MEG Energy Corp.

Road Map of Christina Lake Regional Project - Phase 3

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1 OVERVIEW

MEG Energy Corp. (MEG) is a Calgary-based, privately held energy company focused on the development and recovery of bitumen, shallow gas reserves and the generation of power in northeast Alberta. MEG's Christina Lake Regional Project (CLRP) consists of 80 sections of oil sands leases within the Regional Municipality of Wood Buffalo (RMWB) in northeastern Alberta, approximately 15 km southeast of Secondary Highway 881 and 20 km northeast of Conklin.

MEG currently has approval to construct and operate the first two phases of the CLRP over 23 sections of land. In addition, MEG is developing a facility expansion (Phase 2B) to increase the production capacity of the Central Plant to 60,000 barrels per day (bpd). The Phase 2B plant will be located immediately adjacent to the existing Phase 1 and 2 processing facilities.

MEG is now proposing a further expansion of the CLRP to fully develop its Christina Lake oil sands leases. The Christina Lake Regional Project – Phase 3 (the Project) is an expansion of the current CLRP development area and will use Steam Assisted Gravity Drainage (SAGD) bitumen recovery technology. The Project will consist of two additional processing facilities (Plants 3A and 3B), 138 SAGD multi-well pads and associated steam generating equipment. Plant 3A will be located in the southeast corner of the lease (Sections 20 and 29-76-4 W4M); and Plant 3B will be located in the northwest end of the lease (Sections 32 and 33-77-6 W4M).

Construction of the Project is proposed to occur in two phases. Phase 3A is anticipated to begin construction in 2010, with initial steam injection in 2012. Phase 3B is anticipated to begin construction in 2012, with initial steam injection in 2014. The operational life of each plant is expected to be 25 years, producing an incremental 150,000 bpd of bitumen (approximately 23,800 m^3/d). It is anticipated that reclamation of the Project will be complete by 2044.

Phase 1 of the CLRP is currently in operation. Construction for Phase 2 is underway with anticipated completion in Q1 2009. Construction of Phase 2B is scheduled to begin in Q1 2009 with anticipated completion in Q1 2011. Phase 1, Phase 2 and Phase 2B combined will produce 60,000 bpd of bitumen.

MEG is respectfully requesting to amend the approvals to increase the bitumen production capacity to 210,000 bpd for the CLRP facilities. This increase of 150,000 bpd, referred to as Phase 3 (the Project), is the topic of this submission.

MEG is seeking approval from:

- The Energy Resources Conservation Board (ERCB) to:
  - amend approval number 10773 to construct and operate a bitumen recovery scheme under Section 10 of the *Oil Sands Conservation Act* (OSCA), and
- Alberta Environment (AENV) to:
  - amend approval number 216466-00-01 to construct and operate expanded and additional facilities at the CLRP, under Division 2 of Part 2 and Section 63 of the *Alberta Environmental Protection and Enhancement Act* (EPEA); and
  - reclaim components of the CLRP, under Division 2 of Part 2 and Part 5 of the EPEA.

The CLRP is the integration of the previously approved Phase 1 (AENV Approval No. 212127-00-00), Phase 2 and Phase 2B expansions (AENV Approval No. 216466-00-01), and Phase 3, as outlined in this application. The existing Central Plant (which includes the Phase 1 Plant and plant additions for Phase 2 and Phase 2B) is located about 15 km southeast of local Secondary Highway 881 and 15 km northeast of the EnCana Corporation (EnCana) Christina Lake Thermal Project. Two new plant complexes, identified as Plant 3A and Plant 3B, are proposed as part of this application. Plant 3A will be located about 9 km southeast of the Central Plant, and Plant 3B will be located about 11 km northwest of the Central Plant.

This document (Application for Approval of the Christina Lake Regional Project – Phase 3) comprises the Application for Approval of the Project and serves to meet requirements under the OSCA and EPEA. The document is provided as an integrated Application to the ERCB and AENV as outlined in the Alberta Energy and Utilities Board/Alberta Environmental Protection (EUB/AEP) Memorandum of Understanding on the Regulation of Oil Sands Developments (IL 96-07; EUB 1996b).

1.1 MEG ENERGY CORP.

MEG is a Calgary-based, private energy company focused on the development and recovery of bitumen, shallow gas reserves and the generation of power in northeast Alberta. MEG has an experienced management team with a proven track record in oil sands, co-generation and gas development. Members of the management team were involved with the development of several of the original oil sands projects in Alberta.

MEG is committed to being an exemplary steward of the environment and is working hard to ensure operations meet or exceed all environmental protection standards applicable to the oil sands industry. MEG's goal is to exercise a standard of care in all activities that balances the need to protect the environment, comply with all regulatory requirements while, to the extent possible, meet the needs of local communities and stakeholders.

Comments on this application can be submitted to:

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T2P 3P8

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E-mail: info@megenergy.com

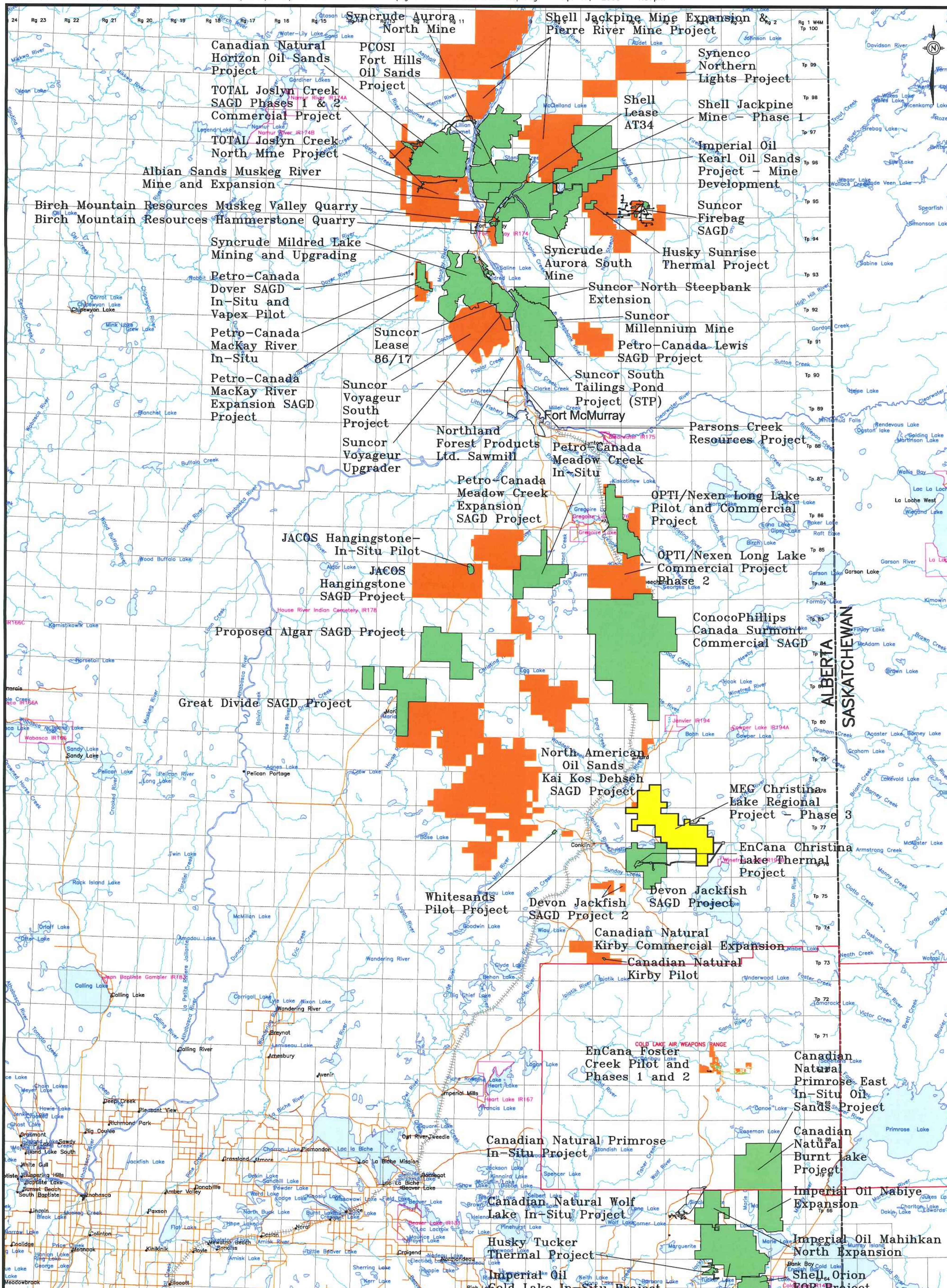
1.2 PROJECT OVERVIEW

1.2.1 History

MEG owns 80 sections of oil sands lease in the Christina Lake area (Figures 1.2-1 and 1.2-2) with an estimated 430 million m^3 of recoverable bitumen in the McMurray Formation. The CLRP is located within the RMWB in northeast Alberta.

The CLRP is in a region that has been extensively explored and developed for natural gas and more recently explored for oil sands production. Several other thermal recovery projects are operating or approved near the MEG lease, including the EnCana Christina Lake Thermal Project, the Devon Canada Corporation Jackfish SAGD Project, the Canadian Natural Resources Limited Kirby Project and Petrobank Energy and Resources Whitesands Pilot Project (Figure 1.2-1).

Upon completion, the CLRP will have a maximum production rate of 33,390 m^3/d (210,000 bpd) of bitumen. Within the lease area, the overburden thickness of the bitumen-bearing formations is typically greater than 325 m; therefore, surface mining is not applicable and MEG will utilize the SAGD process. The SAGD process is proven technology that utilizes multi-well production wellpads and centralized steam production and treating facilities, which results in an efficient extraction process with an optimized project footprint.



LEGEND

(green)	EXISTING AND APPROVED DEVELOPMENTS	(line)	RIVER
(orange)	PLANNED DEVELOPMENTS	(box)	OPEN WATER
(line)	AIR WEAPONS RANGE	(box)	INDIAN RESERVE
(line)	ROAD		
(line)	RAILWAY		

NOTE

* Also known as the Hamlet of Janvier

REFERENCE

ALBERTA NTDB DIGITAL DATA OBTAINED FROM GEOMATICS CANADA, AUGUST 2001. SASKATCHEWAN NTDB DATA OBTAINED FROM ISC, AUGUST 2001. DATUM: NAD 83 PROJECTION: UTM ZONE 12

20 0 20
SCALE METRES

PROJECT

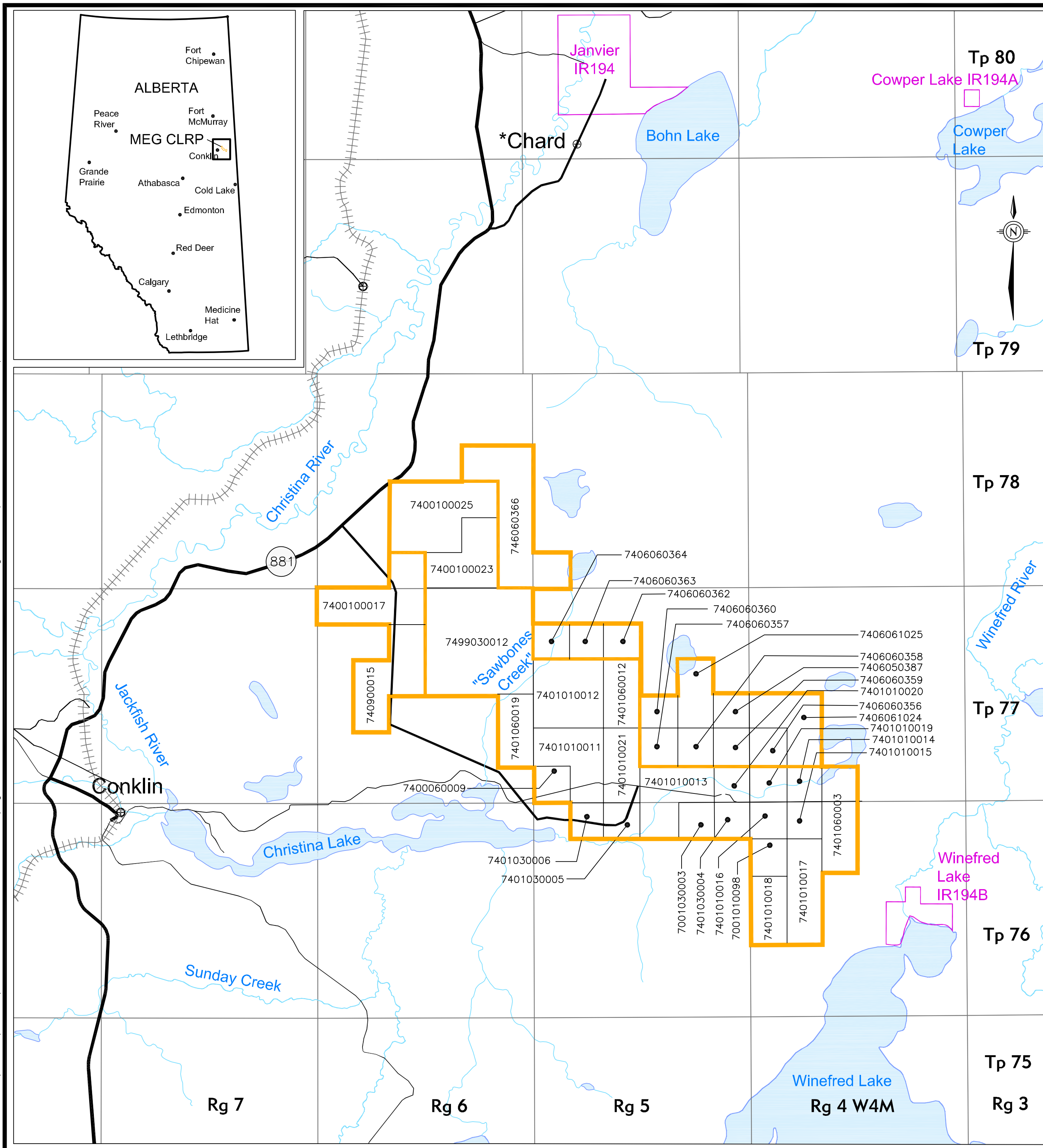
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

OIL SANDS BASE MAP

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No. Oil Sands Base Map	
DESIGN	CM	07/01/08	SCALE AS SHOWN	REV. 0
CADD	PSR	17/04/08	FIGURE: 1.2-1	
CHECK	SG	17/04/08		
REVIEW	SG	17/04/08		



5 0 5

SCALE 1:250,000 KILOMETRES

LEGEND

- ROAD
- RAILWAY
- RIVER
- OPEN WATER
- INDIAN RESERVE
- MEG LEASE BOUNDARY

NOTE

* Also known as the Hamlet of Janvier

Unnamed waterbody locally known as "Sawbones Creek"

REFERENCE

ALBERTA NTDB DIGITAL DATA OBTAINED FROM GEOMATICS CANADA, AUGUST 2001.
DATUM: NAD 83 PROJECTION: UTM ZONE 12

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

CLRP OIL SANDS LEASES

MEG ENERGY CORP.

PROJ	07.1346.0009.5100	
DESIGN	CM	07/01/08
CADD	PSR	08/04/08
CHECK	SG	17/04/08
REVIEW	SG	17/04/08

FILE No. CLRP–Oil Sands Leas

SCALE AS SHOWN REV. 0

FIGURE: 1.2-2

L:\2007\1346 Oil Sands\07–1346–0009–MEG EXPANSION\5100\5190\MEG CLRP Phase 3 Vol 1\Fig 1.2–2 CLRP Oil Sands Leases.dwg Apr 18, 2008 – 6:53pm

Details on the geology of the Project area are provided in Section 2.

The main access route to MEG's lease is by the road that intersects Secondary Highway 881 about 15 km northwest of the CLRP site. MEG purchased this road from AltaGas, and the road has been renamed the MEG road.

1.2.2 Phase 1 (Pilot)

MEG applied for regulatory approval to construct, operate and reclaim the Christina Lake Regional Pilot Project (Phase 1) in September 2004. Phase 1 was designed to have a maximum bitumen production rate of 3,000 bpd (477 m^3/day). The Phase 1 application was approved by the EUB (Approval No. 10159) in January 2005 and by AENV (Approval No. 212127-00-00) in February 2005. MEG's Phase 1 is currently operational.

1.2.3 Phases 2 and 2B

Phase 2 increases the bitumen production rate by 22,000 bpd (3,498 m^3/day) for a total combined bitumen production rate of 25,000 bpd (3,975 m^3/day) at the CLRP. The Phase 2 application was submitted in July 2006, and approved by the EUB (Approval No. 10773) in March 2007 and by AENV (Approval No. 216466-00-01) in July 2007.

Phase 2B increases the bitumen production rate by an additional 35,000 bpd (5,565 m^3/day) for a total combined bitumen production rate of 60,000 bpd (9,540 m^3/day) for the CLRP.

The Central Plant is an integration of the Phase 1 Central Plant, located in N1/2 9-77-5 W4M and S1/2 16-77-5 W4M, and the Phase 2 and Phase 2B expansions. Construction for Phase 2 is underway with anticipated completion in Q1 2009. Construction of Phase 2B is scheduled to begin in Q1 2009 with anticipated completion in Q1 2011.

1.2.4 Phase 3

Phase 3 is designed to increase the bitumen production rate by an additional 150,000 bpd (23,850 m^3/day) for a total combined bitumen production rate of 210,000 bpd (33,390 m^3/day). Phase 3 will be implemented in two phases, Phase 3A and Phase 3B, with each phase designed for an additional 75,000 bpd (11,925 m^3/day) of bitumen production.

Two new plant complexes will be constructed as part of Phase 3. Plant 3A will be located about 9 km southeast of the Central Plant (at S1/2 29-76-4 W4M and N1/2 20-76-4 W4M), and Plant 3B will be located about 11 km northwest of the Central Plant (at 32-77-6 W4M and W1/2 33-77-6 W4M).

Phase 3 can be separated into three major components:

- the plants;
- field facilities; and
- offsite services.

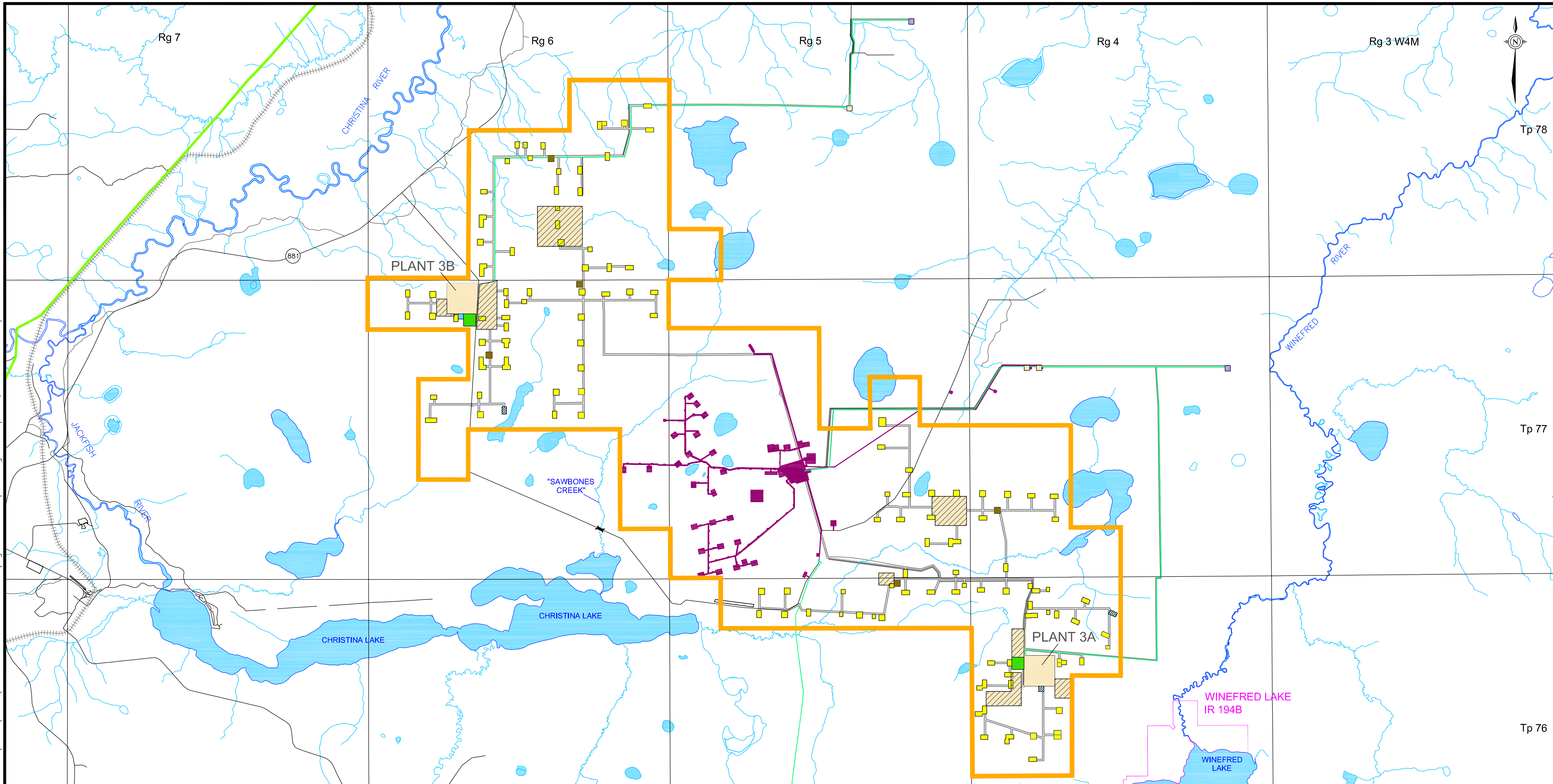
Both Plant 3A and Plant 3B will include processes and facilities that are generally the same as for the previously approved phases of the CLRP. Major components will include steam generation, vapour recovery, bitumen treating, produced water recycling and gas sweetening. Sulphur recovery facilities for Phase 3 will be installed at the Central Plant. The Project will also include reservoir repressurization facilities.

Field facilities for the Phase 3 expansion include production wellpads, source and disposal wells, pumping stations, access roads, pipelines and utility corridors (Figure 1.2-3). Figure 1.2-3 shows the existing, approved and planned MEG developments.

Offsite services for Phase 3 include camps and borrow pits.

The Project's pre-disturbance conditions are shown overlayed on satellite imagery in Figure 1.2-4. Process flow diagrams, provided in Section 3.2, show the proposed process and layout of equipment at Plant 3A and Plant 3B. The acid gas streams produced by the amine sweetening units at Plant 3A and Plant 3B will be treated by additional sulphur recovery equipment (one Claus train) to be installed at the Central Plant. The installation of the new sulphur recovery train at the Central Plant will not result in any additional surface disturbance. The total area for all the components of the Phase 3 development, including both plants, surface wellpads, camps, all potential borrow pits, access roads, utility corridors and pipelines is estimated to be 2,028 ha, which includes 310 ha of existing disturbance.

Production and process rates and steady state utility water usage rates in metric and imperial units and on a stream day and calendar day basis are presented in Tables 1.2-1 and 1.2-2. Calendar day rates are the average annual production divided by the total number of days in a year. Stream day rates are calculated based on 93% plant availability. All numbers provided in text are calendar day rates unless otherwise noted.



LEGEND

- ROAD
- RAILWAY
- RIVER
- TRANSMISSION PIPELINE
- UNDERGROUND PIPELINE
- OPEN WATER
- INDIAN RESERVE
- MEG LEASE BOUNDARY
- EXISTING AND APPROVED DEVELOPMENT
- UTILITY CORRIDOR
- PHASE 3 PROJECT FOOTPRINT
- PHASE 3 POTENTIAL BORROW AREA
- PHASE 3 CAMP
- PHASE 3 POTENTIAL WATER SOURCE WELL
- PHASE 3 WELLPAD
- PHASE 3 PUMP STATION
- PHASE 3 WELLPAD AND POTENTIAL WATER SOURCE WELL
- PHASE 3 WATER DISPOSAL WELL

NOTE

Unnamed watercourse locally known as "Sawbones Creek"

2.5 0 2.5

SCALE 1:125,000 KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

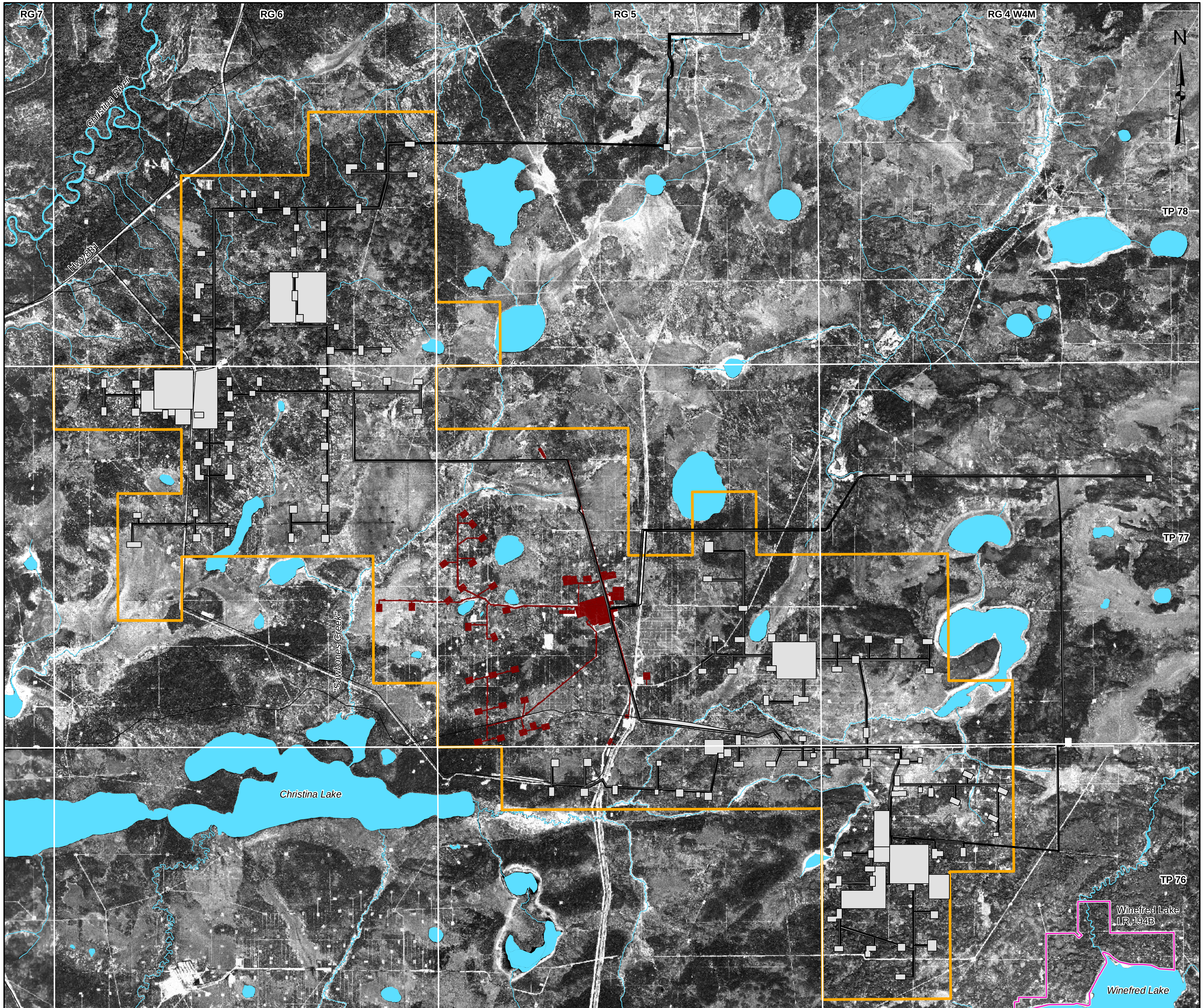
TITLE

FOOTPRINT

MEG ENERGY CORP.

PROJ	07.1346.0009.5100		FILE No.	project footprint
DESIGN	BL	08/04/08	SCALE AS SHOWN	REV. 0
CADD	TRE	17/04/08	**FIGURE: 1.2-3**	
CHECK	SG	17/04/08		
REVIEW	SG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\MEG CLRP Phase 3 Vol 1\Fig 1.2-3 footprint.dwg Apr 17, 2008 - 2:03pm



LEGEND

- MEG LEASE BOUNDARY
- PHASE 3 PLANNED DEVELOPMENT
- INDIAN RESERVE
- OPEN WATER
- RIVER OR STREAM
- ROADWAY

DISTURBED

- EXISTING AND APPROVED MEG DISTURBANCE

NOTE

Unnamed watercourse locally known as "Sawbones Creek"

REFERENCE

Digital data provided by AltaLIS Ltd. (June 2004), Veritas DGC Inc. (July 2004), Alberta Pacific Ltd. (April 2004), Lormel Consultants (imagery, summer 2006), used under license.

Projection: UTM Zone 12 Datum: NAD 83

3 0 3

SCALE 1:100,000 KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

SATELLITE IMAGE - FOOTPRINT

MEG ENERGY CORP.

PROJECT No. 07-1346-0009.5190			SCALE AS SHOWN	REV. 0
DESIGN	RL	07 Jan. 2008	FIGURE: 1.2-4	
GIS	TN	07 Jan. 2008		
CHECK	SG	17 Apr. 2008		
REVIEW	SG	17 Apr. 2008		

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Table 1.2-1 Production and Process Rates

Stream	Calendar Day Basis						Stream Day Basis					
	[bpd]			[m³/d]			[bpd]			[m³/d]		
	Phases 1, 2 and 2B	Phase 3	Total	Phases 1, 2 and 2B	Phase 3	Total	Phases 1, 2 and 2B	Phase 3	Total	Phases 1, 2 and 2B	Phase 3	Total
bitumen	60,000	150,000	**210,000**	9,540	23,850	**33,390**	64,516	161,290	**225,806**	10,258	25,646	**35,904**
steam (80% quality)	210,000	525,000	**735,000**	33,390	83,475	**116,865**	225,806	564,516	**790,322**	35,904	89,760	**125,664**
steam (100% quality)	168,000	420,000	**588,000**	26,712	66,780	**93,492**	180,645	451,613	**632,258**	28,723	71,808	**100,531**
make-up water to water treatment	16,800	42,000	**58,800**	2,671	6,678	**9,349**	18,065	45,161	**63,226**	2,872	7,180	**10,052**
produced water	168,000	420,000	**588,000**	26,712	66,780	**93,492**	180,645	451,613	**632,258**	28,723	71,808	**100,531**
produced water to water treatment	167,513	418,791	**586,304**	26,632	66,582	**93,214**	180,121	450,313	**630,434**	28,637	71,594	**100,231**
water disposal	16,335	40,838	**57,173**	2,597	6,493	**9,090**	17,556	43,911	**61,467**	2,792	6,992	**9,784**
water loss (to BS&W and LS sludge disposal)	632	1,580	**2,212**	103	251	**354**	678	1,699	**2,377**	108	270	**378**
water treatment capacity	210,000	525,000	**735,000**	33,391	83,475	**116,866**	225,806	564,516	**790,322**	35,904	89,760	**125,664**

Table 1.2-2 Utility Water Usage Rates

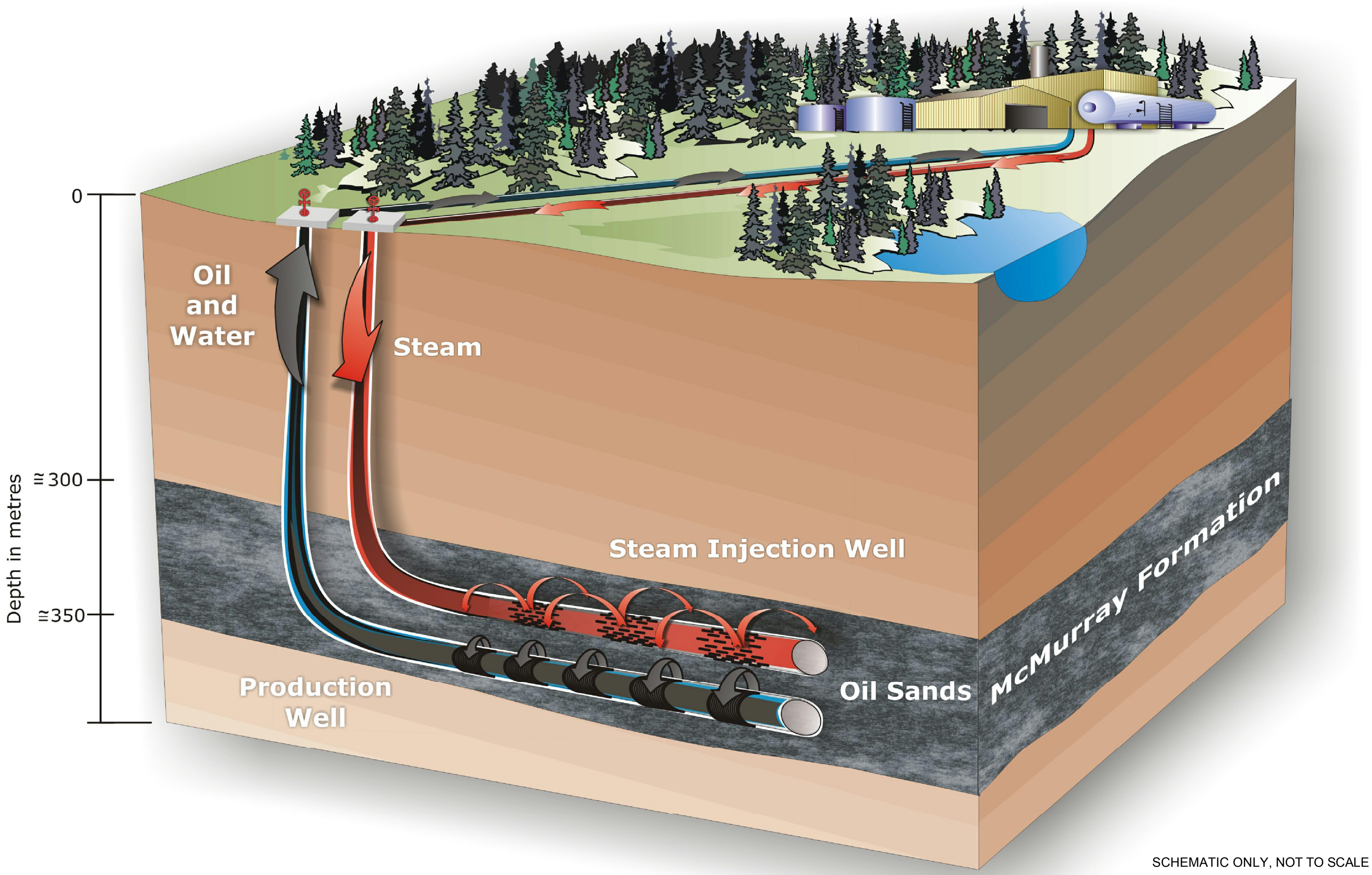
Stream	Calendar Day Basis						Stream Day Basis					
	[bpd]			[m³/d]			[bpd]			[m³/d]		
	Phases 1, 2 and 2B	Phase 3	Total	Phases 1, 2 and 2B	Phase 3	Total	Phases 1, 2 and 2B	Phase 3	Total	Phases 1, 2 and 2B	Phase 3	Total
total utility/potable water	3,684	6,843	**10,527**	586	1,088	**1,674**	3,947	7,358	**11,305**	627	1,170	**1,797**

1.2.5 Phase 3 Design

Engineering, operations and environmental teams collaborated on the design of Phase 3 to maximize energy efficiency and minimize environmental impacts. The footprint was superimposed on mapping systems which incorporate environmental databases. An analysis was undertaken and surface facilities were located to mitigate potential environmental issues, maximize use of existing land disturbances, reduce aquatic and terrestrial fragmentation and avoid potentially sensitive ecosystems. The Project design team also reviewed process issues such as integration with the previously approved phases of the CLRP, water usage, disposal and recycle, vapour recovery and flaring.

The SAGD process utilizes pairs of horizontal wells. The upper wells are the steam injection wells and the lower wells, about 4 to 6 m below the injection wells, near the base of the bitumen pay column, are equipped as the bitumen production wells (Figure 1.2-5). Steam will be continuously injected through the upper well bores to create steam chambers, which will heat the formation. The heated bitumen, under the influence of gravity, then drains to the lower horizontal wells and is produced to the surface.

The SAGD process provides many technological and environmental advantages over other oil sands recovery technologies, and results in recovery factors of 50% or more of the oil in place. The SAGD process is a continuous process that minimizes thermal stress on the well bores due to a minimal number of heating and cooling cycles. The process continuously injects steam below fracture pressure to heat the reservoir. Multiple horizontal well pairs will be drilled from each wellpad to minimize land disturbance.



SCHEMATIC ONLY, NOT TO SCALE

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
CONCEPTUAL STEAM ASSISTED GRAVITY DRAINAGE PROCESS

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	SAGD Process
DESIGN	CM	21/01/08	SCALE AS SHOWN	REV. 0
CADD	DLM	11/02/08	**FIGURE: 1.2-5**	
CHECK	SG	17/04/08		
REVIEW	SG	17/04/08		

1.2.5.1 Plants

Plant 3A is located in S1/2 29-76-4 W4M and N1/2 20-76-4 W4M about 9 km southeast of the Central Plant. Plant 3B is located in 32-77-6 W4M and W1/2 33-77-6 W4M about 11 km northwest of the Central Plant. The locations of Plants 3A and 3B are presented in Figures 1.2-3 and 1.2-4.

The activities conducted at Plant 3A and Plant 3B will generally include the same activities as those approved for the Central Plant. Detailed descriptions of these processes are included in Section 3.2 of this application.

During normal operations, steam will be generated using recycled produced water and make-up water from the Upper Clearwater water sand. Make-up water will be pipelined to Plant 3A and Plant 3B via underground pipelines. Twenty-eight 73.3 MW (250 mmBTU/h) Once Through Steam Generators (OTSGs) will be installed as part of Phase 3 (14 OTSGs each at Plant 3A and Plant 3B). The OTSGs at Plant 3A and Plant 3B will produce steam at 80% quality. Steam separators will then be used to produce 100% quality (dry steam) for injection.

Produced fluids will be separated and treated at the plants using the same process used at the approved Central Plant. Bitumen will be treated by removing gas and entrained water to meet pipeline specifications (pipeline spec oil). Petroleum condensate or synthetic crude oil, also referred to as diluent, will be added to the crude bitumen to reduce the viscosity, thereby facilitating pumping of the diluted bitumen (dilbit) by pipeline.

Tankage at the plants will store diluent, dilbit (sales oil), water (raw, produced and recycled) and chemicals used during the process. Additional information on the storage tanks is provided in Section 3.2.1.6.

At the plants, water will be separated from the produced emulsion (oil and water mixture) and recycled for steam generation. A lime softening and ion exchange process will be used to remove silica and hardness from the produced water, which will then be supplied as boiler feedwater. The water recycle plant is designed to achieve a minimum 90% recycle rate.

The regenerant waste and boiler blowdown, which cannot be recycled, accounts for the remaining (less than 10%) water throughput and will be disposed of into the McMurray water sand at depths ranging from 325 to 365 m. Underground pipelines will be installed to connect Plant 3A and Plant 3B to the Phase 3 water disposal wells.

The lime process waste will be dewatered in lined process ponds before being transported to an approved landfill. Four lined process ponds will be constructed for Phase 3 (two ponds at Plant 3A and two ponds at Plant 3B).

As part of energy conservation and emission reduction measures, gas incidentally produced with the bitumen will be collected, sweetened and used as supplementary fuel in the steam generators. The produced gas will be collected and sweetened using amine sweetening units to be installed at both Plant 3A and Plant 3B. The sweetened produced gas will be sent to the fuel gas system at each of the Phase 3 plants. This sweetened gas stream will be supplemented with purchased natural gas to meet the total fuel gas requirements for Phase 3.

The acid gas stream from the amine sweetening units will be sent to the Central Plant for sulphur recovery. Lift gas will be compressed at both Plant 3A and Plant 3B and transported to the production wellpads via above-ground pipelines that will be housed on pipe racks to be constructed between each of Plant 3A and Plant 3B and their respective production wellpads.

Phase 3 reservoir repressurization facilities have been included at both Plant 3A and the Central Plant.

Each plant will include two process trains and an emergency flare for each train.

Electrical power for Phase 3 will be supplied through tie-ins to the Central Plant. Backup power will be supplied by the Provincial power grid.

Operations at Plant 3A and Plant 3B will require a variety of chemicals, lubricating oils and domestic supplies. Storage and tracking of supplies and disposal of waste products will include provisions for secondary containment, leak detection and inventory reconciliation.

Surface runoff water will be collected at Plant 3A and Plant 3B in one of two industrial runoff ponds; one for Plant 3A and one for Plant 3B. The runoff water ponds will be fed by a system of drainage ditches and culverts to control and contain industrial runoff.

1.2.5.2 Field Facilities

Field facilities for the Project include production wellpads, source and disposal wells, pumping stations, access roads, pipelines and utility corridors. Siting of field facilities will make use of existing disturbances wherever practicable to minimize new disturbance.

Production Wellpads

The general configuration of facilities related to the production wellpads and the utility corridors to Plant 3A and Plant 3B will be similar to those previously approved for the Central Plant. Phase 3 will include a total of 138 production wellpads over the life of the Project. For clarity and completeness, details of the wellpad processes and facilities are provided below.

The Phase 3 production wellpads will include multiple well pairs that will be directionally drilled. Production wellpads for Plant 3A will be located in Townships 76 and 77 in Ranges 4 and 5 W4M. Production wellpads for Plant 3B will be located in Townships 77 and 78 in Range 6 W4M. Each production wellpad will also contain surface facilities necessary for injecting steam and lift gas and recovering the bitumen production with associated test separation and measurement equipment.

Produced fluids will include bitumen, water (condensed steam from the injection process and formation water) and gas. The wellpads will be configured such that one well can be tested while the production from the remaining producing wells on the wellpad is commingled and pipelined to the appropriate plant. A test separator will separate and meter the produced fluids for one well at a time at the wellpads. This production will then be recombined with production from other wells on the wellpad and pipelined to the appropriate plant either directly or through pumping stations. Production flow from the wellpads will be controlled by a choke at each wellhead. The steam pressure in the subsurface steam chambers will be maintained below formation fracture pressure.

The wellpads will be configured to contain surface water runoff for testing and treating before being released back to the watershed. The wells will be placed close together on surface and drilled directionally to limit land disturbances.

The wellpads and their respective plants (Plant 3A and Plant 3B) will be interconnected with Rights-of-Way (ROW) that includes access roads, pipelines and utility corridors. Rights-of-way will use existing disturbed corridors wherever practical. The wellpads and Plant 3A and Plant 3B layouts have been designed to accommodate storage of salvaged soil, where applicable, in accordance with the proposed Conservation and Reclamation Plan (Section 6) and end land use goals.

Source and Disposal Wells

Potable water, utility water, and steam generation make-up water will be supplied from new water source wells to be drilled for both Plant 3A and Plant 3B.

Process waste water (boiler blowdown and water treatment regeneration only) will be disposed of via McMurray disposal wells to be drilled as part of Phase 3.

Additional details regarding source and disposal wells are presented in Section 3.2.2.2.

Pumping Stations

Five pumping stations will be required to assist the transportation of the production to Plants 3A and 3B. Each pumping station will consist of an inlet separator, production pump, gas cooler, compressor package and emergency flare stack. The production will be separated into a liquid phase and a gas phase. The liquid phase will flow through the production pump. The gas phase will be cooled and compressed before being remixed with the liquid phase.

The gas coolers may use cooling glycol from the Phase 3 plants to recover high-grade heat from the pumping stations and return it to the plants, in order to maximize energy efficiency, depending on the proximity of the pumping station to the plants. Additional details regarding pumping stations are presented in Section 3.2.2.3.

Access Roads, Pipelines and Utility Corridors

The Phase 3 plants will each be connected to the Central Plant and their respective wellpads, pumping stations, source wells and disposal wells.

Utility corridors between the Phase 3 plants and the Central Plant will be comprised of an access road, underground pipelines, and overhead electrical and communication lines.

Interconnecting utility corridors between the Phase 3 plants and their respective wellpads and pumping stations will comprise an access road, aboveground pipelines, and overhead electrical and communications lines. Interconnecting utility corridors between the Phase 3 plants and their respective water source and disposal wells will comprise an access road and underground pipelines. In addition, utility corridors between the Phase 3 plants and their respective water source wells will also include overhead electrical lines.

The utility corridors will, where practicable, follow existing disturbances. Additional details regarding access roads, pipelines and utility corridors are presented in Section 3.2.2.4.

1.2.5.3 Offsite Services

Offsite services for the Phase 3 expansion include camps and borrow pits.

Camps

A temporary construction camp will be required for each plant location (Plant 3A and Plant 3B) during construction. Temporary camps will be sized to handle peak facilities construction workforce. Additional details regarding camps are presented in Section 3.2.3.1.

