construction emissions from vehicles / traffic (Heavy Goods Vehicles) associated with transport of materials for construction activities (mostly pipe, water (?) and workers)	Human receptors: residential population living near the access roads used by Heavy Goods Vehicles involved in the construction of the project.	Increase in the concentration of gaseous pollutants in the atmosphere due to emissions of exhaust gases along the access roads used by Heavy Goods Vehicles involved in the construction of the project – main pollutants of concern: NO2, PM10, CO.
Construction activities (construction equipment and construction traffic)	Global	Increase in the concentration of GHG in the atmosphere

Table 10.2: Scoping Matrix – Project Operational Phase[13]

Source of Impact	Receptor(s)	Impact
Functioning of the compressors in the Gas Compressor Stations (GCS)	Human receptors: residential population living near the GCSs;	Increase in the concentration of gaseous pollutants in the atmosphere due to emissions of exhaust gases from the GCSs – main pollutants of concern: NO2 and CO.
Functioning of the compressors in the Gas Compressor Stations (GCS)	Global	Increase in the concentration of GHG in the atmosphere

13 Vehicle movements during operations will be minimal, therefore no key potential impacts foreseen.

With regards to emissions from construction vehicle movements, international good practice such as that included within the UK's Design Manual for Roads and Bridges[14] generally accepts that assessment of construction vehicle emissions is required if there is expected to be an increase in Heavy Goods Vehicles (HGV) movements of more than 200 per day, on a given road, for a year or more. As the total estimated daily number of HGV movements during peak construction activity is anticipated to be no more than 100 (see Chapter 14: Traffic and Transport), including transport of pipe, hydro-testing water, waste, and workers, construction traffic effects (primarily emissions of NO2 and PM10) this has also subsequently been scoped out of the assessment.

With regards to "scoped in emissions" from the GCS, natural gas, rather than electric compressors will be used, and only in the case that the gas generators are not working will the GCS be powered using electricity from the grid. In the case of a general power failure, and only when the back-up provided by the Electricity Company also fails, the fall back for energy for the GCSs (including for the functioning of the electric compressors) will be through the use of back-up gas turbines, that will generate electricity using gas directly from the pipeline, and in the case of in the case failure of the gas turbines, two (alternative / backup) diesel generators.

As outlined in Chapter 6, impacts from project decommissioning are expected to be similar to those for project construction and are not addressed separately.

10.3 Existing Conditions

10.3.1 Baseline Data Collection

The assessment described in this Chapter is based on desk-study and no ambient air quality monitoring has undertaken. Given the rural nature of most of the route, however, it is expected that air quality is generally good with low ambient levels of both NOx and SOx. A precautionary approach has been taken by defining the Area of Influence (AoI) as the distance from the pipeline where human receptors could be negatively affected by project induced changes in air quality (e.g. from an increase in the concentration of respirable dust -PM_{10}, $PM_{2.5}$, or gaseous pollutants -SO_2, NO_x) and then understanding the presence of sensitive receptors within that AoI as shown in Table 10.3 below.

Table 10.3 Proposed AoI and Potentially Affected Receptors

Phase	AoI Description	Potentially sensitive receptors
Construction	Buffer area around all construction sites, i.e. the working strip along the pipeline route (250m to each side side) and 250m around the limit of the reminder construction sites (Compressor Stations, construction yards, pipe yards, and accommodation camps);	Workers and residential population living near the construction sites, as well as hospitals, clinics and schools (considered particularly sensitive receptors) within the AoI
Operation	Global, considering the only impact that will be assessed during this phase will be associated with the emission of GHG related with the generation of electricity for the compressors in the Compressor Stations, which will not be generated by the project, but supplied from the grid).	Global population (as the impacts of the emission of GHG relate to Climate Change, that is a global phenomenon).

10.3.2 Sensitive Receptors

With regards to especially sensitive receptors, no schools or hospitals have been identified within 1km of the proposed RoW or construction sites, and these are therefore not considered specifically further in this assessment. For general receptors, however a large number of settlements have been identified within the AoI as shown in Figure 10.1 (found in the Figures Document). The shortest distances of each settlement to the working strip along the pipeline route has been determined from the GIS, as presented in Table 10.5 below.15

14 UK Highways Agency, 2007

15 Settlements show up more than once when the contour of the settlement went out of the AoI and in again (due to its irregular contour).

Given that impacts of dust on adjacent crops is a potentially material issue for many stakeholders this is considered a sensitive receptor both along the ROW and at the GCS. Given the importance of monitoring, managing and mitigating such emissions the EPC contractors will required to monitor air quality and have measures in place for managing emissions as well as dust suppression for access roads (see later).

Table 10.4 Settlements located within the AoI and shortest distance to the working strip

Settlement	Km point	Closest distance to pipeline (m)		Settlement	Km point	Closest distance to pipeline (m)		Settlement	Km point	Closest distance to pipeline (m)
Dealu	4.0	0		Tetoiu	170.5	64		Totesti	343.9	206
Marsa	12.3	136		Zatreni	177.9	62		Breazova	352.8	246
Poeni	29.8	210		Otetu	179.7	0		Sarmizegetusa	354.1	34
Purcareni	47.0	68		Halangesti	186.6	0		Zeicani	359.1	119
Palanga	51.1	99		Unamed	192.3	0		Bucova	363.7	0
Adunati	55.7	104		Stejari	191.8	0		Unamed	371.4	0
Caldararu	61.3	165		Hurezani	196.9	0		Valea Bistrei	384.4	68
Strambeni	60.5	131		Andreesti	207.1	0		Otelu Rosu	390.6	95
Urlueni	75.8	127		Frasin	209.7	0		Glimboca	393.9	56
Afrimesti	77.5	0		Viersani	215.3	110		Obreja	400.8	78
Zuvelcati	77.5	152		Viersani	217.9	37		Iaz	402.6	87
Corbu	81.5	0		Vidin	224.0	148		Jupa	406.6	216
Chiteasca	95.6	5		Pojogeni	229.5	66		Prisaca	411.6	138
Negreni	95.8	124		Pojogeni	230.7	110		Jena	425.2	141
Cherlestii Mosteni	118.9	0		Budieni	238.1	171		Gavojdia	428.5	217
Mamura	120.7	144		Ungureni	238.5	137		Lugojel	437.8	209
Valea Caselor	137.5	154		Balanesti	250.4	0		Lugoj	442.6	0
Mazili	138.6	88		Tetila	256.7	0		Costeiu	451.0	4
Sutesti	139.7	53		Sambotin	261.8	92		Gruni	454.6	0
Streminoasa	142.8	0		Arsura	266.0	0		Sanovita	462.2	203
Magureni	145.8	47		Schela	268.5	0		Petrovaselo	474.9	162
Gusoieni	147.1	0		Lupeni	293.5	157		Herneacova	480.8	44
Burdalesti	150.3	196		Vulcan	297.3	26		Salciua Noua	486.7	230
Maciuceni	160.6	115		Dealu Babii	297.9	0		Remetea Mica	494.4	28
Oveselu	161.7	144		Baru	313.6	0		Masloc	499.2	152
Unamed	163.1	10		Rau Alb	329.5	51		Fantanele	514.2	208
Dancai	165.6	0		Barastii Hategului	336.7	0				
Tetoiu	170.5	25		Nalatvad	339.6	130				

Whilst this approach does not capture scattered houses it does identify most of the residential receptors and allows general mitigation measures to be developed for construction paying particular attention to those settlements closer to the pipeline. Areas of greater focus include the areas surrounding the gas compressor stations, construction yards, workers' accommodation, and pipe storage yards. Table 10.5 below identifies these sites and highlights where residential properties are present within 250m of these facilities (flagged in red in the last column).

Table 10.5 Description of land use in AoI around key Project sites

Site	Km	Description	Potential Impact?
Area around the GCS's			
Podișor GCS	0.0	Currently agricultural land, surrounded for at least 1km in all directions by agricultural land. No villages within 2 km of this site.	
Bibești GCS	196.3	East of the village of Hurezani on land that is currently used for arable farming, bordered to the north and east by residential properties (a few within 250m, around 50 within 500m)	Yes
Jupa GCS	409.2	Located 4.8km to the north-east of Recas city and 300m north of Petrovaselo village. Currently arable farmland. No residencies identified less than 250m from the site	
Construction Yards, Workers accommodation			
Construction Yard inside Podișor GCS - Podișor	0.0	Currently agricultural land, surrounded for at least 1km in all directions by agricultural land. No villages within 2 km of this site.	
Construction Yard, Pipe storage and Workers accommodation	61.3	Currently arable field located to the north of Caldararu and to the south-west of Strambeni. Close to what seems to be tanks, but no residencies 400m around	
Construction Yard, Pipe storage and Workers accommodation - Gușoeni,	150.1	South of Gusoieni on existing arable land. Few residential properties (not many) in a line, from 100m onwards	Yes
Construction Yard inside GCS - Hurezani	196.3	East of the village of Hurezani on land that is currently used for arable farming, bordered to the north and east by residential properties (a few within 250m, around 50 within 500m)	Yes
Construction Yard, Pipe storage and Workers accommodation - Turcinești	261.8	Located between the villages of Turcinesti and Sambotin. Land currently used for agriculture. Nearest properties located to the east within 30m, around 10 within 250m	Yes
Construction Yard, Pipe storage and workers' accommodation - Bucova	368.4	Located approximately 500m south of the village of Bucova. Land currently used for agriculture. Nearest properties are 0.5km away.	
Construction Yard inside Jupa GCS and Accommodation Camp - Zăgujeni	409.2	Located 4.8km to the north-east of Recas city and 300m north of Petrovaselo village. Currently arable farmland. No residencies identified less than 250m from the site	
Construction Yard and Pipe storage - Petrovaselo	474.0	Located to the North of Petrovaselo. Agricultural land. No residential properties less than 250m, which is more or less the limit of the village, with more residencies	
Pipe Storage areas			
Pipe storage - Poeni	28.4	Outskirts of the village of Poeni, on land that is currently used for agriculture; residential properties from 100m	Yes
Pipe storage - Corbu	80.5	Located on an existing arable field to the east of the village of Corbu, in front of a construction / fenced, but more than 800 m of residencies, all around in arable field.	
Pipe storage - Cherlești	118.2	To the south of the village Cherlestii Mosteni (around 150m	Yes

Site	Km	Description	Potential Impact?
		from residential properties)	
Pipe storage - Zătreni	176.4	East of the village of Zatreni, on agricultural land, next to an industrial site and 500m from residential property. None within 250m	
Pipe storage - Frasin	211.9	Located between the villages of Mucsculesti to the west and Frasin to the south-east, on agricultural land. No properties within 700m of this site	
Pipe storage - Jiu Paroșeni (Vulcan)	292.8	Located on a former industrial site, mainly surrounded by agricultural land, with the nearest property being 60m away - around 15 residencies within 250m	Yes
Pipe storage - Iaz	404.4	Located 1.5km from the village of Iaz on agricultural land. There are no properties situated within 1.5 km of the site.	
Pipe storage - Lugoj	439.0	Located 1.3km east of the town of Lugoj and north of the River Timis. Agricultural land. No properties within 1.3 km.	
Pipe storage - Fântânele	512.6	Located approximately 1.5km to the south of the village of Fantanele. On arable farmland. Closest residential property more than 500m away	

10.3.3 **Ambient Air Quality**

A description of the current ambient air quality (baseline) within the AoI is usually presented in order to allow an assessment of any changes occurring as a result of the project activities (impacts), during the Project. As no detailed quantitative information was available regarding air quality within the AoI an attempt has been made to understand current conditions based on the description of the areas (and economic activities) crossed by the project, given that they are generally very strongly related with the air quality.

As mentioned earlier, the majority of the pipeline route, as well as the areas for the Compressor Stations and the temporary facilities (such as Construction Camps, Workers Accommodation and Pipe Storage Yards) will be located mostly within rural and areas. No industrial areas or facilities that are likely to emit significant air pollutants have been identified within the AoI. Also, no significant sources of dust / particulate matter or exhaust gas emissions were identified in the AoI, except from the traffic on nearby roads (with generally low traffic flows) and dust emissions associated with agricultural activities[16]. As a consequence of the above, there are no reasons to believe that the Project is crossing areas where the quality of the air shed is already compromised or where there is greater sensitivity to air emissions. Transgaz should, however, carry out a further detailed identification of activities within the Area of Influence, to understand potential cumulative effects in terms of the emission of dust and exhaust gases.

16 Concentration of dust (particulate matter) may be relatively high around agricultural areas, namely when the land is not covered by vegetation and the action of the wind and earth movements associated with farming cause the suspension of dust particles.

10.4 Impact Assessment

10.4.1 Assessment Methodology

Significance criteria for air quality impacts are defined in the table below, based on Good International Practice as applied to similar projects. Settlements within the AoI of the project are considered as the "human receptors" of the air quality impacts.

Table 10.6a Significance criteria for air quality

Negligible	Low	Medium	High	Very High
Impact: Increase in the concentration of fugitive construction dust in the atmosphere				
Sporadic (less than 1 month) exposure of settlements within the AoI to construction dust	Temporary (1 to 5 months) exposure of settlements within the AoI to construction dust and precipitation > 0.2mm day-1 or wind speed <3 m/s	Temporary (1 to 5 months) exposure of settlements within the AoI to construction dust and precipitation < 0.2mm day-1 and wind speed >3 m/s	Continuous (more than 5 months) exposure of settlements within the AoI to construction dust	Exposure of high sensitive receptors (Hospitals, clinics, and schools) within the AoI to construction dust
Impact: Increase in the concentration of exhaust gases (NO_2 and CO) in the atmosphere				
Sporadic (less than 1 month) exposure of settlements within the AoI to levels of exhaust gases exceeding quality criteria	Temporary (1 to 5 months) exposure of settlements within the AoI to levels of exhaust gases exceeding quality criteria and wind speed >3 m/s	Temporary (1 to 5 months) exposure of settlements within the AoI to levels of exhaust gases exceeding quality criteria and wind speed <3 m/s	Continuous (more than 5 months) exposure of settlements within the AoI to levels of exhaust gases exceeding quality criteria	Exposure of high sensitive receptors (Hospitals and schools) within the AoI to levels of exhaust gases exceeding quality criteria

With regards to the GHG assessment, this was performed in line with international standards and the significance criteria for GHG emissions are consistent with the EBRD GHG methodology.

Table 10.6b Significance criteria for GHG assessment

Impact: Increase in the concentration of GHG in the atmosphere				
Negligible	Low	Medium-Low	Medium-High	High
NA	< 20,000 ton CO2	20,000 ton CO2 100,000 ton CO2	100,000 ton CO2 1,000,000 ton CO2	1,000,000 ton CO2

Source: EBRD Methodology for Assessment of Greenhouse Gas Emissions, 2010

10.4.2 Sources and Types of Air Emissions

Construction activities that can contribute to air emissions include: land clearing, earthworks, excavations, operation of diesel engines, and working with toxic materials. All construction sites can generate high levels of dust (typically from concrete, cement, wood, stone, silica) and this can carry for large distances over a long period of time. The impact associated to atmospheric emissions can vary widely, depending on the receptors, i.e., whether they are residential areas and particularly sensitive receptors, such as hospitals and schools, as well as if there are sensitive ecological receptors). Public/environmental health and nuisance issues associated with dust and vented fumes can arise from construction activities and may have a significant effect on neighbouring locations and may have accumulative effect with other local activities.

Table 10.7 Key air emissions pollutants

Pollutant	Description
Construction Dust	'Dust' is generally regarded as particulate matter up to 75 µm (micron) diameter and can be considered in two categories. Fine dust, essentially particles up to 10 µm in diameter (invisible to the naked eye), is commonly referred to as PM10. Coarser dust (essentially particles greater than 10 µm) is generally regarded as 'nuisance dust' and can be associated with annoyance.PM10 is defined as health risk dust. Research has shown that PM10 penetrate

Pollutant	Description
	deeply into the lungs and cause a wide range of health problems including respiratory illness, asthma, bronchitis and even cancer. Another major source of PM10 on construction sites comes from the diesel engine exhausts of vehicles and heavy equipment. This is known as diesel particulate matter (DPM) and consists of soot, sulphates and silicates, all of which readily combine with other toxins in the atmosphere, increasing the health risks of particle inhalation. The expression 'nuisance dust' relates to the human perception of, or reaction to, some aspect of dust pollution, such as the long-term, chronic, soiling of surfaces or the visibility of acute, short-lived, dust clouds. In the absence of standards, 'custom and practice' criteria for assessing nuisance dust have been developed. Dust propagation through air is influenced by many factors including particle size, wind energy and disturbance activities. Large dust particles generally travel shorter distances than small particles. It is often considered that particles greater than 30 µm will largely deposit within 100 metres of sources, those between 10 – 30 µm to travel up to 250 – 500 metres and particles less than 10 µm to travel as far as 1 km or more from sources. These distances may be exceeded. Dust can be hazardous to health when inhaled or can cause a nuisance to communities.
Exhaust Gases / other pollutants	Diesel is also responsible for emissions of carbon monoxide, hydrocarbons, nitrogen oxides and carbon dioxide. Noxious vapours from oils, glues, thinners, paints, treated woods, plastics, cleaners and other hazardous chemicals that are widely used on construction sites, also contribute to air pollution.
GHG	Greenhouse gases (GHG) include atmospheric gases that absorb and emit radiation in the thermal infrared spectrum. These include Carbon dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Ozone (O3) and Chlorofluorocarbons (CFCs). Anthropogenic emissions of GHG are contributing to the build-up of atmospheric concentrations of GHG that, in turn, is a major contributing factor to global climate change. The effects of GHG emissions are generally not relevant on a local scale, except in cases of massive uncontrolled or fugitive emissions, but are rather global in nature as the various gases are rapidly dispersed in the atmosphere, where they reside for varying periods of time, from months to thousands of years, and they continue to exert their effects.

During construction, several construction activities are carried out along the working strip and work sites (including Construction Camps, Pipe Storage Yards and Workers Accommodation Camps), many of which make use of vehicles and diverse construction machinery and equipment. These activities, together with the use vehicles and construction machinery and equipment used (mobile sources of air pollution, mostly powered by internal combustion engines burning diesel), are responsible for the emission of pollutants to the atmosphere, and therefore have the potential to induce impacts on the local ambient air quality. The following section addresses the three main issues scoped in of fugitive construction emissions, exhaust gases emissions and GHG emissions.

10.4.3 **Fugitive construction dust**

Many of the proposed construction activities can create fugitive dust emissions. These include:

- earthworks;
- mechanical action on incoherent materials and excavation with excavators, bulldozers, etc.;
- stockpile stacking;
- cement production;
- vehicle and equipment movement;
- pulverization and abrasion of surfaces, caused by vehicle movement, namely from trucks for the transport of pipes and other construction materials to the front sites (namely when unpaved roads are used), and from construction machinery and equipment (such as excavators, bulldozers, and side booms);
- loading and unloading operations;
- involuntary transport of mud by truck wheels, that produces dust when dried out; and
- wind erosion of unpaved surfaces also caused dispersion of dust particles.

Such emissions will take place, to different degrees, from all work sites / construction areas throughout the construction period, although this will depend on several factors, such as the activity

and the particular weather conditions. As usual during construction, it is expected that dust emission in the drier months (during the summer period) will be higher than during other times of the year.

10.4.3.1 Impacts along the Pipeline RoW

With regards to the working strip along the pipeline route, the above-mentioned activities will not have a fixed geographical location, but rather move along the route. On average, the works in each spread will remain in progress for a period of a few weeks only (up to two or three months). As a result, emissions will short in duration, typically lasting only a few weeks. Given the distances at which dust settles out, in areas along the route where settlements are not present (the majority of the route) such impacts are expected to be of only a low significance overall, although of potentially higher perceived impact where they settle out on areas currently under agricultural production.

The main exceptions are where there is potential for disturbed soils to be contaminated (see Chapter 8, soils) or where settlements have been identified within the AoI. Given that no "high sensitive receptors" (hospitals, clinics and schools) have been identified within the AoI, the severity of impacts associated with fugitive construction dust emissions along the pipeline route has been classified as either **medium** or **low**, according to the locally prevailing weather conditions and given that settlements will be exposed only temporarily to construction dust.

In addition, should construction activities at a location along the pipeline route last for more than five months in areas where there are settlements within the AoI, the severity of impacts associated with fugitive construction dust emissions would be classified as high, and mitigation measures in excess of those defined as GIP might need to be defined to further mitigate impacts on the affected receptors. This is, however, considered unlikely and not possible to determine at this stage, and would have to be assessed on a case-by-case basis.

10.4.3.2 Impacts at Compressor Stations and other fixed locations

The construction activities that will be carried out for the construction of the Compressor Stations and those that will occur in the areas surrounding the Construction Yards, Pipe Storage Yards and Workers Accommodation will have a fixed geographical location and may last two years or up to the end of the construction phase. Effects on air quality around these areas are also expected to last for similarly longer lasting periods. Human receptors of this impact correspond to the settlements / residencies identified within the AoI (around the above-mentioned facilities) and are presented in the Tables below. The facilities indicated in those tables are the ones for which residential properties were identified within 250m from the limit of those facilities. Specifically, for these facilities, the severity of the impacts associated with fugitive construction dust emissions along the pipeline route has been classified as **high**, considering that such human receptors will be exposed continuously (i.e. for more than 5 months) to fugitive construction dust.

Table 10.8 Facilities with residential receptors located within its AoI (less than 250m), with a "high" severity impact – fugitive construction dust

Facility	Facility	Km point	Severity
Gas Compressor Station	Bibești GCS	196.3	High
Construction Yard, Pipe storage and Workers accommodation	Gușoeni	150.1	High
Construction Yards, Workers accommodation	inside GCS - Hurezani	196.3	High
Construction Yard, Pipe storage and Workers accommodation	Turcinești	261.8	High
Pipe storage	Poeni	28.4	High
Pipe storage	Cherlești	118.2	High

Facility	Facility	Km point	Severity
Pipe storage	Jiu Parosẹni (Vulcan)	292.8	High
Pipe storage	Pui	329.1	High

10.4.4 **Exhaust gases (NO_2 and CO) emissions**

Many construction activities are associated with the emission of exhaust gases, notably those that require the use of vehicles, diverse construction machinery (generators) and equipment (excavators, bulldozers, side booms, trucks, cars), all powered by diesel engines. Amongst these activities are earthworks, excavations, hammering, drilling, stockpile stacking, and general building / construction activities. Whilst exhaust gases emissions are expected to occur, at different degrees, from all work sites / construction areas throughout the duration of the construction period, generally emissions will be localised and temporary.

10.4.4.1 Impacts along the Pipeline RoW

Impacts associated with the increase in the concentration of gaseous pollutants in the atmosphere due to emissions of exhaust gases along the working strip (and reminder work sites) are related with construction activities that use diesel-powered engines. It is possible to determine the total emissions of these pollutants of concern during the construction of the project, namely of the pipeline, based on an estimate of the total amount of diesel that will be used for construction and emission factors. The total amount of diesel that will be used for construction can be estimated based on type of construction machinery / equipment that will be used, the average diesel consumption of each equipment, and an estimate of the number of hours each equipment will be used to build one km of pipeline.

Table 10.9 Construction machinery / equipment used in pipeline construction, average diesel consumption, estimated hours each equipment will be used to build one km of pipeline, total amount of diesel that will be used for construction / km of pipeline and for the whole pipeline

Equipment	Normal consumption (l/h)	Estimated hours (h/km)	Total consumption (l/km)
Pipa Launchers	36	48	1,728
Bulldozer S 1200	25	72	1,800
Bulldozer S 650	18	72	1,296
Excavator Castor	23	24	552
Rotor Excavator ER 7	30	24	720
Tractor universal	10	50	500
Welding (coupled) devices	20	250	5,000
Welding machine	6	35	210
Pumping machines	9	25	225
Compressors	6	20	120
General Consumption l / 1km			12,151
TOTAL General Consumption	litre for the whole	pipeline	6,415,728

Given the average emissions from consumption of one litre of diesel, this will result in the following emissions to air per km of pipeline:

Table 10.10 Air Emissions (per km of pipeline, and total)

Pollutant	* Emissions per litre/fuel (g)	Emissions per km of pipe (t)	Total Project Emissions (t)
NOx	32.6	0.3965	209.34
CO	10.8	0.1309	69.12
PM10	2.1	0.0256	13.50

** Source: Emission factors: EMEP/EEA air pollutant emission inventory guidebook – 2016; Table 3-1 Tier 1 emission factors for off-road machinery; European Environment Agency*

As with impacts associated with fugitive dust emissions, the construction will generally not have a fixed geographical location, but rather move along the route. On average, the works in each spread will remain in progress for a period of a few weeks only (up to 2 or 3 months). Therefore, the effects on air quality along the pipeline route are expected to last only for a reduced number of days / weeks at each given location, depending on the speed of progress of the pipeline construction (except in particular situations, such as more complicated crossings, where construction works may last for longer periods – areas where hammering will be used).

In general, where no settlements exist along the pipeline route, it is considered that no material impacts exist and this will be the case for the clear majority of the route. Where settlements have been identified within the AoI the **severity** of impacts associated with exhaust gases emissions along the pipeline route has been classified as either **medium** or **low**, according to the weather conditions, respectively Medium: wind speed <3 m/s; Low: wind speed >3 m/s.

In the case construction activities along the pipeline route last for more than five months, in areas where the route is crossing settlements or where there are settlements within the AoI, the severity of impacts associated with exhaust gases emissions would be classified as moderate and mitigation measures in excess of those defined as general / typical good practice might need to be defined to further mitigate impacts on the affected receptors. This is, however, considered unlikely and not possible to determine at this stage, and would have to be assessed on a case-by-case basis.

10.4.4.2 Compressor Stations and other fixed locations

Impacts are associated with the increase in the concentration of gaseous pollutants in the atmosphere due to emissions of exhaust gases for the construction of the Compressor Stations, Construction Yards, Pipe Yards and Workers' Accommodation are related with construction activities that use diesel-powered engines. It is possible to determine the total emissions of these pollutants of concern during the construction of the project based on an estimate of the total amount of diese that will be used for construction and emission factors. The construction activities that will be carried out for the construction of the Compressor Stations and those that will occur in the areas surrounding the Construction Yards, Pipe Storage Yards and Workers Accommodation will have a fixed geographical location and may last two years or up to the end of the construction phase. This will be, in general, the reality, even though some activities (such as excavations, earthworks, and stockpile stacking) will be far less significant than for the construction of the pipeline (and also relatively short-term). Other activities, such as vehicle and equipment movement, loading and unloading operations, general construction activities etc.) will effectively last far longer periods. Therefore, the effects on air quality around these areas are also expected to last for similarly longer lasting periods.

The facilities indicated in those tables are the ones for which residential properties (hence human receptors) were identified within 250m from the limit of those facilities. Specifically, for these facilities, and considering that no "high sensitive receptors (hospitals, clinics and schools)" have been identified within the AoI, the severity of the impacts associated with exhaust gases emissions has been classified as **high,** considering that such human receptors will be exposed continuously (i.e. for more than 5 months) to emissions.

Table 10.11 Facilities with residential receptors located within its AoI (less than 250m), with a "high" severity impact – exhaust emissions

Facility	Facility	Km point	Severity
Gas Compressor Station	Bibești GCS	196.3	High
Construction Yard, Pipe storage and Workers accommodation	Gușoeni	150.1	High
Construction Yards, Workers accommodation	inside GCS - Hurezani	196.3	High
Construction Yard, Pipe storage and Workers accommodation	Turcinești	261.8	High
Pipe storage	Poeni	28.4	High
Pipe storage	Cherlești	118.2	High
Pipe storage	Jiu Paroșeni (Vulcan)	292.8	High
Pipe storage	Pui	329.1	High

10.4.5 **Greenhouse Gas Emissions**

An initial calculation of the GHG emissions from the project during the construction phase was carried out based on the estimate of fuel consumption related to the use of internal combustion engines in vehicles and construction equipment / machinery, stationary sources, and power generated by equipment. The estimated emissions of GHG from the project during construction are as follows:

- CO2 emissions from vehicle/equipment sources during construction
- CO2 emissions from stationary sources during construction

The rough estimate of diesel consumed for the whole duration of the construction phase of the pipeline (including transport of pipe, with estimates provided in Appendix 10.1), compressor stations and reminder facilities (Construction Yards, Pipe Storage Yards and Workers' Accommodation) is shown in Table10.12 below (more in depth break down is available in Appendix 10.2 and 10.3)

Table 10.12 Diesel consumption for the construction of the project and associated emissions of CO_2

Phase	m3 diesel	Tonnes CO2	
Construction		25,491	Total Construction period
Construction machinery	6,416	20,274	
Transport	1,662	5,218	

Based on the above, the severity of the impacts associated with GHG emissions during the construction phase is as per EBRD methodology considered "Medium-Low", as it exceeds 20,000 tonnes CO_2, but is under 100,000 ton CO_2.

10.4.6 **Impacts During Operations**

The key potential impact of the Project on ambient air quality during the operations phase is associated with air emissions (including GHG emissions) associated with the functioning of the Compressor Stations. An initial calculation of the GHG emissions from the project during the operations phase was carried out based on the number of compressors active on each CS for the two

stages of the project and on the power of the compressors. The estimated emissions of GHG from the project during operations are as follows:

- CO2 and other air emissions associated with the energy consumption associated with the functioning of the compressors;
- A secondary source of GHG is fugitive emissions of methane from the pipeline system due to leakages mainly from flanges and valves (not included in the calculations), other air emissions were not estimated as part of this; and
- GHG and other air emissions related to the consumption of the gas transported by the pipeline are not considered within the scope of this assessment.

Each Compressor Station will contain eight main buildings: Compressors Building A, Compressor Building B, Fuel Gas Building, Oil Building, Workshop and Warehouse Building, Administration Building, Electric Building, Firewater Pumps Building. For Stage 1, each GCS will have a total installed power of 10 MW (1 x 5 MW active compressor + 1 x 5MW compressor idle as backup). During Stage 2, a supplementary compressor group will be added at each GCS, for what each one will end up with three compression groups, two in function and one as backup. Each GCS will therefore have a total installed power of 15MW (2 x 5 MW active compressors + 1 x 5 MW compressors idle as backup). Detailed technical specifications for the compressor groups had not been finalised by the time of drafting the SEIA, however, given new compressors / turbines will be used, emissions are expected to be low and well within legal limits.

The total electricity consumption associated with the compressors in all three Compressor Stations is presented in Table 10.13, for each of the two stages of the project (breakdown of calculations available in Appendix 10.4). This table also shows the corresponding GHG emissions for each stage.

Table 10.12 Total electricity consumption from compressors in all three GCS per stage of the project and corresponding GHG and other air emissions

Phase	MWh	Tonnes CO2	Tonnes NOx	Tonnes CO	Tonnes PM10
Operations	per year	per year	per year	per year	per year
Stage 1	131,400	29,794	42	18	0
Stage 2	262,800	59,587	84	37	1

Based on the above, the severity of the impacts associated with GHG emissions during Stage 1 of Operations is considered “Medium-Low”, as it exceeds 20,000 tonnes CO_2, but is under 100,000 ton CO_2. With regards to the Stage 2 of Operations, the severity of the impacts associated with GHG emissions is considered “Medium-Low”, as it also exceeds 20,000 tonnes CO_2, but is under 100,000 ton CO_2.

10.5 Proposed Mitigation

The following mitigation measures are proposed to reduce any negative impacts.

10.5.1 Mitigation Measures during Construction

Most mitigation measures to address impacts on ambient air quality during construction are general mitigation measures that correspond to good practice during construction, and as such are presented in Chapter 6. Only specific mitigation measures defined to address particular impacts is presented here, especially to address impacts of “High” significance.

Despite the fact that some “High” severity impacts have been identified, they occur in very specific and clearly identified locations (around one CS and a few other facilities – construction / accommodation camps and pipe storage yards). Whilst no additional specific mitigation was defined at this point, it is important that – due to the higher severity of the impact in these locations – the general mitigation measures indicated in Chapter 6 are enforced and monitored closely in order to confirm its efficacy and that the impacts are under control. In the case, such monitoring reveal the

measures are being implemented but are not efficient enough, additional measures will need to be defined.

In addition, and as part of this, an air quality monitoring program should be implemented, especially close to the residential areas that determined the impact severity to be “high”, in the surroundings of the GCS and construction storage areas.

10.5.2 Mitigation Measures during Operations

The CGSs (in terms of equipment selection) have been designed to reduce the project’s impacts to air quality during the operation phase and no additional mitigation measures are currently being considered at this stage of the Project with regards to emissions from the GCSs.

10.5.3 Fugitive Pipeline Emissions

Fugitive emissions can be released from leaking pipes and tubing/pump seals. To minimise or avoid release of fugitive emissions from leaking pipes and tubing/pump seals, Transgaz should ensure installations are well maintained and selection of appropriate valves, fittings and flanges. To this they can prevent leaks by:

- Utilising engineering design to provide adequate protection from likely external physical forces, e.g. seismicity, floods, landslides, permafrost, vegetation;
- Installing positive pipe corrosion control measures, for example, coatings, cathodic protection, chemical additives, heaters; and
- Ensuring that the SCADA is well maintained and used correctly to control flow and pressure.

In addition, they should detect leaks by installing leak detection equipment, e.g. Monitoring the flow in the pipe through pressure sensors connected to alarms and automatic pump shutdown systems; and Continuous metering to provide a comparison between input and output for leak detection.

10.5.4 GHG

The GHG initial calculations indicate that the BRUA Project is expected to produce post-investment, more than 20,000 tonnes of CO2-equivalent annually, Transgaz should quantify (in accordance with the EBRD Methodology for Assessment of Greenhouse Gas Emissions) and report annually to the EBRD the Project’s GHG emissions. The scope of GHG assessment shall include all direct emissions from the facilities, activities and operations that are part of the project or system, as well as indirect emissions associated with the production of energy used by the project.

10.6 Monitoring

An appropriate air quality and GHG emissions monitoring program for both the construction and operational phases of the Project should be designed by Transgaz to demonstrate compliance of project activities to the Project limit levels. Monitoring should be conducted, but not limited to, the AoI (250m) of all three GSCs and at ‘high’ risk sites as identified in table 10.8. The monitoring regime should include a minimum of:

- Visual dust monitoring;
- Intermittent emission monitoring (CO2, N2O, NOx, CO, NH3, NMVOC, PM10, PM2.5) around sensitive receptors; and
- GHG reporting schedule.

Monitoring should also be carried for deposition of dust on crops along the RoW (along with dust suppression and appropriate stakeholder engagement) given the high perceived level of impact.

The monitoring program should also identify the appropriate actions required to ensure limits are returned to a level of compliance in the event that the plans monitoring thresholds are exceeded. Further, a detailed complaint procedure will be established as part of the Project Grievance Mechanism and adhered to for the entire construction of the pipeline. The Grievance Mechanism should be used as a tool to identify any non-compliances and the monitoring program should be updated accordingly to monitor any areas where a valid complaint is registered.

10.7 Residual Impacts

Overall, following implementation of proposed mitigation, the project is not expected to have any significant residual impact on air quality as a result of either construction or operations. It does however have the potential to create substantial GHG emissions and these should be monitored and a GHG management plan put in place.

11 Noise and Vibration

This chapter assesses potential noise and vibration impacts on human receptors associated with the construction and operation of the proposed gas pipeline. Assessment of operational maintenance work and emergency situations are outside of the scope of this assessment, decommissioning phase impacts are expected to be similar to construction impacts and are not considered in detail.

Impacts on ecological resources are assessed and considered separately in Chapter 12.

A glossary for the terminology used in this Chapter is given in Appendix 11.1

11.1 Relevant legislation and Guidance

The key Romanian and international regulations relevant to this Chapter are summarised in Chapter 2 and covered in more detailed in the Regulatory EIA. Issues around the prevention of noise pollution are covered under EBRD PR3.

11.2 Scoping Assessment

Key issues addressed in this Chapter are outlined in Table 11.1 below. This presents a brief justification for having 'scoped out' some impacts, and identifies as 'scoped in' a number of issues for further evaluation.

Table 11.1 Scoping Matrix - Project Construction Phase

Source of Impact	Receptor(s)	Key Receptor Sensitivities	Scoped In/Out	Justification for Scoped In/Out
Construction Phase				
Operation of fixed and mobile plant engaged in construction activities	Local residents	Local residents may experience nuisance effects if these activities occur during night time hours which could lead to sleep disturbance. Potential for influence of vibration caused by heavy traffic and other project related activities on the structures of the closest houses, especially old houses in the rural areas	In	Scoped in to enable the determination of the impact of noise levels on sensitive receptors.
Increased vehicle traffic associated with construction activities			In	
Operation of fixed and mobile plant engaged in construction activities	Users of local facilities (e.g. educational facility, healthcare facility, place of worship or open spaces – areas of landscape or historic value)	Disturbance caused by noise/vibration could result in interference with teaching, intrusion during worship, disturbance of the recreational use of an open space.	In	
Increased vehicle traffic associated with construction activities			In	
Operation of fixed and mobile plant engaged in construction activities	Construction Workers	Health effects	Out	It is understood that Transgaz will be applying Good International Practice (GIP) for the protection of construction workers as part of their HSE-MS.
	Fauna	Disturbance, especially	In	Scoped in with

Source of Impact	Receptor(s)	Key Receptor Sensitivities	Scoped In/Out	Justification for Scoped In/Out
Increased vehicle traffic associated with construction activities		during sensitive seasons	In	regard to sensitive ecology receptors – addressed under the Biodiversity Section in Chapter 12.
Operations Phase				
Operation of the Gas Compression Stations (GCSs)	Local residents	Local residents may experience nuisance effects if this occurs during night hours this could lead to sleep disturbance.	In	The distance of sensitive residential receptors from the location of GCSs and expected levels of noise that will be generated by the GCS are unknown at this stage. However, appropriate limits can be considered

11.3 Existing Conditions

11.3.1 Baseline Data Collection

This assessment builds on the work that was done for the Regulatory EIA and considers potential noise and vibration impacts within an Area of Impact (AoI) of 300 metres from the centre of the pipeline, GCSs, construction compounds and access roads. At distances beyond this, elements such as the topography of the land and meteorological conditions have an increasing influence upon sound, resulting and predictions are much less accurate.

