Chapter 5 Project Description

TABLE OF CONTENTS

Tables

Figures

Photographs

5 PROJECT DESCRIPTION

5.1 Introduction

This chapter of the ESIA describes the activities that SCPX propose to carry out to design, construct, commission, operate, maintain and decommission the proposed SCPX pipeline and the above ground facilities that are planned to be located in the Republic of Azerbaijan. It describes the current base case for the proposed Project design, taking account of the alternatives considered for the Project that have been discussed in Chapter 4 of this ESIA. The base case will be subject to refinement and potential change during the detailed engineering, environmental, social, health and safety assessment, but where design decisions have yet to be taken this Project description describes more than one alternative. This chapter represents the proposed project description as this document is subject to review and approval by the appropriate Azerbaijani authorities.

Aspects of the Project design that have been developed specifically to mitigate potential environmental or social impacts associated with this project are termed commitments and are identified in this chapter by a reference number in parentheses following the commitment. The reference number is prefixed by the letter D to denote that it is a design related commitment. An example is given in the box below, where D5-096 is the reference number.

Example commitment:
The block valves have been co-located with SCP block valves to minimise cumulative landscape impact (D5-096).

Commitments referenced with numbers only (00-00) are topic-specific, generic construction phase commitments. Commitments with a prefix X relate to a specific location and commitments relating to decommissioning are numbered with a prefix DE. Commitments with a D prefix are commitments made within the Project design. All the commitments have been included in the Commitments Register (Appendix E). Figure 10.1, Chapter 10 is a guide to how commitments in the ESIA are linked to the Commitments Register.

Where appropriate, this chapter presents details of the Project in a wider sense (i.e. beyond the confines of Azerbaijan).

Where kilometre points (KPs) are mentioned to describe the location of certain feature, these denote the nearest kilometre point on the new 56” pipeline loop. The SCPX kilometre points in Azerbaijan will commence at KP0, which is at approximately KP57 on the existing SCP pipeline.

The activities described in this chapter of the ESIA are the focus of the impact assessment presented in Chapters 10 and 12.

5.2 Project Objective and Overview

The objective of the SCPX Project is to increase the capacity of the existing SCP pipeline to enable the transport of an additional 16 bcma of gas from the Shah Deniz 2 development in the Caspian Sea in Azerbaijan to the Georgia–Turkey border. The gas will be supplied to domestic markets in Georgia and Turkey, with the majority of gas being transported onwards to European markets.

To increase gas transport capacity, the following modifications to the existing SCP pipeline system are proposed for the proposed SCPX Project:

- A new 56"-diameter (1,422mm) looped pipeline in Azerbaijan starting at SCPX KP0 and continuing to SCPX KP390. The pipeline will be routed parallel to the existing SCP and Baku–Tbilisi–Ceyhan (BTC) pipelines for much of its length
- A new intermediate pigging station will be constructed in Azerbaijan at the beginning of the looped section at SCPX KP0
- Five new block valves will be constructed in Azerbaijan, to be co-located with the existing SCP/BTC block valves: BVR A6 (SCPX KP21), BVR A7 (SCPX KP95), BVR A8 (SCPX KP172), BVR A9 (SCPX KP243) and BVR A10 (SCPX KP334)
- A 57km-long looped section of pipeline will be constructed in Georgia. The Georgian section of the pipeline will also have a nominal diameter of 56 inches (1422mm) and will be routed parallel to the existing SCP and BTC pipelines
- An expansion of the existing facility (Area 72) in Georgia, which is located about 3km beyond the Azeri/Georgian border. This facility is currently used as a pumping station for the BTC pipeline and a border custody metering and gas offtake facility for the SCP pipeline. The expansion will comprise the construction of a new SCPX compressor station (CSG1), additional custody metering and gas offtake facilities
- A new block valve station will be constructed in Georgia at approximately 28km from the Azeri–Georgian border
- A pigging station (Area 74) will be constructed in Georgia where the new pipeline reconnects with the SCP pipeline at SCP KP55
- A new compressor station (CSG1) collocated with the existing BTC facility near Rustavi at KP03. This will also contain an Azerbaijan border metering system, pigging facilities and an offtake facility with pressure reduction and metering equipment to provide gas to the Georgian gas supply network (which will have an increased capacity compared with the existing SCP offtake)
- A second compressor station (CSG2) built on a greenfield site at KP142 on the existing SCP pipeline, west of Tsalka Lake, with a 16km access road from the Millennium Road
- A pressure reduction and metering station (PRMS) at the Georgian border with Turkey, collocated with the existing SCP facility.

The proposed SCPX pipeline loop and associated aboveground installations (AGIs) are shown in schematic form in Figure 5-1.

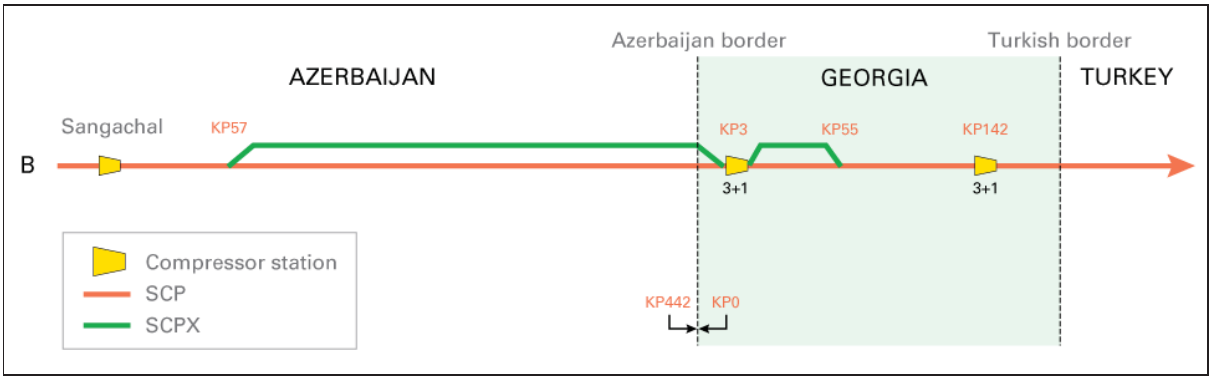


Figure 5-1: Schematic Diagram of SCPX Project

Designing the pipeline concept such that hydraulic requirements are met is of key importance. The aim is to understand where the pressure drops and finding the best point that balances the pressure needs of the Project. In Azerbaijan, this point is at SCP KP57 where the pressure remains high enough not to compromise the 42". Pressure decreases over distance, but non-linearly. Figure 5-2 shows the pressure losses in the SCP system for the following cases:

- SD1 42” System at 7.41 BCMA shows the current variation in pressure for the current system.
- SD1 42” System at +16 BCMA shows how the pressure would rapidly decline in a single line, which demonstrates that this is insufficient to transport the gas.
- SD1 42” and 52” pipelines to the Georgian border shows the effect of adding a 56” line loop in parallel with the 42” starting at kp 57 and ending at the Georgia / Turkey border. The pressure at the border is below that required to deliver to Turkey.
- SD1 42” and 52” and CSG1 - the required pressure at the Turkish border is more than needed and involves building pipelines in geologically challenging high ground in Georgia (green elevation line).
- The Project selected development plan and is shown in the blue line.

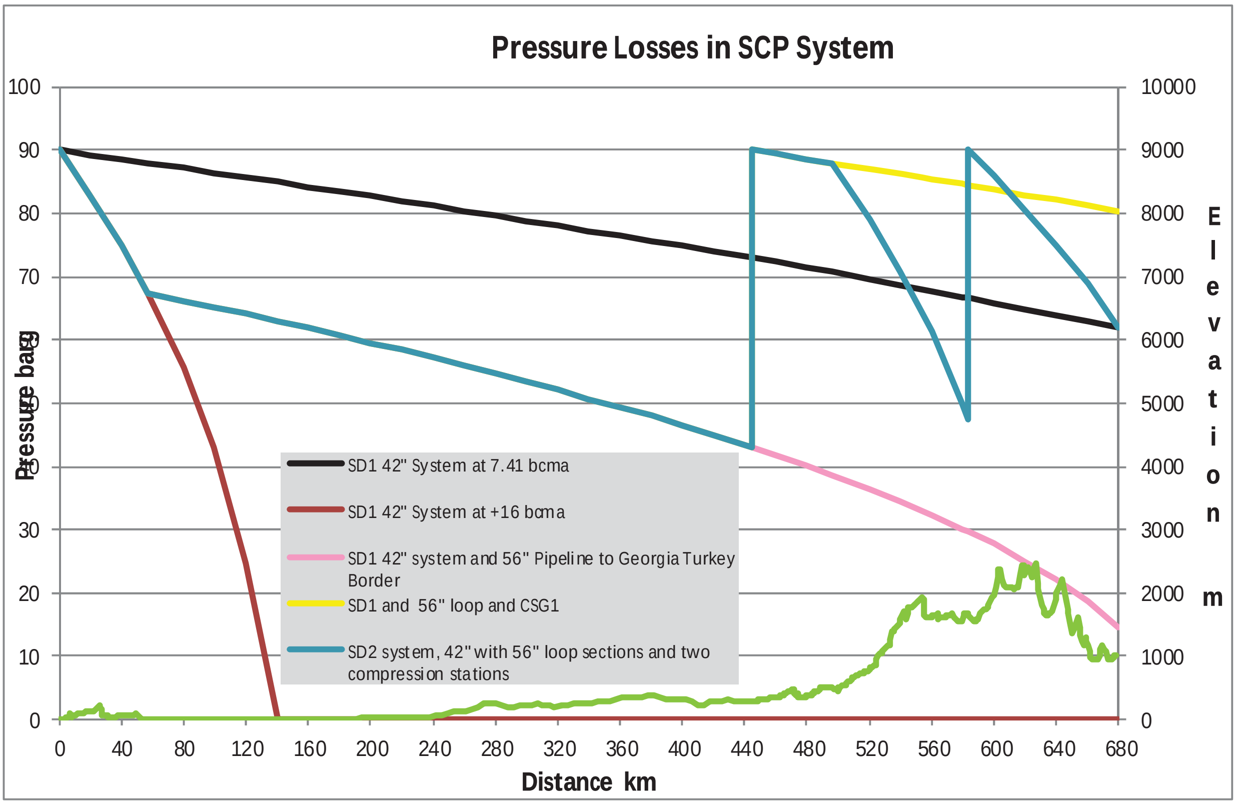


Figure 5-2: Pressure Losses in South Caucasus Pipeline System

The location of the start point has the advantage of avoiding having to cross or route around the Gobustan World Heritage site, active fault zones, challenging terrain and river crossings and sensitive habitats.

There is no expected temperature change in the 42” pipeline with the additional 16bcma of gas that will be carried. The inlet temperature of the gas at Sangachal is the same at present of no more than 50°C. The gas cools through the pipeline and the arrival temperature at the Azerbaijan/Turkey border will depend on the flow rate and season of the year, and will normally be the same as the ambient ground temperature. It is expected that there will be no effect on the environment.

5.3 Project Schedule for Implementation and Development

5.3.1 Project Schedule

It is anticipated that the construction and commissioning of the system will be completed by the mid-2018. The Project is currently nearing completion of the front-end engineering design phase.

Figure 5-3 presents the anticipated programme for design, construction and commissioning of the SCPX Project.

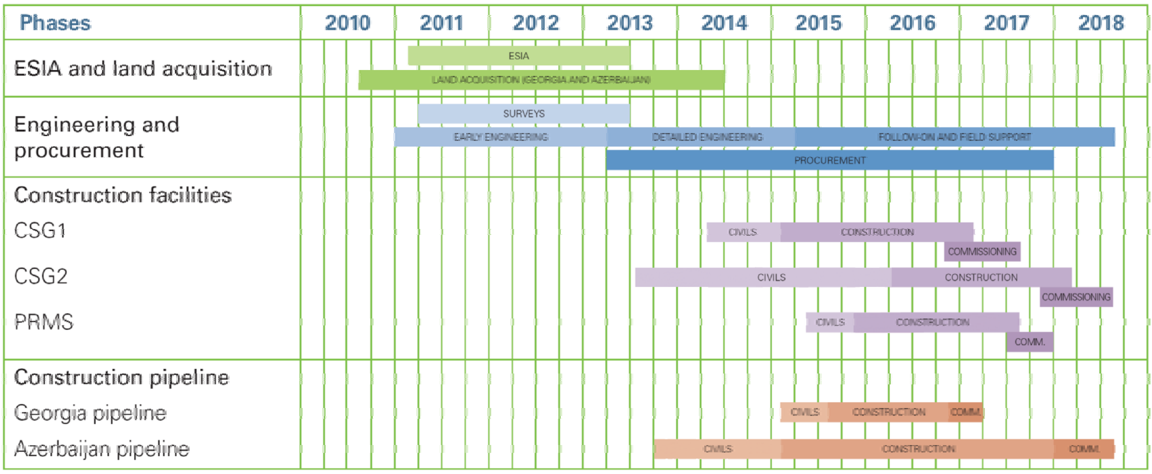


Figure 5-3: Anticipated Project Schedule

The ESIA was submitted to the Azerbaijan Government in draft format for public disclosure in January 2013, and the final version of the ESIA will be submitted for approval in mid-2013. Negotiations for land acquisition will commence in 2013 and be complete by 2014.

The first rail spur upgrade is proposed to start in Azerbaijan in the fourth quarter of 2013. Pre-construction mobilisation in Azerbaijan is currently scheduled for mid to late 2014 with early works to prepare access roads, construction camps and lay-down areas commencing in mid to late 2014. It is estimated that the pipeline construction period in Azerbaijan will commence in early-mid 2015 for the main construction spread, which will complete works in 2017. Commissioning is scheduled to commence at the end of 2017 with system start up and normal operation scheduled for 2018.

5.3.2 Project Development

The sequence of events leading up to the implementation of the SCPX Project is as follows:

- Identify and define the need
- Feasibility study
- Basic engineering (conceptual design)
- Front-end engineering design (FEED)
- Detailed design
- Site preparation and construction works
- Pressure testing (pipeline and AGI facilities)
- Commissioning
- Operation and maintenance
- Decommissioning and abandonment.

5.3.3 Project Need and Consideration of Alternatives

The need for the additional pipeline and associated aboveground installation (AGI) facilities is presented in Chapter 4 of this ESIA. Various strategic alternatives have been studied and evaluated to give the most efficient, cost-effective, safe and environmentally and socially acceptable scheme to provide the increased capacity required of this pipeline delivery system.

5.3.4 Feasibility Studies and Consideration of Design/Routing Alternatives

The Project concept as described in Section 5.2 above represents the culmination of a process of field investigations, design and environmental assessments over a period of many months to determine the best option that meets the Project objectives. The process is ongoing and will continue until the proposed scheme is implemented. The results of key feasibility studies and alternatives are discussed in Chapter 4.

5.3.5 Basic Engineering and Environmental Scoping

The basic engineering generated a conceptual design for the whole of the SCPX Project. An integral part of that process was an assessment of the optimum length of the pipeline and the location of the associated AGI facilities. The environmental baseline surveys, risk assessments and environmental scoping that were carried out informed the conceptual design for the Project.

5.3.6 Front-end Engineering and Environmental and Social Impact Assessment

Front-end engineering started in 2011. International ESIA consultants were appointed to produce this ESIA report, building on scoping studies and environmental and social work undertaken during the basic engineering. The entire route of the proposed SCPX pipeline loop has been walked and surveyed by engineers and environmental specialists, including topographical survey teams and ecologists.

As part of the ESIA, a social assessment has been undertaken to identify potential impacts and reduce potential disturbances to surrounding communities and the livelihoods of the inhabitants. Positive impacts, such as employment, are also identified and, where possible, enhanced. Stakeholders in Azerbaijan were consulted to gain local knowledge of the proposed pipeline route and the locations of the associated AGIs. This allowed for improved identification and assessment of preferred locations for the pipeline route and AGIs.

5.3.7 Project Footprint

The 'Project footprint' is the area of land that will be directly impacted by the Project, e.g. by a building or access road. Site assessments (taking into consideration ecology, cultural heritage, social, erosion risk, and water resources, etc.) will be undertaken if the need for additional land is identified following submission of the ESIA (39-02). An environmental and social assessment report will be prepared by the Project if any additional land outside that described in the ESIA is to be used, the scale of which will depend on the proposed activities and sensitivities of the area (39-03). Table 5-1 breaks down the physical footprint by area.

Table 5-1: Preliminary Estimates of Permanent SCPX Project Footprint

Location	Sub-total (m^2)
5 x Pipeline block valve facilities	7,825
Pigging station (including vent area)	15,464
Pipeline ROW[1]	0
TOTAL	11,625

1 Land on the ROW will be reinstated and handed back subject to restrictions

Table 5-2: Preliminary Estimates of Temporary SCPX Project Footprint

Location	Sub-total (m^2)
Pipeline construction camps (excluding topsoil storage areas)	
Section 1 camp	60,000
Section 2 camp	60,000
Section 3 camp	60,000
Section 4 camp	60,000
Section 5 camp	60,000
Potential satellite (fly) camp	25,000
Sub-total	325,000
Pipeline lay-down areas	
Sub-total	578000
Working areas for river crossings	
HDD river crossings (x5)	50,000
Micro-tunnel river crossing (x1)	8000
ROW expanded stringing site (Kura East)	25,000
Pipeline ROW	13,900,000
Sub-total	13,983,000
TOTAL	14,886,000

5.3.8 *Project Land Requirements*

The 'Project land' area is the total amount of land that will be acquired by the Project, but may not be directly used. Project land requirements will therefore be larger than Project footprint requirements. Land acquisition for permanent land needs is generally larger than the total permanent footprint, as additional areas have been purchased to accommodate land ownership. The permanent land acquisition areas at the facility sites are as follows (Table 5-3).

Table 5-3: Preliminary Estimates of Facility Permanent Land Requirements

Location	Sub-total (m^2)
Pipeline block valves access roads	1500
Pipeline block valves facilities (with ditches)	7,825
Pigging station (including temporary vent area)	15,464
TOTAL	24,789

This land will be acquired and will be occupied by the Project on a permanent basis. Temporary, construction-related land needs are listed in Table 5-4, and preliminary calculations estimate approximately 15,790,200m^2 of land will be required during the construction phase of the Project.

Table 5-4: Preliminary Estimates of Temporary Construction Land Requirements

Location	Sub-total (m^2)
Pipeline construction camps	
Section 1 camp	60,000
Section 2 camp	60,000
Section 3 camp	60,000
Section 4 camp	60,000
Section 5 camp	60,000
Satellite camp	25,000
Sub-total	325,000
Pipeline laydown areas	
Sub-total	608,000

Location	Sub-total (m^2)
Access roads	
Access roads	45,000
Land boxes for crossings	
Road	260,000
Railway	30,000
River	280,000
Canal	252,000
Trenchless foreign service	67,200
Sub-total	889,200
Land boxes for pipeline BVR construction	
BVR A6	1000
BVR A7	1000
BVR A8	1000
BVR A9	1000
BVR A10	1000
Sub-total	5,000
Pigging station	
Pigging station	17,000
Pipeline ROW (based on 36m standard working area)	
Pipeline ROW	13,900,000
TOTAL	15,790,200

This land will be occupied for the duration of construction of the relevant facilities, until they are no longer required (generally three years) and will typically be leased from its current owners. After construction and reinstatement are complete or at the end of the lease, land will be handed back to its owners, who will be able to resume previous utilisation (agricultural or otherwise) subject to safety zone requirements.

