Section 5
Project Description



5. Project Description

5.1 Project Overview

This section describes the proposed TTP by the following phases:

- design
- construction and installation
- commissioning
- operation
- decommissioning

At the time of preparation and submission of the Draft EIS to Government, the TTP was in the Preliminary Design Phase, and as such many project details were well established while others were still under consideration. The project details will be refined when the project enters the 'Detailed Design' phase, during which engineering and construction details will be confirmed and technical decisions made. To ensure a fully transparent and robust environmental and social assessment is conducted as part of this Draft EIS, where details are currently unconfirmed, a range of possible options have been provided for assessment.

The TTP will be approximately 940 km in length with a 406.4 mm (16") external diameter, stretching from a proposed gas plant near Wadeye to the existing Alcan Alumina Refinery at Gove. The project location is presented in **Figure 1-1** and in **Volume 3**.

The pipeline will consist of a buried high-tensile steel pipe. It will generally be constructed within an approved 30 m wide construction corridor, which will be located within a 100 m wide pipeline corridor. At intervals along the pipeline, supporting infrastructure including six scraper stations and seven main line valves (MLV) will also be installed and one compressor station near Katherine. The pipeline will terminate at an outlet facility near Nhulunbuy on the Gove Peninsula. The outlet will be fitted with filtering, flow metering, heating and pressure reduction systems.

The proposed pipeline and associated facilities will be designed, tested, operated, maintained and decommissioned in accordance with relevant legislation, licence conditions and AS2885 'Pipelines–Gas and Liquid Petroleum' (Parts 1, 2, 3 & 5).

5.2 Pipeline Route Environmental Setting

The pipeline transects the Northern Territory in an east west direction between the latitudes of 14.650°S and 12.150°S. The environmental setting has been divided into four sections, the Ord-Victoria, Tipperary, Roper and Arnhem Land. In all four regions the pipeline alignment crosses major rivers, some of which may only consist of a series of waterholes in the dry season, and many ephemeral creeks and watercourses.

Ord-Victoria and Tipperary: The boundary is at Bradshaw Creek near Dorisvale Station, 230 km from the pipeline starting point near Wadeye. The length of proposed pipeline over the Ord-Victoria region is approximately 229 km. The proposed pipeline alignment crosses one larger river, the Moyle, ephemeral creeks and swampy ground adjacent to creeks in the Ord-Victoria region. From Wadeye the alignment crosses the broad coastal plains of the Cambridge Gulf Lowlands that contain a few low hills, a number of residuals rising over 300 m in some places, and broad shallow depressions and widely spaced streamlines. The gently undulating plains overlie sandstone, shale and limestone. The Eucalypt woodland has an understorey of grass and sometimes palms. The area around the Moyle River consists of many braided streams, gently sloping or undulating plains, open woodland and shrub land. To the east of the Moyle River the pipeline crosses steep high slopes and rugged ridges of sandstone and siltstone rock until it reaches the plateau on top of the Wingate Ranges. The majority of the plateau consists of gently undulating plains, with some outcrop covered in tall open forest.

Tipperary and Roper: The boundary is at the Stuart Highway, approximately 362 km from the starting point. The length of the proposed pipeline over the Tipperary region is 131 km. The pipeline enters the Tipperary region at Bradshaw Creek near the Dorisvale Station homestead and exits the region at the Stuart Highway just north of Cutta Cutta Caves. The pipeline alignment crosses the major waterways of the Katherine and Daly Rivers, minor streams of the King River and Bradshaw Creek and many ephemeral creeks. The main rivers are perennial but the levels are subject to considerable fluctuations during flooding. The terrain in the Tipperary region is either gently undulating or level plains of red soils and limestone, soft sandstone or laterite low rises. The area consists of two major geomorphic regions of the plateaux and the plains. The Central Low Plateau between the Daly and Katherine Rivers has a relief of less than 30 m. The Eastern Low Plateaux in the area where the pipeline alignment crosses the Stuart Highway is gently undulating with discontinuous rocky escarpments up to 20 m. The Southern Plains between Bradshaw Creek and the Daly River consist mainly of plains of residual soils, plains with rock outcrop or sandy or stony undulating terrain. Southeast and southwest of Katherine is the Northern Plains characterised by stony plains and undulating terrain of relatively unweathered limestone, sandstone and siltstone.

Roper and Arnhem Land: The boundary is at the boundary between the Mainoru Pastoral Lease and the Arnhem Land Aboriginal Land Trust River, approximately 577 km from the starting point. The length of the proposed pipeline over the Roper region is 215 km and over the Arnhem Land region is 353 km. The four major rivers or creeks that cross the pipeline alignment are Beswick Creek, the Waterhouse River, Flying Fox Creek, and Mainoru Rivers. The majority of the pipeline route is located on sandy undulating plains. Between KP440 and KP460, approximately 20 km east of Beswick, the pipeline route is located on the low hills and foot slopes of the Arnhem Land escarpment. The area between Bukalorkmi and Flying Fox Creek consists of broad or narrowfluvial corridors and gently undulating plains. The land in this area has been used for cattle stations.

5.3 Project Schedule

5.3.1 Project Development Scenario

The TTP will be designed, constructed, commissioned and operated by a BOO consortium for the project life. As the consortium is yet to be selected it is not possible at this stage to describe exactly how the project will be developed. However, to enable a consistent assessment of impacts for the purposes of this Draft EIS, the scenario outlined in this section has been used. This scenario adopts a conservative approach (for example, it is expected that a smaller workforce and fewer construction spreads may eventuate) to ensure that all potential impacts have been included and are considered.

Preliminary design is based on the following key parameters:

- detailed terrain and risk analyses will comply with all parts of AS2885;
- design life will be 50 years, thus providing a long-term asset;
- the number and location of facilities along the pipeline detailed in **Section 5.4**;
- one compressor station to be installed during the initial construction at Katherine.

Construction is based on the requirement of first gas to Gove by 4th quarter 2007 and will be performed as follows:

- using four construction spreads over two consecutive dry seasons during 2006 and 2007 (**Figure 5-1**);
- up to three spreads operational at any one time (**Section 5.5.4**);
- sourcing line pipe from either overseas or within Australia, or a combination of both (**Section 5.5.6**);
- transporting materials, including line pipe, to site using existing port, road and rail networks;
- delivering line pipe to storage yards at Gove and Katherine (it is envisaged that 25% may be transported to Gove and 75% to Katherine) and possibly Darwin;
- accommodating the workforce in construction camps;
- basing the workforce generally on a four week on / one week off working roster;
- carrying work out in a preceding dry season, where a need for significant road/infrastructure upgrade work is identified;
- performing the construction in the indicative construction period between 1 May and 31 October (six months or 180 calendar days);
- restricting all access to the 30 m construction corridor and other work areas along approved access tracks only.

Testing and commissioning (**Section 5.5.14**) is based on the following major principles:

- testing will be completed as and when the pipeline sections are constructed;

- pipe sections completed and tested in 2006 will be protected and preserved, and the pipeline monitored, to ensure that the pipe integrity is maintained until the introduction of gas up to 14 months later, in 2007;
- the amount of water required for hydrotesting has been calculated assuming re-use.

The pipeline operations are based on the following major principles:

- unmanned facilities, including the compressor station (**Section 5.4.4**);
- operations and maintenance depots located at Katherine and Gove;
- twenty to thirty maintenance/operations personnel when and as required.

The pipeline and facilities will be decommissioned in full accordance with the current legislative requirements.

5.3.2 Schedule Milestones

The TTP preliminary schedule is presented in **Figure 5-1**. The pipeline and associated facilities will be constructed and commissioned over two consecutive dry seasons: 2006 and 2007. The dry season (the principal construction period) is assumed to be from May 1 through to October 31. The dry season may begin in April; however, a one-month buffer period has been added to allow soil to dry out and watercourse flows to subside, providing optimal construction conditions and reducing the risk of delay.

The pipeline will be constructed in four sections or 'spreads', with up to three spreads operational at any one time. Prior to May 2006, equipment will be mobilised to Katherine in preparation of commencement of construction and infrastructure works and upgrades, such as road widening and crest lowering and pipe stockpile preparation.

Pipeline commissioning activities will commence in November 2007, with 'first gas' delivery to Gove scheduled for the quarter 4, 2007.

5.4 Pipeline Design

5.4.1 Preliminary Pipeline Design

The proposed pipeline will be constructed of high-tensile steel with an external diameter of 406.4 mm (16”). Individual pipe lengths will be welded together onsite, field coated and buried with a minimum depth of cover of 750 mm. Depth of cover will vary depending on the conditions of the terrain and the surrounding land use. The pipeline will have a design capacity of 50 PJ/a and will be operated to a maximum allowable operating pressure of 15.3 Mpa. This is the maximum pressure to which the line pipe, valves and other fittings have been rated.

The pipeline coating, above ground pipe work, equipment and fittings will be designed for an operational life of 50 years.

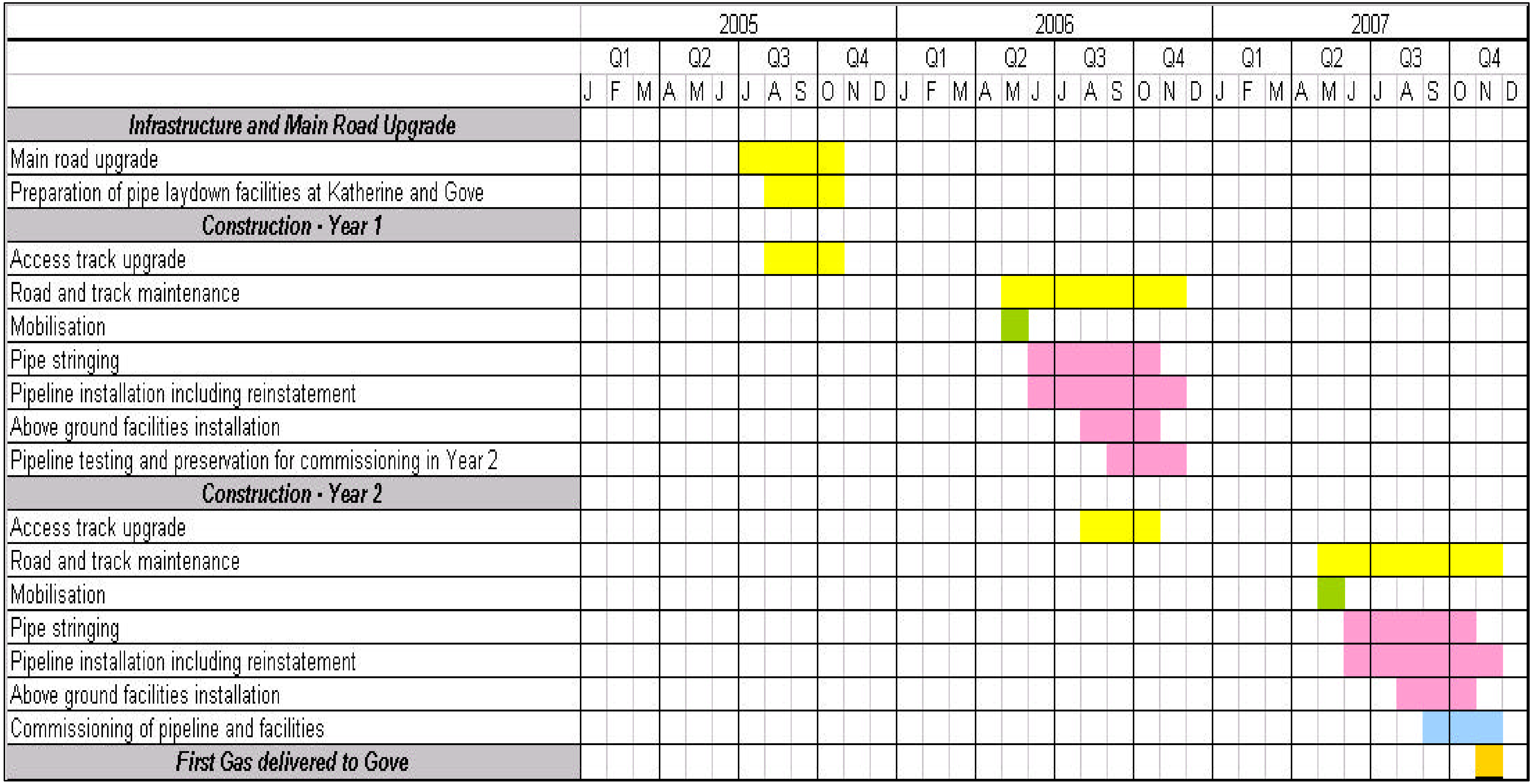

Figure 5.1: Preliminary Project Schedule

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The pipeline will meet requirements under relevant Australian and international standards for pressure containment, fracture control, external loading, corrosion and risk assessment requirements. Design of the pipeline, including the pipeline diameter, grade and wall dimensions has been selected to meet these requirements. The pipeline will be designed and constructed in accordance with AS2885.

Preliminary pipeline design parameters for TTP are summarised in **Table 5-1**. Design specifications will be refined and updated during the detailed design phase.

- **Table 5-1 Preliminary Pipeline Design Specification**

Parameter	Specification
Length	940 km (buried)
Nominal Capacity	50 PJ/a
Outside Diameter	406.4 mm (16")
Minimum Wall Thickness	9.0 mm
Operating Pressure	15.3 Mpa
Cathodic Protection	Impressed current
Design Life	50 years

5.4.2 Above Ground Facilities

A number of facilities will be required at intervals along the pipeline for safety, maintenance and pipeline integrity purposes. These facilities will include:

- meter stations
- main line valves
- scraper stations
- compressor stations

Where possible, facilities will be located to allow easy access via existing roads and tracks, and in areas that are not deemed to be culturally or environmentally sensitive. The locations of such facilities are also strongly influenced by design and engineering requirements. The proposed locations of these facilities along the pipeline route are described in **Table 5-2** and shown on **Figure 1-1**. Compressor station requirements are discussed in **Section 5.4.4**.

- **Table 5-2 Location of Above Ground Facilities & Compressor Stations**

Inlet/Outlet Facility (Metering Stations)	Main Line Valves	Scraper Stations	Compressor Stations
KP0	KP162	KP76	KP364
KP940	KP282	KP234	
	KP419	KP364	
	KP533	KP485	
	KP738	KP638	
	KP915	KP797	
	KP932		

Meter Stations: A meter station will be installed at either end of the pipeline, one at Wadeye within the Blacktip gas plant and the other at the Gove Gate Station (**Section 5.4.3**) within the existing Alcan Gove Refinery. Meter stations are used to measure the volume of gas, entering and exiting the pipeline. Meter stations will include gas analysers and flow computers and will provide information that is essential for commercial transactions associated with the supply of gas.

Main Line Valves: In accordance with AS2885, valves will be required at intervals along the length of the pipeline as a safety measure to enable the isolation of sections of the pipeline in the event of an emergency or leak. Main line valve facilities will be equipped with vent valves both upstream and downstream of the main line valve to enable venting of the gas from the isolated section.

The main line valves will be buried, apart from the operating handle and the vents that will be located above ground. Main line valves will be manually operated except for the valve at Nhulunbuy, which will be remotely operated. A typical main line valve is shown in **Plate 5-1**. As shown in **Figure 1-1** and detailed in **Table 5-2**, a total of seven main line valves will be installed along the length of the TTP. The valve at KP915 will incorporate pressure reduction facilities. All main line valves will be located within a 12 m by 16 m security fenced area approximately 2m high.

- **Plate 5-1 Main Line Valve**

Scraper Stations: Scraper stations allow the manual introduction and retrieval of internal mobile inspection and cleaning tools, 'pigs', into and out of the pipeline during operations. The pigs are launched using the pig launcher, sent through the line using the pressure of the gas, and are retrieved from the pig receiver.

Six intermediate scraper stations will be installed along the pipeline route, as well as a launcher at the start of the pipeline and a receiver at the Gove Gate Station (**Section 5.4.3**). All scraper stations will include isolation valves that may be operated manually or remotely, controlled via a standard industry Supervisory Control and Data Acquisition (SCADA) system (**Section 5.7.2**). Scraper stations will typically be located within a 20 m by 30 m fenced area situated within the construction corridor. Security fencing will be installed approximately 2 m high around the facility.