11.3.2 Background Noise Levels

The Regulatory EIA involved a limited baseline noise survey undertaken at a number of locations (specific details of the context of the measurement locations e.g. next to a road, etc. was not provided) as shown in Table 11.2 below. As noise monitoring was only undertaken on a single day the values should be considered as indicative only.

Whilst not specified in the source documentation supplied to Arcadis the assumption has been made that the values presented in Table 11.2 refer to the L_{Amax} and L_{Amin} levels monitored within the survey period at each location as defined below, based upon the range of values this is the only conclusion that can be drawn without more supporting information. This presents the outer range of values relating to the overall noise climate over the periods monitored at each location.

1. L_{Amax}: is the maximum value that the A-weighted sound pressure level reached during the measurement period; and,
2. L_{Amin}: is the minimum value that the A-weighted sound pressure level reached during the measurement period.

Table 11.2 Baseline noise levels recorded as reported in the Regulatory EIA

Date Location	Measurement Time Period (approximate time of day)											
	00:00		04:00		07:00		11:00		16:00		20:00	
	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}
12.09.2015 Bucşani	21.4	28.7	32.9	67.3	44.8	68.3	44.4	79.1	29.9	61.1	42.0	66.3
14.09.2015 DJ 703 Corbu	41.4	58.9	23.0	48.9	31.2	71.0	40.0	67.5	41.6	66.7	45.7	68.0
16.09.2015 Mal drept Olt	49.9	67.0	46.7	69.3	45.3	69.7	50.1	69.2	44.2	69.2	44.4	69.0

Date Location	Measurement Time Period (approximate time of day)											
	00:00		04:00		07:00		11:00		16:00		20:00	
	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}	L_{Amin}	L_{Amax}
20.09.2015 Pui	39.7	71.9	40.2	70.4	40.2	79.0	40.4	71.2	34.7	101.1	37.9	80.0
22.09.2015 Prisaca	29.4	67.2	33.7	78.9	34.5	80.1	39.4	79.9	44.0	78.4	34.9	77.5
12.10.2015 Herneacova	30.1	44.9	30.8	45.9	30.7	44.5	30.4	44.5	30.7	47.1	32.0	51.6

The majority of the pipeline route, the GCSs and other temporary facilities (such as construction camps, workers' accommodation and pipe storage yards) are located predominantly within rural rather than in urban areas. In such areas the noise climate comprises of such things as agricultural activity, the use of local roads (with generally low traffic flows) and natural/animal sounds.

In certain localities, such as Bucşani, Prisaca and Herneacova, it is identified in Table 11.2 that during the quietest part of the overnight period (00:00), where other sources in an area (roads, agriculture) generally reduce to their lowest levels, night time noise levels are generally very low and as such, care should be taken with activities and operations in these areas at these times.

However, with regard to the remaining measurement localities such as DJ 703 Corbu, Mal drept Olt and Pui. the noise climate is higher and the potential for greater masking of activities occurs.

11.3.3 **Sensitive Receptors**

A key element of the assessment of noise impacts is understanding where sensitive receptors are located. With the project covering such a large distance, it is not practical at this stage of the process to consider every potential noise sensitive receptor along the route in detail. Instead, given that the pipeline generally extends across an area where the population density is inherently low, and specifically takes a route that avoids sensitive receptors wherever possible, a desktop study has established the settlements that are within an influencing distance of the pipeline route corridor along with the offset distances from the pipeline as presented in Chapter 10 (air quality) and Appendix 11.2.

Based upon the current route a total of eight houses have been identified within 20m of the pipeline construction route, these are considered to be sensitive receptors and based upon the separation distances involved have the potential to experience significant impacts if not suitably controlled/mitigated. Work Statements will be produced by the Contractor specific to these receptors to ensure that noise and vibration are mitigated to minimise impact exposure.

No specifically noise sensitive receptors such as hospitals have been identified within 2.5km of the pipeline or schools located within 1km. Such receptors are therefore not expected to receive any adverse noise or vibration effects from the construction works purely as a function of the separation distances involved.

The pipeline does, however, cross / pass close to protected nature areas and some sites of historic importance. These are discussed further within Chapters 12 (Ecology) and 13 (Cultural Heritage). Work Statements will be produced by the Contractors for these identified sites in which noise and vibration impacts must be accounted for.

11.4 **Impact Assessment Methodology**

11.4.1 **Approach and Methodology**

Local Romanian Guidance relating to noise is contained within STAS 10009/88: Urban Acoustics, which specifies permitted limits of noise levels. The standard considers admissible limits for noise within urban areas specifically relating to road traffic and concludes that:

- Category III (collector) streets have a maximum admissible equivalent level of noise of 65 dB(A).
- Category II (connector) streets have a maximum admissible noise equivalent of 70 dB(A)

In addition, the STAS considers that the maximum admissible level of noise at the limit of an industrial zone within an urban area is 65 dB(A).

~~Furthermore, Ministry of Health Order Number 536/July 1997 establishes maximum limits with regard to noise within dwellings, stipulated as noise limits set at 2m from the external face of a residential building:~~

- ~~50dB(A) during the daytime period between 06:00 and 22:00; and,~~
- ~~40dB (A) during the night-time between 22:00 and 06:00.~~

Furthermore, the Ordinance no. 119/2014 for the approval of the Hygiene and public health regarding the population's living environment norms establish that in protected areas the following maximum limits for noise will be assured and abided by:

c) During the day, the weighted equivalent continuous acoustic pressure level A (AeqT), measure outside the house according to standard SR ISO 1996/2-08, at 1.5m above the ground should not exceed 55 dB and the sound curve Cz 50;

d) During the night, between the hours of 23:00-7:00, the weighted equivalent continuous acoustic pressure level A (L(AeqT)), measured outside of the house according to standard SR ISO 1996/2-08, at 1.5m above the ground should not exceed 45 dB and the sound curve Cx 40.

These values accord well with the current World Health Community Noise Guidelines (1999), the more recent accompanying Night Noise Guidelines for Europe (2009) and the International Finance Corporation (IFC) limits.

Specifically, the IFC states in the 2007 document *Environmental, Health, and Safety (EHS) Guidelines* regarding noise management that noise should not exceed 55dB daytime (07:00 – 22:00) and 45dB night-time (22:00 – 07:00), or result in a maximum increase in background of 3dB, at any residential, institutional or educational receptor.

With regard to vibration local Romanian guidance is available and is contained within Romanian Standards SR12025/1-94 and SR12025/2-94, which establish acceptable limits relative to road traffic and permanent machinery vibration sources.

However, all of these limits relate primarily to permanent noise and vibration sources and situations, and as such are appropriate for the consideration of operational impacts from the Project.

However, the construction phase of the Project is primarily a rapidly progressing transient activity, and impacts through construction will be very short term in nature; this needs to be accounted for in the assessment and consideration of resulting impacts. As such the assessment and consideration of construction impacts associated with the Project has been undertaken in accordance with the UK guidance of *BS 5228 (2009 +A1: 2014): 'Code of practice for noise and vibration control on construction and open sites' Parts 1 (Noise) and 2 (Vibration)*, which is designed specifically for the purpose of considering none permanent, fluctuating construction noise/vibration. Using this guidance to consider the impacts of the construction of the Project provides the greatest control to the construction contractor to not overly constrain what are essentially short term, transient impacts; whilst adequately protecting the amenity of the closest receptors. BS5228 allows this context to be inherent within the assessment and consideration of impacts.

11.4.1.1 Construction Noise

Part 1 of BS 5228 outlines basic methods of construction noise control as well as addressing related issues such as community relations; training; occupational noise effects; neighbourhood nuisance; and project supervision. The associated Annexes include information on: EC and UK legislation; noise sources, mitigation options; sound level data (for both onsite equipment and site - source terms that are used for modelling).

Part 1 also provides a methodology for estimating noise from sites (calculation procedures which form the basis of the modelling packages); and guidance relating to noise monitoring, along with specific examples of noise effect significance criteria.

The identified significance criteria are dependent upon the absolute levels of ambient and construction noise (as well as the magnitude, duration, time of occurrence and frequency of the noise change) and are considered based upon two example methods of determining the significance of construction noise, Method 1 'The ABC Method' has been used within the scope of this study given the limited baseline data available for this project.

The specifics of the ABC method are detailed in Table 11.3 below, with a significant impact being reported where Construction noise breaches these limits:

Table 11.3 BS 5228 Example method 1 – ABC Method

Assessment category and threshold value period (LAeq)	Threshold value, in decibels (dB)		
	Category A (A)	Category B (B)	Category C (C)
Night-time (23:00 – 07:00)	45	50	55
Evening and Weekends [D]	55	60	65
Daytime (07:00 -19:00) and Saturdays (07:00 – 13:00)	65	70	75
NOTE 1 A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level. NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total LAeq noise level for the period increases by more than 3 dB due to construction activity. NOTE 3 Applied to residential receptors only.			
[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values [B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values [C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values [D]19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.			

11.4.1.2 Construction Vibration

BS 5228 Part 2, *Vibration*, gives recommendations for basic methods of vibration control relating to construction and open sites, as well as guidance on effective liaison between developers, operators and regulators and on measuring and assessing the effects of vibration. For determination of the significance of vibration impacts on people, BS 5228 cross refers to *BS 6472 - Guide to evaluation of human exposure to vibration in buildings; Parts 1 and 2: 2008* which presents guidelines for the evaluation of vibration issues relating to human perception. Table 11.4 below reproduces the resulting '*Guidance on effects of vibration levels*' (Table B.1 of the standard).

Table 11.4 BS 5228 Guidance on Effects of Vibration Levels

Peak Particle Velocity Vibration Level	Effect
< 0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.14 - 0.3mm/s	Vibration might be just perceptible in residential environments
0.3 - 1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
> 10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level

11.4.2 **Impacts from Construction**

11.4.2.1 Sources of Impact

Construction works will involve a range of processes including site clearance, trench excavation, pipelaying and backfilling of trenches, as outlined in Chapter 4. These will all have noise and vibration implications which will vary depending upon the separation distances involved. However, construction works will progress rapidly along the pipeline (albeit from a number of work fronts) in a linear manner. This rate of progression will limit the length of time during which any given receptor would be exposed to noise and vibration impacts. Progress will however be slower in certain areas (e.g. through areas of hard rock in the mountains), although many of these will be remote areas with fewer human receptors within influencing distance.

Impacts will also arise from deliveries of materials, people and equipment to the storage compounds and then on to the construction area of the pipeline, as well as removal of surplus materials from the construction area such as excavated material, and excavated hard rocks and gravels. In addition, at certain locations along the pipeline specific construction tasks may be required including those outlined below:

1. **Excavations in hard Rock Areas** – This process will involve pneumatic hammering through areas of hard rock, mostly along parts of the route where the pipeline passes through the Carpathian Mountains. The locations where this construction activity is anticipated is indicated on the plan presented in Figure 11.1**.**
2. **Horizontal Drilling** – This process will be employed at specific locations along the route of the pipeline where it is required to pass under roads and larger rivers including the *Neajlov, Olt, Jiu, Raul, Mare, Gilort, Timis and Mures.*
3. **Construction of Gas Compression Stations (GCSs).** Concreting of strip foundations and floor slabs and Vibration and (5) compaction of concrete foundations and floor slabs are examples of worst-case construction activities that may create louder noise emissions for the duration it is required to be carried out.

Associated works to those outlined above include the provision of compound facilities for the construction workers. These areas include provision for offices, welfare facilities and storage areas for construction material. Deliveries of materials to these compounds have been considered as part of each construction activity. The project will also require the construction of several access roads which it is understood will not be constructed with a hard surface. Construction traffic using these access roads may be a source of some disturbance depending on how many vehicles use them, at what time of day and how close they run to sensitive receptors. As the route of these access roads is not presently know a detailed assessment has not been made at this stage.

11.4.2.2 Noise from Pipelaying Activities

Noise predictions have been undertaken for the three main routine construction tasks associated with pipelaying, namely site clearance, trench excavation and pipelaying/backfilling. Typical plant and equipment used in each operation is shown in Table 11.5 below and detailed further in Appendix 11.3, along with sound pressure levels (at 10m) for each item as taken from Annex C of BS5228.

Table 11.5 Plant for Pipelaying

Site Clearance	Trench Excavation	Pipe laying and backfill of trench
• Static/Mobile Plant and equipment • 1no. Bulldozer • 1no. wheeled Loader • 1no. tracked excavator • 1no. Delivery/export Vehicle/hour	• Static/Mobile Plant and equipment • 1no. tracked excavator • 1no. off-road dump truck • 1no. diesel generator set • 1no. water pump • 1no. Delivery/export Vehicle/hour	• Static/Mobile Plant and equipment • 1no. tracked excavator • 1no. pipe bender • 1no. welding machine • 1no. off-road dump truck • 1no. diesel generator set • 1no. tracked crane • 2no. Delivery/export

		Vehicles/hour

These calculations have been used to understand the potential noise propagation at differing distances from the works up to a furthest distance of 300m (the limitation of the BS5228 prediction methodology after which meteorological and other factors make prediction unreliable). These predictions (Table 11.6) are based on a "worst-case" situation of all plant and equipment having a100% on time, all being on at the same time and being on the outer edge of the construction corridor. This would not be expected to occur in practice so is considered to represent an absolute worst case. Additionally, the predictions assume soft ground corrections and do not take account of any screening that may exist, be it topographical or from buildings/other features in the vicinity. This may provide significant noise screening in some areas, particularly where the pipeline passes through mountainous regions.

The noise level calculations also assume neutral meteorological conditions and have been calculated based upon a 10-hour working day, adjusted to a 12-hour period in accordance with the guidelines set out in the assessment standard BS5228.

Table 11.6 Predicted Façade Noise levels; $L_{Aeq,12\ hours}$ for general construction activities

General Construction Activities	Description of plant/vehicles and location	Predicted Façade Noise Level $L_{Aeq,12hour}$ dB at stated distances				
		25m	50m	100m	200m	300m
Site Clearance (without tree/hedge removal)	Static and Mobile Plant at site	76	70	64	58	54
	Delivery vehicles at depot and site	45	42	39	36	34
	Combined static/mobile plant and deliveries at site	76	70	64	58	54
Trench Excavation	Static and Mobile Plant at site	72	66	60	54	50
	Delivery vehicles at depot and site	45	42	39	36	34
	Combined static/mobile plant and deliveries at site	72	66	60	54	50
Pipe Laying and Backfill of Trench	Static and Mobile Plant at site	84	77	71	65	61
	Delivery vehicles at depot and site	48	45	42	39	37
	Combined static/mobile plant and deliveries at site	84	77	71	65	61

Assuming that significant impacts would only occur where the BS5228 defined criteria are breached, and using a Category "A" limits (given the lack of reliable baseline definition and a robust assumption based upon that provided), the analysis indicates the following overall conclusions, shown in Table 11.7.

Table 11.7 Distance to expected significant impacts

Period	Category "A" limit Value	No Effect	Significant Effect
Daytime	65dB	There are not expected to be any significant effects when receptors are at distances of greater than approximately 100m from construction activities	There is the potential for significant effects when receptors are present within approximately 100m from construction activities
Evening	55dB	There are not expected to be any	There is the potential for significant

Period	Category "A" limit Value	No Effect	Significant Effect
		significant effects when receptors are at distances of greater than approximately 200m from construction activities	effects when receptors are present within approximately 200m from construction activities
Overnight[17]	45dB	There are not expected to be any significant effects when receptors are at distances of greater than approximately 300m from construction activities	There is the potential for significant effects when receptors are present within approximately 300m from construction activities

It should be noted, however, that given the linear nature of the activities and the proposed activity progression rates, in practice the maximum closest approach noise levels at any given receptor would only be very short lived. Indeed, noise levels would gradually build as the pipe works approach, hit a maximum closest approach level and then decrease as the works move away. As such impacts to individual receptors from typical pipelaying activities are expected to be of only relatively short duration in the overall timeframe of the project.

11.4.2.3 Noise from Other Activities (Specialist Construction Activities)

As outlined in Section 11.4.2 there are certain areas along the route where specific activities will be required and noise impacts may change. Whilst the exact locations where such activities may be required are to be confirmed by the contractors, expected plant compliments are shown in Table 11.8 and predictions of likely construction noise from these activities are presented in Table 11.9. These predictions have been undertaken to consider propagation to known distances from the activities to conclude where the potential for impacts may occur depending upon the proximity of receptors. Further details of plant noise levels and assumption are presented within Appendix 11.3

Table 11.8 Plant for other activities

Activity	Equipment
Excavation in hard rock areas	• Static/Mobile Plant and equipment • 1no. tracked excavator with pneumatic breaker • 1no. tracked excavator loading rock to trucks for transportation • 1no. diesel generator set • Hand Tools • Delivery/export Vehicles
Horizontal Drilling Technique	• Static/Mobile Plant and equipment • 1no. directional drill equipment • 1no. tracked excavator loading rock to trucks for transportation • 1no. diesel generator set • 1no. water pump • Hand Tools • Delivery/export Vehicles
Concreting Foundations and Floor Slab	• Static/Mobile Plant and equipment • 1no. concrete mixer (truck mounted) • 1no. lorry mounted concrete pump • 1no. diesel generator set • 1no. poker vibrator • Delivery/export Vehicles

17 It is not envisaged that under normal circumstances works would be undertaken outside of normal daytime hours.

Concrete Compaction of Foundations and Floor Slab	• Static/Mobile Plant and equipment • 1no. generator • 1no. compressor • 1no. diesel generator set • 1no. poker vibrator • Delivery/export Vehicles

Table 11.9 Predicted Façade Noise levels $L_{Aeq,12\ hours}$ for additional construction tasks at specific locations

Construction Activities at Specific Locations	Description of plant/vehicles and location	Predicted Façade Noise Level LAeq,12hour dB at stated distances				
		25m	50m	100m	200m	300m
Excavation in Rock	Static and Mobile Plant at site	82	76	70	64	60
	Delivery vehicles at depot and site	53	50	47	44	42
	Combined static/mobile plant and deliveries at site	82	76	70	64	60
Horizontal Drilling	Static and Mobile Plant at site	83	77	71	65	61
	Delivery vehicles at depot and site	48	45	42	39	37
	Combined static/mobile plant and deliveries at site	83	77	71	65	61
Placing concrete in foundations and slab of GCS	Static and Mobile Plant at site	84	78	72	66	62
	Delivery vehicles at depot and site	45	42	39	36	34
	Combined static/mobile plant and deliveries at site	84	78	72	66	62
Compaction of concrete in foundations and slab of CGS	Static and Mobile Plant at site	94	88	82	76	72
	Delivery vehicles at depot and site	48	45	42	39	37
	Combined static/mobile plant and deliveries at site	94	88	82	76	72

Considering the predicted noise levels for these construction activities at the stated distances presented in Table 11.9 above, and assuming that significant impacts would only occur where the BS5228 defined criteria is breached (again using a Category "A" limits given the lack of baseline definition), the analysis indicates the following overall conclusions:

Table 11.10 Distance of expected impacts from "other activities"

Period	Category "A" limit Value	No Effect	Significant Effect
Daytime	65dB	There are not expected to be any significant effects when receptors are at distances of **greater than approximately 200m** from construction activities	There is the potential for significant effects when receptors are present **within approximately 200m** from construction activities
Evening	55dB	There are not expected to be any significant effects when receptors are at distances of **greater than approximately 300m** from construction activities	There is the potential for significant effects when receptors are present **within approximately 300m** from construction activities

Period	Category "A" limit Value	No Effect	Significant Effect
Overnight[18]	45dB	There are not expected to be any significant effects when receptors are at distances of **greater than approximately 300m** from construction activities	There is the potential for significant effects when receptors are present **within approximately 300m** from construction activities

Impacts to individual receptors from these atypical construction activities have the potential to result in significant impacts at greater distances than for normal pipelaying activities. As such specific mitigation will be required for evening and overnight activities as detailed later in this document where sensitive receptors are within influencing distances. This is specifically the case where certain elements of the activities would require construction compounds to be in place for a significantly time period relative to the typical short term linear activities of pipelaying, thus resulting in the potential for relatively longer duration impacts which would need better control.

Additionally, as the assumption is made that the lowest BS5228 Category "A" limits are appropriate (due to the lack of baseline data to the contrary) it would be advisable for baseline noise levels to be established at any sensitive receptors in the vicinity of the sites where these longer term activities are proposed, to ensure that appropriate noise limits are set based upon the prevailing climate of said area.

11.4.3 **Noise from Operational Aspects**

During normal operation, noise and vibration effects would be limited to the operation of the gas compression stations (GCS), and to a lesser degree the block valve stations (BVS).

Each of the GCS facilities will contain three compressor units of which two will operate continuously (24hrs/ 7 days) whilst the other would act as a standby unit in case of failure or maintenance requirements. The BVS facilities would also require to operate on a 24hrs/7days basis following commission.

The units (GCS and BVS) will be located within purpose-built buildings with the specification that the noise levels at the fence must be lower than 65dB(A) where the setting is described as predominantly an industrial area, as required under Romanian Legislation. However, this is combined with a criteria requiring a limit of 55dB during the daytime and 45dB during the overnight, or a maximum increase of +3dB above the prevailing baseline noise climate, as defined within the International Finance Corporation (IFC) requirements.

As shown on the plan in Figure 11.2**,** the following sensitive receptors have been identified near these sites:

- Podișor: one residential property, located some 750m from the facility.
- Bibești: seven residential properties located within 250m of the facility.
- Jupa: two residential properties located approximately 400m and 430m from the facility.

Given the proposed building designs for the GCS and BVS facilities, and accordance with specified Romanian and IFC permanent facility limit levels, impacts associated with these facilities are expected to be controlled by design and are therefore of negligible significance only. However, it is recommended that monitoring is carried out occasionally at the fence line of these facilities/nearest sensitive receptors to determine if any additional mitigation is required under the IFC guidance.

Outside of typical operation, maintenance will be required annually on the compressors which takes approximately half of a day to complete. The annual maintenance involves the depressurisation of the GCS, which will result in intermittent noise emissions when gas is vented via the 70m high vent stack. Similar venting would also be necessary in the case of an emergency requiring gas to be rapidly

18 It is not envisaged that under normal circumstances works would be undertaken outside of normal daytime hours.

released. As these events are very infrequent/emergency they have not been considered as part of this assessment.

11.5 Proposed Mitigation Measures

11.5.1 Construction Noise and Vibration

11.5.1.1 Overview

The primary construction mitigation proposed is the development of an effective Construction Noise and Vibration Management Plan (CNVMP) by the Construction Contractors to include specific limits to be used to control noise and vibration associated with the Pipeline project. This may form part of the overall Pollution Prevention and Control Plan as outlined in Chapter 5.

The Plan should include a protocol which when implemented will identify sensitive receptors, and determine the risk of adverse impacts. It will also highlight mitigation measures that could be considered where necessary and appropriate should the need arise as well as a monitoring protocol that can be used to policy/verify compliance of the construction works with appropriate noise and vibration limits.

11.5.1.2 Construction Noise Limits

Specific construction noise limits will be defined in accordance with *BS 5228: Noise Control on Construction and Open Sites (Part 1); 2009 (+A1: 2014)* to account for the non-permanent nature of the activities. As a result of the detail available relating to the current noise climate along the route, and the nature of the route through predominantly rural/mountainous areas it can only be recommended based upon this information that Category "A" values from the BS5228 "ABC Methodology" are used for the construction noise limit, however, this can be changed where subsequent surveys identify a baseline noise climate conducive to a higher limit. Given that construction impacts will be actively managed a better understanding of the prevailing pre-existing noise climate will be achieved as the scheme progresses. Baseline monitoring should be undertaken where the need is identified and especially as a result of the proximity of the Construction works to sensitive receptors, and for longer duration activities such as those specialist construction activities identified and long term compounds.

Should higher baseline noise climates be encountered along the scheme, which correspond with higher noise limits from the BS5228 scheme, this would be implemented through the active control of construction noise in the Pollution Prevention and Control Plan.

It is understood that construction work will be undertaken during normal daytime working hours, with no construction works normally occurring during evenings, overnight or at weekends. Exceptions to the normal working schedule may occur as a result of site specific parameters, safety concerns, emergencies or to maintain the construction schedule following an adverse weather event or a chance find of cultural heritage that would temporarily cause work to cease. In such instances further assessment would be carried out to determine impacts upon any noise sensitive receptors in the vicinity of working outside of the core hours.

11.5.1.3 Construction Vibration Limits

General pipeline construction activities are not expected to generate significant levels of vibration that would be discernible at the nearest sensitive receptors.

Certain activities proposed do however have the potential to generate ground borne vibration and could result in adverse impacts if not suitably controlled. These include horizontal drilling; rock hammering; and compaction of road bases and GCS foundations[19].

Whilst in most cases the separation distances involved between these activities and sensitive receptors mean that adverse impacts would not be expected, specific construction vibration limits

19 It is understood that blasting will not be required as part of the construction process through areas of hard rock. However, should this change further analysis of this issue should be undertaken.

would be defined for the project[20] and should a specific project requirement become apparent along the route of the Pipeline, or a validated complaint regarding construction generated vibration be received the issue of vibration compliance would be addressed at that time under an active management strategy for construction impacts. However, with this in mind the following limits should be considered within the Pollution Prevention and Control Plan:

- **Ground Borne Vibration**: short term vibration generated by construction activities at any surrounding sensitive receptors (residential) should remain below the levels stated in Table 11.4.

11.5.1.4 Construction Risk Based Noise and Vibration Controls

Control at source and the implementation of Best Available Technique (BAT) is considered the most appropriate method of noise and vibration control during the construction phase, combined with active management of noise and vibration levels through the Pollution Prevention and Control Plan. On this basis specific measures and protocols should be used to control noise and vibration from Project construction activities, based on:

- A RISK based assessment of construction activities and appropriate control measures;
- Protocols for compliance noise and vibration monitoring for construction activities; and
- A robust complaint procedure linked to the Project Grievance Mechanism that could be used to engage with the surrounding communities and ensure direct lines of communication to the construction contractor.

Table 11.11 overleaf provides an initial RISK based assessment of construction noise and vibration, which outlines the general activities which have the potential to generate noise and/or vibration, and provides details of appropriate control measures that could be considered/implemented where appropriate. The list of control measures outlined in the table is by no means exhaustive however, and other options should be considered if and where necessary.

20 To be in accordance with BS 5228: Noise Control on Construction and Open Sites (Part 2); 2009 (+A1: 2014); BS 6472: Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting, 2008 and BS 7385: Evaluation and measurement for vibration in buildings – Part 2. Guide to damage levels from ground borne vibration, 1993.

Table11.11 Example Construction Noise and Vibration Risk Based Assessment (also see Pollution Prevention Construction Management Plan)

Hazard	Source Operations	General control measures (Best Available Technique)
Hazard: Shouting, PA systems and amplified noise **Notes on hazard:** Nuisance caused by shouting on site, any PA systems and audio radios at nearby receptors	• Shouting between operatives on site to relay instructions; • Audible levels of amplified music on site at workstations and within cabs (with open doors/windows); and, • CB Radio noise between staff and within cabs (with open doors/windows) if volumes are set too high.	• Personnel will be instructed on best practice measures to reduce noise and vibration as part of their site induction training; • Shouting and raised voices will be kept to a minimum e.g. in cases where warnings of danger must be given. • Use of audio radios in the open environment will be prohibited except where two-way radios are required for reasons of safety and communication; • Control of noise introduced into site induction to ensure that all operators on site, including contractors, are working in such a way to minimise noise; and, • Compliance monitoring of noise to ensure limits are being met.
Hazard: Unacceptable “out of hours” noise **Notes on hazard:** Nuisance caused by audible noise at the closest residential receptors during unsociable hours	• Noisy operations being undertaken during unsociable hours for safety reasons or emergency situations or requirements.	• General construction hours will be in accordance with the guidance of the environmental agreement, but will also be limited to: – between 07:30 and 17:30 Monday to Friday; – no operations at weekends and during bank/public holidays. • Prior liaison with the Romanian Planning Authority regarding any requirements for out of hours work for Health and Safety, unplanned or emergency reasons; • Appropriate complaint procedure to ensure complaints are logged, investigated and resolved; and, • Control of noise introduced into site induction to ensure that all operators on site, including contractors, are working in such a way to minimise noise.
Hazard: Activity noise levels (allowable hours) **Notes on hazard:** Nuisance caused by the audible level of noisy activities on site at the nearest Sensitive Receptors There is a lower possibility of adverse comment arising from	• Noise generated by careless material movement and management on site; • Noise generated by careless loading and unloading of road lorries/ dump trucks • Noise generated by activities involving mechanical plant and equipment; • Noise associated with falling/dropped material on site; and, • Manual noise including hammering,	• Where appropriate and possible burning equipment or hydraulic cutting will be used in preference to cold cutting techniques; • All materials will be handled, stored and used in a manner that minimises noise, this include the preclusion of dropping material which would be placed in all instances; • Routes and programming for the transportation associated with the works will be carefully considered in order to minimise the overall noise impact generated by these movements and will conform to the operational hours of the works as specified by the Romanian Planning Authority; • Provision of temporary acoustic barriers (or other means) for use when operations are exposed or are identified as problem activities;

Hazard	Source Operations	General control measures (Best Available Technique)
commercial and industrial operations in the area	breaking out of concrete etc.	• Compliance monitoring of noise to ensure appropriate limits are being met; • Appropriate complaint procedure to ensure complaints are logged, investigated and resolved; and, • Control of noise introduced into site induction to ensure that all operators on site, including contractors, are working in such a way to minimise noise.
Hazard: Plant and equipment noise levels (allowable hours) **Notes on hazard:** Nuisance caused by the audible level of noisy plant on site at the nearest Sensitive Receptors There is a lower possibility of adverse comment arising from commercial and industrial operations in the area	• Increased noise levels as a result of general wear and tear; • Use of noisy equipment; • Use of generators for power supply; • Increased noise levels due to incorrect operation of equipment; • Engine idling noise when not in use; • Increased noise levels as a result of lack of appropriate lubrication; and, • Rattling noises from older equipment.	• Where possible modern, silenced and well-maintained plant will be used at all times, conforming to standards set out in EU Directives; • Equipment including vehicles will be shut down when not in use; • Engine compartments will be closed when equipment is in use and the resonance of body panels and cover plates should be reduced by the addition of suitable dampening materials. • Any rattling noise will be addressed by the tightening of loose parts or the addition of resilient materials if appropriate; • Semi-static equipment will be sited and orientated as far as is reasonably practicable away from noise-sensitive receptors and to have localised screening if deemed necessary; • Generators and water pumps required for 24-hour operation will be super-silenced or screened/located as appropriate to reduce noise; • Crane spindles, pulley wheels, telescopic sections and moving parts of working platforms will be adequately lubricated in order to prevent undue screeching and squealing; and, • Where possible mains electricity will be used rather than generators.
Hazard: Materials handling generating vibration (allowable hours) **Notes on hazard:** Damage or Nuisance caused by the level of generated Vibration specifically with regard to: • Hammering • Horizontal drilling	• Vibration generated by inappropriate material handling on site including dropping and careless placement; • Vibration generated by falling unsecured material and items; and, • Vibration generated by toppling of inappropriately stacked materials.	• Careful consideration of material placement and handling; • No dropping of material from uncontrolled heights; • Appropriate training with regard to material handling and operational techniques so as to minimise vibration generation; • Control of vibration introduced into site induction to ensure that all operators on site are working in such a way to minimise vibration; and, • Appropriate complaint procedure to ensure complaints are logged, investigated and resolved.

Hazard	Source Operations	General control measures (Best Available Technique)
Hazard: Operational plant generated vibration **Notes on hazard:** Damage or Nuisance caused by the level of generated Vibration specifically with regard to: • Equipment • Plant • Ground Stabilisation • Hammering • Horizontal drilling	• Vibration generated by fixed and mobile plant operational on site; and, • Piling and other ground stabilisation works.	• Piling and ground stabilisation would be suitably controlled on site if necessary (However, due to the large separation distances to the nearest receptors this is not considered an issue); • Isolation of pumps and generators when positioned in close proximity to sensitive receptors to prevent direct vibration transfer; • Selection of appropriate equipment for the task required; • No use of hydraulic percussive breaking equipment; • Appropriate training with regard to plant operational techniques so as to minimise vibration generation; • Control of vibration introduced into site induction to ensure that all operators on site are working in such a way to minimise vibration; and, • Appropriate complaint procedure to ensure complaints are logged, investigated and resolved.

11.5.2 **Operational Noise and Vibration**

The primary operational mitigation will be achieved through the design of the acoustic enclosures within the GCS/BVS buildings to ensure that noise levels specified within Section 11.4.3 are met relating to the nearest sensitive receptors, in line with both Romanian and IFC limits.

Should this demonstrate that additional measures need to be implemented, this could be done either through the project design (further reducing the noise levels at fence), or by providing additional acoustic insulation at the receptor. Additional measures that could be considered at the site (should further assessment demonstrates a requirement) include the following:

- Appropriately high/laterally extensive acoustic fencing or earth bunds installed around the perimeter of the site;
- Additional sound insulation panels/mitigation to external walls of the building;
- Careful consideration of the design of roof structure;
- Noise and vibration insulation such as rubber isolation strip between the machinery and the floor of the building;
- Careful consideration of the cladding systems, doors, louvres and windows of the buildings to minimise noise break-out; and,
- Installation of screening/fencing/bunding, upgraded window units and ventilation and/or absorbing exterior panels in areas with sensitive receptors.

To confirm whether any such work is needed, additional baseline surveys should also be undertaken in the vicinity of these receptors to better understand baseline noise conditions near the facilities and inform the design. These should be undertaken to meet the appropriate local/IFC guidance.

11.6 **Monitoring**

11.6.1 **Monitoring During Construction**

Appropriate monitoring should be undertaken to demonstrate compliance of construction activities to agreed Project limit levels as determined by the prevailing noise climate, the duration of the works, the proximity of the activities to any sensitive receptors, the activities proposed and appropriate guidance.

11.6.1.1 Noise Monitoring

It is not advocated, or reasonable that monitoring should be undertaken at every receptor along the scheme. The Contractors however, are obliged to enlist the services of an authorised laboratory to undertake noise monitoring at fixed locations (GCSs, storage depots and construction camps) as well as near to any residential receptors or other identified sensitive receptors with the potential for adverse impacts from noise within the working safety corridor.

The monitoring would be undertaken by an authorised laboratory enlisted by the Contractors to conclude compliance with appropriate legal provisions, this would include:

- Undertaking initial baseline/ambient noise level measurements before construction works start; and,
- Measurements of noise levels undertaken in accordance with the Environmental Agreement which imposes a requirement for quarterly monitoring of noise.

Additional monitoring could also be undertaken upon the receipt of a valid complaint (see later) or should any activities be proposed with the potential for significant noise impacts. This could be either for concern from the site itself, voiced by the Regulatory Authority or raised by local residents/bodies.

11.6.1.2 Vibration Monitoring

Vibration is unlikely to be a material consideration within the general construction activities as a result of the separation distances to the sensitive receptors and the nature of the

construction techniques adopted. However, there may be some instances along the route where vibration may become a potential issue either following a complaint or due to the works proposed. These situations may occur where the proposals include for horizontal drilling and/or pneumatic hammering operations through areas of hard rock. Whilst the general low population density and the requirement for these tasks to be carried out only at specific locations means it is likely that a relatively small number of receptors that have the potential to be adversely affected, where this is the case the following should be undertaken:

- Review of the necessity for consideration of vibration based upon the techniques proposed by an authorised laboratory;

Monitoring of vibration will only be undertaken where necessary and not as a norm. Monitoring will be undertaken where necessary at any of the identified sensitive receptors within the working safety corridor (e.g. the 8 houses noted previously), or in response to concerns raised by the Regulatory Authority or a complaint/request from local residents.

11.6.1.3 Complaints Procedures

A detailed complaint procedure will be established as part of the Project Grievance Mechanism and adhered to for the entire construction of the pipeline. An example standardised recording form is presented within Appendix 11.4 of this Chapter.

11.6.2 **Monitoring During Operations**

The overall operational mitigation approach should be supported by more detailed baseline noise surveys considering the full operational periods of the GCS and BVS facilities, to cover both daytime and overnight periods. These surveys would conclude if higher limits are afforded under the IFC guidance within the specific circumstances of each GCS and BVS location.

Where necessary, and possible any noise surveys should be undertaken by Transgaz at the closest noise sensitive receptors to the GCS/BVS facilities (in addition to monitoring at the fence line in accordance with Local Guidance), which should help achieve the required objective that:

Normal noise emitted from the operational GCS/BVS should be controlled by design to ensure that the noise does not exceed:

- *65dB(A) at the facility fence line where the setting is described as predominantly industrial area, as required under Romanian Legislation;*
- *40dB(A) at the closest sensitive receptors during the overnight operation of the facility, as required under Romanian Legislation; and/or*
- *55dB daytime, or 45dB night-time/a maximum increase of +3dB above the prevailing baseline noise climate (L_{A90}) at the nearest noise sensitive receptor as defined within the International Finance Corporation requirements.*

Based upon the nature of the operational plant associated with the pipeline it is not considered or concluded that operational vibration is a topic requiring consideration as it would be entirely controlled through design.

11.7 **Residual Impacts**

Impacts resulting from the proposed construction activities depend upon what activities that are being undertaken at the time. Generally, as detailed within the scope of this report there is a potential for significant impacts to occur at receptors within 100 – 200m of the construction works sites if activities are not appropriately controlled/mitigated.

With regard to the operational phase of the Project, specifically noise associated with the GCS/BVS facilities, design in accordance with the Rumanian and IFC permanent installation criteria recommended within this Chapter would ensure that operational phase noise would result in no undue impacts to people residing within sensitive receptors nearby.