5.4 Project Design Basis

The Host Government Agreement (HGA) requires that the Project conform to "current technical standards and practices generally used by the international community (within Canada, the United States or Western Europe) with respect to Natural Gas pipeline projects comparable to the Project".

5.4.1 Design Codes and Standards

Section 2.2 of Appendix 4 of the HGA contains a Code of Practice that sets out the principles, standards and practices applicable to the design, construction and operation of the pipeline and the associated facilities that comprise the Project.

In accordance with the Code of Practice the SCPX will be designed, fabricated, constructed, tested and commissioned in accordance with the requirements of the American Society of Mechanical Engineers (ASME), namely ASME B31.8 "Gas Transmission and Distribution Pipeline Systems" (2010 Edition). The block valves and pigging station piping will be designed, fabricated, constructed and commissioned in accordance with either ASME B31.8 or ASME B31.3. *'Process Piping Design'*. Road, rail and track crossings will be designed in accordance with API RP1102.

The pipeline is to have a design pressure of 95.5 barg and a maximum operating pressure of 90 barg.

5.4.1.1 Pipeline diameter and materials

The 56" pipeline will comprise X70 grade line pipe with a nominal 19.5mm wall thickness where the route crosses agricultural land. Increased wall thickness is specified where the pipeline route passes through lightly populated areas (23.4mm) or densely populated areas

(28.1mm). Where there is a high risk of damage to or interference with the pipeline, the pipe wall thickness may be further increased.

An increased wall thickness with a design factor of 0.6 will be applied at road, major railway and river crossings to meet the requirements of API RP 1102 (D5-034) ‘Steel Pipelines Crossing Railroads and Highways’.

A wide range of other international codes and standards are also identified and these shall be applied, where appropriate, to specific elements of the Project design.

5.4.2 Design Life

Once constructed, the new SCPX pipeline is expected to have a 30-year design life. An external three-layer high-density polyethylene (HDPE) coating will insulate the outer surface of the pipeline from the surrounding soil. This coating will reduce the potential for induced current corrosion and biological and chemical attack on the pipeline. As the current along the pipeline is earthed, no current would be detectable at the surface. After welding the pipeline sections together in the field, an additional coating will be applied to the pipe joints. Internally, the pipeline will be painted with a material that enhances its hydraulic properties. Additional maintenance measures can be applied on a routine basis during the operational period to ensure that all facilities can operate for an extended lifetime, if required.

5.4.2.1 In high-water-table regions, the pipe will be concrete weight coated to prevent flotation. Depth of cover

Where normal agricultural activities will be carried out over the pipeline, it will be buried in a trench allowing a minimum depth of 1.0m between the top of the pipeline and the ground surface. There will be increased depth of cover at crossings: road crossings will generally be installed with at least 2m cover, rail crossings have at least 3m and unpaved roads have at least 1.5m cover (D11-02). Where it is considered that there is a higher risk of the pipeline being damaged or interfered with, or where other services are crossed and at track and road crossings, the pipeline will be covered by concrete slabs at open cut crossings (D30-01).

5.4.2.2 Pipeline location identification

Subsurface warning tape will mark the position of the pipeline along its entire route. Low-level marker posts will be provided at all station sites, cathodic protection test stations, road, track, rail and water crossings, SCPX facility fences, and any other locations deemed necessary to provide identification of the pipeline route and to aid surveillance. Where appropriate, markers will be within line-of-sight of adjacent markers. All marker posts will be provided with identification plates that will include telephone contact numbers for members of the public to use to contact the operators in the event of a pipeline incident.

Aerial markers will be installed at intervals of up to 5km along the route to assist in aerial surveillance of the route.

5.4.3 Design Safety Factors

In the context of engineering design, the term ‘safety factor’ is a multiplier that is used to ensure that the maximum design load or capacity is maintained below the maximum value that could be sustained by a pipeline system component or structure without failure. Safety factors are used, therefore, to ensure that design proceeds in a manner incorporating a significant margin of safety.

In accordance with normal engineering practice, and the requirements of the engineering standards adopted for the Project, safety factors have been incorporated in each element of the engineering design for the SCPX. A 0.72 design factor will be applied to the majority of the pipeline route; this equates to a design that will accommodate 1.39 times the maximum expected load and is appropriate in less populated areas.

Where required by the applicable design standards, or as considered appropriate by the engineering team, additional safety factors have been incorporated into the design to reflect key sensitivities, including environmental and social conditions. In specific areas, for example close to communities, heavier wall pipe will be used to reduce the risk of pipeline failure in accordance with international standard (ASME B31.8) (D12-02). This may include situations where there are:

- Increased population densities in proximity to the pipeline route
- Road, rail and river crossings
- Sections where the pipeline route runs parallel to existing roads or railways.

The use of a more conservative design factor in such areas has typically led to the provision of thicker walled line pipe than would be required if based only on anticipated hydraulic pressures and construction considerations at these locations.

5.4.4 Pipeline Diameter and Materials

The SCPX line pipe will be formed of continuously welded, high-grade API 5L Grade X70 carbon steel with an outside diameter of 56 inches (1422mm).

The wall thickness of the pipe is determined by operating pressure considerations while applying the specified 0.72 design factor. In areas of particular environmental or social risk, where an increase safety factor applies (see Section 5.4.3), the wall thickness will increase from 19.5mm for a design factor of 0.72 to 23.4mm for a design factor of 0.6, and increasing up to a maximum of 28.1mm for a design factor of 0.5.

5.4.5 Design Pressures and Temperatures

The design pressure of SCPX in Azerbaijan will be 95.5 barg with a maximum operating pressure (MAOP) of 90 barg, this being the same as the existing SCP. The adoption of a design pressure higher than the maximum operating pressure reflects a conservative approach to the design of the SCPX system.

The buried pipeline will be designed for a maximum design temperature range between -10°C to 74°C. The anticipated external temperature of the buried pipeline will be within this range even under extreme climatic and operating conditions. The design range for the aboveground pipeline will be between the temperature range of -46°C to 78°C.

5.4.6 Corrosion Protection

Even though the pipeline will be constructed of high-quality steel, if unprotected it would corrode over time, principally as a result of electrical currents that are naturally induced from contact of the metal pipe with the surrounding soil; such induced currents result in metal loss from the pipe, i.e. corrosion. Biological and chemical activity in the material surrounding the pipeline can also contribute to corrosion.

A high-integrity, three-layer polyethylene coating will be applied to the external surface of the pipe before delivery to the pipe storage yards. This coating will insulate the metal exterior surface of the pipeline from the surrounding soil, thereby reducing the potential for induced current corrosion and biological and chemical attack on the pipeline.

During pipeline construction, a coating will be applied to the pipe joints after welding. This field joint coating will be carried out at the location of the pipeline installation.

The entire coating of the pipe and the welds will be checked by non-destructive testing (NDT) to ensure integrity of the coating before the pipe is laid into the trench. Mechanised ultrasonic testing, which provides instantaneous results, is the preferred method for checking welds.

Internally the pipeline will be protected by an epoxy coating. The pipeline will be painted with a material that enhances its hydraulic properties. If during construction areas of increased corrosivity are encountered, then the corrosion protection system may be supplemented with additional measures such as sacrificial anodes. The coating and corrosion protection systems are generally sufficient to protect against most corrosive water systems, and these conditions are generally absent from the SCPX route.

The internal condition of the pipeline will be monitored regularly and be subject to ongoing maintenance to minimise the potential for corrosion. Following construction and commissioning it is proposed that the SCPX shall be internally inspected at the same time intervals and to the same extent as the SCP.

The SCPX pipeline will be protected from corrosion by an impressed current cathodic protection system (D5-001).

5.4.7 SCPX Pipeline Route

The SCPX route has been selected to take account of social, engineering, geotechnical and environmental constraints. The route selection process and the alternatives considered are described in Chapter 4, Project Alternatives. Where possible the proposed SCPX pipeline will be constructed either adjacent to or in the same corridor as the existing SCP pipeline.

A modern designed pipeline does not suffer any impacts from earthquake-induced ground shaking. The only ‘effect’ on the pipeline from ground shaking comes if the pipeline is laid in soils susceptible to liquefaction. Studies carried out for BTC/SCP identified where these areas are and these areas were avoided. Given that the Project is following the existing corridor for most of the route, this hazard will be avoided. The pipeline is also designed to international standards and the design factor for wall thickness has built in an allowance for disturbance.

A general minimum separation distance of 20m is applied between SCPX and SCP/BTC. At crossings, additional control of work measures will be applied (D11-04). At the block valve sites the separation distance between 56” SCPX pipeline and the 42” SCP pipeline and the SCPX block valves and the BTC/SCP block valves will be no less than 28m (D11-05). Additionally, right of way separation distance may need to be increased if the existing Right of Way (ROW) is unsuitable for a parallel installation owing to constructability or ground stability issues. If it is not practicable, a new corridor will be sought to establish a suitable route.

Where the SCPX pipeline crosses buried services or pipelines, trenchless or open-cut crossing methods will be adopted. A minimum vertical separation between the SCPX pipeline and the existing service or pipeline will be 1500mm where trenchless techniques are used and 900mm where open cut techniques are used (D5-010). Construction of the crossings of the existing BTC and SCP pipelines will be controlled under the existing pipeline operations permit to work system and the activity will be subject to a specific risk assessment undertaken by both the construction contractor and BTC and SCP operations team (D5-011).

5.4.8 Intermediate Compressor and Metering Stations

The current design does not include the installation of any intermediate compressor station or metering facilities between the outlet of the mainline compressor at the Sangachal Terminal and the Georgian border. As such, detailed discussion of compressor technologies and metering is outside of the scope of this ESIA. After Sangachal Terminal the next compression and metering facilities are located within Georgia.

5.4.9 Intermediate Pigging Facility

A pipeline integrity gauge is a device that is used for internally monitoring and cleaning pipelines. All pigging operations require a means of loading pigs into the pipeline and retrieving them from it. These locations are respectively referred to as pig launchers and pig receivers, and collectively as pigging facilities.

The SCPX has been designed to facilitate the use of cleaning and inspection pigs. A pig-launching facility for the SCPX will be constructed at SCPX KP0. Sensitive material and colour finishes will be used for the external facades of buildings (D8-02). The first pig-receiving facility for the pipeline will be established within Georgia and is therefore discussed in the ESIA for the Georgian section of the Project.

Power requirements for the pigging facility are planned to be supplied with approximately five to eight thermal electric generator (TEG) units. The number of TEGs will be dependent on the manufacturer selected. The TEG units will generate electricity by using small quantities of the pipeline gas, which will subsequently be used to supply a trickle charge to batteries in the local equipment room.

Plug sockets will also be installed at the pigging station that will allow for temporary diesel generators to be connected to the switchboard during maintenance works. The intention is that the generator will not be kept on-site, but brought to site when required. Any fuel associated with the temporary generator use will be bunded or held in a double-skinned tank. Drip trays will be used during fuel transfer operations.

It is envisaged that the pigging station will not be manned on a permanent basis by operational staff, although security personnel will be present on a permanent basis.

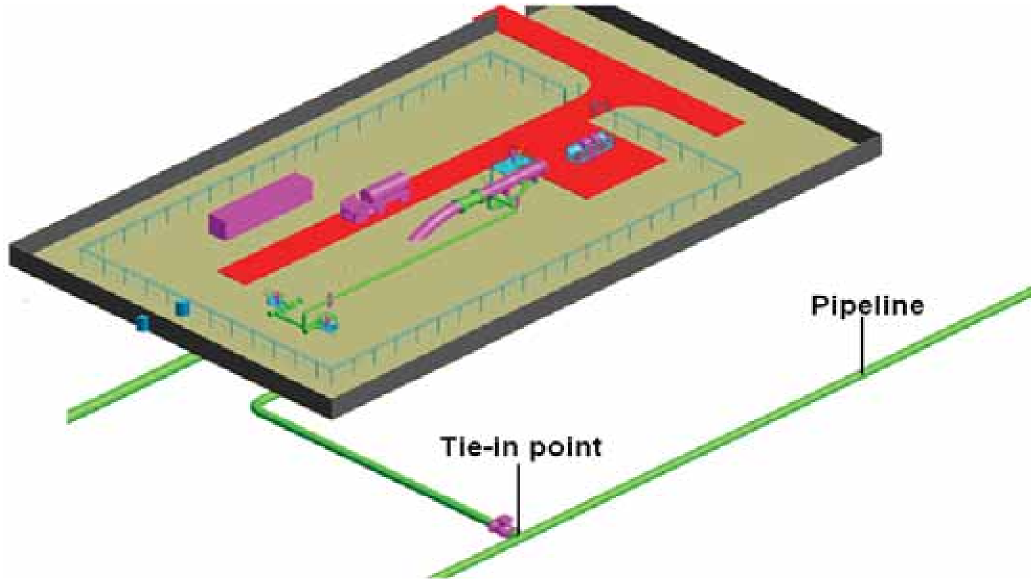


Figure 5-4: Schematic of the Proposed Pig Launching Facility at SCP KP57 (SCPX KP0)

5.4.10 Block Valve Stations

Block valves (BVRs) will be located along the proposed pipeline route to facilitate maintenance and to isolate sections of the pipeline in the event of a loss of containment. The valves will be under the control of the Sangachal Terminal control room operator who will be able to close individual valves remotely.

BVRs will be spaced at intervals ranging from approximately 71km to 88km and will be collocated with the existing BTC/SCP BVRs to avoid duplication of utilities and services. A risk assessment has determined that the minimum separation distance between SCP/BTC and SCPX BVRs shall be 28m (pipeline centre to centre) and for added safety the SCPX BVRs will be located 28m either side of any existing BTC/SCP BVR.

Block valves will be located in a chamber with the actuator above ground and surrounded by a concrete wall. Each site will include an equipment room, located above ground, which will be surrounded by a concrete structure. Sensitive material and colour finishes will be used for the external facades of buildings (D8-02). A chain-link fence will define the perimeter of each site, which is anticipated to be 31m by 28m.

The provisional locations for the block valve stations are listed in Table 5-5: The block valves used for the remotely operated sites will be inline, full-bore and fully welded.

Power supplies will not be required for the valve operation; however, each site will be provided with primary power supplies for ancillary equipment from the Azerbaijani national grid. A back-up generator capable of providing the full power requirements for the site will also be incorporated into the facility. Fuel for the back-up generators will be stored on the associated SCP/BTC block valves; no fuel will be stored at the SCPX block valves. Electrical power will be used for ancillary activities such as lighting, telecommunications and security system operation. Essential and emergency loads will be powered from an uninterruptible power supply (Table 5-5). The final locations of these facilities will be defined through the ongoing detailed engineering design process. The block valves used for the remotely operated sites will be inline, full-bore and fully welded.

Power supplies will not be required for the valve operation; however, each site will be provided with primary power supplies for ancillary equipment from the Azerbaijani national grid. A back-up generator capable of providing the full power requirements for the site will also be incorporated into the facility. Fuel for the back-up generators will be stored on the associated SCP/BTC block valves; no fuel will be stored at the SCPX block valves. Electrical power will be used for ancillary activities such as lighting, telecommunications and security system operation. Essential and emergency loads will be powered from an uninterruptible power supply.

Table 5-5: Proposed SCPX Pipeline Block Valve Locations

SCPX KP	Block Valve Number
21	BVR A6
95	BVR A7
172	BVR A8
243	BVR A9
334	BVR A10

It is anticipated that the existing security personnel based at the BTC/SCP BVRs will also be employed at the SCPX BVRs, which is expected to be on a permanent basis. The communications system (described in detail in Section 5.4.11) will transmit data regarding BVR status and security to the Sangachal Terminal control centre.

The typical example of a BVR is illustrated in Photograph 5-1.

Photograph 5-1: Block Valve Station along SCP Route

Site-specific seismic parameters have been developed for all of the aboveground installations on the SCPX Project. These have been based on a probabilistic seismic hazard assessment (PSHA) carried out by EQE in 2001 for SCP. The seismic design of all facilities is based on ASCE 7-10.

All key buildings have been designed with resistance to seismic events as a prime consideration. They have been designed to survive the maximum considered earthquake (MCE), which corresponds to a return period of 2475 years. The fabric of most buildings will comprise a steel-frame with metal cladding. This type of construction is suitable for earthquake regions and the structural design has been carried out using an appropriate design code for such regions. The use of reinforced-concrete-framed structures has been minimised, as these structures are relatively inflexible and therefore susceptible to earthquake damage. Further, the design specifies that any building masonry shall be reinforced specifically to reduce the potential for earthquake damage.

5.4.11 Integrated Control and Safety System

The existing integrated control and safety system (ICSS) will be upgraded and expanded to cover the SCPX and facilities. The system monitors the entire pipeline using equipment that controls all block valve stations in Azerbaijan. The ICSS measures process parameters including flow rate, pressure and temperature and controls these parameters within the system's acceptable operating conditions.

The ICSS will be designed and configured to maximise availability for critical process and safety functions with the use of redundancy within communications, processing, power and field cabling diversity to avoid single-point failures.

The ICSS system includes the process control system, the emergency shutdown system and the fire and gas detection system.

5.4.11.1 Emergency shutdown systems (ESD)

There are no existing emergency shutdown facilities in Azerbaijan and none are required for the SCPX Project.

5.4.11.2 Leak detection system (LDS)

A leak detection system is provided on the pipeline. Following detection of a leak, the block valves on either side of the leak will be remotely closed so that the volume of release will be limited by the distance between the two block valves (D12-03).

The existing leak detection system will be updated with the latest hardware and software and will be configured to cover the expanded pipeline and facilities. The system operates independently from the above systems but uses available pressure, temperature and flow measurement data from the ICSS.

The system includes online and offline computer models of the pipeline, and a statistical leak detection system. The system alerts the operator in case of unacceptable deviations and possible leaks but does not initiate a shutdown or have any other control or executive actions. The decision on how to proceed in the event of a suspected leak being detected is taken manually by the Operations team.

The philosophy for the new LDS will be the same as defined for the originally system as detailed below:

- The LDS will be capable of continually monitoring the pipeline to high accuracy and with a high confidence level
- The LDS will interface with the Project ICSS at the Sangachal pipeline control centre. Integration of the LDS into the ICSS will be operationally seamless, with all the dynamic variables used in the system being secured from data transfers via the ICSS dual redundant communications network.

The LDS will provide:

- Suspected leak alarms
- Location of leaks.

5.4.11.3 Communications systems

The existing SCP and BTC pipelines share a dedicated telecommunications system based on a multi-core fibre optic cable (FOC) placed within a high-density polyethylene (HDPE) conduit that is installed alongside the buried BTC pipeline in the same trench.

The ICSS will communicate with the block valve stations through the existing optical fibre communications network.

In the event of optical fibre communications failure, stations continue to operate in stand-alone mode retaining previous set points and critical pipeline data is transmitted between relevant sites via dial up telecommunications.

In addition to providing ICSS communications, the telecommunications systems provide voice, data and security services. The FOC is fully backed up via a satellite communications system.

The existing voice, data and security telecommunications system will be upgraded for the new and expanded SCPX stations.

