North American Oil Sands Corporation
A wholly-owned affiliate of StatoilHydro ASA
Upgrader Project

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1 INTRODUCTION

North American Oil Sands Corporation (North American) is an integrated oil sands company operating in Alberta proposing to build a bitumen upgrading facility in Strathcona County northeast of Edmonton, Alberta. North American is wholly owned by StatoilHydro ASA (StatoilHydro).

North American is developing an integrated oil sands project, producing bitumen from its planned Steam-Assisted Gravity Drainage (SAGD) operations near Conklin, Alberta, and an upgrader to convert the bitumen into a valuable light sweet Synthetic Crude Oil (SCO). The SAGD development was applied for previously:

- Application for Approval of the Leismer Demonstration Project (approved in September, 2007); and
- Application for Approval of the Kai Kos Dehseh Project (applied for in August 2007).

Alberta's oil sands are extensive, and are seen as a major future source of petroleum as more conventional oil supplies world wide become more difficult to find. The oil sands contain bitumen, a non-conventional oil that is often referred to as extra heavy oil. Bitumen is extremely viscous and does not readily flow unless it is heated or diluted with lighter hydrocarbons. Bitumen is a difficult feedstock to process, and there is a shortage of refining capacity that can accommodate such heavy feedstock. More heavy oil processing capacity, often referred to as residual capacity, is required in the petroleum value chain to absorb the new bitumen supplies, either in petroleum refineries, or in upgraders which allow the product from the bitumen to then be processed in light crude refineries.

North American plans to develop the Upgrader as one project that will be constructed in several phases to attain the full Project capacity of 1,610 m^3/h (243,000 barrels per stream day [bpsd]) of bitumen feed. This target capacity is staged largely to match the planned bitumen production from North American's upstream bitumen production facilities. Surplus upgrading capacity will be offered to other producers.

The overall project is comprised of Phase 1 and subsequent phases, and they are collectively referred to as "The Project." Phase 1 has a capacity of 530 m^3/h (80,0000 bpsd) of bitumen feed and with the additional phases, the Project will have a capacity of 1,610 m^3/h (243,000 bpsd). The Project includes all of the facilities to reach the target capacity for the Upgrader plus the addition of two stages of petroleum coke (petcoke) gasification to produce hydrogen, electrical power and synthetic natural gas.

Based on the plan outlined by this document, Phase 1 is estimated to come onstream by 2014. Further expansion and subsequent phases should allow the Upgrader to reach full bitumen processing capacity by 2020. The Project, including two stages of gasification, is expected to be fully operational by 2025.

North American has acquired 540 ha (1,351 acres) of land in Strathcona County near Bruderheim, Alberta, for the purpose of building the Upgrader. This location has many advantages including: close proximity to a skilled labour force and a major oil sands feedstock and product pipeline hub, industrial zoning designation, synergies with nearby petrochemical facilities and opportunities to recover carbon dioxide (CO_2) for use in enhanced conventional oil recovery programs or sequestration in depleted reservoirs.

North American introduced its Project to the nearby communities in the fall of 2006 and has continued to keep local residents informed of its plans. The Environmental Impact Assessment

(EIA) for the Upgrader commenced in the summer of 2006. The final Terms of Reference (TOR) for the EIA were published on October 18, 2007. A copy of the TOR is presented in Appendix A.

North American's development plan is based on the use of currently available and commercially proven coking technology and hydroprocessing as the main building blocks for the upgrading scheme. This selection was based on engineering studies, upstream and downstream commercial considerations, and a thorough assessment of a number of processing technologies.

Coking is a widely used, proven process and is well-suited to staged development, which makes coking the technology of choice for North American's multi-stage approach towards construction and implementation. In addition to incremental coking capacity, proposed future phases of the Upgrader include gasification units to use the petcoke produced by the cokers as a feedstock to produce hydrogen and SNG, reducing dependence on natural gas and producing a high quality CO_2 stream that can be used for enhanced oil recovery or sequestration.

North American believes the construction and operation of an upgrader will mitigate the company's exposure to the historically volatile price differential between bitumen and light sweet crude oil, and thus reduce market risk and improve the overall project economic returns. North American plans to upgrade its produced bitumen to premium liquid products in order to ship them to market via pipeline without the need for condensate (which has become increasingly scarce) or other diluents such as SCO and other relatively expensive alternatives. To achieve pipeline specifications, the bitumen must be upgraded to at least a medium sour SCO; however, North American plans to fully upgrade the bitumen to light sweet SCO in order to maximize marketing opportunities. In addition, future market conditions may favour further upgrading to a higher quality sweet SCO and manufacturing by-products such as petrochemical feedstocks, hydrogen, syngas, SNG, synthetic pipeline diluents and high concentration carbon dioxide that can be sequestered. North American's upgrading strategy will allow for expansion in both size and scope to meet market conditions, and to take advantage of potential third party bitumen processing opportunities.

The Upgrader development will be constructed during a time when a number of other projects are also planned for construction in the region. North American has carefully developed a construction plan that is fully cognizant of this high level of activity, primarily by developing the Project in stages that are sized to be more manageable than building a much larger scale project at one time.

The Upgrader will provide many benefits to Alberta. By undertaking this value added step, Albertans will be the beneficiaries of a modern processing facility that will employ approximately 600 long term employees who will live in the region, create economic opportunities for hundreds of local businesses, provide taxes to the region, and bring benefits to the nearby communities. Finally, the Upgrader will be a "building block" as it encourages other developments and businesses in the region, which should help this region to be a continuing economic player for decades to come.

1.1 Project Overview

The current plan for all phases of the Project is to use delayed coking as the primary upgrading technology and hydroprocessing as the secondary technology. The hydrogen required for hydroprocessing will be manufactured initially through steam methane reforming, which will later be supplemented by hydrogen production from petcoke gasification in subsequent phases. Support units such as sulphur recovery and wastewater treatment will expand as the need arises. Phase 1 of the Project will start with a capacity 530 m^3/h (80,000 bpsd) of bitumen feed and will expand through subsequent phases to bring the upgrading capacity to 1,610 m^3/h (243,000 bpsd) of bitumen feed by 2020. Petcoke gasification will be introduced in two stages, the first coming into service in 2018 and producing hydrogen for the hydroprocessing units and the second by 2025 generating SNG and electrical power and consuming the bulk of the petcoke from the cokers.

An overview of the Project is presented in Figure 1.1-1. The full Upgrader capacity of 1,610 m^3/h (243,000 bpsd) of bitumen feed plus the two stages of gasification are referred to as the Project.

Bitumen, a heavy viscous oil, will be converted into products that can be processed by refineries by removing carbon from the bitumen and adding hydrogen to produce lighter hydrocarbon products. Feed to the Upgrader will be a diluent bitumen blend (dilbit). Diluent is a natural gas condensate and is required to promote oil water separation in the bitumen production facilities and to reduce the viscosity for pipeline transportation. The bitumen blend processing capacity will reach 2,299 m^3/h (347,000 bpsd), returning 689 m^3/h (104,000 bpsd) of diluent to the upstream bitumen production facilities.

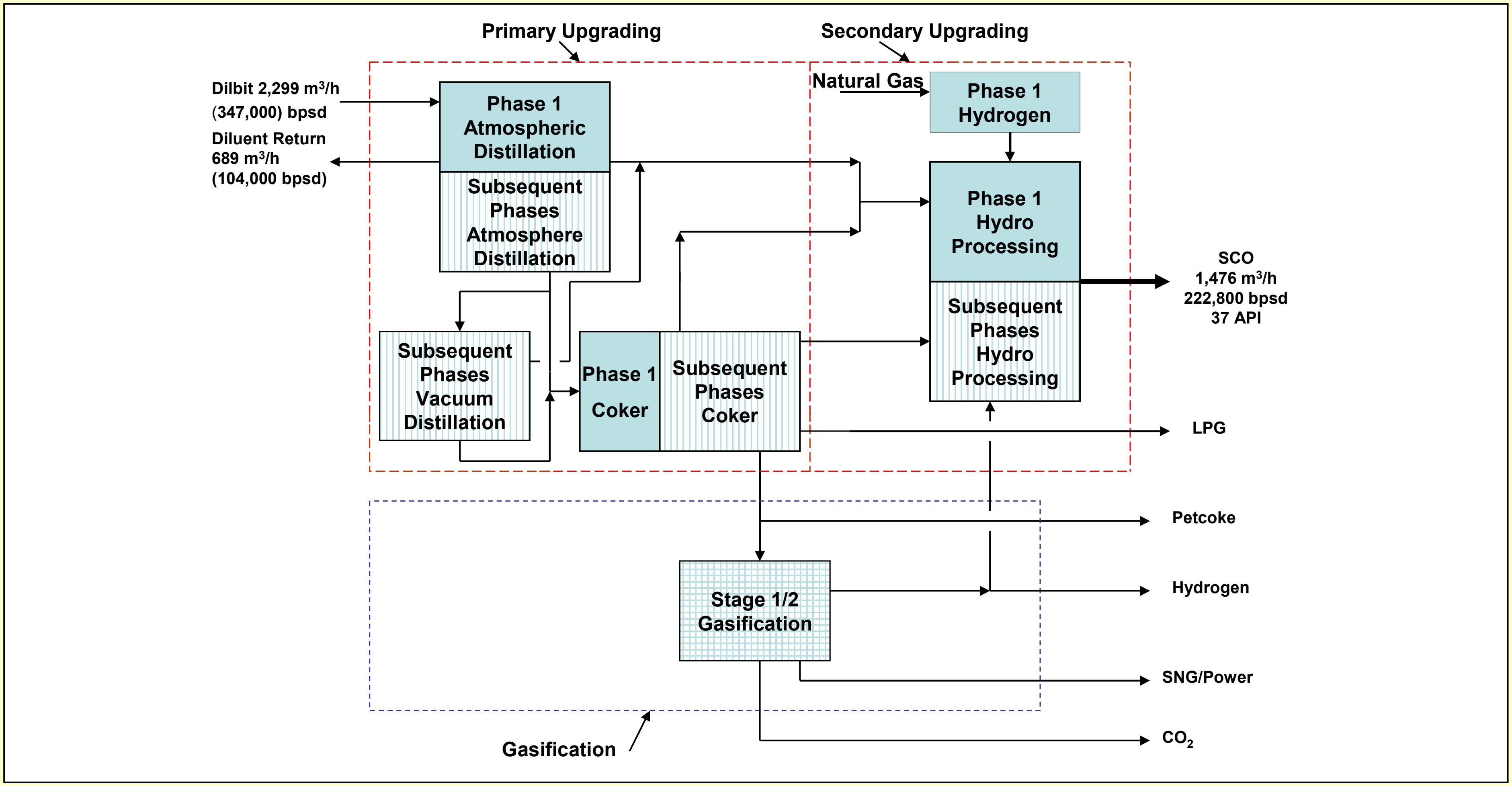
Diluent bitumen blend will be fed from storage tanks to the diluent recovery unit (DRU). The DRU separates the diluent from the bitumen for shipment back to the upstream bitumen production facilities. The lighter material called light gas oil (LGO) contained in the bitumen is removed and sent directly to the hydroprocessing units. The remaining heavier bitumen feeds the delayed coker unit (DCU). The DCU is a semi-continuous thermal cracking process in which bitumen feedstock is converted into lighter, cracked hydrocarbon products.

Hydroprocessing is used to produce a sweet SCO, which is a blend of naphtha, gas oil and butane. Naphtha and gas oil, the two main coker products, are stabilized in the hydroprocessing units, with the addition of hydrogen. The hydroprocessing units also remove impurities such as sulphur and nitrogen through treating in a hydrogen environment over a metal-impregnated catalyst.

The Project requirements for hydrogen will be provided through a combination of steam methane reformation (SMR), purchases from others, and the gasification of petcoke, which is a by-product of the DCU. The hydrogen required in the hydroprocessing step in Phase 1 will be produced through the SMR of natural gas. During Phase 1, the petcoke will be shipped by rail for export. Fuel gas produced in the Upgrader will be used in the upgrading heaters and boilers after the hydrogen sulphide (H_2S) is removed in an amine absorber. The acid gas (H_2S rich stream) that is recovered in the amine regenerator will be sent to the sulphur recovery unit (SRU) to recover the sulphur for sale to market.

Water is required to provide cooling as well as for processing. North American is requesting approval to withdraw water from the North Saskatchewan River. It is also working with industry and government to further explore ways to conserve, recycle and reuse water.

Each phase of the Upgrader incorporates increasing energy efficiency steps. In addition to plans to reduce CO_2 emissions, North American will be ready to recover CO_2 from the hydrogen plant in Phase 1 and the gasification units. StatoilHydro is engaged in many research and development activities to reduce CO_2 emissions and is a world leader in recovering and sequestering CO_2. This experience will be incorporated into North American's projects.



The Project Overview	NORTH AMERICAN	
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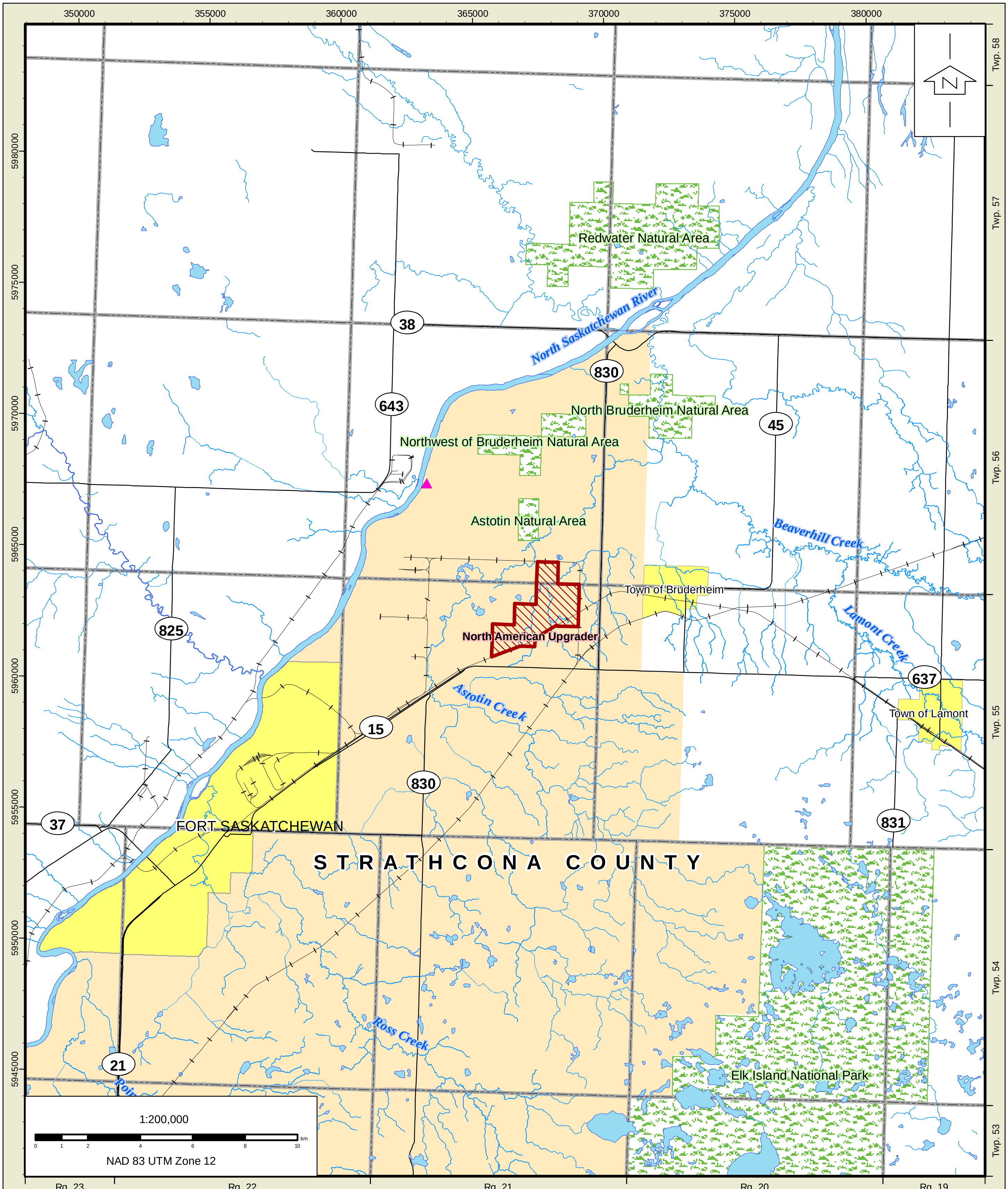
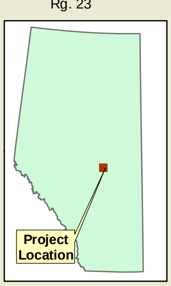
1.2 Project Location

North American plans to construct and operate the Upgrader within Strathcona County, located approximately 15 km from Fort Saskatchewan, Alberta, and approximately 3 km west of Bruderheim, Alberta. It is located within a region referred to as the Alberta Industrial Heartland (AIH), most of which is zoned for heavy industrial use. This region already contains an upgrader, a refinery and several petrochemical plants. Additional projects are under development or planned by others for this region. The Project location is shown on Figure 1.2-1.

North American owns 540 ha (1,351 acres) located within portions of Sections 26, 27, 35 and 36 in 55-21 W4M and SE¼ Section 2 in 56-21 W4M. The site is large enough to include the Project process units, as well as tank farms, water treatment, warehouses, office space and employee/contractor parking. A portion of the site will remain undeveloped to preserve existing wetlands.





Legend

- North American Upgrader
- City/ Town
- Park
- Road
- Rail
- Proposed Intake/Outfall Site
- Waterbody
- Watercourse

Title:

PROJECT LOCATION

NORTH AMERICAN OIL SANDS CORPORATION

Approved: BE	Revision Date: Nov 23, 2007

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1.3 Project Conceptual Design

North American plans the development of a 1,610 m^3/h (243,000 bpsd) bitumen feed Upgrader, producing approximately 1,476 m^3/h (222,800 bpsd) of SCO. The Upgrader design is based on the use of currently available and commercially proven coking technology and hydroprocessing as the main building blocks for the upgrading scheme. The principal criteria assessed in making the technology decision included:

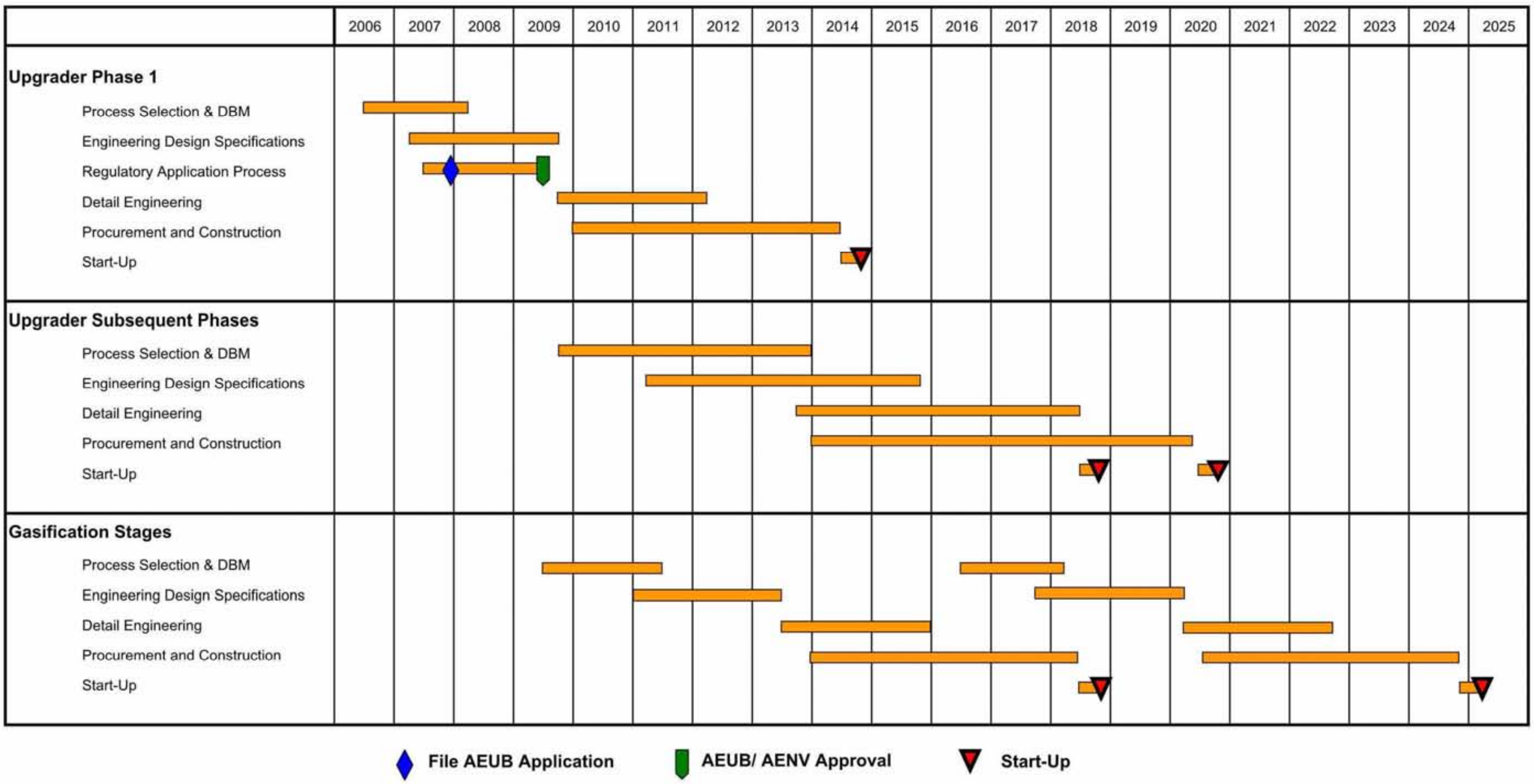
- proven technology;
- safety and reliability;
- environmental management;
- capital cost and economics;
- processing efficiency;
- flexibility to change product quality as the plant expands;
- ability to maximize sweet SCO yield;
- capability to process alternative bitumen supplies;
- ability to readily expand the plant to match bitumen production levels; and
- plant location.

1.4 Project Schedule

The Project schedule is shown in Figure 1.4-1. The schedule is approximate and subject to modification in response to the receipt of regulatory approvals, business considerations and weather factors. Assuming favourable regulatory approval and market conditions, construction of the Project is scheduled to begin in 2010 with Phase 1 production commencing in 2014. Full SCO production from the Project is expected to occur by 2020, with the second stage of gasification complete and operational by 2025.

Stakeholders have been consulted since the fall of 2006 and will continue to be involved throughout the development process. It is North American's intention to continue communication and interaction with the surrounding communities throughout the life of the Project.

The Upgrader is being designed to operate for many years. With proper maintenance and systematic replacement of equipment that has reached the end of its operating life, the Upgrader may remain in operation for over 50 years. It will be able to process a range of bitumen qualities, and could also source supply from other producers.



Project Schedule	NORTH AMERICAN OIL SANDS CORPORATION		
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1.5 Project Execution

1.5.1 Project Stages

Each phase of the project will be managed through six stages:

- Design Basis

  This stage establishes the process design for each phase; in particular, technology selection, feed capacity and product specifications. Engineering contractors are also short listed for the Front End Engineering Design (FEED) and Engineering, Procurement and Construction (EPC) stages.

- Front-End Engineering Design

  During the FEED stage, the overall design and cost estimate are completed with the appropriate risk assessment. Equipment specifications are completed and the long delivery items identified for the procurement program. Details of the construction strategy are prepared. Investment decisions are taken in parallel with the progress of the FEED and accuracy of the cost estimate.

  During this stage, key operations representatives are appointed and an overall operating philosophy established.

- Engineering, Procurement and Construction

  The EPC stage will include detailed engineering and procurement of the materials and equipment. EPC contractors will be mobilized. To reduce construction risk, the Project will be broken down into manageable components and silos. Each will be led by EPC contractors that are best equipped to manage the work.

- Commissioning and Start-up

  To ensure technical continuity throughout the Project, a number of process engineers and operations staff will follow the design from conceptual through engineering to construction and start-up. This enables a smooth transition from construction to operations.

- Operations

  The facilities will be optimized during the first year of operations.

- Decommissioning and Reclamation

  Facilities will be decommissioned and the site returned to appropriate land use.

1.5.2 Key Initiatives, Project Strategies and Management Approach

North American strives to develop and deliver a Project that will lead to a successful business venture. It relies on StatoilHydro's management system that incorporates the company's values, people, and leadership principles. The Project must meet very high standards of health, safety, and protection of the environment and be executed in an ethical manner and in full compliance with local laws and regulations.

North American is committed to sustainable development and its social responsibility in the community. A high level of communication among company employees and contractors must also be achieved so that all have clear vision, clear responsibilities and common goals.

Each phase of the Project will be constructed in several large execution packages. An integrated North American project management team will coordinate the full execution of each phase.

The Upgrader is designed to achieve a high level of sulphur recovery, and will use the best available technology that is technically and economically feasible for burner applications. The Project will be well prepared should the Alberta Government proceed to establish caps on both SO_2 and NO_x emissions in the AIH.

North American plans to be ready to recover CO_2 from the Upgrader, starting with Phase 1. This plan is based on a regional outlet for the CO_2, adequate infrastructure to transport the CO_2, and an appropriate fiscal and regulatory regime for carbon capture.

The justification for gasification of petcoke to produce hydrogen rather than generation of hydrogen from natural gas is based on a high price environment for natural gas, or a shortage of natural gas for industrial use. Gasification generates substantial CO_2 emissions, but most of these emissions can be readily recovered for carbon sequestration. Further, when gasification is implemented, water requirements will increase significantly. Actual implementation of the gasification stages, though, will be dependent primarily on it being the most viable option for providing an energy alternative to natural gas, and the most effective way of recovering the additional CO_2 emissions associated with alternative fuels. If North American implements gasification in the Project, it will be accompanied by development plans for CO_2 recovery, transportation, and storage/sequestration.

Water requirements for the Project are based on having sufficient water to meet all of the upgrading requirements including both stages of gasification. Although the gasification units require substantial volumes of water, increasing levels of water conservation, including the staged introduction of Zero Liquid Discharge Technology (ZLD), will enable North American to satisfy water demands for both stages of gasification.

1.6 Project Need

Substantial growth in bitumen production is expected over the foreseeable future, and bitumen will become an increasingly larger portion of the crude oil supply refined in Canada and the United States. Based on experience over the past several decades, refinery capabilities to process this bitumen usually lag supply increases, resulting in a significant market risk for a producer planning to market only bitumen. North American believes the construction and operation of an upgrader will mitigate exposure of its SAGD bitumen production to the historically volatile price differentials between bitumen and light sweet crude oil, and thus reduce market risk and improve the overall economic returns associated with its bitumen production project.

Most refineries in Canada and the United States are designed to process light and medium crude oil. Those refineries that process heavy crude, including bitumen blends, are operating at capacity. Although more residual processing capacity is planned at some of these refineries, they are not likely to overbuild capacity to enable them to keep up with future bitumen production. Additional residual processing capacity is required in the market; either by building upgraders or by converting light and medium crude refineries to accept heavy oil. North American believes that building upgrading capacity in Alberta captures the best economics for an oil sands project, retaining most of the benefits within Alberta as opposed to marketing bitumen.

1.7 Project Components

The Upgrader will be built in the AIH near other upgrading facilities and corresponding infrastructure. It will be close to the pipeline corridor between the oil sands producing areas and Edmonton. The Upgrader will receive a dilbit stream from North American's upstream developments by pipeline, and potentially from other bitumen producing operations. Diluent will be returned to the bitumen production area by pipeline. Pipeline service may be provided by others, or may be developed by North American under a separate application. SCO will either be delivered to Edmonton by others, or in a new SCO pipeline developed by North American, which would also be under a separate application.

The Upgrader will consist of primary upgrading (carbon rejection through delayed coking), secondary upgrading (hydrogen addition through hydroprocessing), utilities and off-site services. A natural gas-based hydrogen plant will be provided in Phase 1, and in the Project, additional hydrogen will be provided by petcoke gasification. The off-site facilities include storage tanks, by-product handling equipment, minimal storage for petcoke, sulphur, Liquefied Petroleum Gas (LPG), as well as rail loading equipment.

A rail spur will be part of the Upgrader. It will be accessible by both the Canadian National (CN) railway and the Canadian Pacific Railway (CPR). Sufficient track will be provided in the spur to accommodate unit trains.

An administration building will be provided that includes a control room, laboratory and offices. Maintenance and warehousing facilities will also be constructed.

Water to the Upgrader will be withdrawn from the North Saskatchewan River. A water intake, pumphouse, river water pipeline and effluent pipeline will be constructed.

1.8 Site Selection

A thorough evaluation of several site options was undertaken. The primary alternative location was near the SAGD facilities near Conklin, Alberta.

The decision to locate in the AIH at the site west of Bruderheim was made based on a number of criteria. The AIH has zoning already in place to accommodate projects of this nature. The site is close to pipelines, and utility and transportation infrastructure. It is in close proximity to the North Saskatchewan River as a water supply, other upgraders, petrochemical plants, and a refinery, which should facilitate beneficial business arrangements with third party facilities. Finally, it is likely that a CO_2 pipeline system will be built in this region, which would allow the potential for North American to recover CO_2 and have the ability to transport it to a storage location.

Locating the Upgrader near Conklin offered potential synergies with the SAGD operations, but there were also challenges related to footprint and water supply and disposal that were not easily resolved. After completing an intensive location analysis, including risks and benefits, the AIH location was chosen.

1.9 Marketing

1.9.1 Synthetic Crude Oil

Once the Upgrader is operating, North American plans to market the SCO to refineries in Canada and the United States, but will also consider offshore markets as new pipelines make this possible. North American's SCO production will compete with other light sweet crude oils in the marketplace. Based on the current strong market for light sweet SCO, and concerns about declining light crude oil supplies, North American believes that it will be able to source attractive markets for its SCO production.

1.9.2 Other Products

The Project will produce LPG, SNG, sulphur, petcoke, fuel gas and power. Fuel gas and power will be used internally in the Upgrader to offset purchases. The remaining products will be marketed.

LPG will be sold to local gas liquids fractionators for further processing and sale as a petrochemical feedstock. SNG will be sold into the natural gas market and will offset North American's natural gas purchases.

Sulphur will be shipped to market as a solid premium product known as pastilles (Section 3.5.1.7). North American is not designing long-term sulphur stockpiling or sulphur blocking facilities. Sulphur is expected to be exported to Asia-Pacific markets.

Petcoke will be exported to offshore markets as an industrial fuel until the gasification units are operational. Surplus petcoke will remain available for marketing throughout the Project lifespan, because not all petcoke is consumed in gasification.

1.10 Capital Cost

A preliminary capital cost estimate for the Project has been completed. A detailed cost estimate for Phase 1 is underway. Based on industry benchmarks of $40,000 to $60,000 per flowing barrel of bitumen for upgrading, the cost of Phase 1 may reach $4 billion, and the full Project capital cost, including gasification, could reach $16 billion, all in constant 2007 dollars. A significant level of engineering and careful cost tracking will be undertaken to develop a more definitive cost estimate as the Project progresses.

1.11 Operating Cost

The average annual operations expenditure for the Project, including purchased electricity and natural gas, is estimated at $600 million, in 2007 dollars. Operations expenditures will vary year-by-year, depending on plant turnarounds, sustained production levels and variations in the price of inputs. For Phase 1, annual expenditures are estimated to be $130 million in 2007 dollars.

1.12 Viability of the Project

The Project is a long-term investment to enhance the value of the bitumen resource that North American is developing. North America believes that the Project will be economic at crude oil prices above $60 (U.S.) per barrel. The viability of the gasification phases is sensitive to the price of natural gas and the value of carbon credits.

1.13 The Proponent

North American is wholly owned by StatoilHydro, an international oil company, with operations in many regions, including: Norway, Venezuela, Africa, Canada and the Middle East. It is a major crude oil producing company, with oil production of approximately 1.7 million barrels per day. Through the acquisition of North American, StatoilHydro is committed to becoming a key player in the Alberta oil sands industry. Under a separate application submitted in August 2007, North American is planning to develop the Kai Kos Dehseh SAGD project near Conklin, Alberta. The Upgrader is a key component of North American's plans to develop an integrated oil sands project.

North American is currently the working interest owner and operator of approximately 12 townships of oil sands leases between Lac La Biche and Fort McMurray. North American's goal is to develop the Kai Kos Dehseh Project, ultimately producing approximately 1,457 m^3/h (220,000 bpsd) of bitumen through SAGD technology.

2 APPLICATION FOR PROJECT APPROVAL

2.1 Request for Approvals

Approval is sought from the Alberta Energy and Utilities Board (EUB) pursuant to:

- Section 11 of the *Oil Sands Conservation Act* for approval to construct and operate an oil sands processing plant (bitumen upgrader); and

- Section 12 of the *Oil Sands Conservation Act* for an industrial development permit.

In addition, approval is sought from Alberta Environment (AENV) pursuant to:

- Part 2, Division 2 (Sections 60, 61, and 66) of the *Environmental Protection and Enhancement Act* for approval to construct, operate, and reclaim an oil sands processing plant (bitumen upgrader); and

- Part 4, Division 1 (Sections 36 and 37) and Part 4, Division 2 (Sections 49 and 50) of the *Water Act* for approval and licenses to use (withdraw, divert and confine) surface water and divert natural surface waters (on, around or away from the Project site).

Concordance tables are presented in Appendix B that cross-reference the information required by the TOR for the Project, EUB Directive 023, Guidelines Respecting an Application for a Commercial Crude Bitumen Recovery and Upgrading Project (EUB, 1991), the *Oil Sands Conservation Act*, and the *Environmental Protection and Enhancement Act* (EPEA).

2.2 Existing Approvals

North American has received clearance from Alberta Tourism, Parks, Recreation, and Culture under the *Historical Resources Act*, Part 3, Section 34.

2.3 Potential Additional Permits and Approvals

Additional permits and approvals may be required under federal, provincial and municipal legislation, as presented in Table 2.3-1. These approvals (if required) will be the subject of separate applications.

Table 2.3-1 Potential Additional Permits and Approvals for the Project

Approval Required	Approving Authority	Legislation
Development Permit	Strathcona County	*Municipal Government Act*, Part 17
Approval for a water intake and outfall into the North Saskatchewan River	Transport Canada	*Navigable Waters Protection Act*, Section 5
Harmful alteration, disruption, or destruction of fish habitat	Fisheries and Oceans Canada	*Fisheries Act*, Section 35(2)
Construction of on-site electrical generation (as part of gasification units)	EUB	*Hydro and Electric Energy Act*, Section 11
Construction of product and natural gas pipelines	EUB	*Pipeline Act*, Part 7, Section 38
Temporary diversion license for temporary dewatering of excavations during construction	AENV	*Water Act*, Part 4, Section 62
Long-term groundwater diversion license for groundwater withdrawal below ponds	AENV	*Water Act*, Part 4, Section 37

2.4 Compliance with Legislation

The Project will be constructed, operated, and reclaimed in accordance with applicable acts, regulations, and approvals granted. It conforms to the land use bylaw for Strathcona County, which allows for the construction of an oil sands processing plant (bitumen upgrader) within the AIH.

The Project will also comply with applicable AENV standards, guidelines, and codes of practice, and the Canadian Council of Ministers of the Environment (CCME) criteria, guidelines, and codes of practice.

2.5 Communication with the Applicant

Please direct all communication regarding this application to:

Gareth R. Crandall, P.Eng.
Senior Vice President, Upgrader
North American Oil Sands Corporation
Suite 900, 635 – 8th Avenue SW
Calgary, Alberta T2P 3M3

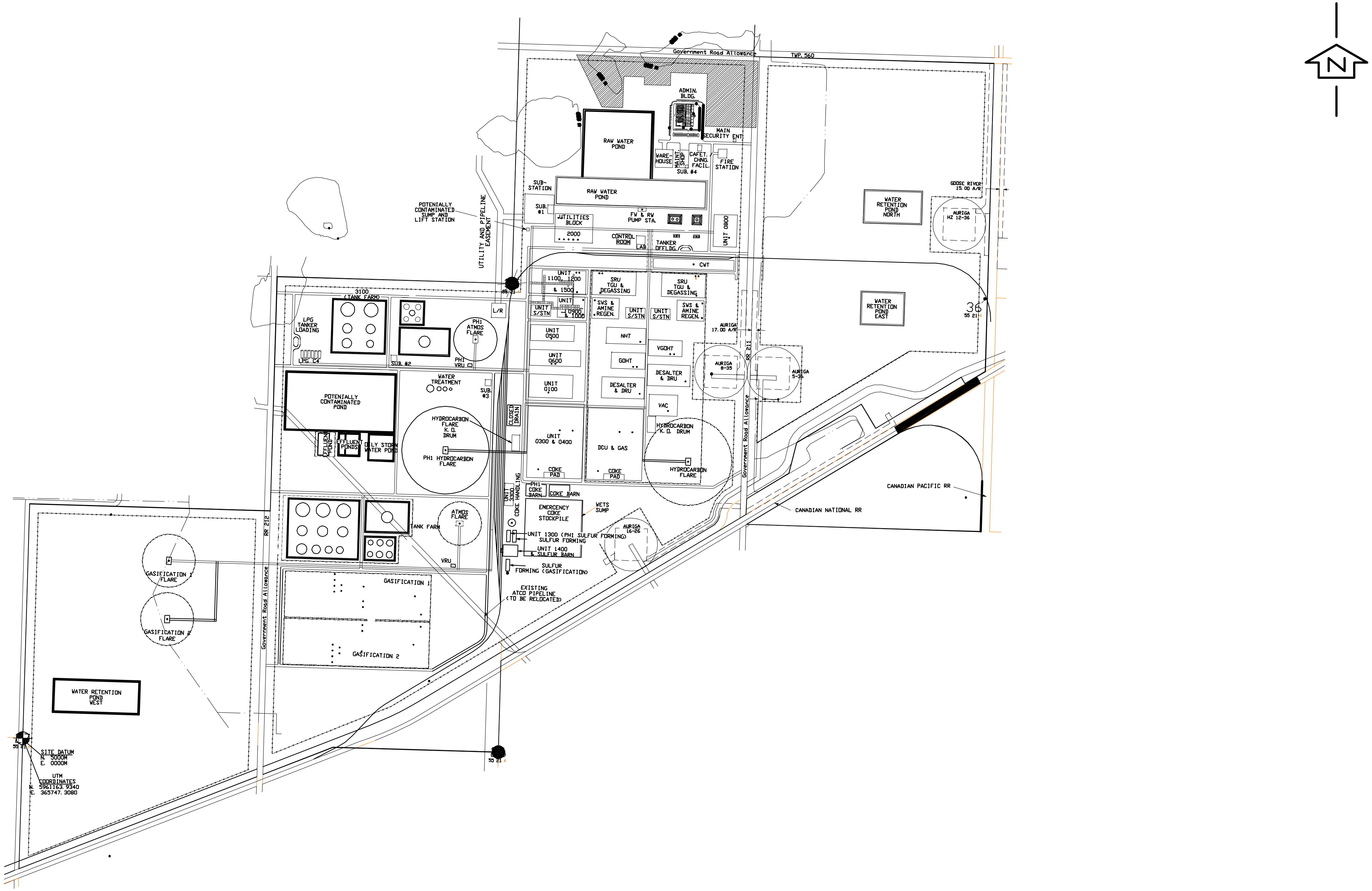
and

Craig Popoff, P.Eng., CRSP
Director, Regulatory Affairs, Environment and Safety
North American Oil Sands Corporation
Suite 900, 635 – 8th Avenue SW
Calgary, Alberta T2P 3M3

3 THE PROJECT

3.1 Plot Plan

Figure 3.1-1 presents the Project plot plan and indicates the layout of the process units, off-site services and by-product handling facilities. The Project plot plan is shown overlain on an aerial photograph in Figure 3.1-2. The process units are centrally located, with the primary and secondary process units from south to north following the process flow path. Phase expansions flow west to east maintaining the process trains in close proximity to minimize cross-over piping. Storage tanks and water ponds are located close to the site perimeter to provide a buffer zone from the nearby community and to improve overall aesthetics. The flares are located to minimize noise and light effects on surrounding communities. Landscaping and berms will improve the visual appearance of the site as well as providing noise attenuation.



LEGEND

NATURAL AREA

SCALE 1:15000 meters

150 0 150 300

Title:

PROJECT PLOT PLAN

NORTH AMERICAN OIL SANDS CORPORATION

Approved: DR	Revision Date: 11/29/07
File: 6198-SP-07.DWG	

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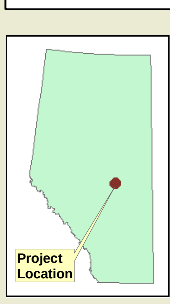

Legend

- North American Upgrader Property Boundary
- Alberta Township / Range
- ATS Section Line
- Road
- Railway
- Existing Pipeline
- Existing Wellsite/Road
- Business
- Plot Plan (Plot Plan Legend is shown on Figure 3.1-1)
- Natural Area

Title:

AERIAL PHOTOGRAPH WITH PLOT PLAN

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
BE	Dec.03, 2007

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3.2 Process Description

Bitumen, a heavy viscous oil, will be converted into products that can be processed by refineries by removing carbon from the bitumen and adding hydrogen to make lighter hydrocarbon products. Feed to the Upgrader will be dilbit. The diluent component of the dilbit is required to promote oil water separation at the bitumen production facilities and to reduce the viscosity for pipeline transportation. The dilbit feed rate will reach 2,299 m^3/h (347,000 bpsd), and 689 m^3/h (104,000 bpsd) of diluent will be returned to the upstream bitumen production facilities.

Dilbit will be fed from storage tanks to the DRU. The DRU separates the diluent from the bitumen. The light gas oil (LGO) material contained in the bitumen is removed and sent directly to the hydroprocessing units. The remaining heavier bitumen feeds the delayed coker.

The delayed coker is a semi-continuous thermal cracking process in which the residue from the DRU is converted into lighter hydrocarbon products and produces petcoke as a by-product. The coker consists of four drums that allow sufficient residence time for the hot vapour from the coker heaters to thermally crack residue and reject carbon. Two coke drums are in service at any one time with the other two out of service for petcoke removal.

Hydroprocessing is used to produce a sweet SCO, which is a blend of naphtha, gas oil and butane. Naphtha and gas oil, the two main coker products, are stabilized in the hydroprocessing units with the addition of hydrogen. The hydroprocessing units also remove sulphur and nitrogen through treating in a hydrogen environment over a metal-impregnated catalyst.

Hydrogen demand will be provided through a combination of SMR and the gasification of petcoke. In Phase 1, hydrogen required in the hydroprocessing units will be produced from natural gas through the SMR, and all of the petcoke will be shipped by rail to export markets.

The fuel gas by-product from the coker provides the bulk of the fuel needs for the Upgrader. The fuel gas will be used in the upgrading heaters and boilers after the H_2S is removed in an amine absorber. The acid gas (H_2S rich stream) that is recovered in the amine regenerator will be sent to the SRU to recover the sulphur for export.

The major process units for the Project are listed in Table 3.2-1. In Phase 1 the hydroprocessing units consist of hydrotreating only. For the Project, hydroprocessing includes both hydrotreating and hydrocracking.

Table 3.2-1 Process Units

Unit Description	Number of Units	
	Phase 1	The Project [1]
Upgrader		
Diluent Recovery Unit (DRU)	1	3
Vacuum Unit (VAC)	-	1
Delayed Coker Unit (DCU) and Coker Gas Plant	1 (4 drums)	2 (8 drums)
Naphtha Hydrotreater (NHT)	1	2
Bulk/Distillate Hydrotreater (BHT/DHT)	1	1
Gas Oil (Mild) Hydrotreater (GOHT)	-	1
Vacuum Gas Oil Hydrocracker	-	1
Hydrogen Plant (SMR)	1	1
Sulphur Recovery Unit (SRU – Claus Trains)	2	5
Tail Gas Treating Unit (TGTU)	1	3
Sour Water Strippers (SWS)	1	3
Amine Regeneration Unit (ARU)	1	3
Gasification		
Gasifiers		5
2 Stage Shift		4
Acid Gas Recovery		2
Pressure Swing Adsorption (PSA)		1
Methanation (SNG)		1
Sulphur Recovery Unit (SRU – Claus Trains)		2
Tail Gas Treating Unit (TGTU)		2
Sour Water Stripper (SWS)		2
Air Separations Unit (ASU)		2

Notes:

1 The Project includes units constructed as part of Phase 1.

3.3 Project Phases

The Project includes Phase 1, subsequent phases and two gasification stages.

3.3.1 Phase 1

Phase 1 will be comprised of the following major process units to achieve a bitumen processing capacity of 530 m^3/h (80,000 bpsd). Figure 3.3-1 presents a process flow diagram for Phase 1.

In Phase 1, a DRU will be used to separate the diluent bitumen blend feedstock into three streams: light, medium and heavy. The light stream (diluent) will be returned via pipeline to the upstream bitumen production facilities to be reused for treating and blending purposes. Bitumen is blended with natural gas condensate diluent to reduce density and viscosity so that it can flow more easily in a pipeline. The medium stream will be routed to the hydrotreating units for removal of sulphur, nitrogen and other impurities. The heavy stream (atmospheric residue) will be routed to the DCU for thermal processing.

The DCU will convert the atmospheric residue into upgraded gas and liquid streams, leaving behind a solid concentrated carbon material known as petcoke. The petcoke will be temporarily stored on-site and then exported to market. The gas from the DCU will be processed through the coker gas plant to recover additional naphtha and other lighter products. The liquid from the DCU will be recovered as light and heavy coker gas oils, which will then be directed to the hydroprocessing units for further upgrading.

Hydroprocessing improves the overall quality of the SCO produced by the Upgrader. The hydroprocessing units will be comprised of a naphtha hydrotreater and a distillate/gas oil hydrotreater that will process the liquid streams from the DRU and the DCU. Hydrotreating entails the addition of hydrogen and removal of impurities such as sulphur, nitrogen and heavy metals. North American will use SMR technology during Phase 1, using natural gas as the feedstock, to generate the hydrogen supply required for hydrotreating. Products from the hydrotreating units (naphtha, distillate and gas oil) will be blended together to produce SCO. Sulphur, a by-product from the hydrotreating units, will be shipped from the site to market.

The Phase 1 upgrader facility is expected to produce 469 m^3/h (70,800 bpsd) of SCO.

3.3.2 Subsequent Phases

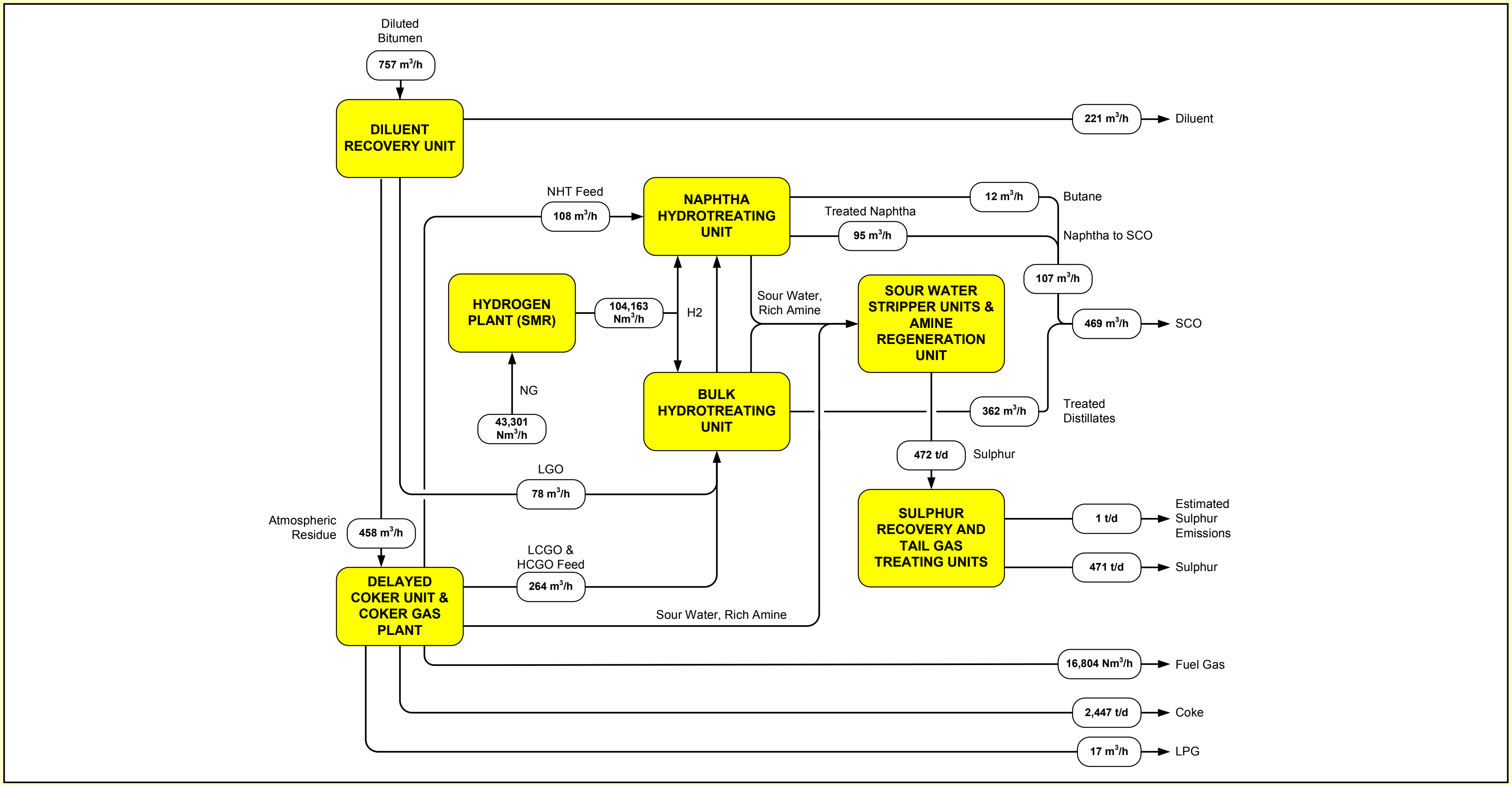
As indicated previously, the Project is the cumulative upgrading capacity plus two stages of gasification installed in several subsequent phases. After Phase 1 (Section 3.5), additional units and modifications will increase the bitumen capacity to 1,610 m^3/h (243,000 bpsd).

A process flow diagram for the Project is shown in Figure 3.3-2.

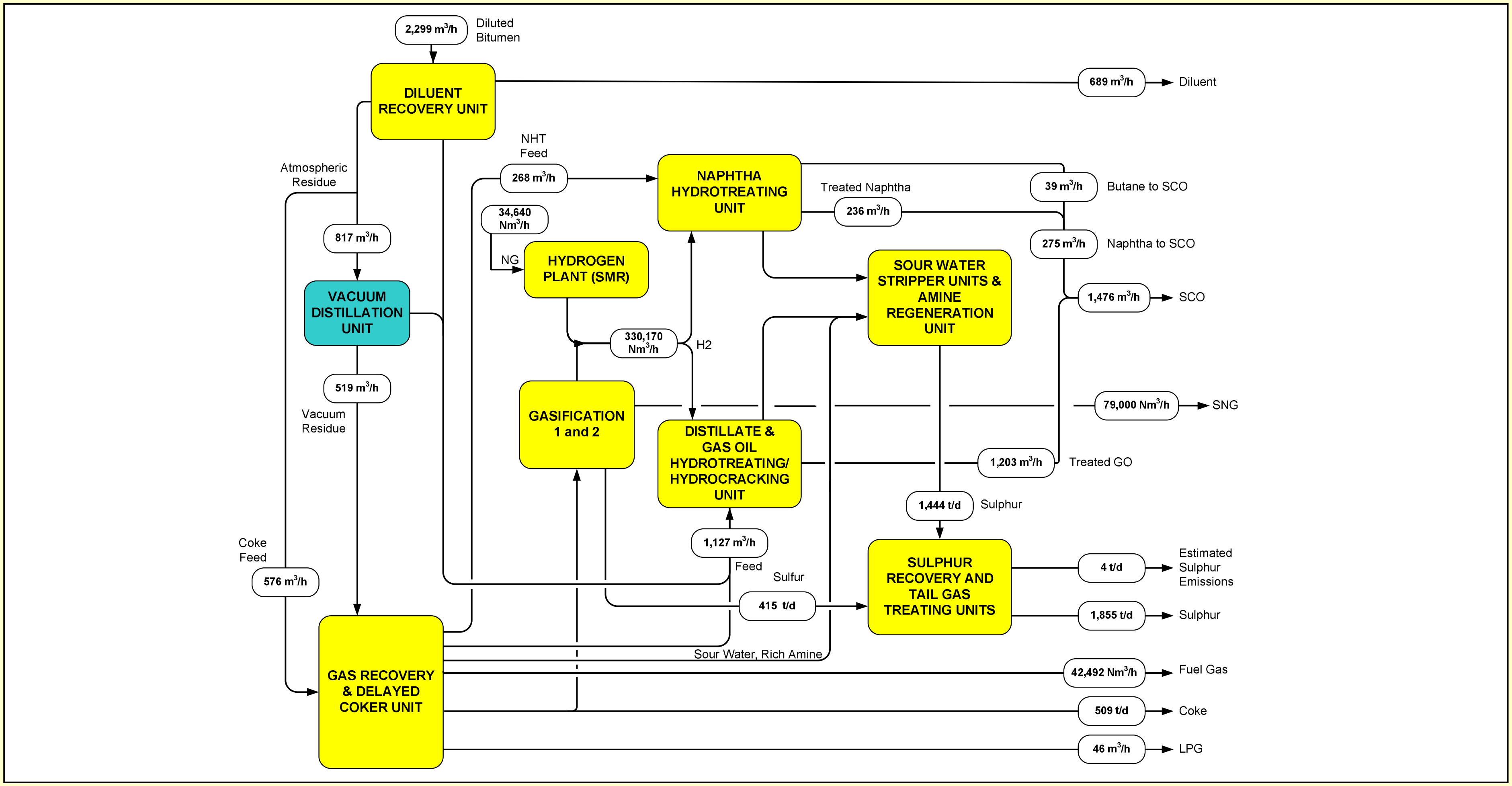
The atmospheric residue from the expanded DRU will be routed to the vacuum distillation unit. The residue from the vacuum distillation unit will provide feed to the expanded coking unit. Hydroprocessing will increase in severity to offset the heavier gas oils from the delayed coker as a result of the vacuum residue feedstock.

3.3.3 Gasification

North American plans to build two stages of petcoke gasification. The intention is to gasify enough petcoke to generate hydrogen for the entire complex (Gasification 1). The two stages of gasification development will consume most of the petcoke by-product. This will reduce the need to purchase natural gas for the generation of hydrogen. For the second gasification stage petcoke will be converted to electrical power and SNG (Gasification 2). The gasification process flow is presented in Figure 3.3-2.



Phase 1 Process Flow Diagram	NORTH AMERICAN OIL SANDS CORPORATION		
	Approved: DR	Revision Date: Dec 5/07	
	File: Figure 3.3-1 Phase 1 Process Flow Diagram.doc		
	Drawn by: BF	Checked: BE	Fig. No.: **3.3-1**



The Project Process Flow Diagram

NORTH AMERICAN OIL SANDS CORPORATION

Approved: DR	Revision Date: Dec 5/07

File:
Figure 3.3-2 The Project Process Flow Diagram.doc

Drawn by: BF	Checked: BE	Fig. No.: **3.3-2**

3.4 Feedstocks and Products

The feedstock will be dilbit primarily from North American's SAGD bitumen production operations but may also include third party supplies. An approximate diluent to bitumen ratio by volume of 30:70 will be required to meet the pipeline transportation specifications. The properties of the full range bitumen, condensate diluent and finished product for Phase 1 and the Project are listed in Tables 3.4-1 through 3.4-3.

Pipelines will be necessary to transport the dilbit to the Project and return the diluent from the Project. Additional pipelines will be required to transport the SCO product to an appropriate terminal. These pipelines or transportation services required may include third party commercial agreements with existing companies. Any new pipelines will be the subject of separate regulatory applications.

Properties identified in Table 3.4-1 are based on a detailed laboratory analysis of bitumen samples.

Table 3.4-1 Full Range Bitumen Feedstock

API		8.5
Specific Gravity		1.0110
Sulphur, weight %		4.80
Viscosity, cSt at 40 degrees C		20,370
Viscosity, cSt at 80 degrees C		584.9
Metals (by Inductively Couple Argon Plasma)		
Nickel, mg/kg		75
Vanadium, mg/kg		187
Carbon Content, weight %		83.24
Hydrogen Content, weight %		9.87
Vacuum Distillation, ASTM D-5236M (normalized)		
Cumulative Volume %	Degrees C	Degrees F
0.04	204	399.0
0.40	250	482.0
12.05	350	662.0
45.76	524	975.2
100.00	---	---

The physical properties of the natural gas condensate diluent shown in Table 3.4-2 are based on typical pipeline specification diluent in the region.

Table 3.4-2 Natural Gas Condensate Diluent Feedstock

API		65.0
Absolute Density at 15 degrees C, kg/m^3		0.7203
Total Sulphur, weight %		0.169
Viscosity, cSt at 5 degrees C		0.8167
Viscosity, cSt at 10 degrees C		0.7667
Viscosity, cSt at 20 degrees C		0.6895
Total Organic Halides as Cl, ppmw		< 1
Aromatics, volume %		6.4
Olefins, volume %		0.9
Saturates, volume %		92.7
ASTM D86 Distillation (normalized)		
Cumulative Volume %	Degrees C	Degrees F
0.00	33.1	91.6
5.56	46.7	116.1
11.11	51.5	124.7
33.33	68.1	154.6
55.56	97.1	206.8
72.22	134.8	251.4
88.89	178.9	354.0
94.44	242.8	469.0
100.00	301.6	574.9

Table 3.4-3 provides the specifications and targets for offgas, and components that are combined to produce the synthetic crude oil product for the Project.

Table 3.4-3 Product Specifications and Targets

Product	Specification	Target
Offgas to Fuel	H_2S Content	25 ppmv max
C_3 LPG	H_2S Content	1 ppmw max
Naphtha (containing C_4s equivalent to 2.5 volume% of the synthetic crude product)	TBP Cut Points	C_{4-} 177°C
	Nitrogen	1 ppmw to 3 ppmw target
	Bromine Number	10 maximum
	Dienes	Nil
Jet Fuel	TBP Cut Points	177-288°C
	Smoke Point	Report (19 mm target)
Diesel	TBP Cut Points	177-343°C
	Cetane Index	38 – 40 min
	Sulphur	0.3 weight% max
Heavy Gas Oil	TBP Cut Points	343°C-plus
	Volume % of Synthetic Crude Product	30 - 40 max (30 target)
	Nitrogen	1,000 ppmw max
	Hydrogen	12.0-12.5 weight % target
Synthetic Crude Product	C_4	2.5 volume% target
	API Gravity	34° to 39°
	Sulphur	0.2 weight % max

3.5 The Project Unit Descriptions and Capacities

The following describes in more detail the process units that make up the Project.

3.5.1 Phase 1

3.5.1.1 Diluent Recovery Unit

The DRU is designed to recover the condensate diluent from the diluent bitumen blend stream for return to the bitumen production facilities. Feedstock to the DRU will be approximately a 30:70 diluent bitumen blend from on-site storage tanks. The purpose of the DRU is to fractionate the diluent condensate from the bitumen. The installed capacity of the DRU for Phase 1 will be 757 m^3/h (114,286 bpsd). The DRU is designed for 98% diluent recovery with the remaining 2% ending up in the hydrotreated naphtha cut.

The DRU will produce the following streams:

- recovered diluent condensate, which will be returned to the bitumen production facilities;
- LGO, which will be treated in the BHT; and
- atmospheric residue will be fed directly to the DCU.

The DRU includes:

- desalters;
- preheat exchangers;
- dilbit feed heater;

- diluent fractionator;
- overhead drum, condenser and pumps;
- LGO pumparound heat exchanger and pumps; and
- fractionator bottoms pumps and coolers.

The DRU feed exchangers and feed heater preheat the dilbit, after desalting, before the dilbit enters the flash zone of the fractionator. Overheads from the fractionator are condensed and collected in the diluent recovery overhead drum. A portion of the hydrocarbon liquid is returned to the fractionator as reflux to aid in the separation. The remainder is recovered diluent condensate which is transferred to storage before shipping back to the bitumen production facilities. Sour water is also collected overhead and is pumped to the sour water stripping unit.

An LGO pumparound is provided for improved heat recovery and a portion of this is withdrawn and routed directly to hydrotreating.

The atmospheric residue from the bottom of the DRU is steam stripped to remove light ends. It is then pumped, cooled and routed to the DCU via intermediate storage.

3.5.1.2 Delayed Coking

Delayed coking is a thermal process in which the residue material is rapidly heated in a furnace and then thermally cracked in coke drums under controlled temperature and pressure. Products from the coking section include overhead vapours (fuel gas and LPG), unstabilized naphtha, light coker gas oil (LCGO), heavy coker gas oil (HCGO) and petcoke.

Delayed coking is an endothermic process with the coker heater providing the necessary heat of reaction. The mechanism of coking is complex, but can be simply described in three distinct steps:

1. Partial vapourization and mild hydrocracking of the feed as it passes through the furnace.
2. Cracking of the vapour as it passes through the drum.
3. Successive cracking and polymerization of the liquid trapped in the drum until it is converted to vapour and coke.

The DCU will convert the atmospheric residue from the DRU into lighter hydrocarbon products and produce petcoke as a by-product. A four drum delayed coker is required for Phase 1. The DCU will have the following features:

- Phase 1 processing rate: 458 m^3/h (69,200 bpsd);
- Feedstock atmospheric residue (AR);
- Two pairs of coke drums; and
- A minimum of 36 hours total cycle time.

The coker will produce the following streams:

- Fuel gas (C_{2-}) to be used as fuel in the Upgrader fired heaters;

- Propane/propylene blend for sale as LPG product/chemical feedstock;
- Butanes/butylenes and naphtha as feed to the naphtha hydrotreater;
- LCGO and HCGO to be hydrotreated in the BHT; and
- Petcoke which will be shipped from the plant site by rail.

Petcoke will be stored in an enclosed storage facility capable of storing up to seven days worth of production. The petcoke storage facility will be outfitted with an automated scraper, hopper and dust control system, which will reduce worker exposure to petcoke and dust. Stored petcoke will be loaded for rail transportation.

An emergency petcoke storage area (e.g., in case of a rail disruption) will be available to contain approximately three weeks worth of petcoke production. The emergency storage area will be designed to protect soil and groundwater from contamination. A collection system will be designed to collect industrial runoff from the emergency petcoke storage area. The collected water will be recycled to the DCU.

3.5.1.3 Coker Gas Plant

The purpose of the coker gas plant is to separate and recover naphtha and LPGs from the lighter gases (fuel gas) collected from the DCU and the hydrotreating units. This unit consists of the following:

- a two-stage compressor to compress, water wash and partially condense the vapour from the coker fractionator overheads;
- a sponge absorber to recover the C_{2+} hydrocarbons using unstripped LCGO from the coker fractionator; and
- an amine scrubber and caustic scrubber to remove the H_2S and mercaptans from the fuel gas.

The naphtha will be sent to the naphtha hydrotreater (NHT). The fuel gas will be used in the heaters and boilers. The recovered sulphur (as H_2S) will be sent to the SRU to produce a solid sulphur product.

3.5.1.4 Naphtha Hydrotreating

As a result of its thermally derived origins, the coker naphtha contains a significant amount of diolefins, olefins, sulphur and nitrogen plus some metals which must be removed to meet the overall SCO specifications. Hydrotreating consists of treating the naphtha in vapour phase over a metallic catalyst under a hydrogen environment. The treatment is carried out in two stages. The first stage is a lower severity stage to saturate the diolefins. Operating initially at the lower severity allows the diolefinic components to be saturated at mild conditions, reducing the potential gum formation and plugging of process equipment and catalyst beds which is prevalent at higher temperatures. This is followed by higher severity conditions required to reduce the other contaminants to an acceptable level. As the olefins are saturated in this stage, the heat generated from saturation is controlled by recycle of hydrotreated naphtha plus unstabilized naphtha from the bulk hydrotreater.

The designed process unit will process 108 m^3/h (16,328 bpsd) of coker C_4's and coker naphtha. The major products are stabilized naphtha and butane. These products will be sent to tankage and blended with the hydrotreated gas oils from the bulk hydrotreating block to form the synthetic crude oil.

3.5.1.5 Bulk Hydrotreater

The BHT is required to treat the light and heavy gas oils from the coker and the LGO from the DRU. This scheme is similar to the naphtha hydrotreatment process in that the treatment occurs in a hydrogen environment over a metallic catalyst. However, due to the heavier feed components, it requires a much higher severity and occurs in liquid phase. The reactor is a specialized piece of equipment that includes proprietary internals to ensure efficient distribution, gas quench and multiple catalyst beds to control the heat release and maintain the catalyst beds at their optimum operating temperature. The operating conditions are designed to remove sulphur, nitrogen and metal impurities from the LGO and both the light and heavy coker gas oil with a total capacity of 342 m^3/h (51,646 bpsd). The treated gas oil will be sent to storage tanks for blending into the final SCO product. Any naphtha produced in the BHT is routed to the NHT for further treatment.

3.5.1.6 Hydrogen Plant

The hydrogen plant will produce hydrogen through steam methane reforming of natural gas. This well established technology is based on a side firing furnace concept which ensures optimum use of high temperature alloy tube materials. Accurate temperature control promotes longer life of the tubes. The gas feed is desulphurized and then combined with high pressure steam at an optimized steam to methane ratio. After further heating in the reformer heater convection section, the gas is contacted with nickel reforming catalyst in the reformer tubes. This process produces a synthesis gas containing hydrogen and carbon oxides. After cooling by generating high pressure steam the synthesis gas is passed through a high temperature shift converter where it is contacted with iron oxide catalyst, forming additional hydrogen and CO_2. After cooling, the synthesis gas is routed to a Pressure Swing Adsorption (PSA) unit where the carbon oxides and residual methane are separated from the hydrogen by beds of solid adsorbent. The PSA unit produces a 99.9% pure hydrogen stream which is used as make-up to the hydrotreaters. The PSA unit also produces a tail gas that, with further treatment, is capable of producing a concentrated CO_2 stream of suitable quality that, once compressed, can be used for enhanced oil recovery or sequestration. When the market conditions are suitable and regional CO_2 gathering facilities are in place there is potential to recover up to 1,370 tonnes of CO_2 per day.

The estimated normal hydrogen requirement for Phase 1 is 104,163 Nm^3/h. The design capacity of the hydrogen plant will be approximately 122,793 Nm^3/h. Natural gas will be the primary feedstock for hydrogen production.

The Phase 1 hydrogen requirements are shown in Table 3.5-1.

Table 3.5-1 Phase 1 Hydrogen Requirements

Unit	Nm^3/h
NHT	14,242
BHT	89,920
Total	**104,163**

3.5.1.7 Sulphur Recovery

A Claus sulphur recovery process followed by tail gas treating will be employed in the Upgrader to maximize the recovery of sulphur from all of the acid gases produced in the upgrading process. The Claus sulphur recovery technology is a well proven technology using the Claus reaction in a thermal stage followed by catalytic stages to produce elemental sulphur as a product. Combined with the tail gas treating unit, the design recovery efficiency is 99.8%. Two Claus train units and a Tail Gas Treating Unit (TGTU) will be installed in Phase 1. The SRU/TGTU will be designed to perform significantly better than the EUB guidelines for sulphur recovery (EUB Sulphur Recovery Guidelines for the Province of Alberta, Interim Directive 2001-03).

The SRU will receive acid gas from the Amine Regeneration Unit (ARU) and the Sour Water Stripper (SWS). The acid gas is partially oxidized with air to achieve a 2:1 H_2S to SO_2 ratio in the reaction furnace. The SO_2 then reacts with the H_2S to form elemental sulphur in the vapour phase which is subsequently condensed in the coolers. As the reaction is highly exothermic, high pressure steam is generated through cooling of the reaction products. The residual tail gas from the reaction process is routed to the TGTU for further sulphur recovery.

