cenovus ENERGY

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CENOVUS ENERGY INC.
PELICAN LAKE GRAND RAPIDS PROJECT
APPLICATION APPROVAL

Under the

Alberta Environmental Protection and Enhancement Act

Submitted to:
Alberta Environment and Water

Submitted by:
Cenovus Energy Inc.

December 2011

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A. INTRODUCTION

Cenovus Energy Inc. (Cenovus) is seeking approval for the proposed Pelican Lake Grand Rapids Project (the Project). The Project is located in northeast Alberta, about 300 km north of Edmonton, primarily in Townships 81 to 83, Ranges 20 to 23, West of the Fourth Meridian. The closest populated areas are the hamlet of Wabasca-Desmarais (Wabasca) and the Bigstone Cree Nation.

The Project will use Steam-Assisted Gravity Drainage (SAGD) technology for enhanced oil recovery. Once the SAGD operation is established, Cenovus may incorporate co-injection of light hydrocarbons, referred to as Solvent Aided Process (SAP), where economically feasible. The Project is expected to have a maximum production capacity of approximately 180,000 barrels of oil per day and will be constructed in three phases over the estimated 40-year life of the Project. The central processing site will cover about 1.5 km^2. The proposed development is expected to include up to 200 well pads over the life of the Project, supporting up to 3,700 well pairs. Wherever reasonably possible, the Project will use existing clearings and infrastructure.

The Project is expected to require other related infrastructure projects including electrical power lines, fuel gas pipelines, produced oil pipelines, and diluent/condensate supply pipelines. These related infrastructure projects will be applied for separately, as appropriate.

The intent of this Application is to gain approval to construct, operate and reclaim Cenovus's Pelican Lake Grand Rapids Project. This Application is being made in accordance with the *Alberta Environmental Protection and Enhancement Act*, Alberta Regulation 113/93 and is consistent with guidance for preparing amendment applications from the *Environmental Protection and Enhancement Act Approvals and Registrations Procedure Regulation Application for Sour Gas Processing Plants and Heavy Oil Processing Plants Guide to Content* (AENV 1999).

A.1 GENERAL INFORMATION

Registered Company Name:	Cenovus Energy Inc.
Mailing Address of Head Office in Alberta:	Cenovus Energy Inc. 421-7th Avenue S.W. P.O. Box 2850 Calgary, AB T2P 2S5
Mailing Address of Applicable Plant:	Not applicable
Phone and Telecopy Numbers:	Not applicable
Date of Applications:	December 2011
Contact Information:	Greg Demchuk Cenovus Energy Inc. 421 – 7th Avenue SW Calgary, AB T2P 2S5 Telephone: (403) 766-6368 Facsimile: (403) 766-7600
Email Address for Company Contact(s):	greg.demchuk@cenovus.com

B. FACILITY DESCRIPTION

Cenovus is seeking regulatory approval for the proposed Project. The Project is expected to have a maximum production capacity of approximately 180,000 barrels per day (bbl/d) (28,600 m^3/d), constructed in phases over the estimated 40-year life of the Project.

In June 2010, Cenovus received approval from the Energy Resources Conservation Board (ERCB) for a pilot project to test the commerciality of the Grand Rapids Formation. Alberta Environment (AENV) approval was received in November 2010. The pilot results have encouraged the submission of this application.

Steam-Assisted Gravity Drainage (SAGD) will be used to recover oil from the Grand Rapids 'A' Member. Once the SAGD operation is established, Cenovus plans to enhance the operations by incorporating co-injection of light hydrocarbons along with the steam, referred to as Solvent Aided Process (SAP), where economically feasible. This enhancement is expected to reduce greenhouse gas emissions and water usage per barrel of oil while increasing oil production and oil recovery rates.

The Project will be constructed in phases. Cenovus will use the experience from the first phase and from the pilot project to operate more efficiently as the Project proceeds. Cenovus will also continue to look for ways to reduce the overall water use by improving reuse and recycle practices. In the Grand Rapids 'A' Member, there is an overlying lower bitumen content area called the lean zone which contains non-saline water in contact with the bitumen. The excess water in this zone will be produced along with the oil and will be recycled for steam injection, which means that the need for additional source water for steam once the initial well pads have progressed to SAGD operations is not anticipated. Start-up water requirements for steam generation will also come from the Grand Rapids 'A' and are being applied for in the *Water Act* applications found in Volume 1, Appendix 1-III.

The Project is expected to include construction of the following:

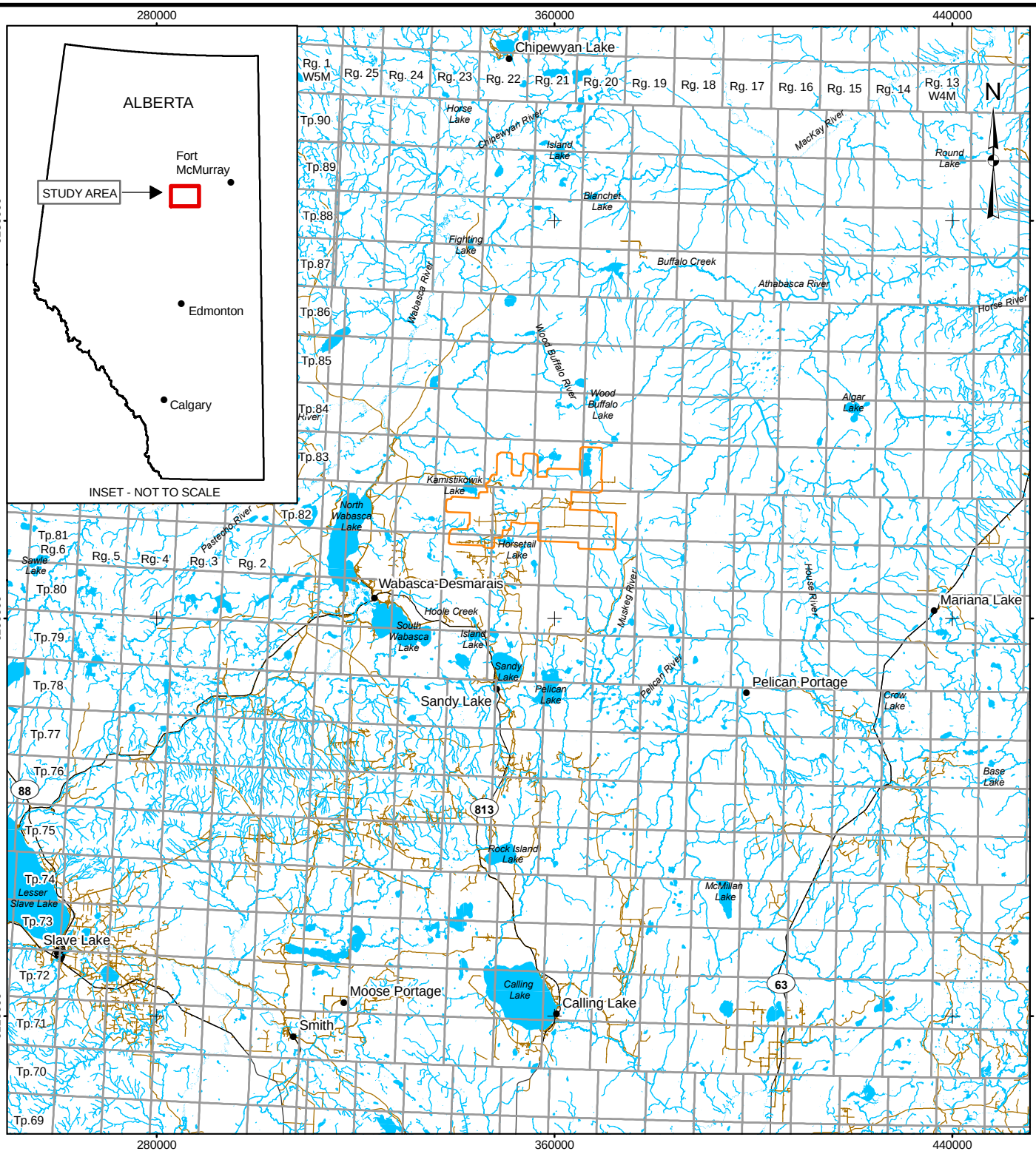
- the central processing site to be constructed in phases will include:
  - oil treatment facilities with a nominal capacity of 180,000 bbl/d (28,600 m^3/d);
  - steam production facilities with up to 36 steam generators, of which four are co-generation; and
  - water treatment facilities.

- an estimated number of five initial well pads and 100 initial well pairs will be operating within 12 months of operations start up;
- an estimated total of 200 well pads supporting up to 3,700 well pairs over the life of the Project;
- roads and pipelines required to operate the wells and transport the oil to the central processing site; and
- up to six disposal wells.

The proposed Project will require other related infrastructure projects including electrical power lines, fuel gas pipelines, oil transportation pipelines and diluent/condensate supply pipelines. These related infrastructure projects will be applied for separately, as appropriate.

B.1 LEGAL LAND DESCRIPTION

The proposed Pelican Lake Grand Rapids Project is located in northeast Alberta, approximately 300 km north of Edmonton, primarily in Townships 81 to 83, Ranges 20 to 23, West of the Fourth Meridian (W4M). The Project location is shown in Figure B.1-1.



LEGEND

- COMMUNITY
- WATERCOURSE
- OPEN WATER
- PROJECT AREA

25 0 25

SCALE 1:1,125,000 KILOMETRES

REFERENCE

ALBERTA DIGITAL BASE DATA OBTAINED FROM ALTALIS LTD. (2004) © GOVERNMENT OF ALBERTA AND IHS ENERGY LTD. (SEPTEMBER 2008).
DATUM: NAD 83 PROJECTION: UTM ZONE 12

PROJECT

cenovus ENERGY

PELICAN LAKE
GRAND RAPIDS PROJECT

TITLE

PELICAN LAKE GRAND RAPIDS PROJECT LOCATION

Golder Associates
Calgary, Alberta

PROJECT NO. 10-1346-0006			FILE No.	
DESIGN	KM	25 Nov. 2011	SCALE AS SHOWN	REV. 0
GIS	SG	01 Dec. 2011		
CHECK	KM	01 Dec. 2011	**FIGURE: B.1-1**	
REVIEW	DB	01 Dec. 2011		

I:\CLIENTS\CENOVUS\10-1346-0006\Mapping\MXD\RSA\Boundaries\FINAL\PL_FigB01_1_ProjectLocation_8-5x11_20111201_FINAL.mxd

B.2 RELATION TO NEAREST COMMUNITIES

Communities near the Project include:

- the hamlet of Wabasca-Demarais (Wabasca) (about 30 km southwest of the plant site); and
- Bigstone Cree Nation (about 30 km southwest of the plant site).

The location of the Project in relation to local communities is shown in Figure B1-1.

B.3 GEOGRAPHICAL DESCRIPTION

The Project is located in northern Alberta and situated about 30 km northeast of Wabasca, Alberta. The Project falls completely within the Central Mixedwood Natural Subregion, in part of the Wabasca Plain District of the Wabasca Lowlands Section of the Northern Alberta Lowlands Region. Terrain includes undulating and gently rolling morainal landforms and a veneer of glaciofluvial deposits over morainal material (Pettapiece 1986). Organic materials overlay these morainal landforms in a large portion of the LSA. The Project area generally contains subdued relief with level to undulating topography in the plains and moderate rolling topography in the uplands. Elevations range from 200 masl over most of the Project area to about 1,050 masl. The lowland areas are dominated by peatlands (bogs and fens).

In the Project area, drainage is west into the Wabasca River and east into the Athabasca River. The terrain is undulating with extensive low-lying wetlands areas.

B.4 RAW MATERIAL PROCESSING CAPACITY AND

B.4.1 SAGD Capacity

Cenovus intends to construct the Project in three phases, each designed for a nominal bitumen production of 60,000 bbl/d.

B.5 OTHER APPROPRIATE CAPACITY MEASUREMENTS

B.5.1 SAGD Capacity Measures

The expected flow rates for the Project are displayed in Table B.5-1.

Table B.5-1 Flow Rates (SAGD)

Plant Inlet Emulsion Temperature	145°C
Plant Inlet Emulsion Pressure	1,595 kPa[(a)]
Steam	
OTSG Steam Quality	77%
Design SOR	3.0
No. of OTSGs[(b)]	32
Boiler feed water (BFW) Design Flow Rate per OTSG	3,560 t/d
BFW Design Flow Rate per HRSG	1,428 t/d
Saturated steam to injection wells [m³/d CWE]	89,532
Steam blowdown to disposal[(a)] [Sm³/d]	5,385
Bitumen	
Standard Density	1,010 kg/m^3
Bitumen production from wells [Sm^3/d]	29,912
Produced Water	
Design Produced Water Steam Ratio (PWSR)	1.0
Produced water from wells [Sm³/d CWE]	89,532
Waste water to disposal[(a)] [Sm³/d]	455
Produced Gas	
Produced Gas to Emulsion (GOR 10.0) [Sm³/d]	299,120
Produced Gas to Casing Gas (GOR 1.0) [Sm³/d]	29,912
Make-up Water	
Make-up water consumption[(a)] [Sm³/d]	5,870
Regen/neutralization waste/warm lime softener sludge to disposal[(a)] [Sm³/d]	50

(a) Refer to the Block Flow Diagram PLGR1-01-42-BFD-00-000-01 (Volume 1, Appendix 1-VIII).

(b) Total plant configuration uses six OTSGs as Second Stage Units.

Hydrogen sulphide (H_2S) and other sulphur compounds, as well as carbon dioxide (CO_2), are removed from the produced gas in the Gas Treating Facility (GTF) at the central plant. Alberta Sulphur Recovery Guidelines identified in the ERCB's *Interim Directive ID 2001-3* (EUB 2001) become more stringent as the sulphur content increases; 70% of the total sulphur present in the produced gas stream when the sulphur content is between 1 t/d to 5 t/d, and 90% have to be recovered for sulphur content up to 10 t/d as defined by the Alberta Sulphur Recovery Guidelines. *Interim Directive ID 2001-3* recovery guidelines are shown in Table B.5-2.

Table B.5-2 Alberta Sulphur Recovery Guidelines

Sulphur Inlet Rate [t/d]	Design Sulphur Recovery Criteria [%]	Calendar Quarter-Year Sulphur Recovery Guidelines [%]
<1	none required	none required
1 to 5	70	69.7
>5 to 10	90	89.7
>10 to 50	96.2	95.9

Source: Alberta Energy Resources Conservation Board Interim Directive ID 2001-3 (EUB 2001).