As such it is concluded that with the application of the noise and vibration limits and controls identified within this Chapter, the construction and operational phases of the Project are not expected to result in any significant adverse impacts to sensitive receptors within the corridor.

To support this an appropriate Noise and Vibration Construction Management Plan (NVCMP) (or equivalent) would be implemented by the Contractor(s) potentially through the Pollution Prevention and Control Plan which adheres to the recommendations of the risk assessment protocol described in this Chapter. This will assist the contractors in identifying sensitive receptors where adverse noise and vibration impacts have the potential to occur, and to investigate the implementation of appropriate mitigation measures to reduce any such impacts so that construction work can proceed without adverse impact, delay or complaint.

12 Ecology and Nature Conservation

12.1 Introduction

This Chapter discusses the implication of the proposed project for the ecology and nature conservation sensitivities of the BRUA Area of Interest (AoI and the zone of influence). As such it outlines both the baseline status of the habitats and species[21] within the AoI (and specifically seeks to evaluate the sensitivity of those resources) and the potential project impacts on them. Internationally recognised criteria are used to ensure that any impacts with the potential to be significant are clearly highlighted and that their appropriate mitigation is clearly addressed in line with the mitigation hierarchy of avoidance, mitigation and offset (in that order).The AoI is a 300m wide corridor along the BRUA route (150m either side of the proposed pipeline).

12.1.1 Report Structure

The reporting within this document follows the following structure:

1. Identifies key issues from scoping;
2. Details the baseline data collection methodology;
3. Summarises the baseline conditions;
4. Assesses the impacts from BRUA (full impact tables are in an appendix 12.3)
5. Details Avoidance, mitigation and restoration measures
6. Details offsetting strategy required to ensure compliance with PR6.

The following figures are associated with this chapter of the report.

- Figure 12.1: Designated Site Map;
- Figure 12.2: Designated Sites in The Vicinity of BRUA (zoom in);
- Figure 12.3: Habitat Categorisation;
- Figure 12.4: Designated Sites Fragmentation Map; and
- Figure 12.5: Locations of Rivers along BRUA.

12.2 Key Issues from Scoping

Key issues identified during the scoping stage of the study are highlighted in Table 12.1 overleaf.

12.3 Relevant Legislation and Guidelines

12.3.1 International and National Commitments

Romania is subject to a range of international commitments and obligations regarding ecology and nature conservation as outlined in Chapter 2. A more in depth account is also given in the regulatory EIA.

12.3.2 EBRD Performance Requirements (PRs)

PR6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources specifically recognises that the conservation of biodiversity and the sustainable management of living natural resources fundamental to environmental and social sustainability. The PR has the core requirements to:

- Protect and conserve biodiversity using a precautionary approach;

[21] For the Romanian EIA, the whole BRUA survey corridor was split into sectors of 5 km. For each 5 km sector an assessment was produced (106 sheets attached in the Annex to the EIA). Using these standard-forms, an evaluation of impact was performed, including required mitigation. Similarly, an assessment for all Natura 2000 criterion species and habitats was made, covering the BRUA survey area. For each species/habitat, an assessment was made in an Annex to the EIA. A discussion on the occurrence of impact categories resulting from BRUA implementation (construction/operation phases) was made for each of these elements.

- Adopt the mitigation hierarchy approach, with the aim of achieving no net loss of biodiversity, and where appropriate, a net gain of biodiversity; and
- Promote Good International Practice (GIP) in the sustainable management and use of living natural resources.

PR6 also refers to those areas that hold the highest tier of irreplaceable (existing in few places) as *critical habitat (CH)* and those with vulnerable (at high risk of being lost) biodiversity features as *Priority Biodiversity Features* (*PBF*). The criteria used to define these explicitly includes ecological functions that are vital for maintaining the viability of CH features. Illustrative examples of such functions, as well as examples of features that would meet other critical habitat criteria, are provided in Appendix 12.2 and in Tables 12.10 to 12.20.

Habitats were scoped into the assessment at the habitat valuation stage, these are then screened below for the inclusion as critical habitats that potentially require offsetting. The critical habitat screening is presented in the Appendix 12.2

Further details of PR6 are provided as an Appendix 12.2.

Table 12.12.1: Key issues identified during the scoping stage of the study

Source of Impact	Receptors (core)	Impact	Key receptor sensitivities/Potential effects
Impacts from Construction			
Vehicle mobilization, including transport of people and equipment within the works area;	Terrestrial habitats; Commuting mammals including bats; Wintering and breeding birds	Disturbance of fauna due to noise, direct mortality due to RTAs and degradation of habitats due to compaction dust and vegetation destruction or the ingress of non-native invasive species.	Currently the receptors are habituated to remote locations with little or no background noise or traffic therefore the additional vehicle traffic has the potential to have a significant effect. Less likely to have a significant effect on less mobile species such as reptiles, amphibians and notable invertebrates and unlikely to affect riparian areas but the mitigation developed for these core receptors is likely to fulfil mitigation requirements for all receptors.
Compounds, field working camps construction and operation, including the effects of the production of wastes and indirect pressure of workers' presence.	Terrestrial and riparian habitats (includes Natura 2000 sites); Breeding birds; Wintering birds; Small and large mammals; Reptiles; Amphibians; Fish; Invertebrates	Disturbance of fauna, particularly while breeding, degradation of habitats, direct and indirect pollution of habitats, potential for direct mortality through illegal hunting and fishing. Potential for impacts from consuming food and waste brought into the area for the project and other impacts from interactions between humans and wildlife.	Currently the receptors are habituated to remote locations with little or no human interaction additional numbers of people and their associated waste has the potential to have a significant effect.
Pipeline working corridor vegetation clearance including compound clearance[22].	Terrestrial and riparian habitats (includes Natura 2000 sites); Breeding birds; Wintering birds; Roosting bats; Mammals (small and large) (breeding and sheltering); Reptiles (breeding and hibernating); Invertebrates; Plants.	Loss of vegetation, fragmentation, degradation of habitats and conversion, disturbance, direct mortality	The clearance of vegetation will remove habitat but more significantly increase fragmentation of existing corridors, this would lead to disturbance of faunal species; and could cause direct mortality.
Pipeline construction activities including top soil removal, pipeline soldering and water crossing construction	Terrestrial and riparian habitats (includes Natura 2000 sites); Breeding birds; Wintering birds; mammals; Reptiles; Amphibians; Fish; Aquatic invertebrates; Other aquatic receptors such as broad clawed crayfish; Plants.	Noise disturbance in the mid-term which may lead to habitat fragmentation. Indirect and direct pollution due to sedimentation of water courses and construction consumables and waste.	While many faunal receptors have the potential to be disturbed by ongoing construction activities it is likely that many will become habituated and/or use other areas. The aquatic species are less likely to be affected by general terrestrial construction disturbance but may be affected by pollution and sedimentation during river crossings. It may be necessary that the impacts of terrestrial and aquatic construction are assessed independently.
Water	Riparian habitats;	Potential for degradation to	The abstraction of water for

22 The compressor stations are proposed to be located within agricultural fields with minimal ecological value. Potential impacts from these compressor stations were screened out and are not assessed within this document as significant impacts resulting from the compressor station installation were considered unlikely.

Source of Impact	Receptors (core)	Impact	Key receptor sensitivities/Potential effects
abstraction	Wintering wildfowl and breeding birds associated with riparian environments; Otters; Amphibians; Fish; Aquatic invertebrates; Other aquatic receptors such as broad clawed crayfish.	banks and direct mortality to fauna, disturbance while breeding.	construction purposes such as damping down and cleaning machinery could result in species being abstracted along with the water and during that abstraction habitat may be damaged and breeding birds and wintering wildfowl disturbed.
Unlikely Events, such as landslides, fires, collapse of trenches.	All	There is potential for effects on all receptors due to unforeseen events	Although somewhat degraded through agricultural practices and logging the area is otherwise relatively stable and undisturbed
Other projects	All	There is a potential for other projects to have an effect when assessed in combination with the BRUA Project	Increased disturbance or the need for wider infrastructure improvements to facilitate accesses etc.
Operational[23]			
Operational Issues: Rights of Ways Maintenance requiring the clearance of vegetation for access to the pipeline	Habitats including those within Natura 2000 sites. Commuting mammals including bats; Wintering and breeding birds; Reptiles.	Degradation to existing habitats Introduction of non-native invasive species. Also, disturbance and direct mortality. Permanent fragmentation effects	The maintenance itself could cause degradation of existing habitats outwith the working corridor for access but also degradation of habitats within the working corridor. ROW maintenance has the potential to prevent the establishment of restored habitats and/or in introduce non-native invasive species. Also, disturbance of breeding animals and potential for direct mortality if they have occupied the area in the interim. The increased fragmentation could make some animals more vulnerable to predation when attempting to cross the gaps or could “sterilise” some areas by preventing commuting.

23 The compressor stations are proposed to be located within agricultural fields with minimal ecological value. These areas are not assessed within this document as significant impacts resulting from the compressor station installation were considered unlikely.

12.4 Baseline Assessment Methodology

12.4.1 Baseline Data Collection

The baseline conditions described here were generated through a combination of desk studies and data provided as part of the specific ecological studies undertaken for the regulatory EIA (USI 2016). A summary of the key approaches used is provided in the table below. Further details of field studies are presented in Chapter 5 of the Regulatory EIA.

Table 12.12.2. Data Collection Approaches.

Data	Collection Approach
Designated sites	Designated Site information relating to Natura 2000 boundaries (European Designated Sites) and extents were obtained from international sources and plotted on the project GIS. High resolution aerial photography was also obtained from a combination of publicly available sources and by taking photographs in digital format high resolution (min. 10MPx) by surveyors in the field or by "aerofotogram" made with the help of a drone (4qrs prototype, DJI DJI Phantom Phantom II and III Advanced).
Desk studies - habitats	Habitats were originally assessed remotely, using aerial imagery and CORINE open source land use data[24] and mapped, classified into 1 of 8 different Biomes, covering the trajectory 529km length of the pipeline and 150m either side of the pipeline corridor (to produce a 300m wide study corridor) which is subsequently termed the Study Area. Faunal data was analysed from USI's own extensive database (more than 100,000 records) using the BIMS (Biodiversity Information Management System), developed by the Ministry of Environment starting 1999.
Field Surveys - habitats	The desk based assessment was followed by limited ground truthing to confirm the classification and extents of habitats. These confirmations were recorded in the field using analysis of permanent sample areas (the sample area size varying per habitat type) in terms of species presence and abundance. The type, location and extents of habitats were assessed using aerial photography and ground truthing via point source data. A baseline was then composed based upon the habitat classification maps which are a combination of desk study data and site survey. The following habitats were classified and mapped, Biomes B1 to B8 as laid out by USI in the BRUA EIA are: • B1: Agro-ecosystems; • B2: Anthropic habitats (manmade) including buildings and roads; • B3: Grasslands; • B4: Eroded terrains (bare earth); • B5: Riparian habitats; • B6: Bushes (both native and introduced); • B7: Forests (semi-natural and plantation, nationally owned and naturally regenerated forests); • B8: Others (transitional communities and areas too small to map).
Field Survey - Fauna	Dedicated faunal data was collected by a variety of methods, three teams were active in the field (from August 2015 to March 2016) gathering data and using technology (drones, wildlife survey cameras, Pettersson DX-1000 expansion/heterodyne bat-detector, Shermann live-traps, UV Goodden GemLight night-traps, Berber

24 http://www.eea.europa.eu/publications/COR0-landcover

Data	Collection Approach
	trapping etc.). The following faunal receptor groups were considered: • Breeding birds; • Wintering birds; • Mammals; • Reptiles; • Amphibians; • Fish, bivalves and crustacea; and • Terrestrial invertebrates.

Sources of information referenced include but are not limited to the following:

- The BRUA EIA (USI 2016) and Appropriate Assessment (USI 2016);
- Data on protected and important areas, and red data book species from IBAT (https://www.ibatforbusiness.org/);
- CCIBIS http://www.ccibis.org/ ;
- IUCN (https://www.iucn.org/);
- Natura 2000 designation information (http://ec.europa.eu/environment/nature/natura2000/data/index_en.htm).

12.4.2 **Limitations to Baseline Assessment**

Primarily limitations to assessment result from the indicative nature of existing baseline data. The predominant limitations are that:

- Habitat data provided for the assessment (from the EIA) was obtained from a CORINE 2000 (2006) publicly available datasets, which although have elements of confirmation from ground and drone surveys, do not align in many occurrences with aerial imagery, indicating a resolution issue.
- Habitats within the Natura 2000 designations, which are presented, have largely not been accurately mapped according to sub-communities within these designations, therefore broad scale habitat assumption were made.
- Within the EIA, the CORINE 2000 dataset habitat information had been reduced to a simplified eight 'Biomes'. This removed resolution from the dataset. For example, it was not possible to determine the type of the forests present within the 300m study corridor (coniferous plantation, mixed semi-natural forest, broadleaved forest etc.). Therefore, to determine the habitat value of each parcel of forest present was not possible and precautionary assessment principles were applied.
- No information on consultations with external experts and stakeholders is captured or recorded.
- Field survey information is not documented in a way that allows a clear understanding of the approach and does not facilitate replication.
- Species data available and provided within the EIA were limited, and were compiled from a number of sources which were not differentiated within that dataset, including:
  - species inferred to be present from known habitat associations;
  - dedicated surveys conducted to inform the EIA;
  - existing dataset information held on a USI database.

It was therefore not possible to determine the veracity of many of the species distribution assessments utilised within the EIA and used to inform this impact assessment. Therefore precautionary assessment principles were applied.

Despite these limitations, the evaluation and impact assessment within this document is considered robust, as precautionary principles have been applied and where possible, further data sources were consulted to verify the data provided within the EIA.

As a component of the pre-construction preparation and in order to inform the required mitigation for the foreseen impacts resulting from the BRUA construction, it is recommended that gaps in the data provided are addressed. A full preworks survey by a suitably qualified ecologist (Biodiversity Specialist) will be required prior to works commencing (details of this survey are contained subsequently within this document). These requirements are fully detailed within the mitigation sections. Any walkover / update field survey conducted will need to be auditable, repeatable and in line with good practice guidance and conducted at the appropriate time of year. Reports will need to be made at appropriate intervals. These requirements will be enclosed and secured within the Management Plans and the ESAPs.

12.4.3 **Habitat and Species Baseline Identification and Valuation Methods**

To determine the potential value of habitats present, all habitats present within the AoI were first identified and plotted in GIS[25.] Those likely to be adversely affected by the BRUA route identified and valuation was then undertaken based on the following:

- The uniqueness and vulnerability of the habitat;
- The importance of the habitat to endangered or critically endangered species;
- The importance of the habitat to endemic or geographically restricted species, or species qualifying as restricted-range under Birdlife or IUCN criteria.
- Input on this valuation was taken from USI (2016).

At the same time a 'long list' of species which had the potential to be present within the AoI and which could be impacted by the works was identified. This list was only taken from the following locations:

- USI EIA and AA (2016)
- IBAT;
- Natura 2000 dataforms

Independent verification of this data was not conducted.

This list of species was then prioritised to those which had the potential to be impacted by the BRUA works by identifying the potential presence of species within the BRUA corridor based on the presence of supporting habitats and detailed assessment of species distribution from data sources, taken from online resources and from the EIA (USI 2016). Further information on the identification of species is presented in the EIA (USI 2016), and the assessment of the presence of species within the zone of influence of the project was largely taken from this document.

This shortlists of species and habitats which could be impacted by the works was then allocated a value from 1 – 5 based on the categories shown Table 12.12.3 below. This valuation was based on the conservation status of the species using the following information:

- The species legal status (in EU law);
- The species conservation status internationally and within Romania (valued with input from the EIA (USI 2016));
- The value of the species to human stakeholders;
- The potential for species to act as umbrella species and drive appropriate mitigation for a range of species; and
- The species global conservation status according to the IUCN red list categorisations.

This assessment was 'qualitative' and in line with PR6 this assessment utilised local experts (USI) within this process.

25 http://natura2000.eea.europa.eu/Natura2000

This also served as a pre-screening process for those habitats and species which were likely to have the potential to be Priority Biodiversity Features and/or Critical Habitat.

The diagram below summarises the identification and assessment process utilised to identify key receptors and PBF within this SEIA. In order to limit the number of PBF to a manageable number, only a selection of valuable species were specifically identified as PBF. PBF that drove the identification of Critical Habitat (CH) and drove suitable mitigation for species which utilised similar habitats were selected.

Figure 12.1: Flow diagram explaining the species identification, valuation and screening process.

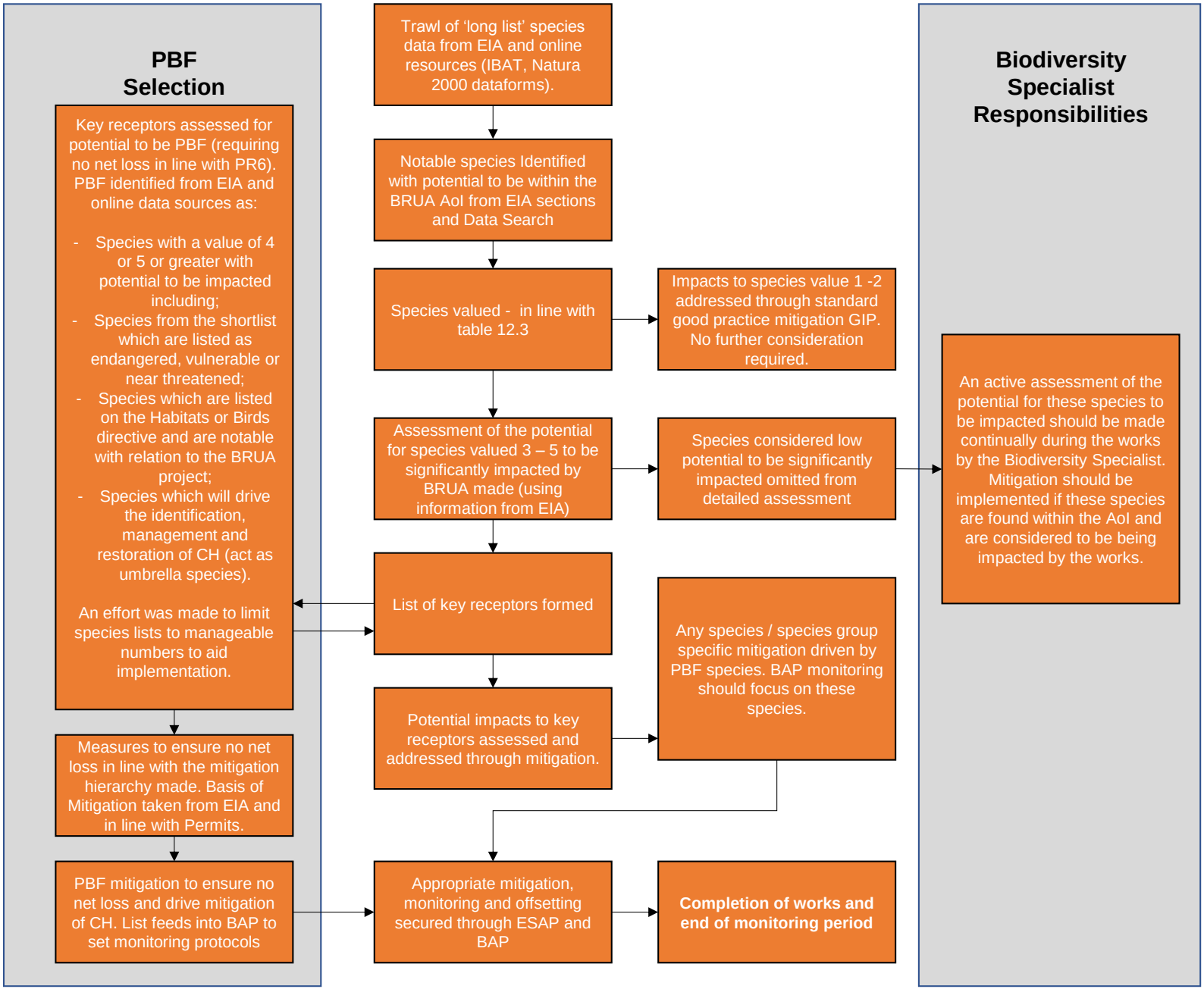


Table 12.12.3: Valuation Criteria Overview

Value	Habitat Valuation	Species Valuation
Very high / International/ 5	Habitat supports globally threatened species of plant and animals or supports Annex 1 habitats on the Habitats Directive AND is within or in proximity to an area designated for those habitats, habitats that would classify as Critical Habitat.	Ramsar, Natura 2000 or IBA qualifying species, IUCN red list – vulnerable/endangered/critically endangered globally threatened species, plant or animals or animals on Annex 2 or 4 of the Habitats Directive (which are notable in the region) and is within or in proximity to an area designated for those qualifying features. Or if Romania supports a significant functioning population that contributes to the species Global conservation status.
High / National/ 4	Habitat supports nationally threatened species of plant and animals or is habitat required to maintain the ecological structure and functions needed to maintain the viability of priority biodiversity features, habitats that would classify as Priority Biodiversity Features.	Nationally threatened species of plant and animals or functioning populations of animals on Annex 2 or 4 of the Habitats Directive which are considered notable in the region. Or if the Study Area supports a significant functioning population that contributes to the special National conservation status.
Moderate /Regional/3	Habitat supports locally rare and/or species rich communities that are of concern at the Regional level.	Locally rare species, species that are of conservation concern in the Regional area. Species which are functioning populations of animals on Annex 2 or 4 of the Habitats Directive.
Low/ Local/2	Habitat supports a low diversity of common species of plants and animals	Relatively common species of plants and animals that are not rare or threatened
Negligible/Less than Local 1	Habitat is artificial and or supports and very low diversity of common species of plants and animals	Very common species of plants and animals

12.5 Overview of Environmental Studies conducted to date

12.5.1 BRUA EIA

The baseline conditions assessment used within this document was taken from the BRUA EIA (USI 2016).

For the EIA the whole BRUA AoI was split into sectors of 5 km. For each 5 km sector an evaluation standard-form was proposed (106 sheets attached in the A3 Annex to the EIA). Using this standard-form, the habitats and species that sector potentially supported were outlined, an evaluation of impact was performed and recommended mitigation was highlighted in these datasheets.

However, the assessment did not include a standardised approach to evaluation, impact assessment and mitigation rather a sector by sector approach that while adequate to discharge the national legislation and permitting, was not in line with EBRD requirements.

This shortfall in the mitigation and offsetting approach within this document is addressed within this document.

12.5.2 BRUA AA Summary

The transposition of EU guidance document ‘Assessment of plans and projects significantly affecting Natura 2000 sites -Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC’ is implemented in Romania through Ministry Order 19/2010. An Appropriate Assessment (AA) was conducted in order to assess impacts to Natura 2000 sites in the vicinity of

BRUA. The AA study undertaken is in line with Romanian national requirements and a permit for the works was confirmed and accepted by National Environmental Protection Agency (NEPA) and The Ministry of Environment, Water and Forests in December 2016.

An assessment for all Natura 2000 criterion species and habitats was made, covering the survey corridor of BRUA. For each species/habitat, an assessment sheet was made. A discussion on the occurrence of impact categories resulting from BRUA implementation (construction/operation phases) was made for each of these elements.

The AA procedure was performed in line with the requirements of the EU Habitats Directive and the EU Birds Directive) as interpreted in Romania. The AA process is aimed at testing the Project impacts against the potential for likely significant adverse effects on Natura 2000 sites, and where these may occur, effects on the integrity of Natura 2000 sites. The EIA performed for the Project only makes reference to the AA and repeats its main elements, the conclusions and the proposed mitigation measures.

For each Natura 2000 site the qualifying features were identified and the impact assessed for each qualifying feature using an impact significance scoring from 0 (no impact) to 5 (irreversible impact). Based on the assessment performed it was concluded that the Project may impact following qualifying features of the Natura 2000 sites crossed by the Project:

- 14 types of habitats included in Annex I of the Habitats Directive (but no habitats listed as European priority habitats). Significance of impact on these habitats varies between 2 (limited impact) and 4 (impact requiring implementation of remediation measures).
- 35 species included in Annex II of the Habitats Directive. Significance of Project impact on these species varies between 1(reduced impact, mainly due to indirect effects) and 4 (impact requiring implementation of remediation measures).

However, the EIA and the AA concluded that the Project would result in *no impacts* (in the case of the 4 Natura 2000 sites not crossed but in proximity of the Project) or *limited impacts* that would not result in a significant effect on the integrity of the 11 Natura 2000 sites crossed (or passed in close proximity) by the Project.

That conclusion was based on the following:

- The limited area affected by the Project (significantly below 1% of the total area of the Natura 2000 sites);
- Absence of the qualifying species' key supporting habitats from the areas affected by the Project;
- Absence of significant populations of Natura 2000 sites' qualifying species at the areas affected by the Project.

However, to align with the EBRD requirements for Natural and Critical Habitat Assessment, further assessment of the potential for the scheme to directly or indirectly affect any of the habitat that supports or maintains qualifying features of the Natura 2000 sites will be undertaken to determine whether there is a need for compensation and offsetting.

12.5.3 **Requirement for Supplementary Information**

To fulfil EBRD requirements for Natural and Critical Habitat Assessment, further assessment of the potential for the scheme to directly or indirectly affect any of the habitat that supports or maintains qualifying features of the Natura 2000 sites or other critical habitats and priority biodiversity features needs to be undertaken to determine whether there is a need for additional mitigation or compensation.

All of the habitats and species identified within the EIA will undergo systematic assessment to ensure that sufficient mitigation is included and that it is directed to the appropriate location at the appropriate Project phasing.

This assessment will be provided in one document, the Biodiversity Chapter in the Supplementary Lenders Information Pack which will summarise the Natural (termed by EBRD as Priority Biodiversity Features) and Critical (Natura 2000 qualifying features) Habitat Assessment (NCHA) which will be supplied as an Appendix 12.2.

Before undertaking this assessment a Scoping exercise has been undertaken to confirm the habitats, species and potential impacts to be carried forward to assessment, which will be followed by the proposed impact assessment methodology.

12.6 Baseline Conditions

12.6.1 Baseline Summary

12.6.1.1 Overview

Almost half of Romania is formed of natural or semi-natural ecosystems, including one of the largest remaining areas of undisturbed forest within Europe. Within these forests there is a range of forest fauna, for example Romania supports 50% of Europe's bears and 30% of its wolves. In addition to forests, Romania supports major and notable grasslands, caves and rivers. There are also a large number of protected sites within Romania, although the protection applied to these sites is variable and it has been reported that many could benefit from more proactive management [26].

Within the pipeline corridor the habitats are heavily modified although some areas of semi-natural habitat are present including forests, naturally regenerated areas of forests and scrub, riparian and scrub corridors as well as small areas of semi-natural grassland and exposed rocky outcrops. For much of the route, and almost all of the lowland areas, the 300m wide corridor (the AoI) runs primarily through agricultural lands, with almost 70% of the land within the corridor cropped. This habitat represents 72% of the land that will be temporarily impacted during construction. 27

After agricultural land, areas of forest areas of forest (13%) and grassland (11%) are the next most abundant habitat within the AoI with 9% and 12% of direct impacts occurring within these areas. Other remaining habitats only account for 7% of the land affected by the works and include areas of introduced scrub (including invasive species), water courses and small areas of human settlements.

The project also crosses 121 natural water courses, with 12 major rivers and 265 manmade channels. A description of habitats per biome type, their status and value within the Study Area is also presented in this section. The habitat along the BRUA route is presented in Appendix 12.2 and in Figure 12.3.

This report outlines the key designated sites, habitats and species (in this order) which have the potential to be impacted by BRUA. The following table summarises the key sensitive receptors identified within the BRUA AoI or within the zone of influence of BRUA.

Table 12.12.4: High level summary of baseline findings

Receptor	Presence within the Area of Influence
Designated sites	A total of 15 Natura 2000 sites, one Geopark and one National Park are potentially affected by the BRUA construction and operation. Of the 15 Natura 2000 sites identified, seven are crossed by BRUA, four are not crossed by BRUA but have the potential to be directly impacted by the BRUA routing and four are considered to have the potential to be impacted by the routing indirectly.
Biomes and Habitats	A total of 12 biomes (from 8 broad biomes) were identified within the BRUA route corridor and were assessed for their value, where possible. In addition to these biomes, habitats listed within the designations of the Natura 2000 sites were also assessed. In all, some 14 broad habitats were identified from the EIA and AA with the potential to be impacted by the proposed works. Of these, specific mitigation was deemed necessary for six different habitats / habitat groupings, with impacts to all other habitats considered fully mitigated through standard Good Industry Practice mitigation

26 http://www.fauna-flora.org/explore/romania/ [accessed January 2017]

27 Figures from USI (2016)

Receptor	Presence within the Area of Influence
Species	Approximately 400 species were identified as notable potential receptors which could be impacted by the proposed works. Of these, six species were considered to be of very high or international value, 22 were considered to be of high or national value and 136 were considered to be of moderate or regional value. Of these species, specific mitigation was deemed necessary for approximately 30 species or species groups - impacts to others are considered to be fully mitigated through standard Good Industry Practice mitigation.

12.6.1.2 Designated Sites

The original EIA (USI 2016) identified 11 Natura 2000 sites as directly affected by the project and this study has identified a further 4 Natura 2000 sites which may be indirectly affected (these are located within 5km of the works). The pipeline route also runs for around 52km within the “Dinosaurs Geopark”, a nationally protected area for geology and adjacent to a National Park, ‘Defileul Jiului’. Designated sites potentially affected by the project are shown in Table 12.12.5 below.

Table 12.12.5: Natura 2000 sites with the potential to be impacted by BRUA, in order of largest impact area

Site Number	Site Name	Sector	Chainage (km)*	Site Description / Habitats (taken from Natura 2000 designation information)	Impact from BRUA	Distance affected (m)	Distance from BRUA (m)	Direction from BRUA
ROSCI0129	Nordul Gorjului de Vest	Hurezani - Hateg	270-284	*Supports extensive ecological and biological diversity represented by beech forest, with large areas of alpine meadows, cliffs, caves, steep slopes, alpine scrub and gorges. Also, designated for numerous species including large carnivores: bear (Ursus arctos), wolf (Canis lupus) and lynx (Lynx lynx), bats, amphibians, invertebrates and alpine plants. It also supports 873 ha of natural, sweet chestnut (Castanea sativa) forest - one of only two such areas in Romania.*	Crossed By BRUA	13,720	0	On line
ROSCI0236	Strei - Haţeg	Hurezani - Hateg	314-318	*The site supports notable habitats including steppe grasslands, caves and beech (Fagus sylvatica), oak (Quercus sp.) and hornbeam (Carpinus sp.) forests. The site is also important for the golden eagle (Aquila chrysaetos), collared flycatcher (Ficedula albicolis), red-breasted flycatcher (Ficedula parva), and the European honey buzzard (Pernis apivorus) as well as bear (Ursus arctos), otter (Lutra lutra), wolf (Canis lupus), bats, amphibians, invertebrates and plants.*	Crossed By BRUA	3,610	0	On-line
ROSCI0292	Coridorul Rusca Montană - Ţarcu - Retezat	Hateg - Recas	360-363	*The site includes forests, main forest types are beech (Fagus sylvatica), oak (Quercus sp.) and hornbeam (Carpinus betula) forests and spruce (Picea sp.) forests, but also present are juniper (Juniperus sp.) shrubs and rhododendron (Rhododendron sp.). It is also important for large carnivores, namely wolf (Canis lupus), bear (Ursus arctos) and lynx (Lynx lynx). Otter (Lutra lutra) and the fire-bellied toad (Bombina bombina) are also present.*	Crossed By BRUA	2,920	0	On-line
ROSCI0138	Pădurea Bolintin	Posidor - Corbu	2-4	*It is designated for groves with white willow (Salix alba) and white poplar (Populus alba); and oak (Quercus sp.) species and hornbeam (Carpinus sp.). European pond turtle (Emys orbicularis), otter (Lutra lutra) and fire bellied toad (Bombina bombina) are also present within this site.*	Crossed by BRUA	1,990	0	On line
ROSPA0106	Valea Oltului Inferior	Corbu - Hurezani	119	*The river of Olt and its surroundings are an important area for resident and migratory birds. During the migration season,*	Crossed By BRUA	1,290	0	On line

Site Number	Site Name	Sector	Chainage (km)*	Site Description / Habitats (taken from Natura 2000 designation information)	Impact from BRUA	Distance affected (m)	Distance from BRUA (m)	Direction from BRUA
				around 20,000 water birds inhabit the region. Abundant species are: white stork (Ciconia ciconia), great cormorant (Phalacrocorax carbo), Little bittern (Ixobrychus minutus), Stone curlew (Burhinus oedicnemus), European roller (Coracias garrulous), Smew (Mergus albellus), Whooper (Cygnus cygnus) Mute swan (Cygnus olor), Caspian gull (Larus ribidundus), Seagull (Larus michaelis), Black-headed gull (Larus ribidundus).				
ROSCI0385	Râul Timis între Rusca şi Prisaca	Hateg - Recas	406	*Riparian habitat designated for otter (Lutra lutra), bats, amphibians and reptiles including the Hermann's tortoise (Testudo hermanni) and fish.*	Crossed by BRUA	740	0	On-line
ROSCI0063	Defileul Jiului	Hurezani - Hateg	282-284	*Mostly virgin stands of beech (Fagus sylvatica) and oak (Quercus petraea) forests with areas of hornbeam (Carpinus betula) and lime within the gorge associated with cliffs and caves. There are also areas of smaller tree and shrub species such as wild cherry (Prunus sp.), rowan (Sorbus sp.), elder (Sambucus nigra), juniper (Juniperus sp.) and dogwood (Cornus sp.) species. Also, designated for bats, amphibians, invertebrates and the Carpathian tozzia plant (Tozzia carpathica).*	Crossed By BRUA	740	0	On-line
ROSCI0296	Dealurile Drăgăşaniului	Corbu - Hurezani	146	*This site contains beech (Fagus sylvatica), oak (Quercus sp.) and hornbeam forests (Carpinus betula) typical of the slopes of the eastern and southern Carpathians.* *Also supports great capricorn beetle (Cerambyx cerdo) and long horned beetle (Rosalia alpina).*	BRUA located adjacent to site	0	15	SE
ROSCI0087	Grădiştea Muncelului - Ciclovin	Hurezani - Hateg	312	*Site important for numerous habitats such as beech forests, juniper scrub on heaths or calcareous grasslands, alpine and subalpine calcareous grasslands, semi-natural dry grasslands and purple moorgrass (Molinia caerulea), wetland grasslands and lowland hay meadows and caves. There are important orchid species. It is also important for numerous species such as bear (Ursus arctos), wolf (Canis lupus), lynx (Lynx lynx), bats, invertebrates and plants.*	BRUA located adjacent to site	0	75	NE

Site Number	Site Name	Sector	Chainage (km)*	Site Description / Habitats (taken from Natura 2000 designation information)	Impact from BRUA	Distance affected (m)	Distance from BRUA (m)	Direction from BRUA
ROSPA0045	Grădiştea Muncelului - Ciclovin	Hurezani - Hateg	312	*Mostly beech forest, with meadow areas designated for its bird assemblage such as hazel grouse (Bonasa bonasia) Ural owl (Strix uralensis), woodpecker - white-backed (Dendrocopos leucotos), black woodpecker (Dryocopus martius), grey-headed woodpecker (Picus canus) collared flycatcher (Ficedula albicollis), and small flycatcher (Ficedula parva)*	BRUA located adjacent to site	0	75	NE
ROSCI0126	Munţii Ţarcu	Hateg - Recas	380	*This site is dominated by forest, with areas of grassland, rocks and lakes. Fauna present within the site include lynx (Lynx lynx) and wolf (Canis lupus).*	Indirect impacts	0	391	S
ROSCI0109	Lunca Timişului	Hateg - Recas	450	*Lowland meadow associated with the Timis River. The site includes some willow (Salix sp.) and poplar (Populus sp.) wetland forests. It's also designated for fire-bellied toad (Bombina bombina), 10 species of fish and a species of invertebrate.*	BRUA located adjacent to site	0	675	S
ROSCI0219	Rusca Montană	Hateg - Recas	382	*This site is designated for the forests it contains. Fauna for which the site is designated includes wolf (Canis lupus), bear (Ursus arctos) and lynx (Lynx lynx).*	Indirect impacts	0	2860	NW
ROSCI0045	Coridorul Jiulu	Hurezani - Hateg	217	*This site is designated for its lakes, meadows and forests. The flora and fauna it is designated for include a range of invertebrates (including Pholidoptera transsylvanica), mammals (including otter), plants, reptiles, amphibians including fire-bellied toad (Bombina bombina) and fish.*	Indirect impacts	0	3650	W
ROSCI0052	Dăncioanea	Hateg - Recas	365	*Fauna present within this site include brown bear (Ursus arctos), wolf (Canis lupus), wild cat (Felis silvestris), capercaillie (Tetrao urogallus), black woodpecker (Dryocopus martius) and white-backed woodpecker (Dendrocopos leucotos) the vegetation is represented by pure spruce forests.*	Indirect impacts	0	4750	S

** All km distances quoted are taken from the EIA should be considered approximate*

12.6.2 **Habitats within the AoI**

Within the AoI a total of 12 biomes (from 8 broad biomes) were identified within the BRUA route corridor. In addition to these biomes, habitats listed within the designations of the Natura 2000 sites were also identified. Habitats listed within Annex 1 of the EU Habitats Directive are present within the AoI. None of the Annex 1 habitats with the potential to be impacted by BRUA works are listed as European priority habitats.

Details of the habitats along the BRUA route are presented in Appendix 12.2 and Figure 12.3.