5.5 Project Construction

5.5.1 Construction Overview

The pipeline will be constructed in accordance with the HGA and applicable government regulations, contractual requirements, applicable permits and authorisations, and Project-approved drawings, plans, procedures and specifications. However, within this regulatory and contractual framework, the selection of many of the detailed construction methodologies and plant for the proposed SCPX Project will be the responsibility of the successful construction contractor(s). As such, much of the more detailed approach in terms of construction methodologies has yet to be defined. This section aims to present an indicative outline of the approaches that are likely to be adopted by the construction contractor(s), recognising that some details may change at a later stage of the Project.

Pipeline construction is a sequential process and comprises a number of distinct operations, undertaken by a large range of specialised and general crews (teams of workers and the necessary plant and equipment collectively referred to as the construction spread). It is anticipated that two separate spreads will be used to construct the pipeline in order to achieve the schedule shown in Table 5-2. Pipeline construction will occur simultaneously at more than one location to make efficient use of the workforce and machinery, to meet programme requirements and work within the constraints imposed by seasonal weather. There are also likely to be specialist teams installing the major crossings.

Prior to the commencement of each element of the construction programme, the construction contractor(s) will develop detailed designs, drawings and method statements for the work to be performed, which will be reviewed by the Project. These documents will incorporate the reasonable requirements of landowners and occupiers, the mitigation measures outlined in this ESIA and the requirements of the regulatory authorities in Azerbaijan. These activities will be monitored by the SCPX Project team in accordance with the requirements outlined in Chapter 13 of the ESIA and also the ESMMP (see Appendix D).

Construction is expected to involve the following main activities, which are described in this section:

- Establishment of temporary construction camps and storage areas
- Widening and improvement of access tracks/roads where necessary
- ROW preparation
- Delivery of materials and personnel to site
- Trench excavation
- Installation of line pipe
- Installation of block valves
- Open-cut crossings of minor irrigation canals, watercourses, tracks, roads, services etc.
- Trenchless crossings of the major roads, rivers and canals
- Hydrotesting and pre-commissioning of the new pipeline sections
- Installation of cathodic protection systems
- Tie-in of the new pipeline sections
- Reinstatement of all disturbed areas.

5.5.2 Construction Workforce

A small number of workers will be required for the rail spur upgrades that commence in October 2014. There will be an estimated 150 workers who will be required in mid–late 2014 to undertake early civil works including camp and pipe storage yard construction. As the main construction activities will commence in early 2015, the workforce will begin to increase during this period. The assumption is that construction will be undertaken with one main spread, and a second smaller spread will be required to work in the area with a higher density of crossings. The directly employed construction workforce located in the camps will reach an estimated peak of approximately 500–700 personnel in mid-2015 and will carry through to late 2017 before numbers decrease. The indirect manpower (camp cleaners, cooks etc.) has been estimated to be around 35% of the direct workforce.

Project manpower (including indirect personnel) will peak at approximately 1270 personnel. Manning levels will vary during the course of construction and activities such as stringing, welding, coating, trenching, backfilling and reinstating. The maximum number of personnel during the main construction period will be subject to revision following appointment of a main works contractor.

A smaller spread will work almost simultaneously with the main spread but with the start delayed by approximately two months. The smaller spread will work within the section of the route between KP94 and KP145, which has a high density of irrigation channels, watercourses and roads that need to be crossed.

As construction progresses, the peak number of workers at each camp will vary depending on the project progress. There will be two camps operating almost simultaneously, but the peak manpower required at each of the camps will not overlap.

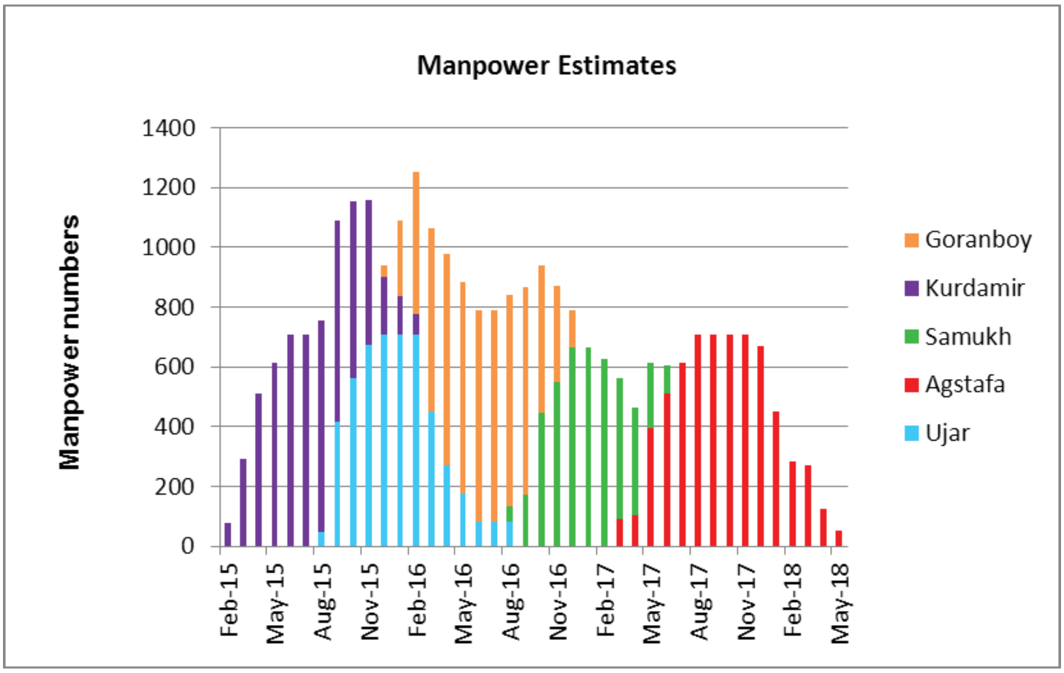


Figure 5-5: Workforce and Manpower Estimates

The above workforce and manpower estimates have been calculated based on the assumption that there will be one main construction spread that will work along the entire route and one smaller spread that will operate between KP94 and KP145. The estimates include both direct and indirect workforces.

In parallel to the main pipeline construction there will be separate construction sites for HDD and micro-tunnel works. The workforce for the separate construction sites is likely to be based at the main construction camps.

A smaller, satellite camp is being considered in Saloghlu to serve the micro-tunnel operations at the Kura West crossing. Any site will be subject to further studies and reviews.

5.5.3 Construction Camps and Pipe Storage Areas

5.5.3.1 Camp and pipe storage area locations

During the construction of the SCPX Project temporary facilities will be needed for pipe storage, mechanical maintenance, fuelling, warehousing, Project offices and worker accommodation.

In order to ensure that camps and pipe storage areas are appropriately placed to meet logistical requirements, including minimisation of travel, the pipeline route has been divided into five sections. The approximate sections of the proposed route against KPs are as follows:

- Section 1: Mugan to Kurdemir (KP0–94)
- Section 2: Kurdemir to Turianchay crossing (KP94–145)
- Section 3: Turianchay crossing to Borsunlu (KP145–235)
- Section 4: Borsunlu to Zeyamchay crossing (KP235–306)
- Section 5: Zeyamchay crossing to Georgian border (KP306–390).

There are two alternative groups of proposed camp and pipe storage areas identified during the Project which are referred to as Alternative 1 and Alternative 2 and described in detail in Section 4.7. Alternative 1 construction camp and pipe storage locations were initially identified through consideration of existing infrastructure and brownfield sites. Following a philosophy change (see Section 4.7.1), the locations of many of the Alternative 1 sites were no longer in the optimum locations. In order to address this, further work was undertaken to identify a second set of options (known as Alternatives 2).

Within the five sections described above, the following have been identified as preferred locations for temporary facility infrastructure.

Section 1
- Mugan Pipe Storage Area
- Kurdemir Camp Option 5

Section 2
- Ujar Camp Option 5
- Kurdemir Pipe Offloading Area and Rail Spur - Option 1 (Mususlu)
- Kurdemir Pipe Storage Area Option 1 (Mususlu)
- Kurdemir Pipe Storage Area Option 2 (Mususlu)

Section 3
- Goranboy Camp Option 3
- Yevlakh Pipe Storage Area, Offloading Area and Rail Spur

Section 4
- Samukh Camp Option 3
- Gazanchi Rail Spur and Offloading Area
- Gazanchi Pipe Storage Area
- Dallar Pipe Storage Area and Rail Spur and Offloading Area

Section 5
- Agstafa Camp Option 3
- Saloghlu Pipe Storage Area

- Saloghlu Camp
- Saloghlu Rail Spur and Pipe Offloading Area
- Poylu Pipe Storage Area, Offloading Area and Rail Spur.

5.5.3.2 Camp and pipe storage area facilities

Each camp will include the following facilities:

- Accommodation and offices
- All relevant utilities: water supply and treatment, electricity, sewage treatment and disposal, waste disposal, etc.
- Medical suite
- Site security: security hut at gate, traffic barrier
- Emergency response facilities (where appropriate for the emergency response plan)
- Emergency muster point
- Helipad/airlift facilities (if deemed necessary as a result of the development of the Project emergency response plan)
- Maintenance building
- Kitchens and cold storage
- Dining rooms
- All communications: telephone, data and postal services, pay phones
- Paved roads and hard standing for lorries and car parking (concrete, asphalt or aggregate)
- Hard surface or aggregate walkways serving all buildings
- Boundary fences/walls
- External lighting to roads and walkways
- Storm-water drainage
- Fuel storage
- Recreation facilities
- Shop
- Laundry
- Equipment storage
- Radiographic equipment storage
- Diesel generators and/or connections to mains electricity
- Plant workshop
- Diesel fuel storage tanks with secondary containment
- Waste storage and handling facilities
- Waste water treatment units
- Material and equipment storage areas.

Additionally, each camp is likely to require the use, and therefore storage, of the following chemicals:

- Fuel
- Paints and paint thinners
- Cleaning products
- Oil
- Spent caustic.

To accommodate the above, each camp will also have a chemical storage facility.

Figure 5-6 is an indicative camp layout for Azerbaijan. The waste storage area is not indicated on the layout, but it would be located in the area adjacent to the sewage treatment plant.

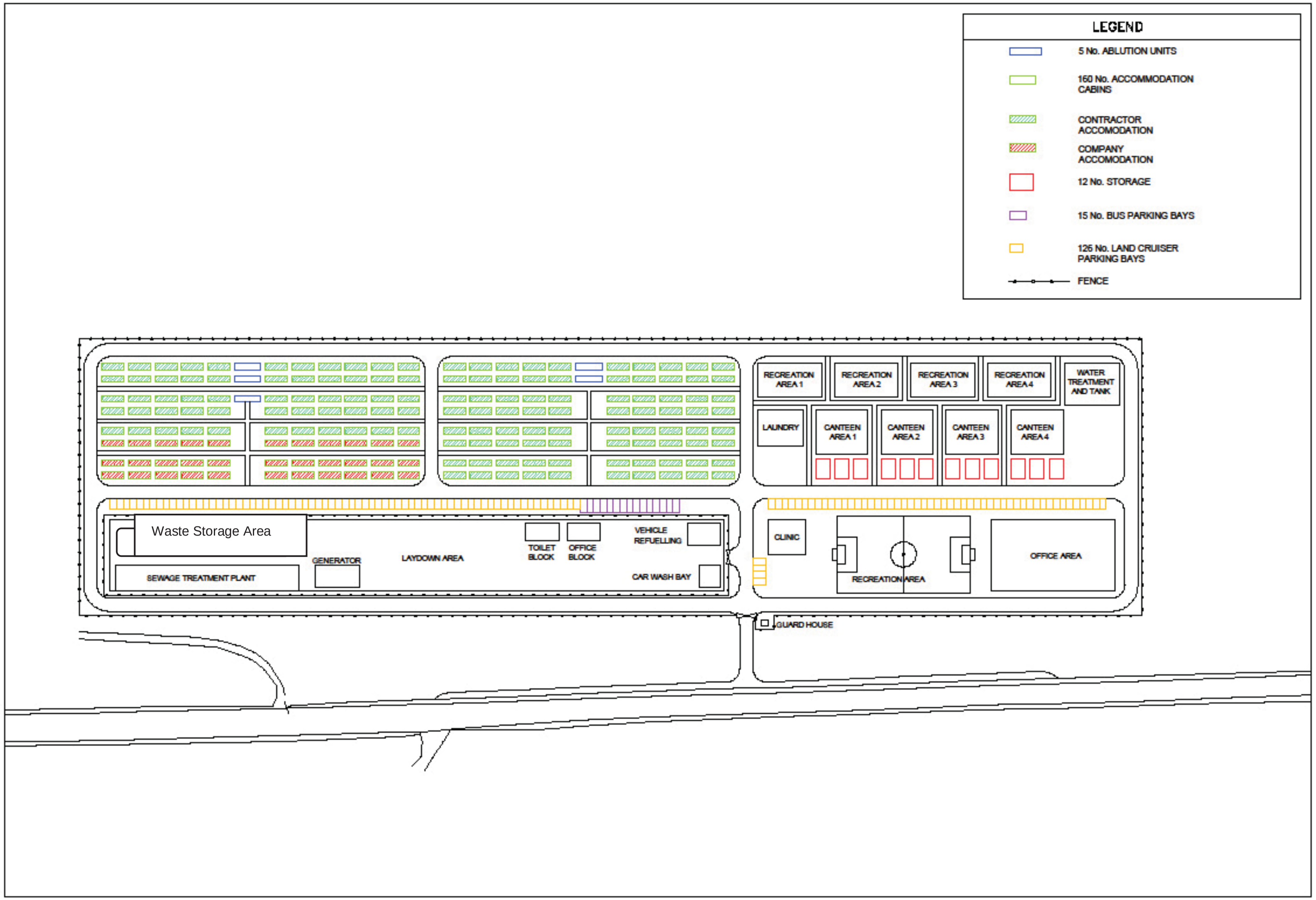


Figure 5-6: Indicative Camp Layout

5.5.4 *Access Roads and Tracks*

The road conditions in some parts of Azerbaijan are poor and many roads, particularly the minor roads, are unpaved, with limited lighting or safety infrastructure. In the last 10 years, however, there have been some major road improvement schemes including the Silk Road Project, which has significantly improved the main east–west highway from Baku through Azerbaijan in to Georgia, and the north–south highway, a key road that carries traffic between Russia and Iran through Azerbaijan. The east–west highway predominately parallels the majority of the SCPX pipeline route and will therefore be utilised by most Project traffic. Access roads to the pipeline ROW will typically originate from the highway, and construction camps and pipe dumps will be located in close proximity for easy access.

The Project will aim to prioritise use of existing access roads, in particular those that were used for BTC and SCP construction. Depending on existing access to the ROW, new temporary access roads may be installed to ensure that access is available approximately every 5km. The exact location of the roads will be determined with due consideration to local traffic flows.

The Project will use the existing access roads established for construction of the BTC and SCP pipelines to access the pipeline ROW as far as practical (37.18). New access roads are likely to be required at the following locations:

- Where the proposed SCPX route deviates from the existing BTC/SCP routes between SCPX KP168 and KP179
- Between SCPX KP247 and KP248
- At some of the preferred camp and pipe storage locations.

To give adequate and safe access for equipment, materials and personnel to the construction sites and permanent facilities, several existing roads and tracks will need to be upgraded.

Upgrading may be achieved by filling potholes with a suitably graded aggregate and widening the surface, where possible, to a minimum of 4m with 1m gravelled shoulders either side. Passing places may be created, where appropriate.

Flumes will be installed to provide cross drainage access and, where necessary, small drainage ditches may be provided adjacent to the roads. All access roads to be widened will be surveyed prior to construction. Prior to selection, all access routes will be subject to a multidisciplinary assessment (37-20).

New sections of temporary road may be needed to supplement the existing road network and provide safe access to all sections of the ROW, particularly where SCPX deviates from the existing SCP/BTC ROW. These temporary roads will be 4m-wide unbound gravel roads (or geotextile grid) with 1m-wide granular shoulders. Drainage ditches will be included where necessary to reduce erosion of the road by rain or snowmelt. The roads will be designed to sustain heavy-use construction traffic.

A new, permanent road to the pigging station will be required. It is likely to extend from the existing access.

Once the new and upgraded sections are operational, the access roads will be subject to routine maintenance to keep them in a satisfactory condition to allow ROW entry for construction equipment, construction and inspection crews, pipeline operations and security staff.

Upgrading and maintenance works will be planned to achieve minimal interruption to local road users.

5.5.5 Pipe and Equipment Transport to the ROW

An important aspect of the construction process is the transport of pipe sections, plant and other equipment to the construction areas, dedicated storage areas and construction camps. For the Azerbaijani section of the Project, it is anticipated that the majority of such transportation will be accomplished through the use of the existing infrastructure in Azerbaijan (road and rail) and Georgia (port and rail). A description of the existing infrastructure within Azerbaijan is presented in Chapter 8, Socio-economic Baseline.

Line pipe delivery will represent the majority of movements associated with the construction phase in Azerbaijan. Approximately 32,300 of 12m lengths of 56"-diameter line pipe will be transported from the pipe fabricating/pipe coating factories into Georgia via the port of Poti on the Black Sea coast and then onwards by rail to Azerbaijan.

Pipe will be stockpiled and offloaded onto rail cars at the port and secured with dunnage and strapping to prevent damage to the pipe coating during transit. It is anticipated that concrete coating of those sections of pipe that need to be coated to prevent buoyancy (see Section 5.6.1.1) will be undertaken prior to arrival in Georgia, prior to rail transport to Azerbaijan. The rail systems of Georgia and Azerbaijan will then be used to transport the pipe sections to the pipe storage areas established for the Project. The line pipe will be transported by rail to off-loading points. The rail offloading points will be close to or co-located with pipe storage areas to reduce the number of HGV movements (D5-036). Line pipe shall be transported by trucks from the pipe yards to the ROW along approved access routes and then along the ROW to the required location (D5-055).

Mobile cranes or other specialist lifting equipment will be used to offload pipes from the railcars to storage areas or pipe trucks at the pipe yard rail sidings. Although some of the pipes will be transported directly to the ROW, it is likely that most will be stored initially in the pipe storage areas. From the pipe storage areas, pipe sections will be transported to the ROW on trucks that will travel along approved access routes. It is anticipated that there will usually be two pipes on each truck, resulting in approximately 16,150 vehicle movements to take pipe from the pipe storage areas to the ROW.

It is anticipated that the majority of the equipment needed for the pipeline construction programme, for construction support facilities and for the permanent installations will also be imported and transported by a mixture of rail and road haulage to site. Individual items of equipment (e.g. mainline valves) will be of considerable size and weight and may necessitate special measures (such as bridge strengthening) to enable their safe delivery.

5.5.6 Pipeline Construction Plant

The majority of the pipeline construction plant will be imported temporarily into Azerbaijan for the construction works. The pipeline construction is expected to need the plant and equipment listed in Table 5-6.

