Chapter 4 Project Development and Evaluation of Alternatives

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4 PROJECT DEVELOPMENT AND EVALUATION OF ALTERNATIVES

4.1 Introduction

This chapter describes the process that has led to the adoption of the WREP-SR Project as detailed in Chapter 5, the various alternative options that were assessed and the reasons why they were discounted.

The final project design was informed by an assessment of various alternative options and is intended to support the continued safe and efficient operation of WREP, taking into account:

- Design, safety and operational constraints
- Environmental and social considerations
- Economic considerations.

The no-development option is detailed in Section 4.2, where the risks of taking no corrective action and operational adjustments to enhance the integrity of the WREP are discussed.

Section 4.3 provides an overview of the project base case development and option assessment process.

Section 4.4 outlines design options and rationale for the final decisions.

The review of options for the de-oiling and removal from service of the redundant sections of the WREP is discussed in Section 4.5. This includes the strategies to be employed during construction and tie-in of the new pipeline sections, and in the long-term.

Access roads required for this Project have been subject to detailed review and assessment. An overview of the option evaluation process is presented in Section 4.6.

4.2 No-Development Option

The key purpose of WREP-SR Project is to improve integrity of the pipeline system.

The ‘no-development option’ for the WREP-SR Project would remove all potential environmental and social impacts associated with replacement of the pipeline sections. However, the benefits associated with the Project would not be realised and there could be a number of potential consequences, both locally and internationally as described below:

- Although WREP transports significantly smaller oil volumes than BTC (WREP maximum capacity is 145,000 barrels per day, versus 1.2 million barrels per day for BTC), if the Project were not to go ahead and the WREP system were to be shut down if its integrity was threatened, the ability to export Caspian region oil would be restricted with potential loss of revenues not only to the oil producers but also to the Georgian Government as a transit country.
- WREP currently provides an additional export route for Caspian oil if BTC is shut down for any reason, thereby helping to provide continuity of supply to international markets. Therefore, by reducing the risk of pipeline failure, the Project should help to maintain current available export options for a proportion of Caspian oil.
- The WREP-SR Project reduces environmental risks and possible transboundary impacts arising from high risk landslide areas and high-energy river crossings. These risks would remain and increase if the Project was not undertaken.

The option of closing WREP and using rail to transport the oil to the Supsa terminal is not considered practical in economic terms and would have significant implications in terms of safety and environmental risks. Therefore, this option has not been considered further.

Without the proposed WREP-SR Project, the pipeline will not be able to operate at the higher throughput and faces ongoing risks from landslides and rivers. The option of leaving WREP in its current state, i.e. the 'no development option', has therefore been discounted on financial, safety and both local and international environmental and social grounds.

4.3 Development Process

Ongoing pipeline monitoring and management has been part of normal operational activities since operations began. This work has focussed on a number of areas namely:

- Integrity monitoring by in line inspection pigs (magnetic flux, electro-magnetic acoustic transducer, ultrasonic and geometric) to determine pipeline integrity and prioritise maintenance and repairs
- Monitoring of landslide features and section repairs including excavation, sleeving, and drainage improvement
- River bed and bank monitoring with installation of river protection such as rock dumping.

To support the above activities, a number of studies have been undertaken, including:

- Pipeline inspection studies
- A landslide review to provide an assessment of the landslide hazard along the pipeline route and identify related actions
- A river evaluation study to assess the potential for the pipeline to be exposed due to erosive action
- A routing study to identify pipeline re-routes to avoid potential landslide areas and alternative river crossing alignments.

The results of the above studies were used to inform the scope of work for WREP-SR project and to identify the base case and alternative options, as described in this section and Chapter 5 Project Description.

4.4 Design Options

The engineering design of the new pipeline sections is an iterative process, starting with a base-case design. The base-case design is refined and additional detail added as more information becomes available through the completion of studies or if external circumstances change, e.g. political and commercial requirements. The result is to achieve an optimised design taking into account all available information.

This section describes the rationale behind some of the key design decisions that have been necessary. It also places the preferred base-case project design described in Chapter 5 Project Description, in a wider context.

Key engineering decisions described in more detail in the following sections include re-routing around landslides and replacement of river crossings.

The results of the option selection process are outlined in Table 4-1 (see also constraints maps in Appendix A). The environmental and social baseline and key constraints for the final chosen route option for the WREP-SR Project are described in Chapters 7 and 8 of this ESIA. Impacts and mitigation are discussed and presented in Chapter 10 Environmental

and Social Impacts and Mitigation (Planned Activities) and Chapter 12 Hazard Analysis and Risk Assessment (Unplanned Events).

