



ENVIRONMENTAL IMPACT  
MITIGATION

Changes shown by ⇒

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## ENVIRONMENTAL IMPACT MITIGATION

### 1.0 Scope

Measures to protect the Work Site and surrounding areas from unacceptable impacts are defined in this specification. General measures that apply to all elements of the project are discussed. Other technical specifications include provisions to mitigate impacts resulting from their specific activity/unit.

Sections, below, on baseline assessment and site monitoring, effluent water criteria, air emissions criteria and soil protection mitigations contain information that needs to be considered during the design of Contractor's temporary and permanent facilities and parameters to be monitored during the Work.

Soil protection, water-body and wetland protection, control of Work Site area, and mitigation of construction related impacts sections contain information on how Contractor's in-country Work shall be conducted in order to minimize environmental impacts. Sections on surface restoration and site reclamation provide additional requirements that need to be met before closure of temporary Work Sites and Acceptance of the Work by ESSO.

Contractor's environmental monitors shall be able to suspend activities if these activities are clearly having a markedly adverse effect on the environment (for instance, in periods of heavy rainfall it may be necessary to cease earth-moving activities, without stopping all of the Work).

### 2.0 Baseline Assessment and Site Monitoring

In accordance with the Coordination Procedure, Contractor shall document Work Site conditions before beginning the Work in a given area. Contractor shall note the type of environment and current condition (e.g., evidence of human impacts or natural soil erosion). Contractor shall sample surface water and ground water (if appropriate) and document the water quality.

Surface effluents from Work activities will be monitored daily and resulting changes in surface water quality recorded.

Work Site conditions, and relevant soil and water samples shall be analyzed and reported to ESSO upon completion of Work Site restoration activities. Samples shall be analyzed by a third-party independent laboratory approved by ESSO.

### 3.0 General Mitigation Measures

Contractor's responsibilities with respect to management of wastes, spill prevention and response, and protection of plant and animal species and habitat, and complementary requirements with respect to air and water pollution and site restoration are as outlined

in the Environmental Management Coordination Procedure (Section 30) in the Job Specification.

#### 4.0 Effluent Water Criteria

All liquid effluents disposed via surface discharge as per Contractor's approved waste management plan as well as any other surface run-off from the Work Site shall meet World Bank effluent standards for waste water. All discharges of treated effluents to perennial surface water bodies must provide for at least a 100:1 dilution of the effluent. Water treatment shall include all processes necessary to achieve these standards. Effluents containing human wastes shall also be treated with 2-5 mg/L chlorine for a minimum of thirty minutes prior to discharge. Key World Bank effluent criteria are shown in Table 1.

Contractor shall test effluents daily for parameters shown in Table 1 using methods in Standard Methods for the Examination of Water and Wastewater (Mary Ann H. Franson, editor, American Public Health Association, 1995). Test results shall be certified by Contractor and the records of said tests kept as per Section 30 of the Coordination Procedure.

**TABLE 1  
 WORLD BANK LIQUID EFFLUENT CRITERIA<sup>1</sup>**

Parameter	Maximum Levels
pH	6-9
BOD <sub>5</sub>	< 50 mg/L
Oil and Grease	< 20 mg/L
Heavy Metals, Total (except Barium)	< 10 mg/L
Phenolic Compounds	< 100 mg/L
Total Suspended Solids	< 50 mg/L
Coliform Bacteria	< 400 MPN/100 mL <sup>2</sup> (MPN-Most Probable Number)
Temperature - at the edge of the mixing zone	Max 5°C above ambient temperature of receiving waters - max 3°C if receiving waters > 28°C)

Source: The World Bank Environment, Health and Safety Guidelines, Onshore Oil and Gas Development (World Bank, 1995)

1. Maximum daily discharge limits
2. Average monthly concentration (i.e., 30 consecutive days of sampling)

#### 5.0 Air Emissions Criteria

The contractor shall ensure that air pollutant emissions from facility sources do not cause exceedances of the World Bank ambient air quality concentration standards shown in Table 2 at locations outside the Work Site boundary. ESSO will consider these standards to be met if the air emissions source performance measures given in Table 3 are met. If the measures in Table 3 are not met, then air emission control measures shall be implemented and equipment/facility design modified, as necessary, to comply with these source performance measures. Testing for stack emission rates, exhaust gas temperatures and exhaust gas flow rates shall be measured by Contractor at start-up, and shall be performed in accordance with testing methodologies deemed appropriate per the World Bank; in the absence of established World Bank testing methodologies, US EPA Source Test Sampling and Analysis Methods shall be used.