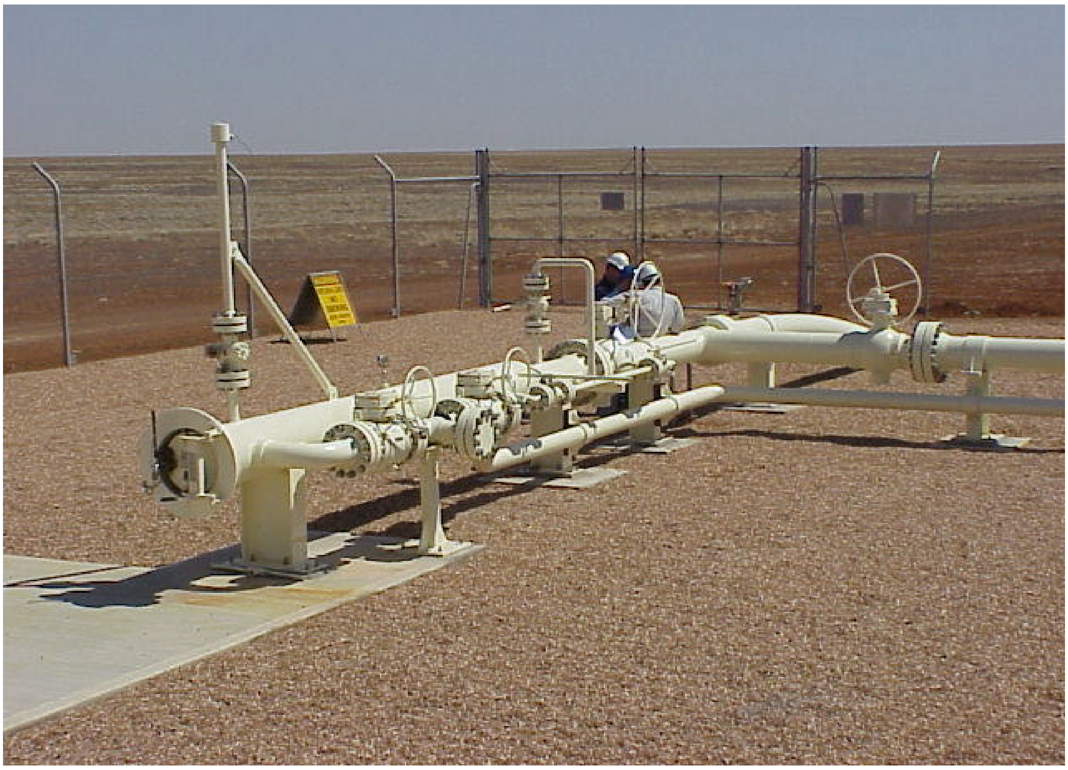
The scraper stations will include the following equipment and facilities:

- pig launcher and pig receiver;
- valves, including a remotely operated isolation valve;
- a flat roofed, prefabricated building approximately 3 m high, standing on pillars up to 1m high;
- Remote Area Power Supply (RAPS) and associated solar panels;
- a satellite dish for Supervisory Control and Data Acquisition (SCADA) communications.

The RAPS solar panels will be 5–10 m high (**Section 5.7.6**). The satellite dish will be approximately 3 m high. **Plate 5-2** and **Plate 5-3** illustrates a typical scraper station layout and pig launching facility, respectively.

- **Plate 5-2 Typical Scraper Station**

- **Plate 5-3 Pig Launcher**



Future Offtakes: In addition to the principal offtake at the Alcan Gove Refinery, the following offtakes will be installed to cater for future potential customers (**Figure 1-1**):

- KP322 – to provide for connection to the Northern Territory Gas Pipeline and supply gas to Darwin;
- KP935 – to provide gas to the Nhulunbuy township.

Both offtakes will consist of a barred Tee, buried welded ball valve, pump piece and weld cap.

The MLVs and scraper stations will be designed to cater for minor offtake points. In particular, the MLV at KP419 has been identified as a possible future supply point to the Beswick Community.

Pipeline Markers: Pipeline markers will be designed and installed in accordance with AS2885. They indicate the location of the pipeline, and will be installed during reinstatement of the corridor. The markers will be erected at intervals along the pipeline where they are visible and will be positioned at points such as road and water crossings, fence lines and at changes in direction along the pipeline route. Each marker will be double-sided and will contain the following information:

- nature of pipeline contents (for example, high pressure gas pipeline);
- safety instructions (for example 'Do Not Dig');
- emergency phone number;
- location of the pipeline.

Aerial markers will be located at 10 km intervals and will be visible from any aerial approach along the construction corridor in either direction.

An example of a typical pipeline marker is presented in **Plate 5-4**.

- **Plate 5-4 Typical Pipeline Marker**

5.4.3 Gove Gate Station

Long distance transmission of gas is most efficiently undertaken at high pressure. However, the gas to be transported through the TTP will be reduced in pressure in order to meet the required supply pressures to the Alcan Gove Refinery distribution network. The gate station provides the first level of pressure reduction and also provides a measurement of the gas for sale to the customer.

The Gove Gate Station will be located at the end of the pipeline (KP940) and will have the multi-function of metering and pressure regulation. The area of land required for the gate station is estimated to be 70 m by 30 m and lies within the fenced area of the existing Alcan Gove Refinery. The station will contain the following elements:

- pig receiver
- venting facilities
- water bath heaters
- filter/separators
- gas metering
- pressure reduction

Pig receiver facilities and pipeline venting are discussed in **Sections 5.7.3**.

When natural gas is reduced in pressure it also experiences a temperature drop. If the temperature is allowed to fall below a certain point, liquids may form in the downstream pipes, causing problems in the downstream equipment. To avoid liquid dropout, the gas will be heated in water bath heaters, using the gas as the fuel. Heating may only be necessary during winter months when the ground temperatures and gas pipeline temperatures are low. One heater will be connected online, with a second heater available as a back up.

Filter/separators will be used to collect solids and liquids from the pipeline that may damage downstream equipment such as the meters. The filter elements are disposable and will be changed at regular intervals, especially following pigging.

The pressure of the gas in the pipeline is likely to vary, due to the imbalance between the volume of gas entered into the line at Wadeye and the demand at the outlet at the Alcan Gove Refinery. Pressure regulation of the gas will be employed to ensure that a fixed pressure is maintained at the outlet. The regulators are usually self-powered, and use the pressure of the gas to operate, with the result that some minor venting of the gas occurs during operation of the regulators. In order to ensure that the downstream pipework is not over pressured, two regulators will be operated in series, the second valve closing if downstream pressures exceed a set value. An additional safety measure, a slamshut valve, will also be installed which will close if the downstream pressure exceeds a certain value. The pressure reduction system will be duplicated to ensure continuity of gas supply in the event of failure of the primary system.

5.4.4 Compressor Stations

Compressor stations are primarily used to boost the pressure of gas, as the gas demand increases. The primary processes that are undertaken at a typical compressor station on receipt of gas from the upstream pipeline section include:

- gas filtering;
- compression of gas to a maximum outlet pressure of 15.3 MPa;
- cooling the gas after compression and prior to pipeline delivery;
- providing a venting facility for pipeline sections upstream and downstream, and for the compressor station itself;
- launching and receiving pipeline pigs to/from the pipeline.

One compressor station will be constructed with the pipeline initially. However, it is envisaged that the pipeline may require additional compression at a later stage, as the Gove gas demand increases or as other customers are added (**Figure 1-1**). Three additional sites have been identified to allow for this at KP162 (MLV), KP322 (Manbulloo Interconnect) and KP533 (MLV), although a future compressor station may also be located at any of the scraper stations. A typical compressor station layout is presented in **Plate 5-5**.

- **Plate 5-5 Typical Compressor Station Layout**

As the gas within the pipeline enters the compressor station, it will be filtered to five microns to separate any solid debris from the gas. A pipeline offtake will be required to supply fuel gas to the gas turbine that drives the compressors. Centrifugal compressor units will compress the incoming gas to pressures of up to 15.3 MPa. Heat exchange using finned tubes and fans will then be undertaken to cool the compressed gas to temperatures suitable for flow in the pipeline. During this process the gas flow will be measured to determine the amounts used to operate the station. In addition the outlet pressures will be monitored.

Compressor stations include numerous safety features including:

- isolation valves at the inlet and outlet of the compressor units;
- an emergency shutdown system that is tripped by gas detection;
- flame detection or manual tripping;
- a station vent system;
- venting for the station or for isolated pipework sections.

The compressor station as a whole will be controlled by operating systems that will allow the remote operation of the compressor stations.

At present, the exact specifications of the compressor station is not known and for the purpose of this Draft EIS, typical specifications that are representative of standard pipeline design have been provided. The major components of a typical compressor station are detailed in **Table 5–3**. These components are discussed in the order of gas flow through the station.

- **Table 5–3 Major Components of a Compressor Station**

Equipment in Sequential Order
Gas Inlet - incorporating a Station Isolation Valve
Filter Separator Assembly
Gas Filter Separator (element type filters of approximately five Microns)
Turbine Fuel Gas Offtake
Fuel Gas Skid
Fuel Gas Metering of System Use Gas
Unit Limit Valves (inlet and outlet)
Gas Compressors
Gas Coolers
Gas Outlet – incorporating the station outlet isolation valve
Emergency Shut Down System (ESD)
Gas Turbine Control Panel
Station Control Panel
Outlet Pressure Transmitter
Station Vent System
Other Venting Devices
Minor Venting Locations
Station Check Valves
Ancillary Equipment

Land Requirements and Security: The initial location of the pipeline facilities will be determined by hydraulic studies that will be performed during detailed design. However, the final site selections will include a combination of the following factors:

- availability of existing electrical power;
- proximity to maintenance centres;
- access, in particular the compressor stations will be provided with all-weather access;
- the distance from housing and other sensitive locations;
- cultural heritage and environmental approvals;
- the need to place the site in a flat area, not prone to flooding.

The compressor station (and future compressor stations) will be located in an area up to 500 m by 500 m area, of which approximately 150 m by 150 m will be graded and fenced. The land will be either purchased or leased. The maximum height associated with the compressor station will result from the stack at a height of approximately 12.5 m. The equipment and above ground facilities are likely to be painted in neutral tones which blend into wooded areas to improve the appearance of the station. Trees may also be planted to further screen the station; however, a buffer will be left to reduce bushfire risks.

Fencing of the station is necessary to exclude unauthorised people and stock from the facility. This will protect the facility from vandalism, minimise risks to the public and ensure that only authorised people are able to access the site. The station perimeter will be secured with a stock-proof fence, and the compressor facilities will be enclosed with a security fence, creating a buffer zone between the fences.

The buffer zone will be kept free of vegetation to provide protection to the facilities in the event of a bush fire, acting as a firebreak. A tree-free zone will be maintained around the security fence where all trees will either be trimmed or removed. This is to ensure that no trees will fall and damage the security fence.

The compression facility will be laid out in such a manner so as to offer the maximum protection to all equipment and personnel. During the design process a site risk assessment will be undertaken to determine all the risks that could impact on safety of the facility, staff and the general public and other stakeholders.

Station Management: The compressor station has been designed to act as a stand-alone facility and will not require a 24 hour workforce presence on site. The compressor station will be situated near Katherine and will house a maintenance base, thereby enabling workers to be on site during normal work hours and allowing a rapid response to any maintenance situations of the compressor station and pipeline.

5.4.5 Pipeline Protection

Corrosion Protection: To protect the buried pipeline from atmospheric, chemical or bacterial attack, and from stray currents it will be necessary to install corrosion protection systems. This will be provided by a combination of external coating and cathodic protection.

External Coating: External coating will be applied to the pipeline lengths as part of the manufacturing process. The coating will consist of a dual layer Fusion Bonded Epoxy (FBE) or trilaminate coating. The pipeline will be factory grit blasted before the protective coating is applied.

Approximately 100 mm at each end of the pipe lengths are left bare and are coated after welding. The joint coating that is applied will be compatible with the parent coating material and the quality will be checked against strict acceptance criteria.

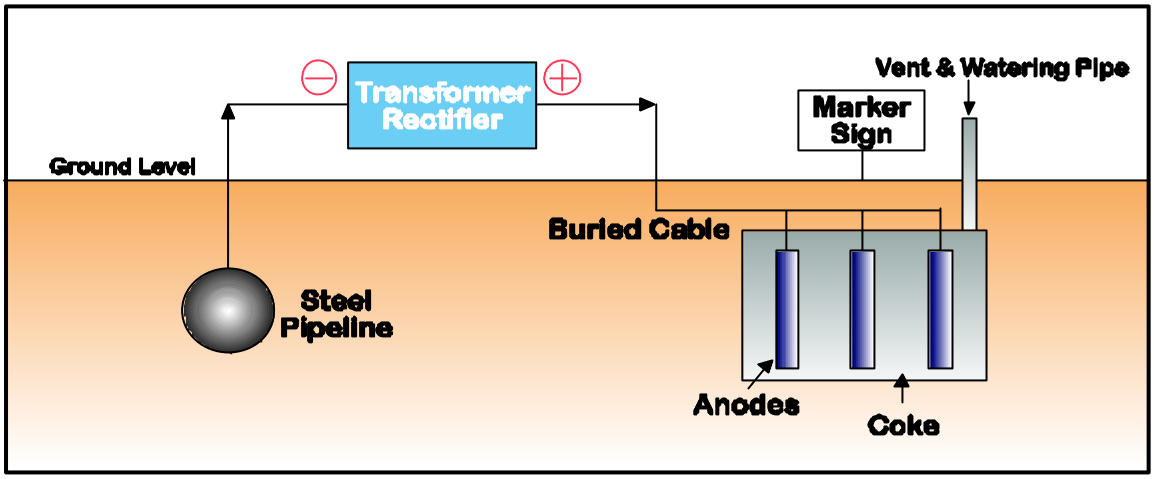
Cathodic Protection (CP): Due to the presence of unavoidable coating defects it will be necessary to install a cathodic protection system. Cathodic protection is an electrical method of preventing pipe corrosion (**Figure 5-2**).

Temporary cathodic protection will be applied during pipeline construction. At completion of pipeline construction, the temporary cathodic protection system will be disconnected and a permanent impressed current protection system will be commissioned and operated.

The impressed current system utilises a direct current supplied by an external power source, such as solar power, to prevent the pipeline from corroding. The CP system places a negative voltage potential onto the pipe, and the positive from the controller is connected to an anode bed. The anode bed consists of a number of buried silicon/cast iron anodes placed in a petroleum coke backfill.

Provision will be made for the installation of anode beds at every scraper and main line facility. A trench will be excavated 3 m deep, 600 mm wide and 25 m long and backfilled around the anodes with petroleum coke which acts as the conductor. These beds may be situated up to 300 m perpendicular from the pipeline, depending on the soil resistivity, and will be connected to the pipeline via a buried cable. The anode bed will only be visible by a plastic pipe extending above the ground to allow for ventilation and watering of the anode bed if required (**Plate 5-6**).

- **Figure 5-2 Cathodic Protection System Layout**



Sites for the anode beds will be surveyed prior to installation to ensure that they are not located within any ecologically or culturally sensitive areas.

Following installation and commissioning, the system will be regularly monitored to ensure the adequacy of protection is maintained. Monitoring will be carried out using test points connected to the pipeline every 2–5 km intervals. The vertical test point will be visible from the surface as a 1 m length of 50 mm diameter galvanised pipe with a small electrical terminal box mounted on the top.

Buoyancy Control: Buoyancy control may be applied to certain sections of the pipe to give the pipeline stability where it crosses flood plains or rivers. Buoyancy control options will include:

- extra depth of cover;

- geotech fabric control;
- weight coating (factory or site applied, generally concrete);
- bolt-on (river) weights;
- screw anchors.

The type of buoyancy control selected will depend on the soil conditions and will be determined during detailed design. Any coating conducted on site in close proximity to watercourses will be undertaken in accordance with the Construction Environmental Management Plan (**Section 12**).

Abrasion Coating: Mechanical or abrasion protection coating will be applied to sections of the pipeline being prepared for HDD. This coating involves applying a protective jacket to the pipe section. The type of jacket applied will depend on the terrain and installation detail. Often a thin layer of a special hard coating of high solids epoxy is applied to the pipe at the coating yard.

- **Plate 5-6 Cathodic Protection Test Point**

5.5 Construction Activities

5.5.1 General

The following sections describe the principal activities that will typically be undertaken to install the pipeline and associated facilities.

5.5.2 Land Acquisition

The proposed pipeline route will traverse a range of land tenures and land uses (**Section 7**). The TTP proponents are actively negotiating land access agreements for the purpose of installing and operating the pipeline. The land access agreements will generally provide for a 30 m wide permanent interest in the land. All scraper stations and main line valves will be constructed within the 30 m corridor and will be included in the negotiations for land access.

Additional land will be secured on a permanent basis for the installation and operation of the compressor stations (**Section 5.4.2** and **5.4.4**) and for the installation of the anode beds (**Section 5.4.5**).

Temporary access will also be provided within the 100 m wide pipeline corridor (centred on the proposed pipeline centreline) to enable additional work areas such as campsites, borrow pits, truck turning bays, water storage dams, and extra space at creek crossings to be used during construction only (**Section 5.5.9**).

In addition, any of the above listed work areas that are identified outside the 100 m pipeline corridor will be negotiated on a temporary basis for the duration of the construction work only.

5.5.3 Access to the Construction Corridor

During construction, access will be required along the construction corridor and to the campsites, pipe stockpiles, water bores and borrow pits.

The majority of heavy equipment will be transported along existing roads, which are generally sealed or gravel roads, however upgrades to the roads and ongoing maintenance will be required in particular areas to ensure that any sections of road, bridges and grids are capable of carrying the loads of pipe trucks and heavy equipment floats.

The pipeline will be accessed from the main roads detailed in **Table 5–4**.

