Project Description – Appendix B
OceanWay SPM & Offloading Subsea System Technical Description

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

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Project Description – Appendix C
OceanWay SPM System – Design Brief (Preliminary)

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

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Project Description – Appendix D
OceanWay Mooring System – Design Analysis (Preliminary)

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

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Project Description – Appendix E
Riser & Umbilical System – Design Brief

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

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Project Description – Appendix F
Riser System – Design Analysis

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

Project Description – Appendix G
OceanWay SPM & Offloading System – Outline of Installation Method (Preliminary)

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

Project Description – Appendix H
OceanWay Regulatory Feasibility ABS Approval in Principal

AMERICAS DIVISION

9 June 2006

Woodside Natural Gas
2425 Olympic Blvd., Ste. 4030W
Santa Monica, CA 90404

Attn: Adrian MacMillan- Floating and Mooring Systems Engineering Leader

Subject: Program Class- Approval in Principle for
–Oceanway Secure Energy Deepwater Port

Dear Mr. MacMillan:

ABS has received APL Drawings:

1- O-KA-001 rev. 2 - STL Operation Procedure
2- W-RA-0001 rev 2 - Mooring Design Analysis
3- W-FE-0001 rev 2 - Mooring Design Brief
4- Y-FE-0001 rev 1 - Metocean Design Basis
5- Y-SD-0001 rev 1 - STL Subsea System Technical Description
6- N-XD-BP-0001 rev 01- STL pick up System
7- W-XD-MG-0002 rev 01 - Mooring Line Buoyancy Element
8- W-XD-MS-0001 rev 01 - STL Suction Anchor
9- Y-XD-SG-0001 - Deck Level 1
10- Y-XD-SG-0002 - Deck Level 2
11- Y-XD-SG-0003 - Deck Level 3
12- Y-XD-SG-0004 - Deck Level 4
13- Y-XD-SG-0005 - SLT Elevation

ABS has reviewed these documents and notes that the Oceanway Secure Energy Deepwater Port consists of:

1- 2 x APL Buoys (Submerged Turret Loading)
2- 2 x risers per buoy
3- 1 x umbilical per buoy
4- 2 x PLEM (Pipeline End Manifold)
5- Dual Pipelines to Shore

ABS grants AIP to the Oceanway Secure Energy Deepwater Port based on review of the above and a similar installation previously approved. ABS' AIP is limited to the first four (4) items above for Oceanway Secure Energy Deepwater Port. A Hazard Identification Study (SWIFT-Structured What If Technique) is to focus on the first four (4) components of the Deepwater Port. The results of the Hazard Identification are to be incorporated in the final design. A HAZID

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Register is to be maintained. HAZOP is also required. ABS has had a similar installation and does not note any details that cannot be developed during detail design for the Oceanway Secure Energy Deepwater Port. Safety studies remain to be conducted for the Oceanway Secure Energy Deepwater Port with the RLNG Carrier in place; these are Evacuation, Escape and Rescue; Fire and Explosion, Gas Dispersion Analysis and Thermal Radiation Analysis.

ABS also requires that all recommendations and findings in the Hazard Identification and HAZOP will be addressed in final design as well as periodic update to the Hazard Register.

With the design developed as for the previously noted natural gas import buoy, and all of the issues associated with HAZID and HAZOP satisfactorily resolved, Oceanway Secure Energy Deepwater Port can be approved by ABS. The design is to be in accordance with ABS Rules for Building and Classing Single Point Moorings and the relevant parts/sections of the ABS Rules and guides listed below. ABS is also prepared to act as Certifying Entity in accordance with USCG NVIC 03-05.

Final design of the Oceanway Terminal is to be submitted for approval and is to include the following:

1. During final design details are to comply with ABS Rules and Guides for:
   - **ABS Rules for Building and Classing Single Point Moorings – 1996**
   - **ABS Guides for Subsea Riser Systems**
   - **ABS Guide for Subsea Pipeline Systems**
   - **ABS Guidance Notes on Risk Assessment Application for the Marine and Offshore Oil and Gas Industries**
   - **ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities**

2. HAZARD Register is to be maintained to confirm that any necessary mitigation provided will satisfy the intent of ABS Rules and Guides as well as any additional requirements of the administration involved. This is to include hazards identified by current studies and those requested.

We look forward to completing Classification activities for the Oceanway Secure Energy Deepwater Port with Woodside Natural Gas.

Regards,

Philip G. Rynn
Sr. Staff Consultant

Cc: H. Patel
I. Simpson
File

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Project Description – Appendix I
OceanWay Shipboard Equipment – Technical Description

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Project Description – Appendix J
OceanWay DWP Design & Construction – Rigid Pipeline System

Appendix J

OceanWay DWP Design and Construction –

Rigid Pipeline Systems

Contents

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1.0 Scope of Document

This document covers the design and construction of the rigid pipeline systems and facilities of the OceanWay Secure Energy Project.

Specifically, this document covers the following project components:

- Rigid offshore pipelines
- Pipeline end manifolds (PLEMs)
- Rigid pipeline jumper connecting the two PLEMs
- The shore approach installation method as the offshore pipelines transition onshore
- Receiving and Custody Transfer Station (RCTS)
- Onshore pipelines
- Tie-ins to the Southern California Gas (SCG) grid

Specifically, this document does not cover the following project components:

- Single point moorings
- Submersible loading and mooring buoy
- Flexible dynamic risers
- Riser end manifolds (REMs)
- Flexible static pipelines
- Umbilicals
- Inert gas injection facility (IGIF)

2.0 Line Pipe Material Supply

The line pipe for both offshore and onshore pipelines will be manufactured in accordance with API Specification 5L, *Steel Line Pipe.* The line pipe will have an external corrosion coating of fusion bond epoxy (FBE) or other high performance corrosion coating system as determined during the detailed design phase of the project. Additionally, the internal diameter of the line pipe may be flow-coated to enhance the ease of precommissioning and improve operational efficiency.

2.1 Manufacture

2.1.1 Steel Line Pipe

Line pipe will be double-submerged arc welded (DSAW) in accordance with current industry practice. All manufacture of welded line pipe to be installed on the project will be performed using the longitudinally welding process; no spiral welded pipe will be used. The line pipe will be supplied in the following lengths:

- Offshore pipelines will be supplied in nominal 40-foot (12-meter), double random lengths
- Onshore pipelines will be supplied in nominal 60-foot (18-meter), triple random lengths.

2.1.2 Application of Internal Flow Coating

If deemed economically desirable and technically appropriate during the detailed design phase of the project, internal epoxy flow coating of nominal 1.5 mils (0.0015 inches, or 40 microns) dry film thickness (DFT) may be specified for application at the pipe mill or coating yard. Pipelines with internal flow coating can be dewatered and dried much more efficiently and effectively during the precommissioning phase. Internal flow coating also reduces the pressure drop in operating gas pipelines and thereby allows for lower required inlet pressure, lower sendout pumping power requirements, and therefore lower air emissions due to the resulting lower electrical energy demand. However, due to the periodic internal inspection requirements of the U.S. Department of Transportation, coatings will be studied during the detailed design phase of the project to ascertain whether or not available flow coatings will be able to stand up to the periodic runs of internal inspection pipeline tools.

2.1.3 Application of External Corrosion Coating

During the detailed design phase of the project an external corrosion coating study will be conducted to fully evaluate viable coating systems. At present, Woodside envisions using FBE typically applied to a nominal dry film thickness of 16 mils (0.016 inches, or 400 microns). A more robust coating system, or a thicker FBE coating, may be selected for the line pipe to be installed by the slick bore method and for the line pipe to be threaded through the HDD casings. The external corrosion coating will be applied either at the line pipe mill or at the Fontana, California, coating yard.

2.1.4 Mill Inspection of Line Pipe

Welding inspection will consist of visual and ultrasonic testing of the longitudinal welds, and magnetic particle and/or liquid penetrant testing of the pipe ends. Pipe joints will be inspected to ensure conformance to dimensional tolerances on outside diameter, wall thickness, ovality, and individual pipe joint length. All individual pipe joints will be hydrostatically tested in the pipe mill.

2.2 Transportation and Staging

Upon completion of detailed design and award of construction contracts, the source of the pipeline materials will be determined. Transportation will probably occur either by railroad or barge and then be trucked to the construction staging areas. If procured locally the line pipe could be trucked from the line pipe mill to the staging yard. Otherwise, all line pipe will be transported to the storage yard in accordance with API RP 5L1 *Recommended Practice for Railroad Transportation of Line Pipe* and/or API RP 5LW *Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels*. A single pipe yard in Fontana, California will be established for staging the line pipe.

Line pipe for offshore installation will be trucked to the Port of Long Beach for load out onto barges. Line pipe for onshore installation will be trucked directly to the pipeline installation site.

3.0 Offshore Pipelines

The offshore pipeline system will be designed to have a total instantaneous capacity of 1,600 mmsfcd and consist of parallel 24 inch (nominal 600 mm) diameter high strength carbon steel pipelines. The subsea pipelines will be approximately 35 miles long. Some of the offshore pipeline sections will be externally coated with concrete weight coating (CWC) to provide sufficient submerged weight (negative buoyancy) for pipeline on-bottom stability requirements. Sacrificial aluminum-zinc-indium anode “bracelets” will be installed on the pipeline at spacing intervals to be determined during the detailed design phase of the project. The CWC will be applied at the coating yard / pipe storage area in Fontana, California, near the project site to minimize transportation costs.

The offshore pipeline system, as well as the onshore pipeline system and related facilities, will be designed in accordance with 49CFR192, “Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards” (latest edition). The pipelines will be installed on the ocean floor from their origin at the two pipeline end manifolds (PLEMs) to the offshore endpoint of the HDD-installed pipeline section, which will be located approximately 3000 feet (900 m) from the shoreline at approximately 37-foot water depth. No trenching or burying of the offshore pipeline beyond the 37-foot water depth is envisioned. Benthic surveys were conducted in 2006 to identify areas of hard and soft sediment. Areas of hard bottom will be avoided to the maximum extent feasible. Woodside is working with fishing interests to minimize or eliminate impacts to fishing operations (Topic Report 3, “Biological Resources” and Topic Report 5 “Socioeconomics” including the associated “Fisheries” appendix, presents additional discussion of the hard bottom resources and the potentially affected fisheries.)

Codes and/or recommended practices in **Table 1** will be the principle guides for the design and installation of the offshore pipelines.

Table 1 Offshore Pipeline Primary Codes and Standards

Code	Title
49 CFR 192	Code of Federal Regulations, Title 49 Transportation, Part 192 - Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
API RP 1111	American Petroleum Institute: Recommended Practice for Design, Construction, Operation and Maintenance of Offshore Hydrocarbon Pipelines (Limit State Design)
ASME B31.8	American Society of Mechanical Engineers: Gas Transmission and Distribution Piping Systems
DNV OS-F101	Det Norske Veritas: Submarine Pipeline Systems
API Spec 6D	American Petroleum Institute Specification for Pipeline Valves (Gate, Plug, Ball, and Check Valves)

A bathymetric map, **Figure 5-1**, Project Location, and a schematic diagram, **Figure 6-2,** Pipeline Schematic, are provided in Exhibit A, Project Description.

3.1 Pipeline End Manifolds (PLEMs)

The two pipeline end manifolds (PLEMs) provide an interface between the rigid subsea pipelines and the flexible pipelines associated with the submersible loading and mooring buoys (SPM).

Description

The PLEMs, which will be outfitted with hydraulically- or electrically-operated valves, provide a means of isolating one or both of the subsea pipelines from the RLNGC. The PLEMs with the associated jumper piping connecting them provide a continuous loop to and from the scraper launcher and receiver located at the onshore receiving and custody transfer station (RCTS). See **Figure 1**, PLEM Assembly.

Design and Fabrication

Design and fabrication of the PLEMs will be governed by AISC-ASD, Steel Construction Manual, and API RP2A-WSD, Recommended Practice for Planning, Designing and Construction Fixed Offshore Platforms – Working Stress Design for structural design. The piping systems of the PLEMs will be treated the same as the offshore pipelines which are governed by 49CFR192 and ASME B31.8. The PLEMs will be completely prefabricated offsite.

Installation

The prefabricated PLEMs will be delivered to the project site pre-tested and ready for installation on the ocean floor. The PLEMs will be welded to the pipeline while on the pipelay vessel and lowered over the side of the vessel to the seabed as a part of the pipelay operation offshore.

3.2 Offshore Pipeline Design

3.2.1 Design Criteria

The offshore pipelines will be designed to the following criteria:

Pressure Containment

Pipeline hoop stress will meet the requirement of 49CFR192 and ASME B31.8.

Collapse Resistance

Pipeline wall thickness will be checked for collapse resistance against the external hydrostatic pressure, the combined loading of external hydrostatic pressure and bending in accordance with API RP 1111 or DNV OS F101, when appropriate.

Propagating Buckle Resistance

Buckle arrestors will be used to resist a propagating buckle initiated from the deep water pipeline sections. The buckle arrestors will be designed in accordance with API RP 1111.

External Corrosion Resistance

External corrosion coating will be applied on to the outer surface of the pipelines for corrosion protection. Sacrificial anodes will be used to protect the pipeline in areas where the coating has been damaged during handling or installation or where the coating has otherwise failed.

Pipeline Negative Buoyancy and On-Bottom Stability

The pipeline will be coated with concrete weight coating to provide the additional submerged weight required to ensure the pipeline has negative buoyancy, i.e., will not float, and for pipeline on-bottom stability. The empty concrete-coated pipeline will have a minimum specific gravity relative to water of 1.3 and the weight coating will be designed to meet the on-bottom stability requirements for the following load cases:

- 100-yr current with associated waves - operation
- 100-yr storm with associated current - operation
- 1-yr current with associated waves - installation
- 1-yr storm with associated current - installation

The effect of seabed slope on the pipeline on-bottom stability will also be addressed in the analysis.

Pipeline Free Spans

As the first approach, allowable pipeline free span lengths will be determined based on the von Mises and longitudinal stress requirements set forth in ASME B31.8 for different water depth ranges along the pipeline route. In addition, the maximum allowable free span lengths that eliminate the occurrence of pipeline vortex induced vibration (VIV) will be established for these water depth ranges using DNV RP F105. The minimum of the two lengths will be selected as the allowable free span length in each water depth range.

The pre-lay survey will provide the number of potential spans. If the results from the pre-lay survey coupled with this first approach results in an unusually large number of free spans, which will result in unusually high costs of mitigation by free span correction, a second approach will be taken by using the limit state design. Instead of controlling the von Mises and the longitudinal stress, collapse control will be implemented to obtain allowable span lengths. These allowable span lengths will be further check for VIV fatigue.

Hydrostatic Testing and Drying

The pipelines will be minimally hydrostatically tested in accordance with the requirements of 49CFR192, and generally will be hydrotested to 90% of SMYS (for the thinnest wall thickness segments). After dewatering the pipelines will be dried to a minus 40°F (-40°C) dew point.

Pipeline Shore Approach

The installation method for the shore approach will be by a modified Horizontal Directional Drilling (HDD) approach that will utilize a 30 inch (750 mm) threaded casing. The HDD technology requires that drilling mud be used in the bore hole to hydraulically remove soil cuttings and to keep the bored hole from collapsing. This installation method has a practical length limit governed by the resultant pressures required to keep the drilling mud circulating over long distances. This limit varies from 4,500 to 6,000 feet (1,370 to 1,830 m), depending upon soil conditions.

Pipelines at shore crossings must be buried out to a suitable water depth to ensure stability during operations. For the OceanWay Secure Energy Project, this requirement, combined with the elevated ground profile downstream of the shore crossing results in an HDD of approximately 4,000 feet (1200 meters) length.

Offshore Pipeline Placement

For the offshore pipeline beyond the shore approach, the pipeline section from the HDD exit to the PLEMs at the SPMs will be placed on the seabed.

Leak Detection

If required by regulation, a real-time leak detection system for the offshore / onshore 24 inch (600 mm) pipelines will be provided. If needed, leak detection technologies and systems will be evaluated for reliability and practicality and a system will be selected on that basis during the detailed design phase of the project.

Siting Considerations

The pipeline route for the Santa Monica Basin location will extend from the PLEMs at the SPMs to landfall at LAX. The pipeline route up the continental slope passes to the northwest of the Santa Monica Submarine Canyon. The pipeline route up the slope will be located at a distance no less than 3,000 feet (900 m) from the edge of the canyon to provide a safe setback.

The pipeline routing will avoid cultural or archaeological features and debris; the minimum separation distance from such features will be 1,000 feet. The pipeline routing also will avoid, to the maximum practical extent, seafloor hazards such as areas of unstable seafloor, faults, irregular bottom, and hard bottom areas. The pipeline routing will also minimize the number of locations where the pipelines cross existing pipelines or other utilities, i.e., communication cables. Where seafloor hazards or cable crossings are unavoidable, routing minimizing the potential conflict between the pipelines and the hazards will be selected.

Seismic Considerations

Several faults will be crossed along the pipeline route from the PLEMs to the shore. Woodside will evaluate the need for various risk mitigation measures during the detailed design phase of the project, but at the present time fault crossings are planned to be designed by selecting unburied placement on the seabed to allow free movement during a seismic event, and by selecting a crossing angle that will minimize stress on the pipeline in the event of ground movement.