Given the makeup of the habitats within the Study Area, many of the species found along the route are widespread and common and much of the cropped agricultural land and the urban areas are of local value only. Approximately 70% of the area within the AoI is agricultural land. A number of protected habitats are however present within the study area, the most valuable habitats of which lie within the Natura 2000 sites, as well as other areas of semi-natural and virgin forests, alpine calcareous grasslands and selected riparian areas and wetlands.

Table 12.12.6: Representation of habitats within the BRUA AoI

Habitat classification	Habitat description	Area (ha) within AoI (150m either side of pipeline)	% of land within Study Area	Permanent land take (ha)	Temporary land impact (ha)	Temporary land impact (%)
B1: Agro-ecosystems	Cropped land	10869.21	68.88	0	763.34	72.1
B2.1 Roads	Roads	371.21	2.3	0	24.7	2.3
B2.2 Buildings	Buildings and hardstanding, curtilages	218.47	1.3	0	11.2	1.1
B3: Grasslands	Hay meadows, natural grassland, pastures	1722.27	10.9	0	122.68	11.6
B4: Eroded terrains	Bare earth	40.65	0.2	0	3.14	0.3
B5: Riparian	Wetland, rivers and banks	299.1	1.9	0	22.4	2.1
B6 Bushes	Semi-natural and introduced and sub alpine shrubs,	209.93	1.3	0	13.86	1.3
B7 Forests	Semi-natural and plantation forests	2047.64	12.9	17.64ha	97.95	9.2
B8 Others (Transitional Communities)	agricultural land currently uncropped, set aside, scree, other habitats too small to map	Too small to map				
Totals		**15778**	**100**	**17.64**	**1059**	**100**

The habitats within the AoI were valued according to the methods in Table 12.12.3, once valued the habitats were submitted to a Critical Habitat (CH) and Priority Biodiversity Feature (PBF) assessment to determine if any of the habitats qualified. High level valuations of habitats are shown in the following table and fuller details of this process and the results can

be seen in Appendix 12.2. Habitats are assessed in further detail in the Critical Habitats assessment provided in Appendix 12.2.

Table 12.12.7: valuation of broad habitat types along the BRUA route

Habitat	Description	Valuation (1 - 5)	Explanation
Agro-ecosystems (B1)	Areas that are under agricultural management. These habitats have a simple species composition and a simple energy and nutrient flow, (characterized by a low biodiversity index). Usually widespread species are associated with these agroecosystems. Scattered within these homogeneous habitats, in some areas there are still small parcels of semi-natural and natural habitats, functioning as important biodiversity reservoirs. The margins of agroecosystems are also very important, because of their role as ecological corridors. In some years, patches of non-farmed areas (set aside) are serving as important refuges for important number of species. The margins of these areas may support foraging and sheltering habitat for small mammals, reptiles, amphibians, nesting birds and occasional foraging for larger mammals.	2	Mostly common and widespread species are supported by this habitat type.
Anthropic (B2) (Urban)	Areas that are completely artificial, comprising urban and rural areas including private gardens, industrial sites, roads, railway deposits, etc. Among these structures there are some semi-natural habitats such as parks, orchards, private gardens, green corridors, etc., with biodiversity value, although the majority of these anthropic semi-natural areas are not within the zone of influence of the scheme. Within the category two subcategories were considered: buildings (built areas) and roads.	1	Supports a limited assemblage of common species.
B2.1 Roads	Roads	1	Areas largely absent of flora, Unlikely to support any notable species
B2.2 Buildings	Buildings and hardstanding, curtilages	1	Unlikely to support any notable species
Grasslands (B3)	Areas covered by semi-natural and agricultural grassland features. In this category are included natural meadows, hay-meadows, pastures, etc. these may support notable plant species and a range of fauna such as invertebrates, small mammals, ground nesting birds Within the Natura 2000 sites there are also areas of notable grassland habitat, including mountain pasture (Natura 2000 habitat: '6520 Fânețe montane').	3-5	May support protected and notable plant flora and invertebrates, small mammals, reptiles and amphibians with foraging habitat for large mammals. Some of the grasslands within the Natura 2000 sites form notable habitats, these are of

Habitat	Description	Valuation (1 - 5)	Explanation
			increased biodiversity value. These habitats are assessed whether they are CH or PBF.
Eroded terrains (B4)	Bare earth habitats, either stripped of vegetation cover by erosion due to man-made pressure or naturally occurring poorly vegetated areas, these areas may include occasional areas of notable vegetation.	1	Largely this is absent of flora.
Riparian habitats (B5)	Habitats developed in and around water bodies and comprising the water surface of the rivers and lakes, their banks, sandy shores, islands formed within the water valleys, as well as the major vegetation formations (bushy areas, forests and luxuriant herbaceous vegetation) on their banks. The watercourse and banks have the potential to support fish, crustacean and invertebrates as well as otter (*Lutra lutra*), small mammals and some protected amphibians. There are riparian habitats associated with Natura 2000 site designations within the study area. Approximately 10 water courses to be directionally drilled for BRUA, these can be seen on Figure 12.5. In addition to these crossings, Figure 12.5 shows riparian which were identified from aerial imagery which may be ecologically notable or sensitive, and may require specific mitigation or avoidance measures.	2-5	The man-made channels may be of limited biodiversity value but there are numerous larger watercourses which are linked to designated sites and support protected species. Riparian areas with a complex bankside assemblage are of increased value.
Bushes/Scrub/Shrubs/Heath (B6)	Semi-natural and introduced and sub alpine shrubs, Habitats formed by bushes (in plains, hills and lower mountains) both native and introduced as well as the *Juniperus* sp., and *Pinus mugo* assemblies (in higher mountains). Within the study area there are notable scrub habitats associated with Natura 2000 sites, including Alpine and Boreal heathland (Natura 2000 habitat: '4060 Tufărişuri alpine și boreale').	2-5	These habitats can support notable birds. The areas of semi-natural sub alpine vegetation are notable at the national level.
Forests/Forests (B7)	Semi-natural and plantation Forests areas, covered by deciduous, mixed or coniferous forests, as well as structures associated with forests, such as crops installed for game species, forestry roads, etc. These include the following four subcategories:	3-5	There are areas of semi-natural forest designated for their floral assemblage and they support a wide range of protected and notable species
B7.1 Forests within Natura 2000 Sites	Forests within Natura 2000 Sites (some state owned by National Forestry Fund – NFF)	5	These may or may not be National Forestry Fund forests but are within the Natura 2000 site designations
B7.2 Semi-natural forests	Semi-natural NFF forests outside of Natura 2000 sites	5	These forests are of intrinsic

Habitat	Description	Valuation (1 - 5)	Explanation
(National Forestry Fund)			biodiversity value and support notable fauna
B7.3 Plantation forests (NNF)	Plantation NFF forest outside of Natura 2000 sites	3	These areas are generally of lower biodiversity value but can support notable flora and fauna
B7.4 Natural forest regeneration	Semi-natural forests which have arisen from natural regeneration not state owned	5	These areas can support notable flora and fauna
Other (B8) (Transitional Communities), microhabitats and ponds, ephemeral water bodies.	All other types not mentioned above. These include non-native invasive species such as Japanese knotweed (*Fallopia japonica*) false acacia (*Robinia pseudoacacia*) bracken (*Pteridium aquilinum*) and Jerusalem artichoke (*Helianthus tuberosus*). This includes microhabitats such as log piles, rock piles etc. and habitats not mapped at the resolution of the mapping to date, such as ponds and ephemeral water bodies. Includes agricultural land currently uncropped	2 -5	Some of these habitats are particularly important as transitional habitats. Some ponds are important refuges for notable plants, invertebrate and amphibians

12.6.3 **Protected and Notable Species:**

12.6.3.1 Overview of key Receptors

Of the approximately 400 floral and faunal notable species identified as having the potential to be present within the AoI, 226 are considered to be common and widespread, 135 are of regional value, 23 of national value and 6 are considered to be internationally important. Those species of local or lower value are considered generally common and not under threat, these are not discussed further within this Chapter. Generic Good International Practice (GIP) mitigation is proposed to avoid or minimise impacts to these receptors (Table 12.12.24). Priority Biodiversity Features and species of regional, national or international value are summarised below and bespoke mitigation requirements are subsequently detailed (Table 12.12.25). Table 12.12.8 summarises the total number of broad groups of species likely to be present within the Study with a regional or higher 'value' (of 3+).

Table 12.12.8: Summary of valuable receptors within each broad receptor groups and their values

Broad Group	Regional/3	National/4	International/5	Total Valuable receptors
Plants	6	4	0	10
Terrestrial Invertebrates	20	4	1	25
Crustaceans and bivalves	2	0	0	2
Fish	15	2	0	17
Amphibians	10	2	0	12
Reptiles	10	1	1	12
Birds	51	4	0	55
Bats	12	4	0	16
Small mammals (excluding bats)	6	2	0	8
Large mammals	3	0	4	7
Totals	**135**	**23**	**6**	**164**

The sections below give further details of notable specie identified as PBF, including information on ecology and distribution where appropriate. Details of notable species with the potential to be impacted by BRUA were identified from the EIA (USI 2016). Full details of the species which were assessed are presented in the Appendix 12.1.

12.6.4 **Species**

The species assessment results can be seen in full within the species value assessment tables shown in appendix to this SEIA. In summary, a number of species were identified as PBF due to their 'value' in the assessment tables and/or their IUCN red list categorisation, in line with PR6.

Species with a value of 4 or greater and / or identified as endangered / vulnerable were identified as PBF, however this list was only used to determine habitat valuations and offsetting requirements. Not all species listed under Annex 2 and 4 of the EU Habitats Directive were identified are PBF due to their status in Romania. The presence of PBF in areas was also used to inform the CH assessment. The PBF list was also used to determine species which require specific mitigation.

Selection of PBF was qualitative in nature, whereby selection of PBF was made based on the valuations above but also upon which species would drive suitable mitigation. The number of species identified was limited in number to aid implementation. Where a number of species would be protected by the same mitigation, a limited number of species were listed.

As a result, a range of PBF species were identified and comment on their selection is listed in the Table 12.12.9 (in alphabetical order of latin name).

Table 12.12.9: Species identified as PBF / requiring specific mitigation.

Common Name	Latin Name	IUCN Conservation Status	Value	Comment on selection
Lesser white-fronted goose	*Anser erythropus*	VU	4	Considered to drive Biodiversity Specialist actions and mitigation around water courses.
Broad-Clawed Crayfish	*Astacus astacus*	VU	3	Selected to drive Biodiversity Specialist and mitigation actions around water courses.
Barbastelle	*Barbastella barbastellus*	NT	4	Will drive habitat restoration in forests, provision of roosts and drive Biodiversity Specialist actions (tree roost checks).
Fire-Bellied Toad	*Bombina bombina*	LC	4	Considered to drive Biodiversity Specialist actions and PBF mitigation around ponds and water courses.
Yellow-Bellied Toad	*Bombina variegata*	LC	4	Considered to drive Biodiversity Specialist actions and PBF mitigation around ponds and water courses.
Blue Bell	*Campanula serrata*	LC	4	Will drive habitat restoration.
Wolf	*Canis lupus*	LC	5	Considered to drive Biodiversity Specialist actions in forests and Natura 2000 sites. Drives good site practice, mitigation and restoration.
Great Capricorn Beetle	*Cerambyx cerdo*	VU	3	Considered to drive good practice restoration such as provision of habitat piles etc.
Danube Clouded Yellow	*Colias myrmidone*	EN	5	Will drive habitat restoration.
European Pond Turtle	*Emys orbicularis*	NT	4	Will drive good site practice to prevent killing and injury and drive Biodiversity Specialist actions (moving individuals away from harm etc.).
Carpathian Brook Lamprey	*Eudontomyzon danfordi*	LC	4	Considered to drive Biodiversity Specialist actions and mitigation around water courses. Will act as an umbrella species for many fish species.
Danubian Brook Lamprey	*Eudontomyzon vladykovi*	LC	4	Considered to drive Biodiversity Specialist actions and mitigation around water courses.
Scarce Fritillary	*Euphydryas maturna*	DD	4	Will drive habitat restoration.

Common Name	Latin Name	IUCN Conservation Status	Value	Comment on selection
Red-Footed Falcon	*Falco vespertinus*	NT	4	Will drive good practice and Biodiversity Specialist actions around the presence of nesting birds in and around forests. Will act as an umbrella species for other raptors and species such as the black stork.
Fisher's Estuarine Moth	*Gortyna borelii lunata*	DD	4	Will drive habitat restoration.
Eurasian Oystercatcher	*Hematopus ostralegus*	NT	4	Considered to drive Biodiversity Specialist actions and mitigation around water courses, including checking for ground nesting birds.
Steppe Iris	*Iris aphylla ssp. hungarica*	Insufficient data	4	Will drive habitat restoration.
Otter	*Lutra lutra*	NT	5	Considered to drive Biodiversity Specialist actions and mitigation around water courses, including checking for holts. Will help inform the presence of CH riparian areas.
Eurasian Lynx	*Lynx lynx*	LC	5	Considered to drive Biodiversity Specialist actions in forests and Natura 2000 sites. Drives good site practice, mitigation and restoration.
Scarce Large Blue	*Maculinea teleius*	NT	4	Will drive habitat restoration.
Long fingered Bat	*Myotis capaccinii*	VU	3	Will drive habitat restoration in forests.
Hermit Beetle	*Osmoderma eremita*	NT	4	Will drive habitat restoration.
Greater Pasque Flower	*Pulsatilla grandis*	LC	4	Will drive habitat restoration.
Mediterranean Horseshoe Bat	*Rhinolophus euryale*	NT	4	Will drive habitat restoration in forests.
Greater Horseshoe Bat	*Rhinolophus ferrumequinum*	LC	4	Will drive habitat restoration in forests.
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	LC	4	Will drive habitat restoration in forests.
Rosalia Longicorn	*Rosalia alpina*	VU	3	Considered to drive good practice restoration such as provision of habitat piles etc
Balkan mole rat	*Spalax graecus*	NT	4	Will drive good site practice and inform Biodiversity Specialist actions to prevent killing and injury.
European ground squirrel	*Spermophilus citellus*	VU	4	Will drive good site practice and inform Biodiversity Specialist actions to prevent killing and injury.

Common Name	Latin Name	IUCN Conservation Status	Value	Comment on selection
European Turtle Dove	*Streptopelia turtur*	VU	3	Will drive good practice and Biodiversity Specialist actions around the presence of nesting birds in and around forests.
Hermann's Tortoise	*Testudo hermanni*	NT	5	Will drive good site practice to prevent killing and injury and drive Biodiversity Specialist actions (moving individuals away from harm etc.).
Carpathian Tozzia	*Tozzia carpathica*	DD	4	Will drive habitat restoration.
Mussel	*Unio crassus*	VU	3	Considered to drive Biodiversity Specialist actions and mitigation around water courses.
Brown Bear	*Ursus arctos*	LC	5	Considered to drive Biodiversity Specialist actions in forests and Natura 2000 sites. Drives good site practice, mitigation and restoration.

In some instances, the mitigation for the PBF above will protect a range of other PBF species. Where this is the case the mitigation is not repeated to reduce repetition and to determine the need to achieve no net loss in line with PR6.

12.6.5 **Species details**

The sections below provide some ecological and conservation status details for notable species identified within the BRUA AoI, in taxonomic order.

12.6.5.1 PBF and Notable Plants

Four species of plant are evaluated as being nationally valuable. The main threats to these plant species are habitat change and intensification of agriculture.

Table 12.12.10: PBF / notable plant species potentially present within the BRUA survey corridor

Species Name	Description	Location along BRUA route (km)	European Legal Protection
Steppe iris Iris aphylla subsp. hungarica	A rhizomatous perennial, from the Carpathian Mountains and Pannonian Basin. Found in Romania, Hungary, Slovakia, Ukraine, Moldova, and Italy. It is rare plant, of which there is insufficient data on its abundance, distribution and threats.	Likely to be present km 271-286, but potential in all meadows and grasslands.	HD* 2
Greater pasque flower Pulsatilla grandis,	A perennial plant that grows on calcium-rich soil in dry grasslands, in rocky outcrops, and in pine and oak forests.	Likely to be present km 271-286, but may be present in all grasslands, rocky areas and oak and pine forests.	HD 2
Blue bell Campanula serrata	Endemic to the Carpathians and found in Poland, Slovakia, Ukraine and Romania.	Likely to be present km 271-286, but may be present in all forest, subalpine and alpine belts.	HD 2;4
Carpathian tozzia Tozzia carpathica's	The natural range lies in the Carpathians and Balkan Mountains, the species is found in flood plains and montane stream margins rarely also in dwarf pine and alder stands and moist forests on wet, nutrient-rich, neutral to alkaline soils, in the montane vegetation belt. This species is classed as Data Deficient, and data from Romania and Bulgaria is missing.	Likely to be present km 271-286, but may be present in all moist riparian, meadow and forest habitats.	HD 2

** Habitats Directive Annex 2 or 4*

12.6.5.2 PBF and Notable Invertebrates (Terrestrial)

Of the hundreds of species of invertebrates that are likely to inhabit the Study Area, 22 were assessed as having regional, national or international importance. One of these species is considered to be of international importance, four are of national importance and 17 are of regional importance. Of these 7 species were identified as PBF.

Table 12.12.11: PBF/ notable terrestrial invertebrates which may be present along the BRUA route

Species Name	Description	Location along BRUA route	European Legal Protection
Danube clouded yellow butterfly *Colias myrmidone*	Considered to be of international importance, *C. myrmidone* is one of the fastest disappearing butterflies in the EU. Out of eleven EU member states with former populations, it now survives only in Poland, Romania and Slovakia, where the dramatic population declines and range contractions still continue [28]. Its stronghold now being Romania where it survives on grasslands where light grazing encourages the growth of the larval food plant which are *Cytisus sp.* and it thrives in dry hillsides with open flowery grassland usually low but not short grassland. Climate change and the intensification of agriculture are its primary threats	Most likely to be present within km 1 – 272 and km 395 – 529 but may be present where *Cytisus* sp. occur along the route	HD 2;4
Scarce large	Of national importance, it is one of the large	Most likely to be	HD 2;4

28 European Species Action Plan for Colias myrmidone (2012)

Species Name	Description	Location along BRUA route	European Legal Protection
blue *Maculinea teleius*	blues, requires a marshland habitat, Single brooded, flying between June and August eggs are laid on the plant great burnet (*Sanguisorba officinalis*) and adults frequently visit the larval food plant for nectar. The larvae first feed on the plant then move onto ant nests and is a predator of the ant brood. *Myrmica rubra* and *Myrmica scabrinodis* which have been reported as frequent host ant species. Young larvae are tended by the ants and spend the latter stages in the ant nest where they pupate. A recent microhabitat preference study indicates that grazing is necessary for maintaining the present distribution and abundance of these butterflies. It is threatened in particular by habitat destruction through draining29.	present within km 272-285 and Km 313-318, but may occur in areas where great burnet (*Sanguisorba officinalis*) is present	
Scarce fritillary *Euphydryas maturna*	Of national importance it occurs in clearings, where young ash trees are growing in open, mixed forest. The eggs are laid in one batch on a leaf of Ash (*Fraxinus* excelsior) or Aspen (*Populus tremula*), preferably at a height of 4 to 10 m. The caterpillars build a nest of silk and leaves and feed together at first, while still quite small. They go into hibernation, remaining in the nest, which usually falls to the ground onto the forest floor. In spring, they leave the nest and separate, spreading out in search of food. They use a variety of larval foodplants at this stage, including honeysuckle (Lonicera spp.), plantains (*Plantago* spp.), or privets (*Ligustrum* spp.). They pupate in the litter layer. The nectar plants include a wide range of flouring plants for in grassland meadow including rough hawkbeard (*Crepis biennis*) and meadow buttercup (*Ranunculus acris*). They require open forest and are threatened by intensification of agriculture and forestry and a decline of coppice practices.[30]	May be present all along BRUA most likely to be present where grasslands occur in areas adjacent to forests containing ash trees.	HD 2;4
Fisher's estuarine moth *Gortyna borelii lunata*	Of national importance, it is a little known moth for which the Carpathian basin is a stronghold31. It is associated with saline steppe habitats its major food plant in this area are two members of the celery family, *Peucedanum longifolium* and P. *officinale*. The European site ROSCI0236 Strei-Hateg has been designated in part for this species. Threats to this species are currently not understood.	Most likely to be present in km 311 - 321	HD 2;4
Hermit beetle *Osmoderma eremita*	Of national importance it is a species that relies on veteran wood. The larvae of this species develop by consuming wood which has already been attacked by mycelium covering the walls of cavities (rot-holes) in old deciduous trees and also in yew-trees. Species uses many different food plants and has been recorded from a large number of tree species. In contrast with this, it	Potential to be present within dead wood all along the route but primarily Km 311- 316.	HD 2;4

29 http://www.eurobutterflies.com/sp/telejus.php

30 http://www.pyrgus.de/Euphydryas_maturna_en.html

31 Gyulai, P. (1987) Notes on the distribution of Gortyna borelii lunata Freyer in the Carpathian Basin Nota lepid. 10: 54–60.

Species Name	Description	Location along BRUA route	European Legal Protection
	has very special requirements as to the selection of the cavity species declining due loss of habitat. In Romania, there are large populations in the oak and beech forests from the foothills of the southern Carpathians. Threats to the species in Romania in particular are due to forest exploitation without replanting or natural regrowth.		
Great Capricorn Beetle Cerambyx cerdo	It is a forest tree species, usually found in old oak forests. The species is declining in Europe due to the disappearance and semi-natural habitats, namely dead or downed wood.	Most likely to be present from km 1 to 6 and from, from 117 to 286 and from 309 to 530.	HD 2;4
Rosalia Longicorn *Rosalia alpina*	This longicorn is a forest species which is predominantly found on tree trunks of Fagus sylvatica. Becchwood is of particular importance to this species.	Most likely to be present from km 270 to 285	HD 2;4

The other 17 regionally important species are Transylvanian, steppe and bush grasshopper (*Pholidoptera transsylvanica, Isophya costata* and *I. stysi*), stag beetle (*Cerambyx cerdo*), large copper butterfly (*Lycaena dispar*), marsh fritillary butterfly (*Euphydryas aurinia*), clouded Apollo (*Parnassius mnemosyne*), Fenton's wood white butterfly (*Leptidea morsei*), Jersey tiger moth (*Callimorpha quadripunctaria*), *Carabus hungaricus, Cucujus cinnaberinus; Dioszeghyana schmidtii Eriogaster catax; Leucorrhinia pectoralis; Ophiogomphus Cecilia and Pilemia tigrina.*

12.6.5.3 PBF / Notable Fish, Crustacea and Bivalves

Of the fish identified as receptors within the Study Area, only two are considered to be of national value and six of regional value. One crustacean and one bivalve are assessed as being of regional value. Of these species, two fish, one crustacean and one bivalve are considered PBF.

Table 12.12.12 –PBF/ notable fish, crustaceans and bivalves likely to be present along the BRUA route.

Species Name	Description	Location (approx.)	European Legal Protection
Carpathian Brook Lamprey Eudontomyzon danfordi	This species of national value is predatory, freshwater resident which dies after spawning. There is the potential for this species to be present in watercourses throughout the route, however this species is also listed on the designations for ROSCI0385 Raul Timiş între Rusca şi Prisaca, and ROSCI0236 Strei-Hateg.	Potential to be present within watercourses across the route but primarily those within km 313-314	HD 2
Danubian Brook Lamprey Eudontomyzon vladykovi	This species of national value is a detritivore and also dies after spawning. There is the potential for this species to be present in watercurses throughout the route, however this species is also listed on the designations for ROSCI0385 Raul Timiş între Rusca şi Prisaca, these species are susceptible to pollution.	Potential to be present within watercourse across the route but primarily those within km 313-314	HD 2
Broad-Clawed Crayfish Astacus astacus	This species is considered vulnerable by the IUCN.	May be present within suitable water courses throughout the BRUA route.	N/A

Species Name	Description	Location (approx.)	European Legal Protection
Thick Shelled River Mussel Unio crassus	They are considered as being 'Endangered' by the IUCN. The mussels are restricted to fresh water, living only in unpolluted streams, rivers and lakes.	They may be present within suitable watercourses along the route.	HD 2; 4

The regionally important species are Mediterranean Barbel (*Barbus meridionalis*) Golden Spined Loach (*Sabanejewia aurata*); Spined Loach (*Cobitis taenia*), Romanian loach (*Sabanejewia romanica*) Souffia (*Leuciscus Telestes*) Common Dace (*Leuciscus leuciscus*), Aral Asp (Aspius aspius) *Gobio kessleri*, Danubian gudgeon (*Gobio uranoscopus*) Balon's Ruffe (*Gymnocephalus baloni*) Striped Ruffe (*Gymnocephalus schraetzer*); Mud Loach (*Misgurnis fossilis*) Amur bitterling Rhodeus sericeus amarus, Romainian Loach (*Sabanejewia romanica*) and Streber (*Zingel streber*).

12.6.5.4 PBF / Notable Amphibians

Seventeen amphibian species have been recorded in the AoI of which two are considered to be of national value, seven of regional value and the other eight of local or less than local value. Two of these amphibians are considered PBF.

Table 12.12.13 - PBF / notable amphibians which may occur along the BRUA route

Species Name	Description	Location along BRUA route	European Legal Protection
Fire-bellied toad *Bombina bombina*	The nationally valuable species are the fire-bellied toad (*Bombina bombina*) and the yellow bellied toad (*Bombina variegata*). The toads have similar habitat requirements inhabiting zones of steppe, forest steppe, broad-leaved and mixed forests consisting of different species of trees. In the forest steppe and steppe zones, they inhabit bushlands, forests and wetlands in floodplains, covered with dense vegetation but also open landscapes, using drainage channels as pathways for dispersal. Sometimes they inhabit semi-flowing waters: springs, irrigation channels, rivers and stream pools. In some areas, *B bombina* will live in almost entirely in stagnant water bodies although as a rule, they have a preference for higher water quality. In the Carpathian region, *B. bombina* lives in wetlands with clearer water than the congeneric *B. variegata*. Breeding *B. variegata* typically use unshaded temporary pools within, or close to, forest and are more tolerant of poor water quality. They eat insects, spiders, millipedes, molluscs and earthworms captured in or nearby the water. Reproduction takes place from April to July/August and is induced by heavy rainfall. Spawn consists of small clutches of several clutches of 10–40 eggs each which are attached to plants. Tadpoles hatch after 2–5 days and metamorphose after 5–12 weeks from July to September or after hibernation in spring. Young toads are 11–15mm long and remain at the water's edge. Maturity is reached at an age of 1–2 years. Destruction of wetlands due to intensification of agriculture is the most serious threat to populations.	May be present associated with wet areas and surrounding habitats all along BRUA	HD 2;4
Yellow bellied toad *Bombina variegata*			

Other amphibians of regional value include the agile and pool frog (*Rana dalmatina* and *R. Lessonae*) the tree frog (*Hyla arborea*) the great crested and alpine newt (*Triturus cristatus and Triturus alpestris alpestris*), green toad (*Bufo viridis)* and the salamander (*Salamandra salamandra*). These species have the potential to occur across the route.

12.6.5.5 PBF / Notable Reptiles

Seventeen important reptile species have been identified within the AoI. These include one internationally important species, one nationally important species, eight regionally important species and four locally important species. Of these two species are considered to be PBF.

Table 12.12.14: PBF / notable reptiles which may occur along the BRUA route

Species Name	Description	Location along BRUA route	European Legal Protection
Hermann's tortoise *Testudo hermanni*	Considered to be of international value, it is found in Romania at its European limit in the Southwestern part of the country. The tortoise is found in small patches of agricultural land, grassland, pastures or sparsely vegetated areas, in association with temperate forest. It is almost entirely herbivorous, feeding on a variety plants which are found in its habitat, generally in the late afternoon and evening this includes clover, dandelions, strawberries, and numerous other plants and herbs. To supplement this plant-based diet, Hermann's tortoise eats smaller amounts of earthworms, snails, slugs and insects, and also feeds occasionally on the flesh of dead rabbits, lizards and amphibians. Between May and July, female Hermann's tortoises deposit between two and twelve eggs into flask-shaped nests dug into the soil, up to ten centimetres deep. The eggs are incubated for around 90 days. The population is strongly declining the main threats being due to a number of factors such as housing and urban area encroachment, tourism and recreation areas, annual and perennial non-timber crops, mining and quarrying, energy production and mining, recreational activities, increase in fire frequency/intensity, droughts, temperature extremes, climate change and fluctuating weather[32].	Most likely to be present km 404-406, but may be present within agricultural land, grassland, pastures or sparsely vegetated areas, in association with temperate forest.	HD 2;4
European pond turtle *Emys orbicularis*	Valued at the national level Sites of Community Importance (SCI) are partly managed to protect the Romanian distribution of the species. It is found in a wide variety of freshwater habitats, including ponds, lakes, streams, rivers and drainage canals, some of which may dry up completely during the summer months. The species hunts underwater for fish, amphibians, tadpoles, worms, molluscs, crustaceans and aquatic insects, as well as foraging for the occasional plant. Mating begins from March to May, depending on the latitude and temperature, eggs, usually nine or ten, are laid in May and June in small holes dug in the ground. The incubation period varies from around 57 to 90 days, and young may emerge in autumn or stay in the nest until the following spring. In the northern parts of its range, a long hot summer is required for eggs to hatch, so this turtle may only successfully reproduce one in every four or five years. Threats to the species are largely from intensive agriculture and climate change[33].	Most likely to be found within Pădurea Bolintin in km 1 – 6.	HD 2;4

32 L. Rozylowicz and M Dobre (2010) Assessing the threatened status of Testudo hermanni boettgeri Mojsisovics, 1889 (Reptilia: Testudines: Testudinidae) population from Romania North-Western Journal of Zoology Vol. 6, No. 2, 2010, pp.190-202

33 Tibor Sos (2013) Conservation activities for European pond turtles (Emys orbicularis) in Romania. Herpetology Notes, volume 5: 147-148 (2013) (published online on 22 March 2013).

Other reptiles of regional value are the sand, meadow and Balkan lizard (*Lacerta agilis*, *Lacerta trilineata and Lacerta praticola*), the slow worm (*Anguis fragilis*), the dice, smooth and aesulapian snake (*Natrix tessellata, Coronella austriaca and Elaphe longissimi) and the horned viper (Vipera ammodytes*). These species could occur along the route.

12.6.5.6 PBF / Notable Birds

One hundred and ninety-seven notable bird receptors have been identified within the study area, of which 41 species are considered to be of regional value or above. Due to the large number of bird species identified, only those identified as being of value of 4 or 5 will be described further. More details of the species identified can be found in Appendix 12.1. Four species are considered to be of PBF value, as presented in the table below.

Table 12.12.15: PBF / notable birds with potential to be present along the route

Species Name	Description	Location along BRUA route	European Legal Protection
Eurasian oystercatcher Hematopus ostralegus	This species is declining[34] and listed as Near Threaten. The species breeds on coastal saltmarshes, sand and shingle beaches, dunes, cliff-tops with short grass and occasionally rocky shores, as well as inland along the shores of lakes, reservoirs and rivers or on agricultural grass and cereal fields, often some distance from water. In the BRUA study area they have been found foraging in the agricultural grassland areas.	Species may be present breeding within short grass, arable fields and riparian areas all along the route.	
Red footed falcon Falco vespertinus	Declining and listed as Near Threatened 35. It is also identified as a priority species in Hungary and Romania. Together these two countries account for 90% of the total red-footed falcon European population, notwithstanding a separate sub-population in the former Soviet Union[36]. The species breeds in open lowlands with trees and plenty of insects, on which it feeds, as well as amphibians, reptiles, mammals and birds including steppe and forest-steppe, open forest, cultivation and pastureland with tall hedgerows or fringing trees, agricultural areas with shelterbelts and, in the north-east, boggy areas and taiga edge. It is usually colonial, breeding in disused nests of other birds (most commonly the rook, Corvus frugilegus), but can also be solitary.	May be breeding in suitable trees all along the BRUA route.	BD1*
Lesser white-fronted goose Anser erythropus	This species is fully migratory, and may be breeding in Romania. This species' population is suspected to have decreased rapidly, owing to levels of hunting on the staging and wintering grounds, and habitat deterioration (largely as a result of land cultivation). The decrease in numbers has been accompanied by fragmentation of the breeding range and is continuing to affect all populations. This species breeds in low-lying bogs, scrub-covered tundra and taiga-forest edges close to wetlands, up to 700 m above sea level	May be breeding in suitable habitats at low density along the BRUA route, but most likely to be present around km 119.	BD1
European	The species uses a wide variety of forest types,	May be breeding	

34 http://datazone.birdlife.org/species/factsheet/eurasian-oystercatcher-haematopus-ostralegus/text

36 Palatitz, P., P. Fehérvári, S. Solt and B. Barov (2009) European Species Action Plan forthe Red-footed Falcon Falco vespertinus. 49 p. ISSN

Species Name	Description	Location along BRUA route	European Legal Protection
Turtle Dove Streptopelia turtur	as well as steppe and semi-desert., It uses hedges, borders of forest, groves, spinneys, coppices, young tree plantations, scrubby wasteland, woody marsh and scrub, all with agricultural areas nearby for feeding. Transformation of agricultural land, including destruction of hedges, is thought to be an important factor in the decline of this species as well as the loss of semi-natural habitats.	in suitable habitats along the BRUA route.	

** Birds directive annex 1.*

Other bird species valued at the regional level include warblers, other birds of prey, storks including *Ciconia nigra* geese and other wildfowl and typical farmland birds. General Good International Practice (GIP) mitigation is proposed to safeguard these species.

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12.6.5.7 PBF / Notable Bats [37] [38]

Thirteen species of bats are evaluated as being nationally or regionally important. All are listed within Annexes 2 and or 4 of the EU Habitats Directive. Of these bats, four species are identified as PBF.

Table 12.12.16: PBF bat species which may be present along the BRUA route

Species Name	Description	Location along BRUA route	European Legal Protection
Barbastelle *Barbastella barbastellus*	The Western Barbastelle (*Barbastella barbastellus*) forages in mature forest and forest edges, feeding mostly on large moths. In summer, roosting sites occur in mature forests and occasionally in older buildings.	May be roosting in trees along the BRUA route	HD 2;4
Mediterranean horseshoe bat *Rhinolophus euryale*	Is at the edge of its northern range in Romania. Summer colonies are generally fairly small, usually containing up to a few hundred individuals, while winter colonies are often much larger, sometimes numbering over 2,000 individuals. This species also forms large groups during the breeding season. Broadleaved forests have been found to be the one of the most important habitats although it will readily forage in other types of forest, shrublands and riparian vegetation, up to elevations of around 1,000 metres. It is often found in valley bottoms. In the summer the Mediterranean horseshoe bat roosts in natural or artificial underground sites, including attics, caves and mines. During the winter, it typically hibernates in large caves and tunnels. It is considered to be a species of national importance.	May be present all along the route of BRUA, roosting in caves.	HD 2;4
Greater horseshoe bat	Were originally cave dwellers, but few now use caves in summer – most breeding females use buildings, Males also use caves and tunnels, and as for the	May be present all along the	HD 2;4

37 http://www.batlife.ro

38 http://www.iucnredlist.org

Species Name	Description	Location along BRUA route	European Legal Protection
Rhinolophus ferrumequinum	Mediterranean horseshoe bat during the winter, it typically hibernates in large caves and tunnels. It hunts in open tree habitats such as pasture, parkland and hillsides, often by water taking its prey on the wing. In Romania is a relatively common and widespread species, especially in Southern and Western Carpathians, with a few records in the Eastern Carpathians and Dobrogea. It is considered to be a species of national importance.	route of BRUA, roosting in caves.	
Lesser horseshoe bat *Rhinolophus hipposideros*	Feed amongst vegetation in sheltered lowland valleys. They rarely fly more than five metres above the ground, frequently circling over favoured areas and often gleaning their prey from branches. They summer and winter roost in habitats similar to the GHB. In Romania is present throughout the country. It is considered to be a species of national importance.	May be present all along the route of BRUA, roosting in caves.	HD 2;4
Long-fingered bat *Myotis capaccinii*	Regionally important: is a medium-sized bat that feed by 'scooping' their prey from water surfaces with their feet and the help of their tail membrane. The long-fingered bat feeds over the water surface of lakes, ponds, streams and rivers. It is an obligate cave-dweller, preferring warm underground sites (natural and artificial caves such as mines) in summer and cool sites in winter, using transient sites over the seasons in-between. It is on decline in Romania and is currently largely restricted to the south.	May be present all along the route of BRUA.	HD 2;4

In addition, the following species may also be in the area: Greater mouse-eared bat (*Myotis myotis*), Lesser mouse-eared bat (*Myotis blythii*), Particoloured bat (*Vespertilio murinus*), Long-fingered bat (*Myotis capaccinii*), Common bent-wing bat / Schreibers' long-fingered bat (*Miniopterus schreibersii*), Geoffroy's bat (*Myotis emarginatus*), Serotine (*Eptesicus serotinus*), Whiskered bat (*Myotis mystacinus*) and Noctule (*Nyctalus noctula*). For most of these species existing threats are habitat fragmentation and intensive agriculture, in addition to cave disturbance. Impacts from BRUA may result from loss of foraging habitat and the potential for the destruction of roosts when trees are removed (for species which roost in trees).

12.6.5.8 PBF / Notable Small Mammals

Nineteen notable species of small mammal (excluding bats) have been identified within the Study Area. Two small mammals are considered to be PBF due to their status in Romania.