Table 5–4 Pipeline Corridor Access Roads

Main Road	Pipeline Access	Access
Port Keats–Daly River Road	KP0–KP78	Pipeline does not cross road, but numerous access tracks up to 7 km long will be used between the road and corridor.
Dorisvale Station Road	KP78–KP266	Pipeline crosses road at KP232.
Florina Road	KP266–KP309	Pipeline crosses road at KP278 and KP307. Between these two points the pipeline parallels the road and the corridor will be accessed directly from the road.
Victoria Highway	KP309–KP341	Pipeline crosses highway at KP322.
Stuart Highway	KP341–KP376	Pipeline crosses highway at KP366.
If pipe is delivered to the Gove Peninsula and Katherine, then pipe will be transported from Katherine and strung along the corridor KP376–KP701, and from the Gove Peninsula between KP701–KP940.		
Central Arnhem Road - pipe transported from Katherine	KP376–KP701	Pipeline crosses road at KP382.
Central Arnhem Road - pipe transported from Gove	KP701–KP940	Pipeline crosses road at KP739, KP888 and KP915. From KP739–KP784 the pipeline parallels the road and the corridor will be accessed directly from the road.

Although the major roads often parallel the proposed pipeline route, in many cases there is a gap of up to 25 km between the road and the corridor. New access tracks will be constructed between the roads and the corridor to minimise the movement of heavy traffic and to allow permanent access for operation personnel once the pipeline is constructed.

Between KP78 and KP214 the pipeline traverses the Wingate Mountain plateau with escarpments at each end with slopes between 30 and 40 degrees. There are no public roads or tracks along this section. Access to the plateau from the west will be directly up a ridge leading to the escarpment. There is the possibility of constructing a circuitous access road around the escarpment to KP79. Access from the east will be along Thompson's Pocket track, which crosses the pipeline at KP206.

The preliminary data indicates that approximately 75% of the pipe stringing will travel along the designated access tracks to reach the pipeline, whilst 25% will access directly from the highway and road crossing points or at points where the pipeline is adjacent to an existing road.

The following key considerations have been taken into account in the access track selection process:

- existing tracks will be used where possible, although the establishment of additional new tracks will be necessary;
- tracks will be adequately spaced apart to minimise the distance travelled;
- the construction corridor will be used in preference to a track in areas where high road maintenance is expected, such as sand and soft soil;
- access will be provided to either side of a watercourse, to enable construction traffic to reach both sides whilst avoiding the need for installing crossings.

All access routes identified will be approved for use by the relevant authorities and landowners prior to construction activities.

Additional Access Tracks: Additional access tracks may be required to access local water bores and watercourses supplying water for dust suppression, potable use and for hydrotesting. These access tracks will be identified in detail following an investigation into water source options.

Details relating to the transportation of construction materials are provided in **Section 5.5.8**.

5.5.4 Workforce Profile

Pipeline construction will be carried out using a number of ‘spreads’. A spread refers to the equipment and crew required to build one section of pipeline. The direct construction workforce for the TTP will consist of up to 300 people per main line spread, although it is expected that this number may be lower. Due to the length of the TTP, and the potential for significant impacts associated with the wet season, there is potential to have more than one construction spread operating at once, although this will depend on the progress of the first year of scheduled construction and final logistics and construction plans.

In the event that two spreads were to be operating at once, there maybe up to 550 people employed at any one time (some personnel would work on both spreads).

The construction roster is likely to generally involve an approximate four week work cycle followed by a one week rest break. Each working day will generally comprise a 12 hour shift during daylight hours.

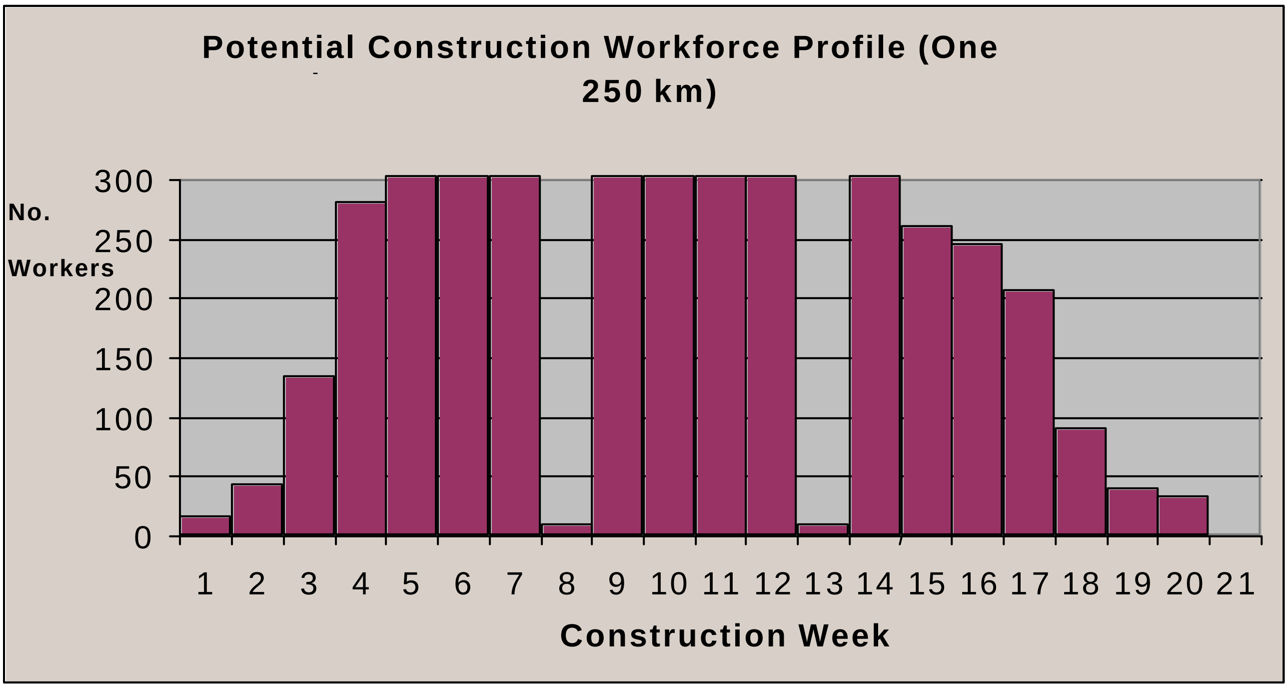
A summary of the workforce required for the construction of a single 250 km pipeline spread is shown in **Table 5-5**.

- **Table 5-5 Workforce Required per Main Line Spread**

Site Based Workforce	No. of Personnel
Construction Crews	241
Construction Management	22
Field Services	14
Camp And Catering	23
Total	300

The pipeline installation activities are staggered and therefore not all the work crews are needed at any one time (**Figure 5-3**). The workforce numbers will ramp up over a four week 'mobilisation' period. Similarly, the workforce will wind down during the 'demobilisation' period (**Section 5.5.7**). In ideal circumstances, it is expected that the construction resources will be suitable to allow each crew to undertake their component of the construction process at a rate of approximately 3 to 5 km per day.

- **Figure 5-3 Potential Construction Workforce Profile**



The first crews travelling on the construction corridor will be the fencing crew, cutting fences that cross the corridor and installing temporary fences. This crew will also comprise the surveyors who will install markers to denote the corridor boundaries. At the same time, crews responsible for preparation of the first campsite, the upgrading of the access tracks and installation of traffic controls will commence. The corridor will then be cleared of trees and bushes, the vegetation stockpiled, and the trench strip graded, to provide a relatively flat surface for the trenching machines to operate on. At this stage heritage and environmental protection measures will also be implemented along the corridor as required.

Once the corridor has been cleared and graded for a sufficient distance that will ensure the trenching will not catch up, surveyors will mark the trench centreline and trenching will commence. Pipe stringing and bending will follow. Once sufficient pipe has been strung and bent, the welding, Non-Destructive Testing (NDT) and coating crews will commence. The welding crew is the most critical component of pipeline installation activities and it is crucial that the preparation work is sufficiently ahead of the welding crew, to allow a four-week continuous welding period without catching up with the stringing crew. After welding has progressed for a distance, pipe lowering into the trench and tie-in will commence, followed by trench backfill. Following backfill, the corridor and fences will be reinstated and the CP test points and pipeline warning marker signs installed.

As the construction progresses, the first section of the corridor will undergo reinstatement at the same time as the installation of the later sections. By this time, the installation of the main line valve facilities will have commenced, as well as special road, rail and watercourse crossings, and the full spread will be operational. All the necessary catering, maintenance, administrative and project management personnel will be on site and the workforce will have reached its peak of approximately 300. Project personnel will also have been in the field before, during and after the construction period, liasing with landowners.

The order of the work may change, depending on overall logistics and ground conditions. For example, special crossing crews including HDD, boring and watercourse open-cut crossings may be dispatched prior to main line construction. In this way, the crossings will be completed and ready for tie-in when the main line welding crew reaches them. Some plant and equipment may also be used between crews, such as clear and grade plant being relocated to reinstatement. However, in general, as the crews complete their activities, they will demobilise from the field. The trench may also be excavated after the line pipe has been strung and welded.

The expected make-up of the crews for a single main line spread is shown in **Table 5-6**.

- **Table 5-6 Assumed Typical Make-Up of the Crews Required per Spread**

Site Based Personnel [1]	Personnel	4WD	Truck	Minibus
Fencing Removal	4	2		
Corridor Survey	2	1		
Traffic Management	3	1	1	
Environmental Supervision	4	2		
Heritage Management	5	2		
Clear & Grade	12	6	1	
Corridor Maintenance & Access Roads	5	3	2	
Ditching	20	6		
Stringing	8	3		
Marking Bends	2	1		
Pipe Bending	4	2		
Pipe Support Skids – Layout And Pick Up	6		3	
Welding	42	4		3
Non-destructive Testing	6	3		
Pipe Joint Grit/Blasting/Wrapping	8	3	1	
2 X Mobile Joint Blast/Wrap Crews	4		2	
Lowering In	8	4		
Pipe Section Tie-In	11	4		
2 X Mobile Tie-In Crews	12	4		
Bedding And Padding	12	6	1	
Trench Backfilling	3	2		
Reinstatement of Corridor and other work areas	14	3	1	1
Fencing Reinstatement	4	2	1	
Marker Post Installation	2		1	
Trench Breakers	2	1	1	
Horizontal Bore / HDD Crews	12	5	1	
MLV and Gove Gate Station Facilities	12	5	1	
Pipeline Hydrotest and Drying	14	5	2	
Subtotal	241	80	19	4
Construction Management	22	15		
Field Services	14	5		
Camp and Catering	23	2		
Subtotal	59	20	0	0
Total Construction Crew	300	102	19	4

Note 1: Office-based personnel, such as the project manager and safety manager, as well as visitors, are not included in these numbers.

5.5.5 Accommodation & Travel

Camp Footprint & Facilities: It is proposed that the vast majority of construction personnel will be accommodated in purpose-built construction camps that are strategically located along the pipeline route. The exception to this is likely to be the use of Katherine as a base for small numbers of personnel associated with construction and commissioning operations that are remote from construction camps.

Up to 300 personnel can be accommodated in a single construction camp. In some instances a spread may seek to run a second 'fly camp' simultaneously, where the distance makes travelling from the single main camp unproductive. In the event of two camps operating at once, it is likely that the main camp would hold up to 200 people and the smaller second camp would contain in the order of 100 people.

The footprints of standard camp facilities are shown in **Table 5-7**.

- **Table 5-7 Footprints of Standard Camp Facilities including all Facilities**

Camp Type	Footprint (m)
Main Camp	500 by 500
Fly Camp	300 by 300

The main construction camps will consist of approximately 120 transportable buildings and ancillary services for water storage, power generation, communications and maintenance facilities. Fly camps will require the same facilities as the main camps.

Each camp will generally consist of:

- accommodation units;
- messing facilities (dining, canteen);
- ablution blocks (toilet, showers);
- laundry facilities;
- entertainment facilities;
- workshop and stores;
- engineering and administration offices.

In addition, a vehicle washdown facility may be installed at the main camp for vehicle maintenance, cleaning or for preventing the spread of weeds along the corridor. Similarly, washdown facilities along the construction corridor are likely to be required and may include water spray, brush or air blown facilities.

Camp Logistics: The construction camps will be located along each main line spread. The selection criteria for the camp locations includes:

- logistics of pipeline construction;
- statutory and landowner approvals;
- distance from dwellings or stock (to minimise noise, dust and visual aspects);
- suitable terrain – flat, good drainage and not adjacent to watercourses;

- ease of access – camps are often located near major roads;
- availability of water.

The locations of the construction camps are currently unconfirmed, but possible locations are shown in **Figure 1-1**. As illustrated, the campsites are proposed to be located adjacent to main roads near the following KPs:

- Tom Turners Camp – KP75;
- Dorisvale Camp - KP234;
- KP330 (at Katherine);
- Beswick Camp - KP413;
- Mainoru Camp – KP533;
- Annie Creek Camp – KP635;
- Buckingham Camp - KP787;
- Wonga Creek Camp - KP888.

To minimise travelling time camps are likely to be located approximately 120 km apart. With this distance between camps, workers generally do not have to travel more than 60 km to get to the work site. With the distance to the work site minimised, the potential for safety hazards is also reduced.

The construction workforce will travel from the camps to the work sites by approved access roads and the corridor. To minimise vehicle movements four wheel drive (4WD) vehicles will be used such as troop carriers and utilities, and multiple passenger vehicles (for example mini buses) will be encouraged where appropriate.

However, due to the nature of the distances to be covered, the majority of the vehicles will be 4WDs (80%). There will also be in the order of 19 trucks being driven to and from the camp facilities, which are required for transporting men and equipment for tasks such as joint coating, organisation of skids and corridor maintenance.

If it is assumed that the main camp for each construction spread can accommodate up to 250 men, and the fly camp up to 150, then proportionally the workforce of around 300 men may consist of 190 and 110 at the two camps. In this case, approximately 80 and 45 vehicles would be required at the main and fly camps, respectively. Approximately 85% of the traffic will be moving in and out of the camp on a daily basis, with the remaining being stationed predominantly at the camp with occasional trips along the corridor. The daily traffic along one spread may therefore consist of up to 106 vehicles. Peak traffic movements will occur during the periods 6–7 am and 5–6 pm.

Whenever construction crews are mobilised to site, sent on leave breaks or when work is completed, the workforce will be transported to Darwin or other agreed points of hire. The crews may be driven to airports at Darwin, Katherine, Wadeye or the Gove Peninsula located near the camps and flown out using commercial airlines or on chartered aircraft. The logistics of the crew movements will depend on numbers for each destination and the availability of airline seats. Buses will generally be used to move the workforce from the airport to the construction camps.

In the event of an emergency, personnel will be transported offsite via helicopter, light plane or with the RFDS, or transported by road to the nearest airport or medical facility.

Camp Movement: During the construction period, it is expected that there will be three stages of camp transportation: mobilisation at the start; relocation during construction (or conversion from main to fly camp); and demobilisation of all facilities at the end of the construction period.

It is expected that camps will need to be moved at least once during construction to minimise travelling time for the workforce. Therefore, as the work proceeds, the main camp may be converted into the fly camp and vice versa. Camp relocation will consist of transporting the accommodation huts and other facilities by road to the new location. Relocation will be planned to coincide with the leave breaks or when the move will have the least impact on the workforce. Most camp locations will be used for approximately two months. It is anticipated that camp mobilisation and demobilisation will consist of around 120 semi-trailer movements. Conversion of a main camp to a fly camp may only require half this number.

The smaller fly camps will use the same sites as the main camps, so that the intermediate camp moves will convert the fly camp to the main camp and vice versa.

Camp movements along the corridor are listed below and possible camp locations are shown in **Figure 1-1**.

- Spread one - initial camp at KP234 (Dorisvale), relocated to KP75 (Tom Turners);
- Spread two - initial camp near KP370 (at Katherine), relocated to KP413 (Beswick);
- Spread three - initial camp at KP533 (Mainoru), relocated to KP635 (Annie Creek);
- Spread four - initial camp at KP787 (Buckingham), relocated to KP888 (Wonga Creek).

5.5.6 Transportation of Construction Equipment & Materials

Equipment will be sourced either from within Australia or overseas and will be transported to the construction corridor via existing road networks. Some materials will be transported for storage at the construction camps via the Stuart Highway and access roads.

The main construction items that will be required will include:

- line pipe;
- construction plant and equipment;
- diesel and other fuels;
- compressor station and scraper station components;
- MLVs and other facilities required at the Gove Gate Station;
- construction camps and consumables;

- workshops and equipment for maintaining camp facilities and plant;
- wooden skids, coating materials and fencing materials;
- construction materials and other miscellaneous items.

The approximate tonnage of equipment to be transported to site has been calculated using standard pipeline data as shown in **Table 5-8**.

- **Table 5-8 Approximate Tonnage of Equipment Transported to Site per Spread**

Item	**Approximate tonnage (t)**
Line pipe for 250 km	23,250
Plant & Equipment for One Spread	
Construction Plant	8,400
Diesel and Fuels	3,500
Valves / Facilities	1,280
Workshops	950
Camp and Facilities	900
Consumables	75
Minor Construction Materials	600
Miscellaneous	1,000
Total for One Spread	40,000

Line Pipe: The line pipe will be sourced from a pipe mill with suitable capacity and the external corrosion coating applied at a separate pipe coating mill. The source of the line pipe will dictate the final transport arrangements but it is likely that the line pipe will be delivered to the Northern Territory either by road, rail or sea transport, as there is no pipe mill in the Northern Territory capable of manufacturing the line pipe. The port facilities at Darwin and Gove and the Adelaide Darwin Railway provide opportunities to minimise the use of roads to transport the line pipe.