Borrow Pits

Construction materials (sand, clay and aggregate) are required for plant, wellpads and road construction. Potential borrow areas have been identified that are expected to yield the required construction materials. Suitably sized borrow pits will be constructed within these areas; it is not expected that all of the potential borrow areas will be fully developed.

1.2.6 Regional Initiatives and Public Consultation

As described in Section 5, MEG has assembled a comprehensive list of stakeholders in the region as a result of the public consultation process and has initiated a wide-ranging public consultation program as part of the CLRP planning and development process. MEG recognizes and accepts the need for regional co-operation and planning among a broad variety of regional stakeholder groups to ensure the sustainability of oil sands development.

MEG's Public Consultation Plan:

- established specific goals and objectives;
- identified the scope of the consultation process;
- assembled a comprehensive list of stakeholders to consult with, in co-operation with regional leaders and groups; and

- set out a clearly defined process for engaging in the consultation activities.

MEG has been engaging in consultation for the CLRP with community stakeholder groups since 2003. MEG has committed to continuing this consultation through the regulatory/application process and through each succeeding phase of the CLRP up to eventual reclamation and decommissioning. MEG established databases to record all consultation activities and outcomes. MEG released the Public Disclosure Document (PDD) and the Draft Terms of Reference (TOR) for the Phase 3 Environmental Impact Assessment (EIA) in September 2007. Copies of these documents were placed in population centres around the Project and visits to these centres were made to ensure receipt of the documents, to review the content with stakeholder groups and to advise on the process required to provide stakeholder input. MEG has established a process for advertising information about the CLRP to interested stakeholders.

In addition to direct consultation with affected stakeholder groups, MEG has become a member of several regional and local organizations to further facilitate ongoing consultation and relationship with the local community. MEG has joined or is in the process of joining:

- Athabasca Regional Issues Working Group (RIWG);
- Southern Athabasca Oil Sands Producers (SAOP);
- Athabasca Tribal Council All Parties Core Agreement (ATC-APCA);
- Regional Aquatics Monitoring Program (RAMP);
- Cumulative Environmental Management Association (CEMA); and
- Wood Buffalo Environmental Association (WBEA).

During the consultation for CLRP, MEG identified areas of interest to the various stakeholder groups. These areas of interest were expressed both in terms specific to MEG's project and in more general terms regarding resource development in the RMWB. Interests ranged from enquiries about potential economic benefits to the communities adjacent to the CLRP to enquiries about the relationship between CLRP development and quality of the environment. Due to the recent increase in industrial initiatives in this area of the Athabasca Oil Sands, stakeholders considered the CLRP both independently and as a part of the overall regional developments currently being experienced.

The areas of interest identified during the consultation process were broken down into four broad themes:

- Culture and Traditional Land Use;
- Environment;
- Employment, Training and Business Opportunities (Economic Benefit); and
- Regional and Community Infrastructure.

Table 1.2-3 presents an overview of the key components of the four themes of interest.

Table 1.2-3 Themes of Interest

Theme	Focus of Interest
culture and traditional resource use	protection of medicinal and other rare plants protection of archaeological and other sites protection of traditional land use activities (e.g., medicinal plant gathering, berry picking, trapping, hunting, fishing) access to the land
environment	air quality water sulphur dioxide traffic and impact on wildlife cumulative effects monitoring of environmental impacts and mitigative actions reclamation
employment, training and business opportunities (economic benefits)	local hiring of employees on both a casual and permanent basis provision of education and training to help local people obtain employment procurement of goods and services from local businesses
regional and community infrastructure	emergency response planning traffic and impact to people security and policing housing balance between economic benefits and potential negative impacts impacts on local and regional health services financial support for infrastructure needs (identified in one community)

These themes and specific interests to stakeholders and MEG's responses and/or actions taken to address these interests are described in detail in Section 5.4.2.

In summary, the public consultation process identified areas of importance to stakeholders and contributed significantly to the overall CLRP planning. MEG has focused significant effort on the Public Consultation process with its current operations and will continue to do so for the Project.

1.2.7 Project Schedule

The proposed Project schedule is shown in Table 1.2-4. The schedule is approximate and subject to modification in response to the receipt of regulatory approvals, business considerations and weather factors. Assuming favourable regulatory approval and market conditions, construction of Phase 3A is scheduled to begin in 2010 with operations commencing in 2012. Phase 3B is expected to begin construction in 2012, with operations commencing in 2014.

Table 1.2-4 Project Schedule

Activity	2008				2009				2010				2011				2012				2013				2014			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Regulatory Review		■	■	■	■	■	■	■																				
Facilities Construction									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Operations																	■	■	■	■	■	■	■	■	■	■	■	■
Public Consultation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Note: Shaded cells indicate activity to be conducted during this quarter.

1.2.8 Resource and Development Need

Continued development of the MEG CLRP leases is needed to effectively produce the bitumen resources located on the lease, and to supply bitumen to the North American market. Delays in proceeding with this Project in a timely fashion will result in:

- reduced North American hydrocarbon supply;
- reduced economic benefits for the RMWB, Lac La Biche County; Government of Alberta and Government of Canada;
- reduced economic benefits, including employment, for local area residents; and
- delay in optimization of the existing CLRP facilities.

MEG believes utilization of the SAGD technology is the appropriate technology. It is MEG's intention to monitor and evaluate the progress of bitumen recovery technologies. Any improvements that are economically viable and relevant to the CLRP may be incorporated into future development, subject to regulatory approval.

1.3 LEARNINGS APPLIED TO PHASE 3

The key learnings applied to Phase 3 include:

- **Water treatment methods:** Learnings from phases 1 and 2 water treatment are going to be reflected in the design for Phase 3 systems. The Phase 3 water treatment design uses primary Weak Acid Cation (WAC) treatment followed by WAC polishing. This is expected to reduce the variety of chemicals necessary for produced water treatment.
- **Start-up procedure for steam injection:** The start-up and operating procedures have been strengthened to provide additional detail regarding start up and operating procedures.
- **Stripping/soil salvage procedures:** Phase 3 design provides the potential for construction of wellpads on peat to avoid the need for removal and storage of this material.
- **Road construction and culvert placement:** Phase 3 design provides for larger and/or more culverts to prevent ponding and backing up of culverts (debris or freeze).
- **Wellpad design improvements:** Wellpads have been re-designed to optimize layout and function.

1.4 PHASE 3 INTEGRATION

1.4.1 Connection to Existing Utilities

Phase 3 will require connection of Plants 3A and 3B to several existing utilities at the Central Plant, including the incoming diluent pipeline, the outgoing sales oil pipeline and the electrical power line. Electricity for Phase 3 will be supplied through tie-ins to the Central Plant.

Incoming fuel gas will be supplied from a pipeline connected to either the Central Plant or directly to the existing infrastructure, depending on the results of detailed engineering.

1.4.2 Integration

Sulphur recovery will be consolidated with the existing operations performed at the Central Plant as part of the previously approved phases of the CLRP. Phase 3 produced gas will be sweetened at Plant 3A and Plant 3B. The acid gas streams from the amine sweetening units will be pipelined to the Claus sulphur recovery units at the Central Plant for treatment. The existing sulphur recovery facilities at the Central Plant will be expanded to recover sulphur from all acid gas streams at the CLRP, as presented in Figure 3.2-3.

The dilbit produced at Plants 3A and 3B will be stored in tankage available at each plant and then blended, metered and marketed at the Central Plant. This will reduce the need for additional metering equipment and LACT connections at Plants 3A and 3B.

A single operations camp for all phases of the CLRP is anticipated, which will minimize the disturbance for Phase 3 and centralize transportation and utility consumption. Support and emergency services such as EMS, security and maintenance will be integrated for all CLRP facilities.

The proposed Project footprint has been designed to take advantage of existing infrastructure and disturbances in an effort to minimize additional surface disturbance.

1.5 APPLICATION FOR APPROVAL

1.5.1 Existing Approvals

The following approvals and registrations exist for the MEG CLRP:

- Approval 212127-00-00. MEG Energy Corp. Christina Lake Regional Pilot Project, issued under the provisions of the EPEA, issued as of February 24, 2005 and superceded by Approval 216466-00-01.
- Approval 216466-00-01. MEG Energy Corp. Christina Lake Regional Project, issued under the provisions of the EPEA, issued July 20, 2007 and expires January 31, 2017.
- Approval No. 10159. MEG Energy Corp. Christina Lake Regional Pilot Project. February 2005.
- Approval No. 10773. MEG Energy Corp. Christina Lake Regional Project. March 2007.
- License to Divert Water No. 00227262-00-00. MEG Energy Corp. Issued under the provisions of the *Water Act*, issued February 13, 2006 and expires February 12, 2010.
- License to Divert Water No. 00233515-00-00. MEG Energy Corp. Issued under the provisions of the *Water Act*, issued October 17, 2006 and expires October 16, 2011.

- Wastewater Treatment Plant Approval No. 223057-00-02. MEG Energy Corp. Issued under the provisions of the EPEA, issued June 19, 2007 and expires June 1, 2012.
- Permit No. 2005-0461. *Municipal Government Act*, Part 17, for a development permit from the RMWB for the construction and operation of the Phase 1 and related infrastructure, dated June 13, 2005 and does not expire if construction starts within one year of issuance date.
- Permit No. 2007-0345. *Municipal Government Act*, Part 17, for a development permit from the RMWB for the construction and operation of the Phase 2 and related infrastructure, dated April 27, 2007 and does not expire if construction starts within one year of issuance date.

1.5.2 Request for Approval

MEG is seeking approval from:

- The ERCB to:
  - amend approval number 10773 to construct and operate a bitumen recovery scheme under Section 10 of the OSCA; and
- Alberta Environment to:
  - amend approval number 216466-00-01 to construct and operate additional facilities at the CLRP, under Division 2 of Part 2 and Section 63 of the EPEA; and
  - reclaim components of the CLRP, under Division 2 of Part 2 and Part 5 of the EPEA.

1.5.2.1 Application for Commercial Oil Sands Project

Under Alberta Regulation 276/2003, *Activities Designation Regulation*, the scope of the Project meets the criteria set out in Schedule 1 and is, therefore, designated as an activity for which an approval is required. Alberta Environment formally notified MEG in a letter dated October 1, 2007 that an EIA is required for the proposed Phase 3 expansion.

The information needed to satisfy the requirements for joint ERCB and AENV approval is contained herein.

1.5.3 Associated Applications

MEG will file applications for other aspects of Phase 3 under various other statutes. The provincial application and approval requirements applicable to Phase 3 that will be submitted under separate cover are:

- *Public Lands Act*, for surface rights;
- *Historical Resources Act*, for clearance to construct the facilities (submitted December 2007);
- *Pipelines Act* and Alberta EPEA, for the construction and operation of new pipeline tie-ins for the Phase 3 plants;
- *Water Act*, for the water diversion licenses;
- *Oil and Gas Conservation Act*, for well and water disposal licenses;
- *Electric Utilities Act*, for the electrical power interconnection; and
- *Municipal Government Act*, Part 17, for a development permit from the RMWB.

1.5.4 Guide to the Application

The applications for approval to ERCB and AENV have been integrated in accordance with ERCB and AENV guidelines to facilitate an efficient review of the application by regulators and the public. This application is presented in six volumes:

- MEG Christina Lake Regional Project – Phase 3;
  - Volume 1: Application;
  - Volume 2: Introduction to the Environmental Assessment;
  - Volume 3: Air Quality, Noise and Health;
  - Volume 4: Aquatic Resources;
  - Volume 5: Terrestrial Resources; and
  - Volume 6: Social Aspects.

A copy of the Final TOR issued by AENV is provided in Volume 2, Appendix 2-I. A list of abbreviations, acronyms, units of measures and a glossary are provided at the end of each volume.

Concordance tables for the TOR, ERCB Directive 23 and EPEA Guide to Content are located in Volume 2, Appendix 2-VII, Tables 1 to 3, respectively.

2 GEOLOGY

2.1 INTRODUCTION

2.1.1 Study Area

MEG's oil sands leases at the Christina Lake Regional Project (CLRP) consist of 80 contiguous sections located in the southeastern Athabasca Oil Sands Deposit (Figure 2.1-1). For the purposes of the geological discussion in this Application, the Geological Study Area (GSA) is defined as MEG's 80 sections with a border of one section. An Initial Development Area (IDA) is identified for the eastern portion of MEG's oil sands leases where the initial drainage patterns for the Project are located. The IDA is intended to provide production for Plant 3A.

2.1.2 Well Data

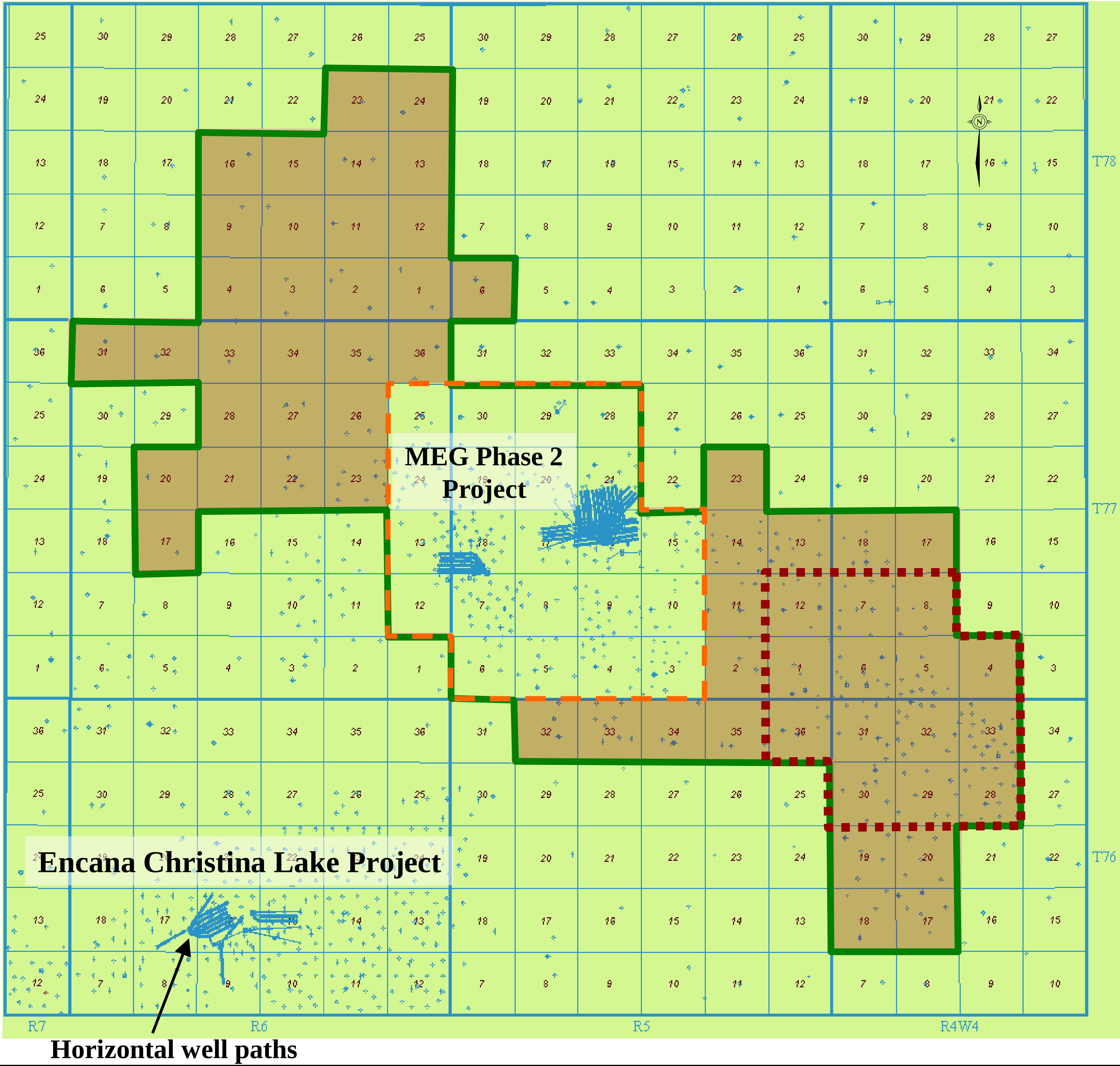
The McMurray Formation is the bitumen bearing reservoir in the Christina Lake area. A total of 451 vertical delineation wells penetrate the McMurray Formation within MEG's Christina Lake oil sands leases (Figure 2.1-2). Of this number, 393 have been drilled between 2003 and 2008 by MEG. These wells typically have a standard suite of open hole, petrophysical logs (resistivity, gamma ray, sonic, neutron and/or density logs). A selected number of wells also have dipmeter, borehole imager and/or dipole sonic logs. Nearly all the wells drilled by MEG have cores cut through part or all of the McMurray Formation. These cores, along with the well logs, provide the means to evaluate the quality and extent of the McMurray reservoir sands.

2.1.3 Seismic Data

Ninety-six percent of MEG's Christina Lake oil sands leases are covered with three-dimensional (3-D) seismic (15 m x 15 m bins). This seismic was acquired during the winter seasons between 2004 and 2007 (Figure 2.1-3).

2.2 STRATIGRAPHIC OVERVIEW

Carbonates of the Beaverhill Lake Group (Devonian) are overlain by lower Cretaceous siliciclastics of the Mannville Group (Figures 2.2-1 and 2.2-2). The Mannville Group is made up of (in ascending order) the McMurray, Clearwater and Grand Rapids Formations. The McMurray Formation is the main bitumen bearing stratigraphic unit in the area. The Mannville Group is in turn capped by the shale dominant Upper Cretaceous Colorado Group. Colorado shales and silts are truncated and overlain by a succession of Quaternary sand, gravel and till.



LEGEND

- MEG Oil Sands Leases
- Phase 2 Development Area
- Phase 3 Development Area
- Phase 3 Initial Development Area

1.6 0 1.6
SCALE KILOMETRES

PROJECT	CHRISTINA LAKE REGIONAL PROJECT - PHASE 3				
TITLE	MEG CHRISTINA LAKE OIL SANDS LEASES AND COMMERCIAL DEVELOPMENT AREAS				
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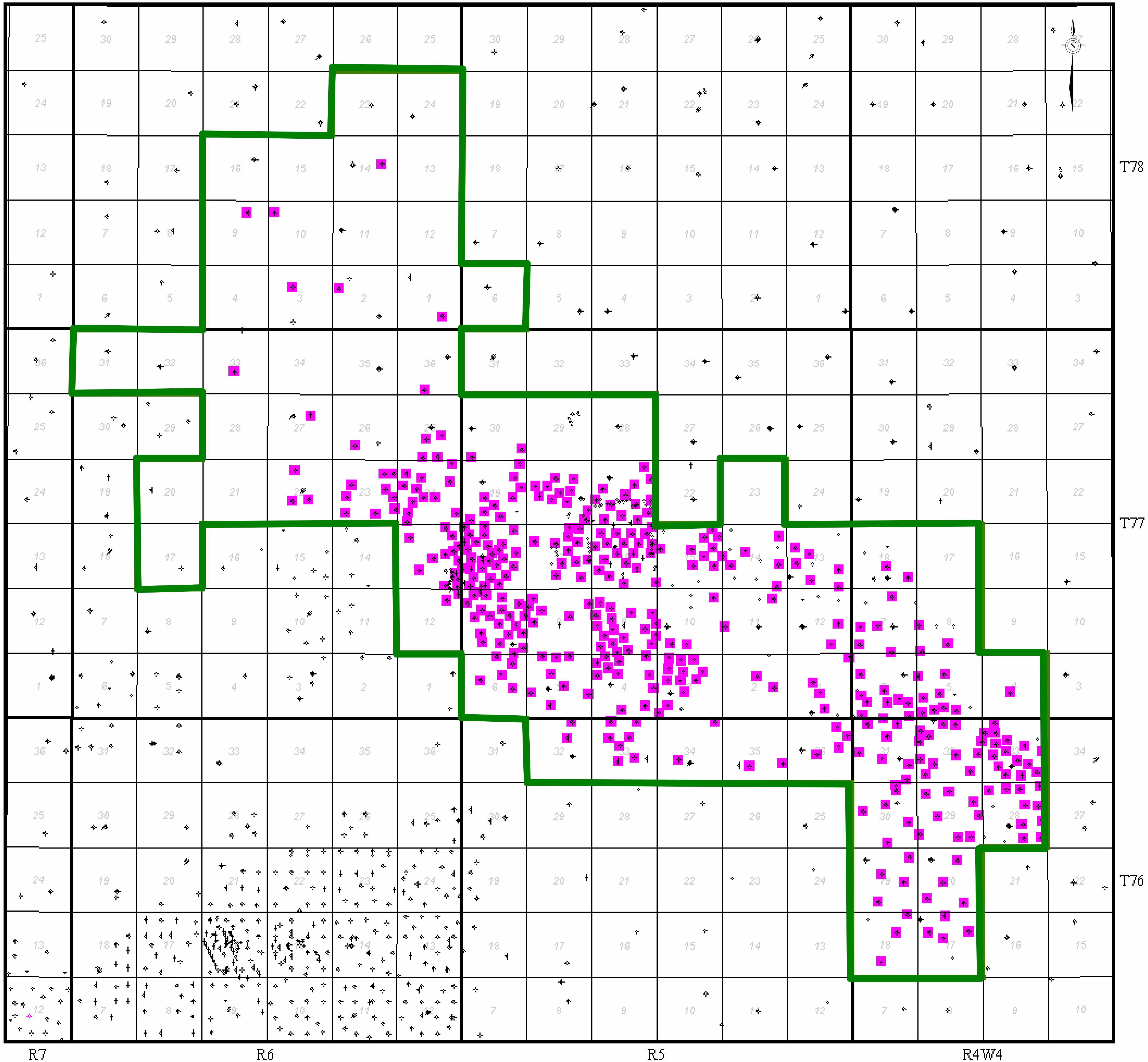
	DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
	CADD	PSR	17/04/08	FIGURE: 2.1-1	
	CHECK	AJF	17/04/08		
	REVIEW	SG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.1-1_MEG CL-OSL +Commercial Development Areas.dwg Apr 17, 2008 - 7:59pm

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.1-2_Cored Wells.dwg Apr 17, 2008 - 7:07pm



LEGEND

MEG Oil Sands Leases

Wabiskaw / McMurray Cores

well type	total wells	cored
pre-2003 gas exploration	58	1
MEG 2003	8	8
MEG 2004	60	60
MEG 2005	72	72
MEG 2006	88	88
MEG 2007	101	99
MEG 2008	58	58
Water Disposal	3	0
Water Source	4	0

total wells	452	386
total MEG wells	394	385

1.6 0 1.6

SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

CORED WELLS

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Cored Wells
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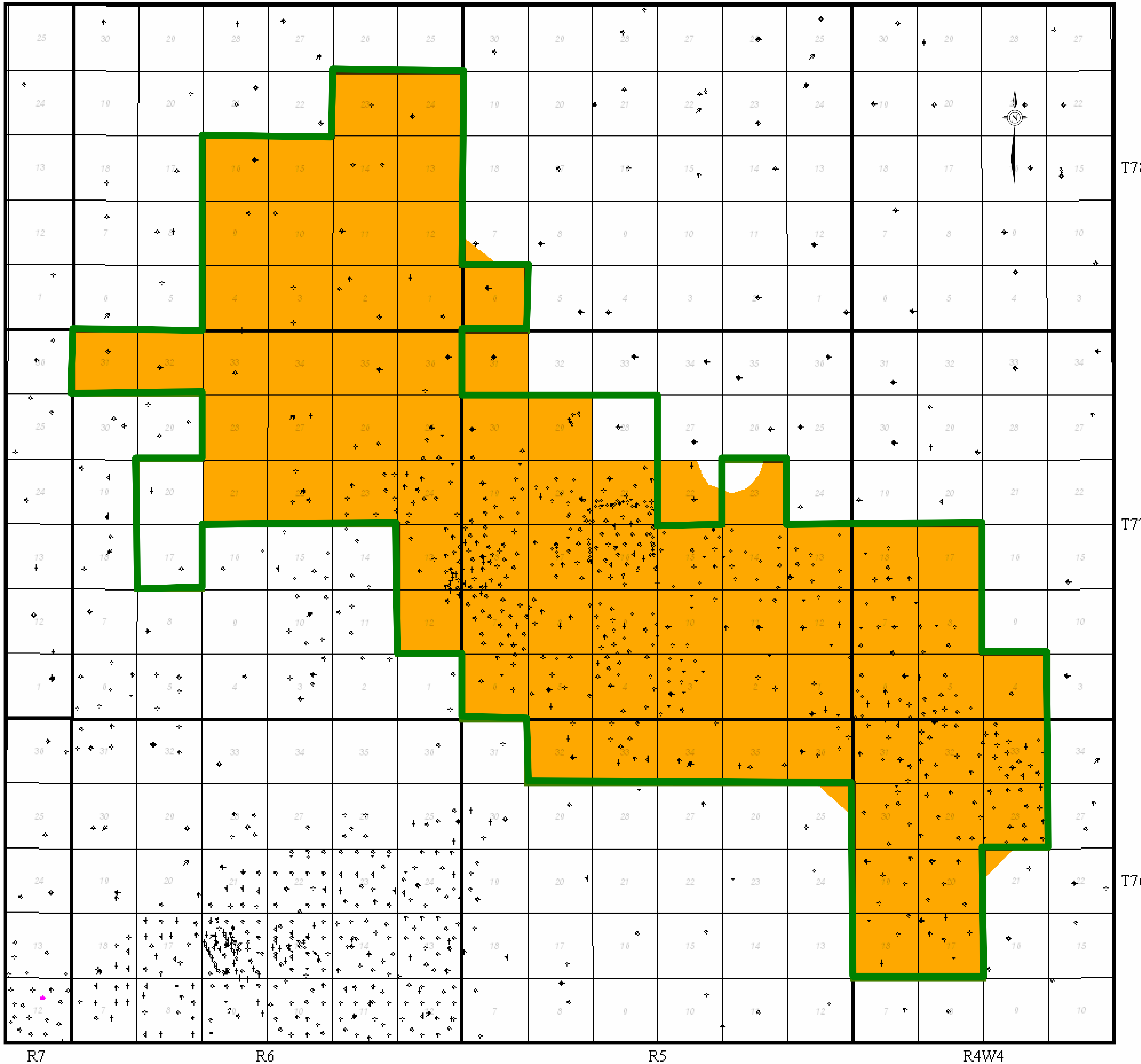
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

FIGURE: 2.1-2



LEGEND

- MEG Oil Sands Leases
- 3-D Seismic

1.6 0 1.6
SCALE KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
3-D SEISMIC

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	3-D Seismic
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
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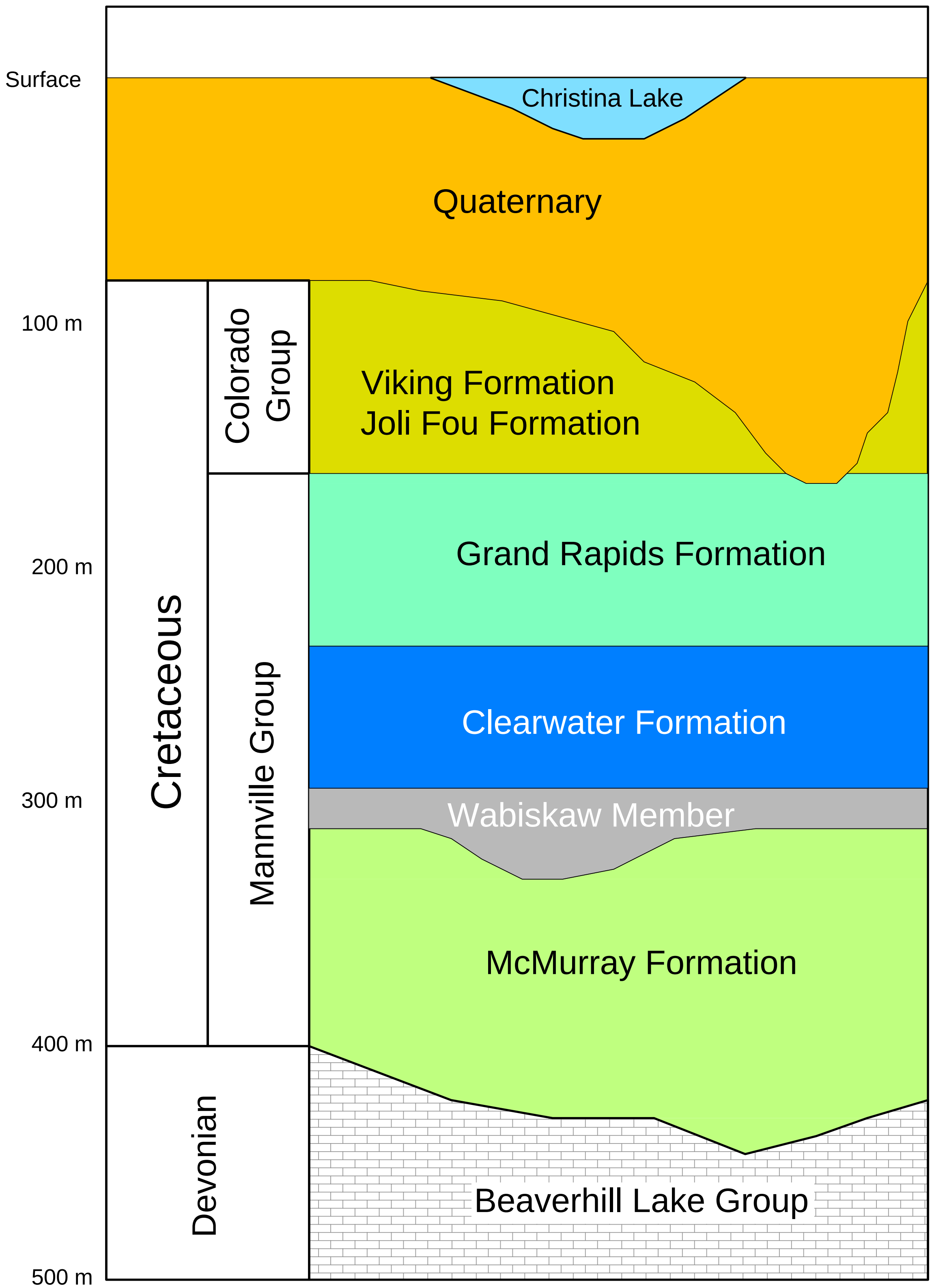
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

FIGURE: 2.1-3



PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

STRATIGRAPHIC COLUMN

MEG ENERGY CORP.

PROJECT	07.1346.0009.8000		FILE No. Stratigraphic Column
DESIGN	MEG	31/03/08	SCALE AS SHOWN REV. 0
CADD	PSR	02/04/08	
CHECK	AJF	17/04/08	
REVIEW	SG	17/04/08	

FIGURE: 2.2-1

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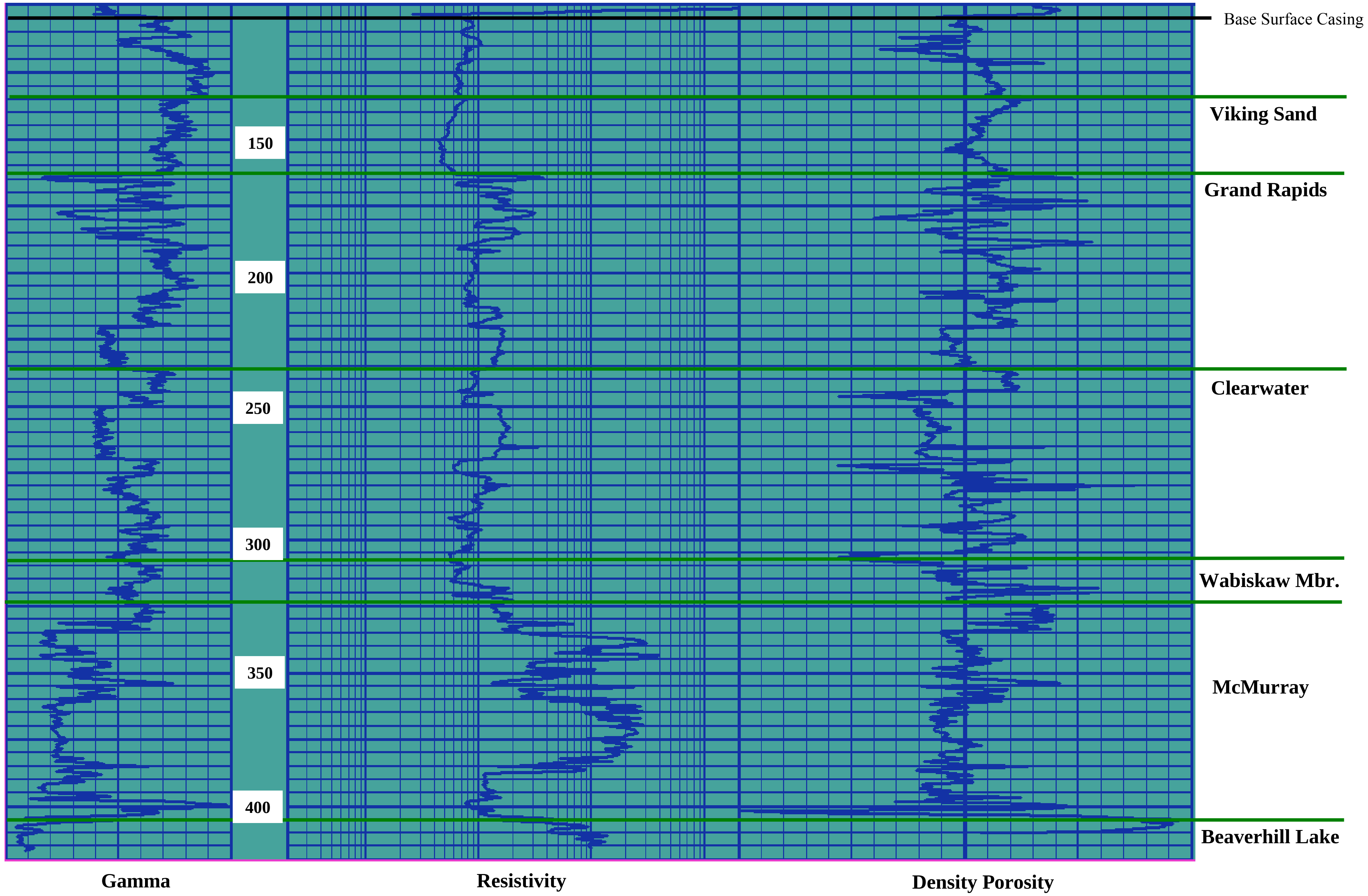

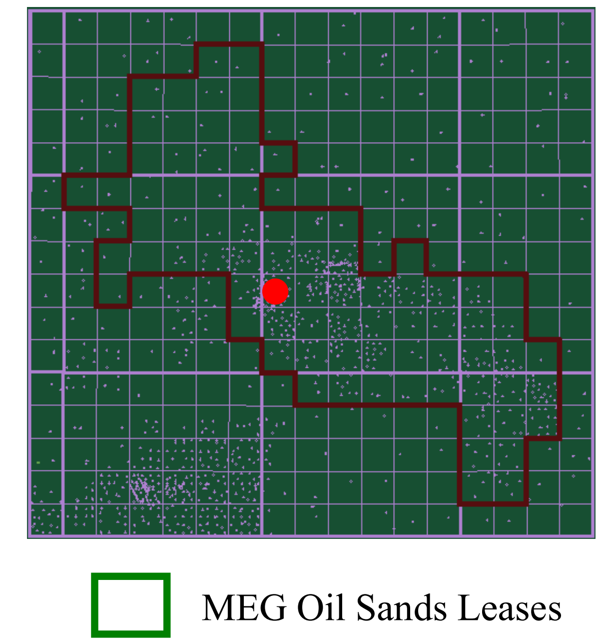

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

TYPE WELL LOG
1AE/06-18-77-05W4

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Type W-Log1A-0618
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CADD	PSR	07/04/08	**FIGURE: 2.2-2**	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

2.2.1 Stratigraphic Details

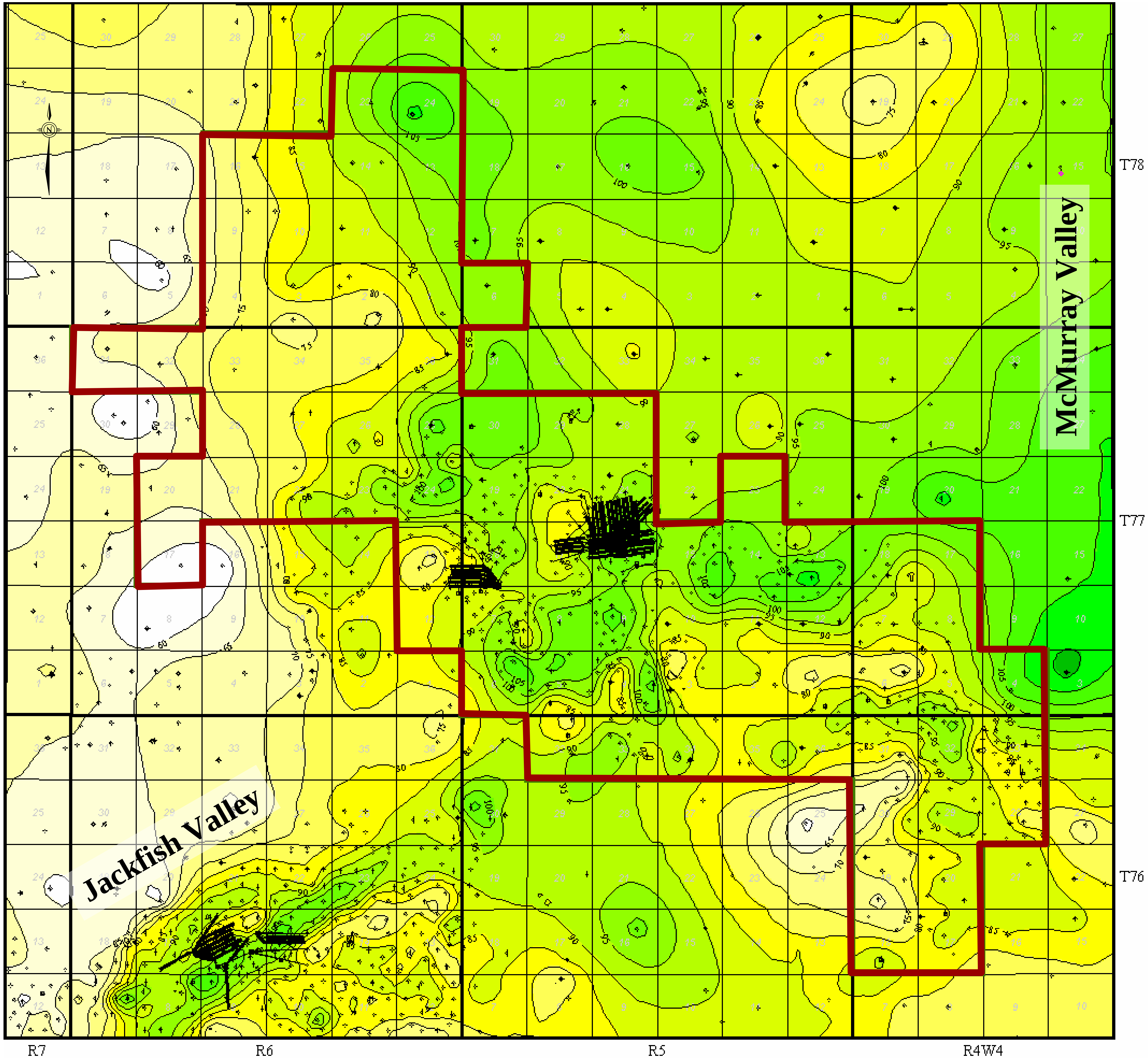
The GSA is underlain by fossiliferous limestone and calcareous mudstone of the Devonian-aged Beaverhill Lake Group. The top of the Beaverhill Lake Group is eroded, marking a major depositional hiatus between the Devonian and the beginning of the lower Cretaceous. A series of major valleys and their tributaries developed on this erosional surface, controlling sedimentation when the McMurray Formation was deposited. The topography of this sub-Cretaceous erosional surface is best illustrated using the isopach of the Wabiskaw Member (lower Clearwater Formation) and McMurray Formation succession (Figure 2.2-3).

Isopach thicks are interpreted to be lows (valleys) on the unconformity whereas isopach thins are considered to be topographic highs (or ridges). McMurray sediments are thickest where the sub-Cretaceous topography was low. On the eastern margin of the map, the large, northward trending McMurray Valley is clearly visible. A smaller valley system, referred to as the Jackfish Valley in this application, debouched into the main McMurray Valley in the area of the MEG's Oil Sands leases. The Canadian Natural Resources Limited (Canadian Natural) Kirby, Devon Jackfish and EnCana Corporation (EnCana) Christina Lake SAGD projects are situated along the Jackfish Valley. The structure of the Pre-Cretaceous Unconformity (Figure 2.2-4) also reflects the topography but has also been influenced by post depositional structure caused by dissolution of deeper Devonian evaporites and the resulting collapse of overlying strata.

2.2.2 McMurray Formation

The stratigraphic framework established by the Energy Resources Conservation Board (ERCB) Regional Geological Study (EUB Report 2003-A) was used to characterize the McMurray succession on MEG's oil sands leases. The McMurray Formation is dominated by the "McMurray Channel" succession which is comprised of fluvial/fluvial estuarine channel fills and overlying tidal flat and tidal creek deposits (Figure 2.2-5). The McMurray Channel is variably overlain by a series of regional shoreface successions called the "McMurray A1", "McMurray A2", "McMurray B1" and "McMurray B2".

The McMurray Formation consists of a complex succession of unconsolidated sand and mud (Figure 2.2-6). McMurray sands are variably saturated with saline water, bitumen and natural gas. The lowermost McMurray is typically localized within topographic lows on the sub-Cretaceous unconformity. It is characterized by medium to coarse grained, large-scale cross-stratified sand. Carbonaceous grains and lithic pebbles are common in these sands. Sand beds are variably interbedded with grey, carbonaceous mud.