For in-situ thermal facilities, the sulphur inlet rate refers to the sulphur content of the produced gas. The produced gas is used as fuel in the Once Through Steam Generator (OTSG). It is expected that the inlet sulphur tonnage exceeds 1 t/d in Phase A (first 60,000 bbl/d of production). Therefore, the produced gas must be sweetened before being used as fuel.

The inlet sulphur ratio for the project design was assumed to be 0.26 kg of sulphur in the produced gas per m^3 of bitumen. The ratio was estimated based on the current observed ratios at both the Christina Lake Thermal Plant (CLTP) and the Foster Creek Thermal Plant (FCTP) and prior to any production data from the Grand Rapids Pilot. It is significantly greater than what has been measured to date at the Grand Rapids Pilot. The most recent H_2S concentrations are under 50 ppm at a gas-bitumen ratio of 16 m^3/m^3. This converts to 0.0008 kg of sulphur per m^3 of bitumen, less than 1% of the facility design basis. Unless H_2S rates increase significantly, the facilities are over-designed and not appropriate for the current concentrations of H_2S. This will continue to be reviewed as more information becomes available. The Predicted Sulphur Content of Produced Gas for the Project is presented in Table B.5-3.

Table B.5-3 Design Sulphur Rates

Cumulative Bitumen Production [Sm^3/d]	Nominal Bitumen [bbl/d]	Project Phase	Sulphur Ratio [t/d]	[kg S/m^3 bitumen]
9,539	60,000	A	4.99	0.523
28,618	180,000	C	9.99	0.349

A non-regenerative liquid scavenger (chemical absorbent that removes H_2S from the gas stream) system is used to treat the produced gas when the total sulphur is less than 5 t/d. Beyond this production rate, a GTF (consisting of an Amine Treating Unit and Acid Gas Injection) is used.

The function of an Amine Treating Unit is to remove CO_2 and H_2S from the sour gas and hydrocarbon streams in the Amine Contactor. The Amine is regenerated in the Amine Regenerator, and recycled to the Amine Contactor.

After the Amine Treating Unit is installed, it becomes the primary method of gas treatment. The sulphur scavenger system, similar to that currently in operation at the FCTP, is placed in a cold standby mode. If the GTF is not operating, the sulphur scavenger system is used to sweeten the sour produced gas. Its

intended use is for planned maintenance outages, short-term process upsets, or for treating produced gas which cannot meet the operating envelope of the GTF.

B.6 SIZE OF AFFECTED AREA

The total area disturbed for the Project is 3,291 ha. This includes the plant site, well pads, camp, borrow pits, access roads, utility corridors and pipelines, and includes 207 ha of existing disturbance. The Project Area and footprint is shown in Figure B.6-1.

B.7 FACILITY SITE PLAN

The detailed plot plan is shown in Figure B.7-1 and provided in Volume 1, Appendix 1-VII.

B.8 WORKFORCE

The construction workforce is expected to peak at 1,055 workers in 2021, 2022 and 2023, with smaller peaks of 995 occurring in 2018, 2019 and 2020. Construction is expected to wind down by the end of 2024. Operations will begin in 2017 with 330 workers and finish in 2053 with 60 workers (Volume 6, Section 6.5.1.5).

Operations employment will consist of field and plant operators, maintenance trades, contractors and millwrights, as well as management positions, office and technical support positions.

During operations, SAGD drilling will require about 130 full-time drillers beginning in 2016. Ongoing well pad and pipeline construction will require mostly equipment operators and metal trades, such as welders. Drilling will require rig workers, including roughnecks, motormen and drillers.

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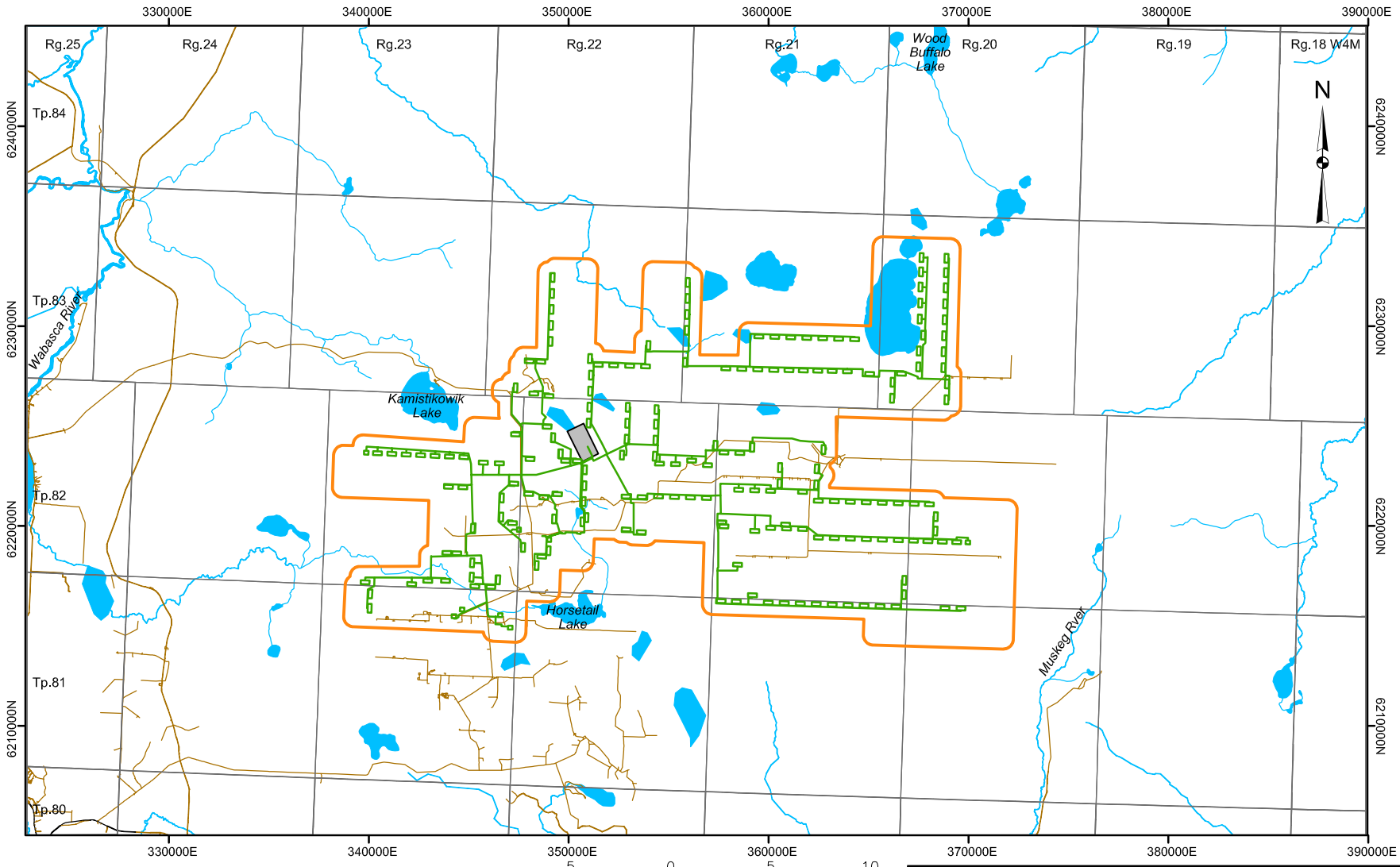


LEGEND

- PLANT SITE
- PROJECT AREA
- PROJECT FOOTPRINT
- OPEN WATER
- UNPAVED ROAD
- WATERCOURSE

SCALE 5 0 5 10 KILOMETRES

REFERENCE

ALBERTA DIGITAL DATA OBTAINED FROM ALTALIS LTD. (SEPTEMBER 2004.)
OTHER ALBERTA BASE DATA OBTAINED FROM IHS ENERGY INC. USED UNDER LICENSE. DATUM: NAD83 PROJECTION: UTM ZONE 12

PROJECT

cenovus ENERGY

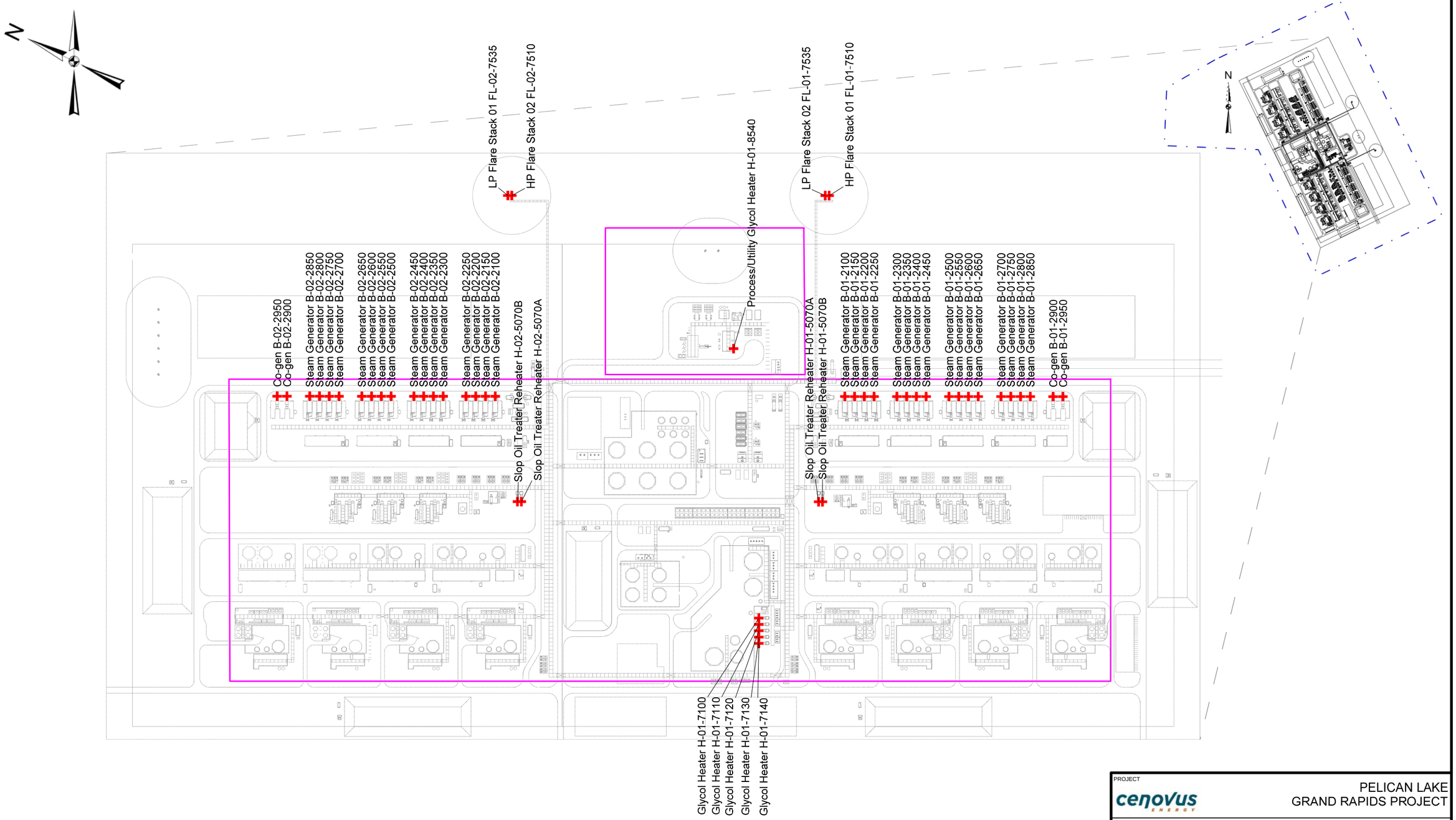
PELICAN LAKE
GRAND RAPIDS PROJECT

TITLE

PROJECT AREA AND PROJECT FOOTPRINT

Golder Associates
Calgary, Alberta

PROJECT	10.1346.0006.5000		FILE No.	10134600065000A006	
DESIGN	KM	22 Nov. 2011	SCALE	AS SHOWN	REV. 0
CADD	KJM	24 Nov. 2011	FIGURE: B.6-1		
CHECK	KM	02 DEC. 2011			
REVIEW	DB	02 DEC. 2011			



REFERENCE
IMAGE PROJECTED TO UTM ZONE 12, DATUM: NAD83
TAKEN FROM: PLGR1-44-SK-00-001 04
REV 0 11/06/14

LEGEND
- AREA SOURCE
- PLANT SITE BOUNDARY
- POINT SOURCE

25 0 25
SCALE METRES

PROJECT
cenovus ENERGY
PELICAN LAKE
GRAND RAPIDS PROJECT

TITLE
PLOT PLAN

Golder Associates
Calgary, Alberta

PROJECT	10-1346-0006-8000		FILE No.	10-1346-0006-8000
DESIGN	GT	22 Sep. 2011	SCALE AS SHOWN	REV. 0
AIR	GT	12 Oct. 2011		
CHECK	KM	27 Nov. 2011	**FIGURE: B.7-1**	
REVIEW	DB	27 Nov. 2011		

R:/Active/_2010/1346/10-1346-0006 - Cenovus Pelican Lake/8000_Air/8020_EIA/6_Reporting/Figures/emission_src_final_Figure_1.srf

C. NATURE OF ACTIVITY

C.1 CLASSIFICATION OF FACILITY

Cenovus is applying for regulatory approval to construct, operate and reclaim the Project. Under the *Activities Designation Regulation (AR 276/2003)*, the Project is listed in Schedule 1, and therefore is designated as an activity for which an approval is required.

The Project is also a mandatory activity described in Schedule 1 of the *Environmental Assessment (Mandatory and Exempted Activities) Regulation (AR 111/93)* and thus the preparation of an Environmental Impact Assessment (EIA) is required. Cenovus received formal notice from Alberta Environment (AENV) that an EIA is required.

In June 2011, Cenovus publicly disclosed the Project and made the proposed Terms of Reference (TOR) for the EIA available for review. A final TOR was issued on August 24, 2011 and has been included as part of this application (Volume 2, Appendix 2-I).

C.2 GENERAL PURPOSE

The Project is expected to include construction of the following:

- the central processing site to be constructed in phases will include:
  - oil treatment facilities with a nominal capacity of 180,000 bbl/d (28,600 m^3/d);
  - steam production facilities with up to 36 steam generators, of which four are co-generation; and
  - water treatment facilities.
- an estimated number of five initial well pads and 100 initial well pairs will be operating within 12 months of operations start up;
- an estimated total of 200 well pads supporting up to 3,700 well pairs over the life of the Project;
- roads and pipelines required to operate the wells and transport the oil to the central processing site; and
- up to six disposal wells.