The need for large stockpiles of pipe along the corridor (greater than 10 km) will be avoided as far as practicable. However, small stockpiles may be required at various points along the corridor (**Figure 1-1**). For example, stockpiles may be established for up to 10 km of pipe to offset transport delays. In these cases, attempts will be made to locate the stockpiles either at campsites or at other locations in close proximity to the corridor, in agreement with relevant landowners and in accordance with regulatory requirements.

Construction Plant and Equipment: The construction contractor will be responsible for providing the construction plant and equipment. Accordingly, the equipment may be transported interstate by rail or road, or from overseas, most likely into the port at Darwin. The origin of the equipment depends on the contractor that is selected and where their last project was located; most likely interstate or South East Asia.

Typical plant and equipment to be transported to site includes:

- bull dozers, loaders and graders;
- sideboom tractors and forklifts;
- trucks (water, fuel, mechanics) and trailer units;
- trenching and padding machines;
- welding rigs;
- excavators, rock saws and wheel ditching machines;
- semi-trailers and low loaders (for equipment relocation);
- mobile cranes;
- camp buildings.

Fuel Supply: The diesel required for fuelling the plant and camps will total approximately three million litres per spread. The diesel will be transported via the road network from the most convenient depot to the construction camp for bulk storage. Bunded and secure storage tanks will be located at the camps and refuelling trucks will travel the corridor refuelling the plant. Road vehicles will generally refuel at the camps.

Above Ground Facilities & Valves: Compressor units, scraper facility components, MLVs and the equipment at the Gove Gate Station will likely be purchased within Australia and from overseas. It will be transported to site via the national road or rail network from the point of manufacture in Australia or from the delivery port at which it is received, and transported to site.

Construction Consumables: Construction consumables and miscellaneous items will be sought locally or from within Australia, as far as possible. For example, marker signs may be made in Darwin, whilst joint blasting and coating materials and weld consumables will most likely be sourced interstate.

5.5.7 Mobilisation & Demobilisation

Approximately 10,250 t of machines and equipment (excluding pipe and materials) will be mobilised at the start of the construction period for each main line spread (**Table 5-8**). Mobilisation for each spread will comprise approximately 3,760 single trailer pipe truck trips, as well as 250 trips for the plant and equipment and 120 for the main camps.

Camp facilities will also be mobilised to the first camp location of each of the three spreads. Personnel will be transported to their work locations by a combination of air and road travel. Helicopters may occasionally be used to transport materials and personnel along the corridor.

All plant, equipment and personnel will be demobilised at the end of the construction period. Mobilisation and demobilisation is expected to take place over a one month period.

5.5.8 Transportation

Transport Systems: Major items including line pipe, construction materials, plant and consumables will be delivered to the work site by a combination of rail, road and ship freight (**Figure 1-1**). The majority of heavy equipment transportation will use existing road systems. However, the source of line pipe is not currently known, and will not be selected until a tender has been conducted to seek prices and availability.

There is capacity in Australia to produce the type and quantity of line pipe required for the TTP, as well as numerous overseas mills. It is possible that a combination of local and overseas line pipe will be used.

If some or the entire length of pipe is sourced overseas, it will be transported to the Northern Territory by sea and unloaded at suitable ports such as Darwin and Gove. If the line pipe is sourced from within Australia, the line pipe will be transported from the Wollongong region of NSW where the pipe mills are located. In this instance, road, rail or sea transport options exist for delivering the line pipe to the Northern Territory.

In the event of transport to the Northern Territory by sea, either from overseas or from within Australia, the pipe will be stockpiled in Darwin, Katherine and Gove for subsequent delivery to the construction corridor by road. In this case, it is likely that at around 25% of the pipe will be shipped and stored at Gove, ready for direct stringing along the corridor by road transport. This may also serve to ensure that adequate line pipe is delivered to the eastern end of the pipeline, in the event of bad weather holding up deliveries from the stockpile at Katherine.

In the event that rail transport from NSW is adopted for some or all of the line pipe, it is expected that the pipe will be stockpiled at a large stockpile site in the vicinity of Katherine, adjacent to the Adelaide to Darwin rail line, prior to transportation to the corridor by road.

Road transport direct from NSW to the corridor is not considered likely, due to the length of return journey, costs and potential impacts on state and territory road networks.

The total tonnage of line pipe is approximately 93,000. Assuming the line pipe is manufactured in triple random lengths (approximately 18 m) this equates to approximately 52,000 lengths of line pipe or 3,760 single pipe trailer truck trips.

Line Pipe Stringing: The pipe will be transported from the coating yard in 18 m triple random lengths.

Table 5-9 lists the number of single truck movements required to string the pipe from the stockpiles at Katherine and Gove, as per the scenario in **Section 5.3.1**. Based on these calculations it is estimated that approximately 2,820 laden trailer movements will be required to move the 74,500 tonnes of line pipe from Katherine, based on each truck carrying 22 tonnes of pipe. The estimates are based on a fully laden truck with a single trailer on the outward trip (weighing 42 tonnes) and an empty truck on the return trip (20 tonnes). A total of 3,760 single trailer truck movements are required for the whole 940 km pipeline length.

The majority of pipe haulage will be on roads, with minor sections along the corridor. Pipe trucks will utilise the Victoria Highway, Florina Road, Dorisvale Station Road and the Daly River-Port Keats Road to access the pipeline route west of Katherine (**Figure 1-1**). The Central Arnhem Road will be used to access the route east of Katherine. A survey has been conducted of the roads accessing the pipeline and the proposed routes are listed in **Table 5-9**. Access is discussed further in **Section 5.5.3**.

Wherever regulations and road conditions permit, double trailers will be used to minimise the number of truck movements.

The potential daily traffic estimates are based on a 100 day welding period for a 250 km main spread. It is assumed that 14 pipes will be stacked on a standard truck trailer, equivalent to 250 m of pipeline.

- **Table 5-9 Truck Movements to Transport Line Pipe from Katherine & Gove**

Pipeline Section	KP	Proposed Access	Single-trailer Return Truck Trips
Wadeye to Wingate escarpment at KP78	0–78	From Katherine stockpile via Daly River – Port Keats Road	312
KP78 to Daly River	78–266	From Katherine stockpile via Dorisvale Station Road	752
Daly River to Katherine River	266–309	From Katherine stockpile via Florina Road	172
Katherine River to Alice Springs – Darwin railway	309–341	From Katherine stockpile via Victoria Highway	128
Alice Springs – Darwin railway to Roper Creek	341–376	From Katherine stockpile via Stuart Highway	140
Roper Creek to Goyder River	376–701	From Katherine stockpile via Central Arnhem Rd	1,300
Goyder River to Gove	701–940	From Gove stockpile via Central Arnhem Rd	956

Note: Truck movements represent the total number of truck movements required to transport the pipeline. A truck movement consists of a fully laden inbound voyage (42 tonnes) and an empty outbound voyage (20 tonne).

Transportation of Construction Camps: The construction camps and associated infrastructure will be transported to the corridor on float trailers. Up to 120 transportable buildings for each spread will be required, along with ancillary facilities.

Camp supplies will be delivered by road from the nearest warehouse or market source. Surveys will be carried out to determine if potable water can be sourced from local watercourses, wells and bores. If a suitable source of water is not found then the water will be trucked in from the nearest source. All water will be sourced in accordance with the requirements of landowners and regulations, including the *NT Water Act 1992.*

Traffic Interruptions: Truck movements on the corridor and access tracks will take place during daylight hours where possible. Night traffic will be avoided; however, in the event that no other option is viable access arrangements will be made with landowners and in accordance with local regulatory requirements.

The larger plant, for example trenching machines and the larger dozers, may be considered as ‘oversize’; however, as the regulations concerning ‘wide’ or ‘oversize’ loads differ between states and between rural and urban classifications, the requirement for flags or escort pilot vehicles will be determined during construction. Appropriate licences and permits for the transport of large loads will be obtained prior to construction.

***Road Upgrades & Maintenance*:** The majority of heavy equipment transportation will use existing road systems. The existing roads are generally well constructed sealed or gravel roads. Some upgrades may be required in particular areas, to ensure that any sections of road, bridges and grids are capable of carrying the loads of pipe trucks and heavy equipment floats. Infrastructure upgrades will be carried out prior to the commencement of construction, and will be performed in consultation with relevant government departments, landowners and authorities. **Section 5.5.3** describes existing access tracks that may require upgrading to facilitate the transportation of line pipe, labour and equipment to the pipeline corridor.

Ongoing road maintenance will be performed during the construction period and at the end of construction to ensure that the roads are maintained in a similar pre-construction condition throughout the construction phase of the project.

5.5.9 Construction Methodology

Standard, proven pipeline construction techniques will be used to install the TTP, as illustrated in **Figure 5-4a**, and will comprise the stages detailed below.

Survey: Detailed terrain surveys will be conducted to profile the pipeline and to determine the areas where special construction methods will be required such as at river, rail and road crossings. These surveys will be completed as part of the detailed design. Survey pegs will be placed in the ground to facilitate the layout and clearing of the construction corridor.

Preparation of Construction Corridor: The pipeline will be constructed within the approved 30 m wide construction corridor. Prior to and during construction, any measures agreed with the stakeholders will be implemented.

Fences across the construction corridor will be cut and temporary fences installed, to enable access along the corridor.

The corridor will be cleared of heavy vegetation and suitable vegetation will be stockpiled for respreading during rehabilitation. Roots will be left in the ground, except in the location of the trench, to stabilise the soil and minimise erosion, and mature trees will be preserved wherever possible.

Erosion control measures will be put in place as required alongside the corridor, such as installing silt fences to prevent run-off.

The construction corridor will be 30 m wide to accommodate the various working widths, as shown in **Figure 5-4b**. Adequate width is required on the non-working side of the trench to allow the vegetation, topsoil and excavated spoil stockpiles to be separated, for the trenching machine to straddle the trench and for the padding machine to operate – approximately 12 m. Similarly, adequate width is required on the working side of the trench to allow the pipe stringing trucks, welding rigs and lowering-in sidebooms and excavators to traverse alongside the trench, whilst allowing a safe passing lane for trucks and vehicles between this work strip, and the stockpiled vegetation and topsoil at the edge of the corridor – approximately 18 m.

Although all construction activities will be contained within the construction corridor, it may be necessary to increase the width of the construction corridor over short lengths in certain areas where increased working space is required for constructing river, rail and road crossings (**Section 5.5.10**) and in areas of rock. In this case, the appropriate approvals will be sought. The corridor will not be fenced during construction, except at points of public access or deep excavations.

Preparation of Supporting Facilities: Preparation of areas required to support the construction process will also be required. These areas may include:

- borrow pits for sand, gravel and rock;
- camp sites;
- water storage dams ground water bores and pipes;
- truck turning areas that extend beyond the 30 m corridor;
- additional space for HDD and horizontally bored watercourse crossings, for spoil piles and equipment layout;
- additional space at open-cut watercourse crossings, for separate bank material and excavated spoil stockpiles;
- additional corridor width in areas of rock.

The locations of these sites are currently undecided and will be determined by existing ground conditions and logistical issues prior to and during construction, as and when required. The location of supporting facilities will be selected to minimise environmental disturbance and will be subject to all relevant approvals.

Erosion control and spoil containment measures will be put in place during the preparation of these additional work areas, including silt fencing and appropriate spoil placement.

Topsoil Stripping and Grading: The topsoil and associated seed stores will be stripped from the work area and stored separately from other stockpiled soil, on either side of the corridor, away from fence lines, tracks, stock routes and existing or constructed drainage.

The working area will be levelled to the required contour. Breaks will be left in the stockpiled vegetation and topsoil to allow access for fence line tracks, stock pads and drainage lines.

Trenching: The trench will be prepared using a bucket wheel trencher where ground conditions allow; otherwise excavators and rock saws may be used. The trench will be excavated to a depth of 1.5–2.0 m and will be sufficiently wide to allow the pipe to be installed in position without being damaged and to permit full consolidation of padding and backfill material, approximately 700 mm wide. The trenching machinery will travel along the pipeline centreline excavating the trench material and placing spoil in a row on the non-working side of the trench (**Plate 5-7**).

- **Plate 5-7 Pipeline Trenching**

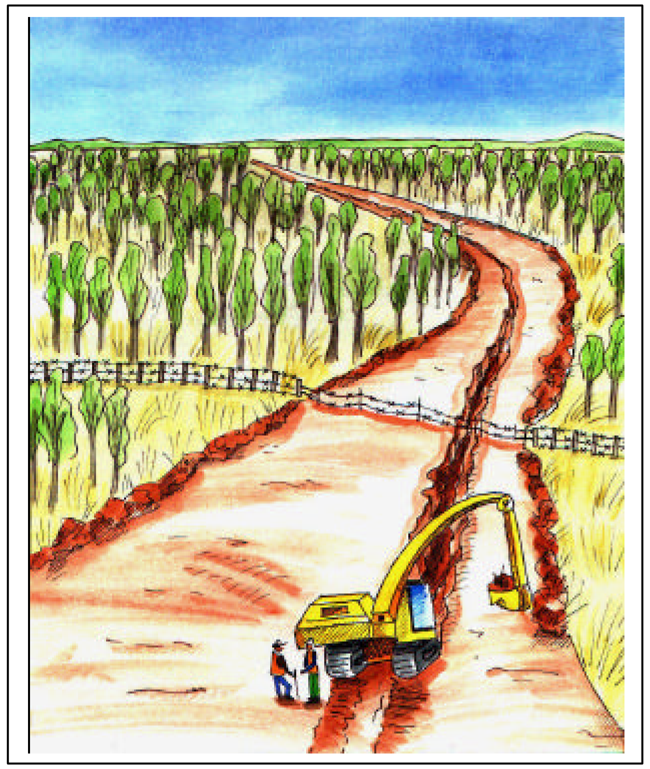
The pipeline will have a minimum depth of cover of 750 mm but will be buried deeper at road crossings and rivers. Where solid rock is present within 300 mm of the surface the total cover may be reduced to 600 mm. In all cases, the depth of cover will be in accordance in with AS2885 (**Section 5.5.10**).

Where the public can easily access the trench, it will be clearly marked by bunting, hazard lighting and will be fenced off..

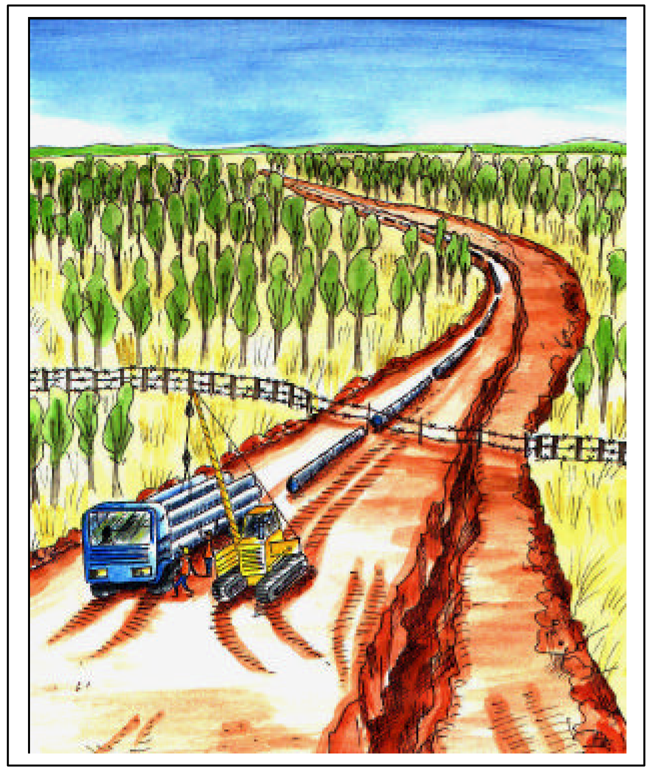
Blasting: Where dictated by the ground conditions, blasting will be used to assist trench construction. Blasting will utilise explosive charges to break up rock. Two areas that have been identified as potentially requiring blasting are between KP80 and KP100 (20 km) and in the Mitchell Ranges, KP770 to KP790 (20 km) (**Figure 1-1**). However, other areas may be identified during construction. Blasting will be carried out in accordance with AS2187.2.