LEGEND

MEG Oil Sands Leases

1.6 0 1.6
SCALE KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
WABISKAW MARKER TO TOP PALEOZOIC ISOPACH CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	FILE No.	WM-Top Pale-Isopach
DESIGN	MEG	31/03/08	SCALE AS SHOWN REV. 0
CADD	PSR	05/04/08	
CHECK	AJF	17/04/08	
REVIEW	SG	17/04/08	

FIGURE: 2.2-3

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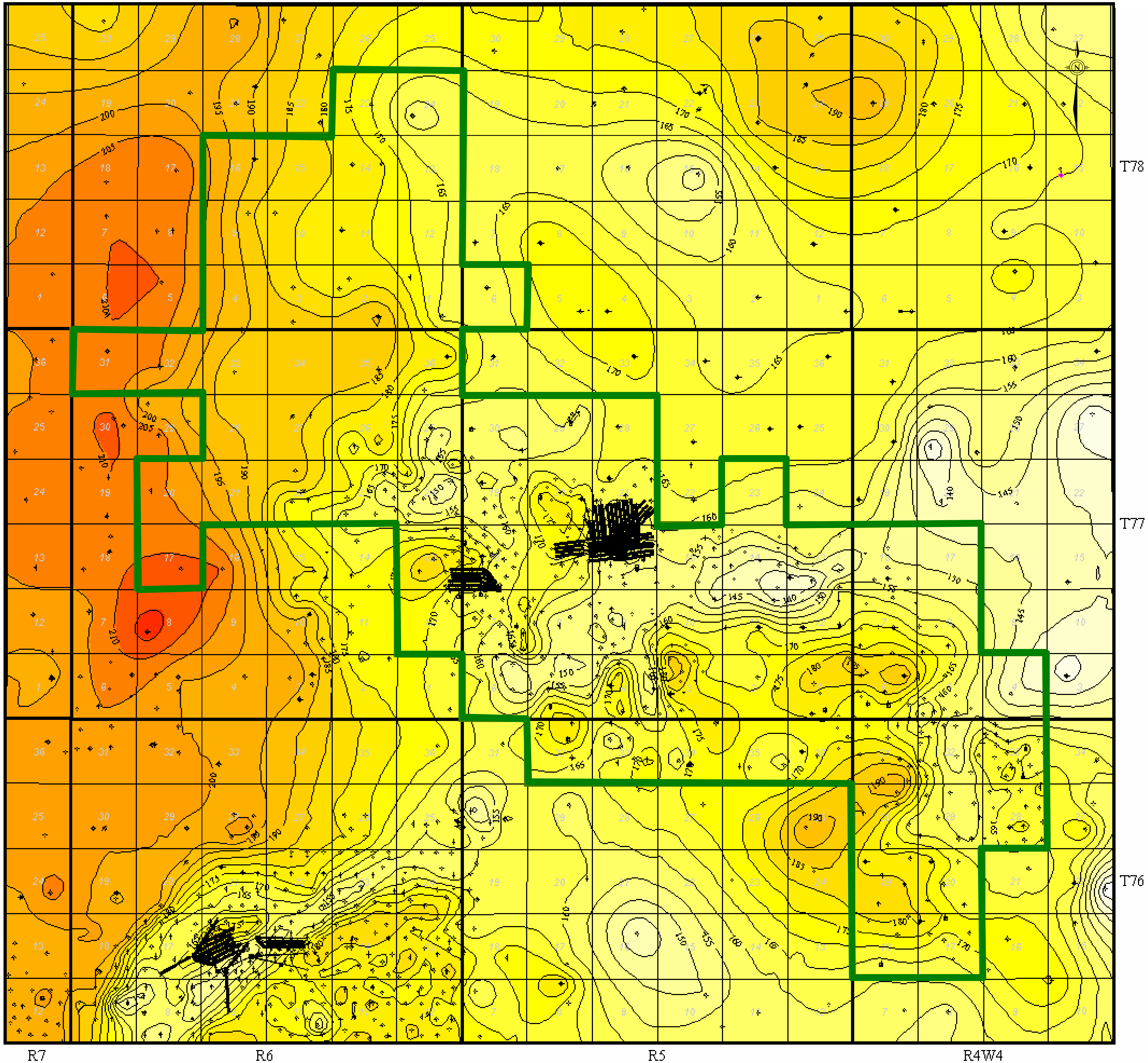

LEGEND

MEG Oil Sands Leases

1.6 0 1.6
SCALE KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
TOP PALEOZOIC STRUCTURE
CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.	PROJECT	07.1346.0009.5100	FILE No. Top Paleo-structure	
	DESIGN	MEG	31/03/08	SCALE AS SHOWN REV. 0
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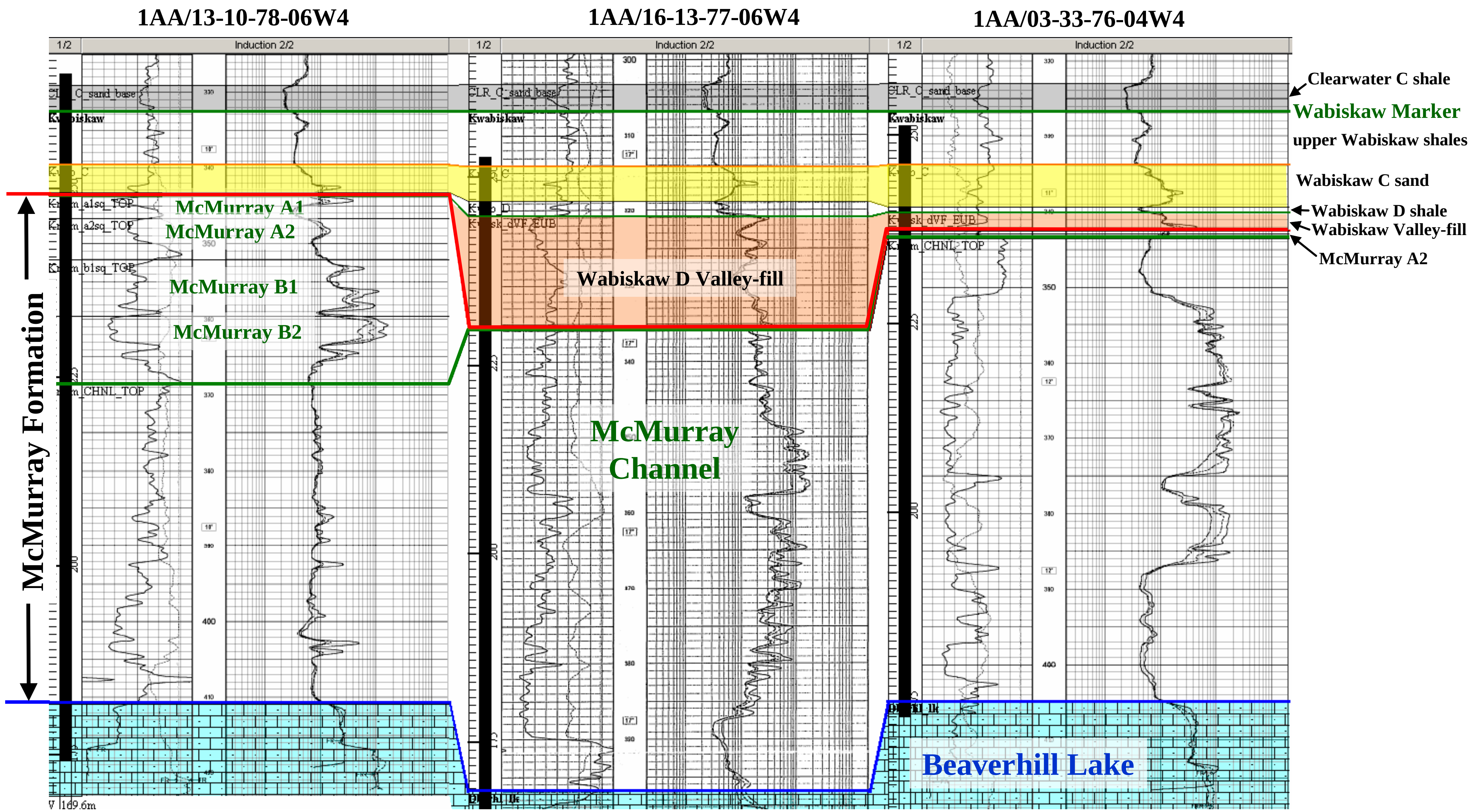
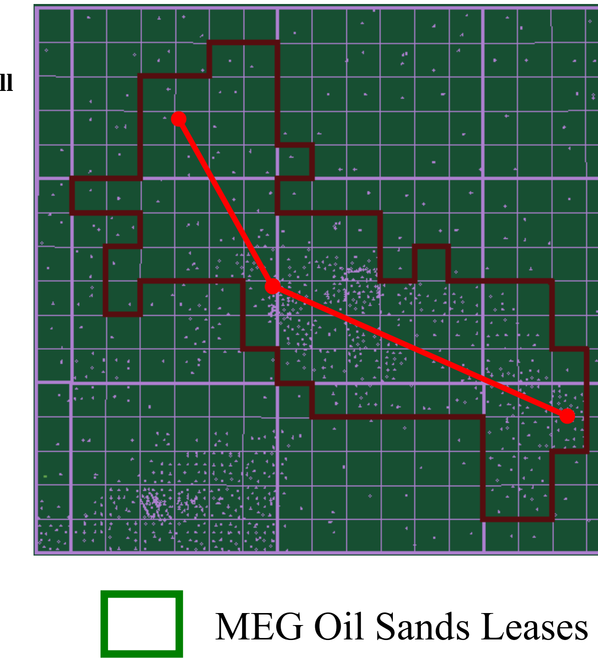
	CHECK	AJF	17/04/08	
	REVIEW	SG	17/04/08	





Stratigraphic Unit	Deposits
Wabiskaw C	shoreface sands
Wabiskaw D Shale	bay shale
Wabiskaw D Valley-fill	bay sands and shales
McMurray A1	shoreface sands, shales and coal
McMurray A2	shoreface sands, shales and coal
McMurray B1	shoreface sands, shales and coal
McMurray B2	shoreface sands, shales and coal
McMurray Channel	fluvial channel sands and overbank muds, estuarine channel and tidal flat sands and muds

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
WABISKAW / McMURRAY STRATIGRAPHY USING ENERGY RESOURCES CONSERVATION BOARD REGIONAL GEOLOGICAL STUDY NOMENCLATURE

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	W+McM Stratigraphy
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CADD	PSR	17/04/08		
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

FIGURE: 2.2-5

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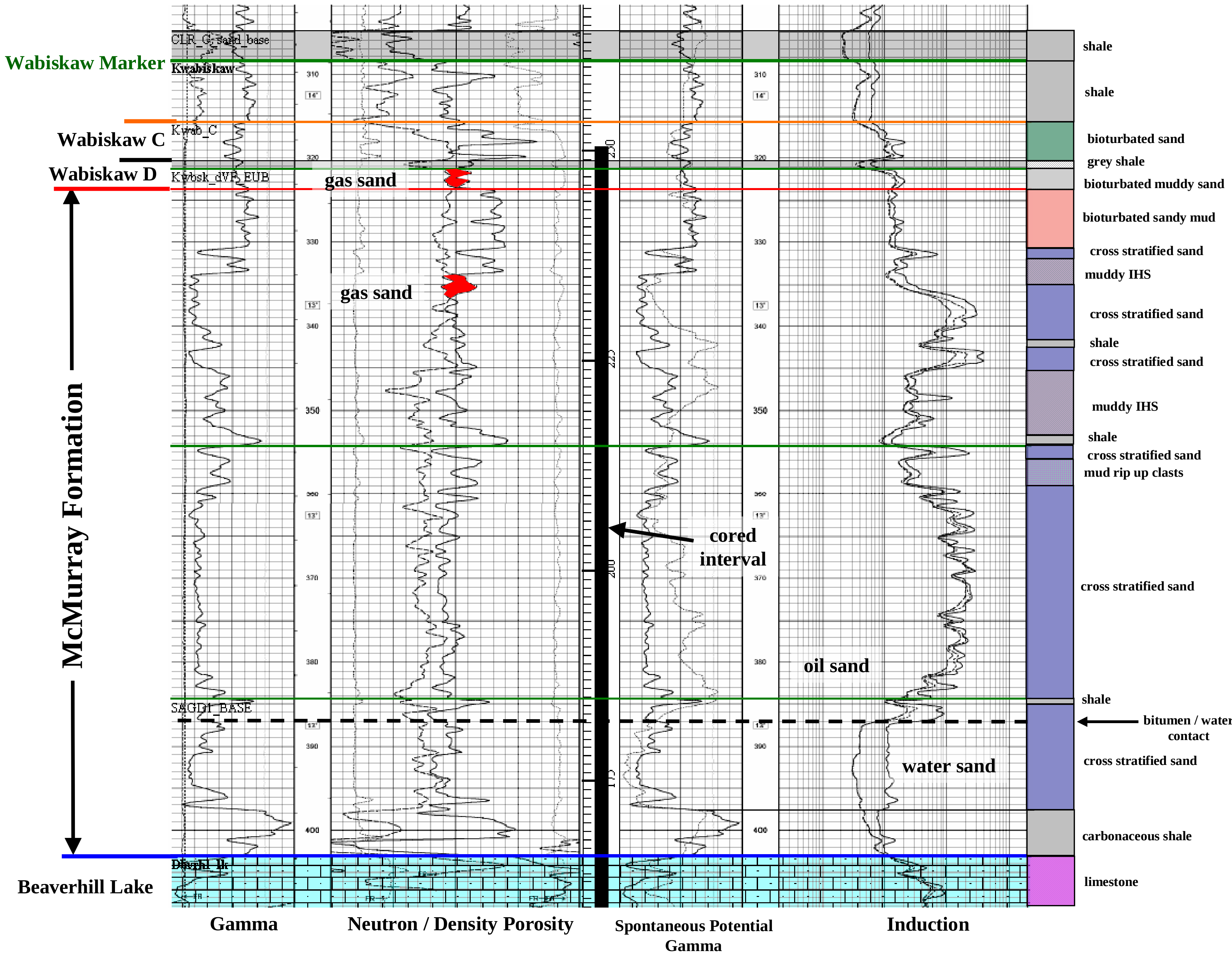
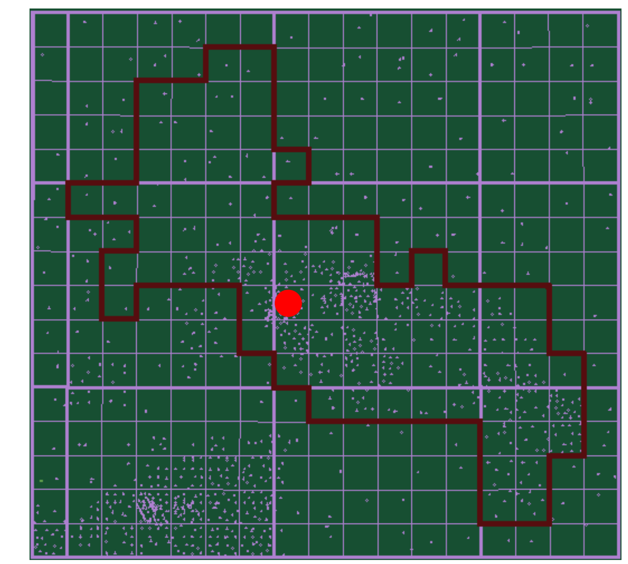




MEG Oil Sands Leases

PROJECT	CHRISTINA LAKE REGIONAL PROJECT - PHASE 3
TITLE	McMURRAY FORMATION TYPE LOG 1AE/06-18-77-05W4

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	FILE No.	McM Fm.Type Log
DESIGN	MEG 24/03/08	SCALE	AS SHOWN
CADD	PSR 05/04/08	REV.	0
CHECK	AJF 18/04/08	FIGURE:	2.2-6
REVIEW	SG 18/04/08		

The presence of rooting and the general lack of infaunal bioturbation suggest that the lowermost McMurray sands and muds were likely deposited in a fluvial environment confined to the lows on the sub-Cretaceous unconformity. However, localized beds of bioturbated sediments indicate marine incursions occurred during lower McMurray deposition. In the Christina Lake area, the lowermost McMurray sands are water saturated.

The middle portion of the McMurray is a complex succession of sand and mud deposited in a marginal marine or estuarine environment.

The middle McMurray is characterized by four distinct lithofacies:

1) massive to cross-stratified sand;
2) Inclined Heterolithic Stratification (IHS);
3) bedded to massive mud; and
4) bioturbated interbedded sand and mud.

Massive to cross-stratified sands deposited in a high energy, marine and tide influenced channel setting form the main reservoir quality lithofacies in the middle McMurray. Cross stratification is either large-scale (through cross bedding) or small-scale (ripple cross lamination). The massive to cross-stratified sands typically have oil saturation in excess of 75%, in-situ porosity greater than 30% and absolute permeability greater than 5 darcies. These sands can form thick continuous successions of bitumen-saturated pay as amalgamated and stacked channel sand deposits. Locally, these sands can contain angular mud clasts deposited with the sand when channels cut into pre-existing mud dominant sediments.

Cross-stratified sands can also contain discrete mud or carbonaceous laminations, paired mud laminations (mud couplets) and mud or composite sand and mud partings with variable bioturbation. These muddy intercalations are thought to have limited lateral extent because they were deposited within a relatively high energy, sand dominated setting where substrate reworking was common. Mud beds were deposited during periods of low or negligible current activity only to be eroded when stronger current flow was reactivated.

The massive to cross-stratified sands are commonly overlain by a succession of IHS. Inclined Heterolithic Stratification is characterized by interbedded sand and mud which reflect the alternating deposition of traction and suspended loads. Dipmeter and borehole imager data over IHS successions show bedding typically dipping at 10° from horizontal, but ranging between 5° to 30°. Inclined

Heterolithic Stratification with higher dips often displays small-scale faulting and contorted bedding.

Where sand content is much greater than that of mud, this lithofacies is referred to as sandy IHS. Sandy IHS is considered to be reservoir quality, though of a lesser quality than the massive to cross-stratified sand. Muddy IHS is characterized by mud content greater than sand and is considered to be non reservoir. Bioturbation is quite variable with some successions of IHS exhibiting only small, scattered burrows while others are intensely burrowed. Inclined Heterolithic Stratification is interpreted to represent lateral accretion deposits of actively migrating mixed load channels. The alternation of sand and mud coupled with the presence of bioturbation supports a tide and marine influenced depositional setting.

Massive to cross-stratified sands and IHS can also be sharply overlain by thick successions of bedded to massive mud. Distinctive bioturbation is typically absent in this lithofacies but the mud can have a distorted or churned appearance or have thin, often bioturbated very fine to fine-grain sand interbeds. This non-reservoir lithofacies is interpreted to represent channel abandonment deposits.

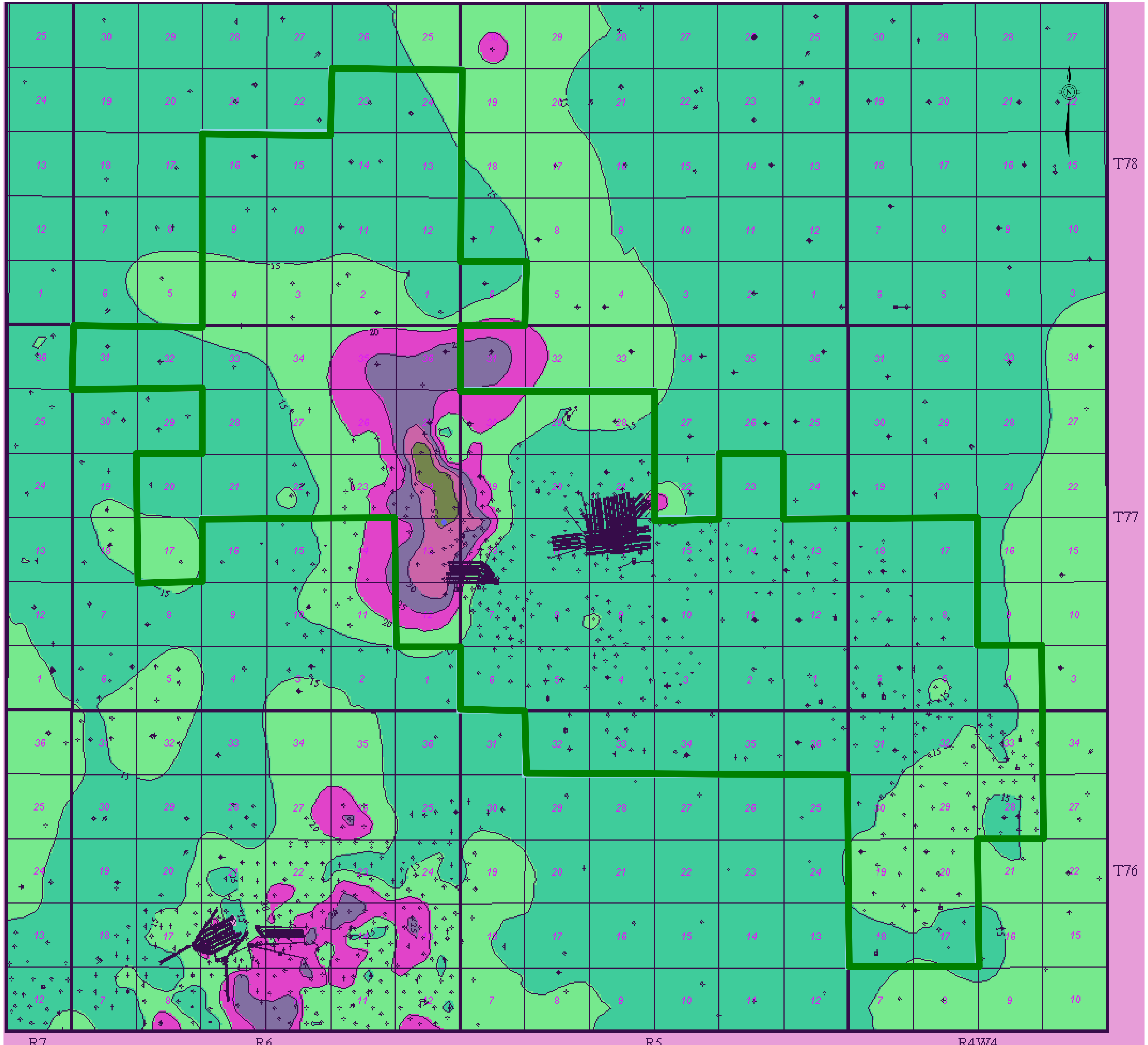
The upper portion of the middle McMurray is often capped by a variable thickness of highly bioturbated interbedded sand and mud. Stratification is typically flat to very low angle. The intensity of bioturbation indicates very low sedimentation rates. This non-reservoir lithofacies was likely deposited in a tidal flat setting. Thin, sand-filled tidal creek deposits are infrequently interbedded within the muddy tidal flat and upper point bar deposits.

The uppermost McMurray consists of one or more shoreface parasequence sets that can each be capped by carbonaceous shale or coal.

2.2.3 Clearwater Formation

The Wabiskaw Member of the Clearwater Formation overlies the McMurray Formation. The Wabiskaw can be subdivided into (in ascending order) the Wabiskaw D and C (Figure 2.2-6). Under most of the GSA, the McMurray is overlain by a thin shale-dominant unit known as the Wabiskaw D Shale. The Wabiskaw D Shale is a lithologically distinct unit in drill cores, composed of weakly bioturbated interbedded dark grey mud with minor very fine sand lenses and interbeds.

The Wabiskaw D Shale, which is between 0.1 and 3.2 m thick in the GSA, is the first regionally extensive cap rock shale above the McMurray Formation. Locally, the top of the McMurray was eroded during a lowstand and overlain by deposits of the lower "Wabiskaw D Valley-fill". The Wabiskaw D Valley-fill is best developed in the central part of the GSA, where it is up to 28 m thick and oriented in a north to south direction (Figure 2.2-7). The Wabiskaw D Valley-fill can only be definitively recognized in drill cores. The confidence in identifying this unit is quite low for wells without cores. The impact of the Wabiskaw D incision can be observed on the structure of the top of the McMurray Formation (Figure 2.2-8). The Wabiskaw D Valley-fill succession was also overlain by the Wabiskaw D Shale.



LEGEND

MEG Oil Sands Leases

1.6 0 1.6

SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

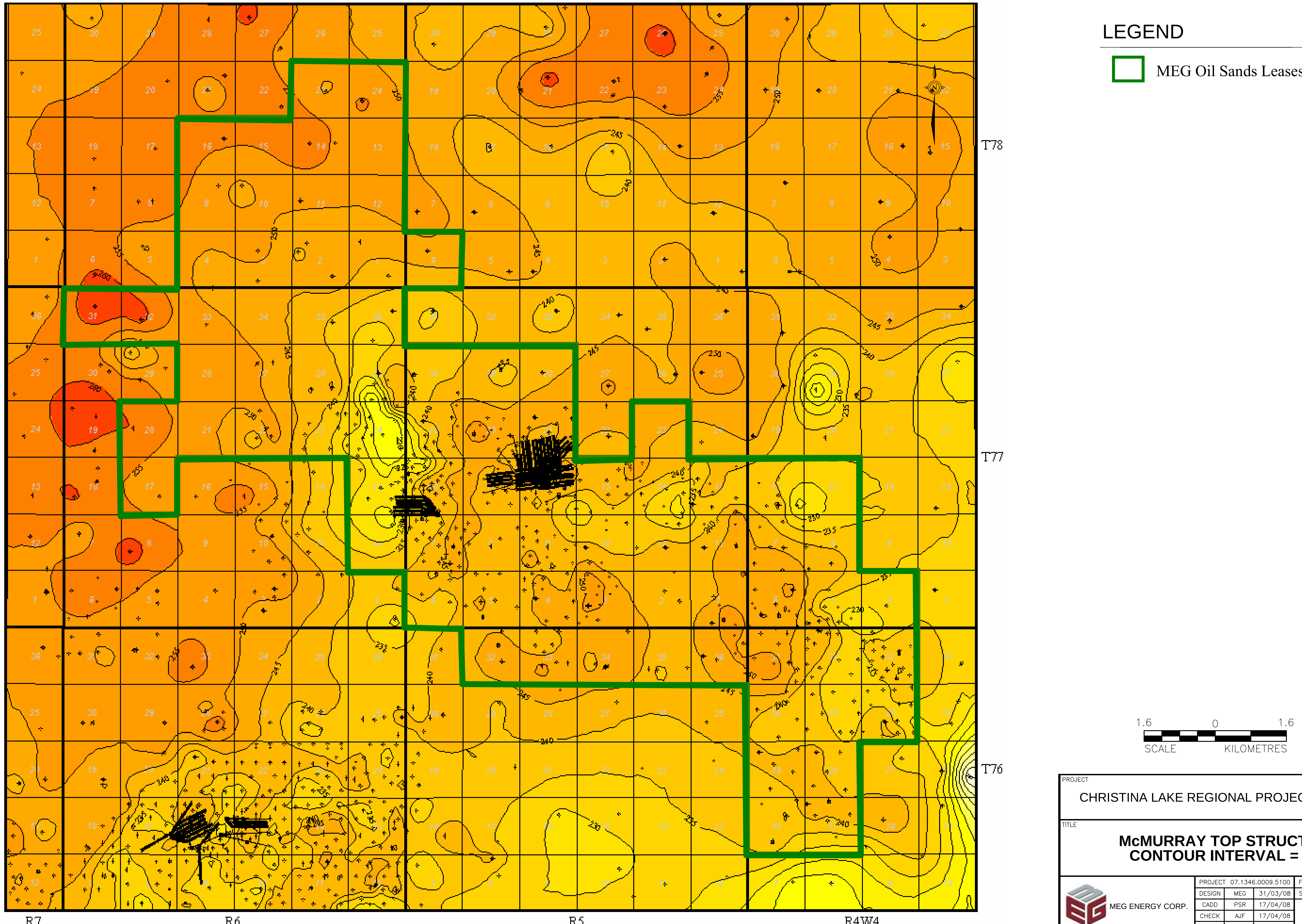
TITLE

WABISKAW MEMBER ISOPACH
CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	WabiskawM-Isopach
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	17/04/08	**FIGURE: 2.2-7**	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.2-7_Wabiskaw Memberisopach.dwg Apr 17, 2008 - 7:11pm



PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

McMURRAY TOP STRUCTURE
CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	McM–TopStructure
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	17/04/08	FIGURE: 2.2-8	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

Bioturbated muddy sands and stratified sands of "Wabiskaw C Sand" were deposited on top of the Wabiskaw D Shale. The Wabiskaw C is a regionally extensive, heavily bioturbated glauconitic sand with generally poor reservoir quality. These sands are overlain by regionally extensive shales and silts of the upper Wabiskaw. The top of the Wabiskaw (also known as the "Wabiskaw Marker") is a significant, regionally extensive marine flooding surface in the south Athabasca Oil Sands deposit (Figure 2.2-9). It is typically used as a datum for stratigraphic correlation within the highly complex McMurray Formation.

The Wabiskaw Member is overlain by a regionally extensive succession of four prograding, shoreface parasequences informally referred to (in descending order) as the Clearwater O, A, B and C sands. Each parasequence set is typically separated by a 3 to 5 m thick basal marine shale (Figures 2.2-10 and 2.2-11). These shale units act as laterally extensive seals within the Clearwater.

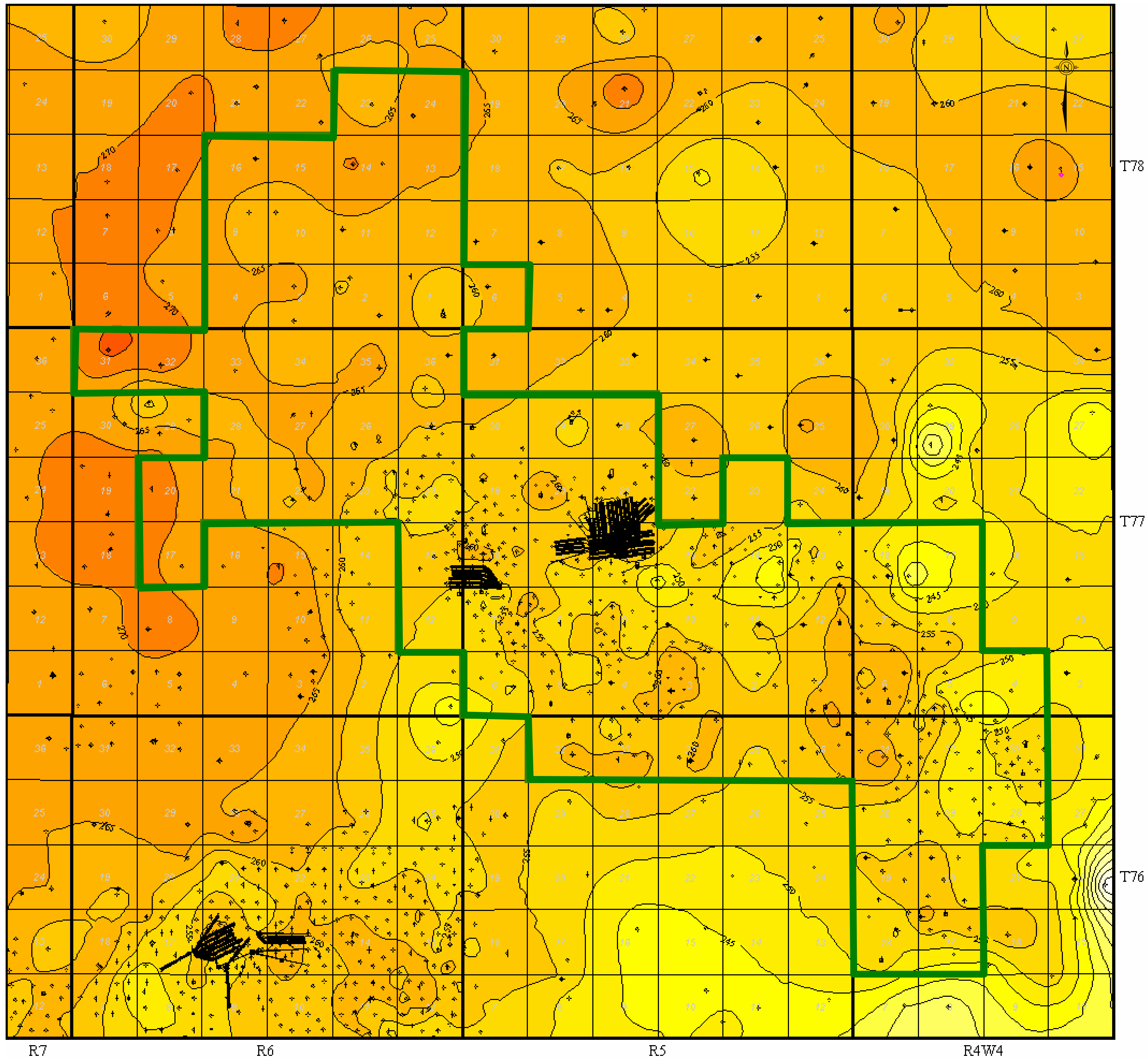
Clearwater sands are typically water saturated. Currently, water from the Clearwater A sand is being used for boiler feedwater make-up in the previously approved phases of the CLRP. The Clearwater A water sand is considered to have an adequate volume of water for MEG's Christina Lake Project (Figure 2.2-12). Local gas accumulations occur where the Clearwater sands are structurally high and have closure.

2.2.4 Grand Rapids Formation

The Clearwater Formation is overlain by sand and mud of the Grand Rapids Formation (Figure 2.2-13). The Grand Rapids is a complex succession of variable thickness progradational shoreface sands cut by a series of lowstand valleys. The valleys are variably filled with sand and mud. Porous sands are typically water saturated with local accumulations of natural gas.

2.2.5 Colorado Group

The Mannville Group is overlain by a thick regionally extensive succession of marine shale, silt and sand of the Colorado Group (Figure 2.2-14). The Colorado Group ranges in thickness from 0 to 95 m. The Joli Fou shale is the lowermost unit ranging in thickness from 0 to 35 m. The Joli Fou is overlain by silts and very fine sand of the Viking Formation. These are capped by another succession of Cretaceous marine shale that is between 0 and 64 m thick. The Colorado Group is considered to be a regional seal separating Mannville Group sand reservoirs from the Quaternary aquifers in the GSA.



LEGEND

MEG Oil Sands Leases

1.6 0 1.6
SCALE KILOMETRES

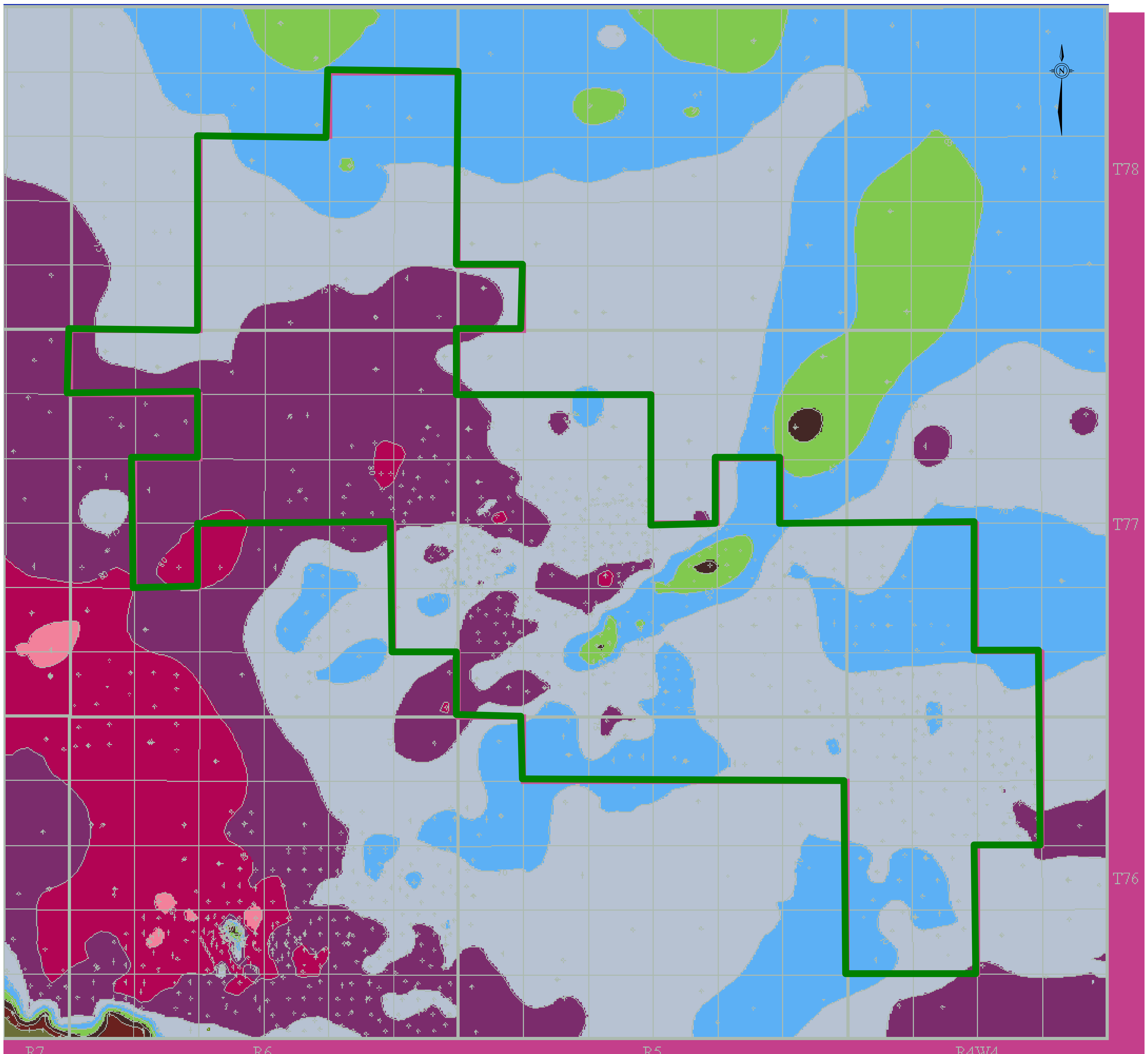
PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
WABISKAW MARKER STRUCTURE
CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Wabiskaw-Mrk-Struct
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	03/04/08	FIGURE: 2.2-9	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.2-9_Wabiskaw Marker Structure.dwg Apr 17, 2008 - 8:29pm



LEGEND

MEG Oil Sands Leases

1.6 0 1.6
SCALE KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

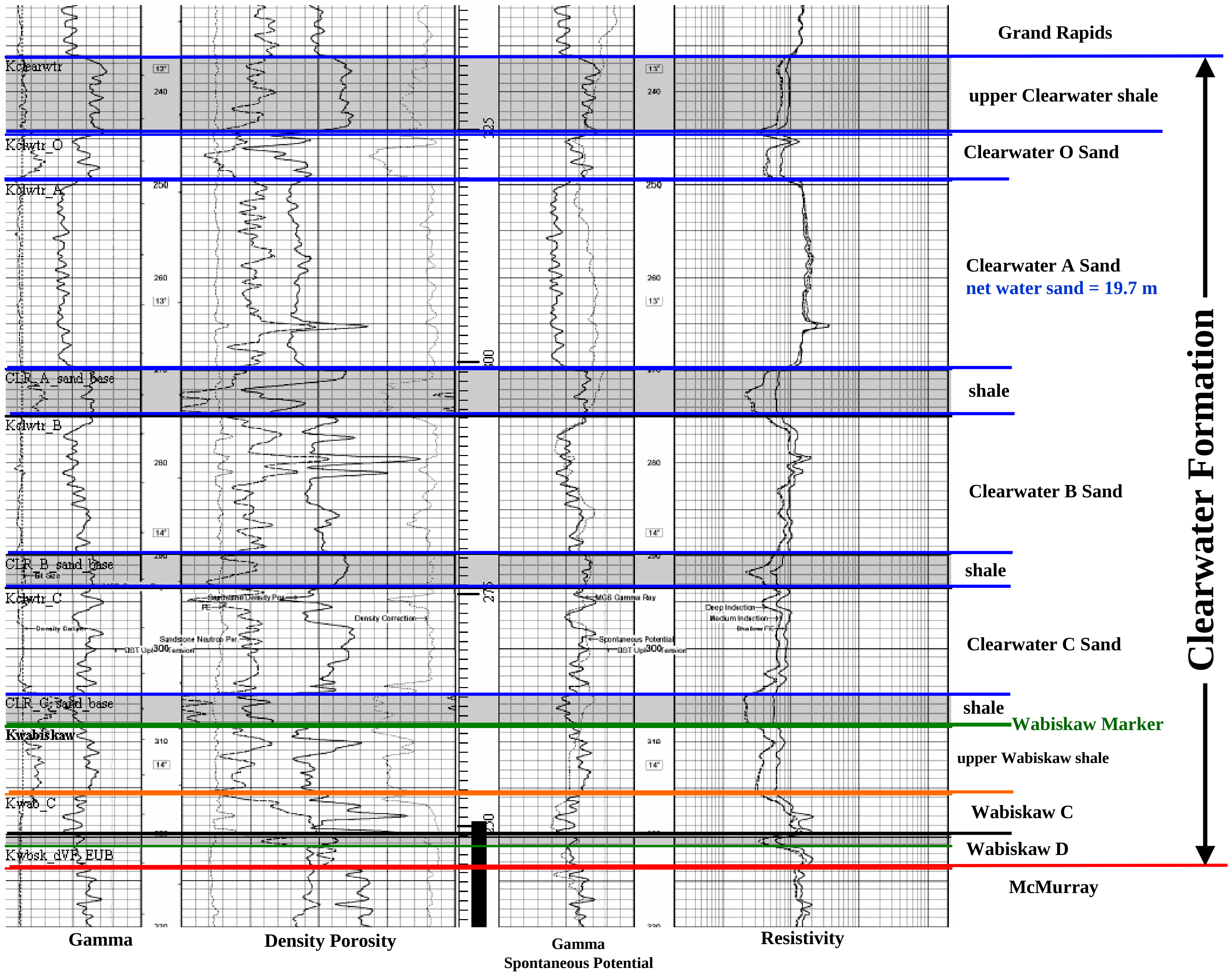
TITLE
CLEARWATER TO WABISKAW MARKER ISOPACH CONTOUR INTERVAL = 5 m

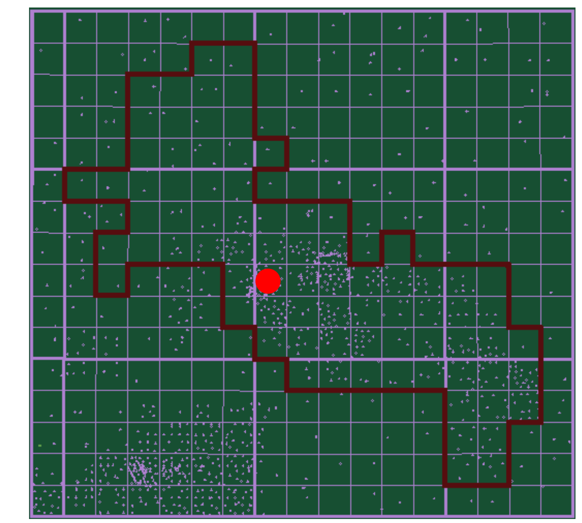
MEG ENERGY CORP.