Table 12.12.17: PBF / notable small mammals which may be impacted by BRUA

Species Name	Description	Location along BRUA route	European Legal Protection
European ground squirrel or souslik *Spermophilus citellus*	Currently in serious decline and considered to be of national importance It is restricted to short-grass steppe and similar artificial habitats (on light, well-drained soils, where it can excavate its burrows. It is a diurnal animal, emerging from burrows during the day to feed upon seeds, plant shoots and roots or flightless invertebrates. Breeding takes place in early summer when a single litter of five to eight young is borne. The European ground squirrel	Potential to occur within short grassland all along route	HD 2;4

Species Name	Description	Location along BRUA route	European Legal Protection
	hibernates between autumn and March. The main threats to this species are the conversion of steppe-grassland and pasture to cultivated fields or forestry, and the abandonment of pasture and its subsequent reversion to tall-grass meadows or scrubby habitats which are not suitable.		
Balkan mole rat *Spalax graecus*	A European endemic, known only from a small number of sites in Romania (Suceava, Craiova, Transylvania, and the lower Danube), south-eastern Ukraine (Cernovcy), and Moldov and due to the importance of this area to the species are of national importance. The Bukovina blind mole rat is so far known from 13 localities in north-eastern Romania and adjacent Ukraine[39]. It feeds on bulbs, roots, tubers, and other underground parts of a range of plants. A similar species Spalax leucodon is threatened by agricultural intensification, as it cannot survive in intensively-farmed arable land. Spalax graecus may be similarly vulnerable to intensive agriculture. Although in decline in Europe, subsistence agriculture continues in Transylvania, and the mole rat population appears to be stable there.	Potential to occur within short grassland all along route	N/A

Four locally rare and regionally important species of small mammal are garden dormouse (*Eliomys quercinus*), which lives in steppe deserts, hollow trees, rock crevices, and human dwellings, forest dormouse (*Dryomys nitedula*) it also lives in a broad variety of habitats including broad-leaved, mixed, coniferous and dwarf montane forest, the Common hamster (*Cricetus cricetus*), the alpine shrew (*Sorex alpinus*) which is found associated with the banks of mountain streams in the alpine meadows and coniferous forests of Southern European mountain ranges and its breeding behaviour is largely unknown.

39 Chişamera et al., 2014. Bukovina blind mole rat Spalax graecus revisited: phylogenetics, morphology, taxonomy, habitat associations and conservation (pages 19–29). Mammal Review, Volume 44, Issue 1.

12.6.5.9 PBF / Notable Large Mammals

Seven notable large mammals (value 3 or greater) have recorded within the study area. Of these four are considered to be of international importance and PBF (due to the importance of the Romanian population internationally, their status as umbrella species or their relative rarity), as shown in the table below.

Table 12.12.18 – PBF / notable large mammals which may be present within the BRUA corridor

Name	Description	Location along BRUA route	European Legal Protection
Brown bear *Ursus arctos*	Not territorial animals. They can migrate seasonally huge distances when searching for anthills, fruits and crops and their dispersal relates closely to the period of the year and food availability. Of the 200,000 brown bears estimated worldwide, approximately 6000 individuals are thought to be present in the Carpathian region of Romania[40]. Although, as a whole, this species is secure with relatively large numbers and an expansive range, many small, isolated populations are threatened due to forest management reducing the numbers of some important fruit trees and risk of mortality during frequent contact with humans.	Most likely to be present km 275-288 but may be in surrounding habitats and have the potential to occur between km 270 – 440.	HD 2;4
Wolf *Canis lupus*	Romania is believed to have the largest wolf population in Europe, around 2,500 wolves live in Romania (over 15 percent of Europe's wolf population, excluding Russia)[41], according to estimates after World War II, there were 4000 to 5000 wolves in the forests of Romania. Their decline is due to poisoning and deliberate persecution due to predation on livestock. They mate between January and March and the young are born 7 weeks later in a den which has been dug among bushes or rocks.	Most likely to be present km 275-288 but may be in surrounding habitats and have the potential to occur between km 250 – 440.	HD 2;4
Lynx *Lynx lynx*	Typically, crepuscular, (active at dawn and dusk) often sleeping out day and night in dense thickets and other safe hiding places, they prey largely on small to fairly large sized mammals and birds. Breeding season focuses on February/March when females come into oestrous for about a week, and have their young	Most likely to be present km 275-288 but may be in surrounding habitats and have the potential to occur between km 250 – 440.	HD 2;4

40 Romanian Bear Management Plan 2006

41 Wolves of Transylvania by Alan E. Sparks international wolf the quarterly publication of the international wolf centre vol. 21, no. 1, spring 2011

Name	Description	Location along BRUA route	European Legal Protection
	in time for spring/summer. The Carpathians host one of the largest continuous lynx populations in Europe (area of occupancy about 100,000 km2). The overall number is about 2,500 lynx and is stable. A range expansion towards the south (Serbia) was noticed since 2000. For these reasons the population qualifies as Least Concern but Romania is an international stronghold for the species.		
Otter *Lutra lutra*	There is little data on otter in Romania[42], they shelter and breed all year round in holts within river banks and feed largely on fish, crustaceans and amphibians and are vulnerable to man-made changes such as canalization of rivers, removal of bank side vegetation, dam construction, draining of wetlands, aquaculture activities. Otters are vulnerable to persecution due to the perception of otter's depredation on fish.	Potential to be present within all major watercourses	HD 2;4

Three large mammals considered to be locally rare and of regional importance are the wild cat (Felis silvestris), the golden jackal (Canis aureus) and red deer (Cervus elaphus) these species could occur all along the route. All of these species are hunted although trophy hunting has just been banned for wild cat, the jackal is currently expanding its range and is potentially becoming a pest species. Red deer population are stable. The remaining species are of local or low importance, and include badger (meles meles), wild boar (Sus scrofa), chamois (Rupicapra rupicapra) and roe-deer (Capreolus capreolus). These species could occur all along the route, however the chamois is most likely to occur in alpine areas between km 250 and 400.

12.6.6 **Summary of Key Receptors by Section**

The table below shows the key receptors for each section of the route.

Table 12.12.19 – Key receptors for each section of the route.

Section	Designated Sites	Priority Species*
Podisor - Corbu	Pădurea Bolintin (km 2-4)	TBC by pre-works survey and Biodiversity Specialist, but likely to include European turtle dove (*Streptopelia turtur*); European ground squirrel (*Spermophilus citellus*); European pond turtle (*Emys orbicularis*); Bats; Amphibians; Reptiles.
Corbu – Hurezani	Valea Oltului Inferior (km 119) Dealurile Drăgăşaniului (km 146)	TBC by pre-works survey and Biodiversity Specialist; but likely to include: Eurasian Oystercatcher (*Hematopus ostralegus*); White fronted goose (*Anser albifrons*); Otter (*Lutra lutra*); Bats; Reptiles; Amphibians; Balkan mole rat

42 George Bouroş ROM. J. Biol. – Zool., Volume 59, No. 1, P. 75–86, Bucharest, 2014

Section	Designated Sites	Priority Species*
		(*Spalax graecus*).
Hurezani to Hateg	Nordul Gorjului de Vest (km 270-284) Defileul Jiului (km 282-284)	TBC by pre-works survey and Biodiversity Specialist; but likely to include: Brown bear (*Ursus arctos*); Wolf (*Canis Lupus*); Lynx (*Lynx lynx*); Otter (*Lutra lutra*); Bats, (including forest and cave roosting species); Birds, especially falcons including red footed falcon (*Falco vespertinus*); Plants including Carpathian tozzia (*Tozzia carpathica*), blue bell (*Campanula serrata*), greater pasque flower (*Pulsatilla grandis*), Steppe iris (*Iris aphylla ssp. hungarica*), invertebrates (including Danube clouded yellow (*Colias myrmidone*), scarce large blue (*Maculinea teleius*), hermit beetle (*Osmoderma eremita*), Fisher's esturine moth (*Gortyna borelii lunata*), Amphibians, Reptiles.
	Strei – Haţeg (km 314-318)	
	Grădiştea Muncelului – Ciclovin (km 312)	
Hateg - Recas	Coridorul Rusca Montană - Ţarcu – Retezat (km 360 – 363)	TBC by pre-works survey and Biodiversity Specialist; but likely to include: Otter (*Lutra lutra*); Lynx (*Lynx lynx*); Notable fish including Danubian brook lamprey (*Eudontomyzon vladykovi*); Red footed falcon (*Falco vespertinus*); Hermann's tortoise (*Testudo hermanni*); Scarce large blue (*Maculinea teleius*); Reptiles; Amphibians; Bats.
	Râul Timis între Rusca şi Prisaca (km 401-411)	
	Lunca Timişului (km 450)	
Recas- Horia	N/A	TBC by pre-works survey and Biodiversity Specialist; but likely to include: Red footed falcon (*Falco vespertinus*); Danube clouded yellow (*Colias myrmidone*); Reptiles; Amphibians; Bats.

** Priority species are to be confirmed and identified as a component of the preparation works – see mitigation.*

12.6.7 **Summary of Priority Biodiversity Features and** Critical **Habitat**

Each of the habitats and species scoped into the BRUA Impact Assessment were assessed to determine if they qualified as Critical Habitats (CH) or Priority Biodiversity Features (PBF). Habitats identified as potential CH or PBFs are presented in Table 12.12.20 below. The full assessment process is presented as a table in Appendix 12.3.

PR6 (paragraph 14) addresses the areas identified as critical habitat that hold the highest tier of irreplaceable (existing in few places) and vulnerable (at high risk of being lost) biodiversity features. The criteria used by the EBRD's PR6 to define critical habitat build on and are closely aligned with those used by the International Finance Corporation Performance Standard 6 (IFC PS6). PR6 also explicitly includes ecological functions that are vital for maintaining the viability of critical habitat features. Illustrative examples of such functions, as well as examples of features that would meet other critical habitat criteria, are provided in Appendix 12.2 to this document.

All species which were awarded a 'value of 4 or 5 at the valuation stage or are listed as vulnerable or endangered according to the IUCN were listed as Priority Biodiversity Features in line with EBRD PR6.

- Habitats were scoped into the assessment at the habitat valuation stage, these are then screened below for the inclusion as critical habitats that potentially require offsetting. The critical habitat screening is presented in Table 12.12.7.

Table 12.12.20: Potential CH or PBF areas (no European priority habitats present)

Habitat / Annex I Habitat Number and Name (Natura 2000 designation)	Romanian Name	Approximate Chainage*	Primary reason for selection	CH?	PBF? (N/A where already CH)	Further survey works to determine location and distribution required?
Mountain hay meadows (6520) and Alpine and subalpine calcareous grasslands (6170) within Natura 2000 sites	6520 Fânețe montane, 6170 Pajişti calcifile alpine şi subalpine	Km 270 – 284; Km 360 -363.	Annex 1 Habitat in EU Habitats Directive. May support Danube Clouded Yellow butterfly (*Colias myrmidone*), important for a range of species including Steppe iris (*Iris aphylla ssp. Hungarica*), Carpathian tozzia (*Tozzia carpathica*) and Alpine shrew (*Sorex alpinus*).	Yes	N/A	Yes
Other grassland habitats within Natura 2000 sites: Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)	6430 Comunități de lizieră cu ierburi înalte higrofile de la nivelul câmpiilor, până la cel montan și alpin	Km 270 – 284.	May support Danube Clouded Yellow butterfly (Colias myrmidone), important for a range of species including Steppe iris (Iris aphylla ssp. Hungarica), Carpathian tozzia (Tozzia carpathica) and Alpine shrew (Sorex alpinus).	Yes	N/A	Yes
Semi-natural riparian areas within Natura 2000 sites	N/A	Km 118 – 120 Km 405 – 410 Km 314 – 318.	May support birds including Eurasian Oystercatcher (*Hematopus ostralegus*) and reptiles including Hermann's Tortoise (*Testudo hermanni*)	Yes	N/A	No
Semi-natural riparian areas (excluding those within Natura 2000 sites)	N/A	All along route	The riparian areas throughout the route have the potential to support species such as Otter (*Lutra lutra*), Carpathian Brook Lamprey (*Eudontomyzon*	Some river crossings have potential to be Critical Habitat / PBF.		Yes

Habitat / Annex I Habitat Number and Name (Natura 2000 designation)	Romanian Name	Approximate Chainage*	Primary reason for selection	CH?	PBF? (N/A where already CH)	Further survey works to determine location and distribution required?
			danfordi) and Danubian Brook Lamprey (*Eudontomyzon vladykovi*)			
Flooded areas / small wetlands	N/A	Potential to be present all along the route	May support species such as Otter (*Lutra lutra*) and notable bird species.	No	May qualify as PBF	Yes
Alpine and boreal heath (4060)	4060 Tufărişuri alpine și boreale	Km 270 - 284	This habitat may support notable bird and mammal species.	Yes	N/A	Yes
Forests within Natura 2000 sites. Includes Beech Forests (9110, 9130); Medio-European limestone beech forests of the Cephalanthero-Fagion (9150); Illyrian oak and hornbeam forests (Erythronio-Carpinion) (91L0); Pannonian-Balkanic turkey oak – sessile oak forests (91M0); Dacian beech forest (91V0); Dacian oak (91Y0); Alpine acidophilous spruce forest (9410)	9110 Păduri de fag de tip Luzulo-Fagetum, 9130 Păduri de fag de tip Asperulo-Fagetum, 9150 Păduri medio-europene de fag din Cephalanthero-Fagion pe substrate calcaroase , 9170 Păduri de stejar cu carpen de tip Galio-Carpinetum, 91L0 Păduri ilirice de stejar cu carpen (Erythronio-Carpinion) , 91M0 Paduri balcano-panonice de cer si gorun , 91V0 Păduri dacice de fag	Km 2 – 4; Km 270 – 284; Km 314 – 318; Km 360 – 363.	Important habitat for a range of species including Brown bear (*Ursus arctos*), Red footed falcon (*Falco vespertinus*), roosting bats, and invertebrates such as Hermit Beetle (*Osmoderma eremita*)	Yes	N/A	Yes

Habitat / Annex I Habitat Number and Name (Natura 2000 designation)	Romanian Name	Approximate Chainage*	Primary reason for selection	CH?	PBF? (N/A where already CH)	Further survey works to determine location and distribution required?
	(Symphyto-Fagion), 91Y0 Paduri dacice de stejar si carpen, 9410 Păduri acidofile de molid (Picea) din etajul montan până în cel alpin (Vaccinio-Piceetea)					
Semi natural forests	N/A	Potential to be present in numerous locations along the route.	Important habitat for a range of species including Brown bear (*Ursus arctos*), Red footed falcon (*Falco vespertinus*), roosting bats, and invertebrates such as Hermit Beetle (*Osmoderma eremita*)	Some of these areas may qualify as Critical Habitat and/or PBF.		Yes
Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii) (8120)	8120 Grohotişuri calcaroase şi de şisturi calcaroase din etajul montan până în cel alpin (Thlaspietea rotundifolii	Km 270 – 284.	May support notable fern species assemblages.	Yes	N/A	Yes
Ponds and ephemeral water bodies	N/A	Potential to be present all along the route.	These habitats may support a range of notable species including Fire-Bellied Toad (*Bombina bombina*) and Yellow-Bellied Toad (*Bombina variegate*)	Some of these areas may qualify as Critical Habitat and/or PBF.		Yes

12.7 Impact Assessment

12.7.1 Approach and Methodology

12.7.1.1 Summary

Full details of the impact assessment methodology, tables, mitigation and residual impacts are provided in Appendix 12.3. The following section below provides an overview of key potential impacts. As with other Chapters impacts are rated on the following scale:

- Negligible Impact
- Low impact
- Medium impact
- High Impact
- Very High Impact

Potential impacts on sensitive receptors within the AoI have been assessed before mitigation is applied to ensure that the correct mitigation can be signposted for each receptor where required. In order to do this the potential impacts of the project were identified and characterised. As described earlier, impacts for both species and habitats valued at >3 and CHs and PBFs were specifically assessed to determine if mitigation beyond GIP mitigation (as outlined in Chapter 5) were required.

12.7.1.2 Detailed Approach

Once an interaction between an aspect and a receptor is identified the level of impact is identified and evaluated. Professional judgment and experience, data, models and regulatory and industry standards can all contribute to the assessment of impacts, which ranges from technical analysis using quantitative criteria (such as quality standards for water or air) to more subjective measures, such as loss of visual amenity or community dissatisfaction due to real or perceived inequitable distribution of project benefits. Most impact assessments combine both quantitative and qualitative analysis. However, the criteria used to evaluate impacts are clearly defined and hence the basis for each assessment should be explicit and accessible to scrutiny.

For the purpose of this assessment, impact significance was assessed for both the unmitigated and mitigated situations (i.e. residual effects). Deciding whether a project aspect is likely to cause significant adverse environmental effects is central to the concept and practice of impact assessment. The significance criteria used in this assessment are severity, spatial extent, duration, and frequency. In addition, the nature of the impact was taken into consideration, including whether the impact was adverse or beneficial, direct or indirect, and reversible or irreversible. Impact significance was also considered in context of the sensitivity/importance of the environmental receptor. Full details of the methodology utilised for the impact assessment can be seen in Appendix 12.3.

In effect only impacts to habitats and species valued at 3 or above which have the potential to be impacted by the proposed works will be discussed in detail in the Impact Assessment within the Biodiversity Chapter. Specific mitigation is only provided for Habitats and Species valued at level 3 or above, impacts to other receptors is included within the GIP mitigation (Good International Practice). The zone of direct influence is currently the 300m working corridor (150m either side) along the Project route, however indirect effects will be assessed on Natura 2000 sites within 5km.

12.7.1.3 Construction impacts

These potential impacts upon biodiversity are derived from multiple sources largely relating to pipeline construction and associated activities such as:

- Vehicle mobilization, including transport of people and equipment within the works area;
- Compounds, field working camps construction and operation, including the effects of the production of wastes, interactions with wildlife and indirect pressure of workers' presence;

- Pipeline working corridor vegetation clearance and topsoil removal and fragmentation;
- Pipeline construction activities including disturbance of soils and the potential for indirect and direct pollution from construction, including water crossings of the pipeline;
- Water abstraction;
- Unlikely Events; and
- Cumulative effects.

12.7.1.4 Operational Impacts

Operational impacts are associated with the maintenance of the Rights of Way (RoW) of the pipeline, i.e. keeping the over ground area above the pipeline free of vegetation so that access can be maintained and so that roosts from vegetation will not damage the pipeline.

- Increase in hunting or predation utilising the RoW for access;
- Spread on non-native invasive species along the maintained ROW or transferred during maintenance of the ROW;
- Impacts upon habitats and species directly resulting from the maintenance of the RoW;
- Increased disturbance due to increased accessibility and activity during maintenance; and
- Visual, noise and air quality issues related to the operation of the compressor stations.

12.7.1.5 Impact Characterisation

With regards to the particular receptors present, the following impacts identified from the project have the potential to cause the following adverse effects:

- Habitat loss; degradation and simplification;
  - vegetation clearance for the preparation of the working corridor;
  - habitat removal to facilitate pipe installation;
  - construction of camp facilities / pipe laydown areas etc.;
  - vehicles causing soil compaction and erosion;
  - dust produced by vehicles causing reducing the fitness of plants and therefore habitats; and
  - laying of temporary roads.
- Habitat Conversion
  - Conversion of valuable habitats (e.g. Forests) to less valuable habitats (scrub, grasses etc.) in order to maintain a 6m RoW along the route.
- Fragmentation;
  - From disruption to routes through which fauna utilise to move through the landscape, both physically and through creating barriers of disturbance.
- Changes in water conditions (hydrological impacts).
- Habitat pollution; including deposition and runoff;
  - For the Natura 2000 sites within the zone of influence of the project Nitrogen deposition is the most potentially damaging adverse effect from air quality[43]. The sensitive designated habitat types are largely forest, alpine grasslands and riparian areas. In terms of sensitivity to air pollution the critical load for nitrogen deposition for these types of habitat is 10–20 kg N/ha/yr.
  - The threshold criteria for air quality assessment in the UK are a change of +/- 1000 vehicles per day, +/- 200 Heavy Duty Vehicles (HDV), 10kph change in daily average speed or 20kph change in peak hour speeds[44].
  - The impacts of the project fall below this threshold; therefore, Nitrogen deposition is scoped out.

43 http://natura2000.eea.europa.eu/Natura2000

44 DMRB Volume 11 Section 3, Part 1 (Highways Agency, 1993)

- The impacts of airborne dust generated during the construction phase of the project have been assessed qualitatively. Dust emissions can pose a number of problems including detrimental effects on health, nuisance problems and effects on vegetation such as:
  - Covering of the leaf surface, resulting in shading and consequently reduction in net photosynthesis, altered pigment levels and/or reduced productivity;
  - Blocking of stomatal pores to prevent them from fully functioning;
  - Additional nutrients from the dust that may lead to increased growth and or deficiencies;
  - Changes in PH levels over time if the dust has different pH conditions to surrounding soils;
  - Soil pollution via deposition from the air or water run-off;
  - Creation of a surface film on still water bodies.
- Direct mortality of fauna due to vegetation clearance and pollution;
- Direct mortality to fauna due to interactions with workers and through the consumption of wastes / food brought into the works area;
- Disturbance to species including visual and noise disturbance;
  - Construction noise and visual disturbance can result in short term, localised effects, although many animals will become habituated to the noise;
  - Birds are amongst the best studied animal receptors in response to noise. Noise levels in excess of 65dB over the long term or spikes over 70dBs are likely to elicit an adverse response[4546].
- Spread of non-native or invasive species;
- Spread of non-native invasive species such as Japanese knotweed will reduce the ecological value of an area.

45 Wright, M.D., Goodman, P & Cameron, T.C. (2010). Exploring behavioural responses of shorebirds to impulsive noise. Wildfowl 60: 150-167.

46 Dooling RJ, Popper AN, (2007). The effects of highway noise on birds. Environmental BioAcoustics LLC for the California Department of Transportation, Division of Environmental Analysis.

12.7.2 **Summary of Impact Assessment Results**

Full results of the impact assessment are presented in the tables in Appendix 12.3, with a summary presented in Table 12.12.21.

Table 12.12.21: Potential Impact Assessment Results (by Impact Character)

Issue	Potential Impacts
Habitat loss, conversion, degradation and simplification	Pre-works surveys will confirm the baseline conditions to which the site must be required post construction.
	In line with the mitigation hierarchy, the majority of habitats will be restored immediately following construction, in so far as is possible. This will minimise long term impacts, however there will be some short term degradation and disturbance within the AoI. The mid-term habitat loss will be in those areas of habitat that will be replanted, due to the time it will take until the habitat matures (e.g. forest). There will be a long term impact from the retention of a 6m wide RoW through certain habitats, including forest. This impact will need to be addressed through an offset strategy. Some areas will be converted to a habitat of lower quality.
Fragmentation;	The fragmentation of habitats is largely temporary and unlikely to result in a significant effect on populations. However, in areas of forest where fragmentation is permanent (in order to maintain a 6m wide RoW) it will be small scale once the replacement trees planted within the cleared RoW (outwith the maintained 6m strip) have matured. Additional mitigation will reduce the significance of fragmentation for species (such as proposed dormouse 'bridges') and is not likely to be significant in the long term.
Changes in water conditions (hydrological impacts);	Three construction methods for water crossings have been proposed. Direct drilling were no trenching will occur across the watercourse. Then trenching via coffer dam (to isolate the works from the water) or open cut (within the watercourse) Hydrogeological surveys involving drilling boreholes to 6m depth at 500m intervals along the pipeline route to measure shallow groundwater levels determined the appropriate crossing per watercourse.
	A series of pollution prevention measures will be used as appropriate per crossing type. These will involve; retaining vegetation cover on the banks where possible to mimimise the soil exposure, the use of silt fences to prevent silt from travelling downstream, minimising the duration of trenching by back filling as rapidly as possible and restoring banks to pre-construction contours using temporary erosion control measures (such as straw bales, silt fence, etc.).
	Pre-clearance site surveys will map sensitive vegetation and apply additional mitigation where required. Reinstatement of banks will use mid-term soil stabilisation measures if required such as willow revetments, gabions and/or geo textiles membranes to retain soil until the vegetation has established.
Habitat pollution; including deposition and runoff;	GIP mitigation will ensure that there are no significant impacts from run off. Where there are particularly sensitive watercourses bespoke mitigation and monitoring by the Biodiversity Specialists will ensure no significant effects.
	With regards to dust, for this site it is anticipated that PM10 in the absence of mitigation would result in effects from dust being minor with and effect up to 50m from the source. With the proposed mitigation, however this distance would be reduced to a likely 25m and is unlikely to be significant.

Issue	Potential Impacts
	In sensitive areas deposit gauges will monitor the dust. The dust collected can also be analysed to determine its composition to confirm our assessment with regards to dust.
Direct mortality:	Locating construction camps away from sensitive areas and enforcing a hunting ban of construction workers will help ensure that there are no significant adverse effects, along with good site practice regarding the storage of waste and food.
	Speed limits on vehicles and restrictions to existing and/or dedicated haul routes will prevent direct mortality and disturbance from vehicles;
	In addition to a hunting ban, pre-clearance site surveys and the movement of animals out of the working corridor by the Biodiversity Specialist, combined with timing of works in sensitive areas will prevent direct mortality. There may be some low level unavoidable direct mortality but this would not be significant in the short or long term.
Disturbance to species including visual and noise disturbance	Construction noise and visual disturbance will result in short term, localised effects, although many animals will become habituated to the noise.
	The nosiest activities associated with the development are those from static plant used to excavate trenches, clear vegetation, lay pipes, hammering and compacting concrete. The nose levels at the site are likely to be in excess of 80dB decreasing to 50 to 64dB at 300m. This is likely to result in abandonment of the areas closest to the construction sites although there may be a degree of habituation.
	This will result in a short term adverse effect, however the most sensitive habitats and species, works will be confined to the least sensitive timeframes. Monitoring by Biodiversity Specialists will also ensure that should valuable species be breeding in an area, works do not take place during these sensitive times i.e. for birds that the young have successfully fledged or that fish have successfully spawned.
Spread of non-native or invasive species.	Pre-clearance surveys combined with the demarcation and treatment of non-native species will prevent their spread. Monitoring post-construction will ensure that newly restored areas are not inundated with non-native species from adjacent areas.

The majority of the BRUA route passes through habitat of low ecological value, predominantly agricultural land and grazed pasture with small areas of residential and road infrastructure. Impacts in such areas are generally expected to be on negligible to low ecological impact.

However, the pipeline also passes through some much more valuable habitats including semi-natural and virgin forests (some of which are within Natura 2000 sites), riparian areas, and some notable grasslands and scrub areas (some of which are within Natura 2000 sites). A range of potential impacts have been identified, as fully discussed within the impact tables within Appendix 12.3. Mitigation is proposed to avoid these impacts or minimise the impacts to acceptable levels. Where mitigation does not fully mitigate these effects compensation via offsetting is proposed. The proposed mitigation is presented in summary in the impact tables, but also within the GIP mitigation and specific mitigation tables presented below. Offsetting is presented within the offsetting section below.

Residual impacts to Critical Habitats and/or Priority Biodiversity Features identified within the impact assessment are also identified in Appendix 12.3. Appropriate offsetting to address these residual impacts is also proposed below.

12.7.3 **Impacts to Designated Sites**

Potentially significant impacts to designated sites can be summarised in Table 12.12.22 below.

Table 12.12.22: Potential impacts to designated sites

Issue	Description
Construction Impacts	
Direct impacts:	Impacts have generally been limited through appropriate route selection, and for the seven sites through which the pipeline passes the route has been designed to generally pass through disturbed areas or areas not containing the habitats for which the sites are designated. Impacts will be further reduced by working methods, for example directional drilling of watercourses within SPA sites.
Mitigation Measures:	Where impacts to designated sites are unavoidable, a range of mitigation measures are proposed. These include both sensitive timings of works and appropriate working methodologies including noise reduction, pollution control and habitat restoration. Full details of the control measures proposed are presented in the tables and will be specified in site-specific method statements.
Offsets:	Despite this, some residual impacts will result as a result of permanent habitat loss and fragmentation. These impacts will be addressed through suitable offsetting as proposed in Table 12.40. .
Indirect impacts:	A further eight Natura 2000 areas may be indirectly impacted by BRUA, through fragmentation, disturbance or pollution. Impacts to these sites will be addressed through timings of the works, working methodologies and other control measures. No significant residual effects on these sites is foreseen.
Operational Impacts	
Operational Impacts	During the operation of BRUA, impacts upon Natura 2000 sites identified are related to the maintenance of a Right of Way along the Route, if required. Suitable mitigation for these impacts is shown in Appendix 12.3. If this mitigation is correctly implemented, no additional significant residual effects are anticipated.

All works within designated sites will be conducted according to site specific method statements to ensure that appropriate mitigation is implemented.

12.7.4 **Impacts to Habitats**

A number of notable habitats outwith Natura 2000 sites, have been assessed as having the potential to be impacted by the BRUA construction. These include semi-natural forests, riparian areas, notable grasslands and some scrub areas. The BRUA route has largely been selected to avoid impacts to these areas (e.g. by following existing pipeline routes), however impacts, including habitat loss and degradation and potential pollution impacts, do require mitigation. Mitigation to address the impacts will be required. Mitigation for impacts to habitats is presented in the GIP and in Table 12.12.25, Table 12.12.26, Table 12.12.27 and summarised in the applicable sections of the impact tables presented in Appendix 12.3. For work in all riparian areas identified by the Biodiversity Specialist as being CH or ~BF or supporting PBF species, a specific method statement will be created. Mitigation proposed includes reduction in BRUA corridor working width in notable habitats, avoiding impacts to habitats through directional drilling, habitat restoration and post construction remediation. Once the identified mitigation is implemented, some residual impacts to notable habitats, including CH and PBF were identified associated with the mid-term effect on the habitats before restoration matures. These residual impacts will be addressed through offsetting, presented in section 12.9.

Minimal impacts to habitats resulting from the operation of the BRUA pipeline are foreseen, and are predominantly related to the limited maintenance of the RoW along the route. The mitigation for these impacts mean that no additional significant residual effects are anticipated.

12.7.5 Impacts on Species

As a component of the impact assessment, the value the species likely to be within the Study Area and with the potential to be impacted by the project were assessed. Of these species, 164 were assessed as being of regional, national or international value, and a number were assessed as being Priority Biodiversity features in line with PR6. Potential impacts to these species were identified, and are presented in Appendix 12.3. Impacts identified include direct mortality from the construction works, from fragmentation of habitats, visual and noise disturbance and impacts from pollution. Generic mitigation for these impacts is presented in the GIP in Section 12.8.3. Where appropriate, species specific prescriptions are presented in Table 12.12.27. Some offsetting of impacts to Priority Biodiversity Features may be required. This proposed offsetting strategy is presented in **Error! Reference source not found.**.

Potential impacts resulting from the operation of BRUA identified were limited to impacts form the maintenance of the BRUA Row and the potential for increased hunting in the areas around the BRUA route as accessibility would be increased. Specific mitigation to prevent this impact is proposed.

12.8 Proposed Avoidance, Mitigation, Restoration and Offsetting

Mitigation proposed follows the mitigation hierarchy, whereby avoidance is the primary approach, to limit impacts, followed by mitigation, restoration and finally offsetting if necessitated.

In addition to the Good International Practice (GIP) generic mitigation measures proposed in Chapter 5, the following bespoke mitigation is proposed to address impacts to ecology and nature conservation. This will be developed further by the project into a project Biodiversity Action Plan and an ESAP.

12.8.1 General Avoidance Overview

The project seeks to reduce impacts initially through avoidance. These measures are primarily based around the positioning of the route along the RoW of an existing pipeline, through already degraded habitats (along roadsides) and through habitats of low biodiversity value. The avoidance measures implemented in the selection of the BRUA routing are recorded within the EIA (USI 2016).

Other avoidance measures to be implemented include seasonal timings of works (for example to avoid removing trees when birds are nesting). Where residual effects are identified, mitigation is proposed to address these issues.

12.8.2 General Mitigation Overview

All of the works to be conducted must be completed according to GIP (Good International Practice). This will prevent or reduce the impacts to a suite of receptors.

Beyond the GIP, the Project seeks to proactively address the majority of direct impacts to habitats and species to reduce their potential severity, based around detailed pre-construction surveys and the use of Biodiversity Specialist. These surveys / inputs are also considered necessary to bring the project in line with PR6 (Performance Requirement 6). The use of a Biodiversity Specialist will be a condition of the ESAP. After the completion of the construction, the impacted areas are to be restored insofar as is possible.

Details of the requirements for the Biodiversity Specialist, including responsibilities, training and daily tasks can be seen in the BMP (Biodiversity Management Plan)47, one of the ESMPs to be produced for the project.

47 The BMP is to be produced once the habitats and species within the RoW have been mapped in detail prior to and during the construction. The BMP will specify the baseline condition of each habitat and species, the target condition and the recommended actions required to achieve this restoration,

This section of the SEIA provides an overview of the avoidance mitigation and restoration considered to be required to meet EBRD standards.

12.8.2.1 Pre-works surveys

Prior to works starting, the BRUA route must be fully surveyed for the up to date baseline condition and to identify the presence / potential presence of notable species, PBF (Priority Biodiversity Features) and CH (Critical Habitats). This should focus on areas which may support CH, including riparian areas, forested areas and areas within Natura 2000 sites.

This survey must be conducted by suitably qualified ecologist(s) (Biodiversity specialist) and in line with PR6 should consider should consider all vertebrates (mammals, birds, reptiles, amphibians, fish). The survey must be fully auditable, repeatable and in line with good practice guidance. The survey must be conducted at a suitable time of year for the target habitats and species to be identified. It is considered that spring / to autumn is likely to be the key survey periods. The biodiversity specialist will confirm the most appropriate survey period for each receptor. This survey must be undertaken a minimum of two weeks ahead of the works to allow for any modification to the working methodology to be implemented if required. The data collected must be secured in line with the baseline requirements stated in the Framework Biodiversity Action Plan (BAP), ~~Section 12.7~~ for use as a baseline from which the success of the species and habitat restoration can be compared to the BAP targets. The Biodiversity Specialist will be responsible for confirming that adequate information has been collected to ensure that there is an appropriate baseline to inform the bespoke mitigation and monitoring alternatively they will determine the appropriate pre-cautionary approach to take.

In addition to his pre-works survey, a component of the responsibilities of the Biodiversity Specialist will be to reassess the BRUA RoW ahead of the works through a ‘walkthrough’. This will need to be conducted ideally one to two days ahead of the works to obtain up to date information on the presence of flooded areas; nesting birds etc.

Table 12.12.23 summarises the approach to pre-commencement survey

within an action plan. This should be a working document updated in response to the findings of the monitoring surveys.

Table 12.12.23: Summary of approach to pre-commencement surveying

Survey Type	Purpose	Timing (minimum time before commencement)	Timing (maximum time before commencement)	Seasonal restrictions	Person Responsible	Notes
Pre-commencement detailed baseline data collection well in advance of enabling works	Allow habitat and species distribution to be accurately mapped in order to inform mitigation, confirm baselines and therefore targets for offsetting and KPIs for monitoring of Critical Habitats and PBFs. Look for potential presence of PBF species not identified as being present within the AoI in the EIA.	2 weeks	6 months	Must be conducted in Spring / to Autumn as advised by the Biodiversity specialist	Biodiversity Specialist	To focus on habitats graded at value >3.
Pre-commencement walkthrough (rapid assessment) just before enabling works	Identify presence of sensitive receptors such as nesting birds, roosting bats and sheltering reptiles etc.. Look for potential presence of PBF species not identified as being present within the AoI in the EIA.	1 day	2 weeks	N/A	Biodiversity Specialist	To focus on sensitive receptors graded at value >3 or legally protected

12.8.2.2 Biodiversity Specialist Role

The overarching goal of the Biodiversity Specialist is to translate mitigation requirements written in the Biodiversity Management Plans into practical measures on the ground and be able to be responsive to changeable situations. A key challenge for the Biodiversity Specialist is to ensure that all staff are fully aware of the environmental sensitivities of the site and their responsibilities, as outlined in the BMPs. This would be conducted via practical 'toolbox talks' ahead of the construction. Additional toolbox talks may be required prior to all supervision of enabling and construction, if there are new team members or new issues to address.

Since construction through multiple habitat types provide environmental challenges, key concerns are likely to be around sensitive habitats (including effective control of silt near water) and effective avoidance and minimization of impacts during works in sensitive sites (e.g. the Natura 2000 sites – see below) and where protected or notable species may be present in the working corridor. The Biodiversity Specialist will be responsible for ensuring that the prescriptions of any specific method statement are completed.

To coordinate responses to environmental concerns, a number of technical reporting mechanisms should be set up to allow for issues to be raised and resolved in an efficient manner. These can be integrated with the projects own proposed project management system. They should form pre-enabling surveys ahead of the work teams by the Biodiversity Specialist and the production of hazard maps regarding the location of particularly sensitive habitats and species. These should be used by the Biodiversity Specialist to update the contractor BMPs, including timing of works, and amendments to construction method statements for sensitive areas, as required. Demonstration of compliance of the BMPs via daily field notes and photographs will also be part of the Biodiversity Specialist responsibility.

In addition to the daily field notes, a weekly or fortnightly report on issues and/or the status of the construction, with regards to protected habitats and species, will be presented at an environmental construction group meeting, attended by the client, selected environmental specialists (including the Biodiversity Specialist), the individual in charge of overall Environmental Protection and any other regulators/monitors. Regular meetings will assist with rapid solutions to ecological issues, by gathering all interested parties together in one room at one time and agreeing BMPs amendments as required.

Transgaz will require its Contractors to employ a biodiversity specialist to ensure commitments in the Biodiversity Management Plan, including pre-construction/pre-clearance surveys, are carried out in accordance with Project commitments. and managed by the contractor, but monitored by an overarching Ecologist on the client's team. This individual may also require additional support when multiple contractors are included within the overall project work fronts. A minimum of one Biodiversity Specialist perspread (i.e. one per working team) will be required. At times of high construction activity and works in sensitive areas, two Biodiversity Specialists should be present on site at any one time to manage the workloads and to ensure effective communication. Biodiversity Specialists should be well trained in the practical elements of protected species including handling of species that they may have to move and the recognition of sensitive habitats; they should also have a working understanding of wider environmental issues and the construction/engineering process.

12.8.3 **Good international practice (GIP)**

The Biodiversity Specialist should ensure that the following GIP for identified impacts is followed at all times during the BRUA project. Table 12.12.24 below outlines the GIP relating to biodiversity.