3.3 Shoreline Crossing Construction

Woodside examined several subsurface installation methods and determined that a modified HDD method utilizing forward reaming and threaded casing pipe will be both technically feasible, have the highest likelihood of success, and will present the least impact to the environment. The specializations proposed include use of a 48 inch (1200 mm) diameter by 300- to 400-foot (90 to 120 m) long steel conductor casing to be installed, via a boring or pipe jacking technique, into the ground near the initiation point onshore to prevent hydrofracture of drilling muds onto the surface during initiation of drilling. Following the final 40 inch (1000 mm) reaming bit, a threaded 30 inch (750 mm) casing pipe will be forward thrust into the HDD hole, but stop at roughly 20 feet (6 m) below the seabed surface. Woodside will then utilize an offshore dredging vessel to expose the end of the casing pipe, cut off the “bullnose”, and install a “bellmouth” through which the carrier pipe will be passed. The natural gas carrier pipe string will be welded offshore on the pipelaying vessel and threaded through the in-place HDD casing. With the assistance of an onshore winch, the 24 inch (600 mm) carrier pipe will be pulled from offshore to the onshore endpoint of the HDD hole. This methodology will limit the discharge of drilling muds onto the seabed while utilizing an HDD crossing method with a high likelihood of success due to the limited drilling interruptions afforded by the use of quick-connect threaded casing sections. The process is illustrated in **Figure 2**, HDD Installation Sequence, involves the following installation sequence:

- Install approximately 400 feet of 48 inch (1200 mm) conductor casing, via boring or jacking, at each of the two onshore HDD entry points; these points will be 30 feet (9 m) apart. These conductor casings will be grouted permanently in place.

- Drill the first pilot hole from onshore to offshore using downhole survey equipment and surface surveying equipment as verification. The pilot hole is halted prior to the punching out on the seabed at a depth of 20 feet (6 m) below the sea floor.

- The hole is forward reamed in a number of separate passes until the hole has achieved a final diameter of 40 inches (1000 mm).

- After the hole has been reamed, the 30 inch (750 mm) steel casing pipe is forward thrust into the hole. The first pipe length is fitted with a cap, called a “bull nose”, to seal the casing, and each subsequent pipe length is fitted to the previous one using threaded connectors. Threaded connectors have the benefit of providing quick and simple joints between the pipe lengths compared to welding, and negates the need to have an onshore stringing area. Thrust loads are expected to be in the range of 50 to 100 tons.

- The casing pipe is thrust until it reaches the end of the reamed bore hole (20 feet [6 m] below the seabed). The drilling mud that is present in the HDD hole will be forced back up the hole and will be recovered at the point of entry. The bulk of the drilling mud will be forced into the interstitial spaces in the soil surrounding the HDD hole.

- The rig is then moved across 30 feet (9m) and the second hole is drilled, reamed, and the casing is installed in the same manner as the first hole.

- A dredging vessel is deployed to excavate and expose the extremity of the casing pipe by means of a mechanical dredge.

- The dredging operations will include the forming of a sloped transition trench. The dimensions of the trench will be approximately 310 feet (94 m) wide by 485 feet (148 m) long by 26 feet (8 m) deep at the HDD exit hole sloping to zero depth at the shallow, seaward end, creating a wedge-shape excavation. This sloped transition will accommodate the pipeline overbend that will be created as a result of the pipeline being laid on the seabed when the pipelaying operation continues on toward the PLEMs.

- Each bull nose is fitted with pressure relief valve to allow the divers to flood the casing pipe and equalize the pressure. The bull noses are then removed and replaced with bell mouths to facilitate the insertion of the product pipe.

- A pull wire is installed in each of the HDD casings and a winch is mobilized onshore.

- A laybarge retrieves the pull wire, attaches one end of the first product pipe joint to it and begins pipelaying operations while the product pipe is winched through the casing pipe until it emerges at the onshore HDD exit hole.

See **Exhibit A, Project Description, Figure 7-2A** for the layout of the HDD equipment.

This method has a number of advantages, with two of them being it does not require the pipeline strings to be prefabricated onshore in one continuous length, and it will not result in the discharge of drilling fluids into the ocean. The installation of the HDD casing and dredging operations for the shore approach will have a duration of approximately 8.5 months. .

3.4 Offshore Pipeline Construction

The parallel subsea pipelines will be installed with a separation distance of 100 feet (30 m) for most of the offshore alignment, narrowing to 30 feet (9 m) at the offshore HDD endpoint. The following sections discuss the various phases of the construction.

3.4.1 Pipelay

Pipelay will be accomplished with a conventional S-lay (or S-lay and J-lay) vessel(s) starting at the HDD exit holes laying westward toward the SPMs. The pipelaying operation will be used to thread the carrier pipe through the previously-installed HDD casing pipes. The pipelaying vessel will install the first HDD section and lay the offshore end on the seabed, then move to the second HDD section. After the second HDD section is inserted the pipelaying vessel will continue with the offshore pipelay out to the SPM, including installation of the first PLEM. For the second pipeline the pipelaying vessel will steam back to the nearshore area, retrieve the product pipe end previously threaded through the HDD casing section and commence conventional pipelaying out to the SPM, including installation of the second PLEM.

During pipelay, the pipeline will form an S-curve with an “overbend” beginning on the stern of the barge, and a sag bend that ends where the pipeline rests on the seafloor.

This operation is depicted in **Figure 3**, S-Lay Pipeline Construction.

Typically, a laybarge will have several welding stations, a non-destructive examination (NDE) station, and a field joint coating station. All welding and coating will comply with the relevant industry-standard specifications cited in 49CFR192, “Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards”, i.e., American Petroleum Institute (API) Standard 1104 and National Association for Corrosion Engineers (NACE) standards for coatings.

Laybarges utilize tension machines to hold the pipeline in a calculated configuration to prevent overstressing of the steel pipe as it “leaves” the barge. As the barge moves forward and a new pipe segment is added to the front of the production area, a similar length of welded pipeline will be lowered off the stern with the assistance of a “stinger”. The stinger is a mechanical device with rollers that protrudes off the stern of the barge providing extra support for the welded pipeline as it is lowered into the water. The stinger reduces stress from excessive bending of the pipeline.

The ends of the pipe joints will be cleaned as they are lifted onto the laybarge. The joints will be placed in the line-up station, where a line-up clamp will be utilized to align the ends of the pipe joints prior to the first welding passes. Once the initial welding passes have been completed in the line-up station, the laybarge will be moved forward, incrementally moving the barge beneath the pipe string. This process allows the new field joint to be “moved” to the next station in the pipeline assembly line. The process will continue through several stations, the number of which will be dependent on the actual vessel doing the installation, until all welding, inspection, and coating processes have been completed.

Pipelay may also be conducted using the J-lay method, a method specially developed for pipeline installation only in deep water. If utilized, J-lay installation will be conducted from a specialized pipelay vessel. A J-lay configuration differs from a conventional S-lay configuration by removing the top overbend of the pipeline catenary. The pipeline is clamped on the J-lay vessel at a steep angle (60° to 90° from the horizontal) and the welding, non-destructive examination (NDE) and field joint coating application will be conducted at this near vertical angle, making this pipelay method most suitable for deepwater pipeline installation. Typically, pre-fabricated quadruple line pipe joints, nominally 160 feet (49 m) in length, are used for J-lay. This operation is depicted in **Figure 4**, J-Lay Pipeline Construction.

Offshore installation of the pipelines and rigid spools may be by one of the above methods or a combination of the two pipelay methods described above.

The offshore pipelaying operations will have a duration of approximately 5 months.

3.4.2 Pipeline Lowering

The term “pipeline lowering” refers to the processes used to insure that the marine pipeline has been installed below the natural bottom of the seabed. Typical pipeline lowering methods include pre-lay dredging, post-lay jetting/plowing, post-lay diver hand jetting, and mechanical pumping. Except for the dredging at the HDD exit hole, no pipeline lowering for the OceanWay project is envisioned. No cover is envisioned necessary over the overbend at the HDD seaward end point. The offshore concrete weight-coated pipeline will lie on the seabed.

3.4.3 Foreign Pipeline and Utility Crossings

At the single cable crossing that the proposed offshore pipelines will encounter, the installation method will provide that positive separation and protection is maintained between the two systems. A minimum of eighteen inches separation will be accomplished with layers of articulated concrete mats. See **Figure 5**, Typical Offshore Pipeline Cable Crossing Arrangement.

3.4.4 Tie-Ins

Offshore pipeline tie-ins will occur at the following locations:

- A rigid pipeline jumper, approximately 100 feet (30 m) long, will connect the two PLEMs
- Downstream ends of the flexible static pipelines from the riser end manifolds (REMs) will be tied into the PLEMs

Figure 6-2, Pipeline Schematic, in Exhibit A, Project Description, depicts the entire offshore pipeline system, including the interfaces described above.

3.4.5 Offshore Construction Vessels

Table 2 below lists typical construction vessels envisioned for the offshore pipeline installation.

Table 2 Pipelaying Equipment

Area of Construction	Range of Functional Capacities
Pipelay Vessel	
Size	450 ft. x 130 ft. x 30 ft. (137 m x 40 m x 9 m)
Positioning	Dynamically Positioned
Method of pipelay	S-Lay
Pipe Capacity	To 30 inch (750 mm)
Tension Capacity	50 to 350 tons
A&R Winch Capacity	150 to 350 tons
Stinger	Sectional to 220 ft. (67 m)
Pipe Storage On-board	500 to 10,000 tons

Area of Construction	Range of Functional Capacities
Welding System	Automatic
Crane Capacity	250 to 800 tons
Accommodations	150 to 250 persons
Draft	16 to 32 ft. (5 to 10 m)
Helideck	Yes
Classed	Yes
Fuel Type	Diesel
Fuel Tanks Number	12-16
Fuel Tanks Total Volume	150,000 to 600,000 gals (approx. 600 to 2300 cubic meters [m^3])
Engine Type	Diesel electric
Engine Size	46,000 hp (34 mw)
Construction Support Vessel	
Positioning	Dynamically Positioned
Length overall (LOA)	250 to 450 ft. (76 to 137 m)
Width	65 to 95 ft. (20 to 30 m)
Depth	23 to 39 ft. (7 to 12 m)
Crane Capacity	100 to 300 tons
ROV	2 Working class, 150 hp (112 kw)
Classed	Yes
Accommodations	75 to 115 persons
Fuel Type	Diesel
Fuel Tanks Number	10-12
Fuel Tanks Total Volume	150,000 to 600,000 gals (approx. 600 to 2300 m^3)
Engine Type	Diesel electric
Engine Size	13,000 hp (10 mw)
Supply Vessel	
Positioning	Dynamically Positioned
LOA	200 to 250 ft. (61 to 76 m)
Width	60 to 75 ft. (18 to 23 m)
Depth	18 to 24 ft. (5 to 7 m)
Crane Capacity	12 to 35 tons
Classed	Yes

Area of Construction	Range of Functional Capacities
Accommodations	to 50 persons
Fuel Type	Diesel
Fuel Tanks Number	10-12
Fuel Tanks Total Volume	150,000 to 400,000 gals (approx. 600 to 1600 m^3)
Engine Type	Diesel electric
Engine Size	13,000 hp (10 mw)
Bucket Dredge	
Positioning	Spud
LOA	150 to 225 ft. (46 to 69 m)
Width	40 to 68 ft. (12 to 21 m)
Depth	7 to 15 ft. (2 to 5 m)
Bucket Capacity	5 to 12 cu. yds. (4 to 9 m^3)
Fuel Type	Diesel
Fuel Tanks Number	8-10
Fuel Tanks Total Volume	30,000 gals (114 m^3)
Engine Type	Diesel
Engine Size	1000 – 1200 hp (750 to 900 kw)
Dump Barges	
Positioning	4 Point Anchoring
LOA	140 to 180 ft. (43 to 55 m)
Width	50 to 55 ft. (15 to 17 m)
Depth	14 to 22 ft. (4 to 7 m)
Capacity	1,900 to 4,300 cu. yds. (1450 to 3300 m^3)
Fuel Type	Diesel
Fuel Tanks Number	4-6
Fuel Tanks Total Volume	20,000 gals (76 m^3)
Engine Type	Diesel
Engine Size	400 – 550 hp (300 to 410 kw)

3.4.6 Installation Anchoring Plan

Installation of the offshore pipelines and PLEMs will be undertaken by a Dynamically Positioned (DP) Vessel, which does not used anchors.

The dredging vessel, needed only for the transition from the HDD seaward end, will not use anchors.

Construction support vessels including ROV, diving, etc. will not use anchors.

3.4.7 Emergency Repair

In case of a buckled or burst pipeline during construction or service, the repair of the damaged pipeline section(s) has to be made by installing pipeline spool section(s) or by installing a new pipeline, depending on overall cost of such a repair. The repair cost will be determined by the number of damaged sections, water depth, and other pertinent factors. Spool replacement is an expensive operation which is economical only for a small number of damaged pipeline sections.

In the event of a buckled or burst pipeline, in general it will take at least several weeks to a few months for Woodside to allocate resources to identify the problem, select a contractor for the repair, and for the contractor to mobilize the vessels and equipment spread for the work. If the damage is excessive enough to require that a new pipeline has to be installed, it will take at least 4 to 6 months to complete the installation exclusive of the time for acquiring new or revised permits.

Two types of subsea pipe spool replacement technologies are currently available: one for shallow water that involves diving and the other for deep water which is diverless. The following subsections describe the operations involved for a subsea spool replacement in shallow and deep water.

3.4.8 Shallow Water Spool Replacement

If an emergency repair is required in shallow water, only pre-qualified service providers with access to a vessel capable of maneuvering and making repairs in that water depth would be employed for this task. An example of such a technically qualified service provider is Oil State; an example of the product used would be the MK IV Spool Repair Package.

Description of the operation:

1. Excavate the damaged pipeline section to leave a minimum of 3-foot (1-m) clearance between the pipe bottom and the seabed.
2. Cut the pipeline; the damaged pipe section is removed.
3. Concrete coating is removed 120 inches (305 cm) back from the cut end, and anti-corrosion coating is removed 115 inches (292 cm) from the cut end.
4. Pipe ends are beveled and marked.
5. A mechanical connector is lowered to the seabed with a spread bar.
6. A diver attaches the rigging between the pipe and the connector and pull-in the connector to stab the connector to the pipe end; diver confirms the connector is fully stabbed.
7. Lower epoxy applicator to diver. Diver attaches the applicator to the connector and starts to fill the annulus gap between the pipe and connector.
8. Repeat Steps 4 to 7 for the other cut.

9. Spool is made on the vessel based on the measurement results and the completed spool is lowered to the seabed.
10. Diver tightens the flanges at the two ends of the spool to secure the connections to the connectors.
11. Sand bags are placed under the pipe/spool.

3.4.9 Deep Water Spool Replacement

If an emergency repair is required in deep water, only pre-qualified service providers with access to a vessel capable of making repairs in that water depth would be employed for this task. An example of a technically qualified service provider is Sonsub; an example of the product used would be the Diverless Sealine Repair System (DSRS) for pipeline diameter up to 36 inch (900 mm).

Description of Operation:

(1) Two H-frames are lowered to the seabed and the damaged pipe is lifted three feet (one meter) above the seabed.

(2) Pipeline is cut using diamond wire cutter and the damaged pipeline is removed.

(3) Concrete coating and anti-corrosion coating are removed from the pipeline a specified distance, i.e., 120 inches (305 cm) and 115 inches, (292 cm), respectively, at both pipe ends; pipe clamps are mounted on the pipe ends.

(4) Metrology tools are mounted on the two ends of the pipeline and the measurements are used to fabricate the spool piece on the vessel with two mechanical connectors at both ends of the spool. The completed spool is lowered to the seabed with pipe trestle.

(5) Two mating pieces of the mechanical connectors are placed on the two pipe ends using ROV and an end connector tool.

(6) One mating piece is connected to the mechanical connector using end connector tool.

(7) The spool is pulled into the other pipe for mechanical connection using a winch module.

(8) Connect the mating piece to the connector using end connector tool.

(9) Seal the annulus gap between the mating piece and the pipe at both ends.

3.4.10 Offshore Construction Work Plan

The offshore construction activities covered by this section include:

- Pipeline construction offshore including pipelay start-up, normal pipelay, PLEM laydown, and jumper installation.
- Retrieval and tie-in of the pipe string inside the HDD hole to the offshore pipeline
- Pipeline pre-commissioning including free-flooding, hydrotesting, gauging and cleaning, and dewatering, and drying.
- Pipeline as-built survey

Table 3 lists the tasks and details of their implementation.