The proposed Project will require other related infrastructure projects including electrical power lines, fuel gas pipelines, oil transportation pipelines and diluent/condensate supply pipelines. These related infrastructure projects will be applied for separately, as appropriate.

C.3 MAJOR UNIT OPERATIONS

C.3.1.1 SAGD Major Unit Operations

Cenovus intends to construct the Pelican Lake Grand Rapids Project (the Project). It is intended to be constructed in three phases, each designed for a nominal bitumen production of 60,000 bbl/d.

The Project facilities are built to produce a maximum dry steam rate of 89,532 m^3/d for injection. This requires the installation of 32 Once-Through Steam Generators (OTSG), and 4 Heat Recovery Steam Generators (HRSG – 14 MW cogeneration/unit). A Second Stage OTSG scheme is used to recover a portion of the blowdown. The facility has a fixed maximum steam rate based on the number of steam generators available, while the maximum bitumen production rate depends on the actual dry Steam-Oil Ratio (SOR) achieved. The bitumen is blended with diluent to facilitate treating and pipeline transportation.

The Project is designed to use produced water from the Grand Rapids 'A' Member as make-up water. Make-up water is required as losses result from boiler blowdown, ion exchange wastes and intermittently during start-ups and upsets. Throughout this process narrative, excess water management is described using disposal operations. Cenovus is evaluating the opportunity to reduce the volume of disposed water and instead use the excess water produced in the Grand Rapids 'A' in-situ operations to support the water needs for the existing Pelican Lake Wabiskaw Operations. This is further described in Volume 1, Section 4.1.2 The Grand Rapids 'A' Aquifer Model.

All produced gas from the wells is used as fuel gas and burned in the OTSG and HRSG respectively. The produced gas contains H_2S and is sweetened as required to reduce the H_2S content before combustion.

Cenovus has gained significant experience in Steam-Assisted Gravity Drainage (SAGD) production from its Christina Lake and Foster Creek facilities. Most of the equipment for the Project is sized based on proven results at Christina Lake and Foster Creek. The design of the Project incorporates this experience as well as technological developments that have occurred since the design of these past

projects. These design changes will result in a facility with lower costs, higher reliability and better operability.

A reference plot plan is provided in PLGR1-44-SK-00-001-01, PLGR1-44-SK-00-001-02 and PLGR1-44-SK-00-001-03 in Volume 1, Appendix 1-VII. A reference block flow diagram is provided in PLGR1-42-BFD-00-000-01 in Volume 1, Appendix 1-VIII. A reference equipment list is provided in PLGR1-43-EQL-00-001-03 in Volume 1, Appendix 1-VII.

C.4 PROJECT SCHEDULE

The Project timeline depends on regulatory approvals, market conditions and company approval. Assuming company approval to proceed, construction is expected to last for up to 10 years followed by an operational life of up to 40 years.

Commissioning for each phase will occur upon construction completion. This proposed schedule has been assumed for the purpose of the application and supporting Environmental Impact Assessment (EIA). The proposed schedule for the Project, which consists of three phases utilizing 36 OTSGs of which 4 are co-generation, is shown in Table C.4-1.

Table C.4-1 Pelican Lake Grand Rapids Project Schedule

Activity	Phase A	Phase B	Phase C
Public Consultation	Ongoing	Ongoing	Ongoing
Project Application Submission	Q4 2011	Q4 2011	Q4 2011
Regulatory Approval	Q1 2014[(a)]	Q1 2014[(a)]	Q1 2014[(a)]
Start Field Construction	2014[(a)]	2017[(a)]	2020[(a)]
Commissioning/Start-Up (First Steam)	2017[(a)]	2021[(a)]	2024[(a)]
Decommissioning Start*	2050[(a)]	2050[(a)]	2050[(a)]
Reclamation Start*	2052[(a)]	2052[(a)]	2052[(a)]

[(a)] Target dates based on conceptual schedule.

(*) Central Processing Facility site will be decommissioned and reclaimed at end of project life; well pads will be decommissioned and reclaimed throughout project life.

C.5 PLANT DIAGRAMS

The detailed plot plan is provided in Volume 1, Appendix 1-VII.

C.6 PROCESS FLOW DIAGRAM

Process flow diagrams are provided in Volume 1, Appendix 1-IX. Descriptions of the SAGD processes are provided in Volume 1, Section 4.3.

C.7 UNITS AND MATERIAL BALANCE FLOW SHEET

A detailed equipment list is provided in Volume 1, Appendix 1-VII. Block flow diagrams are provided in Volume 1, Appendix 1-VIII.

C.8 WASTEWATER DISCHARGES AND AIR EMISSIONS

Cenovus proposes to dispose of wastewater into the Paleozoic Carbonates. Multiple porous, saline aquifers are available within the Wabamun, Winterburn and Woodbend groups. Hydraulic isolation and fluid compatibility will be evaluated to determine the most suitable zone(s) for disposal.

Up to four water disposal wells located at the proposed Central Processing Facility (CPF) in Township 82, Range 22 W4M will be required over the Project life. The number and location of wells on the CPF site will be optimized as appropriate so that ground disturbance to the area is minimized. The disposal area on the CPF site is located in section 2-32-82-22 W4M.

During Project operations, the annual average quantity of water disposed will be up to 5,840 m^3/d (with 455 m^3/d comprising regeneration waste disposal).

The water disposal wells will be applied for through regular licensing processes, and the appropriate regulatory bodies and stakeholders will be contacted and consulted for approval as per the normal drilling process.

The sulphur dioxide (SO_2), dioxide nitrogen (NO_X), carbon monoxide (CO), Particulate Matter ($PM_{2.5}$), Volatile Organic Compound (VOC) and Total Reduced Sulphur (TRS) emission rates from the Project are summarized in Table C.8-1. The emissions presented include both stream-day and calendar-day SO_2 emission rates. The SO_2 emission rates during normal operations are often referred to as “stream-day” emissions, when all pollution control and facility processes are on-stream and in operation. The average annual SO_2 release rates are often referred to as “calendar-day” rates and are determined by dividing the annual SO_2 emission rate from the facility by 365 days (Volume 3, Sections 1.8 and 1.9).

Table C.8-1 Summary of Project Emissions

Source	Emission Rates[a] [t/d]						
	SO_2[b] [t/sd]	SO_2[c] [t/cd]	NO_X	CO	$PM_{2.5}$	VOC	TRS
Plant Site							
Steam Generator (B-01-2100)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2150)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2200)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2250)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2300)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2350)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2400)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2450)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2500)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2550)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2600)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2650)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2700)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2750)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2800)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-01-2850)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2100)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2150)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2200)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2250)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2300)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2350)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2400)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2450)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2500)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2550)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2600)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2650)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2700)	0.061	0.062	0.324	1.014	0.026	0.019	—

Table C.8-1 Summary of Project Emissions (continued)

Source	Emission Rates[a] [t/d]						
	SO_2[b] [t/sd]	SO_2[c] [t/cd]	NO_X	CO	$PM_{2.5}$	VOC	TRS
Steam Generator (B-02-2750)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2800)	0.061	0.062	0.324	1.014	0.026	0.019	—
Steam Generator (B-02-2850)	0.061	0.062	0.324	1.014	0.026	0.019	—
Cogen (KGT-01-2900 + B-01-2900)	0.014	0.014	0.316	0.386	0.018	0.008	—
Cogen (KGT-01-2950 + B-01-2950)	0.014	0.014	0.316	0.386	0.018	0.008	—
Cogen (KGT-02-2900 + B-02-2900)	0.014	0.014	0.316	0.386	0.018	0.008	—
Cogen (KGT-02-2950 + B-02-2950)	0.014	0.014	0.316	0.386	0.018	0.008	—
Glycol Heater (H-01-7100)	—	—	0.026	0.126	0.003	0.002	—
Glycol Heater (H-01-7110)	—	—	0.026	0.126	0.003	0.002	—
Glycol Heater (H-01-7120)	—	—	0.026	0.126	0.003	0.002	—
Glycol Heater (H-01-7130)	—	—	0.026	0.126	0.003	0.002	—
Glycol Heater (H-01-7140)	—	—	0.026	0.126	0.003	0.002	—
Slop Oil Treater Reheater (H-01-5070A/B)	—	—	0.007	0.036	0.001	0.001	—
Slop Oil Treater Reheater (H-02-5070A/B)	—	—	0.007	0.036	0.001	0.001	—
GPF-Process Glycol Heater (H-01-8540)	—	—	0.028	0.135	0.003	0.003	—
Total Plant Fugitives	—	—	—	—	—	0.004	0.051
Production Well Pads							
Fuel Gas Heater (H-9300)[d]	—	—	0.159	0.473	0.012	0.009	—
Total	**1.996**	**2.056**	**11.982**	**35.303**	**0.939**	**0.664**	**0.051**

[a] Emission rates are expressed in tonnes per day (t/d).

[b] Emission rates are expressed in tonnes per stream-day (t/sd).

[c] Emission rates are expressed in tonnes per calendar-day (t/cd).

[d] Emissions from a total of 197 production well pads were included in the air quality assessment.

— = Not applicable.

Note: The emissions presented in the above table have been rounded to three decimal places. Therefore, the totals may not appear to equal the sum of individual values.

C.9 CONTRIBUTING COMPONENT STREAMS

Further information on air quality, including release volumes, concentrations and characteristics of component streams is provided in the Air Quality Assessment (Volume 3, Section 1).

C.10 COOLING SYSTEM

A 60/40% (by weight) solution of tri-ethylene glycol/water is used as a heat transfer media for both process cooling and utility heating loads such as those listed below:

- Process Heat Exchangers (sales oil cooling, produced water cooling, slop oil treating system cooling, steam blowdown cooling, fuel gas heating, brackish water heating, diluent heating, slop oil heating);
- building heaters;
- tank heaters;
- heat tracing;
- combustion air heaters; and
- air make-up units.

Additional information on cooling systems is provided in Volume 1, Section 5.6.4 under the heading Plant Glycol System.

C.11 RAW WATER

Cenovus strives to maximize the efficient use of water in each of our in-situ projects. For example, water is necessary to our operations and plays an important part in many of the processes, such as creating steam, required to produce oil. Depending on the specifics of the particular project, combined with the hydrogeological setting, actual source(s) for industrial purposes, steam make-up water and waste water disposal are determined. The Project will be compliant with current ERCB water use requirements by recycling more than 90% of produced water (ERCB 2009). This produced water is cleaned and softened as described in Volume 1, Section 5.6.6 for re-use in the steam generators. Because there will be an excess of produced water (i.e., produced water will exceed make-up water requirements), the plant will use produced water to replace the water imbalance due to boiler blowdown disposal and water treatment regeneration waste streams.

Cenovus's source water management approach is to use produced water from the Grand Rapids 'A' lean zone, which directly overlies the bitumen zone, for make-up water. This approach has several advantages. First, use of produced water means that it will not be necessary to divert groundwater from any other aquifer. Although non-saline (Total Dissolved Solid [TDS] is in the range of 1,100 mg/L to 1,200 mg/L), groundwater from the lean zone may contain trace levels of organic compounds (e.g., petroleum hydrocarbons and polycyclic aromatic hydrocarbons) and would require treatment if used for human consumption. Second, Cenovus is evaluating the feasibility of excess produced water from the Project for use as make-up water for Cenovus's Pelican Lake Wabiskaw Operation. In the *Water Conservation and Allocation Guideline for Oilfield Injection* (AENV 2006), produced water is listed as one of the alternate water sources to offset or replace strictly non-saline make-up water. By using excess produced water from the Pelican Lake Grand Rapids Project for the Pelican Lake Wabiskaw Operations, groundwater withdrawals from the present non-saline source (e.g., Grand Rapids 'B' aquifer) will be positively affected. Wastewater from the Project will be injected into one of the saline Paleozoic Carbonates.

Cenovus retained Westwater Environmental Ltd. (Westwater) to conduct a hydrogeological effect assessment of the water supply and wastewater disposal strategy. As part of this assessment, Westwater developed a groundwater flow model that extends over an area between Townships 74 to 90 and Ranges 14 W4M to Range 5 W5M. This area includes leases owned by Canadian Natural Resources Limited, Husky Energy Inc. (Saleski and McMullen), Laricina Energy Ltd., and BlackPearl Resources Inc., as well as Cenovus. Hydrogeological data were provided by all five industry operators and these data were incorporated into the model development and calibration process. This model will be used for water source management for the Project.

Additional details on water management are provided in Volume 1, Section 6.

C.12 SANITARY WASTE TREATMENT AND DISPOSAL

All off-site waste disposal and recycling will be completed at an approved facility for the designated waste types. Off-site destination of each waste type is described in Volume 1, Section 8, Table 8.5-1.

Most of the solid waste streams generated by the Project will need to be transported off-site to an approved third-party landfill or approved waste management facility.

Disposal wells are planned for the Project. These wells will be used for the disposal of waste fluid streams, provided appropriate criteria are met.

The Project facility will use both first stage OTSGs and second stage OTSGs. The second stage OTSG scheme will use boiler blowdown water from the first stage OTSG scheme for feedwater, greatly reducing blowdown disposal volumes.

The Project will employ on-site domestic wastewater treatment similar to that in use in other areas such as our Christina Lake Thermal Project.

C.13 ENVIRONMENTAL CONTROLS

Segregation and interim storage are key elements to Cenovus's waste management strategy. By properly segregating and storing waste, the possibilities for waste reuse and recycling are maximized, while the possibility of cross-contamination is minimized. Waste segregation also allows for reduction of waste handling, treatment and disposal costs. Separate and appropriate containers will be located at all points of waste generation for immediate sorting of waste types.

The Project will have infrastructure in place for waste collection and storage before transportation, treatment and recycling/disposal. Any construction during the new phase may require temporary waste and recyclables storage sites and containers. Separate and appropriate containers will be located at all points of waste generation for immediate sorting of waste types at these sites.

Waste types will be sorted according to their:

- waste classification (i.e., storing hazardous and non-hazardous waste separately), as above;
- compatibility characteristics (chemical, biological and physical); and
- final destination (i.e., recyclable materials will be stored separately from waste intended for disposal).

The three key containment methods employed by the Project and their associated requirements include the following:

- Primary Containment – maintain the integrity of all primary containment devices for waste, including all associated equipment such as valves, fittings, piping and pumps.
- Secondary Containment – use waste storage and transportation containers that prevent leaks. Containment could include leak detection and weather protection for storage facilities. Secondary containment will be provided for all oilfield wastes, excluding domestic garbage and debris.
- Pond – The Project will have an industrial runoff pond/surface water runoff situated on the facility lease site. Integrity of the pond will be maintained through the development of procedures, maintenance practices and inspection programs, and regulatory reporting.