Table 4-1: Location and Routing Decisions by Section

Section name	Section KP (Approx. AM)	Length (km)	Routing decisions
RP-001a	KP0.0–2.8 (AM52-55)	2.8	The new alignment will be re-routed away from the current alignment to avoid landslide areas. The route was determined taking into consideration the steep topography, the recently constructed GOGC pipeline and the need to maintain a separation distance. Specific measures will be taken to protect the GOGC pipeline during the construction of this section.
RR-001	RR-001 KP0.0–7.6 (AM63-70)	7.6	The existing WREP passes to the south of Tbilisi National Park (TNP), an IUCN Category II reserve, and through woodland extending outside the TNP boundaries. The priority for the re-routing exercise was to avoid TNP, reduce impact on forest sections and minimise route length within the Mtskheta World Heritage Site Landscape Protection Zone (LPZ). Other significant routing constraints were also taken into consideration, including: • Rich cultural heritage potential and therefore sensitivity between RR-001 KP5.3 and KP7.6 (near AM 68) due to proximity to Jvari Monastery, part of the Mtskheta World Heritage Sites (route option A) • Tbilisi Water Authority extraction property (regional routing considered to the north of TNP could not avoid this feature) • Tsitsamuri village and cemetery (route option A) • Aragavi River (route option A) • Main Georgia east–west highway (route option A) • Areas known to be at risk of landslides (route option C) • GOGC pipeline (route option C). This re-route is discussed in detail below because of the complexity of the constraints identified.
RR-004a	KP0.0- 0.51 (AM224-226)	0.5	The new alignment will be re-routed away from the current alignment to avoid a landslide area. The route of the new section of pipeline is around the area of landside risk as close to the current WREP route as is feasible. The proposed re-route is largely in an open field and is set back from a line of trees to avoid damaging their roots.
Supsa River Crossing	Supsa WREP KP0.0-KP0.9 (AM371-383)	0.9	This wide estuarine river flowing into the Black Sea will be crossed using Horizontal Directional Drilling (HDD) close to and parallel to the existing crossing points. The alignments have been influenced by the route of the proposed GOGC pipeline and are constrained by Supsa Terminal, nearby houses and proximity of the existing WREP pipeline which will remain operational during construction of the new sections. Selection of the HDD entry points is influenced by the requirement for adequate land to string the pipe prior to drilling. The alignment of the Supsa Export pipeline has changed since the draft ESIA was disclosed in order to improve pipe layout within the Terminal and reduce environmental and social impact. The new alignment moves the HDD reception site away from a house and farm on AR373 and the stringing area will now avoid the block of woodland where there are numerous wingnut trees (a GRL species).
Supsa River Crossing (export line)	Supsa Export KP0.0–1.62	1.6	

In common with other types of linear development, careful routing to avoid sensitive receptors can significantly reduce the potential impacts of a pipeline. A comprehensive and systematic selection process has been undertaken to define an optimal 100m-wide route corridor for all the re-routed sections of WREP pipeline that minimises environmental and social impacts, constructability problems and cost and time penalties.

Fine tuning of the route has been undertaken in sections that are particularly sensitive, such as woodland to the south of Tbilisi National Park (TNP), where there is mature forest and trees. This has involved a combination of micro-routing and defining locations where a reduced working width will be selected in order to minimise forest disturbance. The ROW width will be reduced to 16m through these woodland areas where not precluded by engineering or constructability constraints.

At a few locations in each section it will be necessary to have additional working areas to accommodate storage of materials and equipment for hydrotesting and de-oiling. Within woodland, the storage areas will be located on land with lower ecological value such as grassland, low density woodland and scrub, and existing tracks. A final route walk will be undertaken before construction to carry out a final check of the alignment, survey river crossings in detail, and confirm soil erosion classes and reinstatement requirements. At this stage, it is not anticipated that there will be any major changes to the route, although minor readjustments may be made if necessary.

4.4.1 Route selection process

The route selection process for the re-route sections began with the definition of an area of search wide enough to allow the identification of all practicable route corridor options between the fixed start point and end points of each re-route section. Potential route corridors were identified within this area based on an initial desk-based assessment of constraints.

These corridors were then characterised, assessed and compared through a series of site visits, a more detailed desk-based assessment and consultations.

The following key factors were assessed and taken into consideration during the routing process:

- Geohazard evaluation and terrain assessment – including zones of seismic activity, faults, landslides, steep slopes and rivers
- Constructability and long-term integrity – including ground conditions, river gorge and gully crossing assessments, access and logistics requirements, reinstatement assessments
- Environmental and social constraints and the requirement to minimise impacts – including soil erosion, reinstatement potential and requirements, land use, settlements, livelihoods, protected areas, flora, fauna, hydrogeology, hydrology and water quality, landscape and cultural heritage
- Security – short- and long-term security risks including terrorism, sabotage and civil unrest
- Minimisation of disturbance to other land users, including compensation requirements
- Safety and health – of construction works and long-term safe operations of the pipeline
- Route optimisation – minimising the route length.

To gather sufficient data to allow a meaningful assessment of route alternatives, literature reviews and baseline surveys were undertaken that covered corridors of varying width according to a particular subject. The final routes were determined in light of the constraints identified during the baseline surveys. Key baseline surveys completed for the WREP-SR Project include:

- Landslide identification assessment and monitoring
- Ecological baseline field survey including flora, fauna, identification of protected species and aquatic macro-invertebrates

- Identification of protected areas
- Cultural heritage desk top review and field survey
- Socio-economic desk top review and field survey of Project-affected communities (PACs)
- Hydrogeology
- Soil classification
- Geotechnical survey including boreholes
- An unexploded ordnance review of RR-004a (potentially affected by the Russian–Georgian conflict in August 2008)
- Topographical survey
- Hydrology, watercourse crossings assessment and surface water quality analysis
- Geohazard and erosion risk assessment.

Where no constraints have been identified, the new sections will follow a route parallel to the existing route of the WREP, at a nominal separation distance of 14m. This is a preferred environmental and security solution as it will occupy part of, and be adjacent to, an existing pipeline corridor. The re-route sections will take the shortest route around an area prone to potential landslide, after taking into consideration any constraints identified.

4.4.2 RP-001a

This short re-route is required to avoid a series of landslides on the southern flank of a steep ridge. Alternative routes to the south or north were discounted as they would encounter further landslides and steep topography. The only viable option was considered to be the selected one which is higher up the ridge than the existing pipeline and between the landslides that are to the north and the south (Figure 4-1).