In the TGTU, any remaining sulphur vapour and SO_2 is hydrogenated back to H_2S along with hydrolysis of carbon sulphides such as CS_2 and COS. The H_2S is then recovered through amine treating and routed to the front end of the SRU.

The molten sulphur collected in the SRU will be routed to the sulphur forming facility. This is a simple solidification system that consists of distributing the molten sulphur as droplets on a cooled steel belt. The solid droplets at the end of the belt, referred to as pastilles, are discharged into a collection conveyor and transferred to silo storage. The pastilles are a premium sulphur product because they are less friable than other solid sulphur products. The formed sulphur product will be loaded from the silos into railcars for transport off-site. Dust suppressants and control procedures will be employed within the sulphur forming and handling facilities.

Table 3.5-2 provides an estimate of the sulphur extracted from the various streams.

Table 3.5-2 Phase 1 Sulphur Extraction Estimate

Stream	Flow m^3/h (bpsd)	Sulphur (weight %)	Sulphur (t/d)
Coker Fuel Gas	8,379 kg/h H_2S	94.06	189
Coker Naphtha (AR)	94 (14,189)	1.649	28
Light Coker Gas Oil (AR)	121 (18,194)	2.796	73
Heavy Coker Gas Oil (AR)	143 (21,652)	4.503	154
Light Gas Oil	78 (11,800)	1.663	28
Phase 1 Total			**472**

From the above table, the sulphur plant for Phase 1 will include two 75% Claus trains and a tail gas treatment unit (nominal 480 t/d).

3.5.1.8 Amine Regeneration Unit

Amine is used to absorb the acid gas (H_2S) from fuel gas. The amine solution is regenerated by stripping off the H_2S and any residual hydrogen using low pressure steam to a reboiler. Amines rich in acid gas (MDEA solution) from the DCU and the hydrotreaters are combined and routed to the amine flash drum. The vent from this drum is connected to the tail gas incinerator. From the drum, the amine is pumped to the stripping tower where the rich amine cascades down the trayed or packed column in contact with the countercurrent steam. The overhead vapour is condensed and the acid gas removed and sent to the SRU. The lean amine from the bottom of the stripping tower is cooled and returned to the amine absorbers.

Table 3.5-3 provides an estimate of the Phase 1 amine regeneration.

Table 3.5-3 Phase 1 Amine Regeneration Estimate

Stream	Sulphur Removed (t/d)	Average Amine Loading (mol H_2S/mol MDEA)	Estimated Amine Flow (m^3/h)
NHT Rich Amine	28	0.29	32
BHT Rich Amine	255	0.29	244
Coker Rich Amine	189	0.29	219
Total	**472**	**0.29**	**495**

3.5.1.9 Sour Water Stripper

The SWS will be installed to remove sulphides from the process water to enhance water recycle opportunities. Sour water from the on-site units is collected in the sour water feed drum in which the water and oil are separated. From there the sour water is transferred to a tank designed for 24-hour minimum residence time to smooth out any fluctuations in the sour water composition. The sour water is then pumped to the stripper where it is stripped of gas pollutants such as H_2S, NH_3 and CO_2 using low pressure steam reboil. The stripped gas is routed to the SRU and the bottoms water is cooled before recycling to the desalter or wastewater treatment units.

Table 3.5-4 provides estimates of the sour water flows from the process units. The SRU and the ARU also produce small amounts of sour water that are not reflected in Table 3.5-4; however, these minor streams are treated in the sour water stripper.

Table 3.5-4 Sour Water Flow Estimates

Unit	Sour Water Flow (m^3/h)
Diluent Recovery	13
Delayed Coker	57
Naphtha Hydrotreater	4
Bulk Hydrotreater	52
Total	**126**

3.5.1.10 Utility and Off-site Systems

The following utility and off-site systems are planned for Phase 1:

- Nitrogen receiving and distribution system;
- Raw and potable water supply;
- Cooling water system;

- Fuel gas and natural gas supply and distribution;
- Instrument and utility air systems;
- Steam generation;
- Electrical distribution and substations;
- Flare system (hydrocarbon and acid gas);
- Wastewater Treatment Unit (WWTU);
- Interconnecting pipe racks;
- Diluted bitumen, intermediate and product storage tanks; and
- Fire protection system.

Details of these systems can be found in Section 4 for both Phase 1 and the Project.

3.5.2 Subsequent Phases

The following describes development of subsequent phases of the Project.

3.5.2.1 Diluent Recovery Unit

Two additional DRU trains will be installed to increase the dilbit capacity to 2,299 m^3/h (347,000 bpsd). The products from the three DRUs will be as follows:

- Recovered condensate diluent for return to the upstream bitumen production facilities;
- LGO, which will be directed to the distillate hydrotreater (DHT) (operating as the BHT in Phase 1); and
- Atmospheric residue, which will be split between the DCU and vacuum unit.

3.5.2.2 Vacuum Unit

The vacuum unit is a fractionation unit that operates close to vacuum pressure to extract the maximum quantity of hydrocarbon components that boil at temperatures below 524^{o}C without reaching thermal cracking temperature in the heater.

The vacuum unit feed is a portion of the 360°C atmospheric residue produced in the diluent recovery units. The remaining atmospheric residue will flow directly to one of the delayed coking units. The feed rate to the vacuum unit is 817 m^3/h (123,333 bpsd). The products are vacuum residue (feed to the second coker) and Vacuum Gas Oil (VGO). The VGO is processed separately in the gas oil hydrocracker.

The offgas from the vacuum unit will be combined with the DRU offgas and sent to the coker compressor, where it will be combined with the offgas from the blowdown system. Compression of these offgas streams may be required depending on the operating pressure at the suction of the coker compressor.

3.5.2.3 Delayed Coker Units

The delayed coking capacity will be expanded by the addition of a second four drum coker, which will process atmospheric residue. The first four drum coker will process the vacuum residue from the vacuum unit. The total capacity of the two DCUs will be 1,095 m^3/h (165,300 bpsd). The two cokers combined will have the following features:

Delayed Coker 1

- Capacity: 519 m^3/h (78,350 bpsd);
- Feedstock: vacuum residue (VR);
- Two pairs of coke drums; and
- A minimum of 36 hours total cycle time.

Delayed Coker 2

- Capacity: 576 m^3/h (86,950 bpsd);
- Feedstock: atmospheric residue (AR);
- Two pairs of coke drums; and
- A minimum of 36 hours total cycle time.

The combined DCUs will produce the following streams:

- Fuel gas (C_{2-}) to be used as fuel in the Upgrader fired heaters;
- Propane/propylene blend for sale as LPG product/chemical feedstock;
- Butanes/butylenes and naphtha as feed to the NHTs;
- LCGO to be treated in the DHT;
- HCGO to be treated in the gas oil hydrotreater (GOHT); and
- Petcoke will be used as feedstock to the gasifiers, the balance will be shipped from the plant site by rail.

For the Project, no additional storage capacity for the petcoke is required.

3.5.2.4 Coker Gas Plant

The Phase 1 coker gas plant will be expanded and an additional coker gas plant will be added to accommodate the increased volume of light ends and naphtha from the DCUs and naphtha hydrotreaters.

3.5.2.5 Naphtha Hydrotreaters

An additional NHT will be installed to increase the total naphtha treatment capacity to 268 m^3/h (40,500 bpsd). The design features of the NHT will be the same as described in Phase 1 (Section 3.5.1.4).

3.5.2.6 Gas Oil Hydroprocessing Block

The Project gas oil hydroprocessing block will include hydrotreating and hydrocracking. The service of the DHT will change to hydrotreat LGO from the DRUs, VGO from the vacuum unit and LCGO from the delayed cokers. A separate gas oil hydrotreater will treat the lighter gas oils, the heavier gas oils will be treated in a hydrocracker. The hydroprocessed gas oils will be blended with naphtha and butanes from the naphtha hydrotreaters to produce the synthetic crude oil. The gas oil hydroprocessing block is expected to produce a synthetic crude oil with API gravity of approximately 37.

Table 3.5-5 presents the process units in the gas oil hydroprocessing block.

Table 3.5-5 Gas Oil Hydroprocessing Block Process Units

Hydroprocessing Unit	Capacity m^3/h (bpsd)	Gas Oil Treated (from Process Unit)
Distillate Hydrotreater (DHT) [1]	428 (64,553)	LGO (DRU), LCGO-VR (DCU), VGO (VAC)
Gas Oil Hydrotreater (GOHT)	430 (64,945)	LCGO-AR, HCGO-AR (DCU)
Gas Oil Hydrocracker (GOHC)	269 (40,616)	VGO (VAC), HCGO-VR (DCU)

Notes:
1 The BHT will be converted to a DHT in the Project and it will no longer treat HCGO as in Phase 1.

The two hydrotreaters are expected to be single stage, once through units capable of mild hydrocracking. The hydrocracker is expected to be a two-stage unit with hydrotreating in the first stage and hydrocracking in the second stage.

3.5.2.7 Hydrogen Requirements for Hydroprocessing

The overall consumption is expected to reach 330,170 Nm^3/h, as shown below in Table 3.5-6. The bulk of the hydrogen will be provided from the first stage of gasification. The balance will be provided by the Phase 1 SMR operating at approximately 80% capacity. The Project hydrogen requirements have been estimated using the same basis as described in Phase 1 (Section 3.5.1.6).

Table 3.5-6 Project Hydrogen Requirements

Unit	Nm^3/h
NHT	35,551
DHT	86,937
GOHT	113,075
GOHC	94,607
Total	**330,170**

3.5.2.8 Sulphur Recovery Unit and Tail Gas Treating Unit

Table 3.5-7 lists the sulphur extracted from the various streams.

Table 3.5-7 Project Sulphur Extraction Estimate

Stream	Flow m^3/h (bpsd)	Sulphur weight%	Sulphur t/d
Coker Fuel Gas	22,470 kg/h H_2S	94.06	507
Coker Naphtha (VR)	115 (17,355)	2.02	42
Coker Naphtha (AR)	118 (17,843)	1.65	35
Light Coker Gas Oil (VR)	141 (21,336)	3.53	108
Light Coker Gas Oil (AR)	152 (22,879)	2.80	92
Heavy Coker Gas Oil (VR)	118 (17,781)	5.46	155
Heavy Coker Gas Oil (AR)	180 (27,228)	4.50	196
Light Gas Oil	238 (35,877)	1.66	85
Vacuum Gas Oil	298 (45,011)	3.25	224
Total			**1,444**

As shown in Table 3.5-7, the sulphur plants for the Project (excluding the gasification units) will produce a total of 1,444 t/d, recovering 1,441 t/d, based on annual average recovery efficiency of 99.8%. There will be a total of five Claus Unit trains for the Upgrader (nominal 354 t/d each).

3.5.2.9 Amine Regeneration Units

Table 3.5-8 presents the ARU capacity estimate for the Project, excluding gasification. Two additional units are required in addition to the ARU for Phase 1 to meet the Project's bitumen upgrading capacity.

Table 3.5-8 Project Amine Regeneration Unit Capacity Estimate

ARU (Phase)	Capacity (m^3/h)
ARU-1 (Phase 1)	492
ARU-2	619
ARU-3	363
Total	**1,474**

3.5.2.10 Sour Water Strippers

Table 3.5-9 presents the capacity estimate for the sour water strippers for the Project, excluding gasification. Two additional units are required to meet the Project's bitumen capacity.

Table 3.5-9 Project Sour Water Strippers Capacity Estimate

SWS (Phase)	Capacity (m^3/h)
SWS-1 (Phase 1)	126
SWS-2	154
SWS-3	102
Total	**382**

3.5.2.11 Utilities and Off-site Systems

The utility and off-site systems defined in Section 3.5.1.10 will be expanded for the increased plant throughput. Off-site facilities will be added to support the new capacity. Additional storage tanks and additional flares will be added for the Project. Details of these systems can be found in Section 4.

3.5.3 Gasification

3.5.3.1 Process Units

The proposed gasification facilities will include the following process blocks:

- coke handling and storage;
- gasification island producing synthesis gas;
- ASU for supply of oxygen to the gasifier;
- sour shift section to convert carbon monoxide to hydrogen through the addition of water;
- Acid Gas Removal (AGR) section to remove hydrogen sulphide;
- PSA section to purify the hydrogen – Gasification 1;
- methanation unit to produce SNG – Gasification 2;
- SRU and TGTU; and
- utilities such as plant air, instrument air, nitrogen and steam.

Water treatment, utility water supply and boiler feedwater will be provided through expansions of the existing utility and off-site facilities of the Upgrader.

3.5.3.2 Petcoke Handling and Storage

Petcoke will be transferred from the Upgrader to the gasification facility through a closed conveyor system. The petcoke is processed in the coke grinding and slurry preparation section, which includes a grinding mill, a number of drums, pumps and a slurry storage tank. The petcoke feed rate has been set at the maximum capacity for the gasifiers. Data from the licensor indicates that this results in a dry-coke feed rate of 3,256 t/d total for each facility (two gasifiers on-line). Hydrocarbon air emissions and particulate emissions from the coke grinding and slurry preparation section will be minimized by drawing a slight vacuum on the system and discharging the stream to the tail gas treating unit.

3.5.3.3 Gasification Island Producing Synthesis Gas (Syngas)

The petcoke slurry will be fed to the gasifier to generate raw syngas (major components are CO, CO_2, H_2, and water), which is routed to the sour shift and gas cooling system.

The petcoke is fired with oxygen from the ASU and also with steam, which acts as a moderator to control the reaction temperature and to adjust the syngas composition. A fluxant (typically limestone) is required to adjust the slag fusion temperature to be lower than the gasifier operating temperature to allow the slag to flow from the gasifier reaction zone to the quench zone.

In Gasification 1 all of the raw syngas is sent through the sour shift and cooling sections. Major components are CO, CO_2, H_2 and water; however most of the water is removed in the cooling section. The cooled gas is routed to an acid gas removal unit.

In Gasification 2 a portion of the raw syngas bypasses the sour shift to achieve the desired ratio of (1:3) CO to H_2 in the sweet syngas stream. It will be necessary to include a hydrolysis reactor to convert the COS to CO_2 and H_2S in the bypass stream. Major components are still CO, CO_2, H_2 and water; however most of the water is removed in the cooling section. The cooled gas is routed to an acid gas removal unit.

A solid waste stream of the non-combustible ash material is generated (slag) that will be shipped by truck or railcar to an approved waste disposal facility or for metal reclamation.

Recycling of the process water is maximized. Some water must be purged from the system to control impurities that will build up in the water. This water is routed to the wastewater treatment unit within the Upgrader facility.

There are no process heaters or normal process vents in the gasifier facilities.

There are two 50% gasifier trains in service in each stage. The gasifiers are operated at maximum capacity on petcoke feed at high temperature and pressure. In the reactors the petcoke is converted primarily to CO, CO_2 and H_2 by partial combustion in the presence of pure oxygen and then quenched. Quench water is injected through a quench ring at the base of the reaction section. Molten ash that flows out of the reaction section of the gasifier falls into a water-filled sump where it forms a solid slag.

From the gasifier the syngas is sent to a scrubber where the gas is contacted by recycled process water to remove ash/solids. Water from the scrubber is partially recycled as quench water, the remainder is sent (i.e., blowdown) to the blackwater handling section. Each gasifier train includes its own petcoke feed and grinding system, gasifier, scrubber, upstream blackwater handling system, and slag/ash handling system. Downstream char water handling/recovery and char removal systems are shared between the trains. Char is fine ash and unconverted carbon.

3.5.3.4 Air Separations Unit

The ASU provides oxygen at a purity of 99.5% to the gasification unit. Air is compressed, cooled and processed cryogenically to separate oxygen from air. A portion of the residual nitrogen will be stored on-site and used for storage tank blanketing. The excess non-oxygen gases, primarily nitrogen and argon, are vented to atmosphere. An ASU will be required for each gasification facility.

3.5.3.5 Sour Shift Section

The saturated syngas from the scrubber is sent to the sour shift section, where CO plus water is converted to H_2 and CO_2 through an exothermic catalytic reaction. This section consists of two stages of high temperature shift reaction converters. The amount of shift required depends on the downstream process stoichiometric requirements. For instance, for maximum hydrogen production, a full shift is desired and for other products less-shift is needed. Typically a one-stage shift can achieve up to 85% CO conversion; a two-stage shift can achieve up to 95%. From the shift reaction, syngas is cooled in the Low Temperature Gas Cooling (LTGC) section, where low-grade heat can be recovered.

For maximum hydrogen production in Gasification 1, a two-stage shift is required to convert about 95% of the CO to H_2 and CO_2.

3.5.3.6 Acid Gas Removal

The AGR units remove the H_2S and the majority of the CO_2 from the sour shifted syngas. A physical solvent is used in a series of absorber and stripper columns to generate sweet syngas containing approximately 20 ppm of H_2S that is routed to the H_2 PSA unit for Gasification 1 and the SNG methanation unit for Gasification 2. The acid gas from the regeneration of the solvent, containing approximately 50% CO_2 and 50% H_2S, is routed to the SRU.

Due to the large volume of gas and the low H_2S requirement in the treated gas, the AGR units typically have high volume solvent circulation. Solvents such as Selexol or Rectisol are preferable depending on the application. Solvent circulation rates are in the order of 13,000 m^3/h.

A CO_2 stream will be either vented to atmosphere from the AGR or shipped to a downstream conditioning and compression unit for CO_2 recovery for sale or sequestration.

The sweet gas is routed to the PSA unit.

3.5.3.7 Pressure Swing Adsorption

The hydrogen PSA removes the remaining CO_2 from the hydrogen product stream. Using PSA, a high purity hydrogen product is generated for export to the upgrader facility. A tail gas stream remains (major components are CO, CO_2, and H_2) containing approximately 100 ppm of H_2S.

High pressure hydrogen exits the PSA at high pressure. The purge gas or tail gas exiting from the PSA unit has a low heating value. As it leaves the PSA at low pressure, it is compressed and routed to the Upgrader fuel gas system.

3.5.3.8 Methanation

The methanation process is required in Gasification 2 to produce maximum SNG for market. For this case only a partial shift of about 60% (CO conversion to CO_2 and H_2) is required.

The sour gas from the shift converter is sent to the AGR contactor where H_2S is removed by a circulating solvent. This solvent reduces the H_2S to approximately 0.1 ppm in the sweet gas stream. The remaining acid gas is stripped from the circulating solvent in a reboiled stripper. The two-step system also removes most of the CO_2, which can be vented to the atmosphere or recovered for sale or sequestration. Removal of the CO_2 is desired as it uneconomically competes with CO in the SNG reaction.

The methanation process is an exothermic, catalyzed reaction whereby CO and H_2 react to form methane and water. The technology includes three catalyst beds in series with the outlet stream from the first bed being cooled and partially recycled for temperature control. The second and third beds have cooling but no recycle. From the last bed the cooled gas is sent through a drying column to remove water, producing SNG similar to market quality natural gas.

For the methanation process, sulphur must be removed down to the 20 ppb to 50 ppb range to prevent deactivating the SNG catalyst. Sulphur guard beds (i.e., zinc oxide) are used upstream of the unit for this purpose.

The highly exothermic reaction allows heat recovery by the generation of steam, which is then used to produce power via a steam turbine driven generator.

3.5.3.9 Sulphur Recovery

The SRU is designed to recover 99.8% of the sulphur from the acid gas feed from the AGR. The acid gas from the AGR is combusted with purified oxygen (from the ASU) in the SRU and routed through catalytic reactors to produce liquid sulphur. The liquid sulphur is degassed of residual H_2S, stored, and processed in the sulphur forming and handling unit in the Upgrader.

Tail gas from the recovery unit is treated and then passed through a thermal incinerator to reduce the H_2S to 10 ppm and limit the CO in the flue gas to 50 ppm. Heat recovery of the flue gas will produce high pressure superheated steam for electrical power production.

Sulphur handling capacities for the SRUs and the TGTUs within the gasification section of the Project are presented in Table 3.5-10.

Table 3.5-10 Project Sulphur Extraction Estimate

Stream	Flow (t/d)	Sulphur (weight %)	Sulphur (t/d)
Petcoke to Gasification 1	3,700	5.62	207.8
Petcoke to Gasification 2	3,700	5.62	207.8
Total			**415.6**

As shown in Table 3.5-10, the sulphur plants for the gasification units will produce a total of 415 t/d sulphur, recovering 414 t/d, based on an annual average recovery efficiency of 99.8%. There will be two separate Claus unit trains for each gasification stage (nominal 105 t/d each). Each set of two trains will be accompanied by a TGTU with a capacity of 210 t/d.

Table 3.5-11 lists the gasification process units and capacities by train.

Table 3.5-11 Gasification Process Units and Capacities by Train

	Gasification 1		Gasification 2	
	Number of trains	Capacity per Train	Number of trains	Capacity per Train
Gasifier Reactors	3 (one spare)	1850 t/d	2	1850 t/d
2 Stage Shift	2	10.7 mm Sm^3/d	2	10.6 mm Sm^3/d
AGR	1	13.2 mm Sm^3/d	1	11.6 mm Sm^3/d
PSA	1	7.5 mm Sm^3/d	n/a	n/a
Methanation	n/a	n/a	1	7.1 mm Sm^3/d

	Gasification 1		Gasification 2	
	Number of trains	**Capacity per Train**	**Number of trains**	**Capacity per Train**
SRU	2	105 t/d	2	105 t/d
TGTU	1	210 t/d	1	210 t/d
ASU	1	3722 t/d	1	3722 t/d
Flares	2	HP/Acid Gas	2	HP/Acid Gas
Incinerator	1	TGTU	1	TGTU
Coke Feed	n/a	3700 t/d (wet)	n/a	3700 t/d (wet)
H_2 product	n/a	6.2 mm Sm^3/d	n/a	n/a
SNG product	n/a	n/a	n/a	2.0 mm Sm^3/d
CO_2 product	n/a	4.5 mm Sm^3/d	n/a	3.6 mm Sm^3/d
Slag	n/a	355 t/d	n/a	355 t/d
Sulphur product	n/a	207 t/d	n/a	207 t/d
Power	n/a	60.9 MW	n/a	95.1 MW

3.6 Alternative Technologies

North American evaluated several alternative bitumen conversion technologies and processing configurations that have been commercially proven. They included slurry hydrocracking, solvent deasphalting, and pitch gasification. Both high conversion and low conversion options were studied. The primary criteria in making the technology selection included:

- proven technology;
- safety and reliability;
- environmental management;
- capital cost and economics;
- processing efficiency;
- flexibility to change product quality as the plant expands;
- ability to maximize sweet SCO yield;
- capability to process alternative bitumen supplies;
- ability to readily expand the plant to match bitumen production levels; and
- plant location.

The technology evaluation also gave serious consideration of approaches and technical solutions to reduce water consumption, improve energy efficiency, and reduce CO_2 emissions. In the SNG option, coke gasification to produce a fungible high heating value gas stream will reduce natural gas consumption in North American's overall oil sands projects.

North American will continue to evaluate alternative options as engineering on the Upgrader proceeds. This relates to all aspects of the Project, including bitumen processing, reduction of emissions, and improvements in energy efficiency.

StatoilHydro is a world leader in carbon capture and sequestration. Extensive research is being undertaken by StatoilHydro to find new ways to reduce CO_2 emissions and to develop better recovery methods.

In Phase 1, the SMR will be designed to allow CO_2 to be recoverable. North American's planned gasification stages were justified based on recovery of CO_2, while reducing petcoke exports and producing hydrogen from petcoke rather than natural gas. The gasification step would allow for a rich CO_2 stream to be available as a byproduct from producing hydrogen. Actual recovery will be dependent on a suitable outlet for the CO_2, the existence of an appropriate fiscal and regulatory regime, and availability of adequate infrastructure to take away the CO_2.

As technological advances occur, it is possible that new methods may be developed that will provide superior approaches to emissions recovery over the gasification approach outlined in this application. North American is committed to evaluating new technologies and adopting technologies that benefit both the Project and the environment.

4 INFRASTRUCTURE, UTILITIES AND OFF-SITES

The following section describes infrastructure, utilities and off-sites. The information below is presented for Phase 1 and the Project. The Project includes Phase 1, the subsequent phases and both gasification stages.

4.1 External Supply

Table 4.1-1 lists the external utilities required during the Project.

Table 4.1-1 External Utility Requirements for Project Operations

Utility	Unit of Measure	Phase 1	The Project
Electrical Power	kW	61,166	236,009
Raw Water	m^3/h	396	1,646
Potable Water	m^3/h	2	3
Natural Gas	Nm^3/h	44,888	38,543
Nitrogen	Nm^3/h	2,000	0

4.1.1 Electrical Power

The electrical power requirement is estimated at 61 MW for Phase 1 and will be supplied by a transmission connection and substation on the Alberta electrical system grid at a supplied voltage of 240 kV. From the supply voltage of 240 kV the distribution within the facility will be stepped down to 34.5 kV. The ultimate electrical power requirement for this power requirement for this project will be approximately 240 MW.

Table 4.1-2 summarizes the electrical power requirement estimate for the Project.

Table 4.1-2 Electrical Power Requirements Estimate

Unit	Phase 1 (kW)	The Project (kW)
Diluent Recovery	3,166	9,625
Delayed Coker	19,214	58,411
Vacuum Unit	--	1,600
Naphtha Hydrotreater	1,254	3,135
Bulk/Distillate Hydrotreater	13,269	14,330
Gas Oil Hydrotreater	--	14,850
Vacuum Gas Oil Hydrocracker	--	8,900
Hydrogen Plant	2,666	2,320
Support Units [1]	7,800	23,712
Air Separations Units	---	148,000
Gasification Units	---	-90,817 [2]
Utilities and Off-site System/Miscellaneous	13,967	41,943
Total	**61,166**	**236,009**

Notes:

1 Support units include SRUs, amine regeneration and sour water stripping units.

2 Power produced in the gasification unit from steam turbines is equivalent to 156,000 kW, resulting in a surplus to be consumed in the ASUs.

4.1.2 Raw Water

Raw water will be withdrawn from the North Saskatchewan River, with a new intake and pipeline connected to the Upgrader. The annual average raw water demand is expected to be 1,646 m^3/h for the Project and 396 m^3/h for Phase 1. North American is continuing to evaluate alternative sources of water, including treated municipal wastewater. The Project will incorporate a ZLD philosophy with the use of evaporator technology.

During normal operation, the raw water will be used for the following major purposes:

- cooling tower makeup;
- boiler feed water makeup;
- hydrogen production;
- gasification;
- utility water; and
- fire water.

Through the development of the Upgrader from Phase 1 to the Project, North American is committed to the staged implementation of water reuse through water recirculation, evaporative recovery, and reductions in the use of evaporative cooling.

4.1.3 Potable Water

North American is coordinating the supply of potable water for the Project from Strathcona County through the existing Vegreville Corridor water distribution system.

The Project will include an on-site potable water tank with a distribution system within the Upgrader site. It will be constructed during Phase 1. A chemical feed system will maintain required levels of free chlorine residual within the potable water tank. Operations will monitor the free chlorine residual in the distribution system.

The potable water demands (eyewash, safety shower, administration building, washrooms, and other miscellaneous users) are estimated to be 3 m^3/h for the Project and 2 m^3/h for Phase 1.

4.1.4 Natural Gas

The natural gas required by the Upgrader will be acquired from an outside supplier. A new natural gas supply line will be installed. Table 4.1-3 estimates natural gas consumption for the Project.

Table 4.1-3 Natural Gas Consumption

Process Unit	Normal Heat Fired (GJ/h)		Natural Gas Demand (Nm^3/h)	
	Phase 1	The Project	Phase 1	The Project
Diluent Recovery	270	730	355	961
Delayed Coker	488	1,076	642	1,416
Vacuum Unit	-	207	-	272
Naphtha Hydrotreater	13	27	17	36
Distillate Hydrotreater	57	57	75	75
Gas Oil Hydrotreater	-	56	-	74
Vacuum Gas Oil Hydrocracker	-	40	-	53
Hydrogen Plant [1]	104	87	-	-
Hydrogen Production [2]	-	-	43,301	36,373
Flare Stacks	-	-	140	327
Gasification Units	--	-	--	69
Utility Boilers [3]	272	403	358	530
Total	**1,204**	**2,683**	**44,888**	**40,186**

Notes:

1 Natural gas used as fuel in the hydrogen plant reformer furnace. Duty shown is for fuel gas make-up consumption only. The balance of its fuel consumption is PSA tailgas.

2 Natural gas requirement as feedstock for hydrogen production.

3 Utility boilers' heat duty has been derived from the steam generation required to balance the process, tankage and steam tracing. Two boilers are expected to be in service at 50% capacity for Phase 1, three boilers for the Project.

4.1.5 Nitrogen

For the Project, nitrogen will be available from the ASU, installed as part of the gasification unit. In Phase 1, nitrogen will be supplied by a third-party in an inert form and stored on-site. Nitrogen will be used for tank blanketing, to purge equipment during shut downs and to remove air from equipment during commissioning when steam cannot be used.

4.2 Internal Supply

Table 4.2-1 lists the internal utilities required during the Project.

Table 4.2-1 Internal Utility Requirements for Project Operations

Utility	Phase 1	The Project
Fuel Gas (Nm^3/h)	21,013	46,754
Instrument Air (Nm^3/h)	3,037	11,176
Utility Air (Nm^3/h)	4,480	14,120
Cooling Water Circulation (m^3/h)	5,260	56,151
Steam (kg/h)	150,099	1,075,820

4.2.1 Fuel Gas

Light hydrocarbons from the DCU and major process units will be desulphurized and used as plant fuel gas.

4.2.1.1 Fuel Gas Production

All the C_{2-} gas produced in the delayed coker will be the main source of fuel gas. Off-gases from the naphtha and gas oil hydrotreaters will be sent to the coker gas plant to also become part of the fuel gas supply. Natural gas is available to supplement the internally generated fuel if necessary. The bulk of the propane gas produced by the coker will be sold as LPG/chemical feedstock.

4.2.1.2 Fuel Gas Composition

Table 4.2-2 shows the fuel gas composition to be used in the Upgrader. All the C_{2-} gases are used and are supplemented with the C_3/C_4 material that is not extracted for sale. H_2S concentrations are based on amine treating down to 25 ppm.

Table 4.2-2 Fuel Gas Composition

Component	Mol %	Molar Weight	Lower Heating Value (MJ/m^3)
H_2	11.6	2.01	10.2
CH_4	36.6	16.04	34.0
C_2H_4	2.6	28.05	56.4
C_2H_6	20.1	30.07	61.1
C_3H_6	4.0	42.08	81.4
C_3H_8	12.1	44.1	88.9
C_4H_8	3.9	56.1	138.2
C_4H_{10}	9.1	58.1	116
Total	**100**	**27.4**	**57.3**

4.2.1.3 Fuel Gas Consumption

The fuel gas consumption is presented in Table 4.2-3 for each of the Upgrader process units.

Table 4.2-3 Fuel Gas Consumption

Process Unit	Normal Heat Fired (GJ/h)		Fuel Gas Demand (Nm^3/h)	
	Phase 1	The Project	Phase 1	The Project
Diluent Recovery	270	730	4,712	12,740
Delayed Coker	488	1,076	8,517	18,778
Vacuum Unit	-	207	-	3,613
Naphtha Hydrotreater	13	27	227	471
Distillate Hydrotreater	57	57	995	995
Gas Oil Hydrotreater	-	56	-	977
Vacuum Gas Oil Hydrocracker	-	40	-	698
Hydrogen Plant [1]	104	87	1,815	1,449
Sulphur Recovery (Incinerator) [2]	-	-	-	-
Gasification Units	--	-	--	-
Utility Boilers [3]	272	403	4,747	7,033
Total	**1,204**	**2,683**	**21,013**	**46,754**

Notes:

1 Hydrogen plant reformer furnace duty is shown for fuel gas consumption only. The balance of its fuel consumption is PSA tailgas.

2 Fuel gas firing is assumed to be acceptable for the sulphur recovery Incinerators.

3 Utility boilers' heat duty has been derived from the steam generation required for process, tankage and steam tracing. Two boilers are expected to be in service at 50% capacity for Phase 1, three boilers for the Project.

4.2.2 Instrument and Utility Air

Compressor facilities will be built to supply instrument air (IA) and utility air (UA). Utility air will be required on an intermittent basis for the following:

- Utility stations;
- Plant start-ups, shutdowns and turnarounds; and
- Petcoke cutting equipment.

Compressor facilities will be expanded as necessary to provide the additional air for the Project.

Table 4.2-4 lists the estimated instrument and utility air demands for the Project.

Table 4.2-4 Instrument Air and Utility Requirements Estimate

Unit	Phase 1		The Project	
	IA (Nm^3/h)	UA (Nm^3/h)	IA (Nm^3/h)	UA (Nm^3/h)
Diluent Recovery	150	1,540	456	4,620
Delayed Coker	338	2,040	1,028	4,080
Vacuum Unit	-	-	240	2420
Naphtha Hydrotreater	226	-	452	-
Bulk/Distillate Hydrotreater	289	-	290	-
Gas Oil Hydrotreater	-	-	320	-
Vacuum Gas Oil Hydrocracker	-	-	280	-
Hydrogen Plant	80	-	80	-
Support Units	751	300	2,280	1,000
Air Separations Units	--	--	810	--
Gasification Units	--	--	1,660	800
Utilities and Off-site System/Miscellaneous	1,203	600	3,600	1,200
Total	**3,037**	**4,480**	**11,176**	**14,120**

4.2.3 Cooling Water

The Project will use process heat recovery and both conventional evaporative and aerial cooling to satisfy process cooling requirements. The majority of the process cooling is achieved using aerial coolers, with the remaining, trim cooling, provided by cooling towers. For the Project, the cooling water circulation rate is estimated to be 56,151 m^3/h. For Phase 1, the cooling water circulation rate is estimated to be 5,260 m^3/h. A 20% process allowance is included in the design of the cooling towers.

The cooling water circulation requirements for major process units are shown in Table 4.2-5.

Table 4.2-5 Cooling Water Circulation Requirements

Unit	Phase 1 (m^3/h)	The Project (m^3/h)
Desalter & Diluent Recovery	39.7	132.4
Delayed Coking	398.0	871.6
Gas Recovery Unit	184.5	505.1
Naphtha HT	32.8	72.1
Distillate HT/HC	559.7	1,861.7
Hydrogen Plant	18.1	19.8
Amine Regeneration	18.1	60.2
Sour Water Stripper	18.1	60.2
Sulphur Recovery Unit	18.1	60.2
Sulphur Degassing	18.1	60.2
Sulphur Forming Unit	539.0	1,793.1
Tail Gas Treatment	861.4	2,865.3
Boiler Feed Water Production	36.2	120.3
Steam Generation and Distribution	18.1	60.2
Plant/Instrument Air System	18.1	60.2
Feed, Intermediate and Product Storage	1189.2	3,955.6
Wastewater Treatment	607.1	1,329.6
Stage 1 Gasification	0.0	13,358.0
Stage 2 Gasification	0.0	19,547.3
% Design Allowance	15%	20%
Contingency	686.1	9,358.6
Total	**5,260.4**	**56,151.4**

4.2.4 Steam

Table 4.2-6 summarizes the steam generation from the process units and steam boilers for the Project.

Table 4.2-6 Steam Production

Component	Phase 1 (kg/h)	The Project (kg/h)
Hydrogen Plant	80,663	72,600
SRUs [1]	50,630	153,920
Utility Boilers [2]	18,806	28,200
Gasification 1 [3]	---	254,000
Gasification 2 [3]	---	548,300
Total Steam Production	**150,099**	**1,057,020**

Notes:

1 SRU is assumed to generate high pressure steam.

2 For the Project, the utility boilers are assumed to accommodate the shortfall in steam production and to meet the steam requirements for tankage and steam tracing.

3 The steam production from the gasification units is used to generate electrical power using condensing turbines.

4.2.4.1 Process Steam Requirements

The steam utilization, condensate recovery and Boiler Feed Water (BFW) requirements for each process unit are summarized as follows:

- DRU
    - Medium pressure steam required for the stripping in the DRU column.
    - No condensate is recovered.
    - No BFW is required.

- Vacuum Unit
    - Medium pressure steam is required for the vacuum ejectors.
    - The vacuum tower is assumed to be dry (i.e. no stripping steam).
    - No process steam is generated from waste heat.
    - No condensate is recovered.
    - No BFW is required.

- DCU
    - High pressure, medium pressure and low pressure steam are needed.
    - Steam consumption/production has been estimated from simulation model.

- NHT
    - High pressure steam is required for the first stage reactor heater and the stripper reboilers.
    - Condensate is used for the injection water for the reaction loop.
    - The recycle gas compressor is assumed to be steam driven.

- GOHT/HC
    - Recycle compressors are assumed to be turbine driven with high pressure steam exhausting to the low pressure steam header (no surface condenser).
    - Medium pressure steam is required for the stripper and is also generated from waste heat in the gas oil product.

- ARU
    - Low pressure steam is required for the regenerator reboiler.

- SWS
    - Low pressure steam is required for the stripper reboiler.

- Hydrogen Plant
    - High pressure steam generated during hydrogen production will be used for turbine drives.
    - Hydrogen plant will remain in service during the Project.
    - Utility boilers will provide the balance of the steam requirements.

- Gasification 1
    - High pressure/medium pressure/low pressure steam generated in the gasification process will be used to produce electrical power in a condensing turbine.
    - Low pressure steam will be used where necessary in the process and for heat tracing.

- Gasification 2
  - o High pressure/medium pressure/low pressure steam generated in the gasification process will be used to produce electrical power in a condensing turbine.
  - o Low pressure steam will be used where necessary in the process and for heat tracing.

4.2.5 Flares

The flare system provides safe gas disposal during start-up and emergency situations such as power outages and the unlikely event of a fire. During normal operation, there are only intermittent loads (such as the coker compressor suction vent) sent to flare. Each flare will be equipped with an automatic electric ignition with a continuously burning pilot. There are three types of flares for the Upgrader: the main hydrocarbon flare to handle the off-gases and pressure relieving flows from the process units, the low pressure flare to handle low pressure vapours, and the acid gas flare to handle the high concentration H_2S stream that feeds the SRU in the event of an SRU shut down.

The flare system will be designed to meet regulatory requirements for the safe disposal of process material.

Table 4.2-7 summarizes the hydrocarbon flares for the Project:

Table 4.2-7 Estimated Hydrocarbon Flare Loads and Flare Stack Parameters

Phase	Flare No.	Design Flow (kg/h)	Stack Height (m)	Exit Velocity (m/s)	Exit Temperature (degrees C)	Inside Tip Diameter (m)
Phase 1	1	1,038,744	137	112	1,000	1.524
Subsequent Phases	2	1,042,370	152	82.5	1,000	1.524
Gasification 1	3	11,124	34	24.8	1,000	0.914
Gasification 2	4	9,933	34	24.3	1,000	0.914

4.2.5.1 Hydrocarbon Flare Sizing

The hydrocarbon flare relief system will be designed to handle released hydrocarbon vapours from several different Upgrader processes safely. The flare headers, flare knockout drums, flare seal drum and elevated flare stack have been sized according to a total refinery wide power failure.

The flare sizing is based on a general power failure scenario. Since the Project will be completed in several phases, multiple flare systems are required.

Feed streams to the relief system include safety valves and vents from various Upgrader processes, as well as introduction of purge gas into both the low pressure and high-pressure headers. The purge gas is provided to prevent flash back by preventing air from entering the system. Purge gas rate estimates are based on a flare stack design that includes a velocity seal which reduces the flows required. As a further precaution, the continuous gas purge will be used in conjunction with a flare seal drum. Purge gas is assumed to be natural gas.

The flare designs are based on locations that are sufficiently removed from each other that their radiant energies are not additive. These values will be confirmed during detailed design.

4.2.5.2 Non-Emergency Flare Loads

The largest intermittent load to the flare system is from the coker compressor suction vent. The coker unit blowdown vent gas is normally recovered within the gas plant. However during a compressor emergency shutdown, venting to the flare system could occur for up to one hour.

4.2.5.3 Flare Header Purges

The flare header requires a continuous fuel gas purge to ensure that oxygen levels in the header are minimized. Upgrader fuel gas will be used for purge. Table 4.2-8 presents the non-emergency flare loads.

Table 4.2-8 Non-Emergency Flare Loads

Project Phase	Flare No.	Flare Tip Diameter (m)	Flow Rate (Nm^3/h)	Heat Release (GJ/h)
Phase 1	1	1.524	290	9.8
Subsequent Phases	2	1.524	290	9.8
Gasification 1	3	0.914	50	1.7
Gasification 2	4	0.914	50	1.7

4.2.5.4 Acid Gas Flare Loads/Low Pressure Flares

A separate acid gas flare system and low pressure flares are planned. The information on these flare loads and their disposition are indicated in Tables 4.2-9 and 4.2-10.

Table 4.2-9 Estimated Acid Gas Flare Loads and Flare Stack Parameters

Project Component	Upgrader			Gasification 1	Gasification 2
Acid Gas Flare Number	1	2	3	4	5
Design Flowrate (kg/h)	4,276	4,276	4,276	2,648	2,648
Stack Height (m) [1]	90	90	90	90	90
Tip Height (m)	0.356	0.356	0.356	0.305	0.305
Temperature (degrees C)	1,000	1,000	1,000	1,000	1,000
Exit Velocity (m/s)	141.5	141.5	141.5	183.4	183.4
Flare Release Scenario	Power Failure	Power Failure	Power Failure	Power Failure	Power Failure
Estimated Flaring Duration (minutes)	20	20	20	20	20

Notes:

1 The acid gas flares for the Upgrader will be strapped to the TGTU incinerator stacks.

Separate low pressure flares are planned. The information on these flare loads and their disposition are presented in Table 4.2-10.

Table 4.2-10 Low Pressure Flare Design Data

Phase	Phase 1	Subsequent Phases
Low Pressure Flare Number	1	2
Design Flowrate, kg/h	26,939	40,454
Stack Height, m	16	16
Tip Diameter, m	0.305	0.305
Temperature, degrees C	1,000	1,000
Exit Velocity, m/s	223.8	247.1
Flare Release Scenario	Power Failure	Power Failure
Estimated Flaring Duration, minutes	20	20

4.3 Water

The operation of the Upgrader requires a reliable supply of water, which must be treated to meet the various quality requirements of the Upgrader processes. In addition, all wastewater streams from the Upgrader must be treated to an acceptable standard prior to discharge. This Application is based on using the North Saskatchewan River as a raw water source. Design of the Upgrader is based on water quality from this source. Prior to full ZLD, wastewater will be treated on-site and discharged to the North Saskatchewan River.

Table 4.3-1 provides a summary of annual average daily water use for Phase 1 and the Project, including raw water demand, river discharge, consumption, and water use intensity presented as cubic metres of water required to process a cubic metre of bitumen. Table 4.3-1 values include 20% design allowance, and a 15% contingency.

Table 4.3-1 Summary of Upgrader Water Use by Phase

Phase	Phase 1	The Project (excluding Gasification 1 and 2)	The Project (excluding Gasification 2)	The Project
Upgrading Capacity (bpsd)	80,000	243,000	243,000	243,000
River Withdrawal (m^3/d)	9,500	17,187	31,158	39,500
River Discharge (m^3/d)	4,814	2,550	4,306	0
Net Water Consumption (m^3/d)	4,686	14,637	26,852	39,500
Water Withdrawal Intensity (m^3 water/m^3 bitumen)	0.25	0.44	0.81	1.02
Water Consumption Intensity (m^3 water/m^3 bitumen)	0.12	0.38	0.70	1.02
ZLD Employed	No	Yes – select streams	Yes – select streams	Yes - 100%

The water withdrawal intensity for the Project, at 1.02 m^3 water/m^3 bitumen, is higher relative to other upgraders proposed for the AIH because North American is including two stages of gasification. Gasification increases net water consumption without increasing bitumen processing capacity.

Development of the Project excluding Gasification 2 provides a benchmark for comparison to other proposed AIH upgraders. The water withdrawal intensity for this stage of development (0.81 m^3 water/m^3 bitumen) compares favourably to other proposed upgraders operating with similar unit processes, including one stage of gasification. Table 4.3-1 also provides an indication of the significant water that is required to support the gasification processes.

Water processes for the Project involve:

- water supply and treatment;
- wastewater treatment;
- stormwater control and treatment;
- water reuse; and
- fire water.

A detailed water balance for the Project is presented in Section 5.3. Figures 5.3-1 and 5.3-2 provide a summary of the water balances for Phase 1 and the Project, respectively. Incremental water conservation and reuse is phased with Project development, which is reflected by increased water recycling in the Project as compared to the Phase 1 water balance.

4.3.1 Water Supply and Treatment

The Project requires a reliable water supply to meet the process demands. All of these demands are relatively constant throughout the year, except for cooling water makeup. Warmer temperatures in the summer result in increased evaporation from the cooling towers, which must be replenished with fresh water. Table 4.3-1 shows the anticipated water usage for the Project, including the expected variation between annual average day and average summer day water usage. Water will be required for:

- cooling tower make-up;
- boiler feed water makeup;
- hydrogen production;
- gasification;
- utility water; and
- fire water.

4.3.1.1 Raw Water Supply

The raw water source for the Project is the North Saskatchewan River. Average annual day river water demand for the Project is 1,646 m^3/h, and the Phase 1 river water demand is 396 m^3/h. Both of these river withdrawal values include a 15 percent contingency factor.

A river intake structure and pumphouse will be constructed, with a transfer pipeline to the Upgrader site. The intake structure will be designed using modules to enable ease of construction, expansion and to minimize disruption of the river. The location for the intake is shown on Figure 1.2-1. North American is currently negotiating with landowners regarding pipeline routing.

North American is also evaluating alternative water supplies that could reduce its requirements from the North Saskatchewan River, and is participating in a Northeast Capital Industrial Association (NCIA) committee regarding regional water issues. North American is supporting the following:

- A study by Strathcona and Sturgeon Counties for a regional industrial water system; and
- Discussions with EPCOR to supply treated effluent from the City of Edmonton Gold Bar Wastewater Treatment Plant for reuse by upgraders located in the AIH.

A *Water Act* application for an annual average day withdrawal of 39,500 m^3/d (14,417,500 m^3/y) of water from the North Saskatchewan River is included in Appendix C.

4.3.1.2 Raw Water Treatment

At the Upgrader, the raw water treatment system has been designed to meet the minimum water quality requirements for utility and fire water. Subsequent treatment will be required on a process-specific basis. The raw water treatment involves the addition of a coagulant with pH adjustment upstream of the raw water pond, to assist in the gravity settling of suspended solids. Sodium hypochlorite is also added to the raw water upstream of the raw water pond as a disinfectant to reduce biological growth in the pond. The raw water pond will be lined and have two cells. Raw water flows into the first cell which provides one day of residence time and is used to settle suspended solids. Water then flows into the second cell providing approximately 13 days of storage in addition to the water required for fire fighting requirements. The cells will require periodic removal of settled solids for disposal at an appropriate landfill.

On-site raw water storage provides protection from potential exclusion periods from the river due to low in-stream flow, and periods of high suspended solids associated with spring runoff.

Settled raw water from the raw water pond will be pumped to the various upgrader processes through a distribution network. Water required for boiler feed makeup and hydrogen production will require additional treatment, including ultrafiltration, reverse osmosis, ion exchange, and deaeration.

4.3.1.3 Potable Water Supply

North American is currently coordinating the supply of potable water for the Project with Strathcona County. Strathcona County will construct the necessary off-site infrastructure to utilize potable water from the existing Vegreville Corridor potable water forcemain, including the distribution pipeline.

At the North American site, potable water will be stored in a tank with minimum 1-day capacity. Potable water will be pumped from the tank and distributed throughout the Upgrader site. Sodium hypochlorite will be added to meet provincial and federal potable water standards.

4.3.1.4 Water for Construction Activities

For the initial construction period, North American will use a variety of water sources. Initial construction will utilize stormwater collected from the site and excavation dewatering. Water requirements that exceed the capacity of these supplies will be obtained from the potable water supply. Water during construction will be required for the concrete batch plant as well as for dust suppression and soil compaction. Following Phase 1 start-up, subsequent construction water will be provided by the utility water system.

4.3.2 Wastewater Treatment

A treatment facility will be provided on-site to treat the following major wastewater streams prior to reuse and/or discharge to the North Saskatchewan River:

- cooling tower blowdown;
- boiler blowdown;
- desalter wash water;
- excess stripped sour water;
- gasification wastewater;
- ultrafiltration backwash;
- reverse osmosis reject;
- ion exchange regeneration waste;
- miscellaneous process waste streams;
- stormwater;
- potentially contaminated stormwater;
- contaminated water; and
- sanitary waste.

4.3.2.1 Wastewater Segregation

The Upgrader waste streams have varying degrees of water quality. Impurities include dissolved solids, oil and grease, biodegradable organics, nitrogen, phosphorus, sulphides, cyanide, and phenols. To optimize the wastewater treatment facilities, the wastewater streams are segregated into organic and high Total Dissolved Solids (TDS) streams. The organic waste streams typically contain oil and grease and other biodegradable contaminants; they will be treated separately from the high TDS waste streams. For Phase 1, all of the excess treated waste streams are directed to the effluent pond, for temporary storage prior to discharge to the river. However, for the Project all of the waste streams will be reclaimed by a ZLD evaporation process and recycled.

Organic Wastewater Treatment

The organic waste stream includes desalter wash water, potentially contaminated stormwater, oily wastewater, and sanitary wastewater; these combined streams will be treated by the following processes:

- desalter break tank (initial skim tank for desalter wash water);
- skim tanks;
- dissolved gas flotation;

- membrane bioreactor equalization tank; and
- membrane bioreactor.

Excess biological solids from the membrane bioreactor will be treated by aerobic digestion followed by digested biosolids dewatering, prior to off-site disposal.

High TDS Wastewater Treatment

Wastewater streams that have elevated TDS, including boiler and cooling tower blowdowns, excess condensate, reverse osmosis reject, and neutralized ion exchange waste will not be treated by the organic wastewater treatment process unless they are contaminated by hydrocarbons. These streams have little or no organics, and typically do not require treatment prior to river discharge. For Phase 1, all of the high TDS streams will be discharged to the effluent pond and blended with the treated organic waste stream, unless contamination is detected. As the Upgrader expands from Phase 1 towards the Project, ZLD treatment of targeted high TDS streams will be phased in. Eventually, the Project will incorporate ZLD treatment of all waste streams. However, for the first stage of ZLD, North American will segregate the reverse osmosis reject and neutralized ion exchange waste streams for treatment with an evaporator. The distillate from this first stage of ZLD will be recycled as boiler feed makeup. Targeting these high TDS wastewater streams for the first stage of ZLD will reduce the risk of elevated TDS concentrations in the river discharge as the overall volume of wastewater from the Upgrader declines. Contaminated high TDS wastewater will be diverted to the WWTU for treatment.

The evaporation process will produce a concentrated brine waste that will be disposed of off-site in accordance with regulatory requirements. North American is currently investigating other disposal options, including on-site crystallization.

Raw Water Treatment Waste

The ultrafiltration membrane system used as part of the raw water treatment process will generate a waste stream associated with backwash. This waste stream, which contains suspended solids, will be directed to the first cell of the raw water pond to allow suspended solids to settle, and the clarified water recycled.

4.3.2.2 Wastewater Discharge

Table 4.3-2 provides a summary of the wastewater discharges from the Project, which includes a 20% design allowance and a 15% contingency. Complete ZLD will be employed to treat all waste streams for the Project, eliminating discharge to the North Saskatchewan River. The maximum average annual day river discharge will occur during Phase 1. Incremental water reuse and the implementation of ZLD treatment of targeted waste streams with Upgrader development will maintain average annual day river discharges at or below Phase 1 levels as the Upgrader is expanded.

For Phase 1, treated wastewater will be discharged from the effluent pond to a diffuser in the North Saskatchewan River via a new discharge pipeline. The submerged diffuser will provide efficient mixing of the effluent in the river channel. The construction of the in-channel diffuser will require the use of a temporary coffer dam, which will follow Provincial guidelines that govern allowable in-stream construction activities and seasonal schedule. The completed outfall diffuser will not result in permanent alterations or diversions to the river.

The location for the outfall diffuser is shown on Figure 1.2-1. North American is currently negotiating with landowners regarding the proposed wastewater discharge pipeline routing. It is expected that the treated wastewater pipeline will follow the same right-of-way as the raw water supply pipeline. The treated wastewater outfall diffuser would similarly be installed downstream of the proposed raw water intake.

The effluent pond will have short-term capacity to retain effluent in the event that it does not meet effluent discharge criteria. In the event of contamination, the effluent pond will be recycled to the WWTU for additional treatment. The discharge from the effluent pond will be monitored for temperature, pH, flow rate and other parameters as directed by AENV. A composite sampler will be used for daily analysis of the river discharge.

Table 4.3-2 Upgrader River Discharge

	Phase 1		The Project (excluding Gasification 2)		The Project	
Waste Stream	**AAD (m^3/h)**	**ASD (m^3/h)**	**AAD (m^3/h)**	**ASD (m^3/h)**	**AAD (m^3/h)**	**ASD (m^3/h)**
Biox Effluent	108.4	108.4	0.0	0.0	0.0	0.0
Boiler Blowdown/ Ion Exchange Waste/ RO reject	69.2	69.2	36.5	36.5	0.0	0.0
Cooling Tower Blowdown	23.0	45.4	142.9	282.1	0.0	0.0
TOTAL	200.6	223.0	179.4	318.6	0.0	0.0

Notes:

AAD = Average Annual Day

ASD = Average Summer Day

4.3.3 Stormwater Control and Treatment

Stormwater will be collected and retained on-site through a network of drains, ditches and ponds. Figure 4.3-1 shows the conceptual drainage plan for the Project. There are no watercourse diversions on the site associated with the Upgrader. Local drainage south of the CN rail line will be directed to ditches along Range Road 211, to enhance existing wetlands on the north portion of the Project site SE 2-56-21 W4M. Stormwater will be contained on the site using a combination of berms, ditches, ponds and site grading. The ponds used to temporarily store stormwater collected from the developed areas of the site will be lined to prevent accidental contamination to underlying groundwater.

Stormwater collected on the developed areas of the Project site is categorized as either potentially contaminated stormwater or oily stormwater. Oily stormwater is generated within the processing areas, which are surfaced with concrete/asphalt to prevent infiltration. Oily stormwater is collected in a network of sewers, and directed to the lined oily water pond. Potentially contaminated stormwater is generated within the developed areas of the site that are outside the processing area boundaries. Potentially contaminated stormwater drains through a series of surface ditches to the lined potentially contaminated pond. Oily stormwater is treated in the WWTU. The potentially contaminated pond contents are treated in the WWTU if hydrocarbon contamination is detected; otherwise, clean potentially contaminated stormwater is either recycled to the raw water pond to supplement raw water requirements, or discharged through the effluent pond. In the undeveloped site areas and the administration complex area, there are a series of unlined ponds that collect clean stormwater, which if uncontaminated can be used to supplement raw water, discharged to the effluent pond, or discharged to wetlands located north of the site (Volume 3, Section 6). Accidental spills on the site, both within and outside the process areas, will be subject to environmental procedures requiring prompt containment and clean-up to minimize the risk of stormwater and groundwater contamination.

Stormwater ponds within the developed areas of the site are designed based on the 1:25 year storm event, with freeboard such that a 1:100 year storm event will be contained. For the 1:25 year storm event, the pond levels will not exceed the invert of inlet sewers or ditches. For storm events that exceed the 1:25 year storm, water will be stored in the ponds above the inlet invert level resulting in a backwater effect in the sewer and ditches.

The average annual volume of water that may be diverted to the stormwater ponds is 114,000 m^3. An application for a *Water Act* licence for diversion of this amount is included in Appendix C.

All stormwater ponds that collect stormwater from the developed areas of the Project site ponds will be lined and their slopes surfaced with a protective cover. Any pond bottoms extending below the high water table will have groundwater dewatering systems that will discharge to the potentially contaminated stormwater pond.

4.3.3.1 Potentially Contaminated Stormwater

Potentially contaminated stormwater is defined as surface drainage collected from areas of the site that have a low risk of hydrocarbon contamination. This generally includes the developed portions of the site that are outside the process areas. The potentially contaminated stormwater will be collected in a series of open ditches that drain to the potentially contaminated stormwater pond.

Following a storm event, the contents of the potentially contaminated stormwater pond are sampled for hydrocarbon contamination. If the stormwater meets discharge criteria, it will be directed to either the raw water pond for process use, to wetland discharge, or to the effluent pond for river discharge. Stormwater that is determined to be contaminated is sent to the WWTU for treatment. Any hydrocarbon that collects on the surface of the potentially contaminated stormwater pond will be removed using a floating skimmer and vacuum truck, and sent to the WWTU for treatment.

Stormwater is also collected and retained in the undeveloped areas of the site and the administrative complex area, and retained in one of four satellite ponds. This stormwater is tested, and, if uncontaminated, is periodically transferred to either the raw water pond, effluent pond, or discharged to maintain natural wetlands. Contaminated water from the satellite stormwater ponds is transferred to the WWTU for treatment.

Water collected within the bermed area of the tank farm following a storm event will be retained and analyzed for hydrocarbon contamination. Clean stormwater will be released to the potentially contaminated stormwater system, and contaminated stormwater discharged to the oily stormwater sewer for treatment.

4.3.3.2 Oily Stormwater

Oily stormwater is defined as water that is collected within processing areas, that is at risk of hydrocarbon contamination. Oily stormwater is collected within the processing areas through a series of catch basins and underground sewers. The sewer system will include water seals to contain fire within any one catch basin.

Oily stormwater collected from the various processing areas will be diverted to the oily stormwater collection hub, which incorporates lift pumps to transfer oily stormwater to the wastewater treatment facility. Oily stormwater in excess of the capacity of these pumps overflows to the oily stormwater pond for temporary storage. Hydrocarbon that forms on the surface of the oily stormwater pond is removed with a floating skimmer and vacuum truck. The contents of the oily stormwater pond are pumped to the wastewater treatment facility following a storm event. The oily stormwater system is designed to provide storage for the greater of a 1:100 year storm event, or a fire event within the process areas.

Stormwater runoff collected within the coke handling and storage area will be contained and recycled for either coke wetting or coke cutting. Excess stormwater from the coke handling and storage area will only be released to the oily stormwater collection system under severe stormwater conditions in which the capacity of the storage area sump is exceeded.

4.3.4 Water Reuse

North American's water management plan will involve significant investment in water reuse technologies and strategies. The following is a summary of the major water conservation initiatives being employed in the Project.

- Ultrafiltration Backwash Reuse: The backwash waste stream from the ultrafiltration process will be recycled to the raw water pond to allow suspended solids to settle out, and the clarified water reused to supplement raw water makeup.
- Stripped Sour Water Recycle: Stripped sour water will be recycled to the desalters, and delayed cokers as coke cutting makeup water.
- BIOX Effluent Reuse: Treated effluent from the membrane bioreactors will be reused to supplement water required for cooling tower and BFW make-up.
- Evaporators and ZLD: Evaporators will be employed to initially treat the reverse osmosis reject and neutralized ion exchange waste streams. The distillate from the evaporators will be used to supplement demineralized water requirements. The concentrated brine stream from the evaporators will be transported off-site for disposal or crystallizers will be employed to produce a solid waste. For the Project, all waste streams will be reclaimed through additional evaporative capacity to achieve ZLD treatment of all waste streams.
- Stormwater Recycle: Provision will be made to allow the diversion of clean stormwater collected from the Project site to the raw water pond to supplement raw water makeup, diverted to maintain wetlands on and adjacent to the Project site, or discharged to the North Saskatchewan River.
- Biosolids Dewatering: The WWTU membrane bioreactor system generates excess biological solids that must be removed from the system. These solids are dewatered using a belt filter press, and the filtrate is recycled to the membrane bioreactor for subsequent reuse as BIOX effluent reuse.

Water reuse and recycling for the Project will be implemented using a phased approach, with the introduction of ZLD treatment of targeted waste streams after Phase 1. Stripped sour water recycle, stormwater recycle, and ultrafiltration backwash reuse will be incorporated into Phase 1.

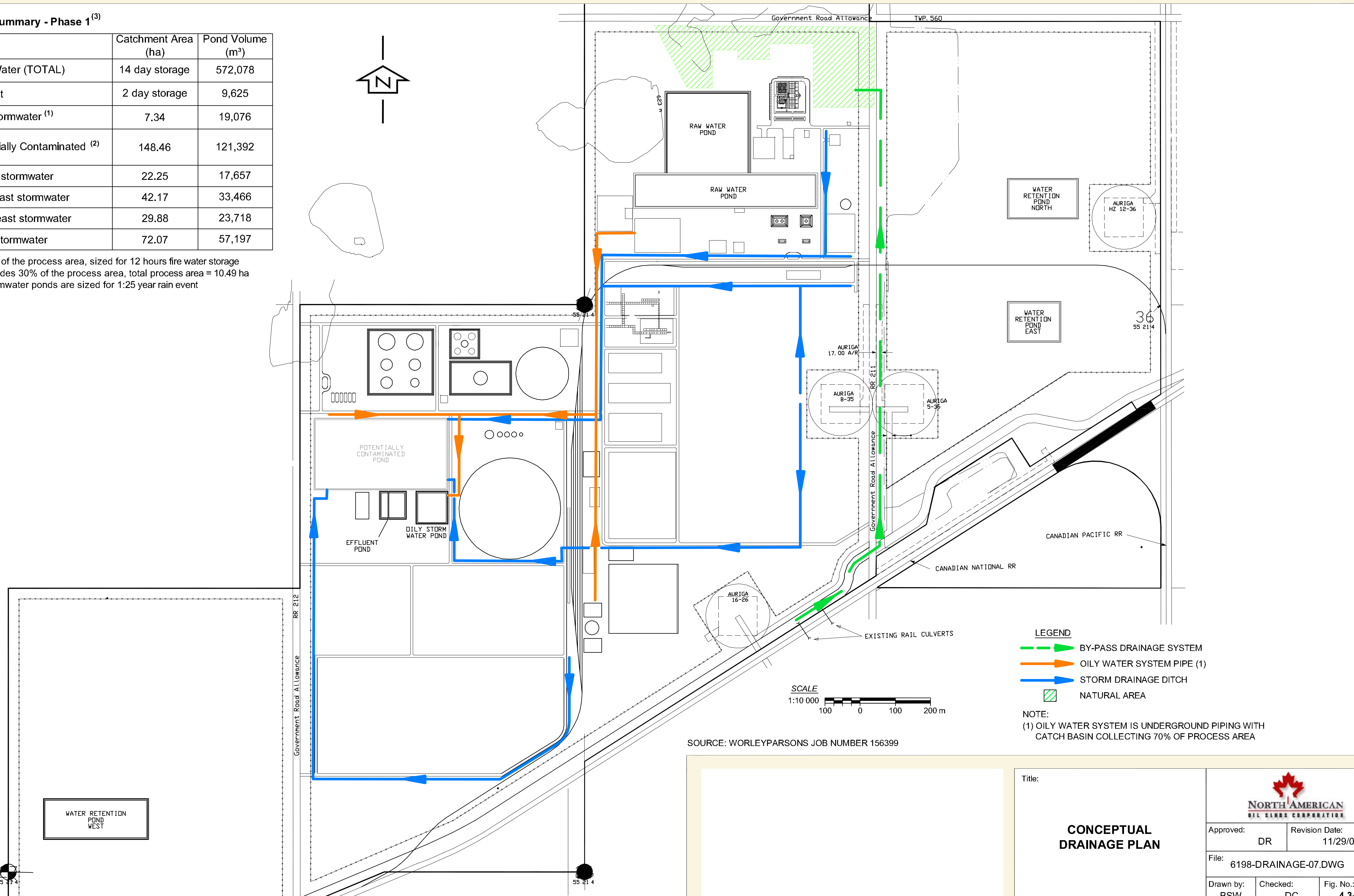
4.3.5 Fire Water

The fire water system for the Project will be designed to meet the requirements of National Fire Protection Association 20: Standard for the Installation of Stationary Fire Pumps for Fire Protection. Fire water is supplied through a fire water distribution system which includes underground piping, pumps, hydrants, monitors and manifolds. Fire water pumps are designed to supply sufficient water to all parts of the Project at the necessary pressure. Required firewater reserves have been calculated for the Project and the raw water pond has been designed for a sufficient volume to ensure an adequate fire water supply is available and maintained during an emergency.

Pond Summary - Phase 1[3]

Pond	Catchment Area (ha)	Pond Volume (m³)
Raw Water (TOTAL)	14 day storage	572,078
Effluent	2 day storage	9,625
Oily stormwater (1)	7.34	19,076
Potentially Contaminated (2)	148.46	121,392
Admin stormwater	22.25	17,657
Northeast stormwater	42.17	33,466
Southeast stormwater	29.88	23,718
West stormwater	72.07	57,197

(1) 70% of the process area, sized for 12 hours fire water storage
(2) Includes 30% of the process area, total process area = 10.49 ha
(3) Stormwater ponds are sized for 1:25 year rain event



SOURCE: WORLEYPARSONS JOB NUMBER 156399

Title:

CONCEPTUAL DRAINAGE PLAN

NORTH AMERICAN OIL SANDS CORPORATION

Approved: DR	Revision Date: 11/29/07	
File: 6198-DRAINAGE-07.DWG		
Drawn by: BSW	Checked: DC	Fig. No.: 4.3-1

4.4 Storage Tanks

Hydrocarbon products and chemicals from the process units will be stored in specific tanks. Tanks with toxic or volatile contents will not be vented to the atmosphere and vapours from these tanks will be recovered. Fixed-roof tanks will be blanketed with either natural gas or nitrogen, and large tanks containing volatile contents will be floating-roof tanks.

Light hydrocarbon material generated during unit start-ups and shut-downs will require isolation in off-specification storage (reject system). From time to time, the production may also be diverted to the reject system. Heavier, more stable material will be stored in atmospheric tanks. Lighter material (with Reid Vapour Pressure (RVP) greater than 12 psi) or odorous streams will be stored in a pressurized sphere. The sphere will be connected to the low pressure flare. Any lighter material will be diverted to the sphere on start-up until it is determined to meet specifications for atmospheric tank storage.

All tanks will meet the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products and the AENV Secondary Containment Guideline for Containers and Aboveground Storage Tanks.

The storage tank requirements for the Project are outlined in Tables 4.4-1 and 4.4-2.

No intermediate storage has been provided for vacuum unit feed. Should the vacuum unit shut down, excess atmospheric residue could be sent to the coker feed tanks and/or the upstream diluent recovery units will be cut back on flow.

Table 4.4-1 Hydrocarbon Storage Tank Requirements

Tank [1]	Surge Time (h/ tanks)	Phase 1 Working Capacity (m^3)	The Project Working Capacity (m^3)	Tank Type [2]	Vapour Pressure (kPa) [3]
Dilbit	48 / 2 tanks	2 x 20,923	2 x 20,923 3 x 24,411	VFRT	28
Diluent Return	24 / 2 tanks	2 x 3,203	2 x 3,203 3 x 3,843	IFRT	36
DCU Feed	24 / tank	1 x 12,010	1 x 12,010 1 x 14,532	VFRT	0.04
Untreated Naphtha	24 / tank	1 x 2,882	1 x 2,882 1 x 3,843	IFRT	36
Treated Naphtha	48 / product	2 x 2,882	2 x 2,882 2 x 3,843	IFRT	36
Untreated Gas Oil	24 / tank	1 x 8,896	1 x 8,896 1 x 11,107 1 x 7,566	VFRT	0.04
Treated Gas Oil	48 / product	2 x 8,896	2 x 8,896 3 x 11,107	VFRT	0.04
Reject (Slops)	N/A	1 x 5,124 1 x 2,385	3 x 5,124 2 x 2,385	VFRT Sphere	0.04

Notes:

1 There are no underground storage tanks.

2 Tank type abbreviations
IFRT – Internal floating roof tank
VFRT – Vertical fixed roof tank

3 Vapour pressure is at standard conditions, 15^{o}C and 101.3 kPa (a).

Table 4.4-2 Major Off-site and Utility Tankage Requirements

Tank [1]	Surge Time (h/ tanks)	Phase 1 Working Capacity (m^3)	The Project Working Capacity (m^3)	Tank Type [2]
Sour Water Feed Tank	24 / tank	1 x 3,275	1 x 3,275 2 x 3,275	IFRT
Wastewater Skim Tank	---	3 x 500	9 x 500	VFRT
Wastewater Equalization Tank	12 / tank	1 x 1,000	3 x 1,000	VFRT

Notes:

1 There are no underground storage tanks.

2 Tank type abbreviations
IFRT – Internal floating roof tank
VFRT – Vertical fixed roof tank

5 ENERGY AND MATERIAL BALANCES

5.1 The Project (Excluding Gasification)

5.1.1 Design Criteria

The material balance for the Project (excluding gasification) is based on the following design criteria:

- The Upgrader will have the following processing capacities:
  - 530 m^3/h (80,000 bpsd) bitumen or 757 m^3/h (114,300 bpsd) diluent bitumen blend for Phase 1;
  - 1,610 m^3/h (243,000 bpsd) bitumen or 2,299 m^3/h (347,000 bpsd) diluent bitumen blend for the Project.
- Diluent recovered from the dilbit in the DRU will be returned to the upstream bitumen production facilities.
- The Upgrader will operate with an average on-stream factor of 0.95.
- The SRUs will be designed to recover an annual average of 99.8%.