C.14 STORAGE TANKS AND

The list of storage tanks is provided in the Equipment List in Volume 1, Appendix 1-VII. Volume 1, Section 5 outlines the facilities for the SAGD Project.

C.15 STORAGE TANK TESTING AND INSPECTIONS

Environmental controls are outlined in Section C-13.

C.16 POTABLE WATER

It is anticipated that a new fresh water supply for domestic and utility use will be required for the Project. Up to two new utility wells will be located near the new plant site in NE-29-82-22 W4M at an expected rate of approximately 80 m^3/d. Drilling, testing, reporting and licensing activities would all be carried out before developing the actual fresh water supply as per AENV requirements. The fresh water supply for the existing camp supporting the Pelican Lake Wabiskaw Operations is located at NE-07-82-22 W4M.

C.17 RECIPROCATING OR TURBINE ENGINES

Two casing gas booster compressor turbines will be installed at each well pad. The turbines will burn natural gas. One of two casing gas booster compressors will be used during normal operations, and the other compressor will serve as a back-up unit.

Air emission sources are listed in Section C-8. Additional information on emission sources is provided in Volume 3, Appendix 3-I.

C.18 PLOT PLAN

The detailed plot plan is provided in Volume 1, Appendix 1-VII.

C.19 COMPRESSOR BUILDING

Not applicable.

C.20 HEATERS, TREATERS AND BOILERS

The Project has incorporated compliance with the relevant provincial and federal emissions guidelines in the design of the process and selection of equipment. Air quality management initiatives for the Project include the following:

- The steam generators and heaters at the Project will use low oxides of nitrogen (NO_x) burners and will be in compliance with Canadian Council of Ministers of the Environment (CCME) *National Emission Guidelines for Commercial/Industrial Boilers and Heaters* (CCME 1998), where applicable.
- Sulphur recovery equipment will be installed as part of the Project to minimize sulphur dioxide (SO_2) and acidifying emissions. Equipment will be designed to meet ERCB *Sulphur Recovery Guidelines for the Province of Alberta* (EUB ID 2001-3; EUB 2001).
- Oxides of nitrogen (NO_X) from the cogeneration units will be limited following both the *Alberta Air Emission Standards for Electricity Generation* (AENV 2005) and the *CCME National Emission Guidelines for Stationary Combustion Turbines* (CCME 1992).
- Flaring will be minimized for the Project (e.g., upset/emergency conditions, start-up and commissioning). Equipment and systems will be designed to meet ERCB *Directive 060: Upstream Petroleum Industry Flaring, Incinerating and Venting* (EUB 2006).
- Above-ground storage tanks will conform to *Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Above Ground Storage Tanks* (CCME 1995).
- A vapour recovery system will be installed to recover produced gas from the slop oil treater system and tanks.

- The Project will establish a fugitive emissions management plan to identify and manage fugitive emissions sources (EUB 2006).

Air emission sources are listed in Section C-8. Additional information on emission sources is provided in Volume 3, Appendix 3-I.

C.21 AUXILIARY OR STANDBY PROCESS EQUIPMENT

Air emission sources are listed in Section C-8. Additional information on emission sources is provided in Volume 3, Appendix 3-I.

C.22 FLARE STACKS

Two flare systems, each consisting of a high-pressure and a low-pressure stack, will be operated at the CPF. All flaring upset scenarios at the CPF are discrete events and no continuous flaring will occur at the Project.

Air emission sources are listed in Section C-8. Additional information on emission sources is provided in Volume 3, Appendix 3-I.

C.23 FLARE PITS

Not applicable.

C.24 INACTIVE FLARE PITS

Not applicable.

C.25 EMERGENCY FLARING SCENARIOS

Four upset scenarios were included as part of the air quality assessment for the Project. These scenarios are as follows:

- Upset Scenario 1: Upset Scenario 1 – Free-Water Knock-Out (FWKO) and Two Treaters Fire: A FWKO and two treaters, which are located in a confined area within the same building, have a fire causing all three vessels' pressure safety valves to release. The vented gases are sent to the high-pressure (HP) flare stack. This upset event is expected to last up to 15 minutes and could occur once every 30 years.

- Upset Scenario 2: Acid Gas Compressor Outage: An outage of equipment on the compressor unit would cause acid gases, which normally flow to the unit, to be bypassed directly to the low-pressure (LP) flare stack. During this upset scenario, the facility continues to operate on mixed fuel gas comprised of sweetened produced gas and natural gas and the 32 Once-Through Steam Generators (OTSG) and the duct burners for the four co-generation (co-gen) units are emitting SO_2. This upset event is anticipated to occur twice per year and to last up to four hours.
- Upset Scenario 3: Blocked Acid Gas Compressor Outlet: A blockage on the first stage outlet of the unit would cause the pressure safety valves valve to vent, flashing acid gases directly to the HP flare stack. The estimated duration of this event is five minutes, occurring once per year.
- Upset Scenario 4: Amine Unit Outage: Equipment outages on the Amine Unit causes produced gas that normally flows to the unit to bypass the unit and route directly to the HP flare stack. During this upset scenario, the facility continues to operate on mixed fuel gas comprised of sweetened produced gas and natural gas and the 32 OTSG and the duct burners for the four co-gen units are emitting SO_2. This upset event is expected to occur for four hours, four times per year.

Regional sources were not included in the modelling because the upset scenarios are short-term events. Facility sources such as steam generators and Heat Recovery Steam Generators (HRSGs) were included in Upset Scenarios 2 and 4, in which the facility continues to operate on mixed fuel gas during these upset scenarios.

Details on the upset scenarios are provided in Volume 3, Appendix 3-II.

C.26 SOLID WASTE INCINERATION

Not applicable.

C.27 NO_2 DISPERSION MODELLING

The maximum 1-hour and annual nitrogen dioxide (NO_2) predictions within the Regional Study Area (RSA) (outside the plant site boundary) were 91.4 and 3.8 µg/m³, respectively. Within the Local Study Area (LSA) (outside the plant site boundary), the maximum 1-hour and annual NO_2 concentrations were predicted to be 69.7 and 2.7 µg/m³, respectively. In both the LSA and RSA, the predicted

NO_2 concentrations for both averaging times were below the Alberta Ambient Air Quality Objective (AAAQO; AENV 2009b) (Volume 3, Section 1.6.2).

C.28 SO_2 DISPERSION MODELLING

The maximum 1-hour, 24-hour, 30-day and annual ground-level SO_2 concentrations in the RSA (outside the plant site boundary) were predicted to be 45.8, 15.9, 3.9 and 1.7 µg/m³, respectively. Within the LSA (outside the plant site boundary), the maximum 1-hour, 24-hour, 30-day and annual SO_2 concentrations were predicted to be 29.0, 10.1, 1.8 and 1.0 µg/m³, respectively. In both the LSA and RSA, the predicted SO_2 concentrations for all averaging times were below the AAAQO (Volume 3, Section 1.6.2).

Additional details on dispersion modelling are provided in the Air Quality assessment (Volume 3, Section 1).

D. ENERGY RESOURCES CONSERVATION BOARD APPROVAL

D.1 DATE OF APPROVAL

Not applicable.

D.2 ERCB APPROVAL NUMBER

Not applicable.

E. ENVIRONMENTAL SCREENING PROCESS

E.1 REQUIREMENT FOR ENVIRONMENTAL IMPACT ASSESSMENT

Under the *Activities Designation Regulation (AR 276/2003)*, the Project is listed in Schedule 1, and therefore is designated as an activity for which an approval is required.

The Project is also a mandatory activity described in Schedule 1 of the *Environmental Assessment (Mandatory and Exempted Activities) Regulation (AR 111/93)* and thus the preparation of an Environmental Impact Assessment (EIA) is required. Cenovus received formal notice from Alberta Environment (AENV) that an EIA is required.

In June 2011, Cenovus publicly disclosed the Project and made the proposed Terms of Reference (TOR) for the EIA available for review. A final TOR was issued on August 24, 2011 and has been included as part of this application (Volume 2, Appendix 2-I).

This application is supported by an EIA (Volumes 2 to 6).

E.2 DATE OF SUBMISSION

The EIA submission date is December 2011 and is provided as part of this joint application to Alberta Environment and Water and the Energy Resources Conservation Board.

F. COPIES OF EXISTING APPROVALS

F.1 EXISTING APPROVALS

Not applicable.

G. ACTIVITY TIMELINE

G.1 PROJECT CONSTRUCTION AND DURATION

The Project timeline depends on regulatory approvals, market conditions and company approval. Assuming company approval to proceed, construction is expected to last for up to ten years followed by an operational life of up to 40 years.

Commissioning for each phase will occur upon construction completion. This proposed schedule has been assumed for the purpose of the Application and supporting Environmental Impact Assessment (EIA). The proposed schedule for the Project, which consists of three phases utilizing 36 Once Through Steam Generators (OTSGs) of which 4 are co-generation, is provided in Table G.1-1.

Table G.1-1 Pelican Lake Grand Rapids Project Schedule

Activity	Phase A	Phase B	Phase C
Public Consultation	Ongoing	Ongoing	Ongoing
Project Application Submission	Q4 2011	Q4 2011	Q4 2011
Regulatory Approval	Q1 2014[a]	Q1 2014[a]	Q1 2014[a]
Start Field Construction	2014[a]	2017[a]	2020[a]
Commissioning/Start-Up (First Steam)	2017[a]	2021[a]	2024[a]
Decommissioning Start[b]	2050[a]	2050[a]	2050[a]
Reclamation Start	2052[a]	2052[a]	2052[a]

[a] Target dates based on conceptual schedule.

[b] Central Processing Facility site will be decommissioned and reclaimed at end of Project life; well pads will be decommissioned and reclaimed throughout Project life.

H. SUBSTANCE LIST

H.1 SUBSTANCE USED

The list of substances used is provided in Section C.3.

H.2 WATER DEMAND

It is anticipated that a new fresh water supply for domestic and utility use will be required for the Project. Up to two new utility wells will be located near to the new plant site in NE-29-82-22 W4M at an expected rate of approximately 80 m^3/d. Drilling, testing, reporting and licensing activities would all be carried out before developing the actual fresh water supply as per AENV (2011) requirements.

The fresh water supply for the existing camp supporting the Pelican Lake Wabiskaw Operations is located at NE-7-82-22 W4M, and is completed within a Quaternary sand aquifer at a depth of 112.6 m to 116.7 m below ground level. Groundwater quality from the existing camp well is characterized as a mixed-cation bicarbonate-sulphate hydrochemical type with a Total Dissolved Solids (TDS) concentration of approximately 1,200 mg/L. The water supply is treated to manage elevated levels of iron and TDS, as described in Volume 1, Section 6.

H.3 TYPE OF SUBSTANCE(S) RELEASED AND

H.4 AMOUNT OF SUBSTANCE(S) RELEASED

Wastewater release substances and air emissions are listed in Section C.8.

H.5 RELEASE METHOD

Wastewater release sources and air emission sources are listed in Section C.8.

H.6 POLLUTION PREVENTION AND CONTROL

Cenovus's objectives are to reduce waste, prevent soil and groundwater contamination, and mitigate future environmental liabilities.

Waste minimization is encouraged in all operations as a means to achieve efficient business practices. This practice includes the following:

- reduce – eliminate waste types and reduce waste volumes;
- reuse – reuse waste materials where possible;
- recycle – recycle where possible; and
- recover – recover valuable materials from waste streams.

Activities are closely monitored to ensure compliance with environmental regulations and encourage the most effective and efficient use of resources. Cenovus's waste management objectives include:

- comply with industry guidelines/best management practices;
- minimize the amount of waste generated when possible by using a waste management hierarchy;
- accurately characterize and classify all hazardous wastes;
- properly store, track, transport and dispose of wastes;
- ensure contractors operate according to Cenovus standards;
- ensure the integrity of primary containment devices for waste, including all associated equipment such as valves, fittings, piping or pumps;
- provide adequate secondary containment, leak detection and weather protection for waste storage facilities; and
- apply operating procedures, maintenance practices and inspection programs to all waste handling and storage facilities.

All federal, provincial and municipal regulatory requirements regarding waste and wastewater management are adhered to and in part form the basis of Cenovus's waste management strategy. For projects in Alberta the provincial regulations, guidelines and standards provide the most extensive requirements, criteria and recommendations. The main regulatory agencies involved with administering the provincial regulations are the ERCB and AENV.

H.7 INDUSTRIAL RUNOFF VOLUME

The Project will have an industrial runoff pond situated on the facility lease site. Integrity of the pond will be maintained through the development of procedures, maintenance practices and inspection programs, and regulatory reporting.

I. SUMMARY OF ENVIRONMENTAL MONITORING REQUIREMENTS

I.1 BASELINE DATA

I.1.1 Existing Air Quality

Air quality or meteorological parameters are not monitored at the Project site and the Project is not located in a monitored airshed (Volume 3, Section 1.5). The closest monitored airsheds are the Wood Buffalo Environmental Association (WBEA), the Lakeland Industry and Community Association (LICA) and the Peace AirShed Zone Association (PASZA). The WBEA, LICA and PASZA are multi-stakeholder, non-profit organizations whose purpose is to provide third-party monitoring and analysis of regional air quality. The monitoring programs are comprised of continuous, passive and mobile air quality monitoring (and are administered jointly by WBEA, LICA, PASZA and AENV).

The Project is located about 50 km west of the WBEA boundary, 115 km east of the PASZA boundary and 160 km northwest of the LICA boundary. The stations in the PASZA and LICA airsheds are far from the Project and hence were not included in the assessment. The WBEA is the closest airshed to the Project and the data from the nearest representative stations are summarized in this section.

The WBEA maintains an ambient air quality monitoring network in the Regional Municipality of Wood Buffalo, including 15 continuous air quality monitoring stations, stretching from Fort Chipewyan in the north to Anzac in the south. One of these 15 stations, the Lower Camp Met Tower, only measures meteorological parameters (i.e., no air quality).

Monitoring data from the Anzac station (the station that is closest and that best represents the Project Area in terms of industry and population) are summarized in this section. The Anzac station is about 155 km east-northeast of the Project and is more representative of rural ambient background concentrations than the slightly closer stations located in Fort McMurray. The Anzac monitoring data are from January 2006 to December 2010 (Clean Air Strategic Alliance Data Warehouse 2011). The station continuously monitors sulphur dioxide (SO_2), oxides of nitrogen (NO_X), nitrogen dioxide (NO_2), ozone (O_3), Total Hydrocarbons (THC), Total Reduced Sulphur (TRS) and particulate matter with a mean aerodynamic diameter of 2.5 microns (µm) or smaller ($PM_{2.5}$).