Activity 1: Pre-Construction

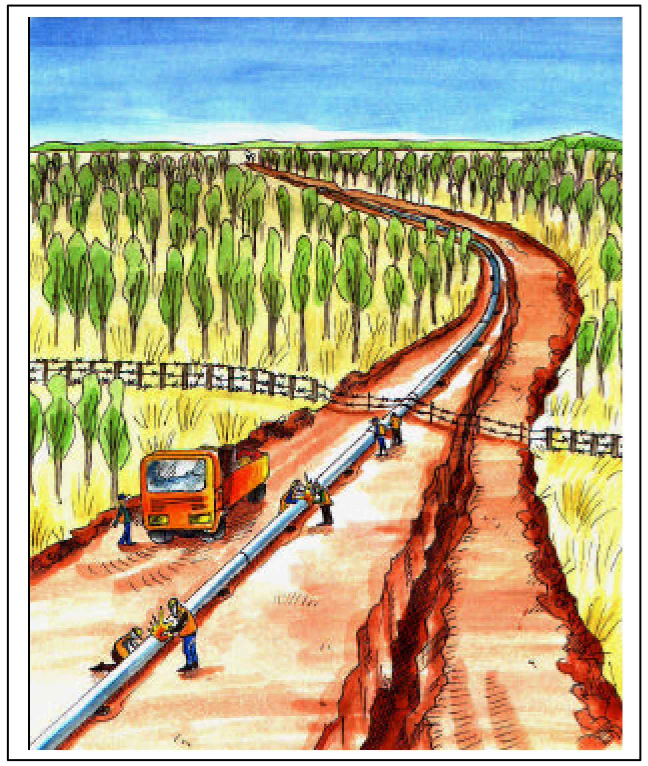
Activity 2: Clear and Grade



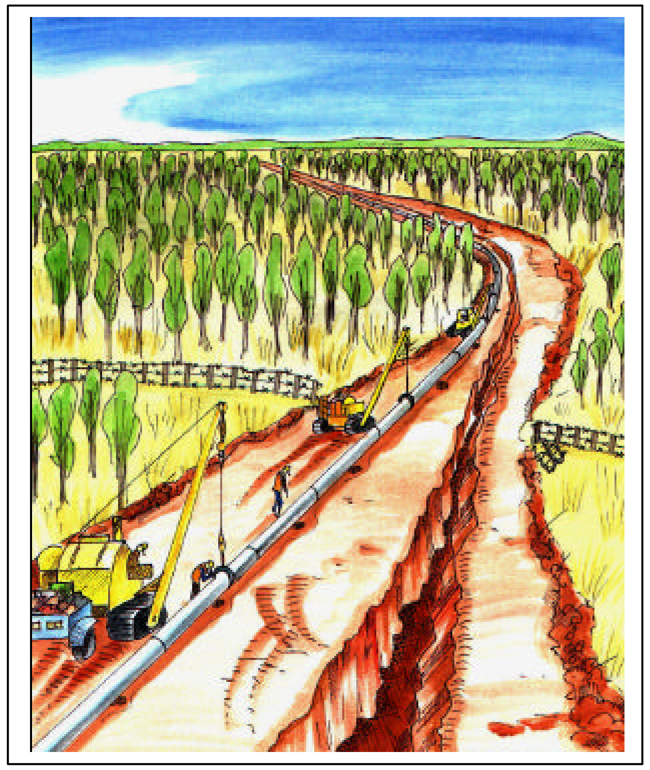
Activity 3:Trenching



Activity 4: Pipe Stringing



Activity 5: Pipe Welding



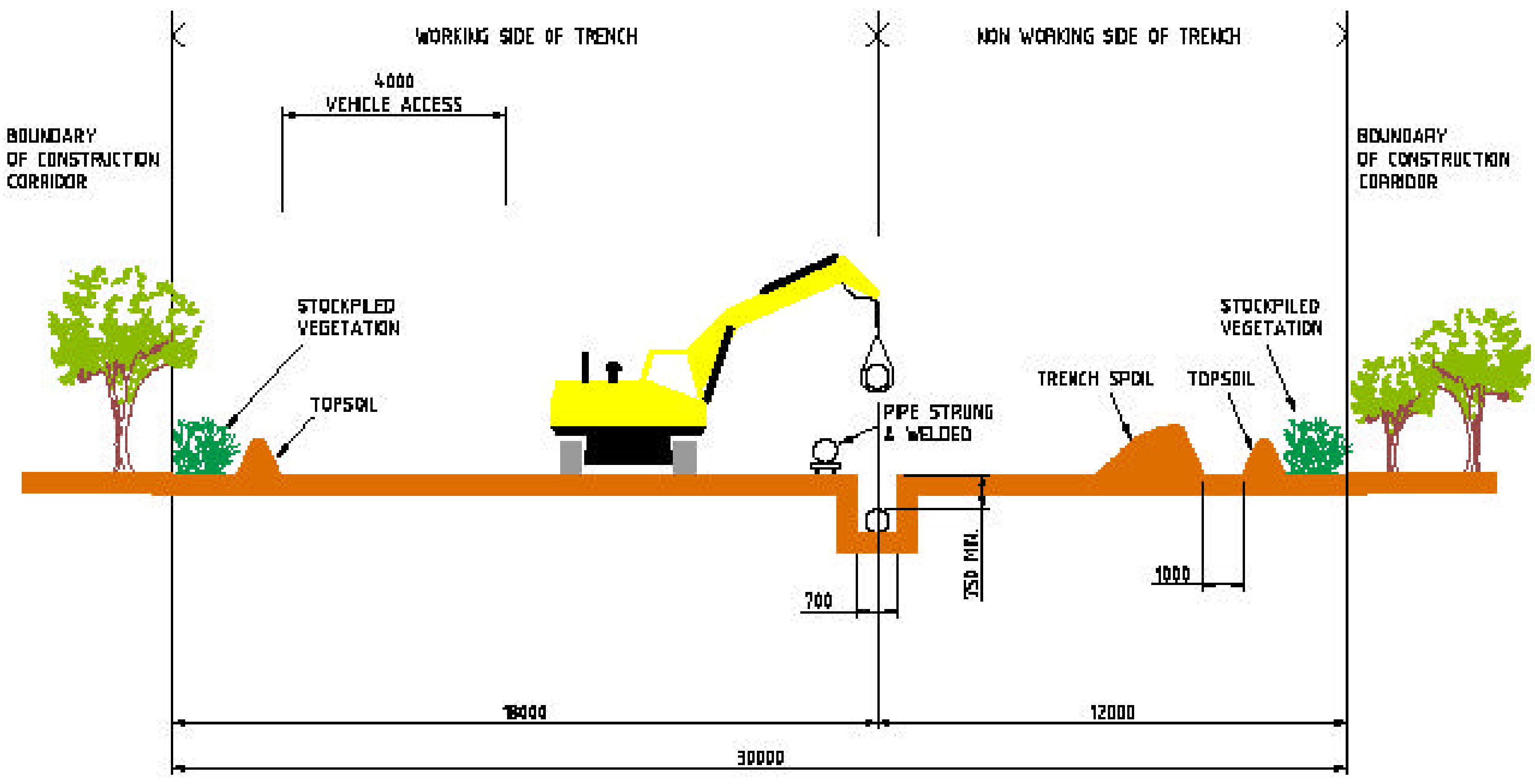
Activity 6: Lowering In

Activity 7: Backfilling

Activity 8: Post Rehabiliation

Figure 5-4A Typical Construction Corridor for a Buried Pipeline

Figure 5-4b Typical Construction Corridor for Buried Pipeline



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Stringing: The 18 m long coated pipe lengths will be transported to the construction corridor from the stockpile areas at Katherine and Gove, on semi-trailers.

The pipes will be placed parallel to the trench and on wooden skids, using a vacuum lift arm on an excavator. The pipe coating will be protected by hessian bags filled with sawdust to act as a cushion.

Welding: Pipe lengths will be welded together on site prior to placement in the trench. Weld quality will be a key concern, and so only qualified welders will be used for this operation. Strung pipes will be positioned using sidebooms and line up clamps, and welded together. Appropriate levels of non-destructive testing (generally x-ray) will be implemented that comply with AS2885.

Coating: Following welding, joint coatings will be applied to the joints to prevent the pipeline from corroding (**Plate 5-8**). The weld joints will be grit blasted and coated using a suitable field coating system which is compatible with the factory applied coating system. The coating quality will be checked against strict acceptance criteria. Corrosion coating is discussed in **Section 5.4.5**.

- **Plate 5-8 Pipe Joint Coating**

Bedding and Padding: To ensure that sharp stones or rocky protrusions in the bottom of the trench do not damage the pipeline coating, the trench may be "padded" with sand or fine soil to a depth of around 150 mm (**Plate 5-9**). This material will either be sifted from the trench spoil by a purpose built padding machine or will be imported from borrow pits, the locations of which are yet to be confirmed. Padding is not required where the trench bottom is smooth and contains nothing that would damage the pipe coating. The requirements for padding are determined on site following a visual inspection of the trench.

An alternative method is to support the pipe on blocks at regular spacing along the trench bottom, and then pad and fill the trench in one operation by letting the fine material flow around the pipe to fill up the space between the pipe and the trench floor.

Pipe Bending: The pipeline will cross over crests and sharp changes in horizontal direction. To accomplish this, a specialised hydraulic pipe-bending machine will be used to bend some of the pipes to the shape required. For severe bends, factory induction bends will be used.

Pipeline Lowering: The pipe will be lowered into the trench using a series of side booms as shown in **Plate 5-10**. The side-booms will raise a section of pipe off the skids and lower it into the centre of the trench. Careful handling will be required during this operation to ensure that the external coatings are not damaged during the lowering-in process.

- **Plate 5-9 Padding**

- **Plate 5-10 Pipe Lower & Lay**

Continuous coating tests will be carried out to ensure that any coating damage to the pipeline is detected and repaired prior to the pipeline being lowered into the trench.

Negative buoyancy measures such as weight coating will be applied to the pipeline where the final pipeline design dictates (**Section 5.4.5**).

Where the pipeline is installed along a steep grade it will be necessary to install trench breakers to avoid erosion of the trench. Either stabilised sandbags or a urethane foam sprayed in-situ may be used for the construction of the trench breakers.

Backfilling: Following the lowering of the pipeline string into the trench backfilling will commence. To ensure that the coating is not damaged by coarse materials and rocks, a fine material will be placed in the trench first to act as 'shading'.

In areas where additional protection is required, under AS2885, marker tape will be installed above the pipe prior to backfill.

The trench will then be backfilled in the reverse order to which it was excavated, using the stockpiled soil adjacent to the trench. The trench will be compacted using a rubber-tyred grader. Where the pipeline passes through solid rock it may be necessary to import material for backfilling however trenching spoil will be used wherever possible. If additional material is required it will be sourced from borrow pits.

Tie-in: At regular intervals along the pipeline route, generally no more than 1km, it will be necessary to weld the pipeline sections that have been lowered into the trench together. The tie-in locations will also be at road, river and rail crossings and will be installed before the remainder of the pipeline by a separate crew. Welds will be tested and coating applied as described above.

Reinstatement: Clean up measures will be applied to the corridor, access tracks and campsites in consultation with relevant landowners. After backfilling the trench, the stockpiled topsoil and vegetation will be respread. If topsoil and respread vegetation are not sufficient for re-growth to occur, the disturbed areas will be reseeded with appropriate grass species and the ground surface re-profiled and contoured to reduce the risk of erosion and allow regular surface water flows. Once the corridor is reinstated, pipeline markers will be installed as required, and any general restoration work will be carried out. Permanent gates will be installed in the fences to allow access along the corridor by the operating personnel.

There will be provision for vehicle access along the corridor following restoration, however this will be restricted to a single 4WD track adjacent to the pipeline, approximately 4 m wide. This area will be kept free of trees and re-spread brush, but grass coverage will be encouraged. The track will be used for commissioning and maintenance during pipeline operations. It is anticipated that land users will be able to resume their previous activities on top of the pipeline providing that excavation activities are not undertaken and deep rooting vegetation does not establish.

5.5.10 Standard Crossing Techniques

Where the pipeline route crosses roads, the Alice Springs-Darwin railway line, the NT Gas Pipeline or significant watercourses, specialised techniques for installing the pipeline will be employed. The selected techniques for these crossings will reflect environmental and cultural sensitivities whilst providing the best technical solution. In most cases the crossing construction will require additional areas of temporary access outside the 30 m corridor. These areas will be subject to environmental, landowner and cultural clearances, in accordance with management plans and stakeholder agreements. Open cut, HDD and horizontal boring are the preferred construction methods to be used for crossings. The design requirements for the various crossing types under AS2885 are summarised in **Table 5-10** and an outline of each method is provided below.

- **Table 5-10 Proposed Crossing Methods**

Crossing Type	Design Factor	Nominal Length of Heavy Wall Pipe (m)	Minimum Depth of Cover (mm)	Anticipated Crossing Technique
Gazetted/Unmade Road	0.72	0	1200	Open cut
Minor Gravel Road	0.6	18	1200	Open cut
Minor Sealed Road	0.6	75	1200	Horizontal bore
Major Road (Highway)	0.6	200	1500	Horizontal bore
Minor Stream Crossing	0.6	18-50 as required	1500	Open cut
Minor River Crossing	0.6	18-50 as required	1500	Open cut
Major River Crossing	0.6	Length of drill	2000	HDD
Railway Crossing	0.6	100	3000 below rail	Horizontal bore
Other services including NT Gas Pipeline	0.72	0	500 minimum separation	Open cut

Note: HDD – Horizontal Directional Drill

As part of the crossing selection process, the following requirements will be incorporated into the pipeline design:

- all crossings (river, highway, sealed road, NT Gas Pipeline and rail) will be constructed using open cut trenching, HDD or horizontal boring;
- concrete slabs will protect the pipeline where it crosses under table drains adjacent to roads;
- the design of major road, highways and railway crossings will cover the full width of the road reserve;
- all pipeline wall thickness will have sufficient strength to resist external loads under worst case conditions;
- buoyancy control will be applied at river crossings where the design dictates;
- all crossing designs will be implemented in accordance with any relevant agreements with Traditional Landowners;
- crossings will be designed as per AS2885.1.

Road and Rail Crossings: There are four sealed road crossings, which will be horizontally bored:

- Victoria Highway;
- Stuart Highway;
- Florina Road;
- Central Arnhem Road.

All unsealed road crossings will be open-cut, and will be subject to the approval of the relevant road authority.

In addition to the sealed roads, it is proposed that the Melville Bay Road on the Alcan Gove lease will be horizontally bored.

The Alice Springs–Darwin rail line crossing is the only rail crossing. This crossing will be horizontally bored.

The pipeline will cross the existing NT Gas Pipeline once. This crossing will be horizontally bored.

Watercourse Crossings: During the preliminary field investigations the method of installing the pipeline across each watercourse was identified. The options that were considered are open-cut and HDD and the reasons for selecting the crossing method were based on construction and environmental requirements.

A total of 12 watercourses have been identified as potentially requiring to be crossed by HDD for ecological reasons. These are listed in **Table 5-11** with their location along the pipeline and the justification for HDD.

- **Table 5-11 Directionally Drilled (HDD) River Crossings**

Watercourse	KP	Justification for Selection
Moyle River	75	Riparian vegetation and in-stream habitat of conservation significance – potential for significant impacts if construction machinery is transported across multiple braided channels. Declared wetland of national significance.
Daly River	266	Riparian vegetation and in-stream aquatic habitat of conservation significance. Deep river channel with steep banks which could be difficult to stabilise and rehabilitate. Significant weed infestation along river banks. Known habitat of the freshwater sawfish *Pritis microdon* - a fish species listed as Vulnerable under the EPBC Act.
Katherine River	309	Riparian vegetation and in-stream aquatic habitat of conservation significance. Deep river channel with steep banks which could be difficult to stabilise and rehabilitate. Significant weed infestations along river bank. Known habitat of the freshwater sawfish *Pritis microdon* a fish species listed as Vulnerable under the EPBC Act.
King River	370	Deep and wide river channel with steep banks which could be difficult to stabilise and rehabilitate.
Waterhouse River	424	Riparian vegetation and in-stream habitat of conservation significance – potential for significant impacts if construction machinery is transported across multiple braided channels.
Mainoru River	550	Riparian vegetation and in-stream habitat of conservation significance – potential for significant impacts if construction machinery is transported across multiple braided channels.
Wilton River	600	Riparian vegetation of conservation significance. Deep river channel with steep banks – specific attention is required to stabilise and rehabilitate. Note that access road across the river, adjacent to proposed pipeline alignment, will be used to transport equipment across river.
Goyder River	701	Riparian vegetation and in-stream habitats of conservation significance - potential for significant impacts if construction machinery is transported across multiple braided channels. Deep river channel with steep banks – specific attention is required to stabilise and rehabilitate.

Watercourse	KP	Justification for Selection
Boggy Creek	852	Riparian vegetation and in-stream habitats of conservation significance. Deep river channel. Potential for impacts on hydrology of waterhole which has a small outflow.
Cato River	880	Riparian vegetation and in-stream habitats of conservation significance. Known habitat of the Wood Frog *Rana daemeli* a species listed as Vulnerable under NT legislation.
Giddy River	912	Riparian vegetation and in-stream habitats of conservation significance – potential for significant impacts on the vegetation island in the river channel. Known habitat of the Wood Frog *Rana daemeli* a species listed as Vulnerable under NT legislation. Banks require specific attention to stabilise and rehabilitate.
Latram River	922	Known habitat of *Pternandra coerulescens* a plant species listed as Vulnerable under NT legislation. High level of recreational use as a waterway. Riparian vegetation and in-stream habitat of conservation significance.

Open Cut Crossings: This method involves the excavation of a trench in a similar fashion to that employed for standard trenching (**Section 5.5.9**). The welded pipe is placed in the trench and the excavated material returned. The disturbed area is then reinstated.