5.1.2 Material Balance

Table 5.1-1 summarizes the overall material balance for the Project (excluding gasification). In these balances, hydrogen is treated as a direct input, both from the SMR and from the gasification unit. Figure 5.1-1 presents the material balance for Phase 1. Figure 5.1-2 presents the material balance for the Project (excluding gasification).

Table 5.1-1 Overall Material Balance

Material Balance	Phase 1 (t/d)	The Project (t/d)
Feeds		
Diluent Bitumen	16,762	50,967
Hydrogen from SMR	225	189
Hydrogen from Gasification	-	524
Total	**16,987**	**51,680**
Products		
Synthetic Crude Oil	9,479	29,439
Diluent Return	3,819	11,906
Coke	2,447	6,960
Fuel Gas	493	1,247
LPG	254	570
Solid Sulphur	471	1,441
Estimated Sulphur Emissions	1	3
Others (Water, N_2, CO_2, etc.)	23	114
Total	**16,987**	**51,680**

5.1.3 Energy Balance

Tables 5.1-2 and 5.1-3 summarize the energy balance for Phase 1 and the Project (excluding gasification).

Table 5.1-2 Phase 1 Energy Balance

Energy Balance	Electrical Power (kW)	Natural Gas (GJ/h)	Other Fuel (GJ/h)
Primary Source of Energy			
Equivalent energy from burning refinery gas from process units	N/A	N/A	1860
Equivalent energy from burning purchased natural gas for fuel gas	N/A	60.4	N/A
Equivalent energy from purchased natural gas for hydrogen production	N/A	1,645	N/A
Imported electrical power	61,166	N/A	N/A
Total production	61,166	1,705.4	1860
Primary Consuming Source			
Fuel gas required for:			
DRU	3,166	13.5	270
DCU	19,214	24.4	488
Coker Gas Plant [1]	- [1]	- [1]	- [1]
NHT	1,254	0.7	13
BHT	13,269	2.9	57
Hydrogen Plant (SMR)	2,666	-	760
Support Units [2]	7,800	-	-
Utilities and off-site systems/miscellaneous	13,967	18.9	272
Equivalent energy of natural gas used for hydrogen production	N/A	1,645	N/A
Total consumption	61,166	1705.4	1860
Summary of Steam Consumed			
Equivalent energy for low pressure steam	N/A	N/A	213
Equivalent energy for medium pressure steam	N/A	N/A	135
Equivalent energy for high pressure steam	N/A	N/A	179
Total steam consumed	N/A	N/A	527

Notes:

1 Coker Gas Plant requirements included in DCU.

2 Support units include SRU, TGTU, ARU and SWS.

Table 5.1-3 The Project Energy Balance (excluding Gasification)

Energy Balance	Electrical Power (kW)	Natural Gas (GJ/h)	Other Fuel (GJ/h)
Primary Source of Energy			
Equivalent energy from burning refinery gas from process units	N/A	N/A	3,234
Equivalent energy from burning purchased natural gas for fuel gas	N/A	142.3	N/A
Equivalent energy from purchased natural gas for hydrogen production	N/A	1,382	N/A
Imported electrical power	178,826	N/A	N/A
Total production	178,826	1,524.3	3,234
Primary Consuming Source			
Fuel gas required for:			
DRU	9,625	36.5	730
Vacuum Unit (VAC)	1,600	10.3	207
DCU	58,411	53.8	1,076
Coker Gas Plant [1]	- [1]	- [1]	- [1]
NHT	3,135	1.4	27
DHT [2]	14,330	2.9	57
GOHT	14,850	2.8	56
Vacuum Gas Oil Hydrocracker	8,900	2.0	40
Hydrogen Plant (SMR)	2,320	-	638
Support Units [3]	23,712	-	-
Utilities and off-site system/miscellaneous	41,943	32.6	403
Equivalent energy of natural gas used for hydrogen production	N/A	1382	N/A
Total consumption	178,826	1,524.3	3,234
Summary of Steam Consumed			
Equivalent energy for low pressure steam	N/A	N/A	393
Equivalent energy for medium pressure steam	N/A	N/A	243
Equivalent energy for high pressure steam	N/A	N/A	430
Total steam consumed	N/A	N/A	1066

Notes:

1 Coker gas plant requirements included in DCU.

2 Bulk hydrotreater (Phase 1) converted into distillate hydrotreater for the Project.

3 Support units include SRU, TGTU, ARU and SWS.

5.1.4 Production Accounting Summary

Key measurements will be as follows.

- Diluent bitumen feed to tankage (custody transfer);
- Reconciliation with pipeline shipments;
- Diluent bitumen feed to DRU;
- Diluent shipments to bitumen production facility;
- Bitumen feed to coker;
- SCO transfer (in-line blending) to shipment tanks (custody transfer);
- LPG shipments by pipeline and rail (custody transfer);

- Sulphur shipments by rail (custody transfer); and
- Coke shipments by rail (custody transfer).

5.1.5 Sulphur Balance

Table 5.1-4 lists the sulphur balance for the Project (excluding gasification).

Table 5.1-4 Sulphur Balance

Sulphur Balance	Phase 1 (t/d)	The Project (t/d)
Sulphur in Diluent Bitumen Feed [1]	624	1,895
Sulphur in Products		
Sulphur Recovered [2]	471	1,441
Sulphur in Coke [1]	141	417
SCO [3]	5	14
Naphtha Diluent [3]	6	20
Sulphur to emissions [4]	1	3

Notes:

1 Sulphur in the feed and coke are based on the coker yields.

2 Sulphur recovered is the average annual recovery rate.

3 The sulphur in SCO and naphtha diluent have been based on the sulphur percent by weight for each stream.

4 Sulphur emissions from all combustion equipment include those from the SRU and TGTU.

5.1.6 Catalysts and Chemicals

The catalysts and chemicals used in the Project will be similar to those used throughout the refining industry. Details for the catalysts and chemicals are provided in Tables 5.1-5 through 5.1-8.

5.1.6.1 Catalysts

Tables 5.1-5 and 5.1-6 summarize the catalysts for Phase 1 and for the Project (excluding gasification).

Table 5.1-5 Phase 1 Catalyst Estimate

Unit	Service	Catalyst	Quantity (m^3)	Expected Life (y)
NHT	Diolefin Reactor	KG-55	0.63	2
		KF-542-5R	1.27	2
		HC-DM-3Q	2.53	2
		N-205-1.5Q	27.04	2
	Naphtha Hydrotreater Reactor	KG-55	1.08	2
		KF-542-5R	2.15	2
		HC-DM-3Q	9.48	2
		HC-DM-1.3Q	34.33	2
		N-205-1.5Q	85	2
BHT	Bulk Hydrotreater Reactor 1 and 2	KG-55	2.72	2
		KF-542-9R	2.72	2
		KF-542-5R	8.18	2
		KF-647-3Q	69.98	2
		KF-647-1.3Q	18.16	2
		KF-848-1.3Q	243.32	2
Hydrogen Plant	Hydrogenator	Hydrogenator	12.74	4
	Desulphurizer	Zinc Oxide	42.47	6
	Reformer	Reformer	38.79	4
	HT Shift Converter	HT Shift	45.31	4
SRU	Claus Converter 1 and 2	Activated Alumina	182	4
	Tail Gas Treatment	Hydrogenation (Co, Mo)	40.6	4
Instrument Air System	Desiccant	Drying Agent	1361	5
Raw Water Treatment	Mixed Bed Deionizer	Cation Exchange Resin	11.3	5
		Anion Exchange Resin	11.3	5

Table 5.1-6 Project Catalyst Estimate

Unit	Service	Catalyst	Quantity (m^3)	Expected Life (y)
Naphtha Hydrotreater (NHT-1)	Diolefin Reactor	KG-55	0.63	2
		KF-542-5R	1.27	2
		HC-DM-3Q	2.53	2
		N-205-1.5Q	27.04	2
	Naphtha Hydrotreater Reactor	KG-55	1.08	2
		KF-542-5R	2.15	2
		HC-DM-3Q	9.48	2
		HC-DM-1.3Q	34.33	2
		N-205	65	2
Naphtha Hydrotreater (NHT-2)	Diolefin Reactor	KG-55	0.63	2
		KF-542-5R	1.27	2
		HC-DM-3Q	2.53	2
	Naphtha Hydrotreater Reactor	N-205-1.5Q	27.04	2
		KG-55	1.08	2
		KF-542-5R	2.15	2
		HC-DM-3Q	9.48	2
		HC-DM-1.3Q	34.33	2
DHT (formerly BHT in Phase 1)	Distallate Hydrotreater Reactor 1 and 2	KG-55	2.72	2
		KF-542-9R	2.72	2
		KF-542-5R	8.18	2
		KF-647-3Q	69.98	2
		KF-647-1.3Q	18.16	2
		KF-848-1.3Q	243.32	2

Unit	Service	Catalyst	Quantity (m^3)	Expected Life (y)
GOHT	Gas Oil Hydrotreater Reactors 1 and 2	KG-55	2.72	2
		KF-542-9R	2.72	2
		KF-542-5R	8.18	2
		KF-647-3Q	69.98	2
		KF-647-1.3Q	18.16	2
		KF-848-1.3Q	243.32	2
Vacuum Gas Oil Hydrocracker	Vacuum Gas Oil Hydrocracker Reactors 1 and 2	KG-55	0.92	2
		KF-542-9R	0.98	2
		KF-542-5R	2.92	2
		KF-647-3Q	24.14	2
		KF-647-1.3Q	25.54	2
		KF-848-1.3Q	85.94	2
Hydrogen Plant	Hydrogenator	Hydrogenator	12.74	4
	Desulphurizer	Zinc Oxide	42.47	6
	Reformer	Reformer	38.79	4
	HT Shift Converter	HT Shift	45.31	4
SRU	Claus Converters (5)	Activated Alumina	455	4
	Tail Gas Treatment (3)	Hydrogenation (Co, Mo)	121.8	4
Instrument Air System	Desiccant	Drying Agent	4133	5
Raw Water Treatment	Mixed Bed Deionizer	Cation Exchange Resin	34.3	5
		Anion Exchange Resin	34.3	5

Hydrotreater Catalysts

The hydrotreater catalysts used in the Project will be similar to those in other upgraders currently in design or operation. The catalysts listed for the naphtha and gas oil hydrotreaters in Tables 5.1-5 and 5.1-6 have been specified by the process licensor. These catalysts support desulphurization, denitrification and hydride-metalation. Commercial supply and disposal channels are well established.

Sulphur Recovery Catalysts

The sulphur recovery process will use standard industry catalysts. The specific catalysts used in the SRUs and their quantity are provided by the licensor. Commercial supply and disposal channels are well established.

Steam Methane Reformer Catalyst

The SMR process will use the standard industry catalysts throughout the hydrogen manufacturing process. Commercial supply and disposal channels are well established.

5.1.6.2 Chemicals

Tables 5.1-7 and 5.1-8 summarize the chemicals for Phase 1 and the Project, respectively (excluding gasification).

Table 5.1-7 Phase 1 Chemical Consumption Estimate

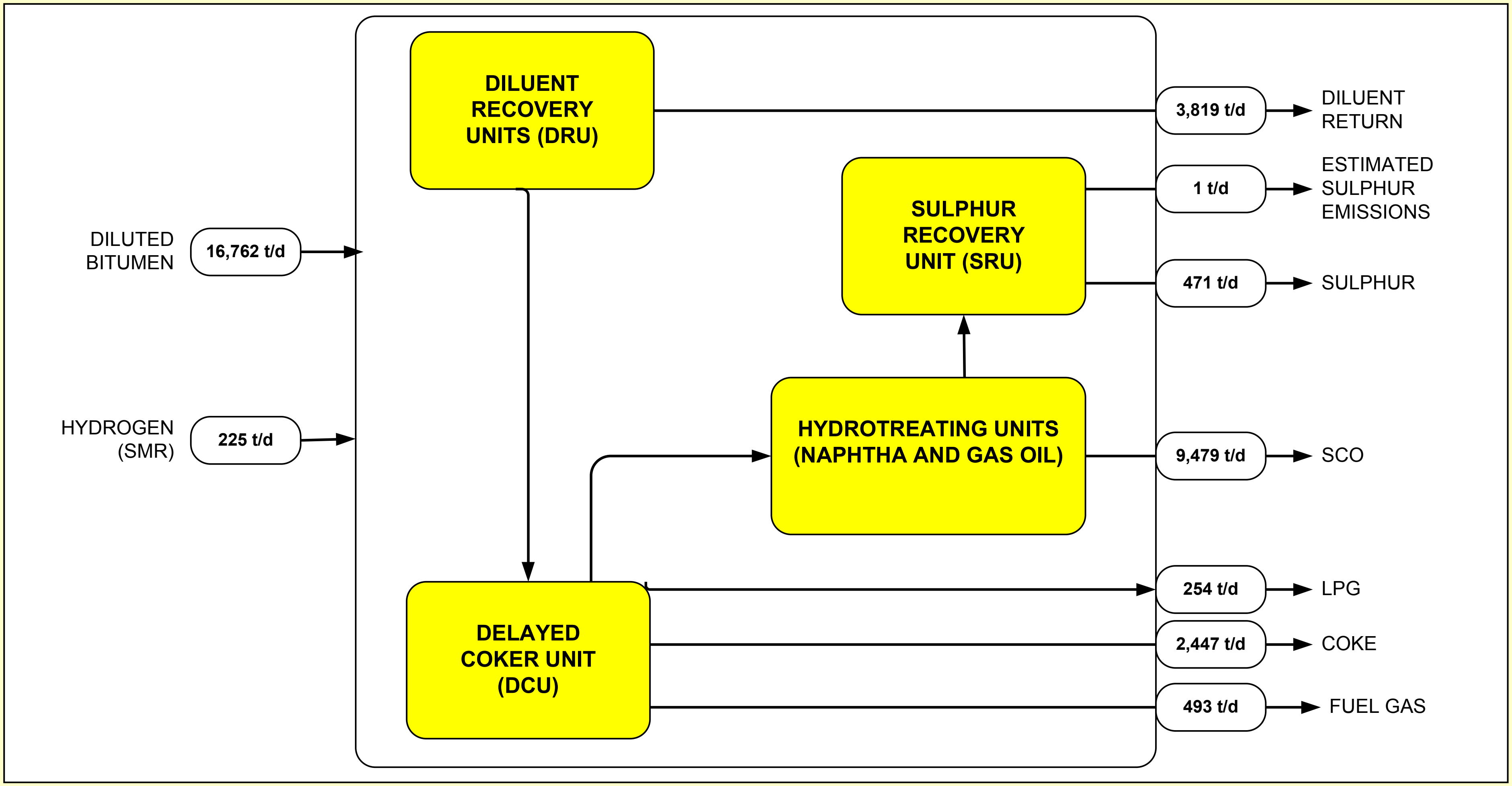
Unit	Chemical	Purpose	Initial Charge	Annual Consumption
DRU	Ammonia Solution	Neutralization	-	36 m^3
DCU	Ammonium Polysulphide	Corrosion Inhibitor	-	38 m^3
	Antifoam (NALCO EC9019A or Equivalent)	Prevent foam over coke drums	-	38 m^3
	De-Emusilfer (RE-SOLV EC2345A or Equivalent)	Separation of oil-water	-	19 m^3
Desalter	De-Emusilfer (RE-SOLV EC2345A or Equivalent)	Separation of oil-water	-	76 m^3
NHT	Corrosion Inhibitor (Unicor C or Equivalent)	Corrosion Inhibition	-	1 m^3
	Sulphiding Agent (DMDS)	Catalyst activation	22.5 t	2 t
	Neutralization Solution (Soda Ash)	Neutralization	6.4 t	-
BHT	Corrosion Inhibitor (Unicor C or Equivalent)	Corrosion inhibition	-	4 m^3
	Sulphiding Agent (DMDS)	Catalyst activation	32.6 t	10 t
	Neutralization Solution (Soda Ash)	Neutralization	8.7 t	-
SRU	Caustic Soda (50% NaOH)	Neutralization	-	40.8 t
	MDEA (100%)	H_2S Absorbent	70.7 t	17.7 t
	Antifoam	Prevent foaming in contactor	1 t	3.9 t
ARU	MDEA (100%)	H_2S absorbent	236 t	59.0 t
	Antifoam	Prevent foaming in contactor	3 t	13.1 t
SWS	Caustic Soda (50% NaOH)	Neutralization	-	18.6 t
Potable Water	Sodium Hypochlorite (12% by weight)	Disinfection residual	-	6 m^3
Cooling Water System	Sulphuric Acid	$CaCO_3$ scaling control	-	27 m^3
	Sodium Hypochlorite (12% by weight)	Microbiological growth control	-	1,535 m^3
	Corrossion Inhibitor	Corrosion control	-	30 m^3
	Dispersant	Scale control	-	30 m^3
	Antifoam Agent	Foam control -intermittent	-	30 m^3
Raw Water Treatment	Sodium Hypochlorite (12% by weight)	Microbiological growth control	-	145 m^3
	Sulfuric Acid (98% by weight)	pH adjustment	-	180 m^3
	Poly Aluminum Chloride (PACl)	Coagulant	-	1,140 m^3
Water Treatment (Ultra Filtration)	Sodium Hypochlorite (12% by weight)	Membrane cleaning	-	100 m^3
	Citric Acid	Membrane cleaning	-	1400 kg
Water Treatment (Reverse Osmosis)	Sodium Bisulfite	Dechlorination	-	4,120 m^3
	Caustic Soda (50% NaOH)	Membrane cleaning	-	4 m^3
	Citric Acid	Membrane cleaning	-	1,200 kg
	Sulfuric Acid (98% by weight)	pH adjustment	-	21 m^3
	Antiscalant	Membrane conditioner	-	12 m^3
	Antifoulant	Membrane conditioner	-	12 m^3

Unit	Chemical	Purpose	Initial Charge	Annual Consumption
Water Treatment (Mixed Bed Ion Exchange)	Sulfuric Acid (98% by weight)	Bed regeneration	-	65 m^3
	Caustic Soda (50% NaOH)	Bed regeneration	-	126 m^3
Boiler Feedwater Treatment	Sodium metabisulfite	Oxygen scavenger	-	7,450 kg
	Coordinating PO_4	Corrosion control	-	75 t
	Neutralizing Amine	CO_2 control	-	75 t
WWTU	Demulsifier	Emulsion treating	-	15 t
	Reverse demulsifier	Emulsion treating	-	3,650 kg
	Cationic Polymer	Dissolved gas flotation flocculation	-	7,275 kg
	Solids Dewatering Polymer	Digested biosolids dewatering aid	bags	300 kg
	Sodium Hypochlorite (12% by weight)	Membrane cleaning	-	48 m^3
	Citric Acid	Membrane cleaning	-	1,400 kg
	Soda Ash	Supplemental biox alkalinity	-	58 t

Table 5.1-8 Project Chemical Consumption Estimate

Unit	Chemical	Purpose	Initial Charge	Annual Consumption
DRU	Ammonia Solution	Neutralization	-	109 m^3
DCU	Ammonium Polysulphide	Corrosion inhibitor	-	116 m^3
	Antifoam (NALCO EC9019A or Equivalent)	Prevent foam over coke drums	-	116 m^3
	De-Emusilfer (RE-SOLV EC2345A or Equivalent)	Separation of oil-water	-	58 m^3
Desalter	De-Emusilfer (RE-SOLV EC2345A or Equivalent)	Separation of oil-water	-	231 m^3
NHT	Corrosion Inhibitor (Unicor C or Equivalent)	Corrosion inhibition	-	2 m^3
	Sulphiding Agent (DMDS)	Catalyst activation	45 t	4 t
	Neutralization Solution (Soda Ash)	Neutralization	12.8 t	-
DHT	Corrosion Inhibitor (Unicor C or Equivalent)	Corrosion inhibition	-	4 m^3
	Sulphiding Agent (DMDS)	Catalyst activation	32.6 t	10 t
	Neutralization Solution (Soda Ash)	Neutralization	8.7 t	-
GOHT	Corrosion Inhibitor (Unicor C or Equivalent)	Corrosion inhibition	-	4 m^3
	Sulphiding Agent (DMDS)	Catalyst activation	32.6 t	10 t
	Neutralization Solution (Soda Ash)	Neutralization	8.7 t	-
VGO Hydrocracker	Corrosion Inhibitor (Unicor C or Equivalent)	Corrosion inhibition	-	4 m^3
	Sulphiding Agent (DMDS)	Catalyst activation	26.6 t	8 t
	Neutralization Solution (Soda Ash)	Neutralization	7.1 t	-

Unit	Chemical	Purpose	Initial Charge	Annual Consumption
SRU	Caustic Soda (50% NaOH)	Neutralization	-	124 t
	MDEA (100%)	H_2S absorbent	215 t	53.8 t
	Antifoam	Prevent foaming in contactor	3 t	11.9 t
ARU	MDEA (100%)	H_2S absorbent	717 t	179 t
	Antifoam	Prevent foaming in contactor	9 t	39.8 t
SWS	Caustic Soda (50% NaOH)	Neutralization	-	56.5 t
Potable Water	Sodium Hypochlorite (12% by weight)	Disinfection residual	-	6 m^3
Cooling Water System	Sulfuric Acid (98% by weight)	$CaCO_3$ scaling control	-	283 m^3
	Sodium Hypochlorite (12% by weight)	Microbiological growth control	-	16,240 m^3
	Corrossion Inhibitor	Corrosion control	-	185 m^3
	Dispersant	Scale control	-	277 m^3
	Antifoam Agent	Foam control -intermittent	-	30 m^3
Raw Water Treatment	Sodium Hypochlorite (12% by weight)	Microbiological growth control	-	520 m^3
	Sulfuric Acid (98% by weight)	pH adjustment	-	640 m^3
	Poly Aluminum Chloride (PACl)	Coagulant	-	4,126 t
Water Treatment (Ultra Filtration)	Sodium Hypochlorite (12% by weight)	Membrane cleaning	-	300 m^3
	Citric Acid	Membrane cleaning	-	4,250 kg
Water Treatment (Reverse Osmosis)	Sodium Bisulfite	Dechlorination	-	8,800 kg
	Caustic Soda (50% NaOH)	Membrane cleaning	-	12 m^3
	Citric Acid	Membrane cleaning	-	3,900 kg
	Sulfuric Acid (98% by weight)	pH adjustment	-	45 m^3
	Antiscalant	Membrane conditioner	-	36 m^3
	Antifoulant	Membrane conditioner	-	36 m^3
Water Treatment (Mixed Bed Ion Exchange)	Sulfuric Acid (98% by weight)	Bed regeneration	-	196 m^3
	Caustic Soda (50% NaOH)	Bed regeneration	-	384 m^3
Boiler Feedwater Treatment	Sodium metabisulfite	Oxygen scavenger	-	31 t
	Coordinating PO_4	Corrosion control	-	306 t
	Neutralizing Amine	CO_2 control	-	306 t
WWTU	Demulsifier	Emulsion treating	-	37 t
	Reverse demulsifier	Emulsion treating	-	9,300 kg
	Cationic Polymer	Dissolved gas flotation flocculation	-	19 t
	Solids Dewatering Polymer	Digested biosolids dewatering aid	bags	1,000 kg
	Sodium Hypochlorite (12% by weight)	Membrane cleaning	-	150 m^3
	Citric Acid	Membrane cleaning	-	4,250 kg
	Soda Ash	Supplemental biox alkalinity	-	150 t

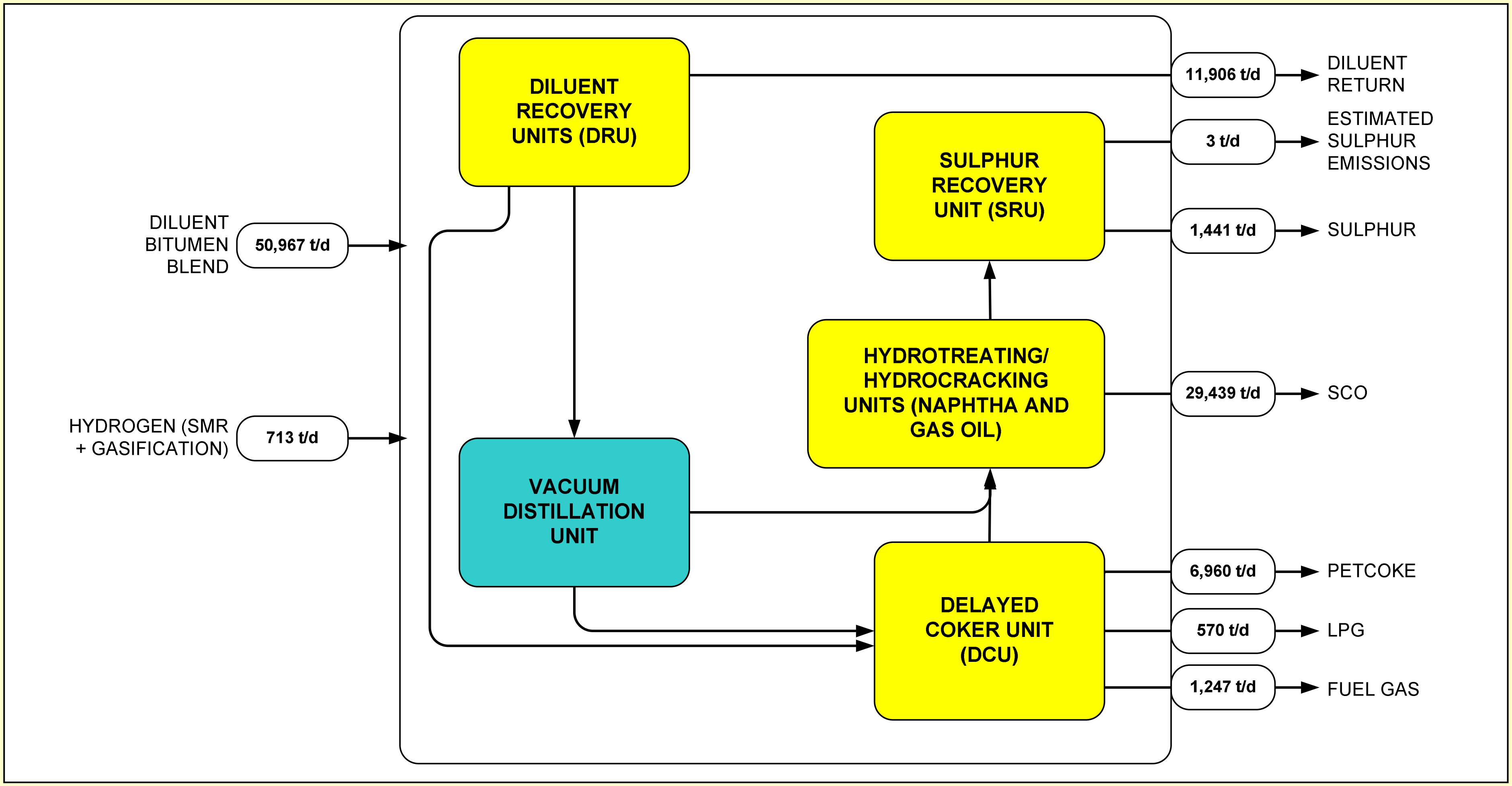


Overall Material Balance for Phase 1

North American Oil Sands Corporation

Approved: DR	Revision Date: Dec 5/07
File: Figure 5.1-1 Overall Material Balance for Phase 1.doc	

Drawn by: BF	Checked: BE	Fig. No.: **5.1-1**



Overall Material Balance for the Project (Excluding Gasification)

North American Oil Sands Corporation

Approved: DR	Revision Date: Dec 5/07	
File: Figure 5.1-2 Overall Material Balance for The Project.doc		
Drawn by: BF	Checked: BE	Fig. No.: **5.1-2**

5.2 Gasification Stages

5.2.1 Design Criteria

The material balance for the gasification stages of the Project is based on the following design criteria:

- Maximum petcoke feed to fill two quench type reactors trains with the largest commercially available reactor size. This has been identified by the licensor as 24.5 m^3 or 900 ft^3.
- Maximum hydrogen production from Gasification 1 with the surplus heat used to generate steam to produce power using a condensing steam turbine.
- Maximum SNG production from Gasification 2 with the surplus heat used to generate steam to produce power using a condensing steam turbine.
- Gasification 1 will operate with an average on-stream factor of 0.93 based on having a third standby reactor. On stream availability is crucial for hydrogen production as the gasifiers will supply greater than 70% of the hydroprocessing hydrogen needs.
- Gasification 2 will operate with an average on-stream factor of 0.87 with no standby reactor.
- The SRUs will be designed to recover an annual average of 99.8%.

5.2.2 Material Balance

The overall material balance for the gasification stages is presented in Table 5.2-1 and Figures 5.2-1 and 5.2-2.

Table 5.2-1 Overall Material Balance (Gasification Stages)

Material Balance	Gasification 1 (t/d)	Gasification 2 (t/d)
Feeds		
Petcoke	3,257	3,257
Fluxant	94.5	94.5
Oxygen	3,721.6	3,721.6
Water (as steam, make-up)	4104	3,216
Total	**11,177**	**10,289**
Products		
Hydrogen	523.8	-
SNG		1365
Tail Gas to Fuel	616	-
CO_2	8853	7,230
Solid Sulphur	207.4	207.4
Slag	355.5	355.5
Waste Water/Blowdown	240	420
Acid Gas	381	711
Total	**11,177**	**10,289**

5.2.3 Energy Balance

Tables 5.2-2 and 5.2-3 summarize the energy balance for the gasification stages.

Table 5.2-2 Gasification 1 Energy Balance

Energy Balance	Electrical Power (kW)	Natural Gas (GJ/h)	Other Fuel (GJ/h)
Primary Source of Energy			
Equivalent energy from gasifying petcoke	N/A	N/A	5,396
Equivalent energy from burning purchased natural gas for fuel gas	N/A	1.3	N/A
Produced electrical power	60,900	N/A	N/A
Imported electrical power	47,926	N/A	N/A
Total production	108,826	1.3	5,396
Primary Consuming Source			
Coke handling and slurry	5,705	N/A	N/A
ASU	73,824	N/A	N/A
Gasification island including black water and slag handling	1,827	N/A	N/A
Sour shift and low temperature cooling	410	N/A	N/A
AGR and SWS	18,792	N/A	N/A
Hydrogen PSA	3,728	N/A	N/A
SRU & TGTU	521	1.3	-
Utilities and off-site system/miscellaneous	4,019	N/A	N/A
Total consumption	108,826	1.3	-
Summary of Steam/H_2 Produced			
Equivalent energy for H_2 produced	N/A	N/A	2,498
Equivalent energy for low pressure steam [1]	N/A	N/A	316
Equivalent energy for medium pressure steam [1]	N/A	N/A	295
Equivalent energy for high pressure steam [1]	N/A	N/A	219

Notes:

1 Steam produced is used to generate electrical power through a condensing turbine.

Table 5.2-3 Gasification 2 Energy Balance

Energy Balance	Electrical Power (kW)	Natural Gas (GJ/h)	Other Fuel (GJ/h)
Primary Source of Energy			
Equivalent energy from gasifying petcoke	N/A	N/A	5,396
Equivalent energy from burning purchased natural gas for fuel gas	N/A	1.3	N/A
Produced electrical power	9,257	N/A	N/A
Imported electrical power	95,100	N/A	N/A
Total production	104,357	1.3	5,396
Primary Consuming Source			
Coke handling and slurry	5,705	N/A	N/A
ASU	73,824	N/A	N/A
Gasification island including black water and slag handling	1,827	N/A	N/A
Sour shift and low temperature cooling	340	N/A	N/A
AGRand SWS	17,530	N/A	N/A

Energy Balance	Electrical Power (kW)	Natural Gas (GJ/h)	Other Fuel (GJ/h)
Methanation unit (SNG)	210	N/A	N/A
SRU & TGTU	521	1.3	N/A
Utilities and off-site system/miscellaneous	4,400	N/A	N/A
Total consumption	104,357	1.3	N/A
Summary of Steam/SNG Produced			
Equivalent energy for SNG production	N/A	N/A	3,002
Equivalent energy for low pressure steam [1]	N/A	N/A	306
Equivalent energy for medium pressure steam [1]	N/A	N/A	285
Equivalent energy for high pressure steam [1]	N/A	N/A	705

Notes:

1 Steam produced is used to generate electrical power through a condensing turbine.

5.2.4 Production Accounting Summary

Key measurements will be as follows.

- petcoke feed to the gasifiers;
- HP steam to the gasifiers;
- H_2 production to the Upgrader;
- SNG production to pipeline (custody transfer);
- power production from the steam turbines; and
- sulphur shipments by rail (custody transfer).

Agreement will be reached with the EUB on procedures to calculate hydrocarbon and sulphur losses, flaring, etc.

5.2.5 Sulphur Balance

Table 5.2-4 lists the sulphur balance for the gasification stages.

Table 5.2-4 Sulphur Balance for the Gasification Stages

Sulphur Balance	Gasification 1 (t/d)	Gasification 2 (t/d)
Sulphur in petcoke	207.8	207.8
Sulphur recovered	207.4	207.4
Sulphur in products	-	-
Sulphur to emissions [1]	0.4	0.4

Notes:

1 Sulphur emissions from the SRU and TGTU.

5.2.6 Catalysts and Chemicals

Details for the catalysts and chemicals are provided in Tables 5.2-5 to 5.2-8.

5.2.6.1 Catalysts

Tables 5.2-5 and 5.2-6 summarize the catalysts for the gasification phases.

Table 5.2-5 Gasification 1 Catalyst Estimate

Unit	Service	Catalyst	Quantity (m^3)	Expected Life (y)
ASU	O_2 supply to Gasifiers	Adsorbent	380	5
Hydrogen PSA		Mole Sieve Adsorbent	40	20
SRU	Claus Converter	Activated Alumina	41.5	4
		Titania	8.5	4
	Tail Gas Treatment	Hydrogenation (Co, Mo)	12.8	4 to 5
Instrument Air System	Desiccant	Drying Agent	30	5 to 10
Boiler Feed Water Treatment	DI Beds	Cation Resin	14	3 to 5
		Anion Resin	14	3 to 5

Table 5.2-6 Gasification 2 Catalyst Estimate

Unit	Service	Catalyst	Quantity (m^3)	Expected Life (y)
ASU	O_2 supply to Gasifiers	Adsorbent	380	5
		Anion Resin	14	3 to 5
Methanation Unit (SNG)	Conversion of Syngas to SNG	Nickel Catalyst	100	2
SRU	Claus Converter	Activated Alumina	41.5	4
		Titania	8.5	4
	Tail Gas Treatment	Hydrogenation (Co, Mo)	12.8	4 to 5
Instrument Air System	Desiccant	Drying Agent	30	5 to 10
Boiler Feed Water Treatment	DI Beds	Cation Resin	14	3 to 5

5.2.6.2 Chemicals

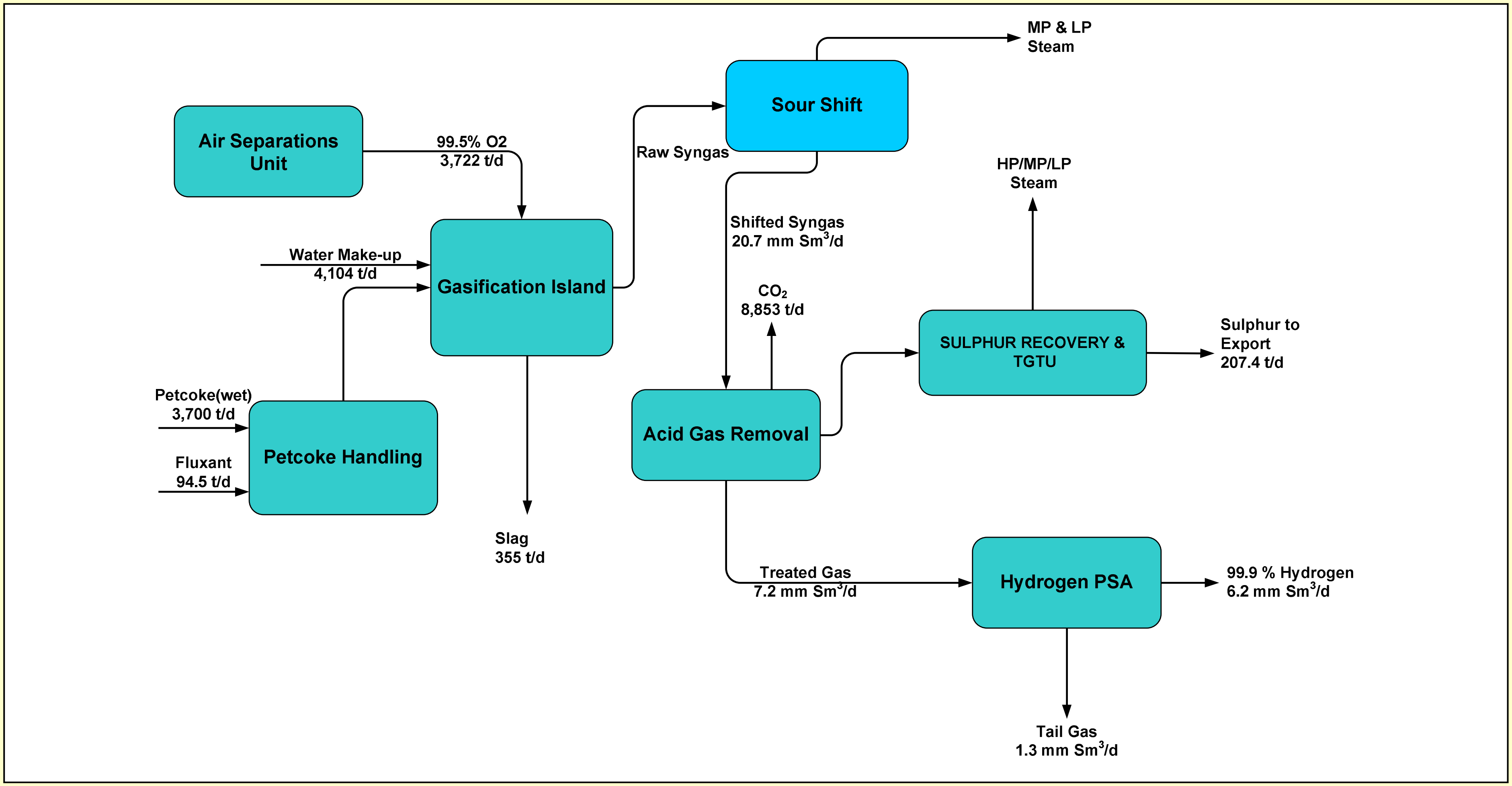
Tables 5.2-7 and 5.2-8 summarize the chemicals for both stages of gasification.

Table 5.2-7 Gasification 1 Chemical Consumption Estimate

Unit	Chemical	Purpose	Initial Charge	Annual Consumption
Coke Handling & Slurry Preparation	Flux	Corrosion Inhibitor	3,000 t	35,040 t
	Slurry Additive	Viscosity reduction	15 m^3	700 m^3
SRU	Caustic Soda (50% NaOH)	Neutralization	3.8 m^3	30 m^3
	MDEA (100%)	H_2S Absorbent	82 m^3	3 m^3
	Antifoam	Reduce foaming	0.5 m^3	0.4 m^3
Selexol Regeneration	Selexol (100%)	H_2S Absorbent	650 m^3	65 m^3
SWS	Caustic Soda (50% NaOH)	Neutralization		35 t

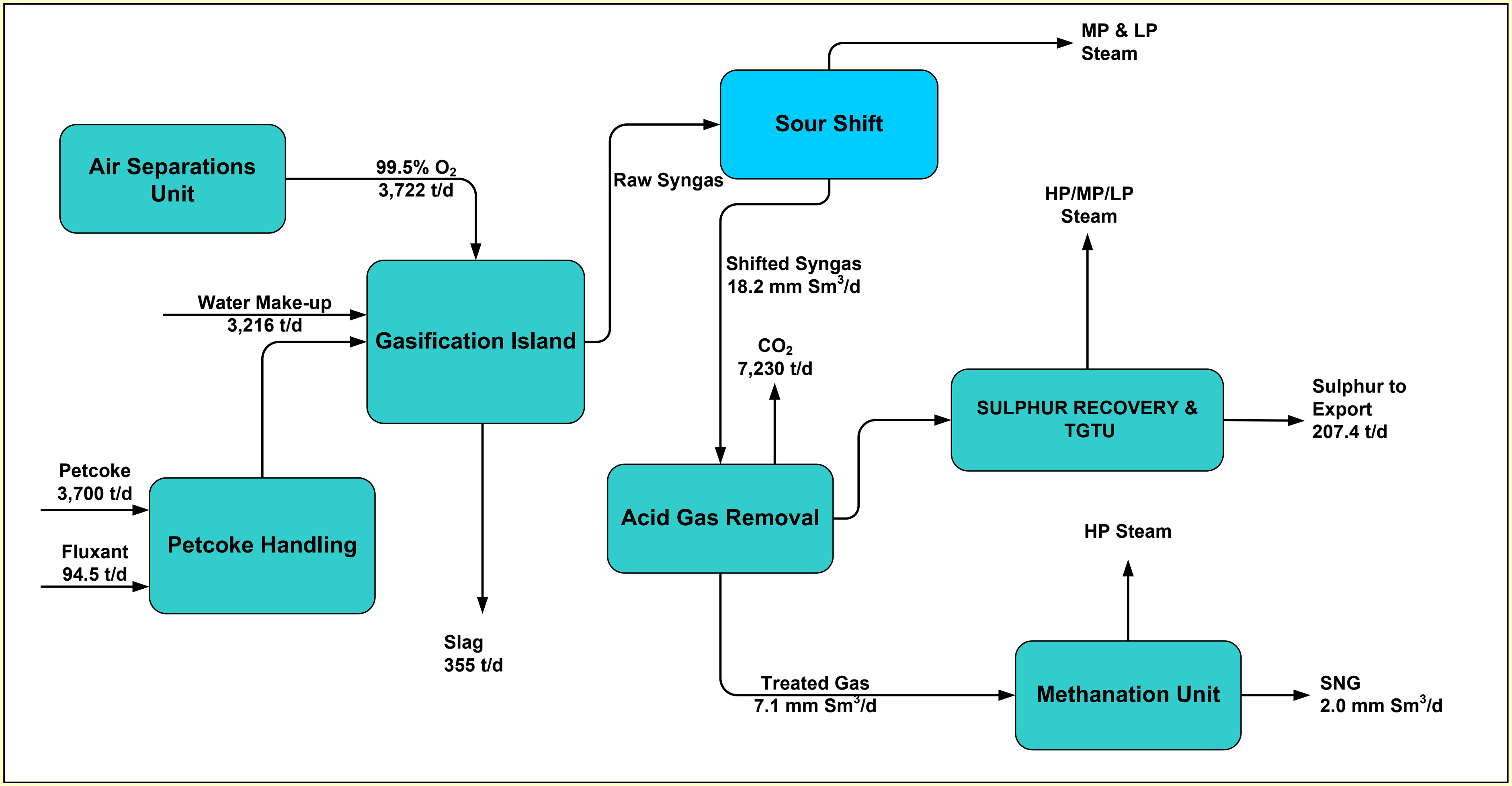
Table 5.2-8 Gasification 2 Chemical Consumption Estimate

Unit	Chemical	Purpose	Initial Charge	Annual Consumption
Coke Handling& Slurry Preparation	Flux	Corrosion Inhibitor	3,000 t	35,040 t
	Slurry Additive	Neutralization	15 m^3	700 m^3
SRU	Caustic Soda (50% NaOH)	Neutralization	3.8 m^3	30 m^3
	MDEA (100%)	H_2S Absorbent	82 m^3	3 m^3
	Antifoam	Reduce foaming	0.5 m^3	0.4 m^3
Selexol Regeneration	Selexol (100%)	H_2S Absorbent	650 m^3	65 m^3
SWS	Caustic Soda (50% NaOH)	Neutralization		35 t



Gasification 1 – Maximum H_2 - Overall Material Balance

Approved: DR	Revision Date: Dec 5/07	
File: Figure 5.2-1 Gasification 1 Overall Material Balance.doc		
Drawn by: BF	Checked: BE	Fig. No.: **5.2-1**



Gasification 2 – Maximum SNG - Overall Material Balance

NORTH AMERICAN OIL SANDS CORPORATION

Approved: DR	Revision Date: Dec 5/07	
File: Figure 5.2-2 Gasification 2 Overall Material Balance.doc		
Drawn by: BF	Checked: BE	Fig. No.: **5.2-2**

5.3 Water Balance

The Project water requirements are separated into water consumption associated with upgrading processes, evaporative cooling, gasification 1, and gasification 2.

Figures 5.3-1 and 5.3-2 summarize the annual average daily water balance for Phase 1 and the Project, respectively. The water balances will vary depending on the season, largely due to fluctuations in cooling tower evaporation. Table 5.3-1 summarizes the anticipated water use for Phase 1 and the Project, based on the annual average daily, and peak cooling season (average annual summer day) water balances.

Table 5.3-1 River Water Withdrawals

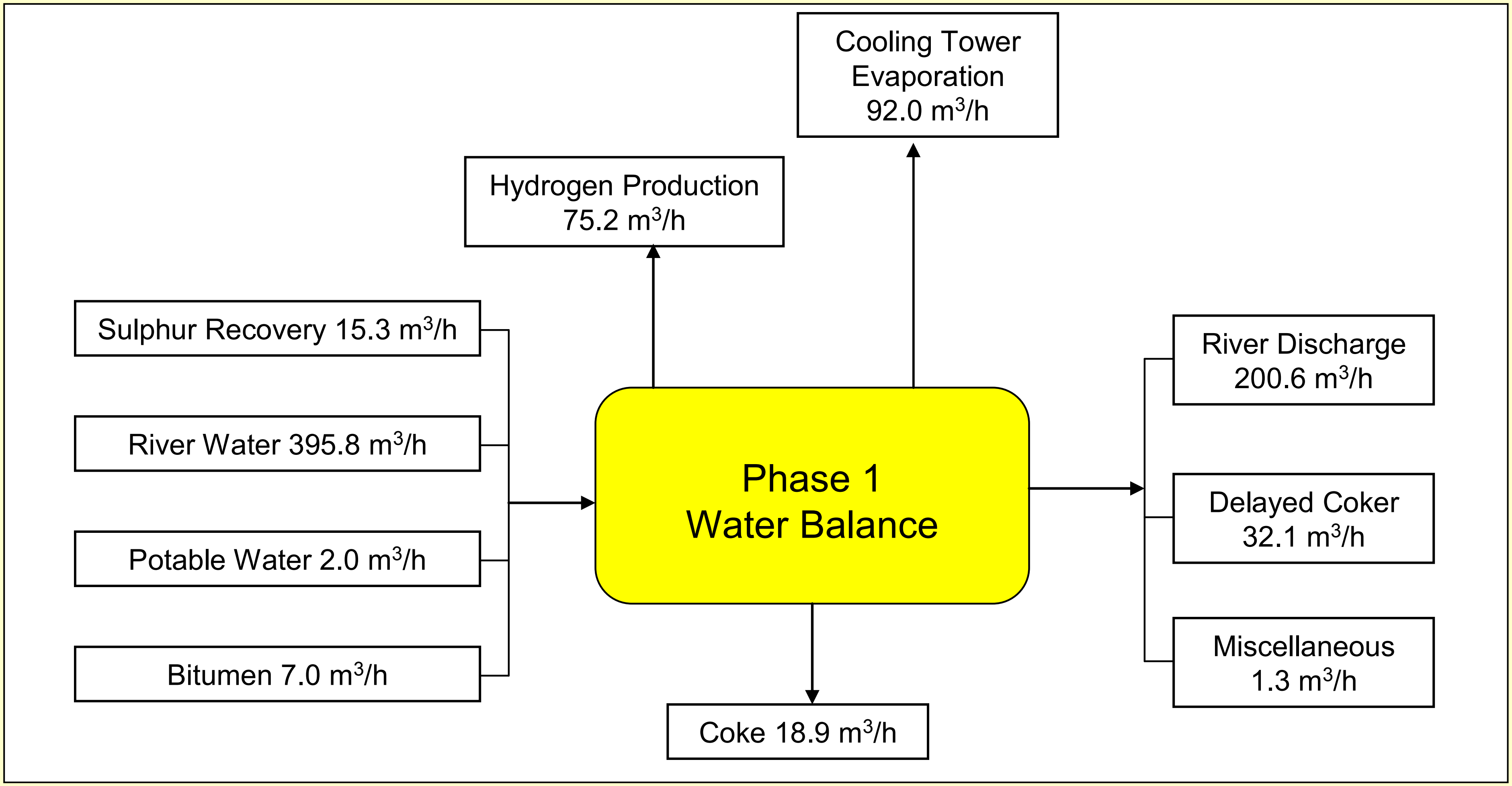
	Phase 1		The Project	
Project Phase	**AAD (m^3/h)**	**ASD (m^3/h)**	**AAD (m^3/h)**	**ASD (m^3/h)**
River Withdrawal	395.8	507.7	1,645.8	2,592.9
Upgrader Process	103.2	103.2	335.6	335.7
Cooling Water Make-up	92.0	181.5	981.5	1,919.0
Gasification 1	0.0	0.0	234.5	234.5
Gasification 2	0.0	0.0	94.2	94.2
River Discharge	200.6	223.0	0.0	0.0
Consumption	195.2	284.7	1,645.8	2,592.9

Notes:

AAD: Annual Average Day

ASD: Average Summer Day

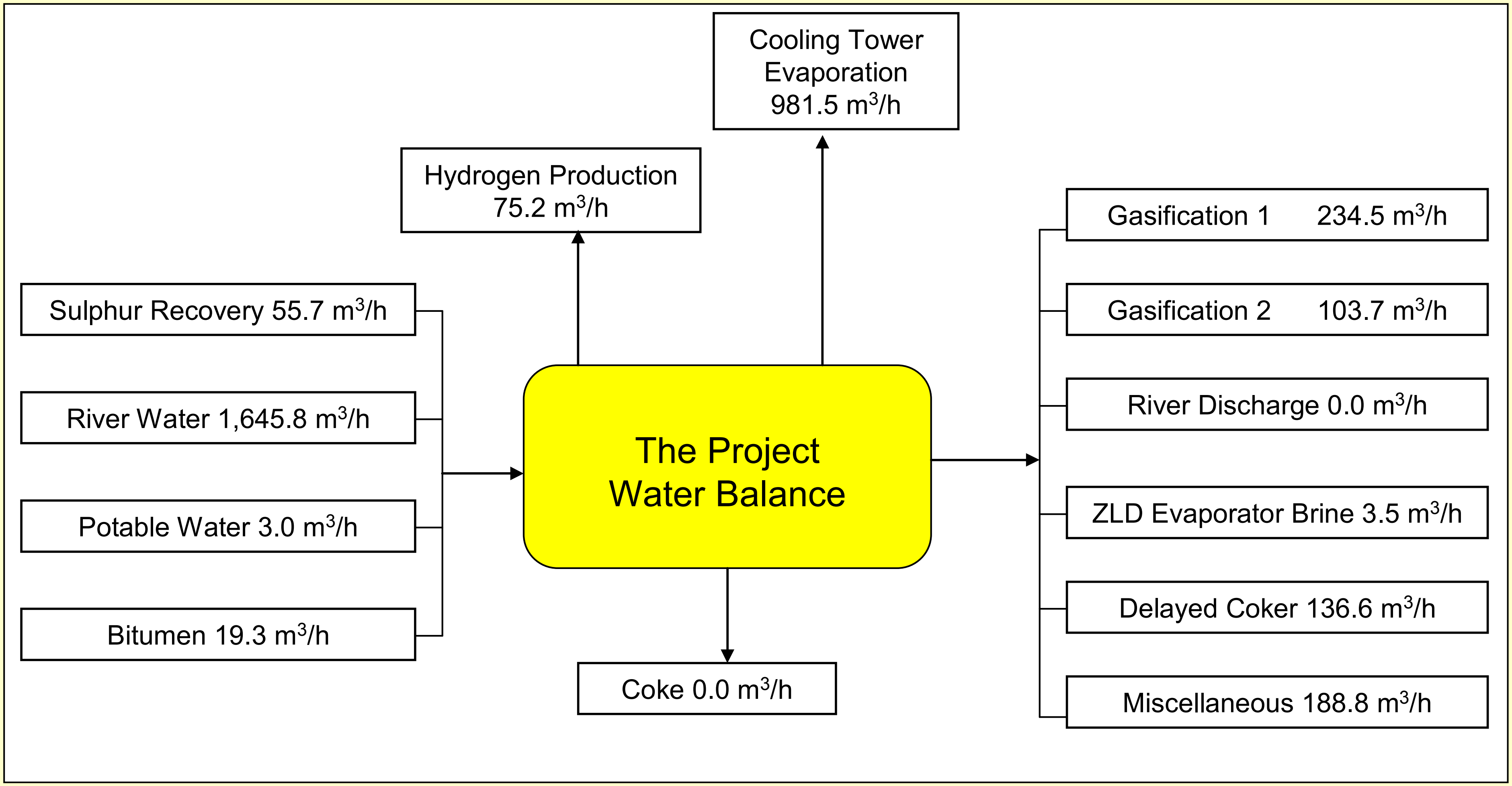
Water consumption intensity for North American's Upgrader is similar to other planned upgraders without a second stage of gasification. Water consumption at the Upgrader will increase when the gasification stages are added and become operational. North American's plans for gasification will proceed in stages when this step is economically justified, taking into account the costs of increased water use, the availability and price of natural gas, the availability to accommodate CO_2 that is captured, and applicable charges on carbon that is not recovered. Gasification to produce hydrogen and fuel is a sound option if there are shortages of natural gas, and there is adequate infrastructure and storage capabilities to accommodate the CO_2 produced from gasification; and accordingly represents a sound use of water.



Average Annual Day Water Balance for Phase 1

NORTH AMERICAN OIL SANDS CORPORATION

Approved: DM	Revision Date: Dec 5/07	
File: Figure 5.3-1 Average Daily Water Balance for Phase 1.doc		
Drawn by: BF	Checked: BE	Fig. No.: **5.3-1**



Average Annual Day Water Balance for the Project

North American Oil Sands Corporation

Approved: DM	Revision Date: Dec 5/07	
File: Figure 5.3-2 Average Daily Water Balance for The Project.doc		
Drawn by: BF	Checked: BE	Fig. No.: **5.3-2**

6 ENVIRONMENTAL MANAGEMENT

6.1 Corporate Philosophy

6.1.1 HSE Management System

North American is implementing a comprehensive Health, Safety and Environment Management System (HSE MS) for the Project. The HSE MS is an integral part of the StatoilHydro total management system. The HSE MS will also reflect North American's commitment to minimize the health, safety and environmental impacts associated with the Project.

Programs developed within the HSE MS will be designed in accordance with StatoilHydro's principles and requirements for HSE. More specifically, the HSE MS will focus on the Project's compliance with government legislation, verification that required approvals are in place, HSE protection plans are implemented and that there is appropriate training for employees and contractors.

6.1.2 Emergency Response Management

The North American Corporate Emergency Response Plan has been developed to facilitate an effective response by North American operations, management and support personnel in the event of an emergency occurrence. To ensure a state of emergency preparedness throughout the company, North American has developed the Corporate Emergency Response Plan to protect the public, employees, contract employees, property and the environment.

With development of the Corporate Emergency Response Plan, North American is prepared to:

- Minimize danger to the public, employees, contractors and environment;
- Provide appropriate responses to, and handling of, emergency occurrences;
- Establish and maintain effective communications with all parties in an emergency; and
- Make maximum use of the combined resources of North American, government agencies and other non-company services.

A site specific emergency response plan will be developed to address emergency preparedness and response needs for the Upgrader, including spills, releases, evacuation and fire protection. This plan will be developed in accordance with EUB Directive 071 (2003) requirements. Emergency preparedness planning will be done in conjunction with Northeast Region Community Awareness and Emergency Response (NR CAER) mutual aid initiatives.

6.1.2.1 Fire Protection Plan

The plan for the prevention and reduction of fire hazards associated with the Upgrader considers fire protection measures beginning with the conceptual planning through to detailed engineering design, including procurement, construction and start-up of operations. North American's fire protection priorities are:

- Protection of life – including responders, workers, employees, contractors and the public;
- Protection of the environment – including sensitive land and aquatic resources; and

- Protection of property – including private and public property, including drinking water and other amenities.

In order to determine the fire protection requirements for the Upgrader project, an in-depth fire safety assessment will be conducted during the early stages of planning and revised periodically throughout the Project. The fire safety assessment will evaluate fire risks and provide direction for fire protection and emergency response planning.

The emergency response planning will consider numerous factors including, but not limited to, the availability and location of emergency response personnel and their qualifications, evacuation routes, site plan, fire department access and site security. Relevant legislation includes the Alberta Building Code 2006, Alberta Fire Code 2006, and *Transportation of Dangerous Goods Act*.

Fire and Gas Detection

Compressor buildings and analyzer shelters will be fitted with H_2S, CO, and Lower Explosive Limit (LEL) detectors. H_2S and LEL detectors will also be installed next to pumps to detect any gas leakage from the pump seal.

Ionization smoke detectors will be used to detect fire in cable pits, electrical switchgear rooms, computer rooms, control buildings, offices, workshops and other locations required by the National Fire Protection Association (NFPA). Fixed temperature automatic pilot sprinklers will be used to activate automatic water spray systems in required areas.

Combination ultraviolet/infrared flame detectors will be provided to detect fires in areas such as compressors and truck loading racks.

Building Protection

All buildings will have fire detection and suppression systems to meet federal, provincial and municipal standards. Adequate exits will be provided for personnel to egress the building during and emergency.

Fireproofing

The unit and area fire zone classification consistent with industry norms, codes and standards will determine the coverage and type of fireproofing required for vessels, piping, instrumentation and other process equipment.

6.2 Air Emission Management

The Upgrader design is focused on limiting atmospheric releases. An air monitoring program will be developed and implemented to meet government requirements. Working with the Fort Air Partnership (FAP), North American is committed to participating in appropriate air monitoring in the Bruderheim area.

The AIH region is a focus area for the Alberta government regarding air emissions. Caps on both SO_2 and NO_x emissions are being considered. North American is cognizant of these intentions, and is planning to use the Best Available Technology Economically Achievable (BATEA) to reduce emissions.

6.2.1 Basis for Emissions Estimate

Estimates of the Upgrader air emissions from the Project process units are provided in Volume 2, Section 2 - Air. Emissions were estimated for the following sources: conventional stacks, flare stacks, storage tanks, process areas and cooling towers. Conventional stacks will be the main sources of emissions from the Project. Flaring emissions will be infrequent, as they occur due to plant maintenance or emergency operations. There will be fugitive emissions from storage tanks and process areas and they will be comparatively small in volume.

6.2.2 Construction Emission Control

As part of the air emissions management plan, a number of measures will be implemented during the construction period. Vegetation that is cleared will be mulched rather than burned to reduce smoke emissions. Wet suppression will be used to reduce the potential for wind-blown dust under dry, windy conditions. Temporary access routes and parking lots within the site will be constructed to reduce emissions. Fugitive dust emissions will be further reduced by chemical stabilization for relatively long-term unpaved roads or parking lots. The early paving of permanent access roads will also reduce fugitive dust emissions. Bus transport for most workers will be used to reduce emissions associated with the use of individual vehicles to reduce commuting emissions. A no-idling policy will be implemented to control vehicle emissions.

6.2.3 Operations Emission Control

The FEED stage of the Upgrader focused on utilizing energy efficient steps at all stages wherever practical. Continuing engineering studies are being undertaken to identify further reductions in energy consumption that can be implemented as the Project moves forward. As the plant commences operations, continuous improvements should also assist in reducing energy consumption. These improvements in energy efficiency should help reduce air emissions.

A number of mitigation measures will be implemented to control emissions to the atmosphere during operations. The SRUs for the Project are designed for a sulphur recovery efficiency of 99.9% with an expected annual average recovery of 99.8%, and a minimum average quarter-year sulphur recovery of 99.5%. The heaters and furnaces will be fired with low sulphur plant fuel gas.

The furnaces and combustion turbine units will be designed to surpass CCME guidelines for NO_x and CO emissions. The Project will use ultra-low NO_x burners to reduce flue gas NO_x emissions, where technically feasible. Proven technology will be used to reduce toxic emissions (e.g., H_2S) of relevant tanks within the tank farm. A Leak Detection and Repair (LDAR) program will be implemented to identify and reduce fugitive emissions.

An operating plan will be developed to manage and control the duration and frequency of major upset flaring events. This plan will be prepared after commissioning to reflect actual operating conditions.

6.2.4 Greenhouse Gas Emissions Management

Greenhouse gas emissions are primarily a result of CO_2 emissions associated with the combustion of fossil fuels (i.e., natural gas and plant fuel gas). The Upgrader will consume energy to process and convert the bitumen into higher value premium products.

North American, as part of StatoilHydro, will be able to benefit from StatoilHydro's world leading experience in CO_2 capture and sequestration in Europe and elsewhere. StatoilHydro is planning and undertaking research initiatives to find new and better ways to reduce and recover CO_2 emissions. North American plans to incorporate StatoilHydro's findings into the Project where technically and economically feasible. North American is working on plans to develop viable solutions for CO_2 disposition, and is considering participation with others regarding the development of CO_2 transportation infrastructure in the vicinity of the Upgrader.

Table 6.2-1 provides an estimate of greenhouse gas emissions expected to occur from the operation of the Project, and estimated intensity of emissions per barrel of bitumen processed. As presented in Volume 2, Section 2 of this application, emissions from Phase 1 are similar to emissions from other upgraders that rely on delayed coking and produce a similar quality of SCO. Emissions from the Project are similar to other upgrading projects that plan to use gasification.

North American is examining the potential to recover CO_2 from the SMR hydrogen plant, such that it will be ready to recover CO_2 commencing with Phase 1. Preliminary estimates suggest that there is the potential to recover around 30% to 35% of the Phase 1 emissions from the hydrogen plant, and these estimates are being evaluated in more detailed engineering reviews of various hydrogen plant designs. North American is also undertaking further technology evaluations regarding CO_2 recovery for the subsequent phases of the Project. Actual recovery will be dependent on a suitable outlet for the CO_2, the existence of an appropriate fiscal and regulatory regime, and availability of adequate infrastructure to transport and store the CO_2.

As shown in Table 6.2-1, gasification of coke to produce hydrogen and SNG will generate significant CO_2 emissions. If these units are constructed, North American intends to be ready to recover a substantial portion of the resulting CO_2 produced. The gasification plans were developed to fit a business environment where natural gas is not available or is extremely expensive. Actual implementation of the gasification stages, though, will be dependent on it being the most viable option for addressing both CO_2 emissions and the need to find energy alternatives to natural gas. Ongoing research may lead to improved methods of dealing with emissions without gasification. If gasification is not implemented, the emission intensity from the Project would be slightly less than for Phase 1 based on using SMR units to produce hydrogen instead of gasification. There will be potential for CO_2 recovery from the sour shift reaction of the SMR units. If 70% of these CO_2 emissions were recovered, the total CO_2 emissions for the Project (excluding gasification) would be reduced (from 3.734 million t/y) by approximately 25%. If gasification is implemented as outlined in this application, it will be accompanied by development plans for CO_2 recovery, transportation, and storage/sequestration.

As North American proceeds with further engineering, it is planning to include a number of measures so as to have an energy efficient design, including:

- pre-heating of combustion air to increase combustion efficiency;
- extra insulation of pipelines and hot process vessels to further conserve energy;
- installation of thermally efficient heaters, furnaces and boilers; and
- implementing an LDAR program to control and reduce fugitive methane emissions.

Throughout the life of the Project, North American is committed to reducing greenhouse gas emissions. This will be an ongoing commitment to continuous improvement.

Greenhouse gas emissions at the Project site will also occur from construction activities, although small relative to emissions from operations. These emissions will be mainly from the operation of construction equipment and other vehicles, with smaller amounts caused by land use and land coverage changes. Off-site greenhouse gas emissions will be associated with the transportation of material to the site. Decommissioning activities will also create greenhouse gas emissions, and they are expected to be somewhat less than construction emissions.

Table 6.2-1 Estimate of Greenhouse Gas (GHG) Emissions by Project Phase

Project Phase	Base GHG Emissions [1] (million t/y)	Base GHG Intensity [2] (annual t/annual bbl)	Comments
Phase 1	1.389	0.0501	Phase 1 at 80,000 bpsd of bitumen. H_2 from SMR.
The Project	7.910 [3]	0.0939	The Project at 243,000 bpsd of bitumen. H_2 from Gasification 1 plus Phase 1 SMR online at 80% of design capacity. SNG from Gasification 2.

Notes:

1 GHG emissions refer to CO_2, based on 95% operating availability.

2 GHG intensity refers to tonnes of CO_2 emitted per barrel of bitumen processed.

3 GHG emissions without recovery of CO_2. If gasification is not implemented, GHG emissions would be reduced to 3.734 million t/y, reducing the intensity to 0.0443. If gasification is implemented, plans for CO_2 recovery will be developed.

6.2.5 Emission Monitoring, Control, and Reporting

The environmental approvals for such facilities as upgraders issued under EPEA require emission source and ambient air quality monitoring with associated reporting. The *Climate Change and Emissions Management Act* requires that GHG emissions be reported annually; the calculation can require monitoring or other indirect measures. The EUB will also require emission information relating to sulphur compounds to be reported. North American will also submit the required annual report to the federal government on estimated substance emissions to meet the *Canadian Environmental Protection Act* (CEPA) National Pollutant Release Inventory (NPRI). This annual report will also meet the CEPA requirement for greenhouse gas reporting.

6.2.5.1 Source Monitoring

The following emission source monitoring and ambient air quality monitoring will be undertaken.

- **SO_2/Total Reduced Sulphur (TRS) Source Monitoring -** Since the incinerator stacks represent the largest continuous SO_2 emission sources, continuous stack emission monitors will be used to measure key stack parameters. The monitoring will be undertaken in accordance with the Alberta continuous stack emission monitoring procedures. This will be complemented by two manual stack surveys per year, and these surveys will be carried out in accordance with the Alberta Stack Sampling Code. The TRS content of the incinerator flue gas will be determined as part of the manual stack surveys. The interval for this monitoring will be reviewed after the initial measurements have been obtained. The sulphur content of the plant fuel gas and the plant fuel gas consumption will be monitored to allow for the calculation of Project-wide SO_2 emissions from the other continuous combustion sources. A flare management plan will be developed to identify potential flaring scenarios based on refined engineering operations. SO_2 emissions from the flare stacks will be calculated daily. Representative gas stream compositions will be measured and used to estimate SO_2 emissions. Flaring events will be documented and reviewed on an ongoing basis to examine opportunities to reduce the frequency, duration and magnitude of flaring. The monitoring results will be reported in accordance with the terms and conditions identified in the AENV approval. In addition, the sulphur balance and sulphur recovery efficiencies will be reported to the EUB.

- **NO_x Source Monitoring** – Continuous stack emission monitors will be used to monitor NO_x on selected stacks, and manual stack surveys will be undertaken for other stacks. The SMR stack represents one of the larger continuous NO_x emission sources. The DRU heaters and the coker heater stacks are also large emission sources. One manual stack survey per year will be completed for these stacks, and the interval for continued monitoring will be reviewed after the first few surveys. The fuel use rate will be monitored to allow plant-wide NO_x emissions to be calculated for inventory reporting purposes. The results of the continuous monitoring and stack surveys will be reported in accordance with the terms and conditions identified in the AENV approval.