Equipment-specific performance criteria presented in Table 3 are based on the size, model, relative location, operating schedules, and fuel type assumed in the Design Basis for this project. The Contractor's design of permanent facilities, including facility layout (equipment location, orientation, and building size/configuration) shall not differ substantially from facility design assumed in the Design Basis without written approval received from ESSO.

**TABLE 2  
 WORLD BANK AMBIENT AIR QUALITY CRITERIA**

Parameter	Maximum Level
Particulate Matter (<10µm) Annual Arithmetic Mean Maximum 24-hour Average	100 µg/m <sup>3</sup> 500 µg/m <sup>3</sup>
Nitrogen Oxides, as NO <sub>2</sub> Annual Arithmetic Mean Maximum 24-hour Average	100 µg/m <sup>3</sup> 200 µg/m <sup>3</sup>
Sulfur Dioxide Annual Arithmetic Mean Maximum 24-hour Average	100 µg/m <sup>3</sup> 500 µg/m <sup>3</sup>

Source: The World Bank Environment, Health and Safety Guidelines, Onshore Oil and Gas Development (World Bank, 1995)

**TABLE 3. DESIGN PARAMETERS FOR AIR EMISSIONS MODELING**

EQUIPMENT TYPE	EQUIPMENT SIZE		EMISSION RATE <sup>(1)</sup>				STACK HEIGHT <sup>(2)</sup>		EXHAUST GAS TEMPERATURE <sup>(3)</sup>			EXHAUST GAS FLOW RATE <sup>(4)</sup>	
			NO <sub>x</sub>	PM	SO <sub>2</sub>		(ft)	(m)	(K)	(F)	(C)	(ft <sup>3</sup> /s)	(m <sup>3</sup> /s)
<b>PUMP STATIONS</b>													
Main Pump Diesel Engines	6000	HP	12.1	0.63	0.51	g/HP-hr	50	15.24	644	700	371	393	11
Generator Diesel Engines	1000	HP	12.1	0.63	0.51	g/HP-hr	50	15.24	644	700	371	98	3
Fired Heater	98	MBtu/hr	135	55.4	66.3	g/MBtu	125	38.1	561	550	288	894	25
<b>DOBA OPERATIONS CENTER</b>													
Flare	14000	m <sup>3</sup> fuel/hr	30.9	9.2	~0 <sup>(5)</sup>	g/MBtu	50	15.24	1272	1830	999	10,000	283
Crude Oil Topping Plant Fired Heater	11.2	MBtu/hr	135	55.4	66.3	g/MBtu	30	9.15	561	550	288	397	11
Turbines	33,000	HP	2.97	0.34	0.63	g/HP-hr	35	10.66	767	921	494	1782	50
Incinerator	3,455	tonne/year	3005	917	1084	g/tonne	20	6.10	380	225	107	125	4

(1) Values shown are maximum allowable emission rates. Incinerator emission rates are based on the following waste percentage and heat content values (where waste classifications are as defined in the Waste Incinerator Specification).

<u>Waste Classification</u>	<u>%</u>	<u>Heat Content (Btu/lb)</u>
Type 0	2.30	8500
Type 1	1.60	6500
Type 2	0.40	4300
Type 3 & 4	0.05	2500
Type 5	44.75	18000
Type 6	50.90	18000

(2) Values shown are minimum allowable stack heights.

(3) Exhaust temperatures should not differ from degrees Fahrenheit values presented by more than 10%.

(4) Exhaust gas flow rates should not differ from values presented by more than 20%.

(5) Expected to be very low because of the fuel source, assume no control measures are needed.

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## 6.0 Soil Protection Mitigations

### 6.1 Soil Erosion Mitigations

Contractor shall take actions necessary to prevent erosion from occurring as a result of construction activities. Minimum standards and mitigation measures are included in the Soil Erosion Mitigation Specification. This specification applies to all Work Site areas including borrow pits/areas, storage and laydown areas, camps, and access roads.

### 6.2 Spill Remediation Standards

#### 6.2.1 Hydrocarbons

In the event of a spill of a hydrocarbon based product, Contractor shall bring all soil containing over one weight percent hydrocarbon to the surface (top 30 cm or less) for remediation or disposal.

Soil containing over five weight percent hydrocarbon shall either be mixed in place to less than five weight percent total hydrocarbons or shall be removed to an ESSO approved treatment or disposal site.

Soil shall be treated to below one weight percent hydrocarbon (as measured using a test method accepted by ESSO).