Table 5-6: Estimated Plant Requirements for Main Activities on Spreads

Plant type	Estimated Number	Plant Type	Estimated Number
Backhoe	30	Pole Trailer	29
Sideboom	39	Tractor	22
Dozer D7	10	4"/6" Pumps	54
Dozer D7 - ripper	5	Filling Pump	6
Dozer D8	9	Automatic Welding Machine	30
18T Tracked Crane	4	Welding set	26
36T Tracked Crane	12	Compressor 600	22

Plant type	Estimated Number	Plant Type	Estimated Number
50 T Crane	1	Excavators	4
100T Crane	1	Grading Machine	4
Road Roller	4	Lighting Sets	96
7.5T Truck	35	Test House Equipment	4
Tipper Truck	16	Rotavator	4
Flat Bed Lorry	32	Bending Machine 10"-28"	6
Pick Up	73	NDT Equipment	12
4WD	88	Sandwacker	14
Telehandler	15	Test Pumps	10
Vacuum Lifter	9	Compactor	10
Testing Equipment	1	Micro Tunnel Rig	1
HDD Rig	1		

5.5.7 *Preparation of the Pipeline Loop ROW*

The right of way (ROW) as referred to throughout this ESIA is, however, more correctly known as the facilities construction and installation right of way (FCI ROW). The FCI ROW is the corridor that is required for the pipeline construction and installation activities, and for the 56"-diameter pipeline it will generally be 36m wide with potential extra width locally at river and other crossings and side slopes.

5.5.7.1 *Land acquisition*

For most of its length, the 56" SCPX route will run beside the existing SCP and BTC pipelines, with a 20m separation from the existing pipelines. The SCPX ROW will generally be 36m wide, with a 7m-wide topsoil stack on one side, a 13.7m running track in which construction vehicles will manoeuvre, and space for a trench and a subsoil stack. The SCPX will partly use the SCP and BTC ROWs but will require additional land where the SCPX ROW is outside of the existing ROW.

The SCPX Project will acquire the following areas, referred to as the "Land acquisition Corridor":

- The construction corridor, which is 36m wide (where the SCPX does not run parallel to the BTC/SCP corridor) or less where part of the construction corridor is on land that is part of the BTC/SCP corridor already purchased by BTC Co. and SCP Co.
- Restriction zones 1 and 2, which altogether are 30m wide with the SCPX at their centre (zones where re-use and planting restrictions are imposed to reduce the risk of damage to the pipeline during operation)
- The width of the construction corridor varies dependent on the location of the SCPX in relation to existing SPC and BTC pipelines, as specified below
- Where SCPX will be running parallel on the right-hand side of an existing pipeline (either BTC or SCP), the width of the land acquisition corridor is 31m
- Where SCPX will be running parallel on the left-hand side of an existing pipeline (either BTC or SCP), the width of the land acquisition corridor is 36m.

The layout of the construction corridor for left- and right-hand side pipeline construction is illustrated in Figure 5-7.

Where constraints prevent parallel installation, the SCPX diverges from the SCP and BTC ROWs. In these situations the width of the land purchase corridor is 41m.

Left-Hand Side Construction **Right-Hand Side Construction**

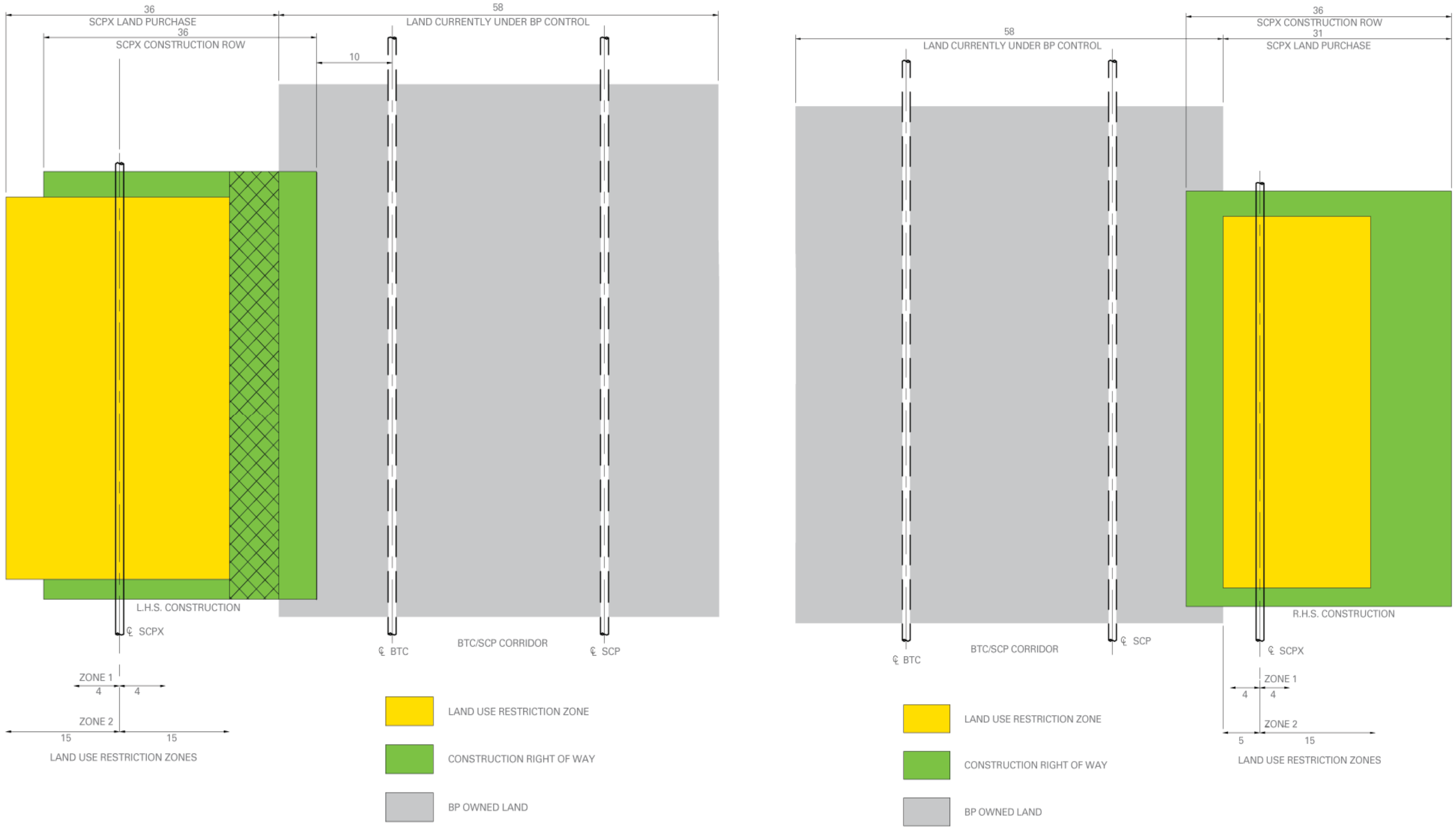


Figure 5-7: Layout of Construction Corridor and Restriction Zones 1 and 2 – SCPX Parallel to BTC/SCP

5.5.7.2 Setting out/staking of the pipeline route

The ROW of the SCPX pipeline and any additional temporary workspaces will be surveyed and set out (i.e. marked out and, where necessary, fenced off). The Contractor will be required to keep within the designated footprint (30-23) using light vehicles and equipment. Existing third-party services and sensitive receptors that need to be avoided during construction (e.g. cultural heritage sites or specific trees that are to be retained) will be marked (D5-045). Warning posts and bunting will be erected to mark overhead cables and temporary crossing points (30-17).

Areas of potential cultural heritage impact will be examined and any necessary excavations conducted prior to construction (27-02). A programme of archaeological surveillance (watching brief) will be implemented during topsoil stripping of the ROW, the facility sites, construction camps and equipment lay-down areas and ancillary areas, and ROW trenching. The Company will be empowered to temporarily stop works, pending archaeological examination, if artefacts are seen (27-05). A record will be made of the condition of access roads, construction camps, lay-down areas and rail offloading areas and any special features on the ROW before construction to inform the reinstatement works (17-14).

5.5.7.3 Surface preparation and grading

The pipeline route will be cleared and graded to permit the safe installation of the proposed pipeline and associated pigging facility and block valves. This process typically includes the removal of trees, scrub and other surface vegetation, removal and storage of the fertile top layer of soil (Photograph 5-2) and levelling (‘benching’) of the ROW in sloping ground.

The construction contractor(s) will produce method statements incorporating plans for erosion control, sediment control and reinstatement before work begins at river crossings (4-12). Load-bearing materials, such as bog mats and geotextile membranes, will be used to support heavy loads in areas of soft ground (including wetland areas) unless deemed impractical by the Company (2-01).

Earth-moving equipment will strip the topsoil across the working width. It will be stored on the ROW. Topsoil stacks along the RoW will be free draining and stored in accordance with the Project Reinstatement Specification (4-05) and will be kept free from disturbance to reduce the risk of physical damage and compaction. Soil storage areas will be protected from vehicle movements to avoid soil compaction (4-06). Stored subsoil and topsoil will be segregated in a manner that avoids mixing (4-02). If topsoil is stored for more than six months, the stacks will be monitored for anaerobic conditions and manual aeration will be undertaken if they develop (4-04). This aims to provide sufficient fertility for reinstatement at the end of the construction period. Topsoil will be stored outside the running track used by construction plant, equipment and vehicles (4-03).

Where the Project considers that ground is sufficiently steep (generally greater than 25%), topsoil stockpiles will be protected with silt fence to help reduce washout and loss of topsoil during heavy rains (4-07). Topsoil stacks will be regularly inspected for compaction and erosion; corrective measures will be implemented if compaction or erosion is identified (4-13). The topsoil and subsoil stack surface will be compacted sufficiently with the aim of preventing erosion, without leading to the development of anaerobic conditions (4-08). Reinstatement will be undertaken as early as practicable and in accordance with the reinstatement specification (4-09).

Where benching is required, surplus subsoil will be stored on the ROW or, if disposal is necessary, it will be transported to an approved disposal site and/or approved borrow pits (1-11).

Vegetation clearance work will usually be undertaken using hand tools, agricultural and earth-moving equipment as appropriate. However, in the event of any areas of special vegetation that is to be crossed by the pipeline, site-specific construction method statements will be prepared and agreed with the relative authorities and implemented.

To ensure that the ROW can be reinstated properly and to allow regrowth of vegetation, the topsoil and subsoil will be stored separately as illustrated in Figure 5-8.

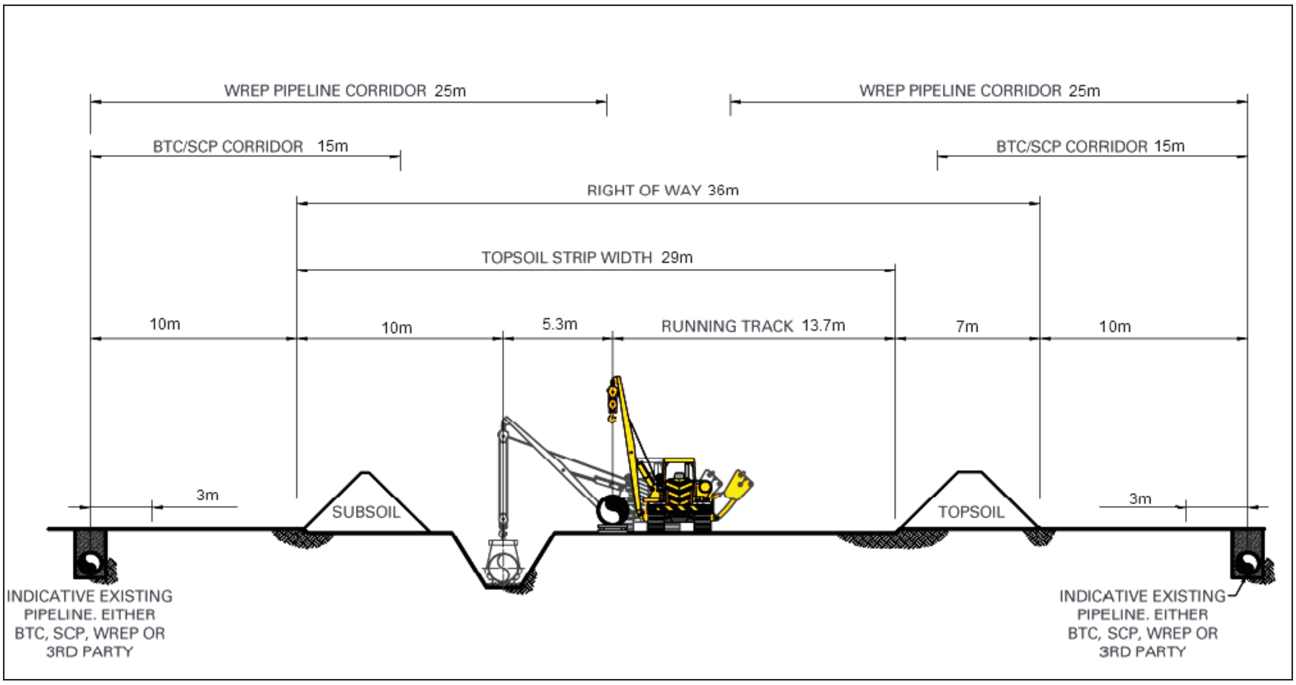


Figure 5-8: Indicative Layout of Construction Right of Way

At watercourses, bank and bed material will be stored separately, away from the active channels, and will not be placed where flow or drainage could be obstructed.

Where necessary, measures will be taken to maintain the flow capacity of watercourses including ditches and drainage channels that cross the ROW, while ensuring a continuous running track for construction vehicles. The measures to be implemented (e.g. fluming) will be selected by the construction contractor in consultation with the appropriate authorities.

5.5.8 Pipeline Installation

Once the topsoil has been stripped and stored to one side the next stage is to deliver the pipes in preparation for the sequence of activities that will lead up to the installation of the pipeline.

5.5.8.1 Pipe stringing and bending

Line pipe shall be transported by trucks from the pipe yards to the ROW along approved access routes and then along the ROW to the required location (D5-055). Cranes or other specialist equipment will lift the lengths of line pipe from the trucks and lay them out offset from the centreline. Gaps will be left in pipe strings where safe to do so and necessary to allow people, wildlife and livestock to cross the ROW (32-08).

Photograph 5-2: Topsoil-Stripped ROW and Pipeline String Ready for Welding

Factory-manufactured bends will be used for acute changes of pipe direction or elevation along the route. Less severe bends will be formed using pipe-bending machines in the field. The quality of the bends will be controlled by approved bending procedures, witnessing trial field bends before production and inspection of completed field bends.

5.5.8.2 Pipe welding and inspection

Following stringing and bending, the pipe sections will be elevated onto wooden blocks (skids) or mounds of earth to the correct height to allow proper alignment of the sections and safe welding. Internal clamps will be used to align pipe lengths.

Welded pipe will be inspected to ASME 1104 plus additional Project requirements. Welds will be visually inspected initially, then subject to 100% radiographic inspection or automatic ultrasonic testing. In addition, the following non-destructive tests (NDTs) will be performed on specific welds by the inspection teams:

- Automatic ultrasonic testing
- Magnetic particle inspection (MPI)
- Dye penetrant inspection (DPI).

Rejected welds will be repaired or replaced as necessary, in line with Project specifications, and re-inspected. To reduce the number of tie-in welds below ground level, the pipe will be welded into the longest practicable strings at ground level before being lowered and connected to the mainline. These strings will take into account third-party access requirements across the ROW and will generally be limited to no greater than 1000m long.

Photograph 5-3: Welded Pipeline

5.5.8.3 Field coating

The line pipe will be supplied with a factory-applied three-layer polyethylene coating. A field coating will be applied to all welds, fittings and areas where the factory coating has been damaged to provide continuous protection along the pipeline. Following welding, the joint area will be grit-blasted and a liquid epoxy coating will be applied. The coating thickness will be tested after application and then, immediately before lowering into the trench, checked for pinholes by electrical continuity tests.

5.5.8.4 Trenching

The pipeline contractor will excavate a trench to a depth that allows pipeline installation with a minimum of 1m of cover from the top of the pipe to the pre-existing ground surface. The presence of sub-surface structures (e.g. other pipelines) or surface features such as roads, railways and watercourses will require deeper installation of the pipeline at these locations.

The material (sub-soil) excavated from the trench will be stored immediately adjacent to the trench on the opposite side to the pipe string that is to be lowered into the trench. The excavated sub-soil will be stored in such a manner that there will be no mixing of sub-soil or topsoil. The two excavated materials are stored on opposite sides of the ROW to prevent this from happening. Any surplus subsoil from trench excavations will normally be spread within the working width and within zones that exhibit similar subsoil types. The spreading work will be carried out in a manner that avoids the mixing of soil types to the greatest extent possible (D5-066).

The trenching operation will be undertaken using methods to suit the local terrain and ground conditions. Trenching equipment will include tracked excavators, with rock hammers used in areas of rock. As an option, the contractor may also elect to mobilise trenching machines and deploy these on specific sections of pipeline. In confined areas, such as adjacent to existing pipes, a combination of tracked excavators and hand tools will be used to open and reinstate the trench.

It is not anticipated that trenching will require blasting in Azerbaijan, as there are no areas where hard rock is known to be present close to the surface.

The length of the continuous open trench (including trench with pipe installed but not backfilled and a void space greater than 1m) will not exceed 10km per spread and the maximum length of the open trench will not exceed 15km per spread (21-01). Where the ROW is near settlements, measures will be implemented to limit public access to the ROW or excavated trench. The ROW of the SCPX pipeline and any additional temporary workspaces will be surveyed and set out (i.e. marked out and, where necessary, fenced off). The contractor will be required to keep within the designated footprint (30-23).

If water accumulates in the open trench (either from rainfall or because of a high water table), it will be pumped out before the pipe is lowered into the trench. All trench water will be discharged safely with the aim of minimising erosion (3-34). When discharge velocities have the potential to create erosion, energy dissipaters will be used to establish sheet flow. Trenches will be dewatered in such a manner that no heavily silt-laden water flows into any wetland or water body (3-30). Sediment control fencing, drainage channels and trench barriers will be installed where appropriate (10-12). The Project will aim to avoid the direct discharge of trenchwater to watercourses, except where approved by the Company (10-02). The locations for discharge of hydrotest water and where possible trench water will be identified in the contractor's Pollution Prevention Implementation Plan (10-03). If discharge of trench water to a watercourse is unavoidable, discharge will be through a filtering medium (10-04).

Safe trench crossings will be constructed at locations where public access is required across the excavation. Warning signs and barricades will be erected around the trench; adequate warning lights will be provided during the hours of darkness.

Following excavation, the trench will be prepared to accept the pipe. Rocks or debris that could damage the pipe coating will be removed from the trench. Some excavated material will be screened to remove rocks and placed in the bottom of the trench as a layer of soft padding. Where excavated material is unsuitable for padding or backfilling, padding materials (e.g. sand or small-grained soils/gravel materials) will be bought or sourced from approved borrow pits (1-10).

5.5.8.5 Lowering-in and backfilling

After pipe joint coating and testing, the welded pipe string will be lowered into the trench. Sideboom tractors and specialist lifting equipment will be used to lift the pipe and lower it into the prepared trench. Several sidebooms and lifting equipment are typically used simultaneously to accomplish the lowering-in procedure (as illustrated in Photograph 5-4). Once lowered into the trench, each pipe string will be welded onto the preceding or adjacent section.

Photograph 5-4: Lowering-in of the Pipeline

Concrete slabs will be installed at open-cut crossings to provide additional pipeline protection at:

- Roads
- Tracks
- Ditch and stream crossings
- Foreign service crossings.