- **Other Source Monitoring/Reporting** – North American will implement an LDAR program, which is typically specified in the AENV approval. North American will measure trace volatile organic compound and polycyclic aromatic hydrocarbon emissions, and they will also be used to support the NPRI reporting needs. NPRI and the greenhouse gas reporting requirements will be met by a combination of monitoring or direct measurements, mass balance, process specific emission factors and engineering estimates.

- **Ambient Monitoring** – North American is a member of the NCIA which addresses air quality issues in the region. North American also participates in and supports the multi-stakeholder FAP in the ongoing and future regional air monitoring efforts.

6.3 Land Management

The land use planning framework includes the Strathcona and Lamont counties Municipal Development Plans, the Strathcona County Alberta's Industrial Heartland and Lamont County Complementary Area Structure Plan and the Strathcona and Lamont Counties Land Use Bylaws.

Environmental considerations in facility siting and design included:

- location in the AIH which provides land use compatibility, as well as potential for synergies and shared infrastructure and rights-of-way with nearby industries;

- minimizing surface disturbance in the AIH Agricultural Transition buffer zone;

- observation of required setbacks;

- avoidance of sensitive areas (including the wetlands located along the northeast edge of Section 35 in 56-21 W4M and sandy dune landscapes in the SE¼ of Section 2 in 56-21 W4M); and

- minimizing surface disturbance by making use of existing infrastructure, corridors and disturbed areas wherever possible.

Facility designs have been developed to avoid as much of the area covered by wetlands as practical.

To protect and enhance the North Wetland Complex the following will be completed:

- The administration building will be built directly south of these wetlands, providing a buffer from industrial processes.

- To maintain part of the natural drainage pattern, water from the two culverts located under the rail line on the south end of the site will be directed north along the east side ditch of Range Road 211 to the wetland.

A portion of the natural drainage may be captured by the stormwater ponds. To maintain natural water levels to support the wetland, the three stormwater ponds in the north and east may have managed releases to the North Wetland Complex, if the water meets regulatory requirements for release.

All runoff water will be contained on-site and directed to ponds via ditches and berms. The only drainage coming onto the property will be the drainage from two culverts located under the rail line on the south. This local upslope drainage will be directed north to maintain part of the natural drainage pattern into the North Wetland Complex.

Best management practices will be used to reduce erosion and provide runoff control during construction of the plant site, roads, drainage ditches and pipelines. These measures will include: appropriate planning, scheduling and layout of works, installing sediment/runoff retention structures such as silt fences and biotechnical erosion control measures; and maintaining buffers and minimizing disturbances. The plant area will be reclaimed by grading and re-vegetating to restore natural drainage patterns following decommissioning, as described in the Conservation and Reclamation (C&R) plan (Section 7).

The local impact of on site drainage will be a loss of the local pothole wetlands in the development area. Enhancement of the North Wetland Complex in SE 2-56-21 W4M is planned as the main area of focus to offset these losses. A reduction in runoff to the North Wetland Complex from the developed area will be offset by more efficiently directing the upslope drainage south of the Project area via road ditching to this area. In addition, monitoring of the water levels in the North Wetland Complex will assess when periodic releases from the stormwater ponds may be desirable to sustain and enhance this North Wetland Complex. Opportunities for further enhancement may involve establishing greater riparian vegetation buffers and enhancing the wetlands in the northern quarter.

The Project will potentially affect vegetation community abundance and diversity as some parts of the footprint fall on areas of native vegetation. Following closure and reclamation, the total area of natural or semi-natural terrestrial vegetation will be reduced in area by 1.6 ha.

The Project C&R plan provides for reclamation to land capability equivalent to pre-disturbance conditions. Areas currently under cultivation will be reclaimed to a condition that will allow them to support similar agricultural land uses.

Siltation fencing will be placed between areas with high erosion potential and wetland or drainage channels. Strategic placement of culverts and diversion channels in operational schemes are other mitigation options to minimize impacts of possible flooding or impounding.

A vegetation control program will be developed and implemented to prevent the introduction or spread of weeds during construction. Details of the program are outlined in the C&R plan in Section 7. Requirements of the program include the following:

- construction equipment will arrive clean;
- where required for erosion control, only weed-free straw bales will be used;
- weed infestations will be controlled; and

- weeds that have been removed will not be deposited in a place where they might grow and spread.

Individual facilities for the Project will be decommissioned and reclaimed when it is determined a particular facility will not be needed in future. At the end of the Project, all Project facilities will be decommissioned. Six months prior to the plant ceasing operation, a decommissioning and final land reclamation plan will be submitted to AENV, which will contain reclamation and closure details as specified by the AENV Approval. Contamination will be managed in accordance with the AENV Approval, which outlines the Soil Monitoring and Soil Management Program requirements.

Prior to the removal of any facilities, additional site assessments will be conducted to further delineate any contamination remaining on the Project site and any affected lands. Removal of facilities will occur in a manner that prevents release of contaminants. A plan for remediation of any contamination will be completed in accordance with AENV requirements. Confirmatory sampling will be carried out to indicate compliance with the remediation objectives of the day.

When reclamation is complete, an assessment will be carried out to demonstrate that the reclamation guidelines of the day, demonstrating achievement of equivalent capability, have been met.

6.4 Water Management Plan

Water management requires that the supply of process water matches the development plans for the Upgrader, as described in Section 4 of this volume. In addition, water management requires that efforts be made to manage the resource in such a way as to minimize potential impacts to the environment. Water reuse and recycling for the Upgrader will be implemented using a phased approach, including the introduction of ZLD on targeted waste streams after Phase 1. Complete ZLD will be incorporated for the Project. North American will continue to explore technologies to further improve water use efficiency.

6.4.1 Water Requirements

The Project requires a reliable water supply to meet the process and utility water demands. Water will be required for:

- cooling tower make-up;
- boiler feed water makeup;
- hydrogen production;
- gasification;
- utility water; and
- fire water.

The raw water source for the Project is the North Saskatchewan River. A diversion permit application under the *Water Act* is included in Appendix C. Average annual day river water demand for the Project is 1,646 m^3/h, and the Phase 1 river water demand is 396 m^3/h. Both of these river withdrawal values include a 15% contingency factor. A river intake structure and pumphouse will be constructed, with a transfer pipeline to the Upgrader site. The intake structure will be designed using modules to enable ease of construction, expansion and to minimize disruption of the river.

North American is also evaluating alternative water supplies, and is participating in an NCIA committee regarding regional water issues. North American is supporting the following:

- a study by Strathcona and Sturgeon Counties for a regional industrial water and wastewater system, and
- participation with AENV and other stakeholders to investigate alternate water sources, including treated effluent from the City of Edmonton Gold Bar Wastewater Treatment Plant for reuse by upgraders located in the AIH.

During the initial construction period, North American will use a variety of water sources. Initial construction will utilize stormwater collected from the site and excavation dewatering. Water requirements that exceed the capacity of these supplies will be obtained from the potable water supply. Water during construction will be required for the concrete batch plant as well as for dust suppression and soil compaction. Following Phase 1 start-up, subsequent construction water will be provided by the utility water system.

6.4.2 Wastewater Treatment

A treatment facility will be provided on-site to treat the following major wastewater streams prior to reuse and/or discharge to the North Saskatchewan River:

- cooling tower blowdown;
- boiler blowdown;
- desalter wash water;
- excess stripped sour water;
- gasification wastewater;
- ultrafiltration backwash;
- reverse osmosis reject;
- ion exchange regeneration waste;
- miscellaneous process waste streams;
- clean stormwater;
- potentially contaminated stormwater;
- contaminated stormwater; and
- sanitary waste.

6.4.2.1 Wastewater Segregation

The Upgrader wastewater streams have varying degrees of water quality. Impurities include dissolved solids, oil and grease, biodegradable organics, nitrogen, phosphorus, sulphide, cyanides, and phenols. To optimize the wastewater treatment facilities, the wastewater streams are segregated into organic and TDS streams. The organic wastewater streams typically contain oil and grease and other biodegradable contaminants; they will be treated separately from the high TDS wastewater streams. Water reuse and recycling for the Upgrader will be implemented using a phased approach, with the introduction of ZLD treatment on targeted waste streams after Phase 1. For Phase 1, excess treated wastewater streams will be directed to the effluent pond, for temporary storage prior to discharge to the North Saskatchewan River. ZLD treatment of all wastewater streams will incorporated into the Project when Gasification 2 is completed, which will eliminate effluent discharges to the North Saskatchewan River.

6.4.2.2 Wastewater Discharge

Table 4.3-2 provides a summary of the wastewater streams from the Project. This includes all data for the Project, including the case of the Project excluding Gasification 2, which incorporates ZLD treatment of the reverse osmosis reject and ion exchange regeneration waste streams. Once ZLD is implemented for Gasification 2, there will be no wastewater streams discharged to the North Saskatchewan River.

Treated wastewater will be discharged from the effluent pond to a diffuser in the North Saskatchewan River via a new discharge pipeline. The submerged diffuser will provide efficient mixing of the effluent in the river channel. The construction of the in-channel diffuser will require the use of a temporary coffer dam and will be dealt with under a separate regulatory application. The completed outfall diffuser will not result in permanent alterations or diversions to the river.

The effluent pond will have short-term capacity to retain effluent in the event that it does not meet effluent discharge criteria. In the event of contamination, the effluent will be recycled to the WWTU for additional treatment. The discharge from the effluent pond will be monitored for temperature, pH, flow rate and other parameters as specified in the AENV approval. A composite sampler will be used for daily analysis of the river discharge.

6.4.3 Stormwater Control and Treatment

Stormwater will be collected and retained on-site through a network of drains, sewers, ditches and ponds. Figure 4.3-1 shows the conceptual drainage plan for the Project. There are no watercourse diversions on the site associated with the Upgrader. Local drainage south of the CN rail line will be directed to ditches along Range Road 211, to maintain water flow to existing wetlands on the north portion of the Project site (SE 2-56-21 W4M).

Grading, berms and ditches will be used to prevent stormwater runoff from leaving the site by overland flow. The ponds used to temporarily store stormwater collected from the developed areas of the Project site will be lined to prevent accidental contamination to underlying groundwater. In addition, the process areas will be surfaced with concrete/asphalt and the stormwater collected will be diverted to a sewer system connected to a lined pond. Accidental spills on the site, both within and outside the process areas, will be subject to environmental procedures requiring prompt containment and clean-up.

Stormwater collected on the Project site is categorized as either potentially contaminated stormwater or oily stormwater. The potentially contaminated stormwater, if clean, can be used as a supplemental raw water source, diverted to wetlands, or discharged to the North Saskatchewan River.

All stormwater ponds that collect stormwater runoff from the developed areas of the site will be lined. Any pond bottoms extending below the high groundwater table level will have groundwater suppression systems that will discharge to the potentially contaminated stormwater pond.

Stormwater runoff collected within the coke handling and storage area will be contained and recycled for either coke wetting or coke cutting. Excess stormwater from the coke handling and storage area will only be released to the oily stormwater collection system under severe stormwater conditions that exceed the capacity of the area sump.

6.4.4 Water Reuse and Conservation

North American's water use plan will involve significant investment in water reuse technologies and strategies as the Upgrader expands beyond Phase 1, such as phased ZLD treatment of targeted waste streams and reducing the use of evaporative cooling. The Project incorporates a philosophy of water recycle and reuse to ultimately reclaim 100% of the wastewater that would otherwise be discharged to the North Saskatchewan River.

Water reuse and recycling for the Project will be implemented using a phased approach. In addition to the phased implementation of ZLD treatment of targeted waste streams after Phase 1, additional water treatment and conservation methods will be employed for the Project. These include: stripped sour water recycle, stormwater recycle, ultrafiltration backwash reuse, BIOX effluent reuse, and biosolids dewatering filtrate reuse. Stripped sour water recycle, stormwater recycle, and ultrafiltration backwash reuse will be implemented for Phase 1. North American will continue to explore technologies to further improve water use efficiency.

6.5 Waste Management

Waste management systems followed at the Project site will comply with provincial legislation, including EUB Directive 058 (Oilfield Waste Management Requirements for the Upstream Petroleum Industry; EUB, 1996) and EUB Directive 055 (Storage Requirements for the Upstream Petroleum Industry; EUB, 1995), as well as corporate requirements. These systems will:

- provide for the safe storage and handling of wastes;
- dispose of waste in a timely manner and meets industrial hygiene and personnel safety considerations; and
- provide for appropriate transportation and disposal of waste materials.

6.5.1 Waste Collection and Storage

Wastes from construction and site operations (warehouses, vehicles, shop areas, office areas) will be characterized according to the Alberta User Guide for Waste Managers (AEP, 1996a). Wastes will be segregated into hazardous wastes, recyclable materials and non-hazardous materials. Each type of waste will be managed, treated and disposed of appropriately.

Collection and storage bins will be placed in convenient, low traffic areas away from processing areas. These bins will be clearly marked and labelled to encourage proper collection, sorting and disposal. Good housekeeping practices will be followed to reduce risks to employees.

6.5.1.1 Storage Site for Hazardous Wastes and Hazardous Recyclables

The AENV storage requirements for hazardous materials will be followed as outlined in the Waste Control Regulation and the Storing Hazardous Waste and Recyclables (AENV, 2004). Features of the hazardous materials storage area will be:

- security to prevent entry by unauthorized persons;
- volumes limited as to not cause an adverse effect to personnel or the environment;
- signage as a hazardous waste/recyclables storage area;
- suitable equipment to handle emergency situations;
- assigned trained personnel that are responsible for the site and to respond to emergency situations specific to the hazardous waste/recyclables stored; and
- appropriate storage containers available.

6.5.1.2 Waste Tracking

The site wastes and recyclables will be tracked following the AENV Waste Control Regulation. The following criteria will be used in preparing waste documentation:

- characteristics and classification of waste or recyclable material;
- quantities of waste or recyclable material;
- location of generation and collection;
- storage requirements;
- disposal frequencies and requirements;
- manifesting and tracking requirements;
- approved transporters;
- approved disposal and/or treatment facilities; and
- disposal costs.

6.5.2 Waste Disposition

Table 6.5-1 shows the disposition of potential wastes generated and exiting the Upgrader site.

Table 6.5-1 Waste Storage and Disposal

Waste	Storage	Disposal Method
Spent amine	Spent amine tank	Returned to supplier for recycle
Carbon filters	Filter housings	Returned to supplier for regeneration
Cartridge filters	Local collection containers	Sent to approved disposal facility
Spent catalyst	Spent catalyst storage bin	Returned to vendor or sent to approved disposal facility
Construction material	Local collection drums	Recycled or sent to municipal landfill
Cooling water tower sludge	Removed during maintenance	Sent to approved disposal facility
Domestic garbage	Local collection containers	Sent to municipal landfill or recycled if aluminum, plastic or glass
Laboratory waste	Local collection containers	Sent to approved disposal facility
Lubrication oil (pumps, compressors)	Local collection drums	Recycled via contractor
Other chemicals	Local collection containers	Sent to approved disposal facility
Used chemical drums and totes	Designated storage area	Returned to supplier or recycle facility
Pond bottom sludge	Removed during pond service	Sent to municipal landfill or third party wastewater treatment plant
Sanitary sewage	Sanitary sewage treatment unit	Processed water to wastewater treatment unit, sludge sent to approved treatment and disposal facility
Spill debris	Local collection container	Sent to approved disposal facility

6.6 Follow-up and Monitoring

Follow-up and monitoring activities are described in Volumes 2 through 5. Additional environmental monitoring will be conducted as specified in the AENV approvals.

6.7 Adaptive Management Considerations

North American is committed to using best available technology economically achievable. Throughout the Project, new technologies will be assessed and implemented as appropriate. The staged development described in this application will allow for future modifications required by changes in emission standards, limits and guidelines. North American will use StatoilHydro's structured quality assurance system, which provides project and change management processes to provide optimal decision-making.

7 CONSERVATION AND RECLAMATION PLAN

7.1 Introduction

Section 4.8 of the TOR requires provision of a C&R plan for the Project and specifies additional items that must be addressed.

The C&R plan describes the specific conservation, mitigation and reclamation measures to be implemented throughout the development of the Project. These measures will minimize the potential environmental impacts identified in the EIA and achieve equivalent land capability after reclamation. The C&R plan focuses on land and soil conservation, surface disturbance, and reclamation concepts, as well as reclamation options, throughout the lifespan of the Project. C&R measures are presented for Project design (facility siting), construction, operation and final reclamation/closure phases of the Project and will be implemented throughout all these phases.

Information sources consulted and considered in the C&R plan design include:

- Project TOR;
- Project design;
- Regional initiatives including Strathcona County's Industrial Heartland Area Structure Plan (Strathcona County, 2001a), Strathcona County's Strategic Plan (Strathcona County, 2006), Strathcona County's Municipal Development Plan Bylaw 38-98 (Strathcona County, 1998), and associated zoning maps;
- Pre-existing biophysical information for the area;
- Biophysical information (including soils, terrain, vegetation, and wildlife) collected for the Local Study Area, and interpretations for potential impacts and mitigative measures;
- Other upgrader EIAs and their C&R plans (Petro-Canada Oil Sands Inc., 2006; Shell Canada Limited, 2005 and 2007; Synenco Energy Inc., 2006; North West Upgrading Inc., 2006; BA Energy, 2004), and an existing Upgrader Approval for Shell Scotford (AENV, 2005);
- Published oil and gas facility reclamation documentation; and
- Professional reclamation experience.

7.2 Project Overview

7.2.1 Local Study Area and Project Footprint

The C&R Local Study Area (LSA) is located in portions of Sections 26, 27, 35, & 36 in Township 55 Range 21 W4M and Section 2 in Township 56 Range 21 W4M, and covers approximately 562 ha. Portions of the LSA will not be disturbed, including areas of wetlands and existing roads. The LSA also includes lands occupied by Providence Grain and a CN rail line. The Project footprint area, where new disturbance and soil salvaging will occur, includes approximately 485 ha of previously undisturbed lands within the LSA (Figure 3.1-1).

Project facilities will include the Upgrader process operations, and administration building and parking, several engineered ponds, a water treatment facility, various storage tanks, etc. The C&R plan for the proposed water intake and pipeline is not part of this plan, and will be submitted under separate cover. During construction, there will be a laydown area.

7.2.2 Development and Reclamation Phasing

The Upgrader will be developed in stages. Contingent upon regulatory approval and market conditions, construction of Phase 1, with a capacity of 80,000 bpsd of bitumen feed, is anticipated to begin in 2010. The full Project buildout will bring the capacity to 243,000 bpsd. With proper maintenance and systematic replacement of equipment that has reached the end of its operating life, the Upgrader may remain in operation for over 50 years.

At the end of the Project life, facilities will be decommissioned, final remediation carried out if necessary and the site reclaimed.

Partial or interim reclamation before final plant decommissioning will be undertaken where possible, including but not restricted to:

- landscaped areas; and
- conservation of salvaged soil stockpiles.

Reclamation monitoring will commence after reclamation of the site. Further reclamation measures as needed will be on-going until the reclamation criteria of the day are met.

7.3 Reclamation Planning Concepts

7.3.1 Conservation and Reclamation Plan Objectives

The C&R plan provides a general guideline for reclamation throughout the Project life. The objective of reclamation defined by the Conservation and Reclamation Regulation under EPEA is to return areas disturbed for industrial development to equivalent land capability. This means that the ability of the land to support various land uses after conservation and reclamation should be similar to the ability that existed prior to disturbance; however, the end land use for a specific site will not necessarily be identical to what existed before.

In a general sense, objectives of C&R planning to achieve the desired environmental outcome include:

- conserving existing resources as much as possible;
- adopting measures to mitigate, minimize or prevent environmental impact; and
- undertaking appropriate reclamation or other ameliorative measures.

Reclamation objectives include the following:

- reclaiming the Project area to provide equivalent to pre-disturbance land capability; and
- ensuring that reclaimed areas will be compatible with the surrounding area and land use.

7.3.2 Reclamation Guidelines

Current applicable regulatory reclamation related guidelines for the Project include, but are not limited to, those listed in Table 7.3-1.

Table 7.3-1 Applicable Reclamation Guideline Documents

Guideline for Monitoring and Management of Soil Contamination Under EPEA Approvals	AENV, 1996
Reclamation Certificates for Overlapping Activities (C&R/IL/97-6)	AENV, 1997
Voluntary Shut Down Criteria for Construction Activity or Operations (C&R/IL 98-4)	AENV, 1998
Applications for Sour Gas Processing Plants and Heavy Oil Processing Plants – A Guide to Content	AENV, 1999
Borrow Excavations (C&R/IL/00-3)	AENV, 2000a
Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body	AENV, 2000b
Code of Practice for Watercourse Crossings	AENV, 2000c
Environmental Protection Guidelines for Roadways	AENV, 2000d
Environmental Protection Guidelines for Oil Production-sites – Revised January 2002 (C&R/IL/02-1)	AENV, 2002
Weeds on Industrial Development Sties (R&R/03-4)	AENV, 2003
Guide for Pipelines Pursuant to the Environmental Protection and Enhancement Act and Regulations	AEP, 1994
Environmental Protection Guidelines for Electric Transmission Lines (C&R/IL/95-2)	AEP, 1995a
Reclamation Criteria for Wellsites and Associated Facilities – 1995 Update (C&R/IL/95-3)	AEP, 1995b
EPEA Conservation and Reclamation Regulation (AR 115/93, as amended)	AEP, 1996b
Land Suitability Rating System for Agricultural Crops: 1. Spring-seeded small grains.	AIWG, 1995
Storage Requirements for the Upstream Petroleum Industry (Directive 055)	EUB, 1995
Oilfield Waste Management Requirements for the Upstream Petroleum Industry (Directive 058)	EUB, 1996

7.4 Existing Conditions

7.4.1 Current Land Use

The dominant land use in the LSA is agriculture with some industrial land use, mainly oil and gas well sites and access roads. The majority of the agricultural area is under cultivation. A southwest-northeast CN rail line cuts through the south end of the LSA, and a CPR rail line runs north-south along the eastern edge of the easternmost portion of the LSA. A northwest-southeast ATCO Gas pipeline cuts through SW 35-55-21 W4M and NW 26-55-21 W4M. Township Road 560 and Range Roads 211 and 212 are present in the LSA.

Most of the LSA is within the Strathcona Heavy Industrial Policy Area, with two exceptions:

- Section 36-55-21 W4M is located within the Agricultural Transition Area (Strathcona County, 1998). This area will contain the laydown area and two water retention ponds; and

- the part of NW 26-55-21 W4M south of the tracks is located within the Agricultural Transition Area but is not slated for development.

Portions of the LSA have undergone some previous disturbances, including county roads, rail lines, active oil and gas well sites and access roads and habitations. The area of disturbed land is approximately 19 ha (3.4%).

The surrounding area has a mix of land uses, including industrial and agricultural. Numerous energy and chemical industrial sites are present west of the site and further southwest in Fort Saskatchewan. In the surrounding area, there are several officially designated natural areas; these areas are Provincial Crown land, protected and administered by the Government of Alberta. These natural areas include the Astotin Natural Area, the Northwest of Bruderheim Natural Area and the North Bruderheim Natural Area. These natural areas contain dune sands and organic soils and provide habitat for a variety of wildlife, and recreational opportunities. Astotin Creek is also an environmentally significant area (Strathcona County, 2001b).

7.4.2 Soils and Terrain

The topography of the LSA is fairly uniform with undulating surface expression. Slopes are 2% to 10% with the exception of the dunes located in the northernmost quarter section (SE 2-56-21 W4M) of the LSA. Slopes of the dunes ranged from 5% to 15%.

There are some low-lying areas and permanent wetlands within the LSA. There is a north-south draw in the eastern half of Section 35-55-21 W4M draining into the wetland along the northeastern edge of Section 35.

A variety of soils and surficial material deposits were encountered in the LSA. The soils in the LSA are dominantly Black Chernozems developed on glaciolacustrine deposits with gleyed subgroups common. Black Chernozems also occur on till, with Orthic subgroups dominant; these soils are more prevalent in the higher or better drained areas. More coarsely textured Black Chernozems on fluvioeolian and glaciofluvial deposits occur in SE 2-56-21 W4M and NE 35-55-21 W4M. This area is part of a larger southwest-northeast trending area of sandy soils located northwest of the LSA and paralleling the North Saskatchewan River. Gleysolic soils occur in the wetter low areas scattered throughout the LSA.

The dominant topsoil texture in the glaciolacustrine and till soils is loam. The subsoil textures of the glaciolacustrine soils tend to have higher clay content than the till soils. The dominant topsoil and subsoil textures in the glaciofluvial soils and fluvioeloian soils are much coarser than the glaciolacustrine and till soils. Glaciofluvial soils with textures ranging from sandy loam to loamy sand for the topsoil and subsoil layers tend to be slightly less coarse than the fluvioeolian soils, which have loamy sand topsoils over loamy sand to sand subsoils.

All soils found in the LSA were non-saline and non-sodic, with the exception of the small Peace Hills gleyed variant (PHSglxc) unit (6 ha) in NE 35-55-21 W4M. The PHSglxc map unit had slightly elevated electrical conductivity (EC) values in the topsoil and subsoil. EC values in the topsoil are rated fair (2.74 dS/m) with subsoil ratings of poor to fair (6.20 dS/m and 4.99 dS/m) according to AENV guidelines (AENV, 2001c).

Soils in the LSA are dominantly moderately well to well drained and occur on mid to upper slopes. Imperfectly drained soils, found on depressional to mid slope positions, and poorly drained soils in depressional to lower slope positions are also common. Rapidly drained soils are found on coarser textured soils on mid to upper slope positions.

Additional information on baseline terrain, soils and vegetation conditions can be found in Volume 4, Sections 9 and 10.

7.5 Potential Impacts on Land Capability

The agricultural land capability of the LSA is assessed in the Soils report (Volume 4, Section 9). Land capability classes on the Upgrader site are Classes 3 and 4. Potential impacts to land capability are restricted to surface disturbance areas. The C&R plan provides measures to prevent, mitigate or ameliorate on-site impacts, and to return land disturbed by the Project to equivalent to pre-disturbance capability. The most significant potential impacts to land capability are:

- water erosion;
- wind erosion;
- compaction and loss of structure of mineral soils;
- loss of soil, or salvaged soil degradation, (e.g., decrease in organic carbon or adverse change in soil texture and consistence);
- drainage problems resulting in excess soil moisture;
- dewatering of groundwater resulting in loss of soil moisture;
- contamination from operations; and
- potential adverse effect of soil acidification due to acid deposition.

7.6 Conservation and Reclamation Details

Conservation activities are integral to all phases of the Project, including pre-construction planning, construction, operations and closure. Pre-construction planning includes taking environmental issues into consideration for facility siting. It also includes creation and implementation of this C&R plan, which ensures that environmental aspects of construction, operations and closure are considered before construction begins.

Integration of conservation and reclamation measures with construction and operations includes measures such as soil salvage, weed control, surface water management, sediment and erosion control, waste management and interim reclamation and re-vegetation.

Reclamation of currently existing industrial (mainly oil and gas related) sites in the LSA is the responsibility of the owners of those facilities. The AENV Conservation and Reclamation Information Letter: Reclamation Certificates for Overlapping Activities (AENV, 1997) provides regulatory guidance for these areas.

7.6.1 General Conservation and Mitigation Measures

Environmental considerations that apply to all phases of the Project, including planning and design, construction, operation and reclamation/closure are outlined in this section. The general objectives of these measures are to protect and conserve biophysical resources and carry out mitigation measures to minimize impacts.

7.6.1.1 Facility Siting

Environmental considerations in facility siting and design include:

- locating the Project in the Heavy Industrial Area which provides land use compatibility, as well as potential for synergies and shared infrastructure and rights-of-way with nearby industries;
- minimizing surface disturbance in the AIH Agricultural Transition buffer zone;
- observing required setbacks;
- avoidance of sensitive areas wherever practical (including the wetlands located along the northeast edge of Section 35 and sandy dune landscapes in the SE 2-56-21 W4M); and
- minimizing surface disturbance by using existing infrastructure, corridors and previously disturbed areas wherever possible.

7.6.1.2 Surface Water Management

Detailed mitigation measures for potential hydrological impacts are provided in the Surface Water Quality section (Volume 3, Section 7) and the Hydrology section (Volume 3, Section 6). General surface water management measures include:

- The Upgrader site will be graded in a manner to control surface water flow on and off the site.
- The Upgrader site will include ditching and will utilize grading and berms to divert off-site runoff and to collect the on-site runoff in a series of stormwater ponds.
- Disturbed surfaces will be contoured when needed to prevent unintended depressional areas that would accumulate water.
- Where practical, facilities will be located to minimize interference with natural drainage.
- Culverts and ditches will be used as needed to prevent blockage of surface water flow, to avoid accumulation and formation of unwanted wet areas, as well as to prevent flow onto disturbed areas.

The only drainage coming onto the property will be the drainage from two culverts located beneath the CN rail line. This local upslope drainage will be directed north along the east side ditch of Range Road 211 to drain to the wetland area at the north end of the site. This will maintain part of the natural drainage pattern into the North Wetland Complex.

Clean water from the stormwater ponds in the undeveloped areas of the Project site will be periodically sent to the raw water pond as process make-up water or transferred to the effluent pond. On occasion, if water meets regulatory requirements for release, these stormwater ponds could have managed releases to enhance and maintain natural water levels in the wetland area to the north. This may be required, as a portion of the wetlands natural drainage system is captured by these ponds. Water that does not meet requirements for process use or release would be treated in the wastewater treatment plant.

7.6.1.3 Mitigation of Erosion Impacts

Where needed, erosion control will be implemented. Some examples of erosion control measures that may be used include:

- silt fencing or settling ponds will be used during construction where needed to contain sediment in surface runoff;
- disturbed surfaces will be contoured when needed to avoid concentrated surface flow and formation of rills and gullies down slopes;
- surface water flow impediments (e.g., rip rap) will be used where needed in ditches to slow water flow;
- unstable ditch banks will be protected with appropriate measures such as rip rap, gabians or naturally rooted deciduous sapling cuttings;
- excessive slope gradients in ditches and graded surfaces will be avoided;
- ditches and culverts will be used to control water flow;
- exposed soil areas (including salvaged soil stockpiles) will be re-vegetated or otherwise protected with site appropriate measures such as straw matting, crimping or coconut mats;
- surface disturbance and exposed soil will be minimized;
- soil disturbance will not take place under conditions where significant erosion, rutting or soil compaction – especially in wet conditions - may occur; and
- erosion resulting from Project activities will be addressed in a timely manner.

7.6.1.4 Weed Control

Equipment arriving at and leaving the site will be cleaned of soil if necessary to prevent migration of weed seeds. Weeds will be managed as per municipal and AENV requirements. The following weed control measures will be used:

- Restricted and noxious weeds as identified in the Alberta *Weed Control Act* will be eradicated.
- Only appropriate herbicides will be used on-site, following all recommended label practices. All federal and provincial legislation regarding use, transportation and storage of chemicals will be followed.
- The AENV Code of Practice for Pesticides (AENV, 2001) will be followed.
- The AENV guidelines Weeds on Industrial Development Sites (AENV, 2003) will be followed where applicable.
- Herbicides applied will be appropriate for site conditions and weed type; a provincially licenced contractor will carry out vegetation spraying.
- Herbicides will not be applied under windy conditions that could cause movement off the intended receiving area.
- Non-chemical control of weeds (mowing, cultivation, hand picking) will be used where practical; chemical weed control will be used when necessary.

- Soil sterilants will not be used.

- Areas treated with non-selective herbicides will be monitored to assess any movement off-site.

- The LSA will be inspected for weed problem areas through construction, operation and reclamation phases; weed control will be undertaken in a timely manner as required. Pre-disturbance conditions observed during the vegetation survey will be used to evaluate changes in weed communities.

7.6.1.5 Wetlands

Facility designs have been developed to avoid as much of the area covered by wetlands as practical. The largest wetlands in the LSA located in Section NE 35-55-21 W4M will not be disturbed. North American will consult with AENV and other provincial wetland groups about opportunities to compensate for the loss of the small lower class wetlands in the southern part of the Project area. For more detailed information on the types of wetlands found on the LSA and proposed compensation, refer to the Vegetation and Wetlands Section (Volume 4, Section 10).

To protect the North Wetland Complex the following will be completed:

- The administrative complex will be built directly south of these wetlands, providing a buffer from industrial processes.

- To maintain part of the natural drainage pattern, water from the two culverts located under the rail line on the south end of the site will be directed north along the east side ditch of Range Road 211 to the wetland.

- A portion of the natural drainage may be captured by the stormwater ponds. To maintain natural water levels, the stormwater ponds in the undeveloped and administrative areas may have managed releases to the North Wetland Complex, if the water meets regulatory requirements for release.

- Stormwater from the potentially contaminated stormwater pond may have managed releases to the wetlands to the north, if the water meets regulatory requirements for release.

- A buffer will be provided between the administrative complex and the North Wetland Complex.

7.6.2 Construction Phase

General construction activities will include vegetation clearing, soil salvage and storage, grading and placement of gravel.

If artifacts of cultural or historical significance are encountered, work will be suspended in the area, Alberta Tourism Parks Recreation and Culture will be contacted and a permit holder will investigate the site.

7.6.2.1 Vegetation Clearing

Vegetation clearing will be minimized and buffer zones will be maintained where required. Most of the LSA is cropped and vegetation clearing will not be a major issue. The Upgrader layout has been designed to avoid most existing small treed/bush areas in the LSA. There is no merchantable timber in the LSA.

Tree and brush clearing, if any, will be conducted between August 30 and April 1 to protect birds and their nests, and to ensure compliance with the federal *Canada Wildlife Act* and *Migratory Birds Convention Act*. If clearing is required within the restricted time period, the area will be surveyed by a biologist to determine presence of nesting birds, including raptors and owls. Woody debris, if any, will be disposed of by mulching.

7.6.2.2 Soil Salvage

Soils will be salvaged from all areas undergoing surface disturbance by Project construction and development activities. Areas requiring soil salvage are shown on Figure 7.6-1.

Topsoil will be salvaged in an upper lift. The topsoil stripping depth in the LSA will be guided by the colour change from the darker coloured Ap/Ah/Ahe/AB to the lighter Ae or subsoil (B) horizon below, as well as the topsoil depth information collected in the soil survey. Topsoil salvage recommendations for soil map units are presented in Table 7.6-1. Colour change between topsoil and subsoil is good to fair through most of the Project area and can be used as a guide to topsoil salvage in the field.

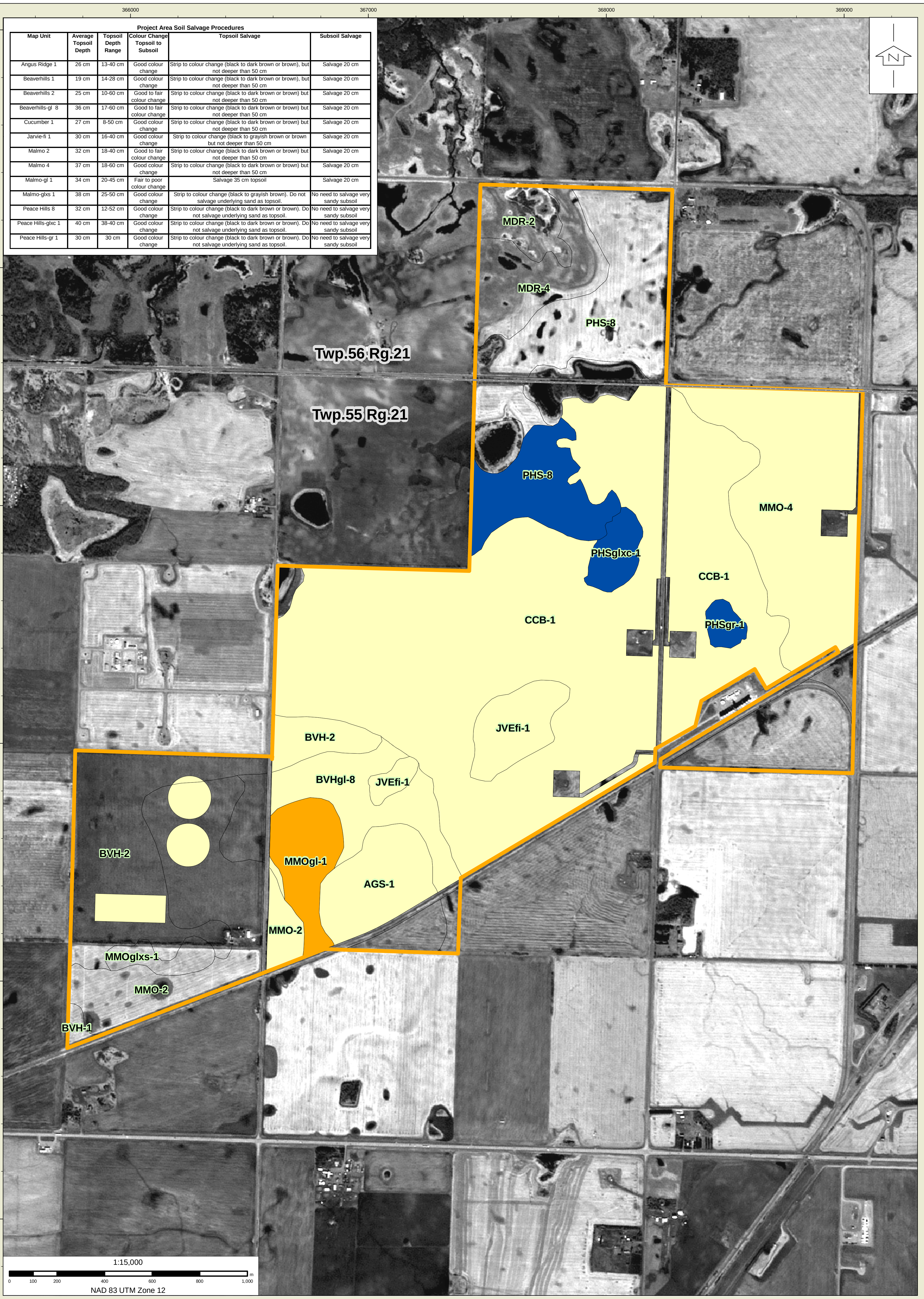
Salvage of the subsoil of soils with glaciolacustrine or till parent material will include the top 20 cm of the upper subsoil (Bm, Bt, Btg). Due to the large volume of topsoil on-site, greater subsoil stripping depths are not required to effectively restore equivalent land capability to the area.

Sandy subsoil will not be salvaged because the upper and lower subsoil are so similar in their physical properties that salvaging of the upper subsoil is not required to ensure adequate restoration of soil properties at reclamation.

Based on topsoil depths under the proposed areas of surface disturbance (485 ha), the estimated volume of topsoil to be salvaged is approximately 1,370,790 m^3. The volume of topsoil may decrease as the exact size and location of the laydown area is finalized. The estimated subsoil to be salvaged is approximately 871,280 m^3. All topsoil and subsoil salvaged will be replaced, which will be sufficient to reclaim the area to equivalent capability.

As surface soils are important determinants of land capability, the following general soil conservation measures will be undertaken in soil salvage operations to conserve soil quantity and quality:

- A qualified supervisor, familiar with the soils of the area, will be on-site throughout soil salvage and handling operations. The supervisor will ensure accuracy of soil salvage depths to minimize topsoil mixing with subsoil, in order to preserve salvaged soil quality.
- Topsoil and subsoil salvage and handling will be suspended when wet or frozen conditions will result in mixing, loss or degradation of topsoil.
- Topsoil and subsoil salvage and handling will be suspended when high wind velocities will result in degradation of topsoil soil quality, and not recommence until such conditions no longer exist.



Project Area Soil Salvage Procedures

Map Unit	Average Topsoil Depth	Topsoil Depth Range	Colour Change Topsoil to Subsoil	Topsoil Salvage	Subsoil Salvage
Angus Ridge 1	26 cm	13-40 cm	Good colour change	Strip to colour change (black to dark brown or brown), but not deeper than 50 cm	Salvage 20 cm
Beaverhills 1	19 cm	14-28 cm	Good colour change	Strip to colour change (black to dark brown or brown), but not deeper than 50 cm	Salvage 20 cm
Beaverhills 2	25 cm	10-60 cm	Good to fair colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Beaverhills-gl 8	36 cm	17-60 cm	Good to fair colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Cucumber 1	27 cm	8-50 cm	Good colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Jarvie-fi 1	30 cm	16-40 cm	Good colour change	Strip to colour change (black to grayish brown or brown but not deeper than 50 cm	Salvage 20 cm
Malmo 2	32 cm	18-40 cm	Good to fair colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Malmo 4	37 cm	18-60 cm	Good colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Malmo-gl 1	34 cm	20-45 cm	Fair to poor colour change	Salvage 35 cm topsoil	Salvage 20 cm
Malmo-glxs 1	38 cm	25-50 cm	Good colour change	Strip to colour change (black to grayish brown). Do not salvage underlying sand as topsoil.	No need to salvage very sandy subsoil
Peace Hills 8	32 cm	12-52 cm	Good colour change	Strip to colour change (black to dark brown or brown). Do not salvage underlying sand as topsoil.	No need to salvage very sandy subsoil
Peace Hills-glxc 1	40 cm	38-40 cm	Good colour change	Strip to colour change (black to dark brown or brown). Do not salvage underlying sand as topsoil.	No need to salvage very sandy subsoil
Peace Hills-gr 1	30 cm	30 cm	Good colour change	Strip to colour change (black to dark brown or brown). Do not salvage underlying sand as topsoil.	No need to salvage very sandy subsoil

Project Location

Legend

Local Study Area

Stripping Depths

- Strip topsoil to colour change but not deeper than 50 cm. Salvage 20 cm of subsoil.
- Salvage 35 cm of topsoil and 20 cm of subsoil.
- Strip topsoil to colour change but not deeper than 50 cm. Do not salvage subsoil.
- No Salvage

Title:

Topsoil Salvage Depths

Approved:	Revision Date:	
CG	November 26, 2007	
File: Fig 9.5-1 Topsoil Salvage Depths 20071126.mxd		
Drawn by: JC	Checked: BE	Fig. No.: 7.6-1

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Table 7.6-1 Soil Salvage Procedures

Map Unit	Average Topsoil Thickness	Topsoil Thickness Range	Colour Change Topsoil to Subsoil	Topsoil Salvage	Subsoil Salvage
Angus Ridge 1	26 cm	13-40 cm	Good colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Beaverhills 1	19 cm	14-28 cm	Good colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Beaverhills 2	25 cm	10-60 cm	Good to fair colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Beaverhills-gl 8	36 cm	17-60 cm	Good to fair colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Cucumber 1	27 cm	8-50 cm	Good colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Jarvie-fi 1	30 cm	16-40 cm	Good colour change	Strip to colour change (black to grayish brown or brown) but not deeper than 50 cm	Salvage 20 cm
Malmo 2	32 cm	18-40 cm	Good to fair colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Malmo 4	37 cm	18-60 cm	Good colour change	Strip to colour change (black to dark brown or brown) but not deeper than 50 cm	Salvage 20 cm
Malmo-gl 1	34 cm	20-45 cm	Fair to poor colour change	Salvage 35 cm topsoil	Salvage 20 cm
Peace Hills 8	32 cm	12-52 cm	Good colour change	Strip to colour change (black to dark brown or brown). Do not salvage underlying sand as topsoil.	No need to salvage very sandy subsoil
Peace Hills-glxc 1	40 cm	38-40 cm	Good colour change	Strip to colour change (black to dark brown or brown). Do not salvage underlying sand as topsoil.	No need to salvage very sandy subsoil
Peace Hills-gr 1	30 cm	30 cm	Good colour change	Strip to colour change (black to dark brown or brown). Do not salvage underlying sand as topsoil.	No need to salvage very sandy subsoil

7.6.2.3 Soil Stockpiles

Salvaged topsoils and subsoils will be stored in berms on the property. Other on-site storage locations besides berms may be required due to the large topsoil and subsoil volumes.

Topsoil and subsoil will be stored separately in different berms in different locations on the property. The subsoil berm will be top dressed with 15 cm of topsoil to enable vegetation establishment. Additional topsoil will be used in landscaping during the operational phase of the Project. The berm slopes will be designed to facilitate access of seeding, weed control and mowing operations during the operational phase of the Project. As well, the berms will be designed to facilitate topsoil salvage from subsoil berms during final reclamation.

The following measures will be undertaken to maintain salvaged soil quality.

- Salvaged topsoil will be placed on topsoil material; salvaged subsoil material will be placed on subsoil material.
- Locations of stored topsoil and subsoil will be recorded for future reference and clearly signposted to prevent misuse during operations.
- Topsoil and subsoil will be stockpiled separately from each other, and from other soil materials.
- Stockpile areas will be stable, accessible and retrievable.
- Salvaged soil will be stored out of the way of surface water flow and operational activities.
- Salvaged topsoil will be seeded with a non-invasive, low maintenance grass/legume seed mixture to encourage biological activity in the rooting zone and prevent erosion.
- Salvaged subsoil will be top-dressed with 15 cm salvaged topsoil material, to ensure adequate re-vegetation. Like salvaged topsoil, stockpiled subsoil will be seeded with low maintenance grass/legume seed mixture
- Erosion of salvaged soil will be prevented by seeding to achieve a cover of non-invasive species on stockpiles, and the salvaged soil will be controlled for weeds. Other measures to protect the soil before vegetation is established will be used if needed (e.g., tackifier, matting).

7.6.2.4 Construction Dewatering

Dewatering of excavations will be required during construction. This water will be discharged to the stormwater ponds and any required regulatory approvals will be obtained. Assuming a conservative drawdown of 6 m at the excavations for a period of six months, the measurable drawdown is predicted not to extend beyond 20 m from the excavations.

7.6.2.5 Roads and Electrical Transmission Lines

There are no new roads currently proposed. If transmission lines are constructed, the following guidelines will be followed.

- The Code of Practice for Watercourse Crossings (AENV, 2000c), the Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body (AENV, 2000b) and applicable Fisheries and Oceans Canada Operational Statements will be followed.

- An erosion and sediment control plan will be implemented for all watercourse crossings. Watercourse crossings will be conducted in winter where possible to minimize impacts of sedimentation and channel alteration.

7.6.2.6 Borrow Pit Area and Gravel Pits

All borrow material and gravel will be obtained from a commercial source. No new borrow pits or gravel pits are proposed.

7.6.2.7 Aesthetics and Landscaping

As most of the Project area is on agricultural land, there will be little disturbance to natural tree/bush or recreational areas. Treed areas in the LSA north of the administration building will be preserved as a sight barrier at the northern edge of the development. A small amount of the salvaged topsoil will be used as surface replacement soil on the subsoil berms and any landscaped areas, and will be seeded to grass and maintained. Any disturbed areas no longer in active use will be re-vegetated to prevent erosion and improve appearance. At Project closure, the landscaped area will be left or reclaimed (including salvage of topsoil) as appropriate for the next intended land use.

7.6.3 Operational Phase

General erosion control, surface water management and weed control described in Section 7.6.1 will be conducted throughout the operational phase.

7.6.3.1 Waste Management

Regulatory provincial and federal waste handling requirements will be met; some examples include the Alberta *Waste Control Regulation* and Alberta User Guide for Waste Managers (AEP, 1996), EUB Directive 058 (Oilfield Waste Management Requirements for the Upstream Petroleum Industry; EUB, 1996), and EUB Directive 055 (Storage Requirements for the Upstream Petroleum Industry; EUB, 1995).

Sulphur extraction and forming of pastilles will occur on-site, but no long-term storage is planned. Short-term storage will be in silos with concrete bases to prevent leaching and mitigate dust dispersion until the material is transported off site.

7.6.3.2 Spill Prevention and Contingency Plans

A spill is defined as an uncontrolled release of a product into the environment that may or may not cause an adverse effect, have an impact on the environment which requires immediate actions to control and mitigate, and/or have the potential to cause hazard to life, property or the environment. As described in Section 6.1.2 of this Volume, North American will develop a site specific emergency response plan that will include spill response procedures. The procedure will include requirements for notification of personnel and designation of equipment required to mitigate a release.

7.6.3.3 Dewatering

Ponds that will extend below the normal water table will require a sump drawdown system during operations. This water will be discharged to the stormwater ponds. Any required regulatory approvals will be obtained.

Receptors that may be potentially at risk from dewatering during Project operations include the North Wetland Complex in NE 35-55-21 W4M and the sandy soils in NE 35-55-21 W4M and SE 2-56-21 W4M. Assuming a conservative drawdown of 6.1 m under the ponds for a period of 50 years during operations, the measurable drawdown is predicted not to extend beyond 200 m from the ponds. Both potential impact areas are outside of the predicted drawdown area and therefore no mitigation is recommended.

7.6.3.4 Reclamation During Operations

Some reclamation will be carried out before final decommissioning, reclamation and closure. Portions of the plant site will be landscaped as an interim reclamation measure. Temporary workspace used during plant construction that is no longer required will be reclaimed. Underground pipelines in areas where surface disturbance was not otherwise required will undergo reclamation as the end stage of pipeline construction (surface soils salvaged for any underground pipelines will be replaced at the completion of pipeline construction and re-vegetated). Areas that undergo surface disturbance that will not be needed for any current or future operational activities will be reclaimed. Appropriate soil handling and re-vegetation procedures will be implemented.

7.6.4 Reclamation and Closure Phase

7.6.4.1 End Land Use

The C&R plan provides for reclamation to land capability equivalent to pre-disturbance conditions. Thus reclaimed areas currently under cultivation will be able to support similar agricultural land use. Current zoning for most of the Project area is Heavy Industrial, with a small area zoned as a transition area. The actual land use to which land is returned at closure will depend on the zoning at the time and the subsequent planned use of the land, and may result in modifications to the C&R plan.

7.6.4.2 Final Decommissioning and Abandonment

Individual Upgrader facilities will be decommissioned and reclaimed when it is determined a particular facility will not be needed in future. At the end of the Project, all Project facilities will be decommissioned. Six months prior to the Upgrader ceasing operation, a decommissioning and final land reclamation plan will be submitted to AENV, which will contain reclamation and closure details as specified by the AENV Approval. Contamination will be managed in accordance with the AENV Approval, which outlines the Soil Monitoring and Soil Management Program requirements.

Prior to the removal of any facilities, additional site assessments will be conducted to further delineate any contamination remaining on the Project site and any affected lands. Removal of facilities will occur in a manner that prevents release of contaminants. A plan for remediation of any contamination will be completed in accordance with AENV requirements. Confirmatory sampling will be carried out to indicate compliance with the remediation objectives of the day.

7.6.4.3 General Reclamation Measures

The general approach to reclamation of surface disturbances includes:

- Consultation with AENV regarding target reclamation objectives, criteria and land use;
- Removal of surface gravel, and its reuse elsewhere as appropriate;
- Alleviation of compaction on operational surfaces;
- Replacement and re-contouring of subsoil for compatibility with surrounding land and drainage, including removal of berms and ditches and restoration of grade cuts to stable contours;
- Replacement and assessment of soil depths for salvaged soil;
- Seed bed preparation of replaced soil for re-vegetation;
- Amendments if required (e.g., fertilizers, manure);
- Re-vegetation as appropriate for the subsequent land use;
- Following re-vegetation, monitoring to assess reclamation success, and remedial measures undertaken (e.g., weed control, amelioration of drainage or erosion problems) as required; and
- Erosion control and surface water management will be carried on throughout the reclamation closure phase.

When reclamation is complete, assessment will be carried out to demonstrate that the reclamation guidelines of the day, demonstrating achievement of equivalent capability, have been met.

7.6.4.4 Contouring, Decompaction and Soil Replacement

After removal of surface gravel, the site will be contoured to blend with the surrounding terrain and provide interconnectivity with the surrounding landscapes. Drainage ways similar to pre-disturbance natural drainage will be established, which blend into the surrounding drainage pattern without causing erosion or unintended excess accumulation of water. Contouring will generally be re-established similar to baseline topography and drainage. It is anticipated that the final landscape, if returning to an agricultural end land use, will be constructed to very gently to gently rolling (less than 5% slope) topography, consistent with good quality agricultural land.

Once surface contours have been established, the lower subsoil will be de-compacted by ripping, cultivation, heavy duty discing or other means as appropriate to the severity of the compaction. The salvaged subsoil will then be replaced evenly and any additional preparation will be undertaken (e.g., ripping, discing, rock picking). Finally, the salvaged topsoil will be evenly replaced and the topsoil prepared for seeding to create a soil with similar depths and characteristics as pre-disturbance conditions. Such preparation could include cultivation, roto-tilling or addition of amendments, including fertilizer determined by soil testing or good quality manure.

7.6.4.5 Pipelines

Aboveground and underground pipelines within the plant area and the water intake pipeline will be removed during decommissioning of the plant or abandoned in place. Pipe racks will be removed and the rights-of-way re-contoured and reclaimed with the rest of the Upgrader site.

7.6.4.6 Re-vegetation and Weed Control

Vegetation species will depend on the intended final land use of the site. The vegetation planted will be appropriate for the intended land use and will integrate with the vegetation on the surrounding landscapes. If the final land use is cultivated agriculture, as is the case of most of the development area at present, reclaimed soils will be seeded to agronomic crops appropriate to the area. All seed used will be certified seed that has been analyzed for weed content, and complies with the Alberta *Weed Control Act*.

In addition to erosion and weed control measures previously described, re-vegetation measures on reclaimed areas will include:

- inspecting and washing equipment if necessary to remove soil potentially containing weed seeds and plant parts before arriving at a site; weeds will be controlled in the washing area;
- avoiding use of straw bales for erosion control unless certified as weed free with a Certificate of Inspection;
- not using invasive/persistent agronomic forage species, such as Crested Wheat Grass;
- conducting ongoing weed monitoring and treating weed infestations in a timely manner; and,
- re-vegetating reclaimed areas as soon as practical after soil preparation in order to avoid exposure of bare soil for extended periods, to prevent erosion and discourage weed establishment.

7.6.4.7 Reclamation Constraints and Mitigation Measures

Soil suitability for reclamation was assessed; the majority of the topsoil was rated fair, and the subsoil was rated poor (Volume 4, Section 9). The limiting topsoil factors are dominantly texture, pH, percent saturation and total organic carbon. Subsoil limiting factors are dominantly texture and consistency. The limiting factors are not considered sufficient to restrict reclamation success. Care will be taken during reclamation to avoid handling or working topsoil or subsoil when wet, due to their texture. Topsoil depths are sufficiently thick (i.e., of sufficient volume) such that they do not present constraints for adequate salvage and replacement. Some potential soil-related constraints are presented below with mitigation measures to address the constraints.

- Sandy soils in SE 2-55-21 W4M and NE 35-55-21 W4M, are very susceptible to wind erosion, have a low water holding capacity, have low fertility, and are more difficult soils in which to re-establish vegetation. Sandy soils in SE 2-55-21 W4M will not be disturbed. The Peace Hills soils under agriculture in NE 35-55-21 W4M and any other sandy soils encountered will be mixed with other, finer textured topsoil salvaged in the Project area to improve texture and associated properties for agriculture. Vegetation in these areas will be established as quickly as possible after soil replacement to minimize wind erosion.

- The presence of slopes can lead to rill/gulley soil water erosion from concentrated flow. This will be minimized by contouring to avoid concentrated flow down long slopes, and/or providing protected (e.g., vegetated) drainage ways.

- The more finely textured glacial lacustrine soils are susceptible to compaction. Compaction will be minimized by avoiding soil stripping and handling in wet and frozen periods, and by ensuring adequate de-compaction of the subsoils before soil replacement.

7.6.4.8 Monitoring and Reporting

Environmental monitors will be on-site during the construction phase of the Project to ensure the environmental protection measures are followed. Monitoring of the LSA for potential impacts such as erosion, weed infestation, drainage problems, landscape instability, and release of substances, will be carried out throughout the life of the Project, and problems will be addressed in a timely manner. Monitoring will also include the effectiveness of mitigation measures (e.g., drainage management, erosion control). Soil, air and groundwater monitoring will be carried out and reported in accordance with the AENV approval.

For reclaimed areas, reclamation monitoring will be carried out to ensure that reclamation is progressing in a manner that will be adequate to achieve land capability equivalent to pre-disturbance, and meet the applicable reclamation certification criteria. Reclamation monitoring will comply with the AENV approval and will continue until the applicable reclamation criteria are met. Reclamation activities will be reported to AENV in an Annual Conservation and Reclamation Report, or as otherwise directed.

The reclamation monitoring program will follow the guidelines of the day to evaluate reclamation success. At a minimum, reclamation monitoring will provide information to ensure reclamation has addressed the required soil, landscape and vegetation parameters for the appropriate land use and reclamation criteria, and may include:

- acceptable landscape characteristics (drainage, erosion, contour, slope stability, gravel and rocks, and debris);

- topsoil depth;

- surface soil quality parameters (e.g., texture, admixture, soil aggregate size/strength, gravel/rocks);

- soil profile assessment (water permeability/aeration, root restrictions/ compaction); and

- adequate re-vegetation of disturbed areas (e.g., plant health, cover/density, bare areas, height, species composition [including weeds]).

Reclaimed areas will be routinely monitored for issues relating to drainage, erosion, re-vegetation and weeds. Reclaimed areas will be inspected after the first growing season following reclamation for the landscape, soil parameters and initial vegetation establishment. Subsequent monitoring will assess progress toward re-establishing the target vegetation. Additional sampling of soils for laboratory analysis of soil parameters may be carried out where re-vegetation progress appears to be delayed (e.g., selected nutrients, pH, sulphur); fertilizer and/or manure may be used in agricultural areas where soil nutrient status appears low.

7.6.4.9 Return of Land Capability

The conservation and reclamation measures contained in this C&R plan, as well as mitigative measures in other sections of the EIA (e.g., soils, hydrology) are designed to return the soil and landscape to similar conditions as those that existed before disturbance. Implementation of the measures as outlined in the C&R plan will sufficiently maintain or return soil quality and landscape conditions to equivalent land capability.

Overall landforms will not change significantly as the surface disturbance will be relatively surficial (grading, soil salvage and contouring for drainage control). Reclamation will return disturbed areas to pre-disturbance landform conditions compatible with the surrounding landscape.

Reclamation experience has demonstrated that maintaining topsoil quantity and quality are critical in determining land capability, particularly for cultivated agricultural land uses. Topsoil on the Project site is of fair suitability for reclamation and of sufficient depth to allow the site to return to similar land capability with the ability to support a similar range of vegetation types as pre-disturbance conditions.

A post-reclamation assessment will be conducted to document soil, terrain and vegetation conditions and the assessment information will be included in the application for a reclamation certificate. The parameters assessed will include those in Section 7.6.4.8 as well as others specified in applicable reclamation criteria at the time of reclamation or by AENV.

Final reclamation will commence shortly after cessation of operations and decommissioning. It is anticipated reclamation will be completed within five to ten years after the completion of decommissioning depending on final land use, weather, unforeseen reclamation problems and coordination with remediation of accidentally released substances, if required.

8 SUMMARY OF THE EIA

8.1 Introduction/Approach

The purpose of the Project EIA (Volumes 2 through 5) is to explain the environmental and socio-economic effects of the proposed Project individually, as well as in conjunction with other existing and planned projects in the area.

The EIA has been prepared in accordance with the requirements prescribed under the *Environmental Protection and Enhancement Act* (EPEA) and the Final TOR for the Project (Appendix A). The EIA forms part of North American's joint application to the EUB and AENV.

Preliminary work for the Project EIA was initiated in 2006 to evaluate Project alternatives, identify pertinent data sources and define required data collection programs. Initial discussions were held with government departments to scope out the Project requirements, application procedures and regulatory processes.

Consultation was conducted with local residents, government representatives, First Nations and other public representatives during this period to identify biophysical and socio-economic issues and to confirm study requirements.

Field work was undertaken in 2006 and 2007 to enhance regional water, fisheries, soil, vegetation, wildlife and historical resources information.

Potential environmental and socio-economic impacts for both the Project alone and the Project contribution to cumulative effects were identified and assessed by team members using the following steps:

- Issues of greatest concern to stakeholders and regulators were identified in each discipline in order to focus the assessment.
- Ecological or socio-economic indicators (i.e., selected variables or parameters for in-depth analysis) were identified for each discipline to help quantify or evaluate the potential effect of disturbances.
- Spatial and temporal boundaries were considered for each indicator. An LSA and a Regional Study Area (RSA) were spatially defined for each study. Similarly, temporal boundaries were defined for the development of the Project.
- Management methods including construction, design and/or scheduling principles were applied to prevent, minimize or mitigate adverse effects.
- Quantitative or qualitative assessments were made by comparing predicted residual effects (i.e., effects remaining after the application of management methods) to determine environmental or socio-economic consequence. Consequence and a final impact rating was defined based on established objectives or scientific criteria.
- Monitoring or follow-up programs were identified, if required.

There are numerous measurable parameters which may contribute to the assessment of environmental or socio-economic conditions and potential effects. Measuring and assessing all of the possible parameters and interactions is impractical. An accepted approach is to select key parameters or variables that are indicators for a broader group of parameters. Indicators are useful in quantifying or evaluating the effects of disturbances on ecological and socio-economic conditions. Selected indicators for each component are described in the applicable section.

Assessment criteria were used to describe and evaluate the predicted significance of Project effects and the cumulative effects for various indicators.

The integration of the various effects criteria ratings result in a final impact rating for each identified Project effect. The possible final impact ratings are: no impact, negligible impact, low impact, medium impact and high impact. The result of combining objective and quantitative assessments with subjective evaluations and best professional judgment provides a conclusion for each predicted Project effect.

Cumulative effects likely to result from the combination of the Project and other existing and proposed projects in the area and reasonably foreseeable environmental changes were considered and evaluated for each discipline using methods suitable to the discipline-specific issues.

8.2 Air

A standard assessment approach consistent with the Project TOR and the Alberta Model Guideline was used to determine the air quality implications of the North American Upgrader. The CALPUFF/CALMET air quality simulation model system was one of the primary tools used for the assessment and it was used to predict air quality changes in the region and the air quality predictions were then compared to the ambient air quality and deposition criteria. The air quality assessment findings can be summarized as follows:

- **SO_2 concentrations:** The maximum values due to the Project are predicted to occur in the immediate vicinity of the Project, that is, along the Project property line (PPL). For the Project operating at the design sulphur recovery, the AAAQO are not exceeded. The simultaneous occurrence of a low sulphur recovery and poor dispersion conditions indicate a potential to exceed the AAAQO at the PPL. This conclusion is applicable to other approved and proposed upgraders in the region.

- **NO_2 concentrations:** The maximum values due to the Project are predicted along the PPL. Along and outside the PPL, the predicted NO_2 concentrations do not exceed the AAAQO. The regional NO_2 concentration pattern is dominated by Edmonton urban sources.

- **$PM_{2.5}$ concentrations:** The maximum values due to the Project are predicted along the PPL. Along and outside the PPL, the predicted $PM_{2.5}$ concentrations do not exceed the 24-hour CWS. The regional $PM_{2.5}$ concentration pattern is dominated by Edmonton urban sources.

- **PAI deposition:** The approved and proposed upgraders provide a large PAI contribution because of the associated SO_2 emissions. The urban areas provide a large contribution to the regional PAI because of the associated NO_x emissions. The maximum predicted PAI depositions in Elk Island National Park are 0.31 keq H^+/ha/y, 0.32 keq H^+/ha/y and 0.41 keq H^+/ha/y for the Baseline, Application, and Cumulative Cases, respectively. The 80 km x 80 km Deposition Study Area (DSA) average for the Baseline, Application and Cumulative Cases are 0.14 keq H^+/ha/y, 0.15 keq H^+/ha/y and 0.18 keq H^+/ha/y, respectively. These are less than the most stringent Target Load criteria of 0.22 keq H^+/ha/y for sensitive areas.

- **Nitrogen deposition:** The urban sources dominate the regional nitrogen deposition pattern due the associated NO_x emissions. Values in excess of 10 kg N/ha/y are predicted in the Edmonton and Fort Saskatchewan areas because of the urban emissions. The predicted nitrogen depositions in Elk Island National Park are 4.4 kg N/ha/y, 4.4 kg N/ha/y and 5.0 kg N/ha/y for the Baseline, Application, and Cumulative cases, respectively.

- **Human health and odour related concentrations:** For the Application Case, the maximum predicted 1-hour and 24-hour H_2S concentrations at some nearby agricultural/residential locations are larger than the respective AAAQO. The health and odour implications of the predictions for H_2S and the other 53 substances that were evaluated are discussed in the Human Health section of the EIA (Volume 2, Section 4).

- **Ozone concentrations:** The Environment Canada model predictions indicate that future upgrader NO_x and VOC precursor emissions could potentially increase the peak ozone concentrations between 3% and 5% in the FAP region, and by as much as 8.6% to the east of the FAP region.

- **Visibility Restrictions:** Under low-temperature, high-humidity conditions, plumes from combustion and cooling tower sources will be clearly visible, and their heights are expected to be typically in the 100 m to 250 m range. The plumes from the cooling towers could have the potential reduce ground-level visibility on nearby highways by up to 12 hours per year, which represents an approximate 13% increase over background levels.

- **GHG emissions and climate influences:** The Project operations GHG emissions of 2,962 kt CO_{2e}/y (based on CO_2 recovery from gasification) represents 1.2% of projected 2015 provincial total estimate, and 0.4% of projected 2015 national total estimate. While future climate change may influence the availability of source water, the sensitivity of operations to future climate changes is ranked as low.

The assessment identified four areas to be addressed when the detailed engineering design is undertaken and during the operation of the Project:

- Operate the SRU/TGTUs as close as possible to the design sulphur recovery efficiency of 99.8% to preclude the occurrence of high 1-hour average SO_2 concentrations at the PPL.

- Develop a flare management plan consistent with EUB Directive 060 to preclude high 1-hour average SO_2 concentrations when upset/emergency flaring occurs under unfavourable meteorological conditions.

- Design and operate the Project to minimize fugitive RSC emissions in order to prevent off-site odours.

- Monitor fog formation from the cooling tower to determine the need for highway signage.

Addressing these areas will minimize the air quality effects of the Upgrader and preclude the potential for any AAAQO exceedances.

8.3 Noise

An environmental noise impact assessment was conducted for the Project. The purpose of the assessment was to measure the baseline noise levels for the existing surrounding residents (due to traffic and existing industrial facilities) and to determine the projected application case and cumulative case noise effects from the Project and other existing, approved and planned facilities within the region.

The baseline noise monitoring indicated that there are currently relatively high noise levels for those residents near the existing industrial noise sources. The dominant noise sources in the area are associated with the industrial facilities as well as the local highways. The noise modelling of the baseline conditions indicated results similar to those obtained from the baseline noise monitoring.

Project construction noise is likely to be within acceptable limits due to the existing noise levels and mitigation measures to be utilized by North American. There will be times, however, when construction related activities result in subjectively noticeable noise levels for the adjacent residents. Efforts will be undertaken to minimize these impacts.

Application case noise levels resulted in low increases for most surrounding residents. Only those residents directly near the Project will experience medium noise level increases. Projected sound levels from existing and proposed nearby facilities are projected to be at or within the permissible sound levels at all receptors. The final impact rating for all Project components ranges from low impact to medium impact.

8.4 Health

The Human Health Risk Assessment (HHRA) considered both acute (short-term) and chronic (long-term) health risks associated with the Project using a conventional approach developed in part by Health Canada and the United States Environmental Protection Agency. In the past, this approach has been endorsed by regulatory agencies, including Alberta Health and Wellness, AENV, and the EUB.

Chemicals of Potential Concern (COPCs) to human health identified by other disciplines (e.g., air quality) as being relevant to the Project were evaluated within a quantitative HHRA. Relevant exposure pathways were identified, and conservative estimates of human exposure to the COPCs via inhalation, ingestion and physical contact were determined. Estimated exposures were compared to health-based exposure limits. Potential health risks were expressed as either risk quotients (RQs) for non-carcinogenic effects, lifetime cancer risks (LCRs) or incremental lifetime cancer risks (ILCRs) for carcinogenic effects. An assessment of the potential additive effects of COPCs with common health-related endpoints was also completed.

The HHRA also considered the potential for nuisance odours stemming from the Project's emissions in combination with existing or approved and planned developments in the region. As part of the odour assessment, predicted short-term air concentrations were compared against established odour thresholds.