If selected as the remediation method, in-place bioremediation of the product shall be initiated by using the following steps:

- Add slow release fertilizer at a rate of 1 kg urea per 10 m<sup>2</sup> and 0.5 kg of triple superphosphate per 10 m<sup>2</sup> (alternate forms of nitrogen and phosphorous may be used with ESSO's approval). If run-off from the site could impact nearby streams or sensitive vegetation, the level of fertilizer should be reduced by an amount appropriate for the distance to the receptor.
- Till in fertilizer
- Water, if practical, to initiate biodegradation process (target: 70% of the soil's water holding capacity).

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### 6.2.2 Acids and Bases

In the event of a spill of materials with a pH more than 2 units above or below native soil pH, Contractor shall neutralize the affected soils, adjusting the pH to that of native soil in the area.

### 6.2.3 Miscellaneous Materials

Hydraulic fluid, anti-freeze, solvents and other specialty fluids used on the construction site should be selected so that impacts are minimized in the event of a release (e.g. using less toxic versions of these products). Characteristics of the product will determine the appropriate treatment/disposal action and the concentration of product that could be left in the site soil without significant impact. Spill response and remedial actions shall be approved on a product-by-product basis by ESSO as per the requirements of Section 30 of the Coordination Procedure.

## 7.0 Water-body and Wetland Protection Measures

### 7.1 Equipment Operation and Refueling

Where mobile equipment is required to operate and refuel within 30 meters of a water-body or wetland, the following measures shall be employed by Contractor to minimize the risk of fuel spills into the water-body:

- (i) ensure that all containers, hoses and nozzles have no leaks;
- (ii) ensure that pumps have operational emergency shut-off switch;
- (iii) ensure that nozzles are equipped with automatic back flow shut-off switches;
- (iv) where fueling must be performed within this area, operators shall be stationed at both ends of the hose unless the ends are visible and are readily accessible by one operator;
- (v) fuel remaining in the hose shall be returned to the storage facility; and
- (vi) sorbant boom or similar material capable of capturing oily substances from the surface of the water shall be placed so that any released materials shall be absorbed or contained for subsequent recovery.

### 7.2 Vehicle Crossings

Contractor shall install and maintain vehicle crossing structures such as temporary bridges at watercourses so that no machinery need ford a watercourse except as otherwise provided in 9.4.1.

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## 8.0 Control of Work Site Disturbance Area

Work Site access shall be restricted to existing roads, railroads, additional road right-of-way provided by ESSO, waterways designated by ESSO and ESSO provided pipeline right-of-way, storage and laydown areas, and permanent facilities sites.

Contractor shall take the following measures to control the Work Site:

- a) Work activities, project-related vehicle traffic, and equipment storage shall be restricted to approved roads, designated access roads, pipeline right-of-way, storage areas, staging and parking areas, and other Work Site areas;
- b) Contractor shall not construct any roads without prior approval from ESSO;
- c) All traffic safety and road closure regulations shall be followed;
- d) Off-road traffic outside of designated areas shall be prohibited;
- e) Project-related vehicles shall observe a 30 kilometer per hour maximum speed limit on the Work Site. The 30 kilometer per hour maximum speed limit applies to congested work areas and camps. Contractor shall apply judgment, such as Job Safety Analysis (including factors such as dust, population and environment) to determine safe speeds for other areas;
- f) Parking, storage, and general Work Site areas shall be designated by flagged stakes. These areas shall be established in locations disturbed by previous activities, to the extent possible;
- g) Pipeline right-of-ways shall be clearly marked at their centerline and outside boundaries, prior to construction;
- h) Construction shall be limited to daylight hours;
- i) Unauthorized public use of the Work Site areas and non-public access roads shall be minimized by placement of physical barriers and signs (with English, French and pictorial representations of the messages); and
- j) Unless specified by ESSO, temporary roads and Work Site areas shall be removed, and the surface reclaimed as described below, when they are no longer needed for the Work. Restoration of temporary access roads shall require the planting of trees or placement of other barriers to prevent vehicular access. Clean-up and reclamation shall be completed as quickly as practical following completion of Work activities in Work Site areas.

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## 9.0 Mitigation of Construction Related Impacts

### 9.1 Clearing

Cleared areas include pipeline right-of-way, sites for facilities construction, access roads, storage and laydown areas, camps, and other related Work Site areas.