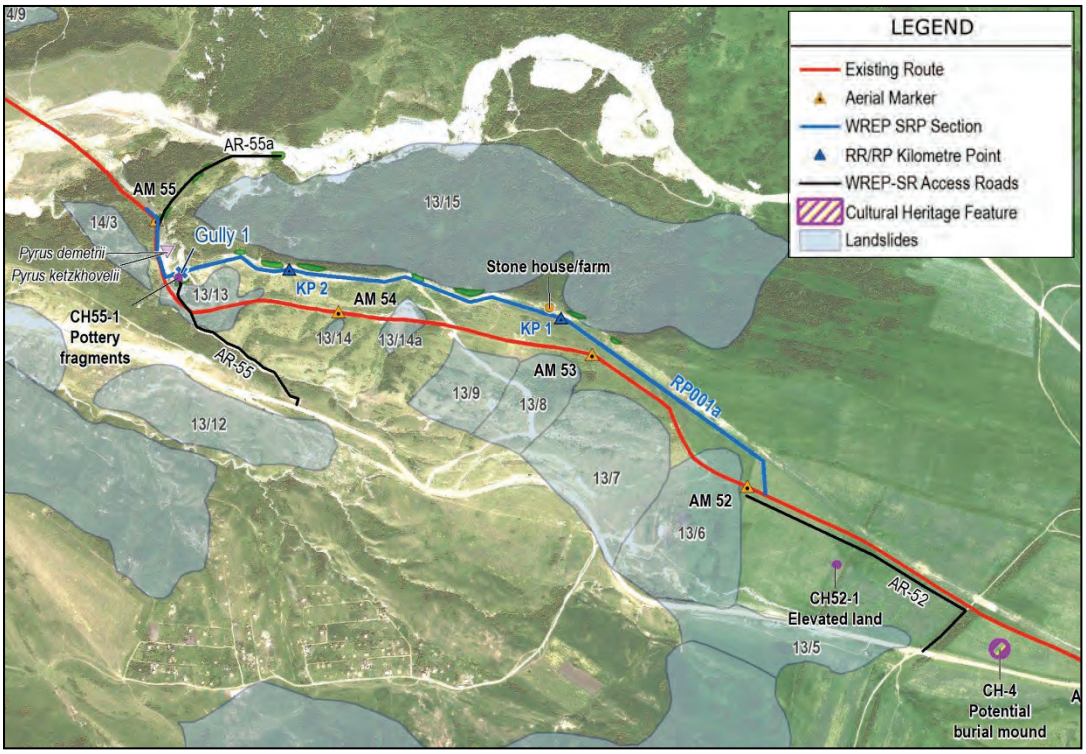

Figure 4-1: Existing WREP and proposed RP-001a section in relation to landslides

Specific measures will be taken to protect the GOGC pipeline during the construction of this section.

4.4.3 RR-001

Owing to the complexity of the constraints associated with this re-route, a more detailed explanation of reasons behind the routing process for RR-001 is provided in this section.

In this area, the existing WREP crosses numerous potential landslide areas and passes close to Tbilisi National Park (TNP), an IUCN Category II reserve (further details are provided in Chapter 7 Environmental Baseline).

The priority for the re-routing exercise was to locate the re-route pipeline section away from active landslides and outside the boundaries of TNP. However, during the route review exercise, several sensitive constraints were identified in the locations of possible re-routes. The paragraphs below describe the process that led to the final route decision for RR-001.

Regional routing considerations

Initially, two routes were considered, one to the north and one to the south of the Tbilisi National Park. After a review of constraints for both route options, the route to the north of TNP was discounted as it was not possible to cross the Tbilisi Water Authority extraction property located on the Aragvi River. A meeting held with the Water Authority ruled against this option. In addition, further constraints including ecology, slope stability and constructability were identified. Consequently, a route to the south of Tbilisi National Park was considered in more detail as described below.

Local routing considerations

Three possible route options to the south of TNP, A, B and C were identified and reviewed (Figure 4-2).

GOGC provided route information for a proposed 700mm gas pipeline (Saguramo-Navtlughi); the section between WREP AM 39-72 has subsequently been constructed. The location and design of RR-001 was therefore determined in consultation with GOGC engineers to consider the needs of both pipelines. The routing process aimed to avoid routing in close proximity to the GOGC pipeline and to minimise the number of pipeline crossings required.