The trench will be backfilled with the material taken from the trench in the reverse order to which it was excavated and will be consolidated by compacting in layers. This process helps ensure that appropriate compaction of the material in the backfilled trench is achieved and reduces the risk of future settlement, washout and erosion. Care will be taken to remove organic debris, such as vegetation and branches from backfill materials.

Trench breakers will be installed where downhill flow within the backfilled trench may lead to erosion (3-07). These act as barriers to subsurface water flows that could channel through the pipe trench, washout the backfill material and potentially expose the pipeline.

Any surplus material from trench excavations will normally be spread within the working width and within zones that exhibit similar subsoil types. The spreading work will be carried out in a manner that avoids the mixing of soil types to the greatest extent possible. Care will be taken to spread the trench spoil beneath the topsoil and not leave it on the surface. Where off-site disposal of spoil is necessary, it will be disposed of in conformance with the Project waste management plan.

Any pre-existing land drains will be restored as part of the backfilling operation.

5.6 Crossings of Linear Features

Crossings are defined as the intersection between the proposed route and pre-existing features such as:

- Rivers, stream, irrigation channels and canals
- Public roads and tracks
- Rail tracks
- Underground foreign services.

The number of crossings are given in Table 5-7 against the different features.

Table 5-7: Number of Different Crossing Types Crossed by Proposed SCPX Pipeline Route

Crossing Type	Number of Crossings
Ditch	1063
Track	410
Stream	352
Underground pipe or cable	246
Overhead cable	238
Canal	96
Road	76
Aboveground pipe or cable	47
Channel	25
Major river or canal	21
Gully	7
Railway	6
Marsh or pond	4

Crossing techniques for each of the above are discussed below.

5.6.1 Watercourse Crossings

With respect to crossings, watercourses include canals, aqueducts, irrigation channels, drainage ditches and natural streams and rivers.

The majority of watercourse crossings will be constructed using conventional open-cut (OC) methodologies as outlined below. The exceptions to this are the major river crossings which will be constructed either in open-cut or using one of three non-open-cut techniques as follows:

- Horizontal directional drilling (HDD)
- Micro-tunnelling
- Auger boring.

These techniques are explained in more detail in the sections below.

Table 5-8 presents a summary of the main watercourse crossings along the pipeline route and the techniques that may be applied to constructing the crossing.

The route also crosses a number of intermittent watercourses that may be dry at the time of construction. Plans will be developed to address the potential for the watercourse to become active during construction; however, these are normally seasonal watercourses and construction will normally be scheduled for the dry periods. Additionally, marshy areas and areas with high water tables may call for similar construction methodologies to those adopted for watercourses.

A detailed hydrological assessment has determined where riverbed scour may occur and each river crossing design will reflect this through the depth of burial and the need for additional protective features. Each major river crossing will have a site-specific design which will be set to account for the maximum flow rates (1:200 year storm event), sediment movement patterns, anticipated changes to the river bed contour and the predicted extent of lateral erosion (D12-06).

Special construction crews and equipment will typically be utilised for the installation of pipeline sections crossing watercourses. A variety of techniques is available for the crossing of watercourses and it is likely that several of them will be employed for the proposed SCPX Project in Azerbaijan.

It should be noted that all of the construction techniques described will be subject to suitable ground conditions, site investigation borehole surveys, an agreed method statement for each crossing, and the applicable environmental compliance requirements.

Table 5-8: Major Watercourse Crossings

Watercourse	Approximate KP	Potential Installation Methods
Agsu canal	54	HDD
Geokchay	115	HDD
Turianchay	137	HDD
Kura (east crossing)	167	HDD
Karabakh canal	189	HDD
Goranchay	202	OC
Kurekchay	221	OC
Korchay	237	OC
Ganjachay	240	OC
Goshgarachay	261	OC
Shamkirchay	277	OC
Zeyamchay	303	OC
Asrikchay	323	OC
Tovuzchay	324	OC
Hasansu	345	OC
Kura (west crossing)	358	Micro-tunnelling
Kurudere River	369	OC

5.6.1.1 Open-cut crossings

River and stream crossings will generally be constructed using the conventional open-cut methodologies. All methodologies assume flowing water or the immediate potential for flowing water during construction. The open-cut trench technique will typically be used in conjunction with weighted (usually concrete coated) pipe. The purpose of the concrete coating is to ensure negative buoyancy of the pipeline and to provide additional mechanical protection. If concrete-coated pipe is not used, a concrete slab, or concrete filled bags, may be buried in the pipeline trench above the pipe.

To avoid interruption of the flow of the watercourse, open-cut crossings usually use wet-trenching or flumed water-crossing techniques. Where appropriate and advantageous, seasonal constraints on construction activities may be imposed to ensure that crossings are built during low flow conditions.

Pipe to be installed in the crossing is welded, inspected and coated at a site near the crossing, prior to being lowered into place. Trench breakers are then installed in the trench near stream banks to prevent subsurface flow.

For the SCPX Project it is anticipated that the disturbed portion of the watercourse bed and banks associated with any open-cut crossings will be returned to pre-construction dimensions, where possible. The trenching of the watercourse banks and bed will normally be undertaken immediately prior to installing the pipeline section and the trench will typically be backfilled as soon as possible following installation. This will reduce environmental impacts to the watercourse.

The material placed over the pipe as backfill will be at least as erosion-resistant as the original bed material. In addition, where the riverbanks have been disturbed, these areas will typically be stabilised within two days of pipeline installation and restored to near original condition and contours. Where this is not possible, site-specific plans will be developed to reduce environmental impacts.

Erosion and sediment control measures may be installed and maintained until the area has stabilised and vegetation is sufficiently re-established (as discussed in Chapter 10, Environmental and Social Impacts and Mitigation). Sediment interception techniques may be used, which could include filter berms, silt fences and straw bale barriers.

One of the following three methods will be used to install open-cut crossings, and Figure 5-9 and Figure 5-10 are typical drawings for open-cut crossings at streams that are either greater or less than 5 metres in width.

Method 1: flumed crossing
In this method, water flow is maintained using temporary flume pipes installed in the bed of the watercourse:

- The trench line will be prepared by stripping the topsoil from the watercourse banks and ramping them down to allow the safe installation of the pipeline
- Suitably sized flume pipe(s) will be installed. The size will be calculated so that the maximum anticipated flow will not exceed 80% of the flume pipe(s) capacity
- The upstream end of the crossing will be dammed, forcing the flow through the flume pipe(s)
- The downstream end will then be dammed to prevent backflow into the open trench
- Where appropriate, fish and other aquatic life caught between the dams will be transferred downstream of the crossing
- The pipe trench will be excavated below the flume pipes. De-watering and/or trench supports may be used to facilitate safe excavation. If pumps are used, the discharge hose will be directed to an upland area that is well vegetated or through a filtering medium to reduce silt loads, before the pumped water is allowed to percolate back into the watercourse
- Pipe to be installed in the crossing will be welded, inspected and coated at a site near the crossing
- The pipeline will be installed in the trench that will then be backfilled with the excavated material and, where existent, the watercourse's armour bed within two days of pipe installation
- At larger watercourses, trench breakers will be installed in the trench after transition to standard cover to prevent subsurface flow

- The riverbanks will be reformed and profiled in accordance with the Project reinstatement plan. The banks will be returned to maintain the pre-construction channel width/ hydraulic capacity
- Erosion control measures (e.g. silt fencing erosion control fabric) will be installed and maintained until the area has stabilised and vegetation is sufficiently re-established. Where there is a risk of sediment run-off, sediment interception techniques will be used (e.g. filter berms, silt fences or straw bale barriers)
- The downstream dam, the upstream dam, and the flume pipe(s) will be removed in that sequence once the crossing is complete.

Method 2: dammed crossing
This method is similar to that described above, except the water is pumped around the trench:

- The site will be prepared as for method 1 and a dam constructed upstream of the crossing within the approved ROW
- Pumps, intake hoses and discharge hoses will be installed to pump the water around to the downstream side of the pipe crossing. Where necessary, pumps will be fitted with grills to prevent fish entering them and will be provided with secondary containment to prevent fuel spills into the watercourse
- Energy dissipaters will be used to prevent erosion/scour at the downstream discharge point
- Once the pumps have begun diverting water, a downstream dam will be installed to prevent water from flowing back into the working area
- Where appropriate, fish and other aquatic life caught between the dams will be transferred to a point downstream of the crossing
- The trench will then be excavated in a manner similar to method 1
- The pipe will be installed, the trench backfilled and the whole area reinstated as for method 1.

Method 3: wet crossing (or dry crossing, when water is absent)
These are crossings using ‘wet’ installation by means of an open-cut trench. It is anticipated that this method will be used at the majority of ditches as they are generally dry, small or have low flow. The typical procedure will be as follows:

- The site is prepared as for method 1
- The river bed material is then excavated (potentially through the running water) and stored separately
- The pipe is installed and the trench is backfilled
- The pipe is protected and the whole re-instated as for method 1.

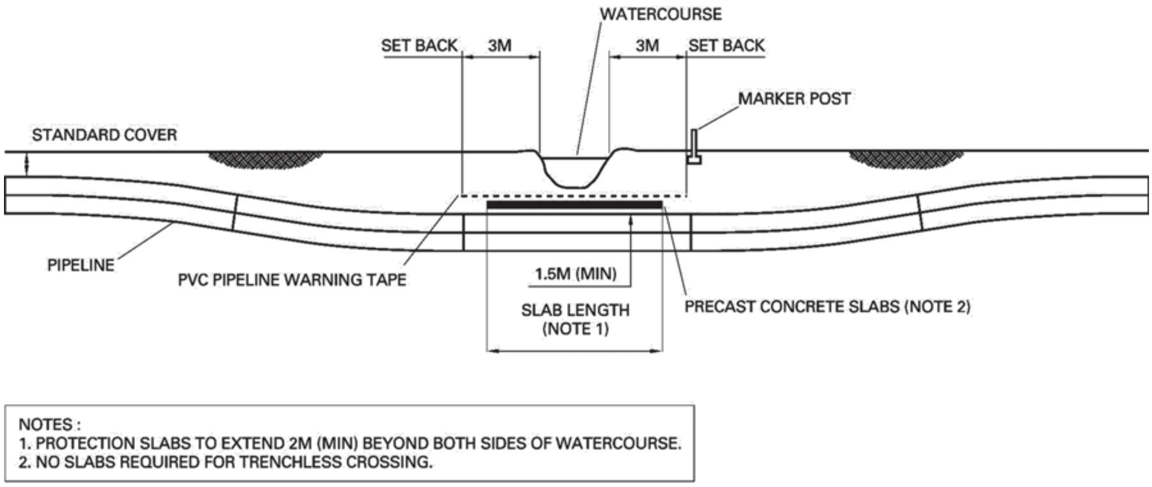


Figure 5-9: Preliminary Typical Ditch/Stream Crossing (width less than 5m)

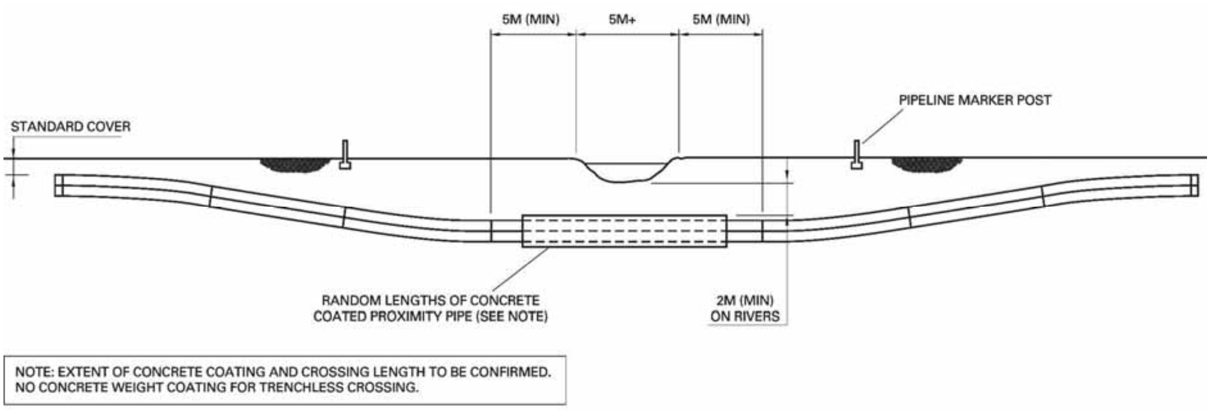


Figure 5-10: Preliminary Typical Ditch/Stream Crossing (width greater than 5m)

5.6.1.2 Non-open-cut crossings

One of the following three methods will be used to install non-open-cut crossings.

Method 1: micro-tunnelling

Micro-tunnelling is widely used to cross beneath linear features such as deep river crossings and where the geological conditions are suitable. Micro-tunnelling can also be used where there is a need to minimise reinstatement post-construction, where ground vibrations need to be especially controlled to reduce disturbance of river species, for example.

Figure 5-11 shows the typical layout of a micro-tunnelling operation. This method typically involves excavating shafts or pits, as can be seen in Photograph 5-5 and Photograph 5-6. Within the entry shaft, pre-cast concrete jacking pipes are placed behind a micro-tunnelling machine with the excavated material being removed mechanically via the tunnel entrance.

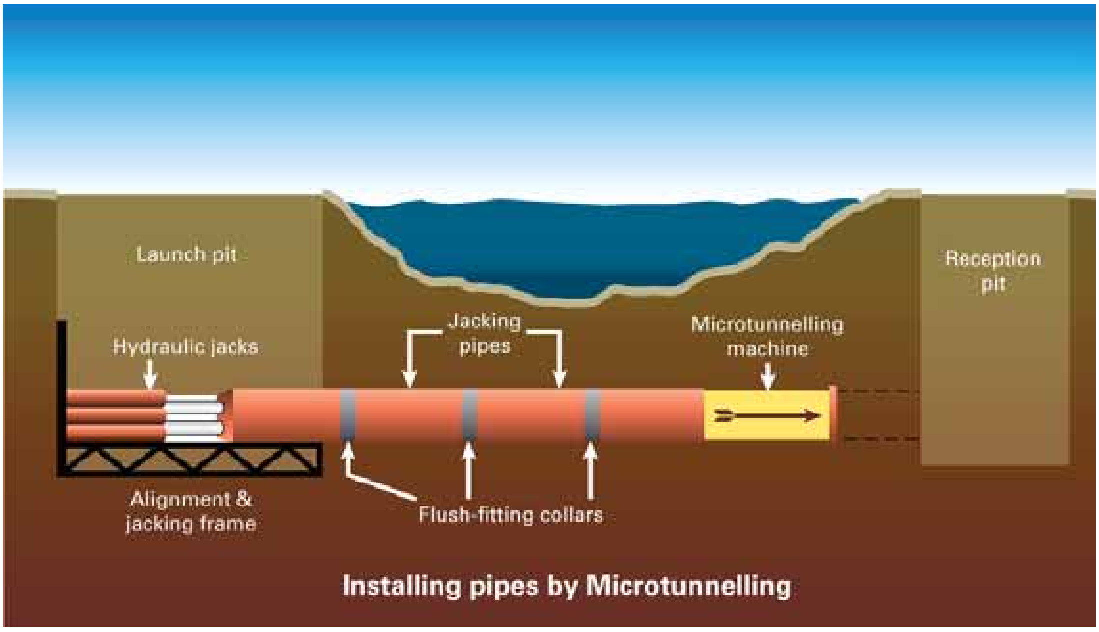
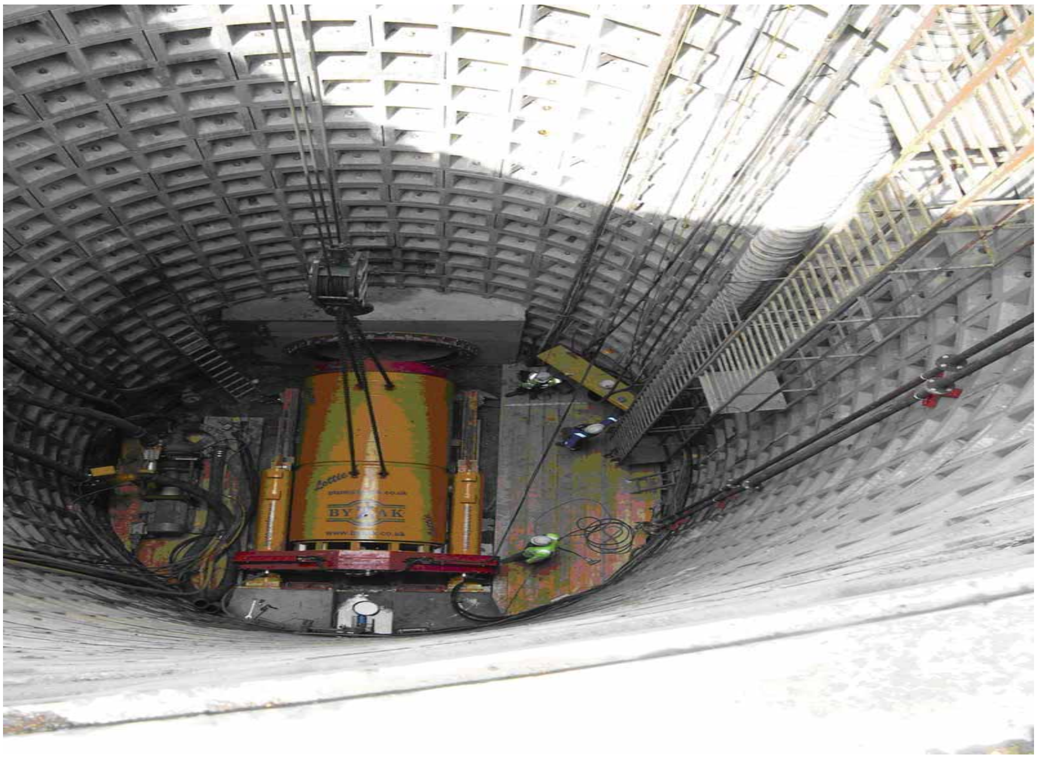


Figure 5-11: Typical Micro-tunnelling Operation

Photograph 5-5: Micro-tunnelling Beneath a River



Photograph 5-6: Micro-tunnelling Entry Shaft – View from Above

The cutting head lubricated with water and bentonite (natural, inert, non-toxic clay) or non-toxic lubricating polymers may also be used to reduce friction. The drill fluid is returned to the surface where it is filtered to remove the cuttings and returned to temporary mud storage tanks for re-use. The drilling is usually a continuous 24-hour operation.

Equipment associated with micro-tunnelling includes a power unit, one or two storage tanks for cuttings, separation plant, operation board, a crane and ancillary equipment.

Used drilling fluids are sampled, analysed and recycled or disposed off-site to a waste disposal facility in accordance with the Waste Management Plan in the ESMMP (Appendix D).