Emissions from Baseline, Application and Cumulative sources are predicted to result in potentially elevated health risks for a number of individual chemicals and mixtures of chemicals (described below). However, due to the conservative nature of the HHRA, the predicted risk estimates are not expected to result in measurable health effects in the region. The Project emissions on their own and in combination with other area sources are expected to result in some infrequent odours in the area. Through implementation of its planned mitigative measures and monitoring programs, North American will identify, and promptly respond to, odours originating from its site.

Acute Assessment Summary

Overall, the Project's contribution to acute health risks is expected to be negligible. The predicted short-term air concentrations generally meet health-based exposure limits for the COPCs. However, exceedances of the acute exposure limits are predicted for a number of COPCs, including acrolein, SO_2, respiratory irritants and eye irritants for the Application case. When considering the Cumulative case, exceedances are predicted for formaldehyde, fine particulate matter and nasal irritants.

Given the probable overestimation of background exposure levels, the degree of conservatism incorporated into the different exposure limits, and the use of maximum concentrations to characterize risks, the results of the acute inhalation assessment are likely conservative.

Chronic Assessment Summary

Generally, the Project's contribution to chronic health risks is expected to be negligible. Predicted long-term air concentrations meet health-based exposure limits for the COPCs in most cases. Long-term exceedances are predicted for acrolein and nasal irritants for the Application case at the maximum of the industrial locations. The acrolein exceedance is largely due to the conservative nature of the exposure limit. Because the exceedance for the nasal irritants is primarily due to acrolein, it can be said that the exceedance for the nasal irritants is due to the conservative nature of the acrolein exposure limit as well.

All incremental lifetime cancer risks associated with the Project's emissions appear to be within acceptable levels, as defined by AENV and Health Canada.

None of the exposure estimates for the multiple exposure pathway assessment are anticipated to exceed their health-based exposure limits. The results suggest that the Project's air emissions are not expected to adversely affect the quality of the area's locally grown foods.

Odour Assessment Results

With the exception of H_2S, maximum predicted short-term air concentrations were less than mean odour thresholds for all development cases. As indicated by the results of the odour assessment, the Project's emissions may result in nuisance odours in the immediate vicinity of the Project area. However, the majority of the area residents are not expected to detect any odours as a result of the Project's emissions.

8.5 Hydrogeology

A hydrogeology study was undertaken to assess baseline conditions and assess potential impacts to groundwater. Overburden sediments at the Project footprint range from 15 m to 23 m in thickness and consist primarily of clay till overlying a lower sand and gravel aquifer. A surficial eolian sand unit exists at the northwestern corner of the Project footprint. Upper bedrock deposits consist of sandstone, siltstone and claystone of the Oldman Formation. The buried Beverly Channel, containing Empress Formation sands and gravels, lies to the northwest of the Project footprint. Groundwater flow is generally directed northwest towards the North Saskatchewan River. Groundwater is a calcium/magnesium-sulphate type in the clay till unit and is a sodium-bicarbonate in the lower sand and gravel and bedrock units.

Key indicator groundwater resources associated with the Project include Shallow Overburden Aquifers, the Lower Sand and Gravel Aquifer, the Beverly Channel Aquifer, and Bedrock Aquifers. Project components that may impact groundwater resources are identified as the operation of surface facilities, dewatering of excavations during construction and groundwater withdrawal under the potentially contaminated and oily water ponds. The final impact rating for all Project components ranges from no impact to low impact.

8.6 Hydrology

The hydrology study considered the watercourses, waterbodies and wetlands that may be affected by the Project. The Project will require water from the North Saskatchewan River at an average rate of 39,500 m^3/d, with ZLD treatment technology planned at full Project production. This amounts to 0.76% of the 1:10 year 7-day consecutive low flow rate in the North Saskatchewan River (60 m^3/s). Cumulative changes anticipated in flows and water levels in the North Saskatchewan River are less than the existing daily fluctuations presently occurring in this reach of the river due to dam regulation. Cumulative licenced withdrawals from downstream of Edmonton to the Alberta – Saskatchewan border equate to a flow rate of 23.56 m^3/s, with return flows of 16.26 m^3/s. This results in a net withdrawal rate of 7.30 m^3/s. This net withdrawal rate is 3.7% of the mean annual flow and 12.2% of the 1:10 year 7-day consecutive low flow rate at Edmonton.

There are no defined watercourses in the Project area and no changes in drainage patterns will be required. Minor upslope natural drainage will continue to drain north past the Project area via the Range Road 211 road ditch. Local stormwater runoff will be contained and collected from the Project area and either used to supplement raw water or discharged to the North Saskatchewan River. Controlled releases of suitable quality runoff water are proposed to sustain and enhance the wetland complex on the north side of the Project, identified as the North Wetland Complex. Some wetlands will be removed within the Project area, while the North Wetland Complex will be enhanced and protected. No change in runoff rates is expected to be detectable downstream within the Astotin Creek and unnamed tributary watersheds that drain to Beaverhill Creek. Reclamation can restore the area to pre-Project hydrologic conditions. The final impact rating for surface water issues ranges from low impact to medium impact.

8.7 Surface Water Quality

An assessment was completed of the Project impacts on surface water quality. Baseline water quality data in the region show an increase in the concentrations of a number of water quality parameters downstream of Edmonton, mainly due to loading from the Edmonton wastewater treatment plants.

Modelling of the predicted effluent discharge indicates that AENV's mixing zone requirements will be met in the LSA. No chronic water quality guidelines will be exceeded at the edge of the mixing zone of the proposed treated effluent outfall (1.29 km downstream) with the exception of total phosphorus and total nitrogen, which are already exceeded upstream of the proposed discharge. These parameters will attain near-background concentrations when the effluent discharge is fully mixed.

The application of the appropriate measures (including erosion and sediment control, wastewater treatment and discharge control, stormwater control and treatment, and containment and collection of spills) during construction and operations is expected to mitigate the potential effects of runoff and sediment release to local waterbodies and the North Saskatchewan River. Effluent recycling will reduce the volume discharged to the river, and staged ZLD treatment of targeted waste streams will reduce the load of the various chemical parameters in the effluent.

The release of sediment and surface runoff is predicted to have a low impact on local waterbodies. Effluent discharge to the North Saskatchewan River is predicted to have a low impact on regional water quality. The effects of dewatering on local waterbodies and the release of acidifying emissions on regional lakes will be negligible. The overall impacts of the Project on surface water quality are therefore rated as negligible to low.

8.8 Fish and Fish Habitat

An assessment was completed of the fish and fish habitat and benthic invertebrate communities on the North American Project site, as well as in the local and regional study areas. Field assessments focused on determining presence and absence of fish species in the region, as well as the quality and availability of fish habitat (including the benthic invertebrate community).

The change in fish and fish habitat related to riparian and instream fish habitat and combined industrial disturbances is predicted to be low. Potential impacts related to increases in suspended sediments and the accidental release of chemicals is predicted to be low. Changes in fish habitat as a result of the footprint of the water intake are predicted to be low. Mitigation measures implemented during construction, operation and reclamation will protect watercourses and waterbodies in the area.

Potential changes to fish and fish habitat as a result of changing surface water levels are predicted to be low. Surface water levels are predicted to be within natural variation for the life of the Project. The mitigation and restoration measures implemented during construction, operation and reclamation will protect the watercourses and waterbodies in the area.

No potential decreases in fish populations are predicted resulting from operation of the water intake. No potential impacts to fish and fish habitat are predicted as a result of acidifying emissions. The overall impact of the Project on fish and fish habitat is rated as low.

8.9 Soils

The soils assessment considered potential impacts related to changes to soil and terrain resources from the construction, operations, decommissioning and reclamation phases of the Project. Impacts included change in soil moisture due to dewatering during the construction and operations phases, changes in agricultural land suitability, and potential soil acidification. Construction and operation of the Project will require the lowering of the shallow water table to approximately 6 m below ground surface in the vicinity of the ponds; however, drawdown effects are expected to be negligible at a distance of 200 m from the ponds. Potential soil receptors at risk of dewatering include a wetland complex and sandy soils; and these occur outside the area of drawdown, and therefore no mitigation is recommended. No cumulative effect is predicted as a result of dewatering around the Project ponds.

The goal of reclamation activities at site closure is to achieve land capability equivalent to pre-disturbance conditions. Mitigation measures to reduce the effects of physical disturbances during the construction and operations phases will be required to reduce residual effects following reclamation and site closure. The residual impact to land suitability following completion of reclamation will be neutral and of low magnitude in the LSA. No cumulative adverse effects are predicted in the RSA provided proper soil handling and mitigation strategies are followed during all phases of the Project.

Of the soils in the RSA, 1.5% of the overall RSA soils and 2.5% of the undisturbed soils in the RSA are at risk of potential acid input (PAI) greater than critical load. A comparison of the baseline and application cases indicates an increase of 369 ha of soils where PAI may exceed the critical load for the soils in the RSA. The potential risk from PAI will occur throughout the operation of the Project, but will cease at closure. The cumulative case results in an additional 4,684 ha of soil where the critical load may be exceeded by PAI. This change represents an increase of 3.2% of the undisturbed soils in the RSA at risk of exceeding critical load. In the cumulative case, the change in soils at risk of having critical load exceeded by PAI is negative in direction but low in magnitude. High sensitivity soils constitute 71% of the soils where PAI may exceed critical load of soils.

The predicted residual impacts to the key parameters of soil moisture, land capability and acidification potential are low for soils and terrain in the application case. The Project is anticipated to have a low impact to soils and terrain in the cumulative case.

8.10 Vegetation and Wetlands

In the LSA the Project is predicted to have a low impact on terrestrial plant communities and a medium impact on wetlands. One terrestrial community, classified as Mixed Shrubland, will be removed. This community occupies only 0.1% of the LSA and contains species that occur frequently in the region. Mitigation for this impact is not considered necessary.

One Class III wetland will be dewatered during construction. A compensation program to mitigate the effects of this dewatering will be designed in conjunction with AENV. An area of Class I/II wetlands is expected to be reduced by 86.3% through dewatering. However, mitigation for these impacts is not considered necessary because these wetlands are ephemeral and they are plowed over to support cropland for several months of each year.

No rare plant communities and only one rare plant species, *Asclepias ovalifolia* Dcne. (low milkweed), were recorded in the LSA. The Project is not expected to impact this rare species because construction will not take place in the community in which it was found.

In the RSA the Project is predicted to have negligible impacts on vegetation and wetlands. Vegetation removal will reduce the area of impacted plant communities by less than 1.0% compared to baseline levels. Furthermore, construction of the Project is likely to only slightly increase the area in which plant communities will be exposed to air emissions that exceed recommended thresholds for vegetation. The contribution of the Project to cumulative effects on terrestrial vegetation communities and wetlands in the RSA is predicted to be of low magnitude. Therefore, the cumulative impact rating for vegetation and wetlands is predicted to be low.

8.11 Wildlife

The wildlife study included baseline wildlife surveys (amphibians, reptiles, birds, and mammals) and an assessment of Upgrader development on local and regional wildlife. Surveys completed included winter track counts, owl surveys, amphibian call surveys and breeding bird surveys.

Impacts from various Project features were assessed, including: sensory disturbance (noise and light), loss and/or alteration of habitat, mortality due to traffic incidents and habitat destruction, and air emissions.

The loss of some ephemeral wetlands will lead to the displacement of some amphibians and waterbirds. Small remnant patches of woodlots will be removed, thus some bird species may lose potential nesting or foraging sites. The introduction of higher levels of noise and light may displace some animals from affected areas, while attracting others closer to the sources. The effect of the Project on the valued ecological species is rated as no to low impact. In fact, due to the preservation of the important habitat in SE 2-56-21 W4M and the northern portion of NE 35-55-21 W4M, the reduction in wildlife species richness and/or biodiversity is predicted to be negligible.

8.12 Biodiversity

The biodiversity assessment considered the impacts of ground disturbance and the loss of habitat area on indicators of habitat richness, species biodiversity and habitat fragmentation. In the LSA, habitat richness will be reduced by Project construction due to the complete removal of some habitats. Mitigation is not considered necessary for these impacts except in the case of a Class III wetland. The dewatering of the Class III wetland will be mitigated through the implementation of a compensation program to be designed in conjunction with AENV. Most of the habitats in the LSA that will not be removed exist as a few small patches at baseline and are not expected to show substantially increased fragmentation at closure. Class I/II wetlands and ephemeral draws will show reductions in patch frequency, and total and mean patch area. However, mitigation is not considered necessary for these impacts because these habitats are ephemeral and are typically plowed over to support cropland for several months of each year. The complete removal of some habitats in the LSA may result in a reduction in species diversity at the local scale because some species were found only in the habitats that will be removed. However, these species are not considered rare in the Central Parkland.

In the RSA, habitat richness is expected to be unchanged from baseline levels and the total area, patch frequency and mean patch area of all habitats is expected to be similar at closure to that at baseline.

Therefore, the Project is not expected to substantially impact species diversity at the regional scale. Project contributions to cumulative impacts on landscape and species diversity are expected to be negligible.

8.13 Land Use

Land use considerations in the assessment included: municipal land use objectives, zoning and planning; recreational uses; environmentally important areas; residential areas; agricultural activities/development; and other industrial land uses.

The development of the Project is in compliance with local land use objectives and planning parameters for the area of Strathcona County in which the Project is located. The Upgrader will be built on land zoned for heavy industrial development. Portions of North American's land that are in the transition zone will be used for parking, laydown and stormwater collection. The Project footprint is located entirely on private land owned by North American and access is restricted, including access for consumptive and non-consumptive forms of recreation. The Project footprint does not impact the land use of any municipally, provincially or federally protected environmental areas.

The Project will have a low impact on the existing oil and gas activity on-site. Future development on the Project site will be limited by North American, but it is anticipated that the existing wells will be depleted in the next few years.

The Project will have no cumulative impact on land use in the region.

8.14 Light

A lighting assessment was completed to evaluate potential effects of Project lighting on nearby residences. This was accomplished by studying illuminance levels (light incident on a plane) and luminance levels (the brightness of a point of light) on residential receptors. A baseline was established by taking field measurements of the light levels at specific receptors within 2 km of the Project. Project light levels were then predicted at each receptor using a light level database for existing facilities. Specifically, light levels at a given distance from similar facilities were applied to receptors at the same distance from the Project. Predictions were then compared to baseline measurements and applicable criteria.

Results indicate that most receptors will not experience a measurable increase in illuminance or experience luminance values that are different than baseline measurements. The exceptions are two residential receptors (R14 and R24) which, due to their proximity to the Project, may potentially experience higher light levels. The increased light levels however, remain below applicable residential criteria. Cumulative effects from new or existing light sources in addition to the Project are not expected to occur.

8.15 Historical Resources

A Historical Resource Impact Assessment (HRIA) was conducted. The HRIA consisted of a literature review followed by a series of mapping and field surveys on the Upgrader site.

During previous historical resource studies in the region, six archaeological and historic sites have been recorded. Three new archaeological sites and five historic homesteads were recorded during the Upgrader HRIA. The archaeological sites that were discovered are similar to others in the area. The new sites are located in a portion of the site that will not be disturbed by construction of the Upgrader, and as such no negative impacts will result. No palaeontological material was noted during the field surveys.

Through consultation with, and review by, Alberta Tourism, Parks, Recreation and Culture, it has been confirmed that no additional historical resources site investigations or monitoring are required.

9 SOCIO-ECONOMIC SUMMARY

The North American Upgrader is a 243,000 bpsd upgrader with an estimated overall capital cost of $16 billion, including gasification components. The Project will be constructed in multiple phases creating 24,000 person-years of construction and engineering employment over a 16-year period. The construction labour force is expected to peak at approximately 3,000 on-site workers in 2017.

Average annual operations expenditure is estimated at $357 million, excluding purchased electricity and natural gas, or approximately $600 million in total per year. The Project is expected to create 525 full-time direct operating jobs and 75 full-time equivalent contracted positions.

With regard to both the construction and operations of its Upgrader, North American promotes local sourcing. Following the policies and practices of StatoilHydro, its parent company, North American is committed to developing sustainable and competitive local enterprises.

North American has selected the proposed location of the Upgrader in part due to the region's large population base, and its associated diversified economy, amenities and social infrastructure. Measured against the region's large base, the Project is expected to have a small effect on the regional social infrastructure. Project-related impacts include changes in traffic volumes and patterns in the immediate vicinity of the Project site. Overall, the Project is expected to make a positive contribution to the local, provincial and national economies, and strengthen its host and neighbouring communities.

The proposed development timeline of the Project overlaps with other upgrader construction in the region. When evaluated together, the cumulative activity of oil sands investment represents high levels of direct economic investment and on-site construction workforces, as well as resultant indirect and induced economic activity and employment creation. Cumulative upgrader construction and operations activity is expected to support continued strong employment and population growth in the region.

Generally, the strong economic growth is contributing to skill shortages in the region. Other areas affected by economic growth include housing and temporary accommodation, health and social services. A number of government-led initiatives are underway to address and manage growth pressures in the region. In light of these initiatives, and taking into consideration the region's large and diversified base, the impact of the North American Upgrader and other upgrader projects on the social fabric of the region is likely to be minimal.

10 PUBLIC CONSULTATION

10.1 Introduction

North American is committed to creating and maintaining a constructive dialogue with regional stakeholders to ensure the environmental, social and economic sustainability of the Project. North American's primary objective of the public consultation program is to develop and maintain the trust of all stakeholders. In order to realize this objective, North American has developed a public consultation program that focuses on:

- Building a working relationship with the various stakeholders through early and ongoing consultation;
- Facilitating public understanding of the Project and its potential impacts, both positive and negative;
- Enhancing North American's understanding of stakeholder priorities, experiences and concerns related to the Project and other projects in the region;
- Implementing innovative approaches to issue discussion and conflict resolution in order to maximize the opportunity for mutually acceptable solutions; and
- Promoting effective communication between stakeholders and North American regarding all Project phases, from planning, construction and operation through to decommissioning.

10.2 Goals

The goals of North American's public consultation program are to:

- Effectively identify stakeholders;
- Make contact with all identified stakeholders;
- Proactively provide stakeholders with clear and relevant information;
- Identify stakeholder issues and concerns;
- Involve community stakeholders in planning, design and implementation of the Project in order to address these concerns; and
- Be a good neighbour.

10.3 Public Consultation Program Methods

North American has designed its public consultation program to be as inclusive as possible and has met or exceeded the requirements outlined in the TOR.

10.3.1 Geographic Area for Stakeholder and Public Involvement

The Local Stakeholder Engagement Area (LSEA) for public consultation is defined as a 5 km radius from the property boundary of the Project lands (Appendix D). While North American identified, consulted with, and continues to consult with landowners, land users, local groups and occupants within this 5 km radius, North American also informed stakeholders outside of the LSEA through media advertisements and open houses. Stakeholders are added to the stakeholder list as they become known to North American.

10.3.2 Preparation of a Stakeholder List and Distribution of Information

In November 2006, a preliminary stakeholder list was compiled that included the following: landowners and occupants in the LSEA; local special interest groups; nearby industrial stakeholders; and government organizations (municipal and provincial). The list was expanded as additional stakeholders were identified.

Interactions with stakeholders are being documented. Actions taken to address stakeholder issues, suggestions, and concerns are also being recorded.

In order to ensure that stakeholders were identified, the following engagement tools were utilized:

- Direct contact – Direct contact was used primarily for the stakeholders that were located within the LSEA. Direct contact involved addressed mailings, phone calls, and face to face visits. This method was also used for contacting known special interest groups, government and industry.
- Website – The North American website contains relevant information on the Project and appropriate contact information (www.naosc.com).
- Open houses – Open houses were used to introduce North American to the local community; to present details of the Project and EIA process; to make the public aware of avenues for providing input to the process; and to discuss areas of interest or concern.
- Media advertising – advertisements in local and regional newspapers were used to inform a much larger geographic and population base about the details of the Project and any upcoming open houses, and to provide relevant contact information.
- Local office - A North American Upgrader Community Affairs Office (the Office) was set up at the Project site and is regularly staffed by the North American Stakeholder Engagement Advisor (the Advisor). The Advisor regularly attends community events.

10.4 Public Consultation Activities

The following sections outline the consultation activities that have taken place with each stakeholder group up to October 31, 2007.

10.4.1 Stakeholders in the LSEA

Stakeholders in the LSEA include landowners, renters, and people who have an interest in the area. A land title search was conducted to identify landowners within the LSEA except within the Town of Bruderheim.

Initial one-on-one consultation has focused on all stakeholders within 1.6 km from the Project property boundary. North American has notified stakeholders within 5 km of the Project property boundary through mail outs and face to face contact. It is North American's intention to have face to face consultation with as many people within 5 km of the Project property boundary as possible.

Individual visits with residents within the LSEA began in November 2006. Landowners were given an overview of the Project and an information package (Appendix D) and were invited to provide feedback and provide their contact information for future consultation activities. Information was mailed to non-resident landowners about the Project. A public disclosure document (PDD) (Appendix D) was distributed to everyone identified during the land title search. Addresses for returned mail were checked and updated. North American continues to try to contact non-resident landowners and update the list with new or revised information as it is obtained.

Non-addressed mailings have been distributed in the Town of Bruderheim. On the advice of Town Council, Bruderheim residents have been consulted through the open houses and follow-up visits on request.

10.4.2 Open Houses and Community Consultation

The consultation program for the surrounding communities involved meeting with elected officials, holding open houses, directly contacting stakeholders, and issuing media advertisements.

In October 2006, and before the PDD was released in March 2007, North American representatives met with elected officials from the Town of Bruderheim, Strathcona County, Lamont County (with representation from the Town of Lamont), and the Mayor and Development Officer from the City of Fort Saskatchewan.

A public open house was held on January 25, 2007, in Bruderheim. The open house was announced through newspaper advertisements and mail drops at the Bruderheim Post Office and Rural Route 2 of Fort Saskatchewan. The open house featured a series of displays and a short information package. Staff from North American was on hand to answer questions. The open house was attended by 133 people.

After the release of the PDD, two additional open houses were held. The open houses were advertised by mail drops in Bruderheim, Lamont, and Rural Route 2 of Fort Saskatchewan. Advertisements were placed in local newspapers and direct mail was sent to landowners within 5 km and stakeholders that were in the stakeholder database at the time. An open house was held on April 17, 2007 in Josephburg and was attended by 46 people. Another was held on April 18, 2007 in Lamont and was attended by 39 people. The open houses featured a number of displays, copies of the PDD, and the proposed TOR. North American staff were on hand to answer questions.

On April 20, 2007, North American was a participant in the Fort Saskatchewan Chamber of Commerce Trade Show and North American staff were available to answer questions regarding the Project. Approximately 250 people visited the North American booth.

On June 10, 2007, North American hosted a community picnic to celebrate the grand opening of the Community Office. Approximately 200 people were in attendance. North American staff were available to answer questions and provide information on the Project.

In addition to the formal, organized events, stakeholders are encouraged to stop by the Office to ask questions or discuss the Project. Issues and concerns identified during these conversations are documented. The Stakeholder Engagement Advisor also makes regular trips into the surrounding communities, including Bruderheim, and is available to discuss the Project.

10.4.3 Government Organizations

Regulators were primarily contacted directly through either phone calls or face-to-face meetings. Table 10.4-1 provides a description of the government consultation that has occurred to date.

Table 10.4-1 Government Consultation

Government Organization	Date	Topic
City of Edmonton	September 6, 2006	Meeting with the Mayor and advisors to present information related to the Project.
AENV	October 12, 2006	A Project overview was given by North American to the Director of the Northern Region and the EIA Review Team.
Town of Bruderheim	October 18, 2006	An introduction to North American and the Project was given to the Town of Bruderheim Council.
City of Fort Saskatchewan	October 24, 2006	An introduction to North American and the Project was given to the Mayor and Economic Development Officer of the City of Fort Saskatchewan.
Strathcona County	October 24, 2006	An introduction to North American and the Project was given to the Strathcona County Council.
Town of Lamont	October 27, 2006	An introduction of North American and the Project was given to the Lamont County Council with representation from the Town of Lamont attending.
Lamont County	October 27, 2006	An introduction to North American and the Project was given to the Lamont County Council with representation from the Town of Lamont attending.
EUB	July 27, 2007	Meeting with Bob Germaine to discuss public consultation requirements.
City of Edmonton	July 30, 2007	An introduction to North American and the Project was given. The intent of the meeting was to open the lines of communication between North American and the City of Edmonton to discuss areas of mutual interest.
City of Edmonton	August 14, 2007	Participated in a series of workshops entitled Edmonton Region Growth Management Strategy hosted by the City of Edmonton to develop the regional growth strategy.
Strathcona County	August 15, 2007	The focus of the meeting was for Strathcona County to give industry an overview of the labour strategy and its intended direction.
Canadian Environmental Assessment Agency	October 16, 2007	Representatives from North American met with the Director for Alberta and the Northwest Territories to review the TOR for the Project.

10.4.4 Special Interest Groups and Non-Governmental Organizations (NGOs)

There are a number of special interest groups and NGOs that have been consulted regarding the Project. Table 10.4-2 presents a description of the organizations and the consultation that has been conducted.

Table 10.4-2 Special Interest Group and NGO Consultation

Group Name	Date	Topic
The Friends of Lamont County (FOLC)	February 5, 2007	The Stakeholder Engagement Advisor made a presentation and handed out an information package to the FOLC, before the PDD was available.
Fort Saskatchewan Rotary Club	April 24, 2007	A presentation was given to the Fort Saskatchewan Rotary Club to introduce the Project and to answer any questions. The PDD and TOR were distributed to attendees.
Astotin Creek Residents Coalition	April 26, 2007	North American attended a joint industry meeting and made a short presentation on the Project.

10.4.5 Industry Organizations

Other industrial operators in the area have been consulted primarily through direct contact, either through phone calls or face-to-face meetings. Most of the other industrial operators are involved with the Northeast Region Community Awareness and Emergency Response (NR CAER) and the NCIA and were consulted through North American's involvement with these organizations. Table 10.4-3 presents a description of the consultation with industry organizations.

Table 10.4-3 Industry Organization Consultation

Operator Group Name	Date	Topic
Northeast Region Community Awareness and Emergency Response (NR CAER)	On-going	North American has been an active participant in the NR CAER group since January 2007.
Alberta's Industrial Heartland (AIH)	On-going	On October 21, 2006, a collaboration session was attended by North American and AIH in order to address stakeholder concerns. The issues generally focused on emergency response, cumulative effects, traffic, and health effects due to air emissions. On April 11, 2007, North American attended an AIH Round Table that occurred in Fort Saskatchewan. On June 26, 2007, North American attended an AIH Forum that occurred in Fort Saskatchewan.
Alberta Capital Region Alliance (ACRA)	March 1, 2007	North American gave a presentation to ACRA representatives in order to answer questions regarding the Project.
Northeast Capital Industrial Association (NCIA) Upgrader Subcommittee	On-going	North American attends the monthly meetings of this subcommittee to work on industry strategies for air and water management.
Fort Air Partnership (FAP)	On-going	North American is a participant in the FAP via its membership in the NCIA.

10.4.6 Industry and Business Stakeholder Consultation

There are several companies and farming businesses that are located adjacent to the Project site, or are associated with the Project site, as outlined in Table 10.4-4. These companies and businesses have been informed of North American's plans to construct an Upgrader through local community meetings, direct discussions involving potential commercial arrangements, or direct disclosure. In addition, North American has notified companies and individuals that hold mineral resource rights beneath the Project site. North American is not aware of any objections from these stakeholders.

Table 10.4-4 Industry and Business Consultation

Company Name	Comments	Consultation
Sunwest Energy Marketing	This company is developing plans for storing hydrocarbons in the salt formations adjacent to and under one of the Project site quarter sections.	This company has been informed of North American's development plans. Discussions are expected to be ongoing for some time as plans are advanced.
Providence Grain Group Inc.	This company operates a grain receiving and shipping terminal, and is located adjacent to the southeastern edge of the Project site. Providence would like to expand their operation and are working on an expansion plan with North American.	This company has been informed of North American's development plans. Discussions have been ongoing for several months regarding potential joint venture railyard and other infrastructure, and its plans for expansion.
Aruiga Energy Inc.	Currently owns four producing wells on the Project site. These wells have a series of surface leases, rights of way, road access agreements and a surface rights board entry order.	This company has been informed of North American's development plans. Discussions are ongoing.
ATCO Pipelines	ATCO has approached North American regarding commercial opportunities for raw water supply from ATCO facilities, fuel gas supply to the upgrader, and potential storage opportunities.	This company has been informed of North American's development plans. Discussions with this company are ongoing.
TransCanada Pipelines	TransCanada has a terminal near the Project site. North American has discussed using this terminal for fuel gas supply to the Upgrader, and potential pipeline and terminal use opportunities.	This company has been informed of North American's development plans. Discussions with this company are ongoing.
Husky Energy	Husky has 4 abandoned wells on the Project site. Three have reclamation certificates and one is in the final stages of testing and cleanup in the attempt to have the reclamation certificate granted. The wells are 6-35, 7-2, 11-36 and 6-36 respectively.	A letter has been sent to this company informing them of North American's plans to develop an upgrader at this site.
Encana Corporation	This company owns petroleum and natural gas and coal rights under land owned by North American.	A letter has been sent to this company informing them of North American's plans to develop an upgrader at this site.
Elk Island Terminals Inc.	This company owns salt rights for hydrocarbon storage under land owned by North American.	A letter has been sent to this company informing them of North American's plans to develop an upgrader at this site.
Enbridge Pipelines Inc.	Enbridge is currently constructing pipelines and a terminal near the Project site. North American has discussed potential pipeline and terminal use opportunities.	This company has been informed of North American's development plans. Discussions with this company are ongoing.
The Hutterian Brethren Church of Scotland	Farm lease on a portion of the Project site.	This group has been informed of North American's development plans.
Farm lessee 1	Farm lease on a portion of the Project site.	This farmer has been informed of North American's development plans.
Farm lessee 2	Farm lease on a portion of the Project site.	This farmer has been informed of North American's development plans.
Farm lessee 3	Farm lease on a portion of the Project site.	This farmer has been informed of North American's development plans.
Farm lessee 4	Farm lease on a portion of the Project site.	This farmer has been informed of North American's development plans.

10.4.7 Aboriginal Consultation

On June 8, 2007, in response to an invitation from the Alexander First Nation, the Stakeholder Engagement Advisor attended an industry workshop hosted by the Alexander First Nation to discuss the Alexander First Nation's consultation policy. The workshop was attended by several other industrial operators in the region and did not specifically discuss the Project.

10.4.8 Other Consultation and Collaboration

Other stakeholders in the area have been consulted primarily through direct contact, either through phone calls or face-to-face meetings. Table 10.4-5 presents a description of the consultation.

Table 10.4-5 Other Consultation and Collaboration

Operator Group Name	Date	Consultation and Collaboration Completed
North Saskatchewan Watershed Alliance (NSWA)	November 15, 2006	Representatives from North American gave a presentation to NSWA in order to introduce the Project and identify opportunities to work together.
Water Committee for the Industrial Heartland and Capital Region	On-going	North American participates in this multi-stakeholder task force convened by AENV as part of the Industrial Heartland project. This committee is investigating alternative water supply sources for upgraders in the AIH region.

10.5 Concerns and Issues

Through the public consultation process, stakeholders shared with North American the issues of greatest concern to them. The three most frequently raised concerns are cumulative in nature and include:

- The cumulative loss of agricultural land due to the creation and subsequent heavy industrial zoning of AIH;
- Cumulative impacts perceived to be associated with the concentration of industry in the region; and
- Rising levels of traffic in the area.

There have been no concerns identified by Aboriginal stakeholders that suggest that their traditional lifestyle would be impacted by the Project.

North American recognizes the need to address stakeholder concerns on both a Project specific and a cumulative basis. Stakeholder concerns, North American's responses to those concerns, and the section of the EIA that addresses each concern are summarized in Table 10.5-1.

Table 10.5-1 Stakeholder Concerns and Summary of Action Taken

Stakeholder Concern	Summary of Action Taken	Reference in EIA
Air		
Impact of dust generated during the construction phase	Wet suppression and/or chemical suppression will be used to reduce the potential for wind-blown dust from relatively long-term unpaved roads or parking lots under dry, windy conditions. Permanent access roads will be paved to reduce fugitive dust emissions.	Volume 1, Section 6 Volume 2, Section 2
Chronic human health impacts (e.g., cancer, asthma, etc.) caused by the Project and cumulative effects in the region	Generally, the Project's contribution to chronic health risks is predicted to be negligible. The results of the chronic inhalation assessment are likely conservative.	Volume 2, Section 4
Animal health impacts caused by the Project and cumulative effects in the region	Long-term exposure to the modelled air quality values for the Project is not deemed critically detrimental to wildlife. The long-term effects of emissions are not expected to affect wildlife in the LSA either through inhalation or consumption.	Volume 4, Section 11
Specific impacts of sulphur dust on human health, land and plants	The predicted risk quotient (RQ) value for SO_2 is greater than one only for the industrial receptor group, and only for the acute case. The predicted short-term SO_2 concentrations are not expected to result in adverse health effects to the industrial receptor group. Long term exposure to the modelled SO_2 values for the Project is not deemed critically detrimental to wildlife. Approximately 187 ha (0.1% of the RSA) will be exposed to annual average SO_2 concentrations exceeding critical concentration thresholds for cryptogams (10 $\mu g/m^3$).	Volume 2, Section 4 Volume 4, Section 10 Volume 4, Section 11
Potential impacts of emissions from upsets causing flaring	A flare management plan will be developed to identify and evaluate potential flaring scenarios based on refined engineering operations. Flaring events will be documented and reviewed on an ongoing basis to examine opportunities to reduce the frequency, duration and magnitude of flaring.	Volume 1, Section 6 Volume 2, Section 2
Need for air monitoring in the valley near Bruderheim	North American is a member of the NCIA which addresses air quality issues in the region. North American also participates in and supports the FAP in the ongoing and future regional air monitoring efforts. Air monitoring near Bruderheim will be addressed in conjunction with the NCIA and the FAP.	Volume 1, Section 6 Volume 2, Section 2
Noise		
Noise from construction phase activities (including traffic) in the early morning and late evening	Project construction noise is likely to be within acceptable limits due to the existing noise levels and mitigation measures to be utilized by North American. There will be times, however, when construction-related activities result in subjectively very noticeable noise levels for the adjacent residents. Efforts will be undertaken to minimize these impacts	Volume 2, Section 3
Noise from operations phase activities (including flaring)	All predicted sound levels for the Project are at or within the PSLs presented in EUB Directive 038 (Noise Control). North American will actively participate in the NCIA Noise Management Plan. As a participant, North American will conduct ongoing assessments of its noise mitigation program and maintain best practices and continuous improvement programs in facility noise control.	Volume 2, Section 3

Stakeholder Concern	Summary of Action Taken	Reference in EIA
Health		
Human health impacts (e.g., cancer, asthma, etc.) caused by the Project and cumulative effects in the region	Generally, the Project's contribution to chronic health risks is predicted to be negligible. The results of the chronic inhalation assessment are likely conservative.	Volume 2, Section 4
Hydrogeology		
Potential groundwater impacts from accidental spills and releases	North American will conduct groundwater monitoring and implement mitigative measures in the vicinity of surface facilities to ensure that any releases will be identified and response measures implemented to minimize impacts. Because of these mitigative measures, the depth below ground surface, and the low hydraulic conductivity of the overlying till, accidental releases from ground surface pose little threat to the Beverly Channel Aquifer.	Volume 3, Section 5
Impacts to local water well levels caused by dewatering	Dewatering of excavations may occur during construction of the Upgrader. Assuming a conservative required drawdown of 6 m for a period of 6 months, the measurable drawdown is predicted be localized (not extending beyond 20 m from the excavation). Based on the low impact to water levels in the Lower Sand and Gravel Aquifer, dewatering of excavations would have no detectable effect on water levels in the Beverly Channel and Bedrock Aquifers.	Volume 3, Section 5
Surface Water Quality		
Impacts to water quality caused by acid deposition and sulphur dust	The potential for acidification of the study lakes is considered extremely low, due to the high acid neutralizing capacity of the lakes and the small incremental increase in PAI caused by the Project. The residual effects of acid emissions on the water quality of the study lakes will be negligible.	Volume 3, Section 7
Impacts to water quality caused by effluent discharges into the North Saskatchewan River	Modelling of the predicted effluent discharge indicates that AENV's mixing zone regulations will be met in the LSA. No chronic water quality guidelines will be exceeded at the edge of the mixing zone of the proposed treated effluent outfall (1.29 km downstream) with the exception of total phosphorus and total nitrogen that are already exceeded upstream of the proposed discharge. Effluent discharge to the NSR will have a low impact on regional water quality.	Volume 3, Section 7
Fish and Benthics		
Impacts to aquatic life caused by water withdrawal from the North Saskatchewan River	Changes in stream flows and lake levels will be very limited, and the nearest water body with fish habitat potential is located well outside the zone of predicted impact. Environmental impacts on the receiving environments are predicted to be negligible.	Volume 3, Section 8
Impacts to aquatic life caused by effluent discharges into the North Saskatchewan River	Based on proposed water treatment plans and the results of conservative water quality modelling, environmental impacts to fish and fish habitat as a result of wastewater discharge are predicted to be low. The collection and treatment of stormwater runoff will limit any impacts to surface water quality.	Volume 3, Section 8

Stakeholder Concern	Summary of Action Taken	Reference in EIA
Wildlife		
Disturbance of wildlife by traffic and noise during construction phase	It is predicted that wildlife in habitats adjacent to the LSA will be temporarily displaced due to the noise from construction activities. Noise levels are predicted to subside to tolerable levels (below 55 dB) at the locations of suitable wildlife habitats (300-400 m from the Project site) due to distance attenuation. At the predicted levels, habituation will likely occur for both birds and mammals. The noise levels associated with the Project are anticipated to have a negligible impact on wildlife health, behaviour and persistence.	Volume 4, Section 11
Loss of wildlife habitat during construction and operations phase	In general, the wildlife habitat of the LSA is of poor quality in comparison to the RSA. Habitat in which sensitive species were noted will be retained in part or in whole. In addition to the preservation of a large portion of the important habitat in the LSA, the Project will also include the creation of new or enhanced wetlands to offset the loss of larger wetlands that are found within the developmental footprint.	Volume 4, Section 11
Land Use		
Conversion of high quality farm land to industrial use	The Project will be located within the AIH, an area of the province that was previously designated for heavy industrial development.	Volume 5, Section 13
Loss of hunting opportunities during operations phase	The Land Use LSA is located on private land and therefore access is restricted, including access to the area for hunting purposes.	Volume 5, Section 13
Socio-Economic		
Impacts on property values in the transition zone areas	North American supports and helps fund the Voluntary Property Purchase Program (VPPP). The VPPP is a collaborative effort of residents, industry and municipal representatives and is administered under the AIH Land Trust Society. Property value assessments are conducted by third party appraisal companies.	Volume 5, Section 15
Application of the Land Trust buyouts as it relates to property value	North American supports and helps fund the VPPP. The VPPP is a collaborative effort of residents, industry and municipal representatives and is administered under the AIH Land Trust Society. Property value assessments are conducted by third party appraisal companies.	Volume 5, Section 15
Historical		
Loss of historic resources	Three new archaeological sites were identified by the HRIA; however, these new sites are located in a portion of the site that will not be disturbed by construction of the Upgrader. No other potential historic resources were identified.	Volume 5, Section 16
Light		
Lack of darkness at residences near the Project site	All but one of the receptors evaluated are not expected to experience a measurable increase in illuminance levels. One receptor may experience a measurable increase in illuminance levels; however, the increased illuminance levels will remain within the LEED criteria for urban residential areas. Luminance levels will be similar to baseline conditions.	Volume 5, Section 14

Stakeholder Concern	Summary of Action Taken	Reference in EIA
Traffic		
Potential travel delays caused by increased traffic on Highway 15	Strathcona County has recently completed a transportation study, which takes into consideration anticipated industrial activity in the foreseeable future. This study included several road expansions and upgrades to accommodate the expected traffic increase. North American will work with other stakeholders to follow up on possible implementation of recommended road improvements arising out of the transportation study. In addition, North American will provide a bus service for construction workers and will schedule material and equipment deliveries in off-peak hours, where appropriate.	Volume 5, Section 15
Need to enforce traffic laws on a larger volume of vehicles	Policing service for the County of Strathcona is provided by the Royal Canadian Mounted Police (RCMP) under a municipal services contract. North American respects the needs for police services and is committed to working and consulting with local police services and engaging security services, where appropriate.	Volume 5, Section 15
Potential safety concerns (especially school buses on rural roads) caused by increased traffic	North American will work with other stakeholders to follow up on possible implementation of recommended road improvements arising out of the transportation study. In addition, North American is committed to working and consulting with local police services, where appropriate, to ensure the safety of local residents.	Volume 5, Section 15
Emergency Response		
Inadequate response time after notification of an incident (i.e., releases, etc.)	A site specific ERP will be developed to address emergency preparedness and response needs for the Project. The ERP will be developed in accordance with EUB Directive 071, Emergency Planning and Response Management for the Upstream Petroleum Industry. In the event of an incident, all potentially-affected parties will be contacted in accordance with the ERP.	Volume 1, Section 6
Inadequate area notified of an incident (i.e., releases, etc.)	A site specific ERP will be developed to address emergency preparedness and response needs for the Project. The ERP will be developed in accordance with EUB Directive 071, Emergency Planning and Response Management for the Upstream Petroleum Industry. A list of potentially-affected parties will be established as part of the ERP development.	Volume 1, Section 6
Lack of information provided in public notifications	A site specific ERP will be developed to address emergency preparedness and response needs for the Project. The ERP will be developed in accordance with EUB Directive 071, Emergency Planning and Response Management for the Upstream Petroleum Industry. In the event of an incident, all public notifications will be conducted in accordance with the ERP.	Volume 1, Section 6
Lack of notification to schools outside the response zone who bus children into the response zone	A site specific ERP will be developed to address emergency preparedness and response needs for the Project. The ERP will be developed in accordance with EUB Directive 071, Emergency Planning and Response Management for the Upstream Petroleum Industry. A list of potentially-affected parties will be established as part of the ERP development, which will include contact information for all local schools.	Volume 1, Section 6

10.6 Project Updates

10.6.1 Agreements Reached with Stakeholders Regarding North American's Operations and Activities

To date, no issues have been identified by stakeholders necessitating that agreements be reached.

10.6.2 Unresolved Issues

Issues identified by stakeholders are presented in Table 10.5-1.

10.7 Ongoing Public Consultation

North American is committed to maintaining the public consultation program throughout the EIA review process and throughout the life of the Project. North American will continue the process using the most appropriate method of contacting stakeholders to communicate Project milestones and provide Project updates. Methods will include, but are not limited to, the following:

- Newsletters - North American will produce and distribute a regular newsletter that provides Project updates to stakeholders in the stakeholder database.
- Open Houses - Future open houses will be held on a regular basis to provide the communities and stakeholders with an opportunity to meet with North American staff to discuss the Project. North American will also schedule open houses during the application public comment period.
- Local Company Representative - North American will maintain a company representative at the Office throughout the life of the Project. This representative will serve as the local point of contact for stakeholders requiring information or wishing to express concerns regarding North American's activities.
- Meetings with Stakeholders – Representatives of North American will meet with stakeholders throughout the life of the Project to cooperatively address any issues or concerns that may arise.
- Regional Cooperative Efforts - North American will continue to be involved in regional cooperative efforts such as the NCIA.
- Media - North American will use the media to deliver important messages about the Project in order to reach as many stakeholders as possible. The media will also be used to announce open houses and regulatory submissions.
- Mailings - North American will use direct mailings to all stakeholders listed in the stakeholder database to update the stakeholders on Project activities and milestones and will use non-addressed mailings to update local residents, as appropriate.

11 LITERATURE CITED

Alberta Environment (AENV). 1996. Guideline for Monitoring and Management of Soil Contamination Under EPEA Approvals. Produced by Chemicals Assessment and Management Division. Environmental Regulatory Service. ISBN 0-7785-0817-X. Edmonton, AB. 7 pp.

AENV. 1997. Reclamation Certificates for Overlapping Activities. C&R/IL/97-6. October 1997. Edmonton, AB. 3 pp.

AENV. 1998. Voluntary Shutdown Criteria for Construction Activity or Operations. C&R/IL/98-4. March 1998. Edmonton, AB. 2 pp.

AENV. 1999. *Environmental Protection and Enhancement Act* Approvals and Registrations Procedure Regulation Applications for Sour Gas Processing Plants and Heavy Oil Processing Plants: A Guide to Content. Revised September 1999. Available on the internet at www.gov.ab.ca/env/protenf/publications/appsourgas.pdf.

AENV. 2000a. Borrow Excavations. C&R/IL/00-3. March 2000. Edmonton, AB. 2 pp.

AENV. 2000b. Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body. *Water Act – Water (Ministerial) Regulations.*

AENV. 2000c. Code of Practice for Watercourse Crossings. *Water Act – Water (Ministerial) Regulations*.

AENV. 2000d. Environmental Protection Guidelines for Roadways. Conservation and Reclamation Information Letter. C&R/IL/00-5. November 2000. Edmonton, AB. 5 pp.

AENV. 2001. Alberta Environmental Code of Practice for Pesticides. Alberta Queens Printer. Edmonton, AB.

AENV. 2002. Environmental Protection Guidelines for Oil Production Sites – Revised January 2002. C&R/IL/02-1. March 2002. Edmonton, AB. 5 pp.

AENV. 2003. Weeds on Industrial Development Sites. AENV. Edmonton, AB. Available on the internet at http://www.environment.gov.ab.ca/info/library/5929.pdf.

AENV. 2004. Storing Hazardous Waste & Recyclables. August 2004. Edmonton, AB. 2 pp.

AENV. 2005. Approval No. 49587-01-00 for the Construction, Operation and Reclamation of the Scotford Oil Sands Processing Plant. Edmonton, AB.

Alberta Environmental Protection (AEP). 1994. Guide for Pipelines Pursuant to the *Environmental Protection and Enhancement Act and Regulations*. Available at: http://www3.gov.ab.ca/env/protenf/publications/GuideForPipelinesPursuantToTheEPEARegulations_March1994.pdf

AEP. 1995a. Environmental Protection Guidelines for Electric Transmission Lines. C&R/IL/95-2. Edmonton, AB.

AEP. 1995b. Reclamation Criteria for Wellsites and Associated Facilities - 1995 Update. C&R/IL/95-3. Edmonton, AB.

AEP. 1996a. Alberta User Guide for Waste Managers. August 1996. Edmonton, AB. 520 pp.

AEP. 1996b. Conservation and Reclamation Regulation of AEPEA. AR 115/93, as amended. October 1996. Edmonton, AB.

Agronomic Interpretations Working Group (AIWG). 1995. Land Suitability Rating System for Agricultural Crops: 1. Spring-seeded Small Grains. Technical Bulletin 1995-6E. Centre for Land and Biological Resources Research, Agriculture and Agri-Food Canada. Ottawa, ON.

BA Energy Inc. 2004. Application for Approval of the Heartland Upgrader Project. Submitted to AENV and Alberta Energy and Utilities Board (EUB). May 2004.

EUB. 1991. Directive 023 – Guidelines Respecting an Application for a Commercial Crude Bitumen Recovery and Upgrading Project. Available on the internet at http://www.eub.ca/docs/documents/directives/Directive023.pdf

EUB. 1995. Directive 055 – Storage Requirements for the Upstream Petroleum Industry. Available on the internet at http://www.eub.ca/docs/documents/directives/Directive055.pdf.

EUB. 1996. Directive 058 – Oilfield Waste Management Requirements for the Upstream Petroleum Industry. November 1996. Available on the internet at http://www.eub.ca/docs/documents/directives/Directive058.pdf

EUB. 2001. Interim Directive ID 2001-03: Sulphur Recovery Guidelines for the Province of Alberta. Available on the internet at http://www.eub.ca/docs/ils/ids/pdf/id2001-03.pdf

EUB. 2003. Directive 071 – Emergency Preparedness and Emergency Response Requirements for the Upstream Petroleum Industry. Available on the internet at http://www.eub.ca/docs/documents/directives/Directive071.pdf

EUB. 2007. Directive 038 – Noise Control. Available on the internet at http://www.eub.ca/docs/documents/directives/Directive038.pdf

North West Upgrading Inc. 2006. North West Upgrader Project: Integrated Application for Approval. Submitted to AENV and the EUB. January 2006.

Petro-Canada Oil Sands Inc. (PCOSI). 2006. Application for Approval of the Sturgeon Upgrader. Submitted to the EUB and AENV. Submitted by PCOSI on behalf of Fort Hills Oil Sands L.P. December 2006.

Shell Canada Limited. 2005. Scotford Upgrader Expansion Project. Environmental Impact Assessment and Application for EPEA Renewal and Amendment. Calgary, AB.

Shell Canada Limited. 2007. Application for Approval of the Scotford Upgrader 2 Project. Submitted to EUB and AENV. July 2007.

Strathcona County. 1998. Municipal Development Plan, Bylaw 38-98. August 1998. Available on the internet at: http://www.strathcona.ab.ca/Strathcona/Departments/Planning+and+Development+Services/Zoning+and+planning+documents/Municipal+Development+Plan/default.htm

Strathcona County. 2001a. Strathcona County; Alberta's Industrial Heartland Area Structure Plan. May 2001. Available on the Internet at: http://www.industrialheartland.com/pages/main.html

Strathcona County. 2001b. Strathcona County Land Use Bylaw, Bylaw 8-2001. Strathcona County, AB. July 10, 2001.

Strathcona County. 2006. Strategic Plan. November 2006. Available on the internet at: http://www.strathcona.ab.ca/Strathcona/default.htm

Synenco Energy Inc. 2006. Application for Approval of the Northern Lights Upgrader Project. Submitted to AENV and EUB. September 2006.

11.1.1 Websites Referenced

Alberta Capital Region Alliance (ACRA). 2007. www.capregion.ab.ca

Alberta's Industrial Heartland. 2007. www.industrialheartland.com.

Friends of Lamont County. 2007. www.folc.ca.

Northeast Capital Industrial Association (NCIA). 2007. www.ncia.ab.ca.

Northeast Region Community Awareness and Emergency Response (NR CAER). 2007. www.nrcaer.com.

North American Oil Sands Corporation. 2007. www.naosc.com

FINAL TERMS OF REFERENCE

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR THE

NORTH AMERICAN OIL SANDS CORPORATION

UPGRADER PROJECT

Strathcona County, Alberta

October 18, 2007

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to identify for North American Oil Sands Corporation (North American) and the public, the information required by government agencies for an Environmental Impact Assessment (EIA) report. North American will prepare and submit an EIA report that examines the environmental and socio-economic effects of the construction, operation and reclamation of the proposed Upgrader (the “Project” or the “Upgrader”) in Strathcona County.

1.2 Scope of Environmental Impact Assessment Report

North American will prepare the EIA report in accordance with these Terms of Reference and the environmental information requirements prescribed under the Environmental Protection and Enhancement Act (EPEA) and Regulations, the Oil Sands Conservation Act (OSCA) and any federal legislation which may apply to the Project. The EIA report will:

a) assist the public and government in understanding the environmental and socio-economic consequences of the Project’s development, operation and reclamation plans, and will assist North American in its decision-making process;
b) include a discussion on the possible measures, including established measures and possible improvements based on research and development to:
   i) prevent or mitigate impacts;
   ii) assist in the monitoring of environmental protection measures; and
   iii) identify residual environmental impacts and their significance including cumulative and regional development considerations;
c) address:
   i) Project impacts;
   ii) mitigation options;
   iii) residual effects relevant to the assessment of the Project including, as appropriate, those related to other industrial operations. As appropriate for the various types of impacts, predictions should be presented in terms of magnitude, frequency, duration, seasonal timing, reversibility and geographic extent.
d) include tables that cross-reference the report (subsections) to these final Terms of Reference; and
e) include a glossary of terms with the definition source and a list of abbreviations to assist the reader in understanding the material presented.

The EIA report will form part of North American’s application to the Alberta Energy and Utilities Board (EUB) and Alberta Environment (AENV) for construction and operation of the Project. A summary of the EIA report will also be included as part of the application.

1.3 Public Consultation

The preparation of the EIA report will include a public consultation program to assist with project scoping and issue identification. The results of these consultations will be documented as part of the EIA report (see Section 9.0). To meet the public consultation requirements North American must, at a minimum, communicate with those members of the public who may be affected by the Project and provide them with the opportunity to participate in the environmental assessment process.

1.4 Proponent’s Submission

North American is responsible for the preparation of the EIA report and related applications.
The submission will be based upon these final Terms of Reference and issues raised during the public consultation process.

2.0 PROJECT OVERVIEW INFORMATION REQUIREMENTS

Provide an overview of the Project, the key environmental, resource management, and socio-economic issues that, from North American's perspective, are important for a public interest decision and the results of the Environmental Assessment process.

2.1 The Proponent

Provide a corporate profile for North American and a brief history of North American's operations including a summary of existing and proposed activities. Provide the legal name of the entity involved and the names of those who are expected to develop, manage and operate the Project.

2.2 Project Need and Alternatives Considered

Discuss the need for the Project and the alternatives to the Project, including the alternative of not proceeding with the Project.

Include the following:

a) an analysis of the alternative means of carrying out the Project that are technically and economically feasible and indicate their potential environmental effects and impacts. Include the rationale for selecting the proposed option;
b) how a balance between environmental, resource recovery or conservation and economic goals has been achieved through planning and preliminary design, highlighting any areas where planning focused on one goal in exclusion of others;
c) contingency plans, if selected major Project components or methods during any phase prove to be unfeasible or do not perform as expected; and
d) the environmental performance of the technology selected and a comparison to the alternative technologies considered.

2.3 Project Components and Development Timing

Provide an overview of the Project activities and physical components. Specifically, provide the following:

a) a summary list, brief description and drawings of the Project components and activities which are addressed in detail under Section 3.1; and
b) the proposed stages or phases of the activities and the expected development schedule, explaining:
    i) the timing and expected duration of key construction, operation and reclamation activities for the life of the Project including mitigation and compensation plans;
    ii) the key factors controlling the schedule and uncertainties; and
    iii) the implications of a delay in the Project development schedule. Consider the regulatory process as a potential delay to the Project development schedule.

2.4 Regulatory and Planning Framework and Classifications

Identify the legislation, policies, approvals, and current multi-stakeholder planning initiatives applicable to this Project. Identify any components of the Project that will require approval(s) under the EPEA and *Water Act* (WA) and that will be constructed within the duration of the approval(s). Address the following:

a) other regulatory approvals that are required and any approvals that have already been issued including provincial, municipal, and federal government requirements;
b) the primary focus of each regulatory requirement, such as water allocation, environmental protection, land use/development, and the element(s) of the Project that is(are) subject to the regulatory requirement;
c) any regulatory classification systems which apply to the Project, such as solid waste or air pollution classifications and land use zones; and

d) a summary of the objectives, methodologies, or guidelines which have been used by North American to assist in the evaluation of the significance of effects.

2.5 Principal Development Area and EIA Study Area

The Principal Development Area (PDA) includes all lands subject to direct disturbance from the Project and associated infrastructure, including access and utility corridors. For the PDA, provide:

a) the legal land description;
b) the boundaries;
c) a map identifying the locations of all proposed development activities; and
d) a map and photo mosaic showing the area proposed to be disturbed in relation to existing topographic features, township grids, wetlands and waterbodies.

Study Areas for the EIA report include the PDA and other areas based on individual environmental components where an effect from the proposed development can reasonably be expected. Identify:

a) the Local and Regional study areas chosen to assess the impacts of the Project and provide maps of appropriate scale to illustrate boundaries; and
b) the rationale used to define Local and Regional Study Areas (see also Section 4.5).

2.6 EIA Summary

Provide a summary of the EIA report. Address:

a) the environmental and land use conditions in the EIA Study Area without the Project;
b) activities and components of the Project that are anticipated to influence environmental and land use conditions;
c) the anticipated environmental effects, with emphasis on regional and cumulative considerations;
d) the proposed mitigation measures, monitoring and management plans;
e) any Project-related residual effects, their contribution to regional cumulative effects, and their implications for the future management of regional cumulative effects; and
f) effects of the environment on the Project.

List and discuss key environmental issues and issues which are important for the achievement of sustainable environmental and resource management that were identified during the preparation of the EIA report and public consultation. Differentiate between emerging issues (with ongoing uncertainties), issues with quantifiable and significant environmental effects, and issues that can be resolved through available technology and existing management approaches. Provide a matrix or summary chart to describe this section.

3.0 PROJECT DESCRIPTION AND MANAGEMENT PLANS

Describe activities and components of the Project and relevant management plans. Provide sufficient scope and detail in the Project description information to allow quantitative assessment of the environmental consequences. If the scope of information varies among components or phases of the Project, provide rationale demonstrating that the information is sufficient for assessment purposes.

3.1 Project Components and Site Selection

3.1.1 Project Components

Describe the nature, size, location and duration of the significant components of the Project including, but not limited to, the following:

a) the plant site and any chemical/fluids storage locations;
b) the design capacities of the Project;
c) temporary structures, dewatering, water control facilities, and processing/treatment facilities;

d) buildings and infrastructure, transportation, utilities, access routes, and storage areas;
e) water source well locations and intakes;
f) the types and amounts of waste materials, locations of waste storage, and disposal sites;
g) a site development plan illustrating the locations of components including an outline of the proposed phasing and sequencing of components (include pre-construction, construction, operation, reclamation, decommissioning, and end land use);
h) how North American incorporated community input for Project design and development; and
i) potential cooperative ventures to minimize environmental impacts.

3.1.2 Site Selection

Discuss the site selection process including, but not limited to, the following:

a) factors that were considered in determining the preferred plant site and associated Project components;
b) the site selection process for the proposed location of Project components;
c) the rationale for choosing the proposed sites instead of alternative sites;
d) the technical, geotechnical, economical, and environmental criteria considered;
e) potential impacts on environmental and land use conditions; and
f) maps of suitable scale showing the location of proposed Project facilities in relation to existing township grids, wetlands, watercourses, waterbodies, and other significant topographic features.

3.2 Process Description

Provide material balances, energy balances, process flow diagrams, and descriptions of the processes. Include:

a) energy and process efficiency for the technologies chosen;
b) alternate technologies considered;
c) shared facilities and utilities associated with the Project;
d) catalysts and chemicals needed for the upgrading processes included in the Project;
e) Project inputs such as energy and water, and the outputs such as emissions and wastes;
f) effect of technology on waste generation and storage requirements, air and water discharges, water requirements, waste streams, and reclamation programs; and
g) source of major feed materials for the upgrading process include bitumen feedstock and limestone, as well as any additional feedstocks.

3.3 Product Handling

Identify the location and amount of all on-site storage associated with production including storage of catalysts, chemicals, products, by-products, intermediates and wastes (additional detail can be found in Section 3.7). Identify potential interactions between stored chemicals and wastes. Identify hazardous by-products that could potentially be formed and process design and operational practices that will minimize their formation. Explain containment and environmental protection measures.

3.4 Utilities and Transportation

Describe and discuss the Project energy requirements, and associated infrastructure and other infrastructure requirements including, but not limited to, the following:

a) the amount and source of energy required for the Project;
b) the options considered for supplying the thermal energy and electric power required for the Project and their environmental implications;
c) worker accommodations and travel routes to the plant site during construction and operation phases, including:
    i. desired traffic routing;
    ii. control methods; and
    iii. road use agreements;

d) any expected changes and impacts in traffic volume by Average Annual Daily Traffic (AADT) and any seasonal variability in traffic volume;
e) the result of consultation with the local transportation authorities including transportation studies that are underway or planned;
f) the alignment, contents, and size of any raw material or product pipelines to be located within the EIA Study Area. If regional pipeline and storage infrastructure is required, identify the locations and routes of these facilities and the authority responsible for their approval, installation and operation;
g) describe sulphur storage (short and long term), transportation (from the Upgrader site) and the effects on local residents;
h) the adequacy in design and upgrades required of all utility lines, roads, and pipeline crossings of roads, rivers and streams with respect to the construction and operation of the facilities;
i) design features to prevent spills, contingencies for spill response, and any environmental risks associated with product releases or management practices;
j) the natural gas source and pipeline, electrical power transmission and access to the Project. Illustrate the proposed location of these facilities. If regional infrastructure is required, identify the locations and routes, and who would be responsible for installation and approval of the facilities;
k) identify cumulative impacts on the transportation network, including any secondary highways leading to Project areas; and
l) plans to minimize the impacts of the Project's energy and infrastructure requirements and associated infrastructure on area residents and businesses.

3.5 Water Supply, Water Management and Wastewater Management

3.5.1 Water Supply

Describe the water supply requirements for the Project including, but not limited to, the following:
the overall water balance(s);

a) the water requirements for construction, start-up, normal operating conditions, worst case conditions, emergency operating situations, decommissioning and reclamation;
b) the variability in the amount of water required on a monthly and seasonal basis as the Project is implemented;
c) the supply options including on-site storage referencing, as appropriate, technical information in the *Water Act* application;
d) the location of water sources/intakes and associated infrastructure (pipelines) and potential modifications with the Project; and
e) intake design, where water is to be sourced from local waterbodies.

3.5.2 Water Management

Provide a Water Management Plan including, but not limited to, the following:

a) measures taken by North American to contribute to the improvement in efficiency and productivity of water use as identified in the Water for Life; Alberta's Strategy for Sustainability;
b) permanent or temporary alterations or diversions of watercourses and waterbodies;
c) factors used in the design of water management facilities including expected flood levels, and flood protection; and
d) an explanation of how this plan will be incorporated into Project design.

3.5.3 Wastewater Management

Provide a Wastewater Management Plan to address site runoff, groundwater protection, deep well disposal, and wastewater discharge including, but not limited to, the following:

a) source, quantity and composition of each wastewater stream from the proposed facilities;
b) those waste substances produced by the Project that are reportable under theNational Pollutants Release Inventory (NPRI), Priority Substances List 1 (PSL1), Priority Substances List 2 (PSL2), and/or Accelerated Reduction and Elimination of Toxics (ARET) substances relevant to the Project;
c) the design of the facilities that will handle, treat, and store wastewater streams;
d) the type, name and quantity of chemicals used in wastewater treatment;
e) options considered for wastewater treatment and management strategies, in the context of best available technologies and best management practices. Include reason(s) (including water quality and environmental considerations) for selecting the preferred options;
f) potable water and sewage treatment systems that will be installed as components of the Project for both the construction and operation;
g) the discharge of aqueous contaminants (quantity, quality, and timing) beyond plant site boundaries and the potential environmental effects of such releases;
h) design parameters for managing site runoff during precipitation and snowmelt events;
i) programs to monitor the effects of Project operations on local surface and groundwater quantity and quality;
j) options considered for wastewater disposal, in the context of best available technologies and best management practices (including zero liquid drainage). Include the reason(s) for selecting the preferred options; and
k) an explanation of how this plan will be incorporated into Project design.

3.6 Air Emissions Management

Develop an emissions profile (type, rate, and source) for each component of the Project including point and area sources, fugitive emissions, and construction emissions. Consider normal operating conditions, worst-case conditions and upset conditions. Include definitions for these conditions.

a) calculate the intensity of Criteria Air Contaminant (CAC) emissions per unit of product processed through the Project and discuss how it compares with similar projects and technology performance;
b) provide explanations, where possible, for any differences between the CAC emission intensities computed for this Project and those of other similar projects.

Discuss the following:

a) any NPRI, PSL1, PSL2, or ARET substances relevant to the Project;
b) any odorous or visual emissions from the proposed Project;
c) the amount and nature of any acidifying emissions, probable deposition patterns and rates and programs North American may implement to monitor the effects of this deposition;
d) the fugitive emissions control program to detect, measure, repair and control emissions and odours from equipment leaks and the applicability of the Canadian Council of Ministers of the Environment’s (CCME) Environmental Code of Practice for Measurement and Control of Fugitive Emissions from Equipment Leaks and the CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks;
e) the emission control technologies proposed for the Project in the context of best-available and economically viable commercial technologies, and the applicability of Alberta Environment and CCME emission control technology guidelines;
f) gas collection, conservation, and applicability of technology for vapour recovery for the Project’s air emissions;

g) control technologies used to minimize air emissions such as sulphur dioxide (SO_2), hydrogen sulphide (H_2S), oxides of nitrogen (NO_x), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH) and particulate matter;
h) technology or management programs to minimize emissions which lead to the formation of particulate matter and ozone (O_3) having regard for the provisions of the CCME Canada wide Standard for Particulate Matter and Ozone;
i) the incremental contribution of the Project to regional (Edmonton Census Metropolitan Area) emissions of $PM_{2.5}$ and PM_{10} and ground-level ozone precursors including NO_x, SO_2, VOC, and ammonia;
j) applicability of sulphur recovery, acid gas re-injection, or flue gas desulphurization to reduce sulphur emissions and applicability of EUB sulphur recovery guidelines (Interim Directive ID 2001-3);
k) non-routine flaring scenarios (e.g. emergencies, upsets, and maintenance), proposed measures to ensure flaring events are minimized and a preliminary flare management plan; and
l) monitoring programs North American will implement to assess air quality and the effectiveness of mitigation, during the Project's development and operation. Discuss how these monitoring programs are compatible with those used by regional multi-stakeholder air initiatives.

3.6.1 Greenhouse Gas Emissions

Provide the following:

a) the expected annual and total greenhouse gas (GHG) emissions over the construction, operation and decommissioning phases of the Project separated by emission sources (i.e. mine sources, gasification, and plant sources etc). Include calculations;
b) the Project's contribution to total provincial and national GHG emissions on an annual basis;
c) the intensity of GHG emissions per unit of bitumen processed through the Project and discuss how it compares with similar projects and technology performance;
d) North American's overall GHG management plans, any plans for the use of offsets, (nationally or internationally) and the expected results of implementing the plans; and
e) details on North American's plans for CO2 once it is captured and (i.e. transportation to market or sequestration) and what effect the CO2 transportation and storage/use will have on both GHG and criteria air contaminant (CAC) emissions.

3.7 Hydrocarbon, Chemical and Waste Management

Characterize and quantify the anticipated hazardous, non-hazardous, recyclable, dangerous goods and wastes generated and used by the Project. Demonstrate that the selected management options are consistent with the current regulatory requirements and industry practice. Describe and provide the following:

a) the composition and volume of specific waste streams generated by the Project, and identify how each stream will be managed. Demonstrate that the selected practices comply with provincial and federal legislations including EPEA's *Waste Control Regulation* and Alberta Environment's *Hazardous Waste Storage Guidelines*;
b) a listing of chemical products to be used for the Project. Identify products containing substances that are:
    i) Canadian Environmental Protection Act (CEPA) toxics;
    ii) on the PSL1, PSL2 and ARET list and those defined as dangerous goods pursuant to the federal *Transportation of Dangerous Goods Act*. Classify the wastes generated and characterize each stream under the *Alberta User Guide for Waste Managers*;
    iii) on the NPRI;
    iv) Track 1 substances targeted under Environment Canada's Toxic Substances Management Policy;

c) the location, nature, and amount of on-site hydrocarbon storage. Discuss containment and other environmental protection measures. Demonstrate how selected practices comply with the provincial and federal regulations;

d) the strategy for on-site versus off-site waste disposal and hydrocarbon storage. Identify:
   - i) the location of on-site waste disposal, including landfills where applicable;
   - ii) the suitability of the site(s) from a groundwater perspective (provide geo-technical information to support the siting of disposal facilities);
   - iii) the suitability of the site(s) with regard to existing and potential human activities in the area;
   - iv) potential effects on the environment; and

e) plans for waste minimization, recycling, pollution prevention and management over the life of the Project. Discuss methods and technologies to reduce waste quantities to the lowest practical levels.

3.8 Environmental Management System and Contingency Plans

Summarize key elements of North American's environmental, health, and safety management system and discuss how it will be integrated into the Project, addressing the following:

a) corporate policies and procedures, operator competency training, spill and air emission reporting procedures, and emergency response plans;

b) plans to minimize the production or release into the environment of substances that may have an adverse effect;

c) a conceptual contingency plan that considers environmental effects associated with operational upset conditions such as serious malfunctions, fires, accidents, or extreme weather events; and

d) the emergency response plan's capability to deal with unpredicted negative impacts.