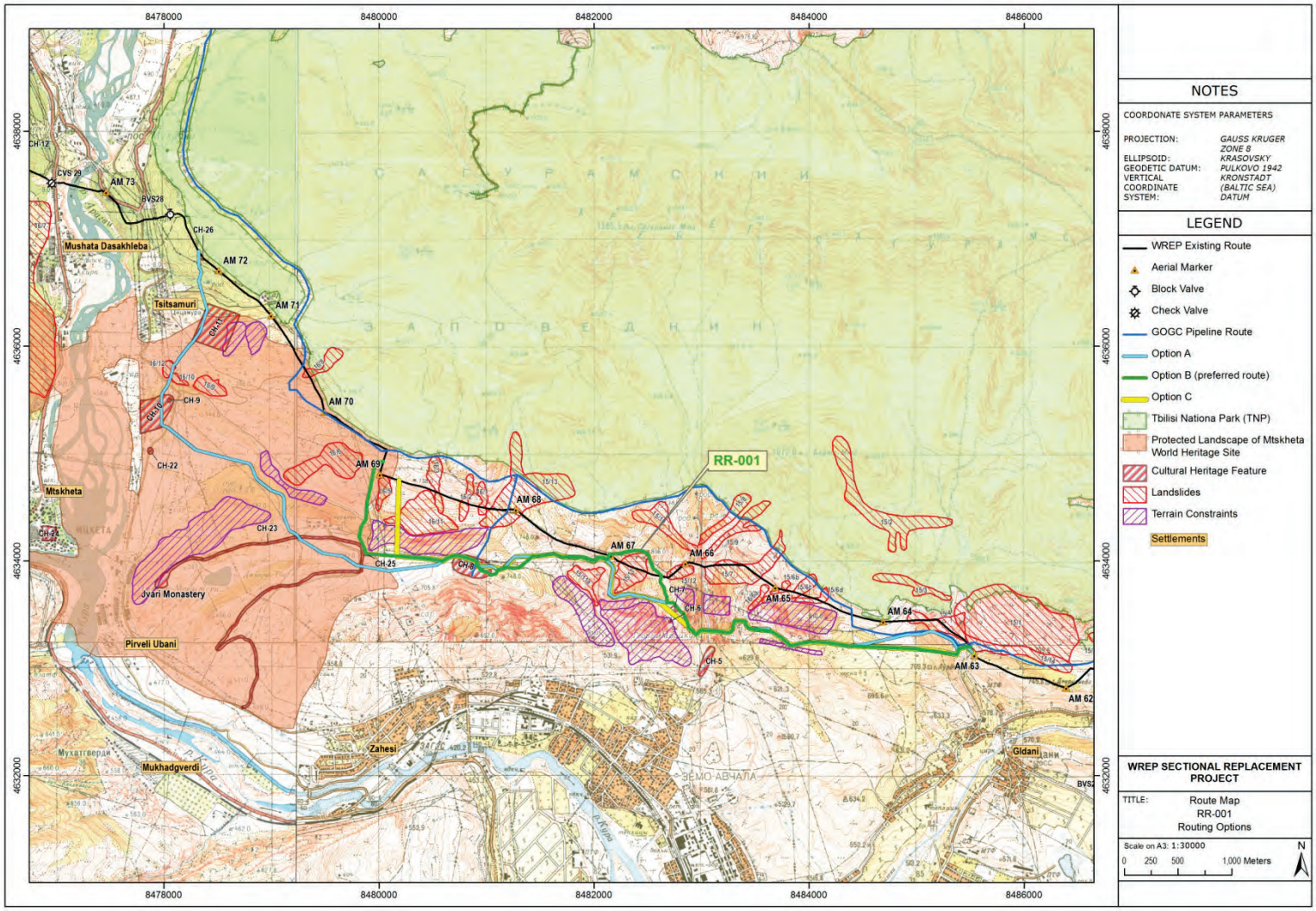

Figure 4-2: Routing Options for RR-001 – Options A, B and C

The initial route considered was Option A. However, significant archaeological constraints were encountered on this route owing to its proximity to the culturally rich area around Mtskheta Town and Jvari Monastery. Several infrastructure constraints (such as main water supply pipelines, gas pipelines and villages) were also identified and it became apparent that it would not be possible to avoid the area of archaeological sites and keep the pipeline outside the boundaries of TNP. Constraints encountered along route options A include:

- Encroachment on Mtskheta Landscape Protection Zone (LPZ)
- Rich cultural heritage potential and therefore sensitivity between RR-001 KP6.0–KP7.6 (AM 68 and 69) due to proximity to Mtskheta Town and Jvari Monastery UNESCO World Heritage Sites
- Proximity to the Aragavi River
- Main Georgia east–west highway (M27).

As a result, two additional options, B and C, were identified with the aim of avoiding TNP and all areas at risk from landslides and minimising:

- Any clashes with the new GOGC pipeline
- Any impact on the archaeologically rich area between RR-001 KP6.0–KP7.6 (between AM 68 and AM69) and the Mtskheta LPZ.

Option C was subsequently rejected, as it was found to be at risk from a previously unidentified landslide. The optimum route was therefore determined to be option B.

Option B initially passes through the outskirts of Gldani village to avoid areas at risk from landslides and very steep slopes. The route crosses several third party services including water and gas pipelines, all of which will be carefully mapped prior to construction. Option B avoids direct impacts to the culturally sensitive Jvari Monastery which forms part of the Mtskheta World Heritage Site, but passes through a short section of the Mtskheta LPZ.

Selected option (Option B)

When compared with Option A, Option B was found to be the optimum route. This route option entirely avoids Tbilisi National Park, significantly reduces the amount of new corridor within the Landscape Protection Zone and is approximately 3.8km shorter. Option C was discounted because of a previously unidentified landslide.

The new section will therefore follow Option B with implementation of the following additional mitigation measures (note that the Commitments Register in Appendix E is the definitive source of all ESIA commitments):

- Construction corridor restrictions: In section RR-001 where the ROW is through dense woodland with high biodiversity value, the working width has been reduced (subject to constructability constraints) with the aim of minimising impacts on these areas (17-21)
- Micro-routing considerations to minimise high value habitat disturbance. At the locations listed in Section 7.7 of the ESIA, protected species (e.g. GRL, IUCN) will be identified prior to construction and will be avoided where deemed practicable by the Company during the setting out of the ROW (17-25).
- Seasonal Constraints: A preconstruction survey will be carried out (during April, May or June) by the Company to identify the presence of Imperial Eagle nest sites within the vicinity of the ROW where construction activities have the potential to impact them. If any nests are identified, a site-specific ecological management plan will be developed (19-17).
- Offset biorestoration: Compensation planting will be undertaken to off-set the essential removal of trees from non forest-fund land in accordance with a site-

specific ecological management plan (17-30). Compensation will be paid to offset the loss of trees from forest-fund land in accordance with national legislation (17-44)

- Protection/translocation of species: Individual mature trees will be marked prior to construction and shall be avoided as deemed practicable by the Company during the setting out of the ROW and access roads; retained trees will be protected from damage during construction .g. by erecting warning barriers (17-33).
- Biorestoration: Pre-construction ecological surveys will be undertaken to record details of trees and rare species that will be lost; this information will be used in development of bio-restoration measures (17-23). Reinstatement and initial biorestoration will be undertaken in the first growing season after construction (17-34). Soil loss will be monitored and corrective actions taken if it exceeds erosion class 3[1] (3-08).