Table 3 Offshore Construction Work Plan

1. **Product pipe into HDD casing / Pipeline / PLEM / Jumper Installation**

Sub Task	Description of Work Plan, Methods and Procedure	Manpower & Day Shift	Vessel & Equipment	HSE Training & Certificate
Mobilization of Pipelay Spread	Mobilize equipment spread for the pipelay. Conduct DP trials and other field trials according to the procedures established for system performance test during mobilization	Permanent crew of 125, 2 x 8 riggers, 2 x 14 welders, 2 x 6 field joint coaters, 2 x 4 X-ray technicians, 2 of 12 hrs shifts /day,	DP lay barge spread	RSO Contractors Safety Training a) MMS Env. b) IADC - Rigpass c) Helicopter: HUET/MS or if Crewboat: Offshore Transfer course
Mobilization of Supporting Vessels and Spreads	The same as above	Permanent crew of 25, 2 x 4 Divers 2 x 2 ROV operators 2 x 4 Riggers 2 of 12 hrs shifts /day	DSV, crew boat, pipe haul barge(s), tug(s), survey vessel, hydrotest equipment	
Concrete mat Installation	DSV installs the concrete mattress for crossing of pipeline over the existing cable prior to pipelay.	As above	DSV	Same
Pipelay Initiation of 1st Pipeline	Set up pipelay vessel and initiate pipelay	As above	DP lay barge spread	Same
Pipelay of 1st product line through 1st HDD casing	Retrieve wire from onshore winch; attach to pipe string; lay out pipeline while onshore winch pulls it through the HDD casing; set seaward end of product pipeline on seabed and move to 2nd HDD.	As above	DP lay barge spread	Same
Pipelay of product line through 2nd HDD casing and Pipelay of 1st pipeline	Retrieve wire from onshore winch; attach to pipe string; lay out through 2nd HDD casing while onshore winch pulls product pipeline through; upon completion of HDD section continue regular pipelay from HDD to deep end.	As above	DP lay barge spread	Same

Sub Task	Description of Work Plan, Methods and Procedure	Manpower & Day Shift	Vessel & Equipment	HSE Training & Certificate
PLEM laydown, 1st Pipeline	Laydown 1st 24" pipeline with PLEM to predetermined target box in -3000-ft water depth.	As above	Same	Same
Pipelay of 2nd Pipeline	Move vessel back to the other tie-in location at the HDD, retrieve product pipe at exit in shallow water and lay-out 2nd pipeline to deep water end.	As above	Same	Same
PLEM laydown, 2nd Pipeline	Laydown 2nd pipeline with PLEM to predetermined target box at the deep water end.	As above	Same	Same
Jumper Installation	Metrology for jumper spool fabrication, fabricate the jumper on the pipelay barge /DSV (or an onshore location), lowering the jumper to seabed using a spread bar. Install jumper spool.	As above	Same	Same
As-Built Survey	Pipeline as-built survey to be started from - 40-ft water depth to the deep end in -3000-ft water depth for both pipelines.	As above	Same	Same
Demobilization	Pipelay vessel to be demobilized to port upon completion of the pipeline installation. Other supporting vessel and spreads may be relocated to different site for subsequent operations or may be demobilized per project schedule.	As above	Same	Same

Note:

(1) Operation assumes that the ROV is operated from the survey vessel or pipelay vessel.

2. Pre-Commissioning (Hydrotesting, Pigging, Gauging and Cleaning)

Sub Task	Description of Work Plan, Methods and Procedure	Manpower & Day Shift	Vessel & Equipment	HSE Training & Certificate
Mobilization	Onshore pre-commissioning spread is deployed at the onshore RCTS.	2 x 10 crew	Onshore hydrotest / pre-commissioning spread, including pump, water storage tank	RSO Contractors Safety Training

Sub Task	Description of Work Plan, Methods and Procedure	Manpower & Day Shift	Vessel & Equipment	HSE Training & Certificate
Close Flooding Valve at Deep End	Close the valve to the flexible riser used for free flooding by ROV.	Permanent crew of 50, 2 x 2 ROV operators 2 x 4 Riggers 2 of 12 hrs shifts/day	DSV/ROV vessel and spread	Same
Pipeline Filling	Municipal water source will be used. Fill water into the two pipelines for the pipeline sections to the onshore test site.	Onshore + offshore	Onshore hydrotest / pre-commissioning spread	Same
Gauging, Pigging and Cleaning	Launch gauge plate, cleaning brush together with pig from a pig launcher at the onshore test site, pumping water into the pipeline to drive the pig through the pipeline. Retrieve the gauging plate, brush and pig at the onshore test site.	Same	Same	Same
Hydrotesting	Conduct hydrotest on the two pipelines.	Same	Same	Same
De-watering, Purging And Nitrogen Filling(Note 1)	If required, the pipeline will be dewatered using polymer pig launched from the onshore test site and driven by air pumped into the pipeline from the onshore test site. Water (treated) from pipeline will be discharged to agency-approved storm water sewers near the RCTS. Pipeline is purged and filled with Nitrogen upon completion of dewatering.	Same	Same	Same
Demobilization	Demobilize all the pre-commissioning spreads upon completion of this operation.	Same	Same	Same

Note:

(1) The above description is based on the assumption that the riser installation will follow the completion of pipeline pre-commissioning and pipeline dewatering will be completed regardless of possible water in the risers. Due to fact that the flexible risers are likely to be installed with free flooding, hence the pipeline dewatering, purging and Nitrogen filling are subject to the flexible riser installation schedule and the project requirements.

(2) The training acronyms are explained as follows: Refinery Safety for Operators (RSO) is the West coast equivalent of the Basic Plus Safety course. HUET/MS - Helicopter Underwater Egress Training/Marine Survival course - must include both classroom and in-pool training. This course is required for anyone who will transfer offshore or to a vessel by helicopter. Offshore Transfer Training is a DVD course or classroom course. International Association of Drilling contractors (IADC) Rig-pass - This course must be completed by anyone who will perform work where work is defined as “effort applied by a gloved hand” and must be completed before going offshore on a vessel or rig. Minerals Management Service (MMS) Marine Trash and Debris is a power-point training slideshow created for the MMS by the Offshore Operators Committee. J P Kenny has this course in hand and can make it available. RSO is a basic safety course in safety fundamental taught in the Los Angeles Area by the Occupational Safety council of America in Long Beach or other RSO training provider.

3. As-Built Survey

Sub Task	Description of Work Plan, Methods and Procedure	Manpower & Day Shift	Vessel & Equipment	HSE Training & Certificate
DSV Relocation,	Relocate the DSV spread to the job site	Permanent crew of 25, 2 x 2 ROV operators 2 x 4 Riggers 2 of 12 hrs shifts/day	DSV spread, ROV spread	RSO Contractors Safety Training a) MS Env. b) IADC - Rigpass c) Helicopter: HUET/MS or if Crewboat: Offshore Transfer course
Survey Relocation or Mobilization	Relocate the survey spread to job site. Mobilize the survey spread if a different Contractor is to be used.	Permanent crew of 40, 2 x 2 technicians, 2 x 2 surveyors 2 of 12 hrs shifts/day	Survey vessel spread. Vessel is Not needed if the survey equipments can be deployed from DSV.	
Survey of 1st Pipeline	Complete as-built survey of the 1st pipeline	Same	Same	Same
Survey of 2nd Pipeline	Complete as-built survey of the 2nd pipeline	Same	Same	Same
Span rectification	Pipeline free span correction offshore for identified excessive free spans	Same	Same	Same
Free Span Survey during Hydrotest	While assisting the hydrotest operation, conducting survey of rectified free spans and other critical areas that have been identified when the pipeline is filled with seawater	Same	Same	Same
Demobilization	Demobilize all the as-built survey spreads upon completion of this operation.	Same	Same	Same

3.4.11 Work Plan for Construction during Stormy Weather & Weather Forecasting

In the event that weather and or sea state change beyond the acceptable working range of the sea-going pipeline construction vessels, the following contingency plan will be implemented.

<u>Temporary Abandonment and Resuming Offshore Construction</u>

Dynamic analysis will be performed for offshore operations to identify the weather limits for each operation. Construction procedures will be prepared based on the information of limiting sea states to cover the execution of these operations for both normal and contingency conditions.

A temporary abandonment of the undergoing offshore construction operations will be considered when the established limits have been reached. Weather forecasts will be closely monitored on the vessel. For emergency situations offshore that imposes immediate threats to the safety of the vessel or crew, Woodside will take immediate actions to protect crew and vessels.

Temporary abandonment operations will commence whenever Woodside decides to do so. The abandonment operations will be dependent upon on the severity of the site environmental conditions. The construction vessel may stay at the job site or steam back to the port for shielding.

Similarly, resuming normal construction activity will be depending on the environmental conditions.

Weather Forecasting

Five days weather forecasting or longer for named storm event is typically achievable. However, for small construction vessels with limiting sea states for safe operations less than typical monthly maximum weather conditions, a reliable five days weather forecasting may be questionable. In this case, a daily based weather prediction for the project job location may be more realistic.

3.4.12 Marine Crew

Woodside will man the vessels or cause the vessels to be manned with a full complement of qualified (licensed, where necessary) officers and crew. The marine crew will comply with all applicable rules, regulations or orders to operate the vessel and to comply with all applicable federal, state, and municipal rules, regulations, conventions, requirements, and laws. Additionally,

3.4.13 Utilities

Woodside will assume responsibility for any work that may be performed near, upon, over and/or under existing utilities, including but not limited to oil, gas, or other pipelines, electric power, telephone and other cables. Woodside will assume responsibility for giving all required notices, including written notices to the owners of the utilities, prior to performing any work near, upon or under a utility. Woodside will coordinate, as necessary with the appropriate utilities, any design, construction, safety, and work permits that are required for construction activities in and around the applicable utility facilities. If utility facilities are negatively impacted in any way by Woodside's operations, Woodside will ensure repairs are promptly made.

3.4.14 Temporary Abandonment and Recovery of Pipeline

Pipelaying conditions will be determined by comparing pipelay dynamic analysis results with vessel limiting conditions as determined by vessel motions. When weather conditions are determined to be a threat to pipelay operations, temporary abandonment operations will be enacted. Weather forecasts will be monitored on the vessel to project the need for pipelay abandonment.

Temporary abandonment operations will commence whenever weather conditions do not allow continuing pipelay operations, or if component failures occur within the pipelay system.

In case the pipeline is to be temporarily abandoned, the following procedure will be used:

- The abandonment head will be welded to the pipeline and shackled to the abandonment and recovery (A&R) cable with an intermediate sling.
- Optionally, a depth transponder may be installed on the A&R head before deployment.
- Abandonment parameters will be determined.

- Upon completion of the abandonment operation, two methods will be available for the handling of the A&R cable:
  - Vessel stays attached to the pipeline.
    - The pipelay vessel abandons the pipe on the seabed using the A&R cable. The vessel then remains on station with the A&R cable paid out and connected to the pipeline abandonment head.
  - Vessel disconnects from the pipeline.
    - The pipelay vessel abandons the pipe on the seabed with an acoustic transponder and a recovery sling affixed to the abandonment head. The vessel then abandons the pipe, cuts the intermediate sling, and moves off station. After the weather calms, the vessel can move back to the station, locate the abandoned pipeline, via the transponder, and recover by hooking on to the recovery sling.

3.4.15 As-Built Survey

Woodside will conduct an as-built field survey on the installed pipelines upon completion of offshore installation work. As a minimum the following information will be provided to the authorities as a part of the as-built documentation covering the area of the offshore pipeline:

- Pipeline alignment sheets showing the as built coordinates of the following pipeline locations: HDD exit, block crossings, shipping lane crossings, foreign cable crossing, all pipeline curves with starting and end points and the corresponding radii, PLEM at the deepwater end, all locations with abnormal geophysical and geotechnical features. In addition to the evenly spaced regular station numbers (such as mile post) on the pipeline alignment sheets, station numbers in feet will also be provided on the drawings for all of the above locations. Pipeline details such as pipe diameter, wall thickness, anti-corrosion coatings and concrete weight coating where applicable and the locations where pipeline cross section changes, buckle arrestors and anode locations will also be reflected as additional station numbers on the alignment sheets.

- Pipeline route survey three dimensional coordinates in digital format will also be provided at the resolution that meets the industrial standard.

- Pipeline construction stalk sheets showing the line pipe ID number, pipeline field joint number, weld ID number, and cumulative pipeline length in the same convention as station number on the alignment sheets

- All inspection reports on line pipe, line pipe coating, field joint weld, field joint coating, and the ID numbers for each compiled in a pipeline as-built database.

- The as-built survey will be conducted before hydrotest and cover the period of hydrotest.

- Report on free span inspection. For each pipeline free span, span ID number, span starting and end station numbers in feet, span length and the height of the pipeline bottom above the seabed will be provided. If any span correction measure is made offshore then the span data after the correction will also be provided.

- Report on pipeline buckle inspection and sea bottom feature inspection. If a buckle is suspected the location should be identified and the suspected buckle should be verified by the gauging plate result available after the pre-commissioning operation. Pipeline natural settlement on the undisturbed sea floor will also be provided along the pipeline route. Special geophysical and geotechnical seabed features identified in the earlier route survey will be reexamined in the as-built survey and any new features found in the as-built survey will be reported.

4.0 Receiving and Custody Transfer Station

The 24 inch (600 mm) subsea / onshore pipelines terminate at the Receiving and Custody Transfer Station (RCTS). The RCTS will be located approximately 4 miles inland from the onshore endpoint of the HDD pipeline section. The proposed location for the RCTS is at 5651 96th Street, Los Angeles, CA.

4.1 Description

The property on which the RCTS will be installed is a 3 acre site currently comprised of a level paved parking area around a 57,000 square foot office building and warehouse. The RCTS equipment will occupy some of the current parking area. Some of the warehouse space will be utilized to house the future IGIF equipment. The site will be provided with perimeter security chain link fencing and other security systems as may be deemed necessary during the detailed design phase of the project. The two parallel 24 inch (600 mm) pipelines will transition from below ground to above ground and each pipeline will terminate at a 30-inch (750 mm) diameter scraper trap. Mainline valves will be provided to isolate the 24 inch pipelines from the downstream pipeline system.

Pressure regulating valves will be provided to reduce the pressure of the natural gas from the offshore pipeline to a level compatible with the maximum allowable operating pressure (MAOP) of the onshore distribution system, which at present can be 650 psig or 465 psig (45 barg or 32 barg) depending on tie-in location. A gas preheating system will be required upstream of the pressure reducing valves to ensure the gas can be delivered to SCG at or above the contracted minimum temperature.

A high integrity pressure protection system (HIPPS) will be provided to protect the downstream low pressure distribution system from potential over pressurizing by the higher pressure subsea pipelines.

While the natural gas is initially odorized immediately following regasification on the RLNGC, a supplemental odorization injection system will be provided at the RCTS.

An inert gas injection facility (IGIF), described in detail elsewhere, will be required to meet the natural gas specification recently modified by the California Public Utilities Commission (CPUC). The IGIF will be installed at the same property address as the RCTS.

Custody transfer metering will be provided at the RCTS.

Downstream of the gas preheating, pressure regulating, odorant and inert gas injection facilities, and custody transfer metering, the gas piping will connect to a single 42-inch (1050 mm) scraper trap serving the 36 inch (900 mm) onshore pipeline that will transition from above ground to below ground inside the facility.

The facility will be provided with Supervisory Control and Data Acquisition (SCADA) instrumentation and telecommunications equipment allowing for the remote monitoring of operations and actuation of the mainline valves. This equipment will be housed in a climate-controlled SCADA telecommunications room within the existing building.

Scraper traps for each of the upstream 24 inch (600 mm) pipelines will consist of a 24 inch x 30 inch (600 mm x 750 mm) eccentric reducer, 30 inch diameter x 12 foot (750 mm x 3.7 m) long pipe (length and barrel diameter to be verified during detailed design), quick-opening 30 inch (750 mm) diameter closure at the end of the barrel, and all necessary piping, control, and locking systems for safe operations. A single scraper trap for the 36 inch (900 mm) onshore pipeline will consist of a 36 inch x 42 inch (900 mm x 1050 mm) eccentric reducer, 42 inch diameter by approximately 12 foot (1050 mm x 3.7 m) long pipe, quick-opening 42 inch (1050 mm) diameter closure at the end of the barrel, and all necessary appurtenances as listed above.

All scraper traps will be outfitted with lifting equipment necessary to move cleaning pigs and pipeline inspection tools off service vehicles onto the loading trays at the rear of the scraper traps. The scraper traps will be installed within a diked area. The scraper traps will be designed in accordance with 49CFR192, ASME B31.8, and the ASME Boiler and Pressure Vessel code.

Figure 7-4, Proposed Woodside Onshore Receiving and Custody Transfer Station Process Flow Diagram, illustrates the operations performed at the RCTS; and **Figure 7-3**, Proposed Woodside Onshore Receiving Station, illustrates the piping and equipment arrangement at the RCTS; both of these figures are provided in Exhibit A, Project Description.

Figure 6 shows a typical scraper trap arrangement.

4.2 Station Construction

Facility construction will consist of pipeline line-up, welding, and non-destructive examination (NDE) of the girth welds; joint coating and subsequent testing of the joint coating for buried piping; pavement cutting, trenching, padding, lowering in, backfilling and compaction for the buried portions of the pipelines; installation of above ground piping, valves and instrumentation; installation of a gas preheating system; installation of the HIPPS system, installation of a prefabricated odorization skid with tie-in to the onshore pipeline; installation of electrical power and control wiring; hydrostatic testing of facility piping; installation of concrete foundations; painting of above ground process piping; and installation of cathodic protection materials and equipment; and modifications to the interior of the existing building to accommodate the SCADA/telecommunications equipment.

5.0 Onshore Pipelines

The 24 inch (600 mm) subsea pipelines transition from laying on the seabed to being “threaded” through the HDD casing pipes buried deep below the near shore area. The HDD sections terminate at a point approximately 1000 feet (300 m) inland from the high tide mark, just east of Vista del Mar. Downstream from the onshore endpoint of the HDD sections, 24 inch (600 mm) remotely-actuated block valves will be provided to isolate each 35-mile long offshore pipeline from each onshore pipeline. These block valves will be buried with a minimum depth of cover of 3 feet (1 m). Downstream of these block valves the onshore pipelines cross the sand dunes between Vista del Mar and Pershing Drive. After crossing Pershing Drive the pipelines will be installed beneath the road surfaces of Westchester Parkway / Arbor Vitae Street and Bellanca Avenue terminating at the RCTS about 4 miles inland.