PROJECT 07.1346.0009.5100			FILE No. CW–WabMrk–Isopach	
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	03/04/08	**FIGURE: 2.2-10**	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.2-10_Clearwater to Wabiskaw Marker Isopach.dwg Apr 17, 2008 - 8:33pm

1AE/06-18-77-05W4





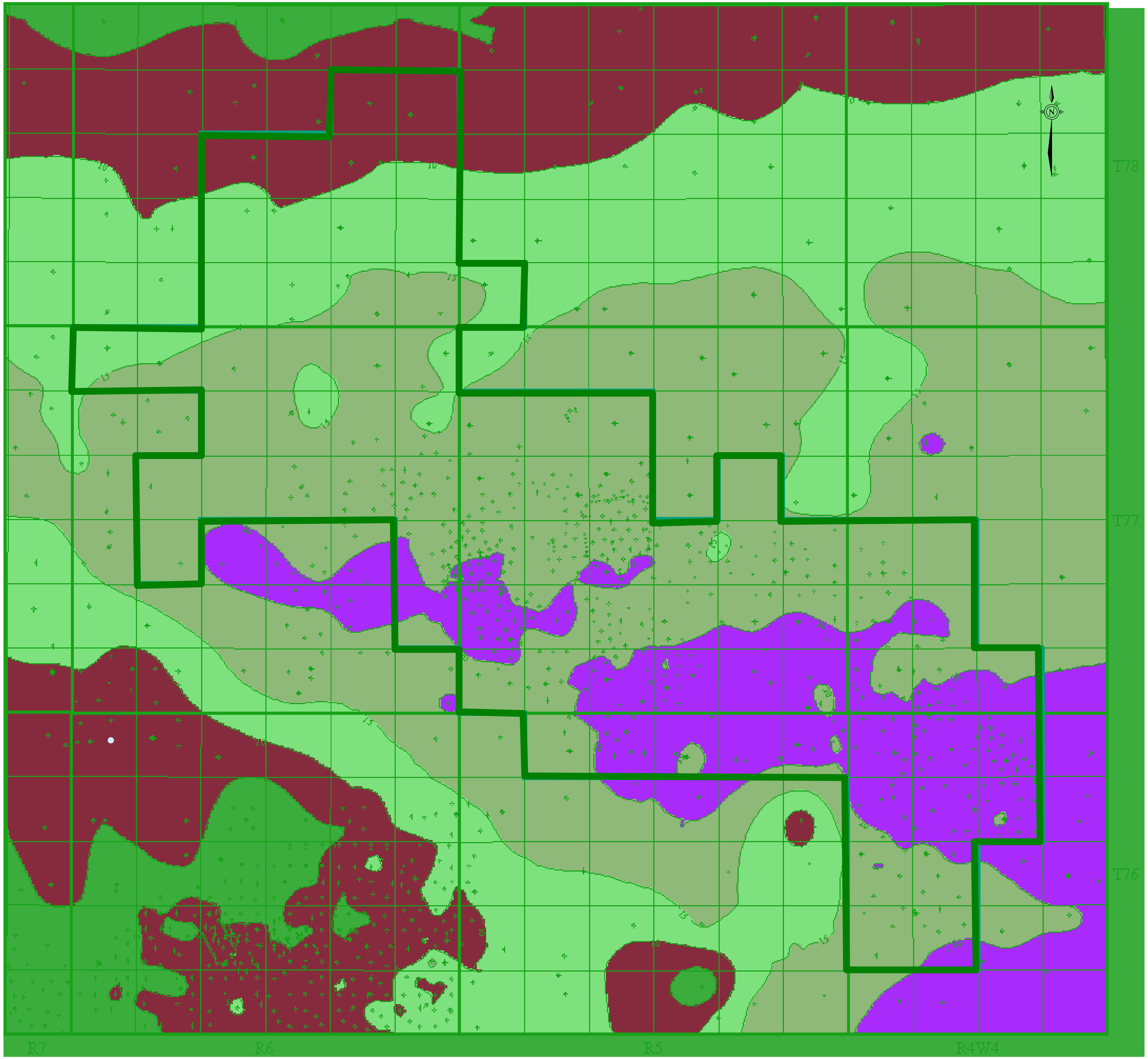
MEG Oil Sands Leases

PROJECT	CHRISTINA LAKE REGIONAL PROJECT - PHASE 3
TITLE	CLEARWATER FORMATION TYPE LOG 1AE/06-18-77-05W4

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	FILE No.	CW-Fm-Log1A-0618
DESIGN	MEG	24/03/08	SCALE AS SHOWN REV. 0
CADD	PSR	07/04/08	FIGURE: 2.2-11
CHECK	AJF	18/04/08	
REVIEW	SG	18/04/08	

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.2-11_Clearwater Formation Type Log_1AE_06-18-77-05W4.dwg Apr 18, 2008 - 9:22am



LEGEND

MEG Oil Sands Leases

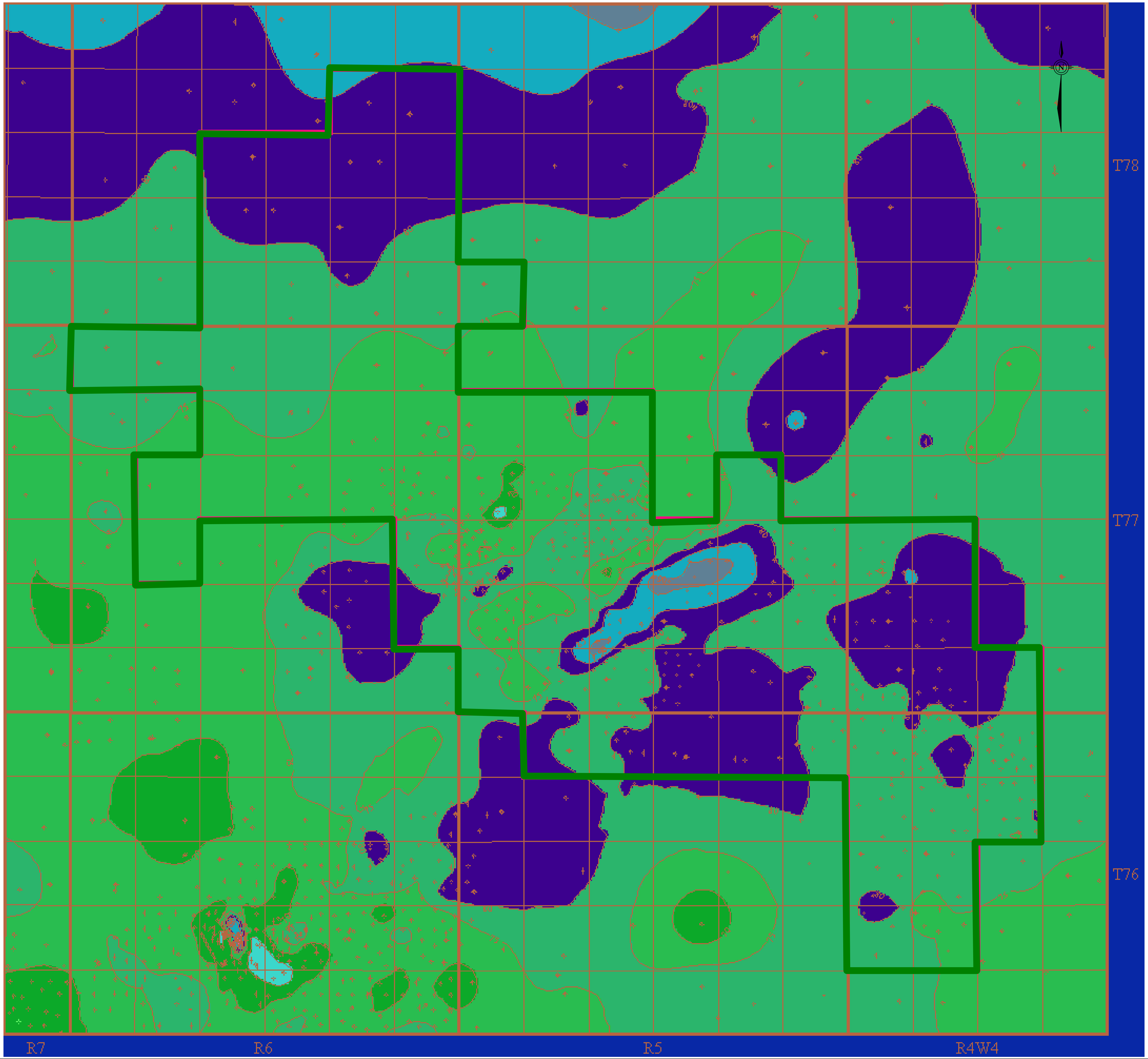
1.6 0 1.6
SCALE KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
CLEARWATER A
NET WATER SAND ISOPACH
CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	ClearW-A-nws-Isop
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	17/04/08	**FIGURE: 2.2-12**	
CHECK	ajf	17/04/08		
REVIEW	sg	17/04/08		



LEGEND

MEG Oil Sands Leases

1.6 0 1.6

SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

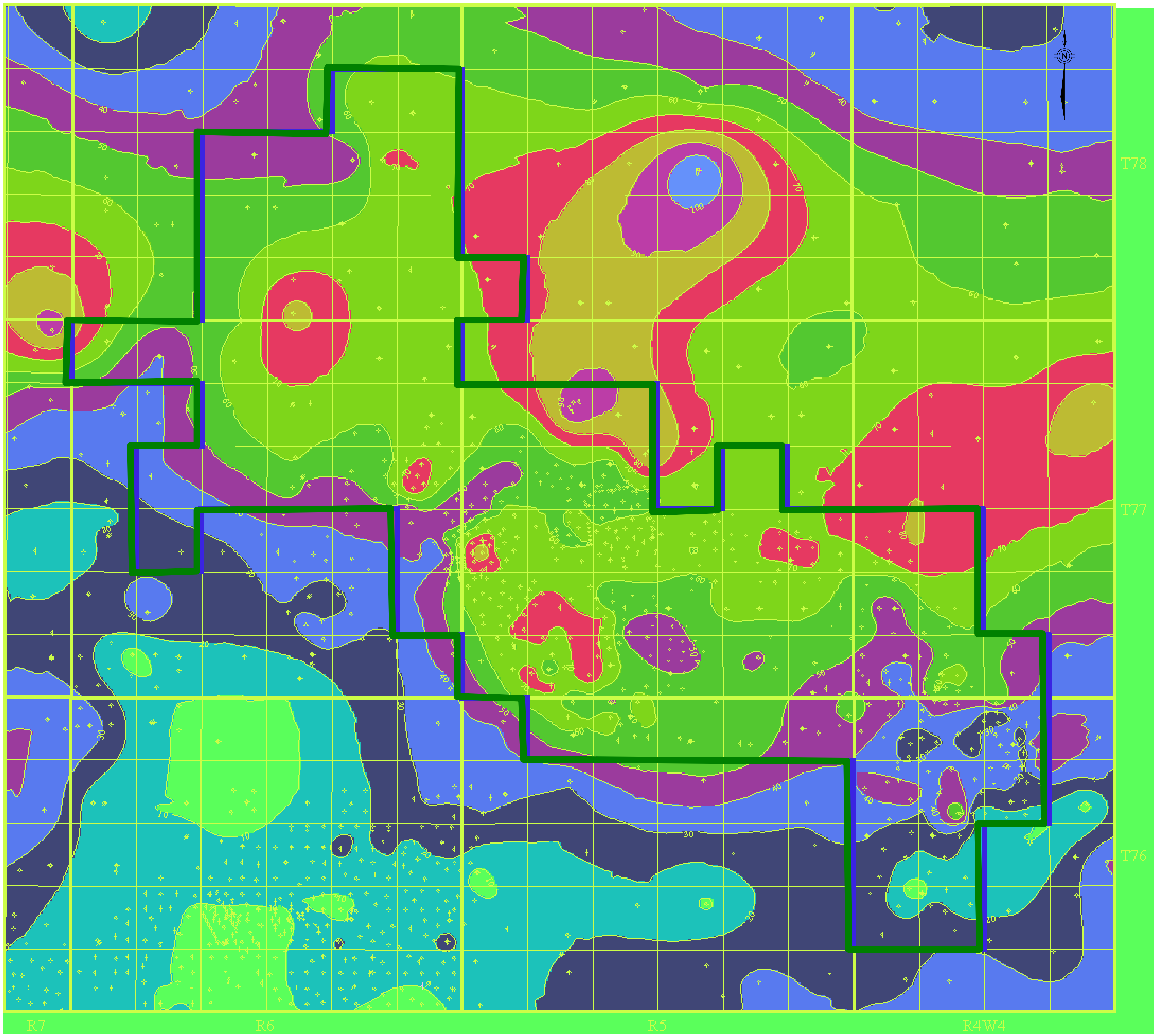
GRAND RAPIDS ISOPACH
CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	FILE No.	GrandRapids-Isopach
DESIGN	MEG	31/03/08	SCALE AS SHOWN REV. 0
CADD	PSR	03/04/08	
CHECK	AJF	17/04/08	
REVIEW	SG	17/04/08	

FIGURE: 2.2-13

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.2-13_Grand Rapids Isopach.dwg Apr 18, 2008 - 9:13am



LEGEND

MEG Oil Sands Leases

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

COLORADO GROUP ISOPACH
CONTOUR INTERVAL = 10 m

MEG ENERGY CORP.

PROJECT 07.1346.0009.5100			FILE No. Colorado Grp–Isopach	
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	03/04/08	**FIGURE: 2.2-14**	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

2.2.6 Quaternary

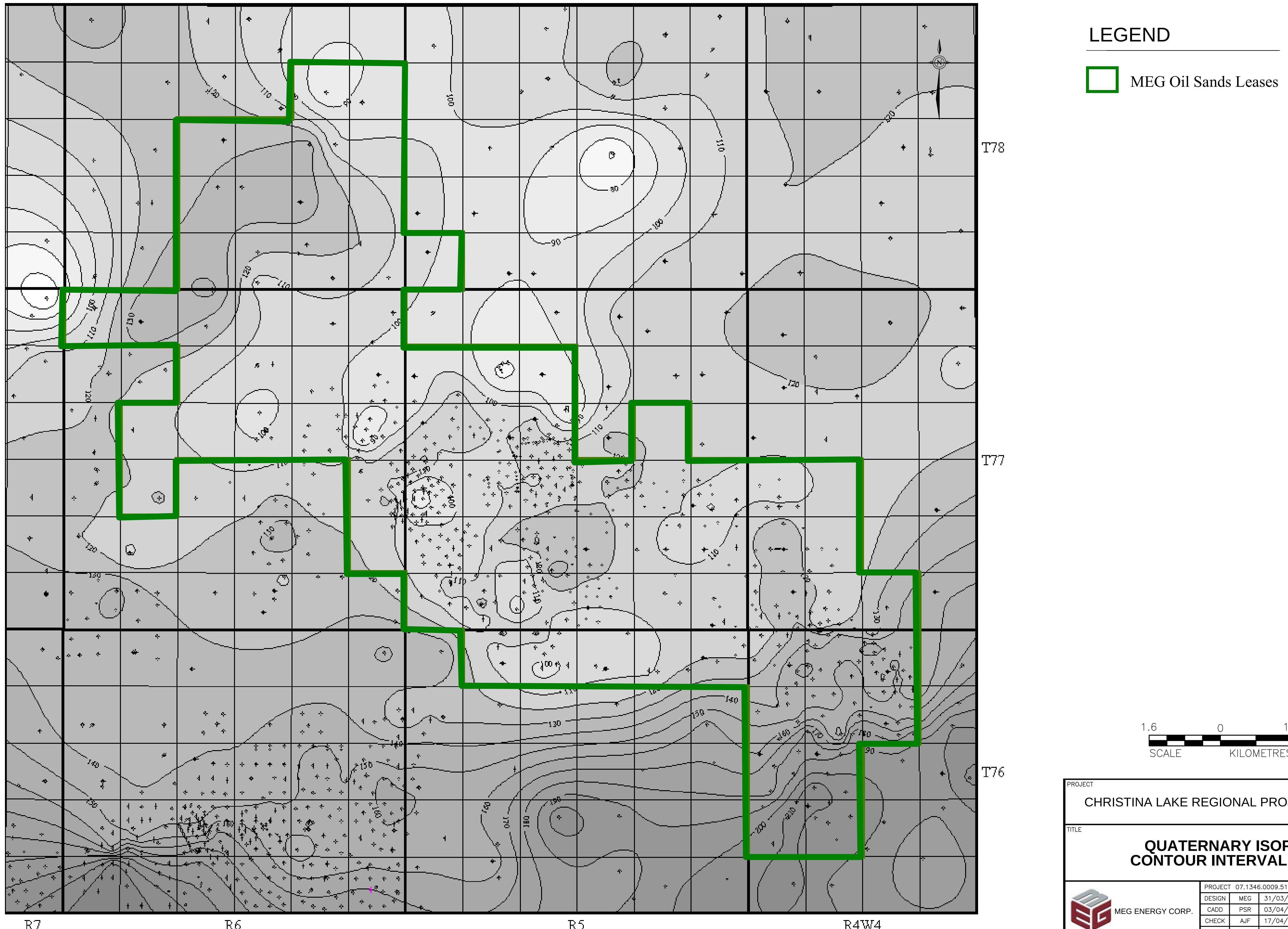
The Colorado Group succession is erosionally overlain by a succession of Quaternary-aged sand, gravel, mud and till. The Quaternary is between 60 to 220 m thick (Figure 2.2-15). In one instance (1AA/04-20-76-04 W4M) the Quaternary completely removes the Colorado Group eroding into the uppermost Grand Rapids Formation. The main Quaternary aquifer units are (in ascending order) the Empress and Ethel Lake formations.

Within MEG's oil sands leases, Quaternary deposits are separated from the bitumen bearing sands of the McMurray Formation by between 153 and 276 m of Cretaceous sediments.

2.3 MCMURRAY RESOURCE CHARACTERIZATION

Core and petrophysical well logs were integrated in order to determine bitumen sand pay intervals for the McMurray Formation (Figure 2.3-1). Well logs provide the most accurate measure of in-situ porosity of unconsolidated sands. Logs also provide a consistent measurement of formation resistivity (deep induction) from which bitumen saturation can be calculated. Cores provide analytical data (weight percent bitumen) that can be used to calibrate resistivity measurements from logs. Cores also provide a qualitative means to characterize reservoir continuity.

High resolution stratigraphic and lithofacies analyses can only be conducted if drill cores are available. Because SAGD requires reservoir sands with good vertical continuity, lithofacies that can potentially slow or halt the rise of steam in the reservoir need to be identified. Potential baffles to vertical steam rise include sands with locally abundant mud clasts and sands with scattered mud interbeds and partings. Mud interbeds and partings are thought to be laterally discontinuous in these sand-dominant lithofacies. Steam can rise through these reservoir lithofacies, albeit at a reduced rate because the overall vertical permeability is decreased. Barriers to vertical permeability include more laterally extensive mud-dominant lithofacies such as muddy IHS.



PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

QUATERNARY ISOPACH
CONTOUR INTERVAL = 10 m

MEG ENERGY CORP.	PROJECT	07.1346.0009.5100	FILE No. Colorado Grp–Isopach	
	DESIGN	MEG	31/03/08	SCALE AS SHOWN REV. 0
	CADD	PSR	03/04/08	FIGURE: 2.2-15
	CHECK	AJF	17/04/08	
	REVIEW	SG	17/04/08	

L:\2007\1346 Oil Sands\07–1346–0009–MEG EXPANSION\5100\5190\Vol 1–Section 2–Geology\Fig 2.2–15_Quaternary Isopach.dwg Apr 18, 2008 – 9:28am

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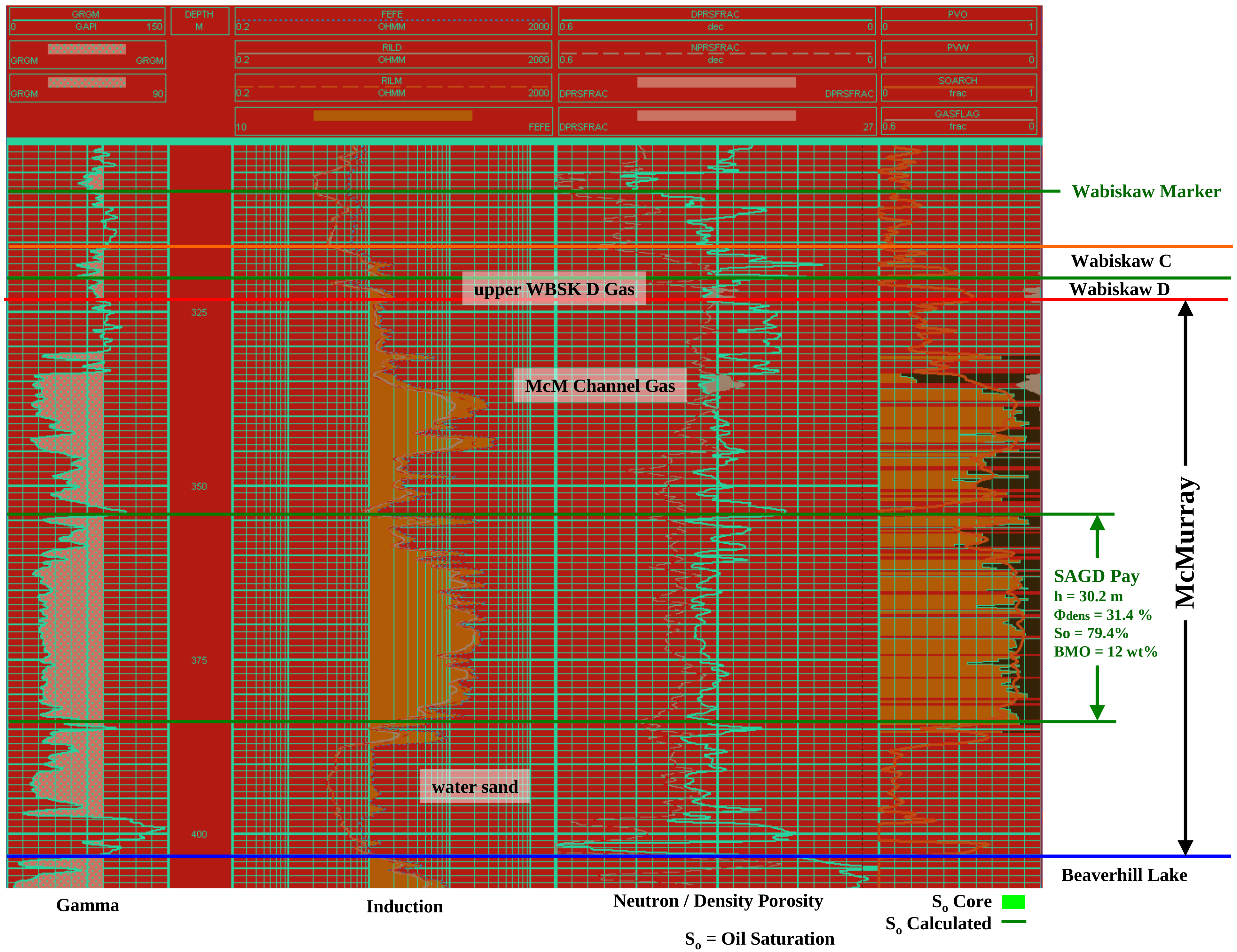
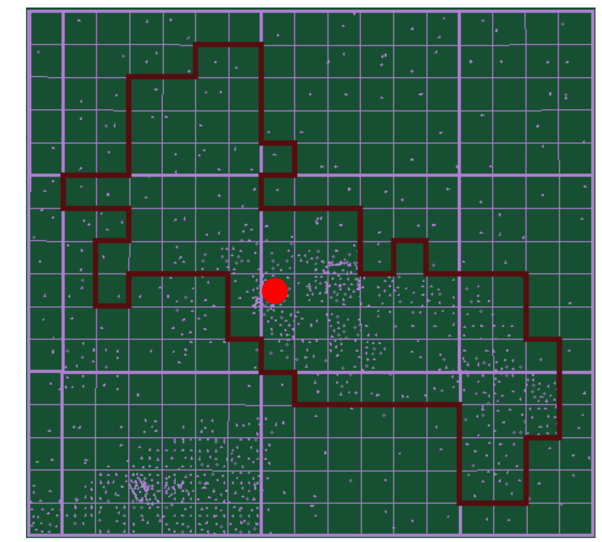




MEG Oil Sands Leases

PROJECT	CHRISTINA LAKE REGIONAL PROJECT - PHASE 3
TITLE	**STEAM ASSISTED GRAVITY DRAINAGE PAY TYPE LOG 1AE/06-18-77-05W4**

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	
DESIGN	MEG	24/03/08
CADD	PSR	05/04/08
CHECK	AJF	18/04/08
REVIEW	SG	18/04/08

FILE No. Type Log 1AE-06-18 | SCALE AS SHOWN | REV. 0

FIGURE: 2.3-1

Bitumen pay for SAGD is generally defined by the following parameters:

- density porosity ≥27%;
- oil saturation ≥50% (equivalent to ≥6 weight percent bitumen at 27% porosity); and
- continuous bitumen pay ≥10 m.

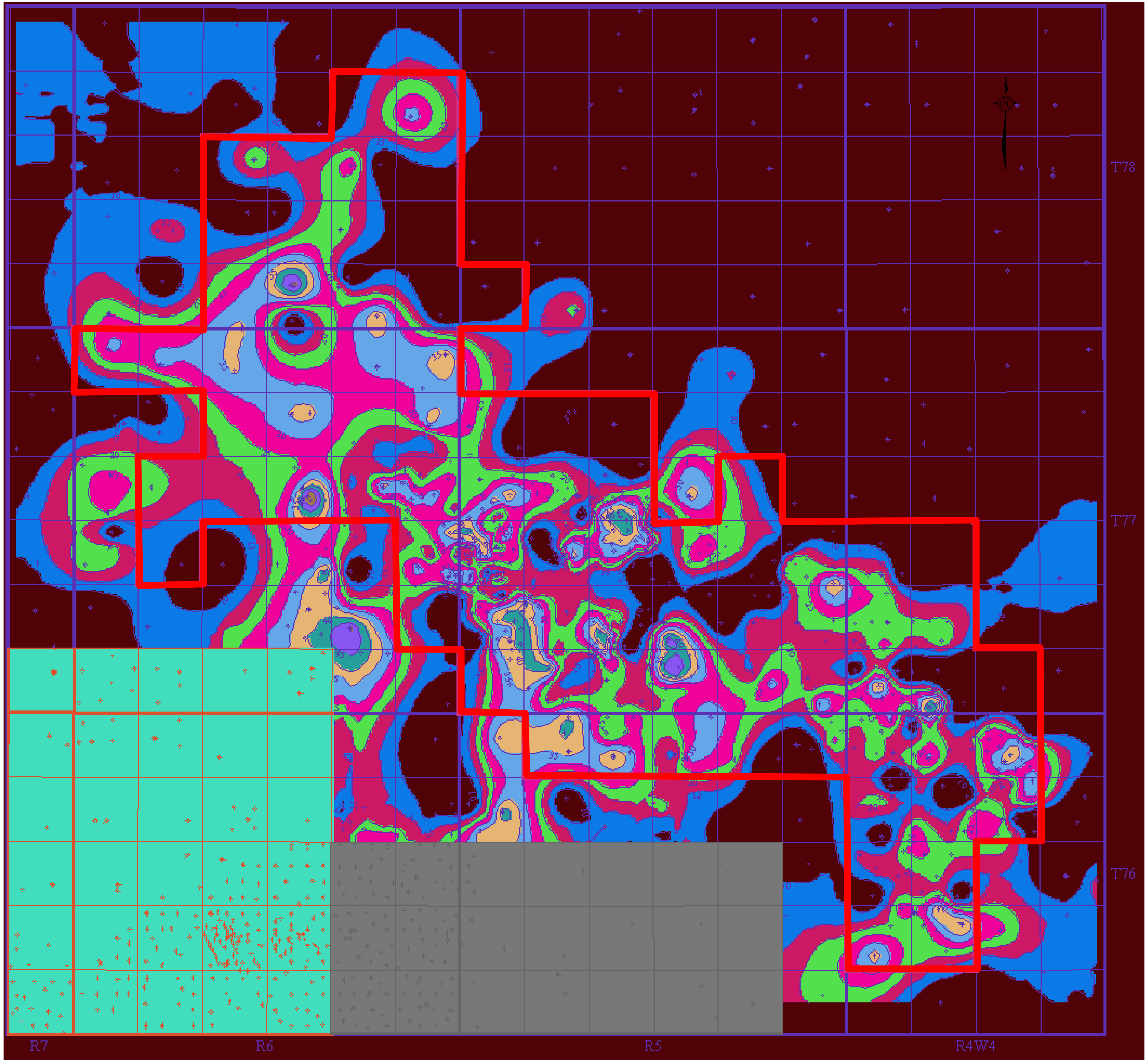
However, the key to defining bitumen pay is the integration of core and log data with the analysis of the interrelationship of the various reservoir and non-reservoir lithofacies. For example, bitumen-saturated sand with abundant mud clasts commonly has log and core properties that fall below the minimum cutoffs for porosity and saturation. However, observation and analysis of this lithofacies concludes that it is still reservoir quality and therefore should be included as bitumen pay. Sandy IHS is another lithofacies that is included as bitumen pay even though porosity and saturation cut offs are not met. Vertical permeability is reduced in sandy IHS but not to the extent that steam rise is inhibited.

McMurray Total SAGD Pay ≥10 m (Figure 2.3-2) represents the sum of continuous SAGD (≥10 m) pay in the GSA. These continuous pay values have been determined through the integration and analyses of all available core and log data. This isopach map reflects the thickness of continuous pay (≥10 m) that MEG expects to potentially access using SAGD.

It is estimated that the McMurray Formation in MEG's oil sands leases contains up to 430 million cubic metres of recoverable bitumen.

2.3.1 Cap Rock

The McMurray Formation is capped by a series of regionally extensive shales of variable thickness in the Wabiskaw and the basal Clearwater Formation (Figure 2.2-6). Locally, MEG considers non-reservoir lithofacies in the upper portion of the McMurray Formation to be cap rock for the SAGD pay interval. These cap rocks typically include the more mud-dominant lithofacies such as bedded mud, muddy IHS and bioturbated sandy mud. These lithofacies were mainly deposited in tidal flat and tidal creek settings.



LEGEND

MEG Oil Sands Leases

1.6 0 1.6

SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

TOTAL McMURRAY STEAM ASSISTED GRAVITY DRAINAGE PAY ≥10 m
CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Tot McM Pay
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	04/04/08		
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

FIGURE: 2.3-2

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-2_Total McMurray SAGD Pay_10m.dwg Apr 18, 2008 - 9:37am

Locally, variable thicknesses of channel sand are interbedded with these mud-dominant successions. These channel deposits are more commonly of poorer reservoir quality because of increased detrital mud content, and are considered to be laterally discontinuous and of limited size. As a consequence, these sands are not considered to be primary targets for SAGD development. However, where these local sands are in direct contact with the underlying SAGD pay interval, it is possible that steam will access these additional resources.

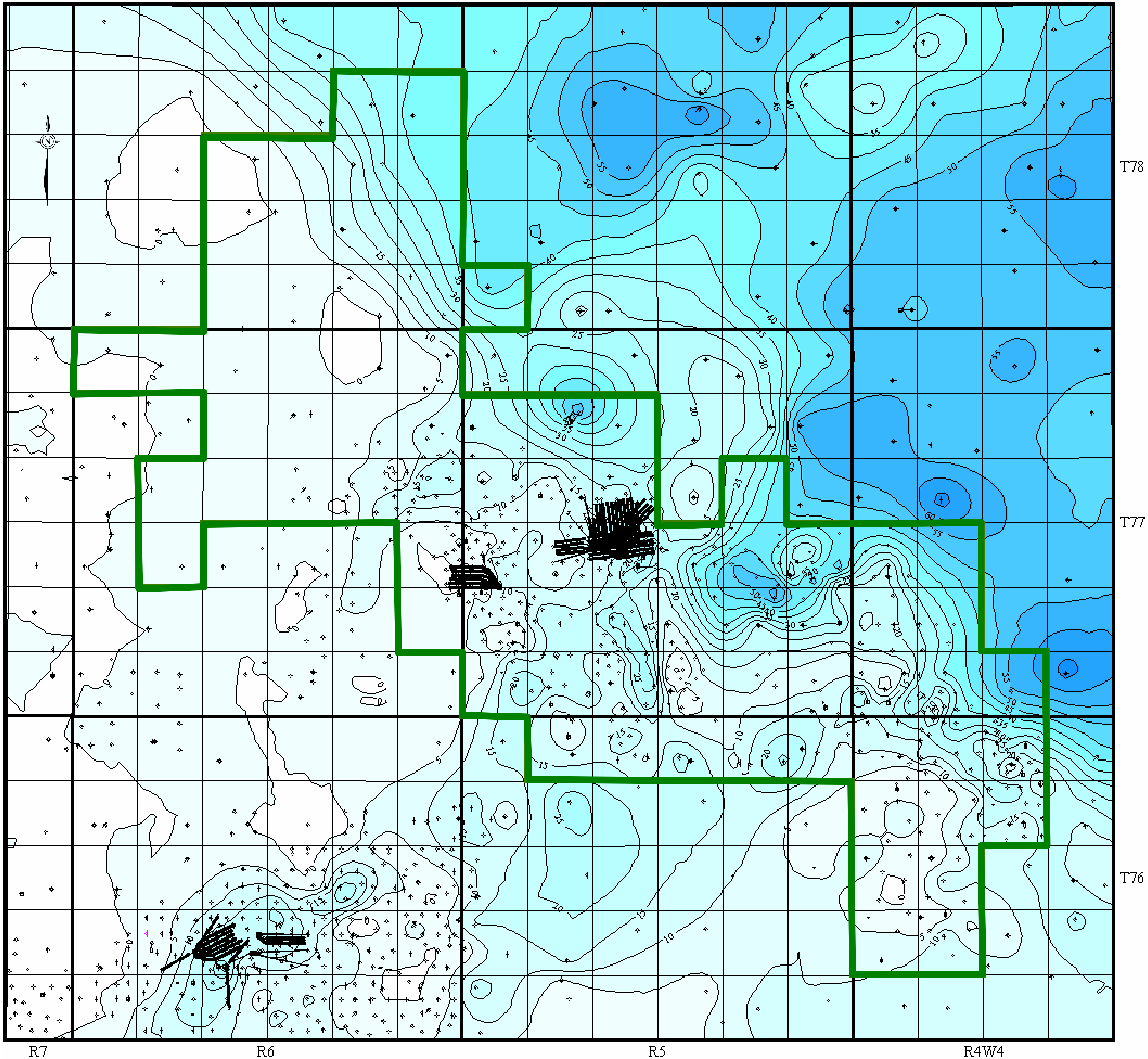
2.3.2 Basal McMurray Water Sand

Bitumen pay can be underlain by water-saturated sand in the GSA. Water sands can occur as a basal water saturated zone that is directly in contact with overlying bitumen pay. Bottom water in direct contact with the bitumen pay is considered to be manageable when using proper SAGD operating strategies. Production wells will be placed as close to the bitumen/water contact as the local geology allows, with the intention to remain within the bitumen-saturated sand. An isopach of the basal McMurray water sand has also been provided (Figure 2.3-3). This is the total thickness of water sand below the bitumen-saturated succession whether the water sand is or is not in direct contact with the overlying bitumen-saturated sand.

2.3.3 Reservoir Development

Sixteen subsurface drainage patterns (A to P) have been identified for the initial development of Phase 3 SAGD production (Figure 2.3-4). Total McMurray SAGD pay ($\geq$10 m) for the initial patterns ranges from 5 to 41 m (Figure 2.3-5). In addition to the SAGD pay trends, the base McMurray SAGD pay structure (Figure 2.3-6) was used to determine SAGD pattern orientations. Production wells will be placed as close to the bottom of the SAGD pay interval as possible while maintaining a nearly horizontal trajectory.

A nominal value of 3 m was used to represent the average stand-off of the production well from the base of the SAGD pay interval for recoverable resource calculations. The actual stand-off of the production well will ultimately be dictated by the local geology and drilling accuracy. Reservoir parameters and resources for each proposed Phase 3 pattern are summarized in Table 2.3-1.



LEGEND

MEG Oil Sands Leases

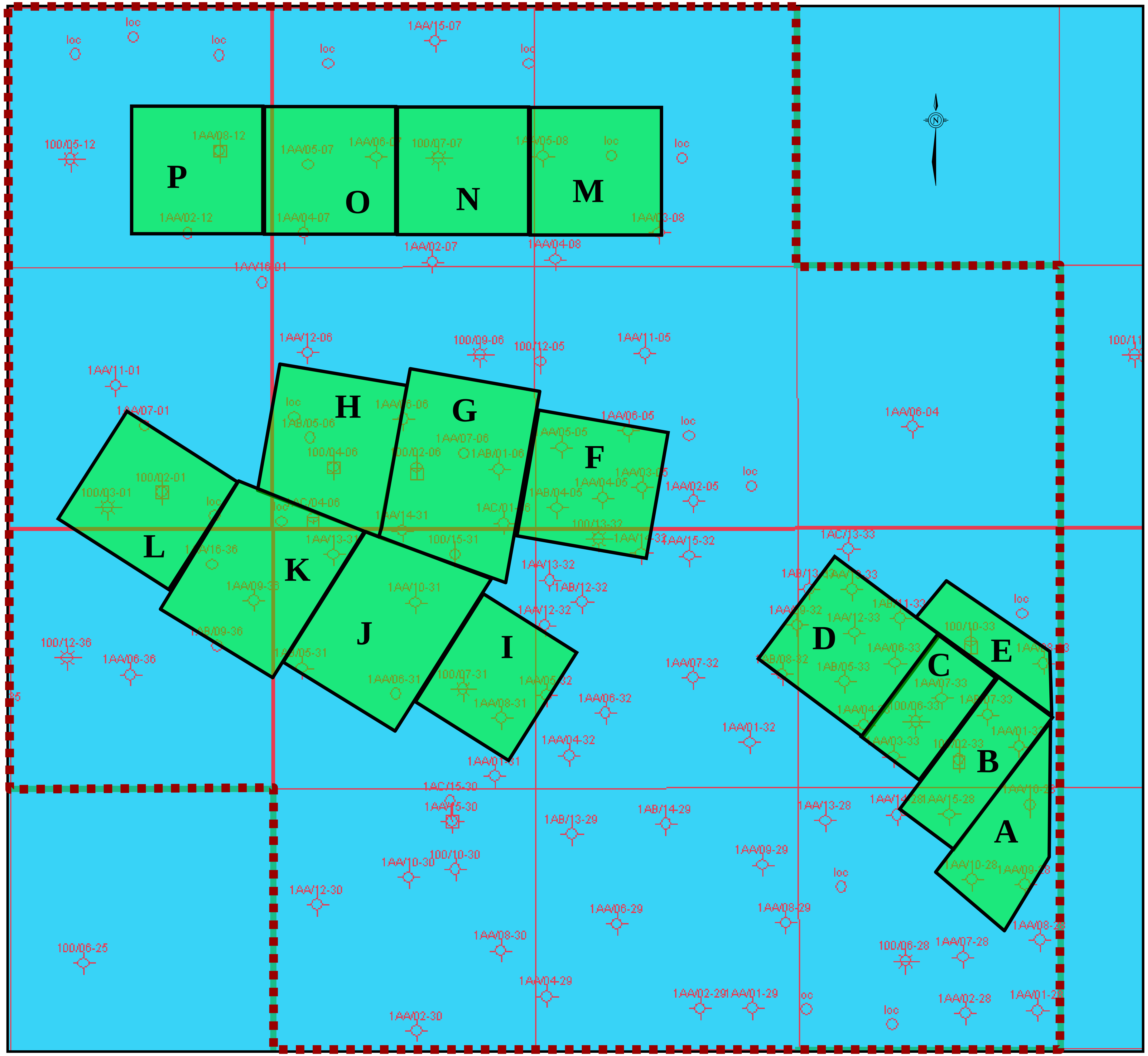
1.6 0 1.6
SCALE KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
BASAL McMURRAY NET WATER SAND ISOPACH CONTOUR INTERVAL = 5 m

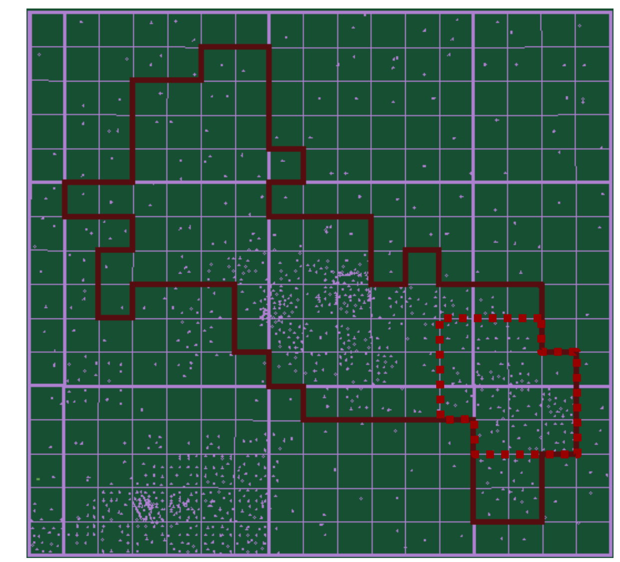
MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Basal McM–Isopach
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	05/04/08	FIGURE: 2.3-3	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		



LEGEND

- MEG Oil Sands Leases
- Phase 3 Initial Development Area
- Subsurface SAGD Patterns



400 0 400
SCALE METRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
PHASE 3 INITIAL STEAM ASSISTED GRAVITY DRAINAGE PATTERNS

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	FILE No. Phase3-SAGDPatterns
DESIGN	MEG 31/03/08	SCALE AS SHOWN REV. 0
CADD	PSR 05/04/08	
CHECK	AJF 17/04/08	**FIGURE: 2.3-4**
REVIEW	SG 17/04/08	

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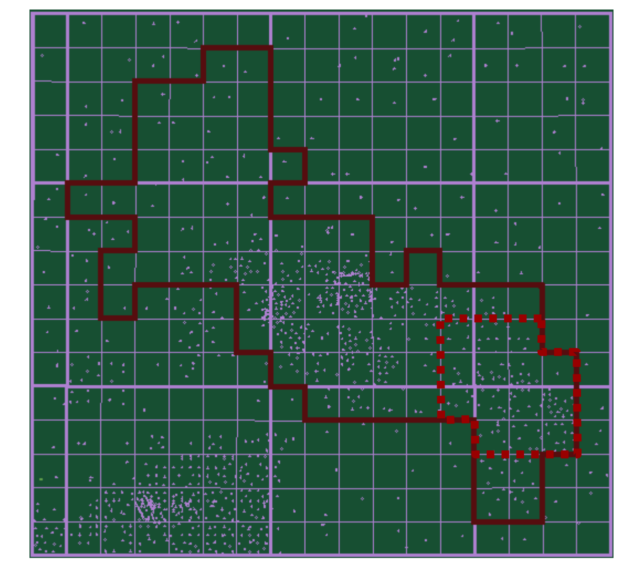
LEGEND

- MEG Oil Sands Leases
- Phase 3 Initial Development Area
- Subsurface SAGD Patterns

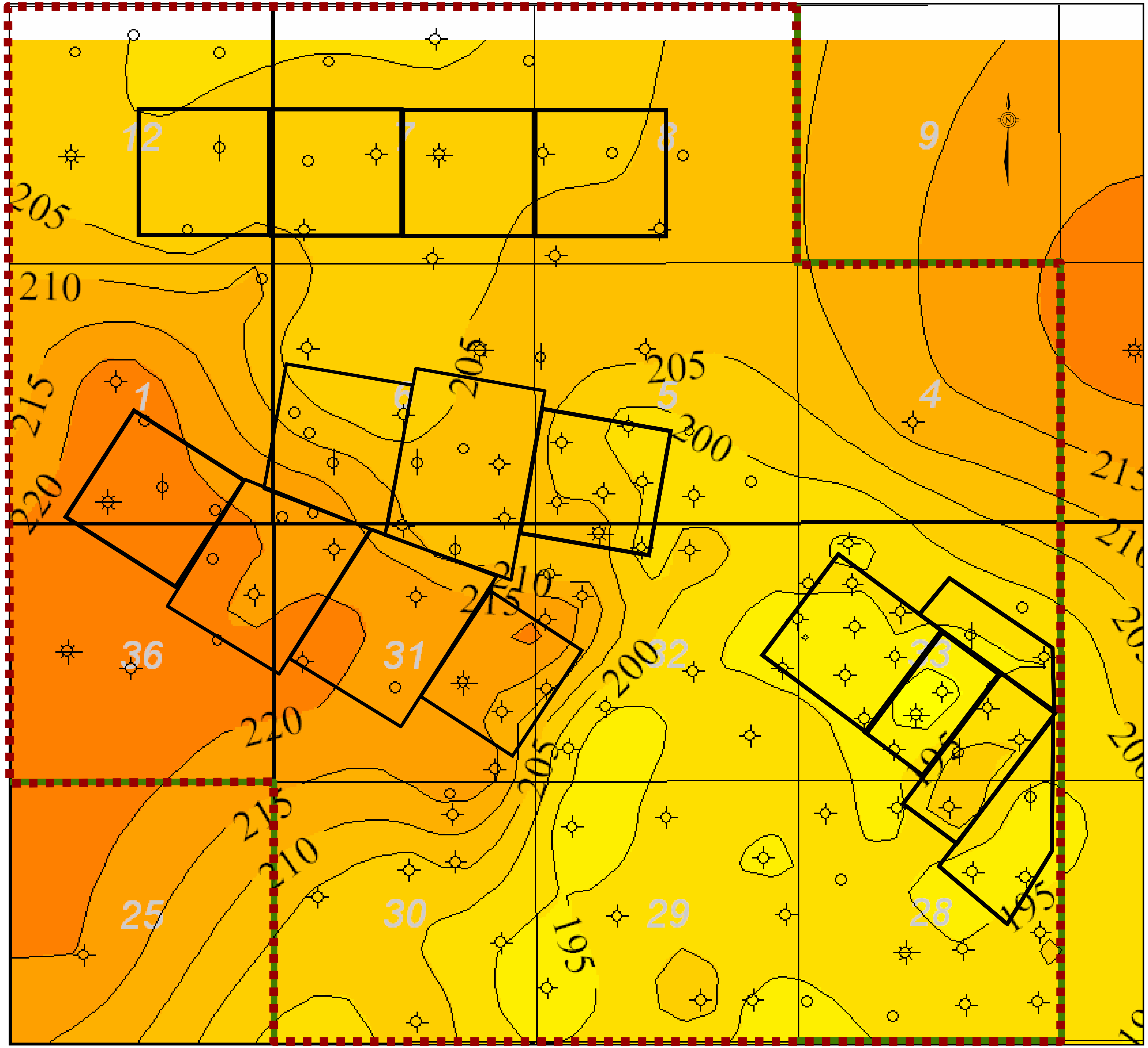


400 0 400
SCALE METRES

PROJECT	CHRISTINA LAKE REGIONAL PROJECT - PHASE 3
TITLE	INITIAL DEVELOPMENT AREA TOTAL McMURRAY STEAM ASSISTED GRAVITY DRAINAGE PAY ≥10 m CONTOUR INTERVAL = 5 m

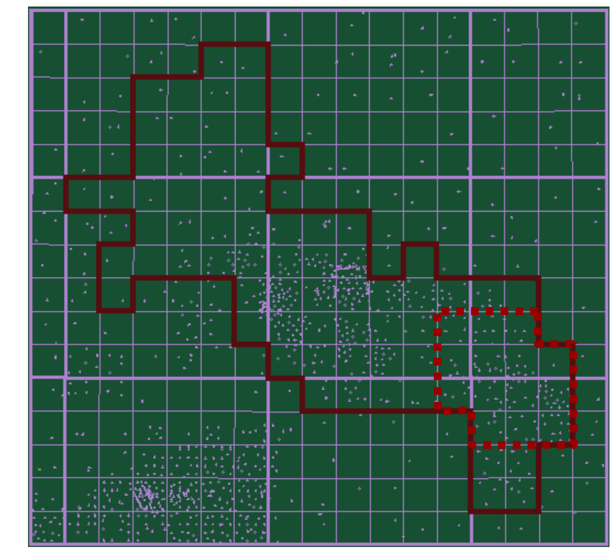
MEG ENERGY CORP.	PROJECT	07.1346.0009.5100		FILE No.	Tot McM-SAGD
	DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
	CADD	PSR	05/04/08	FIGURE: 2.3-5	
	CHECK	AJF	17/04/08		
	REVIEW	SG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-5_Initial Dev Area Total McM SAGD Pay Greater than 10m.dwg Apr 18, 2008 - 10:52am



LEGEND

- MEG Oil Sands Leases
- Phase 3 Initial Development Area
- Subsurface SAGD Patterns



400 0 400
SCALE METRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
INITIAL DEVELOPMENT AREA BASE STEAM ASSISTED GRAVITY DRAINAGE PAY STRUCTURE CONTOUR INTERVAL = 5 m

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Base SAGD-PayStruct
DESIGN	MEG	31/03/08	SCALE	AS SHOWN REV. 0
CADD	PSR	05/04/08	FIGURE: 2.3-6	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-6_Initial Dev Area Base SAGD Pay Structure.dwg Apr 18, 2008 - 10:58am

Table 2.3-1 Phase 3 Initial Patterns McMurray Stream Assisted Gravity Drainage Resources