4.4.4 RR-004a

Section RR-004a is required to avoid a landslide. The proposed re-route around the landslide is as close to the current WREP route as is feasible (Figure 4-3). It is largely in an open field and is set back from a line of trees to avoid damaging their roots. No alternatives were identified as they would have been much longer and required disturbance of a greater area of land.

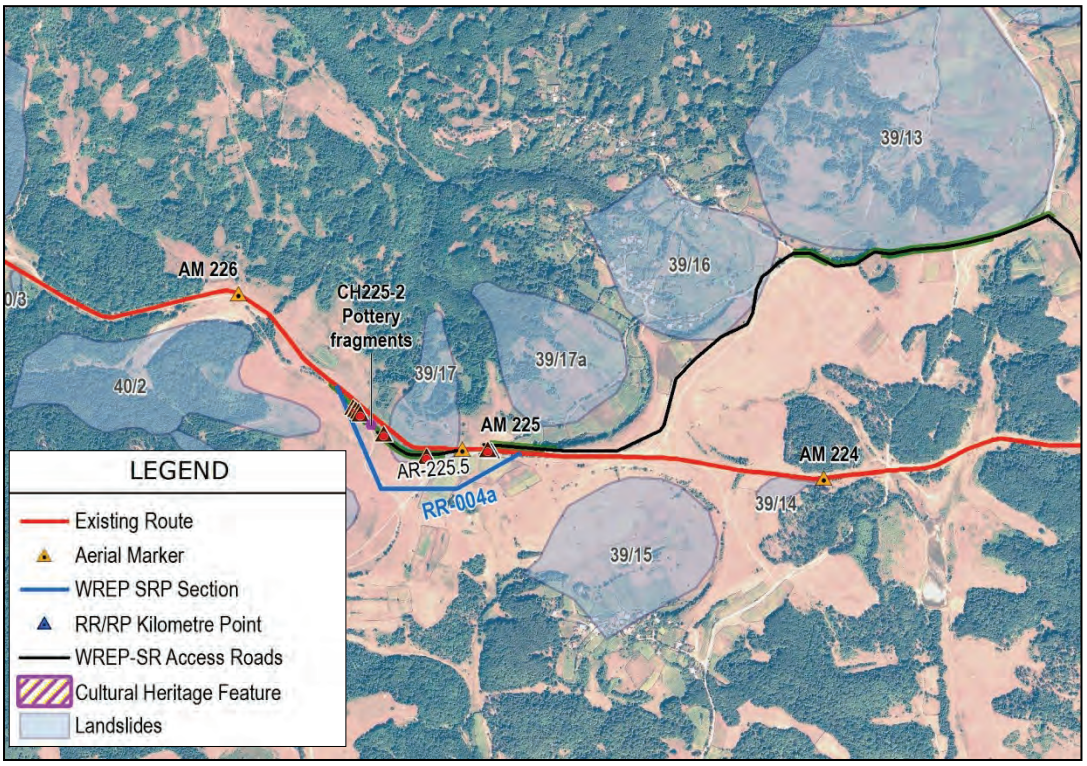

Figure 4-3: Section RR-004a and existing WREP alignment in relation to landslides

4.4.5 Supsa river crossings

Options for the alignment of the two Supsa river crossings are extremely limited as they are both very short. The alignments have been influenced by the route of the proposed GOGC pipeline and are constrained by Supsa Terminal, nearby houses and proximity of the

[1] Classification of erosion severity is provided in Chapter 7, Table 7-1.

existing WREP pipeline which will remain operational during construction of the new sections.

Selection of the HDD entry points is influenced by the requirement for adequate land to string the pipe prior to drilling. The start points of the HDD are at the closest practical point to the north bank of the river but set back sufficient distance to ensure the new pipe sections are well below the active zone of the river. They are located on the southern side of the road between Khidmaghala and Grigoleti to avoid traffic disruption and are close to the road to facilitate access for equipment and vehicles.

The alignment of the Supsa Export pipeline has changed since the draft ESIA was disclosed in order to:

- improve pipe layout within the Terminal
- avoid high voltage power cables which have been installed since the alignment was original identified
- avoid the need for the stringing site to cross the terminal fence line which would disrupt the terminal's security systems
- reduce environmental and social impact. The new alignment moves the HDD reception site away from a house and farm on AR373 and the stringing area will now avoid the block of woodland where there are numerous wingnut trees (a GRL species).

The alignment of both replacement sections is shown in Figure 4-4, together with the originally proposed, but now defunct, alignment of the Supsa export pipeline.