Passive air quality monitoring systems that collect data each month and provide a one-month average concentration, have been used for many years in the

region to gather long-term air concentration information. Passive monitoring techniques allow for the direct measurement of ambient SO_2, NO_2, hydrogen sulphide (H_2S), O_3 and ammonia (NH_3) concentrations. The passive samples are collected each month and provide one-month average concentrations.

The WBEA currently maintains 34 passive air quality monitoring sites in the region to complement their continuous monitoring stations. The nearest representative passive sites to the Project are the WBEA AH7, AMS14, JPL1 and SM7 stations, which are located about 130 km northeast, 155 km east-northeast, 90 km east-northeast and 115 km southeast of the Project, respectively. The passive monitoring data summarized for the passive sites covers the monitoring period from 2008 to 2010. AMS14 and SM7 did not start recording data until 2008. To make the data comparable for all years presented, data previous to 2008 were not used.

Other passive sites that are about 115 km from the Project such as MK1, MK2, MK3 and MK4 are next to other industrial sites and hence are not representative of rural ambient background concentrations at the Project.

I.1.1.1 Sulphur Dioxide

The maximum 1-hour, 24-hour and annual SO_2 concentrations of 180.8 µg/m³, 28.1 µg/m³ and 1.9 µg/m³ at Anzac are below the respective AAAQO (AENV 2011b).

The maximum average monthly concentration of 4.7 µg/m³ was recorded at the AH7 passive monitoring station and is also below the AAAQO.

I.1.1.2 Nitrogen Dioxide

The primary constituents of NO_X are nitric oxide (NO) and NO_2. Studies have shown that the majority of NO_X emissions are in the form of NO (Angle et al. 1997; Baukal and Eleazer 1998; Cole and Summerhays 1979). Since regulatory guideline levels are only available for NO_2, only a fraction of the emitted NO_X is of primary concern. The maximum 1-hour and annual NO_2 concentrations of 158.1 µg/m³ and 6.3 µg/m³, respectively, are below the AAAQOs. There is no AAAQO for the 24-hour average.

The maximum average monthly NO_2 concentration of 3.6 µg/m³ was recorded at the AH7 passive monitoring station. There is no 30-day AAAQO for NO_2.

I.1.1.3 Hydrogen Sulphide

The Anzac continuous monitoring station and the AH7, AMS14, JPL1 and SM7 passive monitoring stations do not monitor H_2S.

I.1.1.4 Ozone

The monitoring indicates that only one exceedance of the 1-hour ozone AAAQO has occurred at Anzac over a five-year period. The CCME's Canada-Wide Standard (CWS) of 65 ppb (CCME 2000) was not exceeded over the same period. The 8-hour CWS for O_3 is based on the fourth highest 8–hour reading annually, averaged over three years.

I.1.1.5 Carbon Monoxide

The Anzac continuous monitoring station does not monitor CO. Passive monitoring of CO was not conducted in the region as this type of monitoring is not technically feasible.

I.1.1.6 Total Hydrocarbon

The maximum 1-hour, 24-hour and annual Total Hydrocarbon (THC) concentrations at Anzac are 2,492.9, 1,685.7 and 1,362.9 µg/m³, respectively. There are no AAAQOs for THC. Passive monitoring of THC was not conducted in the region as this type of monitoring is not technically feasible.

I.1.1.7 Total Reduced Sulphur

The maximum 1-hour, 24-hour and annual TRS concentrations at Anzac are 53.0, 7.4 and 0.8 µg/m³, respectively. There are no AAAQO for TRS. Passive monitoring of TRS was not conducted in the region as this type of monitoring is not technically feasible.

I.1.1.8 Fine Particulate Matter

The maximum 24-hour $PM_{2.5}$ concentration of 77.0 µg/m³ at Anzac exceeded the 24-hour AAAQO of 30 µg/m³ (AENV 2011b) eight times over the five-year monitoring period. The CWS for $PM_{2.5}$ is 30 µg/m³ and is based on the 98th percentile 24-hour reading annually, averaged over three years (CCME 2000). The 24-hour $PM_{2.5}$ concentration of 13.4 µg/m³ at Anzac based on the 98th percentile averaged over a three-year period (2008 to 2010) meets the CWS.

Passive monitoring of $PM_{2.5}$ was not conducted in the region as this type of monitoring is not technically feasible.

I.2 EXISTING WATER QUALITY

Water quality data from waterbodies and watercourses in the Aquatic Resources Local Study Area (LSA) were summarized to characterize baseline water quality conditions. Detailed analyses of the data are included in the Water Quality Baseline Report (Volume 4, Appendix 4-VI). A summary of baseline water quality is provided in this section.

Water quality samples were collected from within the LSA during the spring, fall and winter of 2010. Additional data from the LSA were obtained from three Regional Aquatics Monitoring Program (RAMP 2010) monitoring sites and two Laricina Energy Ltd. Germain SAGD Pilot Project (Laricina 2009) sites. The Regional Study Area (RSA) data derived from the Alberta Environment WDS database (AENV 2011a) were primarily from the summer and fall and included historical data. Water quality data were summarized, tabulated and compared with available historical and recent data. Water quality samples were analyzed for detailed water chemistry, including conventional parameters, total and dissolved metals, and specific organics. Sediment samples were collected in fall 2010 from the same waterbodies used in the LSA water chemistry evaluations. Sediment samples were analyzed for carbon content, particle size distribution, moisture content, metals and selected organics.

Waterbodies and watercourses in the LSA and RSA were generally characterized by high Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) concentrations. The DOC concentrations were most likely due to elevated concentration of humic matter contributed by peatlands.

With few exceptions, Dissolved Oxygen (DO) and pH values were within water quality guideline ranges in waterbodies and watercourses in the LSA and RSA. The exceptions tended to occur in the winter when gas exchange is limited by ice formation.

With the exception of some sulphide concentrations, major ion concentrations were generally below available guidelines. Nutrient concentrations were variable with waterbodies in the LSA having more instances of guideline exceedances than watercourses. Based on Total Phosphorous (TP) concentrations, trophic status of waterbodies and watercourses in the LSA and RSA displayed a wide range, from oligotrophic/mesotrophic to hypereutrophic.

Metal concentrations were generally below guidelines, with the exception of total iron which often had concentrations above chronic guidelines for the protection of aquatic life and human health. Several instances of total aluminum and total

mercury in waterbodies and watercourses were also found in concentrations above the guideline. In addition, total arsenic, chromium and silver were above guideline values in one or more water samples.

Concentrations of organic compounds were usually below detection limits; however, summer concentrations of total phenolics were often greater than the aquatic life guideline. These elevated concentrations can be attributed to natural factors and do not indicate that water quality has been compromised.

The sand fraction dominated in most watercourse sediments. With few exceptions, metal and Polycyclic Aromatic Hydrocarbons (PAH) concentrations in sediments were within guidelines. Total recoverable hydrocarbon (i.e., mineral oil and grease) concentrations were almost always below detection limits. A large portion of the organic matter in sediment in LSA waterbodies appeared linked to long-chain (16 to 50 carbon units) hydrocarbons.

Some seasonal variability was observed in water samples. Concentrations of DO were generally higher during the open-water seasons and lowest in winter under ice. The DOC and TDS concentrations tended to be highest in the winter, likely reflecting the influence of ice cover as well as a greater contribution of groundwater to surface water flows, compared to the open-water seasons. In watercourses, the concentration of TSS and associated parameters (i.e., nutrients, metals) were generally highest in the winter and lower in other seasons.

I.3 MONITORING INFORMATION

I.3.1 Groundwater Monitoring Programs

The groundwater monitoring programs for the Project will be designed to validate the predictions from the effects assessments. The programs will be flexible so that adjustments can be made as new information becomes available.

Plant Site Monitoring Program

The Central Processing Facility (CPF) will be developed in three phases. Shallow groundwater monitoring will be carried out at the plant site to allow early detection of an effect on groundwater quality. The monitoring program will include the installation of groundwater monitoring wells, the monitoring of the water levels in the wells and the collection of groundwater samples for chemical analysis. A comprehensive proposal for the monitoring program will be submitted to AENV following Project approval.

Groundwater Withdrawal Monitoring Program

Cenovus will manage groundwater withdrawal from the Grand Rapids 'A' aquifer as per the terms and conditions of the licences to be issued under the *Water Act*. The groundwater withdrawal monitoring program will include:

- monitoring the water levels in the water source wells on a regular (e.g., hourly) basis;
- monitoring groundwater production (flow rates and volumes) from the wells on a regular (e.g., daily) basis; and
- collecting groundwater samples from the wells for chemical analysis on a regular (e.g., quarterly) basis.

Results of the monitoring program will be provided to AENV using AENV's Water Use Reporting System and in any annual groundwater monitoring report issued during the temporary time period when groundwater is being diverted as make-up water for steam generation.

Monitoring and reporting for the groundwater withdrawal from the Quaternary aquifer for utility purposes will also be undertaken according to the terms and conditions of the *Water Act* licence.

Well Pad Monitoring Program

Shallow groundwater monitoring will be carried out at select well pads for the purposes of assessing groundwater temperature and chemical quality. The monitoring program will include the installation of groundwater monitoring wells, the monitoring of the water levels in the wells and the collection of groundwater samples for chemical analysis. The program will include the collection of samples from watercourses or waterbodies located in close proximity to a well pad where warranted. A proposal for the monitoring program will be included with the proposal document for the plant site monitoring program.

Potential changes in groundwater quality due to thermal effects have been identified as a potential concern. A monitoring program to address this concern will be designed and implemented. The program, which will be developed in consultation with AENV, will document pre-development conditions and monitor potential changes in temperature and groundwater quality. If the monitoring results indicate that effects to groundwater quality are approaching established targets, a groundwater response plan will be initiated.

Non-saline Groundwater in Direct Contact with Bitumen Monitoring Program

The Grand Rapids 'A' lean zone is a non-saline aquifer directly overlying the bitumen reservoir. The Grand Rapids 'B' aquifer underlies a shale unit that separates this aquifer from the reservoir. Due to the non-saline characteristics of these two aquifers, the requirements specified in the draft "Guidelines for the Assessment and Management of Non-saline Groundwater in Direct Contact with Bitumen for In Situ Oil Sands Operations" (AENV 2009) are applicable.

A proposed groundwater monitoring program was submitted to AENV for the SAGD Well Pair Test Project that addresses the requirements in the draft guidelines (Westwater 2011). The proposed program was accepted and it is currently underway in accordance with Section 4.5 of Approval No. 269241-00-00. A proposal to expand the program for the Project will be submitted to AENV once Project approval has been issued.

Additional groundwater monitoring wells will be installed in subsequent phases of project development and/or as warranted.

Groundwater Response Plan

A groundwater response plan will be included in the monitoring program proposal for the plant site and well pad monitoring programs. The groundwater response plan will be implemented in the event an unexpected change in the temperature or chemical quality of the groundwater in a monitoring well is detected. The response plan will include the following actions:

- re-sampling the monitoring well at which the change in temperature or chemical quality was identified to confirm a change has occurred;
- for the plant site program, determining the source of the change and implementing mitigation measures to minimize or halt further effects; and
- determining the magnitude and likely extent of the effect and taking appropriate actions involving remediation, risk assessment, and/or risk management.

The remediation option most appropriate for an adverse effect will depend on the depth and extent of the affected groundwater, the types of surface and geologic materials in the affected zone, the complexity of the situation, and the type of chemical. Remediation options could include soil excavation, recovery trenches, recovery wells and monitored natural attenuation. The selected option would be

based on technical applicability. The remediation program would be modified or expanded as necessary as remediation proceeds.

I.3.2 Surface Water Monitoring Programs

Surface Disturbances

An integral part of Project operations will be the development of a surface water monitoring program that includes remedial maintenance and adaptive management practices undertaken and the timing and locations of these activities. This program will continue until Project decommissioning and will include the following activities:

- Regular monitoring of the stormwater ponds to confirm adequate storage capacity is available to mitigate uncontrolled releases from the plant sites and well pad drainage systems. The downstream drainage path from the slow release lines will also be inspected annually to confirm that the terrain is absorbing the water with no apparent vegetation stress and that no downstream channel development or erosion is occurring.
- If required, culvert installations at road crossings and wetlands areas will be monitored regularly, particularly during or following high runoff periods. Excessive sedimentation, debris or ice accumulation will be removed to maintain the flow capacity of the culvert. Screens or other deterrents may be added to culvert inlets to prevent blockage in areas of potential beaver activity.
- Re-graded areas will be inspected for evidence of erosion or instability, and repaired or stabilized as required. Revegetation efforts will be monitored and maintained to allow growth and survival. Replanting will occur if survival of vegetation is inadequate.
- Drainage courses disturbed during construction will be inspected to confirm that riparian vegetation and stable drainage conditions have been re-established.

Watercourse Crossings

A monitoring program will be implemented so that sediment generation caused by construction and operation of watercourse crossings will be a minimum. The monitoring program will include the following activities:

- If required, culvert operations at road crossings will be monitored, particularly during or following high runoff periods. Excessive sedimentation, debris or ice accumulation will be removed to maintain the flow capacity of the culvert. Screens and other deterrents may be added to culvert inlets to prevent blockage in areas of potential beaver activity.
- Watercourse crossings will be inspected to confirm that properly installed sediment control measures are in place during and following construction.
- Post-construction inspection will be done to verify that affected streambed profiles and bank disturbances have been appropriately reclaimed.

Water Quality

Water quality monitoring will be an integral component of the Project operations. Stormwater ponds will be tested before release to the surrounding environment to verify acceptability of release waters for parameters defined under the EPEA approval for the Project. For example, the EPEA Approval No. 48522-00-09 for the Christina Lake Thermal Project includes sampling for pH, chloride and oil and grease.

Treated domestic wastewaters will be sampled and tested on a regular basis to ensure that the effluent quality is within specified limits for treated wastewater discharge. For example, the current EPEA Approval for the Christina Lake Thermal Project specifies monitoring at a minimum frequency of three times per week and limits of 25 mg/L carbonaceous biochemical oxygen demand and 25 mg/L TSS.

J. PREVIOUS PERFORMANCE OF SUBSTANCE RELEASE CONTROL SYSTEMS

J.1 ENVIRONMENTAL CONTROL SYSTEMS PERFORMANCE

Not applicable.