Contractor shall clear only the areas required for construction and operations as approved and specified by ESSO. ESSO may identify trees and other objects to be preserved depending upon size and location of the area to be cleared. Contractor shall mark vegetation, trees and other objects that are to remain and shall protect these items from damage. The disposition of trees that must be felled shall be as specified below. Contractor may use timber cut on Work Site areas in its construction work (provided appropriate fees are paid to the Government), but shall not cut timber located off the Work Site.

Brush and trees shall be felled parallel to or back toward the area to be cleared in order to minimize damage to structures and trees on adjacent property. Grubbing of root stock and stumps shall be done only where necessary to maintain unobstructed access or protect the installation.

Unless specified otherwise by ESSO, Contractor shall manage and dispose of trees, brush, stumps and limbs in the following manner:

- (i) identify, limb and segregate all trees of commercial value;
- (ii) cut up and neatly stack lesser materials into manageable pieces for use by local inhabitants (not requiring more than two people to carry, and no longer than three (3) meters);
- (iii) upon approval of ESSO, lesser materials may be processed through a chipper for use as bulking agent for land treatment, composting or distribution over cleared areas during site restoration (mulching).

Burning of vegetation shall be minimized to the maximum extent feasible.

### 9.2 Grading

Grading by Contractor shall be limited to that area necessary to permit movement and operation of equipment. Removal of soil seed- banks (topsoil) shall be done in advance of grading or trenching in order to prevent unnecessary delays. Graded material from the right-of-way shall be stockpiled in the cleared portion of the right-of-way for use during backfill and cleanup. Topsoil removal, storage and reuse shall be as described in the Soil Erosion Mitigation Specification.

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Grading by Contractor shall preserve the existing natural drainage topography as nearly as practicable. When terraces, levees, and other such facilities are cut, Contractor shall leave them open only as long as necessary for the Work and restore them to their original state as promptly as practical.

Grading shall not be allowed in riparian areas/stream crossings within 24 hours of significant precipitation.

Contractor shall avoid the formation of continuous rows of spoil or lengths of open trench that interfere with the passage of livestock and vehicles across the Work Site. Gaps shall be left in the rows of spoil at ESSO-designated intervals and to coincide with fences, water courses, access tracks, obvious livestock routes, etc.

Stockpiled topsoil or backfill shall be stored above the stream high water mark, outside any riparian zone, and not in any area where the material could be easily washed back into the stream. The boundaries of unsuitable areas for stockpiling material at stream crossings shall be marked by Contractor's environmental monitors in consultation with its construction crews. Potential erosion into a stream of stockpiled material or soil from the exposed bank shall be prevented by rows of hay bales or available equivalent along the bank. The bales shall be placed at flowing river or creek crossings at the end of each work day during the rainy season, or any other day when rain is forecast. Stockpiled topsoil or spoil shall not be exposed near a stream channel or riparian area for more than 30 days.

Excess material removed from graded areas shall be stockpiled within the cleared area of the Work Site. After construction it shall be replaced as closely as possible to its original location.

### 9.3 Hydrostatic Testing

When Contractor's scope of Work includes hydrotesting of installed facilities, Contractor shall develop a hydrotest plan for approval by ESSO. Hydrotest protocols shall conform with the Hydrostatic Testing Specification and the following practices:

- a) Disposal of the hydrotest water shall conform with Contractor's approved Waste Management Plan. Preferred locations for discharge of water will be onto soil (e.g., into infiltration beds or percolation ponds) rather than into water courses.
- b) When taking on hydrotest water from a watercourse, the intake hose shall be screened to prevent entrainment of fish and other aquatic life. Adequate flow rates must be maintained in the watercourse to protect aquatic life, provide

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for all water-body uses, and provide for downstream withdrawals of water by existing users (no more than ten (10) percent of the watercourse flow may be diverted to hydrotest use).

- c) Hydrostatic test manifolds shall be located outside wetlands and riparian areas to the maximum extent practicable.
- d) Where surface waters with potential biological pathogens are used as the hydrotest water source, Contractor shall take measures to prevent the exposure of workers to these pathogens in the event of a hydrotest leak.
- e) Contractor shall regulate discharge rate and use energy dissipation device(s) in order to prevent erosion, stream bottom scour, suspension of sediments, and excessive stream flow. Test water may need to be discharged into a filter bag, hay bale or silt fence containment structure to remove contaminants and sediments from within the pipeline prior to discharge.
- f) Contractor shall sample the test water during discharge to verify the absence of significant oil and grease or other pollutants

#### 9.4 Water-body Crossings

It is assumed that pipelines are the only facilities that will cross water-bodies, and that pipelines will be buried. Therefore, the following text is written in the context of a buried pipeline. If other facilities cross water bodies, the intent of this section shall apply to their installation as well.