3.9 Adaptation Planning

Describe the flexibility built into the plant design and layout to accommodate future modifications required by changes in emission standards, limits and guidelines. Discuss any follow-up programs and adaptive management considerations.

3.10 Participation in Regional Cooperative Efforts

Document North American's involvement in regional cooperative efforts to address environmental, health and socio-economic issues associated with regional industrial development during the life of the Project, including:

a) North American's current and planned participation in regional monitoring and management activities, such as the Fort Air Partnership, to address environmental, health and socio-economic issues. Provide a list of specific studies that North American plans to participate in;

b) North American's current and planned cooperative ventures with other operators to minimize the environmental impact of the Project or the environmental impact of regional industrial development;

c) how North American will work to develop and implement such cooperative opportunities;

d) the monitoring activities North American will implement to assist in managing environmental protection strategies. Discuss how the results obtained will be used to contribute to North American's participation in regional efforts;

e) how North American will use information from regional cooperative efforts to design and implement mitigation measures (to mitigate specific effects and cumulative effects), monitoring programs (project-specific monitoring and regional monitoring), and research programs outside of these initiatives where necessary.

4.0 ENVIRONMENTAL INFORMATION AND CUMULATIVE EFFECTS ASSESSMENT INFORMATION REQUIREMENTS

4.1 Assessment Scenarios

Define assessment scenarios including:

a) a Baseline Case, which includes existing environmental conditions and existing and approved projects or activities;
b) an Application Case, which includes the Baseline Case plus the Project; and
c) a Cumulative Effects Assessment (CEA) Case, which includes existing and anticipated future environmental conditions, existing, planned and approved projects or activities, and the Application case.

Note: For the purposes of defining assessment scenarios, "approved" means approved by the applicable federal, provincial or municipal regulatory authority. "Planned" is considered any project or activity that has been publicly disclosed during the time period ending six months prior to the submission of the Project Application and EIA report.

4.2 Information Requirements for the Environmental Assessment

To meet the basic environmental information requirements for the EIA report North American must include for each section, where applicable:

a) quantitative and qualitative information about the existing environmental and ecological processes in the EIA Study Area;
b) information about the existing and planned human activities in the EIA Study Area, and the nature, size, location and duration of their potential interactions with the environment, sometimes described as stressors (e.g., land disturbance, discharges of pollutants, changes to access status, consumption of renewable resources);
c) a discussion about changes in environmental conditions, caused by ecological process and natural forces (e.g. climate change, forest fires, flood or drought conditions, predator prey population cycles) that may have an impact on the Project;
d) the demonstrated use of appropriate predictive tools and methods, enabling quantitative estimates of future conditions with the highest possible degree of certainty;
e) quantitative and qualitative description of the effects of the Project;
f) management plans to prevent, minimize or mitigate adverse effects and to monitor and respond to expected or unanticipated conditions, including any follow-up plans to verify the accuracy of predictions or determine the effectiveness of mitigation plans;
g) evaluation of the significance of the Project effects, including the probability of the effect occurring and the importance of the consequences (measured quantitatively against management objectives and guidelines or baseline conditions and described qualitatively with respect to the views of North American and stakeholders);
h) a description of residual effects and their consequences for the environment as well as for regional management initiatives that are underway or in development;
i) evaluation and description of effects on water quality relative to regional, provincial and national guidelines, including the CCME *Water Quality Guidelines for the Protection of Aquatic Life,* as well as any site-specific water quality guidelines that may be available;
j) a description of air quality impact assessment as it relates to the *Alberta Ambient Air Quality Objectives*. Evaluate this against the regional, provincial and national objectives for air quality including the *CCME Canada wide Standards for Particulate matter and Ozone*;
k) a record of all assumptions, including an evaluation of impact prediction confidence in data and analysis to support conclusions; and
l) provide data and clearly identify their sources.

4.3 Modelling

Document any assumptions used in the EIA report to obtain modeling predictions. Clearly identify the limitations of the model(s) and data used in modelling, including sources of error and relative accuracy. Discuss the applicability and reasons for using a particular model.

4.4 Cumulative Environmental Effects

Assessment of cumulative effects will be an integral component of the EIA report. North American will conduct a cumulative environmental effects assessment of the Project based on the EUB/AENV/Natural Resources Conservation Board (NRCB) Information Letter "Cumulative Effects Assessment in Environmental Impact Assessment Reports under the Alberta *Environmental Protection and Enhancement Act*," June 2000. This will include a summary of all proposed monitoring, research and other strategies or plans to minimize, mitigate and manage any potential adverse effects. The cumulative environmental effects assessment for the Project will include the following:

a) the definition of the spatial and temporal Study Area boundaries and the rationale for assumptions used to define those boundaries for each environmental component examined;
b) a description of the current (baseline) state of the environment in the Regional Study Area used for the cumulative effects assessment;
c) an assessment of the incremental consequences that are likely to result from the Project in combination with other existing, approved and planned projects in the region;
d) demonstrate that the information and data used from other development projects is appropriate for use in this EIA report. Include a description of the deficiencies or limitations in the existing database for relevant components of the environment; and
e) an explanation of the approach and methods used to identify and assess cumulative effects including cooperative opportunities and initiatives undertaken to further the collective understanding of cumulative effects. Provide a record of relevant assumptions, confidence in data and analysis to support conclusions.

4.5 EIA Study Area

The EIA Study Area shall include the PDA and associated infrastructure, as well as the spatial and temporal areas of individual environmental components outside the PDA boundaries where an effect can be reasonably expected. The EIA Study Area includes both Regional and Local Study Areas.

Illustrate boundaries and identify the Study Areas chosen to assess effects. Define temporal and spatial boundaries for the Study Areas. Maps of these areas should include township and range lines, waterbodies, wetlands and other significant topographic features, for easy identification and comparison with other information within the EIA report. Describe the rationale and assumptions used in establishing the Study Area boundaries, including those related to cumulative effects.

4.6 Climate and Air Quality

Discuss baseline climatic and air quality conditions. Review emission sources and discuss emissions from industrial development within the EIA Study Areas. Consider point source emissions as well as fugitive emissions. Identify components of the Project that will affect air quality from a local and regional perspective, and:

a) identify any regional air monitoring done in the area and describe North American's participation in any regional forum (e.g., Northeast Capital Industrial Association, Fort Air Partnership);
b) discuss appropriate air quality parameters such as PAH, SO_2, carbon monoxide (CO), H_2S, total hydrocarbons (THC), NO_x, VOC, individual hydrocarbons of concern and their proportion of the THC and VOC mixtures, visibility, trace metals, particulates (PM_{10} and $PM_{2.5}$) and O_3;
c) estimate ground-level concentrations of appropriate air quality parameters, include frequency distributions for air quality predictions in communities and sensitive receptors, and include an

indication of 99.9 percentile for hourly predictions (98 percentile for any 24-hour modeling predictions of $PM_{2.5}$), as well as maximum predictions. Discuss any expected changes to particulate deposition or acidic deposition patterns. Justify the selection of the models used and identify any model shortcomings or constraints on findings. Complete modelling in accordance with *Alberta Environment's Air Quality Model Guidelines*. Include model input files;

d) for acid deposition modeling, provide deposition data from maximum levels to areas with 0.17/keq/ha/yr Potential Acid Input (PAI). Justify the selection models used and identify any model shortcomings or constraints of findings; include analysis of PAI deposition levels on acid sensitive soils and water bodies in the Study Areas, ensuring that deposition levels used are representative of the Region;

e) identify the potential for reduced air quality (including odours and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health;

f) describe how air quality impacts resulting from the Project will be mitigated;

g) identify and describe the ambient air quality monitoring and receptor monitoring that will be implemented during Project development, construction and operation to assess air quality and the effectiveness of mitigation;

i) assess the project-specific air quality impacts and cumulative air quality impacts, and their implications for other environmental resources, including habitat diversity and quantity, vegetation resources, water quality and soil conservation; discuss the relative contribution of the Project (e.g., after mitigation) to regional cumulative effects; and

j) assess the cumulative effects on the air quality of the EIA Study Area and include any related emissions increases from upgrading bitumen.

4.6.1 Climate Change

Discuss the following, with reference to the guide "Incorporating Climate Change Considerations in Environmental Assessment General Guidance for Practitioners" (Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment, 2003):

a) climate change and the local and/or regional, inter-provincial/territorial changes to environmental conditions resulting from climate conditions, including trends and projections where available;

b) the stages or elements of the Project that are sensitive to changes or variability in climate parameters. Discuss the impacts the change in climate parameters may have on these sensitive stages or elements; and

d) the adaptability of the Project in the event the region's climate changes. Discuss any follow-up programs and adaptive management considerations.

4.7 Noise and Light

4.7.1 Noise

Provide representative baseline noise levels and a description of the measurement/prediction methods used. Discuss:

a) and provide the results of a noise assessment based on existing conditions as specified by EUB Noise Control Directive 038, including:
   - i) an estimate of the potential for increased noise resulting from the Project;
   - ii) the identification of potentially-affected people and wildlife; and
   - iii) the implications of any increased noise levels;

b) the effects and mitigative measures to be utilized to minimize the production of noise at sensitive receptors.

4.7.2 Light

Discuss baseline light level conditions. Identify components of the Project that will affect light levels, include:

a) potentially-affected people and wildlife and the implications of increased light levels from the Project;
b) facilities that will affect light levels at night and evaluate the potential effects of increased light from the Project on affected residents; and
c) a discussion on the effects and mitigative measures to be utilized to minimize the production of light and flaring.

4.8 Land Use and Reclamation

Review current land use issues and identify the anticipated changes in nature, location and duration of land use as a result of the Project. Discuss:

a) conformity with land use objectives and planning parameters for the Strathcona County Alberta’s Industrial Heartland Area Structure Plan; Heavy Industrial Policy Area, and the Planning Framework;
b) potential Project impacts on local and regional land use management, residential areas, agricultural activities/development, areas with native vegetation, wildlife habitat, recreation uses, and other industrial uses in the region;
c) mitigation plans to minimize these impacts;
d) the navigability capability and resources, including plans for mitigation and plans to address residual effects:
    i) conduct necessary surveys to characterize the navigation resources in the Study Area; and
    ii) discuss components of the Project that will potentially affect navigable waterways;
e) reclamation concepts and objectives. Develop a conceptual reclamation/closure plan for the PDA taking into consideration regulatory requirements, stakeholder input, land use objectives and other factors necessary for a reclamation plan to be implemented;

Discuss how the reclamation/closure plan design will:

f) assess for and mitigate/remediate on site contamination;
g) return equivalent land capability as compared to pre-disturbance conditions;
h) integrate the proposed landscape with the surrounding landscapes including inter-connectivity to the surrounding landscapes;
i) integrate surface- and near-surface drainage within the PDA; and
j) be incorporated into the planning and development of the Project;

Provide and discuss:

k) soil conservation and salvage plans for topsoil and subsoil indicating salvage areas, depths of salvage, types, quality and volumes of soil to be salvaged. Describe the procedures for soil handling and outline soil storage methods and locations;
l) soil replacement plans specifying the techniques, timing, depth, volume and type of reclamation material;
m) the anticipated timeframes for completion of reclamation activities;
n) the parameters that should be used to monitor and evaluate the reclaimed land;
o) any constraints to reclamation such as timing of activities, availability of materials and influence of natural processes and cycles;
p) any soil-related constraints or limitations that may affect reclamation; and,
q) revegetation for the disturbed terrestrial areas, identifying the species type that will be used for seeding or planting, and the vegetation and weed management practices.

4.9 Terrestrial

4.9.1 General Terrestrial Considerations

Review current biophysical conditions and identify the nature, location and duration of changes anticipated as a result of the Project. Provide and discuss the following:

a) maps indicating the pre-disturbance landscape, elevation and drainage patterns of the Study Areas including the location of the proposed footprint;
b) ownership of bed or shore of any waterbodies or watercourses that fall within the Project Area. If determination of ownership has not been completed, describe the process that will be used to establish ownership, and a schedule for the determination;
c) an assessment of the anticipated changes to the pre-disturbed topography, elevation and drainage patterns of the Study Areas;
d) baseline biophysical conditions, including topography, soil and vegetation characteristics, and wildlife capability within the Study Area. Conduct the necessary surveys to characterize the biophysical resources in the Study Area, and to assist in reclamation planning;
e) components of the Project that will potentially affect these biophysical resources, including soils, vegetation, wildlife and biodiversity;
f) mitigation plans to minimize these effects; and
g) an assessment of the relative contribution of the Project (after mitigation) to regional cumulative pressures on biophysical resources (e.g., project contributions to cumulative PAI)

4.9.2 Soil

a) describe the soil types and map their distribution in the study areas using appropriate soil survey classification procedures as outlined in the Soil Survey Handbook, Volume 1 (Agriculture Canada, 1987) and The Canadian System of Soil Classification (Agriculture and Agri-Food Canada, 1999);
b) provide an ecological context of the soil resource by supplying a soil survey report and maps following Soil Survey Handbook, Volume 1 (Agriculture Canada, 1987) and The Canadian System of Soil Classification, Third Edition (Agriculture and Agri-Food Canada, 1998) to include:
    i) SIL (survey intensity level) 1 for the development footprint areas (PDA);
    ii) SIL 2 for other areas in the Local Study Area;
    iii) appropriate level of detail to determine the effect of the Project on soil types and quality, in the Regional Study Area;
c) characterize the pre-disturbance morphological, physical and chemical properties of the soil types and assess the pre-disturbance land capability;
d) describe the suitability and availability of soil materials within the PDA for reclamation using Soil Quality Criteria Relative to Disturbance and Reclamation (Alberta Agriculture, 1987);
e) discuss sensitivity of soils to wet and dry acidic deposition in the local and regional study areas for baseline, application and cumulative scenarios.
    i) explain the methods used to assess sensitive soils and include information from grid cell sensitivity assessments that may be available for the study area;
    ii) using modeled PAI for the baseline, application, and cumulative scenarios, describe the soils that would exceed the Clean Air Strategic Alliance's (CASA) recommended critical loads in the in the Local and Regional Study areas and include maps showing their spatial distribution; and
    iii) outline any existing monitoring information such as AENV's long-term soil acidification study and any regional initiatives (e.g. NCIA) for acidic deposition;
f) deterioration including acid deposition and changes to land capability at the local and regional scale;

g) discuss mitigation plans to minimize these impacts; and

h) discuss the regulatory requirements for soil monitoring or soil management. Discuss the potential impacts of the Project to soils in the development area and areas that may be potentially affected.

4.9.3 Vegetation

a) provide an inventory, map and a description of the existing terrestrial, wetland and aquatic vegetation. Include any rare vascular and non-vascular plant species and rare plant communities in the Study Areas;

b) describe and assess potential impacts of the Project construction and operation on vegetation (abundance, diversity, health, rare species and rare plant communities) in the Study Areas;

c) describe the potential Project related and cumulative impacts of air emissions, including acidification, acidifying and other air emissions on terrestrial, wetland and aquatic vegetation;

d) describe and discuss measures to be implemented to mitigate and monitor potential impacts of the Project on vegetation in the Study Areas; and

e) discuss how vegetation monitoring programs will be used to adaptively manage the mitigation measures and monitoring programs.

4.9.4 Wildlife

Describe existing wildlife resources (amphibians, reptiles, birds and terrestrial and aquatic mammals), and their use and potential use of habitats in the Study Areas. Document the anticipated changes to wildlife in the Study Areas. Specifically:

a) document and describe, using recognized survey protocols, those species found within the Study Areas that are listed by Alberta Sustainable Resource Development Fish and Wildlife (at risk, may be at risk and sensitive species in the *General Status of Alberta Wild Species 2000*) and the Committee on the Status of Endangered Wildlife in Canada (endangered, threatened, vulnerable in *Canadian Species at Risk 2002*);

b) describe and assess potential impacts of the Project on wildlife species found within the Study Areas. Include impacts on critical habitat, habitat availability and quality, and habitat fragmentation and loss. These impacts should be described for the various phases of the Project both locally and cumulatively with other activities in the Study Areas;

c) describe proposed strategies to minimize and/or mitigate impacts on wildlife species and their habitats that are within the Study Areas. These strategies should be tailored to the various phases of the Project and comply with wildlife legislation;

d) identify and discuss proposed monitoring programs that will be implemented during various phases of the Project to evaluate the effectiveness of mitigative strategies to reduce impacts on wildlife species and their habitats that are within the Study Areas. Describe how the results from the monitoring programs will also be used to evaluate the effectiveness of the programs themselves; and

e) identify and discuss any wildlife studies that are currently being conducted in the Study Areas and how North American plans to integrate its operational and mitigation activities with those studies.

4.9.5 Biodiversity and Fragmentation

a) discuss how the impacts defined in the EIA report could affect local and regional biodiversity and habitat fragmentation, both Project specific and cumulatively. Use quantitative data where possible to describe the potential effects on biodiversity and habitat;

b) discuss how the Project will contribute to changes in regional biodiversity. Include the measures North American will take to minimize these changes;

c) discuss how North American's plans for mitigation and monitoring will meet the expectations of Sustaining Alberta's Biodiversity An Overview of Government of Alberta Initiatives Supporting the Canadian Biodiversity Strategy (Alberta Environmental Protection, 1998);

d) determine the current and proposed level of habitat fragmentation for the Study Areas;
e) describe the techniques used in the fragmentation analysis;
f) identify and evaluate the effects from fragmentation on the Study Areas (e.g., potential introduction of non-native plant species on native species composition and any changes to plant communities) as a result of Project activities; and
g) discuss measures to mitigate, monitor and reclaim the effects of fragmentation.

4.10 Surface Water and Groundwater

4.10.1 Surface Water Hydrology and Quality

Discuss baseline surface hydrology conditions. Identify components of the Project that will affect these conditions from a local and regional perspective. Discuss:

a) existing drainage patterns, surface waterbodies, and wetlands within local and regional Study Areas, and the seasonal flow/water level characteristics of these waterbodies;
b) project-related temporary and permanent alterations to these drainage patterns, waterbodies and wetlands;
c) possible water diversions and return flows from these drainage channels and waterbodies under a variety of operating conditions and scenarios including, emergency conditions, low flow, or drought conditions;
d) effects of site runoff management on flow/level characteristics in these drainage channels and waterbodies;
e) mitigation plans to minimize these effects and the loss of wetland and function;
f) the relative contribution of the Project (after mitigation) to regional cumulative pressures on surface water resources;
g) the monitoring program that will be implemented to assess hydrological impacts and the performance of mitigation plans and water management systems;
h) cumulative impact of water withdrawal on the North Saskatchewan River or any other potential water source; and
i) the potential impact of climate change on water withdrawal requirements during low flow periods.

Discuss baseline surface water quality. Identify components of the Project that will affect these conditions from a local and regional perspective. Discuss:

j) water quality characteristics in surface waterbodies within the Study Area, including but not limited to: temperature, pH, conductivity, TDS, alkalinity, hardness, nutrients, hydrocarbons, cations and anions, metals, dissolved oxygen, suspended solids, phenolics, colour and other water constituents potentially relevant to the effluent discharges and impact assessment, their seasonal variation, relationships to flow and other controlling factors and a summary of existing water quality data including necessary surveys to characterize the water quality;
k) the potential Project related and cumulative impacts of air emissions, including acidification, on surface water quality in the local and regional waterbodies;
l) effects of site runoff on water quality in surface waterbodies within the Study Area;
m) the impacts of the following on surface water quality within the Study Area:
    i) change in groundwater movement;
    ii) spills;
    iii) contaminated groundwater resulting from spills;
    iv) surface water withdrawals (Project and Cumulative); and
    v) industrial effluent discharges;
n) mitigation plans to minimize these impacts during the construction, operation and reclamation phases of the Project;
o) a plan and implementation program for the protection of surface water quality, including the following:

i) a surface water monitoring program for early detection of potential contamination and assistance in remediation planning; and

ii) a discussion of the surface water remediation options being considered for implementation in the event that adverse effects are detected;

p) the relative contribution of the Project (after mitigation) to regional cumulative effects on surface water quality (e.g., project contributions to lake acidification); and

q) the potential impacts on surface water quality within the Study Areas resulting from the Project, including but not limited to, site runoff and project-related wastewater discharges, that may cause adverse effects or an exceedance of the *Surface Water Quality Guidelines for Use in Alberta* (November 1999) or *Canadian Water Quality Guidelines*.

4.10.2 Groundwater Quantity and Quality

Discuss baseline groundwater conditions. Identify components (e.g., dewatering, well supply) of the Project that will affect these conditions from a local and regional perspective. Provide the following:

a) a discussion of the characteristics of major aquifers, aquitards, and aquicludes in the Study Area;

b) lithology, thickness and stratigraphic continuity of both surficial and bedrock geologic units within the Study Area;

c) hydrogeologic information including hydraulic properties, depth to water, flow direction, and velocity of the geologic units. Include a description of the interaction between groundwater and surface water;

d) groundwater quality information of the hydrogeologic units in the Study Area, including but not limited to background concentrations of major ions, dissolved metals, BTEX and other potential contaminants of concern;

e) maps and cross-sections that include groundwater table and piezometric surfaces based on identifiable groundwater systems and accurate data sources, such as drill holes;

f) results of any new hydrogeological investigations, including methodology;

g) an inventory of groundwater users in the Study Area. Identify potential groundwater use conflicts and proposed resolutions;

h) an assessment of potential effects of Project-related water withdrawal on groundwater levels, effects on local and regional groundwater regimes, including vertical gradients and discharge areas;

i) an assessment of the effects of groundwater withdrawal/dewatering and its implications for other environmental resources, including flows and water levels in local streams, wetlands, vegetation and soil saturation;

j) an assessment of potential effects of Project-related activities and surface releases (e.g., accidental contaminant spills) and down-hole wastewater disposal on groundwater quality;

k) a justification for the selection of hydrogeologic models used. Identify any model shortcomings or constraints on findings and any surrogate parameters that were used as indicators of potential aquifer contamination due to the Project;

l) a plan and implementation program for the protection of groundwater resources, including the following:

i) a groundwater monitoring program for early detection of potential contamination and assistance in remediation planning;

ii) a discussion of the groundwater remediation options being considered for implementation in the event that adverse effects are detected;

m) a plan to monitor the sustainability of groundwater production or dewatering effects;

n) identify any regional groundwater monitoring being done in the area and describe North American's participation in any regional forum.

4.11 Aquatic Resources

Identify components of the Project that will affect baseline conditions from a local and regional perspective. Discuss:

a) baseline aquatic resource conditions, including fish, epilithic algae and benthic invertebrate habitat capability in waterbodies within the Study Area. Conduct the necessary surveys to characterize the aquatic resources in the Study Area;
b) the potential for nutrient enrichment, if nutrients are discharged to the aquatic environment, from both the Project and cumulative perspectives;
c) components of the Project that may affect aquatic resources within the Study Area, their impact on the Study Area and significance;
d) cumulative effects of the impacts that already exist, including the use of fertilizer and water draw and potential Project-related impacts on the aquatic resources in relevant waterbodies;
e) mitigation plans to minimize these impacts;
f) an assessment of the relative contribution of the Project (after mitigation) to regional cumulative effects on aquatic resources (e.g., project contributions to lake acidification);
g) the potential for contamination of fish and fish habitat by wastewater discharges relative to fish consumption guidelines;
h) programs to monitor aquatic habitat quality and the effectiveness of mitigation strategies; and
i) the key indicator species and stressors related to the Project.

5.0 ENVIRONMENTAL EFFECTS MONITORING

Describe the environmental effects monitoring (EEM) activities that North American will undertake to manage effects and confirm the performance of mitigative measures. Specifically address:

a) monitoring activities and initiatives that North American is proposing to conduct independently of other stakeholder activities in the region;
b) monitoring activities that North American is proposing to conduct collaboratively with other stakeholders. Include in this discussion the role that North American anticipates taking in each of the programs; and
c) mechanisms for sharing results, reviewing findings and adjusting programs should monitoring identify unanticipated consequences of North American's operations or mitigation plans, include:
    i) corporate adaptive management strategies; and
    ii) consultation with regulators, public stakeholders, and, if necessary, regional management forums.

6.0 PUBLIC HEALTH AND SAFETY

Describe those aspects of the Project that may have implications for public health or the delivery of health services. Determine whether there may be implications for public health arising from the Project. Specifically:

a) identify and discuss the data and methods used by North American to assess the impacts of the Project on human health and safety;
b) assess the potential health implications of the compounds that will be released to the environment from the proposed Project in relation to exposure limits established to prevent acute and chronic adverse effects on human health;
c) identify the human health impact of the potential contamination of country foods and natural food sources taking into consideration all Project activities;
d) provide information on compounds released from the Project found in samples of selected species of vegetation and wildlife known to be consumed by humans and incorporate into the assessment;
e) discuss the potential to increase human exposure to contaminants from changes to water quality, air quality and soil quality taking into consideration all Project activities;

f) during consultation on the Project, document any health concerns identified by Aboriginal stakeholders due to the impacts of existing industrial development and of the Project specifically on their traditional lifestyle. Determine the impact of the Project on the health of the Aboriginal stakeholders and identify possible mitigation strategies;

g) assess cumulative health effects to receptors, including First Nations and Aboriginal receptors, that are likely to result from the Project in combination with other existing, approved and planned projects;

h) as appropriate, identify anticipated follow-up work, including regional cooperative studies. Identify how such work will be implemented and coordinated with ongoing air, soil and water quality initiatives;

i) identify and discuss potential health and safety impacts due to higher regional traffic volumes and the increased risk of accidental leaks and spills;

j) document health and safety concerns raised by stakeholders during consultation of the Project;

k) provide a summary of North American's emergency response plan and mitigation plans that will be implemented to ensure workforce and public safety during the pre-construction, construction, operation and reclamation of the Project. Include prevention and safety measures for wildfire occurrences, water saturated plume from the cooling towers, icy roads in winter months, accidental release or spill of chemicals to the environment and failures of structures retaining water or fluid wastes;

l) describe how local residents will be contacted during an emergency and what type of information will be communicated to them; and

m) describe existing agreements with area municipalities or industry groups such as, safety, co-operatives, emergency response associations and municipal emergency response agencies.

7.0 HISTORIC RESOURCES

a) provide evidence of consultation with Alberta Tourism Parks, Recreation and Culture. Provide a general overview of the results of any previous historic resource studies that have been conducted in the Study Area, including archaeological resources, palaeontological resources, historic period sites, and any other historic resources as defined within the Alberta *Historical Resources Act*;

b) provide a summary of the results of any Historic Resources Impact Assessments that have been carried out with respect to the Project. The Historic Resources Impact Assessment(s) must encompass all projected development and impact areas within the boundaries of the Project; and

c) provide an outline of the historic resources management program and schedule of field investigations that may be required to mitigate the effects of the Project on historic resources.

8.0 SOCIO-ECONOMIC FACTORS

Provide information on the socio-economic effects of the Project. Specifically provide and address the following:

a) the number and distribution of people who may be affected by the Project;

b) information on the economic status of the area and the Project's contribution to this economic status;

c) information on the social impacts of the Project on the Study Area and on Alberta including:
    i) local employment and training;
    ii) local procurement;
    iii) population changes;
    iv) demands on local services, and infrastructure; and
    v) regional and provincial economic benefits;

d) the impacts of the Project during construction and operation phases, on infrastructure, transportation planning, traffic and local services;

e) the economic impacts of the Project on the Study Area and on Alberta, having regard for capital, labour, and other operating costs and revenue from services;

f) North American's policies and programs respecting the use of local, Alberta, and Canadian goods and services;

g) a breakdown of the industrial benefits of the Project (e.g. project management/engineering, equipment and materials, construction labour etc.) for businesses within Alberta, Canada and outside Canada.

h) employment and business development opportunities the Project may create for local communities and the region;

i) a breakdown of the labour force, type of employment, and number of employees with respect for the construction and operational workforces. Identify when the peaks in labour requirements will occur, the extent of the peaks and the source of labour for the Project; and

j) describe and discuss the impacts of the proposed Project on potential shortages of affordable housing and the quality of health care services. Identify and discuss the mitigation plans that will be undertaken to address these issues. Provide a summary of any discussions that have taken place with the Municipality and the Regional Health Authority concerning potential housing shortages and health care services respectively.

9.0 PUBLIC CONSULTATION REQUIREMENTS

North American will undertake a consultation program during the preparation of the EIA report. As part of this consultation program, North American will consult with the following potentially affected stakeholders:

a) the residents of surrounding communities;

b) recognized land users of the Local Study Area;

c) industrial, recreational, environmental groups and individuals expressing a formal interest in the Project;

d) federal, provincial, and municipal regulators, as applicable;

e) other operating or planned developers in the region;

f) Aboriginal groups;

Describe and document the public consultation program implemented including plans to coordinate consultation activities with other developers in the area. Record any concerns or suggestions made by the stakeholders and demonstrate how these concerns have or will be addressed or discounted. Discuss:

g) how the concerns and issues identified by North American and stakeholders influenced the Project development, design, impact mitigation and monitoring;

h) the type of information provided and the issues discussed, including those that have been resolved and those that remain outstanding;

i) in consideration of unresolved issues, the key alternatives which have been identified by North American and stakeholders for future consultations as well as mechanisms and timelines for that resolution;

j) plans to maintain and support the public consultation process following completion of the EIA review; and

k) subject to confidentiality obligations, any agreements reached with stakeholders regarding North American's activities associated with the Project.

APPENDIX

The following information is necessary to be submitted as part of the request for an application to the Water Act (WA) or the Environmental Protection and Enhancement Act (EPEA). It may not be necessary to be considered as part of the EIA report completeness decision-making process under Section 53 of EPEA. Upon review of the information submitted, a final determination will be made if it is necessary for the following information to be considered as part of the EIA report completeness decision.

Water Supply, Water Management and Wastewater Management

Provide the following information:

a) technical information on how the water requirements for the Project will be met including annual volumes from each source: for non-saline groundwater sources and site dewatering activities, follow Alberta Environment's Groundwater Evaluation Guidelines;
b) the design of facilities that will handle, treat and store wastewater streams;
c) the type and quantity of any chemicals used in wastewater treatment; and
d) design details for the potable water and sewage treatment systems for both the construction and operation stages.

Groundwater

Provide a detailed plan and implementation program for the protection of groundwater resources, addressing:

a) a groundwater monitoring program for early detection of potential contamination and assistance in remediation planning;
b) groundwater remediation options to be considered for implementation in the event that adverse effects are detected; and
c) a program to monitor the sustainability of groundwater production.

TOR Section	Environmental Assessment or Topic	Location in Document
1.0	**Introduction**	
1.1 Purpose	The purpose of this document is to identify for North American Oil Sands Corporation (North American) and the public, the information required by government agencies for an Environmental Impact Assessment (EIA) report. North American will prepare and submit an EIA report that examines the environmental and socio-economic effects of the construction, operation and reclamation of the proposed Upgrader (the “Project” or the “Upgrader”) in Strathcona County.	Volume 1, Section 1.0
1.2 Scope of EIA Report	a) The EIA will be prepared in accordance with these Terms of Reference (TOR) and the environmental information requirements prescribed under the Environmental Protection and Enhancement Act (EPEA) and Regulations, the Oil Sands Conservation Act (OSCA) and any federal legislation which may apply to the Project. The EIA will; assist the public and government in understanding the environmental and socio-economic consequences of the Project’s development operation and reclamation plans, and will assist North American in its decision making process;	Volumes 2-5
	b) include a discussion on the possible measures, including established measures and possible improvements based on research and development to: i) prevent or mitigate impacts; ii) assist in the monitoring of environmental protection measures; and iii) identify residual environmental impacts and their significance including cumulative and regional development considerations;	Volumes 2-5
	c) address: i) Project impacts; ii) mitigation options; iii) residual effects relevant to the assessment of the Project including, as appropriate, those related to other industrial operations. As appropriate for the various types of impacts, predictions should be presented in terms of magnitude, frequency, duration, seasonal timing, reversibility and geographic extent.	Volumes 2-5
	d) include tables that cross-reference the report (subsections) to these final Terms of Reference; and	Volume 1, Appendix D
	e) include a glossary of terms with the definition source and a list of abbreviations to assist the reader in understanding the material presented.	Volume 1, Appendix E
	The EIA report will form part of North American’s application to the Alberta Energy and Utilities Board (EUB) and Alberta Environment (AENV) for construction and operation of the Project. A summary of the EIA report will also be included as part of the application.	Volume 1, Section 8
1.3 Public Consultation	The preparation of the EIA report will include a public consultation program to assist with project scoping and issue identification. The results of these consultations will be documented as part of the EIA report (see Section 9.0). To meet the public consultation requirements North American must, at a minimum, communicate with those members of the public who may be affected by the Project and provide them with the opportunity to participate in the environmental assessment process.	Volume 1, Section 10
1.4 Proponent’s Submission	North American is responsible for the preparation of the EIA report and related applications. The submission will be based upon these final Terms of Reference and issues raised during the public consultation process.	Volumes 1-5
2.0	**Project Overview Information Requirements**	
2.0	Provide an overview of the Project, the key environmental, resource management, and socio-economic issues that, from North American’s perspective, are important for a public interest decision and the results of the Environmental Assessment process.	Volume 1, Section 1.0 and Section 1.1
2.1 The Proponent	Provide a corporate profile for North American and a brief history of North American’s operations including a summary of existing and proposed activities. Provide the legal name of the entity involved and the names of	Volume 1, Section 1.13

TOR Section	Environmental Assessment or Topic	Location in Document
	those who are expected to develop, manage and operate the Project.	
2.2 Project Need and Alternatives Considered	Discuss the need for the Project and the alternatives to the Project, including the alternative of not proceeding with the Project. Include the following: a) an analysis of the alternative means of carrying out the Project that are technically and economically feasible and indicate their potential environmental effects and impacts. Include the rationale for selecting the proposed option;	Volume 1, Section 1.6
	b) how a balance between environmental, resource recovery or conservation and economic goals has been achieved through planning and preliminary design, highlighting any areas where planning focused on one goal in exclusion of others;	Volume 1, Section 1.6
	c) contingency plans, if selected major Project components or methods during any phase prove to be unfeasible or do not perform as expected; and	Volume 1, Section 1.5. Section 1.6, and Section 3.6
	d) the environmental performance of the technology selected and a comparison to the alternative technologies considered.	Volume 1, Section 1.6 and Section 3.6
2.3 Project Components and Development Timing	Provide an overview of the Project activities and physical components. Specifically, provide the following: a) a summary list, brief description and drawings of the Project components and activities which are addressed in detail under Section 3.1; and	Volume 1, Section 1.5, Figure 1.1-1,
	b) the proposed stages or phases of the activities and the expected development schedule, explaining: i) the timing and expected duration of key construction, operation and reclamation activities for the life of the Project including mitigation and compensation plans; ii) the key factors controlling the schedule and uncertainties; and iii) the implications of a delay in the Project development schedule. Consider the regulatory process as a potential delay to the Project development schedule.	Volume 1, Section 1.4
2.4 Regulatory and Planning Framework and Classifications	Identify the legislation, policies, approvals, and current multi-stakeholder planning initiatives applicable to this Project. Identify any components of the Project that will require approval(s) under the EPEA and *Water Act* (WA) and that will be constructed within the duration of the approval(s). Address the following: a) other regulatory approvals that are required and any approvals that have already been issued including provincial, municipal, and federal government requirements;	Volume 1, Section 2.1, Section 2.2 and Section 2.3
	b) the primary focus of each regulatory requirement, such as water allocation, environmental protection, land use/development, and the element(s) of the Project that is(are) subject to the regulatory requirement;	Volume 1, Section 2.1 and Section 2.3
	c) any regulatory classification systems which apply to the Project, such as solid waste or air pollution classifications and land use zones; and	Volume 1, Section 2.4, Section 6.2, Section 6.3 and Section 6.5
	d) a summary of the objectives, methodologies, or guidelines which have been used by North American to assist in the evaluation of the significance of effects.	Volume 1, Section 8.1
2.5 Principle Development Area and EIA Study Area	The Principal Development Area (PDA) includes all lands subject to direct disturbance from the Project and associated infrastructure, including access and utility corridors. For the PDA, provide: a) the legal land description;	Volume 1, Section 1.2
	b) the boundaries;	Volume 1, Section 1.2
	c) a map identifying the locations of all proposed development activities; and	Volume 1, Figure 1.2-1
	d) a map and photo mosaic showing the area proposed to be disturbed in relation to existing topographic features, township grids, wetlands and waterbodies.	Volume 1, Figure 3.1-2
	Study Areas for the EIA report include the PDA and other areas based on individual environmental components where an effect from the proposed development can reasonably be expected. Identify:	Volume 2, Section 1.5

TOR Section	Environmental Assessment or Topic	Location in Document
	a) the Local and Regional study areas chosen to assess the impacts of the Project and provide maps of appropriate scale to illustrate boundaries; and	
	b) the rationale used to define Local and Regional Study Areas (see also Section 4.5).	Volume 2, Section 1.5
2.6 EIA Summary	Provide a summary of the EIA report. Address: a) the environmental and land use conditions in the EIA Study Area without the Project;	Volume 1, Section 8
	b) activities and components of the Project that are anticipated to influence environmental and land use conditions;	Volume 1, Section 8
	c) the anticipated environmental effects, with emphasis on regional and cumulative considerations;	Volume 1, Section 8
	d) the proposed mitigation measures, monitoring and management plans;	Volume 1, Section 8
	e) any Project-related residual effects, their contribution to regional cumulative effects, and their implications for the future management of regional cumulative effects; and	Volume 1, Section 8
	f) effects of the environment on the Project.	Volume 1, Section 8
	List and discuss key environmental issues and issues which are important for the achievement of sustainable environmental and resource management that were identified during the preparation of the EIA report and public consultation. Differentiate between emerging issues (with ongoing uncertainties), issues with quantifiable and significant environmental effects, and issues that can be resolved through available technology and existing management approaches. Provide a matrix or summary chart to describe this section.	Volume 1, Section 8
3.0	**Project Description and Management Plans**	
3.0	Describe activities and components of the Project and relevant management plans. Provide sufficient scope and detail in the Project description information to allow quantitative assessment of the environmental consequences. If the scope of information varies among components or phases of the Project, provide rationale demonstrating that the information is sufficient for assessment purposes.	Volume 1, Section 6
3.1 Project Components and Site Selection		
3.1.1 Project Components	Describe the nature, size, location and duration of the significant components of the Project including, but not limited to, the following: a) the plant site and any chemical/fluids storage locations;	Volume 1, Section 3.1 and Section 4.4
	b) the design capacities of the Project;	Volume 1, Section 3.3
	c) temporary structures, dewatering, water control facilities, and processing/treatment facilities;	Volume 1, Section 4.3
	d) buildings and infrastructure, transportation, utilities, access routes, and storage areas;	Volume 1, Section 1.7, Section 3.2, Section 4.1, Section 4.2, and Section 4.4
	e) water source well locations and intakes;	Volume 1, Section 4.3
	f) the types and amounts of waste materials, locations of waste storage, and disposal sites;	Volume 1, Section 6.5
	g) a site development plan illustrating the locations of components including an outline of the proposed phasing and sequencing of components (include pre-construction, construction, operation, reclamation, decommissioning, and end land use);	Volume 1, Figure 3.1-1
	h) how North American incorporated community input for Project design and development; and	Volume 1, Section 10.5
	i) potential cooperative ventures to minimize environmental impacts.	Volume 1, Section 6.2
3.1.2 Site Selection	Discuss the site selection process including, but not limited to, the following: a) factors that were considered in determining the preferred plant site and associated Project components;	Volume 2, Section 1.4
	b) the site selection process for the proposed location of Project components;	Volume 2, Section 1.4
	c) the rationale for choosing the proposed sites instead of alternative	Volume 2, Section 1.4

TOR Section	Environmental Assessment or Topic	Location in Document
	sites;	
	d) the technical, geotechnical, economical, and environmental criteria considered;	Volume 2, Section 1.4
	e) potential impacts on environmental and land use conditions; and	Volume 2, Section 1.4
	f) maps of suitable scale showing the location of proposed Project facilities in relation to existing township grids, wetlands, watercourses, waterbodies, and other significant topographic features.	Volume 1, Figure 1.2-1
3.2 Process Description	Provide material balances, energy balances, process flow diagrams, and descriptions of the processes. Include: a) energy and process efficiency for the technologies chosen;	Volume 1, Section 5.1
	b) alternate technologies considered;	Volume 1, Section 3.3 and Section 3.6
	c) shared facilities and utilities associated with the Project;	Volume 1, Section 4.1
	d) catalysts and chemicals needed for the upgrading processes included in the Project;	Volume 1, Section 5.1
	e) Project inputs such as energy and water, and the outputs such as emissions and wastes;	Volume 1, Section 5.1, Section 5.3, Section 6.2, and Section 6.5
	f) effect of technology on waste generation and storage requirements, air and water discharges, water requirements, waste streams, and reclamation programs; and	Volume 1, Section 4.3, Section 4.4, Section 6.2, Section 6.5 and Section 7.6
	g) source of major feed materials for the upgrading process include bitumen feedstock and limestone, as well as any additional feedstocks.	Volume 1, Section 3.4
3.3 Product Handling	Identify the location and amount of all on-site storage associated with production including storage of catalysts, chemicals, products, by-products, intermediates and wastes (additional detail can be found in Section 3.7). Identify potential interactions between stored chemicals and wastes. Identify hazardous by-products that could potentially be formed and process design and operational practices that will minimize their formation. Explain containment and environmental protection measures.	Volume 1, Section 4.4, Section 5.1 and Section 6.5
3.4 Utilities and Transportation	Describe and discuss the Project energy requirements, and associated infrastructure and other infrastructure requirements including, but not limited to, the following: a) the amount and source of energy required for the Project;	Volume 1, Section 4.1 and Section 5.1
	b) the options considered for supplying the thermal energy and electric power required for the Project and their environmental implications;	Volume 1, Section 4.1
	c) worker accommodations and travel routes to the plant site during construction and operation phases, including: i. desired traffic routing; ii. control methods; and iii. road use agreements;	Volume 5, Section 15.6 and Section 15.7
	d) any expected changes and impacts in traffic volume by Average Annual Daily Traffic (AADT) and any seasonal variability in traffic volume;	Volume 5, Section 15.6
	e) the result of consultation with the local transportation authorities including transportation studies that are underway or planned;	Volume 5, Section 15.6
	f) the alignment, contents, and size of any raw material or product pipelines to be located within the EIA Study Area. If regional pipeline and storage infrastructure is required, identify the locations and routes of these facilities and the authority responsible for their approval, installation and operation;	Volume 1, Section 1.8, Section 3.4 and Section 4.1
	g) describe sulphur storage (short and long term), transportation (from the Upgrader site) and the effects on local residents;	Volume 1, Section 3.5
	h) the adequacy in design and upgrades required of all utility lines, roads, and pipeline crossings of roads, rivers and streams with respect to the construction and operation of the facilities;	Volume 1, Section 1.8, Section 3.4 and Section 4.1
	i) design features to prevent spills, contingencies for spill response, and any environmental risks associated with product releases or management practices;	Volume 1, Section 6.1
	j) the natural gas source and pipeline, electrical power transmission	Volume 1, Section 1.8,

TOR Section	Environmental Assessment or Topic	Location in Document
	and access to the Project. Illustrate the proposed location of these facilities. If regional infrastructure is required, identify the locations and routes, and who would be responsible for installation and approval of the facilities;	Section 3.4 and Section 4.1
	k) identify cumulative impacts on the transportation network, including any secondary highways leading to Project areas; and	Volume 5, Section 15.6
	l) plans to minimize the impacts of the Project's energy and infrastructure requirements and associated infrastructure on area residents and businesses.	Volume 5, Section 15.4 and Section 15.7
3.5 Water Supply, Water Management and Wastewater Management		
3.5.1 Water Supply	Describe the water supply requirements for the Project including, but not limited to, the following: the overall water balance(s); a) the water requirements for construction, start-up, normal operating conditions, worst case conditions, emergency operating situations, decommissioning and reclamation;	Volume 1, Section 4.3 and Section 5.3
	b) the variability in the amount of water required on a monthly and seasonal basis as the Project is implemented;	Volume 1, Section 4.3
	c) the supply options including on-site storage referencing, as appropriate, technical information in the *Water Act* application;	Volume 1, Section 4.3
	d) the location of water sources/intakes and associated infrastructure (pipelines) and potential modifications with the Project; and	Volume 1, Section 4.3
	e) intake design, where water is to be sourced from local waterbodies.	Volume 1, Section 4.3
3.5.2 Water Management	Provide a Water Management Plan including, but not limited to, the following: a) measures taken by North American to contribute to the improvement in efficiency and productivity of water use as identified in the Water for Life; Alberta's Strategy for Sustainability;	Volume 3, Section 7.5
	b) permanent or temporary alterations or diversions of watercourses and waterbodies;	Volume 3, Section 6.6
	c) factors used in the design of water management facilities including expected flood levels, and flood protection; and	Volume 3, Section 6.6
	d) an explanation of how this plan will be incorporated into Project design.	Volume 1, Section 6.4
3.5.3 Wastewater Management	Provide a Wastewater Management Plan to address site runoff, groundwater protection, deep well disposal, and wastewater discharge including, but not limited to, the following: a) source, quantity and composition of each wastewater stream from the proposed facilities;	Volume 1 Section 4.3; Volume 3, Section 7.7
	b) those waste substances produced by the Project that are reportable under the National Pollutants Release Inventory (NPRI), Priority Substances List 1 (PSL1), Priority Substances List 2 (PSL2), and/or Accelerated Reduction and Elimination of Toxics (ARET) substances relevant to the Project;	Volume 3, Section 7.7
	c) the design of the facilities that will handle, treat, and store wastewater streams;	Volume 1 Section 4.3
	d) the type, name and quantity of chemicals used in wastewater treatment;	Volume 1 Section 5.1
	e) options considered for wastewater treatment and management strategies, in the context of best available technologies and best management practices. Include reason(s) (including water quality and environmental considerations) for selecting the preferred options;	Volume 1 Section 4.3
	f) potable water and sewage treatment systems that will be installed as components of the Project for both the construction and operation;	Volume 1 Section 4.3
	g) the discharge of aqueous contaminants (quantity, quality, and timing) beyond plant site boundaries and the potential environmental effects of such releases;	Volume 3, Section 7.7
	h) design parameters for managing site runoff during precipitation and snowmelt events;	Volume 1 Section 4.3
	i) programs to monitor the effects of Project operations on local	Volume 3, Section 7.9

TOR Section	Environmental Assessment or Topic	Location in Document
	surface and groundwater quantity and quality;	
	j) options considered for wastewater disposal, in the context of best available technologies and best management practices (including zero liquid drainage). Include the reason(s) for selecting the preferred options; and	Volume 1 Section 4.3
	k) an explanation of how this plan will be incorporated into Project design.	Volume 1 Section 6.4
3.6 Air Emissions Management	Develop an emissions profile (type, rate, and source) for each component of the Project including point and area sources, fugitive emissions, and construction emissions. Consider normal operating conditions, worst-case conditions and upset conditions. Include definitions for these conditions. a) calculate the intensity of Criteria Air Contaminant (CAC) emissions per unit of product processed through the Project and discuss how it compares with similar projects and technology performance;	Volume 2, Appendix 2A
	b) provide explanations, where possible, for any differences between the CAC emission intensities computed for this Project and those of other similar projects.	Volume 2, Appendix 2A
	Discuss the following: a) any NPRI, PSL1, PSL2, or ARET substances relevant to the Project;	Volume 2, Section 2.7
	b) any odorous or visual emissions from the proposed Project;	Volume 2, Section 2.7
	c) the amount and nature of any acidifying emissions, probable deposition patterns and rates and programs North American may implement to monitor the effects of this deposition;	Volume 2, Section 2.7
	d) the fugitive emissions control program to detect, measure, repair and control emissions and odours from equipment leaks and the applicability of the Canadian Council of Ministers of the Environment's (CCME) Environmental Code of Practice for Measurement and Control of Fugitive Emissions from Equipment Leaks and the CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks;	Volume 2, Section 2.6
	e) the emission control technologies proposed for the Project in the context of best-available and economically viable commercial technologies, and the applicability of Alberta Environment and CCME emission control technology guidelines;	Volume 2, Section 2.6
	f) gas collection, conservation, and applicability of technology for vapour recovery for the Project's air emissions;	Volume 2, Section 2.7
	g) control technologies used to minimize air emissions such as sulphur dioxide (SO_2), hydrogen sulphide (H_2S), oxides of nitrogen (NO_x), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH) and particulate matter;	Volume 2, Section 2.7
	h) technology or management programs to minimize emissions which lead to the formation of particulate matter and ozone (O_3) having regard for the provisions of the CCME Canada wide Standard for Particulate Matter and Ozone;	Volume 2, Section 2.7
	i) the incremental contribution of the Project to regional (Edmonton Census Metropolitan Area) emissions of $PM_{2.5}$ and PM_{10} and ground-level ozone precursors including NO_x, SO_2, VOC, and ammonia;	Volume 2, Section 2.7
	j) applicability of sulphur recovery, acid gas re-injection, or flue gas desulphurization to reduce sulphur emissions and applicability of EUB sulphur recovery guidelines (Interim Directive ID 2001-3);	Volume 2, Section 2.6
	k) non-routine flaring scenarios (e.g. emergencies, upsets, and maintenance), proposed measures to ensure flaring events are minimized and a preliminary flare management plan; and	Volume 1, Section 6.2; Volume 2, Section 2.6 and Section 2.7
	l) monitoring programs North American will implement to assess air quality and the effectiveness of mitigation, during the Project's development and operation. Discuss how these monitoring programs are compatible with those used by regional multi-stakeholder air initiatives.	Volume 2, Section 2.8
3.6.1	Provide the following:	Volume 1, Section 6.2;

TOR Section	Environmental Assessment or Topic	Location in Document
Greenhouse Gas Emissions	a) the expected annual and total greenhouse gas (GHG) emissions over the construction, operation and decommissioning phases of the Project separated by emission sources (i.e. mine sources, gasification, and plant sources etc). Include calculations;	Volume 2, Section 2.7
	b) the Project's contribution to total provincial and national GHG emissions on an annual basis;	Volume 2, Section 2.7
	c) the intensity of GHG emissions per unit of bitumen processed through the Project and discuss how it compares with similar projects and technology performance;	Volume 1, Section 6.2; Volume 2, Section 2.7
	d) North American's overall GHG management plans, any plans for the use of offsets, (nationally or internationally) and the expected results of implementing the plans; and	Volume 1, Section 6.2; Volume 2, Section 2.7
	e) details on North American's plans for CO2 once it is captured and (i.e. transportation to market or sequestration) and what effect the CO2 transportation and storage/use will have on both GHG and criteria air contaminant (CAC) emissions.	Volume 1, Section 6.2; Volume 2, Section 2.7
3.7 Hydrocarbon, Chemical and Waste Management	Characterize and quantify the anticipated hazardous, non-hazardous, recyclable, dangerous goods and wastes generated and used by the Project. Demonstrate that the selected management options are consistent with the current regulatory requirements and industry practice. Describe and provide the following: a) the composition and volume of specific waste streams generated by the Project, and identify how each stream will be managed. Demonstrate that the selected practices comply with provincial and federal legislations including EPEA's *Waste Control Regulation* and Alberta Environment's *Hazardous Waste Storage Guidelines*;	Volume 1, Section 6.5
	b) a listing of chemical products to be used for the Project. Identify products containing substances that are: i) Canadian Environmental Protection Act (CEPA) toxics; ii) on the PSL1, PSL2 and ARET list and those defined as dangerous goods pursuant to the federal *Transportation of Dangerous Goods Act*. Classify the wastes generated and characterize each stream under the *Alberta User Guide for Waste Managers*; iii) on the NPRI; iv) Track 1 substances targeted under Environment Canada's Toxic Substances Management Policy;	Volume 1, Section 5.1
	c) the location, nature, and amount of on-site hydrocarbon storage. Discuss containment and other environmental protection measures. Demonstrate how selected practices comply with the provincial and federal regulations;	Volume 1, Section 4.4
	d) the strategy for on-site versus off-site waste disposal and hydrocarbon storage. Identify: i) the location of on-site waste disposal, including landfills where applicable; ii) the suitability of the site(s) from a groundwater perspective (provide geo-technical information to support the siting of disposal facilities); iii) the suitability of the site(s) with regard to existing and potential human activities in the area; iv) potential effects on the environment; and	Volume 1, Section 4.4 and Section 6.5
	e) plans for waste minimization, recycling, pollution prevention and management over the life of the Project. Discuss methods and technologies to reduce waste quantities to the lowest practical levels.	Volume 1, Section 6.5 and Section 6.7
3.8 Environmental Management System and Contingency Plans	Summarize key elements of North American's environmental, health, and safety management system and discuss how it will be integrated into the Project, addressing the following: a) corporate policies and procedures, operator competency training, spill and air emission reporting procedures, and emergency response plans;	Volume 1, Section 6.1
	b) plans to minimize the production or release into the environment of substances that may have an adverse effect;	Volume 1, Section 6.1

TOR Section	Environmental Assessment or Topic	Location in Document
	c) a conceptual contingency plan that considers environmental effects associated with operational upset conditions such as serious malfunctions, fires, accidents, or extreme weather events; and	Volume 1, Section 6.1
	d) the emergency response plan's capability to deal with unpredicted negative impacts.	Volume 1, Section 6.1
3.9 Adaptation Planning	Describe the flexibility built into the plant design and layout to accommodate future modifications required by changes in emission standards, limits and guidelines. Discuss any follow-up programs and adaptive management considerations.	Volume 1, Section 6.7
3.10 Participation in Regional Cooperative Efforts	Document North American's involvement in regional cooperative efforts to address environmental, health and socio-economic issues associated with regional industrial development during the life of the Project, including: a) North American's current and planned participation in regional monitoring and management activities, such as the Fort Air Partnership, to address environmental, health and socio-economic issues. Provide a list of specific studies that North American plans to participate in;	Volume 1, Section 6.2
	b) North American's current and planned cooperative ventures with other operators to minimize the environmental impact of the Project or the environmental impact of regional industrial development;	Volume 1, Section 10.4
	c) how North American will work to develop and implement such cooperative opportunities;	Volume 1, Section 10.4 and Section 10.7
	d) the monitoring activities North American will implement to assist in managing environmental protection strategies. Discuss how the results obtained will be used to contribute to North American's participation in regional efforts;	Volumes 2-5
	e) how North American will use information from regional cooperative efforts to design and implement mitigation measures (to mitigate specific effects and cumulative effects), monitoring programs (project-specific monitoring and regional monitoring), and research programs outside of these initiatives where necessary.	Volume 1, Section 10.4 and Section 10.7
4.0	**Environmental Information and Cumulative Effects Assessment Information Requirements.**	
4.1 Assessment Scenarios	Define assessment scenarios including: a) a Baseline Case, which includes existing environmental conditions and existing and approved projects or activities;	Volume 1, Section 7; Volumes 2-5
	b) an Application Case, which includes the Baseline Case plus the Project; and	Volume 1, Section 7; Volumes 2-5
	c) a Cumulative Effects Assessment (CEA) Case, which includes existing and anticipated future environmental conditions, existing, planned and approved projects or activities, and the Application case.	Volume 1, Section 7; Volumes 2-5
4.2 Information Requirements for the Environmental Assessment	To meet the basic environmental information requirements for the EIA report North American must include for each section, where applicable: a) quantitative and qualitative information about the existing environmental and ecological processes in the EIA Study Area;	Volumes 2-5
	b) information about the existing and planned human activities in the EIA Study Area, and the nature, size, location and duration of their potential interactions with the environment, sometimes described as stressors (e.g., land disturbance, discharges of pollutants, changes to access status, consumption of renewable resources);	Volumes 2-5
	c) a discussion about changes in environmental conditions, caused by ecological process and natural forces (e.g. climate change, forest fires, flood or drought conditions, predator prey population cycles) that may have an impact on the Project;	Volumes 2-5
	d) the demonstrated use of appropriate predictive tools and methods, enabling quantitative estimates of future conditions with the highest possible degree of certainty;	Volumes 2-5
	e) quantitative and qualitative description of the effects of the Project;	Volumes 2-5
	f) management plans to prevent, minimize or mitigate adverse effects	Volumes 2-5

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	and to monitor and respond to expected or unanticipated conditions, including any follow-up plans to verify the accuracy of predictions or determine the effectiveness of mitigation plans;	
	g) evaluation of the significance of the Project effects, including the probability of the effect occurring and the importance of the consequences (measured quantitatively against management objectives and guidelines or baseline conditions and described qualitatively with respect to the views of North American and stakeholders);	Volumes 2-5
	h) a description of residual effects and their consequences for the environment as well as for regional management initiatives that are underway or in development;	Volumes 2-5
	i) evaluation and description of effects on water quality relative to regional, provincial and national guidelines, including the CCME *Water Quality Guidelines for the Protection of Aquatic Life*, as well as any site-specific water quality guidelines that may be available;	Volumes 2-5
	j) a description of air quality impact assessment as it relates to the *Alberta Ambient Air Quality Objectives*. Evaluate this against the regional, provincial and national objectives for air quality including the *CCME Canada wide Standards for Particulate matter and Ozone*;	Volumes 2-5
	k) a record of all assumptions, including an evaluation of impact prediction confidence in data and analysis to support conclusions; and	Volumes 2-5
	l) provide data and clearly identify their sources.	Volumes 2-5
4.3 Modeling	Document any assumptions used in the EIA report to obtain modeling predictions. Clearly identify the limitations of the model(s) and data used in modelling, including sources of error and relative accuracy. Discuss the applicability and reasons for using a particular model.	Volumes 2-5
4.4 Cumulative Environmental Effects	Assessment of cumulative effects will be an integral component of the EIA report. North American will conduct a cumulative environmental effects assessment of the Project based on the EUB/AENV/Natural Resources Conservation Board (NRCB) Information Letter "Cumulative Effects Assessment in Environmental Impact Assessment Reports under the Alberta *Environmental Protection and Enhancement Act*," June 2000. This will include a summary of all proposed monitoring, research and other strategies or plans to minimize, mitigate and manage any potential adverse effects. The cumulative environmental effects assessment for the Project will include the following: a) the definition of the spatial and temporal Study Area boundaries and the rationale for assumptions used to define those boundaries for each environmental component examined;	Volumes 2-5
	b) a description of the current (baseline) state of the environment in the Regional Study Area used for the cumulative effects assessment;	Volumes 2-5
	c) an assessment of the incremental consequences that are likely to result from the Project in combination with other existing, approved and planned projects in the region;	Volumes 2-5
	d) demonstrate that the information and data used from other development projects is appropriate for use in this EIA report. Include a description of the deficiencies or limitations in the existing database for relevant components of the environment; and	Volumes 2-5
	e) an explanation of the approach and methods used to identify and assess cumulative effects including cooperative opportunities and initiatives undertaken to further the collective understanding of cumulative effects. Provide a record of relevant assumptions, confidence in data and analysis to support conclusions.	Volumes 2-5
4.5 EIA Study Area	The EIA Study Area shall include the PDA and associated infrastructure, as well as the spatial and temporal areas of individual environmental components outside the PDA boundaries where an effect can be reasonably expected. The EIA Study Area includes both Regional and Local Study Areas.	Volume 2, Section 1.5; Volumes 2-5

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	Illustrate boundaries and identify the Study Areas chosen to assess effects. Define temporal and spatial boundaries for the Study Areas. Maps of these areas should include township and range lines, waterbodies, wetlands and other significant topographic features, for easy identification and comparison with other information within the EIA report. Describe the rationale and assumptions used in establishing the Study Area boundaries, including those related to cumulative effects.	
4.6 Climate and Air Quality	Discuss baseline climatic and air quality conditions. Review emission sources and discuss emissions from industrial development within the EIA Study Areas. Consider point source emissions as well as fugitive emissions. Identify components of the Project that will affect air quality from a local and regional perspective, and: a) identify any regional air monitoring done in the area and describe North American's participation in any regional forum (e.g., Northeast Capital Industrial Association, Fort Air Partnership);	Volume 2, Section 1.1 and Section 2.5
	b) discuss appropriate air quality parameters such as PAH, SO_2, carbon monoxide (CO), H_2S, total hydrocarbons (THC), NO_x, VOC, individual hydrocarbons of concern and their proportion of the THC and VOC mixtures, visibility, trace metals, particulates (PM_{10} and $PM_{2.5}$) and O_3;	Volume 2, Section 2.7
	c) estimate ground-level concentrations of appropriate air quality parameters, include frequency distributions for air quality predictions in communities and sensitive receptors, and include an indication of 99.9 percentile for hourly predictions (98 percentile for any 24-hour modeling predictions of $PM_{2.5}$), as well as maximum predictions. Discuss any expected changes to particulate deposition or acidic deposition patterns. Justify the selection of the models used and identify any model shortcomings or constraints on findings. Complete modelling in accordance with *Alberta Environment's Air Quality Model Guidelines*. Include model input files;	Volume 2, Section 2.7, Appendices 2C and 2D
	d) for acid deposition modeling, provide deposition data from maximum levels to areas with 0.17/keq/ha/yr Potential Acid Input (PAI). Justify the selection models used and identify any model shortcomings or constraints of findings; include analysis of PAI deposition levels on acid sensitive soils and water bodies in the Study Areas, ensuring that deposition levels used are representative of the Region;	Volume 2, Section 2.7
	e) identify the potential for reduced air quality (including odours and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health;	Volume 2, Section 2.7
	f) describe how air quality impacts resulting from the Project will be mitigated;	Volume 2, Section 2.6
	g) identify and describe the ambient air quality monitoring and receptor monitoring that will be implemented during Project development, construction and operation to assess air quality and the effectiveness of mitigation;	Volume 2, Section 2.5 and Section 2.6
	i) assess the project-specific air quality impacts and cumulative air quality impacts, and their implications for other environmental resources, including habitat diversity and quantity, vegetation resources, water quality and soil conservation; discuss the relative contribution of the Project (e.g., after mitigation) to regional cumulative effects; and	Volume 2, Section 2.7
	j) assess the cumulative effects on the air quality of the EIA Study Area and include any related emissions increases from upgrading bitumen.	Volume 2, Section 2.7
4.6.1 Climate Change	Discuss the following, with reference to the guide "Incorporating Climate Change Considerations in Environmental Assessment General Guidance for Practitioners" (Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment, 2003):	Volume 2, Section 2.7

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	a) climate change and the local and/or regional, inter-provincial/territorial changes to environmental conditions resulting from climate conditions, including trends and projections where available;	
	b) the stages or elements of the Project that are sensitive to changes or variability in climate parameters. Discuss the impacts the change in climate parameters may have on these sensitive stages or elements; and	Volume 2, Section 2.7
	d) the adaptability of the Project in the event the region's climate changes. Discuss any follow-up programs and adaptive management considerations.	Volume 2, Section 2.7
4.7 Noise and Light		
4.7.1 Noise	Provide representative baseline noise levels and a description of the measurement/prediction methods used. Discuss: a) and provide the results of a noise assessment based on existing conditions as specified by EUB Noise Control Directive 038, including: i) an estimate of the potential for increased noise resulting from the Project; ii) the identification of potentially-affected people and wildlife; and iii) the implications of any increased noise levels;	Volume 2, Section 3.2, Section 3.6 and Section 3.7
	b) the effects and mitigative measures to be utilized to minimize the production of noise at sensitive receptors	Volume 2, Section 3.7
4.7.2 Light	Discuss baseline light level conditions. Identify components of the Project that will affect light levels, include: a) potentially-affected people and wildlife and the implications of increased light levels from the Project;	Volume 5, Section 14.2 and Section 14.6
	b) facilities that will affect light levels at night and evaluate the potential effects of increased light from the Project on affected residents; and	Volume 5, Section 14.5
	c) a discussion on the effects and mitigative measures to be utilized to minimize the production of light and flaring.	Volume 5, Section 14.6
4.8 Land Use and Reclamation	Review current land use issues and identify the anticipated changes in nature, location and duration of land use as a result of the Project. Discuss: a) conformity with land use objectives and planning parameters for the Strathcona County Alberta's Industrial Heartland Area Structure Plan; Heavy Industrial Policy Area, and the Planning Framework;	Volume 5, Section 13.3 and Section 13.4
	b) potential Project impacts on local and regional land use management, residential areas, agricultural activities/development, areas with native vegetation, wildlife habitat, recreation uses, and other industrial uses in the region;	Volume 5, Section 13.6
	c) mitigation plans to minimize these impacts;	Volume 5, Section 13.6
	d) the navigability capability and resources, including plans for mitigation and plans to address residual effects: i) conduct necessary surveys to characterize the navigation resources in the Study Area; and ii) discuss components of the Project that will potentially affect navigable waterways;	Volume 5, Section 13.5
	e) reclamation concepts and objectives. Develop a conceptual reclamation/closure plan for the PDA taking into consideration regulatory requirements, stakeholder input, land use objectives and other factors necessary for a reclamation plan to be implemented;	Volume 1, Section 7
	Discuss how the reclamation/closure plan design will: f) assess for and mitigate/remediate on site contamination;	Volume 1, Section 7.6
	g) return equivalent land capability as compared to pre-disturbance conditions;	Volume 1, Section 7.6
	h) integrate the proposed landscape with the surrounding landscapes including inter-connectivity to the surrounding landscapes;	Volume 1, Section 7.6
	i) integrate surface- and near-surface drainage within the PDA; and	Volume 1, Section 7.6
	j) be incorporated into the planning and development of the Project;	Volume 1, Section 7.6
	Provide and discuss:	Volume 1, Section 7.6

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	k) soil conservation and salvage plans for topsoil and subsoil indicating salvage areas, depths of salvage, types, quality and volumes of soil to be salvaged. Describe the procedures for soil handling and outline soil storage methods and locations;	
	l) soil replacement plans specifying the techniques, timing, depth, volume and type of reclamation material;	Volume 1, Section 7.6
	m) the anticipated timeframes for completion of reclamation activities;	Volume 1, Section 7.2
	n) the parameters that should be used to monitor and evaluate the reclaimed land;	Volume 1, Section 7.6
	o) any constraints to reclamation such as timing of activities, availability of materials and influence of natural processes and cycles;	Volume 1, Section 7.5
	p) any soil-related constraints or limitations that may affect reclamation; and,	Volume 1, Section 7.5
	q) revegetation for the disturbed terrestrial areas, identifying the species type that will be used for seeding or planting, and the vegetation and weed management practices.	Volume 1, Section 7.6
4.9 Terrestrial		
4.9.1 General Terrestrial Consideration	Review current biophysical conditions and identify the nature, location and duration of changes anticipated as a result of the Project. Provide and discuss the following: a) maps indicating the pre-disturbance landscape, elevation and drainage patterns of the Study Areas including the location of the proposed footprint;	Volume 1, Figure 4.3-1; Volume 4, Figure 9.5-1
	b) ownership of bed or shore of any waterbodies or watercourses that fall within the Project Area. If determination of ownership has not been completed, describe the process that will be used to establish ownership, and a schedule for the determination;	Volume 3, Section 6.5
	c) an assessment of the anticipated changes to the pre-disturbed topography, elevation and drainage patterns of the Study Areas;	Volume 4, Section 9.7
	d) baseline biophysical conditions, including topography, soil and vegetation characteristics, and wildlife capability within the Study Area. Conduct the necessary surveys to characterize the biophysical resources in the Study Area, and to assist in reclamation planning;	Volume 4, Section 9.5, Section 10.5 and Section 11.5
	e) components of the Project that will potentially affect these biophysical resources, including soils, vegetation, wildlife and biodiversity;	Volume 4, Section 9.6, Section 10.6, Section 11.6 and Section 12.6
	f) mitigation plans to minimize these effects; and	Volume 4, Section 9.6, Section 10.6, Section 11.6 and Section 12.6
	g) an assessment of the relative contribution of the Project (after mitigation) to regional cumulative pressures on biophysical resources (e.g., project contributions to cumulative PAI)	Volume 4, Section 9.7, Section 10.7, Section 11.7 and Section 12.7
4.9.2 Soil	a) describe the soil types and map their distribution in the study areas using appropriate soil survey classification procedures as outlined in the Soil Survey Handbook, Volume 1 (Agriculture Canada, 1987) and The Canadian System of Soil Classification (Agriculture and Agri-Food Canada, 1999);	Volume 4, Section 9.4 and Section 9.5
	b) provide an ecological context of the soil resource by supplying a soil survey report and maps following Soil Survey Handbook, Volume 1 (Agriculture Canada, 1987) and The Canadian System of Soil Classification, Third Edition (Agriculture and Agri-Food Canada, 1998) to include: i) SIL (survey intensity level) 1 for the development footprint areas (PDA); ii) SIL 2 for other areas in the Local Study Area; iii) appropriate level of detail to determine the effect of the Project on soil types and quality, in the Regional Study Area;	Volume 4, Section 9.4
	c) characterize the pre-disturbance morphological, physical and chemical properties of the soil types and assess the pre-disturbance	Volume 4, Section 9.5