K. ALTERNATE TECHNOLOGIES, STANDARDS AND POTENTIAL EFFECTS

K.1 ALTERNATE PROCESS AND TECHNOLOGIES

The proposed operational modifications have been designed using the best practical technology, to meet or surpass industry standards and to utilize all relevant or applicable accepted engineering practices. An alternatives analysis is presented in Volume 1, Section 9 and includes details on alternate water locations (the use of the Grosmont Formation), disposal wells locations, water treatment technologies (Grand Rapids 'A' Make-Up Water) and carbon capture considerations (energy efficiency, technology development, credit purchase).

A summary of alternatives considered is provided in Volume 1, Section 9.

L. SURFACE EFFECTS

L.1 WASTE MANAGEMENT SUMMARY

The types and estimated quantities of Project-related waste are listed in Table L.1-1

Table L.1-1 Estimated Waste Types and Expected Quantities

Waste Type	Description	Classification	Storage Location/Method	Disposal Location/Method	Estimated Annual Quantity
Liquids			.		
Caustic solutions	Unneutralized, spent	Hazardous	Store in corrosion-resistant (plastic or lined) containers, separate from acids	Off-site disposal	36 m^3
Crude oil or condensate emulsion	Process "Slop Oil" – oily water with entrained solids	Hazardous (if high oil content, testing required)	Store in production tanks	Off-site disposal	248,690 m^3
Glycol	Glycol solution, may or may not contain heavy metals	Hazardous (if containing heavy metals, testing required)	Store in steel drums on barrel dock or in steel tanks	Recycle/disposal off-site	59 m^3
Chemicals – organic	Miscellaneous organic chemicals	Hazardous	Dependent upon specific chemical	Recycle/disposal off-site	52 m^3
Lubricating oil	Hydrocarbon lubricants and grease	Hazardous	Sealed metal or plastic drums	Recycle off-site	21 m^3
Sweetening agents	Gas sweetening – liquid and/or sludge	Hazardous	Store in tanks or steel drums	Off-site disposal	8,435 m^3
Water treatment regeneration wastewater	From the treatment of source water and produced water	Non-Hazardous (typically but depends on analytics)	On-site storage tank	Disposal well	SAGD 140,000 m^3
Wash fluids - organic	Water/solvents used for equipment washing	Hazardous	Store in tanks or sealed drums, closed and away from sources of heat or ignition	Off-site disposal	1,930 m^3
Water	Produced/brine solutions	Non-Hazardous	Handle within a closed system at facility or store in production or water tanks	Off-site disposal	165 m^3
	Contaminated leachate, collected surface waters	Non-Hazardous	Tank storage or surface storage in diked areas	Off-site disposal	245 m^3
	Wash water (floor wash, equipment wash)	Non-Hazardous (unless High Organic, low flash Point or pH issue)	Usually handled in a closed system	Off-site disposal	4 m^3
Miscellaneous hazardous liquids	Flammable liquids, oxidizing liquids, corrosive liquids	Hazardous	Store as per supplier instructions	Recycle/disposal off-site	72 m^3
Sludges					
Hydrocarbon sludge	From production vessels, tank bottoms, slop oil	Hazardous	Store in designated tanks	Off-site disposal	8,064 m^3
Lime sludge	warm lime softener spent sludge	Non-Hazardous	Store in designated tanks	Off-site disposal	48,191 m^3
Solids					
Construction and demolition material	Debris, solid – wood, insulation, scrap metal	Non-Hazardous	Segregate material types, use scrap metal and domestic waste bins	Off-site disposal	41 m^3

Table L.1-1 Estimated Waste Types and Expected Quantities (continued)

Waste Type	Description	Classification	Storage Location/Method	Disposal Location/Method	Estimated Annual Quantity
Empty containers	Metal or plastic, drums, barrels, pails, gas cylinders and aerosols	Non-Hazardous (empty) Hazardous (not empty)	Store according to suppliers instructions	Send back to supplier; recycle off-site. Place in designated waste bin for pick-up by Waste Management Contractor.	1,066 m^3
Bin wastes	Absorbents	Hazardous (mixed waste bins are shipped as hazardous waste)	Place in designated waste bin for pick-up by Waste Management Contractor	Recycle/disposal off-site	63 m^3
	Rags				99 m^3
	Filters				92 m^3
	Thread protectors				11 m^3
	Domestic waste/debris				1,040 m^3
Filter media	Water treatment filter media	Non-Hazardous (unless BTEX or leachate)	Store in waste filter bin	Off-site disposal	396 m^3
Sand	Produced sand	Non-Hazardous (unless low flashpoint or high BTEX)	Store in lined ponds or tanks/drums	Off-site disposal	3,620 m^3
Contaminated soil and debris	Soil, spill material contaminated with condensate, oil, emulsion, hydrocarbons	Non-Hazardous (unless analytics show low flash point, high BTEX or heavy metals)	Store in sealed drums (if saturated). Store small volumes in contaminated soils bin. Store larger volumes in a secure area with secondary containment and protection from precipitation.	Off-site disposal	1,924 m^3
	Soil, spill material contaminated with salt water/produced water	Non-Hazardous	Store small volumes in contaminated soils bin. Store larger volumes in a secure area with secondary containment and protection from precipitation.	Off-site disposal	448 m^3
	Soil, spill material contaminated with refined fuels or oils	Non-Hazardous (unless low flashpoint or high BTEX or heavy metals)	Store in sealed drums (if saturated). Store small volumes in contaminated soils bin. Store larger volumes in a secure area with secondary containment and protection from precipitation.	Off-site disposal	162 m^3
	Soil, spill material contaminated with pesticides	Hazardous	Store in sealed drums or bins. Store larger volumes in a secure area with secondary containment and protection from precipitation.	Off-site disposal	27 m^3
	Soil, spill material contaminated with chemical/solvent	Hazardous	Store in sealed drums or bins. Store larger volumes in a secure area with secondary containment and protection from precipitation.	Off-site disposal	14 m^3
Other					
Drilling waste	Drilling sump waste	Non-Hazardous	Store drilling waste tank/sump	Off-site disposal	27,437 m^3
	Well work over fluids	Hazardous	Store in production/slop tanks or drums	Off-site disposal	36 m^3
	Cement	Non-Hazardous	Store at low traffic area on subsoil horizon or in sump	Off-site disposal	65 m^3
	Frac sand (non-radioactive)	Non-Hazardous (unless low flash point or leachate characteristics)	Store in steel drums or reinforced plastic bags. Prevent rainwater from entering containers.	Off-site disposal	34 m^3

Table L.1-1 Estimated Waste Types and Expected Quantities (continued)

Waste Type	Description	Classification	Storage Location/Method	Disposal Location/Method	Estimated Annual Quantity
First-aid waste	Waste generated from first-aid/medical treatment (i.e., biomedical waste)	Hazardous: infectious or potentially infectious substances (i.e., gloves, masks) and waste sharps	Place in specified bins or containers	Off-site incineration or disposal	low expected volumes
		Non-Hazardous: waste that is not infectious or potentially infectious	Place in specified bins or containers	Off-site disposal	low expected volumes

L.2 WASTE MINIMIZATION

Waste minimization is encouraged in all operations as a means to achieve efficient business practices. This practice includes the following:

- reduce – eliminate waste types and reduce waste volumes;
- reuse – reuse waste materials where possible;
- recycle – recycle where possible; and
- recover – recover valuable materials from waste streams.

Activities are closely monitored to maintain compliance with environmental regulations and encourage the most effective and efficient use of resources. Cenovus's waste management objectives include:

- comply with industry guidelines/best management practices;
- minimize the amount of waste generated when possible by using a waste management hierarchy;
- accurately characterize and classify all hazardous wastes;
- properly store, track, transport and dispose of wastes;
- ensure contractors operate according to Cenovus standards;
- ensure the integrity of primary containment devices for waste, including all associated equipment such as valves, fittings, piping or pumps;
- provide adequate secondary containment, leak detection and weather protection for waste storage facilities; and
- apply operating procedures, maintenance practices and inspection programs to all waste handling and storage facilities.

Cenovus's current methods for handling drilling waste have the following important environmental benefits:

- smaller environmental footprint;
- on-site sumps reduce emissions, noise and travel of large vehicles;
- on-site sumps reduce the amount of equipment required on-site;
- increased water re-use where possible;
- reduced need for remote cement pits;
- reduced tree knockdown; and
- easier reclamation.

The final disposal method for drilling fluids and solids will be determined on the basis of the analytical results of waste sampling, with environmental concerns given primary consideration.

Waste treatment technology can be used to change the physical, chemical or biological character or composition of the waste to eliminate or reduce its toxicity and/or volume. In most cases, treating waste can make it safer and easier to store, transport and dispose of. Any treatment or technology used will comply with regulatory and project requirements, will be screened and selected based on such requirements and best practices, and will have practices and procedures established before use.

M. SURFACE DISTURBANCE

M.1 EXTENT AND NATURE OF SURFACE DISTURBANCE

Distribution of soil and vegetation disturbances among facility types is summarized in Table M.1-1.

Table M.1-1 Project Components and Disturbance Areas

Project Component	Soil Disturbed [ha]	Vegetation Disturbed [ha]
Plant Site	87	87
Well Pads	431	431
Access Roads	2	2
Road Corridor	63	63
Disposal/Source/Sales Corridor	61	179
Associated Components/Infrastructure[(a)]	76	496
Total	**721**	**1,258**

(a) Associated components and infrastructure includes construction facilities, camp, power line and pipeline corridors and stockpile areas.

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

N. EMERGENCY RESPONSE PLANS

N.1 EMERGENCY RESPONSE PLAN

An Emergency Response Plan (ERP) is developed to a level of detail commensurate with risk. Before the Project construction begins, Cenovus will develop a detailed project-specific ERP consistent with Cenovus's Emergency Preparedness and Response processes. Cenovus is a member in good standing with Western Canadian Spill Services and area spill response and engagement information will be included in the ERP.

O. ENVIRONMENTAL CONTINGENCY PLANS

Cenovus has developed a number of environmental contingency plans, specific to water, production, wildfire, greenhouse gas and waste management, as outlined in Volume 1, Section 8.

P. CONSERVATION AND RECLAMATION PLAN

P.1 PRE-CONSTRUCTION SITE AND SOIL ASSESSMENTS

A conceptual Conservation and Reclamation (C&R) plan is presented in Volume 1, Section 12. Before construction begins, a site-specific Pre-Disturbance Assessment will be submitted to Alberta Sustainable Resource Development (ASRD) and AENV that includes detailed, site-specific C&R Plans.

P.2 CONSERVATION AND RECLAMATION PLAN

Conservation and Reclamation Objectives and Key Activities

The C&R Plan (Volume 1, Section 12) covers the entire Project footprint, including well pads, access roads, pipeline rights-of-way (ROW) and other associated infrastructure. The objective of the C&R Plan is to provide a detailed description of how the Project footprint will be reclaimed to a functional ecosystem with equivalent land capability at the end of the productive life of the Project. The C&R Plan presents measures to mitigate effects during construction and operations, and outlines monitoring programs to assess and adapt mitigation for successful reclamation of the Project footprint.

The end land use objective is to return forest capability and wildlife habitat capability to a level equivalent to the pre-disturbance conditions and to restore ecological functionality to reclaimed areas. Alberta's *Land Use Framework* (GOA 2008), emphasizing cumulative effects management and recognizing different end land use objectives between various user groups, was considered in developing this C&R Plan. Development planning includes efforts to use common corridors and existing disturbances for new facilities, and using revegetation prescriptions for commercial forest species and other land uses for the post-reclamation landscape. Cenovus's adaptive management strategy will allow Cenovus to modify reclamation plans and apply new techniques to meet future targets and thresholds that are established for the Lower Peace Land Use Planning Region.

Environmental protection measures are designed and implemented to address effects from the Project. General and Project-specific environmental protection measures are described in the C&R Plan. These measures will be implemented during Project development to minimize the effects that were identified through the Project Application and EIA process. Mitigation will include progressive reclamation to minimize immediate and cumulative total developed area in use,

and to enhance the early return of suitable wildlife habitat. Final reclamation will be completed as Project facilities are decommissioned and Project components are removed.

Cenovus is committed to conservation of the resources in the Project Area. Minimizing disturbance to only those areas required for successful construction and operation of the Project is a priority. Cenovus proposes to follow the *Conservation and Reclamation Guidelines for Alberta* (AENV 1997) for the Project, including:

- clean-up and remediate chemicals, or dispose of chemicals, to meet AENV requirements;
- re-contour the site to be compatible with the surrounding terrain and target end land uses;
- provide proper drainage and stability, and control erosion;
- not use surface soil for grading purposes;
- correct soil compaction where necessary;
- replace salvaged soils in the same sequence as found in the undisturbed areas, unless otherwise directed by the C&R Inspector;
- where required, use native species or mixtures that will allow the establishment of native species that are compatible with the intended end land use;
- use approved seed mixes for revegetation that are compatible with the intended land uses; and
- manage noxious and prohibited noxious weeds.

Additionally, Cenovus will maintain an active stakeholder consultation and engagement program, including discussions on development and Project reclamation, throughout the various phases of the Project.

Reclamation Guidelines

In addition to following the *Conservation and Reclamation Guidelines for Alberta* (AENV 1997), Cenovus will refer to and comply with all relevant guidelines and regulatory criteria. Cenovus will adapt reclamation plans as guidelines change and will follow the most current guidelines available at the time of reclamation.

Alberta Land Use Framework

Cenovus shares the vision of the Alberta *Land Use Framework* (GOA 2008), through its development, operations, monitoring and reclamation processes. Cenovus's goal is to minimize its development area while managing cumulative effects to air, water, land and biodiversity in the region. Cenovus uses a knowledge based approach to design and adapt its development and reclamation procedures by using traditional knowledge, monitoring results and ongoing research in the industry. The end goal is to establish sustainable, healthy ecosystems that support a variety of end land uses. As the Land Use Framework and the Lower Peace Regional Plan develop, and new knowledge is acquired, Cenovus will work to adapt its operations and reclamation procedures to allow for a process of continual improvement.

Detailed Conservation and Reclamation Plan

The detailed C&R Plan for the Project is included in Volume 1, Section 12. Recommendations from regulators and, where practical, other interested stakeholders will be integrated in the final end land uses for the Project Area. Guidelines from regional multi-stakeholder committees (e.g., CEMA) have also been considered throughout the planning process. When reclamation occurs for a given Project component, Cenovus will consult with Alberta Sustainable Resource Development (ASRD), AENV reclamation staff and relevant stakeholders before starting reclamation activities, to ensure that the most appropriate site-specific reclamation plans are implemented.