Table 12.12.24: GIP Mitigation

Impact	Mitigation General
Impacts due to scarcity of data	Ahead of all works, sensitive habitats (including ponds, grasslands etc.) will be mapped and notable species, will be identified and mapped in 'pre works surveys' (details above). Bespoke mitigation will be applied in all areas where sensitive habitats are identified (see specific mitigation tables). This will allow suitable mitigation to be identified and the success of any remediation to be monitored. A minimum of one Biodiversity Specialist will be present at every lot / spread. A monitoring report and hazard map should be prepared with GIS mapping of sensitive locations by the Biodiversity Specialists and submitted to the workers so that sensitive areas can be avoided or bespoke mitigation implemented. The Biodiversity Specialist will ensure that habitat degradation is minimized and baseline data for the BAP (Biodiversity Action Plan) is obtained. At least four non-native invasive species are known to be present along the route. Prior to any enabling works site survey, mapping and/or demarcation will be required, particularly for Japanese knotweed (see non-native species section and specific mitigation) by the Biodiversity Specialist.
General impacts from works and operation - avoidance	Single vehicle track policy to reduce extent of works footprint. Use of low-impact vehicles (in terms of emissions and load bearing) where applicable. Vehicles will be driven at designated speed limits. Off-road travel will be prohibited where possible. Laydown areas and compounds to be sited to avoid unnecessary clearance of vegetation. Use natural breaks in vegetation as preferred access routes where possible. The workforce will adhere to working corridors. The workforce will be provided with environmental awareness training. The workforce should not deviate from approved clearance areas. Implement and enforce hunting and fishing ban on the workforce. Prohibit all cutting of wood by workers. All staff will be provided with environmental awareness training. Fencing will be minimized and no areas vital for wildlife will be isolated by the workforce activities but temporary barriers will be used to prevent wildlife from accessing waste disposal areas.
Habitat loss general	Restoration should follow the prescriptions of the RMP (Restoration Management Plan) and the habitat specific mitigation within this chapter and the EIA (USI 2016). On flat areas once subsoil and topsoil has been restored and after any reseeding pull cut scrub and vegetation back onto the area to stabilise the soil and to promote natural re seeding.

Impact	Mitigation General
	Any reseeding or replanting of selected areas to be restored using locally collected seed mixes and saplings (also see specific mitigation). Identify a local source of indigenous saplings suitable for replanting programs in advance to facilitate restoration. Avoid the felling of significant trees. All efforts should be made to minimise removal of mature trees and maintain connectivity between areas of forest habitats. Soils will be removed as subsoil and top soil and will be stored separately management as specified in the EIA, this SEIA and good working practice. Educate workforce on preventing bush fires. Ensure bush fires are not used as a land clearance method.
Habitat degradation and simplification, erosion - General	Demarcation and offsets for camp and storage locations and field activities of at least 50m from watercourses where possible. Erosion control using 'polders', pads of plants and geo-nets should be implemented, as specified in the EIA and the relevant chapter of this SEIA.
Habitat Loss, Degradation and minimising fragmentation - forests	Limiting working width to 14m in forest habitats. Avoid the felling of mature trees wherever possible. Restrict working hours to daytime preventing noise pollution during twilight (dusk and sunrise). After BRUA installation, remediate impacts through restoration of impacted area as in specific mitigation below and as specified in the RMP (Restoration Management Plan). Restoration principles should be as follows unless there is bespoke specific mitigation for an area: • 8m should be planted with understorey trees; • 6m should be kept clear as a maintained RoW.
Habitat Loss, Degradation and minimising Fragmentation - Riparian areas	The BRUA route will cross 12 main rivers through directional drilling to minimise impacts. This should be conducted according to the prescriptions of the water Crossing CSEMP. Minimise works within riparian areas to safeguard aquatic organisms. Crossing points across other rivers will be conducted where there is clear access to the banks and vegetation clearance is minimised. The Biodiversity Specialist will determine for which riparian crossings a site specific method statement is required. Standard pollution control measures will be implemented i.e. to prevent silt contamination by keeping water out of the works area using appropriate isolation techniques, such as coffer dams, silt fences and by-pass channels. Protection of the pump inlet for abstraction to avoid drawing in aquatic life and other debris will be required. Ensure reinstatement is like-for-like (i.e. bank makeup, shape etc. should be maintained)

Impact	Mitigation General
	Where trees have to be removed to facilitate the crossing, these should be replanted with a similar species composition. Erosion control as specified in the appropriate chapter of the EIA, this SEIA and the Water Crossing CSEMP should be installed.
Habitat Loss and Degradation - general	Creation of new habitat features to include boulder piles (at a density of 3 – 5 stacks per km in suitable habitat), each one containing 3-5 cubic meters of material; and Dead wood piles and brash, to be created from removed forest features and installed at a density of 3 – 5 stacks per km, containing 3 – 5 cubic meters of material. Creation of ephemeral water bodies / ponds along the route at a minimum density of 1 feature per 3 – 5km as specified in the EIA (USI2016).
Fragmentation from clearance of vegetation	When working in areas utilised by large carnivores, do not sever entire forest block at any one time, stagger works to ensure that wildlife can traverse the forest block (see specific mitigation).
Habitat pollution due to run off into water and air pollution	Standard pollution control measures will be implemented i.e. to prevent silt contamination by minimizing the time spent on in water works, keeping water and sediment out of the works area using appropriate isolation techniques, such as coffer dams and by-pass channels and silt fences as specified in the water chapter of this SEIA. The Biodiversity Specialist will determine when further monitoring (e.g. for turbidity) and/or bespoke mitigation for in water works are required. Dust emissions due to road travel shall be minimized by regulating vehicle speed and watering roads (where required). Spill kits should be continually available and standard industry refuelling protocols should be followed. Vehicle refueling and maintenance to be undertaken on a purposely provided drip tray. Erosion control as specified in the appropriate chapter of the EIA should be installed.
Direct mortality of notable species	Store all food and food waste securely to prevent supporting populations of opportunistic species and minimize interactions between humans and animals. One Biodiversity Specialist will be associated with every active lot /spread. All Biodiversity Specialists will be appropriately skilled/trained for undertaking site supervision and species relocations where required. The location of sensitive species identified by the Biodiversity Specialist will be reported to the workforce appropriately. Biodiversity Specialist will be present during commencement of all works to conduct pre-construction checks, to prevent animals present within the working being killed or injured during the works. Checks will be for all vertebrate species such as ground nesting birds, reptiles, amphibians and bats. Checks will include within hollow trees and other places of shelter. As far as possible tree and scrub clearance will not be undertaken during the breeding bird season (March to August inclusive). Should clearance during this time be necessary a pre-clearance nesting bird check of the vegetation to be cleared will be undertaken by the Biodiversity Specialists and a decision on whether to move the nest or defer the clearance will be made by the Biodiversity Specialist.

Impact	Mitigation General
	The site will not be lit except in exceptional circumstances. Where lighting is required it will be directional and the lighting strategy will be designed with the input of a Biodiversity specialist. Only non-UV lighting sources will be employed in line with the EIA (USI 2016). Fill in pits and excavations as soon as possible following works; trenches and pits to be created for longer than 48h periods will have 45O ground ramps to allow escape by fauna should they fall in. A pre start check for fauna will be completed prior to works commencing in the morning if trenches are left open overnight. Ensure wildlife can cross excavations, berms and drainage channels. Install regular crossing points.
Disturbance to habitats and species Noise	Noise is likely to be highly localised and most receptors will likely avoid the noisiest areas or become habituated to certain noise. Some species may be particularly vulnerable and additional mitigation measures will be implemented as appropriate). These may be greater offsets or timing of works (see specific mitigation). Monitoring noise emitted from machinery, using less noisy machinery where appropriate. Noise barriers should be used around static equipment at all times and especially when noisy work (hammering) is being conducted.
Spread of non-native or invasive species (general)	Use of native plants that are locally sourced for re-planting. Identify a local source of indigenous saplings suitable for replanting programs in advance to facilitate restoration. Monitor restored areas implement mowing etc. to control growth of non-native species (see operational mitigation). Store all food and food waste securely to prevent supporting populations of opportunistic species (which could include non-native invasive fauna). A site wide ban on workers bringing vegetation or soil from outside the site area to prevent dispersion of non-native invasive species. Minimize topsoil movements. Wash down of all vehicles and equipment before entering the sensitive sites (see specific mitigation with regards to JK). Follow species specific mitigation regarding invasive species which includes demarcation and avoidance.
Operational Mitigation	During the operation of BRUA, maintenance of the RoW through forests will be required. Teams conducting this maintenance must be accompanied by a Biodiversity Specialist who will advise upon any sensitive areas and any remediation required. Vegetation removal within Natura 2000 sites must be conducted outside of March – August inclusive or a check for nesting birds must be conducted immediately prior to works commencing.
Unlikely events	Full time presence of a Biodiversity Specialist during the daytime for the works in sensitive areas Mitigation for unlikely events will include training of staff in: • The sensitivities of the habitats and species in the area via toolbox talks including health and safety recommendations regarding poisonous or otherwise dangerous plants or animals, provided by the Biodiversity Specialists.

Impact	Mitigation General
	• Prevention of accidents by adhering to good practice behaviour throughout the works. • Delegating authority to a Biodiversity Specialist whose job it is to ensure compliance of the required mitigation • Training in immediate response to bush fire, spillages etc. • Emergency numbers provided for Biodiversity Specialists should protected species be found on site in the absence of site supervision

12.8.4 **Mitigation and Restoration for Designated Sites**

Within all of the designated sites, mitigation will be implemented via bespoke method statements that will be developed for the following sites based on the information provided in the tables below:

- ROSCI0129 Nordul Gorjului de Vest;
- ROSCI0236 Strei – Haţeg;
- ROSCI0292 Coridorul Rusca Montană - Ţarcu – Reteza;
- ROSCI0138 Pădurea Bolintin;
- ROSPA0106 Valea Oltului Inferior;
- ROSCI0385 Râul Timis între Rusca şi Prisaca and
- ROSCI0063 Defileul Jiului.

Where these sites contain habitats identified as Critical Habitat, these habitats will be replanted within the RoW, insofar as is possible whilst maintaining an access strip of 6m. Where this access strip is provided, offsetting will be required to ensure that the conditions of PR6 are met. Offsetting is described in detail in the sections below.

12.8.5 **Bespoke Habitat Mitigation**

In addition to the GIP mitigation, proposed construction mitigation for all sensitive habitats identified along the route is outlined in Table 12.12.25, for all habitats, areas that support the sensitive habitat to be affected (including transitional/degraded states) will be mapped before construction commences using an International Association of Vegetation Science approved data collection method[48].

For CH not located within Natura 2000 sites, a bespoke method statement will also be created. Habitats likely to fall into this category include:

- Major river crossings;
- Natural forests outwith the Natura 2000 sites.

12.8.6 **Bespoke Species Mitigation**

Bespoke species mitigation for sensitive species is presented in the following tables. Impacts to other species can be adequately addressed via GIP mitigation.

48 http://iavs.org/

Table 12.12.25: Summary of bespoke habitat mitigation

Habitat Type and location	Mitigation / Restoration Method Description	Post restoration Monitoring	Trigger for Offset Requirements
Erosion/Scree Slopes			
8120 Grohotişuri calcaroase şi de şisturi calcaroase din etajul montan până în cel alpin (Thlaspietea rotundifolii); Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii); Thlaspietea rotundifolii is a class of vegetation developed on unstable, mobile screes formed of small to mid-sized rock fragments Present within ROSCI0129 Nordul Gorjului de Vest	Preconstruction surveys (as described above) Spring - Autumn will determine the extent of these habitats. Unless already recorded vegetation to be removed will first be mapped accurately using an International Association of Vegetation Science approved method data collection method. Soil/substrate sections will be removed (1x1m x 30cm deep) and will be stored in alignment to the route. During ecological restoration phase these soil/substrate sections will be reintroduced in the impacted area and properly watered if required during rain-deficient periods. These measures will be included within a bespoke method statement for the ROSCI0129 Nordul Gorjului de Vest Natura 2000 site.	Monitoring of the restoration success shall be targeted and monitored via the development of a BAP. Monitoring of the success of ecological restoration measures is recommended for 5 years (a minimum of 36 months monitoring is required) intervening as appropriate if corrective measures are required to support the restoration of habitats. During establishment, invasive species such as Bracken will be controlled.	There will be some short term loss of these habitats until the replacement habitat has established. This will require offsetting. (See Offset Strategy and table 12.40).
Grasslands (within Natura 2000 sites)			
6170 “Pajişti calcifile alpine şi subalpine”; Alpine and sub-alpine calcareous grasslands; 6430 Comunități de lizieră cu ierburi înalte higrofile de la nivelul câmpiilor, până la cel montan și alpin; Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels; 6520 Fânețe montane; Mountain hay meadows All located within ROSCI0129 Nordul Gorjului de Vest	Preconstruction surveys (as described above) in Spring to Autumn will determine the extent of these habitats. Unless already recorded, vegetation to be removed will first be mapped accurately using an International Association of Vegetation Science approved method data collection method. From the area to be directly impacted where these characteristic herbaceous flora assemblages are identified, soil/substrate sections will be removed (1x1m x 30cm	Monitoring of the restoration success shall be targeted and monitored via the development of the Framework BAP. Monitoring of the success of ecological restoration measures will be undertaken for a minimum of 36 months (5 years is recommended) intervening as appropriate if corrective measures are required to support the restoration of habitats.	There will be some short term loss of these habitats until the replacement grassland has established. This will require offsetting. (See Offset Strategy and table 12.40).

Habitat Type and location	Mitigation / Restoration Method Description	Post restoration Monitoring	Trigger for Offset Requirements
	deep) and will be stored in alignment to the route. The contractor must create the appropriate conditions for temporary storage of the sections in close proximity to the route (placing on pallets or on foil and nylon) and water the turfs as required. On completion of work, the turfs will be replaced on impacted areas. It may be necessary to water the turfs during periods of rain-deficiency. These measures will be included within a bespoke method statement for the ROSCI0129 Nordul Gorjului de Vest Natura site.		
Alpine heath			
4060 Tufărişuri alpine și boreale Alpine and Boreal heath ROSCI0129 Nordul Gorjului de Vest	Preconstruction surveys (as described above) in Spring to Autumn will determine the extent of these habitats. Unless already recorded vegetation to be removed will first be mapped accurately using an International Association of Vegetation Science approved method data collection method. Any woody vegetation removed will be stored at the extents of the working corridor and will be placed on top of the restored habitat to encourage natural re-colonisation. Where appropriate, substrate will be stripped with vegetation attached, this will be completed by stripping 1m2 turfs at a thickness of about 10 - 30 cm. The contractor must create the appropriate conditions for temporary storage of the sections in close proximity to the route (placing on pallets or on foil and nylon) and water the turfs as required. On completion of work, the turfs will be	Monitoring of the restoration success shall be targeted and monitored via the development of the Framework BAP. Monitoring of the success of ecological restoration measures will be undertaken for a minimum of 36 months (5 years is recommended) intervening as appropriate if corrective measures are required to support the restoration of habitats.	There will be some short term loss of these habitats until the replacement grassland has established. This will require offsetting. (See Offset Strategy and table 12.40).

Habitat Type and location	Mitigation / Restoration Method Description	Post restoration Monitoring	Trigger for Offset Requirements
	replaced on impacted areas. It may be necessary to water the turfs during periods of rain-deficiency. These measures will be included within a bespoke method statement for the ROSCI0129 Nordul Gorjului de Vest Natura 2000 site.		
Forests – Within Natura 2000 sites and semi-natural forests outwith Natura 2000 sites.			
Beech and Oak / Hornbeam forests 9110 Luzulo-Fagetum beech forests 9130 Asperulo-Fagetum beech forests 9150 Medio-European limestone beech forests of the Cephalanthero-Fagion 9170 Galio-Carpinetum oak-hornbeam forests 91L0 Illyrian oak –hornbeam forests (Erythronio-Carpinion) 91M0 Pannonian-Balkanic turkey oak-sessile oak forests 91V0 Dacian Beech forests (Symphyto-Fagion) 91Y0 Dacian oak & hornbeam forests Spruce Forests 9410 Acidophilous Picea forests of the montane to alpine levels (Vaccinio-Piceetea) Within Natura Sites: ROSCI0129 Nordul Gorjului de Vest, ROSCI0138 Pădurea Bolintin, ROSCI0292 Coridorul Rusca Montană - Ţarcu - Retezat	The detail of the community composition for these areas are included within the associated permits for tree removal. The working corridor will be reduced to 14m in these areas. Felling of trees will be undertaken between September and February inclusive, felling of trees during the breeding bird season (March to August inclusive is to be avoided). Noisy work (i.e. hammering is not permitted in these areas from March to August inclusive). Dead wood should be retained on site. Replanting of forest will include appropriate native species and replaced at a 1 for 1 ratio. Large trees will not be planted on the 6m area RoW although this area will be permitted to colonise naturally. These measures will be included within a bespoke method statement for the following sites. ROSCI0129 Nordul Gorjului de Vest ROSCI0138 Pădurea Bolintin ROSCI0292 Coridorul Rusca Montană - Ţarcu - Retezat	Monitoring of the restoration success shall be targeted and monitored via the development of the Framework BAP. Monitoring of the success of ecological restoration measures will be undertaken for a minimum of 36 months (5 years is recommended) intervening as appropriate if corrective measures are required to support the restoration of habitats.	There will be some mid-term loss of these habitats until the replacement planting within the RoW has matured. There will also be a permanent loss of some of the forest resulting from the maintenance of the RoW (a 6m wide corridor is to be maintained). This will require offsetting. (See Offset Strategy and **Error! Reference source ot found.**).
Ponds / ephemeral water bodies			

Habitat Type and location	Mitigation / Restoration Method Description	Post restoration Monitoring	Trigger for Offset Requirements
Ponds / ephemeral water bodies Throughout the route	Large waterbodies and wetlands were avoided by the BRUA route, however small ponds occur throughout the route and have not been mapped. Some ponds along the route will qualify as priority biodiversity features. All ponds likely to qualify as PBF should be mapped prior to enabling or construction. If the ponds are to be destroyed, drainage should be conducted via pumping with a suitable pump filter (to prevent animals and debris being drawn into the pump). All animals present within the pond should be moved to appropriate habitats away from the works. If possible, pond drainage should be avoided April – September. Replacement of these ponds is required on a minimum of a 1 to 1 replacement, dug to mimic the size and location of the ponds lost and using liners to retain water where hydrologically required.	Monitoring of the restoration success shall be targeted and monitored via the development of the Framework BAP. Monitoring of the success of ecological restoration measures will be undertaken for a minimum of 36 months (5 years recommended) intervening as appropriate if corrective measures are required to support the restoration of habitats.	There will be short-term impacts until new / replacement ponds have established. This will require offsetting. (See Offset Strategy and Table 12.40). The offsets would include the additional creation of 1 pond / ephemeral water body per 3-5km (in addition to the 1 for 1 replacement) to allow for the short term loss of ponds throughout the route. This is described in the Environmental Permit for the project.
Riparian Areas			
Riparian Areas	There are areas of riparian habitat that qualify as priority biodiversity features and may qualify as CH. The method of crossing has been determined by considering the width of the river, the composition of the river bed and the volume and the flow of the river. Crossings will either be directionally drilled avoiding the need to dig up the river bed or open cut (wet or dry using coffer damns depending on the status of the watercourse). Silt fences would be used in areas of wet open cut, strategically positioned to prevent sedimentation	Monitoring of the restoration success shall be targeted and monitored via the development of the BAP. Monitoring of the success of ecological restoration measures will be undertaken for a minimum of 36 months (5 years recommended) intervening as appropriate if corrective measures are required to support the restoration of habitats.	There will be short to mid-term impacts until the benthos (river bed) self establishes and the banks re-vegetate and stabilise. This will require offsetting. (See Offset Strategy and Table 12.40). Offsetting will take the form of improved bankside vegetation in degraded areas to offset impacts across the project RoW.

Habitat Type and location	Mitigation / Restoration Method Description	Post restoration Monitoring	Trigger for Offset Requirements
	downstream. Banks would be restored using either gabion cages, wooden revetments or appropriate geo textile membranes to ensure soil/integrity before vegetation matures to provide soil stability. There would be re-planting of scrub in some areas or vegetation would be allowed to colonise naturally as appropriate. All riparian works and river crossing should follow the prescriptions of the water chapter of this SEIA.		

Table 12.12.26 – Specific mitigation for plant species (including non-native invasive species)

Species and reasons for Specific Mitigation	Mitigation Method Description	Works ahead of construction programme required	Locations	Offsetting / Monitoring
Uncommon Plant Species				
Carpathian Tozzia, Greater Pasque Flower, Blue Bell Steppe Iris Species of value = or > 3, present within Natura 2000 sites.	Investigate the areas to be affected prior start of the works in order to identify the presence of these species during Spring - Autumn, this will also set targets for the BAP. Mapping of local distribution of the species and the local conditions of microhabitat; Cutting of turfs 1 by 1m and 30cm deep containing the species; Appropriate storage of the turfs; Restoration of the turfs post construction. Monitor the success of the restoration measures will be undertaken for a minimum period of 36months (5 years is recommended). The translocation of habitats for these species will be formalised by a bespoke method statement.	Mapping of locations (	For Carpathian Tozzia primarily from 271 to 286, for other locations see Section 12.6.5.	No – Offsetting via Natura grasslands and forests Monitoring via BAP
Invasive Plant Species				
Acacia (Robinia pseudoacacia) is present throughout the route and	Robinia pseudoacacia establishes readily in open areas with exposed soil so minimise the amount and time of soil exposure.	Tool box talks to help the construction team	Unknown - to be mapped prior to works	No offsetting

Species and reasons for Specific Mitigation	Mitigation Method Description	Works ahead of construction programme required	Locations	Offsetting / Monitoring
can spread reducing the quality of other habitats cutting of trees enhances vigorous regrowth of root suckers and necessitates increased future control measures to limit dispersal.	When cutting trees, the best season to do so is in August which gave the lowest volume of sprouts.49	identify the species so that they do not cut indiscriminately.	commencing.	Monitoring via BAP
Jerusalem artichoke (Helianthus tuberosus) is present throughout the route and can spread reducing the quality of other habitats	Mowing twice a year in late June and in August or hand pulling the tubers in October has proved successful50	Mapping of plant locations	Unknown to be mapped prior to works commencing	
Japanese knotweed ~(Fallopia japonica) is extremely invasive it is present throughout the route and can spread reducing the quality of other habitats	Investigate the areas to be affected prior start of the works in order to identify the presence of this species during April-October. Identify this species to the construction workers and ensure that stands of these species are demarcated. Avoid all ground-breaking works within 10m of this species. Works in exclusion areas should be conducted according to the prescriptions of a bespoke method statement. When works are completed in areas where Japanese knotweed is present, machinery must be washed down prior to moving into non-infested areas, preferably with a jet wash.	Pre-enabling - mapping a demarcation of stands of this species. Tool box talks to help the construction team identify the species.	Unknown to be mapped prior to works commencing	
Bracken (*Pteridium* sp.**)** is native but can become invasive rapidly and so is a threat to Annex 1 habitat quality when habitat is temporarily removed and degraded	Particularly within ROSCI0236 Strei-Haţeg, For bracken control following restoration (rather than eradication one can cut/roll/flail bracken at least twice in the first year (in May/June and again in July/August).	Tool box talks to help the construction team identify the species.	Unknown to be mapped prior to works commencing	

49 E. Boer, 2013, Risk assessment *Robinia pseudoacacia* L. Naturalis Biodiversity Center, Leiden.
50 http://www.cabi.org/isc/datasheet/26716

Table 12.12.27 Specific Mitigation for PBF Animal Species

Species and Reasons for Specific Mitigation requirement	Mitigation Method Description	Works ahead of construction programme required	Locations	Offsetting / Monitoring
Amphibians				
Fire-Bellied Toad (*Bombina bombina*), Yellow-Bellied Toad (*Bombina variegata*) etc. Protected under European law. Species of value = or > 3, present within Natura 2000 sites	Identification and mapping of areas occupied by these species prior to the commencement of clearance. If ponds are to be destroyed, drainage should be conducted via pumping with a suitable pump filter (to prevent animals and debris being drawn into the pump). Animals present within the pond to be moved to appropriate habitats away from the works. Pond drainage to be avoided April-September where possible. Checks to be conducted by Biodiversity Specialist ahead of excavation. Where highly suitable habitat is in close proximity to the active working corridor barriers to movement of amphibians into the works (fences mesh fabric/plastic) may be required to be determined by the Biodiversity Specialist; the active working corridors will be maintained properly in order to avoid creation of puddles capable of attracting amphibians; Conduct standard measures to limit water pollution. Offset requirement: For impacts to this species group some offset is required to ensure a no net loss outcome inline with PR6. See the 'Ponds' offsetting details.	Mapping of all ponds. Translocation of amphibians away from works area.	Entire route	No – Offsetting via Ponds Monitoring via BAP
Birds				
Nesting waterfowl including Eurasian Oystercatcher (Hematopus ostralegus) Listed on Red book of vertebrates in Romania. Species of value = or > 3.	Ensure that checks are made nests of these species, particularly Eurasian Oystercatcher (Hematopus ostralegus) ahead of the clearance (March to August inclusive). The oystercatcher nest location is usually a bare scrape on pebbles or bare earth, on the coast or on inland gravelly islands. 2–4 eggs are laid. Both eggs and chicks are highly cryptic. Once works are complete, ensure that habitat utilised (i.e. bare scrape etc.) is reinstated.	Check for nests in occupied sections. Mapping of suitable nesting habitat for post construction replication.	See section 12.6.5	No – Offsetting via Riparian Areas and Monitoring via BAP
Raptors, gliding birds and other PBF birds including red-footed	If practicable, all trees should be removed outwith the bird nesting season prior to works commencing. Conduct specific checks for nests of these species if tree	Check for nests in	All trees should be	Offsetting via bird boxes in

Species and Reasons for Specific Mitigation requirement	Mitigation Method Description	Works ahead of construction programme required	Locations	Offsetting / Monitoring
falcon (Falco vespertinus). Near threatened on IUCN red list. Species of value = or > 3, present within Natura 2000 sites	removal required in the bird nesting season. (March to August inclusive). The red-footed falcon (Falco vespertinus) species largely nests in colonies, using abandoned corvid (crow) nests. If this species is identified to be nesting within the works areas, the trees within which they are nesting must not be removed until the young have fledged and noisy works will be avoided.	occupied sections.	assessed for bird nests ahead of removal during the bird nesting season. Ex corvid nests in mature trees along the route should be particularly focussed on. See section 12.6.5	Environmental Permit (150 boxes) and forest planting. Monitoring via BAP
European Turtle Dove Endangered, present along the route. Species of value = or > 3	Specific checks for nests of this species must be conducted if tree removal is required in the bird nesting season. (March to August inclusive).	Check for nests in occupied sections.	Within trees along the route	Offsetting via bird boxes in Environmental Permit (150 boxes) and forest planting. Monitoring via BAP
Fish				
All fish graded as 3 or above, most notably Carpathian Brook Lamprey (*Eudontomyzon danfordi*), Danubian Brook	Works will follow general mitigation for riparian crossings to limit impacts from silt and pollution. In riparian areas and crossings identified as CH or PBF works will follow a specific	Identify sensitive areas - fast flowing rivers with rocky bottoms and rivers within Natura 2000	See section 12.6.5	Offsetting via riparian area offsetting.

Species and Reasons for Specific Mitigation requirement	Mitigation Method Description	Works ahead of construction programme required	Locations	Offsetting / Monitoring
Lamprey (*Eudontomyzon vladykovi*) Golden Spined Loach (*Sabanejewia aurata*). species of value = or > 3, present within Natura 2000 sites	method statement. Prior to work commencing, river bed will be disturbed with a rake so to drive away the specimens hiding under the rocks and silt. Any specimens found within a coffer dam will be moved by hand to the river channel. Seek to avoid works during periods of maximum sensitivity of the species in river located at 313 – 314km (April – August).	sites. Highest sensitivity is April-August.		Monitoring via BAP
Invertebrates (Terrestrial)				
Scarce Fritillary Butterfly (*Euphydryas maturna*) Species of value = or > 3, present within Natura 2000 sites	Search for species. If present relocate by carefully cutting the branches of ash tree or leaf litter filled with larvae or pupae of the colonies of this species and these will be moved to the vicinity of ash trees in close proximity In the long term, planting of hazel (*Corylus avellana*) and management of hazel through coppicing may have a positive impact upon this species. The searches and movement of this species will be formalised by a bespoke method statement.	Identification of larvae on ash trees and in leaf litter Movement of ash cuttings away from works.	Throughout BRUA – See section	Offsetting via forest area offsetting. Monitoring via BAP
Fisher's Estuarine Moth (*Gortyna borelii lunata*) Species of value = or > 3, present within Natura 2000 sites	Identify areas containing the host plant (*Peucedanum officinale*) and collect seeds. Transplanting plants of *Peucedanum officinale* together with a deep section of surrounding earth (up to 70 - 80 cm), into adjacent suitable areas. When replanting the impacted corridor through areas where this plant was present, reseed the area with a seed mix containing *Peucedanum officinale*. The searches and movement of this species will be formalised by a bespoke method statement.	Excavating and moving *Peucedanum officinale* from the works corridor to adjacent habitats when within kms 311 – 321.	See section 12.6.5	Offsetting via grassland area offsetting. Monitoring via BAP
Scarce Large Blue Butterfly (*Maculinea teleius*) Species of value = or > 3, present within Natura 2000 sites	Prior to works commencing in areas suitable to support *Maculinea teleius,* a thorough investigation will be made in order to spot the presence of host-plants (*Sanguisorba officinalis*) and to verify the presence of, *Myrmica scabrinodis* heaps (an ant species with which the lifecycle of *Maculinea teleius* is linked). Where habitat conditions are met, translocation of plants with soil, in the areas to be impacted into nearby suitable habitat will be conducted, in the vicinity of *Myrmica scabrinodis* heaps. The translocation of this habitat for this species will be formalised by a bespoke method statement.	Translocation with soil of *Sanguisorba officinalis plants when on the route to adjacent retained habitats.* *Primarily in sections* 272 to 285 and 313 to 318.	See section 12.6.5.	Offsetting via grassland area offsetting. Monitoring via BAP
Hermit Beetle (Osmoderma	Dead, decaying or veteran trees/wood will be preserved where possible or	Identification and	km 311 to	Offsetting via

Species and Reasons for Specific Mitigation requirement	Mitigation Method Description	Works ahead of construction programme required	Locations	Offsetting / Monitoring
eremita) and other dead wood invertebrates Species of value = or > 3, present within Natura 2000 sites	retained as cut timber on site; i.e. all trees with hollows offering potential habitat conditions for this species will be cut and laid in front of some trees with similar hollows thus facilitating individuals of the species switching from one micro-site to the other. The translocation of this habitat for this species will be formalised by a bespoke method statement.	inspection of all dead or hollow trees within section 311 to 316. These should be cut and placed adjacent to retained hollow trees.	316, See section 12.6.5	forest area offsetting. Monitoring via BAP
Danube Clouded Yellow Butterfly (Colias myrmidone) IUCN Endangered Species of value = or > 3.	Survey for presence of food-plant (genus Chamaecytysus.) Where identified, translocate plants and plantlets with soil (turfs up to 1 by 1m and 30cm deep), to nearby areas supporting similar conditions. During ecological restoration works, seeds of Chamaecytisus will be used in order to restore the vegetal cover and to contribute to the multiplication of food-sources. The translocation of this habitat for this species will be formalised by a bespoke method statement.	Identification and excavation ./ translocation of Chamaecytysus plants from within the working corridor in kms 1 – 272 and 395 – 529. Collection of Chamaecytisus seeds ahead of the works.	km 1 - 272 km 395 - 529, See section 12.6.5..	Offsetting via grassland area offsetting. Monitoring via BAP
Steppe Grasshopper (Isophya costata), Bush Grasshopper (Isophya stysi) Species of value = or > 3, present within Natura 2000 sites	In meadows containing long grass that might support this species, the grass sward should be cut / strimmed ahead of the works and piled to dry away from the works corridor. Once the works are complete, this hay should be scattered across the impacted area to facilitate ground stabilization and to encourage regrowth of the meadow species.	Strimming / cutting of tall meadow to be traversed by the route.	where long meadow grass is present.	Offsetting via grassland area offsetting. No monitoring
Mammals				
Otter (Lutra lutra): Protected under EU law. Species of value = or > 3, present within Natura 2000 sites	All river crossings to have dedicated survey to confirm absence of holts or other resting features within the direct zone of impact of the works. This can be completed by the Biodiversity Specialist during the walkthrough. If features are found, features to be excluded to otters prior to works commencing. During works within rivers, movement through the works area by Otters will be permitted over the banks.	Searching for holts within areas to be impacted by river crossings.	All river crossings.	Offsetting via riparian area offsetting. Monitoring via BAP
Bats ALL – including Barbastelle (Barbastella barbastellus), Mediterranean Horseshoe Bat,	Any tree above 100mm in diameter to be checked by the Biodiversity Specialist for the potential of roosting bats prior to removal (i.e. the presence of potential roosting features). If bats are found, the roost will be left undisturbed until	Investigation of all trees over 100mm with suitable hollow ahead	Throughout the route particularly	Offsetting via forest area offsetting and

Species and Reasons for Specific Mitigation requirement	Mitigation Method Description	Works ahead of construction programme required	Locations	Offsetting / Monitoring
Greater Horseshoe Bat, Lesser Horseshoe Bat (Rhinolophus Euryale, Rhinolophus ferrumequinum, Rhinolophus hipposideros), Long-fingered bat (Myotis capaccinii) Protected under EU law. Species of value = or > 3, present within Natura 2000 sites.	vacated by bats. All felled trees with evidence of roosting bats (i.e. with suitable cavities showing signs of occupation (droppings, feeding remains, grease markings), including those which could not be inspected by the Biodiversity Specialist will be left in situ (on the ground) for 24 hours to allow any bats to move. If possible no trees will be felled in the period March to August. Non-UV sources of lighting will be used for working sites, deposits and permanent facilities (SCG) not to attract the nocturnal insects and thus the bats that feed on them in order to avoid the risk of predation competition. Installation of bat boxes within forests to mitigate for loss of roosting sites. See Specific offsetting table. Offset - see specific offsetting table to mitigate for potential midterm habitat loss.	of works.	old forest stands – see section 12.6.5.	the installation of 200 bat boxes. Monitoring via BAP
Brown Bear (*Ursus arctos*), Wolf (*Canis lupus*), Eurasian Lynx (*Lynx lynx*) Protected under EU law. Species of value > 4, present within Natura 2000 sites.	Identification and mapping of areas occupied by these large mammal species prior to the commencement of the work. A 500m wide buffer should be surveyed by the Biodiversity Specialist for tracks and dens. If tracks & dens are found and litter presence confirmed, a case by case solution will be considered. Sections that overlap with the territory of lynx, in the period from March to May, the works will be carried out only during the day in order to limit disturbance. Sections that overlap the territory of bears during March-June, will work only during the day in order to limit disturbance. Where hammering is required within areas which support these species, works should be avoided in the period March – June. Work within sectors which contain bears, wolf or lynx will be staged in that the entire section will not be severed at any one time (so that bears can traverse the working area). All staff will receive a tool box talk identifying the potential presence of these species and advising upon the correct actions to take should these species be encountered. The need for good housekeeping (i.e. no litter, food stored appropriately will also be communicated). Offset as a precautionary measure due to lack of field data knowledge.	Planning of works to ensure complete severance of areas utilized by these species does not occur.	km 271-289 see section 12.6.5.	Offsetting via forest area offsetting and prescriptions for Natura 2000 sites. Monitoring via BAP
Forest Dormouse (*Dryomys nitedula*) Red list in Romania Species of value = or > 3.	Restore forest as within general mitigation. within forests, when BRUA pipeline completed create crossing points between retained trees to allow species dispersal.	N/A	All forested areas	Offsetting via forest area offsetting. Monitoring via

Species and Reasons for Specific Mitigation requirement	Mitigation Method Description	Works ahead of construction programme required	Locations	Offsetting / Monitoring
				BAP
European ground squirrel (*Spermophilus citellus*) Balkan mole rat (*Spalax graecus*) Red list in Romania, Species of value = or > 3.	Prior to works commencing Biodiversity Specialist to identify any burrows of these species present and limit impacts within these areas insofar as possible. In such areas soil will be stripped using hand tools and any individuals of these species found will be moved / allowed to move to unaffected habitat. Ramps should be installed within open trenches to allow these species to escape should they become trapped and in areas where this species is present a morning trench check should be performed. All works must be informed of the threatened status of these species to prevent persecution.	Identifying areas where these species are present.	Primarily within grasslands	Offsetting via grassland area offsetting. Monitoring via BAP
Reptiles				
European Pond Turtle (*Emys orbicularis*) Protected by EU law. IUCN Near threatened	Working areas to be carefully searched by the Biodiversity Specialist prior to the commencement of the work; Any individuals found on site will be relocated to favourable habitats. Ramps should be installed within open trenches to allow these species to escape should they become trapped and in areas where this species is present a morning trench check should be performed.	Installation of barrier around working corridor km 1 -6 if deemed necessary by the Biodiversity Specialist.	Primarily km 1 -6 see section 12.6.5..	Offsetting via riparian and forest area offsetting. Monitoring via BAP
Hermann's Tortoise Protected by EU law (*Testudo hermanni*). IUCN Near threatened,	The sectors overlapping ROSCI0385 will be searched by Biodiversity Specialist immediately prior to start of works; Nearby locations fulfilling ecological requirements of the species will be identified and any individuals within the works area will be moved to these sites. No dogs will be allowed within working area in the vicinity of ROSCI0385. Ramps should be installed within open trenches to allow these species to escape should they become trapped and in areas where this species is present a morning trench check should be performed.	Installation of barrier around working corridors km 404 – 406 if deemed necessary by Biodiversity Specialist.	Primarily km 404-406, s see section 12.6.5.	Offsetting via riparian and forest area offsetting. Monitoring via BAP

12.8.7 **Residual Effects**

After the initial stages of the mitigation hierarchy have been applied, some residual impacts remain. These residual impacts after mitigation are outlined in Appendix 12.3. After the implementation of the mitigation outlined in the section above, the majority of residual effects are expected to be low and many will be significant in the Short-term only. There will be a range of Short-term impacts upon receptors including disturbance, fragmentation, conversion of habitats to habitats of lower value and potential mortality during construction. Suitable mitigation for this including the installation of artificial habitat features is presented in Appendix 12.3. Temporary habitat loss and degradation issues due to the construction will be addressed largely through habitat restoration.