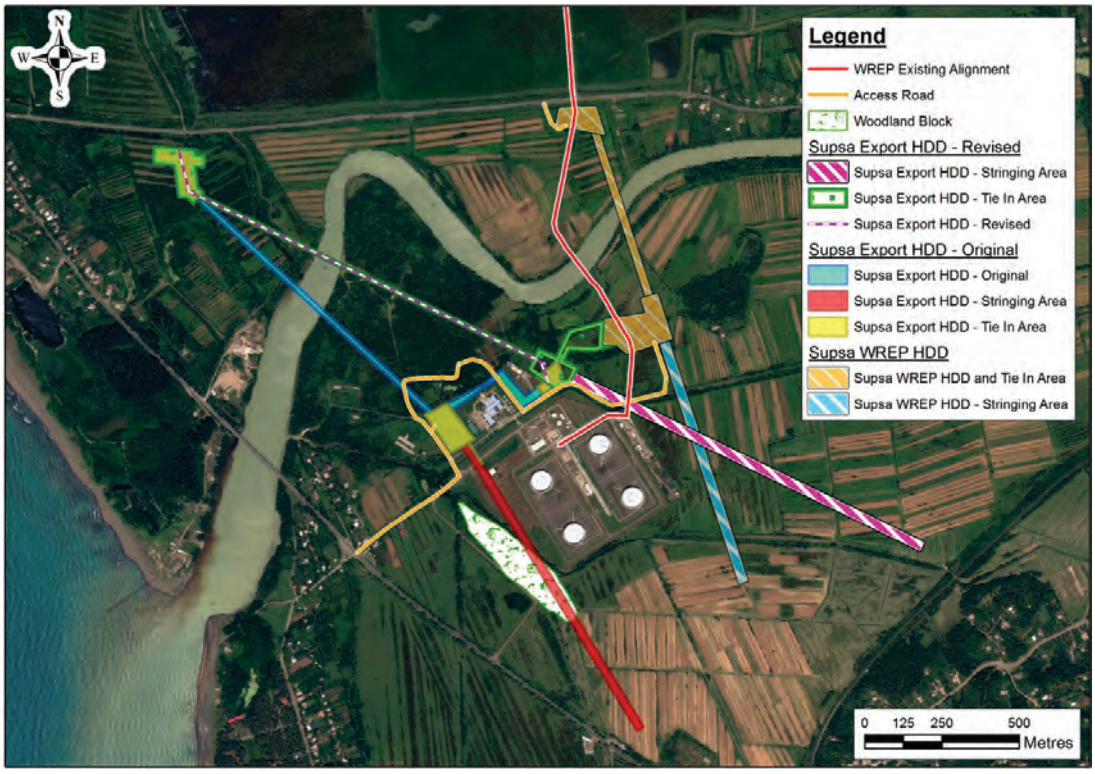

Figure 4-4: Options for r. Supsa crossings

4.5 De-oiling and Removal from Service of Redundant Pipeline

The combined length of the pipeline sections to be removed from service is approximately 13.6km. To remove the redundant sections from service, the pipeline needs to be emptied of its oil inventory (de-oiled) and cleaned before the sections are cut out to allow tie-in of the new sections to the existing pipeline. The resulting redundant sections of the pipeline will be decommissioned i.e. removed from service. This section outlines the options considered for de-oiling, decommissioning and removal from service of the redundant sections of the WREP. The preferred option is described in more detail in Section 5.5.

4.5.1 De-oiling

The sections to be replaced are as follows:

- RP-001a
- RR-001
- RR-004a
- Supsa River Crossing
- Supsa River Crossing (export line).

All of the sections to be replaced must be de-oiled and cleaned prior to their removal from service. De-oiling operation will be from nearest permanent facility (e.g. block valve or pump station) to the nearest permanent facility. Two main options have been evaluated for de-oiling, both of which utilise nitrogen as the driving medium:

- Continuous displacement where a complete pipeline segment is de-oiled in one operation between permanent facilities. This method has been previously used between PRS1 and PRS2 to allow tie-in of the Zestaphoni landslide diversion that was completed in 2007/8
- Sectional displacement where each new section of line is completed and tied in, leaving the replaced section full of oil. Each section is subsequently de-oiled and cleaned individually.

Both continuous and sectional displacement methods, and various hybrid combinations of the two, are considered to be technically viable methods.

The fundamental consideration for selecting between continuous and sectional displacement methods is the prediction of both the internal pressure required to displace the oil, and the likelihood of failure of the pipe during de-oiling. Extensive technical assessment studies have been undertaken and have concluded that:

- Option 1: Continuous displacement de-oiling with valve intervention allows de-oiling to be undertaken in a controlled environment at existing facilities but requires much more of the pipeline to be emptied and cleaned than Option 2 and a longer shut-down period. It would therefore be considerably more disruptive to operation of WREP than Option 2. Option 1 would also require much larger quantities of cleaning chemicals than Option 2 and more nitrogen to displace the oil inventory.
- Option 2: Sectional displacement can be configured to keep pressures within the reduced maximum allowable operating pressure (MAOP) in all sections but requires the use of more interventions along the pipeline route than Option 1. Each intervention requires an environmental footprint and carries a potential risk of loss of containment which may have serious environmental consequences. However, de-oiling operations will be carried out in a strictly controlled manner, and this risk will be managed by the implementation of specific procedures and appropriate oil containment measures at the de-oiling sites. The use of chemicals, and the requirement for nitrogen generation would be significantly lower than for Option 1.

Option 2 is preferred on operational grounds and because it can be completed in a shorter timeframe with the use of fewer cleaning agents and with a smaller requirement for nitrogen generation. The risk of oil spill can be managed by the implementation of good containment practice and operational procedures. A more detailed description of de-oiling is provided in Section 5.5.

An environmental risk assessment has been undertaken for de-oiling operations and is summarised in Chapter 12 Hazard Analysis and Risk Assessment (unplanned events).