##### 9.4.1 General Crossing Procedures

Construct crossings as close to perpendicular to the axis of the water-body channel as engineering and routing conditions permit.

Adequate flow rates must be maintained to protect aquatic life, provide for all water-body uses, and provide for downstream withdrawals of water by existing users.

Construction equipment (except that used by clearing crews) must cross water-bodies on bridges consisting of one of the following:

- a. Equipment pads and culvert(s);
- b. Clean rock fill and culvert(s); or
- c. Flexi-float or portable bridge.

If clearing or grading equipment must cross water-bodies prior to installation of equipment bridges, crossings shall be limited to the maximum extent feasible.

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Contractor shall limit use of equipment operating in the water-body to that needed to construct the crossing.

Contractor shall limit the size of the crossing and adjacent impacted area to the minimum necessary for passage of the trench and associated equipment.

Contractor shall attempt to complete trenching and backfill work within the water-body (not including blasting) within 48 hours, unless site-specific physical conditions make completion within 48 hours impractical.

#### 9.4.2 Equipment Bridges

All equipment bridges shall be designed to withstand the maximum flow and maintained to prevent flow restriction during the period the equipment bridge is in place.

Unless otherwise instructed by ESSO, remove all flue, dams and equipment bridges after final cleanup and grading but prior to completion of initial permanent seeding (if seeding is required).

Where appropriate alternative access is available to the applicable parts of the Work Site, equipment bridges shall be removed if there will be more than 1 month between final cleanup and grading and the beginning of initial permanent seeding (if seeding is required).

Consistent with the availability of reasonable alternative access, temporary bridges across water-bodies shall be removed at the earliest time practical to minimize impacts.

#### 9.4.3 Temporary Erosion and Sediment Control

Contractor shall comply with the requirements of the Soil Erosion Mitigation section of this specification in order to minimize impacts to watercourses. Contractor shall also implement the additional measures to control sediment loading in water-bodies as described here.

Install and maintain, in proper working order, temporary sediment filter devices adjacent to all water-bodies in the vicinity of disturbed soil.

Use trench plugs at all non-flumed water-body crossings to prevent diversion of water into upland portions of pipeline trench during construction.

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Dewater the trench in such a manner that no heavily silt-laden water flows into any water-body.

Install permanent slope breakers and trench breakers at base of all slopes adjacent to water-bodies.

#### 9.4.4 Bank Stabilization and Revegetation

Limit use of rip-rap to areas where flow conditions preclude effective vegetative stabilization, unless otherwise specified by ESSO.

#### 9.4.5 Maintenance

Allow a riparian strip at least 5 meters wide, but preferably 8 or more meters wide, as measured from the water-body's mean high water mark to permanently revegetate with native woody plant species across the entire right-of-way. However, to facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline up to 3 meters wide may be maintained in an herbaceous state. In addition, trees that are located within 5 meters of a pipeline and are greater than 5 meters in height may be selectively cut and removed from the right-of-way.

### 9.5 Wetland Crossings

It is assumed that pipelines are the only facilities that will cross wetlands, and that pipelines will be buried. Therefore, the following text is written in the context of a buried pipeline. If other facilities cross wetlands, the intent of this section shall apply to their installation as well.

#### 9.5.1 General Procedures

The only access roads other than the construction right-of-way which shall be used in wetlands are those existing roads that can be used with no modification and no impact on the wetland.

Contractor shall limit the size of the crossing and adjacent impacted area to the minimum necessary for passage of the trench and associated equipment.

Do not locate above-ground facilities in any wetland unless approved in writing by Esso.

#### 9.5.2 Crossing Procedures

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Avoid wetland areas to the maximum extent practicable. If a wetland cannot be avoided or crossed by following an existing right-of-way, route the pipeline in a manner that minimizes disturbance to wetlands.

Minimize the duration of construction-related disturbance within wetlands to the maximum extent practicable.

Limit the width of the construction right-of-way to the minimum required for passage of the trench and associated equipment.

Limit pulling of tree stumps and grading activities to directly over the trenchline. Do not grade or remove stumps or root systems from the rest of the right-of-way in wetlands unless the ESSO Inspector determines that safety-related construction constraints require removal of tree stumps from under the work-pad.