Pattern	Volume	well pairs	pattern area (m2)	pattern area (ha)	RF (frac)	avg h (m)	avg So (frac)	avg PHI (frac)	pattern OOIP (m3)	pattern OOIP (bbl)	OOIP / well (m3)	OOIP / well (bbl)	ROIP / well (bbl)
A	McMurray OOIP (≥6 wt% BMO)	5	400,000	40		32.7	0.75	0.34	3,322,000	20,920,000	664,000	4,184,000	
A	SAGD pay	5	400,000	40		30.5	0.77	0.34	3,209,000	20,204,000	642,000	4,041,000	
A	SAGD pay above producer	5	400,000	40	0.6	27.5	0.77	0.34	2,893,000	18,217,000	579,000	3,643,000	2,186,000
B	McMurray OOIP (≥6 wt% BMO)	4	400,000	40		34.1	0.71	0.31	3,028,000	19,067,000	757,000	4,767,000	
B	SAGD pay	4	400,000	40		25.8	0.75	0.31	2,425,000	15,271,000	606,000	3,818,000	
B	SAGD pay above producer	4	400,000	40	0.6	22.8	0.75	0.31	2,143,000	13,495,000	536,000	3,374,000	2,024,000
C	McMurray OOIP (≥6 wt% BMO)	4	320,000	32		42.4	0.78	0.33	3,501,000	22,042,000	875,000	5,511,000	
C	SAGD pay	4	320,000	32		33.7	0.80	0.34	2,912,000	18,334,000	728,000	4,584,000	
C	SAGD pay above producer	4	320,000	32	0.6	30.7	0.80	0.34	2,652,000	16,702,000	663,000	4,176,000	2,505,000
D	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		30.9	0.73	0.32	4,548,000	28,641,000	569,000	3,580,000	
D	SAGD pay	8	640,000	64		24.3	0.75	0.32	3,764,000	23,699,000	470,000	2,962,000	
D	SAGD pay above producer	8	640,000	64	0.6	21.3	0.75	0.32	3,299,000	20,773,000	412,000	2,597,000	1,558,000
E	McMurray OOIP (≥6 wt% BMO)	3	240,000	24		43.0	0.72	0.34	2,508,000	15,791,000	836,000	5,264,000	
E	SAGD pay	3	240,000	24		31.1	0.77	0.33	1,926,000	12,126,000	642,000	4,042,000	
E	SAGD pay above producer	3	240,000	24	0.6	28.1	0.77	0.33	1,740,000	10,956,000	580,000	3,652,000	2,191,000
F	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		39.3	0.78	0.31	6,162,000	38,803,000	770,000	4,850,000	
F	SAGD pay	8	640,000	64		23.7	0.80	0.32	3,898,000	24,546,000	487,000	3,068,000	
F	SAGD pay above producer	8	640,000	64	0.6	20.7	0.80	0.32	3,405,000	21,439,000	426,000	2,680,000	1,608,000
G	McMurray OOIP (≥6 wt% BMO)	10	800,000	80		32.8	0.77	0.31	6,429,000	40,481,000	643,000	4,048,000	
G	SAGD pay	10	800,000	80		25.1	0.80	0.32	5,060,000	31,863,000	506,000	3,186,000	
G	SAGD pay above producer	10	800,000	80	0.6	22.1	0.80	0.32	4,455,000	28,055,000	446,000	2,805,000	1,683,000
H	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		33.3	0.74	0.32	5,008,000	31,537,000	626,000	3,942,000	
H	SAGD pay	8	640,000	64		25.6	0.74	0.31	3,817,000	24,038,000	477,000	3,005,000	
H	SAGD pay above producer	8	640,000	64	0.6	22.6	0.74	0.31	3,370,000	21,221,000	421,000	2,653,000	1,592,000
I	McMurray OOIP (≥6 wt% BMO)	7	560,000	56		22.3	0.69	0.31	2,685,000	16,906,000	384,000	2,415,000	
I	SAGD pay	7	560,000	56		17.0	0.74	0.31	2,199,000	13,847,000	314,000	1,978,000	
I	SAGD pay above producer	7	560,000	56	0.6	14.0	0.74	0.31	1,811,000	11,404,000	259,000	1,629,000	977,000
J	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		26.2	0.75	0.32	4,024,000	25,340,000	503,000	3,168,000	
J	SAGD pay	8	640,000	64		19.9	0.80	0.33	3,337,000	21,011,000	417,000	2,626,000	
J	SAGD pay above producer	8	640,000	64	0.6	16.9	0.80	0.33	2,834,000	17,844,000	354,000	2,230,000	1,338,000
K	McMurray OOIP (≥6 wt% BMO)	9	720,000	72		27.6	0.79	0.32	5,067,000	31,908,000	563,000	3,545,000	
K	SAGD pay	9	720,000	72		20.0	0.85	0.33	4,046,000	25,479,000	450,000	2,831,000	
K	SAGD pay above producer	9	720,000	72	0.6	17.0	0.85	0.33	3,439,000	21,658,000	382,000	2,406,000	1,444,000
L	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		28.9	0.76	0.31	4,384,000	27,602,000	548,000	3,450,000	
L	SAGD pay	8	640,000	64		18.2	0.83	0.33	3,133,000	19,730,000	392,000	2,466,000	
L	SAGD pay above producer	8	640,000	64	0.6	15.2	0.83	0.33	2,617,000	16,478,000	327,000	2,060,000	1,236,000
M	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		24.3	0.71	0.32	3,530,000	22,230,000	441,000	2,779,000	
M	SAGD pay	8	640,000	64		19.3	0.73	0.32	2,915,000	18,356,000	364,000	2,294,000	
M	SAGD pay above producer	8	640,000	64	0.6	16.3	0.73	0.32	2,462,000	15,502,000	308,000	1,938,000	1,163,000
N	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		27.7	0.74	0.32	4,255,000	26,791,000	532,000	3,349,000	
N	SAGD pay	8	640,000	64		22.3	0.77	0.33	3,682,000	23,186,000	460,000	2,898,000	
N	SAGD pay above producer	8	640,000	64	0.6	19.3	0.77	0.33	3,187,000	20,067,000	398,000	2,508,000	1,505,000
O	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		35.9	0.70	0.32	5,239,000	32,986,000	655,000	4,123,000	
O	SAGD pay	8	640,000	64		19.8	0.78	0.33	3,333,000	20,986,000	417,000	2,623,000	
O	SAGD pay above producer	8	640,000	64	0.6	16.8	0.78	0.33	2,828,000	17,806,000	353,000	2,226,000	1,335,000
P	McMurray OOIP (≥6 wt% BMO)	8	640,000	64		31.3	0.71	0.33	4,708,000	29,642,000	588,000	3,705,000	
P	SAGD pay	8	640,000	64		20.0	0.76	0.34	3,315,000	20,875,000	414,000	2,609,000	
P	SAGD pay above producer	8	640,000	64	0.6	17.0	0.76	0.34	2,818,000	17,744,000	352,000	2,218,000	1,331,000

pattern (drainage) area = # of wells X 100 m X 800 m
Some patterns have variable well pair lengths
Pattern B wells 1000 m long
producer stand off from base SAGD pay = 3 m

h = continuous bitumen pay
So = bitumen saturation
PHI = porosity
BMO = Bulk Mass Oil

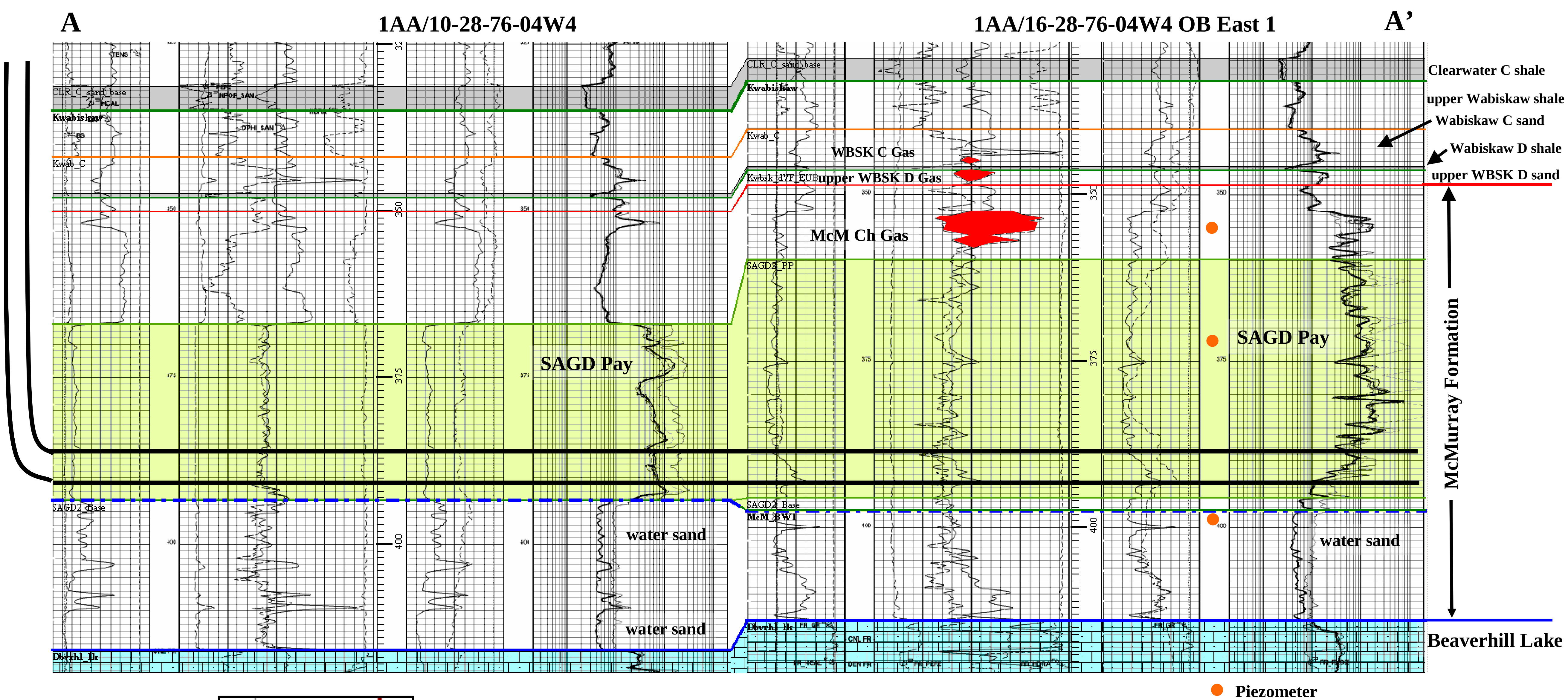
RF = recovery factor
OOIP = Original Bitumen in Place
ROIP = Recoverable Bitumen in Place

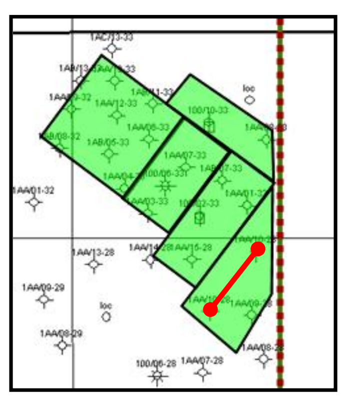
A structural cross section with an anticipated horizontal well trajectory through the McMurray reservoir has been provided for each SAGD pattern (Figures 2.3-7 to 2.3-22). Patterns are delineated by 2 to 8 core holes. More core holes may be added in order to gain more geological certainty for drilling operations. Some of these future core holes may be instrumented (pressure and temperature) to help monitor the progress of the SAGD operations.

The IDA proposed to support Plant 3A development is shown in Figure 2.1-1. Subsurface patterns provided for the Project development (Figure 2.3-23), include initial patterns for Plant 3B and sustaining patterns required for the entire Project development. Final locations will be determined by additional delineation drilling and submitted to the ERCB before development.

2.3.4 Gas Resources

MEG's oil sands leases are within the ERCB's designated "Wabiskaw – McMurray Gas Production Application Area" (Figure 2.3-24). Historically, natural gas has been produced from the McMurray Formation and Wabiskaw Member from 40 production wells on MEG's oil sands leases (Figure 2.3-25 and Table 2.3-2). Gas production from the McMurray Formation and Wabiskaw Member has been suspended since 2004. In the initial development area, depleted gas zones are considered to be in contact with some of the SAGD pay intervals. These gas zones may require repressurization for SAGD operations. The distribution of gas resources is summarized in the maps of McMurray Channel and B1, B2 and A1 Gas Pools, Upper Wabiskaw D Gas Pools, Wabiskaw D Channel Gas Pools and Wabiskaw C Gas Pools (Figures 2.3-26 to 2.3-30).





PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

STEAM ASSISTED GRAVITY DRAINAGE PATTERN A STRUCTURAL CROSS SECTION A-A'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Pod A-X-Sec A-A'
DESIGN	MEG	24/03/08	SCALE AS SHOWN	REV. 0
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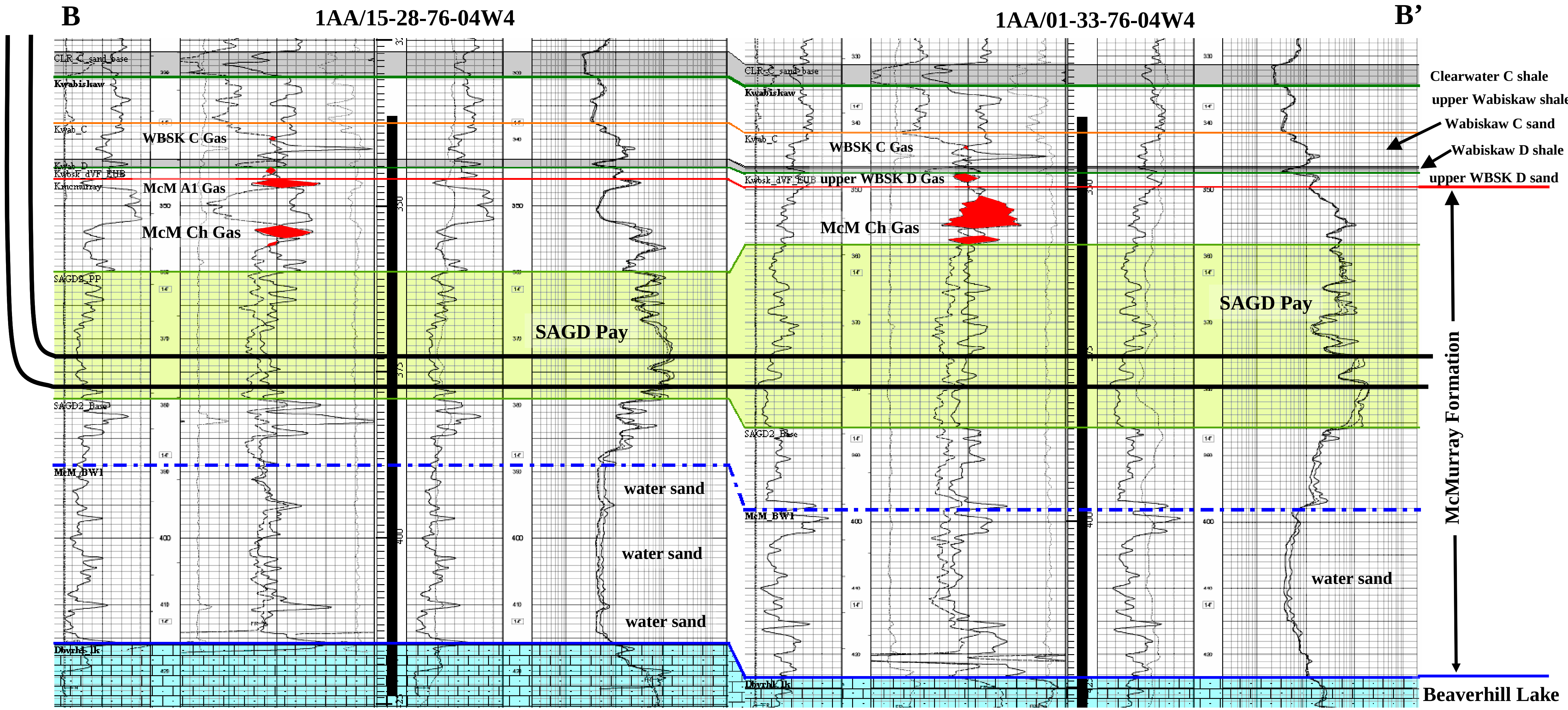
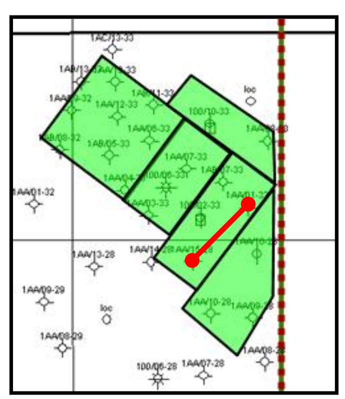
CHECK	AJF	18/04/08		
REVIEW	SG	18/04/08		





PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

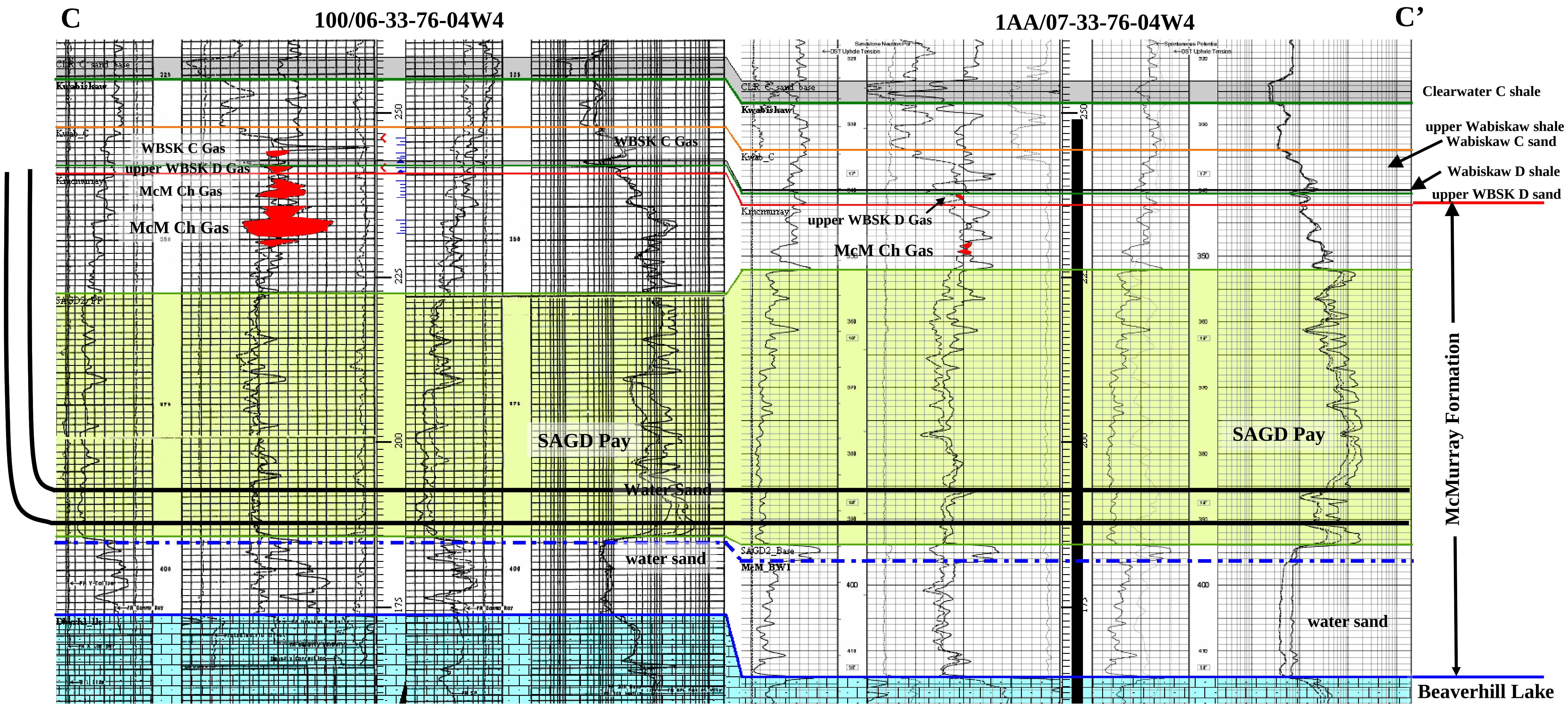
TITLE

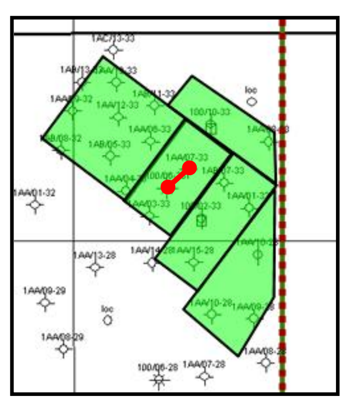
STEAM ASSISTED GRAVITY DRAINAGE PATTERN B STRUCTURAL CROSS SECTION B-B'

MEG ENERGY CORP.

PROJECT 07.1346.0009.5100			FILE No. Pad B-X-Sec B-B'
DESIGN	MEG	24/03/08	SCALE AS SHOWN REV. 0
CADD	TRE	07/04/08	**FIGURE: 2.3-8**
CHECK	AJF	18/04/08	
REVIEW	SG	18/04/08	

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-8_SAGD Pattern B Structural Cross-Section B-B'.dwg Apr 18, 2008 - 9:15am





PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

STEAM ASSISTED GRAVITY DRAINAGE PATTERN C STRUCTURAL CROSS SECTION C-C'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Pad C-X-Sec C-C'
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CADD	TRE	07/04/08	FIGURE: 2.3-9	
CHECK	AJF	18/04/08		
REVIEW	SG	18/04/08		

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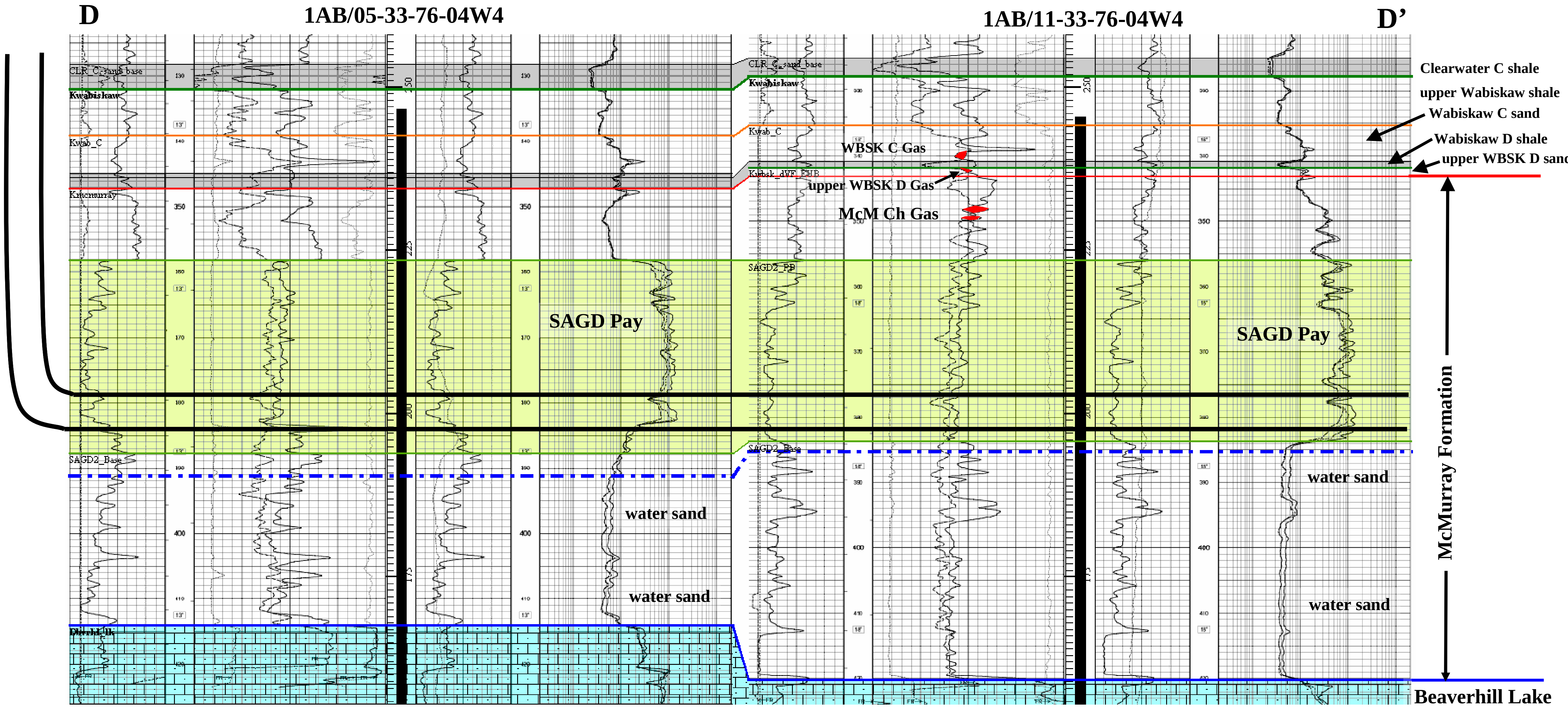

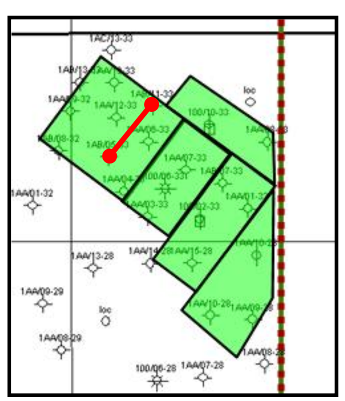

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

STEAM ASSISTED GRAVITY DRAINAGE PATTERN D STRUCTURAL CROSS SECTION D-D'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	FILE No.	Pad D-X-Sec D-D'
DESIGN	MEG	24/03/08	SCALE AS SHOWN REV. 0
CADD	TRE	07/04/08	FIGURE: 2.3-10
CHECK	AJF	18/04/08	
REVIEW	SG	18/04/08	

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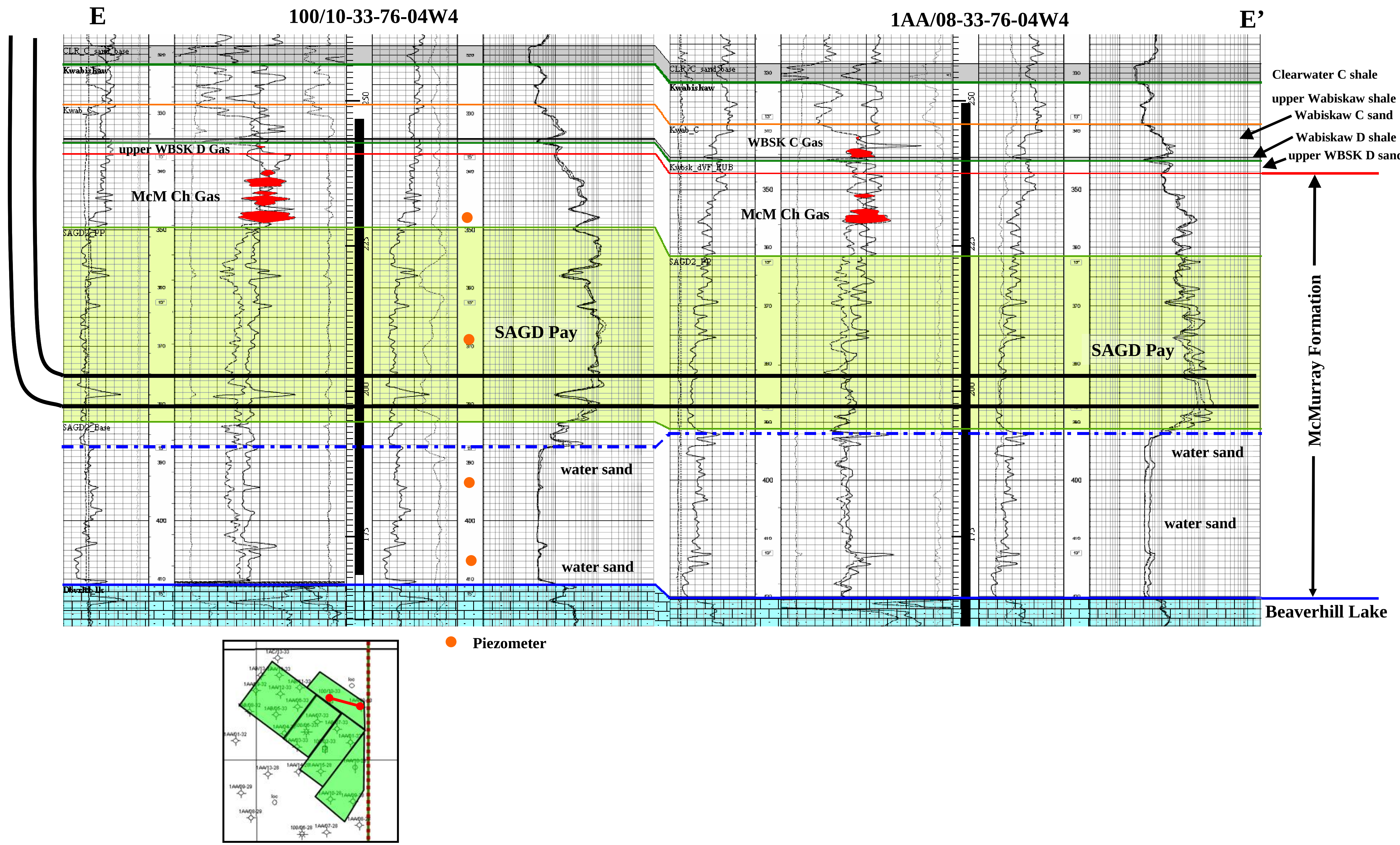

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

STEAM ASSISTED GRAVITY DRAINAGE PATTERN E STRUCTURAL CROSS SECTION E-E'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	FILE No.	Pod E-X-Sec E-E'
DESIGN	MEG	24/03/08	SCALE AS SHOWN REV. 0
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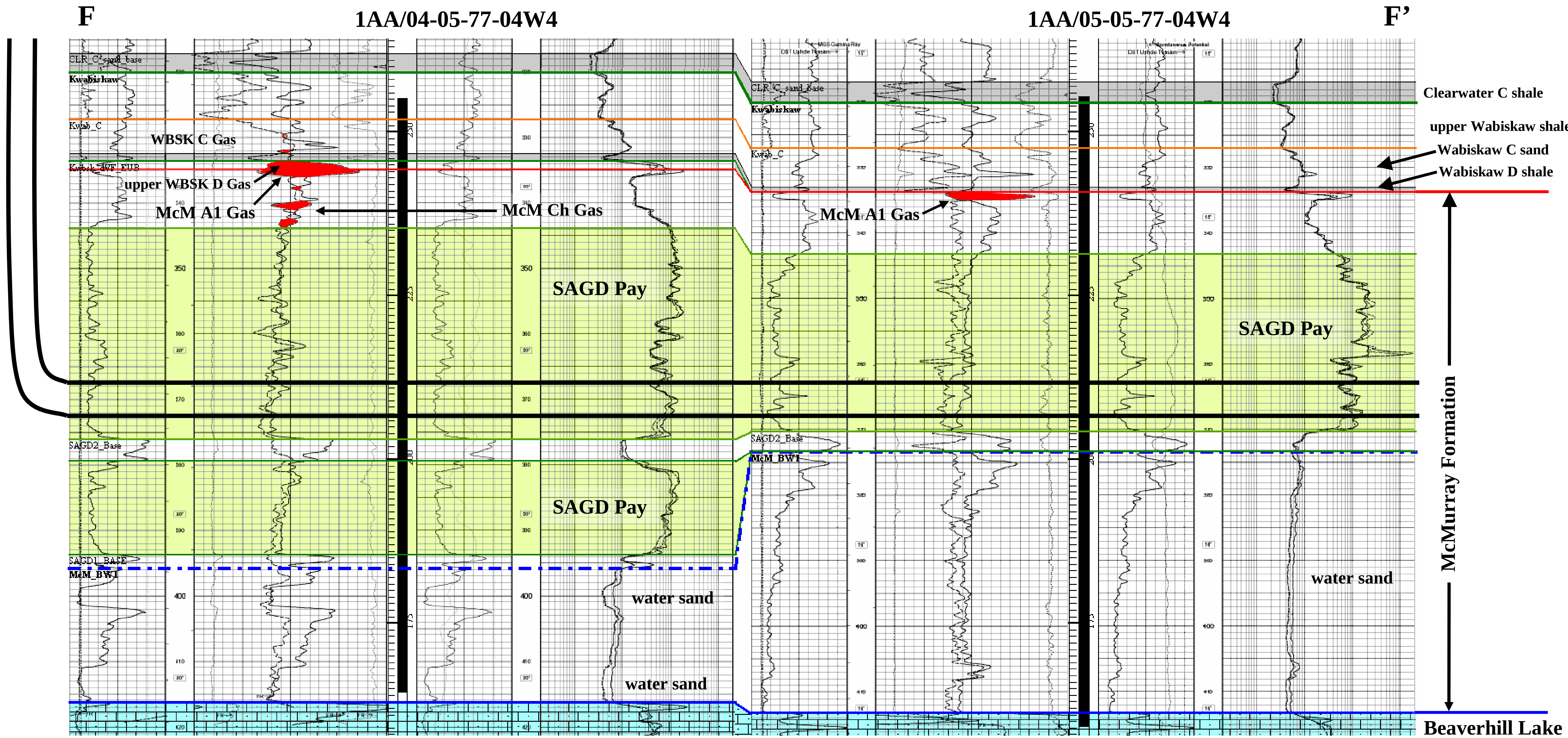
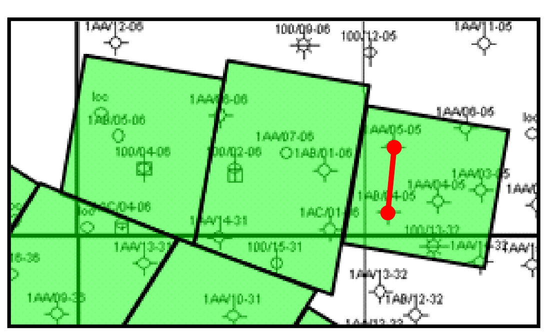
CHECK	AJF	18/04/08	
REVIEW	SG	18/04/08	





PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

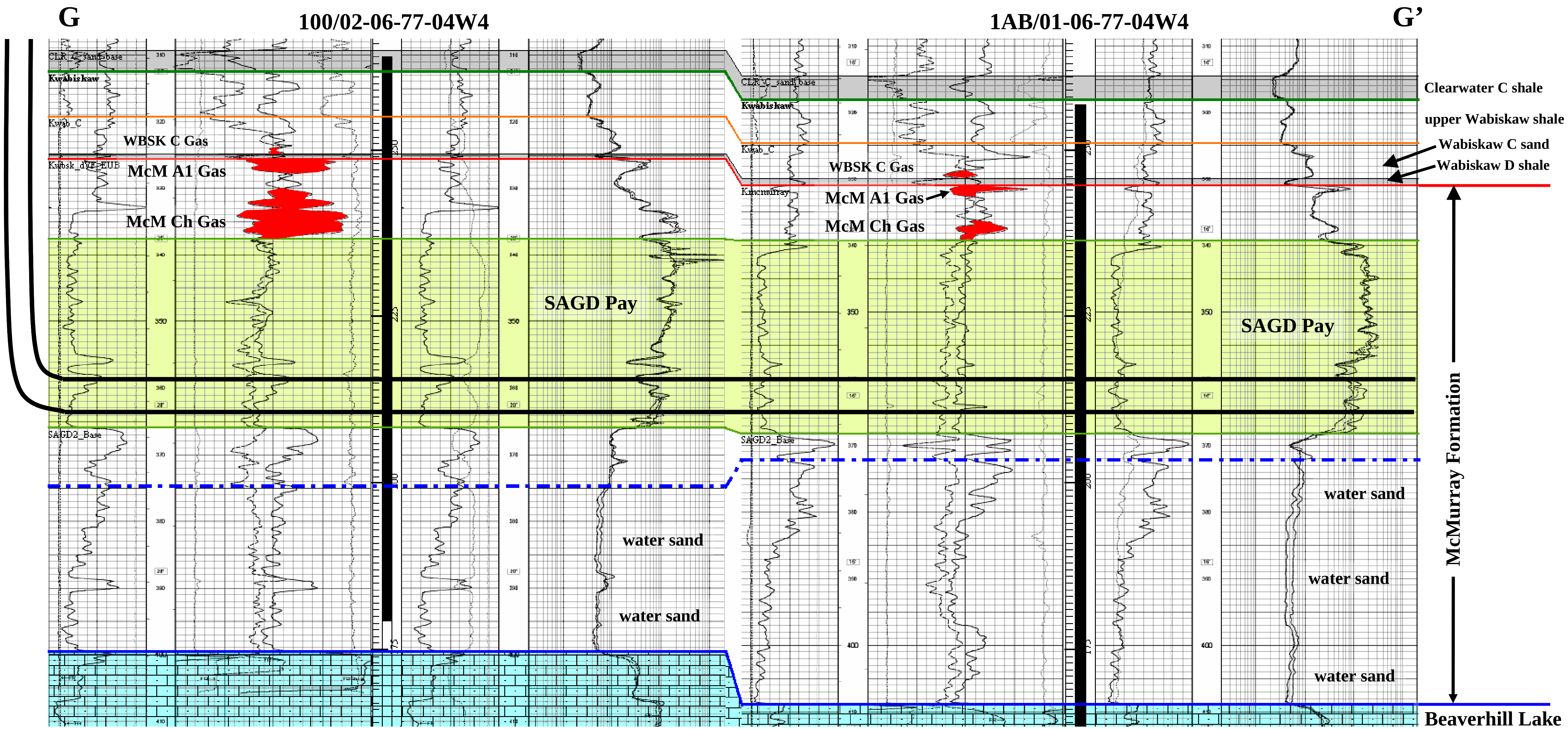
TITLE

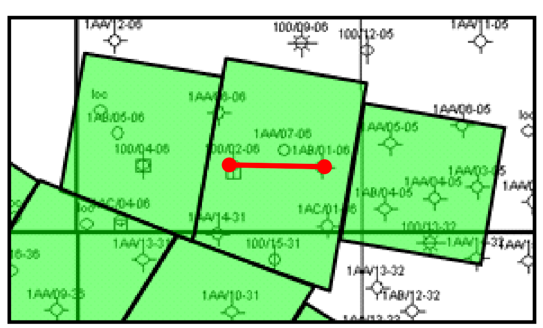
STEAM ASSISTED GRAVITY DRAINAGE PATTERN F STRUCTURAL CROSS SECTION F-F'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Pod F-X-Sec F-F'
DESIGN	MEG	24/03/08	SCALE AS SHOWN	REV. 0
CADD	TRE	07/04/08	FIGURE: 2.3-12	
CHECK	AJF	18/04/08		
REVIEW	SG	18/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-12_SAGD Pattern F Structural Cross-Section F-F'.dwg Apr 18, 2008 - 9:01am





PROJECT	CHRISTINA LAKE REGIONAL PROJECT - PHASE 3
TITLE	STEAM ASSISTED GRAVITY DRAINAGE PATTERN G STRUCTURAL CROSS SECTION G-G'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No. Pad G-X-Sec G-G'
DESIGN	MEG	24/03/08	SCALE AS SHOWN REV. 0
CADD	TRE	07/04/08	FIGURE: 2.3-13
CHECK	AJF	18/04/08	
REVIEW	SG	18/04/08	

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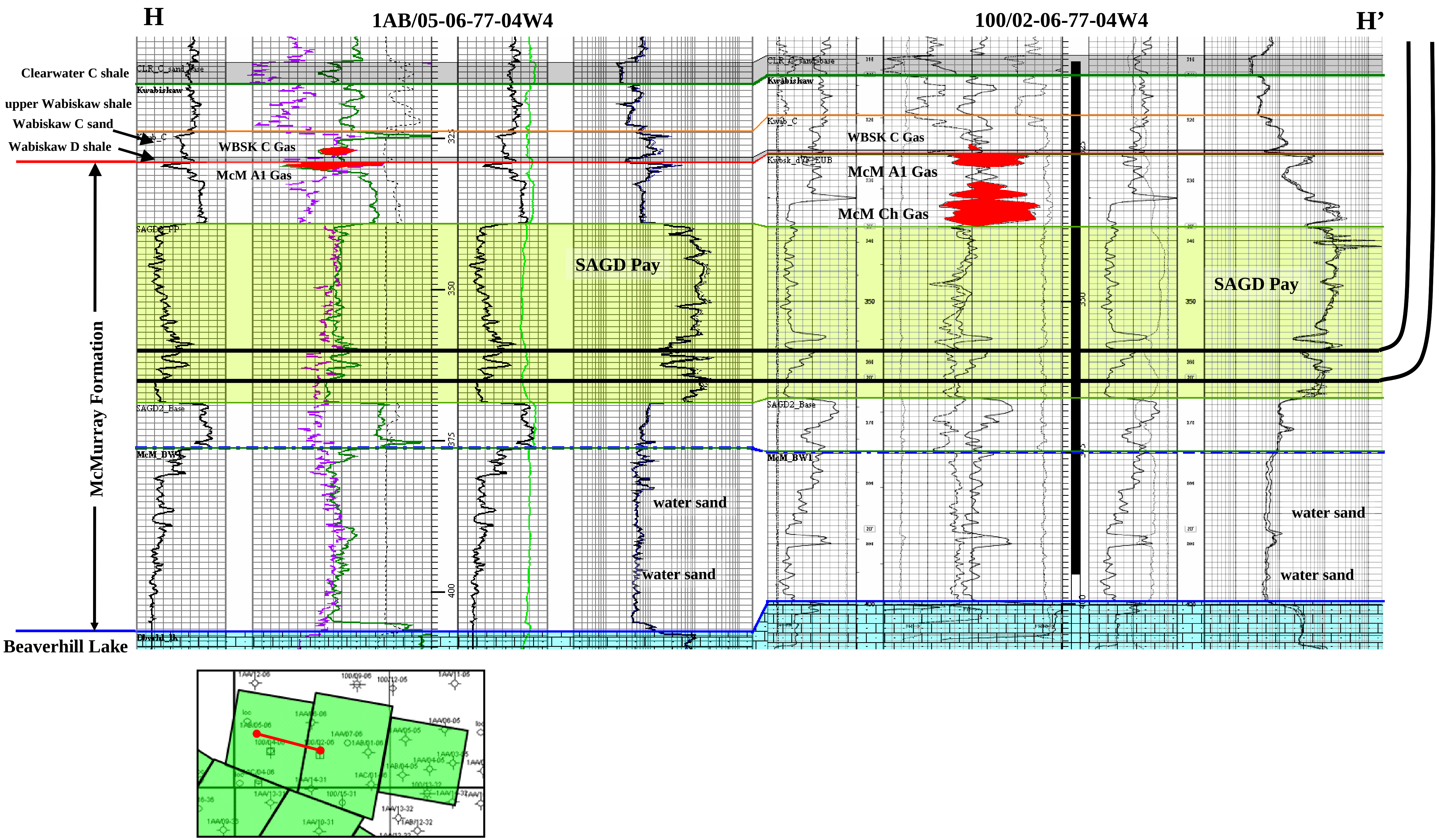

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

STEAM ASSISTED GRAVITY DRAINAGE PATTERN H STRUCTURAL CROSS SECTION H-H'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No. Pad H-X-Sec H-H'	
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CADD	TRE	07/04/08	FIGURE: 2.3-14	
CHECK	AJF	18/04/08		
REVIEW	SG	18/04/08		