Method 2: horizontal directional drilling (HDD)
HDD is generally used at the largest crossings, as long lengths can be drilled, subject to the size of the pipeline and soil conditions. Figure 5-12 explains in a schematic way how the HDD operation is performed:

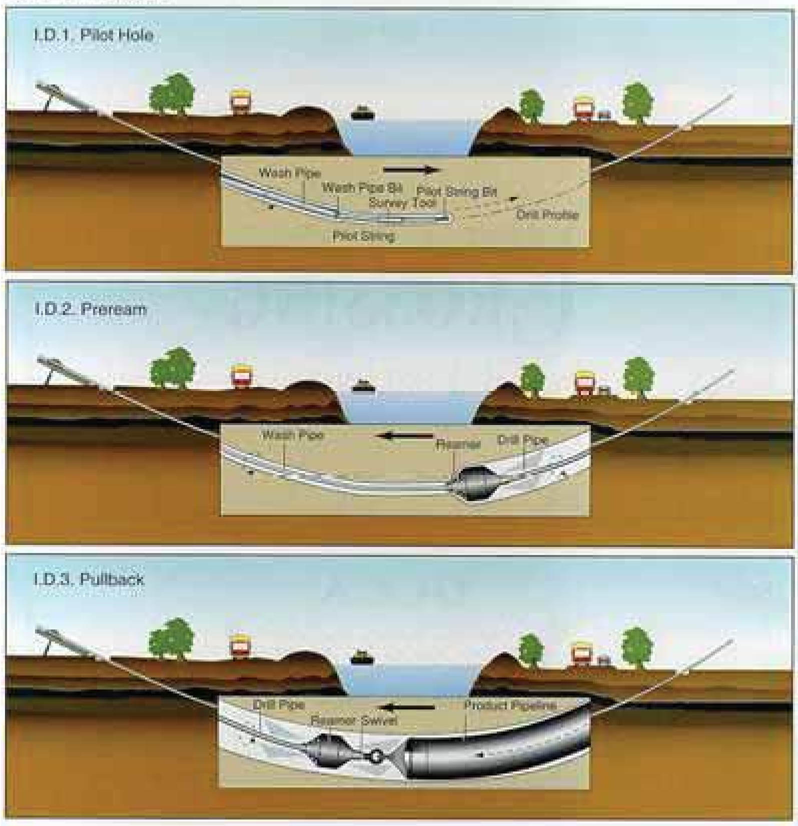


Figure 5-12: Typical Horizontal Directional Drill Operation (figure courtesy of Pfeiffer)

The HDD (or "launch") site is set up on one side of the crossing and contains the plant associated with directional drilling. This typically comprises the drill rig, two power units mounted on skids, bentonite storage tanks and mixing tanks, a filter for separating cuttings from the used drilling mud, control cab and ancillary equipment.

Stage 1: pilot hole

The first stage of the HDD is to drill a pilot hole using a drilling rod under the crossing to the end point where it will emerge in the area known as the "reception" pit. As the drilling proceeds, the drilling fluid, comprising water and bentonite or lubricating polymers, is pumped down the centre of the hollow drill rods to the drilling face. This lubricates the drill bit and picks up cuttings before returning to the surface via the drill hole. The drilling fluid is then filtered to remove the cuttings and returned to temporary storage tanks for reuse. The position and progress of the drill head is monitored and controlled from the surface using electromagnetic detection equipment.

The drill may encounter groundwater as it progresses. If this occurs, the pressure under which the drilling fluid or mud is pumped down the borehole will be controlled to prevent migration into the groundwater and vice versa. Drill fluid usage will be monitored at the surface to confirm no significant losses are occurring.

Stage 2: reaming

After the pilot hole is drilled, reaming devices are attached and pulled back through the borehole to enlarge it to the required diameter.

While the above work is proceeding, the pipe sections are laid out in a straight line ("strung") away from the reception pit and welded together.

Stage 3: pull back

When the drilled hole has reached the required diameter, typically 1.5 times the diameter of the pipe, the pipe is attached to the reaming device and pulled through the borehole in one continuous length. This minimises the risk of it becoming stuck during the pull. Bentonite is injected around the reamer to support the sides of the hole as the pipe is pulled through.

Typically drilling and pull back operations will be continuous 24-hour operations.

Once the pipe has been installed, the drilling rig and associated plant are removed. The drilling mud is sampled, analysed and disposed off-site to a waste disposal facility in accordance with the Waste Management Plan.

Method 3: auger boring

This crossing method involves guiding a pilot hole beneath the ground from a launch pit to a reception pit and enlarging the bore using steel casing and augers to the required diameter for the installation of the product pipeline.

The principal operations are as follows:

- Site establishment
- Launch pit construction
- Reception pit construction
- Auger boring
- Pipeline installation
- Demobilisation and reinstatement.

The following sections detail the operations that will be undertaken at each stage.

Site establishment

The size of the working area required can vary as pipes can be installed in excavations between 6m and 24m in length. In general a working area of 30m x 50m would be required for the construction of the launch/reception pit and the storage of equipment.

Launch pit construction

The dimensions and construction of a launch pit for an auger bore can vary according to the length and diameter of the crossing, in the case of a short crossing the operations can be undertaken from an excavated trench. For the longer crossings launch pits are normally constructed using steel piles or precast reinforced concrete segmental rings to form rectangular or circular pits that are installed to the relevant depth required for the launch of the auger bore.

When the launch pit has been installed to the required depth, a thrust wall is installed at the rear of the launch/thrust pit to transfer the forces into the ground.

Reception pit construction

The dimensions of the reception pit must be of a suitable size for the removal of the sacrificial steel casing and augers during the reaming process. The reception pit may also be constructed as a trench excavation, from steel sheet piles or from precast reinforced concrete segmental rings, and will be as deep as required by the proposed crossing alignment.

Auger boring

With the launch pit completed auger boring is then undertaken, which either can be guided or non-guided. Non-guided auger boring involved continuous flights (contained within a steel pipe) being rotated and simultaneously pushed through the ground. As the bore progresses the ground is cut and the auger flights convey the material back into the work pit.

With guided auger boring it is normal for a guide rail system to be installed at the bottom of the pit between the thrust wall and head wall. This guide rail will assist with the initial alignment of the auger boring equipment. The auger-boring machine is then lowered onto the guide rail system and a pilot rod with steerable head is added to the machine. A theodolite is set up central to the back of the machine to receive and relay guidance LED to the operators' console. Pilot rods are advanced into the ground in 1m lengths with steering corrections undertaken by the operator as required to ensure the bore remains on the designed profile. This operation is repeated until the pilot rods exit within the reception pit.

Enlarging/reaming of the pilot bore is undertaken by attaching a steel pipe with an internal auger to the pilot rods and pulling the auger into the ground along the path of the pilot bore while rotating it to remove soil into the launch pit. This operation continues until the steel casing and auger exit in to the reception pit having pushed out all of the pilot rods. This operation is then repeated in stages until the bore is enlarged up to the diameter required for the pipeline. Spoil is removed from the launch pit by mechanical plant.

Pipeline installation
Once the auger bore is enlarged to the required diameter, pipe lengths are lowered into the launch pit and welded. The pipe is pushed into the ground replacing the steel casing being removed in the reception pit. The operation of welding, NDT testing and pushing the pipe is repeated until the entire steel casing is pushed out of the hole leaving the pipeline installed.

Demobilisation and reinstatement
Once all activities are completed the auger-boring equipment is removed from site and transported to the next crossing location. The site is reinstated back to the same condition as upon commencement.

5.6.2 Road and Rail and Foreign Service Crossings

Minor road crossings are likely to be accomplished by open trenching of one-half of the road at a time, with steel plates used to maintain one lane of through traffic at all times. Smaller rural roads may be closed to through traffic, following consultation with local officials and residents.
Appropriate signs, barricades, and other traffic management measures will be used to minimise inconvenience to road users and to promote safety during temporary closure of roads. The pipe to be installed in the crossing will be welded, inspected and coated nearby. The completed fabrication will be lowered into the trench during a low traffic period, and one-half of the trench will be covered with steel plates to restore traffic flow. The trench will be backfilled in one-half of the road at a time using a lean-mix concrete or other readily compacted fill.

There will be increased depth of cover at crossings: road crossings will generally be installed with 2.0m cover; rail crossings have at least 3.0m cover and unpaved roads will have at least 1.5m cover (D11-02). Concrete slabs will be installed at open-cut road crossings to protect SCPX from future road construction activities and excavations along roads or the verges (D11-03).

The proposed pipeline is expected to cross approximately six railway lines and forty-five paved roads. Major roads and railways will be crossed using a trenchless technique; either pipe jack or thrust/auger bored (see Figure 5-13). Pits are excavated either side of the road or railway and a casing or carrier pipe is driven between them using hydraulic jacks, and a rotational head is used to cut the earth from the front of the casing/ carrier pipe. The earth is removed through its exposed end and collected in skips for disposal.

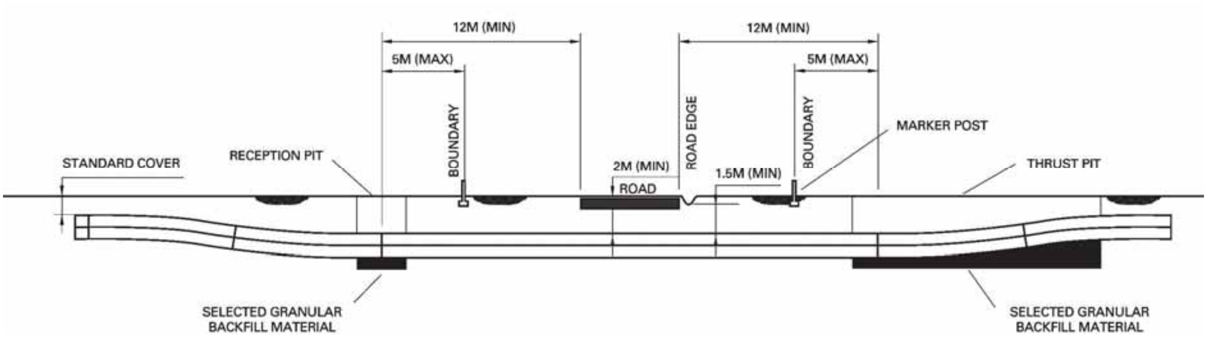


Figure 5-13: Preliminary Typical Thrust/Auger Bored Road Crossing

Minor road and track crossings will be accomplished by open trenching as shown in the typical drawing (see Figure 5-14).

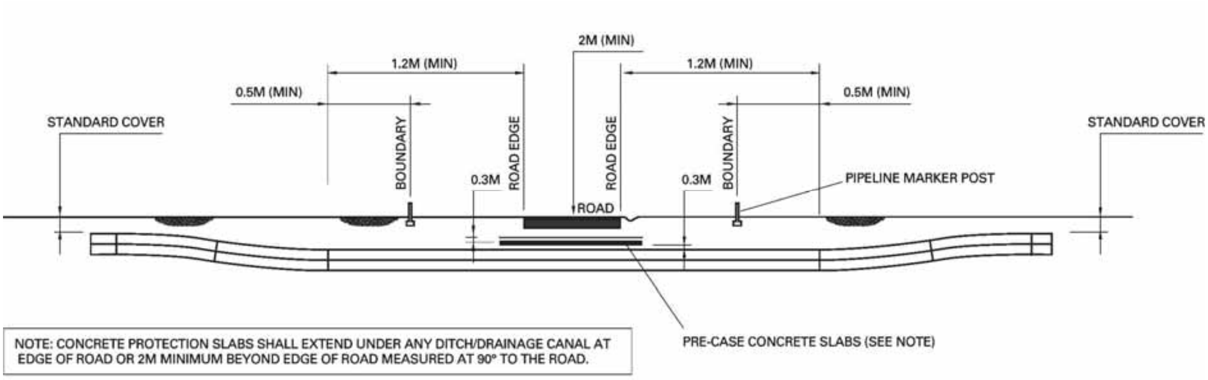


Figure 5-14: Typical Open-Cut Road Crossing

Other service crossings will be accomplished with open-cut or trenchless techniques, as necessary, as shown in typical drawings Figure 5-15 and Figure 5-16.

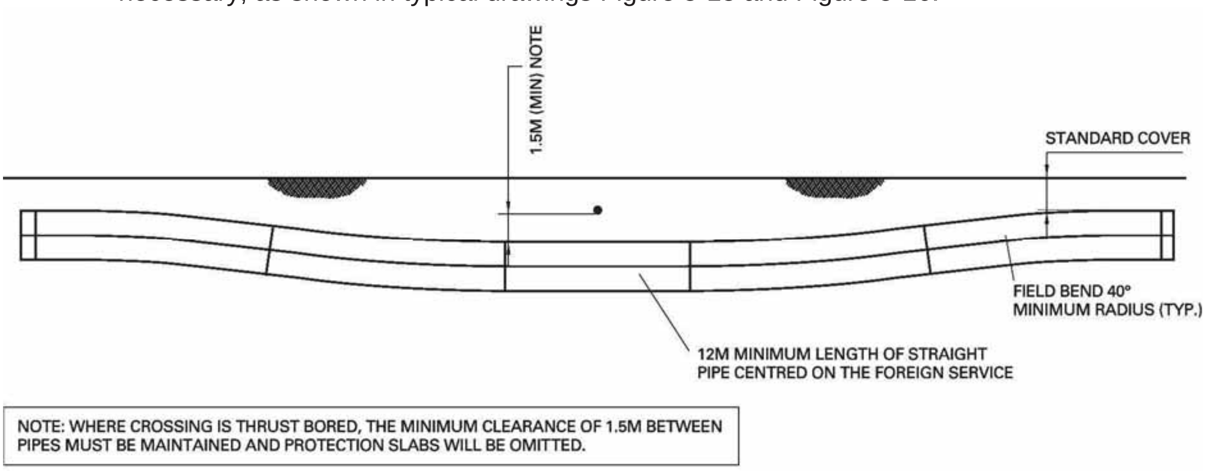


Figure 5-15: Preliminary Typical Open-Cut Service Crossing

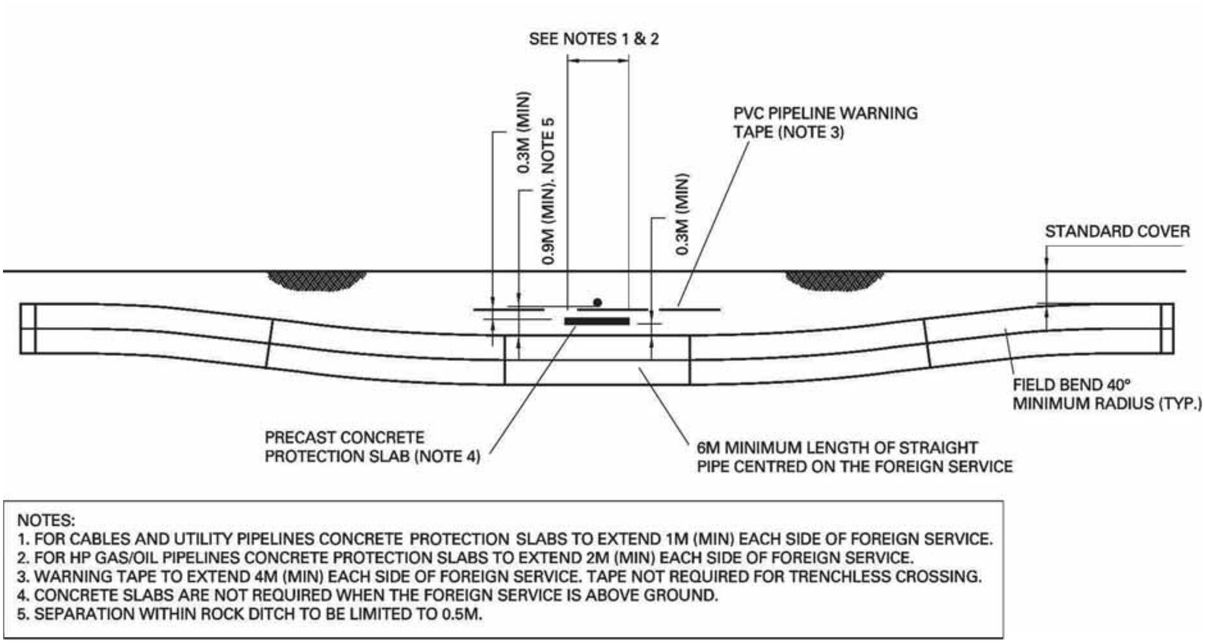


Figure 5-16: Preliminary Typical Trenchless Service Crossing

5.7 Project Commissioning

5.7.1 Commissioning of Facilities

The equipment that will have been installed at the facilities, in most cases, will have undergone rigorous testing for certification by the manufacturer before it is delivered to the site.

After confirming that all systems and sub-systems have been built, aligned and documented in accordance with the design specifications, drawings, codes, safety standards and statutory requirements a dedicated commissioning team will undertake a commissioning programme that aims to prove that the facility functions as expected. The commissioning programme also provides an opportunity for the operational staff to become familiar with the operation of the new equipment. The commissioning programme includes on-line, on-load functional testing of individual systems using inert non-hydrocarbon fluids such as water to simulate process fluids.

Piping will be dried and pressure tested with a nitrogen and helium mixture. Testing with water and inert gases will allow gas leaks to be corrected safely. The hydrotest water will be discharged and the pressurised inert gas used to test piping will be vented. Some critical sections of pipework will require chemical cleaning for the equipment to meet the required cleanliness levels for operation.

The utility systems will be energised, and parts of the plant will be tested using natural gas. At some stages of commissioning, venting may be needed to depressurise equipment containing natural gas.

After commissioning, the process systems will be ready for the introduction of natural gas.

5.7.2 Pipeline Hydrostatic Testing

5.7.2.1 Testing procedures

The 56” SCPX pipeline will be hydrotested to ensure that it is free from material defects and is suitable for the containment of hydrocarbon gas at the design operating pressure.

Each new pipeline section will be subjected to hydrostatic pressure testing to prove the strength and integrity of the section in accordance with the relevant standard and additional Project requirements.

The longer pipeline sections may be tested in sub-sections to:

- Limit elevation changes, allowing the test pressure to be maintained between the minimum required test pressure and maximum pressure that the pipeline will safely withstand
- Accommodate the maximum stress criteria.

Hydrostatic testing activities will be carried out in sequence and will include the following:

- Internal cleaning of pipeline sections using cleaning pigs to remove construction debris
- Gauging pig run to confirm the internal geometry is within specified limits
- Welding of certified test ends onto each end of the pipeline test section
- Controlled filling of pipeline sections with water
- A temperature stabilisation period to allow the water and line pipe steel temperature to stabilise
- Pressurisation of the pipeline test section
- A test pressure hold period (i.e. commencement of up to 24-hour strength and leak tests)
- De-pressurisation of the pipeline test section
- Controlled dewatering of the pipeline test section
- Swabbing of the pipeline test section to remove as much water as practicable
- Removal of test ends.

The displaced hydrostatic test water may be transferred to another section of pipe or discharged at a suitable location, as agreed with the Azerbaijani regulators. Filters and break tanks will be used to remove any solids and control the rate of discharge. Discharge locations and rates will be agreed in advance with the relevant authorities. If chemical additives have been used, the water will be tested and treated, as required, before discharge to ensure all discharges are in compliance with applicable environmental requirements, as detailed in the Project environmental standards (see Appendix B of Appendix D (ESMMP)). In general, chemical dosing of the test water is to be avoided wherever possible.

A risk assessment will be undertaken before any chemical additives are used in hydrotest water (10-08).

During discharging operations, samples for water quality analysis will be taken and stored for reference, to confirm that Project environmental standards are being met.

Following successful hydrostatic testing and dewatering, tie-in closing welds will be carried out to link the each section.