In the full development, the onshore pipeline system downstream of the RCTS will be owned and operated by SCG and will be approximately 12 miles (19 km) long. The SCG pipeline will begin as a 36 inch (900 mm) diameter x 0.25 miles long pipeline to Tie-In #1, and then, subject to market demand, continue for an additional 11 miles (18 km) as a 24 inch (600 mm) line to the terminus at Tie-in #3. Again depending on market demand, there may be a 1-mile long 24 inch (600 mm) diameter lateral to Tie-In #2. At all tie-ins with the existing SCG gas grid, pressure limiting stations will be provided to protect the lower pressure downstream system. At Tie-In #1, connections for 36 inch and 24 inch (900 mm and 600 mm) temporary scraper traps will be provided. At Tie-Ins #2 and #3, connections for 24 inch (600 mm) temporary scraper traps will be provided. An impressed current cathodic protection system will be installed to supplement the corrosion coating. Mainline isolation valves will be installed at spacing intervals in accordance with 49CFR192.

Refer to **Figure 5-2**, Onshore Pipeline Route and Tie-Ins, provided in Exhibit A, Project Description.

5.1 Applicable Codes and Standards

Codes and/or recommended practices in **Table 4** will be the principle guides for the design and installation of the onshore pipelines.

Table 4 Onshore Pipeline Primary Codes and Standards

Code	Title
49CFR192	Code of Federal Regulations, Title 49 Transportation, Part 192 - Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
CPUC G.O. 112E	State of California Rules Governing Design, Construction, Testing, Operation, and Maintenance of Gas Gathering, Transmission, and Distribution Piping Systems.
API Spec 6D	American Petroleum Institute: Specification for Pipeline Valves (Gate, Plug, Ball, and Check Valves)
ASME B31.8	American Society of Mechanical Engineers: Gas Transmission and Distribution Piping Systems
ASME B&PV code	American Society of Mechanical Engineers: Boiler & Pressure Vessel Code

5.2 Design Criteria

The onshore pipelines will be designed to the following criteria:

5.2.1 Pressure Containment

Pipeline hoop stress will meet the requirement of 49CFR192 and ASME B31.8.

5.2.2 External Corrosion Resistance

External corrosion coating will be applied on to the outer surface of the pipelines for corrosion protection. An impressed current cathodic protection system will be used to protect the pipeline in areas where the coating has been damaged during handling or installation or where the coating has otherwise failed.

5.2.3 Hydrostatic Testing and Drying

The pipelines will be minimally hydrostatically tested in accordance with the requirements of 49CFR192, and generally will be hydrotested to 90% of SMYS for the thinnest pipe wall segments. After dewatering the pipelines will be dried to a minus 40°F dew point.

5.2.4 Foreign Pipeline and Utility Crossings

A minimum vertical separation distance of 18” (46 cm) will be provided at foreign pipeline and utility crossings. Where deemed necessary by engineering, Woodside will coordinate with the owners of such crossed pipelines for the purpose of determining the need to electrically bond the new pipeline(s) to any existing pipelines that are crossed or in a parallel encroachment.

5.2.5 AC Mitigation

At locations where the pipeline alignment cross overhead high voltage power lines, the detailed design of the onshore pipeline(s) will take into consideration the effects of induced AC current and provide the necessary facilities to mitigate those effects.

5.2.6 Road and Railroad Crossings

Where open cut crossings are not allowed, i.e., at a highway crossing, road crossings will be accomplished via the slick bored or cased crossing method. Bridged crossings may be considered where implementation of the bored crossing method is deemed impractical.

5.2.7 Mainline Valves

Remotely-operable block valves will be provided at the downstream ends of the HDD-installed landfall pipeline sections to isolate each offshore pipeline segment from each onshore pipeline segment. The valve bodies will be buried with the valve stems and actuators protruding approximately 6 ft (2m) above grade. A stainless steel cabinet will house control instrumentation and telemetry equipment. This MLV site will be 50 ft by 80 ft (15m x 24m) in area and will be graveled and fenced. The MLVs will be sited on the previously disturbed area occupied by the HDD equipment.

Mainline isolation valve spacing will be determined by applying the results of a class location study, to be performed during the detailed design phase of the project, and the requirements of federal pipeline code section 49CFR192.179. Mainline valves in city streets will be direct buried with their actuators installed below grade in vaults. Isolation sections will be provided with the capability to be depressurized to atmosphere.

5.2.8 Seismic Considerations

One fault zone will be crossed along the pipeline route from the RCTS to the SCG tie-in(s). Woodside will evaluate various risk mitigation measures during the detailed design phase of the project, including optimizing the crossing angle, increasing pipe wall thickness, increasing the yield strength of the pipe, altering the ditch backfill, utilizing casing, or adding line break valves on either side of the fault zone.

5.3 Onshore Pipeline Construction

Onshore pipeline construction in the streets will typically proceed at approximately 300 feet (90 m) per day per pipeline spread (one spread is planned for Stage I). Onshore pipeline construction will proceed as progress dictates to remain on schedule, occurring either 4 or 5 days per week, Monday through Thursday or Friday, from 9 a.m. to 3 p.m.

During construction, temporary construction easements and workspaces will be established as summarized in **Table 13-2**, “Temporary Work Space Requirements”, in Exhibit A, Project Description.

Construction of the pipeline within the existing paved roads will require temporary closure of at least one or two lanes; a detailed traffic control plan will be developed as part of the onshore construction procedures, which will be submitted by Woodside for approval by the responsible jurisdiction (affected county or municipality). Appropriate warning signs will be placed at strategic locations to warn drivers of the closed lanes. Flagmen will be used at busy intersections or roadways. Conventional boring techniques may be employed to install the pipeline beneath high-volume roads, highways and railroads. Potential impacts to specific roadways are discussed in Topic Report 9, "Traffic."

5.3.1 Dunes Crossing

To avoid disturbing the surface environment of the sand dunes east of the landward end of the shore crossing, installation along this segment of the pipeline alignment will be performed via the traditional HDD method. This HDD will include the crossing of Pershing Drive.

At the completion of drilling and casing installation for the landfall, the same HDD rig will be utilized to drill a crossing of the dunes east of the drill site. This is achieved by repositioning the drilling rig to face the new alignment, followed by pilot hole drilling and back reaming in the conventional manner.

The HDD will exit at a predetermined location and will require an area of approximately 100-feet (30 m) by 200-feet (60 m) for pipe side operations. The prefabricated 24 inch (600 mm), 2600 foot (852 m) carrier pipeline is then pulled into the HDD hole using the drilling rig.

The area required to pre-fabricate the pipeline string is 50-foot (15 m) wide by 2800-foot (920 m) long.

The process involves the following installation sequence:

- Prepare two 24–inch 2600-foot natural gas carrier pipelines behind the proposed exit point and support on rollers. Welding of the carrier pipeline strings and protective coating of those joints will be undertaken prior to the commencement of drilling.
- The drill rig is positioned facing the proposed 'dune crossing' alignment and the pilot hole is drilled. The alignment provides adequate cover beneath Pershing Drive prior to punching out at the exit point within LAX property.
- At the exit point a small pit is excavated to contain any drilling fluids.
- A reaming tool is fitted to the drill string and the hole is back reamed. An excavator and crew are situated at the exit point to connect the drill string behind the reamer.
- Once the first back reaming pass is completed a larger reamer is fitted at the exit point and pulled through the borehole. This process is continued and a hole of 36" is achieved.
- The drill string is then connected to the carrier pipe string via a swivel. The prefabricated carrier pipe is then pulled through the completed hole until it reaches the drill rig.
- The same process is repeated for the second natural gas carrier pipe.
- Once completed the drilling operation can be demobilized from the site and the winching assembly established for the shore pull operations (see Section 1.3.3).
- At the completion of the winching operation for the landfall pipeline, the mainline isolation valves can be installed and the dune crossing HDDs can be tied in using a spool to connect the pipelines.

Refer to **Figure 2A**

5.3.2 In Street Construction

East of the Pershing Drive the onshore pipeline construction will be conducted using one main construction "spread" (workers and equipment). As shown in **Figure 7-6,** Typical Onshore Pipeline Construction Sequence City Streets, in Exhibit A, Project Description, construction will proceed in the following general order: (1) pre-construction activities, including surveying and marking the construction ROW, (2) pavement cutting; (3) ditching; (4) hauling, stringing, and bending the line pipe; (5) lowering in, line-up, and welding; (6)

weld inspection; (7) application of protective coating to weld joints; (8) backfilling and compaction; (9) hydrostatic testing; and (10) ROW cleanup, paving, and restoration. Due to the nature of pipeline construction in congested city streets, the entire spread is concentrated in a 1000 foot (300 m) section of the pipeline alignment to minimize the disruption to traffic.

Pre-Construction Activities

Onshore pipeline construction work will begin with a ROW survey and pavement marking, property owner notifications, and a One-Call notification to identify buried utilities and other uses that may be impacted by the construction. The construction ROW and extra workspaces necessary for boring beneath highways and railroads and the ROW required for trenching will be prepared.

Potholing

This task involves digging a small hole or trench to positively locate any existing substructures so they can be protected during construction.

Pavement Breaking

In paved roadways, a saw is used to cut the outline of the trench to be excavated. Once outlined, the pavement is broken and removed.

Ditching – Dual 24 inch (600 mm) Pipelines

The pipelines will be installed within the same ditch with 12 inches (30 cm) of horizontal separation between them to allow for maintenance access. A 7- to 8-foot (2.2 to 2.4 m) wide, 6-foot (1.8 m) deep ditch will be excavated with a backhoe or trencher. At the weld joints a bell hole will be dug to allow for up to 3 pipeline welders to weld the joints of pipe together in the ditch. The line up crew will endeavor to align the ends of the joints of the parallel pipelines near each other so welding of both pipelines can be done in a common bell hole. The dimensions of the bell hole for welding will be 11 to 12 feet (~3 to 4 m) wide and 8 to 10 feet (~3 m) long. Ditch depth can vary if special conditions are encountered, e.g., crossing existing substructures. Previously identified buried utilities such as other pipelines, cables, water mains, and sewers will be located by hand digging; see the subsection on potholing below.

To minimize damage to the roadway, rubber tired or tracked vehicles will be used.

If groundwater is encountered, temporary dewatering can be required. Water discharges will be in accordance with the National Pollutant Discharge Elimination System (NPDES) permit for the Project.

Fugitive dust emissions during earthmoving operations will be controlled using water trucks equipped with fine-spray nozzles. Depending on weather conditions, up to 30,000 gallons (114 m^3) of water may be used per day for dust suppression. The most likely source will be municipal water purchased from a local water supply or other similar source.

Ditching – Single 36 inch (900 mm) and Single 24 inch (600 mm) Pipelines

The dimensions of the main trench for the single 36 inch (900 mm) will be 4.5 feet (1.4 m) wide and 7 feet (2.2 m) deep. The dimensions of the bell hole for welding will be 9 to 10 feet (~3 m) wide and 8 to 10 feet (~3 m) long. All other aspects of the ditching for this pipeline would be the same as those described above for the 24 inch (600 mm) dual pipelines.

The dimensions of the main trench for the single 24 inch (600 mm) will be 3.5 feet (1.1 m) wide and 6 feet (1.8 m) deep. The dimensions of the bell hole for welding will be 9 to 10 feet (~3 m) wide and 8 to 10 feet (~3 m) long. All other aspects of the ditching for this pipeline would be the same as those described above for the 24 inch (600 mm) dual pipelines.

Plating and Barriers

In order to maintain access to businesses and residences, steel plates are installed over the ditch. Where a wide portion of trench must be left open overnight, barriers may be employed in lieu of trench plating.

Hauling, Stringing, and Bending

Pipe-stringing trucks will transport the pipe in 60- foot (18 m) lengths to the pipeline ROW. Where sufficient space exists, trucks will carry the pipe along the ROW. Side boom tractors will unload the pipe joints and lay them end-to-end beside the ditch line for future line-up and welding.

The line pipe will be hauled from the storage yard next door to the CSI pipe mill in Fontana, California, along U.S. Interstates 10 and 405, approximately 61 miles to the construction area. The onshore pipeline will be installed starting at the landfall at the HDD location near Vista del Mar and Sandpiper Street near the northwestern corner of Los Angeles International Airport. Line pipe will be hauled four (4) joints per load. Assuming the line pipe is provided in 60-foot joints will result in 240 linear feet per load. To achieve the anticipated 300 linear feet per day lay rate, one load per day will be delivered for three days, then two loads on the fourth day, and then this pattern will be repeated.

The pipe will be bent in the field, vertically and horizontally, to fit the contour of the ditch. Construction in roadways with existing substructures will require pipe bends for which bending in the field will not be practical. In these cases, manufactured or shop-made bends will be used.

Lowering In, Line-up, and Welding

After laying the pipe next to the ditch for one spread, the pipe will be lowered into the ditch by side boom tractors, which will be spaced so that the weight of unsupported pipe will not cause mechanical damage. For in street construction, ditch welds will be required and will be made at the final elevation. Each weld will require pipe handling for line-up, coating, and backfilling, in addition to normal welding and weld inspection.

Welders certified and tested to meet project procedures will perform all field welding. Welding will comply with the specifications of all applicable State and Federal regulations, including 49CFR192 (for natural gas pipelines) and CPUC regulations regarding gas pipelines, General Order 112E.

All welds will be 100 percent radiographically inspected. Radiographs will be recorded and interpreted for acceptability according to applicable regulatory requirements. All rejected welds will be repaired or replaced as necessary and reradiographed. Woodside will retain the X-ray reports and a record indicating the locations of welds.

Backfilling

Spoils will generally be returned to the ditch within two days of trenching. The spoils will be screened using standard construction screening equipment, as required. The pipe will be covered along the sides with a minimum of 6 inches (150 mm) of native fill free of rocks, then covered on top with at least 12 inches (300 mm) of backfill free of rocks. In certain areas where the pipe coating might be damaged by abrasive soils along the bottom of the trench, clean sand or earthen backfill will be used to pad the pipeline. The backfill in the remainder of the trench above the padding will be native material excavated during trenching.

During backfilling, a colored warning tape will be buried approximately 18 inches (460 mm) above the pipeline to indicate the presence of a buried pipeline to future third-party excavators. Backfilled soil will be compacted using a sheepsfoot compactor, vibratory roller, or hydraulic tamper before paving. Compaction density and compaction testing will be performed in accordance with the affected municipalities' requirements.

5.3.3 Mainline Valve Station Installation

Mainline valves are envisioned for the onshore sections of the 24 inch (600 mm) pipelines at the HDD landfall and at the scraper traps at the end of the pipelines at the RCTS.

In the full development, one or two intermediate mainline isolation valves are envisioned for the SCG pipeline. The valves will be direct-buried and set on foundations with their actuators installed in underground vaults with provisions for blowing down the upstream and downstream sections in the event of an emergency. The mainline valves will be installed by a separate tie-in crew so as not to interrupt the work flow of the main construction spread.

5.3.4 Hydrostatic Testing

The installed onshore pipelines will be hydrostatically tested after construction and before startup pursuant to Federal regulations (49CFR192). Such tests are designed to ensure that pipe, fittings, and weld sections maintain structural integrity without failure or leakage under pressure. The test period will be in accordance with CPUC and U.S. DOT guidelines. An estimated 8.6 million gallons (32,600 m^3) will be used for the two 24 inch (600 mm) pipelines tested as one test section, including both offshore and onshore sections, and 1.4 million gallons (5,400 m^3) of water would be used in testing the single 24/36 inch (600/900 mm) pipeline if it were to be built during the initial phase of the project. Water will be obtained from a potable water source along the route. Hydrostatic test water will be discharged to an existing channel or wash along the route pursuant to a NPDES permit.

Before discharge, the hydrostatic test water will undergo laboratory analysis to ensure that it meets local, State, or Federal water quality standards. A suitable energy dissipater will be utilized at the outlets and suitable channel protection structures will be used to ensure that there will be no erosion or scouring of natural channels within the affected watershed. These structures will be removed from the site upon completion of hydrostatic testing.

Woodside will keep permanent records of each hydrostatic test for the life of the pipeline. These records will be accessible to the responsible regulatory agencies and will contain the exact locations of the test segment, the elevation profile, a description of the facility, and continuous pressure and temperature readings of the line throughout the test.

5.3.5 Right-of-Way Cleanup, Paving, and Restoration

After completing the pipeline construction, cleanup, paving, and restoration will occur. Restoration will entail repairing the trench cut within the roadway by paving; repairing any damaged landscaping and sidewalks, and removing any debris, construction signs, surplus material, and equipment from construction areas.

5.3.6 Road Crossings

The proposed pipelines will cross several primary roadways as well as U.S. Highway 405 and U.S. Highway 110. Most road crossings will be open cut. Before construction, all utilities will be identified and marked. Once traffic control measures are in place, a 7-foot (~2 m) deep ditch will be excavated; previously identified buried utilities will be located first by manual digging and will be measured to determine the trench depth required to clear them. Road crossings will be completed in accordance with the municipalities' requirements. Where excavating across roadways or highways is not practical, such as areas with very wide roadways, roadways with heavy traffic loads, or where permission of landowner can not be obtained, the pipeline will be constructed by conventional boring methods. Cased crossings will be avoided.