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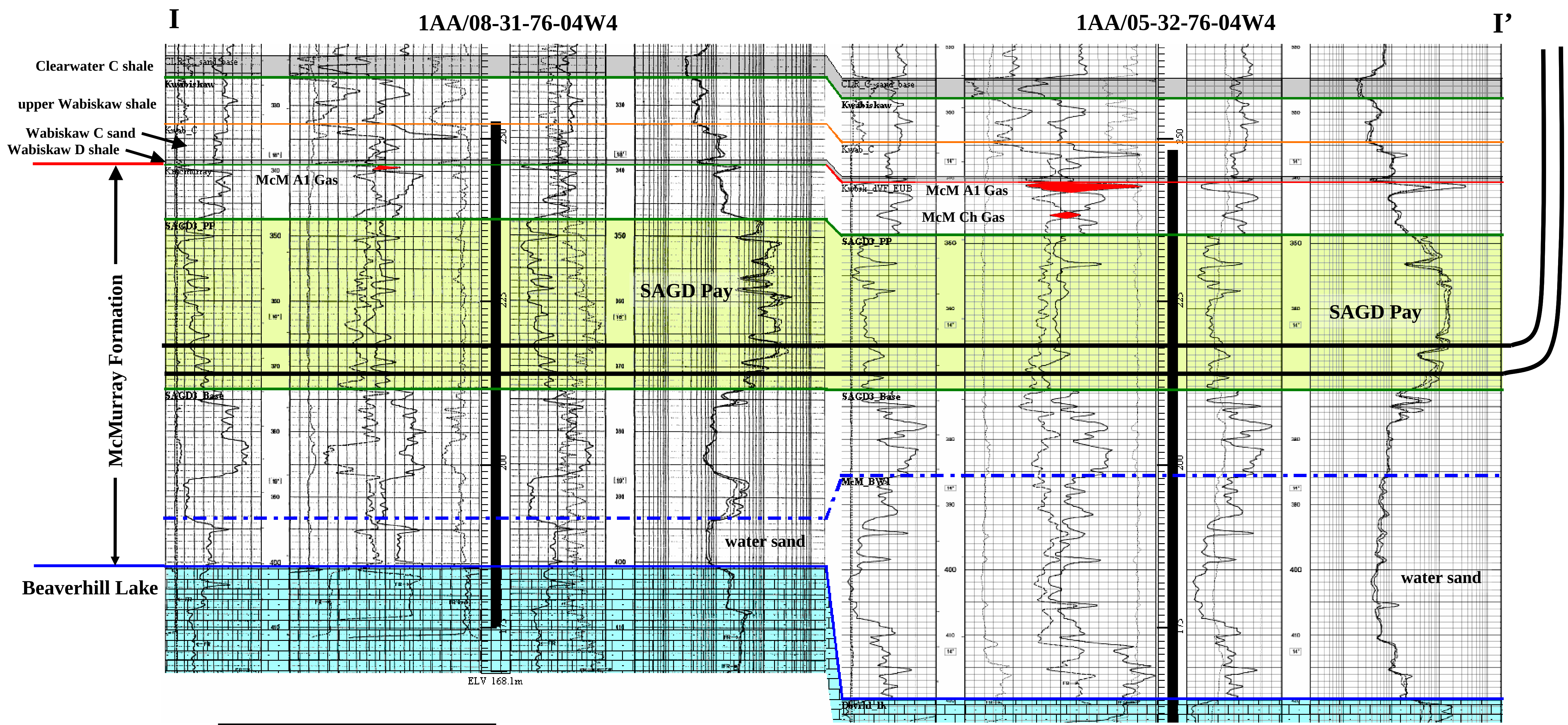

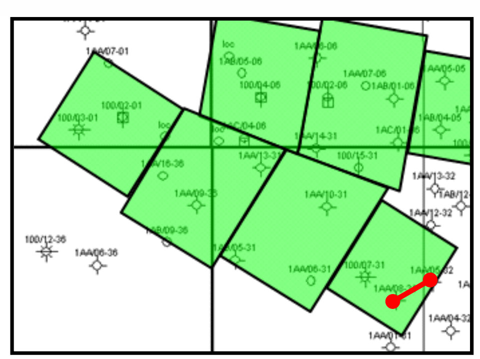

PROJECT				
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3				
TITLE				
STEAM ASSISTED GRAVITY DRAINAGE PATTERN I STRUCTURAL CROSS SECTION I-I'				
MEG ENERGY CORP.	PROJECT	07.1346.0009.5100	FILE No.	Pad I-X-Sec I-I'
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	CHECK	AJF 18/04/08		
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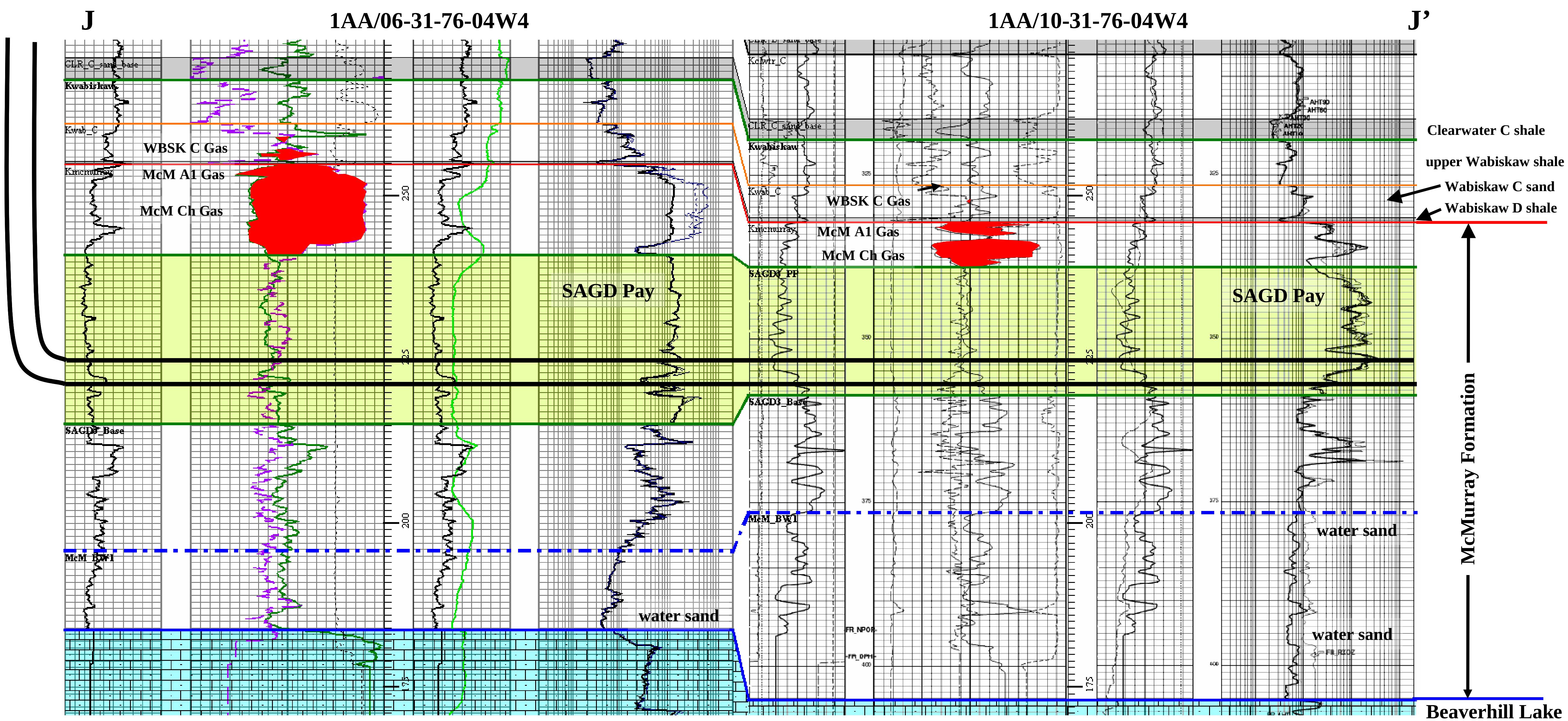
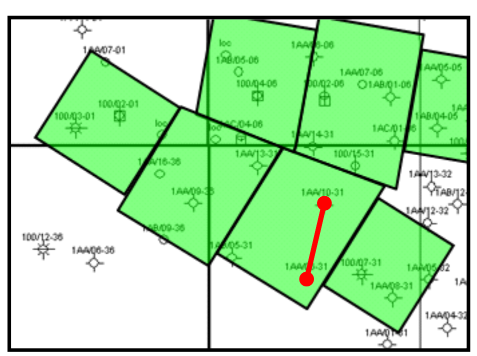




PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

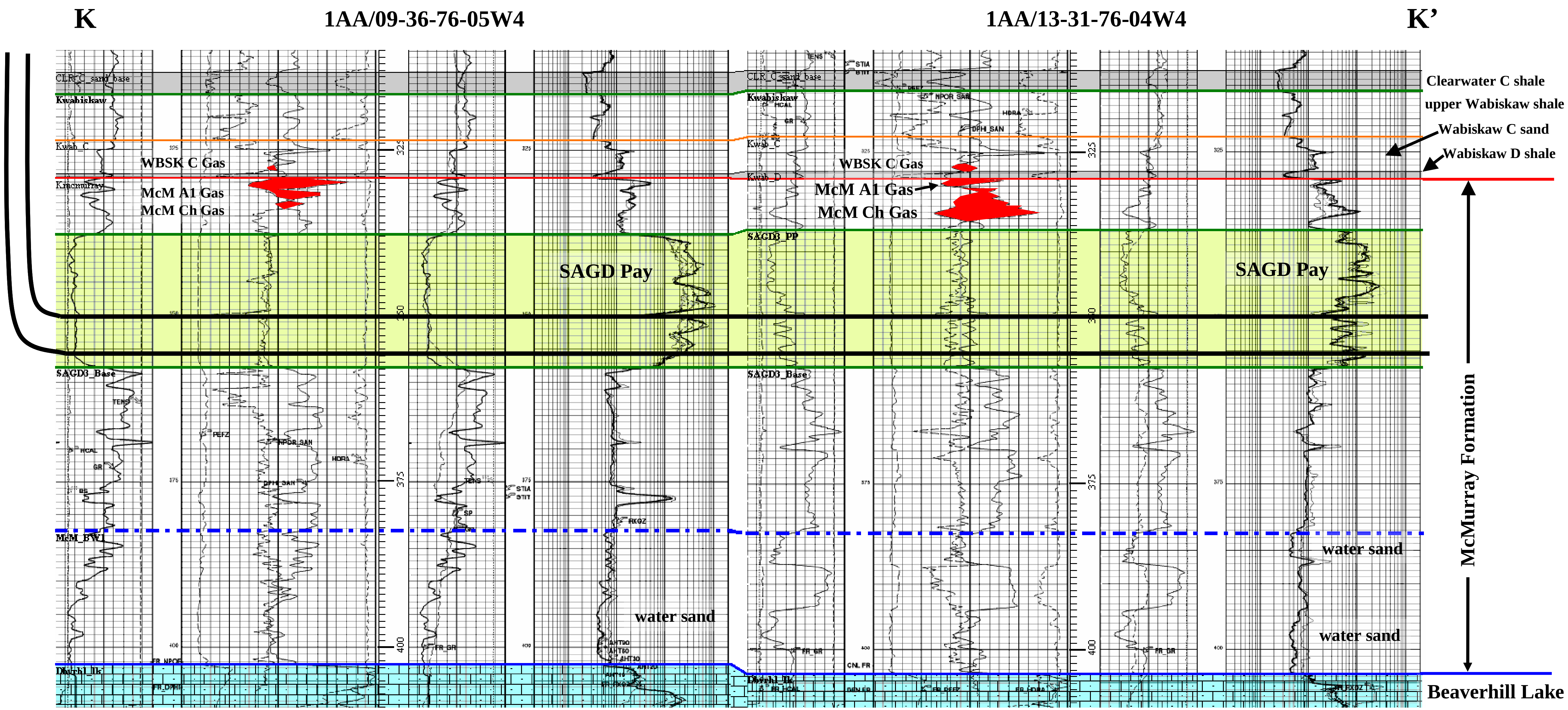
TITLE

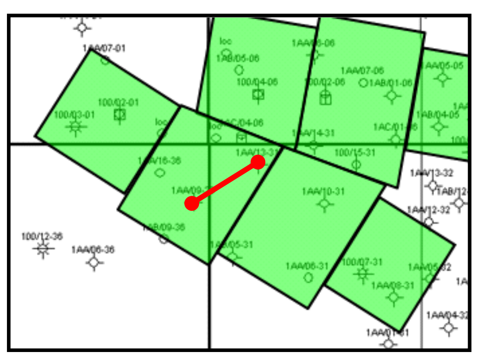
STEAM ASSISTED GRAVITY DRAINAGE PATTERN J STRUCTURAL CROSS SECTION J-J'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Pad J-X-Sec J-J'
DESIGN	MEG	24/03/08	SCALE AS SHOWN	REV. 0
CADD	TRE	07/04/08	**FIGURE: 2.3-16**	
CHECK	AJF	18/04/08		
REVIEW	SG	18/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-16_SAGD Pattern J Structural Cross-Section J-J'.dwg Apr 18, 2008 - 9:08am





PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

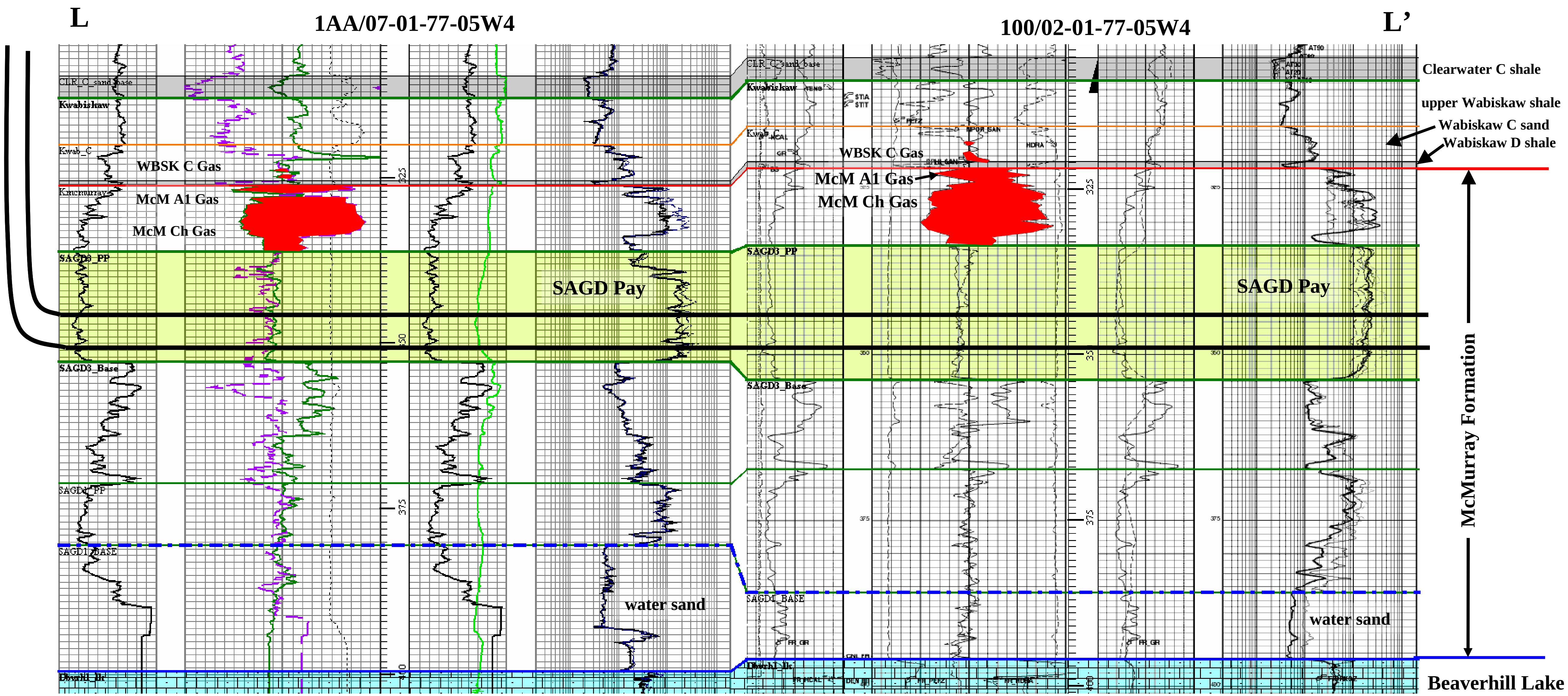
TITLE

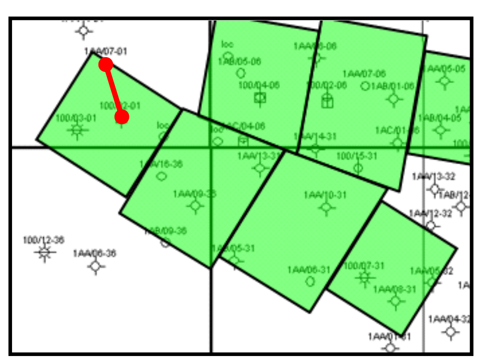
STEAM ASSISTED GRAVITY DRAINAGE PATTERN K STRUCTURAL CROSS SECTION K-K'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Patt K-X-Sec K-K'	
DESIGN	MEG	24/03/08	SCALE	AS SHOWN	REV. 0
CADD	TRE	07/04/08	FIGURE: 2.3-17		
CHECK	AJF	18/04/08			
REVIEW	SG	18/04/08			

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-17_SAGD Pattern K Structural Cross-Section K-K'.dwg Apr 18, 2008 - 9:09am





PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

STEAM ASSISTED GRAVITY DRAINAGE PATTERN L STRUCTURAL CROSS SECTION L-L'

MEG ENERGY CORP.

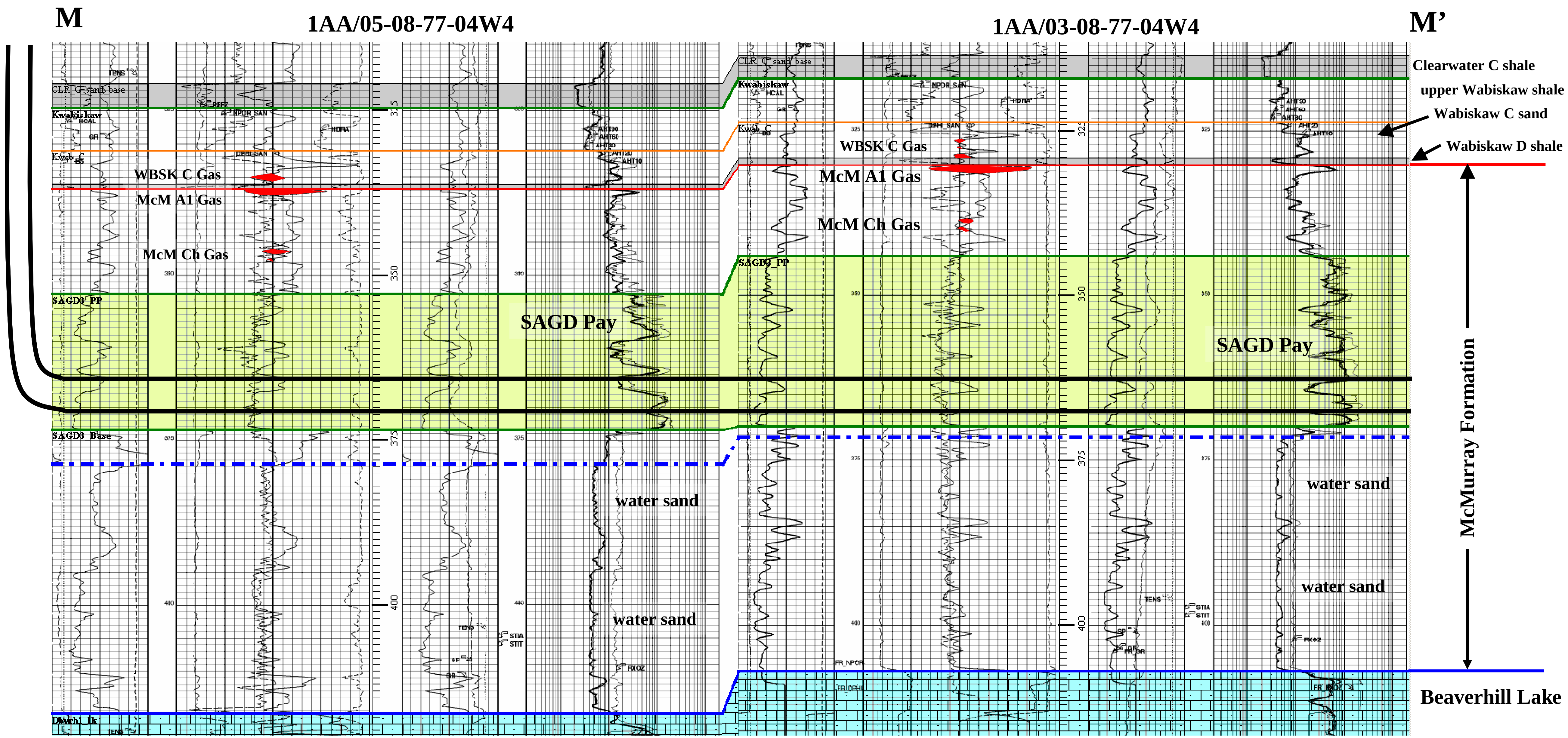
PROJECT	07.1346.0009.5100	
DESIGN	MEG	24/03/08
CADD	TRE	07/04/08
CHECK	AJF	18/04/08
REVIEW	SG	18/04/08

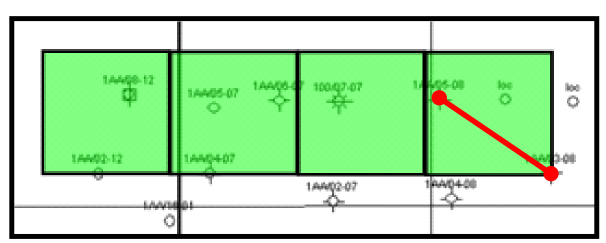
FILE No. Patt L-X-Sec L-L'

SCALE AS SHOWN REV. 0

FIGURE: 2.3-18

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-18_SAGD Pattern L Structural Cross-Section L-L'.dwg Apr 18, 2008 - 9:11am





PROJECT

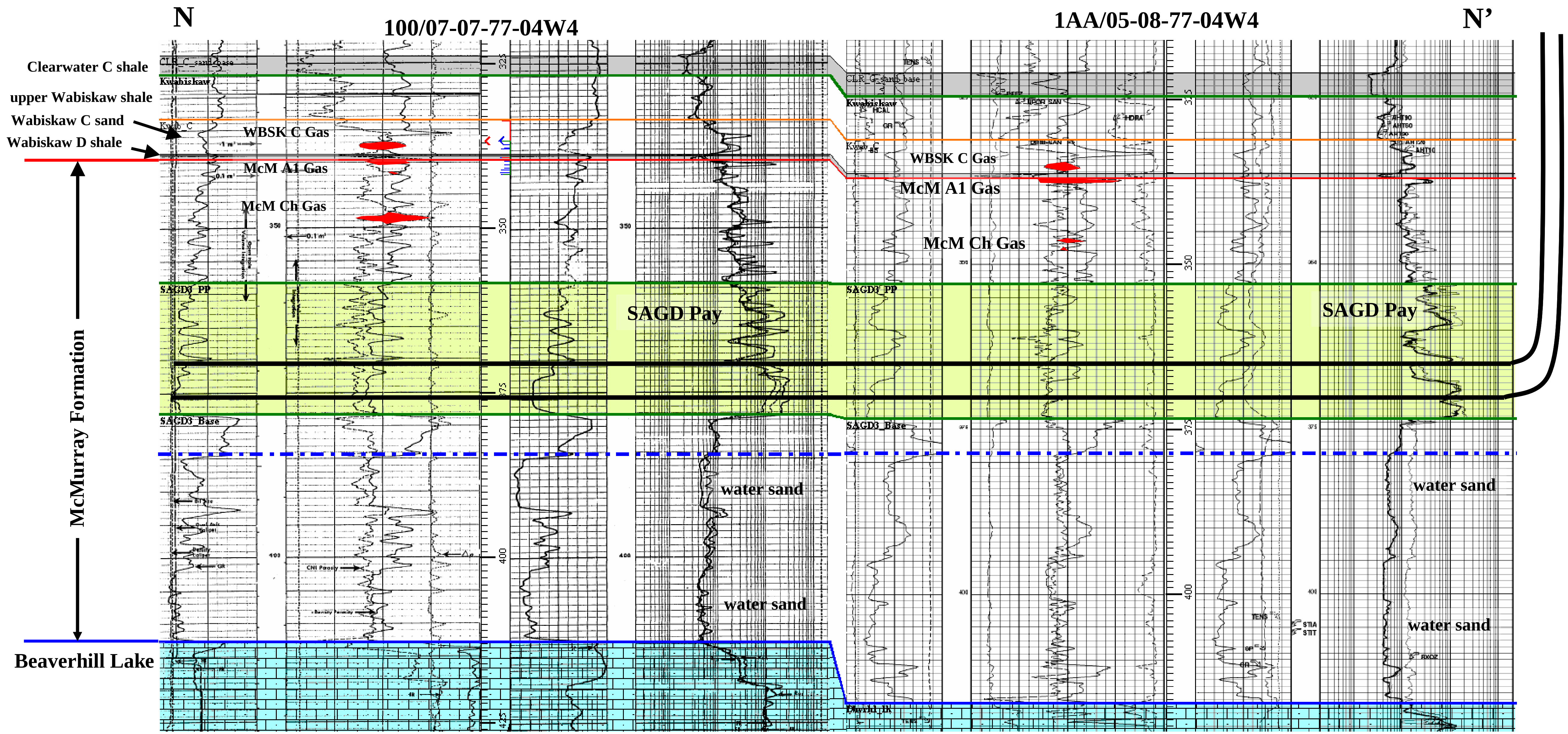
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

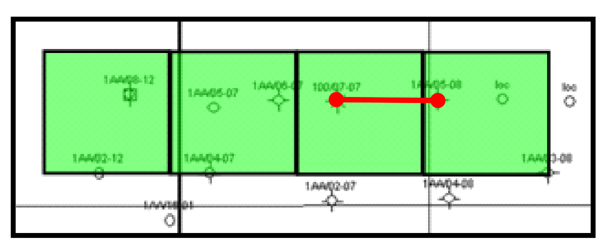
TITLE

STEAM ASSISTED GRAVITY DRAINAGE PATTERN M STRUCTURAL CROSS SECTION M-M'

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Patt M-X-Sec M-M'
DESIGN	MEG	24/03/08	SCALE AS SHOWN	REV. 0
CADD	TRE	07/04/08	**FIGURE: 2.3-19**	
CHECK	AJF	18/04/08		
REVIEW	SG	18/04/08		



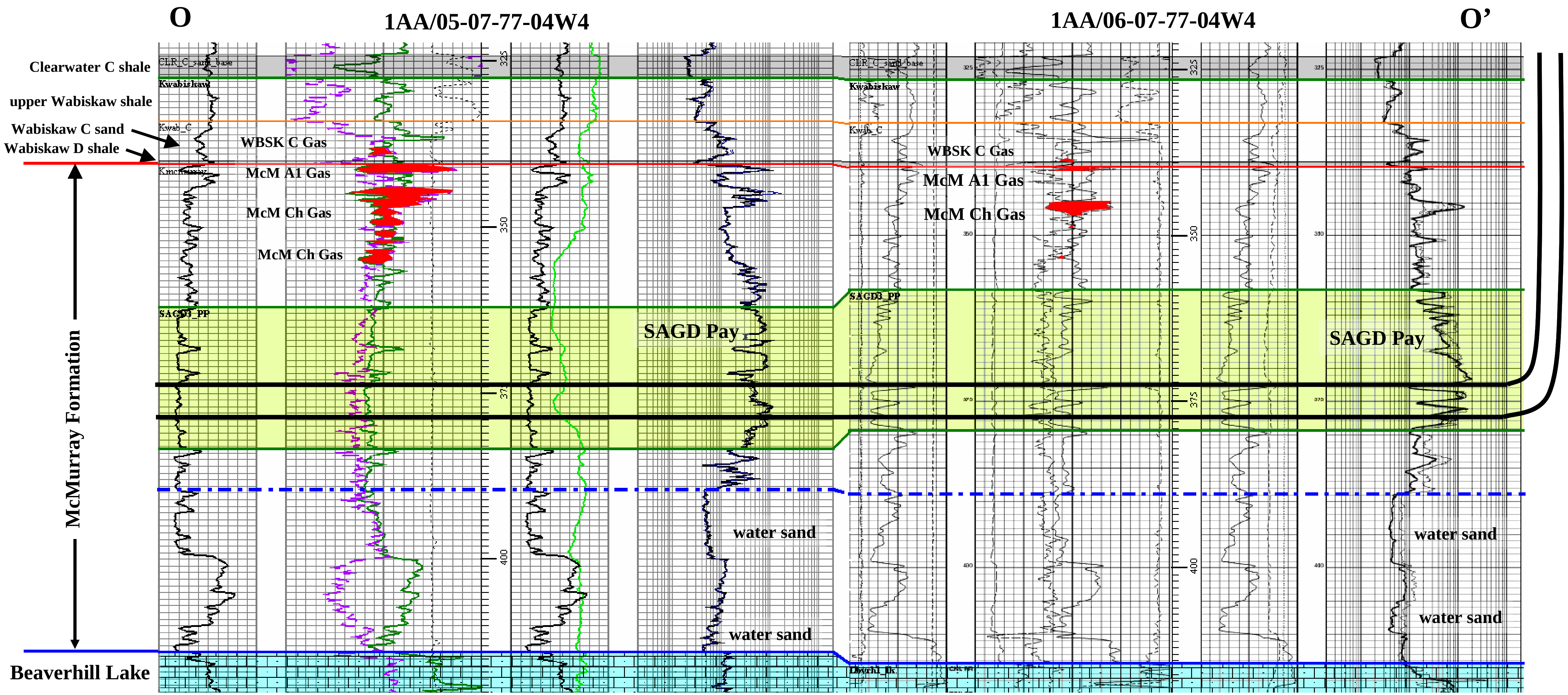


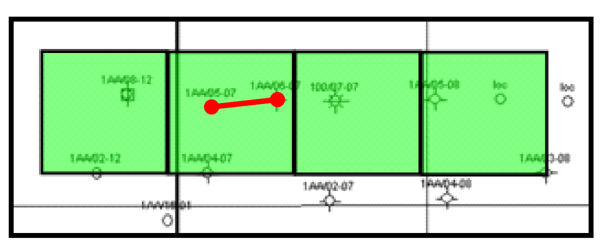
PROJECT	CHRISTINA LAKE REGIONAL PROJECT - PHASE 3
TITLE	STEAM ASSISTED GRAVITY DRAINAGE PATTERN N STRUCTURAL CROSS SECTION N-N'

PROJECT	07.1346.0009.5100		FILE No.	Patt N-X-Sec N-N'
DESIGN	MEG	24/03/08	SCALE AS SHOWN	REV. 0
CADD	TRE	07/04/08	FIGURE: 2.3-20	
CHECK	AJF	18/04/08		
REVIEW	SG	18/04/08		

MEG ENERGY CORP.

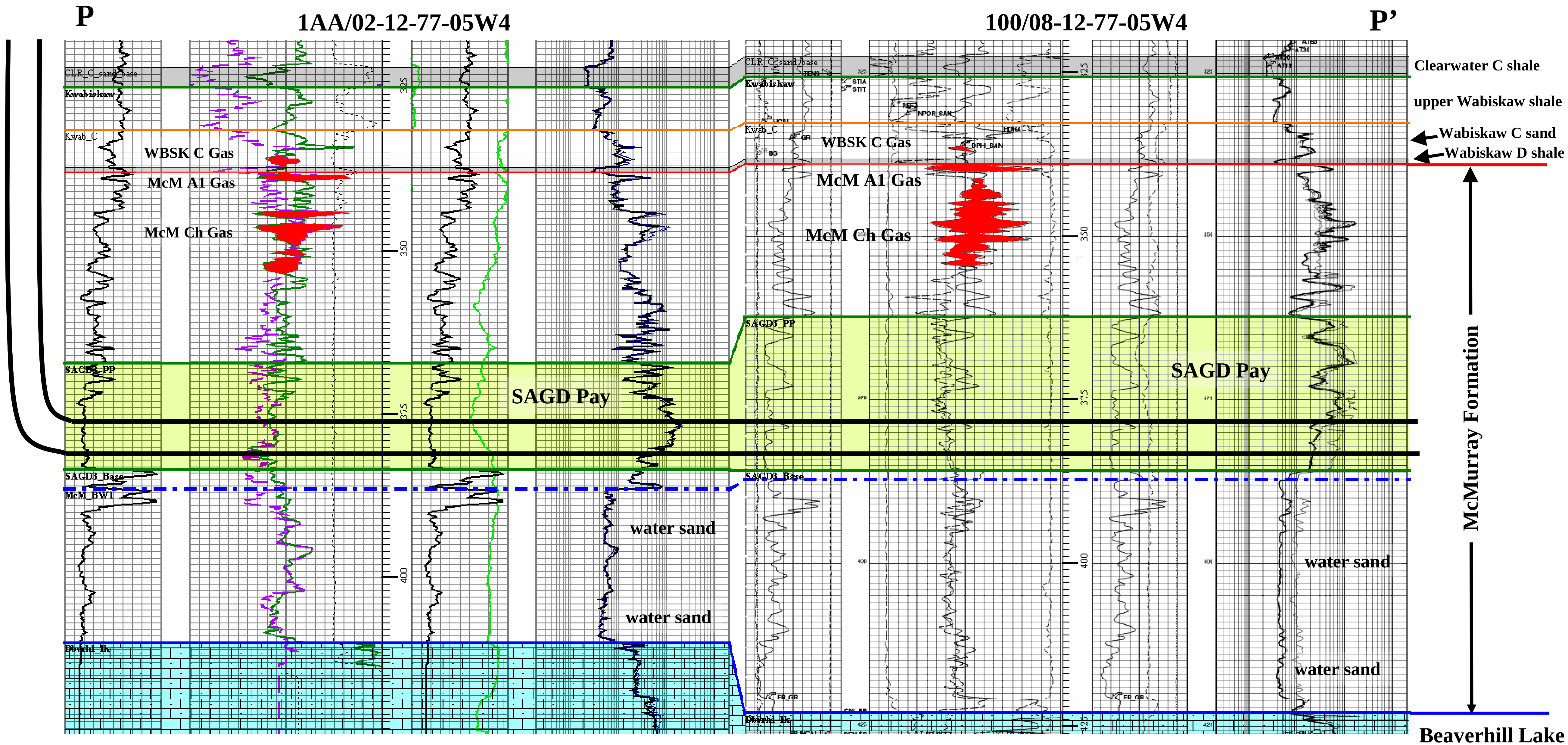
L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-20_SAGD Pattern N Structural Cross-Section N-N'.dwg Apr 18, 2008 - 9:14am

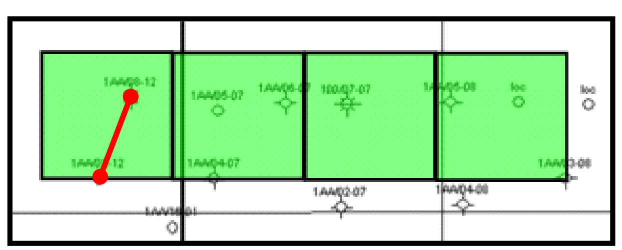




PROJECT	
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3	
TITLE	
STEAM ASSISTED GRAVITY DRAINAGE PATTERN O STRUCTURAL CROSS SECTION O-O'	

MEG ENERGY CORP.			
PROJECT	07.1346.0009.5100		FILE No. Patt O-X-Sec O-O'
DESIGN	MEG	24/03/08	SCALE AS SHOWN REV. 0
CADD	TRE	07/04/08	FIGURE: 2.3-21
CHECK	AJF	18/04/08	
REVIEW	SG	18/04/08	

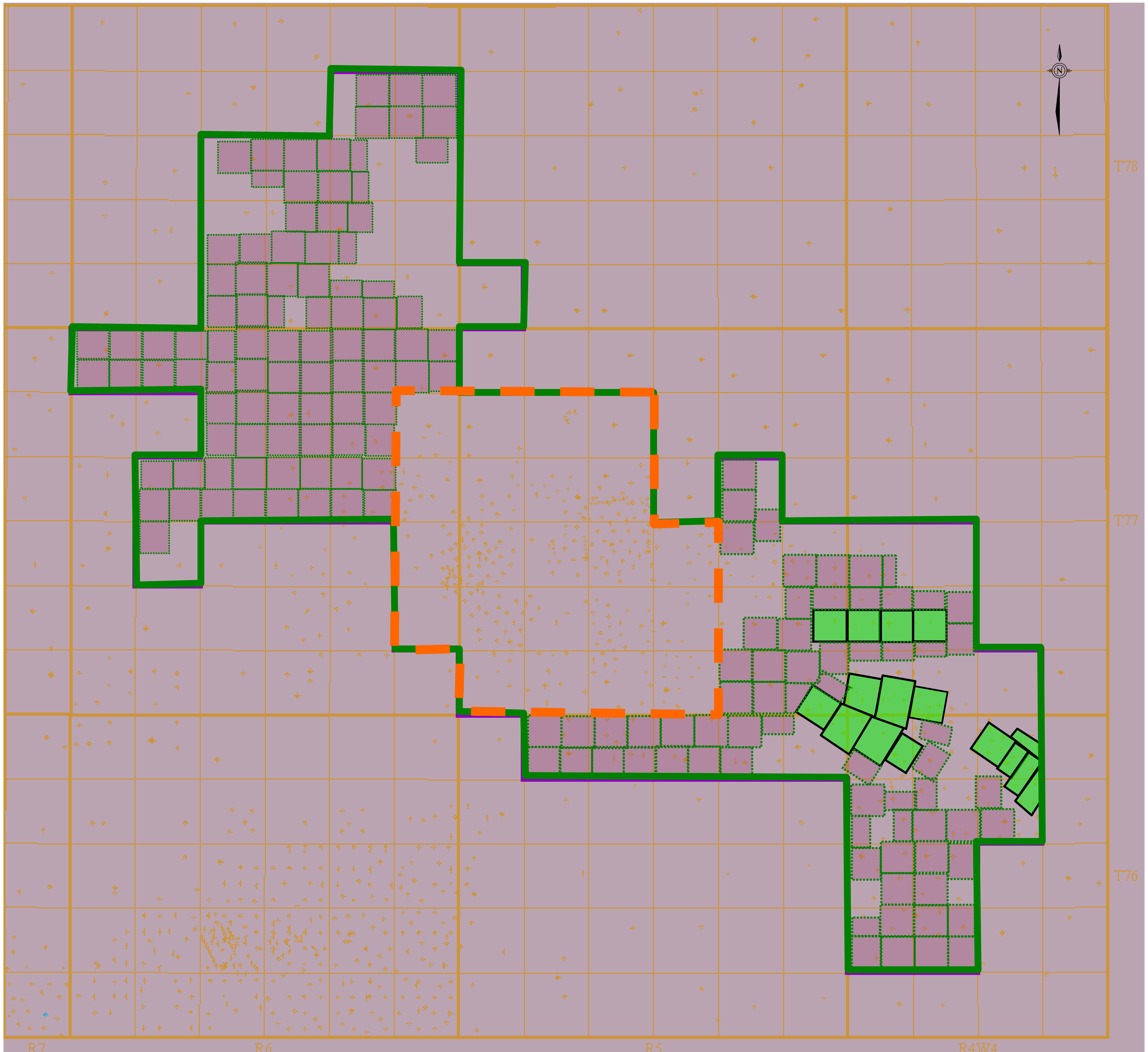




PROJECT	
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3	
TITLE	
STEAM ASSISTED GRAVITY DRAINAGE PATTERN P STRUCTURAL CROSS SECTION P-P'	

MEG ENERGY CORP.				
PROJECT	07.1346.0009.5100		FILE No.	Patt P-X-Sec P-P'
DESIGN	MEG	24/03/08	SCALE AS SHOWN	REV. 0
CADD	TRE	07/04/08	FIGURE: 2.3-22	
CHECK	AJF	18/04/08		
REVIEW	SG	18/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-22_SAGD Pattern P Structural Cross-Section P-P'.dwg Apr 18, 2008 - 8:51am



LEGEND

- MEG Oil Sands Leases
- Phase 2 Project Area
- Phase 3 Initial Patterns
- Phase 3 Replacement Patterns

1.6 0 1.6
SCALE KILOMETRES

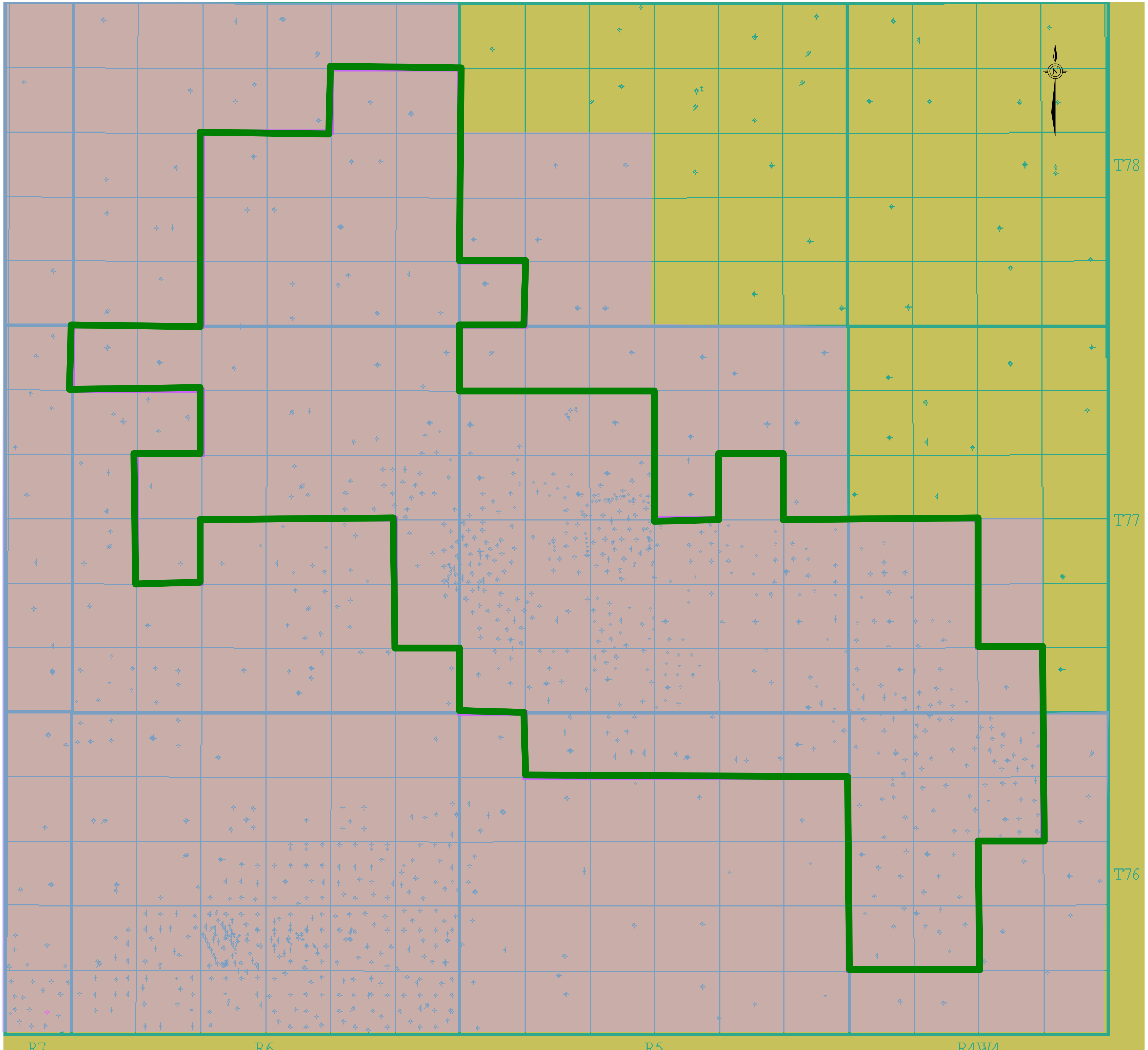
L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-23_Phase 3 Replacement Patterns.dwg Apr 18, 2008 - 10:02am

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
PHASE 3 REPLACEMENT PATTERNS

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No. Phase3–ReplaPattern	
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	05/04/08	FIGURE: 2.3-23	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		



LEGEND

- MEG Oil Sands Leases
- Gas Production Application Area

1.6 0 1.6

SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

WABISKAW / McMURRAY GAS PRODUCTION APPLICATION AREA

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	
DESIGN	MEG	31/03/08
CADD	PSR	05/04/08
CHECK	AJF	17/04/08
REVIEW	SG	17/04/08

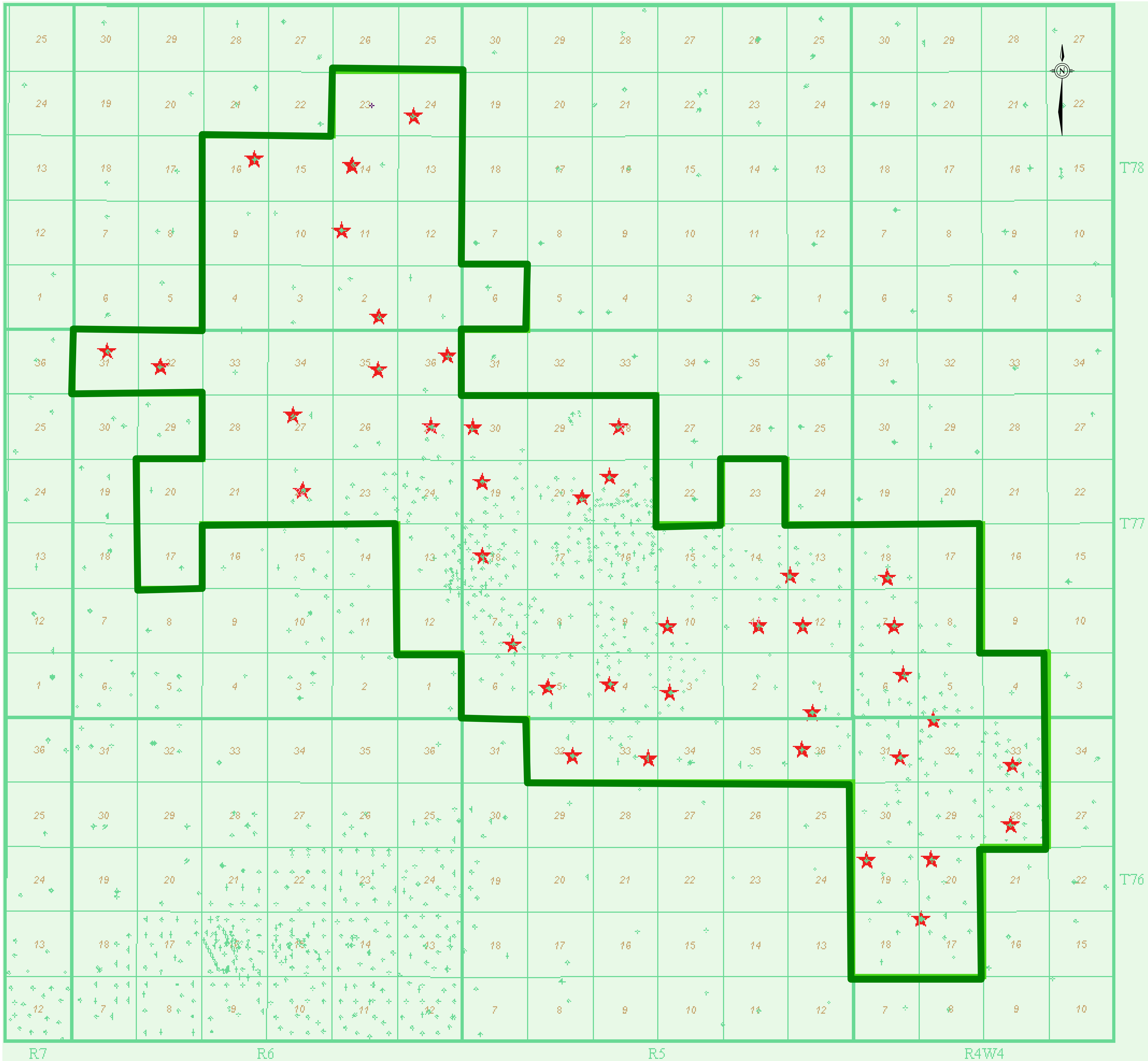
FILE No. Wabis+McM-Gas Prod

SCALE AS SHOWN REV. 0

FIGURE: 2.3-24

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-24_Wabiskaw+McMurray Gas Production-Application Area.dwg Apr 18, 2008 - 10:06am

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-25_Wabiskaw+McMurray Gas Production Wells.dwg Apr 18, 2008 - 10:14am



LEGEND

- MEG Oil Sands Leases
- Wabiskaw / McMurray Gas Production

1.6 0 1.6
SCALE KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
WABISKAW / McMURRAY GAS PRODUCTION WELLS

MEG ENERGY CORP.