Construction equipment operating in wetland areas shall be limited to that needed to dig trench, install pipe, backfill trench, and restore the Work Site. All other construction equipment shall use access roads located in upland areas to the maximum extent practicable. Where use of access roads in upland areas cannot provide appropriate access, all other construction equipment may pass through the wetland once, using the right-of-way.

If standing water or saturated soils are present, use low-ground-weight construction equipment, or operate normal equipment off of timber mats, rip-rap, prefabricated equipment mats, or geotextile fabric overlain with gravel fill. Geotextile fabric use for this purpose must be flexible and strong enough to allow removal of all gravel fill and fabric from the wetland during the clean-up phase.

Do not use dirt, rock fill, tree stumps, or brush to stabilize the Work Site in wetlands.

Attempt to use no more than two layers of timber rip-rap to stabilize the Work Site. In the event that more than two layers of timber rip-rap must be used due to site-specific construction constraints, the following information must be provided as specified at the beginning of these Procedures.

- a) Contractor shall explain why alternative construction methods that do not involve the use of timber rip-rap (e.g., prefabricated equipment pads, low-ground-weight equipment) cannot be used in these areas;

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- b) A detailed plan which addresses the procedures to be used to remove all timber rip-rap, specific measures (including the import of additional fill material) to restore pre-construction surface contours, and specific measures (including the planting of herbaceous and shrub species) to ensure successful revegetation of the construction right-of-way with native wetland plant species within 3 years after construction.

Remove all timber mats, rip-rap, prefabricated equipment mats, and geotextile fabric overlain with gravel fill upon completion of construction.

Assemble pipeline in upland area and use "push-pull" or "float" techniques to place pipe in trench where water and other site conditions allow.

#### 9.5.3 Spoil Pile Placement and Erosion Control

Contractor shall comply with the requirements of the Soil Erosion Mitigation Specification in order to minimize impacts to wetlands. Contractor shall also implement the additional measures to control sediment loading in wetlands as described here.

Contractor shall place all spoil from water-body crossings, and wetlands crossings at least 3 meters away from water's edge, as a minimum, and shall contain spoil within sediment filter devices. Where the extent of the wetland makes placement away from the water's edge impractical, Contractor shall place spoil in areas where impact will be minimal and control water flow in the area with sediment filters.

Contractor shall install and maintain, in proper working order, temporary sediment filter devices adjacent to all wetlands in the vicinity of disturbed soil to avoid sediment flow into wetlands.

Contractor shall install and maintain in proper working order permanent slope breakers and trench breakers near the boundary between wetlands and adjacent disturbed upland areas to avoid sediment flow into the wetland.

When dewatering trench, Contractor shall discharge the water in such a manner that no heavily silt-laden water flows into any wetland.

#### 9.5.4 Wetlands Restoration

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Where the pipeline trench may drain a wetland, Contractor shall construct trench breakers and/or seal the trench bottom as necessary to maintain the original wetland hydrology.

Do not use fertilizer or lime within wetlands.

Restore surface contours and topsoil as required by the Surface Restoration and Site Reclamation sections, above.

#### 9.5.5 Maintenance Practices

Vegetation maintenance practices over the full width of the permanent right-of-way in wetlands are prohibited. However, to facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline up to 3 meters wide may be maintained in a herbaceous state. In addition, trees that are located within 5 meters of the pipeline and are greater than 5 meters in height may be selectively cut and removed from the wetland.

## 10.0 Surface Restoration

### 10.1 Pipeline (and Other Buried Facilities) Right-of Way

Following backfill of trench, the disturbed portion of the Work Site shall be returned to natural contours by Contractor where possible. Re-contouring to natural lines and grade shall be accomplished without disruption to adjacent undisturbed habitat. The area shall be compacted sufficiently to minimize erosion or excessive future settlement. Permanent water breakers and/or terraces shall be constructed on sloping ground to prevent erosion as specified in the Soil Erosion Mitigation Specifications. Natural drainage patterns shall be restored and in potentially high erosion areas (such as the banks of water courses) earth-filled sacks, stone rip-rap or other stabilization methods shall be used to ensure that the soil does not wash out before becoming consolidated. All restoration activities other than foot traffic shall be limited to previously disturbed portions of the Work Site.

When restoring disturbed right-of-way, Contractor shall:

- use clean, efficient construction techniques to minimize short term disruptions and prevent long term degradation of the environment;
- restore all banks of watercourses, hills and steep slopes to as near their original condition as practical;
- properly rip-rap and terrace banks and slopes to control erosion;
- restore terraces, levees and drainage ditches to as near their original conditions as practical;
- clean-up the right-of-way immediately following the backfill of the trench; and

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- remove spoil, debris, piling, cofferdams, and false-work from watercourses to prevent interference of the normal water flow and watercourse use.