Conventional boring under U.S. Highway 405 and U.S. Highway 110 will require bore pits on each side of the highway. The pits will be approximately 15 to 30 feet (5 to 10 m) long and 8 feet (2+ m) wide. The depth of the pits will depend on the final pipeline depth. Excavation spoils will be placed alongside the pits and will be used as backfill. Casing (if needed) and pipe sections will be welded, inspected, and coated (only the line pipe will be coated; casing pipe will remain bare) in the pit before boring. Upon completion of the pipeline installation, the excavated areas will be backfilled, compacted, and restored to natural contours.

5.3.7 Staging and Storage Areas

There will be at least two staging areas for the onshore pipeline. The staging areas will hold equipment, excess spoils, and contractor offices and materials and will serve for parking for construction workers. Each staging area will be located as close as practical to the construction route. Roads will be used for all construction-related traffic and equipment mobilization; no new temporary or permanent access roads will be needed. Staging or laydown areas will be located on private property on previously disturbed land. During all phases of construction, refueling and lubrication of construction equipment will occur in the contractor's staging areas.

No new pipe yards will be required for the onshore project.

5.3.8 Transportation

Most heavy construction equipment will be delivered to the initial point of the spread on lowboy trucks or trailers. Mobile cranes and dump trucks will be driven to the construction site from existing local contractor yards. Construction equipment will be left overnight either at the site, at contractor yards, or at other existing storage yards in the area. All construction materials will be transported to the construction spreads by truck on existing roadways. In the full development, an estimated 438 truck trips (loads) will be required to deliver the approximate 20 miles of onshore pipeline materials for the 4 miles (about 6 km) of dual 24 inch (600mm), 0.25 miles (0.40 km) of single 36 inch (900 mm), and12 miles (about 19 km) of single 24 inch (600 mm). Each load will consist of four 60 foot lengths of pipeline. All vehicles will be regulation-sized except for pipe-laying equipment, which will likely require oversized loads. The vehicles will include one-ton flatbed trucks, lowboys, pipe dollies, and dump trucks. The contractor will be responsible for local hauling permits with appropriate agencies.

5.3.9 Installation Equipment

The onshore pipeline spreads will each consist of approximately 75 pipeline construction personnel and nearly an equal number of traffic control staff. The envisioned equipment is listed in **Table 5**:

Table 5 Onshore Construction Equipment and Personnel – One Spread

Equipment	Quantity	Fuel Type and Consumption Rate (gal / hr)	Usage (hrs/day)
Pickup Truck	4	Gasoline 3	4
Side Boom	4	Diesel 20	3
Welding Rig	6	Gas 1	6
Gang Truck	2	Diesel 15	3
Dewater Pump Compressor (Note 1)	1	1	5
Water Truck	2	15	4
Back Hoe	4	14	4
Track Hoe	2	25	5
Bending Machine (Note 2)	1	2	6
Boring Machine (Note 3)	1	[_]	[_]
Boom Truck	1	15	3
Wacker Compactor	2	Gasoline 1	4
Steam Roller	1	Diesel 12	2
Asphalt Trucks	2	15	2
Pipe Hauling Trucks	2	15	3
Diesel Pipeline Fill Pump (Note 4)	1	2	6
Diesel Test Pump (Note 5)	1	2	2
1 Ton Flat Bed Truck	2	12	3
Vacuum Truck	1	15	2
Light Plant (Note 6)	1	1	4
1500 sfcm Compressor (Note 7)	1	3	4
Crane	1	18	2

Note 1: Compressors are used to operate air powered ditch water pumps which will only be required when there is water in the ditch after rain events or from groundwater intrusion in deep excavations.

Note 2: Bending machine will be used one day out of three during construction.

Note 3: Boring machine will only be used on major intersections and average one day per week.

Note 4: The pipeline fill pump will operate 1 day during project after the pipeline is constructed.

Note 5: Test pump will operate 2 days during project after the pipeline is constructed.

Note 6: Emergency use only. No night work is planned.

Note 7: Compressor used during cleaning and drying. 1 week use after the pipeline is constructed.

5.4 Tie-Ins to Existing Infrastructure

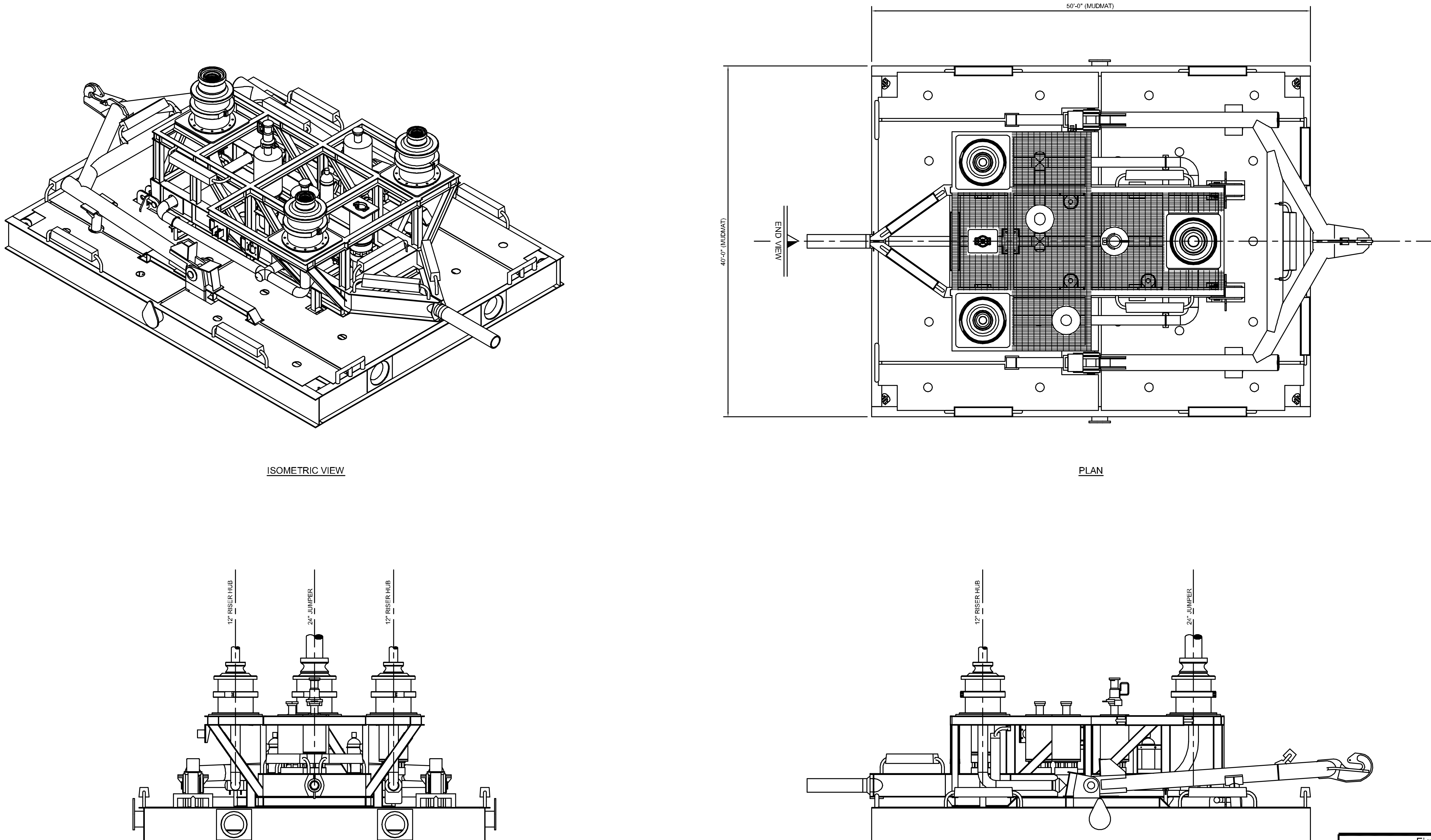
Up to three tie-ins to the existing gas infrastructure are being considered as part of the phased development approach. Construction of the tie-ins will be staged to align with natural gas demand.

All tie-ins will be downstream of the single custody transfer point at the RCTS. The first stage will tie into the gas grid between SCG Lines 2003 and 3007 located near the RCTS near the intersection of Aviation Boulevard and Arbor Vitae Street. The full development will extend the 24 inch (600 mm) line to SCG Lines 2003 and 2006 at the intersection of Century Boulevard and Central Boulevard and to SCG Line 765 and 2003 at the intersection of Santa Ana Street and Otis Avenue. All final tie-in locations will be determined by SCG.

All tie-ins will include pressure limiting facilities to protect the lower pressure downstream systems. The pressure limiting facilities will consist of pressure regulating valves, high integrity pressure protection systems (HIPPS), and, if deemed necessary as a result of studies performed during the detailed design phase, gas preheating equipment will be provided. Process control and monitoring instrumentation at the tie-in facilities will be connected to the SCADA / telecommunications system. The termination of the pipelines at each tie-in location will include piping provisions for the installation of a temporary scraper receiver for the purpose of internal pipeline inspection.

6.0 Other Facilities

Woodside Natural Gas Inc. initial operations will be based out of its office headquarters at 2425 Olympic Boulevard, Santa Monica, California. Operations may later be relocated to the office facilities at the RCTS site. Gas operations management (dispatching) personnel will coordinate deliveries by communicating with SCG, other gas customers, and operations personnel on the RLNGCs from its office location. Woodside will build no separate maintenance facilities. Spare parts and materials will be inventoried at the RCTS and/or at selected suppliers' facilities. Maintenance equipment for the offshore and onshore pipelines will be kept by a complement of qualified contractors.



ISOMETRIC VIEW

PLAN

END VIEW

ELEVATION

SOURCE:
J P KENNY
85267.02-40-S-DW-001-REVB

Figure 1
PLEM ASSEMBLY

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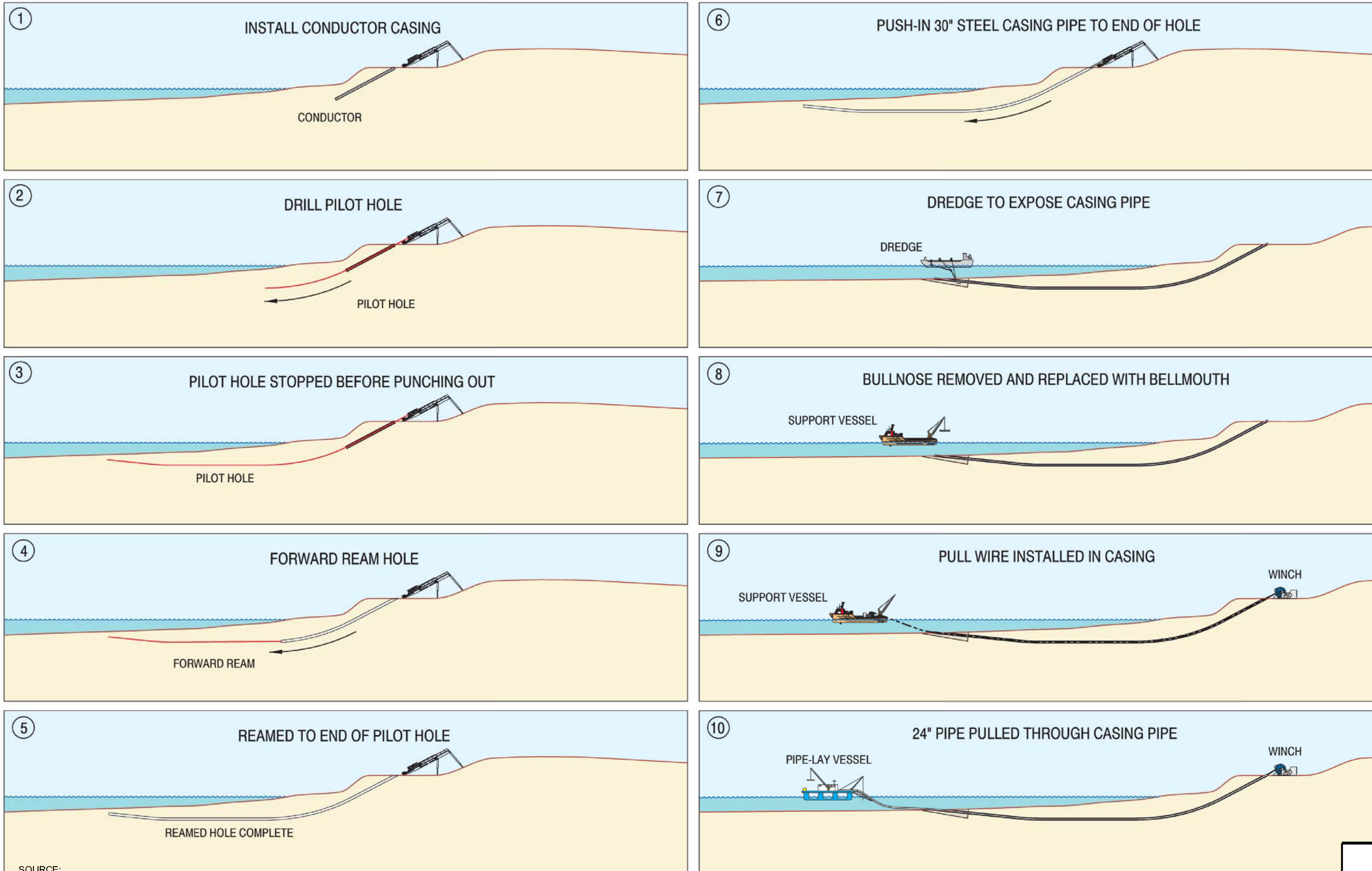
OCEANWAY SECURE ENERGY ENSR AECOM



SOURCE:

Atteris Pty Ltd
Level 6, 68 St Georges Tce
Perth WA 6000
PO Box 7305
Cloisters Square WA 6850

DRAWN: KN	DATE: 22.05.06	PROJECT:	OCEANWAY
CHECKED: DC	DATE: 22.05.06	TITLE:	LA AIRPORT SHORE CROSSING FORWARD REAMED & CASED HDD
APPROVED: EJ	DATE: 22.05.06		
CLIENT:	DATE:	SCALE: NTS A3 DWG No : 05-018-D-004	REV C

Figure 2

HDD INSTALLATION SEQUENCE

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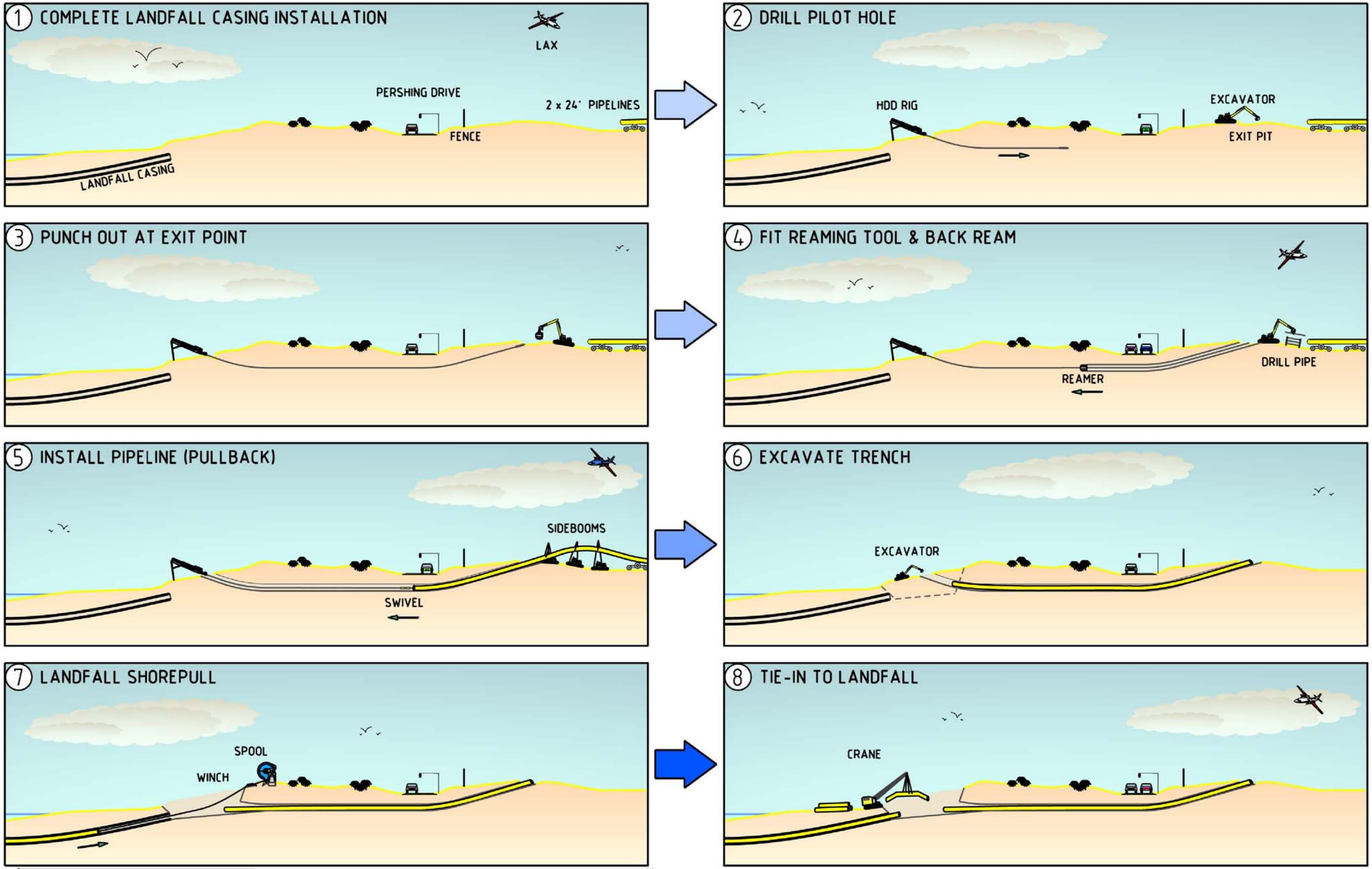
ENSR | AECOM