4.5.2 Removal of Redundant Pipeline from Service

Four options were considered for removing the redundant sections of the WREP pipeline from service:

- Option 1 - Pipeline removal
- Option 2 - Leave pipeline *in situ*, filled with nitrogen and protected with cathodic protection
- Option 3 - Leave pipeline *in situ* and filled with concrete/grout
- Option 4 - Leave pipeline *in situ*, filled with air, with no cathodic protection.

The four options are assessed in Table 4-2 to Table 4-5 below.

Table 4-2: Option 1 – Pipeline Removal

Risk Description	Aspect Unavoidable Consequence	Aspect due to Mishandling, Non-Compliance	Potential Adverse Impact	Prevention, Mitigation or Legal Requirement
Removal of residual hydrocarbon product from cleaning process.	Hazardous substances on site.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Supervision by competent person. Piped transfer from pig receiver to storage tank. Strict adherence to de-oiling plan. Hazardous substances stored in safe, designated areas located away from watercourses and drains. Tanks with containment bunds. Adequate supply of spill kits.
ROW clearance for bypassed sections, sections with increased separation and additional 5m clearance.	Topsoil stripping on existing ROW alignment and through environmentally sensitive areas.	Excessive disturbance to local environment and ecology.	Detrimental effects to local eco-system, soil micro environment, damage to indigenous flora and fauna, topsoil loss, visual impact.	Supervision by competent person. Mitigation to limit erosion during construction. Use of approved ROW layouts to prevent soil mixing. Full reinstatement, erosion control and bio restoration measures to be implemented.
Proximity of pipeline to be removed from operating line.	Simultaneous operations.	Interference with operating parallel service.	Damage to new pipeline. Loss of containment.	Operations approval/simultaneous permits in place. Risk assessments conducted, centreline marking.
Residual hydrocarbon product after cleaning.	Sections of oil pipeline to be cut up, loaded and transported of site.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Supervision by competent person/environmental officer. Inspection of pipe lengths before removal from trench, plugging/capping of pipe lengths before lifting/transport. Adequate supply of spill kits.

Risk Description	Aspect Unavoidable Consequence	Aspect due to Mishandling, Non-Compliance	Potential Adverse Impact	Prevention, Mitigation or Legal Requirement
Removal of pipeline sections from original trench.	Soil and substructure disturbance.	Excessive disturbance to local environment.	Landslide destabilisation/ acceleration of soil movements/ trench collapse leading to injury/ fatality.	Supervision by competent person. Trench excavation using adequate benching (wider excavation required), safe access and egress, close attention to backfill compaction.
Plant operation.	Operation of heavy-duty plant and equipment.	Excessive disturbance to local environment. Reduction in hearing, complaints from local residents leading to suspension of operation.	Noisy equipment, dust levels, vibration.	Notification/community liaison, set up warning signs, PPE, noise/vibration surveys, restricted working hours, water spraying to reduce dust levels
Lifting.	Elevated objects.	Dropped objects from lifting equipment. Collision of equipment into personnel/other equipment.	Injury/fatality to personnel. Damage to equipment.	Supervision by competent person. Inspection/certification of lifting slings and equipment to be valid. Certified personnel to perform lifting operation. Warning signs, signal men, PPE.

Table 4-3: Option 2 – Leave Pipeline in situ Filled with Nitrogen

Risk Description	Aspect Unavoidable Consequence	Aspect due to Mishandling, Non-Compliance	Potential Adverse Impact	Prevention, Mitigation or Legal Requirement
Disused pipeline rupture through landslide movement.	Presence of buried disused pipeline in landslide complex.	Spills and leaks.	Injury/fatality. Nitrogen asphyxiation. Ground and water contamination from hydrocarbon products.	Management of landslide monitoring strategy (visual surveys). Pressure monitoring/gas testing.
Removal of residual hydrocarbon product from cleaning process.	Hazardous substances on site.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Supervision by competent person. Piped transfer from pig receiver to storage tank. Strict adherence to de-oiling plan. Hazardous substances stored in safe, designated areas located away from watercourses and drains. Tanks with containment bunds. Adequate supply of spill kits.
Residual hydrocarbon product in disused pipe after cleaning process.	Presence of residual hydrocarbons.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Pipe to be cleaned according to good international practice. Sections to be checked for residual oil according to risk assessment (see Chapter 12). Pipe to be sectionalised in accordance with good international practice.
Degradation of disused pipe.	Presence of buried disused pipeline.	Spills and leaks. Ground subsidence/ settlement.	Ground and water contamination from hydrocarbon products. Ground/infrastructure destabilisation.	Pipeline cathodic protection system to be maintained. Section to be filled with benign fluid (nitrogen). Coating system applied to exposed pipe sections.

Risk Description	Aspect Unavoidable Consequence	Aspect due to Mishandling, Non-Compliance	Potential Adverse Impact	Prevention, Mitigation or Legal Requirement
Risk of hot tapping and third party.	Presence of residual hydrocarbons.	Explosion.	Fatality/injury to employees and or third parties. Damage to properties.	Section to be filled with benign fluid (nitrogen).
Risk of hot tapping and third party interference.	Presence of residual liquids in buried disused pipeline.	Spills and leaks.	Fatality/injury to third party. Ground and water contamination from hydrocarbon products.	Maintain pipeline patrol and security.