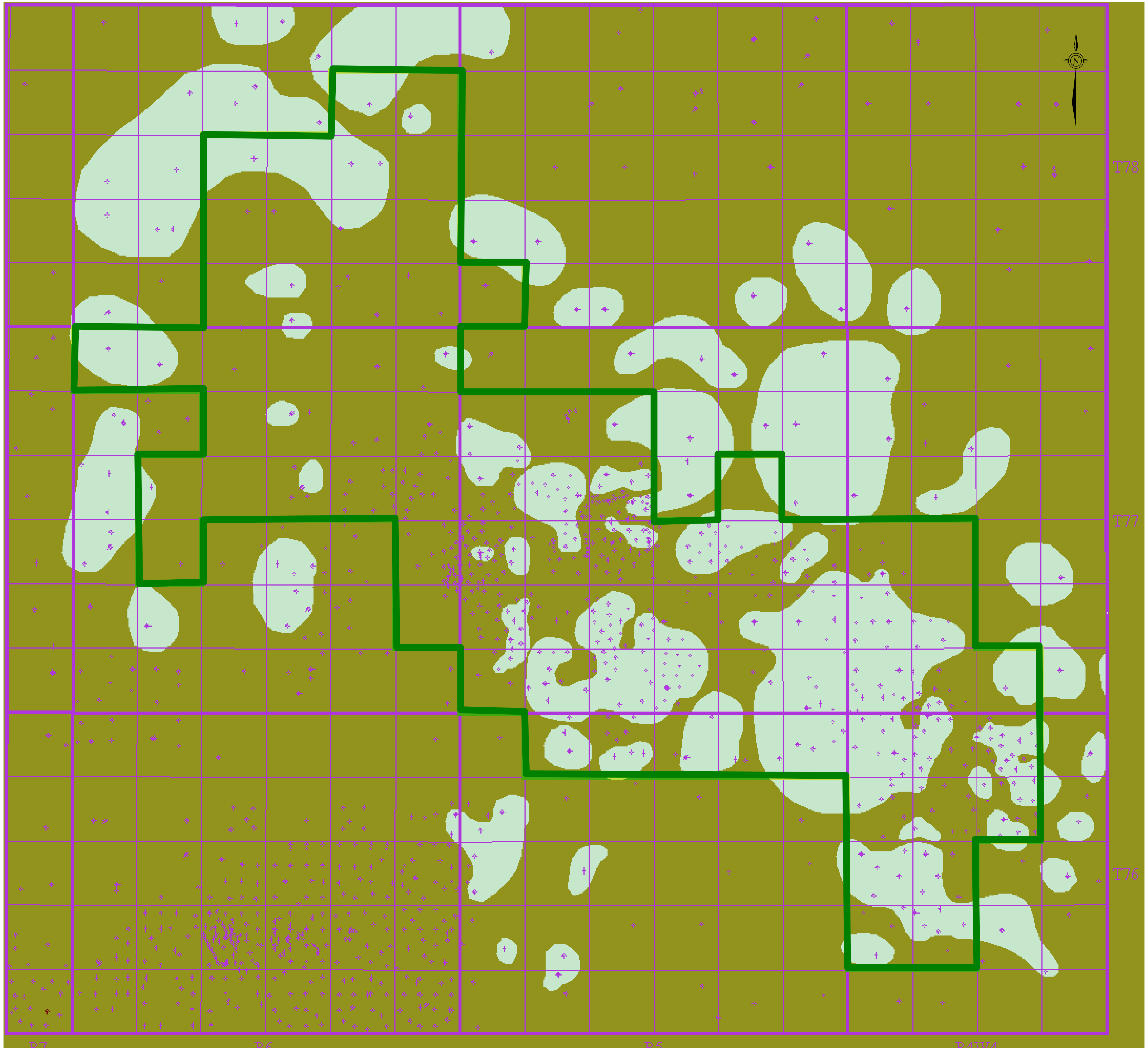
PROJECT	07.1346.0009.5100	FILE No.	Wabis+McM-Gas Well
DESIGN	MEG	31/03/08	SCALE AS SHOWN REV. 0
CADD	PSR	05/04/08	
CHECK	AJF	17/04/08	
REVIEW	SG	17/04/08	

FIGURE: 2.3-25

Table 2.3-2 Christina Lake Oil Sands Leases Historical McMurray/Wabiskaw Gas Production

		ERCB Stratigraphic Framework
well	Cumulative Gas (x 1000 m^3)	Perforated Zone(s)
100/13-17-076-04W4/00	113,343	WBSK C, McM A1, McM Chnl
100/13-19-076-04W4/00	24,575	WBSK C, WBSK D
100/13-20-076-04W4/00	75,641	WBSK C, WBSK D
100/06-28-076-04W4/00	1,213	WBSK C, WBSK D, McM Chnl
100/07-31-076-04W4/00	66,913	WBSK C, McM A1
100/13-32-076-04W4/00	140,776	WBSK C, McM A1, McM Chnl
100/06-33-076-04W4/00	2,368	WBSK C, Wab D, McM Chnl
100/07-32-076-05W4/00	186,599	WBSK C, McM A1, McM Chnl
100/06-34-076-05W4/00	66,750	WBSK C, McM A1, McM Chnl
100/12-36-076-05W4/00	6,659	WBSK C, McM A1
100/09-06-077-04W4/00	28,066	WBSK C, McM A1, McM Chnl
100/07-07-077-04W4/00	59,046	WBSK C, McM A1
100/02-18-077-04W4/00	15,376	WBSK C, McM A1, McM Chnl
100/03-01-077-05W4/00	86,585	McM A1, McM Chnl
100/05-03-077-05W4/00	166,343	McM Chnl
100/11-04-077-05W4/00	24,320	WBSK C, McM A1, McM Chnl
100/06-05-077-05W4/00	21,674	WBSK C, WBSK D, McM A1, McM Chnl
100/01-07-077-05W4/00	16,429	McM A1
100/05-10-077-05W4/00	6,365	McM A1
100/07-11-077-05W4/00	59,402	WBSK C, McM A1
100/05-12-077-05W4/00	55,574	WBSK C, McM A1, McM Chnl
100/04-13-077-05W4/00	6,673	WBSK C, McM A1, McM Chnl
100/11-18-077-05W4/00	24,689	WBSK D, McM Chnl
100/11-19-077-05W4/00	34,748	WBSK D
100/08-20-077-05W4/00	48,400	WBSK C, McM A1
100/11-21-077-05W4/00	54,591	WBSK C, McM A1
100/11-28-077-05W4/00	71,161	WBSK C, WBSK D
100/05-30-077-05W4/00	14,279	WBSK D
100/10-22-077-06W4/00	44,760	McM Chnl
100/07-25-077-06W4/00	9,725	WBSK D
100/11-27-077-06W4/00	65,069	McM Chnl
100/10-31-077-06W4/00	21,121	McM A1, McM Chnl
100/06-32-077-06W4/02	52	McM A1
100/07-35-077-06W4/00	19,702	WBSK D, McM Chnl
100/09-36-077-06W4/00	23,657	WBSK C, WBSK D
100/02-02-078-06W4/00	12,724	McM Chnl
100/12-11-078-06W4/00	14,777	WBSK D, McM A1
100/11-14-078-06W4/00	36,410	McM A1, McM Chnl
100/09-16-078-06W4/00	8,717	McM A1
100/05-24-078-06W4/00	20,734	McM A1

Legend
WBSK C = Wabiskaw C
WBSK D = Wabiskaw D
McM A1 = McMurray A1 Sand
McM Chnl = McMurray Channel



LEGEND

MEG Oil Sands Leases

Gas Pools

1.6 0 1.6

SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

WABISKAW C GAS POOLS

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	Wabis+C Gas Pools
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	05/04/08	FIGURE: 2.3-26	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

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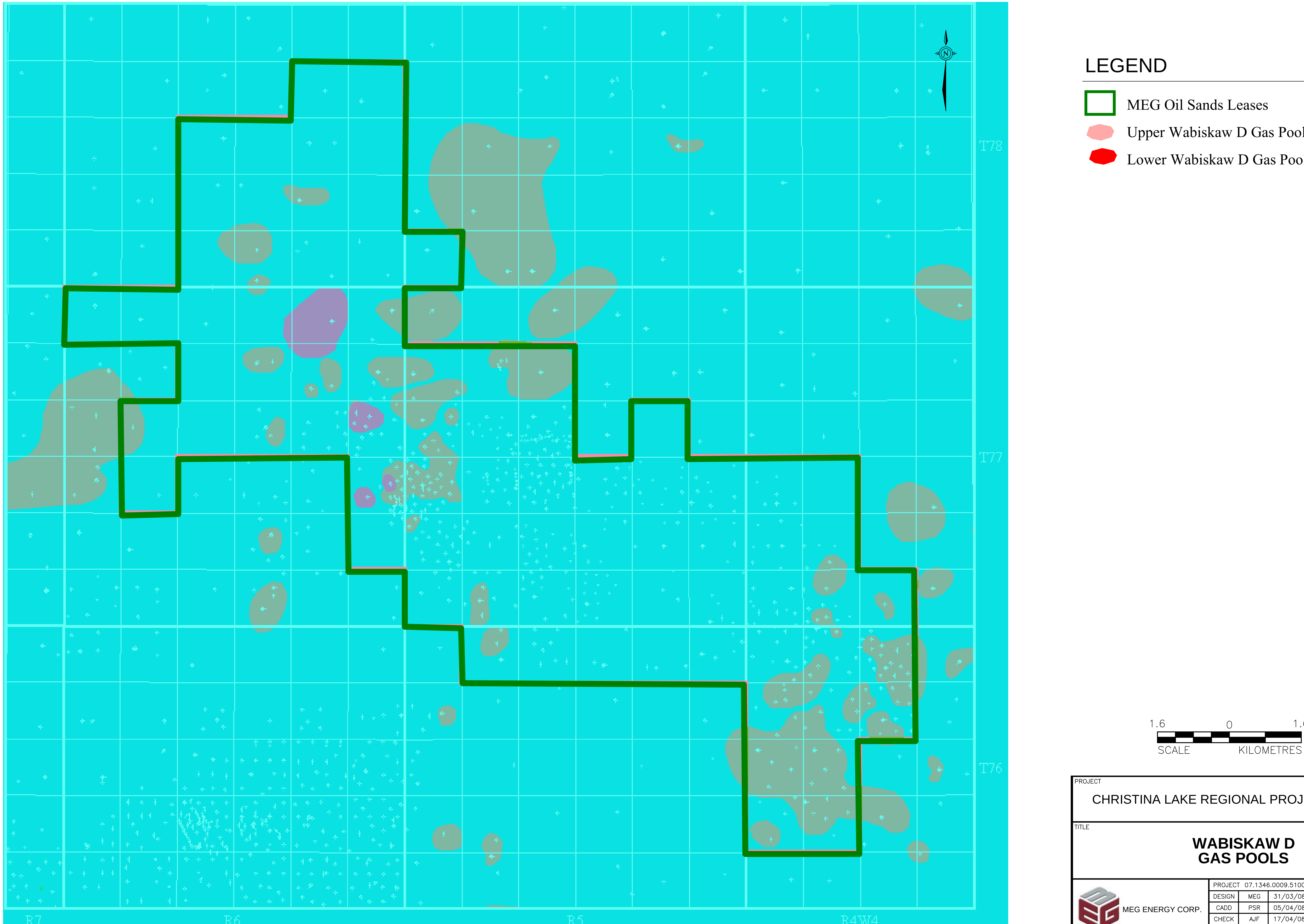

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
WABISKAW D GAS POOLS

PROJECT	07.1346.0009.5100	FILE No.	Wabis+D Gas Pools
DESIGN	MEG 31/03/08	SCALE	AS SHOWN REV. 0
CADD	PSR 05/04/08		
CHECK	AJF 17/04/08		
REVIEW	SG 17/04/08		

MEG ENERGY CORP.

FIGURE: 2.3-27

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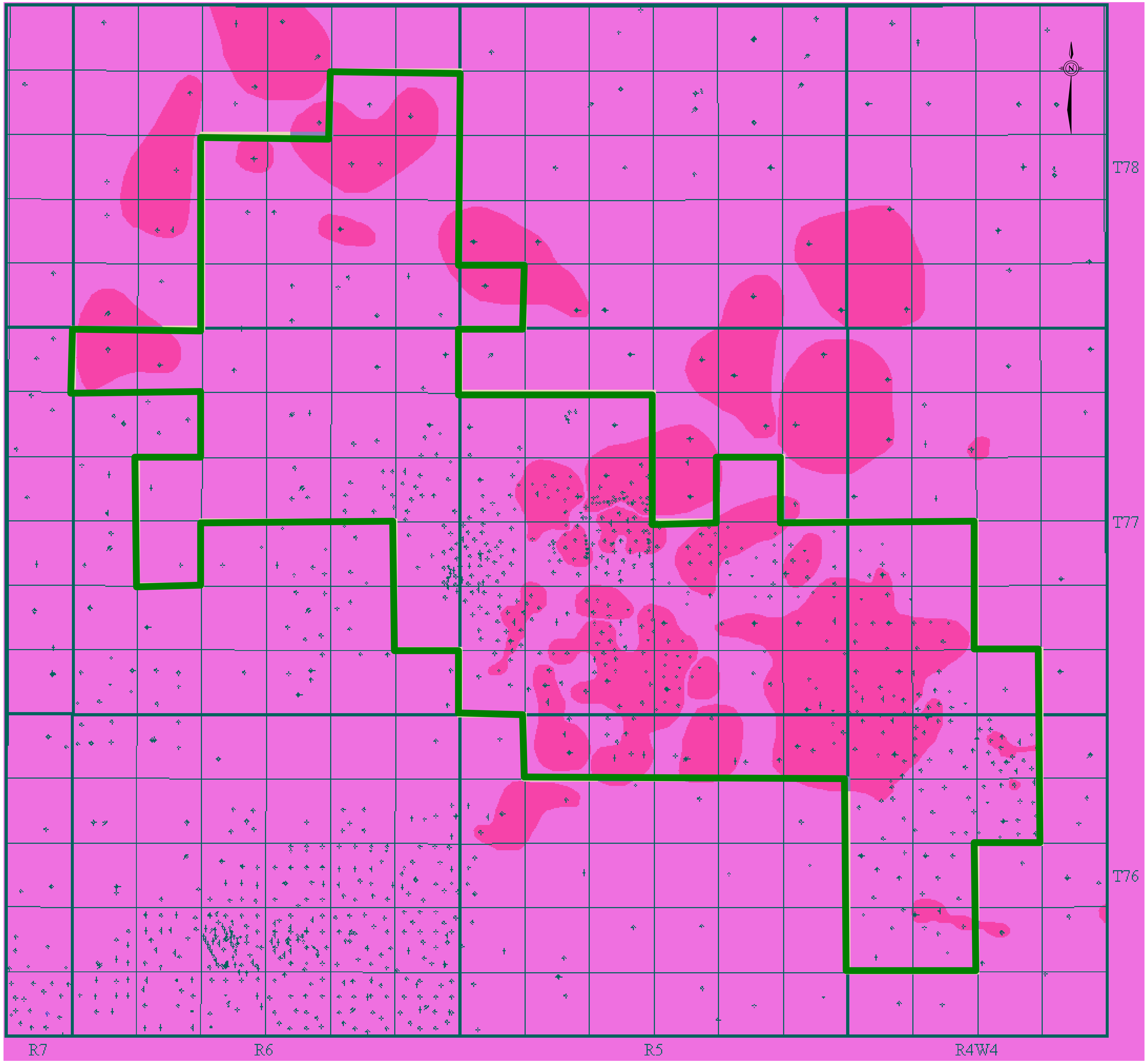


LEGEND

MEG Oil Sands Leases

Gas Pools

1.6 0 1.6

SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

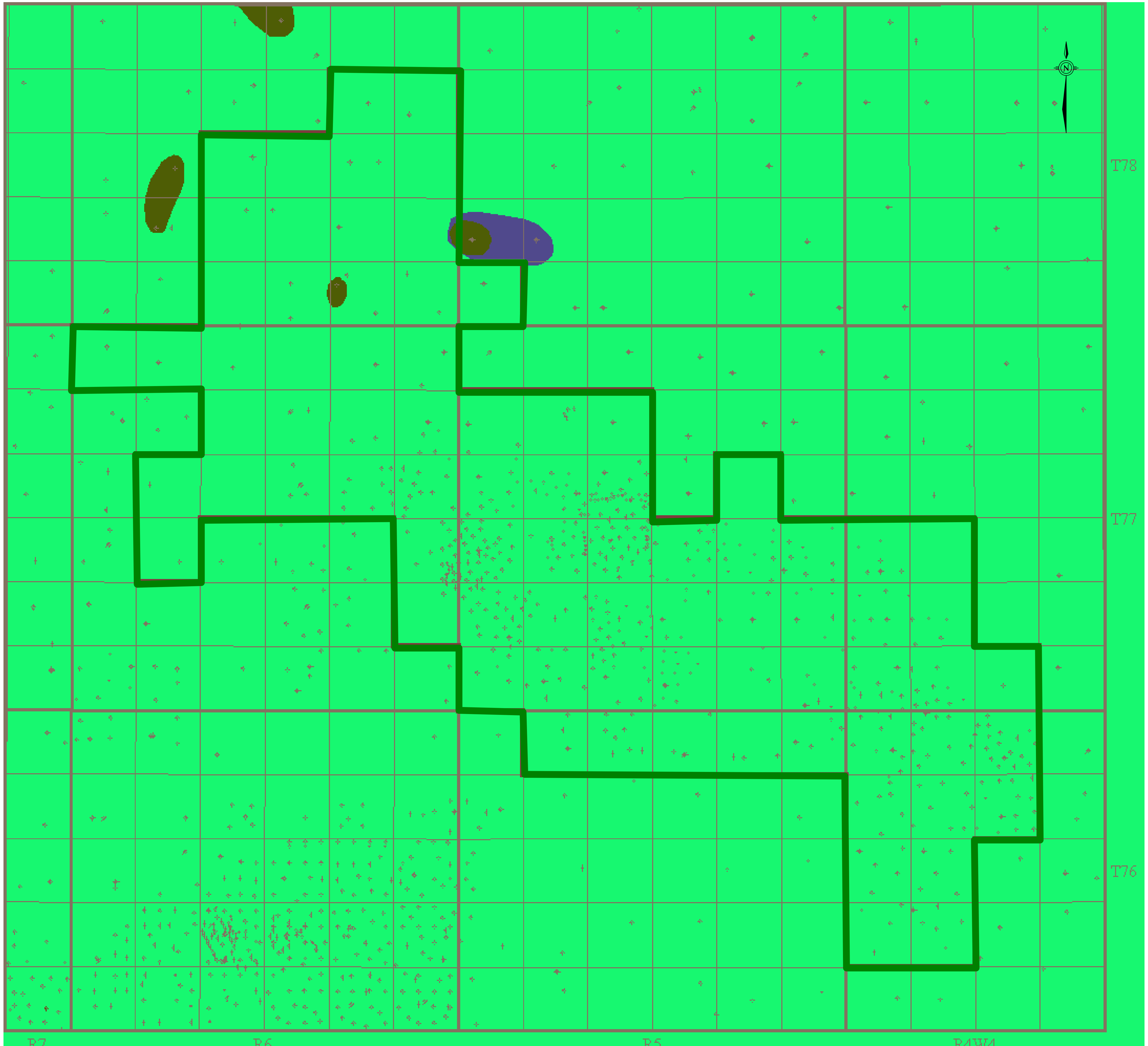
McMURRAY A1
GAS POOLS

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	McM A1 Gas Pools
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	05/04/08		
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

FIGURE: 2.3-28

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-28_McMURRAY A1Gas Pools.dwg Apr 18, 2008 - 10:26am



LEGEND

- MEG Oil Sands Leases
- McMurray B1 Gas Pools
- McMurray B2 Gas Pools

1.6 0 1.6
SCALE KILOMETRES

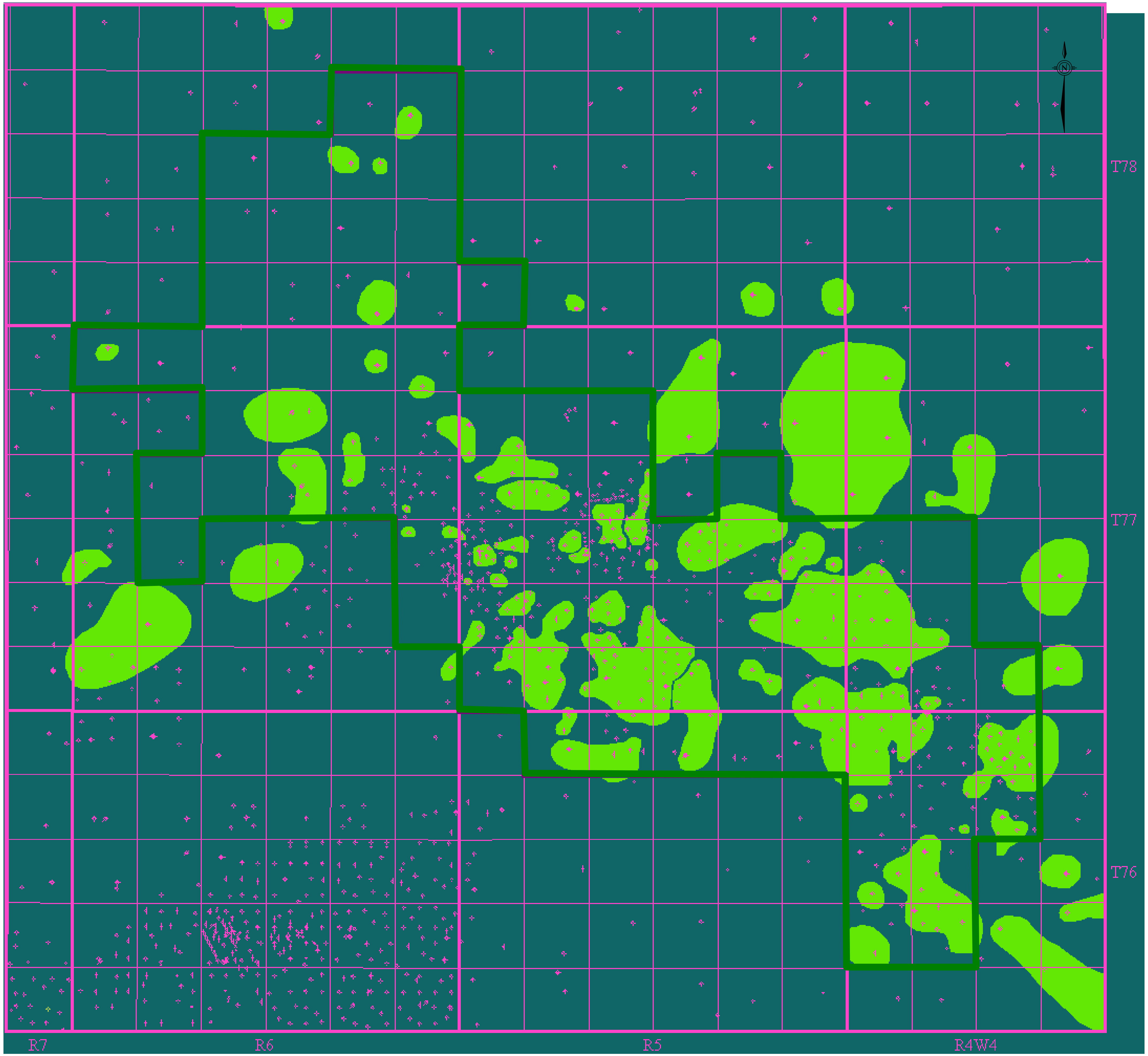
PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
McMURRAY B1 / B2 GAS POOLS

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	McM B1+B2 GasPls
DESIGN	MEG	31/03/08	SCALE AS SHOWN	REV. 0
CADD	PSR	05/04/08	**FIGURE: 2.3-29**	
CHECK	AJF	17/04/08		
REVIEW	SG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-29_McMURRAY B1+B2 Gas Pools.dwg Apr 18, 2008 - 10:28am



LEGEND

- MEG Oil Sands Leases
- Gas Pool

1.6 0 1.6
SCALE KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
McMURRAY CHANNEL GAS POOLS

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	
DESIGN	MEG	31/03/08
CADD	PSR	05/04/08
CHECK	AJF	17/04/08
REVIEW	SG	17/04/08

FILE No. McM Channel GasPls
SCALE AS SHOWN REV. 0

FIGURE: 2.3-30

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-Section 2-Geology\Fig 2.3-30_McMURRAY Channel Gas Pools.dwg Apr 18, 2008 - 10:31am

2.4 RESERVOIR RECOVERY PROCESS

It is accepted that Athabasca Oil Sands reservoirs would not produce bitumen at appreciable rates in their native state. The main challenge for in-situ production is the high bitumen viscosity at the initial reservoir temperature that is typically around 10°C. Bitumen viscosity can be reduced substantially by either heating it or diluting it with solvents. Most research carried out as far back as 1930, both in the field and the laboratory, has been focused on using thermal or steam-based technologies to reduce bitumen viscosity in order to enhance recovery. Most recently, solvent injection either alone or with steam, is being piloted in the field.

2.4.1 Recovery Process Selection

The most piloted recovery method in the Athabasca Oil Sands was the Cyclic Steam Stimulation (CSS) process mainly because of its success in producing heavy oil deposits in California and Venezuela. Although the CSS process has been successful in recovering less viscous bitumen from some reservoirs in the Cold Lake oil sands deposit, it has never been proven commercially viable in the Athabasca bitumen reservoirs. Even under the most favourable reservoir conditions, the process has not achieved economic production rates or steam-oil-ratios.

Another recovery method that was also piloted extensively in the Athabasca Oil Sands was steamflooding (SF) using vertical wells. In the original applications of CSS in heavy oil reservoirs, where oil was much less viscous, steam flooding was typically used as a follow-up process to increase recovery. It was recognized that the CSS process provided maximum heating around the wellbore regions and gave a quick investment return on injected steam. However, the recovery was limited as reservoir drive energy was rapidly depleted. Steamflooding was then used to replenish the drive energy leading to higher recovery.

Steamflooding pilots in the Athabasca Oil Sands typically involved several production wells surrounding a steam injection well (i.e., 5-spot or 9-spot patterns). The wells were pre-conditioned with several cycles of steam stimulation to create some bitumen mobility in the reservoir. This was then followed by an attempt to link up the injector and the producers, usually involving a fracturing process.

The main problem with the steamflooding process was how to maintain the communication between injection and production wells and achieve good sweep efficiency. The initial communication channels were plugged with bitumen quite easily and steam was often re-directed into less desirable regions. One way to ensure good communication was to place the wells very close to one another but this resulted in limited recoverable bitumen because well spacing became smaller. No steamflooding scheme has been proven to be commercially viable in the bitumen reservoirs in Canada.

The research in the past seventy years has thus far yielded only one commercially viable in-situ recovery method for the Athabasca Oil Sands deposits which is the SAGD process. Steam assisted gravity drainage can be viewed as a special form of steamflooding. Unlike the conventional steamflooding processes where the oil is moved by pushing it with the injected fluids, the movement of oil to the production well is caused by gravity forces in the SAGD process. Since gravity drainage dominant processes are usually slow, long (500 to 1,000 m) horizontal wells are used to obtain acceptable performance. In a typical arrangement, a production well is completed near the base of the reservoir with a steam injection well several metres directly above it. Steam is injected continuously into the injection well where it rises and forms a steam chamber. The heated bitumen along with steam condensate fall under the force of gravity and are removed continuously from the lower production well.

This recovery concept has several advantages. Firstly, although the injection well and production well are very close to each other, the process mechanism will cause the steam chamber to expand gradually and effect a drainage area much larger than that covered by the two wells. Secondly, the heated bitumen remains hot as it flows towards the production well. In conventional steamflooding as discussed previously, the bitumen that is displaced from the steam chamber is cooled and is hard to push to the production well. Thirdly, it is well documented in the literature that the recoveries of hydrocarbon in gravity drainage dominant systems are very high. Hence, the SAGD process also gives high recoveries.

The CLRP reservoir is well-suited for the SAGD process. Encana's Christina Lake SAGD pilot located about 10 km to the southwest of MEG's leases has been in operation since mid-2002. It has demonstrated sustained plateau bitumen production rates in the order of 150 to 200 m^3/d per wellpair with steam-oil-ratios of about 2.5. Based on the demonstrated performance and the similarity of the two reservoirs, the SAGD process has been chosen to recover bitumen from the CLRP.

2.4.2 Recovery Process Description

The SAGD process adopted for the CLRP is very similar to dual horizontal well configurations used by other existing SAGD projects. A production well is placed near the base of the reservoir with a steam injection well several metres directly above it. The startup of the SAGD process involves circulating steam into both of the injection and production wells to heat the intervening bitumen between the two wells to the bitumen mobilization temperature. This preheat phase usually lasts for two to three months depending on the actual well spacing and local geology. Once communication is achieved and maintained, steam is then injected continuously into the injection well where it rises and forms a steam chamber. The heated bitumen along with steam condensate will fall under the force of gravity and be removed continuously by the lower production well.

The initial operating pressure is anticipated to be as high as 5,000 kPa to encourage faster chamber development and better utilization of surface facilities. Then it is expected that the operating pressure will be reduced with time to 3,000 to 4,000 kPa, or perhaps lower, depending on the actual field performance. In the areas where the bitumen is in direct contact with top gas and/or bottom water, the long-term operating pressure will likely to be close to the original reservoir pressure of about 2,200 kPa. The production stream and pressure drawdown of each well will be monitored and adjusted continuously to avoid excessive steam coning and to optimize production rate and steam-oil-ratio. Produced fluids are expected to initially flow to surface either by steam lift or gas lift. Provisions for future downhole pumps are included in the design of the production wells. The field operating strategy will be continuously refined based on actual well performance and from data collected from strategically located observation wells.

2.4.3 Gas Caps

Most of the SAGD pads in the initial development area are overlain by gas caps and underlain by water sands. Although the delineation well data show that not all of the SAGD bitumen pay zones are connected to the gas and the water, it is prudent from an engineering perspective to assume the gas, bitumen and water sands are in direct contact. The pressures of some of these gas pools were reduced significantly from the initial level of about 2,000 kPa to about 600 kPa because of prior gas production (Table 2.3-2). All the gas production from the Wabiskaw/McMurray intervals had been suspended since 2004 as part of the gas-over-bitumen shut-in order. This pressure imbalance, if unchecked, can create steam containment issues resulting in excessive losses of steam into the depleted gas caps.

MEG intends to restore the gas cap pressures to near the initial levels in areas where bitumen and gas are believed in direct contact. Ideally, the restoration of gas cap pressure should be completed prior to the top of steam chamber contacting the gas. At this time, MEG plans to inject flue gas into the depleted gas caps for the repressurization. The source of the flue gas will likely come from the steam boilers used to generate steam for the SAGD operation.

MEG is currently operating a Gas Re-injection and Production Experiment (GRIPE) in the Surmont area to pilot the potential of displacing natural gas in depleted gas caps over bitumen using flue gas. The objective is to recover additional natural gas while maintaining (or perhaps increasing) reservoir pressure. Although the on-stream time of the pilot has been relatively low at 60% mainly due to surface facility issues, the results from pilot demonstrate that flue gas can be safely and efficiently injected into the McMurray Formation.

Although the current plan is to use flue gas, it is possible that other type of gases, such as high purity CO_2 and air, can be utilized. MEG is carrying out engineering and field studies to finalize the plan which will be submitted to the ERCB at an appropriate time.

2.5 PRODUCTION FORECAST

Production forecasts for some of the initial SAGD patterns of Phase 3 have been carried out with the Exotherm reservoir simulator by T.T. & Associates Inc. Exotherm is a three-phase, multi-component reservoir simulation model designed to simulate thermal and steam additives recovery processes.

The horizontal well length ranges from 600 to 1,000 m with most of the wells averaged at about 700 m. The actual well length will vary depending on the final pad placement. The lateral well spacing between SAGD well pairs is about 100 m.

The peak plateau production rates are forecasted to be between 100 and 170 m^3/d per well pair for a 700-m-long well. The predicted steam-oil-ratios are between 2.6 and 3 depending on the local geology and the operating pressure.

2.6 POTENTIAL FUTURE IMPROVEMENTS

There are several initiatives currently in the piloting stage to improve SAGD performance. The results from these pilots will be available to the public in the next few years which will undoubtedly add to the understanding and improvement of the SAGD technology. It is MEG's intention to monitor and evaluate the progress of these pilots. Any improvements that are economically viable and relevant to MEG's operations may be incorporated into future development, through the filing of separate applications.

2.6.1 Addition of Non-Condensable Gases with Steam in Steam Assisted Gravity Drainage

As discussed in the Phase 2 application, MEG continues to believe the addition of suitable amounts of non-condensable gases to steam can increase the thermal efficiency. In the SAGD process, about one-third of the injected heat returns as sensible heat in the produced bitumen and water. The remaining two-thirds stay in the reservoir. Hence, there is a large amount of injected heat remaining in the reservoir after a prolonged period of steaming. The effective recovery of this stored energy is critical to the overall process economics.

When steam injection is reduced or discontinued, the pressure of the chamber falls as the system cools. The sensible heat stored in the rocks, particularly within the core of the chamber where temperature is the highest, is recovered and transferred to water in the pore space, and further steam is produced. The in-situ generated steam flows toward chamber boundaries, where it heats the bitumen and continues the recovery operation. It is desirable to keep reservoir pressure at a sufficiently high level during this mode of heat recovery operation to maintain reservoir inflow into the production well. In addition, if the chamber pressure declines too low, it encourages encroachments from surrounding regions, (e.g., steam from adjacent chambers and water from connected wet sands).

The first non-condensable gases addition to steam pilot was carried out at the Dover SAGD Project (formerly Underground Test Facility [UTF]) with very encouraging results. In this case, non-condensable gases was added to steam after about five years of SAGD operation. The injection of non-condensable gases had no detrimental effect on bitumen but it reduced the steam injection volume significantly. Other SAGD projects, such as EnCana's Foster Creek and Christina Lake operations, have achieved similar results.

2.6.2 Addition of Solvent With Steam

As discussed previously, the bitumen viscosity can be reduced substantially by either heating it or diluting it with solvents. The idea of adding solvents to steam is not new and had been tested in a number of past pilots with mixed results. In recent years, the interests on steam/solvent have been rekindled. Currently, there are several thermal projects that are piloting the addition of light hydrocarbons (e.g., butane, natural gas condensate) to steam injection. The project that is of particular interest to MEG is EnCana's Solvent-Assisted-Processes (SAP) pilot at Christina Lake because of its close proximity and similar geological settings. Butane has been added to the SAGD wells after they have established sizable steam chambers. While there are some initial improvements to the production rate and the steam-oil-ratio, the commerciality of the process has yet to be established.

3 PROJECT DESCRIPTION

3.1 INTRODUCTION

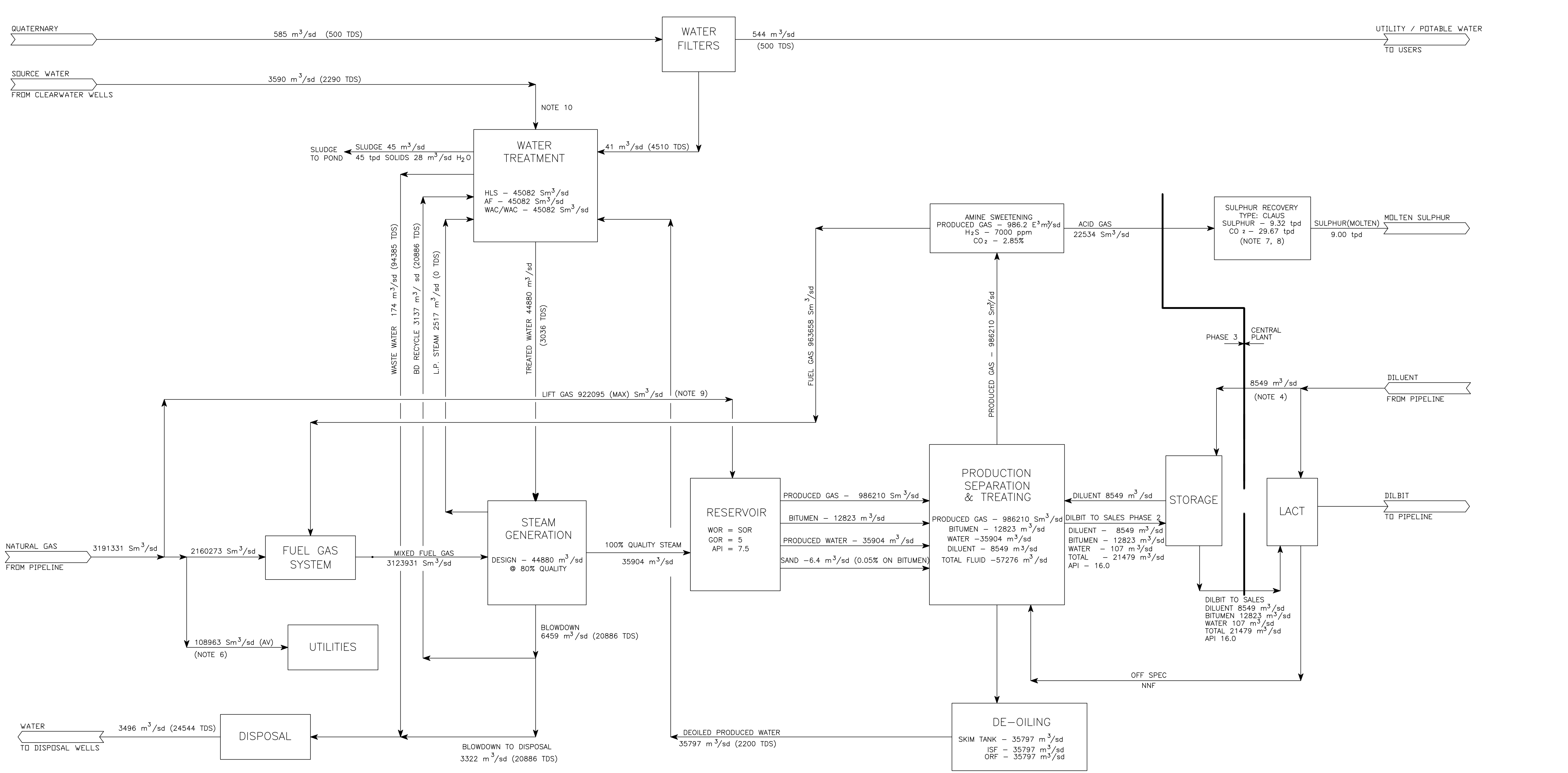
The Project will utilize SAGD in-situ technology to recover bitumen from the McMurray Formation. The previously approved phases of the CLRP were designed to use this same technology and to have a maximum bitumen production rate of 60,000 bpd (9,540 m^3/day). The addition of Phase 3 to the CLRP will increase the bitumen production by 150,000 bpd (23,850 m^3/day) for a total combined bitumen production of 210,000 bpd (33,390 m^3/day).

3.2 PROCESS DESCRIPTION

The Project can be separated into three basic components: the plants, field facilities and offsite services. The CLRP is the integration of the previously approved Phase 1, Phase 2 and Phase 2B and Phase 3 (as outlined in this application). The previously approved phases of the CLRP will continue to operate while the Phase 3 facilities are being constructed. Phase 3 will share some facilities with the previously approved phases of the CLRP, including the sales and diluent pipeline connections, electricity and potentially the fuel gas pipeline connection. The layout and location of proposed facilities including Plant 3A and Plant 3B, production wellpads, source and disposal wells, access roads, pipelines and utility corridors are presented on Figures 1.2-3 and 1.2-4.

Figure 3.2-1 presents a block flow diagram for Plant 3A or 3B and shows the interconnections of the individual Project processes. Production rates for the Project are double the values presented in Figure 3.2-1. For production and process rates for the previously approved phases, Phase 3 and the CLRP, refer to Table 1.2-1.

There will be two 37,500 bpd trains at each of the Phase 3 plants. The process flow diagrams provided show the equipment for one 37,500 bpd train.



NOTES:

1. ALL FIGURES IN STREAM DAY RATES. BASED ON RELIABILITY OF 0.93.
2. STEAM FIGURES ARE COLD WATER EQUIVALENT (CWE).
3. FUEL GAS FLOWS SHOWN ON DRY BASIS WITH BFW PREHEAT TO 150°C, C/W PG AT 60°C & AIR PREHEAT TO 80°C.
4. DESIGN DILUENT 32 API(OSA DILUENT)
   DESIGN BITUMEN 7.5 API (MIN)
   DILUENT FLOWS ASSUME 0.5% SHRINKAGE OF DILBIT, PLANT DILUENT LOSSES NOT INCLUDED.
5. RAW WATER RATES ALLOW FOR UTILITY WATER RETURN TO PLANT.
6. UTILITY FUEL GAS ALLOWANCE INCLUDES GAS FOR PILOT, PURGE, UTILITY BOILER, AMINE AND SULPHUR RECOVERY.
7. H_2S & CO_2 QUANTITIES GIVEN IN ACID GAS STREAM.
8. LOCATED ADJACENT TO CENTRAL PLANT.
9. MAXIMUM LIFT GAS AT SOR = 2.8, WINTER CONDITIONS CASE.
10. P/L FROM CLEARWATER WELLS LIMITED TO 2300 m^3/sd.
11. RECYCLE RATE INCLUDES ALL WATER WELL FLOWS.

PROJECT				
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3				
TITLE: PLANT 3A OR PLANT 3B BLOCK FLOW DIAGRAM (75,000 BPD)				
MEG ENERGY CORP.	PROJECT 07.1346.0009.5100			FILE No. 085349.4900.3012.RA
	DESIGN	PT	09/04/08	SCALE NTS REV. 0
	CADD	PSR	09/04/08	FIGURE: 3.2-1
	CHECK	SG	17/04/08	
	REVIEW	SG	17/04/08	

3.2.1 Phase 3 Plants

Plant 3A and Plant 3B will each occupy an area of approximately 100 ha. At Plant 3A and Plant 3B, steam will be generated using recycled produced water and make-up water from the Upper Clearwater water sand. Steam generation make-up water for the process will be supplied from new water source wells to be installed for Phase 3. Additional detail regarding source water is presented in Section 3.2.2.2.