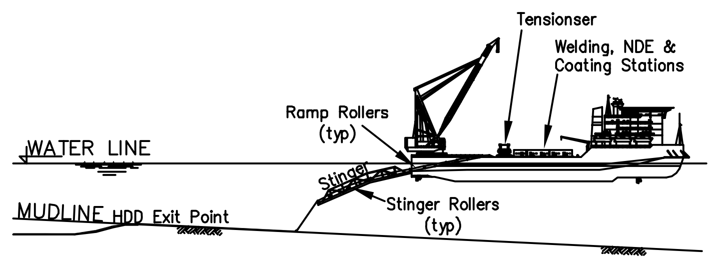


ATTERIS ATTERIS PTY LTD LEVEL 6, 68 ST GEORGE TCE PERTH WA 6000 PO BOX 7305 CLOISTERS SQUARE WA 6850	DRAWN: DATE: 27.06.07	PROPOSED HDD LANDFALL TO PERSHING DRIVE CONSTRUCTION SEQUENCE	
	CHECKED: DATE: 27.06.07		
	APPROVED: DATE:		
	CLIENT: DATE:	SCALE: NTS A3	DWG No 05-018-D-012 REV A

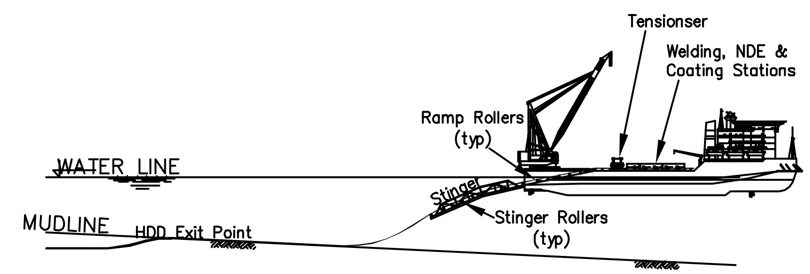
Figure 2A

HDD DUNES CROSSING CONSTRUCTION SEQUENCE

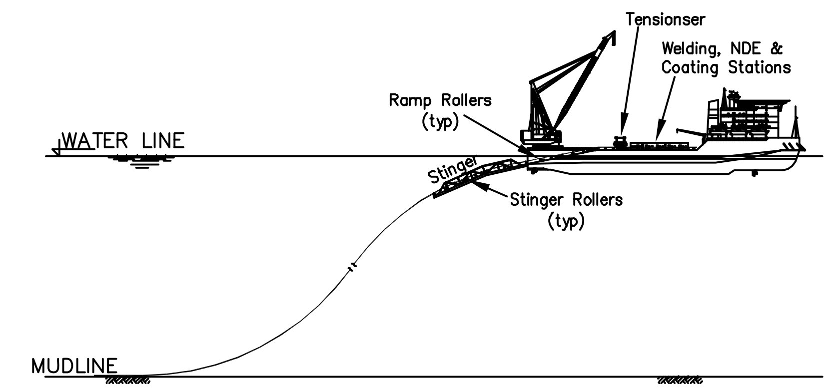
OceanWay Secure Energy



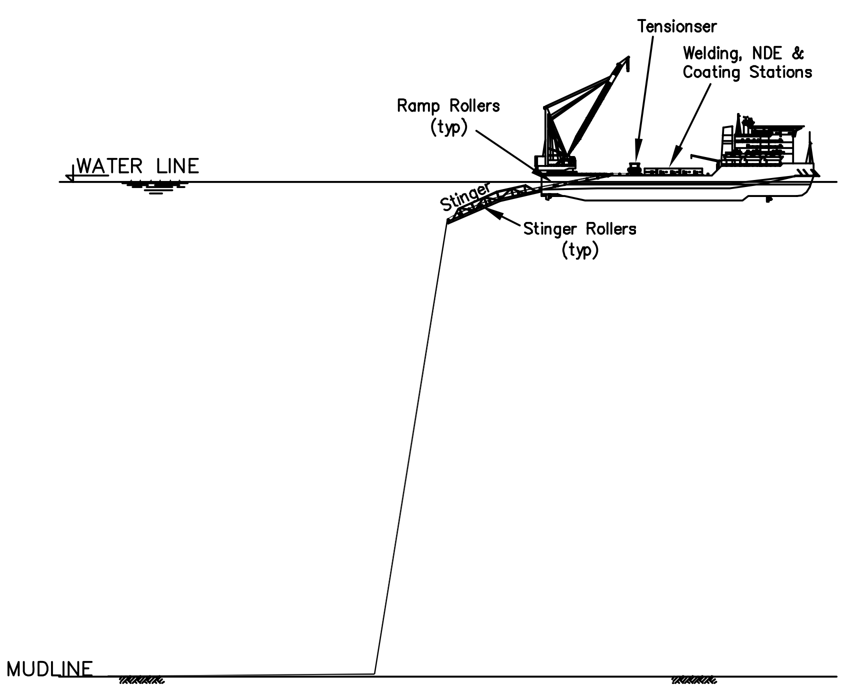
S-LAY PHASE 1
PICKUP HDD PIPELINE FOR TIE-IN TO OFFSHORE PIPELINE
Sketch # 85267-S01, 23/05/06



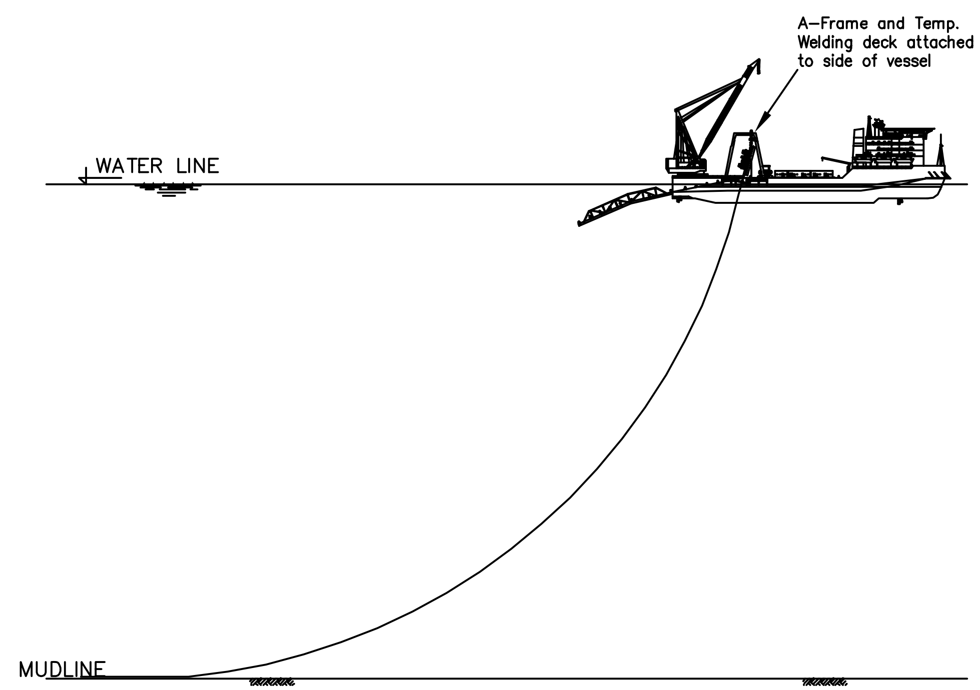
S-LAY PHASE 2
OFFSHORE PIPELINE IS WELDED TO THE HDD PIPELINE
AND START NORMAL PIPELAY
Sketch # 85267-S02, 23/05/06



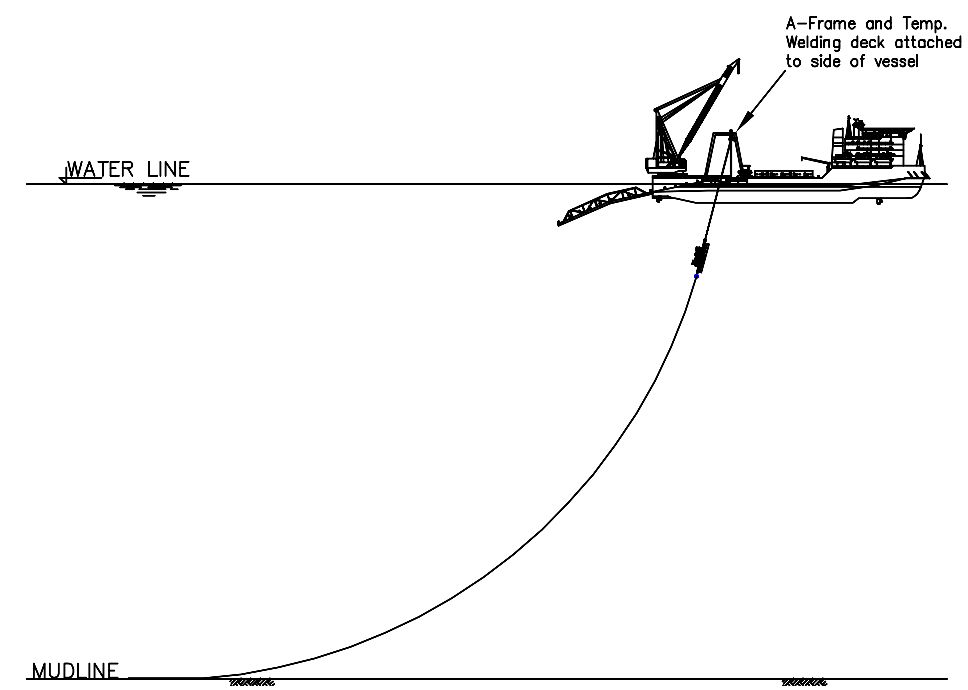
S-LAY PHASE 3
NORMAL PIPELAY FROM SHORE TO
DEEP WATER PLEM LOCATION
Sketch # 85267-S03, 23/05/06



S-LAY PHASE 4
LAY DOWN THE PIPELINE ON SEABED TEMPORARILY
Sketch # 85267-S04, 23/05/06



S-LAY PHASE 5
RECOVER PIPELINE TO SIDE OF VESSEL
AND WELD PLEM ONTO PIPELINE
Sketch # 85267-S05, 23/05/06



S-LAY PHASE 6
LOWERING PLEM TO SEABED FROM VESSEL SIDE
Sketch # 85267-S06, 23/05/06

Figure 3
S-LAY PIPELINE CONSTRUCTION

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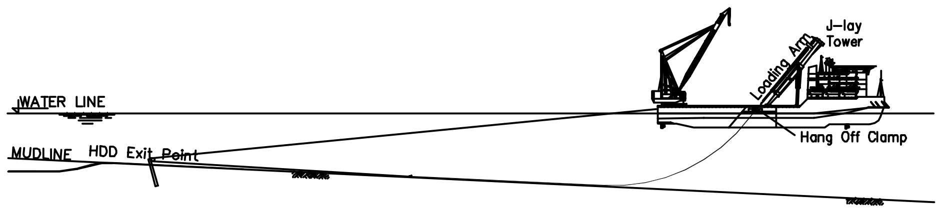
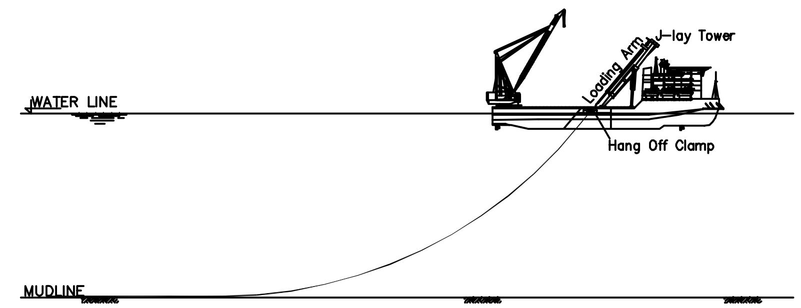
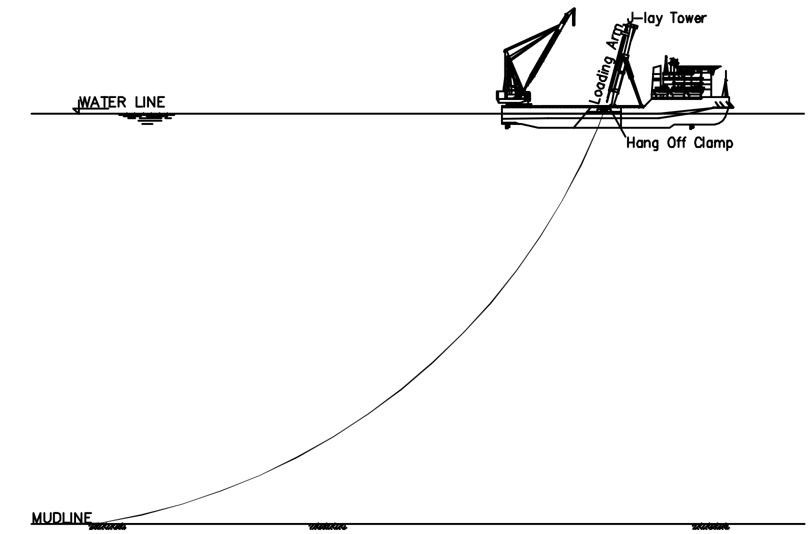
OCEANWAY SECURE ENERGY ENSR | AECOM



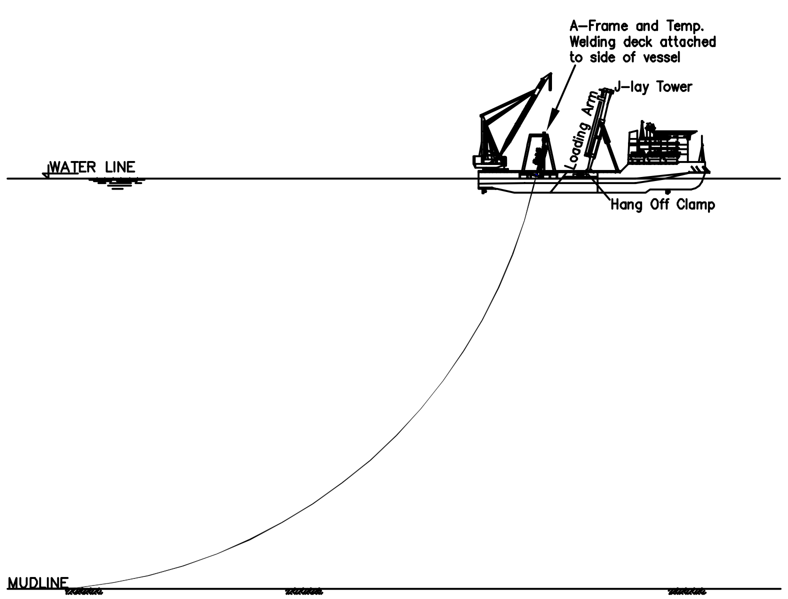
J-LAY PHASE 1
VESSEL PULLS PIPELINE FROM OFFSHORE TO TIE-IN TO THE INSTALLED HDD PIPELINE SECTION
Sketch # 85267-J01, 23/05/06



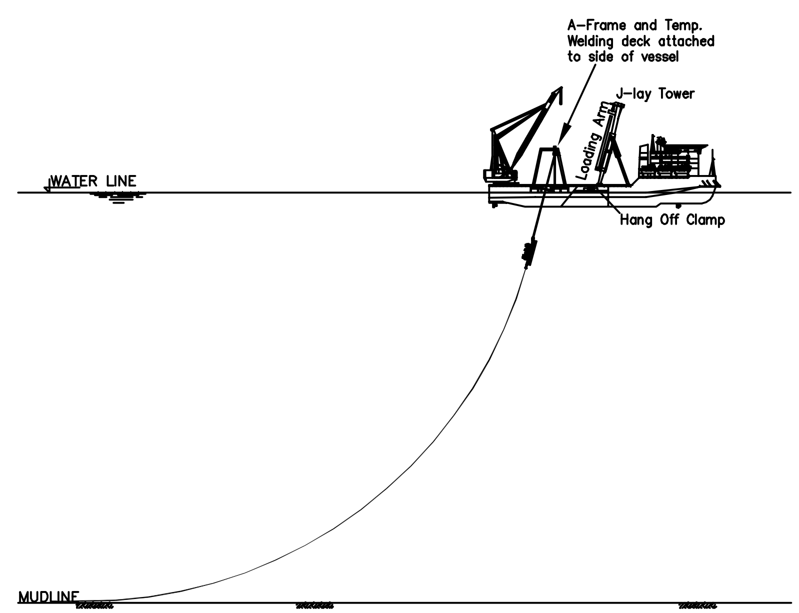
J-LAY PHASE 2
NORMAL PIPELAY FROM SHORE TO DEEP WATER
Sketch # 85267-J02, 23/05/06