Watercourses disturbed by construction of the pipeline (or other buried facility) shall be opened across the right-of-way and trenched for the proper flow of water. Furrows and terraces shall be constructed across the right-of-way as necessary to divert the flow of water away from the backfilled trench and into natural drainage courses to prevent excess erosion along the facility.

Contractor shall replace the soil from side hill cuts as directed by ESSO. All side hill cuts and fills shall be sloped sufficiently to prevent injury to personnel, livestock, and wildlife and to prevent erosion.

Topsoil shall be spread over cleared areas once any re-grading or deep ripping of compacted areas is complete in accordance with the Soil Erosion Mitigation Specification. Chipped vegetative debris may be mixed with the topsoil and spread over cleared areas. Contractor shall evenly spread topsoil over the right-of-way to restore the natural contour of the ground and allow normal surface drainage.

Where disturbed right-of-way passes across watercourses or through marshland, Contractor shall provide, place, and compact all fill material necessary to restore waterway and marshland banks to natural lines and grades or to the lines and grades specified on the drawings. Fill material shall be environmentally compatible with existing bank material to ensure consistency in vegetative growth. Where required by the drawings and/or specified in the Soil Erosion Mitigation Specification, Contractor shall utilize soil and bank stabilization to prevent bank slough and wash and to enhance vegetation growth.

## 10.2 Camps, Laydown Areas, Temporary Access Roads

Unless ESSO has specified that an area or a part of an area of the Work Site used during the construction phase of the project will also be needed for the operations phase, all affected areas shall be restored by Contractor. These areas (camps, laydown areas and storage yards, temporary access roads, fabrication areas, etc.) shall be returned to natural contours where possible. Re-contouring to natural lines and grade shall be accomplished without disruption to adjacent undisturbed habitat. If these areas have been compacted during use, they shall be scarified to loosen the soil.

Permanent water breakers and/or terraces shall be constructed across areas of sloping ground to prevent erosion as specified in the Soil Erosion Mitigation Specification. Natural drainage patterns shall be restored and, in potentially high erosion areas, earth-filled sacks, stone rip-rap or other stabilization methods

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shall be used. All restoration activities other than foot traffic shall be limited to previously affected areas and marked construction zones.

Contractor shall replace the soil from side hill cuts on the Work Site as directed by ESSO. All side hill cuts and fills shall be sloped sufficiently to prevent injury to personnel, livestock, and wildlife and to prevent erosion.

Topsoil shall be spread over cleared areas once any re-grading or deep ripping of compacted areas is complete. Contractor shall evenly spread topsoil over the area to restore the natural contour of the ground and allow normal surface drainage. Flat areas and slopes up to 3(H):1(V) grade shall be loose and friable to a depth of at least 120 millimeters. Compacted Work Site soils shall be loosened on the surface by scarifying (raking, disking, or other acceptable means). Slopes steeper than 3(H):1(V) shall have at least 70 millimeters of loose, friable, surface soil.

### 10.3 Borrow Pits/Areas

When borrow pits/areas will no longer be needed, the site shall be graded to ensure that it will not accumulate standing water or divert the flow of watercourses that may engulf it. If tracks were cut into river/stream banks, they shall be reinstated and measures take to prevent erosion, as necessary. The sides of the pits/areas shall be sloped sufficiently to prevent injury to personnel, livestock, and wildlife and to prevent erosion.

The reclamation provisions (including topsoil conservation and replacement) described in this specification for other Work Site areas shall also apply to borrow sites.

## 11.0 Site Reclamation

All areas not under permanent facilities shall be restored to an equal or better soil condition than when disturbance occurred so that the pre-disturbance vegetation type can re-establish itself in a short period of time. In order to facilitate revegetation, mitigations that may apply for reclamation of portions of the Work Site include fertilizing and seeding, mulching, and surface texturing. Locations where one or more of these techniques will be required to facilitate revegetation shall be identified in the field by ESSO and Contractor environmental monitors (or other qualified personnel approved by ESSO). Close attention shall be paid to areas where erosion potential is high (e.g. at the crossings of watercourses, areas of the Work Site that are seen to be subject to active erosion, etc.), and where unauthorized access to the Work Site needs to be actively discouraged (e.g. where the Work Site passes through relatively undisturbed vegetation and intersects a road or track). Large plots of land such as storage yards, borrow pits and main camp sites shall be actively revegetated.