5.7.2.2 Hydrotest water supply

Water for hydrostatic testing will be clean, contain the minimum achievable concentrations of contaminants (e.g. sediment, bacteria) and be non-corrosive. A water analysis shall be undertaken to confirm the quality of the water prior to use and the water will be treated if necessary to bring it to the desired quality for hydrotesting purposes. Water abstraction sources will be selected to suit the geographical location of the pipeline and will be of sufficient quantity and quality to facilitate filling of the pipeline test sections without any detrimental effect to the surrounding ecology and downstream consumers.

The number of hydrotest sections, their volume and the amount of water that can be reused for more than one section will not be known until the completion of the construction contractors' detailed plans for construction and commissioning. Hydrotest water will be re-used between sections, where practical, to minimise the volume required (10-09). Based on the information currently available, it is likely that the Azerbaijan section of the proposed SCPX pipeline will be tested in at least six but more probably eight to ten sections. Experience gained during the hydrotesting of the SCP pipeline will also be used in the determination of the optimum hydrotesting strategy for the SCPX.

Hydrotest water will be abstracted from surface water bodies located in close proximity to the ROW. Seven watercourses are likely to be used as sources for hydrotest water for the SCPX Project (see Table 5-9). Table 5-9 shows the maximum volume of water that may be required from each of the watercourses for both pipeline testing and HDD and tunnel testing. The total maximum volume of water likely to be required for the SCPX Project in Azerbaijan, for both pipeline testing and HDD and micro-tunnel testing, is approximately 781,400m^3. However, the total volume of the pipeline is approximately 615,000m^3, and this volume is not likely to be exceeded for pipeline testing, meaning the 700,000m^3 total represented in Table 5-9 is unlikely to be reached.

Hydrotest water will only be taken from and disposed of at pre-approved locations. It is likely that the testing programme will require continuous water abstraction for periods of several days at each abstraction point.

Table 5-9: Hydrotest Abstraction Points and Maximum Abstraction Volumes

Watercourse	Maximum volume required for testing pipeline (m^3)	Maximum volume required for HDD and microtunnel testing and working (m^3)
Agsu canal	100,000	14,000
Geokchay	100,000	13,000
Turianchay	100,000	15,500
Kura East	100,000	16,400
Karabakh canal	100,000	13,500
Tovuzchay	100,000	0
Kura West	100,000	9,000
TOTAL	700,000	81,400

Prior to the commencement of the testing programme, the construction contractor will prepare, and submit for approval, a hydrostatic test and monitoring plan. The plan will detail methods to be used for water quality analysis, for line fill and discharge, and the environmental controls to be implemented to prevent or minimise the following potential impacts:

- Erosion at intake location (e.g. buoy intake)
- Erosion/scour protection at the discharge location
- Fish entrainment into the pump (i.e. in identified fish habitats)
- Fuel spillage (e.g. secondary containment of pump)
- Inadequate reinstatement of disturbed lands.

The hydrotest water abstraction points identified by the construction contractor(s) will be subject to an environmental review by the Project team prior to their adoption. All necessary permits required for water abstraction and disposal will be obtained from the owner/occupier/local authorities and will be in accordance with Project environmental requirements. The test water will be analysed to check quality before and after use; the use of chemicals will be minimised but it may be necessary to add corrosion inhibitors, oxygen scavengers or biocides.

5.7.3 Drying and Lay Up

Following hydrostatic testing, the water left in the pipeline will be removed by pigging and disposed of appropriately, using a method that will first be agreed with the Azerbaijani Regulators. Following successful pigging of the pipeline it will be dried prior to commissioning.

The pipeline will be dried using one of three possible drying methods:

- Nitrogen drying
- Super-dry air drying
- Vacuum drying.

The following are brief descriptions of the different procedure for drying pipelines.

5.7.3.1 Nitrogen drying

Owing to its low temperature and liquefied state the moisture content of nitrogen is extremely low and its ability to absorb moisture is very high. Nitrogen drying is generally used on short pipelines where stringent dew point specifications are required. As large quantities of nitrogen are required as well as equipment such as evaporators, the nitrogen is obtained from a local supplier or a nitrogen-generating unit is mobilised to site.

5.7.3.2 Super-dry air drying

This technique is similar to that of nitrogen drying. The equipment necessary to produce dry air with a low dew point is generally more extensive, but the raw material is abundant and this makes the method more attractive than nitrogen.

The line is swept by the dry air under the lowest possible pressure, taking into account that the absorption capacity of non-saturated air increases when the total pressure decreases. The disadvantages of working under the lowest possible pressure while maintaining turbulent flow is that it reduces the air throughput and consequently increases the drying time.

When the drying procedure is completed, the pipeline can be left with a positive pressure of dry air and mothballed. Prior to commissioning the pipeline with hydrocarbon product, a slug of nitrogen between two pigs would have to be introduced to avoid air or gas bypassing the separation pigs and forming an explosive mix.

5.7.3.3 Vacuum drying

This method involves vaporising the water remaining on the pipe walls by reducing the internal pipeline pressure to below the boiling point corresponding to the pipeline internal temperature. The technique has advantages in that it allows for the complete elimination of the water and does not require nitrogen purging because of the low residual amount of oxygen. This method is only undertaken by specialist companies and the drying time is generally longer than for the dry air method, although it is often used in conjunction with dry-air purging.

Vacuum drying is undertaken in three stages:

- The rapid removal of the majority of the air trapped in the pipeline. During this phase the pressure will decrease to the water boiling pressure corresponding to the pipeline temperature

- The evaporation of the water and pumping it out through the vacuum system. This is undertaken at a relatively constant pressure and continues until the residual water on the pipe walls has been vaporised, which can be a lengthy process
- Drawing the vacuum continues to reduce the pressure to finally eliminate all residual water.

When the drying procedure is complete, the pipeline will either be commissioned and filled with gas or mothballed. To mothball the pipeline it will need to be filled with either super dry air or nitrogen at a positive pressure.

5.7.4 Pre-commissioning

Pre-commissioning of the pipeline, pigging station and block valves will ensure the pipeline system has been constructed in accordance with the Project design drawings and specifications. Unlike hydrostatic testing, pre-commissioning activities will be carried out over entire sections of the pipeline (e.g. from launching pig trap to receiving pig trap). All tie-in welds and mainline equipment will have been installed and the pipeline system will be mechanically complete.

Pre-commissioning activities will be carried out in sequence and will include the following activities:

- Final internal cleaning of pipeline using cleaning pigs
- Geometric survey using a specialist calliper pig to confirm the internal geometry of the pipeline
- Drying of pipework using either vacuum drying or dry air
- Purging of the pipeline with inert gas such as nitrogen or with dry air. The pipeline will be purged to a positive pressure for preservation and left ready for introduction of natural gas.

5.7.5 Commissioning

Commissioning of the pipeline and block valves will ensure that the pipeline system has been constructed in accordance with the design and that the system is ready for operation. Commissioning will also ensure that there are no defects in the pipeline system, which could cause problems during start-up or during operation. The commissioning procedures will be developed in conjunction with the pipeline operators during the final design stages of the Project.

Commissioning activities for the pipeline and block valves will be carried out in sequence and will include the following:

- Checking the opening, closing, sealing and operation of mainline block valves
- Operational checks on all instrumentation
- Operational checks on all ICSS and control equipment
- Operational checks on all metering
- Checking the operation of all pressure protection systems
- Checking the operation of other facilities (e.g. generators)
- Checking the CP system to ensure that it is operating
- Undertaking integrity surveys to confirm continuity of pipeline coating.

Following the successful completion of all required testing of the SCPX it will be purged using a slug of nitrogen immediately followed by gas from the Sangachal Terminal gas plant introduced at a carefully controlled rate. Suitable detection apparatus to check the change from air to nitrogen (assuming that the pipeline has been filled with air during pre-commissioning) and from nitrogen to gas will be provided at appropriate locations. Local venting arrangements will be provided to release the air and nitrogen until the pipeline is full of gas.

5.8 Reinstatement and Erosion Control

5.8.1 Introduction

Before the construction programme commences, the construction contractor(s) will be required to develop a Project-specific Reinstatement Implementation Plan based on the Reinstatement Management Plan in the ESMMP (see Appendix D) and the Project reinstatement specification. The full width of the ROW and all other Project areas will be re-instated in accordance with the Reinstatement Implementation Plan on completion of the works. The construction contractor will also be required to incorporate reinstatement measures into relevant method statements for each critical element of the construction programme (e.g. watercourse crossings, site clearance, re-grading).

The key areas that need full reinstatement are:

- The ROW
- Construction camps
- Pipe and materials storage areas
- Maintenance areas
- Temporary roads and transport facilities
- Waste management sites
- Project borrow and spoil pits.

The following sections provide a summary of reinstatement works that will be required for the pipeline.

5.8.2 Reinstatement Philosophy

The Project reinstatement specification is based on the following principles:

- Disturbed areas will be reinstated to pre-construction conditions as far as reasonably practicable
- There will be very limited vehicular access along the ROW, which will not normally be permitted, although there will be a continuing requirement for access for maintenance and in case of emergency
- Disturbed areas will be stabilised to protect the integrity of the pipeline and reduce potential impacts associated with erosion, transportation and sedimentation of material from disturbed areas
- Disturbed areas will be re-vegetated to achieve conditions similar to those that exist immediately adjacent to the ROW
- Regular monitoring of all reinstated areas will be undertaken until environmental requirements and goals are achieved.

5.8.3 Erosion Control

An assessment of the proposed SCPX route has been undertaken to identify areas of potential erosion and to support the development of appropriate erosion control measures for such areas. Based on the erosion assessment and the technical objectives of the Project, the following goals have been set:

- No risk of exposure of the pipe
- Very low risk of off-site pollution and sedimentation

- Lower risk of damage to bio-restoration by erosion of soils containing seed-bank resources, vegetative material and plants.

Further details of the erosion assessment and the classification of the soils along the route are provided in Chapter 7.

5.8.4 Timing of Reinstatement

Reinstatement will be undertaken as early as practicable and in accordance with the Reinstatement Specification (4-09). Reinstatement of the ROW and facilities will be undertaken on a sequential basis dependent on the completion of construction and hydrostatic testing activities in each area. Where practicable, the ROW will be cleared of any residual construction debris, construction signs, and equipment prior to the successful completion of hydrostatic testing.

5.8.5 Site Clean-up

Before demobilisation of construction personnel and equipment, clean-up activities will be conducted in accordance with applicable environmental standards and industry best practice. Before construction personnel and equipment are demobilised, temporary buildings and equipment, tools and any excess material brought on site or generated during the construction and commissioning programme will be removed (D5-093). Any disposal will be in accordance with the Project Waste Management Plan in the ESMMP (see Appendix D).

5.8.6 Reinstatement

The first stage of the reinstatement programme will comprise the re-grading of all working areas to achieve a final surface that is sympathetic to the natural landform contours where practical. Any permanent erosion control measures (e.g. diversion berms) will also be installed at this time.

To facilitate natural re-vegetation of the ROW, the separately stockpiled topsoil and vegetation debris will be spread over the surface of the ROW following completion of grading, as appropriate (D5-086). The construction contractor(s) will be required to comply with all requirements for the reinstatement and will be required to submit a reinstatement schedule and methodology that, as a minimum, complies with the Project reinstatement specification and the ESIA requirements (see ESMMP (Appendix D) and Chapter 10). In some instances, areas of sensitive natural habitats or high erosion potential may be seeded with a mixture of native plant species to facilitate re-vegetation. If considered necessary by the Project, additional surface stabilisation measures may be adopted in areas of high erosion potential.

Specific commitments relating to soil handling and reinstatement are provided in Chapter 10, however the key reinstatement principles are summarised below:

- Minimise reduction in soil quality and structure through predetermined stripping, handling and storage procedures
- Use of appropriate temporary erosion control measures (including erosion matting, sediment traps, silt fences, and filter berms)
- Use of permanent erosion control (including diverter berms, and trench breakers)
- Reinstate all third-party assets affected by Project activities in accordance with pre-entry agreements
- Reinstate all redundant spoil disposal sites. These will be closed, capped and landscaped in accordance with the relevant requirements of the Project reinstatement plan and Waste Management Plan in the ESMMP (see Appendix D)
- Reinstate watercourses and locations prone to erosion as soon as practicable after installation of the pipeline

- Undertake joint inspections of all reinstated areas (e.g. involving construction contractors' reinstatement personnel and Project representatives) to verify that all necessary measures have been undertaken
- Reinstatement of uncultivated areas to facilitate re-establishment of natural (pre-existing) vegetation communities (including, as appropriate, final grading, ripping, cultivating, reseeding and planting of trees and shrubs). Agricultural land will be tilled and left for reseeding by land users
- Where erosion control seeding is needed, a target minimum cover of pre-existing ground vegetation established within one year of final reinstatement
- An aftercare, monitoring and corrective action programme will be developed and implemented based on examining the bio-restoration process periodically after reinstatement.

Following construction, the contractor will repair roads to at least their pre-construction condition (37-07). Surface of frequently used access roads will be subject to regular inspections and repair, with the aim of ensuring they are maintained in a good condition particularly where fragile buildings are close to roads (subject to site specific survey) (37-08). Any disrupted irrigation or drainage systems will be reinstated on completion of construction to a standard at least equal to their original condition (35-08).

Before construction personnel and equipment are demobilised, temporary buildings and equipment, tools and any excess material brought on site or generated during the construction and commissioning programme will be removed (D5-093).

Upon completion of subsoil and topsoil reinstatement, the Contractor and Company personnel will inspect disturbed areas jointly for signs of erosion, slope stability, relief, topographic diversity, acceptable surface water drainage, capacity and function, and compaction, and implement remedial measures if necessary, at locations where reinstatement does not meet the Project criteria (3-15).

Any fences, services, structures, roads, tracks, pavements or other facility affected by the works connected with the Project will be repaired or replaced to a condition that is at least as good as that found prior to construction.

5.8.7 Watercourse Reinstatement

Watercourse banks will be restored to near original condition, which will be assessed individually for each watercourse and defined in the contractor's Reinstatement Implementation Plan. Any deviations (e.g. because hard reinforcement is required for erosion control) shall be subject to Company approval (10-14). The construction contractor(s) will produce method statements incorporating plans for erosion control, sediment control and reinstatement before work begins at river crossings (4-12).

As a minimum, the method statements will include information on the following:

- Recording of the original channel width, depth and slope prior to disturbance to allow reinstatement as near to the original as is practicable
- Re-contouring of banks to match surrounding slopes
- Installation of erosion protection measures at areas susceptible to washout or run-off. These may include the provision of riprap, gabions or impervious membranes. An ecological survey may be undertaken before any reinforcements are constructed, with appropriate mitigation measures identified and implemented
- Replacement of the channel substrate
- Replacement of the bank topsoil
- Reseeding of the banks.

5.9 Project Operation and Maintenance

5.9.1 General

An environmental and social management system will be developed to maintain compliance with the ESIA during operations. This is described further in Chapter 13 and, as far as practicable, this system will be integrated into the existing SCP management systems.

The pipeline system has been designed for minimal operational and maintenance intervention. The operating and maintenance requirements for the pipeline system have been developed to achieve the following objectives:

- Safety of operation for operations employees, customers and third parties
- Environmental compliance in accordance with the SCP Host Government Agreement (HGA); permits and authorisations; BP company policy; and Project plans, specifications and requirements
- Continuity of supply within design criteria
- Minimised operational expenditure consistent with meeting contractual obligations and sustaining the design life of the system
- Maintenance of the system's technical integrity and performance over its design life
- Full compliance with statutory and regulatory obligations
- Maintenance of the security of the system
- To demonstrate 'fitness for purpose' of the SCPX for the length of its design life allowing it to operate at optimum condition during this period
- Centralisation and integration of operations and maintenance activities.

The main Control Room will be located within the Sangachal Terminal. As an emergency response centre, a high-level communication network (telephone/e-mail) will be established between the Sangachal Terminal and the existing Emergency Response Centre in BP's offices in Baku.

The pipeline will be operated in accordance with international codes and standards. These codes place stringent requirements upon the operating company to ensure that:

- The pipeline is operated safely
- Staff are appropriately trained
- A thorough programme of preventive maintenance is implemented
- The pipeline is surveyed regularly.

5.9.2 Operation and Maintenance Organisation

The operation and management of SCPX will be incorporated into the Midstream export pipeline management and functional organisation. There will be an increase in certain functional roles, such as technicians and ROW patrols, which will be introduced to support the running of the pipeline in Azerbaijan and will report into existing midstream export operational management teams.

It is anticipated that SCPX will use existing BTC maintenance facilities at IPA1 and PSA2 (see Maps 4 and 10, Figure A7-1, Appendix A). Each location will be responsible for a part of the pipeline within its geographical area, including associated block valves.

5.9.3 Pipeline Control

There will be a manned centralised control centre at the Sangachal Terminal with remote control units at the strategic facilities in Georgia.

Under normal conditions pipeline throughput will be achieved by controlling the speed of the main compressor units at the compressor station within Sangachal Terminal to achieve the required flow.

5.9.4 Pipeline Maintenance

The pipeline system will be monitored and maintained to ensure that the system, as designed, constructed and tested, remains 'fit for purpose' throughout the proposed SCPX Projects design life. In general, SCPX surveillance, function checks and condition monitoring will be used to anticipate system problems and allow them to be rectified in a timely manner. Planned maintenance will be implemented with the objective of minimising any risks associated with long-term operations. The incorporation of planned maintenance has been a fundamental element of the Project development to date and it will be implemented throughout the operation of the SCPX system.

SCPX inspection and maintenance activities during operation will include the following tasks:

- Pipeline monitoring and surveillance
- Special crossing inspections
- Monitoring of population and third party activities in close proximity to the SCPX
- CP system monitoring
- Functional operational checks and verification of plant and equipment
- Routine maintenance of block valves, plant and equipment at pre-defined intervals.

Maintenance procedures for the SCPX facilities will be developed and scheduled utilising a computerised maintenance management database. Maintenance procedures will provide the necessary instructions and technical information to support operational and maintenance activities that are necessary to satisfactorily maintain day-to-day plant operation, including:

- Stage by stage inspection, care and maintenance instructions
- Essential manufacturer's maintenance instructions and references
- Isolation and permit to work requirements
- Previous historical reading/results etc.

5.9.5 Pipeline Surveillance

It is anticipated that the SCPX surveillance programme will include the following activities:

- Patrolling
- Aerial survey
- Vantage point survey
- Liaison with owners/occupiers, tenants and other authorities
- Coating defects survey
- CP system monitoring
- Inline intelligent pigging
- LDS monitoring.

The surveillance programme will monitor the entire length of the SCPX, although particular attention will be given to sensitive locations such as:

- River crossings

- Rail and road crossings
- Block valves
- Population settlements.

The design of the surveillance programme will also take into account experience gained through the operation of the existing SCP in Azerbaijan.

In addition to the pipeline surveillance measures described above, closed circuit television (CCTV) and intruder alarm systems will be provided at each facility and BVR station.

5.9.6 Training Provision

During Project development the pipeline operator will develop a comprehensive training programme for all SCPX operation and maintenance personnel. The programme will deliver operations, maintenance, environmental, social, health and safety training requirements as well as ongoing development of personnel skills.

Skills will be regularly assessed and a system maintained for recording and ensuring that all personnel working on the SCPX system are fully trained and competent to perform their assigned duties.