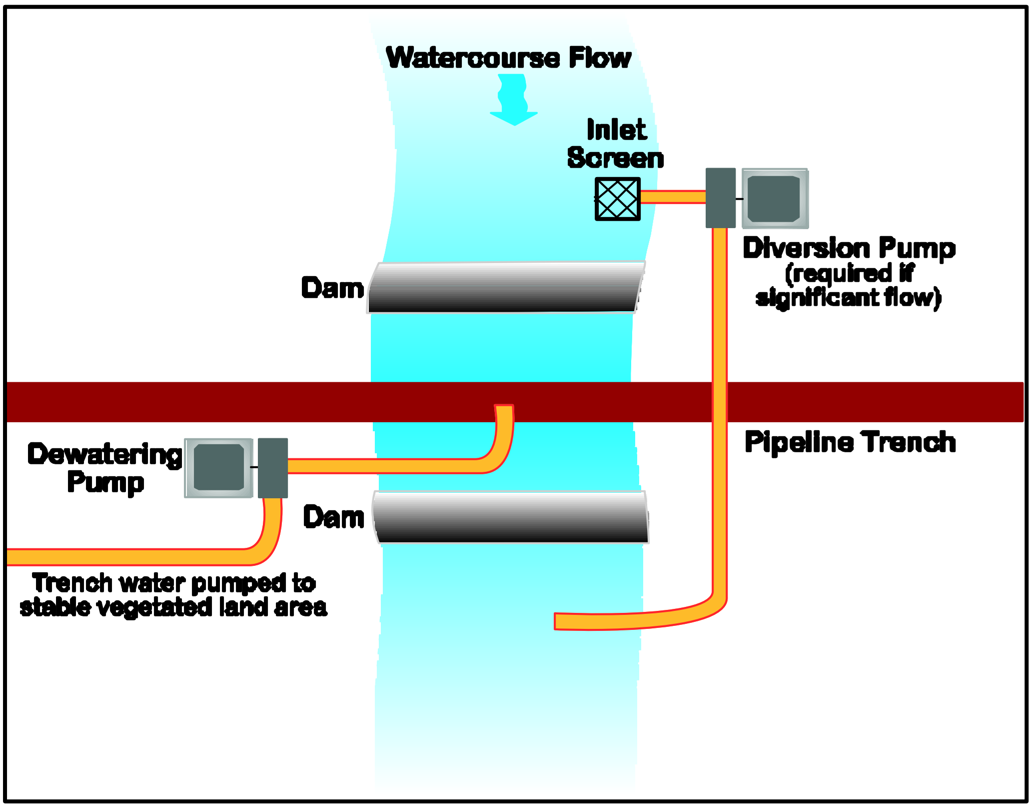
At road crossings vehicle access will be maintained across the trench by the use of bypasses or steel plates. Trenches will remain open for the shortest possible time period to minimise impacts on traffic. All road surfaces will be returned to a standard equal to that prior to construction. Appropriate signage and other traffic control measures will be employed to ensure safety at all times.

If the open cut method is employed during minor stream or river crossings then stream flow will be diverted. Flow diversion will involve temporary damming the watercourse and pumping the flow around work areas (**Figure 5-5**). The water, which is pumped around the area, will be suitably filtered or settled before being reintroduced to the watercourse. This activity would be short term, generally taking up to one week per crossing. Silt fencing will be installed where required to prevent run-off and to contain stockpiled spoil.

The pipeline trench will be excavated so that the minimum cover above the pipeline to the riverbed is 1500–2000 mm depending on the size of the river. Pipe bends required to profile the pipeline into and out of the river will generally be formed on site.

Following pipeline laying, the trench will be backfilled initially with a 150 mm sand surround followed by coarse silt free material or, depending on quality, the excavated material. Loose rocks or “rip-rap” may be placed on the banks or in the stream to reduce the risk of erosion and seeding or seed mats will be placed along the slopes, if required.

Figure 5-5 Typical Open Cut Technique across Watercourses

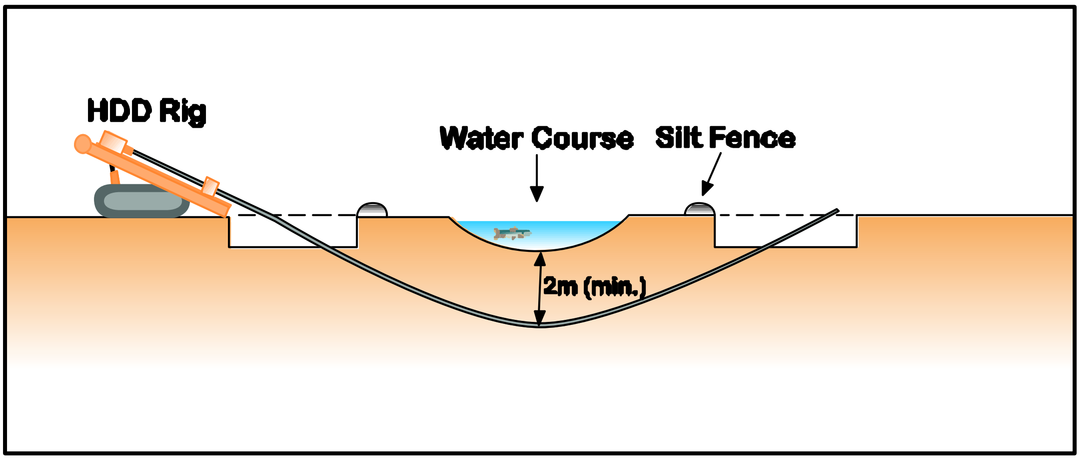


Horizontal Directional Drilling: HDD involves drilling a hole into the ground at one side of the crossing at a 10–15^{o} angle, drilling a curved hole with the drill surfacing on the other side of the crossing. The hole acts like a tunnel through which the pipeline is threaded **Figure 5-6**. Drilling is conducted by a specially designed drill rig and operated by a specialist contractor. The pipeline section to be laid will be welded and fully tested prior to tie-in with the main line sections. This technique usually results in a stockpile or tanks full of saturated cuttings and drilling mud displaced from the hole. This material will be disposed of in an approved manner.

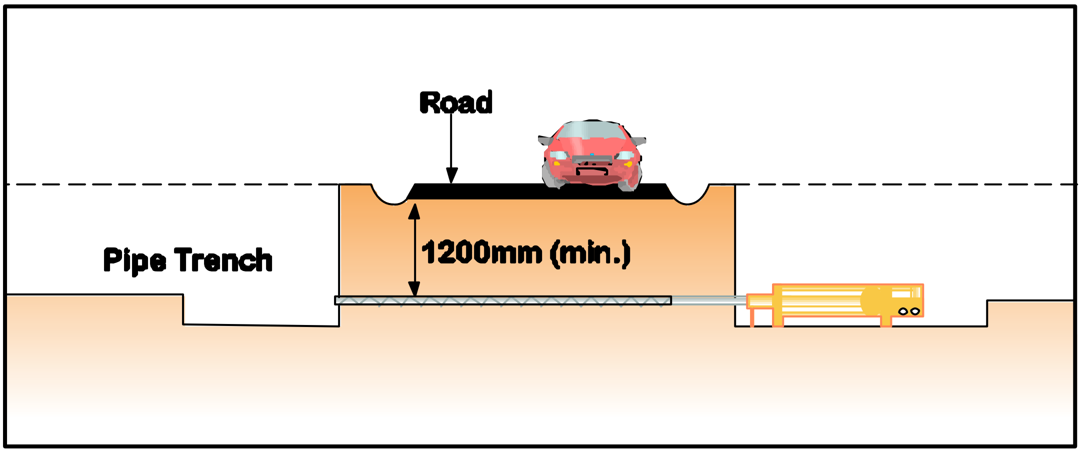
Horizontal Boring: This technique uses an auger to bore under a road or railway (**Figure 5-7**). This method is used for a wide range of ground conditions including rock and does not require complex machinery.

Waste material from horizontal boring will be stockpiled, and re-used as a source of fill for other pipeline sections if appropriate, or otherwise disposed of in an approved manner.

- **Figure 5-6 Directional Drilling (HDD) Layout**



- **Figure 5-7 Horizontal Boring Layout**



5.5.11 Electrical Supplies, Communication Systems & Power

High frequency communication systems are proposed along the construction corridor for voice radio coverage during construction. Satellite communication systems will also be used.

Diesel generators will be used to supply electricity to the construction camps.

Compressor stations will be powered by gas turbines, driven by fuel offtake gas obtained from the TTP. The use of this gas will be metered and monitored. Each compressor station will be designed to have an initial installed power in the order of 4.5 MW.

5.5.12 Water Supply & Usage

During construction, water will be required for activities such as dust suppression, HDD, hydrotest and camp supplies. The water may be sourced from local bores, rivers and creeks, trucked from existing bores or council supplies, or new bores may be required to be drilled.

Potable water may be piped in from watercourses, wells or bores, and treated, or trucked in from the nearest existing source.

Water usage during pipeline construction is likely to be required at the following volumes:

- fully occupied 300-man camp – 45,000 litres per day;
- dust control along the worst track stretches – 100,000 litres per day;
- hydrotest (**Section 5.5.14**);
- HDD – 8,000 litres per day.

5.5.13 Dangerous Goods

Dangerous goods associated with the construction phase include:

- diesel fuel;
- explosives (for blasting);
- engine oil;
- lube oil;
- lube oil;
- isotopes for non-destructive testing of pipe welds;
- corrosion inhibitors, biocides and urethane.

All hazardous materials and dangerous goods will be stored according to relevant Australian Standards and in accordance with legislation and guidelines where applicable. The quantities of hazardous materials required for construction, operation and maintenance are not yet known; however, all materials will be screened according to their technical requirements and environmental performance.

All storage facilities and handling equipment will be designed and constructed to prevent and contain any spills, and will be maintained in good order. All waste and products will be stored, handled and transported with consideration for dangerous goods segregation, as per the *Dangerous Goods Act 1998,* and the *Dangerous Goods Regulations 1985.* Spill clean-up kits and Material Safety Data Sheets will be stored in easily accessible areas. Transport of dangerous goods will be in accordance with the *Dangerous Goods (Road and Rail Transport) Act 2003* and associated Regulations.

5.5.14 Testing

Testing of a pipeline and ancillary components is an integral part of pipeline construction. Testing will generally take the following forms:

- testing materials prior to construction;
- testing of welds;
- hydrostatic testing.

Testing Materials Prior to Construction: The manufacturers of materials and equipment will carry out quality assurance tests during manufacture of all items. Any items that fail the quality test will be marked and quarantined to ensure they are not used as part of the TTP.

Testing of the Welds: All welds will be checked in accordance with strict industry standards. Testing of welds will be carried out using X-ray techniques as discussed in **Section 5.5.9**.

Hydrostatic Testing: Hydrostatic testing is used to determine:

- Strength and leak tightness of a test section to establish that a pipeline is capable of withstanding the pressure for which it is designed and for leak tightness.

During hydrostatic testing the pipeline will be filled with water, pressurised to greater than normal operating pressure and then leak tested. It is proposed that the pipeline be tested in 16 test sections, averaging 60 km. The finalised section lengths will depend on the land profile and will be determined by the project hydrotest engineer. Test sections will be governed by the following criteria:

- the permissible elevation differences;
- sensitivity to detecting a leak - the section will not be so long as to render a leak undetectable by the pressure sensors at either end of the section;
- construction logistics schedule;
- geographic features which suit section breaks;
- the availability of water sources and discharge locations;
- ease of access.

Hydrotest water will be sourced from approved sources (local bores, rivers and creeks) and stored, where required, in a 'turkey nest' (dam). If required, the turkey nest may measure up to 40 m by 40 m and 4 m deep and may be polyethylene lined. The water may be required to be treated with biodegradable chemicals such as biocides and oxygen scavengers. The aim of biocide is to prevent the growth of algae in the pipeline, whilst oxygen scavengers prevent corrosion. The water will be tested prior to use to confirm the need for chemical treatment and the required chemical dosing rates. Dosing rates will also be dependent on how long the water is expected to remain in the test section.

The exact methodology for hydrostatic testing will depend on water availability but may include transferring water from one section of the pipe to another to minimise the overall volume of water used. The total volume of the 940 km pipeline is 111,372 m^3 (based on a 16", 9 mm wall thickness). However, if the water is transferred between test sections and re-used three times (ie treated water is used a total of four times) then the total amount of hydrotest water being discharged would be approximately 7,109 m^3 at four different locations. The longest test section is expected to be 100 km, resulting in 11,848 m^3?of water to be discharged.

Following completion of the hydrostatic testing, ‘dewatering’ of the pipeline is necessary. Pigs will be propelled through the pipe using compressed air to sweep appreciable quantities of water and debris such as weld slag and dust from the pipeline. To prevent an increase in corrosion potential or hydrate formation, once dewatering is complete, the pipeline will be dried using an air compressor fitted with dehydration equipment. The sequence of pigs sent through the line will be a combination of bi-directional and hard foam pigs. Pigging will stop when pigs exit the line relatively dry. Medium density foams pigs and softer swab foam pigs will then be sent through the line. This combination will be continued until a number of criteria are satisfied, including that of the final pig run, using a new swab pig. These include:

- the air that is purged in front of the pig as it exits the pipe is clear;
- the line contains no freestanding water, ie the swab pig exits the line with no visible wet patches;
- the air emerging from the pipe has a dew point of not more than –20^{o}C (measured using a handheld tool near the pipe exit);
- dust has not penetrated the swab pig to more than a pre-determined depth.

A repeat test is carried out after a 24 hour hold period to confirm the –20^{o}C dew point.

In the unlikely event that a leak is detected during hydrotest, there are two options for repair:

- Dewater the section of pipeline, repair the pipe and retest the section. The repair may be located along the pipe section such that partial dewatering will allow dry access to the repair site, for example, at the top of a rise.
- Freeze the pipe section over the repair site, by using liquid nitrogen to form a plug of ice inside the pipe. The repair can then be carried out, the frozen section thawed, and the section retested. In this case, strict safety procedures would apply, including the use of a specialised contractor and the implementation of a specific Safety Management Plan and Job Hazard Analysis (JHA), or equivalent, for the activity prior to any work commencing.

5.6 Commissioning

5.6.1 Commissioning Procedures

Instrumentation: All instrumentation will be checked to ensure correct calibration. These tests will be carried out in accordance with appropriate industry guidelines.

Performance Testing: All valve and equipment will be tested to ensure operation to design specifications. Strict industry guidelines will be applied, particularly during the testing of emergency shut down equipment.

All methodologies and acceptance criteria will be approved prior to carrying out any test. Where tests fall outside of the agreed acceptance criteria repair work or modifications will be carried out. Subsequently, the acceptance tests will be repeated.

Pipeline Purging: During the introduction of gas, the pipeline will be purged of air to ensure safe entry of the gas. If a nitrogen plug is used the nitrogen/air mix will be vented. Odourants will not be used.

5.6.2 Workforce & Accommodation

Commissioning activities will be coordinated by a 'Commissioning Manager', who will take responsibility for each system until handing over to the pipeline operator. A team of specialist commissioning staff, with extensive experience in pipeline commissioning and operation, will be employed for all commissioning activities. It is anticipated that approximately 23 people will be required specifically for the commissioning phase of the project, as summarised in **Table 5-12**.

- **Table 5-12 Commissioning Workforce Requirements**

Commissioning Area	Personnel Required
Supervisory Control and Data Acquisition (SCADA)	4
Communications	4
Facilities	3
Electrical & Instrumentation	2
Pipeline	8
Cathodic Protection	2
Total	23

The commissioning team will be accommodated in a mobile camp, or in nearby towns where possible.

5.6.3 Access & Transportation

During commissioning activities some light vehicles are required such as small trucks to move the pigs and 4WDs to carry personnel and tools. Access to the pipeline will be via existing roads (**Section 5.5.3**), nominated access tracks, and an established access track along the construction corridor.

5.6.4 Electrical Supplies & Communication Systems

Electrical supplies and communication systems required for commissioning activities will be as per **Section 5.5.11**.

5.6.5 Dangerous Goods

Nitrogen in either gaseous or liquid form is a dangerous substance potentially causing asphyxiation, so extreme caution and safety management is required during venting and the pigging operations if nitrogen is used; however, gaseous nitrogen is expected to dissipate rapidly upon venting to the atmosphere, and therefore presents only minor safety risks. A detailed safety plan (**Section 13**) will cover the measures used to reduce the risks associated with using nitrogen gas.

5.7 Pipeline Operation & Maintenance

The pipeline, associated above ground facilities (main line valves and scraper stations) and compressor stations will be operated and maintained in accordance with AS2885.3 and appropriate industry guidelines.

5.7.1 Plans and Procedures

Prior to start-up, a Safety and Operating Plan (SOP) will be prepared for the pipeline as required under AS2885.3. This plan will be the overarching document that draws together the engineering and operation details. The SOP will ensure comprehensive information is available to personnel regarding operations, inspections and maintenance of all facilities. Emergency and reporting procedures will also be in place. Plans and procedures will be reviewed and updated if significant incremental change has occurred.

5.7.2 Operating Systems

A maintenance and operations base will be located near Katherine for central access to the pipeline and all facilities. All remote controlled functions will be directed from a centralised control room via a SCADA system. This system will monitor operating parameters, equipment status and malfunction alarms at the remote facilities via specialised instrumentation and will present them to the operator via colour graphic displays.

Personnel responsible for operation and maintenance of the pipeline, above ground facilities and compressor stations will be trained and experienced in all aspects of the equipment in their control.