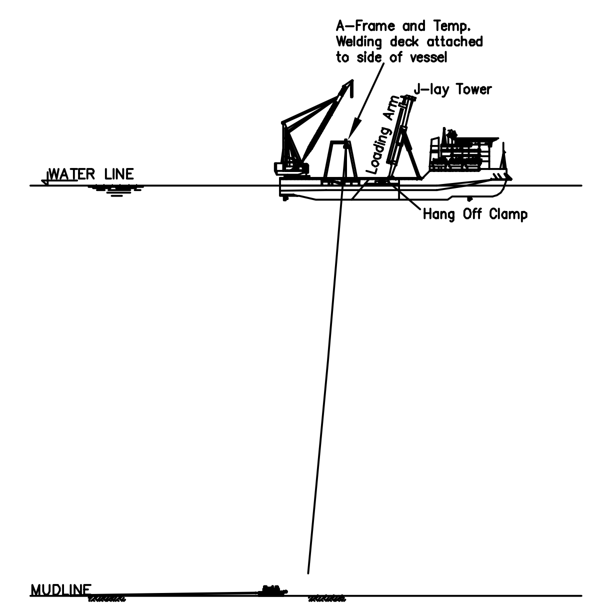
J-LAY PHASE 3
END OF NORMAL PIPELAY AT DEEP WATER PLEM LOCATION
Sketch # 85267-J03, 23/05/06



J-LAY PHASE 4
WELDING PLEM ON END OF PIPELINE FROM VESSEL SIDE
Sketch # 85267-J04, 23/05/06



J-LAY PHASE 5
LOWERING PLEM TO SEABED FROM VESSEL SIDE
Sketch # 85267-J05, 23/05/06



J-LAY PHASE 6
PLEM INSTALLED-RECOVERING WINCH CABLE
Sketch # 85267-J06, 23/05/06

Figure 4

J-LAY PIPELINE CONSTRUCTION

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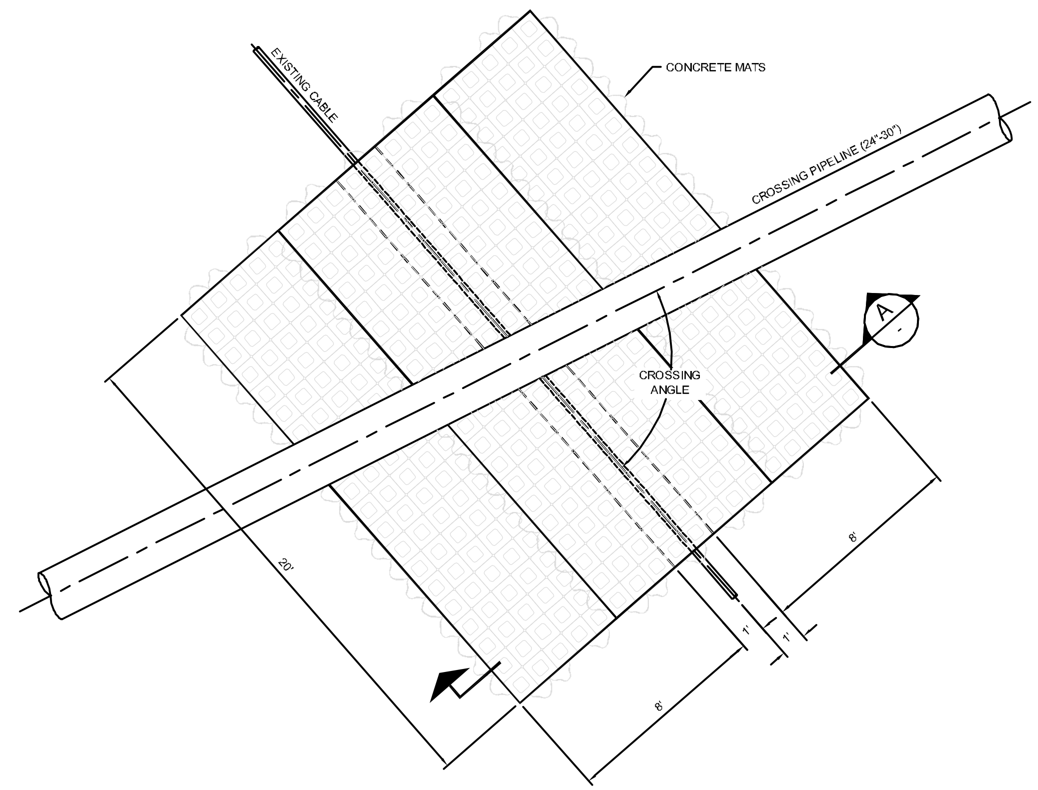
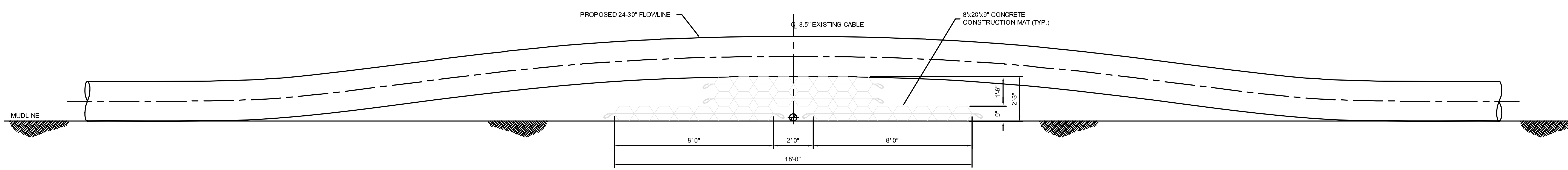
NOTES

1. THE CROSSING ANGLE AND LOCAL WATER DEPTH AT THE CROSSING SITE ARE TO BE DETERMINED FROM THE PIPLINE ALIGNMENT SHEETS.



TYPICAL CABLE CROSSING - PLAN VIEW

SCALE: N.T.S.



SECTION A -

SCALE: N.T.S.

SOURCE:
J P KENNY
85267.02-40-P-DW-003-REVB

Drawing 5

TYPICAL OFFSHORE PIPELINE CABLE CROSSING ARRANGEMENT

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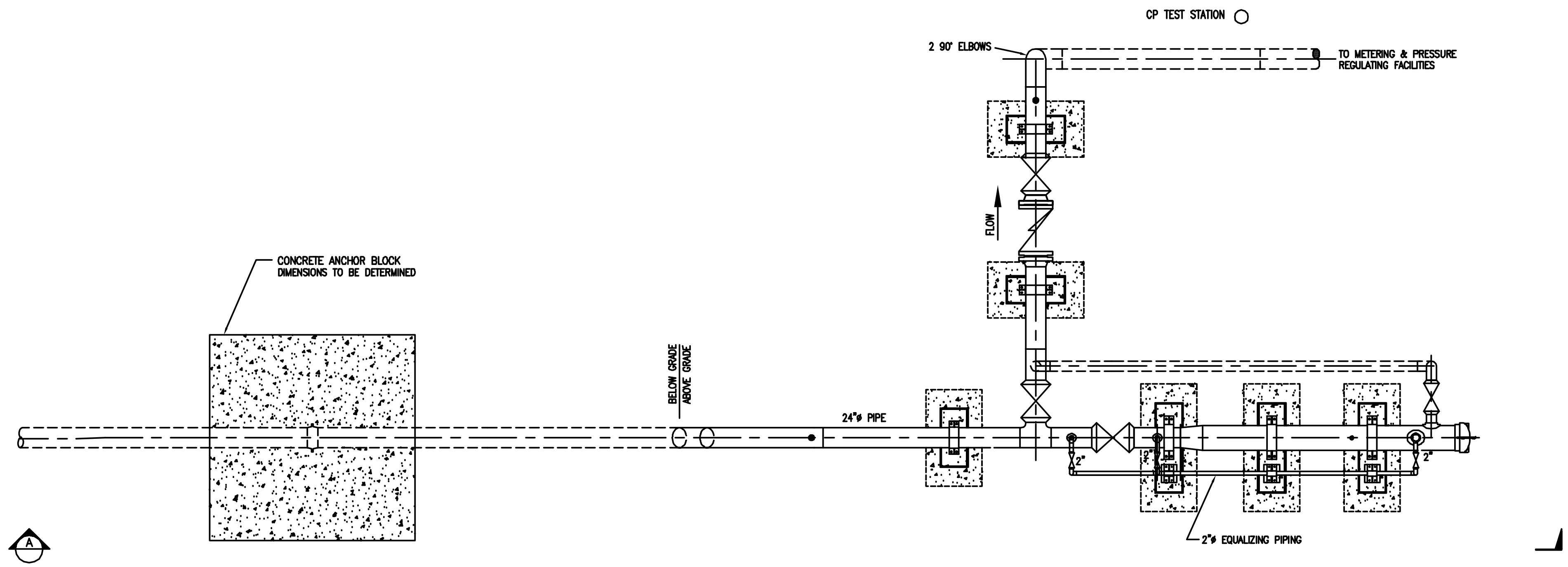
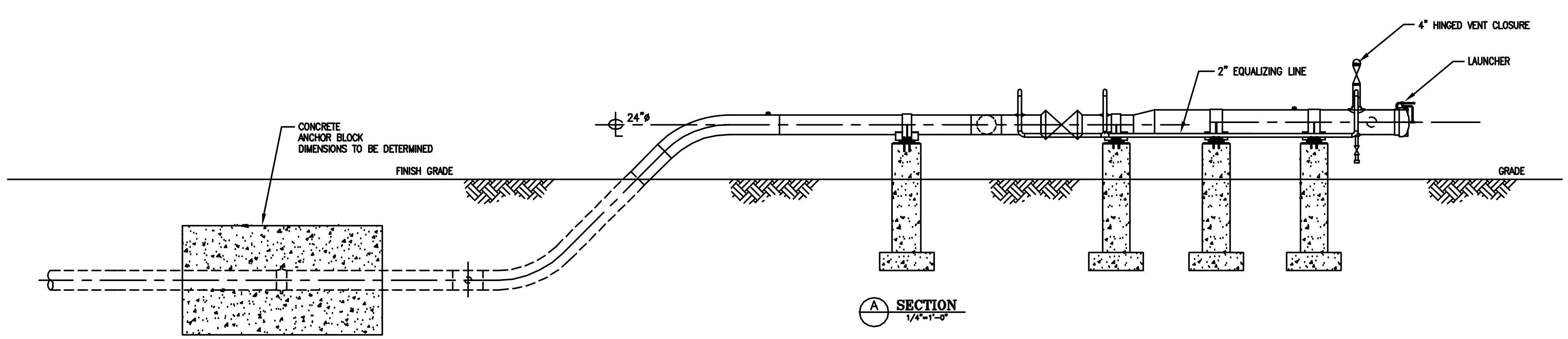


PLAN VIEW
SCALE: 1/4"=1'-0"



A SECTION
1/4"=1'-0"

Figure 6
TYPICAL SCRAPER TRAP ARRANGEMENT

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Project Description – Appendix K
Process Schematics

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

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Project Description – Appendix L
Preliminary OceanWay DWP Operations Manual

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

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Project Description – Appendix M
Decision Note: Power Generation & Air Emissions Control

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

Project Description – Appendix N
Please see Appendix M

This is Privileged and Confidential and is contained in the associated Privileged and Confidential Binder

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Project Description – Appendix O
Drilling Fluid Release Management Plan

CLIENT	**WOODSIDE NATURAL GAS**
PROJECT	**OCEANWAY SECURE ENERGY PROJECT**
DOCUMENT TYPE	**PROCEDURE**
DOCUMENT TITLE	**DRILLING FLUID RELEASE MANAGEMENT PLAN**
DOCUMENT NO.	**05-018-P-003**

0	26-Jul-07	Issued for Approval	TS	DRC	EJ
B	21-Jul-06	Client Comments added	ST	SVB	EJ
A	20-Jul-06	Issued for Comments	ST	SVB	EJ
Revision	**Date**	**Description**	**Originator**	**Checked**	**Approved**

Atteris Pty Ltd

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68 St Georges Terrace
Perth WA 6000

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 General

Woodside Natural Gas Inc (Woodside) is preparing an application to build a natural gas import facility to receive and supply gas to the Southern Californian gas grid, in the vicinity of Los Angeles.

The proposed natural gas import buoys will be in the order of 20 nautical miles offshore in a water depth of approximately 3000 ft. Two 24-inch diameter pipelines will be installed to transport the natural gas from the offshore receiving buoys, through Santa Monica Bay, across the coast and to designated tie-in points.

The installation of the two pipelines across the shore and the dunes east of the landfall are planned to be performed by Horizontal Directional Drilling (HDD). The HDD method uses a drilling fluid which has the potential to fracture the formation, with the possibility of drilling fluid surfacing along the alignment of the shore crossing. Drilling fluid accidentally reaching the surface during a HDD operation is known as a frac-out.

This Drilling Fluid Release Management Plan (DRMP) addresses this risk and provides practical measures which mitigate the risks of the adverse effects of drilling fluid frac-out.

1.2 Abbreviations

DRMP	Drilling Fluid Release Management Plan
HDD	Horizontal Directional Drilling
ITP	Inspection and Test Plan
LAX	Los Angeles International Airport

2.0 RISK MANAGEMENT AND ASSESSMENT

Risk combines the probability of an event occurring with the impact of the event. Risk management therefore focuses on eliminating or reducing the probability of an event occurring, in combination with reducing the impact of the consequence, if the event were to occur.

This plan combines both event prevention as well as impact reduction. This Section provides information about the risks associated with frac-out on the OceanWay Project drilled shore crossing and dune crossing by considering the following risk assessment elements:

- Drilling fluid description
- Probability of frac-out
- Consequences of frac-out.

2.1 Drilling Fluid

Drilling fluid consists of a mixture of fresh water and bentonite. Bentonite is a montmorillonite clay, which is a naturally occurring non-toxic material made up of small particles, that when used in a HDD operation as a drilling fluid serves five main purposes:

- **Hydraulic Power** – The drilling fluid transmits hydraulic power to the drill bit by hydraulically turning the down-hole motor. In soft formations, the fluid also assists in cutting the soil.
- **Lubrication** – The drilling fluid reduces the friction between the drill-pipe and the hole wall, thus lubricating the system.
- **Reduces Operating Temperature** – The reduced friction in combination with the low temperature of the drilling fluid reduces the operating temperatures of the drill bit and cutter sets.
- **Removes Spoil Material** – The drilling fluid transports the spoil by suspending the cuttings within the drilling fluid and carrying them to the HDD entry point.

- **Borehole Stability** – The suspension characteristics and hydrostatic pressure created by the drilling fluid act to stabilize the drilled hole.

2.2 Probability of Frac-out

During a HDD operation, most or all of the drilling fluids will flow back to the HDD entry point or be absorbed by the ground formation. The drilling fluid which is transported to the HDD entry point is known as 'returns'. As the drilling operation progresses, and depending on ground conditions, the formation may absorb some of the drilling fluid. Consequently, return of drilling fluid to the drill site reduces as the operation advances. As drilling continues the return of fluid may gradually reduce and it is not uncommon to lose returns entirely. Two conditions are required for a frac-out to occur:

1. When the strength of the soil is less than the hydrostatic pressure of the drilling fluid, the formation is likely to fail (fracture hydraulically). If this occurs, the drilling fluid will escape into the formation. Hydraulic fracture potential can be calculated when detailed soil strength data becomes available.

2. Upon hydraulic fracture occurring, the escaping drilling fluid will follow the path of least resistance into the formation. In areas where there is sufficient depth of cover and formation strength, and down-hole pressure is managed properly, frac-outs are unlikely to occur. Based on the preliminary ground conditions at the shore crossing and dune crossing, a safe depth of cover is 20-30 ft. Frac-outs are more likely to occur in the areas close to the entry and exit points of a HDD, where the depth of cover is less than 20-30 ft.

Shore Crossing

There are two areas at the shore crossing where frac-outs are likely to occur. They are;

- **Entry point** – The high probability of frac-outs at this point is due to the shallow depth of the drilling profile (see attachment 1). The shallow section extends approximately 300 ft from the entry point. Beyond approximately 300 ft along the profile, the depth of cover exceeds 30 ft and the probability of frac-outs is significantly reduced.

- **Exit point** – The probability of frac-outs increases as the exit point is approached, given that the depth of cover of the drilling profile reduces until it ultimately exits at the seafloor (see attached drawing). At approximately 400 feet from the end of the drilling profile, the depth of cover is 30 feet. The cover gradually reduces until the profile intersects the seafloor.

Dune Crossing

The dune crossing, like the shore crossing, is subject to increased risk of frac-out at specific locations;

- **Entry and exit points** – The high probability of frac-outs at these points is due to the shallow depth of the drilling profile where the profile depth is less than 30 feet (see attachment 2).

- **Low points** - Variations in the onshore topography may result in low points along the drilling profile. Low points reduce the cover of the drilling profile and consequently increase the risk of a frac-out.

- **Disturbed ground** – In locations where other earthworks have been performed, weak zones in the soil may exist that will be more susceptible to frac-out.

2.3 Consequences of a Frac-Out

Although bentonite is a natural and inert product, it is not usually natural to the location where it is used and is therefore classified as a contamination, if spilled.