Similar standards of training and competence will also be required of all contractors' personnel who may be required to work within such facilities during operation.

5.10 Project Resources, Wastes and Emissions

5.10.1 Labour

The proposed works will be subject to competitive tender and will be let to an experienced pipeline construction contractor(s). The construction contractor(s) for the Project will directly employ approximately 500 - 700 Project personnel when work is at its peak. The indirect workforce (camp cleaners, cooks etc.) have been estimated to be around 35% of the direct workforce. The majority of the workforce will be skilled or semi-skilled personnel. Some positions will be recruited from the local area according to skills and competencies. All non-local personnel will be housed in temporary worker camps.

5.10.2 Operation

A small number of full-time personnel will be employed during operation to perform routine maintenance, inspection and surveillance duties for the pipeline. It is anticipated that security personnel will be present at the pigging station on a permanent basis and at the block valves there will be a permanent security presence although operational staff will not be present on a full-time basis.

5.10.3 Construction Equipment

The construction works will involve the deployment of earth moving and specialist pipeline-construction equipment. A summary of the estimated mobile and other related equipment needed to accomplish pipeline installation is presented in Table 5-6: and major stationary plant in Table 5-10. It should be noted, however, that the precise type and number of equipment would be at the discretion of the construction contractor(s). Incinerators may also be used at construction camps to deal with special waste, however waste type and incinerator specification are not yet determined.

Table 5-10: Major Stationary Plant

Location	Plant	Function
Construction camps and storage areas	Power will be provided from mains electricity supply, unless this will affect local users, in which case diesel generators will be used. Emergency diesel generator(s) will also be provided	Main power and emergency power generation for construction camps
	Water treatment plant	Water treatment
	Sewage treatment system	Sewage treatment

5.10.4 *Construction Materials*

Estimates for consumption of construction materials are presented in Table 5-11. The average number of vehicle movements associated with material transport, and also the transportation of personnel, is expected to be approximately 80-100 per camp per day, with peaks of up to 160-180. The estimated number of vehicles required to transport water for hydrotesting could result in approximately 4000 truck movements (trucks with a capacity of 20m^3. The number of truck movements associated with aggregates is approximately 6500 trips from the extraction location to point of use. An estimated 1750 truck movements will be required to transport concrete to the permanent facility locations. The estimated number of railcar trips in Azerbaijan based on four pipes per rail car is 9020. The estimated number of truck trips required for taking the pipes from railheads to pipe dumps, based on two pipes per truck, is 16,150 trips in total.

Table 5-11: Estimated Resource Requirements for Construction

Resource Type	Estimated Amount	Units
Line pipe	272,706	Metric tonnes
Aggregates (sand and gravel)	65,000	m^3
Concrete	17,520	m^3
Asphalt/tarmac	Minimal	m^2
Timber	1500	m^3
Fuel/diesel	92,720	m^3
Structural steel (temporary facilities)	5	Metric tonnes
Fibre-optic cable	700	Metres
Power cable	1500	Metres
Copper cable (1mm CSA)	2	Kilometres

5.10.5 *Energy*

5.10.5.1 Construction fuel consumption

Diesel fuels will be needed for the operation of all mobile and stationary plant as presented above.

Electricity will be used at the camp and it is envisaged that this will be supplied at each location by a set of generators, approximately 200 kilowatts each. The camp power requirements will be approximately 1MW. A small diesel generator will be required for pipe storage areas and rail spurs. There is also the possibility that the national electricity grid will be used to supply partial or full power to the camps and pipe storage areas, either for start-up, followed by use of the generators, or as the sole power source, in place of the generators. However, this will depend on the capacity of the local grid that is available. Prior to any use of the national grid as a power source, an assessment will be undertaken with the aim of identifying and avoiding any adverse impacts on other grid users.

In addition to the above, a diesel powered back-up generator will be located at each of the camp, rail spur and pipe storage locations.

5.10.5.2 Operational fuel consumption

Given the absence of major facilities on the Azerbaijani section of the pipeline, it is anticipated that operational fuel consumption will be extremely low. Fuel consumption will be largely limited to the incremental increases required to the SCP block valve power supplies as a result of the presence of the collocated SCPX block valve sites and to that which is required for vehicle movements associated with inspection and maintenance activities. Some fuel consumption will also be necessary at the pigging station, but this is likely to be minimal.

5.10.6 Water

Raw water for sanitary and washing requirements at the construction camps and storage areas will be sourced from local civil or municipal supplies and/or purpose-designed and constructed boreholes. These sources may also be used for potable water supplies if the water quality is shown to meet the World Health Organization (WHO) drinking water guidelines. Should the water supplies fail to meet these guidelines, it is likely that a dedicated water treatment plant will be installed at the camp facilities. The estimated quantity of water person to be factored into the design of the water treatment plant is 240 litres per person per day.

Water for sanitary and washing requirements at the five BVR security cabins will be stored in dedicated water tanks that have a capacity of approximately $2m^3$. The tanks will be supplied with water via water tankers approximately once or twice per month. Operational water consumption volumes at the pigging station have been estimated using 2012 data taken from the WREP intermediate pigging station (IPA1). At IPA1 there are four permanent staff and monthly water consumption is approximately $50m^3$. There are likely to be fewer staff at the SCPX pigging station, therefore $50m^3$ is likely to be a worst case estimate.

Approximately $615{,}000m^3$ of water will be abstracted from local rivers for hydrotesting the pipeline sections. If water is sourced from rivers or channels no more than 10% of the water flow will be extracted at any time (D5-078). Before extracting water the Project will consider the presence of any IUCN/Red data book fish species, particularly during fish-spawning season (which normally occurs within the period April to July) and the mitigations such as 10mm fish screens will be determined by a site assessment and approval by the Company (D5-079). Details of proposed sources of water are provided in Table 5-9.

5.10.7 Wastes and Emissions

The construction work will generate inert, non-hazardous and hazardous wastes during construction and commissioning.

The principal wastes and emissions that will be generated during the construction, commissioning and operation of the SCPX will be:

- Domestic waste (liquid and solid)
- Packaging materials
- Construction plant emissions (e.g. vehicles, generators and pumps)
- Delivery vehicle emissions (bringing people and materials to site)
- Oils/lubricants
- Vegetation and fencing materials from ROW preparation
- Excess construction materials

- Excess soil and rock
- Hydrotest water and chemicals
- Waxes and oils from pipeline de-oiling and cleaning
- Redundant pipe removed from service, although most will be left in situ.

All waste will be disposed of in accordance with the Project waste management plan, which forms part of the ESMMP (Appendix D). In accordance with the SCPX Waste Management Plan, solid wastes generated by construction activities will be collected in waste storage areas (WSA) located at the camps (D5-028). All wastes from the SCPX Project will be managed with the aim of minimising (a) impacts to the natural environment and (b) potential health hazards to personnel. Where appropriate, waste materials will be reused or recycled, with disposal to landfill as a last resort (D5-029). Hazardous waste will be forwarded to a waste disposal contractor licensed to receive and treat hazardous waste (D5-030).

Inert and non-hazardous wastes that cannot be reused or recycled may be incinerated in an incinerator designed and operated in general accordance with World Bank standards. Hazardous wastes may be incinerated in an incinerator, also designed and operated in general accordance with World Bank Standards. It is anticipated that these would small-scale incinerators operating within the construction camps.

Before the construction programme commences, the construction contractor(s) will prepare a Project waste management implementation plan that will:

- Identify and quantify anticipated wastes from the construction process
- Identify minimisation/collection/storage/treatment/reuse/disposal routes for each waste stream including potential third-party re-users
- State the arrangements for properly managing wastes, including training, storage, labelling, transporting and final disposal.

5.10.7.1 Waste inventory

Table 5-12 presents an indicative and approximate estimate of the wastes that will be generated by the Project. The table combines the different waste streams into four major categories: sludge, hazardous, non-hazardous and inert waste.

Table 5-12: Projected Waste Arisings (metric tonnes)

Waste category	Section 1	Section 2	Section 3	Section 4	Section 5	Total
Sludge Post biological treatment at STPs	472	408	536	354	523	2,293
Hazardous Used oil, used oily filters, hydrocarbon contaminated material (rags, drums, soil, used spill response equipment), paint and solvents, batteries (dry-cell/lead) Used drums (chemical cans, drums, containers, packages should be treated and disposed as hazardous waste if their content was defined as hazardous material.) Any other waste process chemicals, fluorescent tubes, contaminated soil	40	35	46	30	45	196
Non-Hazardous Rubber tyres, glass, paper, cardboard,	1,022	945	1096	882	1082	5,027

Waste category	Section 1	Section 2	Section 3	Section 4	Section 5	Total
plastics, scrap metals, wood, general (domestic) waste, grit blast						
Inerts Soil, sub-soil, stones and gravel	6	5	7	4	6	28
Total	1,540	1,393	1,685	1,270	1,656	7,544

The projected figures indicate that post-biological treatment sludge is forecast to be the major component of the waste arisings at every camp.

The current waste strategy has assumed most of the waste will be transported back to Baku for recycling and disposal at BP-approved sites. The total number of waste transport vehicle trips travelling to Baku to dispose of waste from the camps is estimated at 1850 trips during the construction phase of the project, with an equivalent number returning to the camp locations. This number of vehicle trips could be reduced by the use of an incinerator, composter and sludge treatment on-site at the construction camp locations.

Operational waste is expected to be minimal. The pigging station is proposed to be unmanned except for the presence of a security guard. The waste water from the security guard hut will be treated on-site or taken away for disposal. There is no hazardous waste produced from the pigging station. The only waste produced is a dry powder, which is deteriorated internal coating and will be carried through to compressor station 1 in Georgia via pigging operations. Disposal of this waste will therefore be carried out in Georgia, which has been estimated to be around 100kg a year.

5.10.7.2 Releases to the atmosphere

Atmospheric emissions associated with the construction activities are provided in Table 5-13 and are based on the type and number of construction plant and vehicles used and the anticipated duration of each construction activity associated with the camps, pipe storage areas, intermediate pigging station, block valve stations and ROW. These assumptions also include all vehicles that will carry out activities such as transport of aggregate and waste. The mass of emissions was calculated for a two-way journey (100km) by multiplying the mass of fuel by the emissions factors. Every piece of equipment was assumed to be operating for 10 hours a day. The mass emissions for the entire 31-month construction period were then calculated using the following equation:

Mass emission = number of vehicles x mass emissions for 1 day x 972

The suggested bulk emission factors (g/kg fuel) (for CO_2 kg/kg fuel) for the calculations have been taken from the EMEP/EEA emission inventory guidebook 2009 (updated May 2012).
Non-road vehicles and equipment were categorised according to available emission factors in the US EPS's Non-road Engine and Vehicle Emission Study (NEVES). NEVES lists the average horse power ratings and pollutant emissions factors for each of the equipment. The suggested bulk emission factors (g/kg fuel) (for CO_2 kg/kg fuel) have been extrapolated from CORINAIR as a guide (Ref 3. EMEP/EEA emission inventory guidebook 2009, updated May 2012). NEVES does not provide CO_2 emission factors.

Road vehicles were categorised and the emissions factors were determined using the CORINAIR using Table 9-3 of the EMEP/EEA emission inventory guidebook 2009, updated May 2012.

Table 5-13: Assessment of Combustion Emissions from Construction Activities

Source type	Emissions (tonnes)					
	HC	CO	NO_x	PM	CO_2	SO_2
Non-road construction equipment	466	2594	3430	447	307,433	310
Road vehicles	-	44	114	10	10,154	-
TOTAL	466	2638	3544	457	317,587	310

Notes: Vehicles and equipment were categorised according to available emission factors in the US EPS's Non-road Engine and Vehicle Emission Study (NEVES). NEVES lists the average horse power ratings and pollutant emissions factors for each of the equipment. Every unit has been assumed to operate for 10 hours per day, every day for the duration of 31 months construction period, at total of 9720 hours (estimated).

During the operational phase of the proposed SCPX Project, atmospheric emissions are likely to be minimal. The primary sources of emissions will be from the block valves and the pigging station.

Emissions associated with block valves are predominantly those released during a major accident, fugitive emissions from the block valves themselves and annual valve testing emissions. Annual emissions of CO_2 and CH_4 have been estimated using UK Offshore Operators Association (UKOOA) emission factors for onshore gas facilities, based on a gas composition of 94.14% CH_4 and 0.23% CO_2. Each block valve has one actuator that will be stroked once a year for testing, which will result in a gas release of approximately 3.62m^2.

The pigging station in Azerbaijan has minimal power requirements (less than five kilowatts) that will be provided by approximately five to eight thermo-electric generators (TEGs) depending on suppliers, with any possible additional power requirements being supplied by a temporary generator. GHG emissions from the pigging station will primarily be associated with the TEGs, venting operations and fugitive emissions. Annual operational emissions associated with both the pigging station and block valves is detailed in Table 5-14.

Fugitive emissions from the pipeline will also contribute towards GHG emissions although there should be no operation emissions.

Table 5-14: Preliminary Annual Operation CO_{2eq} Emissions at the Block Valves and Pigging Station

Facility	Fugitive emissions (tonnes)	Operation emissions (tonnes)	Total (tonnes)
Pigging station	28	348	376
Block valve stations	94	0.33	94
Pipeline	63	n/a	63
Total (tonnes)	185	348.33	533

5.10.7.3 Waste water

Waste water will be minimised by efficient use of raw water and the implementation of water management schemes that require water to be reused, whenever practicable, prior to treatment and disposal.

All waste water, except for uncontaminated rainwater, will be treated prior to discharge as detailed in the Pollution Prevention Management Plan in the ESMMP (see Appendix D). The camps will discharge domestic wastewater treated by a sewage treatment package designed to meet the Project standards and permit requirements (D5-106). Project standards are detailed in Appendix B of Appendix D (ESMMP). If permanently manned, domestic sewage from the pigging station will either be treated on, or off-site (D5-080).

5.10.7.4 Hydrotest water

The maximum theoretical volume of pipeline hydrotest water would be equal to the entire capacity of the SCPX pipeline in Azerbaijan, i.e. approximately 615,000m^3. In addition, approximately 81,400m^3 of water is also likely to be required for HDD and micro-tunnel testing. Where possible hydrotest water will be reused, which will reduce the total volume required. Before the testing, the construction contractor(s) will be responsible for the development of a hydrotest water supply, use and discharge strategy that incorporates measures to promote efficient resource usage and appropriate management of the abstraction and disposal of hydrotest water.

To the greatest extent possible, hydrotest water will be discharged, via break tanks and additional filters as appropriate, for reuse in the next section of pipeline to be tested. The Contractor will produce a hydrotest management plan that will be approved by the Company. If necessary, additional water will be added to make-up any losses or differences in lengths of test sections. If surplus water is encountered then it will be discharged at Company approved locations. Hydrostatic water will be tested and the results assessed in relation to Project standards (see Appendix D, ESMMP). Water will be discharged in a manner that reduces environmental impacts (e.g. scouring, erosion) to land surfaces and/or watercourses.

It should be noted that all water discharged from a pipeline following hydrotesting would be discoloured/stained. Although visible, the concentration of iron compounds (rust) is normally very low and can be discharged safely to the environment (i.e. to vegetated ground and then indirectly to watercourse or directly to watercourses). If potential contaminants are found to be above Project standards or are likely to cause ambient water quality concentrations to be exceeded, one of several options for appropriate disposal will be adopted:

- The water will be held in an approved holding area (evaporation pond) and allowed to evaporate. The remaining iron residue either will be collected for appropriate disposal or, if concentrations are at or below acceptable limits, will be abandoned in place. Although this option will be retained for use should circumstances require, it should be noted that it is not currently anticipated that evaporation ponds will be used
- Chemicals (e.g. manganese dioxide) will be added to neutralise the environmental effects of the iron or filtration methods will be used.

Hydrotest water that does not meet the water quality standards for direct disposal will not be discharged directly to the environment. After dewatering and disposal activities are complete, disturbed areas will be restored to their pre-construction conditions.

5.11 Decommissioning and Abandonment Plans

5.11.1 Legal Basis

Should the HGA be terminated for any reason during the period of the SCPX Partners ownership of the line then the SCPX Partners or its successor(s) are required to provide to the Azerbaijan Government a written abandonment plan detailing:

- Removal of all surface installations
- Disconnection of the pipelines from the gas supply and abandonment in place (or removal where abandonment causes a risk to the environment)
- Filling all abandoned underwater pipelines with water or inert material and the sealing of the ends

- Re-vegetation of the pipeline corridor consistent with the terrain features and other prevailing conditions.

Within 30 days of termination of the Host Government Agreement a plan must be prepared describing how this will be achieved. This Abandonment Plan will be subject to approval by the Government. An ESIA will be prepared prior to implementation of the Abandonment Plan to assess and minimise potential environmental and social impacts arising from the abandonment operations. This abandonment ESIA will be submitted to the Government (DE-05).

Upon completion of the abandonment operations an assessment of contaminated land will be prepared recording the final contamination status of the location of the Project facilities. This assessment will be subject to governmental approval (DE-06).

In the event of abandonment of the line during the SCPX Partners ownership, they will carry out monitoring for a period of two years to identify (and if required remediate) any adverse environmental impacts related to pipeline activities that may subsequently become evident.

5.11.2 Technical Solutions for Abandonment

The SCPX and associated AGIs have a design lifetime of at least 30 years. It is currently envisaged that they will be decommissioned and abandoned thereafter. As stated above, exact details of how facilities will be abandoned will be determined prior to abandonment, and agreed with the Government. Therefore, it is not possible to determine at this stage exactly what techniques will be used. However, these will be in accordance with recognised international standards. The likely measures to be undertaken are outlined below.

If feasible, aboveground facilities will be left in place for further use. In those locations where this is not appropriate, facilities will be decontaminated before being abandoned in situ or entirely dismantled and removed. Wherever practicable, equipment and materials will be collected for reuse, recycled or material recovery.

Demolished sites will be cleaned up and land will be reclaimed, if unused.

The pipeline itself will be cleaned, filled with an inert gas, air or water and capped. It is likely that it will be abandoned in situ in the ground in a condition that is acceptable to the responsible authorities. This is likely to be the preferred option in environmental terms; the alternative, namely removing the pipe, would involve excavation of the reinstated alignment with the attendant environmental disturbance.

The need to maintain a functional CP system will be assessed to prevent corrosion in critical areas, as corrosion could lead to subsidence. In some particular sections the pipeline may be filled with concrete to prevent collapse.

As an alternative to abandonment, consideration may be given to the reuse of the pipeline for the local/national distribution of low-pressure gas, the transportation of water or as a conduit for services such as telecommunications cables.

The approach described above presents the possible scenario decommissioning which is not anticipated until 2048 at the earliest, and norms for decommissioning could change during this period. Details of how the SCPX facilities will be abandoned will be determined prior to decommissioning and agreed with the Government at that time in accordance with the HGA. Therefore, it is not possible at this stage to determine exactly what steps will be taken, other than to state that decommissioning will be in undertaken in accordance with international standards applicable at the time of the end of the Project’s life.

5.12 Conclusion

This chapter has described the activities proposed to be carried out for the proposed Project and has presented current estimates for fuel use and atmospheric emissions, water use and waste generation.

The aspects of the Project as described here that can impact on the environmental and socio-economic conditions are identified and assessed in Section 10 and 12 of the ESIA.