5.7.3 Inspection & Maintenance

Once installed, inspection and maintenance programmes will be established to monitor the pipeline's integrity and ensure that the public and property along the route are adequately protected during operation. The inspection and maintenance programme will be carried out by approved and appropriately trained personnel and will include the pipeline, all above ground facilities, compressor stations and the cathodic protection system. The pipeline licence, incorporating the Northern Territory statutory requirements, will define the frequency of inspections at the MLVs, scraper stations and along the corridor, as well as the frequency of pigging.

Corrosion Detection: Internal inspection of the pipeline will focus on detection of corrosion, and will be carried out by an intelligent pig capable of inspecting the full circumference and length of the pipeline. Inspections using the intelligent pig are generally carried out once every five years or in accordance with the conditions of the pipeline licence.

Routine Maintenance: Routine maintenance activities will occur at the MLVs, scraper stations or compressor stations located along the main pipeline route. To allow maintenance to take place a small volume of gas must be vented from the pipeline when the pig launchers and receivers are depressurised. This will occur up to twice year when cleaning pigs are deployed, and during other general maintenance activities, as required.

Long Term Maintenance: To allow repairs to the pipeline itself, the connection of new pipeline branches, or repairs to MLVs or scraper stations, the relevant section of pipeline will be isolated between the adjacent valves, and the sections vented. This is unlikely to happen at less than five yearly intervals, if at all, during the life of the pipeline.

Emergency venting may also be required in the case of a compressor station emergency shut down. Under these circumstances all gas will be vented from the station as quickly as possible to minimise the risks of fire or explosion and to minimise the duration of noise emissions.

The impacts and mitigation measures associated with venting events is discussed in **Section 9**.

Post-commissioning Coating Survey: A one-off coating survey will be carried out within 12 months of construction completion. This survey is conducted by a technician walking the entire pipeline route over the pipe, holding probes that are pushed into the ground which measure electrical current. If a current is registered, this implies that the pipeline cathodic protection system is generating a current, as a result of a coating defect. The size of the defect is estimated according to the signal received. Depending on the estimated size, the line may be exposed and the coating repaired.

Cathodic Protection Systems: The cathodic protection system will be checked at regular intervals to ensure that the protection voltages are within limits and to monitor any likely areas of corrosion. Testing points will be located at intervals of between two and five kilometres along the pipeline. These testing points will allow for the measurement of structure-to-electrolyte potentials, using a high input impedance voltmeter and half-cell. Adjustments will be made to the cathodic protection current output to ensure that the protective potential is maintained at a sufficient level. Testing will occur every six to twelve months.

Inspections: Inspections will be carried out along the pipeline construction corridor at scheduled intervals throughout the life of the pipeline. Inspections will focus on checking the integrity of the pipeline and identifying any new or changed threats to the pipeline. Inspections may be carried by helicopter or light plane.

Due to the nature of the major creek crossings and the remoteness of the pipeline, the inspections are likely to be two to six monthly. Inspections may also be carried out after heavy rainfall, or other significant events. More frequent monitoring may be scheduled for major creek crossings or sections with a known risk of erosion or flooding. The surveillance criteria will include, but not be limited to the following:

- variations to surface conditions (for example erosion, trench subsidence or earth movement);
- indication of leaks such as dead vegetation;
- excess vegetation or weed infestation;
- evidence of pipeline exposure;
- construction activity or evidence of impending construction activity on or near the pipeline route;

- impediments to the access of the route;
- deterioration of the pipeline markers;
- security of the site and evidence of unauthorised entry.

Maintenance of the corridor will be an ongoing requirement for the life of the project, to address any erosion, subsidence or weed infestation, but is likely to be less frequent after the first couple of years of operation.

Above Ground Facilities: Regular maintenance of above ground facilities and compressor stations will be carried out to ensure that the control, safety and operating systems are functioning correctly and reliably. Valves will be inspected at regular intervals to ensure that:

- each valve is supported;
- support points are not corroding;
- valves are not leaking;
- valves and actuators are fully operable;
- valves are secured to prevent unauthorised access and usage;
- valves are regularly tested and operated to confirm operability.

Scraper traps, also referred to as ‘pig traps’ are used to launch or receive pigs during maintenance or emergency procedures (**Plate 5-3**). All components of scraper traps (including end closure seals, bleed locks, electrical bonds, locking rings, pig signallers and fasteners) will be maintained at approved intervals. The traps will also be inspected to ensure that:

- mechanical damage (due to handling) has not occurred;
- corrosion is not occurring.

Compressor stations will require specific maintenance to ensure their safe operation, for example:

- cleaning and replacing of gas inlet filters;
- inspection of header boxes and tubing in gas coolers;
- checking and replacing lube oil.

5.7.4 Workforce and Accommodation

During operation/maintenance the TTP is expected to directly employ in the order of 20 to 30 persons as and when required. There will be no permanent staffing of above ground facilities along the pipeline route. A permanent staff base will be associated with the compressor station at Katherine which will also act as a maintenance base. Usually this will be the facility that is closest to a major town, enabling staff to be on site during normal work hours to quickly deal with any maintenance situations that occur on site.

5.7.5 Access and Transportation

Access to the pipeline during operation will be required for inspection and maintenance activities. All access will be via approved access tracks.

5.7.6 Electrical Supplies and Communication Systems

Supporting infrastructure such scraper stations and the cathodic protection system, will be powered by RAPS. A RAPS system comprises of solar electric panels with a battery system (**Plate 5-11**). Solar systems are a cleaner and cost effective alternative to using diesel generation.

- **Plate 5-11 Remote Area Power Supply (RAPS)**

RAPS will supply power to the following:

- telemetry systems;
- cathodic protection system ;
- on-route communication systems.

5.7.7 Water Supply and Usage

Water requirements during operation will be minimal. The only requirements will be for toilet flushing, personal washing and drinking. Rainwater will be collected from roofing and stored in a tank. The rainwater can be supplemented if necessary, by tanker deliveries during the winter months.

5.8 Waste Inventory

Waste will be generated in varying amounts throughout all phases of the project, although it is expected that the majority of waste will be generated during construction and commissioning.

During the life of the project waste will arise from three main waste streams:

1) non-hazardous solid waste stream including:
   - construction;
   - domestic;
   - green waste.
2) liquid waste stream including:
   - sanitary wastewater and greywater;
   - hydrotest water.
3) hazardous waste stream.

Impacts and management of waste is detailed in **Section 9**.

5.8.1 Construction & Commissioning Phase Waste

Some of the main waste streams and their sources that are likely to be generated during construction and commissioning are summarised in **Table 5-13**.

Table 5-13 Construction Waste Stream Inventory

Construction/Commissioning Source	Waste Type
Pipeline Construction	
Clearing and Grading	Fuel spillages Fluid leaks Tyres and consumables from plant and vehicles
Pipe Stringing	As per clearing and grading, and: ▪ rope rings used to separate pipes on the truck.
Pipe Welding and NDT	As per clearing and grading, and: ▪ pipe offcuts; ▪ slag from welding; ▪ Personal Protective Equipment (PPE) items, for example gloves, glasses and dust masks; ▪ welding items, for example grinding disks, electrode stubs and packets; ▪ chemicals for developing x-ray and gamma ray films.
Joint Coating	As per clearing and grading, and: ▪ joint coating packaging; ▪ excess coating; ▪ masking tape; ▪ excess concrete.
Trenching	As per clearing and grading, and: Replacement parts, for example trencher teeth and belts

Construction/Commissioning Source	**Waste Type**
Lowering In	As per clearing and grading, and: ▪ wooden skids; ▪ broken urethane foam trench breakers; ▪ hessian, sawdust, urethane.
Padding and Backfill	As per clearing and grading
Cathodic Protection Installation	As per clearing and grading, and: ▪ excess coke breeze and nylon mesh weaved bags; ▪ packaging for anodes and cables; ▪ epoxy cable sealing kits; ▪ cad-weld charges; ▪ cable cut-offs.
Hydrotesting and Clean and Dry	Fuel spillages Fluid leaks Tyres and consumables from plant and vehicles Used filters Treated hydrotest water Pipeline dust and dirt from inside pipeline Wet and muddy foam pigs (may be <100 pigs)/worn plastic pigs Water treatment chemical spills
Vehicle Washdown	Oily water Chemically contaminated water
Other Construction Waste	Sanitary rubbish Personal rubbish
Corridor Reinstatement	Seed bags Fencing wire and wooden post off-cuts Survey pegs and flagging tape
Construction Camp	Sanitary wastewater and greywater Sewerage Putrescibles and packaging
Mechanical Workshop	Lube oil and grease Used oil spill kits Rags and cotton waste Oil filters and replacement parts Coolant Batteries Fuel drainage Solvents, primers and rust-proofing agents Tyres Washdown liquid collected in oily water pits

5.8.1.1 Non-Hazardous Solid Waste

Construction Waste: Most construction waste can be classified as inert material, and as a result much of it will be reused where at all possible. The quantity of solid construction waste cannot be defined at this stage, as it is highly dependent on the in situ ground conditions and will vary throughout the construction period. It is envisaged that the waste stream will typically consist of:

- soil, for example excavated or surplus soil that is not suitable for pipeline bedding or cover;
- rock fragments, for example shallow rock that has been blasted and is not suitable for reuse elsewhere;
- drill cuttings or spoil, for example material excavated during HDD crossings;
- surplus concrete, for example remaining after concrete pours at ancillary facilities;
- packaging materials, for example plastic, cardboard, paper, pallets and metals;
- pipe off-cuts and reinforcing steel, for example at ancillary facilities;
- damaged products, for example corrugated iron sheets;
- timber formwork at facilities;
- metal at ancillary facilities, pipe off-cuts;
- electrical off-cuts at ancillary facilities;
- waste tyres.

Solid Domestic Waste: Domestic waste will typically consist of:

- putrescibles (food scraps and sewage sludge);
- packaging.

During pipeline construction the greatest quantities of domestic waste will be generated from the construction camps located along each main line spread (**Section 5.5.4**). The main source will be from the messing facilities (dining area, wet canteen etc) at the camps. A small amount of domestic waste will also be generated along the corridor. Putrescible waste will include food scraps and sewage sludge. Packaging waste will include bottles, cardboard, aluminium cans and plastic.

Based on a total workforce of 300 people for a single spread, approximately 12 t/week of domestic waste per spread will be produced over the entire construction period.

Green Waste: Green organic waste for example vegetation, shrubs and trees will be generated as the corridor and above ground facility sites are cleared in preparation for pipe laying. The expected volume cannot be confirmed as the level of vegetation varies along the construction corridor. A lot of the green waste will be respread during corridor reinstatement.

Vegetation which has been cleared from the route and from above ground facilities will be stockpiled in windrows to be used for rehabilitation wherever possible. There may also be excess timber after rehabilitation, especially on compressor station sites and construction camp sites as these are larger areas. No windrows of vegetation will be left along the pipeline route following construction (**Section 9.3.8**).

A number of other options will also be assessed for use of the remaining green waste. For example, there may be business opportunities for the harvest of cycads and other saleable species that will be cleared during site preparation. Furthermore, trees cleared during site preparation could be processed for firewood.

5.8.1.2 Hazardous Waste

Hazardous waste is defined as waste material that is, or contains, ingredients harmful to health or the environment. Detailed information on dangerous goods can be found in **Section 5.5.13**.

Hazardous materials will be used in minimal quantities during construction. The main hazardous materials that may result in the generation of hazardous wastes include hydrocarbons (for example oil, fuel and lubricants), herbicides, explosives, acids (for example batteries), spent solvents and paint. Some biological waste from first aid facilities may also be generated.

Hazardous waste will be generated during testing activities. Dangerous goods requirements for testing will be as per **Section 5.5.13**. Small quantities of isotopes for gamma ray inspection of the pipeline welds will also be required. Isotopes for inspection will be stored and managed in accordance with the relevant regulatory requirements and industry standards.

5.8.1.3 Liquid Waste Stream

Generation of liquid waste will be largely confined to the construction and commissioning phases.

Sanitary Wastewater and Grey Water: Wastewater volumes generated at the construction camps are assumed to total between 200 and 250 l of water per person per day. This amounts to a peak weekly wastewater loading of up to 525 kl/week per main camp, assuming the camp is fully occupied at 300 people. The sanitary wastewater stream will comprise both grey water and sewerage. Sewerage will be treated on site and disposed of in accordance with statutory regulations. Most waste treatment facilities will produce effluent of a sufficient quality to be disposed of in effluent trenches. If water quality is sufficiently good, then treated wastewater may be recycled for laundry and toilet use. In the event that treatment of the wastewater does not produce wastewater that is acceptable for disposal to ground, then it will be removed from site and disposed of appropriately.

The type of sewage treatment that will be implemented at the construction camps and along the corridor will be determined during detailed design. It is likely that portable waste treatment facilities will be used and will be designed to meet Northern Territory Regulations. The number and location of these facilities are also undecided at present. The facilities will be cleaned using biodegradable products. Residue solids or sludge will be road transported and disposed of at sewage plants such as at Katherine, Wadeye, Darwin and Nhulunbuy.

It is likely that a number of mobile chemical toilet facilities will be required for each work crew. The number and location of these facilities are currently under consideration. All disposal will be in accordance with statutory requirements. A dedicated truck and operator will be required to maintain the facilities and transfer them back to a treatment facility at the construction camp or at an existing registered sewage plant.

Hydrotest Water: Hydrotesting is a construction activity that will generate large volumes of liquid waste. As is described in further detail in **Section 5.5.14** the total volume of the pipe is 111,372 m^3. However, assuming that the pipeline is divided into 16 test sections, and that the hydrotest water is re-used three times, the expected volume of test water to be discharged is approximately 7,109 m^3 at four different locations. The longest test section is expected to be 100 km, resulting in 11,848 m^3 of water to be discharged.

Disposal options will largely depend on the water quality and the receiving landform. The cheapest and quickest method of disposing of the hydrotest water is to release it onto stable ground and let it drain away, with the assistance of excavated drain lines. Hydrotest water will not be allowed to enter rivers or creeks. The specific discharge location of hydrotest fluid has not yet been identified.

Presently, a number of disposal options are being considered including:

- release and drain
- dust control
- evaporation ponds
- irrigation

Release and Drain: Hydrotest water which is intended to be released to ground will need to meet the following criteria:

- the receiving ground is not prone to erosion, ie does not consist of softer soils, expansive clays or on steeper slopes;
- the water flow does not lead into an existing watercourse;
- the water does not soak into catchment areas for watercourses or bores used for domestic water supply;
- the water is not discharged onto a site of significant flora/fauna;
- all containment and erosion control measures are in place;
- all approvals have been granted.

Water that is released onto the ground will generally pool and flood, then soak into the ground. There will be run-off, and containment measures such as cutting shallow trench drains in lines away from the water outlet are used to assist drainage and direct the flow. Erosion control measures are used, such as placing hay bales or installing silt fences across the path of the flow. Any damage caused by the water will be repaired.

Spraying the water over a larger area, through nozzles, has advantages over simply releasing the water from a hose; the water is aerated, thereby accelerating the bio-degradation of the chemicals in the sun's UV rays; the rate of evaporation is increased; and erosion can be reduced.

Dust Control: In areas where water is scarce, the test water can be used for dust control. Approximately 350 water trucks could be filled from a 60 km pipeline section. This equates to two water trucks filling up four times daily and watering a section of the corridor within a reasonable distance for one month. If a turkey nest is filled, for trucks to refill from, spraying the water on the corridor for dust control may be viable and can offer relief, as the remainder of the water can be left to evaporate. If there is no turkey nest, dust control only offers partial relief, as it is too slow a method of dewatering, and the pipe should be cleaned and dried within a few days of being dewatered.

Evaporation Ponds: Evaporation ponds can be constructed, and the test water discharged into them. The ponds required will be considerable in size, and shallow by nature to encourage evaporation, and can be in the order of 100 m by 25 m by 3 m deep. However, they can easily be reinstated using dozers and graders, or if in an appropriate place on a pastoral property, left for the landholder.

Irrigation: Hydrotest water can be used for irrigation and livestock watering. However, the feasibility of this option depends on the concentration of the added chemicals and the proximity to the area to be irrigated. If the irrigation area is conveniently adjacent to the discharge point and the water storage is available, then this may be viable. UV degradation and dilution would be the preferred treatment of the water.

All hydrotest disposal and discharge will be managed in accordance with a Hydrotest Management Plan (**Section 12**).

5.8.2 Operation and Maintenance Phase Waste

Each waste stream described in **Section 5.8.1** is likely to be produced during operation but in significantly smaller quantities and volumes. As all facilities will be unmanned, waste will only be generated during general maintenance or repair routines along the pipeline or at the above ground facilities. All waste will be removed and disposed of in an approved manner and in accordance with regulatory requirements.

The key wastes associated with operation of the compressor stations are likely to include:

Sanitary Waste: Sanitary waste will be disposed of using a septic tank. Since the site will normally be unmanned, the required capacity of the system will be minimal.

Oil Lubricants: Turbine and compressor lubricating oil will be replaced on a regular basis. Waste oil will be transported to Katherine where it will be disposed of at the Katherine Town Council landfill subject to approval. Oil will be stored in drums in a roofed and concrete bunded area within the site boundary. Any liquids collected in the bunds will be passed through an oil skimmer prior to discharge.