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	land capability;	
	d) describe the suitability and availability of soil materials within the PDA for reclamation using Soil Quality Criteria Relative to Disturbance and Reclamation (Alberta Agriculture, 1987);	Volume 4, Section 9.5
	e) discuss sensitivity of soils to wet and dry acidic deposition in the local and regional study areas for baseline, application and cumulative scenarios. i) explain the methods used to assess sensitive soils and include information from grid cell sensitivity assessments that may be available for the study area; ii) using modeled PAI for the baseline, application, and cumulative scenarios, describe the soils that would exceed the Clean Air Strategic Alliance's (CASA) recommended critical loads in the in the Local and Regional Study areas and include maps showing their spatial distribution; and iii) outline any existing monitoring information such as AENV's long-term soil acidification study and any regional initiatives (e.g. NCIA) for acidic deposition;	Volume 4, Section 9.7
	f) deterioration including acid deposition and changes to land capability at the local and regional scale;	Volume 4, Section 9.8
	g) discuss mitigation plans to minimize these impacts; and	Volume 4, Section 9.7
	h) discuss the regulatory requirements for soil monitoring or soil management. Discuss the potential impacts of the Project to soils in the development area and areas that may be potentially affected.	Volume 4, Section 9.9
4.9.3 Vegetation	a) provide an inventory, map and a description of the existing terrestrial, wetland and aquatic vegetation. Include any rare vascular and non-vascular plant species and rare plant communities in the Study Areas;	Volume 4, Section 10.5
	b) describe and assess potential impacts of the Project construction and operation on vegetation (abundance, diversity, health, rare species and rare plant communities) in the Study Areas;	Volume 4, Section 10.6
	c) describe the potential Project related and cumulative impacts of air emissions, including acidification, acidifying and other air emissions on terrestrial, wetland and aquatic vegetation;	Volume 4, Section 10.7
	d) describe and discuss measures to be implemented to mitigate and monitor potential impacts of the Project on vegetation in the Study Areas; and	Volume 4, Section 10.6
	e) discuss how vegetation monitoring programs will be used to adaptively manage the mitigation measures and monitoring programs	Volume 4, Section 10.8
4.9.4 Wildlife	Describe existing wildlife resources (amphibians, reptiles, birds and terrestrial and aquatic mammals), and their use and potential use of habitats in the Study Areas. Document the anticipated changes to wildlife in the Study Areas. Specifically: a) document and describe, using recognized survey protocols, those species found within the Study Areas that are listed by Alberta Sustainable Resource Development Fish and Wildlife (at risk, may be at risk and sensitive species in the *General Status of Alberta Wild Species 2000*) and the Committee on the Status of Endangered Wildlife in Canada (endangered, threatened, vulnerable in *Canadian Species at Risk 2002*);	Volume 4, Section 11.3, Section 11.4 and Section 11.5
	b) describe and assess potential impacts of the Project on wildlife species found within the Study Areas. Include impacts on critical habitat, habitat availability and quality, and habitat fragmentation and loss. These impacts should be described for the various phases of the Project both locally and cumulatively with other activities in the Study Areas;	Volume 4, Section 11.6
	c) describe proposed strategies to minimize and/or mitigate impacts on wildlife species and their habitats that are within the Study Areas. These strategies should be tailored to the various phases of the Project and comply with wildlife legislation;	Volume 4, Section 11.6
	d) identify and discuss proposed monitoring programs that will be	Volume 4, Section 11.8

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	implemented during various phases of the Project to evaluate the effectiveness of mitigative strategies to reduce impacts on wildlife species and their habitats that are within the Study Areas. Describe how the results from the monitoring programs will also be used to evaluate the effectiveness of the programs themselves; and	
	e) identify and discuss any wildlife studies that are currently being conducted in the Study Areas and how North American plans to integrate its operational and mitigation activities with those studies.	Volume 4, Section 11.8
4.9.5 Biodiversity and Fragmentation	a) discuss how the impacts defined in the EIA report could affect local and regional biodiversity and habitat fragmentation, both Project specific and cumulatively. Use quantitative data where possible to describe the potential effects on biodiversity and habitat;	Volume 4, Section 12.6
	b) discuss how the Project will contribute to changes in regional biodiversity. Include the measures North American will take to minimize these changes;	Volume 4, Section 12.6
	c) discuss how North American's plans for mitigation and monitoring will meet the expectations of Sustaining Alberta's Biodiversity An Overview of Government of Alberta Initiatives Supporting the Canadian Biodiversity Strategy (Alberta Environmental Protection, 1998);	Volume 4, Section 12.6
	d) determine the current and proposed level of habitat fragmentation for the Study Areas;	Volume 4, Section 12.5 and Section 12.6
	e) describe the techniques used in the fragmentation analysis;	Volume 4, Section 12.4
	f) identify and evaluate the effects from fragmentation on the Study Areas (e.g., potential introduction of non-native plant species on native species composition and any changes to plant communities) as a result of Project activities; and	Volume 4, Section 12.6
	g) discuss measures to mitigate, monitor and reclaim the effects of fragmentation.	Volume 4, Section 12.6 and Section 12.8
4.10 Surface Water and Groundwater		
4.10.1 Surface Water Hydrology and Quality	Discuss baseline surface hydrology conditions. Identify components of the Project that will affect these conditions from a local and regional perspective. Discuss: a) existing drainage patterns, surface waterbodies, and wetlands within local and regional Study Areas, and the seasonal flow/water level characteristics of these waterbodies;	Volume 3, Section 6.5
	b) project-related temporary and permanent alterations to these drainage patterns, waterbodies and wetlands;	Volume 3, Section 6.6
	c) possible water diversions and return flows from these drainage channels and waterbodies under a variety of operating conditions and scenarios including, emergency conditions, low flow, or drought conditions;	Volume 3, Section 6.6 and Section 6.7
	d) effects of site runoff management on flow/level characteristics in these drainage channels and waterbodies;	Volume 3, Section 6.6
	e) mitigation plans to minimize these effects and the loss of wetland and function;	Volume 3, Section 6.6
	f) the relative contribution of the Project (after mitigation) to regional cumulative pressures on surface water resources;	Volume 3, Section 6.7
	g) the monitoring program that will be implemented to assess hydrological impacts and the performance of mitigation plans and water management systems;	Volume 3, Section 6.8
	h) cumulative impact of water withdrawal on the North Saskatchewan River or any other potential water source; and	Volume 3, Section 6.7
	i) the potential impact of climate change on water withdrawal requirements during low flow periods.	Volume 3, Section 6.7
	Discuss baseline surface water quality. Identify components of the Project that will affect these conditions from a local and regional perspective. Discuss: j) water quality characteristics in surface waterbodies within the Study Area, including but not limited to: temperature, pH, conductivity, TDS, alkalinity, hardness, nutrients, hydrocarbons, cations and anions, metals, dissolved oxygen, suspended solids, phenolics,	Volume 3, Section 7.6

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	colour and other water constituents potentially relevant to the effluent discharges and impact assessment, their seasonal variation, relationships to flow and other controlling factors and a summary of existing water quality data including necessary surveys to characterize the water quality;	
	k) the potential Project related and cumulative impacts of air emissions, including acidification, on surface water quality in the local and regional waterbodies;	Volume 3, Section 7.7 and Section 7.8
	l) effects of site runoff on water quality in surface waterbodies within the Study Area;	Volume 3, Section 7.7 and Section 7.8
	m) the impacts of the following on surface water quality within the Study Area: i) change in groundwater movement; ii) spills; iii) contaminated groundwater resulting from spills; iv) surface water withdrawals (Project and Cumulative); and v) industrial effluent discharges;	Volume 3, Section 7.7
	n) mitigation plans to minimize these impacts during the construction, operation and reclamation phases of the Project;	Volume 3, Section 7.7
	o) a plan and implementation program for the protection of surface water quality, including the following: i) a surface water monitoring program for early detection of potential contamination and assistance in remediation planning; and ii) a discussion of the surface water remediation options being considered for implementation in the event that adverse effects are detected;	Volume 3, Section 7.7 and Section 7.9
	p) the relative contribution of the Project (after mitigation) to regional cumulative effects on surface water quality (e.g., project contributions to lake acidification); and	Volume 3, Section 7.8
	q) the potential impacts on surface water quality within the Study Areas resulting from the Project, including but not limited to, site runoff and project-related wastewater discharges, that may cause adverse effects or an exceedance of the *Surface Water Quality Guidelines for Use in Alberta* (November 1999) or *Canadian Water Quality Guidelines*.	Volume 3, Section 7.8
4.10.2 Groundwater Quantity and Quality	Discuss baseline groundwater conditions. Identify components (e.g., dewatering, well supply) of the Project that will affect these conditions from a local and regional perspective. Provide the following: a) a discussion of the characteristics of major aquifers, aquitards, and aquicludes in the Study Area;	Volume 3, Section 5.5
	b) lithology, thickness and stratigraphic continuity of both surficial and bedrock geologic units within the Study Area;	Volume 3, Section 5.5
	c) hydrogeologic information including hydraulic properties, depth to water, flow direction, and velocity of the geologic units. Include a description of the interaction between groundwater and surface water;	Volume 3, Section 5.5
	d) groundwater quality information of the hydrogeologic units in the Study Area, including but not limited to background concentrations of major ions, dissolved metals, BTEX and other potential contaminants of concern;	Volume 3, Section 5.5
	e) maps and cross-sections that include groundwater table and piezometric surfaces based on identifiable groundwater systems and accurate data sources, such as drill holes;	Volume 3, Figure 5.5-1, Figure 5.5-2 and Figure 5.5-3
	f) results of any new hydrogeological investigations, including methodology;	Volume 3, Section 5.4 and Section 5.5
	g) an inventory of groundwater users in the Study Area. Identify potential groundwater use conflicts and proposed resolutions;	Volume 3, Section 5.5
	h) an assessment of potential effects of Project-related water withdrawal on groundwater levels, effects on local and regional groundwater regimes, including vertical gradients and discharge areas;	Volume 3, Section 5.6
	i) an assessment of the effects of groundwater withdrawal/dewatering	Volume 3, Section 5.6

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	and its implications for other environmental resources, including flows and water levels in local streams, wetlands, vegetation and soil saturation;	
	j) an assessment of potential effects of Project-related activities and surface releases (e.g., accidental contaminant spills) and down-hole wastewater disposal on groundwater quality;	Volume 3, Section 5.6
	k) a justification for the selection of hydrogeologic models used. Identify any model shortcomings or constraints on findings and any surrogate parameters that were used as indicators of potential aquifer contamination due to the Project;	Volume 3, Section 5.4
	l) a plan and implementation program for the protection of groundwater resources, including the following: i) a groundwater monitoring program for early detection of potential contamination and assistance in remediation planning; ii) a discussion of the groundwater remediation options being considered for implementation in the event that adverse effects are detected;	Volume 3, Section 5.8
	m) a plan to monitor the sustainability of groundwater production or dewatering effects;	Volume 3, Section 5.8
	n) identify any regional groundwater monitoring being done in the area and describe North American's participation in any regional forum	Volume 3, Section 5.8
4.11 Aquatic Resources	Identify components of the Project that will affect baseline conditions from a local and regional perspective. Discuss: a) baseline aquatic resource conditions, including fish, epilithic algae and benthic invertebrate habitat capability in waterbodies within the Study Area. Conduct the necessary surveys to characterize the aquatic resources in the Study Area;	Volume 3, Section 8.5
	b) the potential for nutrient enrichment, if nutrients are discharged to the aquatic environment, from both the Project and cumulative perspectives;	Volume 3, Section 8.6
	c) components of the Project that may affect aquatic resources within the Study Area, their impact on the Study Area and significance;	Volume 3, Section 8.6
	d) cumulative effects of the impacts that already exist, including the use of fertilizer and water draw and potential Project-related impacts on the aquatic resources in relevant waterbodies;	Volume 3, Section 8.7
	e) mitigation plans to minimize these impacts;	Volume 3, Section 8.6
	f) an assessment of the relative contribution of the Project (after mitigation) to regional cumulative effects on aquatic resources (e.g., project contributions to lake acidification);	Volume 3, Section 8.7
	g) the potential for contamination of fish and fish habitat by wastewater discharges relative to fish consumption guidelines;	Volume 3, Section 8.6
	h) programs to monitor aquatic habitat quality and the effectiveness of mitigation strategies; and	Volume 3, Section 8.8
	i) the key indicator species and stressors related to the Project.	Volume 3, Section 8.4 and Section 8.5
5.0	**Environmental Effects Monitoring**	
	Describe the environmental effects monitoring (EEM) activities that North American will undertake to manage effects and confirm the performance of mitigative measures. Specifically address: a) monitoring activities and initiatives that North American is proposing to conduct independently of other stakeholder activities in the region;	Volumes 2-5
	b) monitoring activities that North American is proposing to conduct collaboratively with other stakeholders. Include in this discussion the role that North American anticipates taking in each of the programs; and	Volumes 2-5
	c) mechanisms for sharing results, reviewing findings and adjusting programs should monitoring identify unanticipated consequences of North American's operations or mitigation plans, include: i) corporate adaptive management strategies; and	Volume 1, Section 6.7 and Section 10.7

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	ii) consultation with regulators, public stakeholders, and, if necessary, regional management forums.	
6.0	**Public Health and Safety**	
	Describe those aspects of the Project that may have implications for public health or the delivery of health services. Determine whether there may be implications for public health arising from the Project. Specifically: a) identify and discuss the data and methods used by North American to assess the impacts of the Project on human health and safety;	Volume 2, Section 4.4
	b) assess the potential health implications of the compounds that will be released to the environment from the proposed Project in relation to exposure limits established to prevent acute and chronic adverse effects on human health;	Volume 2, Section 4.4
	c) identify the human health impact of the potential contamination of country foods and natural food sources taking into consideration all Project activities;	Volume 2, Section 4.7
	d) provide information on compounds released from the Project found in samples of selected species of vegetation and wildlife known to be consumed by humans and incorporate into the assessment;	Volume 2, Section 4.4
	e) discuss the potential to increase human exposure to contaminants from changes to water quality, air quality and soil quality taking into consideration all Project activities;	Volume 2, Section 4.7
	f) during consultation on the Project, document any health concerns identified by Aboriginal stakeholders due to the impacts of existing industrial development and of the Project specifically on their traditional lifestyle. Determine the impact of the Project on the health of the Aboriginal stakeholders and identify possible mitigation strategies;	Volume 1, Section 10.4
	g) assess cumulative health effects to receptors, including First Nations and Aboriginal receptors, that are likely to result from the Project in combination with other existing, approved and planned projects;	Volume 2, Section 4.7
	h) as appropriate, identify anticipated follow-up work, including regional cooperative studies. Identify how such work will be implemented and coordinated with ongoing air, soil and water quality initiatives;	Volume 2, Section 4.9
	i) identify and discuss potential health and safety impacts due to higher regional traffic volumes and the increased risk of accidental leaks and spills;	Volume 5, Section 15.6
	j) document health and safety concerns raised by stakeholders during consultation of the Project;	Volume 1, Section 10.5
	k) provide a summary of North American's emergency response plan and mitigation plans that will be implemented to ensure workforce and public safety during the pre-construction, construction, operation and reclamation of the Project. Include prevention and safety measures for wildfire occurrences, water saturated plume from the cooling towers, icy roads in winter months, accidental release or spill of chemicals to the environment and failures of structures retaining water or fluid wastes;	Volume 1, Section 6.1
	l) describe how local residents will be contacted during an emergency and what type of information will be communicated to them; and	Volume 1, Section 6.1
	m) describe existing agreements with area municipalities or industry groups such as, safety, co-operatives, emergency response associations and municipal emergency response agencies.	Volume 1, Section 6.1 and Section 10.4
7.0	**Historic Resources**	
	a) Provide evidence of consultation with Alberta Tourism Parks, Recreation and Culture. Provide a general overview of the results of any previous historic resource studies that have been conducted in the Study Area, including archaeological resources,	Volume 5, Section 16.1

TOR Section	Environmental Assessment or Topic	Location in Document
	palaeontological resources, historic period sites, and any other historic resources as defined within the Alberta *Historical Resources Act*;	
	b) Provide a summary of the results of any Historic Resources Impact Assessments that have been carried out with respect to the Project. The Historic Resources Impact Assessment(s) must encompass all projected development and impact areas within the boundaries of the Project; and	Volume 5, Section 16.4 and Section 16.5
	c) Provide an outline of the historic resources management program and schedule of field investigations that may be required to mitigate the effects of the Project on historic resources.	Volume 5, Section 16.6
8.0	**Socio-Economic Factors**	
	Provide information on the socio-economic effects of the Project. Specifically provide and address the following: a) the number and distribution of people who may be affected by the Project;	Volume 5, Section 15.3
	b) information on the economic status of the area and the Project's contribution to this economic status;	Volume 5, Section 15.4
	c) information on the social impacts of the Project on the Study Area and on Alberta including: i) local employment and training; ii) local procurement; iii) population changes; iv) demands on local services, and infrastructure; and v) regional and provincial economic benefits;	Volume 5, Section 15.4 and Section 15.5
	d) the impacts of the Project during construction and operation phases, on infrastructure, transportation planning, traffic and local services;	Volume 5, Section 15.4, Section 15.6 and Section 15.7
	e) the economic impacts of the Project on the Study Area and on Alberta, having regard for capital, labour, and other operating costs and revenue from services;	Volume 5, Section 15.4
	f) North American's policies and programs respecting the use of local, Alberta, and Canadian goods and services;	Volume 5, Section 15.4
	g) a breakdown of the industrial benefits of the Project (e.g. project management/engineering, equipment and materials, construction labour etc.) for businesses within Alberta, Canada and outside Canada.	Volume 5, Section 15.4
	h) employment and business development opportunities the Project may create for local communities and the region;	Volume 5, Section 15.4
	i) a breakdown of the labour force, type of employment, and number of employees with respect for the construction and operational workforces. Identify when the peaks in labour requirements will occur, the extent of the peaks and the source of labour for the Project; and	Volume 5, Section 15.4
	j) describe and discuss the impacts of the proposed Project on potential shortages of affordable housing and the quality of health care services. Identify and discuss the mitigation plans that will be undertaken to address these issues. Provide a summary of any discussions that have taken place with the Municipality and the Regional Health Authority concerning potential housing shortages and health care services respectively.	Volume 5, Section 15.7
9.0	**Public Consultation Requirements**	
	North American will undertake a consultation program during the preparation of the EIA report. As part of this consultation program, North American will consult with the following potentially affected stakeholders: a) the residents of surrounding communities;	Volume 1, Section 10.4
	b) recognized land users of the Local Study Area;	Volume 1, Section 10.4
	c) industrial, recreational, environmental groups and individuals	Volume 1, Section 10.4

TOR Section	Environmental Assessment or Topic	Location in Document
	expressing a formal interest in the Project;	
	d) federal, provincial, and municipal regulators, as applicable;	Volume 1, Section 10.4
	e) other operating or planned developers in the region;	Volume 1, Section 10.4
	f) Aboriginal groups;	Volume 1, Section 10.4
	Describe and document the public consultation program implemented including plans to coordinate consultation activities with other developers in the area. Record any concerns or suggestions made by the stakeholders and demonstrate how these concerns have or will be addressed or discounted. Discuss: g) how the concerns and issues identified by North American and stakeholders influenced the Project development, design, impact mitigation and monitoring;	Volume 1, Section 10.5
	h) the type of information provided and the issues discussed, including those that have been resolved and those that remain outstanding;	Volume 1, Section 10.4 and Section 10.6
	i) in consideration of unresolved issues, the key alternatives which have been identified by North American and stakeholders for future consultations as well as mechanisms and timelines for that resolution;	Volume 1, Section 10.6
	j) plans to maintain and support the public consultation process following completion of the EIA review; and	Volume 1, Section 10.7
	k) subject to confidentiality obligations, any agreements reached with stakeholders regarding North American's activities associated with the Project.	Volume 1, Section 10.6

Alberta EPEA Guide to Content for Industrial Approval Applications (AENV 1999)

AEPEA Guide to Content 3(1)	Information Required for New Plants	Locations in Volume 1 unless otherwise noted
(a)1	Applicant Information	1.0, 2.0
(b)	Location, Size and Capacity of the Activity	1.0
2.1	Legal land description	1.2
2.2	Relation to nearest town, city, village and users of the land	1.2
2.3	Geographical description of the surrounding topography and relation to nearby watercourses	Volume 3, Section 6
3	Capacity	3.5
4.1	Size of the affected area	1.0 and Volumes 2 – 5
4.2	Physical dimensions of the plant site including a plot plan	3.1
4.3	Number of employees working at the facility	Volume 5, Section 15
(c)	Nature of the Activity	1.0
5.1	Classification of this facility under AEPEA Activities Designation Regulation 211/96	2.1
5.2	General purpose, products, by-products	3.4
5.3	Major unit operations including a process flow diagram and description of the process	3.0
5.4	Project cost and scheduling	Volume 5, Section 15
5.5	Scale diagrams of the plant, site and surrounding area, including environmental features	1.2, 3.1 and Volumes 2 - 5
5.6	Process flow diagrams	3.3
5.7	Material balance	5.0
5.8	Industrial wastewater and air emission stream information	4.3, 6.2, 6.4, Volume 2, Section 2 and Volume 3, Section 7
5.9	Components of the wastewater and air emission streams	4.3, 6.2, 6.4, Volume 2, Section 2 and Volume 3, Section 7
5.10	Cooling system	4.2
5.11	Raw water treatment	4.3
5.12	Sanitary waste treatment	4.3
5.13	Major environmental control operations	4.0. 6.0, and Volumes 2 - 5
5.14	Underground and aboveground tank details	4.4
5.15	Underground storage tank integrity and overfilling prevention details	N/A
5.16	Potable water source, description of water treatment system used, sanitary sewage handling procedures or septic tank details	4.3
5.17	Details on the reciprocating or turbine engines	4.1.1 and 6.2.3
5.18	Plot plan showing the exhaust stack locations	3.1
5.19	The peak height of compressor buildings	N/A
5.20	Details on all natural gas fired heaters, treaters, boilers and steam generators	3.0
5.21	Details on any auxiliary or standby process equipment or other sources of emission	3.0
5.22	Details on flare stacks	4.2.5

AEPEA Guide to Content 3(1)	Information Required for New Plants	Locations in Volume 1 unless otherwise noted
5.23	Details on any active flare pit on-site	N/A
5.24	Details of any inactive or former flare pit on-site	N/A
5.25	Emergency flaring scenario SO_2 dispersion modeling and rates and composition of flared streams	Volume 2, Section 2 (2.7)
5.26	Description of any on site incineration of solid waste	N/A
5.27	NO_2 and SO_2 dispersion computer modelling input and output	Volume 2, Section 2 (2.7.1 and Appendix 2E)
(d) 8	EUB Approval Status	2.0
(e) 9	Environmental Impact Assessment	Volumes 2 – 5
(f) 10	Existing AEPEA Approvals (not applicable for new plants)	N/A
(g) 11	Schedule	1.4
(h)	Substance Releases	See specifics below
14.1	A list and quantity of substances used in the production process	5.1
14.2	Water demand; sources, purpose and quantities	4.3 and 6.4
14.3	Sources of the substances to be released to the environment	5.0 and Volumes 2 – 5
14.4	Amount of the substances to be released to the environment	5.0 and Volumes 2 – 5
14.5	Methods of release of substances to the environment	6.0 and Volumes 2 – 5
14.6	Pollution prevention and control measures	6.0 and Volumes 2 – 5
14.7	Runoff volume determination	4.3.3 and Volume 3, Section 6
(i)	Environmental Monitoring Information	Volumes 2 – 5
17.1	Any baseline environmental data that may have been collected at the site (for air, water, soils, etc.)	Volumes 2 – 5
17.2	Baseline hydrogeologic characteristics and groundwater monitoring data	Volume 3, Section 5
(j)	Past Use of Substance Release Control Systems (not applicable to new plants)	N/A
(k)	Justification for Substance Releases	6.0 and Volumes 2 – 5
23.1	Application of process technology, management practices and current environmental control technology/control systems	6.0 and Volumes 2 – 5
23.2	Alternatives	6.0 and Volumes 2 – 5
(l)	Waste Minimization Measures	6.5
26.1	Waste Management Summary	6.5
26.2	Waste minimization measures to be implemented	6.5
26.3	Liquid effluent treatment and air emissions treatment	6.0 and Volumes 2, Section 2 and Volume 3, Section 7
(m)	Surface Disturbance Impacts	7.0
29.1	Extent and nature of the surface disturbance	7.6
(n)	Emergency Response Plans (ERP)	6.1.2
32.1	Confirmation of filing of ERP with the EUB and other agencies	6.1.2
(o) 33.1	Environmental Contingency Plans	6.0
(p)	Conservation and Reclamation	7.0
34.1	Soil Assessments	7.0 and

AEPEA Guide to Content 3(1)	Information Required for New Plants	Locations in Volume 1 unless otherwise noted
		Volume 4, Section 9
34.2	Procedures to return site to equivalent land capability	7.0
(q)	Public Involvement Process	10.0
37.1	Proposed or conducted public involvement process	10.0
37.2	Frequency, type and purpose for the public involvement and environmental concerns identified	10.0
(r) 40	Information required under any other regulation under EPEA in support of the application	N/A

EUB Directive 023 Information Requirements (EUB 1991)

Guide	Requirement (abridged)	Locations in Volume 1 unless otherwise noted
1.0 GENERAL INFORMATION		
1.5	**Project description**	
1.5.1	Applicable Acts and Sections under which the application is made	1.0, 2.0
1.5.2	Name and address of the application and any partners involved and the details of company incorporation	2.5
1.5.3	Statement of need and project timing	1.6, 1.4
1.5.4	Overall project description and discussion of schedule Including: location, size and scope, schedule of preconstruction, construction, start up, duration of operations, and a discussion of the reasons for selecting the proposed schedule.	1.0
1.5.5	Regional setting and reference to existing and proposed land use	1.0
1.5.6	a. Maps showing freehold, leasehold, mineral and surface rights of the proposed scheme and surrounding area. b. Maps with legal descriptions showing the locations of landowners and their dwellings in relation to the proposed oil sands site	Appendix D, Figure D2-1
1.5.7	Map showing topography, exiting areas of habitation, industry, the proposed site and any development in the project area	Figure 1.2-1
1.5.8	Aerial photomosaic at an appropriate scale to illustrate the locations of the project components including the mine area, wells, extraction plant, upgrader unit, tanks, discard storage sites including tailing ponds, access roads, railways, pipelines and utility corridors.	Figure 3.1-2
1.5.9	Description of storage and transportation facilities of the final hydrocarbon product, including detail of size and ownership of any pipeline which may be utilized	1.7
1.5.10	Proposed rate of production over the life of the Project	3.3
1.5.11	Description of the subject oil sands	N/A
1.5.12	Status of negotiations held or to be held with the freehold, leasehold, mineral surface rights owners	10.4.6
1.5.13	Proposed energy source, alternatives, resource use, sources and supply	4.0
1.5.14	Description and results of public information program	10.0
1.5.15	The term of the approval sought, including expected project start and completion dates	1.4
1.5.16	Name of responsible person to contact	2.5
2.0 TECHNICAL INFORMATION		
2.1	Surface mining operations -	N/A
2.2	Underground access and development	N/A
2.3	Insitu operations	N/A
2.4	**Processing Plant**	
2.4.1	A separate description of the bitumen extraction, upgrading, utilities, refining and sulphur recovery facilities, including a. a discussion of the process b. process flow diagrams indicating major equipment, stream rates and composition, and the proposed production measurement devices, characteristics and locations c. chemical and physical characteristics and properties of feeds and product materials	3.0

Guide	Requirement (abridged)	Locations in Volume 1 unless otherwise noted
2.4.2	Overall material and energy balances, including information with respect to hydrocarbon and sulphur recoveries, water use and energy efficiency	5.0
2.4.3	Quantity of products, by-products and waste and their disposition	3.0 and 6.5
2.4.4	Surface drainage within the areas of the processing plant, product storage and waste treatment and disposal	6.4 and Volume 3, Section 6
2.4.5	Comparison of proposed process to alternatives considered on the basis of overall recovery, energy efficiency, cost, commercial availability and environmental considerations and the reasons for selecting the proposed process	3.6
2.4.6	This number has been omitted from G-23	
2.4.7	Example of production accounting reports	N/A
2.5	**Electrical Utilities and External Energy Sources**	
2.5.1	A description of any facilities to be provided for the generation of electricity to be used by the project.	4.1.1
2.5.2	Identification of the source, quantity and quality of any fuel, electricity or steam to be obtained from sources beyond the project site	4.1.1
2.5.3	Where energy resources from outside the project boundaries are to be supplied to the project, a detailed appraisal of the options available to eliminate the need for such resources, with consideration for overall recovery, energy balance, costs, technical limitations and environmental implications	4.1.1
2.6	**Environmental Control**	
2.6.1	A description of air and water pollution control and monitoring facilities, as well as a liquid spill contingency plan	6.0
2.6.2	A description of the water management program, including a. the proposed water source and expected withdrawal b. the source-water quality control c. the waste-water disposal program d. water balance for the proposed scheme e. the produced-water clean-up/recycle program	6.4
2.6.3	The manner in which surface water drainage within the Project area would be collected, treated and disposed	6.4 and Volume 3, Sections 6 and 7
2.6.4	A description of the air and water pollution control and monitoring facilities	6.2, 6.4 and Volume 2, Section 2
2.6.5	A description of the emission control system, including a. stack design criteria and process data b. any additions of residue gas or natural gas to the flare system to ensure combustion of hydrogen sulphide for both normal operating conditions and maximum emission conditions c. methods proposed for the control of all air pollutants from all potential or actual emission sources at the operation (including all vents, stacks, flares, product storage tanks, sulphur handling areas, ponds, wells and other fugitive emission sources) during normal, emergency and maximum operating conditions d. monitoring program for hydrogen sulphide, sulphur dioxide, total sulphation, hydrogen sulphide sulphation, soil pH, nitrogen oxides and hydrocarbons in the surrounding area	6.2 and Volume 2, Section 2

Guide	Requirement (abridged)	Locations in Volume 1 unless otherwise noted
3.1	**Commercial Viability**	
3.1.1	An appraisal and projections, on an annual basis of revenues, capital and operating costs (including a breakdown of fuel costs and non-fuel operating costs), royalties and taxes, net cash flow, marketing arrangements, fuel and electric power arrangements	1.0 and Volume 5, Section 15
3.1.2	A description of project costs which include capital and operating cost, including a. a breakdown of capital and operating costs for each component of the project including site preparation, well drilling and completion, central processing facilities (including steam generation, waster treatment and recycling), satellite and surface facilities, production/injection distribution system, upgrading, utilities and off-sites b. depreciation	1.10, 1.11 and Volume 5, Section 15
3.2	**Benefit-Cost Analysis**	
3.2.1	A summary of quantifiable public benefits and costs incurred during the construction and operation of the Project	Volume 5, Section 15
3.2.2	A summary of non-quantifiable public benefits and costs incurred each year during construction and operation of the Project	Volume 5, Section 15
3.3	**Economic Impact**	
3.3.1	An appraisal of the economic impact of the Project on the region, province and nation	Volume 5, Section 15
3.3.2	A discussion of any initiatives undertaken to accommodate regional economic priorities and interests	Volume 5, Section 15
3.3.3	An assessment of direct and indirect employment opportunities for all groups associated with the Project including a. projected max and min workforce demand by skill categories in the construction and operating phases and an analysis of how these demands shall be met b. an analysis of the indirect and induced employment generated by the project due to employment multiplier effects c. a discussion of the employment and training arrangements provided by applicant that would enable residents of the region to participate in meeting the workforce demands	Volume 5, Section 15
4.0	Environmental Impact Assessment	Volumes 2 - 5
5.0	Biophysical Impact Assessment	Volumes 2 – 5
6.0	Social Impact Assessment	Volume 5, Section 15
7.0	Describe the environmental protection plan including mitigation measures, environmental monitoring and research	6.0 and Volumes 2 – 5
8.0	Conceptual Development and Reclamation Plan	7.0
9.0	Solid Waste Management Plan	6.5

Application under the *Water Act* for Approvals and/or Licences

Alberta Environment

Documents or information provided to Alberta Environment pursuant to section 15(1)(a) of the *Water (Ministerial) Regulation* are public records and are accessible by the public.

Check one or more of the following to indicate type of application:

Diversion of water ☒ Renewal of a licence ☐ Constructing Works ☐

Applicant:

Print Name and Company Name (if applicable):		Home Telephone:	Bus. Telephone:
North American Oil Sands Corporation		( ) N/A	(403) 234-0123
Address (Street, PO Box, etc.):	**Place, Province:**	**Postal Code:**	**Fax:**
635 – 8th Avenue SW	Calgary, Alberta	T2P 3M3	(403) 234-0103

Are you the registered landowner? Yes ☒ No ☐ If no, please attach a copy of the consent from the landowner.

Consultant, Signing Authority, or Applicant's Representative (if applicable):

Print Name and Company Name (if applicable):		Home Telephone:	Bus. Telephone:
Matrix Solutions		( ) N/A	(403) 237-0606
Address (Street, PO Box, etc.):	**Place, Province:**	**Postal Code:**	**Fax:**
118, 319 2nd Avenue SW	Calgary, Alberta	T2P 0C5	(403) 263-2493

Contact Person if not shown above:

Print Name:	Telephone:	Fax:
Craig Popoff, P. Eng, CSRP	(403) 269-0437	(403) 234-0103

Project Description:

Tentative Starting Date: 2010
(if applicable)

Duration of Construction/Development: 4 years

Duration of Water Diversion/Use: Project Life–50 years

Provide a detailed description including location of works and activities relating to the project and attach plans:

Containment of on-site surface water runoff from plant and construction laydown areas totalling approximately 400 ha for use as process water. The annual volume of 114,000 m³ is based upon a mean annual runoff rate of 28.5 mm. On occasion, if the water quality meets regulatory requirements, it may be released to the wetland area to the north or discharged to the North Saskatchewan River via the effluent disposal system.

Additional details are provided in the North American Upgrader Project Application.

Affected Water Sources (Location of Works and Activities):

Surface Water (if only constructing works, complete the first two columns):

Source (e.g. lake, stream, or name of source, if known)	Diversion/Activity Location ¼ sec twp rge m	Annual Quantity (cubic metres)	Rate of Diversion (show units)	Is Construction or Development Required? (Yes or No)	Purpose
1. Industrial Surface Runoff	See below 55 21 4	114,000	Varies- natural	Yes – Project	Plant process
2.	NE 27, part SE 27, part NE 26, NW 26, S ½ 35, NE 35, NW 36				
3.	and part SW 36				

Groundwater:

Date Well Drilled or proposed drilling date	Well (proposed) Locations ¼ sec twp rge m	Total Depth (metres)	Production Interval (metres)	Pumping Rate (show units)	Annual Quantity (cubic metres)	Purpose
1.						
2.						
3.						

Please attach a separate sheet if you wish to provide more information.

Statement of Confirmation:

The information given on this form is true to the best of my knowledge.

Date of Signing	Signature	Print Name	Company Name (if applicable)
			North American Oil Sands Corporation

Return the completed form to an Alberta Environment Regional office nearest you:

Northern Region, Peace River
Bag 900–5 Provincial Building
9621 – 96 Avenue
Peace River, AB T8S 1T4
Telephone **(780) 624-6167**
Fax: (780) 624-6335

Northern Region, Edmonton
Twin Atria
111, 4999 – 98 Avenue
Edmonton, AB T6B 2X3
Telephone: (780) 427-5296
Fax: (780) 427-7824

Spruce Grove
250 Diamond Avenue
Spruce Grove AB T7X 4C7
Telephone: (780) 960-8600
Fax: (780) 960-8605

Central Region, Red Deer
304, Provincial Building
4920 - 51 Street
Red Deer, AB T4N 6K8
Telephone: (403) 340-7052
Fax: (403) 340-5022

Southern Region, Calgary
2938 - 11 Street, NE
Calgary, AB T2E 7L7
Telephone: (403) 297-6582
Fax: (403) 297-2749

2nd Floor, Provincial Building
200 - 5 Avenue, South
Lethbridge, AB T1J 4L1
Telephone: (403) 382-4254
Fax: (403) 381-5337

(call the Regional office for the location of area offices)

OFFICE USE:

File Number:	Fee Receipt Number:	Application ID: Operation ID:
Notice Information:	**Application Completion Date:**	**Priority Number:**

Application under the *Water Act* for Approvals and/or Licences

Alberta Environment

Documents or information provided to Alberta Environment pursuant to section 15(1)(a) of the *Water (Ministerial) Regulation* are public records and are accessible by the public.

Check one or more of the following to indicate type of application:

Diversion of water ☒ Renewal of a licence ☐ Constructing Works ☐

Applicant:

Print Name and Company Name (if applicable):		Home Telephone:	Bus. Telephone:
North American Oil Sands Corporation		**( ) N/A**	**(403) 234-0123**
Address (Street, PO Box, etc.):	Place, Province:	Postal Code:	Fax:
635 – 8th Avenue SW	**Calgary, Alberta**	**T2P 3M3**	**(403) 234-0103**

Are you the registered landowner? Yes ☒ No ☐ If no, please attach a copy of the consent from the landowner.

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Address (Street, PO Box, etc.):	Place, Province:	Postal Code:	Fax:
118, 319 2nd Avenue SW	**Calgary, Alberta**	**T2P 0C5**	**(403) 263-2493**

Contact Person if not shown above:

Print Name:	Telephone:	Fax:
Craig Popoff, P. Eng, CSRP	**(403) 269-0437**	**(403) 234-0103**

Project Description:

Tentative Starting Date: 2010
(if applicable)

Duration of Construction/Development: 2 years

Duration of Water Diversion/Use: Project Life–50 years

Provide a detailed description including location of works and activities relating to the project and attach plans:

Withdrawal from the North Saskatchewan River and return via the planned effluent disposal system for the North American Upgrader Project. Project withdrawals are indicated on page 2 at full production. Return flow rates are 4,815 m³/d (avg.) and 5,353 m³/d (peak) at Phase 1, and zero at full stage Project production.

Intake and effluent design plans will be provided pending on-going discussions on alternative supply plans.

Additional details are provided in the North American Upgrader Project Application.

Affected Water Sources (Location of Works and Activities):

Surface Water (if only constructing works, complete the first two columns):

Source (e.g. lake, stream, or name of source, if known)	Diversion/Activity Location ¼	sec	twp	rge	m	Annual Quantity (cubic metres)	Rate of Diversion (show units)	Is Construction or Development Required? (Yes or No)	Purpose
1. North Saskatchewan River	SE	17	56	21	4	14,417,500	39,500 m³/d avg.	Yes	Plant process
2.							62,666 m³/d peak		
3.									

Groundwater:

Date Well Drilled or proposed drilling date	Well (proposed) Locations ¼	sec	twp	rge	m	Total Depth (metres)	Production Interval (metres)	Pumping Rate (show units)	Annual Quantity (cubic metres)	Purpose
1.										
2.										
3.										

Please attach a separate sheet if you wish to provide more information.

Statement of Confirmation:

The information given on this form is true to the best of my knowledge.

Date of Signing	Signature	Print Name	Company Name (if applicable)
			North American Oil Sands Corporation

Return the completed form to an Alberta Environment Regional office nearest you:

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Bag 900–5 Provincial Building
9621 – 96 Avenue
Peace River, AB T8S 1T4
Telephone **(780) 624-6167**
Fax: (780) 624-6335

Northern Region, Edmonton
Twin Atria
111, 4999 – 98 Avenue
Edmonton, AB T6B 2X3
Telephone: (780) 427-5296
Fax: (780) 427-7824

Spruce Grove
250 Diamond Avenue
Spruce Grove AB T7X 4C7
Telephone: (780) 960-8600
Fax: (780) 960-8605

Central Region, Red Deer
304, Provincial Building
4920 - 51 Street
Red Deer, AB T4N 6K8
Telephone: (403) 340-7052
Fax: (403) 340-5022

Southern Region, Calgary
2938 - 11 Street, NE
Calgary, AB T2E 7L7
Telephone: (403) 297-6582
Fax: (403) 297-2749

2nd Floor, Provincial Building
200 - 5 Avenue, South
Lethbridge, AB T1J 4L1
Telephone: (403) 382-4254
Fax: (403) 381-5337

(call the Regional office for the location of area offices)

OFFICE USE:

File Number:	Fee Receipt Number:	Application ID: Operation ID:
Notice Information:	**Application Completion Date:**	**Priority Number:**

List of Sub-Appendices – Stakeholder Consultation Issues

Appendix D1 – Terms of Reference

Appendix D2 – Stakeholder information

- Map of residents within 5 km
- Stakeholder Handout (pre PDD)
- Contact Information Form
- Contact Form

Appendix D3 – Municipal Government Consultation Materials

- Municipal Presentation Handout

Appendix D4 – Bruderheim Open House

- General Information
- Advertising
- Comment Form

Appendix D5 – Public Disclosure Information

- Public Disclosure Document
- Public Disclosure Advertising
- Public Disclosure Open Houses Josephburg and Lamont
    - General Information
    - Advertising

Appendix D6 – North American Community Picnic

- General Information
- Invitation

Appendix D1 – Terms of Reference – Stakeholder Consultation Issues

Section 1.3 of the TOR states: *To meet the public consultation requirements North American must, at a minimum, communicate with those members of the public who may be affected by the Project and provide them with the opportunity to participate in the environmental assessment process.*

The Public Consultation requirements for the Project are found in Section 9.0 of the TOR (AENV 2007) and are stated as follows:

North American will undertake a consultation program during the preparation of the EIA report. As part of this consultation program, North American will consult with the following potentially affected stakeholders:

a) *the residents of surrounding communities;*

b) *recognized land users of the Local Study Area;*

c) *industrial, recreational, environmental groups and individuals expressing a formal interest in the Project;*

d) *federal, provincial, and municipal regulators, as applicable;*

e) *other operating or planned developers in the region;*

f) *Aboriginal groups;*

Describe and document the public consultation program implemented including plans to coordinate consultation activities with other developers in the area. Record any concerns or suggestions made by the stakeholders and demonstrate how these concerns have or will be addressed or discounted. Discuss:

g) *how the concerns and issues identified by North American and stakeholders influenced the Project development, design, impact mitigation and monitoring;*

h) *the type of information provided and the issues discussed, including those that have been resolved and those that remain outstanding;*

i) *in consideration of unresolved issues, the key alternatives which have been identified by North American and stakeholders for future consultations as well as mechanisms and timelines for that resolution;*

j) *plans to maintain and support the public consultation process following completion of the EIA review; and*

k) *subject to confidentiality obligations, any agreements reached with stakeholders regarding North American's operations and activities.*

Other sections in the TOR also mention public consultation and state the following:

Section 3.1.1 Project Components

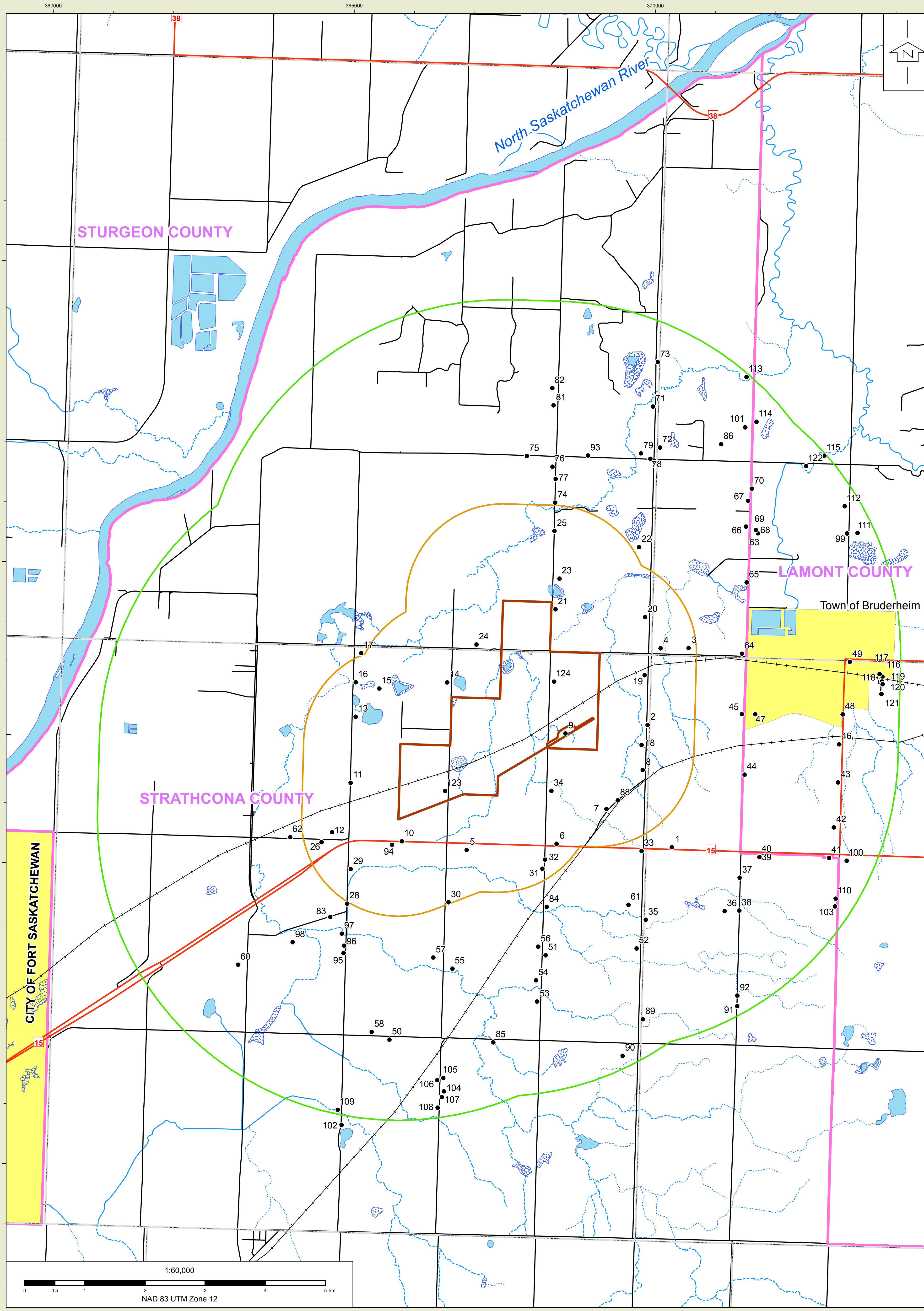
Describe the nature, size, location and duration of the significant components of the Project including, but not limited to, the following:

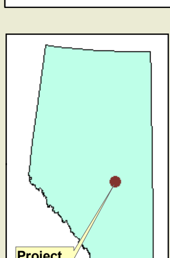
h) how North American has used community input for Project design and development;

Section 6.0 Public Health and Safety

f) during consultation on the Project, document any health concerns identified by Aboriginal stakeholders due to the impacts of existing industrial development and of the Project specifically on their traditional lifestyle.

j) document health and safety concerns raised by stakeholders during consultation of the Project;





Legend

NORTH AMERICAN UPGRADER LSA
ALBERTA TOWNSHIP / RANGE
MUNICIPAL BOUNDARY
WATERBODIES
PERMANENT
RECURRING
STREAM - PERMANENT
STREAM - INTERMITTENT
EPHEMERAL DRAW
HIGHWAY
OTHER ROADS
RAILWAY
RESIDENT
1.6 km BUFFER
5 km BUFFER

Title:

LOCAL STAKEHOLDER ENGAGEMENT AREA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:	
BE	Nov.25, 2007	
File: FIGURE_D2-1_LOCAL STAKEHOLDER_ENGAGEMENT_AREA.mxd		
Drawn by:	Checked:	Fig. No.:
LZ	BF	D2-1

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Proposed Upgrader Project

Overview for Stakeholders

Ryerson Christie

NORTH AMERICAN
OIL SANDS CORPORATION

Corporate Profile

North American Oil Sands Corporation is a private Alberta company formed in 2001.

The company was formed to acquire and develop oil sands property and is currently developing the Kai Kos Dehseh SAGD and upgrading project with a bitumen feed of 160,000 bpd. This development as planned is staged to maximize versatility.

North American has an average 99% interest in 275,200 acres of oil sands leases.

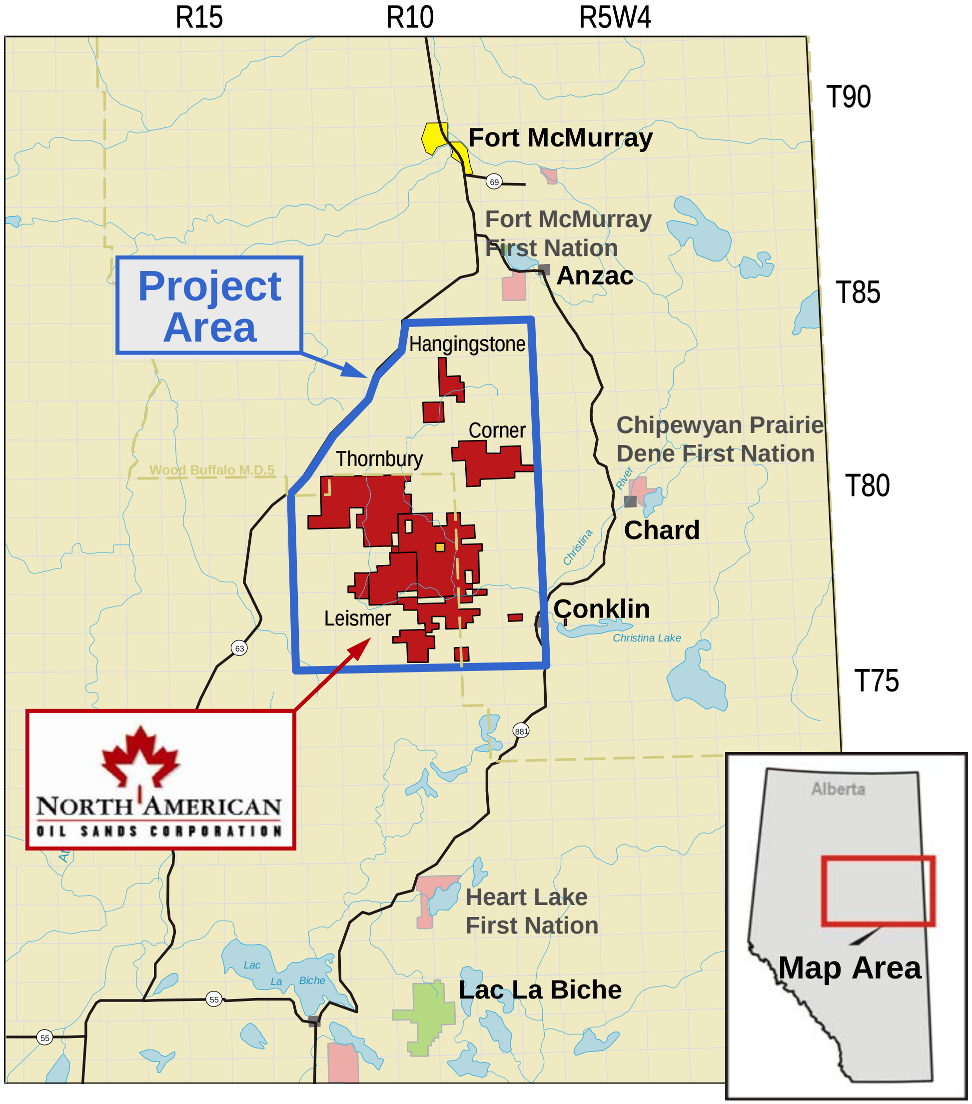
Shareholder: Statoil

North American has a well known and reputable management and technical team.

Current employees: 80 (including full-time consultants)

Capitalization: 95.9 MM common shares

Oil Sands Resource



- 275,200 gross acres of oil sands leases (99% average interest) north of Lac La Biche
- The Project is situated in 4 core areas – Leismer, Corner, Hangingstone & Thornbury
- The project lands are surrounded by SAGD projects, at various stages of development.
- Significant bitumen resource dedicated to supply the upgrader

Locating Our Upgrader Project

- The Government of Alberta has been encouraging the development of upgrading, refining and petrochemical projects within the Alberta Industrial Heartland region

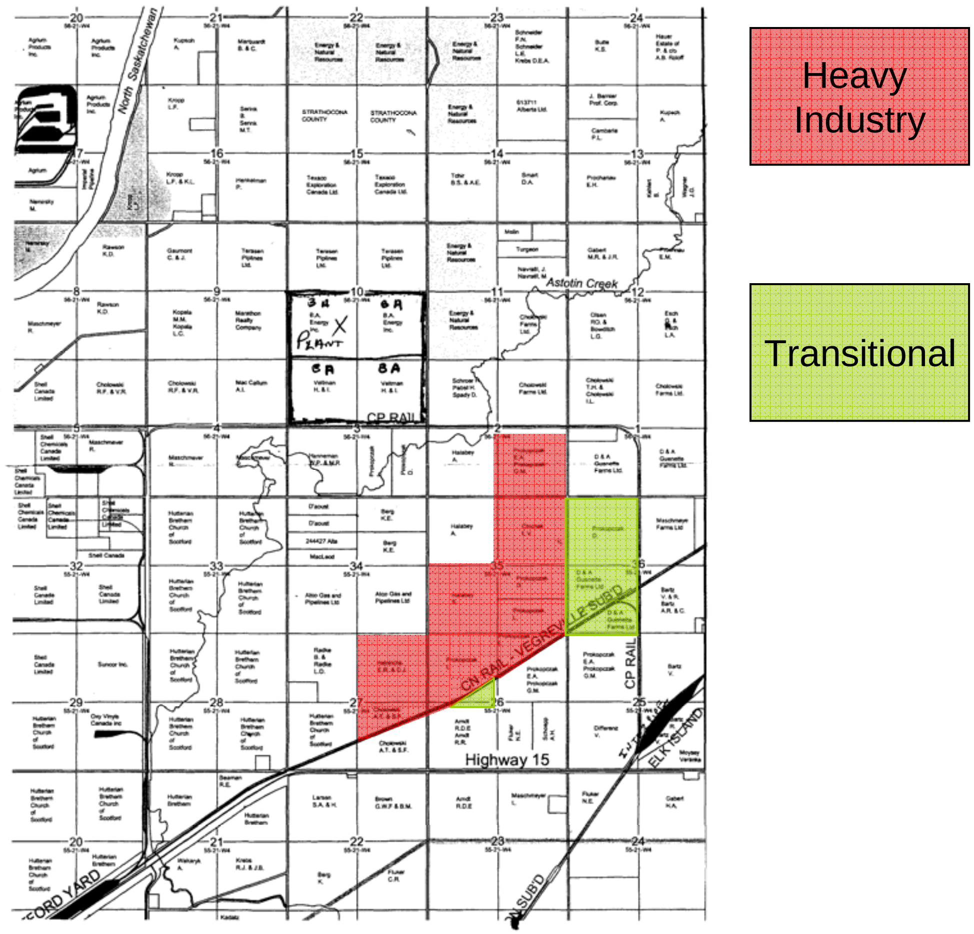
- North American examined a number of sites for its upgrading project:
  - In the field close to its Northern Alberta producing properties
  - Midway between the field and Edmonton
  - In the Alberta Industrial Heartland

- The Industrial Heartland region was the first choice:
  - Existing zoning accommodates projects of this nature
  - Ideal place to do upgrading (location of pipelines, infrastructure)
  - Good potential for business arrangements with other nearby plants
  - Preferred place to initiate carbon dioxide recovery to minimize greenhouse gas emissions

Land Position

Land Strategy

- 2+ Sections (1351 acres)
- Located within Alberta Industrial Heartland
- 6+ quarter-sections zoned heavy industrial land use
- 2 quarter sections transitional land use



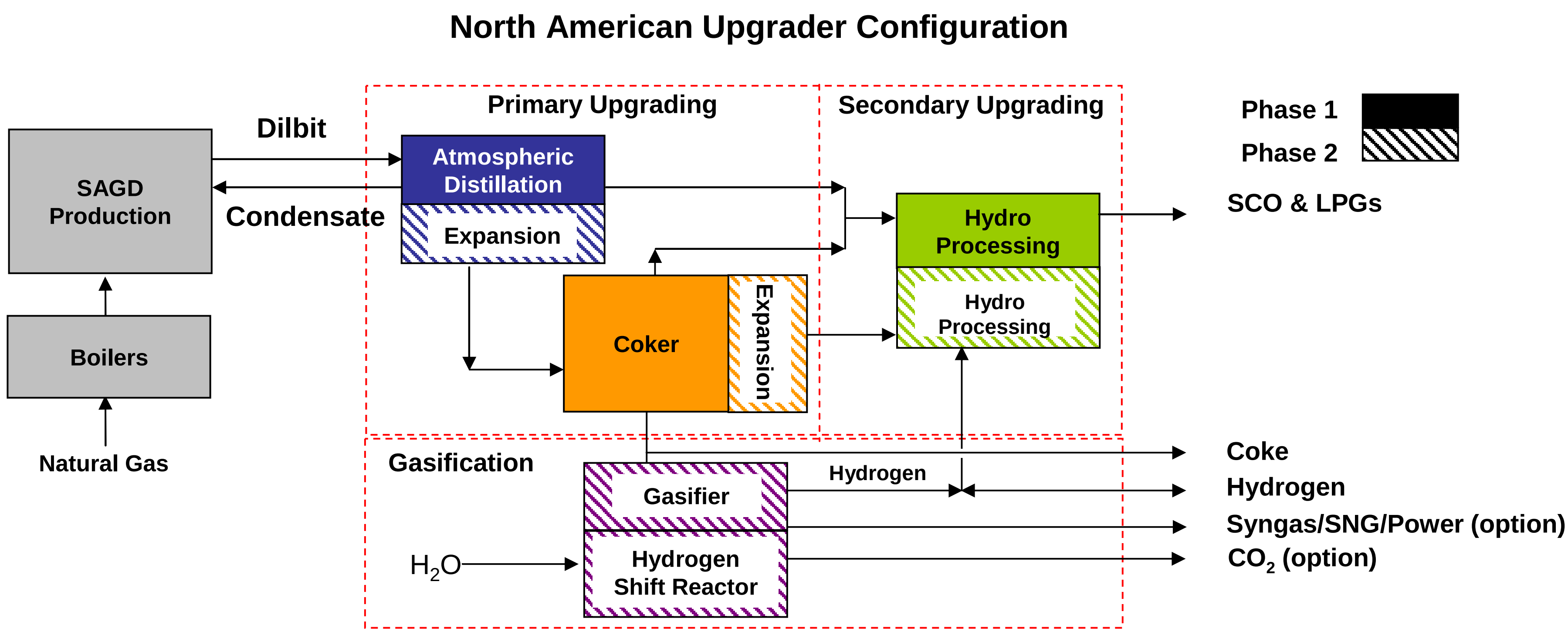
Upgrading Overview

- **Upgrading is an essential part of our oil sands development plan:**
  - **Reduces transportation costs by eliminating diluent**
  - **Mitigates volatility of bitumen pricing**
  - **Potential integration with SAGD or Alberta petrochemical facility**
  - **Manufacturing solvents for future SAGD enhancements**
  - **Product flexibility to respond to market uncertainties**

- **Capacity**
  - **Phase 1: 76,000 bbl/d of bitumen, proposed to startup in 2012**
  - **Phase 2: Increase capacity up to 220,000 bbl/d, proposed to startup in 2015**

- **Configuration**
  - **Phase 1: coking / hydro-treating**
  - **Phase 2: coking / hydro-processing / coke gasification**

Upgrading Process Overview



Project and Operations: Planning and Labour

Planning:

- Maximize definition of projects in the front end
- Seasoned owner Engineering, Procurement and Construction team
- Extensive use of modular construction
- Large project consisting of smaller, easier-to-manage stages

Labour Strategy for Both Construction and Operations

- Assisting in securing labour from outside Alberta
- Modular construction - access to larger labour pools, more productive work environment
- Pro-actively develop skills and support businesses within the local communities
- Position North American as a preferred employer
- Planning for 2000 to 2500 construction workers
- Planning for 300 to 400 permanent employees

Summary

- North American is looking forward to being a responsible participant in the community
- We are committed to using the latest proven technology to ensure a safe, reliable, and environmentally responsible operation
- We are just starting with introducing our project to the community and to the Heartland Region
- We need to better understand the project development process and requirements in your municipality, your insights in this regard would be very much appreciated

Contact Information

Contact Information

Ryerson Christie

Stakeholder Engagement Advisor

Phone: (780) 886-5849

Email: xieassoc@nexicom.net

Craig Popoff

Manager,
Regulatory, Environment & Safety

Phone: (403) 269-0437

Email: cpopoff@naosc.com

Mailing Address

North American Oil Sands Corporation

Suite 900

635 – 8 Avenue SW

Calgary, Alberta

T2P 3M3

Contact Information Form

Date:

NAOSC Representative:

Contact Name(s):

Address:

Phone:

Email:

Type of Contact:

- Phone - Email - Mail - Open House

- Meeting - Personal - Other

Issue:

- Air Quality - Construction Traffic - Operations Traffic - Light

- Construction Noise - Operations Noise - Emergency Response

- Other

Follow Up Required?

Required By:

Follow Up Completed On:

Coordination Required?

Notes On Back:

Email to: xieassoc@nexicom.net or Fax to: 780-997-0683

Email to: xieassoc@nexicom.net or Fax to: 780-997-0683

Contact Information Form

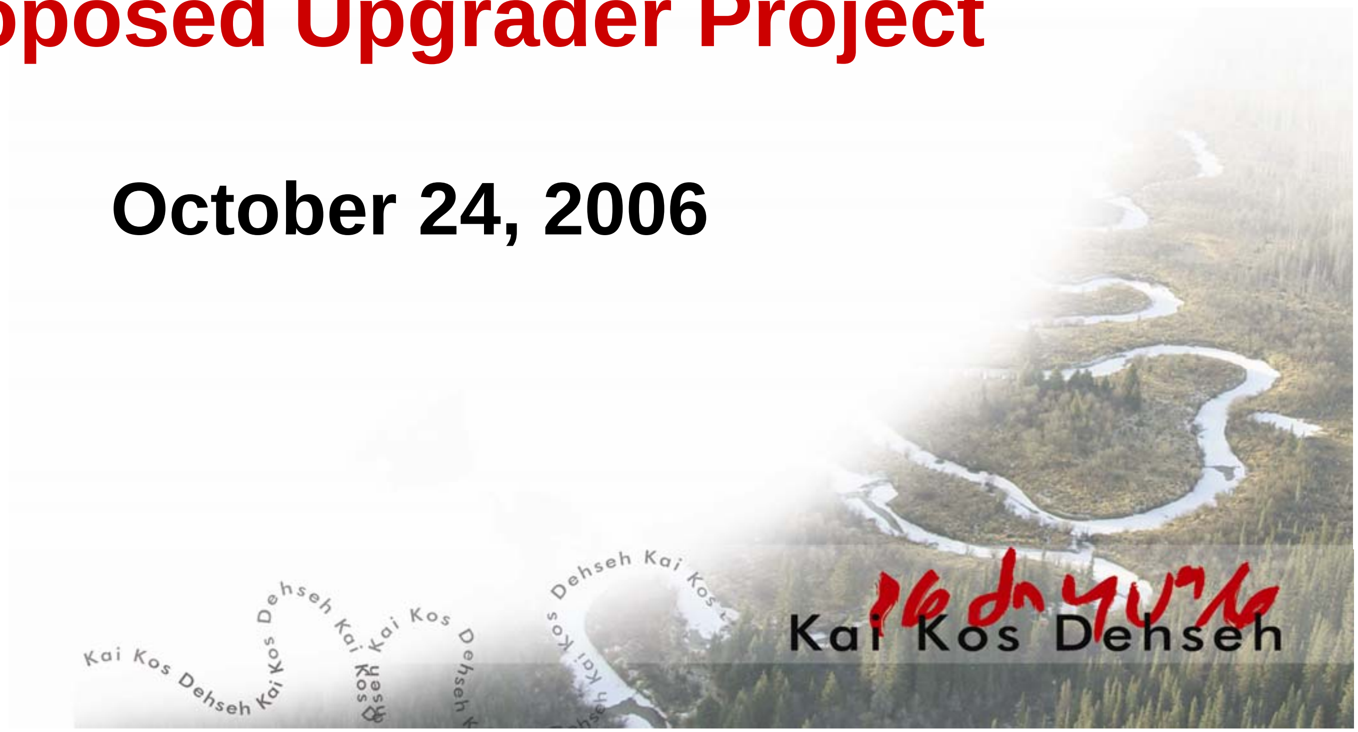
	1st Resident	2nd Resident
Last Name		
First Name		
Address		
Town		
Province		
Postal Code		
Home Phone		
Cellular		
Work Phone		
Fax		
Email		
Legal Description	LSD/ 1/4	Twp – Rge – W4M
UTM	Easting	Northing
Other Occupants		
EIA Requested	CD	Paper

NORTH AMERICAN
OIL SANDS CORPORATION

Proposed Upgrader Project

October 24, 2006

Gareth Crandall
Craig Popoff
Brian Blattler
Ryerson Christie



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Major shareholders: **Paramount Resources Ltd.**
ARC Energy Funds
Ontario Teachers' Pension Plan Board

Private placement completed June 4, 2006.