Table 4-4: Option 3 – Leave Pipeline in situ Filled with Concrete

Risk Description	Aspect Unavoidable Consequence	Aspect due to Mishandling, Non-Compliance	Potential Adverse Impact	Prevention, Mitigation or Legal Requirement
Disused pipeline rupture through landslide movement.	Presence of buried disused pipeline in landslide complex.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Management of landslide monitoring strategy (visual survey). Pressure monitoring/gas testing.
Removal of residual hydrocarbon product from cleaning process.	Hazardous substances on site.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Supervision by competent person. Piped transfer from pig receiver to storage tank. Strict adherence to de-oiling plan. Hazardous substances stored in safe, designated areas located away from watercourses and drains. Tanks with containment bunds. Adequate supply of spill kits.
Residual hydrocarbon product in disused pipe after cleaning process.	Presence of residual hydrocarbons.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Pipe to be capped off, filled with concrete and left buried.
Rupture of abandoned pipe during concrete filling of pipeline	Concrete slurry	Spills and leaks.	Over-pressure of pipe leading to burst	Pressure monitoring along length of pipe with vent relief facility installed along pipe.
Degradation of disused pipe.	Presence of buried disused pipeline.	Spills and leaks. Ground subsidence/ settlement.	Ground and water contamination from hydrocarbon products. Ground/ infrastructure destabilisation.	Section to be completely filled with concrete slurry. Coating system applied to exposed pipe sections.
Risk of hot tapping and third party.	Presence of residual hydrocarbons.	Explosion.	Fatality/injury to employees and or third parties. Damage to properties.	Section to be filled with concrete slurry. Levels of residual hydrocarbons potentially low due to absorption effect of concrete. Residual oil of less than 1% not likely to form an explosive atmosphere.
Risk of hot tapping and third party interference.	Presence of residual liquids in buried disused pipeline.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Section to be filled with concrete slurry. Levels of residual hydrocarbons potentially low due to absorption effect of concrete.

Table 4-5: Option 4 – Leave Pipeline in situ Filled with Air

Risk Description	Aspect Unavoidable Consequence	Aspect due to Mishandling, Non-Compliance	Potential Adverse Impact	Prevention, Mitigation or Legal Requirement
Disused pipeline rupture through landslide movement.	Presence of buried disused pipeline in landslide complex.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Management of landslide monitoring strategy (visual monitoring).
Removal of residual hydrocarbon product from cleaning process.	Hazardous substances on site.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Supervision by competent person. Piped transfer from pig receiver to storage tank. Strict adherence to de-oiling plan. Hazardous substances stored in safe, designated areas located away from watercourses and drains. Tanks with containment bunds. Adequate supply of spill kits.
Residual hydrocarbon product in disused pipe after cleaning process.	Presence of residual hydrocarbons.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Pipe to be cleaned according to good international practice. Sections to be checked for residual oil according to risk assessment (see Chapter 12). Pipe to be sectionalised in accordance with good international practice.
Degradation of disused pipe.	Presence of buried disused pipeline.	Spills and leaks. Ground subsidence/ settlement.	Ground and water contamination from hydrocarbon products. Ground/infrastructure destabilisation.	Intermittent visual monitoring of abandoned pipeline with groundwork maintenance where required
Risk of hot tapping and third party	Presence of residual hydrocarbons.	Explosion.	Fatality/injury to employees and or third parties. Damage to properties.	Residual oil not likely to form an explosive atmosphere
Risk of hot tapping and third party interference.	Presence of residual liquids in buried disused pipeline.	Spills and leaks.	Ground and water contamination from hydrocarbon products.	Use of pipe plugs to minimise the effect of ground contamination.

Based on assessment of the above options, the proposed decision is to leave the pipe in situ, sectionalised (see Section 5.5.5), filled with air at atmospheric pressure (Option 4), except at the following locations:

- Where the pipeline crosses under roads and a railway, it is proposed that the sections be left in place and filled with concrete/grout
- At both crossings of the River Supsa, it is proposed to leave the redundant pipeline in place, capped and filled with water.

The removal from service strategy is considered to represent good international practice and is derived from those approaches used in North America, in particular in Alberta, Canada.

4.6 Access Roads

Access roads will be needed to transport line pipe, equipment and personnel from storage areas and accommodation to the pipeline ROW. These can be existing roads that may or may not need upgrading and widening, or there may be a requirement in remote areas for new temporary access roads to be constructed to allow access to the construction area. These temporary access roads, unless servicing a facility such as a block valve, are usually removed after construction has been completed.

A detailed assessment was made of the potential roads that could be used to access the ROW from the main Georgian east–west highway. These roads were subject to evaluation involving site visits and assessments that considered:

- A preliminary review of engineering and transportation logistics to determine whether an access road is suitable to carry heavy equipment or whether an upgrade (surface quality improvement or widening) might be needed. The final detailed assessment and decisions regarding road upgrade requirements will be made by the construction contractor
- Whether the route passes through or near a settlement and, in particular, sensitive receptors such as schools, hospitals or cemeteries
- Ecological sensitivity of adjacent flora and fauna in areas where roads may require upgrading or widening
- Cultural heritage issues in areas where roads may require upgrading or widening
- Distance – where possible, taking into account the above criteria, the road with the shortest distance between the main highway and the ROW will be used.

Many potential access roads have been evaluated for use by the Project, but are considered unsuitable because of their impacts on sensitive receptors, villages or because of the work needed to upgrade them for use by construction vehicles. A list of access roads identified as suitable for use by the Project is provided in Chapter 5, Table 5-4.

4.7 Base-Case Project Design

This section has summarised some of the key Project alternatives that have been reviewed and have a significant effect on overall environmental and social impacts of the WREP-SR Project. This continual process of environmental and social consideration in the project design has resulted in the adoption of what is considered to be the optimal base-case design for the WREP-SR Project. This base-case design has been described in Chapter 5 Project Description.