Solid Waste from Filter and Pig Receivers: Pipeline dust which is predominantly 'rust' from inside the pipeline will be collected in drums and sent to Katherine for disposal at the licensed landfill subject to approval.

Hazardous Waste: All hazardous waste including oil filter cartridges, oil drums etc. will be removed form site by a licensed waste contractor. Lube oil drums will be returned to the vendor for recycling.

Stormwater: Storm water contained within bunded areas will be passed through an oil/water separator prior to discharge away from the compressor area and into natural drainage areas around the site. Oil from the oil/water separator will be removed by a licensed waste contractor.

5.9 Emissions Inventory

The ambient air quality along the proposed pipeline route is anticipated to be pristine, except in areas where the pipeline route is in close proximity to industrial areas or major highways. The existing Alcan Gove Refinery, at the extreme eastern end of the pipeline, is likely to represent the only significant industrial source in the vicinity of the TTP route.

The composition of gas in the TTP is summarised in **Table 5-14**.

- **Table 5-14 Composition of Gas Transported in the Proposed TTP**

Component	**% Volume**
Methane	87.0
Ethane	2.5
Propane	0.8
Isobutane	0.1
Normal Butane	0.2
Isopentane	0.1
Normal Pentane	0.1
Hexane Plus	0.2
Nitrogen	8.1
Carbon Dioxide	0.9
Total	**100**

The nature of the atmospheric emissions means that greenhouse gases (for example Carbon Dioxide (CO_2), Nitrous Oxide (N_2O) and methane (CH_4)) will also be emitted; these are addressed in **Section 5.9.2**.

Potential impacts, as well as preventative and management measures, are discussed in detail in **Section 9**.

5.9.1 Atmospheric Emissions

Construction: The main source of atmospheric emissions during pipeline construction is likely to arise from vehicle and mobile equipment exhausts as well as combustion emissions from power generation at camps.

Typical emissions would include:

- Carbon Monoxide (CO);
- Carbon Dioxide (CO_2);
- Oxides of Nitrogen (NO_x);
- Oxides of Sulphur (SO_x);
- unburnt hydrocarbons.

Commissioning: During commissioning air pollutants will be similar to those generated during construction but will also include:

- compressor station start up when the compressor is purged with natural gas;
- pipeline and above ground facility venting operations.

These sources would result in the emission of the following:

- nitrogen gas (N_2) from gas purging;
- natural gas from pipeline venting.

Operation: During operation there will be several sources of atmospheric emissions (**Table 5-15**). Emissions will occur due to venting of the pipeline during maintenance at MLVs or compressor stations, with minimal emissions associated with the day-to-day operation of the pipeline. Small gas fired heaters at Gove Gate Station will emit small quantities of CO_2, CO and NO_x.

- **Table 5-15 Atmospheric Emissions during Operation**

Source	Emission
Compressor Station	Combustion emissions: $CO_{(x)}$ $NO_{(x)}$ Hydrocarbons (CH_4, C_2H_6, etc)
MLV and Scraper Facility	Natural gas emitted during pigging, significant venting or emergency venting
Pipeline fugitive losses - valve flange leaks, vents etc	Combustion emissions CO_x NO_x SO_x Hydrocarbons (CH_4, C_2H_6, etc)

The gas turbine units at compressor stations will have a fuel management system that ensures efficient burning of the natural gas fuel. In the unlikely event that the gas turbine is operating at 50% power for a year of continuous operation, the following exhaust gas quantities are anticipated. These estimates are based on operation of a turbine at a single compressor station.

- NO_x – 44 tpa;
- Carbon Monoxide – 11 tpa;
- Unburnt Hydrocarbons – 3 tpa.

5.9.2 Greenhouse Gas Emissions

Greenhouse gases will be generated during construction, maintenance and operation of the project. Relevant greenhouse gases will include combustion products such as CO_2, N_2O, methane (CH_4) and unburned hydrocarbons.

***Sources of GHG Emissions**:* During construction, there will be some emissions of CO_2 and N_2O from combustion of fuel (primarily diesel) in the internal combustion engines of vehicles and generators.

During operation, there will be minor losses of gas from leaks, failures and maintenance operations (pigging). The major greenhouse gas from such releases will be methane. Small volumes of gas will be vented during maintenance of scraper stations or compressor station components.

Gas will be burned as fuel in compressors and heaters, primarily releasing CO_2 as a greenhouse gas. Small gas fired heaters at Gove will emit some CO_2 (500 tpa). During compressor station maintenance, emissions will comprise unit venting, station venting, station pipe venting and engine purge.

Natural gas venting will also occur from the compressor stations during operation and during compressor station maintenance when components of the station may be vented to allow inspections and maintenance to take place. There are several sources of gas emission from the compressor station:

- Unit venting – each time that a compressor package is taken out of operation the pressure needs to be released from the compressor body to save damage to the rotating seals.
- Station venting – triggered by a station emergency shut down. It is likely that the desired venting time is less than 20 minutes.
- Station pipe venting – including depressurisation of pig launchers and receivers and gas filters.
- Engine purge – a small amount of natural gas will be vented during the engine start-up sequence.

As discussed in **Section 5.7.3**, more significant gaseous emissions may be released during maintenance events occurring less regularly (possibly every five years). This will include pipeline venting, undertaken to allow repairs to the pipe itself, the connection of new pipeline branches or repairs to MLVs or scraper stations. Either 80 km or 160 km sections of the pipeline may be vented under these circumstances.

During operation, there will also be emissions of CO_2 and N_2O from internal combustion engines of vehicles associated with pipeline maintenance, but this will be minimal.

Calculation of GHG Levels: Calculated GHG emissions for the pipeline are based on gas volume and fuel usage estimates and emission factors recommended by the Australian Greenhouse Office in the 'Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2002'.

Emissions from the combustion of fuel in internal combustion engines or generators were calculated from total fuel burned and using full fuel cycle emission factors reported in AGO (2004a), assuming that the compressor works continuously at 50% power.

Transmission losses for the pipeline were assumed to be 0.005% as recommended by AGO (2002). Emission factors for CO_2 and CH_4 from the pipeline were calculated from the values tabulated in AGO (2002) for gas of a similar composition (Dongarra), corrected for the differences in CO_2 and CH_4 composition between Dongarra gas and the pipeline gas specification in **Table 5-14**. Dongarra gas is supplied to Perth, Western Australia via a 416 km gas pipeline.

It has been calculated that between 0.5 Mm^3 and 1.7 Mm^3 of gas would be released from the venting of 80 km of pipeline for maintenance and installation of new offtakes.

Summary of GHG Emissions: A summary of predicted greenhouse emissions during construction and operation is provided in **Table 5-16**. Vehicle fuel consumption and compressor station operations are the main sources of greenhouse emissions for the TTP.

- **Table 5-16 Predicted Greenhouse Emissions from the TTP**

Timing	Source	CO_2-e tpa
Construction	Vehicles and generators	12,411 [1]
Operation	Pipeline fugitive losses and planned venting	259
	Gas heater	500
	Compressor station operations	12,063
	Major pipeline venting (~five yearly)	496–1,688
	Vehicles	17

Note 1 – Based on 3,500 t of fuel used during construction

The total volume of GHG during construction will be approximately 12,411 tpa of CO_2-e. During operation the total volume of GHG generated will be approximately 13,300–14,500 tpa of CO_2, which is less than 0.0003% of the Australian total greenhouse emissions of 550.1 Mtpa (AGO 2004b).

5.9.3 Dust

Dust, also referred to as particulate matter is commonly defined as particles that can remain suspended in the air. In terms of particle size, this is dependent upon the amount of turbulence in the air. Particles below 50 µm will typically remain suspended for some time. Smaller particulate matter below 10 µm, termed PM10 are generally associated with respirable dust.

Dust generation will be most significant during the construction and commissioning phases of the project and will be generated from:

- clearing of vegetation;
- earth moving activities;
- vehicle movement along unsealed roads and the construction corridor;
- blasting and trenching activities;
- trench padding;
- backfill activities.

During maintenance operations dust will arise due to traffic, although in much smaller amounts than during construction as only occasional inspections of the pipeline are required.

Impacts and management measures are discussed in **Section 9.4**.

5.9.4 Noise

Noise is expected to be emitted to varying degrees during construction of pipeline and above ground facilities, as well as during operations and planned maintenance. At this stage of the development it is only possible to predict typical noise levels. A noise assessment was undertaken by Air Noise Environment (ANE) and the complete findings are included in **Appendix A**, **Volume 2** of this Draft EIS. The assessment identified noise levels from distinct phases of the project namely construction, and operation and maintenance.

Sensitive Receptors: A desktop review of surrounding land uses was undertaken to identify land uses and receptor locations close to the proposed pipeline route. Key settlements within 5 km of the pipeline were identified as follows:

- Wadeye – approximately 5 km away;
- Palumpa – approximately 4 km away;
- Clarence – approximately 5 km away;
- Dorisvale – approximately 1 km away;
- Beswick Township – approximately 2 km away;
- Mainoru – approximately 4 km away;
- Dhamiyaka – approximately 3.5 km away;
- Nhulunbuy – approximately 3 km away.

The Tchindi Aboriginal Camping Ground close to Wadeye is also used occasionally and is located approximately 2.5 km from the pipeline. Only Dorisvale and Nhulunbuy are within 5 km of above ground facilities. No residential receptors have been identified within 5 km of the proposed construction camps.

Background Noise Levels: Background noise monitoring has been completed at Wadeye Township and at a remote bushland setting to represent the typical environments found along the route. The results of ambient noise monitoring concluded that the areas are generally quiet and typical of a rural/rural residential community.

In summary the Average L_{A90} (the noise level exceeded 90% of the time) was measured as follows:

- 34 dB(A) during day time in remote bushland (the maximum average (L_{AMAX}) was 64 dB(A));
- 28–30 dB(A) during evening and night-time in remote bushland (the maximum average (L_{AMAX}) was 43–47 dB(A));
- 40–43 dB(A) during day time, evening and night-time in rural residential area (the maximum average (L_{AMAX}) was 67–70 dB(A)).

Table 5-17 gives typical sound pressure levels so that comparisons can be made between background noise levels and predicted noise levels during construction and operation and explains what these levels equate to in real terms.

- **Table 5-17 Typical Sound Pressure Levels for Comparison Purposes**

Sound Pressure Level (dB)	Typical Environment	Average Subjective Description
140	30 m from jet aircraft	Intolerable
130	Pneumatic chipping and riveting (operator's position)	
120	Boiler shop (maximum levels)	
110	Chainsaw	Very noisy
100	Disco	
90	Heavy lorries at 6 m	
80	Kerbside of busy road	Noisy
70	Loud radio	
60	Restaurant	
50	Conversational speech at 1 m	Quiet
40	Residential area at night	
30	Quiet bedroom at night	
10–20	Background in TV and recording studios	Very quiet
0	Threshold of hearing	

Construction Phase Emissions: Noise modelling considered noise emissions from the various stages of pipeline construction including:

- clear and grade;
- blasting;
- rock hammering;
- trenching and stringing;
- welding and joint coating;
- hydrotesting and dewatering;
- padding, shading and backfilling;
- string and road crossings;
- restoration and rehabilitation;
- commissioning.

A noise model (ENM) was used to assess this information based on a worse case meteorological scenario. The result is a prediction of what the noise levels will be at the nearest sensitive receptors.

The recommended criteria for noise levels at sensitive receptors for this type of construction project vary depending on the type of project, duration and time of construction. Therefore the recommended levels at sensitive receptors, depending on the particular facility and time of day, varies between 3 and 20 dB(A) greater than the existing background noise level. These criteria are designed to preserve the acoustic amenity of nearby receptors.

Typical source noise levels are attributed to each of the proposed construction plant to calculate a total sound power level for each of the main activities (assuming all operate simultaneously). These predicted noise levels (L_{A10}) for the main pipeline construction activities are detailed in **Table 5-18**.

- **Table 5-18 Pipeline Construction Activities Maximum Sound Power Level**

Stage	Equipment Used	Maximum Sound Power Levels (L_{A10})
Clearing and Grading	Bulldozers, graders, crewcab	117 dB(A)
Blasting	Rotary and percussive rock drill, drill rig, crewcab	109 dB(A)
Trenching, Stringing, Bending, Lowering	Trencher, rock saw, semi trailers, excavators, assorted other heavy machinery	120 dB(A)
Welding And Joint Coating	Tractors, diesel generators, welding equipment	117 dB(A)
Hydrotesting [1]	Pump, air compressor, semi trailers, generator, refrigeration drier	117 dB(A)
Padding, Shading And Backfilling	Padding machines, bulldozer, grader	120 dB(A)
Road crossings	Sideboom tractors, hydraulic excavators, welding machine, air compressor, generator	117 dB(A)
Restoration and Rehabilitation	Dozer Grader Tractor	117 dB(A)
Scraper Facility Construction	Cranes, semi trailers, welder, air compressor	117 dB(A)
Main Line Valve Construction	Hydraulic excavator, sideboom tractors, flatbed semi trailer, welder, air compressor	117 dB(A)
Metering Facilities Construction	Crane, concrete truck, semi-trailer, welders, air compressors	120 dB(A)

Note 1 - Hydrotesting stage is the only construction activity planned for evening and night-time.

Two areas that are likely to require blasting are around the Moyle River and the Mitchell Ranges. Although the maximum sound power levels are expected to be 109 dB(A) blasting will not occur frequently.

Diesel generators will be used to power the various construction camps and will emit noise levels in the order of 100 dB(A) at 1 m but the exact noise level will depend on the exact configuration of the generator.

Commissioning Phase Emissions: During commissioning significant noise generation will be attributed to start up of the compressor stations and above ground facilities; although at most facilities this will be short-lived.

Gas fill is likely to provide the most significant noise sources as air and nitrogen will be vented. Venting may generate noise levels of up to 120 dB(A).

Operation Phase Emissions: Noise emissions during operation will largely be associated with maintenance activities.

Significant non-routine venting may also occur during emergency operations, at most every five years when noise levels may exceed 120 dB(A). These noise emissions arise because the venting of gas occurs at sonic velocities. Additionally, as sections of 80–160 km of pipeline may be vented, this noise can persist for long time periods, up to eight hours in duration.

Of the proposed station facilities, only the proposed compressor station and a pressure reduction valve located at Gove is likely to involve plant items with the potential for significant noise generation. This includes diesel generators, oil pumps and coolers, air compressors, safety relief valves, alarms and sirens. Noise sources from operation of the compressor stations are unlikely to emit noise over 85 dB(A) at 1 m. Scraper facilities or main line valves will only emit significant noise during gas venting, which will occur as part of planned maintenance activities. Pig launchers and receivers will be depressurised at each launcher and receiver barrel, and the gas vented. The predicted noise levels will be 120 dB(A) at 1 m for30 seconds.

Impacts and management measures are discussed in **Section 9.5**.

5.9.5 Vibration

Vibration may be caused by mechanical equipment such as generators, vehicles and earth-moving equipment that are likely to operate during the construction phase. The vibrational energy produced from these sources cannot be quantified.

Where dictated by the ground conditions, blasting will be used to assist during trench construction (**Table 5-18**). Blasting will utilise explosive charges to break up rock. Blasting activities during construction of the TTP are likely to be required at two locations, KP80 to KP100 and in the Mitchell Ranges KP770 to KP790. However, other areas may be identified during construction. Noise and vibration will be generated from the blasting itself and from the 'airtracks' used to drill the holes.

Impacts and management measures are discussed in **Section 9.6**.

5.9.6 Light

Construction & Commissioning: Minimal lighting will be required during construction as night-time works are generally not conducted. However, temporary lighting will be installed for hydrotesting, which is the only planned night-time construction activity. All lighting used will comply with regulatory safety requirements. Lighting will also be required around the construction camps and at pipe storage areas.

Operation: During operation industrial lighting will be required in and around the compressor stations. The lighting of these facilities will be designed to ensure that the light levels are sufficient for safety and plant operations.

5.10 Decommissioning

The objective of decommissioning is to close down operations and abandon the project sites, leaving the environment as near as practicable to its original condition. Decommissioning will be carried out in accordance with legislation, guidelines and industry best available technology at the end of the project life. In general, decommissioning requirements are project-specific, being considered on a case-by-case basis, assessing both the environmental and commercial costs.

There are typically three options involved in the decommissioning of a pipeline. These are:

- suspension
- abandonment
- removal

Abandonment of the pipeline in-situ would be environmentally preferable to the disturbance associated with the removal of the pipeline, which involves excavation (ECOS 2003). In accordance with suspension or abandonment methods it is likely that the TTP will remain buried. Both these methods involve disconnecting the pipeline from the system; however, the former involves filling the pipeline with an inert material, such as nitrogen, and maintaining as per an operating pipeline. Abandonment in place simply involves disconnecting the pipeline from the cathodic protection system and leaving the pipeline to degrade. If the latter option is adopted all above ground facilities and supporting structures will be removed and these areas reinstated.

Decommissioning of the pipeline will comply with legislative requirements, relevant Australian Standards and industry practice in force at the time of abandonment, and in consultation with landowners.

A detailed decommissioning plan and rehabilitation programme will be developed and implemented in consultation with landowners and relevant authorities at the time of decommissioning to ensure that the area is suitably rehabilitated. The plan will address drivers, costing, and timing as well as monitoring and rehabilitation requirements for ‘permanently’ disturbed areas.

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