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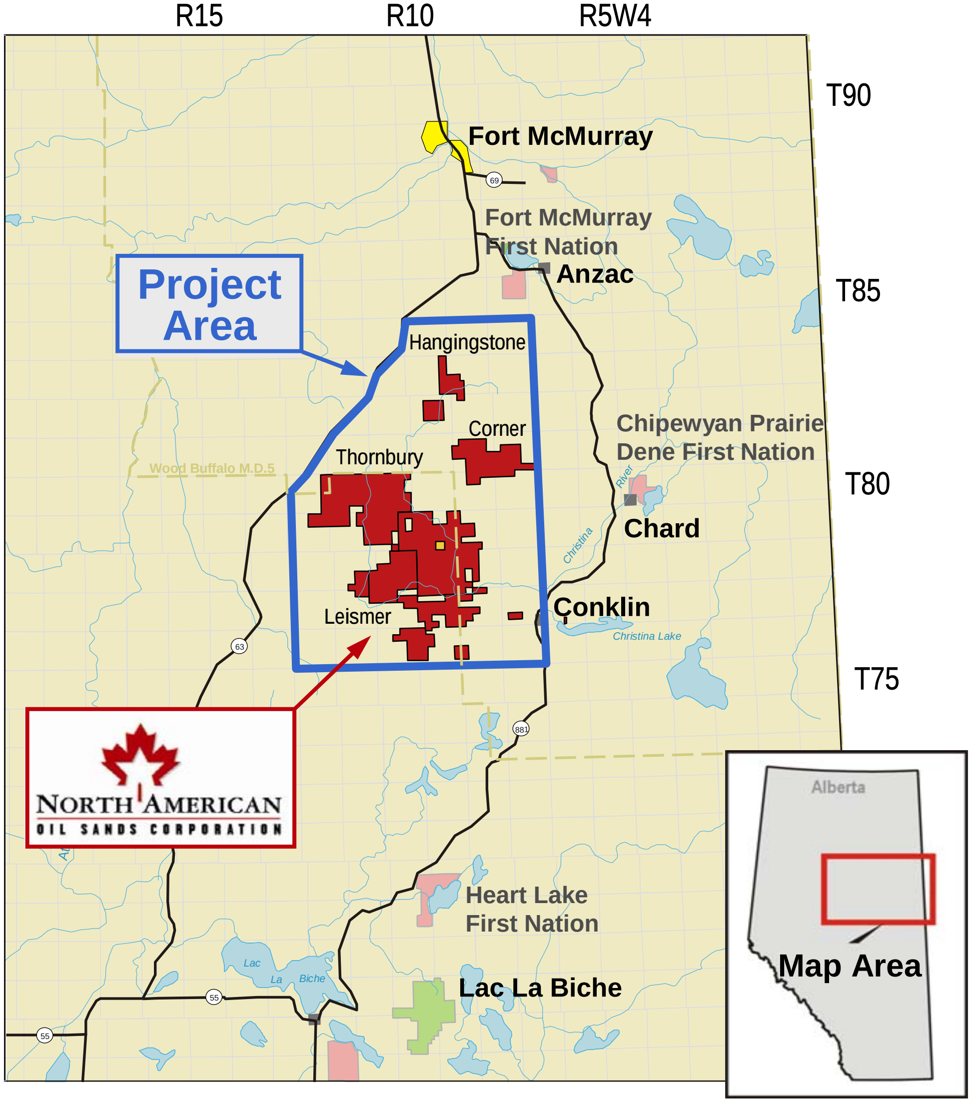

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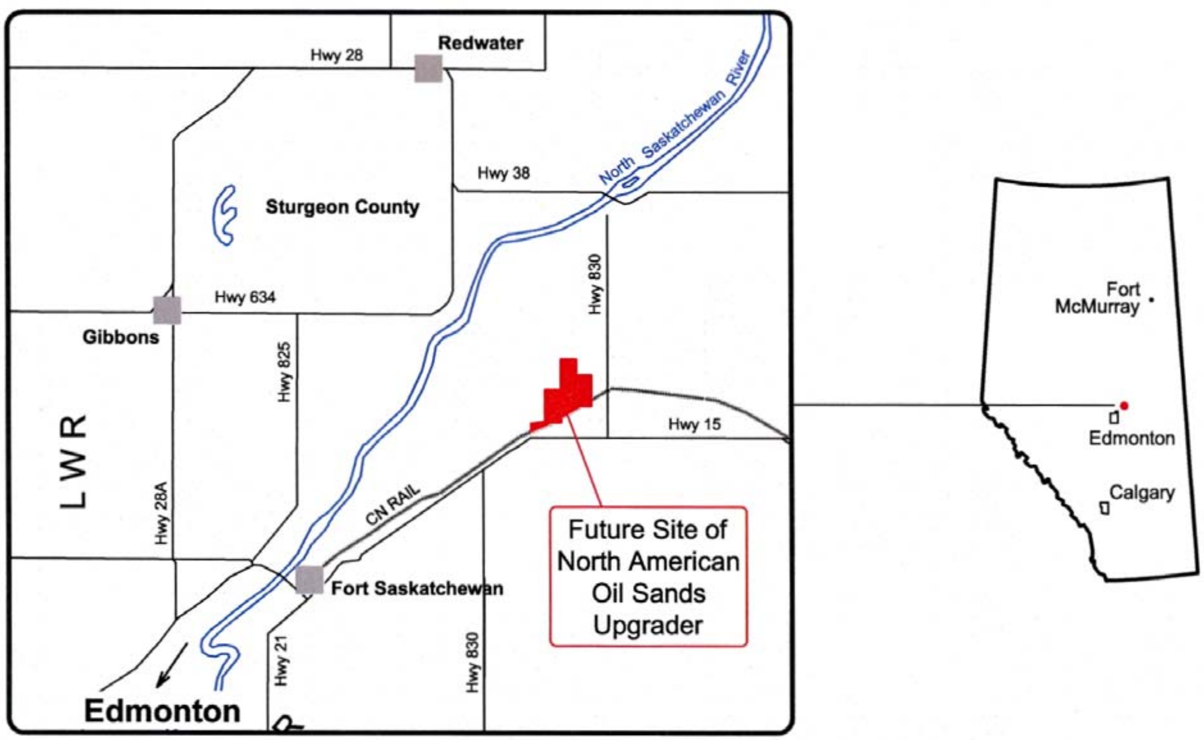
Upgrader Project Lands



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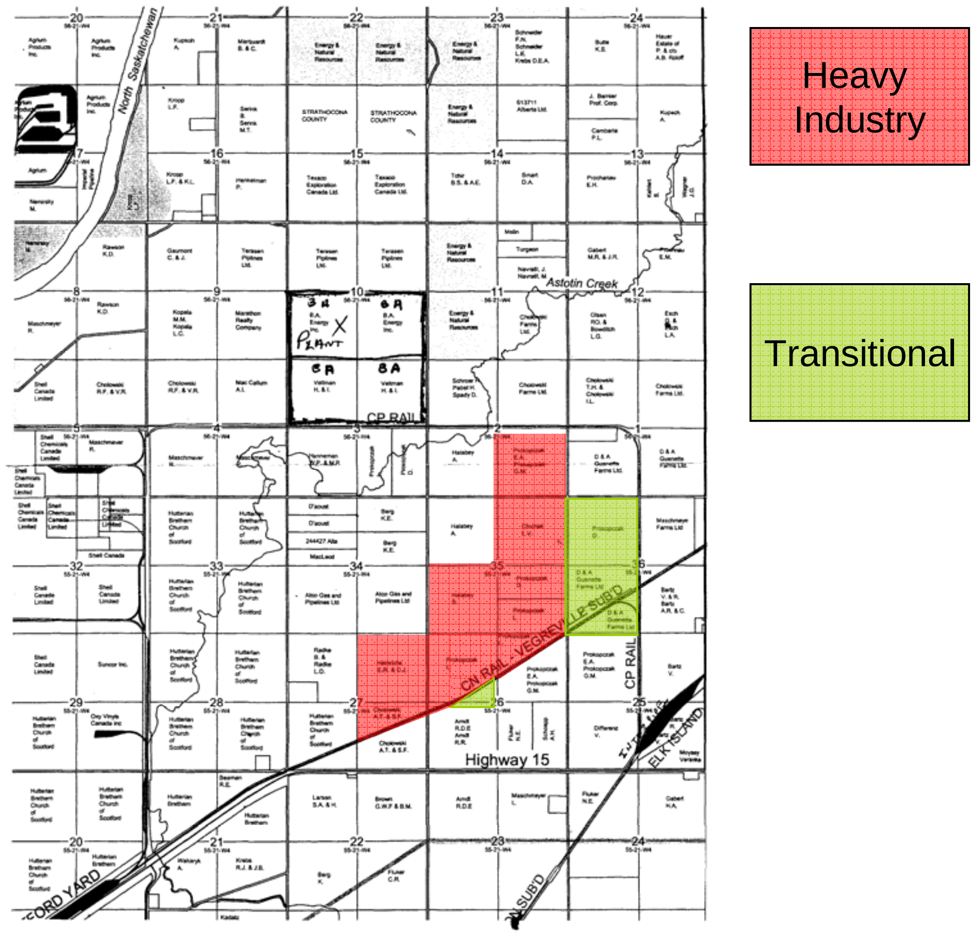

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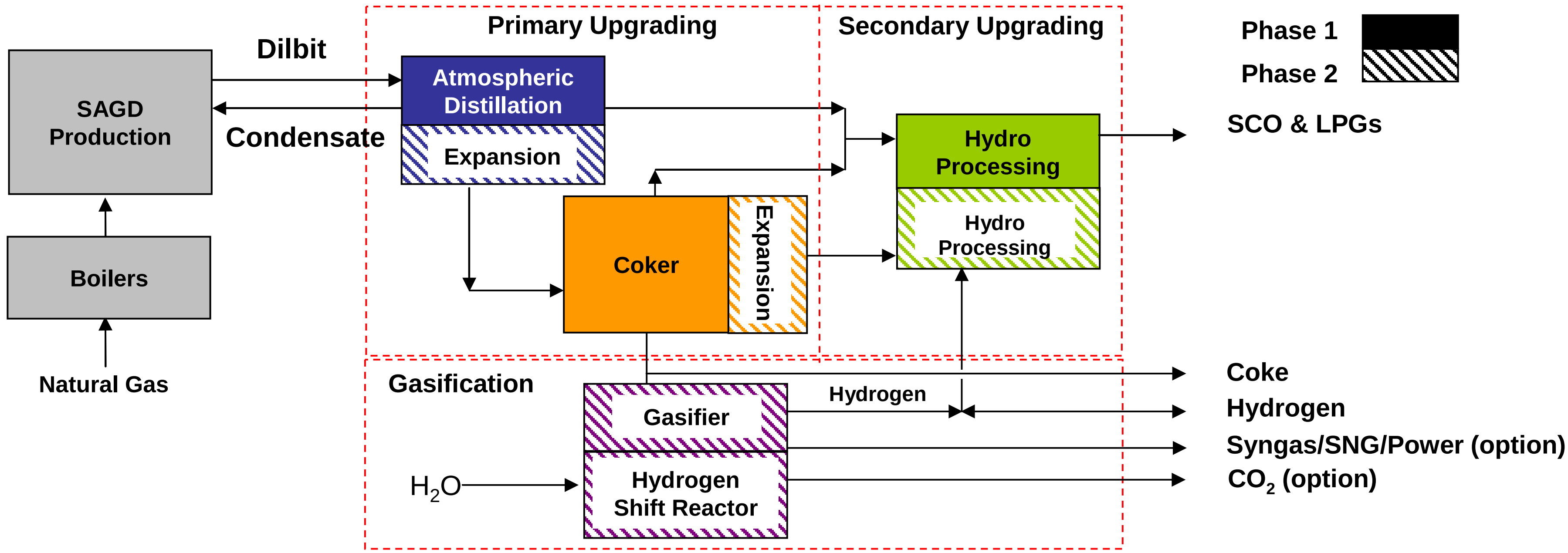
North American Upgrader Configuration



NORTH AMERICAN
OIL SANDS CORPORATION

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Appendix D4 – Bruderheim Open House (pre Public Disclosure)

a. General Information

133 people attended a public open house on January 5, 2007, in the Town of Bruderheim before the release of the Public Disclosure document. There were a series of display stations set up around the room. These displays covered all aspects of what an upgrader is and does. They also covered the timeline for regulatory approval, the EIA template and North American's vision statement. There were large maps available so that participants could actually pinpoint the proposed upgrader site in conjunction with their homes and communities. Various experts from North American and their contractors manned the display stations to meet stakeholders and address their questions and concerns. As people arrived, they were asked to sign in and provide their contact information. Each received an information package and a form that could be used for written questions and comments. The informal feedback within the community over the following weeks was positive.

b. Advertising
   i. Ads were placed in the following newspapers
      1. Strathcona County This Week
      2. Fort Saskatchewan Record
      3. Lamont Leader
      4. Bruderheim Newsletter
   ii. Posters were placed on various public bulletin boards in the Town of Bruderheim
   iii. A notice of the open house was sent as unaddressed mail to the Bruderheim Post Office, 412 pieces, and Rural Route 2 Fort Saskatchewan, 251 pieces.
   iv. A notice was sent by direct mail to land owners, except the town of Bruderheim, and industry within 5 km of the proposed site.
   v. A notice was sent by direct mail to municipal politicians and officials in the surrounding area.

Open House

North American Oil Sands Corporation is holding an open house for a proposed oil sands upgrader 5 km west of Bruderheim. The purpose of the open house is to provide information on the proposed upgrader, meet staff from North American, answer questions and receive comments.

Thursday, January 25, 2007
2:00 pm—8:00 pm

Bruderheim Board Room
4924—51 Avenue

North American Oil Sands Corporation

For more information contact

Ryerson Christie 780-886-5849

NORTH AMERICAN
OIL SANDS CORPORATION

NORTH AMERICAN
OIL SANDS CORPORATION

Comment Sheet – Bruderheim Open House – January 25, 2007

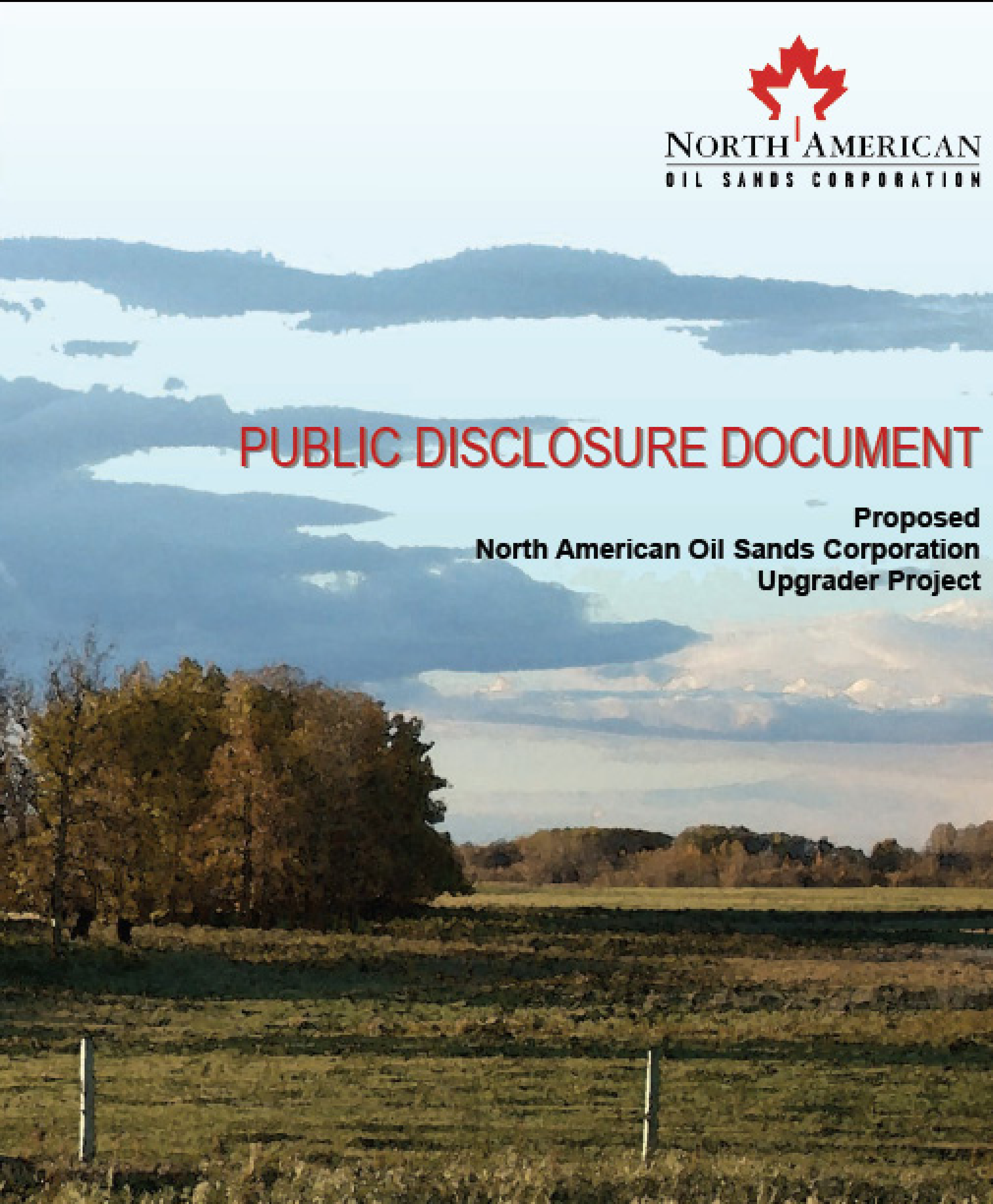
Please inform us of your comments, issues or concerns for the proposed upgrader.

Name (optional): ____

North American Oil Sands Corporation

PUBLIC DISCLOSURE DOCUMENT

Proposed
North American Oil Sands Corporation
Upgrader Project



CONTENTS

THE COMPANY

North American Oil Sands Corporation (North American) is a Canadian-controlled oil sands company operating in Alberta. Our management team is comprised of industry leaders recognized for their extensive heavy oil technical and business experience.

We plan to build an upgrader facility to convert bitumen into synthetic crude oil (SCO). North American's first choice for the location of the upgrader is on land that we have acquired in Strathcona Country near Fort Saskatchewan, Alberta.

North American is also a working interest owner and operator of approximately 12 townships of oil sands leases between Lac La Biche and Fort McMurray. Our goal is to develop the Kai Kos Dehseh Project, producing up to 35,000 cubic metres (220,000 barrels) per day of bitumen through steam assisted gravity drainage (SAGD) technology. The project will be located near Conklin, Alberta. We have already filed a separate Public Disclosure Document for this project, and plan to submit the regulatory application in 2007.

This Disclosure Document provides a summary of the plans for our proposed upgrader. Although we have taken care to accurately represent the plan for the project, circumstances could change which may alter the proposed development. We will communicate any significant changes in a timely manner.

THE PROJECT

North American's proposed upgrader will process up to 40,000 cubic metres (250,000 barrels) per day of bitumen to produce light sweet SCO. Bitumen in its raw form is a lower grade feedstock for refineries to process than conventional crude oils. By upgrading the bitumen to light SCO, its marketability greatly improves and SCO can be readily transported to refineries through crude oil pipelines without the need for costly diluent. SCO varies considerably in terms of its chemical composition. Companies that upgrade bitumen strive to produce SCO of a quality that matches the requirements of the refineries that produce refined products such as gasoline and diesel fuel.

North American will use well established and proven technology for upgrading. Specifically, we will use delayed coking to reduce the carbon content of the bitumen and hydro-processing to upgrade it to a level preferred by many refiners. We are planning to develop the upgrader in two phases, largely to match the planned build-up of our bitumen production. The staged approach will have the additional advantage of allowing us to adjust the configuration of our upgrader to best match market requirements for SCO in an environment of rapidly evolving refinery requirements and product demand.

With our phased approach to building the upgrader, there likely will be times when we have more upgrading capacity than we have bitumen to process from our SAGD projects. This will enable us to process bitumen from other companies as a "merchant upgrader", should market conditions enable us to do so profitably. We are actively studying whether a merchant upgrading component could be a valuable addition to our overall upgrading plan.

Once the upgrader is operational, we plan to actively market SCO, gas liquids, petroleum, coke, sulphur and other upgrader by-products.

Over the longer term, we are planning to add a gasifier to our upgrader facility. A gasifier transforms coke produced by cokers into a mixture of hydrogen and oxides of carbon called "syngas". Gasification enables an upgrader to become self-sufficient with respect to its hydrogen needs, and consequently reduces dependence upon natural gas as a fuel for both upstream and downstream operations. With a gasifier in place, we will also be positioned to convert syngas into a pure carbon dioxide stream and hydrogen. We will then be able to sell carbon dioxide to companies which might require it for enhanced oil recovery projects, or to inject the carbon dioxide into depleted hydrocarbon reservoirs so that it is not released into the atmosphere to contribute to green house gas emissions.

PROJECT LOCATION

North American has acquired 1,350 acres of land in the County of Strathcona as the preferred site for our upgrader. The proposed site is located within portions of Sections 26, 27, 35 & 36, Township 55, Range 21 W4M and SE ¼ Section 2, Township 56, Range 21 W4M all of which are approximately 4 km west of Bruderheim, Alberta. The proposed upgrading complex will be built on land zoned for heavy industrial use within Alberta's industrial heartland.

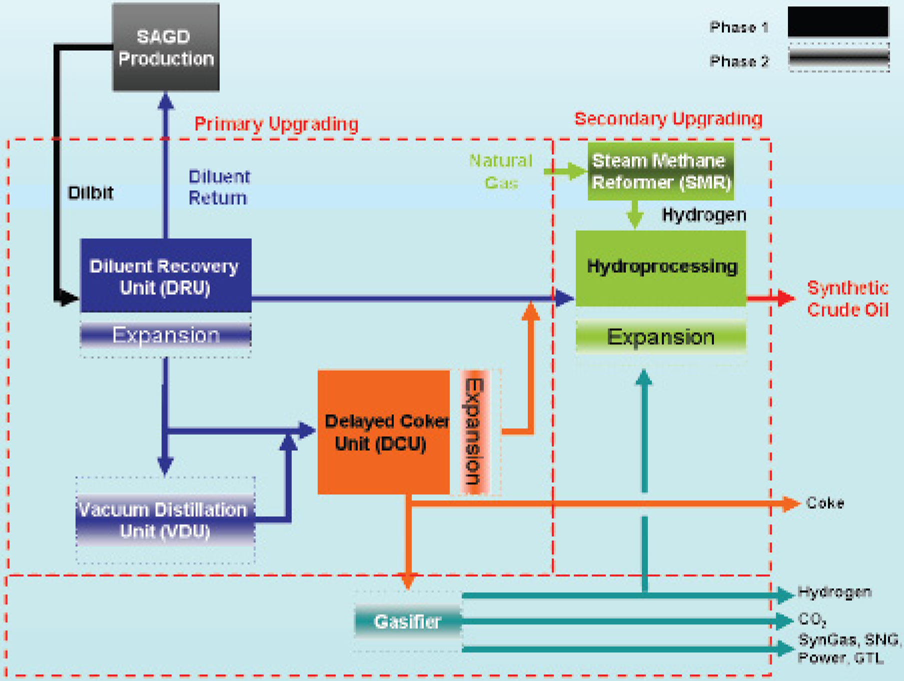
The fully developed site for bitumen upgrading will occupy approximately 700 acres. The site is large enough not only for the upgrader itself but also for tank farms, water treatment, warehouses, office space, and employee/contractor parking.

We prefer this location for the upgrader because the current zoning accommodates projects of this nature. Additionally, there are existing pipelines and infrastructure available to support the facility. In the future, carbon dioxide gathering infrastructure will likely first develop in this region and should accommodate our future plans for carbon dioxide sequestration.

PROCESS OVERVIEW

Upgrading involves the use of temperature, pressure, distillation and catalytic reactions to convert bitumen into SCO. Upgrading is usually a two-step process. In the first step, the heavy oil molecules are broken up and carbon is removed to produce smaller, lighter molecules of crude oil. The second step involves hydro-processing to stabilize the molecules produced during the first step and to remove impurities, resulting in more valuable end products. The proposed upgrader will use proven upgrading technology, including distillation and delayed coking in step 1 and hydro-processing in step 2.

The proposed facility will produce hydrogen to satisfy all site requirements. In the initial phase, the hydrogen will be produced using conventional steam reforming of natural gas. In the second phase, we expect to introduce gasification technology for hydrogen production.


Phase 1
Phase 2
SAGD Production
Primary Upgrading
Secondary Upgrading
Dilbit
Diluent Return
Natural Gas
Steam Methane Reformer (SMR)
Hydrogen
Diluent Recovery Unit (DRU)
Expansion
Hydroprocessing
Synthetic Crude Oil
Expansion
Delayed Coker Unit (DCU)
Expansion
Vacuum Distillation Unit (VDU)
Coke
Gasifier
Hydrogen
CO_2
SynGas, SNG, Power, GTL

PHASE 1

In Phase 1, we will use a diluent recovery unit (DRU) to separate a diluted bitumen blend feedstock into three streams: light, medium and heavy. The light stream (naphtha diluent) will then be returned via pipeline to the SAGD project to be re-used for blending purposes. (Bitumen is blended with naphtha diluent to reduce its density and viscosity so that it can flow more easily in a pipeline.) The medium stream will be routed to the hydro-processing units for removal of sulphur, nitrogen and other impurities. The heavy stream (atmospheric residue) will be routed to the delayed coker unit (DCU) for thermal processing.

The DCU will convert the atmospheric residue into upgraded gas and liquid streams, leaving behind a solid concentrated carbon material known as petroleum coke. The coke will be temporarily stored on site and then exported to market. The gas from the DCU will be processed through a gas plant to recover additional naphtha and other lighter products. The liquid from the DCU will be recovered as light and heavy coker gas oils, which will then be directed to the hydro-processing units for further upgrading.

The hydro-processing units will be comprised of a naphtha hydro-treater and a distillate/gas oil hydro-treater that will process the liquid streams from the DRU and the DCU. Hydro-treating entails the addition of hydrogen and removal of impurities such as sulphur, nitrogen and heavy metals. Hydro-processing improves the overall quality of the SCO produced by the upgrader. We will be using steam methane reforming technology during Phase 1, fuelled by natural gas, to generate the hydrogen supply required for hydro-processing. Products from the hydro-processing units (naphtha, distillate and gas oil) will be blended together to produce SCO. Sulphur, a by-product from the hydroprocessing units, will be exported from the site to market.

The Phase 1 upgrader facility will produce approximately 10,000 cubic metres (65,000 barrels) per day of SCO.

PHASE 2

In Phase 2, we intend to expand the DRU, DCU, and hydro-treater units to accommodate larger feedstock volumes. We expect to process up to 40,000 cubic metres (250,000 barrels) per day of bitumen.

The atmospheric residue from the DRU will be routed to a new vacuum distillation unit. The residue from the vacuum distillation unit will provide feed to the expanded coking unit.

We are also planning to build an air separation plant and petroleum coke gasification unit. We intend to gasify enough coke to generate hydrogen for the entire complex. The development of a gasifier will both eliminate most of the petroleum coke waste by-product and the need to purchase natural gas for the generation of hydrogen. We are also considering converting any surplus syngas produced through coke gasification to electrical power, synthetic natural gas, or light gasoline components.

THE SCHEDULE

We expect the first phase of the upgrader, with a capacity of 12,000 cubic metres (76,000 barrels) per day of bitumen feed, to be operational in 2012. Assuming appropriate market conditions for bitumen upgrading, we intend to build the second phase shortly thereafter, bringing the total upgrading capacity to 40,000 cubic metres (250,000 barrels) per day of bitumen feed.

The upgrader is being designed to operate for many years. With proper maintenance and systematic replacement of equipment that has reached the end of its operating life, the upgrader may well remain in operation for over 50 years.

North American's current efforts are focussed on:

- completing the concept design and the front-end engineering;
- recruiting project development and operating personnel;
- developing operational systems;
- consulting with the various levels of government, communities, industry, and other interested parties to ensure we understand their concerns and address these concerns to the greatest extent possible; and
- preparing and submitting the regulatory application and Environmental Impact Assessment (EIA) so as to obtain all necessary approvals, permits and licenses.

Project development timing will depend on regulatory approvals, and on market conditions. Phase 1 is currently in the early stages of engineering which will continue through to mid-2009, after which we plan to commence site preparation and construction. The construction of Phase 1 will take approximately 40 months, with commissioning expected to occur in 2012.

Phase 2 of the upgrader is in the conceptual planning phase. We expect to begin engineering in 2010, and this process will continue through 2013. We intend to commence site preparation and construction in 2011, with commissioning expected to occur in 2015.

THE PEOPLE

North American will provide significant employment and business opportunities in Alberta, starting with engineering and continuing with on-site construction and, ultimately, plant operation. We expect to employ 2500 workers during the construction period, with a permanent workforce of approximately 400 in Phase 1 and 600 by Phase 2 to operate and maintain the upgrader. Our phased approach should allow for better management of the construction labour requirements.

We will also be generating employment as a result of our requirements for services and equipment, much of which will be provided by Alberta companies and individuals. This direct employment will in turn generate induced employment in the general economy driven by the workers' personal spending.

In terms of procurement policy, when cost and quality of goods and services are competitive, North American will give preference to suppliers from the communities nearest the project site. In conjunction with our Kai Kos Dehseh SAGD project, we have developed local procurement policies and programs through dialogue with the communities, other oil sands operators, and all levels of government. We will be applying these same approaches for our upgrader project as well.

We will be preparing a Socio-Economic Impact Assessment as part of the EIA. Among other issues, this assessment will address issues related to roads, traffic, emergency medical services, municipal services, infrastructure, and potential mitigative measures.

We have been consulting with communities likely to be impacted, and other stakeholders, since the fall of 2006, and we will continue this process throughout the life of the project. We take considerable care in establishing a wide variety of consultation formats to ensure that we engage as many individuals and groups as possible. Our intent is to recognize potential issues of concern as early as we can, so that we can identify appropriate solutions or mitigants, all in full consultation with the regulators.

The upgrader will provide a significant contribution to local, provincial and federal tax bases.

THE ENVIRONMENT

North American will complete a comprehensive EIA for the proposed upgrader. Some of the topics to be considered in the EIA will be potential effects of the project on air, land, water, wildlife and people. In addition, North American will complete an assessment of the cumulative effects on our project, taking into account other industrial facilities and proposed facilities in the region.

We are committed to planning, constructing and operating the upgrader in an environmentally responsible manner. Measures to mitigate potential environmental effects of the upgrader will include design factors that control or reduce air emissions and noise. North American will participate in cooperative monitoring initiatives such as the Fort Air Partnership as well as other environmental initiatives undertaken by the Northeast Capital Industry Association. We are constantly investigating opportunities to reduce the impact of our project, including sharing infrastructure with other operators. Infrastructure which might be well suited for such an initiative includes water treatment, pipelines, waste management facilities, and power generation.

THE REGULATORY PROCESS

Completion of this Public Disclosure Document marks the first step in the regulatory process for North American's proposed upgrader project. In the third quarter of 2007, North American plans to submit an application for approval of the upgrader to the Alberta Energy and Utilities Board and Alberta Environment.

We will be submitting our EIA report, which includes the Socio-Economic Impact Assessment, in support of the application. We invite interested parties to review the proposed Terms of Reference for the EIA, and provide comments to Alberta Environment. North American also welcomes any input or suggestions on the scope of the EIA studies.

CONTACTS

For further information about the North American Upgrader Project please contact:

REGULATORY AFFAIRS, ENVIRONMENT & SAFETY
Craig Popoff, P.Eng, CRSP
Manager, Regulatory, Environment and Safety

North American Oil Sands Corporation
Suite 900, 635 8th Avenue SW
Calgary, Alberta T2P 3M3
Phone: (403) 234-0123 Fax: (403) 234-0103
Toll Free 1-888-Ph-NAOSC (746-2672)
Email: info@naosc.com

Or visit our website:
www.naosc.com

NORTH AMERICAN
OIL SANDS CORPORATION

PUBLIC NOTICE

NORTH AMERICAN OIL SANDS CORPORATION
PROPOSED UPGRADER PROJECT
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

PROPOSED TERMS OF REFERENCE

North American Oil Sands Corporation (North American) is a Canadian-controlled oil sand company operating in Alberta. North American plans to build an upgrader facility to convert bitumen into synthetic crude oil.

The proposed site for the upgrader is within Strathcona County in Alberta's industrial heartland, near Fort Saskatchewan, Alberta. The proposed upgrading complex will be built on 540 hectares (1350 acres) of land that has been purchased in an area zoned for heavy industrial development. A map of this area is included in the Public Disclosure Document. The proposed site is located within portions of Sections 26, 27, 35 and 36, Township 55, Range 21 W4M and SE ¼ Section 2 Township 56 Range 21 W4M, all of which are approximately 4 km west of Bruderheim, Alberta.

Subject to the outcome of environmental, economic and engineering evaluations, North American plans to build an upgrader facility that will process and convert bitumen and/or heavy oil into light sweet synthetic crude oil for the refinery market.

North American's proposed upgrader will process up to 40,000 m^3 (250,000 barrels) of bitumen per day.

The Director, responsible for the Environmental Assessment, has indicated that an Environmental Impact Assessment Report (EIA) be prepared for North American's proposed upgrader project. Accordingly, North American has prepared a Proposed Terms of Reference and a Public Disclosure Document for the Environmental Impact Assessment, and through this Public Notice invites the public to review the Proposed Terms of Reference.

Copies of the Proposed Terms of Reference and Public Disclosure Document can be viewed at:

Public libraries in Sherwood Park, Fort Saskatchewan, Bruderheim and Lamont.

Copies of the Proposed Terms of Reference and Public Disclosure Document can also be picked up at:

Strathcona County Offices – Sherwood Park and Heartland Hall
City of Fort Saskatchewan Office
Town of Bruderheim Office
Lamont County and Town Offices
North American's Community Affairs Office (call 780 997 0682)

To obtain a copy of the Proposed Terms of Reference and Public Disclosure Document, contact:

Craig Popoff, Manager - Regulatory Affairs,
Environment and Safety
North American Oil Sands Corporation
Suite 900, 635 - 8 Avenue SW
Calgary, Alberta T2P 3M3
Telephone: (403) 234 - 0123 Fax: (403) 234 - 0103
Toll Free: 1-888-Ph-NAOSC (746-2672)
Email: info@naosc.com
Or online at: www.naosc.com

Register of Alberta Environment
111 Twin Atria Building
4999-98 Avenue
Edmonton, Alberta T6B 2X3
Attention: Melanie Daneluk

Persons wishing to provide written comments on the Proposed Terms of Reference should submit them by May 1, 2007 to:

Director, Environmental Assessment
Alberta Environment
111 Twin Atria Building
4999 - 98 Avenue
Edmonton, Alberta T6B 2X3 / Fax: (780) 427-9102
Email: environmental.assessment@gov.ab.ca

Any comments filed regarding this project will be accessible to the public.

The EIA report prepared pursuant to these Terms of Reference will be reviewed as a cooperative assessment under the Canada-Alberta Agreement for Environmental Assessment Cooperation. Alberta will be the Lead Party for the cooperative assessment.

Appendix D5 – Josephburg and Lamont Open Houses (post Public Disclosure)

a) General Information

The Public Disclosure Document was released in March 2007. Open houses were held in the Hamlet of Josephburg on April 17, 2007 and the Town of Lamont on April 18, 2007. The open houses were attended by a total of 85 people. There were a series of display stations set up around the room. These displays covered all aspects of what an upgrader is and does. They also covered the timeline for regulatory approval, the EIA template and North American's vision statement. There were large maps available so that participants could actually pinpoint the proposed Upgrader site in conjunction with their homes and communities. Various experts from North American and their contractors manned the display stations to meet stakeholders and address their questions and concerns. As people arrived, they were asked to sign in and provide their contact information. Each attendee was offered the Public Disclosure document. The informal feedback within the community over the following weeks was positive.

b) Advertising

   i. Ads were placed in the following newspapers
      1. Strathcona County This Week
      2. Fort Saskatchewan Record
      3. Lamont Leader
      4. Lamont Farm and Friends
   ii. A notice of the open houses
   iii. A notice was sent as unaddressed mail to the Bruderheim Post Office, 412 pieces, and Rural Route 2 Fort Saskatchewan, 251 pieces.
   iv. A notice was sent by direct mail to land owners, except the town of Bruderheim, and industry within 5 km of the proposed site.
   v. A notice was sent by direct mail to municipal politicians and officials in the surrounding area

Open House

North American Oil Sands Corporation is holding two open houses for a proposed oil sands upgrader 5 km west of Bruderheim. The purpose of the open houses is to provide information on the proposed upgrader, meet staff from North American, answer questions and receive comments on the proposed terms of reference for the Environmental Impact Assessment.

The documents are posted on the North American website:

www.naosc.com under Investor Information.

Tuesday, April 17, 2007
2:00 pm—8:00 pm
Josephburg Agricultural Hall
or
Wednesday, April 18, 2007
2:00pm—8:00pm
Lamont Recreation Centre

North American Oil Sands Corporation

For more information contact

Ryerson Christie 780-997-0682

NORTH AMERICAN
OIL SANDS CORPORATION

Appendix D6 – Community Picnic

a. General Information

On Sunday, June 10, 2007, a community picnic was held at the Upgrader Community Affairs Office. June 10 was selected because it was the Sunday of what is traditionally known in rural Alberta as “Farmers’ Day Weekend”. This is a weekend of events within each rural community to celebrate the fact that spring seeding was done. Approximately 150 local residents attended the picnic, along with a tour group of about 50 business people from the Netherlands and their hosts from Strathcona County.

The picnic featured a number of special events and announcements including:

- A Marquee was set up on the lawn;
- BBQs and portable toilets were brought in;
- Guests received a variety of free gifts, all of which were well received;
- The Bruderheim Boys and Girls Club ran games and face painting for the children;
- Horse and wagon rides were available;
- The major attraction of the meal was the whole roast pig, ably carved by two North American staff from Calgary with pointers from the local resident who supplied the pig.
- A group of eight staff from North American cooked hamburgers, hot dogs and baked beans and mingled with the crowd;
- The sign for the Upgrader Community Affairs Office was unveiled by Councillor Jacquie Fenske; and
- A donation of $5,000.00 was given to the “Green Hectares – Farming for the Future” programme.

The feedback was very positive and it is intended that this will be an annual event. The event lasted from 2 PM to 6 PM and most people stayed two to three hours, chatting with their friends and neighbours and getting to know the individuals in attendance from North American. Local residents helped with the tent set-up and tables and chairs and the Bruderheim Boys & Girls Club did the garbage pickup at the end.

b. Advertising

i. Notification for the event was through direct mail to land owners and residents within 5 km of the site as well as an unaddressed mail drop for the town of Bruderheim residents.

NORTH AMERICAN
OIL SANDS CORPORATION

You Are Invited

North American Oil Sands Corporation
Community Picnic

Date: Sunday, June 10, 2007

Time: 2:00 PM to 6:00 PM

Where: North American Upgrader
Community Affairs Office
55555 – Range Road 211

Activities:

- **Official Opening of the North American Upgrader Community Affairs Office**
- **Donation to a Local Group**
- **Children Games – with prizes**
- **Bar B Que – Roast Pig, Hamburgers, Hot Dogs**
- **Meet staff from North American**
- **Gifts**

For more information contact Ryerson Morley Christie at:
Phone: 780-997-0682
Email: xieassoc@nexicom.net

Glossary

$7Q_{10}$ Discharge	The minimum average discharge over a period of 7 days which has a return period of 10 years, i.e., the probability that the minimum 7-day duration discharge will be equal to, or less than, 10% of the mean flow.
Acidification	The decrease of acid neutralizing capacity in water, or base saturation in soil, caused by natural or anthropogenic processes
Acute Exposure Limit	The amount or dose of a chemical that may be tolerated without adverse effects on a short-term basis
Acute health risks	Health risks that can have a rapid onset and a short course
Adverse effect	An undesirable or harmful effect
Ah horizon	An A horizon of organic matter accumulation containing less than 17% carbon
Airshed	The geographic area requiring unified management to achieve air pollution control
Alberta-Saskatchewan Apportionment Agreement	An agreement by which 50% of the volume of the North Saskatchewan River must be apportioned to Saskatchewan
Alkaline	Having a pH higher then 7
Ambient air	The air in the surrounding atmosphere
Ambient noise	The pre-existing sound environment of a location, before the introduction of , or in absence of, noise from a specific source which also affects the sound environment of that location
Amine	One of a class of organic compounds that can be derived from ammonia by replacing one or more hydrogens with organic radicals
Amine regeneration unit	Equipment that removes absorbed acid gases from amine to reusable condition for acid gas absorption
Amphibian	A cold-blooded, smooth-skinned vertebrate, that characteristically hatches as an aquatic larva with gills. The larva then transforms into an adult having air-breathing lungs.
Anthropogenic	Caused or influenced by human beings
Application case	A condition that considers potential impacts associated with the combination of the Baseline case and the Project
Aquifer	A water-saturated, permeable body of rock capable of transmitting significant or usable quantities of groundwater to wells and springs under ordinary hydraulic gradients
Aromatics	Organic compounds containing a ring structure composed of six carbon atoms. Benzene is the simplest of these molecules which are composed of a single ring with no branch chains
Artifact	Any portable object modified or manufactured by humans
Assessment	Determine or estimate the size, quality, or extent of a resource or impact
Avian	Of or relating to birds
Baseline case	A condition that serves as a reference point to which later assessments are coordinated or correlated, including all projects currently operating or approved within the respective study area
Bedrock	The body of rock that underlies the gravel, soil or other superficial material
Benthic invertebrates	Organisms that live at the bottom of lakes, ponds or streams
Biodiversity	The variety of a plant and animal life in a particular habitat (e.g., plant community or a country). It includes all levels of organization, from genes to landscapes, and the ecological processes through which these levels are connected.
Biodiversity ranking	The relative contribution of an ecosite phase/wetlands type to the overall

	biological diversity of an area.
Bitumen	A non-conventional oil that is often referred to as extra heavy oil, generally more dense than 14ºAPI
Blowdown	The act of emptying or depressurizing material in a vessel
Bog	Ombrotrophic, acidic, peat-forming wetlands that receives its surface moisture from precipitation
Boiler feed water	Water that meets required purity specifications and is used in the heat recovery steam generator to produce steam
BIOX treatment	The use of biological processes to digest carbonaceous and nitrogenous contaminants by oxidation
Borden Blocks	The standard Canadian archaeological geographic units used to delineate the historical resources database
Boreal	Of or relating to the forest areas of the northern North Temperate Zone, dominated by coniferous trees such as spruce, fir, and pine.
Buffer	A transition zone between areas managed for different objectives.
CALMET model	A meteorological model approved by AENV and used in conjunction with the CALPUFF model for predicting spatial concentration patterns for regional air emission sources
CALPUFF model	An air dispersion model approved by AENV and used in conjunction with the CALMET model for predicting spatial concentration patterns for regional air emission sources
Carcinogen	An agent that is reactive or toxic enough to act directly to cause cancer
Catalyst	A substance that reduces the peak activation energy required for a chemical reaction such as by allowing the reaction to occur at a lower temperature
Cations	Positively-charged ions
Chernozem	A productive, well-developed soil with a thick, rich topsoil layer
Chert	A compact rock consisting essentially of microcrystalline quartz
Chronic Exposure Limit	The amount or dose of a chemical that may be tolerated without adverse health effects even with continuous or repeated exposures over extended periods of time, possibly extending over a lifetime
Chronic health risks	Health risks that can have a slow onset and a long course
Cofferdam	A waterproof wall, open at the top, enclosing a construction area below the water level
Concomitantly	To exist or occur with something else
Condensate	A light hydrocarbon liquid obtained by condensing hydrocarbon vapours from natural gas
Coniferous	Any of various mostly needle-leaved or scale-leaved, chiefly evergreen, cone-bearing gymnospermous trees or shrubs such as pines, spruces, and firs.
Conspecific	Belonging to the same species
CORMIX Model	A numerical simulation model designed to evaluate mixing zone water quality conditions
Critical Load	An air deposition threshold based on CASA/AENV deposition criteria that, if exceeded, requires that an Emission Reduction Plan be developed and implemented on an accelerated schedule
Crude oil	Unrefined liquid petroleum
Cryptogams	Referring to plants and fungi that do not reproduce through seeds
Cumulative case	A condition that considers potential impacts associated with the combination of the Application case and any proposed projects that have not yet been approved
Delayed coking	The primary upgrading technology; a thermal process in which the

	residue material is rapidly heated in a furnace and then thermally cracked in coke drums under controlled temperature and pressure
Deposition Study Area	An 80 x 80 km area centred on the Project site that was used for air deposition modelling, based on the anticipated extent of PAI isopleths of interest
Depressional	Areas of lower elevation
Dewatering	Removal of groundwater from a geological formation using wells or drainage ditch systems
Diluent	A light liquid hydrocarbon added to bitumen to lower viscosity and density
Diluent recovery unit	A unit designed to recover the condensate diluent from the diluent bitumen blend stream for return to the bitumen production facilities
Distillation	The process of producing a gas or vapour from a liquid by heating the liquid in a vessel and collecting and condensing the vapours into liquids
Diurnal, birds	Active by day
Drawdown	Decrease in local groundwater level
Duration	The length of time an effect will occur
Ecosystem	An integrated and stable association of living and non-living resources functioning within a defined physical location; a community of organisms and its environment functioning as an ecological unit
Effluent	The liquid waste of industrial processing
Effluent loading	The introduction of constituents into a water body through effluent discharge
Emissions	Substances discharged into the atmosphere through a stack
Endangered	A wildlife species facing imminent extirpation or extinction
Eolian	A designation of rocks and soils whose constituents have been carried and laid down by atmospheric currents
Ephemeral	Lasting a short period of time
Equivalent Land Capability	The ability of land to support various land uses after reclamation is similar to the ability that existed prior to any activity on the land, but the ability to support individual land uses will not necessarily be equal after reclamation
Equivalent sound levels	The level of a steady sound having the same acoustic energy, over a given time period, as a fluctuating sound
Erosion	The process by which material, such as rock or soil, is worn away or removed by wind or water
Exceedance	An emission whose measured value is more than that allowed by government regulations
Exceedance Trigger	An air emissions threshold value established based on the CWS that requires the development of a mandatory plan
Extinct	A wildlife species that no longer exists
Extirpated	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere
Feedstock	Raw material supplied to a processing or refining facility
Fenceline receptors	A group of hypothetical, transient receptors that may be exposed to the COPCs on an acute basis as a result of being present close to the Project fenceline
Fixed roof tank	A tank with a fixed roof that will not vary based on the volume of liquid stored in the tank
Flare	A device for disposing of combustible gases from refining or chemical process by burning in the open
Flare stack	A chimney used to dispose of surplus hydrocarbon gases by igniting

	them in the atmosphere
Flare system	The equipment for flaring gas, including the relief valves, piping and flare stacks
Floating roof tank	A tank with a roof made of steel, plastic, sheet or microballoons, which floats on the surface of the stored liquid
Flue gas	The gaseous combustion product from a furnace
Fluvioeolian	Descriptive of materials transported and deposited by the combined action of streams and wind
Formation	A geologic unit of distinct rock types that is large enough in scale to be mappable over a region
Fugitive emissions	Trace amounts of uncombusted substances that are released into the atmosphere form plant processing and storage equipment
Gas oil (GO)	A petroleum distillate, boiling within the range of 232-426ºC. Usually includes kerosene, diesel fuel, heating oils and light fuel oils
Gasification	A process whereby petcoke is gasified to produce hydrogen, electrical power and synthetic natural gas
Geomorphology	The study of the evolution and configuration of landforms
GHG emission intensity	A calculation of the annual direct GHG emissions divided by the annual number of barrels of bitumen processed through the Upgrader
Glaciofluvial	Geomorphic feature whose origin is related to the processes associated with glacial meltwater
Gleysolic soil	A group of soils in the Gleysolic order; a Gleysol has a thin (less than 8 cm) Ah horizon underlain by mottled grey or brownish grey material, or it has no Ah horizon
Groundwater	Subsurface water that occurs beneath the water table in soils and geological formations that are fully saturated. It is the water within the earth that supplies water wells and springs
Group 1 noise receptors	Receptors within 1,500 m of the nearest Project noise source on the Project boundary
Group 2 noise receptors	Receptors between 1,500 m and approximately 4,500 m of the Project boundary
Habitat	The place or environment where a plant or animal naturally or normally lives or occurs
Habitat Alienation	The loss of habitat effectiveness as a result of sensory disturbances from human activities at disturbed sites
Habitat Connectivity	Ability for populations to move between habitats. A loss of habitat connectivity may be caused by physical barriers, sensory disturbance, and/or changes in habitat
Habitat Effectiveness	The physical characteristics associated with the suitability of a habitat and, the ability of a habitat to be used by wildlife
Habitat Fragmentation	Occurs when extensive, continuous tracts of habitat are reduced usually divides remaining habitat into smaller, more isolated patches
Habitat Generalist	Wildlife species that can survive and reproduce in a variety of habitat types (e.g., red-backed vole)
Habitat Patches	Isolated patches of habitat
Habituate	To become accustomed to a particular situation
Heavy oil	Crude oil that has a high density, generally from about 14ºAPI to about 23ºAPI
Historic site	Any location with detectable evidence of past human activity
Historical resources	Works of nature or by humans valued for their palaeontological, archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest

Human Health Risk	The process of defining and quantifying risks and determining the acceptability of those risks to human life
Hydraulic conductivity	A coefficient of proportionality describing the rate at which water can move through a permeable medium
Hydraulic gradient	Change in hydraulic head per unit of distance in a given direction
Hydrocracking	A catalytic, high-pressure petroleum upgrading process in which hydrogen is added to petroleum-derived molecules that are too complex for gasoline and then the molecules are cracked and converted to the required fuels
Hydrogenation	The saturation of diolefin impurities in gasolines to form a stable product
Hydrogeology	The study of the factors that deal with subsurface water (groundwater) and the related geologic aspects of surface water
Hydroprocessing	The secondary upgrading technology; a process including in which aromatics are removed crude oil using a combination of hydrogenation, hydrocracking, and hydrotreating
Hydrotreating	A catalytic process in which hydrogen contacts petroleum intermediate or product streams to remove impurities, such as sulphur, nitrogen or unsaturated hydrocarbons
Incremental lifetime cancer risk	The regulatory benchmark value for acceptable lifetime cancer risk of 1 in 100,000, approved by Health Canada and AENV
Intergrade	To merge gradually
Invertebrate	An animal without a backbone and internal skeleton
Isopleth	A line drawn on a map connecting points having the same numerical value of some variable
Land Capability	An evaluation of land performance that focuses on the degree and nature of limitation imposed by the physical characteristics of the land unit on a certain use, assuming a management system.
Leak detection and repair program	A program designed to control and reduce fugitive emissions
Lifetime cancer risk	The number of cancer cases that could potentially result in association with exposures to carcinogens per 100,000 people
Liquid petroleum gas	A product of petroleum gases, principally propane and butane
Lithic	Pertaining to or consisting of stone
Luminous flux	The perceived power of light
Luminous intensity	The power of light energy emitted
Makeup water	The process water required to replace that lost by evaporation or leakage in a closed-circuit, recycle operation
Mass balance	An overall material balance based on mass
Material balance	A calculation to inventory material inputs versus outputs
Mercaptan	A group of organosulphur compounds that are derivatives of hydrogen sulphide in the same way that alcohols are derivatives of water. These compounds have a characteristically disagreeable odour, are found with other sulphur compounds in crude petroleum, and are added to odourless fuel gases to give them a distinctive odour for safety purposes
Mitigation	Measures taken to reduce adverse effects on the environment
Mixedwood	A stand containing both deciduous and coniferous trees. Defined in this report as stands where the primary species is deciduous and the secondary species totals ≥30% coniferous species, or vice-versa. Also, multistory stands of an “A” density with a deciduous primary overstorey species, and the dominant understorey species is coniferous, or vice-versa

Mixing Zone	A predefined area within a surface water body beyond an outfall or discharge point in which the applicable jurisdiction or regulatory agency permits water quality criteria to be exceeded
Modelling	A simplified representation of a relationship or system of relationships, involving calculation techniques used to make quantitative estimates of an output parameter based on its relationship to input parameters
Mole	An amount of substance of a system which contains as many elementary units as there are atoms of carbon in 0.012 kilograms of the pure nuclide carbon-12
Monitoring	The process of measuring a condition that must be kept within set limits
Monitoring Load	An air deposition threshold based on CASA/AENV deposition criteria that, if exceeded, requires industry and non-industry stakeholders to discuss appropriate monitoring approaches
Morainal	A ridge, mound or irregular mass of unstratified glacial drift, chiefly boulders, gravel, sand and clay, or a deposit of such material left on the ground by a glacier
Morphological	The form or structure of an organism considered as a whole
Multiple Pathway Exposure Assessment	An assessment including COPCs that, although only emitted into the air, would be likely to deposit onto surface soils and vegetation and persist or accumulate in the environment in sufficient quantities for residents and workers to be exposed via secondary pathways.
Naphtha	A petroleum fraction with volatility between gasoline and kerosene
Nocturnal, birds	Active by night
Non-vascular plants	Plants that do not possess conductive tissues for the transport of water and food
North American	North American Oil Sands Corporation (the Proponent)
North Wetland Complex	A series of wetlands located in SE 2-56-21 W4M which will be preserved and enhanced as part of the Project
Nutrient loading	The introduction of nutrients such as nitrogen or phosphorus from fertilizers into the soil or water
Nutrients	Environmental substances such as nitrogen or phosphorus, which are necessary for the growth and development of plants and animals
Obsidian	Volcanic glass which is easily work into tools and attains a very sharp edge.
Oil sands	An unconsolidated, porous sand formation or sandstone containing or impregnated with petroleum or hydrocarbons
Oily stormwater	Water that is collected within processing areas, that is at risk of hydrocarbon contamination
Ombrotrophic	A type of peatland that receives water and nutrients from precipitation falling directly onto its surface
Oxygen scavenger	An additive used to remove residual trace amounts of oxygen from water, such as from boiler feedwater
Periphyton	Microscopic plants and animals that are firmly attached to solid surfaces under water such as rocks, logs, pilings and other structures
Permanence	The potential for recovery or reversibility of an effect
Permissible sound level	The allowable level of noise from energy industry sources, as specified by the current EUB Noise Control Directive, which might contribute to the sound environment of a residential location
Petcoke	A solid residue that contains mainly carbon produced from the thermal conversion of petroleum
Petrochemical	Chemical products made from the raw materials of petroleum
Phenological	The study of timing of biological events

Planning Trigger	An air emissions threshold value established based on the CWS that requires the development of a management plan
Potable water	Water that is suitable for drinking
Potentially contaminated stormwater	Surface drainage collected from areas of the site that have a low risk of hydrocarbon contamination
Precipitation	rain or snow that falls on the earth's surface
Prehistoric	Belonging to a time before recorded history
Pressure swing adsorption	A process that uses pressure changes through a sequence of adsorption particle beds to purify gases
Procurement	The process of obtaining materials, equipment and services, including purchasing, contracting and negotiating directly with the source of supply
Purging	The act of displacing the contents of a line or vessel by depressurizing and introducing an inert fluid, such as nitrogen
Quartzite	A granular metamorphic rock consisting essentially of quartz in interlocking grains
Receptor	The person or organism subjected to exposure to chemicals or physical agents
Receptor characterization	the identification of people who may be exposed to emissions from the Project
Reclamation	The process of stabilizing and returning disturbed land to a natural state of equivalent or better capability
Reference Concentration (RfC)	The safe level of an airborne chemical for which the primary avenue of exposure is inhalation
Reference Dose (RfD)	The safe level or dose of a chemical for which exposure occurs through multiple pathways (i.e., inhalation, ingestion and dermal)
Remediation	The process of planning for, investigation and potentially managing or removing the effects of chemical substances on the environment
Revegetation	The process of providing denuded land with a new cover of plants
Reverse osmosis	a technique used to remove dissolved solids from water in which pressure is applied to the surface of a saline or waste solution, forcing pure water to pass from the solution through a membrane that will not pass the ions of dissolved solids
Riparian	Relating to or living or located on the bank of a natural watercourse
Risk assessment	The process of evaluating the probability of adverse effects occurring as a result of exposure to one or more stressors
Risk Quotient	A quantification of risk calculating by dividing the predicted levels of exposure for the noncarcinogenic COPCs by their respective exposure limits
Risk-specific Concentration (RsC)	The level of an airborne carcinogen for which the primary route of exposure is inhalation that results in a “regulatory acceptable” incremental increase in cancer (typically 1 in 100,000).
Risk-specific Dose (RsD)	The level or dose of a carcinogen for which exposure occurs through multiple pathways that results in a “regulatory acceptable” increased incidence of cancer (typically 1 in 100,000)
Runoff	The portion of precipitation (rain and snow) that ultimately reaches streams via surface systems
Salinity	The relative proportion of salt
Sedimentation	The process that deposits soils, debris and other materials either on the ground surfaces or in bodies of water or watercourses
Shovel Test	A subsurface test excavated by hand to determine the presence/absence of buried cultural materials
Shutdown	The process of stopping equipment or machinery or a process, partly or

	completely
Socio-economics	The study of social and economic factors
Sodicity	Having a high sodium content
Soil capability	The measure of a soils capacity to sustain vegetation
Spatial	The geographic area
Species of Concern	Species classified as at risk, endangered, threatened or of concern by federal and provincial wildlife agencies
Stakeholder	People or organizations with an interest or share in an undertaking, such as commercial venture
StatoilHydro	StatoilHydro ASA (the parent company of North American)
Steam methane reformation	A process used to generate hydrogen by converting methane (and other hydrocarbons in natural gas) into hydrogen and carbon monoxide by reaction with steam over a nickel catalyst
Stockpile	A gradually accumulated reserve of material
Study Area	The geographic limits within which an impact to a key indicator resource or social component is likely to be significant
Subregion	A division or subdivision of a region
Sump	A pit or tank that receives and temporarily stores drainage at the lowest point of a circulating or drainage system
Surveillance Trigger	An air emissions threshold value established based on the CWS to ensure that appropriate monitoring is in place to assess the region's air quality
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs
Synthesis gas (syngas)	A gas containing CO, CO_2, H_2, and water, used in the production of a pure hydrogen stream
Synthetic crude oil	Oil obtained by refining heavier hydrocarbons, converting them to lighter hydrocarbons that are reblended as an upgrader feedstock
Synthetic natural gas	The product of blending liquid petroleum gas and air to simulate natural gas
Target Load	An air deposition threshold based on CASA/AENV deposition criteria that, if exceeded, requires that an Emission Reduction Plan be developed
Taxonomical	The science dealing with the description, identification, naming, and classification of organisms.
Temporal	Enduring for a defined period of time
the Project	All of the facilities required to reach the target capacity of the Upgrader (243,000 bpsd) plus the addition of two stages of petcoke gasification
Threatened	A wildlife species likely to become endangered if limiting factors are not reversed
Till	Glacial drift consisting of an unsorted mixture of clay, sand, gravel, and boulders
Topography	The surface configuration of an area
Transition Area	Lands within the AIH currently not zoned as Heavy Industrial
Upset scenario	Scenario describing conditions in which unplanned air emissions may occur
Vascular plants	Referring to the majority of plants, which have connecting tissues, leaves, stem, roots
Viscosity	The fluid property that characterizes the amount of functional energy loss during flow
WASP model	A dynamic compartment modelling program for aquatic systems that allows the user to predict the water quality responses to natural

	phenomena and anthropogenic discharges
Waste	Solids or liquids produced in the course of constructing, operating and abandoning facilities
Waste management plan	The system developed to track and control emissions and waste and evaluate pollution-prevention steps
Water table	The upper surface of ground water or the level below which the soil is saturated with water
Waterbody	A natural geographical feature containing water, such as a lake or stream
Watercourse	A natural or artificial channel for the passage of water
Watershed	The entire surface drainage area that contributes water to a lake or river
Zero liquid discharge	A combination of unit processes which reduce the effluent discharge to a negligible brine concentrate. The water reclaimed from the ZLD system is normally of high quality and is recycled. The waste stream from the ZLD system can be a concentrated brine suitable for deep well disposal, or a waste salt suitable for landfilling (if a crystallization process is used)

List of Acronyms

AAAQO	Alberta Ambient Air Quality Objectives
AADT	Average Annual Daily Traffic
AAFC	Agriculture and Agri-Food Canada
AAHTF	Alberta Affordable Housing Task Force
AAQC	Ambient Air Quality Criteria
AAQO	Ambient Air Quality Objective
ACB	Alberta Cancer Board
ACGIH	American Conference of Governmental Industrial Hygienists
ACRA	Alberta Capital Region Alliance
AENV	Alberta Environment
AESCC	Alberta Endangered Species Conservation Committee
AGCC	Alberta Groundcover Classification
AGR	Acid Gas Removal
AGR	Agricultural Receptor
AGRASID 3.0	Agricultural Region of Alberta Soil Inventory Database Version 3.0
AHW	Alberta Health and Wellness
AIH	Alberta Industrial Heartland
AIT	Alberta Transportation & Infrastructure
AIWG	Agriculture Interpretation Working Group
ANC	Acid Neutralizing Capacity
ANHIC	Alberta Natural Heritage Information Centre
ANPC	Alberta Native Plant Council
AR	Atmospheric Residue
ARU	Amine Regeneration Unit
ASDT	Average Summer Daily Traffic
ASRD	Alberta Sustainable Resource Development
ASU	Air Separations Unit
ASWQG	Alberta Surface Water Quality Guidelines
ATSDR	Agency For Toxic Substances and Disease Registry
BATEA	Best Available Technology Economically Achievable
BFW	Boiler Feedwater
bgs	Below Ground Surface
BHT	Bulk Hydrotreater
BHT/DHT	Bulk/Distillate Hydrotreater

BMC	Benchmark Concentration
BMD	Benchmark Dose
BOD	Biochemical Oxygen Demand
bpsd	Barrels Per Stream Day
BSD	Bird Species Diversity
BSL	Basic Sound Level
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
BTF	Biotransfer Factors
C&R	Conservation and Reclamation
CAC	Criteria Air Contaminant
CARB	California Air Resources Board
CASA	Clean Air Strategic Alliance
CASP	Complementary Area Structure Plan
CCEMA	Alberta *Climate Change and Emissions Management Act*
CCME	Canadian Council of Ministers of the Environment
CDWQ	Canadian Drinking Water Quality
CEA	Cumulative Effects Assessment
CEA Agency	Canadian Environmental Assessment Agency
CEC	Cation Exchange Capacity
CECN	Canadian Ecodistrict Climate Normals
CEPA	*Canadian Environmental Protection Act*
CHA	Cardiac Hospital Admissions
CMA	Edmonton Census Metropolitan Area
CMHC	Canadian Mortgage and Housing Corporation
CN	Canadian National Railway
CNS	Central Nervous System
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
COPC	Chemical of Potential Concern
COPD	Chronic Obstructive Pulmonary Disease
CORMIX	Cornell Mixing Zone Expert System
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPR	Canadian Pacific Railway
CR	Concentration Ratio

CRIGMP	Capital Region Integrated Growth Management Plan
CWS	Canada-Wide Standard
dB	Decibel
DCU	Delayed Coker Unit
DFO	Fisheries and Oceans Canada
DHT	Distillate Hydrotreater
dilbit	Diluent Bitumen Blend
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DRU	Diluent Recovery Unit
DSA	Deposition Study Area
EC	Environment Canada
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement and Construction
EPEA	Alberta *Environmental Protection and Enhancement Act*
ERP	Emergency Response Plan
ESL	Effects Screening Level
EUB	Alberta Energy and Utilities Board
FAP	Fort Air Partnership
FCSS	Family Community Support Services
FEED	Front-End Engineering Design
FMIS	Fisheries Management Information System
FOLC	Friends of Lamont County
FPAC	Federal-Provincial Advisory Committee
GCM	Global Climate Models
GDP	gross domestic product
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GOHC	Gas Oil Hydrocracker
GOHT	Gas Oil Hydrotreater
GPS	Global Positioning System
H_2S	Hydrogen Sulphide
HCGO	Heavy Coker Gas Oil
HEC	Human Equivalent Concentration

HHRA	Human Health Risk Assessment
HP	High Pressure
HRIA	Historical Resources Impact Assessment
HS&E	Health, Safety and Environment
HSE MS	Health, Safety and Environment Management System
IA	Instrument Air
IARC	International Association for Research on Cancer
IES	Illuminating Engineering Society of North America
IFRT	Internal Floating Roof Tank
IISD	International Institute For Sustainable Development
ILCR	Incremental Lifetime Cancer Risk
IND	Industrial/Commercial Receptor
IPCC	Intergovernmental Panel on Climate Change
IPM	Individual PAH Method
IRIS	Integrated Risk Information System
ISO	International Standards Organization
kHz	Kilohertz
LCGO	Light Coker Gas Oil
LCR	Lifetime Cancer Risks
LDAR	Leak Detection and Repair
LEC	Lowest Exposure Concentration
LEED	United States Green Building Council Leadership in Energy and Environmental Design
LEL	Lower Explosive Limit
L_{eq}	Energy Equivalent Sound Level
LGO	Light Gas Oil
LOAEC	Lowest Observed Adverse Effect Concentration
LOAEL	Lowest Observed Adverse Effect Level
log K_{ow}	Octanol-Water Partition Coefficient
LP	Low Pressure
LPG	Liquid Petroleum Gas
LSA	Local Study Area
LSEA	Local Stakeholder Engagement Area
LTGC	Low Temperature Gas Cooling
LTRN	Long-Term River Network
MA DEP	Massachusetts Department of Environmental Protection

masl	Metres Above Sea Level
MDL	Method Detection Limit
MDP	Municipal Development Plan
MIACC	Major Industrial Accidents Council of Canada
MON	Monitoring Stations
MPR	Maximum Permissible Risk Level
MRL	Minimum Risk Level
NAAQO	National Ambient Air Quality Objectives
NAPS	National Air Pollution Surveillance
NCIA	Northeast Capital Industrial Association
NFPA	National Fire Protection Association
NH_3	Ammonia
NHT	Naphtha Hydrotreater
NIA	Noise Impact Assessment
NMHC	Non-Methane Hydrocarbon
NO_2	Nitrogen Dioxide
NOAEL	No Observed Adverse Effect Level
non-CACs	Non-Criteria Air Contaminants
NO_x	Nitrogen Oxides
NPRI	National Pollutant Release Inventory
NR CAER	Northeast Region Community Emergency Awareness and Emergency Response
NSR	North Saskatchewan River
NSRB	North Saskatchewan River Basin
NSWA	North Saskatchewan Watershed Alliance
NTP	National Toxicology Program
O_3	Ozone
OEHHA	California Office of Environmental Health Hazard Assessment
OMOE	Ontario Ministry of the Environment
Pa	Pascal
PAH	Polycyclic Aromatic Hydrocarbon
PAI	Potential Acid Input
PDD	Public Disclosure Document
petcoke	Petroleum Coke
PG	Pasquill-Gifford Stability
PHC	Petroleum Hydrocarbon

PL	Property Line
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than 2.5 microns in Diameter
POI	Point of Impingement
ppb	Parts Per Billion
PPL	Project Property Line
ppm	Parts Per Million
Project	North American Upgrader Project
PSA	Pressure Swing Adsorption
PSI	Pounds Per Square Inch
PSL	Permissible Sound Level
PUA	Public Use Area
PVC	Polyvinyl Chloride
RAIS	Risk Assessment Information System
RCP	Petro-Canada Refinery Conversion Project
REL	Reference Exposure Level
RES	Residential Receptor
RfC	Reference Concentration
RfD	Reference Dose
RGDR	Regional Gas Dosimetry Ratio
RHA	Respiratory Hospital Admissions
RIVM	Netherlands National Institute of Public Health and the Environment
RPD	Relative Percent Difference
RQ	Risk Quotient
RSA	Regional Study Area
RSC	Reduced Sulphur Compound
RsC	Risk-Specific Concentration
RsD	Risk-Specific Dose
RVP	Reid Vapour Pressure
SAGD	Steam-Assisted Gravity Drainage
SAIH	Strathcona Area Industrial Heartland
SAR	Sodium Adsorption Ratio
SARA	Alberta Species At Risk
SCO	Synthetic Crude Oil
SEIA	socio-economic impact assessment

SF	Slope Factors
SIL	Survey Inspection Level
SMR	Steam Methane Reformation
SNG	Synthetic (Or Substitute) Natural Gas
SO_2	Sulphur Dioxide
SRU	Sulphur Recovery Unit
STEL	Short-Term Exposure Limit
SW	Sour Water
SWS	Sour Water Stripper
syngas	Synthesis Gas
TC	Tolerable Concentration
TCA	Tolerable Concentration In Air
TCEQ	Texas Commission on Environmental Quality
TDP	Total Dissolved Phosphorus
TDS	Total Dissolved Solids
TEF	Toxic Equivalency Factors
TGCU	Tail Gas Cleanup Unit
TGR	Theoretical Gypsum Requirement
TGTU	Tail Gas Treating Unit
THC	Total Hydrocarbon
TKN	Total Kjeldahl Nitrogen
TLV	Threshold Limit Value
TLV-TWA	Threshold Limit Value – Time Weighted Average
TN	Total Nitrogen
TOR	Terms of Reference
TP	Total Phosphorus
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TPRC	Alberta Tourism, Parks, Recreation and Culture
TRS	Total Reduced Sulphur
TRV	Toxicological Reference Value
TSP	Total Suspended Particulate
TWA	Time Weighted Average
U.S. DOE	United States Department of Energy
U.S. EPA OSW	United States Environmental Protection Agency's office of Solid Waste
U.S. NRC	United States National Research Council

ug/kg bw/d	Micrograms Per Kilogram of Body Weight Per Day
ug/m^3	Microgram Per Cubic Metre
UNEP	United Nations Environment Program
URE	Unit Risk Estimates
UTM NAD	Universal Transverse Mercator, North American Datum
VAC	Vacuum Unit
VCR	Voluntary Challenge and Registry
VFRT	Vertical Fixed Roof Tank
VGO	Vacuum Gas Oil
VGO HK	Vacuum Gas Oil Hydrocracker
VOC	Volatile Organic Compound
VPPP	Voluntary Property Purchase Program
VR	Vacuum Residue
WASP	Water Quality Analysis Simulation Program
WHO	World Health Organization
WISSA	Western Interprovincial Scientific Studies Association
WMM	Whole Mixture Model
WSC	Water Survey of Canada
WWTP	Wastewater Treatment Plant
WWTU	Wastewater Treatment Unit
y	Year
ZLD	Zero Liquid Discharge