This detailed C&R Plan is organized according to the sequence of construction and reclamation activities to be undertaken, including:

- timber salvage;
- vegetation clearing;
- surface soil and subsoil salvage;
- borrow pit construction;
- soil stockpiling;
- constructing on wetlands;
- facility operation, including a surface water management plan;
- facility closure, decommissioning and site contouring;
- soil replacement;
- revegetation; and

- post-reclamation monitoring.

More details can be found in Volume 1, Section 12.

Conservation and Reclamation Monitoring

A C&R monitoring program will be implemented upon completion of reclamation activities on each reclaimed site. The objectives of the monitoring program are to evaluate the success of C&R activities over time and to adjust or modify reclamation practices, where necessary, to achieve reclamation targets and, ultimately, obtain a reclamation certificate. Monitoring will include evaluation of:

- erosion control and slope stability;
- soil quality;
- revegetation and ecosystem development on reclaimed areas;
- effectiveness of noxious and restricted weed control;
- return of equivalent land capability for forestry; and
- re-establishment of wildlife habitat.

The reclamation objectives will be met through:

- regular site inspections;
- implementation of additional reclamation procedures (e.g., direct seeding where natural regeneration is not meeting expectations);
- evaluation of the monitoring program results over time for individual reclaimed areas and the Project area in general;
- use of best practices; and
- program adaptation from key learnings from industry peers and new reclamation information applicable to boreal forest areas.

Where practical, Cenovus will integrate the Project monitoring programs into established monitoring programs for other Cenovus interests in the area. Cenovus supports the long-term, large-scale monitoring of a wide range of taxa to measure changes in relative wildlife abundance and will support and collaborate with other developers in the area to expand monitoring programs.

Cenovus will include wildlife mitigation and monitoring programs (includes biodiversity) as components of its C&R monitoring activities. Monitoring wildlife

use of both natural and reclaimed areas within the Local Study Area will provide information on the success of re-establishing wildlife habitat on reclamation areas. These data will also provide a measure of the success of mitigation implemented to conserve wildlife in the Project Area. It is expected that wildlife (e.g., snowshoe hare, small mammals) will use reclaimed areas as soon as the herbaceous vegetation cover has been established. Site-specific revegetation activities as well as natural colonization of shrub and tree species from the Project Area will contribute to establishing a self-sustaining ecosystem. The diversity of wildlife use will tend to increase over time as the vegetation cover increases and advances through successional stages.

Cenovus will prepare and submit to AENV an Annual C&R Report summarizing the previous year's activities, including:

- completed development activities;
- pre-disturbance assessments completed on facility areas to be constructed in the following year;
- completed reclamation activities;
- reclamation monitoring;
- wildlife mitigation monitoring programs (occurs on a three-year rotation); and
- planned activities for the following year.

Q. PUBLIC CONSULTATION

Q.1 PUBLIC INVOLVEMENT PROCESS

Cenovus employs Local Community Relations representatives to work closely with the stakeholders and their organizations to ensure that consultation objectives for the Project are met. In addition to the formal events outlined in Volume 1, Section 2.3.4, these individuals participate in various community events and have had additional contacts and informal meetings with many of the stakeholders potentially affected by the Project. Cenovus's organization of, and participation in, the events outlined in Volume 1, Section 2.3.4 formed a significant part of the consultation process.

Q.1.1 Aboriginal Community Meetings and Consultation Work Plans

The consultation and engagement undertaken with Aboriginal communities or their consultation bodies focused on identifying questions and issues and trying to resolve them. Consultation varied from community to community but generally included building an understanding of the Project, responding to community concerns related to the Project, and mitigating those concerns where reasonable and within Cenovus's control.

Cenovus met with Bigstone Cree Nation (BCN) leadership to provide them with a high-level overview of the company, an update on the Pelican Lake Wabiskaw Operations and a high-level overview of the Grand Rapids project. At that meeting Cenovus confirmed that they were to deal with the BCN Government and Industrty Relations (GIR) department on all matters related to consultation for the Project. Cenovus and the GIR developed an informal plan to undertake consultation for the Project. Cenovus provided BCN with the proposed Terms of Reference (TOR), maps of the Project, a Plain Language Document, and a presentation on Project details. Cenovus and the GIR have met on several occasions to discuss the details of the Project and the focus of the consultation efforts with BCN as per their direction in the undertaking of a Traditional Land Use (TLU) study. Additionally, Cenovus has been working with the GIR to get them a tour of one of Cenovus's existing thermal facilities.

Cenovus has been dealing with BCN leadership and more recently the GIR on Cenovus's conventional oil development. The GIR has developed an in-depth consultation and monitoring process that Cenovus engages in for our conventional projects. Given that the proposed Grand Rapids project overlaps

Cenovus's conventional footprint, BCN has familiarity with the areas proposed for development. Cenovus continues to work with the BCN to understand if there are any additional issues or steps that need to be undertaken with the group.

Cenovus met with the Wabasca Métis Local #90 (WML) Council and provided them with the maps of the Project, a Plain Language Document, and a presentation on Project details. Cenovus continues to work with the WML to understand if there are any additional issues or steps that need to be undertaken with the group.

The meetings and events that occurred as discussed above are listed in Table Q.1-1.

Table Q.1-1 List of Meetings and Events – Aboriginal Groups and Communities

Aboriginal Group or Community	Date	Meeting or Event[(a)]
Bigstone Cree Nation	May 5, 2011	Meeting with Chief and council and Cenovus Vice Presidents of the area to reacquaint them with Cenovus and our plans for the area.
	May 13, 2011	Meeting with Government and Industry Relations (GIR) group to introduce the Project details and understand consultation steps.
	May 31, 2011	Meeting with the GIR to discuss the collection of Traditional Knowledge, Traditional Land Use and Socio-Economic assessment aspects of the Environmental Impact Assessment.
	August 23, 2011	Meeting with the GIR to finalize the budget and work plan of the proposed community-led Traditional Land Use study for the area.
	August 30, 2011	Open house in Wabasca to discuss details of the Project with the general population. Bigstone Cree Nation Leadership and Consultation staff were invited and attended.
Wabasca Métis Local #90	June 8, 2011	Meeting with the Council to introduce the Project and present development details.
General Population	August 30, 2011	Open house in Wabasca to discuss details of the Project with the general population. Local leadership was invited to attend.

(a) Meetings directly related to the Project application were included in this chart.

Traditional Ecological Knowledge and Traditional Land Use Studies

For several years now, Cenovus has worked with BCN and their internal process for on the ground assessment of our conventional project footprints. In preparation for the proposed Project, BCN will undertake their own TLU/Traditional Knowledge (TK) study with the financial support of Cenovus and will provide that information to Cenovus for review and discussion. The BCN

TLU/TK study forms the bulk of the issue scoping and mitigation discussion associated with the consultation process. Cenovus has not been requested to undertake a TLU/TK study with the Métis Local #90, but has met with them to introduce the Project and the proposed details of the development.

Meetings, Open Houses and Formalized Groups

Local Community Relations representatives have convened several meetings and information sessions to build relationships and Project understanding with Project stakeholders. These meetings have been held in various locations to help foster two-way communication at formal and informal levels.

Non-traditional recreational land users were given the opportunity to participate directly with Cenovus through the public notice exercise or at the Wabasca Open House on August 30, 2011. Individual invites to the open house were provided to the leadership in the community, local trappers, and the provincial and federal government representatives for the region. The open house was also advertised in Wabasca's local paper *The Fever* and on the local radio station.

Trap line holders near the Project have also been involved throughout the exploration process and have been contacted by Cenovus's Local Community Relations Advisors or Cenovus's Land Representatives on a regular basis as a result of our conventional operations. Consumptive and non-consumptive use guides and outfitters were interviewed as part of the Resource Use Assessment in Volume 6, Section 3.

Cenovus has also been in contact with neighbouring proponents and lease holders about shared access, infrastructure and Project details. The collaboration with these stakeholders includes individual meetings and the exchange of relevant Project information.

Business and Employment Discussions

Cenovus has traditionally participated in relevant business opportunity events related to its conventional oil construction and operations activities and intends to continue with that practice. Cenovus will communicate the types of present and future opportunities that will be available at the Project through open houses and one on one discussions with local businesses and local business development resources. Cenovus has existing relationships with several local businesses as part the Pelican Lake Wabiskaw Operations and will build on those relationships throughout the development process.

Cenovus has already met with the business development officers from both BCN and the Municipal District of Opportunity No. 17 to help them understand the current and future business needs. Cenovus has also participated in career fairs in the community and is presently working with the schools and colleges to help them understand the potential opportunities associated with the Grand Rapids Project.

Where possible, Cenovus encourages and provides opportunities at the Project site to local contractors and employees. Cenovus maintains an internal local business capacity directory that it will continue to update.

Q.1.2 Issues and Concerns Identified

As a result of the Stakeholder engagement and consultation process initiated in May 2011, a variety of issues and concerns have been identified. The issues listed in Table Q.1-2 are not intended to be an exhaustive list of community issues but rather a list of issues raised and documented as part of the process. Cenovus will continue to engage in consultation with local stakeholders to address and resolve these issues and concerns where possible.

Table Q.1-2 List of Stakeholder Concerns

Bigstone Cree Nation	**General**
	Bigstone would like to be involved in environmental monitoring, and would like copies of reports and information sent to the province.
	Water
	There is concern about water monitoring, and a desire to receive more information about how we monitor water for both our conventional operations as well as our planned thermal operations in the area.
	Concern about how much water will be used over the life of the Project and the source of that water.
	Wildlife and Vegetation
	Resulting from concern over effects to wildlife and vegetation, developed an on the ground monitoring process where band members are trained and capable of being employed to work with the companies prior to site clearing and construction.
	Cumulative Effects
	There is a concern about the cumulative effects of development by various operators, especially regarding air quality and odours.
	Economic Benefits and Social Conditions
	Want to ensure that there are business opportunities provided to local businesses as well as the band owned businesses.
	Identified a lack of training initiatives in the community so that band members can take advantage of all the work that is taking place in the region.
	Health, Safety and Nuisance
	Concern about the trappers who will be effected in the region and how there may be more vandelization to trappers cabins and equipment if more people are in the area.
	Concern about the emissions and smells coming from the Project and how that would affect people's enjoyment of the area.
Wabasca Métis Local #90	**Economic Benefits and Social Conditions**
	Want to ensure that there are business opportunities provided to local businesses and wanted to know about the qualifications needed to undertake contracting opportunities.
	Identified a lack of training initiatives in the community.

Q.2 ONGOING CONSULTATION

Cenovus will continue with ongoing follow-up and response to community requests as they are received throughout the regulatory process and into the operations phase of the Project. Copies of the Application will also be made available at the following locations:

- Municipal District of Opportunity No. 17 office, Wabasca;
- Bigstone Cree Nation Band Administration building;
- Wabasca Métis Local #90 office, Wabasca; and
- Director Environmental Assessment,
  Northern Region – Alberta Environment and Water
  111 Twin Atria Building,
  4999 98th Avenue
  Edmonton, Alberta T6B 2X3.

Additionally, copies of this Application will be mailed or electronically sent to the primary Aboriginal stakeholders that were identified through the engagement process. The digital version of the Application will be available on the Cenovus website at www.Cenovus.com. Cenovus will also continue to engage Aboriginal communities where they have not been able to finalize or finish executing a consultation work plan for the Project.

Cenovus will also continue to comply with its First Nation Consultation Plan for the Project and the *Alberta First Nation Consultation Policy*. Continued discussions with other communities within the Project area will also take place as needed. Information requests, concerns and issues from this continued interaction will be tracked and included in supplemental information packages if required.

See Volume 1, Section 2.3.6 for information on the handling of issues and concerns identified through the Stakeholder Engagement Process.

Q.3 NEWSPAPERS USED FOR ADVERTISING

In addition to direct contact with stakeholders, Cenovus used local media to advertise its public documents. The Project's proposed Terms of Reference (TOR) was made public on February 2, 2010 and is available for viewing at the following locations:

- Municipal District of Opportunity office No. 17, Wabasca;
- Bigstone Cree Nation Band Administration building;
- Wabasca Métis Local #90 office, Wabasca; and
- Director Environmental Assessment,
  Northern Region – Alberta Environment and Water
  111 Twin Atria Building,
  4999 98th Avenue
  Edmonton, Alberta T6B 2X3

Public notice for the TOR was advertised in the following newspapers:

- Print Daily:
  - Edmonton Journal;
  - Edmonton Sun;
  - Calgary Herald; and
  - Calgary Sun.
- Print Weekly:
  - Athabasca Advocate;
  - Wabasca Fever; and
- Print Monthly:
  - Alberta Sweetgrass.

Additionally, a Cenovus Local Community Relations representative provided copies of the proposed TOR to various stakeholders either in person or electronically through e-mail, ensuring key stakeholders had access to the proposed TOR, the Plain Language Document (a document describing the Project in plain language), Project maps and a summary presentation of the Project. The 45-day comment period on the proposed TOR closed on July 29, 2011.

R. OTHER ACTS AND REGULATIONS

Cenovus will file applications for other aspects of the Project under various other statutes. Additional provincial approvals, which will be applied for under separate cover, are required for the Project pursuant to the legislation listed below:

- *Public Lands Act (RSA 2000*, c. P-40) for surface rights;
- *Historical Resources Act (RSA 2000, c. H-9)*, for clearance to construct facilities (Alberta Legislature 2000);
- *Pipelines Act (RSA 2000, C. P-15)*, for the construction and operation of the related infrastructure; and
- *Alberta Infrastructure and Transportation* for pipeline crossing, power crossing, intersection/access off the proposed East Athabasca Highway.

S. INFORMATION REQUIRED BY DIRECTOR

Not Applicable.