Drilling fluid reaching the surface is a potential concern when the HDD method is used in environmentally sensitive areas and/or near structures such as roads and buildings. The fine particles of bentonite clay can smother aquatic life and vegetation, or may destabilize road structures and building foundations. The amount of drilling fluid which could be potentially lost to the environment in the event of a frac-out depends on the size of the fracture, the drilling pressure, and the time taken to identify the frac-out. The table below assesses the consequences specific to the OceanWay Project shore and dune crossings.

Table 2.1

Consequence Assessment

Event	Consequence of Worst Case Scenario
Frac-out under roads	• Destabilization of road structure • Damage to road surface • Traffic disturbance
Frac-out in beach area	• Destabilization of beach surface • Visual disturbance • Disturbance to beach users • Spillage into the ocean
Frac-out on ocean floor	• Smothering of benthic organisms • Smothering of seabed flora • Visual disturbance
Frac-out under dunes	• Visual disturbance • Destabilization of dunes • Damage to dune vegetation

In addition to environmental consequences, frac-outs can have a serious impact on the progress and ultimate success of the HDD operation. A frac-out can damage the borehole at the frac-out location, and jeopardize the integrity of the borehole elsewhere due to loss of full and controlled circulation. A competent and experienced HDD contractor will ensure that all measures are taken to avoid frac-outs.

3.0 RISK MITIGATION

This Section presents the measures to be taken to avoid frac-outs, and contingencies to reduce the impact in the event of a frac-out occurring.

3.1 Design

There are design controls which can be implemented for the OceanWay Project to reduce the probability of frac-outs occurring. These controls are:

- **Hydraulic Fracture Analysis –** A hydraulic fracture analysis should be performed when more soil strength parameters are known. The analysis performed must define the areas where further design controls should be implemented.

- **Installation of a Conductor Casing –** At the entry point a conductor casing can be installed using conventional boring methods. The conductor casing supports the borehole to a suitable depth below the surface, and prevents drilling fluid from escaping through fractures. This eliminates the potential for frac-out occurring in the high risk HDD entry point zone.

- **Stop the Drill Head before the Exit Point –** This procedure has been developed specifically for the OceanWay shore crossing HDD to avoid spillage of drilling fluid into Santa Monica Bay. It is planned to stop the pilot hole drilling operation at sufficient depth of cover to avoid frac-outs. This depth of cover has currently been nominated to be 20 ft. When pilot hole drilling has been completed, the drill string is withdrawn from the borehole and the borehole held open by the hydrostatic pressure of the drilling fluid. The pilot hole is then forward reamed and cased to the point where drilling has previously ceased. The exit point is subsequently dredged until the end of the casing pipe is exposed. A hydraulic fracture analysis in the area of the exit point is important for this design measure, as it provides a toll to optimize the depth of the dredging required. Dredging directly impacts the marine environment and as such should be limited to the minimum amount possible. The design challenge is to balance the risk of frac-outs with the impact of dredging.

- **Cover under low points –** The drilling profile can be designed in such a manner that adequate cover is provided at low points along the alignment.

3.2 Operation

A biological monitor (biologist experienced with HDD operations and frac-outs) should be on site throughout the HDD operations. The role of the biological monitor will be to identify potential frac-out conditions and monitor the pressure readings of the drilling equipment. The biological monitor has the sole authority to suspend the drilling process when a frac-out has occurred. All associated activities must be suspended and appropriate remedial actions taken to limit the impact of the incident.

The appropriate response to a frac-out situation will depend on the location and severity of the spill. The biological monitor will be at the drill site for the duration of the operation, with additional competent personnel monitoring the location of the drill-head.

The contractor nominated to complete the works must be competent and confident of completing the work as specified. The contractor is to provide experienced personnel for the completion of the works. The operator of the drill in particular must be experienced with the specified scope of works.

When the contractor is performing a directional drill, the drilling fluid pressure will be constantly monitored. If there is an unusual fluctuation in pressure, the contractor will notify the biological monitor and assess if frac-out has occurred. The contractor would then lower the operating pressure to evaluate the situation by having monitors go out and identify any frac-outs. These are considered standard operating procedures for the contractor.

Once a frac-out has been located, the biological monitor will determine the appropriate course of action. The use of “loss of circulation” additives that improve the sealing capacity of the drilling fluid may be considered. The environmental impacts of these products have to be understood and approved prior to commencement of the drilling operations.

All the operational controls detailed above should be implemented through an Inspection and Test Plan (ITP). It is the contractor’s responsibility to ensure the ITP is implemented and followed throughout the operation.

3.3 Monitoring

As part of the monitoring process, trained personnel will patrol a 300 ft corridor centered on the pipeline alignment.

Surface and diver visual inspection will be used in the offshore section of the operation. It should be noted that as the drill head moves within 400 ft of the exit point, frac-outs may occur. Monitoring in the offshore region will be conducted from a dedicated survey vessel with the following operational capabilities;

- Differential Global Positioning System
- Operation under moderate weather and sea state conditions
- Diver support and underwater video system controls.

The vessel shall be in operation at all times during directional drilling provided the operating conditions are safe. Routine inspections along the alignment will be performed from the surface and by divers. The diver operated underwater video system should only be implemented if the biological monitor identifies an irregularity which requires more stringent investigation.

The objective of the control measures detailed in the DRMP is to be able to effectively identify the location, size and degree of impact of a frac-out situation.

3.4 Notification

The following agencies will be notified immediately if frac-out has occurred and the biological monitor considers their involvement is appropriate;

- California Coastal Commission
- Los Angeles Regional Water Quality Control Board
- City of Los Angeles
- County of Los Angeles Department of Beaches and Harbours (if on the beach)
- LAX (if on LAX property)
- United States Army Corps of Engineers (if offshore of the mean high water mark)

Phone numbers of spill response teams in the area will also be kept onsite.

4.0 DRILLING FLUID CLEANUP

The field response to frac-out of drilling fluid will be immediate and will follow the procedures set out in the DRMP. The following actions will be taken to minimize the impact of the release.

- Drilling operations will stop if a drilling fluid release is detected, as detailed in the above sections.
- The appropriate agencies will immediately be notified to ensure adequate response actions are taken.

4.1 Onshore Response

If a frac-out occurs onshore, an onsite vacuum truck will be deployed to remove the spillage.

A vacuum truck with a hose will be used to pump the drilling fluid from the contained area. If the vacuum truck cannot drive next to a frac-out for any reason, they will park as close as practicable and a pump will be deployed to transfer the spillage to the vacuum truck. A typical vacuum truck has a capacity of 4200 gallons.

Hay bales, sand bags, and/or silt fencing will be kept onsite and used to surround and contain the drilling mud in the event of a frac-out. A bund will be erected around the spillage by means of hydraulic excavator or manual tools.

4.2 Offshore Response

Upon detection of drilling fluid in the marine environment, the following response will be implemented:

Diver operated pumps will be deployed to collect the drilling fluid from the seafloor. The divers will transfer the fluid into a storage tank located on the diver support vessel. The drilling fluid will be disposed of in accordance with the local, state, and federal regulations. The extent of the fluid release on the seafloor will be documented by divers and by underwater video recording.

4.3 Cleanup Close-out

Following the initial response and subsequent cleanup of drilling fluid frac-out, measures will be taken to return the environment to pre-release conditions. The response and cleanup implemented by the contractor will be inspected and approved by the client representative and any appropriate regulatory body. The close-out procedures may include but not be limited to the following;

- The drilling fluid recovered from the release will either be returned to the drill site for recycling or it will be disposed of in accordance with the local, state and federal regulations.
- The environment will be returned to the pre-existing conditions with appropriate actions taken to prevent further release.
- All control measures implemented as preventative controls will be removed at the completion of the operation.

The above activities can be conducted either during or at the completion of the operation. Any inadvertent release will be acted upon immediately, however drilling must either continue or be abandoned, to prevent hole blockage.

5.0 DRILLHOLE ABANDONMENT

The abandonment of the hole is a last resort and will only be considered when all other alternatives have been exhausted. The abandonment of the drill hole will require all the appropriate agencies to be notified as soon as the decision is made. The steps to be taken for the abandonment are as follows;

- The as-drilled alignment will be established as best as possible and documented for further reference.
- The drill hole will be plugged with grout as the drill string is withdrawn.

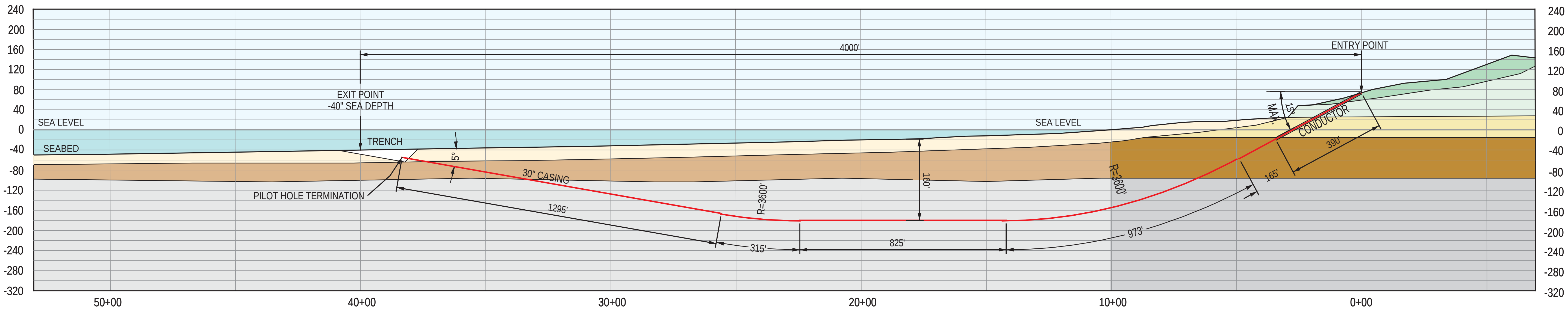
Following the abandonment, the appropriate course of action will be determined through discussions with the appropriate regulatory authorities.

Attachment 1

Shore Crossing Alignment Profile

Entry Point Coordinates CA State Plane Zone 5 NAD83 feet	
Easting	Northing
1 6426802	1804589
2 6426813	1804557

Exit Point Coordinates CA State Plane Zone 5 NAD83 feet		UTM Zone 11 WGS 84 metres		WGS 84 Lat/Long	
Easting	Northing	Easting	Northing	Latitude	Longitude
1 6422959	1803529	1 365329.3	3757272.3	1 33 56.8396	-118 27.4388
2 6422968	1803500	2 365331.6	3757263.4	2 33 56.8349	-118 27.4388



VERTICAL EXAGGERATION x2

HOLOCENE EOLIAN DEPOSITS

LATE PLEISTOCENE EOLIAN DEPOSITS PREDOMINANTLY MEDIUM TO COARSE GRAINED SAND

LATE PLEISTOCENE OLDER ALLUVIUM SAND AND GRAVEL

MARINE SEDIMENTS PREDOMINANTLY INTERSTAINED SAND AND SANDY GRAVEL

PREDOMINANTLY SAND WITH INTERBEDS OF SANDY GRAVEL OFFSHORE

PLEISTOCENE SAN PEDRO FORMATION PREDOMINANTLY SANDY GRAVEL ONSHORE

LATE PLIOCENE PICO FORMATION PREDOMINANTLY SANDY CLAY

SUBSURFACE GEOLOGIC RELATIONSHIPS ARE POORLY KNOWN OFFSHORE

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DWG. No.	REFERENCE DRAWINGS	REV.	DATE	BY	CHK'D	REVISION DESCRIPTION
		C	31.10.06	CR	DC	EXIT POINT CO-ORDINATES ADJUSTED
		B	10.10.06	CR	DC	SPATIALLY CORRECTED
		A	07.06.06	KN	DC	ISSUED FOR REVIEW

CLIENT : WOODSIDE

DRAWN: KN	DATE: 07.06.06
CHECKED: DC	DATE: 07.06.06
APPROVED: EJ	DATE: 07.06.06
CLIENT:	DATE:

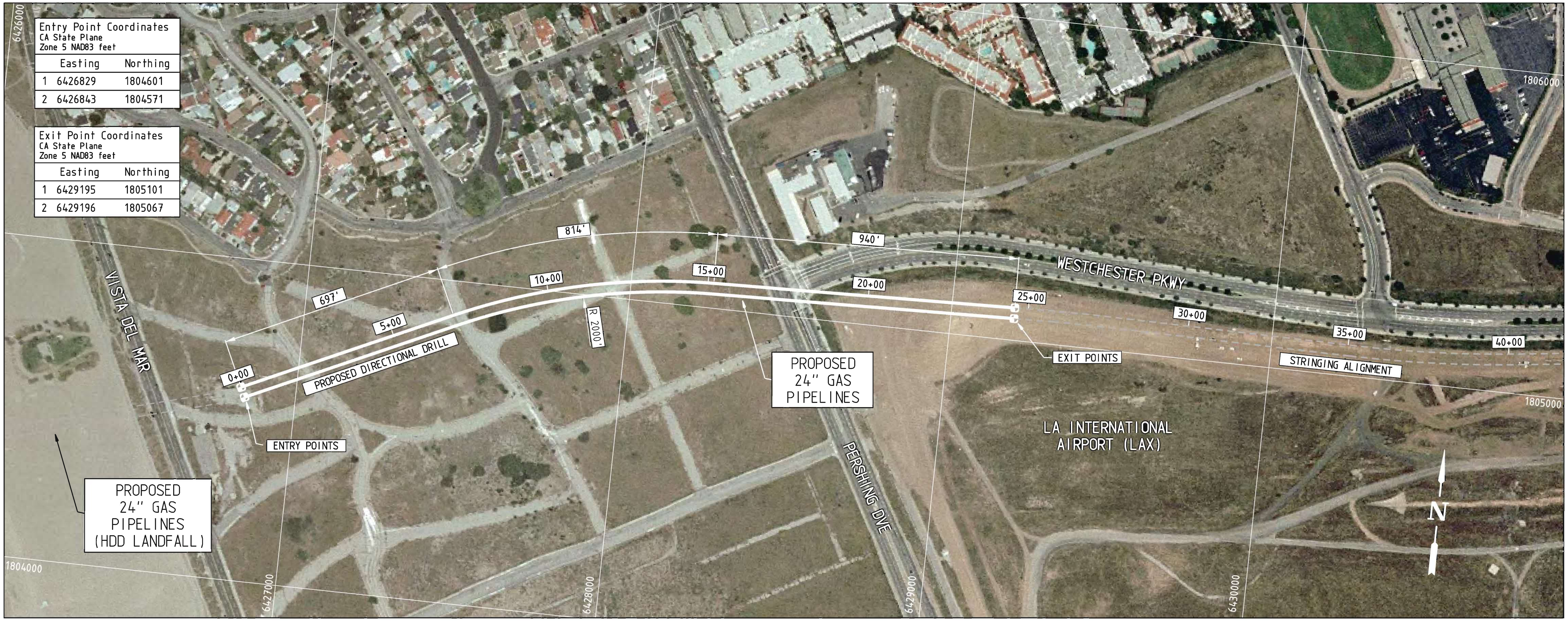
PROJECT: OCEANWAY

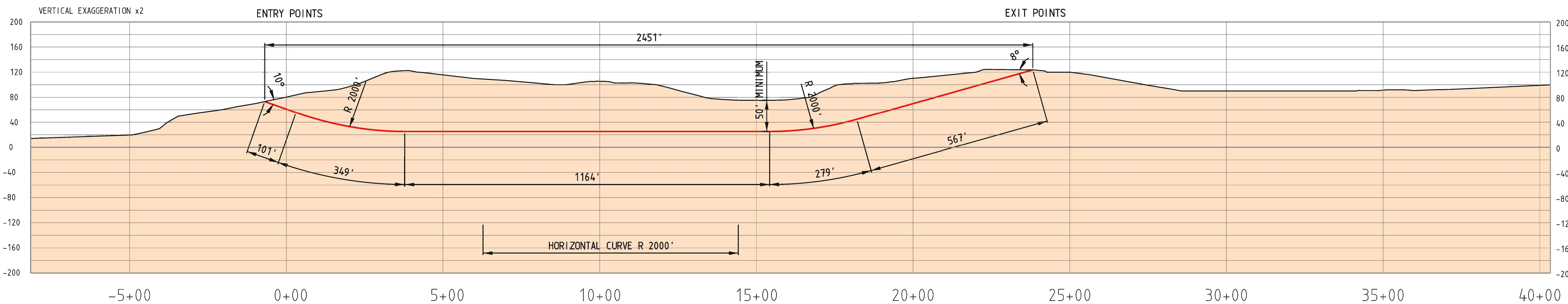
TITLE: LA AIRPORT SHORE CROSSING FORWARD THRUST HDD LANDFALL

SCALE: 1:300 | A1 | DWG No : 05-018-D-006 | REV C

Attachment 2

Dune Crossing Alignment Profile





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		B	20 06 07	JK	DC	REVIEWED FOR INFORMATION
		A	31 05 07	JK	DC	FOR INFORMATION

CLIENT: WOODSIDE

DRAWN: DATE:
CHECKED: DATE:
APPROVED: DATE:
CLIENT: DATE:

PROJECT: OCEANWAY

TITLE: PROPOSED HDD LANDFALL TO PERSHING DRIVE

SCALE: 1:1250 A3 DWG No: 05-018-D-011 REV B