Mid-term impacts from BRUA will need some offsetting, for example, the impact of the loss of forest CHs, uncertainties around restoration success for grassland and riparian areas and the mid-term loss of mature forest until the restored elements mature.

Long-term impacts from the maintenance of a 6m working strip through forest will also need to be mitigated for. Potential approaches to offsetting these impacts are presented below. Certain elements for offsetting require additional data capture to confirm which would be undertaken prior to enabling works.

Offsetting seeks to result in no net loss of PBF and net gain of CH. The details of the offsetting must be calculated once the habitat to be removed and potential offsetting locations have been identified in the pre works surveys. Removal and control of invasive species and by the improvement of other habitat quality via offsetting has the potential for a net benefit.

12.9 Offsetting Strategy

12.9.1 Offsetting Strategy Introduction

In order to meet EBRD PR6, impacts to Priority Biodiversity Features (PBFs) and Critical Habitats (CH) must be mitigated to the extent that there is no-net-loss of PBFs and to achieve net gain of CH. Whilst it may sometimes be possible to achieve this within a Project's own footprint (i.e. on-site) often this must be undertaken off-site (i.e. offsetting).

The concept of no net biodiversity loss lies at the heart of biodiversity offsetting, where biodiversity gains from targeted conservation activities match the losses of biodiversity due to the specific project impacts. As a result there should be no overall reduction in the type, amount and condition (or quality) of biodiversity over a given space and time. A net gain means that biodiversity gains exceed a specific set of losses. The key approaches to achieving no-net -loss are explained in Diagram 12.2 below (from BBOP 2012[51]).

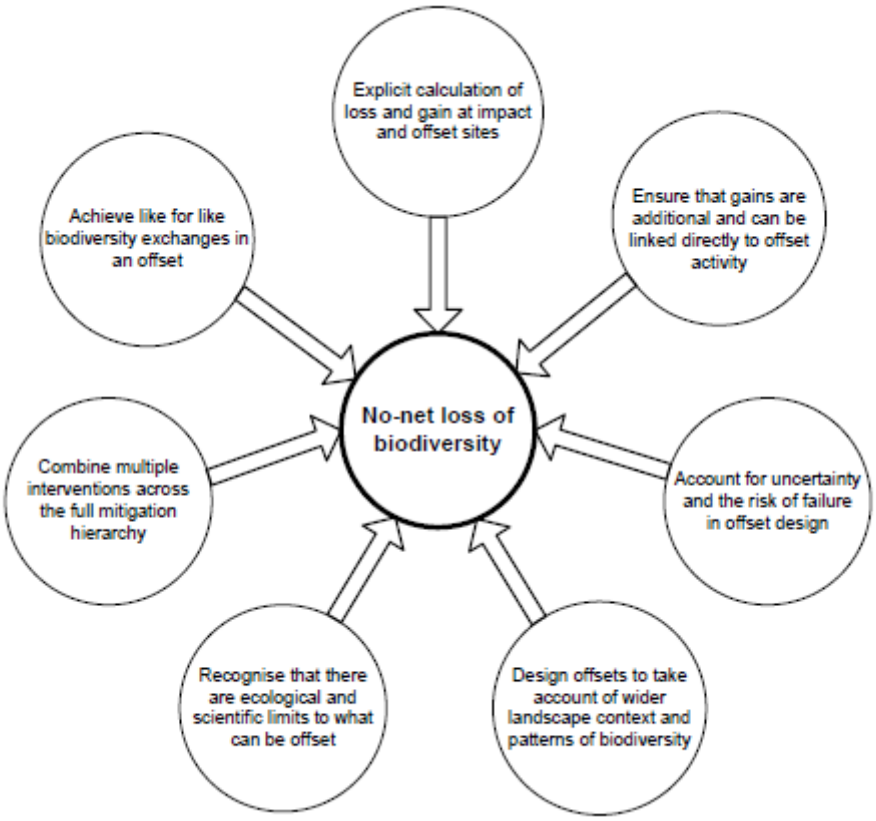

Diagram 12.2: Key approaches to achieving no-net-loss

The methodology through which identified losses are addressed must follow the mitigation hierarchy whereby the preferred approach is to initially avoid, minimise and then subsequently mitigate impacts on site via habitat restoration to an equal or better quality. The figure below outlines the restoration and offset approach. Traditionally a range of approaches are required to be implemented to ensure no-net-loss of PBFs and net gain for CH, these should be centred around habitat creation but can include a range of other measures, termed Additional Conservation Actions which are outlined in Section 12.10.3 below.

51 Business and Biodiversity Offsets Programme (BBOP). 2012. *Resource Paper: No-net-loss and Loss-Gain Calculations in Biodiversity Offsets.*

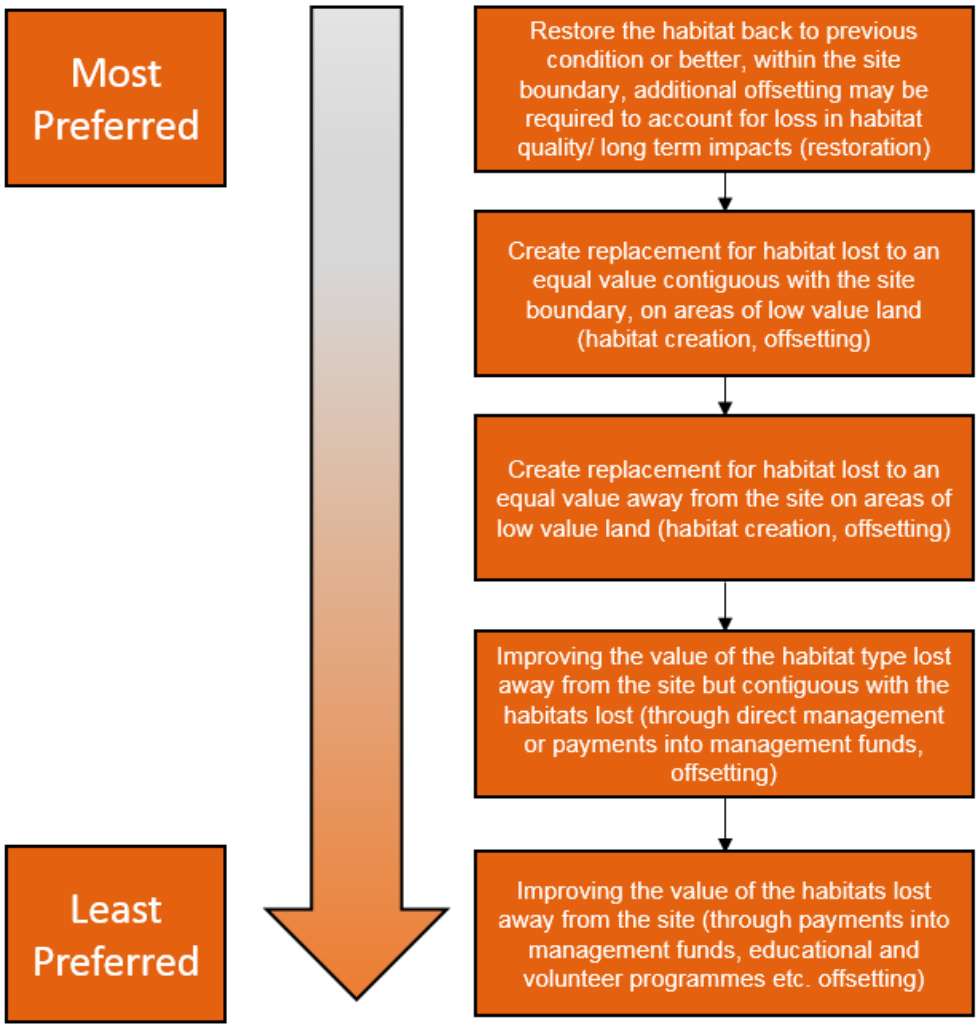

Diagram 12.3: The restoration and offsetting hierarchy

12.9.2 Quantifying biodiversity loss and gain - setting Metrics and Surrogates

The assessment of biodiversity losses and gains between impact and offset sites is a key part of calculating no-net-loss / net gain. There is a wide range of published and unpublished methods for quantifying biodiversity offsets, varying in application and calculation, but broadly they all consider the following steps:

- the selection of key biodiversity receptors (e.g., area of habitat, breeding pairs of a threatened bird species etc.);
- the choice of units of measurements to quantify changes in biodiversity value (e.g., area of vegetation x ecological condition);
- the choice of an accounting model or system based on the chosen units of measurement which integrates various other considerations in order to define offset specifications; and
- the availability of (or opportunity to collect) spatial information on patterns of biodiversity at the impact and candidate offset sites.

As it is often impossible to measure and account for all aspects of biodiversity when designing an offset, such offset design, like other practical conservation applications, relies upon

surrogates or proxies intended to represent biodiversity more generally. Often, the choice of a currency to quantify biodiversity exchanges is habitat areas (e.g. area of vegetation x ecological condition)52. It is likely that a habitat driven approach, potentially using selected species as indicators of success would be utilised in this instance.

12.9.3 **Offsetting Strategy Methodology proposed for BRUA**

The ultimate approach to no-net-loss/net gain calculations should evolve in liaison with key stakeholders, including but not limited to appropriate regulators and the Bank. However, at this stage the following sections propose a general approach to offset design and calculations to be adopted.

Most calculations are based on area and the 'value' of the habitat to be lost and replaced, the latter formulated based on the distinctiveness and condition of the existing and target habitat. These calculations also take into account the reduction in distinction of replacement habitat and the time required for that habitat to reach maturity as well as any uncertainty around the success of habitat restoration/replacement. Resulting from this calculation of change in area and quality a 'multiplier' is formed, whereby replacement habitats are then created at a set multiplier. An example of the scoring matrix is shown in Table 12.12.28 below, this one follows the approach by Treweek and Butcher 2010[53].

Table 12.12.28: Scoring matrix for habitats to be lost/replaced

Scoring matrix		Biodiversity Distinctiveness			
		Very Low (0)	Low (2)	Medium (4)	High (6)
Condition	Optimum (4)	0	8 (0.33)	16 (0.67)	24 (1.0)
	Good (3)	0	6 (0.25)	12 (0.50)	18 (0.750
	Moderate (2)	0	4 (0.17)	8 (0.33)	12 (0.50)
	Poor (1)	0	2 (0.08)	4 (0.17)	6 (0.25

Given that, whilst a portion of the habitat required may be replaced on site, but a portion may also need to be "offset" away from the site, the additional area created is used to account for the mid to long term reduction in habitat quality due to time taken to reach maturity, and also that in the case of certain habitats it may never reach the same "distinctiveness". This calculation is performed per habitat type, as each habitat has differing "value", "distinctiveness" and recovery rates/ease of recreation. To ensure net gain for CH types, an improvement in condition to a larger area of contiguous habitat would generally be considered appropriate.

The area of habitat to be lost, multiplied by the score from the matrix produces the credits required for achieving no-net-loss. If several habitat types are present, the assessment must be repeated for each one and the results summed to give the overall no-net-loss requirement.

An example of how this would be applied is shown in the Tables below and presented in Diagram 12.4 below.

This calculation would evolve during the project as the exact areas of each habitat type to be lost are known. For the loss of CH in this example, a no-net-loss calculation for the 6m to be felled within the RoW (using poor habitat areas such as degraded arable land and/or felled forest to replace the High distinctiveness / optimum condition habitat lost) would result in a ratio of 1 to 1.7 for CH lost to CH replaced. For the 8m within the RoW that is to be replanted with understorey trees appropriate to the CH or PBF habitat type to make up for the loss of

52 Business and Biodiversity Offsets Programme (BBOP). 2012. Resource Paper: No-net-loss and Loss-Gain Calculations in Biodiversity Offsets.

53 Treweek, J., Butcher, B. (2010) Biodiversity offsets: possible methods for measuring biodiversity losses and gains for use in the UK

quality an off-site replanting ratio of 1 to 0.56 ha would be appropriate to demonstrate no-net-loss. Net gain could be achieved by management of the wider area.

The reason for this is that the habitat to be created will be of lower distinctiveness and quality than that lost, and the time required for that habitat to reach functional maturity therefore the replacement habitat requires a greater area. In addition, it would be important to account for the existing "value" of any enhanced site.

For some habitats, providing appropriate restoration, management and monitoring is undertaken, for example Natura grasslands, there should be no-net-loss or significant adverse effect on the habitats in the mid to long term and the BAP may be the best means of securing that result.

For the forest the following calculation will ensure no-net-loss, when considering area and quality of habitat replaced. To ensure net gain further enhancements could take the form of additional planting, management, restoration or financial contributions to management actions within the wider area for example removal of invasive species and management of the age structure of the forest and would add value to the existing habitat.

For example, it would also be possible to produce offsetting 'units' from modifying existing management regimes to increase the value of the CH (i.e. a move from clearcutting to a more sensitive management). Calculations could be conducted as below using the parameters in Table 12.12.28 based on the increase in the 'condition' of the CH type.

In certain cases, lower ratios of habitat replacement may be appropriate, for example if there is greater certainty around the success of the restoration/replacement of habitat in terms of achieving the same quality in a shorter time or if it can be created on existing very degraded land with poor condition and low distinctiveness.

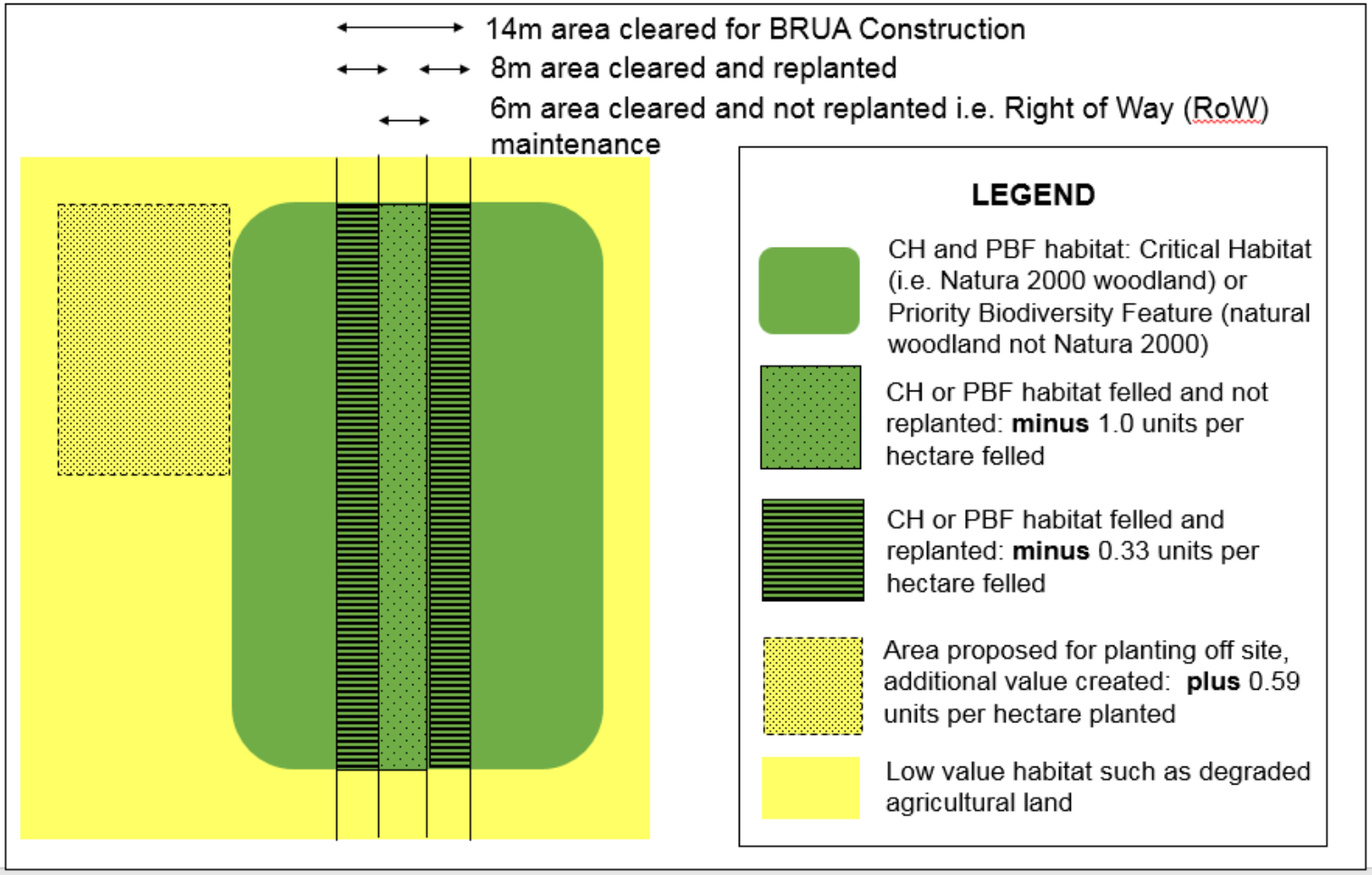

Diagram 12.4: Diagram showing concept of off-site planting and areas referred to in the following calculations

Table 12.12.29: No-net-loss units required for habitat to be lost (example calculation forest felled on the RoW per hectare and not replanted)

Habitat Type	Area (per ha lost to construction (i.e. the 6m wide strip))	Distinctiveness (before construction)	Condition (before construction)	Matrix score (before construction)	Baseline habitat units (per ha)	Distinctiveness(after construction (i.e. replanted grassland))	Condition (after construction)	Matrix score (after construction)	Matrix score value lost
Natura 2000 Forest e.g. Medio-European limestone beech forests of the Cephalanthero-Fagion (9150)	1.0	High	Optimum	1.0	1.0 x 1.0 =1.0	Very low	Moderate	0	1.0

Felling within the 6m right of way and replanting with grassland will result in a loss of a matrix value score of -1 accounting for the loss and conversion of habitat.

Table 12.12.30: No-net-loss units required for habitat to be converted (forest felled and replanted on site on the 8m replanting area) example calculation (example BRUA figures)

Habitat Type	Area (per ha lost to construction (i.e. the 8m wide strip))	Distinctiveness (before construction)	Condition (before construction)	Matrix score (before construction)	Baseline habitat units (per ha)	Distinctiveness (after replanting understorey trees)	Condition (after replanting target)	Matrix score (after replanting)	Matrix score value lost
Natura 2000 Forest e.g. Medio-European limestone beech forests of the Cephalanthero-Fagion (9150)	1.0	High	Optimum	1.0	1.0 x 1.0 =1.0	Medium	Optimum	0.67	1.0ha - 0.67 = 0.33

By losing mature CH and PBF value forest and replanting with understorey trees in the 8m within the RoW a matrix value of -0.33 units has been lost due to the development. This loss in value is after the replanting of the 8m and accounts for the conversion of habitat.

Table 12.12.31: Value example calculation potential 'increase' to achieve no-net-loss using a receptor area off-site

Receptor habitat Type	Area (per ha to be planted	Distinctiveness (baseline)	Condition (baseline)	Matrix score	Baseline habitat units (per ha)	Distinctiveness after planting (i.e. creation of habitat)	Condition (after planting target)	Matrix score (after panting)	Target potential value (after planting per ha)	Change in matrix score value (after planting per ha)
Low value habitat (i.e. felled forest on the RoW or degraded agricultural land off site)	1.0ha	Low	Poor	0.08	1.0 x 0.08 = 0.8	Medium	Optimum	0.67	1.0 x 0.67 = 0.67	0.67 – 0.8 = 0.59

Given a receptor habitat value of 0.08 units, which can increase in value to a total of +0.67 units this gives a net positive change in the receptor habitat type of +0.59 units.

Table 12.12.32: Value example calculation of "created area" to replace 6m CH/PBF habitat felled

Receptor habitat Type	Action	Matrix score value lost (per ha)	Matrix score achieved for planting off site per ha	Ratio of area required to be planted off site to replace habitat lost (per ha)
Low value habitat (i.e. felled forest on the RoW or degraded agricultural land off site)	Plant to Annex 1 forest of type lost (good condition high value offsite)	**1**	0.59	1/0.59 = 1.7

For the CH/PBF habitat felled and planted off site a ratio of 1 to 1.7 would be appropriate to demonstrate no-net-loss. Net gain could be achieved by management of the wider area.

Table 12.12.33: Value example calculation of "replanted area" to replace 8m CH/PBF habitat felled

Receptor habitat Type	Action	Matrix score value lost (per ha)	Matrix score achieved for planting off site per ha	Ratio of area required to be planted off site to replace habitat lost (per ha)
Low value habitat (i.e. degraded agricultural land off site)	Plant to Annex 1 forest of type lost (good condition high value offsite)	**0.33**	**0.59**	**0.33 / 0.59 = 0.56**

To make up for the loss of quality for the CH/PBF habitat felled and replanted on site after the 8m strip replanting a ratio of 1 to 0.56 ha for planting off site would be appropriate to demonstrate no-net-loss. Net gain could be achieved by management of the wider area.

In summary, for each hectare of CH or PBF forest felled and not replanted (in the 6m RoW), 1.7ha will need to be planted in low value land. For each hectare of CH or PBF forest felled and replanted (in the 8m RoW) and additional 0.56ha will need to be replanted off-site to compensate for the conversion of the habitat.

12.10 Application to BRUA

The BRUA EIA gives the following figures for deforestation within Natura 2000 sites. These are then modified to account for design changes (increase in the maintained RoW from 2m to 6m). These figures are for example only and accurate figures should be obtained in the pre-works surveys.

Table 12.12.34: Deforestation figures from the EIA (Natura 2000 sites) (USI 2016) adjusted to account for modified restoration.

Natura Site	Area permanently deforested (in EIA) USI 2016 (assume 2m RoW)	Area 'grubbed up temporarily'	Total	Adjusted area permanently deforested (using new replanting figures)	Adjusted area 'grubbed up temporarily'	Total
ROSCI0129	1.1436	8.1688	9.3124	1.1436 X 3 = 3.4308	9.3124-3.4308 = 5.8816	9.3124
ROSCI0138	0.505	2.7	3.205	0.505 X 3 = 1.515	3.205-1.515 = 1.69	3.205
ROSCI0292	0.589	4.2112	4.8002	0.589 X 3 = 1.767	4.8002-1.767 = 3.0332	4.8002
TOTAL	2.2376	15.08	17.3176	6.7128	10.6048	17.3176
Compound total	17.3176			17.3176		

Table 12.12.35: No-net-loss units required for habitat to be lost (example calculation forest felled on the RoW per hectare and not replanted)

Habitat Type	Area lost to construction (i.e. the 6m wide strip))	Distinctiveness (before construction)	Condition (before construction)	Matrix score (before construction)	Baseline habitat units (per ha)	Distinctiveness(after construction (i.e. replanted grassland))	Condition (after construction)	Matrix score (after construction)	Matrix score value lost
Natura 2000 Forest e.g. Medio-European limestone beech forests of the Cephalanthero-Fagion (9150)	6.7128	High	Optimum	1.0	6.7128 X 1.0 = 6.7128	Very low	Moderate	0	6.7128

Felling within the 6m right of way and replanting with grassland will result in a loss of a matrix value score of -6.7128 units accounting for the loss of habitat.

Table 12.12.36: No-net-loss units required for habitat to be converted (forest felled and replanted on site on the 8m replanting area) example calculation (example BRUA figures)

Habitat Type	Area (per ha impacted by construction (i.e. the 8m wide strip))	Distinctiveness (before construction)	Condition (before construction)	Matrix score (before construction)	Baseline habitat units (per ha)	Distinctiveness (after replanting understorey trees)	Condition (after replanting target)	Matrix score (after replanting)	Matrix score value lost
Natura 2000 Forest e.g. Medio-European limestone beech forests of the Cephalanthero-Fagion (9150)	10.6048	High	Optimum	1.0	10.6048 x 1.0 =10.6048	Medium	Optimum	10.6048 X 0.67 = 7.105216	10.6048 – 7.10521 - = -3.49959

By losing mature CH and PBF value forest and replanting with understorey trees in the 8m within the RoW a matrix value of -3.49959 units has been lost due to the development. This loss in value is after the replanting of the 8m and accounts for the conversion of habitat.

Table 12.12.37: Value example calculation potential 'increase' to achieve no-net-loss using a receptor area off-site

Receptor habitat Type	Example area to be planted	Distinctiveness (baseline)	Condition (baseline)	Matrix score	Baseline habitat units (per ha)	Distinctiveness after planting (i.e. creation of habitat)	Condition (after planting target)	Matrix score (after panting)	Target potential value (after planting per ha)	Change in matrix score value (after planting per ha)
Low value habitat (i.e. felled forest on the RoW or degraded agricultural land off site)	1.0ha	Low	Poor	0.08	1.0 x 0.08 = 0.8	Medium	Optimum	0.67	1.0 x 0.67 = 0.67	0.67 – 0.8 = +0.59

Given a receptor habitat value of 0.08 units, which can increase in value to a total of +0.67 units this gives a net positive change in the receptor habitat type of +0.59 units per hectare.

Table 12.12.38: Value example calculation of "created area" to replace 6m CH/PBF habitat felled

Receptor habitat Type	Action	Matrix score value lost TOTAL	Matrix score achieved for planting off site per ha	Ratio of area required to be planted off site to replace habitat lost
Low value habitat (i.e. felled forest on the RoW or degraded agricultural land off site)	Plant to Annex 1 forest of type lost (good condition high value offsite)	**6.7128**	+0.59	6.7128 / 0.59 = 11.3776

For the CH/PBF habitat felled and planted off site a ratio of 1 to 1.7 would be appropriate to demonstrate no-net-loss. Net gain could be achieved by management of the wider area. In total this would require 11.377ha to be planted off -site.

Table 12.12.39: Value example calculation of "replanted area" to replace 8m CH/PBF habitat felled

Receptor habitat Type	Action	Matrix score value lost TOTAL	Matrix score achieved for planting off site per ha	Ratio of area required to be planted off site to replace habitat lost (per ha)
Low value habitat (i.e. degraded agricultural land off site)	Plant to Annex 1 forest of type lost (good condition high value offsite)	3.49959	+0.59	3.49959 / 0.59 = 5.9315

To make up for the loss of quality for the CH/PBF habitat felled and replanted on site after the 8m strip replanting a ratio of 1 to 0.56 ha for planting off site would be appropriate to demonstrate no-net-loss. In total this would require 5.9315 to be planted off -site. Net gain could be achieved by management of the wider area.

In total for the estimated impacts to the CH / PBF forests within the Natura 2000 sites, **17.3091ha** of off-site planting would be required in order to achieve no-net-loss

12.10.1 Documenting and achieving the offset

All offset approaches should be quantified and described within a suitable document (e.g. Biodiversity Action Plan or BAP). A suggested approach and reporting structure is listed in BBOP 2012 54 and contains the following key sections (building on those in the SEIA):

- Description of project impacts;
- Description of measures for avoidance, minimisations, rehabilitation and restoration;
- Description of residual impacts;
- Description of offset design (including metrics);
- Description of implementation; and
- Reporting.

12.10.2 Monitoring success of offsetting.

The success of the offsetting approaches will need to be monitored, the approach to this should be formalised once the full impact of the project is quantified. The monitoring for the offsetting should be conducted according to the prescriptions of a BAP.

12.10.3 Additional Conservation Actions (ACAs)

Where no-net-loss or net-gain is required, it is often necessary that a range of approaches to achieve this are implemented. Additional Conservation Actions (additional to habitat creation) are outlined in **Error! Reference source not found.** and may potentially include the following:

- Quantifiable training for protected area managers to build capacity;
- Input into forest and protected area management plans;
- Payments into projects with demonstrable conservation benefits;
- Funding of university projects to improve the knowledge base regarding sensitive species to improve the efficacy of conservation actions;
- Payments into management or contracting of management actions which provide a demonstrable conservation benefit.
- Programs for the control of invasive species in sensitive habitats.
- Payments into a conservation fund may also contribute towards the achievement of no-net-loss, however it would need to be demonstrated that the payments were utilised to achieve quantifiable conservation benefits. Payments into conservation funds would need to be determined through liaison between EBRD, Transgaz and any beneficiaries.

In order to implement these ACAs, it may be necessary for Transgaz to contribute a proportion of their CSR budget towards these Actions.

12.10.4 Key Stakeholders

In order to achieve no-net-loss and net gain of PBFs and CH required by EBRD, a range of stakeholders will need to be involved in the identification and approval of offsets. The following parties should be involved in the evolution of the offsetting strategy:

- Transgaz;
- EBRD;
- Private forest owners;
- National Forestry Fund (NFF);
- Managers of the Natura 2000 sites (if appropriate).
- Mangers of Forest fold Bontolin;
- Mangers of Forest District Hurezani;

54 Business and Biodiversity Offsets Programme (BBOP). 2012. Standard on Biodiversity Offsets. BBOP, Washington, D.C.

- Mangers of Forest District Tg. Jiu;
- Mangers of Forest District Carbunesti; and
- Mangers of Forest District Jiul.

13 Cultural Heritage

This Chapter addresses potential impacts on tangible cultural heritage. Issues related to non-tangible heritage are addressed in the accompanying Supplemental Social Impact Assessment (SSIA). The Chapter builds on the work undertaken as part of the regulatory EIA, as supplemented by a series of desk studies, and relevant authority consultations. It outlines how the Project seeks to eliminate, minimise, mitigate offset or compensate for. impacts on tangible cultural heritage.

13.1 Relevant legislation and guidelines

Romanian legislation includes numerous obligations regarding cultural heritage, detailed further in the regulatory EIA. In addition, the country is a signatory to a variety of relevant international conventions, including both the Valetta and Granada Conventions on the protection of archaeological heritage (implemented in Romania by Law no. 150/1997 and no. 157/1997 respectively). The Romanian regulatory process therefore requires construction projects to seek approval and permits in relation to cultural heritage impacts from their local municipalities before works commence. Recently, however, the national Pipeline Law has streamlined this process for projects of national interest by simplifying the procedure for acquiring the archaeological permits, an issue currently under review by the Ministry of Culture.

PR8 describes EBRD's policy on cultural heritage and outlines the necessary actions and mitigation needed to meet these cultural requirements. The PR requires that the client acts in a precautionary manner when assessing cultural heritage sites that a sustainable management plan is developed for sites under their control. The overall objectives of PR8 are to support the protection and conservation of cultural heritage; adopt the mitigation hierarchy approach to protecting cultural heritage from adverse impacts; promote the equitable sharing of benefits from the use of cultural heritage in business activities and to promote the awareness and appreciation of cultural heritage where possible.

13.2 Issues identified through Scoping

The following issues were raised during project scoping regarding tangible cultural heritage:

Table 13.13.1 Issues raised during project scoping.

Source of impact	Receptor(s)	Impact	Key Receptor Sensitivities	Justification for scope
Invasive construction procedures including: directional drilling and trenching	Culturally significant heritage sites & archaeological finds	Potential psychical damage to unidentified tangible cultural heritage sites	Any unexpected archaeological findings, especially located near to the Tibiscum heritage site	Due to unknown location of receptors
Invasive construction procedures including: directional drilling and trenching	Culturally significant heritage sites	Potential psychical damage to identified tangible cultural heritage sites	Designated sites	Further assessment needed to determine if known sites are impacted
AGI use, ROW/ Pipeline maintenance	Known Archaeology	Visual, air, noise	Designated sites	If affecting known archaeology

A number of issues were also raised relating to non-tangible cultural heritage. These are to be addressed through the social impact assessment but are outlined in Table 13.2 below.

Table 13.2 Issues to be adressed through the social impact assessment studies.

Source of impact	Receptor(s)	Impact	Key Receptor Sensitivities	Justification for scope
Disruption caused by construction of roads and ROW/noise during cultural tradition	Local tradition or cultural practice	Obstruction to culturally significant calendar event	Local communities neighbouring BRUA pipeline	Potential conflict between timing of cultural events and construction works
Introduction of non-local personal into local community areas which may lead to disturbance	Cultural identity	Loss or disruption to cultural identity	Local communities neighbouring BRUA pipeline, especially in close proximity to workforce accommodation	Work force demographic is currently unknown

13.3 Existing conditions

13.3.1 Baseline Data Collection

This section is derived from a range of desk studies, as well as the data included within the regulatory EIA. No additional field studies have been undertaken at this stage, although additional information has been obtained from the authorities. For the assessment of impacts upon tangible heritage a precautionary 1km buffer either site of the pipeline RoW has been used for the AoI. This precautionary approach has been taken given the size and extent of many of the archaeological sites that are already known.

13.3.2 Overview

Romania supports at least 18 ethnic and cultural minorities and has a broad cultural heritage. Some of the oldest *homo sapiens* fossils were found in Transylvania, whilst the Dacia and Roman Dacia periods are some of the most important times in Romania's history. As a result, the archaeological interest of the area is substantial and, although the pipeline follows existing infrastructure for much of the way, the likelihood of additional finds is considered high.

The regulatory EIA identified a limited number of sites across the pipeline route of archaeological value. Since then Transgaz has actively engaged with the 11 county level archaeological authorities affected by the pipeline to better identify both known archaeological sites within the AoI and sites of archaeological potential. The results of this assessment (and which recommend archaeological surveillance during construction works) are shown in Table 13.3 below. The responses highlighted the need for a range of further archaeological investigation along the route including at:

- **Intrusive diagnostics sites** – requiring periodical trenching throughout an area that has been identified as being of high archaeological potential, to establish whether artefacts are present
- **Preventative research sites** - requiring further excavation in an area where archaeological material has previously been found to fully assess the archaeological extent of the area
- **Sites requiring intrusive evaluation** - areas which have previously undergone intrusive work but the extent of the finds needs further evaluation before proposing appropriate action
- **Known Sites** – formally recognised sites known to the archaeological authorities

Table 13.13.2 Recommendations from county archaeologists

County	Recommendations
Giurgiu	Intrusive diagnostics recommended at 4 sites, and 6 non-investigated zones. Preventative archaeological research recommended at 3 identified sites.
Teleorman	Preventative archaeological research recommended at 4 archeological sites. Intrusive site evaluation recommended at 9 archeological sites
Dambovita	Final authority permit, after preventive archaeological research
Arges	Preventative archaeological research recommended at 3 archeological sites
Olt	No archaeological sites identified
Valcea	Intrusive diagnostics recommended at the extremities of the 31 archaeological sites. Preventative archaeological research recommended at 5 archeological sites 4 known archeological sites, affected in the protection zone
Gorj	Intrusive diagnostics recommended for all the pipeline route
Hunedoara	Preventive Archaeological Research in archaeological sites identified by intrusive diagnostic
Caras, Severin	Intrusive diagnostics recommended for all the pipeline route
Timis	Intrusive diagnostics recommended for all the pipeline route. 14 archaeological sites
Arad	Intrusive diagnostics recommended for all the pipeline route. 7 archaeological sites

Many of the sites listed above are either sites of potential archaeological significance or require preventative archaeological research to ensure they aren't impacted upon through construction. There are, however, three major sites of cultural significance along the route, these are listed in table 13.4.

Table 13.13.3 Identified Cultural Heritage Sites

County	Places	Protected areas (other than natural areas)	Distance from BRUA (Km)
Caraş-Severin	Jupa	Tibiscum – Dacian Castra	0
Hunedoara	Sarmizegetusa	Dacian colony - Ulpia Traiana Augusta Sarmizegetusa - the capital of the Roman province of Dacia	0.4
Gorj	Schela	St. Demetrius Church	0.7

Of these Tibiscum and Ulpia Traiana Augusta Sarmizegetusa are considered the most important and are large sites covering multiple hectares and date back to the Dacian occupation of Romania. Further details are provided below.

13.3.3 **Tibiscum**

Tibiscum covers an area of 27 hectares near the village of Jupa (location of GCS3). The site was one of the most important cities of the ancient province of Dacia and was occupied from the third century AD. The site includes a complex of ruins, consisting of the old city Tibiscum, a camp and a military Vicus. The Tibiscum Archaeological Reservation was established in 1977 on the left side of Timisoara and archaeological finds from the Roman era are displayed in the museum. The pipeline will go directly under the site using horizontal directional drilling, starting 300m to the west of the site and resurfacing 400m west. Permits have been acquired from the director of Tibiscum for these works.

An analysis of alternatives was conducted regarding routing around the Tibiscum site. The conclusion was that a HDD solution under the site is the most appropriate solution. The routing decision was made on the grounds that it will mitigate against further environmental damage, whilst the technical execution will not result in impacts on the sites cultural assets. Tibiscum enjoys protection at the national level under Romanian law and therefore such a

measure is justified. Any HDD solution will need to be at a sufficient depth across the whole of the protected area at Tibiscum (17ha) to avoid impacts to archaeological remains. It is proposed that the depth of the HDD will be between 14 and 17 metres.

An analysis of alternatives for routing around the Tibiscum site was conducted by Transgaz. The alternative to HDD would require pipeline routing through Natura 2000 ROSCI 0358 designated site, increasing the likelihood for environmental damage. Further, the HDD solution will enable the crossing of Timis River within the same design. Currently there are other pipelines that traverse the Timis River and Tibiscum site via HDD without impacts to either receptor, highlighting that its both technically and environmentally feasible. Figure 13.1 (in the figures document) highlights the BRUA routing across the Timis River and Tibiscum Site.