T. REFERENCES

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U. ABBREVIATIONS

%	Percent
<	Less than
>	More than
°C	degrees Celsius
AAAQO	Alberta Ambient Air Quality Objective
AENV	Alberta Environment and Water
API	American Petroleum Institute
AQLSA	Air Quality Local Study Area
AQRSA	Air Quality Regional Study Area
ARLSA	Aquatic Resources Local Study Area
ARRSA	Aquatic Resources Regional Study Area
ASRD	Alberta Sustainable Resource Development
bbl	Barrel, petroleum (42 US gallons)
bbl/d	Barrel per day
BCN	Bigstone Cree Nation
BFW	Boiler Feed Water
BOPD	Barrels of oil per day
BTEX	benzene, toluene, ethylbenzene, xylene
C&R	Conservation and Reclamation
CCME	Canadian Council of Ministers of the Environment
Cenovus	Cenovus Energy Inc.
CLRWMA	Christina Lake Regional Water Management Agreement
CLTP	Christina Lake Thermal Project
CO	Carbon monoxide
CO_2	Carbon dioxide
CPDFN	Chipewyan Prairie Dene First Nation
CPF	Central Processing Facility
CSR	Corporate Social Responsibility
CWE	Cold Water Equivalent
CWS	Canada-Wide Standards
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
e.g.	for example [Latin exempli gratia]

e^3Sm^3	Standard cubic metre of gas (volume)
EC	Electrical Conductivity
EG	Ethylene Glycol
EIA	Environmental Impact Assessment
EPEA	Alberta Environmental Protection and Enhancement Act
ERCB	Energy Resources Conservation Board
ERP	Emergency Response Plan
EUB	Alberta Energy and Utilities Board (predecessor to the Energy Resources Conservation Board [ERCB])
FCTP	Foster Creek Thermal Project
FWKO	Free Water Knock Out
GIR	Government Industry Relations
GOR	Gas to Oil Ratio
GTF	Gas Treating Facility
H_2S	Hydrogen sulphide
ha	Hectare
HP	High pressure
HRSG	Heat Recovery Steam Generator
i.e.	that is [Latin id est]
ID	Interim Directive
IL	Information Letter
IRC	Industry Relations Corporation
IWMP	Integrated Water Management Plan
kg	kilogram
kg/m^3	kilograms per cubic metre
km	Kilometre
km^2	square kilometre
kPaa	kilopascals absolute
LICA	Lakeland Industry and Community Association
LP	low pressure
LSA	Local Study Area
m	Metre
m^3	Cubic metres
m^3/d	Cubic metres per day
masl	Metres above sea level
Matrix	Matrix Solutions Inc.

MW	Megawatt
N	Nitrogen
NH_3	Ammonia
NO_2	Nitrogen dioxide (gas)
NO_3	Nitrate (particle)
NO_X	Oxides of nitrogen (NO, NO_2) (gas), or all nitrogen species (e.g., NO_X, N_2O, N_3O)
O_3	Ozone
OTSG	Once Through Steam Generator
PAH	Polycyclic Aromatic Hadrocarbons
PASZA	Peace AirShed Zone Association
PDC	Planned Development Case
$PM_{2.5}$	Particulate matter with a mean aerodynamic diameter of 2.5 microns (µm) or smaller
ppb	parts per billion
Project	Proposed Pelican Lake Grand Rapids
PWSR	Produced Water Steam Ratio
RMWB	Regional Municipality of Wood Buffalo
RSA	Regional Study Area
s/m^3	Sulphur per cubic metre
SAGD	Steam-Assisted Gravity Drainage
SAP	Solvent Aided Process
Sm^3/d	Standard cubic metres per day
SO_2	Sulphur dioxide
SOR	Steam to oil ratio
SRF	Sulphur Recovery Facility
SRU	Sulphur Recovery Unit
SSRF	Solvent/Sulphur Recovery Facility
t/cd	Tonnes per calendar day
t/d	Tonnes per day
t/sd	Tonnes per stream day
TDS	Total Dissolved Solids
THC	Total Hydrocarbons
the Project	Pelican Lake Grand Rapids Project
TOC	Total Organic Carbon
TOR	Terms of Reference

TP	Total Phosphorus
TRS	Total Reduced Sulphur
TSS	Total Suspended Solids
VOC	Volatile Organic Compound
W4M	West of the Fourth Meridian
W5M	West of the Fifth Meridian
WBEA	Wood Buffalo Environmental Association
Westwater	Westwater Environmental Ltd.
WML	Wabasca Métis Local #90
$\mu g/m^3$	Micrograms per cubic metre

V. GLOSSARY

Airshed	The geographic area requiring unified management to achieve air pollution control.
Alberta Energy and Utilities Board (EUB) now the Energy Resources Conservation Board (ERCB)	An independent, quasi-judicial agency of the Government of Alberta, the EUB was created in February 1995 by the amalgamation of the Energy Resources Conservation Board and the Public Utilities Board. The purpose of the EUB is to ensure that the discovery, development, and delivery of Alberta's resources take place in a manner that is fair, responsible and in the public interest.
Alberta Environment (AENV)	**Alberta Environment and Water (AEW):** Provincial ministry that establishes policies, legislation, plans, guidelines and standards for environmental management and protection; allocates resources through approvals, dispositions and licenses, and enforces those decisions; ensure water infrastructure and equipment are maintained and operated effectively; and prevents, reduces and mitigates floods, droughts, emergency spills and other pollution-related incidents.
Alberta Sustainable Resource Development (ASRD)	Alberta Sustainable Resource Development (ASRD) is one of the Alberta Ministries whose mission is to encourage balanced and responsible use of Alberta's natural resources through the application of leading practices in management, science and stewardship. ASRD works with Albertans across the province to ensure a balance between the economic, environmental and social values of our province. They fight forest fires, manage fish and wildlife, oversee the development of Alberta's forests, and manage the use of public lands.
Ambient	The conditions surrounding an organism or area.
Ambient Air	The air in the surrounding atmosphere.

Aquifer	A body of rock or soil that contains sufficient amounts of saturated permeable material to yield economic quantities of water to wells or springs. Any water-saturated body of geological material from which enough water can be drawn at a reasonable cost for the purpose required. An aquifer in an arid prairie area required to supply water to a single farm may be adequate if it can supply 1 m3/d. This would not be considered an aquifer by any industry looking for cooling water in volumes of 10,000 m3/d. The term aquifer is commonly used to indicate the water-bearing material in any area from which water is most easily extracted.
Barrels per Day (bbl/d)	A unit of measure for oil production and processing operations.
Baseline	A surveyed or predicted condition that serves as a reference point to which later surveys are coordinated or correlated.
Baseline Case	The EIA assessment case that includes existing environmental conditions as well as existing and approved projects or activities.
Biodiversity	The variety of 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.
Bitumen	A highly viscous, tarry, black hydrocarbon material having an API gravity of about 9 (specific gravity about 1.0). It is a complex mixture of organic compounds. Carbon accounts for 80 to 85% of the elemental composition of bitumen, hydrogen 10%, sulphur 5%, and nitrogen, oxygen and trace elements form the remainder.
Blowdown	The act of emptying or depressurizing material in a vessel.

Bog	Sphagnum or forest peat materials formed in an ombrotrophic environment due to the slightly elevated nature of the bog, which tends to disassociate it from the nutrient-rich groundwater or surrounding mineral soils. Characterized by a level, raised or sloping peat surface with hollows and hummocks. Mineral-poor, acidic and peat-forming wetlands that receives water only from precipitation.
Brackish Water	Water with total dissolved solids concentration ranging from 1,000 to 10,000 g/m3.
Calendar day	Stream day multiplied by a service factor for planned and unplanned downtime.
Cubic metres per day (m^3/d)	A measure of oil production or processing rate.
Development Area	Any area altered to an unnatural state. This represents all land and water areas included within activities associated with the development of oil sands leases.
Diluent	A light liquid hydrocarbon added to bitumen to lower viscosity and density. The thinning agent is used by the oil sands to make heavy oil more fluid so it can be transported.
Dissolved Organic Carbon (DOC)	The dissolved portion of organic carbon water; made up of humic substances and partly degraded plant and animal materials.
Dissolved Oxygen (DO)	Measurement of the concentration of dissolved (gaseous) oxygen in the water, usually expressed in milligrams per litre (mg/L).
Environmental Impact Assessment (EIA)	A review of the effects that a proposed development will have on the local and regional environment.
Erosion	The process by which material, such as rock or soil, is worn away or removed by wind or water.

Fen	Sedge peat materials derived primarily from sedges with inclusions of partially decayed stems of shrubs formed in a eutrophic environment due to the close association of the material with mineral rich waters. Minerotropic peat-forming wetlands that receive surface moisture from precipitation and groundwater. Fens are less acidic than bogs, deriving most of their water from groundwater rich in calcium and magnesium.
Glaciofluvial (or Glacio-Fluvial)	Sediments or landforms produced by melt waters originating from glaciers or ice sheets. Glaciofluvial deposits commonly contain rounded cobbles arranged in bedded layers.
Groundwater	That part of the subsurface water that occurs beneath the water table, in soils and geologic formations that are fully saturated.
Hydrogen Sulphide (H2S)	A colourless gas with strong odour of rotten eggs. It comes from industrial fugitive emissions by way of petroleum refineries, tank farms for unrefined petroleum products, natural gas plants, petrochemical plants, oil sands plants, sewage treatment facilities, pulp and paper plants using the Kraft pulping process and animal feedlots. Natural sources include sulphur hot springs, sloughs, swamps and lakes.
Hydrogeology	The study of the factors that deal with subsurface water (groundwater) and the related geologic aspects of surface water. Groundwater as used here includes all water in the zone of saturation beneath the earth's surface, except water chemically combined in minerals.
Hyper-Eutrophic	Trophic state classification for lakes characterized by high primary productivity and high nutrient inputs (particularly total phosphorus). Hyper-eutrophic lakes are characterized by abundant plant growth, algal blooms and oxygen depletion.
Infrastructure	Basic facilities, such as transportation, communications, power supplies and buildings, which enable an organization, project or community to function.

In-Situ	Also known as “in place”. Refers to methods of extracting deep deposits of oil sands without removing the groundcover. The in-situ technology in oil sands uses underground wells to recover the resources with less impact to the land, air and water than for oil sands mining.
Local Study Area (LSA)	Defines the spatial extent directly or indirectly affected by the project.
Mesotrophic	Trophic state classification for lakes characterized by moderate productivity and nutrient inputs (particularly total phosphorus).
Modelling	A simplified representation of a relationship or system of relationships. Modelling involves calculation techniques used to make quantitative estimates of an output parameter based on its relationship to input parameters. The input parameters influence the value of the output parameters.
Moraine	Sediment generally consisting of well compacted material that is nonstratified and contains a heterogeneous mixture of particle sizes, often in a mixture of sand, silt, and clay that has been transported beneath, beside, on, within and in front of a glacier and not modified by any intermediate agent.
Nitrogen Dioxide	One of the component gases of oxides of nitrogen which also includes nitric oxide. In burning natural gas, coal, oil and gasoline, atmospheric nitrogen may combine with molecular oxygen to form nitric oxide, an ingredient in the brown haze observed near large cities. Nitric oxide is converted to nitrogen dioxide in the atmosphere. Cars, trucks, trains and planes are the major source of oxides of nitrogen in Alberta. Other major sources include oil and gas industries and power plants.
Oil Sands	A sand deposit containing a heavy hydrocarbon (bitumen) in the intergranular pore space of sands and fine grained particles. Typical oil sands comprise approximately 10 wt% bitumen, 85% coarse sand (>44 µm) and a fines (<44 µm) fraction, consisting of silts and clays.
Oligotrophic	Trophic state classification for lakes characterized by low productivity and low nutrient inputs (particularly total phosphorus).

Ozone (O3)	A gas that occurs both in the Earth's upper atmosphere and at ground level. Ozone in the upper atmosphere protects living organisms by preventing damaging ultraviolet light from reaching the Earth's surface. Ground-level ozone is an air pollutant with harmful effects on the respiratory systems of animals.
Ozone (O3)	A gas that occurs both in the Earth's upper atmosphere and at ground level. Ozone in the upper atmosphere protects living organisms by preventing damaging ultraviolet light from reaching the Earth's surface. Ground-level ozone is an air pollutant with harmful effects on the respiratory systems of animals.
Particulate Matter	A mixture if small particles and liquid droplets, often including a number of chemicals, dust and soil particles.
Peatland	Areas where there is an accumulation of peat material at least 40 cm thick. These areas are represented by bog and fen wetlands types.
pH	The degree of acidity (or alkalinity) of soil or solution. The pH scale is generally presented from 1 (most acidic) to 14 (most alkaline). A difference of one pH unit represents a ten-fold change in hydrogen ion concentration.
Project Area	The project area includes all lands subject to direct disturbance from the project and associated infrastructure.
Reclamation	The restoration of disturbed land or wasteland to a state of useful capability. Reclamation is the initiation of the process that leads to a sustainable landscape (see definition), including the construction of stable landforms, drainage systems, wetlands, soil reconstruction, addition of nutrients and revegataion. This provides the basis for natural succession to mature ecosystems suitable for a variety of end uses.
Solvent Aided Process (SAP)	Solvent Aided Process is an enhancement of Steam-Assisted Gravity Drainage where a small amount of solvent (5 to 20% by mass) is added to the injected steam. When this steam solvent mixture contacts the reservoir, the oil in the reservoir drains faster as its viscosity is reduced due to both dilution and heating. This results in greater and faster recovery, improved economics, and reduced carbon dioxide (CO_2) emissions from steam generation.

Stakeholders	Members of the public and special interest groups, federal authorities, provincial or municipal government, landowners or other parties who have an interest in the proposed project.
Steam-Assisted Gravity Drainage (SAGD)	An in-situ oil sands recovery technique that involves the use of two horizontal wells, one to inject steam and a second to produce the bitumen.
Stream Day	Maximum daily rate (design capacity for equipment).
Total Organic Carbon (TOC)	Total organic carbon is composed of both dissolved and particulate forms. Total organic carbon is often calculated as the difference between Total Carbon (TC) and Total Inorganic Carbon (TIC). Total organic carbon has a direct relationship with both biochemical and chemical oxygen demands, and varies with the composition of organic matter present in the water. Organic matter in soils, aquatic vegetation and aquatic organisms are major sources of organic carbon.
Well Pad	1. The platform from which a hole or shaft is excavated, drilled, bored or cut into the earth so as to tap a supply of some material (e.g., water, oil, gas). 2. An area associated with Steam-Assisted Gravity Drainage operations on which pairs of wells are drilled. The pairs of wells include a steam injection well and a production well.
Well Pair	In SAGD terms, a well pair consists of a horizontal production well that is drilled at or close to the base of the SAGD zone, and a horizontal injection well drilled the same length as, and approximately 5m above, the producer. The injector injects steam into the SAGD zone, and the producer (using a specified lift system) produces emulsion (oil, condensed steam, and formation water) to the surface.
Wetlands	Wetlands are land where the water table is at, near or above the surface or which is saturated for a long enough period to promote such features as wet-altered soils and water tolerant vegetation. Wetlands include organic wetlands or “peatlands,” and mineral wetlands or mineral soil areas that are influenced by excess water but produce little or no peat.

Wildlife

Under the *Species at Risk Act*, wildlife is defined as a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus that is wild by nature and is native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.