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### 11.1 Fertilization and Seeding

In disturbed Work Site areas with very little topsoil or naturally sparse vegetation, Contractor may need to fertilize with an N-P-K fertilizer at a loading rate suitable for new grass growth, and seed the area with an ESSO approved native seed mixture. In the absence of soil tests, 0.11 tonnes per hectare of 10-10-10 or equivalent fertilizer shall be used in these areas.

If seeding/planting of the area by Contractor is necessary, fertilizer shall be applied before seeding/planting and harrowed or disked uniformly into the soil to a minimum depth of 80 millimeters on slopes flatter than 3(H):1(V). On slopes steeper than a 3(H):1(V) grade, fertilizer shall be worked the best way possible.

If seeding/planting of the area is necessary, native seed mixtures or plants/sprigs used shall be compatible with local soil conditions and climatic zones, and shall be free of weeds. Seed shall be applied uniformly in a manner appropriate for the type of seed used, and shall be placed in a firm, moist seedbed to a depth suitable for the seed selected. Plants/sprigs shall be planted at a suitable density and in a manner conducive to successful growth.

Any seeded/planted area which fails to show a uniform stand of vegetation after one growing season shall be assessed to determine obvious causes for failure. The site shall then be reseeded/replanted, refertilized, remulched and/or reharrowed, as necessary, and/or the revegetation approach shall be modified to improve the chances of successful revegetation in the next growing season. A uniform stand of vegetation will be considered growth which shows no deterioration or bare spots greater than 1 square meter (10.76 ft<sup>2</sup>) in size and provides a minimum of 80 percent grown cover. Areas not satisfying this definition may be approved by ESSO as satisfactorily revegetated if Contractor can show that these areas are not significantly different from the surrounding environment (outside the project impacted area). One year after initial site reclamation, Contractor shall inform ESSO of the locations of all sites where vegetation is still below the target level so that ESSO may continue site reclamation efforts, as necessary.

### 11.2 Mulching

If mulching of an area by Contractor is necessary, the following types of mulches may be acceptable:

- Hay or other native pasture mixture, unrotted with a low moisture content, applied at a rate of 0.4-0.5 kg/m<sup>2</sup>.
- Straw from wheat, oat, or rice (free of viable seed), unrotted with a low moisture content, applied at a rate of 0.5-0.7 kg/m<sup>2</sup>.
- Wood cellulose fiber, applied at a rate of 0.17 kg/m<sup>2</sup>.

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- Stockpiled vegetation which has been chipped or shredded, applied at a rate of 0.5 kg/m<sup>2</sup>.

On slopes greater than 3(H):1(V) prefabricated blankets (mats) of straw, coconut, wood or other natural plant fibers sewn together with a biodegradable netting may be used. Prefabricated blankets (mats) shall be stapled in place with No. 11 gauge wire staples 150 to 250 millimeters long. The staple pattern shall be in accordance with the manufacturer's recommendations.

Mulch shall be anchored immediately after mulch placement using one of the following methods as approved by ESSO:

#### 11.2.1 Crimping

A notched, straight disk crimper set to push part of the broadcast mulch fiber 50 to 80 millimeters into the soil shall be used to anchor yet leave part standing upright.

#### 11.2.2 Imprinting

Imprinting is expected to be the preferred method of surface soil/seedbed preparation on many of the disturbed portions of the project. Imprinting with a shaped roller is a cost effective practice that is well-suited for use on large portions of the Chad Development Project. The imprinter roller forms funnel shaped seedbed and seedling cradles which concentrate water and improve infiltration. At the same time, the imprinter provides simultaneous mulching of above ground plant material without topsoil inversion in a single operation. Because the surface roughness reduces wind-speed, sand deposition and the capture of wind blown seeds in the imprints are facilitated. Land imprinters generally use three basic tooth geometries to imprint conical, pyramidal or V-trough shaped funnels in the soil surface. When used in conjunction with seeding, seed shall be disseminated directly on top of the roller which allows the seed mix to be imbedded in the surface of the imprint.

#### 11.2.3 Mulch binders/tackifiers

Mulch can be anchored by injecting tackifiers into the mulch stream as the mulch leaves the blower. Non-asphaltic tackifiers consisting of vegetable gum or silicate-based polymers blended with hydrophilic polymers may be used. These shall be applied using the manufacturer's recommended rates.

### 11.3 Surface Texturing

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It is expected that mitigation recommendations will include the use of an imprinter over much of the Work Site requiring restoration (including those areas where fertilizer and seed are not applied).