13.3.4 **Ulpia Traiana Sarmizegetusa**

Ulpia Traiana Sarmizegetusa is located approximately 400m from the BRUA pipeline route and was the capital of Roman Dacia covering an area spanning 30 hectares; once having a population estimated between 20,000 and 25,000. The site's significance and population peaked in the 2nd and 3rd century before being destroyed by the Goths. It was heavily fortified and today exhibits the ruins of a roman forum, an amphitheatre and several temples. The site also has an extremely close affiliation with Tibiscum which acted as one of the many castra tasked with the initial defence of Ulpia Traiana Sarmizegetusa region. Figure 13.2 (in the figures document) provides a visual representation of the spatial relationship between the pipeline route and the Sarmizegetusa site. It should however be noted that the boundaries mapped are the postulated boundary of the roman town, site distance is more accurately gauged at 400m.

13.4 Impact Assessment

13.4.1 **Approach and Methodology**

Impacts on cultural heritage are most likely during the construction phase, primarily as a result of trenching, as the invasive procedures employed may reveal (positive) and/or damage (negative) archaeological artefacts and structures. Significance criteria for the risk/impact assessment on tangible assets are as outlined in Table 13. 5 below.

Table 13.5 Risk/Impact Assessment Criteria

Negligible	Low impact	Medium impact	High impact	Very High
Project activities in areas previously assessed for archaeological sites with no significant findings	Project activities in areas of low archaeological potential; remote or negligible probability of archaeological findings	Project activities in areas with poor presence of archaeological remains, lack of toponyms and presence of a geomorphology (for example, steep slope)	Project activities in areas with many archaeological remains, favourable geomorphological conditions for the ancient settlements, presence of toponyms and documentary sources	Project activities in areas of extremely prevalent archaeological remains or in areas of unknown cultural value

13.4.2 **Impacts from Construction**

13.4.2.1 Overview

Much of the route passes through areas currently considered to be of low archaeological potential, but the presence of key areas such as Tibiscum and Dacia, aligned with the nature of the trenching operations means that, taking a precautionary approach to the presence of unknown archaeology, overall risks of impacts on archaeology are considered high. Whilst the proposed additional archaeological studies (combined with an effective Chance Find

Procedure - see mitigation) will minimise impacts, potential impacts will remain as shown in Table 13.6 below, and described subsequently.

Impact	Receptor	Source of Impact	Impact Score	Key Sensitivities
Physical damage to unidentified tangible cultural heritage	Culturally significant heritage sites and archaeological finds	Invasive construction procedures including: directional drilling and trenching	High to Very High	Any unexpected archaeological findings, most specifically located near to the Tibiscum and Ulpia Traiana Sarmizegetusa heritage sites
Physical damage to identified tangible cultural heritage sites	Culturally significant heritage sites	Invasive construction procedures including: directional drilling and trenching	Moderate to High	Identified sites
Pollution emissions and disturbance to cultural heritage sites	Identified cultural heritage sites	Pollution emissions from construction works, including air, noise and vibration pollution	Moderate to High	Identified sites

Table 13.6 Construction Phase impact assessment

Given this risk an "adaptive management" approach will be taken to archaeological resources within the AoI with the action proposed by the archaeological authorities being carried out prior to or during construction to further assess the extent of tangible cultural heritage present. Key impacts to be addressed include:

- *Physical damage to unidentified tangible cultural heritage sites.* The route crosses through areas of high archaeological potential, particularly in areas surrounding the two known Dacian archaeological complexes. Whilst following existing pipeline infrastructure and implementing the proposed diagnostic procedures will reduce the potential for impact to some extent, the risk of accidental damage to a previously unearthed archaeological artefact remains high to very high, especially given the archaeological legacy raised by the authorities along the route.
- *Physical damage to identified tangible cultural heritage sites.* Insufficient data are available to fully assess construction impacts (including vibration) on known archaeology along the route, especially as not all known sites along the route have yet been mapped. Taking a precautionary approach, the significance of this impact is therefore considered moderate to high.
- *Impacts from pollution and disturbance*. Construction works will result in a range of potential pollutants that could affect the condition or setting/visitor experience of cultural resources. Expected impacts are considered moderate at this stage although potentially higher at the key regional sites.

13.4.3 **Operational Phase**

Impacts for the operational phase of the Project are expected to be limited to those associated with the GCS. The third compressor station being built at Jupa is relatively close to the Dacian city and there is the potential for long-term operational emissions impacts. However, it is currently understood that the GCS will be electrically powered and emissions will be minimal. Under these circumstances impacts on the Dacian city are considered to be low to negligible.

13.5 Proposed Mitigation

The key mitigation proposed is the use of on-site archaeological expertise to implement an "adaptive" approach to impact mitigation, the undertaking of additional archaeological surveys and the implementation of a robust chance find procedure. Both are addressed further below.

13.5.1 Onsite Archaeologists

To effectively manage archaeological impacts across the pipeline route, Transgaz will employ a number of qualified archaeologists to identify and manage cultural heritage risks and help implement the chance finds procedure. This role is envisaged to be very similar to that of the "Biodiversity Specialist" (see Chapter 12) and will include provision of regular watching briefs and management of contractor compliance for archaeological issues as well as ad hoc advice on intangible issues including access to historic sites. The role and incorporation of archaeologists into the construction process has been clearly defined as a requirement within Transgaz's contractor management process, although further work is needed to fully describe the role's responsibilities before construction commences.

13.5.2 Chance Finds Procedure

One of the biggest risks to archaeological artefacts and structures is from the unearthing of unknown finds during construction. To address this potential impact, a chance finds procedure has been established by Transgaz in line with EBRD PR8 requirements. This outlines the protocol that must be followed in the event of discovering any archaeological material55 and will help protect potentially significant cultural heritage materials by ensuring that archaeologists are given sufficient time for extraction and analysis of any new material. All staff members working in the construction process will be trained on how to implement the chance finds procedure and who to contact in the event of a find. In the event of such a find the team on site will have a "stop work" authority over construction works in the vicinity of the archaeological find.

13.5.3 Additional Archaeological Studies

A number of additional archaeological studies are proposed for the Project as outlined in Section 13.3.1. The results of these will be taken into account during the construction of the pipeline, and appropriate mitigation measures developed as applicable.

13.6 Monitoring

Whilst further monitoring is included in the relevant construction management plans, at this stage the following monitoring is proposed:

- Monitoring of excavation activities to detect the presence of unknown archaeology in accordance with the chance find procedure
- Monitoring of existing known archaeology for impacts arising from vibration or pollution during the construction and operation of the pipeline

A Cultural Heritage Management Plan has been produced to accompany this chapter which outlines the projects approach to management of cultural heritage assets and details the management, mitigation and monitoring commitments.

13.7 Residual Impacts

Until the additional archaeological studies have been completed, residual impacts on archaeology and cultural heritage cannot be fully determined. However, with the appointment of suitably qualified on-site archaeologists and the robust implementation of a chance find procedure, as well as the specific mitigation of using HDD techniques to drill under the Tibiscum site, no significant adverse impacts are expected on cultural heritage affected by the project. There is even the potential for a positive impact if new areas of archaeological value are uncovered during the work.

55 The chance finds procedure will also include the findings of explosive ordnance and human remains, albeit with different points of contact. Furthermore, due to the route passing through the Dinosaur geopark in Tara, Haţegului, specific considerations for the finds of dinosaur remains or fossils will also be included into the proposed chance finds procedure.

The key potential residual impacts that remain are:

- Potential physical damage to unidentified tangible cultural heritage sites during construction to be mitigated through further investigation into known and potential cultural heritage sites along the BRUA pipeline route, use of onsite archaeologists' implementation of the 'chance finds procedure'; and
- Potential physical damage to identified tangible cultural heritage sites if the works have the potential to affect any of the identified cultural heritage sites further mitigation shall be advised by the on-site archaeologists.

14 Traffic and Transport

This chapter addresses potential impacts to the transportation infrastructure affected by the Project. This infrastructure allows people to have mobility and social interaction and represents the backbone for social and economic development. The BRUA Project is committed to reducing interferences with existing infrastructure to the maximum extent possible, and where feasible improve the level of services available if required / needed by the Project. Due to the scale and size of the Project, the project can have physical effects on a broad range of infrastructure, which may lead to potential effects on people's livelihood and daily activities.

14.1 Relevant legislation and guidelines

Specific legislation appropriate to this Chapter is included in the Regulatory EIA. This assessment has been based on international good practice approaches and is considered particularly relevant to EBRD PR1 and PR3. Social impacts are addressed through the social impact assessment report.

14.2 Scoping Assessment

Key potential sources of impact, potentially affected resources and receptors (and key receptor sensitivities), and potential impacts on traffic and transport during the key Project phases are discussed below. The Table also present a brief justification for having 'scoped out' some impacts, and identifies as 'scoped in' a number of issues for further evaluation. The following issues were identified for further evaluation at the scoping stage:

Table 14.1 Scoping Matrix – Project Construction Phase

Source of Impact	Receptor(s)	Impact	Key Receptor Sensitivities	Scoped In/Out	Justification for Scoped In/Out
Increased vehicle traffic to and from the active construction sites	Road Users (including local residents); Biodiversity*, Air Quality*, Noise and Vibration*	Vehicular access to active construction sites may result in localised traffic delay and congestion	Driver delays, pedestrian delays and a reduction in pedestrian amenity value (i.e. the pleasantness of the journey) and an increased risk of accidents, especially around site access points.	In	Delivery of 44,000 pipeline segments overall by road, plus other construction related vehicle trips is expected to have a significant impact on vehicle movements. Scoped in for known areas of traffic congestion.
Partial road closures or diversions	Road Users (including local residents)	Alternative routes may result in Increased journey lengths and times; and localised congestion.	Driver and Pedestrian delays.	Out	This will be covered under the Social Report
Increased vehicle traffic/construction plant levels	Existing Road Network Users	The quality of access roads may reduce	There may be deterioration of roads, an increase in potholes, muddy roads etc.	Out	Scoped out with regard to additional studies, however GIP mitigation measures to be incorporated into the SLIP.

** Potential impacts due to an increase in vehicle traffic/fixed and mobile constriction plant levels on noise, air quality and biodiversity are covered in the relevant other Topic Sections within this SEIA Report. Following a further assessment of the potential impacts of the project during the construction phase, it become clear that, apart from "Traffic delay and congestion", other impacts should be further analysed in the SEIA, namely Road Safety; Vulnerable Road Users; and Public Transport.*

14.3 Baseline Conditions

14.3.1 Data collection

Data for this assessment has been obtained from literature review, remote appraisal and insight from comparable studies. No new fieldwork has been done for this assessment.

14.3.2 Regional Infrastructure Overview

The proposed BRUA project will cross the counties of Giurgiu, Teleorman, Dambovita, Arges, Olt, Valcea, Gorj, Hunedoara, Caras-Severin, Timis and Arad. The vast majority (~93%) of land associated with the project is outside of the buildable areas of local municipalities (i.e. towns, cities), but even the small proportion of land that does overlap with buildable areas has been selected where possible to avoid inhabited areas. The land is generally either in the public ownership of municipalities, is state owned, the private property of local communities, the property of individuals / businesses, or managed by agencies and national authorities.

The route crosses or runs within the vicinity of a number of major distributor roads, including A1, DN68, E79, DN61 and DN65. These main roads appear in general to be of adequate construction to accommodate construction traffic, and would allow for construction vehicles to arrive within the general vicinity of the work sites and construction yards. Some of the more local roads in the highway network require upgrading in some locations, and new access roads constructed. Key constraints along the highway network have not been explicitly assessed at present. These should be identified to ensure construction routes can be properly and safely identified in later stages of the project. This should include such issues as width or height restrictions, weight restrictions, one-way arrangements or other restricted access, speed limits, large gradient changes, limited visibility, sensitive receptors adjacent to the public highway, or any other potential issues.

14.3.3 Traffic Flows

Baseline traffic data is not currently available for any sections of the proposed BRUA alignment. A baseline traffic study should ideally be undertaken to gain a better understanding of existing traffic conditions in the project area. This will allow a detailed assessment of impacts on traffic and transportation in the regions along the pipeline route. Due to the length and characteristics of the proposed route, it would not be feasible or necessary to produce a detailed assessment for the whole project area. Therefore, consultation should be undertaken with local authorities, the police, and other relevant bodies, to identify key constraints and bottlenecks along the route. Traffic surveys could then be undertaken at the key locations identified. This may include areas where the proposed route comes in to close proximity to urban areas, or where it crosses key intersections. Site surveys would potentially consist of surveying the following vehicle classes:

- Cycles; Motorcycles; Private cars (sedan, van, RV (e.g. camper-van), etc.); Microbus for private use; Taxi; Small (pickup) truck; Medium truck (< 5 tons); Large truck (>= 5 tons); Minibus; and Bus

For some sections of the route, automatic traffic counters (ATC) could be installed, which could record flows over a longer period, e.g. one week. This would be determined as part of the consultation with the relevant organisations. This baselining of existing traffic conditions will assist in determining the relative impacts of the proposals, e.g. percentage increase in traffic along a key corridor, or absolute numbers of additional vehicles routing through a key intersection. These assessments would be assessed in terms of total traffic numbers, and for heavy vehicles specifically.

14.3.4 Non-Traffic Flow Issues

In addition to traffic flow a range of other issues should also be included. These include the following:

- **Pedestrian and Cycle Flow:** Pedestrian and cycle flow data is not currently available. A similar exercise should be undertaken to identify key locations where this would be required, in consultation with all relevant organisations, and suitable surveys undertaken.

This exercise would assist in identifying the impacts of the project on pedestrians and cyclists, for example identifying areas where heavy vehicle flows increase by a significant percentage and significant numbers of pedestrians are affected. Appropriate remedial measures may therefore be designed in subsequent stages, e.g. construction logistics plan.

- **Public rights of Way and Cycle routes:** Public rights of way have currently not been identified. This would need to be undertaken as part of detailed construction logistics, to ensure public rights of way are maintained, particularly during the construction phase. Cycle routes have not been explicitly identified at this baselining stage, as construction routes are not yet known.
- **Bus services:** A number of local, national and international bus services serve the various towns and villages along the project alignment. In areas of potential impact by the project, more thorough investigation of the bus services should be undertaken to ensure appropriate mitigation measures can be considered.
- **Rail Services;** An assessment of existing rail stations affected has not currently been undertaken. When further details of construction logistics are known, affected stations may need to be assessed to ensure that the operation of IC/ICE, Rapid, Accelerated and Personal trains are not affected. However, the alignment does intersect a number of rail crossings. These are CF 907, DUP, DUP de 32 ori, DC90, DC Odovasnita, DC 90A, DC92, DC 87, DC 88, DC 16A, DC, DC, DC Ciuta village, DC, DC Obreja – Glimboca, DC Vama Marga – Marga, DC 2, DC92, DC91, DC83, DC75, CF 207, and CF 300.
- **Personal Injury Accidents:** A review of personal injury accidents in key locations where construction traffic is predicted to interact with general traffic should be undertaken. Ideally this would cover a five-year period, and would be undertaken in consultation with local government agencies, local police, and other relevant organisations. This would allow specific areas or intersections to be identified, and may reveal locations where remedial measures would be required/recommended.

14.4 Impact Assessment

14.4.1 Approach and Methodology

As per the overall methodology for impact assessment, a classification system based on five categories of significance of impacts (“negligible”, “low”, “medium”, “high”, and “very high”) has been utilised. The significance criteria for the assessment of the impacts on traffic and transport are defined in the table below.

Table 14.14.2 : Significance criteria for the classification of impacts associated with the Delay and Congestion

Negligible	Low	Medium	High	Very High
Delay and Congestion				
Very minor increase in construction traffic, good highway infrastructure, and no existing congestion.	Very minor increase in construction traffic, poor highway infrastructure, and difficult terrain to overtake HGVs.	Small increase in construction traffic, good highway infrastructure, and some existing congestion at junctions.	Small increase in construction traffic, poor highway infrastructure, and difficult terrain to overtake HGVs or existing congestion at junctions.	Major increase in construction traffic, poor highway infrastructure or congested urban environment.
Road Safety				
Very minor increase in construction traffic. No existing road safety issues, sufficient width and visibility to overtake HGV’s, no	Very minor increase in construction traffic. No/low existing road safety issues, difficult terrain to overtake HGVs, some	Small increase in construction traffic. Existing road safety issues, difficult terrain to overtake HGVs, some vulnerable road	Small increase in construction traffic. Significant existing road safety issues, difficult terrain to overtake HGVs, some vulnerable	Major increase in construction traffic. Significant existing road safety issues, difficult terrain to overtake HGVs, high numbers of

Negligible	Low	Medium	High	Very High
vulnerable road users	vulnerable road users	users	road users	vulnerable road users
Vulnerable Road Users				
Very minor increase in construction traffic. No vulnerable road users	Very minor increase in construction traffic. Some vulnerable road users. Good facilities for vulnerable road users	Small increase in construction traffic. Some vulnerable road users. Good facilities for vulnerable road users	Small increase in construction traffic. Some vulnerable road users. Poor facilities for vulnerable road users	Major increase in construction traffic. High numbers of vulnerable road users. Poor facilities for vulnerable road users
Public Transport				
Very minor increase in construction traffic. No public transport provided	Very minor increase in construction traffic. No or very infrequent public transport services provided. No diversions / suspensions of services	Small increase in construction traffic. No or infrequent public transport services provided. Minor effect on services, e.g. temporary traffic signals	Small increase in construction traffic. Multiple public transport services provided. Diversions / suspensions of services	Major increase in construction traffic. Significant number of public transport services provided. Significant diversions / suspensions of services

14.4.2 **Construction Impacts**

Table 14.3 below summarises key traffic and transport considerations for the BRUA construction phase.

Table 14.3 Key Considerations for Assessment

Source of Impact / Risk
• Construction vehicles, heavy plant, transportation of materials and goods to pipe yards and worksites (of particular note: large quantities of pipe section and padding materials and heavy bulky items for the compressor stations),) and transporting workers to/from camps.
Potentially Impacted Resources and Receptors
• Road Users (vehicle users, pedestrians and cyclists) • Local population along the logistics road corridors
Baseline Conditions that Influence Impact / Risk
• Size of existing roads • Current numbers of vehicle movements on the existing road network (including potential daily and seasonal variations) • Existing road user delay and traffic bottlenecks • Existing road safety hot-spots (to be identified by baseline studies) • Existing road condition, i.e. quality of road infrastructure along the route • Existing numbers of vulnerable road users • Existing public transport provision
Project Factors that Influence Impact / Risk
• Construction traffic • Night-time driving of long, wide and heavy loads for Compressor Station components

- Temporary changes to the highway or other infrastructure, e.g. diversions, road closures

Table 14.4 below summarises key traffic and transport impacts of the project during the construction phase.

Table 14.4 Key Traffic and Transport Impacts

Construction Phase
• Construction phase generates traffic movements of mainly heavy vehicles, which would add to existing traffic on the highway network. • Potential for increased delay for other road users at junctions and local roads due to increased traffic, depending on construction traffic generated. • Increased collision risk, potentially mainly at junctions but also elsewhere along construction traffic routes, both in urban and rural locations. • Impacts are associated with the construction phase, and by definition will therefore be limited by the construction programme length. However, there will likely be peaks depending on construction traffic flow variation throughout the project lifecycle.

The traffic and transportation requirements during construction should be based on a proposed Logistics Report, detailing methods of work, detailed programme etc. The logistics of delivering materials such as components of the Compressor Stations, special construction equipment and will have a significant influence on the overall construction impact. The report should identify the physical capacity of the existing road network to carry construction vehicles and the type and current condition of the road surfaces. Confirmation of the following sections would need to be undertaken in the next stage of the BRUA project, to allow impacts to be properly assessed.

14.4.3 **Site Locations**

It is anticipated that the pipes will initially be transported by train. The exact location of the train station(s) to which the pipes will be transported is not yet known. This will need to be confirmed by the Contractor before detailed programming works can begin. For the worst-case scenario, it is assumed that all pipes would be delivered to one rail station, and would be distributed along the BRUA route from this location. However, through efficient planning of initial pipeline delivery locations, then subject to feasibility it may be possible to minimise the distance travelled by road, therefore reducing the impact on the highway network. From the train station(s), it is anticipated that the pipes will be transported to the pipe storage areas via the national and local highway network. In terms of dedicated pipe storage areas providing ‘long term’ storage, ten facilities are provided. These pipe yards (PY), are located as detailed in Chapter 4.

From the ten PY locations listed above, it is anticipated that lengths of pipe would be periodically transported to temporary pipe storage areas, so as to reduce travel times and distances as and when the lengths of pipe are required. Eight such temporary facilities are to be provided. Five of these would be provided at each of the five construction yards/camps along the BRUA route, located as detailed in Chapter 4. In addition to the above five pipe storage areas within the construction yards/camps, there will be an additional three construction yards and temporary pipe storages in each gas compressor station (GCS), of approximately 5000sqm, to serve both the work fronts and nearby sections of the gas transmission pipeline. The locations of the GCSs are described in Chapter 4.

14.4.4 **Work Site Traffic Generation – Worker Transportation**

It is anticipated that each of the five main construction camps/yards will occupy an area of approximately 10000sqm, and that there will be approximately 600 workers in total on all five construction camps/yards. This equates to 120 workers per construction camp/yard. It is assumed that there will be no on-site car parking provided for staff at individual construction

yards. The workforce will be picked up from their accommodation, by minibuses, and taken to the compound offices for a briefing or directly to work fronts. In the evening staff will be returned to their accommodation or meeting point. It is anticipated that each of these construction camps/yards will in turn facilitate the operation of up to four simultaneous work fronts. This equates to a potential maximum of 20 simultaneous fronts to which pipe need to be transported from the pipe storages / construction yards. Based on these assumptions, there may be 30 construction workers on each camp's workfronts. Assuming the workers will be transported from the work sites to the work fronts via minibus, then this would result in four small minibuses from each work site to each work front, assuming one shift per day. Alternatively, depending on logistics, if 60 seats per bus are assumed, this would mean two buses in the morning and two buses in the evening, i.e. four buses daily from each of the five accommodation camps to the working areas. Based on these assumptions this is expected to represent a low level of impact.

14.4.5 **Work Site Traffic Generation – Pipe Transport Vehicle Trips**

As a contractor has not yet been engaged, the pipe transport vehicle trips have not been finalised, as it will be dependent on number of work days per week. Two scenarios have been assessed, namely a seven-day working week and a five-day working week.

The traffic load due to trucks carrying pipes to the operations area before and during the construction works has been calculated based on the assumption that two units of 12-meter long pipe of 30'' diameter could be carried on a heavy vehicle. When it is considered that 528km of 30'' pipes could be carried in 44000 pieces of length of 12 metres, the total semi-trailer truck would be 44000/2 = 22000 times. Based on a construction phase of approximately 2.75 years with a maximum of nine months for pipe transportation, nearly 2450 trucks would enter and exit the pipeline storage areas in a month. Assuming a seven-day working week (i.e. an average of 30 days per month), this would mean that 82 trucks would enter and exit the pipeline storage areas in a day. Considering there will be an assumed 15 pipeline storage areas, there would be 5.5 (in) trailer movements in each of the 15 pipe storage areas per day, i.e. 11 trailer movements in and out each of the 15 pipe storage areas per day. However, if it is assumed that a working week consists of five days, i.e. based on a 20-workday month, then the 2450 monthly trucks would equate to approximately 122 trucks per day. Over the 15 pipe storage areas, there would be approximately 8 (in) trailer movements, i.e. 16 trailer movements in and out each of the 15 pipe storage areas per day.

The same number of pipes would then leave the pipe storage areas. Based on the assumption that this would occur for 2.5 years, then for 44000 tubes leaving two at a time would be 22000 trucks. Therefore, 735 trucks would enter and exit the pipeline storage areas in a month. Based on a seven-day working week, this equates to 25 trucks entering and exiting the pipeline storage areas in a day. Considering there will be 15 pipeline storage areas, there would be 1.6 (in) trailer movements in each of the 15 pipe storage areas per day, i.e. 3.2 trailer movements in and out each of the 15 pipe storage areas per day. When added to the 11 movements calculated above, this equates to approximately 14 trailer movements in and out each of the 15 pipe storage areas per day, based on a seven-day working week. Based on the five-day working week, the 735 monthly trucks would equate to 37 per day, which equates to 2.5 (in) trailer movements in each of the 15 pipe storage areas per day, i.e. 5 in and out trips. When added to the 16 movements calculated in the corresponding five-day section above, this equates to 21 trailer movements in and out each of the 15 pipe storage areas per day.

Based on these assumptions pipe transport vehicle trips are expected to have a low to moderate impact on the highway network, in terms of absolute numbers. This obviously assumes a flat profile in demand for pipeline. In practice, there would likely be peaks and troughs in demand over the project lifecycle.

14.4.6 **Work Site Traffic Generation – Access Road Construction**

A number of new access roads are required to facilitate construction. Similarly, a number of existing roads are to be upgraded. A similar assessment as the above would need to be undertaken to determine the potential trip generation of these activities. This would be

dependent on the methodology employed, e.g. whether spoil was to be removed off site or would remain in the area around the work front, the depth of construction to be employed etc.

14.4.7 Work Site Traffic Generation – Deforestation and Redundant Pipe Removal

It is understood that some sections of pipe line will replace existing pipe. It is therefore assumed that some sections of redundant pipe would need to be disposed of. However, it is assumed that this would not generate additional trips in itself, as the same trucks that delivered the new pipe could be used to take away the old. Similarly, it is understood that some localised deforestation may be required. However, it is assumed that this would be disposed of locally.

14.4.8 Work Site Traffic Generation – Additional Considerations

In addition to the above, there would be other activities leading to trip generation, including transportation of pipe bedding material, servicing of construction yards etc. This should also be assessed as part of construction logistics. Some abnormal loads will need to be delivered from time to time during the construction phase. These will be scheduled wherever possible during off-peak periods on the road network.

14.4.9 Construction Impacts

Overall the additional number of vehicles per day that are estimated to be generated by the works is relatively small, when compared to the subjective volumes of existing traffic using the road network and/or the apparent highway capacity. The addition of construction traffic to the existing flows is therefore anticipated not to have a significant impact upon junction capacity. However, when further details of construction logistics are available, and more robust baseline data, this may need to be investigated further.

However, although absolute numbers of construction traffic generated may not be high, there exists the potential that these vehicle trips do have an impact on the road network. The following impacts will likely arise from the above described construction traffic:

- **Road User Delay:** Simultaneous construction at more than one site, including spoil, pipework delivery etc., could result in a large amount of traffic in the surrounding area. This may affect baseline road users, including local public transport, school bus services etc.;
- **Road Safety Issues:** Due to the increase in construction traffic, there is a potential risk of an increased likelihood of personal injury collisions. The type of construction traffic i.e. slow moving heavy good vehicles, may also increase the level of overtaking especially where heavy vehicles need to use local roads outside of the main road network;
- **Roadway Infrastructure Degradation:** The use of the road network by heavy vehicles can lead to wear and damage of the roadway surface, kerbs and pavements. Traffic volume and certain vehicle parameters, e.g. axle-load and spacing as well as existing infrastructure quality, are the key determinants of infrastructure degradation;
- **Vulnerable Road Users:** The interaction between construction vehicles and vulnerable road users can lead to potential issues. This is dependent on the number of vulnerable road users present, existing facilities for vulnerable users e.g. pedestrian crossings, and number of construction vehicles;
- **Public Transport:** Construction vehicles may affect public transport vehicles in terms of interaction and potential conflict. Construction logistics may affect public transport routes, e.g. railroad crossings being closed leading to cancelled services, road closures / diversions leading to re-routing of bus services; and
- **Increased Levels of Noise, Vibration and Air Pollution from traffic movements:** Traffic volume, vehicle types, operating speeds and proximity to receptors are key determinants of these traffic emissions related impacts.

No schools have been identified in the vicinity of the proposed pipe line (within 1 km). No hospitals have been identified within 2.5km of the pipeline. However, there may be hospitals at further distances from the pipeline, in areas that will be crossed by the vehicles associated with the project. This would need to be assessed.

14.4.10 Operational Phase

Traffic generated by the operational phase will be low, and will be mainly associated with the routine inspection and maintenance of the pipeline and associated infrastructure. It is not anticipated therefore that the impacts on network capacity and road safety will be significant, and this impact has been 'scoped out.

14.4.11 Decommissioning Phase

The **decommissioning phase** may have impacts similar in nature to the construction phase (in particular if the pipeline is removed from the ground), but this is dependent on the technologies and methodologies available at the time of decommissioning, e.g. whether the pipe line is to remain *in situ* or is to be removed from site. A Decommissioning Traffic Management Plan shall then be developed in consultation with the competent authorities, traffic police and municipalities, and implemented throughout decommissioning. Residual traffic impacts are also expected to be similar to those of construction, again, depending on whether or not the pipeline is fully or partially removed, or left in the ground.

14.5 Proposed Mitigation

1.1.1 Overview

Mitigation measures would be required to remove or limit the issues identified. Production of a detailed Construction Traffic Management Plan (CTMP) will be important in addressing detailed issues throughout the project lifecycle, minimising the impacts on the national and local highway infrastructure and environment. This shall be completed by the Contractor in consultation with all relevant national, regional and local authorities, police and municipalities, and other relevant bodies. The CTMP must be kept updated throughout the life of the project.

14.5.1 Construction Traffic Management Plan

The Construction Traffic Management Plan (CTMP) will be developed to manage construction traffic generated by the project, minimise traffic disruption and road user delay and provide for the on-going safety of road users, including pedestrians and cyclists. All of the traffic related impacts described previously can be mitigated very effectively by the implementation of standard best practices in terms of environmental controls and management practices during construction. These measures will be detailed in the CTMP, which will describe in detail the measures that the Contractor will implement during the construction of the Project.

Key management issues addressed by the CTMP will include

- Access to construction areas;
- Routing of construction traffic;
- Prevention of road user delay;
- Temporary traffic control and management;
- Reducing the probability of traffic collisions and improving safety for local road users and others;
- Preventing and remedying highway degradation;
- Road crossings; and
- Parking facilities.

The Contractor shall regularly update their CTMP as the construction methodology is developed and vehicle movement requirements are identified in detail. The Contractor shall consult with all relevant government agencies to identify where the project plans can complement existing road development plans at the district and provincial level. The Contractor will also consult with the principal representative of any communities that will suffer a significant increase in traffic in order to develop awareness of the mitigation measures within the CTMP.

A CTMP is important both in ensuring the safety of construction personnel and local communities. The CTMP is intended to be a 'live' document and its traffic management principles will form the basis for subsequent detailed construction traffic management arrangements between the nominated Contractor and the highway authorities as and when the site construction contract is awarded.

The CTMP will include the following minimum requirements:

- Core construction working hours;
- Detailed construction traffic routes, including details of rail station(s) to which pipes will be delivered;
- Proposed road closures and diversions, including providing sufficient advanced notice and obtaining all relevant consents;
- Details of driver training to be provided;
- Details of any potential lorry holding areas (LHA) necessary;
- Details of any temporary or semi-permanent speed limits, both on and off site, and details of relevant statutory consents to facilitate these;
- Safe ways of working, e.g. the use of banksmen, temporary signals etc.;
- Details of construction vehicles' maintenance;
- Education regarding road safety to be provided by the Community Liaison Officers (CLOs) to local communities, such as schools and kindergartens, which may not normally be subject to construction traffic flow;
- Temporary traffic management, for example keeping the highway network operational during construction activities;
- Details of site and access roads, and appropriate maintenance regimes;
- Impact on local bus services, and details of mitigation measures;
- Impacts on any parking / loading, and proposed mitigation;
- Impacts on pedestrians and public rights of way;
- Monitoring of key performance indicators;
- Specific measures to be implemented around schools, e.g. restricting construction vehicles at school start and end times;
- Levels of development related construction traffic that will use the road network;
- Site access arrangements to the working corridor and within the working corridor;
- Identification of key sensitivities along proposed access routes;
- Identification, demarcation and construction of all access routes;
- Measures to minimise disruption during the construction of new or altered road infrastructure (e.g. timing, one lane working, signage, diversions and advertisement of advance warning of diversions);
- Measures to provide for the on-going safety of road users, including pedestrians and cyclists;
- Project driver training requirements with respect to road safety and environment;
- Project Schedule;
- Roles and responsibilities for implementation of the CTMP;
- Measures to prohibit "off-route" driving;
- Speed limits and methods of enforcement;
- Means to inform the community of traffic risks;
- Vehicle equipment;
- Vehicle maintenance and refuelling locations;
- Inspection, auditing and reporting;
- Monitoring of key performance indicators;

- Driver competency; and

Details and changes to any scope in the programme to achieve the minimum requirements of the TMP the Contractor will:

- Assign heavy vehicle construction traffic to suitable routes to and from the working area;
- Control and supervise the arrival and departure of construction traffic at site entrances;
- Identify those responsible for carrying out and managing the procedures;
- Identify the programme of road restoration measures that are likely to be required post construction;
- Address how the Contractor can reduce the exposure of vehicle drivers, their passengers and other road users from the hazards of road-related accidents;
- Restrictions on construction traffic movements during periods of heavy traffic on the road network, if necessary;
- Agreement of routes to be used by vehicles delivering 'abnormal loads' (i.e. slow moving, very high, heavy or wide loads) and their timing in conjunction with the highway authority (and the Police); provision of advance warning of the routes and times of abnormal load deliveries;
- Temporary road closures (during works for new or altered roads) will be scheduled, as far as is practical, during times which will minimise disruption to road users (and planned in conjunction with the highway authority);
- Advanced warning of the proposed temporary road closures and diversions will be provided to the public (e.g. suitable signage and information in the press);
- All project vehicles will be regularly maintained and drivers will be trained in driving methods designed to avoid unnecessary emissions (e.g. switching engines off when waiting to enter site or stationary on site, avoiding engine stress and reducing vehicle speed in and near communities);
- Drivers of project vehicles will be trained/briefed about safe driving with respect to other drivers, pedestrians and cyclists;
- Project vehicles to be identifiable to the project (e.g. an easy to read/see sign or symbol on vehicles which shows that they are connected to the BRUA Project);
- Monitor the key performance indicators; and
- The Contractor selected will be required to undertake regular inspections to ensure adherence to the Construction Traffic Management Plan.

14.6 Residual Impacts

The production of and adherence to a detailed Construction Traffic Management Plan (CTMP) will minimise as far as possible the impacts of the project on the highway network and surrounding environment. However, it is inevitable that some residual impacts will remain, which should be managed accordingly. The CTMP will be drawn on the findings of baseline studies into traffic and transport throughout the BRUA route and the Logistic Reports produced by Transgaz and its Contractors. The main risk is the interface between heavy and potentially slow-moving construction traffic and the existing general traffic, public vehicles and pedestrians / cyclists. Specifically, this interaction may lead to inappropriate overtaking of slow moving construction vehicles, and the introduction of potential safety issues for non-motorised road users in locations where they are used to low levels of baseline traffic, e.g. conflict between turning heavy vehicles and cyclists.

However, impacts on the local road network from project-related traffic movements will be temporary and, as they are mainly associated with the construction phase of the project, should be relatively short-term. On the basis that appropriate mitigation measures are implemented through the CTMP and that monitoring shows these to be effective, the overall residual impacts will be expected to be of minor significance. The table below presents a summary of the potential residual impacts.

Table 14.5 Construction Phase Residual Impacts

Impact / Risk	Proposed Mitigation	Significance of Residual Risk
Potential increased traffic delay Potential safety issues Degradation of highway surface and sub-base Vulnerable Road Users Potential impact on public transport Noise, vibration, pollution	Construction Traffic Management Plan. The CTMP will cover issues such as: Drivers of Project vehicles will be trained/briefed about safe driving practices Strict speed limits to be enforced Regular maintenance of vehicles to be undertaken Ensuring construction traffic is routed via suitable roads which can accommodate this extra traffic Methods to raise awareness for workers with respect to safe and considerate driving Advance warning of any proposed road diversions and closures Contractor to limit hazards to the general public Clear signage, banksmen and/or signals will be used as and when necessary. Education on traffic safety will be provided by the Community Liaison Officers (CLOs) to communities not normally subjected to high traffic loads. Provision shall be given for the continuation of normal traffic during open-cut road crossings. Access and site roads will be maintained in good condition.	At Hot Spot Locations MINOR residual risk remains as follows: A Minor residual risk of delays is still possible behind slow moving construction vehicles. The implementation of the embedded mitigation measures and the application of the CTMP will however keep this risk as low as reasonably practicable. Minor residual road safety risks are still possible. The implementation of the embedded mitigation measures and the application of the CTMP will however keep this risk as low as reasonably practicable. Minor residual road degradation risks are still possible. The implementation of the embedded mitigation measures and the application of the CTMP will however ensure that construction vehicles travel on roads of a suitable standard and that any road degradation is repaired. The application of these measures will keep this risk as low as reasonably practicable.

14.7 Monitoring

It is important that the CTMP is monitored effectively to ensure its objectives are being met, and that the impacts of the proposals on the existing infrastructure are minimised.

As the project will cover a large geographical area with multiple local authority agencies, a suitable planning authority officer or team of officers will need to be identified. To facilitate this, it may be necessary to set up a construction working group with representatives from all interested parties. The contractor will have main responsibility for collecting data according to a schedule agreed between them and the planning authority and/or working group. Regular meetings would be required, and data would need to be freely available to all parties. If targets are missed, then suitable mitigation would be identified.

The detailed monitoring strategy would be agreed when a contractor is engaged on the project. However, the following list presents typical criteria that will likely need to be assessed:

- Number and type of vehicle movements to site;
- Vehicle mileage;
- Road safety incidents involving construction vehicles;
- Breaches and complaints;
- Excessive construction-related queueing;
- Excessive construction-related parking issues;
- Level of vehicle fill;
- Level of vehicle sharing;
- Staff routes to site;
- Air quality emissions; and
- Noise.

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