Fourteen OTSGs will be included at each of the Phase 3 plants to produce 80% quality high-pressure steam at a rate of 83,475 m^3/d for Phase 3. A steam separator will then be used to produce 100% (dry) quality steam for distribution to the Phase 3 wellpads at a rate of 66,780 m^3/d.

As in the previously approved phases of the CLRP, produced fluids will include bitumen, condensed steam from the injection process, formation water, and gas. Bitumen treating, water de-oiling, steam generation, produced gas sweetening and lift gas compression will occur at both Plant 3A and Plant 3B. Tankage for diluent, sales oil, and produced water will be located at both Plant 3A and Plant 3B. Sulphur recovery facilities for the Project will be located at the existing Central Plant.

The following basic streams will be processed at both Plant 3A and Plant 3B:

- the bitumen emulsion will undergo a separation process to meet the pipeline specifications of 0.5% Basic Sediments and Water (BS&W);
- produced water will be de-oiled and then recycled to the water treatment plant; and
- gas will be removed from the produced fluids, sweetened and used as fuel for the steam generators.

The processing facilities and systems at both Plant 3A and Plant 3B will include:

- boiler feedwater treatment;
- steam generation;
- plant inlet facilities;
- an emulsion treating system;
- produced water de-oiling and recycling facilities;
- slop treatment facilities;

- fuel and produced gas gathering, processing and distribution facilities;
- flare systems;
- glycol cooling and heating facilities;
- produced gas sweetening facilities;
- reservoir re-pressurization facilities (Plant 3A only); and
- utilities.

The processing scheme is described in the following sections and is based on proven industry practices and technologies.

3.2.1.1 Plant Layouts

The major equipment at each plant will be housed in steel-framed buildings. Similar to the previously approved phases of the CLRP, a modularized design has been selected for ease of construction for the Project. Some site fabrication of facilities will also be required, as well as the hook-up of modules. Buildings will be required at each of the Phase 3 plants, including:

- process building;
- water treatment building;
- Motor Control Centre (MCC) buildings;
- steam generator building;
- gas sweetening/dehydrator/compressor building;
- glycol/utility building;
- diluent pump building;
- slop treater building;
- vapour recovery unit building;
- reservoir repressurization building (Plant 3A only); and
- administration building.

Additional infrastructure will be required at each of the Phase 3 plants, including:

- tanks;
- flare stacks;
- lift gas compression;
- sales oil pumps;

- industrial runoff ponds;
- process ponds; and
- substation.

Plant 3A and Plant 3B will both be constructed on a level clay-based site. Gravel will be used to provide access in and around the equipment, buildings, tankage and ponds. Topsoil from the site will be salvaged as described in the Conservation and Reclamation Plan (Section 6).

Figure 3.2-2 presents a plot plan for one of the Phase 3 plants. The plot plans for Plant 3A and Plant 3B are identical, therefore, only one is provided.

The location of the new equipment to be added to the Central Plant is presented in Figure 3.2-3.

3.2.1.2 Boiler Feedwater

Water will be treated to steam generator Boiler Feedwater (BFW) quality as per the steam generator manufacturer's recommendations. The water treatment process is presented in Figure 3.2-4.

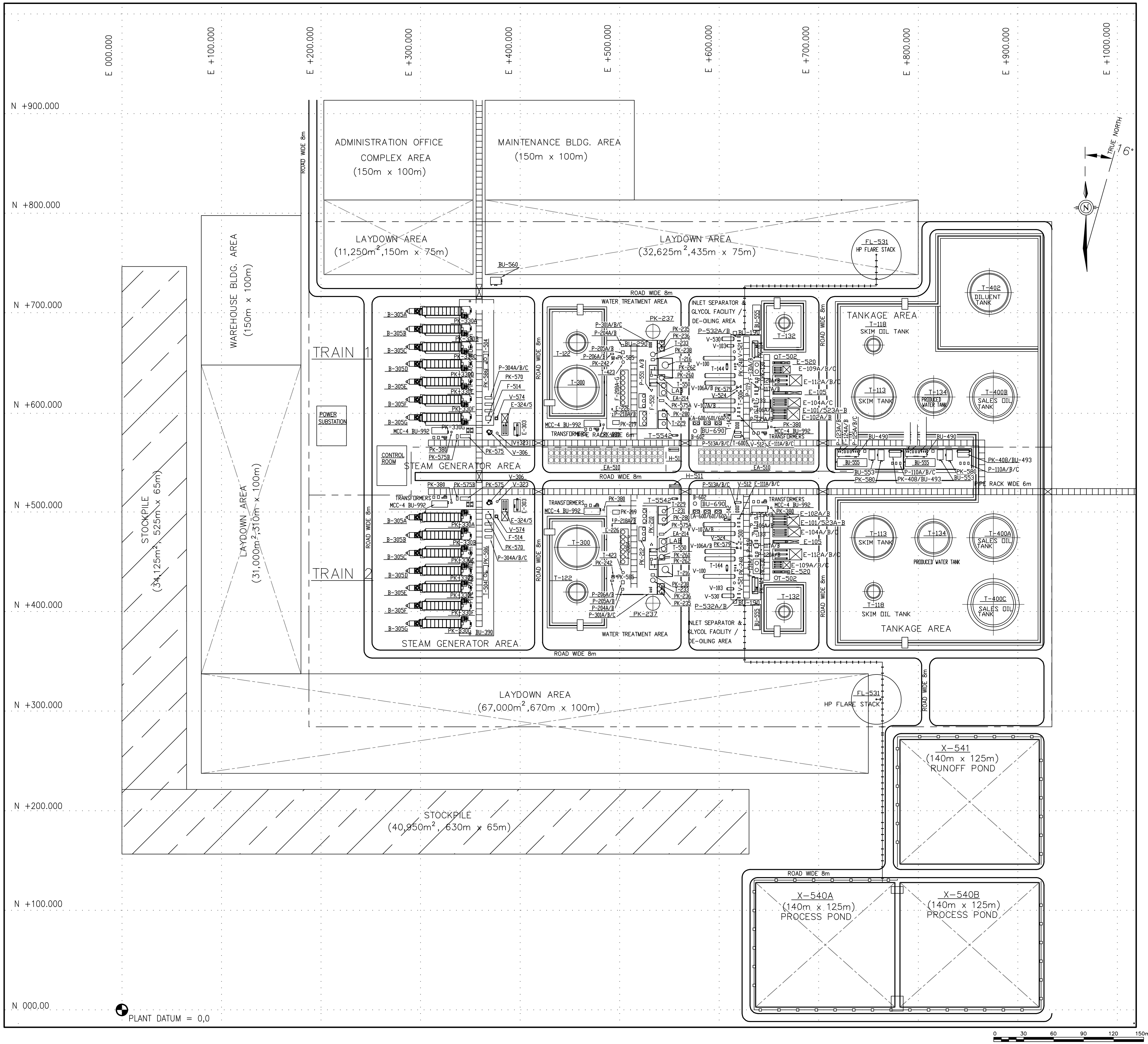
The main BFW source is recycled produced water. Make-up water from the Upper Clearwater water sand will be used as necessary and supplemented from the boiler blowdown recycle and the supernatant from the process ponds. Recycled produced water undergoes pretreatment to remove bitumen through skim tanks, Induced Gas Flotation (IGF) units and oil removal filters.

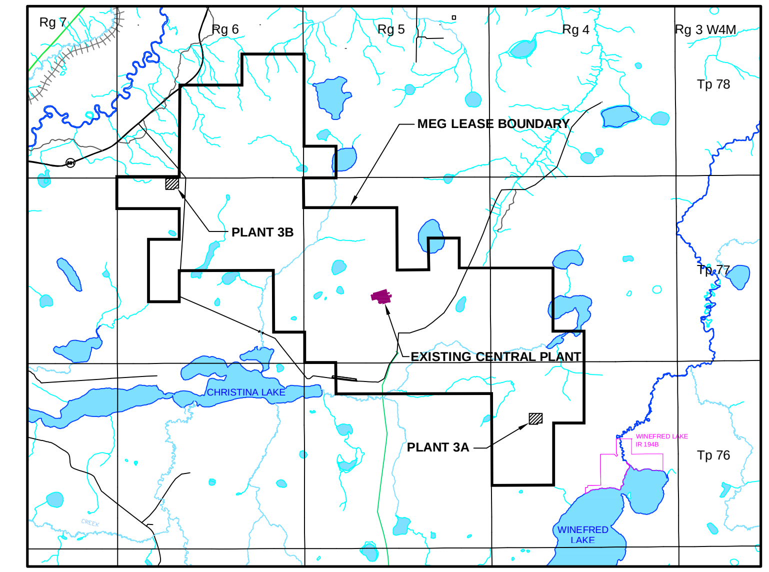
The main BFW specifications will be:

- TDS of less than 8,000 mg/L;
- hardness (calcium and magnesium) of less than 0.5 mg/L as calcium carbonate; and
- dissolved silica of less than 50 mg/L.

The main water treatment system components include:

- Lime Softener (LS);
- after filters;
- primary WAC package; and
- WAC polisher.





KEY PLAN

EQUIPMENT LIST – TYPICAL PER TRAIN

INLET SEPARATOR & GLYCOL FACILITY	
BU-190	PROCESS BUILDING
BU-553	GLYCOL/UTILITY BUILDING
B-602	AMINE BOILER
BU-690	GAS SWEETENING/DEHY/COMPRESSOR BUILDING
E-101A/B/C	PRODUCED GAS/BFW EXCHANGER
E-102A/B/C	PRODUCED GAS/GLYCOL EXCHANGER
E-104A-F	EMULSION GAS/BFW EXCHANGERS
E-105A/B	EMULSION/GLYCOL EXCHANGER
E-109A-E	PRODUCED WATER/HLS FEED EXCHANGERS
E-111A/B/C/D	SALES OIL/GLYCOL EXCHANGERS
E-112A/B/C/D	PRODUCED WATER/GLYCOL EXCHANGERS
E-520	FUEL GAS HEATER
E-523A/B/C	DILUENT RECOVERY/GLYCOL EXCHANGER
EA-510	GLYCOL COOLER
EA-600	SOUR GAS COOLER
EA-601	PRODUCED GAS COMPRESSOR COOLER
EA-602	AMINE RECIRCULATION COOLER
F-131A/B/C	ORF VESSEL
F-514	GLYCOL FILTER
H-511	GLYCOL HEATER
P-108A/B	INTERFACE RECYCLE PUMPS
P-117A/B	IGF FROTH PUMP
P-119	SKIM OIL PUMP
P-120A/B	PRODUCED WATER TRANSFER PUMPS
P-133	ORF BACKWASH TRANSFER PUMP
P-135A/B	LS FEED PUMPS
P-406A/B	OFF-SPEC PUMPS
P-513A/B/C	GLYCOL CIRCULATION PUMPS
P-525	RECOVERED DILUENT PUMP
P-532A/B	HP FLARE KNOCKOUT PUMP
PK-114	INDUCED GAS FLOATATION PACKAGE
PK-130	ORF PACKAGE
PK-248	DEOILING POLYMER PACKAGE
PK-570	PLANT INSTRUMENT AIR PACKAGE
PK-579	DEMULSIFIER/REVERSE DEMULSIFIER PACKAGE
T-142	INLET TREATMENT AREA SUMP TANK
T-144	DE-OILING AREA SUMP TANK
T-500	REVERSE DEMULSIFIER STORAGE TANK
T-502	DEMULSIFIER STORAGE TANK
T-5542	GLYCOL/UTILITY BUILDING SUMP TANK
T-600	AMINE STORAGE TANK
V-100	INLET SEPARATOR
V-103	PRODUCED GAS SAPARATOR
V-106A/B	FREE WATER KNOCKOUT
V-107A/B	TREATER
V-512	GLYCOL EXPANSION DRUM
V-521	FUEL GAS MIX DRUM
V-524	DILUENT RECOVERY SEPARATOR
V-530	HP FLARE KNOCK OUT DRUM
V-574	DRY INSTRUMENT AIR RECEIVER

TANKAGE AREA	
BU-490	DILUENT PUMP BUILDING
BU-493	SLOP TREATER BUILDING
BU-553	GLYCOL/UTILITY BUILDING
BU-555	VRU BUILDING
F-124A/B	PROCESS FILTERS
FL-531	HP FLARE STACK
P-110A/B	SALES OIL PUMPS
P-123A/B	WATER BOOSTER
P-125A/B/C	WATER DISPOSAL PUMPS
P-403A/B	DILUENT PUMPS
PK-408	SLOP TREATER PACKAGE
PK-580	LIFT GAS COMPRESSOR PACKAGE
T-113	SKIM TANK
T-118	SKIM OIL TANK
T-122	DISPOSAL WATER
T-132	ORF BACKWASH/DESAND TANK
T-134	PRODUCED WATER TANK
T-400A/B/C	SALES OIL TANKS
T-402	DILUENT TANK
X-540A/B	PROCESS PONDS
X-541	INDUSTRIAL RUN-OFF POND

WATER TREATMENT AREA	
BU-290	WATER TREATMENT BUILDING
BU-990	MCC #1 BUILDING
MCC-3	MCC #1 BUILDING
E-226	DILUTION WATER COOLER
EA-214	TREATED WATER COOLER
F-208A-G	AFTER FILTERS
F-552	UTILITY WATER FILTER
P-204A/B	DIRTY BACKWASH TRANSFER PUMPS
P-205A/B	LS RECIRCULATION PUMPS
P-206A/B	AFTER FILTER BACKWASH PUMPS
P-217A/B	NEUTRALIZATION PUMPS
P-218A/B	DILUTION/SERVICE PUMPS
P-230A/B	ACID PUMPS
P-301A/B/C	LP BFW PUMPS
P-551A/B	UTILITY WATER PUMPS
PK-210	PRIMARY WAC PACKAGE
PK-212	POLISHER WAC PACKAGE
PK-219	WAC/WAC FEED PUMP PACKAGE
PK-235	MAGOX PACKAGE
PK-236	LIME PACKAGE
PK-237	LIME SOFTENER
PK-238	BRINE FEED PUMP PACKAGE
PK-242	FLOCCULENT PACKAGE
PK-260	CAUSTIC PUMPS PACKAGE
PK-262	ACID DOSING PUMP PACKAGE
PK-280	SHOWER
PK-575	EMERGENCY GENERATOR PACKAGE
PK-575A	EMERGENCY GENERATOR COOLER
PK-575B	EMERGENCY DIESEL TANK
PK-585	O_2SCAVENGER INJECTION PACKAGE
T-216	NEUTRALIZATION TANK
T-229	ACID TANK
T-231	CAUSTIC TANK
T-233	BRINE SATURATOR TANK
T-264	WATER TREATMENT AREA SUMP TANK
T-300	BFW TANK
T-423	FLOCCULENT DAY TANK
T-550	UTILITY WATER TANK
V-211A/B/C/D/E	PRIMARY WAC VESSELS
V-213A/B/C/D	POLISHER WAC VESSELS
AHU-2901	AIR HANDLING UNIT

STEAM GENERATOR AREA	
BU-390	STEAM GENERATOR BUILDING
BU-560	RESERVOIR RE-PRESSURIZATION BUILDING
BU-992	MCC #2 BUILDING
MCC-4	MCC #2 BUILDING
B-305A-G	STEAM GENERATOR
E-303	HIGH TEMP. BLOWDOWN COOLER
E-324	LP BLOWDOWN GLYCOL EXCHANGER
E-325	BLOWDOWN DISPOSAL GLYCOL EXCHANGER
P-304A/B/C	HP BOILER FEED WATER PUMPS
PK-330A-G	STEAM GENERATOR PACKAGE
PK-380	EMER. SHOWER & EYEWASH STATION (2-BU-390)
PK-586	FILMING AMINE PACKAGE
T-362	STEAM GENERATION AREA SUMP TANK
T-504	FILMING AMINE STORAGE TANK
V-306	STEAM SEPARATOR
V-323	LP STEAM SEPARATOR
V-526	FUEL GAS COALESCER

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

PLANT 3A OR 3B PLOT PLAN (75,000 BPD)

MEG ENERGY CORP.

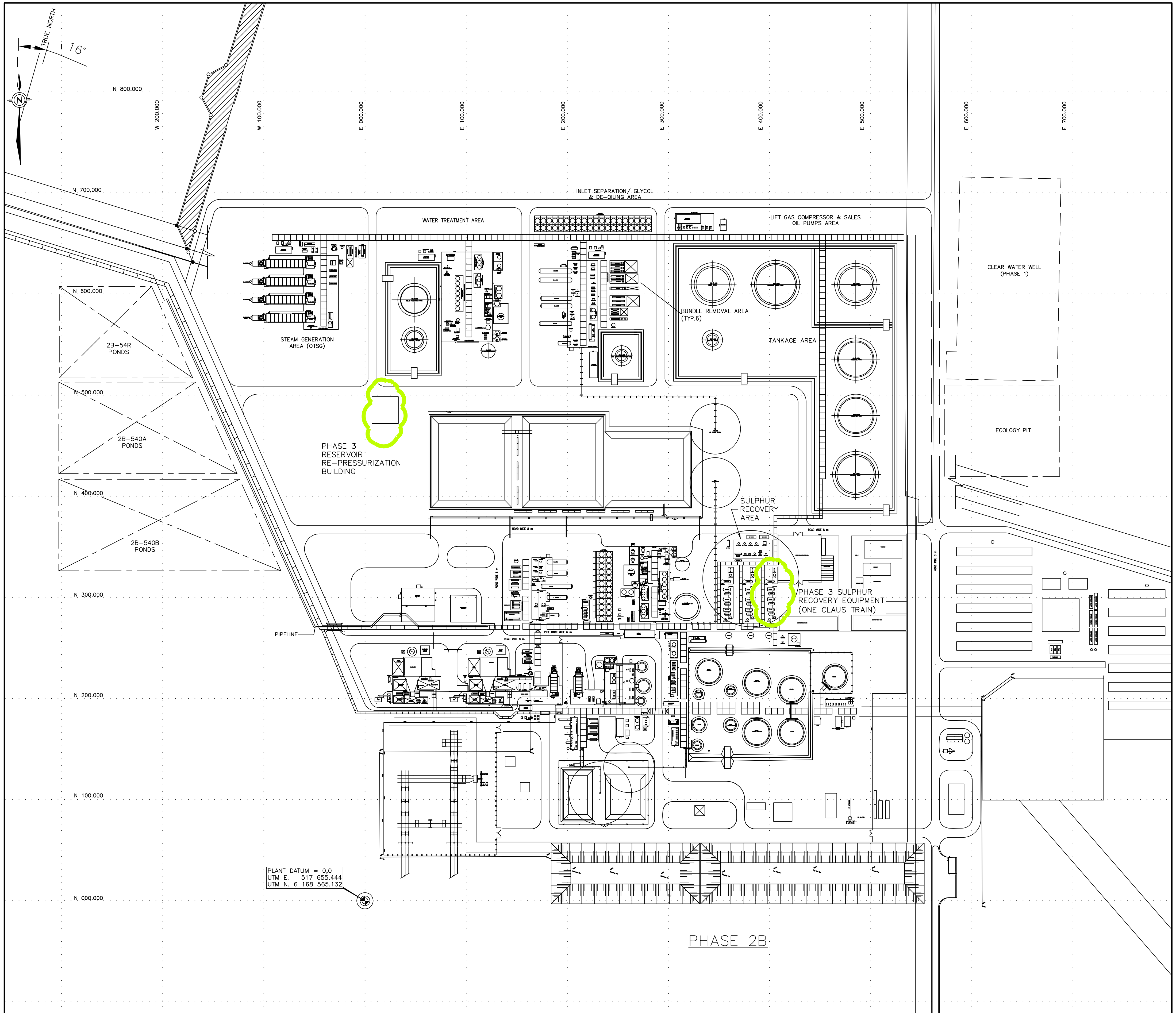
PROJECT 07.1346.0009.5100		
DESIGN	PT	10/04/08
CADD	PSR	18/04/08
CHECK	SG	18/04/08
REVIEW	SG	18/04/08

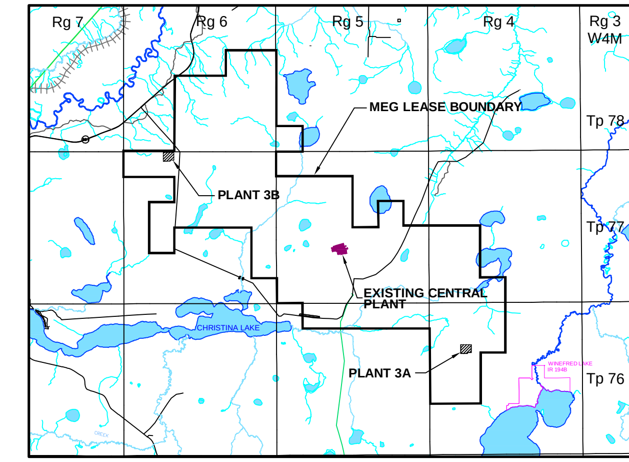
FILE No. Plant 3A+3B Plot Pl
SCALE 1:2000 REV. 0

FIGURE: 3.2-2

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-From Matrix\Fig 3.2-2_ Plant 3A or Plant 3B Plot Plan-75000-BPD.dwg Apr 18, 2008 - 3:35pm

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-From Matrix\Fig 3.2-3_Revised Central Plant Plot Plan-085349-4903-3_2-4-R0.dwg Apr 18, 2008 - 3:38pm





KEY PLAN

0 60 120 180 240 300m

ALL DIMENSIONS ARE IN m UNLESS NOTED OTHERWISE

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

REVISED CENTRAL PLANT PLOT PLAN

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No. 085349-4903-3_R0
DESIGN	RDM	17/05/07	SCALE 1:2000 REV. 0
CADD	PSR	18/04/08	
CHECK	SG	18/04/08	**FIGURE: 3.2-3**
REVIEW	SG	18/04/08	

Reduction of silica to less than 50 mg/L and partial softening of recycled water will be accomplished using an LS. Lime and magnesium oxide will be fed into the LS to coagulate and flocculate components from the water column. Treated water will be collected around the perimeter of the LS vessel while the sludge will collect on the bottom. The bottom of the vessel will be sloped to the middle to facilitate solids removal. A portion of the sludge will be recirculated to improve contact between influent water and precipitate crystals, thus enhancing treatment efficiency.

Residual solids in the LS effluent will be removed in the after filter package. The after filters will be backwashed with backwash water recycled to the LS. When one filter is in backwash the other filters are servicing the total process load. Normally, each filter is backwashed once per day for a period of ten minutes.

The LS and after filter process will reduce water hardness to about 20 to 50 mg/L as $CaCO_3$; however, the OTSGs will require a final BFW hardness of less than 0.5 mg/L. This final hardness removal will be accomplished using a primary WAC package followed by a polisher WAC package. The primary WAC package will remove the majority of the incoming hardness, to a value of about 5 mg/L. The dedicated secondary WAC polishing units will remove the residual hardness to satisfy the BFW requirement of less than 0.5 mg/L.

Water from the WAC packages will be stored in the BFW tank before being used in the OTSGs. Sludge from the LS and backwash and rinse water from the WAC packages and after filters will be sent to the process ponds.

The WAC resins will be internally regenerated via the WAC regeneration packages. When one vessel is out of service the total flow goes to the remaining vessels on line. The WAC units will be regenerated with a hydrochloric acid solution that removes the calcium and magnesium from the resin and converts it to the hydrogen form. The resin is then converted to the sodium form with sodium hydroxide (caustic). The regenerant waste streams will be mixed in the neutralization tank and disposed of by deep well injection. Waste streams from the regeneration process that are not sent to the neutralization tank are recycled back to the LS.

3.2.1.3 Steam Generation

A total of twenty-eight 73.3 MW OTSGs (14 OTSGs at each of the Phase 3 plants) are required to produce the required steam volumes for Phase 3. Figure 3.2-4 presents the steam generation process.

The OTSGs will be used to produce 80% quality steam. High-pressure steam separators will remove the steam condensate to provide 100% quality high pressure steam for distribution to the Phase 3 production wellpads. The steam condensate will be routed to the low-pressure steam separator to produce utility steam for other process uses. The low-pressure steam condensate (blowdown) from the steam separators will be cooled and sent to disposal wells.

The combustion air to each OTSG will be preheated with glycol heat medium. Select OTSGs will each be equipped with stack gas analyzers and Continuous Emissions Monitoring Systems (CEMS), in accordance with the EPEA Approval.

During OTSG start up, hot water and low-quality steam (startup and depressured blowdown) will be temporarily routed to the process ponds. The blowdown lines from the OTSGs will also send steam to ponds in the event of an upset condition or a steam generator shutdown. The supernatant from the process ponds will be recovered and recycled through the water recycle system.

Stack heights and emission parameters for the OTSGs are presented in Table 3.2-1.

Table 3.2-1 Stack Heights and Emission Parameters for One Once Through Steam Generator

Category	Parameter	Phase 3 (73.3 MW) OTSG
Dimensions	stack height (m)	30
	stack diameter (m)	1.956
Stack Gas	exit velocity (m/s)	16.98
	exit temperature (°C)	171.1
Emission Rate	SO_2 (t/d)	0.003
	NO_x (t/d)	0.332
	$PM_{2.5}$ (t/d)	0.027
	CO (t/d)	0.294

3.2.1.4 Bitumen Treating Process

The bitumen treating process for the Project is the same process used for the previously approved phases of the CLRP. Produced fluids will consist of bitumen, water in the form of condensed steam, formation water and gas.

Produced emulsion from the field will be sent directly to the inlet separator (Figure 3.2-5), where the vapours and liquids (emulsion) will be separated.

The vapours will be cooled on route to the produced gas separator where additional two-phase separation will occur. The produced gas will be sweetened and then sent to the fuel gas mix drum and the produced gas condensate will be sent to the skim tank.

After exiting the inlet separator, the emulsion will be cooled through heat exchangers. A reverse demulsifier will be injected prior to diluent addition to promote separation of bitumen from the water and to prevent formation of reverse (oil in water) emulsions. Diluent will be injected into the cooled emulsion to further lower the temperature and to reduce the density and viscosity of the bitumen.

The emulsion will enter the Free Water Knock Out (FWKO) vessels at approximately 130°C. At temperatures between 100°C and 160°C there is very little density difference between the produced water and the bitumen. To widen the density difference, the bitumen density will be lowered through the addition of diluent. Practice has shown that the addition of diluent provides optimal oil separation.

The FWKO vessels and treater vessels will be three-phase gravity separators with vapour leaving from the top, the diluted bitumen leaving from the middle and the water phase leaving from the bottom. The water content in the diluted bitumen will typically be less than 0.5% BS&W as the diluted bitumen leaves the treaters. The diluted bitumen will be cooled, and then sent to the sales oil storage tanks.

Slop oil from the slop oil tank and the skim oil tank and recovered hydrocarbon condensate from the slop treaters will be combined with the emulsion from the wellpads for processing. These recycle streams will be intermittent flows.

All meters and metering calculations for liquids will adhere to the industry standards for petroleum measurements.

Gas will also be collected off the FWKO and treater vessels and sent to the diluent and vapour recovery systems. Produced water collected through the bitumen treating process will be de-oiled and recycled for use as BFW.

The produced fluids will also contain excess heat which will be recovered. Plant 3A and Plant 3B will both be equipped to cool the inlet streams through a heat exchange process that recovers and utilizes the high-grade heat in other areas of the plant. This heat recovery is key to each plant's overall energy efficiency. Low-grade heat will be captured by the glycol cooling system (Section 3.2.1.10).

3.2.1.5 Produced Water De-Oiling and Recycling

The process water de-oiling system is shown in Figure 3.2-6. The oil removal facilities include:

- skim tank(s);
- IGF units; and
- oil removal filters.

Produced water and other recovered liquid streams will enter the skim tank where the first stage of oil removal occurs.

The skim tank provides residence time to allow separation of hydrocarbons from the produced water. A de-oiling polymer will be added to the liquids entering the skim tank to aid in separation. The tank will be supplied with an internal baffle system to maximize water residence time in the tank.

Separated hydrocarbons flow by gravity from the skim tank to the skim oil tank. The skim oil can be recycled to the FWKO or transferred to the slop tank.

The partially de-oiled water will flow to the IGF units. The IGF units provide IGF cells for the removal of oil from the skim tank effluent. Natural gas will be induced into the produced water stream in each cell to assist in the flotation of oil droplets. The oil removal efficiency is expected to be 90%, resulting in an IGF effluent with an oil content between 10 and 20 mg/L. The oil that is separated in the IGF units, the froth, will be skimmed and pumped to the skim tank.

Produced water from the IGF units is routed to the oil removal filter package. The oil removal filters will remove the majority of the residual oil from the IGF unit effluent water. Each oil removal filter contains media which coalesces and filters out the oil droplets. The backwash cycle of the filter will clean and rinse the media. Produced water from the oil removal filters will be further treated and recycled as BFW.

3.2.1.6 Process and Storage Tanks

All tanks will meet the requirements of ERCB Directive 055 – Storage Requirements for the Upstream Petroleum Industry (EUB 2001a) for secondary containment. Table 3.2-2 presents the process and storage tanks required for the Project.

Table 3.2-2 Process and Storage Tanks

Tank	Purpose	Secondary Containment [a]	Venting [b]
Skim Tank	oil-water separation	yes	VRU
Skim Oil Tank	store partially separated bitumen prior to routing to the Free Water Knock Out (FWKO)	yes	VRU
Disposal Tank	store water prior to disposal	yes	VRU[c]
Pop Tank (at wellpads)	pressure safety valve discharge collection, no fluid levels under normal conditions	no	atmosphere
Oil Removal Filter (ORF) Backwash/Desand tank	stores backwash from the ORF prior to routing to the skim tank and desand water	yes	VRU
Produced Water Tank	stores produced water prior to treatment	yes	VRU
Raw Water Tank	stores raw water prior to treatment	yes	atmosphere
Neutralization Tank	stores Weak Acid Cation (WAC) regeneration waste prior to recycling or disposal	yes	atmosphere
Boiler Feedwater Tank (BFT)	store treated BFW prior to use	yes	atmosphere
Acid Storage Tank	store hydrochloric acid prior to use	yes	atmosphere
Caustic Storage Tank	store caustic soda prior to use	yes	atmosphere
Sales Oil Tank	store diluted bitumen prior to shipping	yes	VRU
Diluent Tank	store diluent prior to use in bitumen treating	yes	VRU
Slop Oil Tank	store bottom sludge, FWKO interface	yes	VRU
Glycol Make-up Tank	store glycol prior to use	yes	atmosphere
Magnesium Oxide	store water treatment chemicals	as per D-055	atmosphere
Magox Slurry	store water treatment chemicals	as per D-055	atmosphere
Lime Storage	store water treatment chemicals	as per D-055	atmosphere
Lime Slurry	store water treatment chemicals	as per D-055	atmosphere
Coagulant Storage	store water treatment chemicals	as per D-055	atmosphere
Sodium Sulphite Storage	store water treatment chemicals	as per D-055	atmosphere
De-oiling Polymer	store water treatment chemicals	as per D-055	atmosphere
Reverse Demulsifier	store bitumen treatment chemicals	as per D-055	atmosphere
Demulsifier Storage	store bitumen treatment chemicals	as per D-055	atmosphere
Amine Storage	store gas sweetening chemicals	as per D-055	VRU
Flocculent Day Tank	mixing and storage of flocculent	as per D-055	atmosphere
Filming Amine Storage	store steam oxygen scavenger chemicals	as per D-055	atmosphere
Utility Water Tank	water storage	no	atmosphere
Steam Pipeline Condensate Tanks	remove steam condensate from the pipeline after shutdown and prior to startup	no	atmosphere
Oxygen Scavenger	store oxygen scavenger chemicals	as per D-055	atmosphere

(a) Secondary containment and venting configurations noted as “as per Directive 055” (EUB 2001a).

(b) VRU indicates the vapours will be collected by the Vapour Recovery Unit.

(c) Subject to operational experience and detailed engineering.

3.2.1.7 Fuel Gas, Vapour Recovery Unit and Sour Gas Sweetening

Dry natural gas will constitute the majority of the fuel supply for Phase 3. Natural gas will be provided from an off-site pipeline tie-in and preferentially routed directly to utilities, the lift gas compressor package, tanks and vessels requiring blanket gas. Purchased fuel gas can also be routed to the fuel gas mix drum if required.

Pressure will be maintained in tanks containing potential hydrocarbon vapours by the addition of blanket gas or the withdrawal of vapours as required. The tank vapour streams will be combined and fed to the VRU package through a common header.

The VRU is an important component of the design. The VRU improves the overall plant efficiency by recovering vapours for use as fuel gas as well as reducing flaring emissions.

Gas produced with the bitumen will be collected and will supplement the purchased fuel gas. The largest gas volume consumed at the plants will be for fuelling the steam generators.

It is anticipated that produced gas as well as VRU recovered gas will contain varying amounts of hydrogen sulphide (H_2S). A produced gas sweetening and sulphur recovery process will be employed as required to comply with ERCB Interim Directive (ID) 2001-3 (EUB 2001b).

The amine sweetening units (Figure 3.2-7) will each include:

- amine contactor;
- Low Pressure (LP) flash tank;
- amine regenerator (with reboiler and overhead condenser systems);
- circulation pumps and circulation cooler; and
- amine storage vessel.

The sweetened produced gas will be sent to the fuel gas system where it will be mixed with purchased natural gas. This mixed fuel gas is primarily used in the OTSGs. The mix drum is also used to separate liquids from the fuel to prevent liquid hydrocarbons from entering the OTSG burners. Any recovered liquids will be routed to the skim tank for treating. The fuel gas will be preheated before delivery to the OTSGs to enhance efficiency.

The acid gas produced by the sour gas sweetening process will be compressed, dehydrated, and sent to the Central Plant for processing by the Claus units.

3.2.1.8 Sulphur Recovery

The existing sulphur recovery facilities at the Central Plant (discussed in the Phase 2B expansion application) will be expanded to treat the acid gas streams from the Phase 3 plants. The sulphur recovery facilities will be designed to meet the requirements of ERCB ID 2001-3 (EUB 2001b) pertaining to sulphur emissions. The revised Central Plant Plot Plan, showing the location of the proposed new sulphur recovery equipment, is presented in Figure 3.2-3.

Acid gas generated from the Phase 3 gas sweetening facilities will be transferred to the Central Plant using underground pipelines. The process flow diagram for the sulphur recovery process is presented in Figure 3.2-8.

At each of the Phase 3 plants, the acid gas from each amine sweetening unit will be combined in a common acid gas header and then sent to one of three Claus unit trains at the Central Plant for sulphur recovery in the form of liquid sulphur. Two of these trains were applied for in the Phase 2B application, approval for a third train is being requested as part of the Project. The acid gas produced at each Phase 3 plant is expected to contain 9.32 t/d of sulphur, for a total of 18.64 t/d of sulphur for Phase 3. The acid gas will be processed by the Claus units at the Central Plant. Efficiency of the Claus units is expected to be 96.2% minimum sulphur recovery consistent with ERCB ID 2001-3 (EUB 2001b). The molten sulphur production rate from the Central Plant attributed to each Phase 3 plant will be 9 t/d, for an expected Phase 3 sulphur production rate of 18 t/d. The estimated sulphur production rate for the previously approved phases of the CLRP was 7.5 t/d, for a total sulphur production rate of 25.5 t/d for the CLRP.

The liquid sulphur will be degassed and sent to the storage and loadout facilities for trucking off-site to an approved facility. The remaining acid gas from the final stage of each Claus unit train will be sent to one of three tail gas incinerators.

It is anticipated that up to three Claus unit trains will be required to handle the full range of sulphur recovery from about 1 to 25.5 t/d. Due to the turndown limitations inherent in Claus units, the first Claus unit train will be designed with a capacity of 5 t/d, which will allow sulphur recovery to begin as sulphur production approaches 1 t/d. The capacity of each of the two subsequent Claus unit trains will be 11 t/d. The three combined Claus unit trains will provide for a total sulphur recovery capacity of 27 t/d. Sulphur production will be monitored regularly, and MEG intends to construct additional Claus unit capacity as required to meet the requirements of ERCB ID 2001-03.

The Claus unit trains will each include:

- an acid gas scrubber;
- a reaction furnace with waste heat boiler to produce LP steam;
- Claus units (converters and condensers) to achieve 96.2% recovery and to produce liquid sulphur; and
- a tail gas incinerator.

Facilities common to all Claus unit trains will include:

- a sulphur storage pit (and pumps);
- sulphur degassing units; and
- a liquid sulphur storage tank (and pumps) for loadout.

3.2.1.9 Flare Systems

Four flare stacks, two at Plant 3A and two at Plant 3B, will be constructed for the Project. Each Phase 3 plant will have one high pressure flare and one low pressure flare. The basic design philosophy for each flare is to gather hydrocarbon vapour and liquids, separate liquids from the vapour in the flare knock out drum, ignite and burn hydrocarbon vapours and maintain a reliable flame. The flares are primarily for emergency relief services and will include wind guards, continuous purge gas streams and electronic ignition systems.

The Phase 3 flare stacks will have a nominal diameter of 762 mm and height of 54 m. The flares will handle all flow from emergency relief valves and depressurizing valves. Under normal operations, there will be no release from the relief or depressurization valves. Any liquids from the flare knockouts will be recycled to the process stream.

Flare stack emission data are presented in the air quality section (Volume 3, Section 1) of this EIA.

3.2.1.10 Cooling and Heating Systems

Hot production streams from the reservoir must be cooled for processing in the plant. To the extent practicable, surplus heat will be recovered by cross exchanging the BFW with hot process streams.

Preheating the BFW will reduce the fuel gas consumption of the steam generators. Trim cooling and process cooling will recover additional heat that will be used for building heating, heat tracing, tank coils and combustion air pre-heating. The glycol will be circulated throughout the plants for both heating and cooling requirements. Glycol required for cooling will be cooled in the glycol cooler and then fed to the heat exchangers in the plants on demand.

3.2.1.11 Reservoir Re-Pressurization Facilities

MEG has identified portions of the reservoir in which it is believed that the bitumen and top gas may be in direct contact. MEG intends to restore the gas cap pressure in the reservoir to near the initial operating pressure through injection of flue gas into the depleted gas caps at select locations. A reservoir repressurization building will be constructed at both the existing Central Plant and at Plant 3A which will provide the necessary equipment for reservoir re-pressurization. Compressed gas will be transported via pipeline to select wellpads and injected into targeted zones to re-pressurize the reservoir. Although the current plan is to use flue gas, it is possible that other type of gases, such as high purity CO_2 and air may be utilized.

The locations of the reservoir repressurization buildings to be constructed at Plant 3A and at the Central Plant are presented on Figure 3.2-2 and Figure 3.2-3, respectively.

3.2.1.12 Utilities

The utilities will be the same as for the previously approved phases of the CLRP. Details are provided below for clarity.

Project utilities will include:

- electrical substation and distribution infrastructure;
- emergency electrical generators;
- fuel gas;
- utility water;
- potable water; and
- instrument air.

Each of the Phase 3 plants will be tied into the Central Plant electrical infrastructure via transmission lines. An electrical substation will be located on each of the Phase 3 plant sites.

On-site diesel emergency generators (located at Plant 3A and Plant 3B) will provide emergency back-up power to the Project facilities. Uninterruptible power systems will be used for key plant control systems to provide safe operation while the emergency generators come on line. The emergency power generators will be sized to provide sufficient power for safe shut down and to maintain levels of heat, light, control and communications for Project facilities. It will not be possible to operate the plants on emergency power.

Fuel gas is discussed in detail in Section 3.2.1.7.

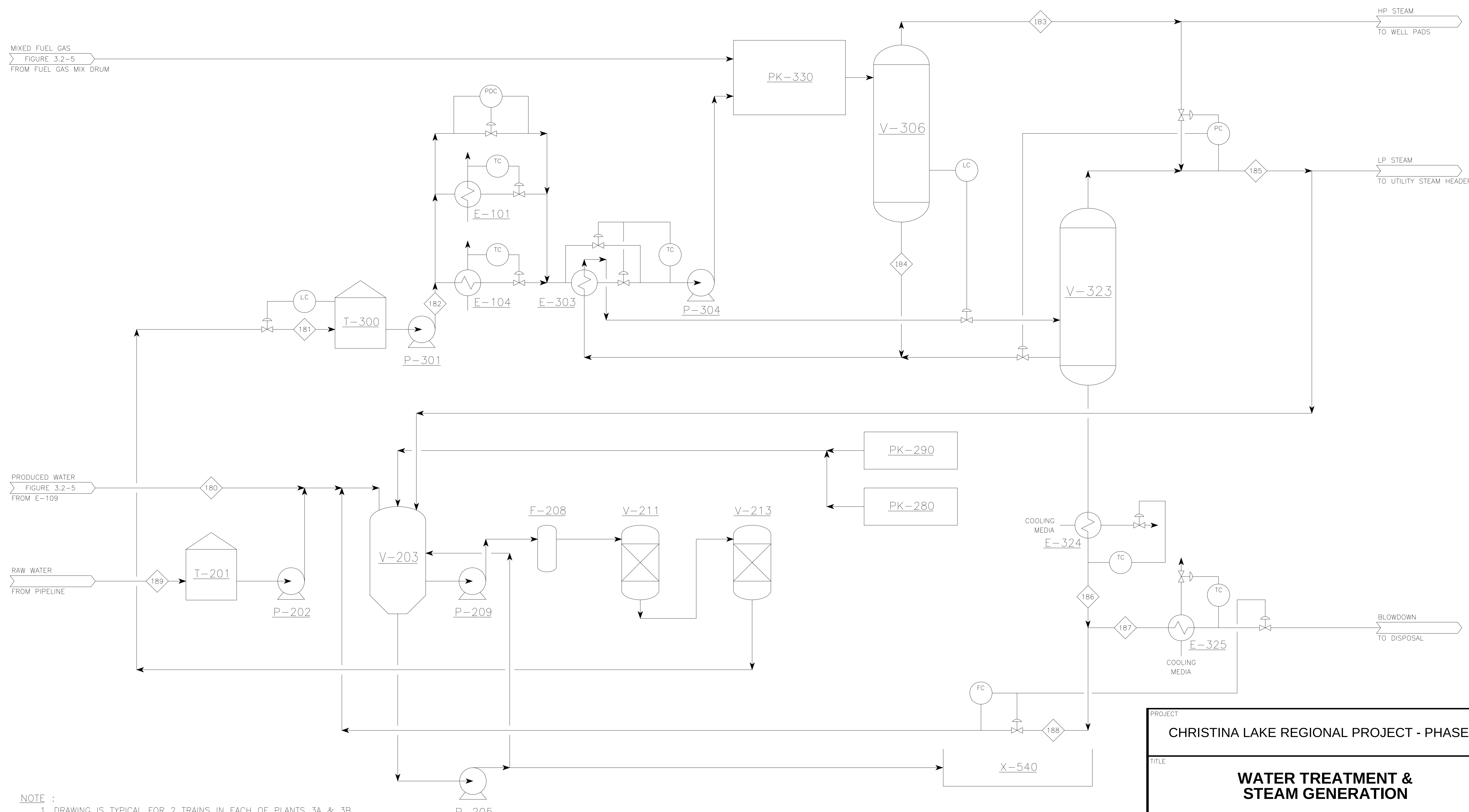
Utility water will be used throughout the plants and will be supplied from the quaternary source wells (Section 3.2.2.2). This water will be filtered for process use, but will not meet drinking water standards and, therefore, will not be suitable for human use or consumption.

Potable water, supplied to various parts of the plants from the same quaternary source wells described in Section 3.2.2.2, will be treated for human consumption and a variety domestic uses.

Plant 3A and Plant 3B will each require a plant instrument air package and dry instrument air receiver.

T-300 BOILER FEEDWATER TANK | P-301 LP BOILER FEEDWATER PUMP | E-101 PRODUCED GAS/BFW EXCHANGER | E-104 EMULSION/BFW EXCHANGER | E-303 HIGH TEMP BLOWDOWN COOLER | P-304 HP BOILER FEEDWATER PUMP | PK-330 STEAM GENERATOR PACKAGE | V-306 STEAM SEPARATOR | V-323 LP STEAM SEPARATOR | E-324 LP BLOWDOWN/GLYCOL EXCHANGER | E-325 BD DISPOSAL/GLYCOL EXCHANGER

T-201 RAW WATER TANK | P-202 RAW WATER PUMPS | V-203 LIME SOFTENER | F-208 AFTER FILTERS | P-209 FILTER FEED PUMP | V-211 PRIMARY WAC VESSELS | V-213 POLISHER WAC VESSELS | P-205 LS RECIRCULATION PUMP | X-540 PROCESS POND | PK-280 MAGOX PACKAGE | PK-290 LIME PACKAGE



NOTE :
1. DRAWING IS TYPICAL FOR 2 TRAINS IN EACH OF PLANTS 3A & 3B.

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

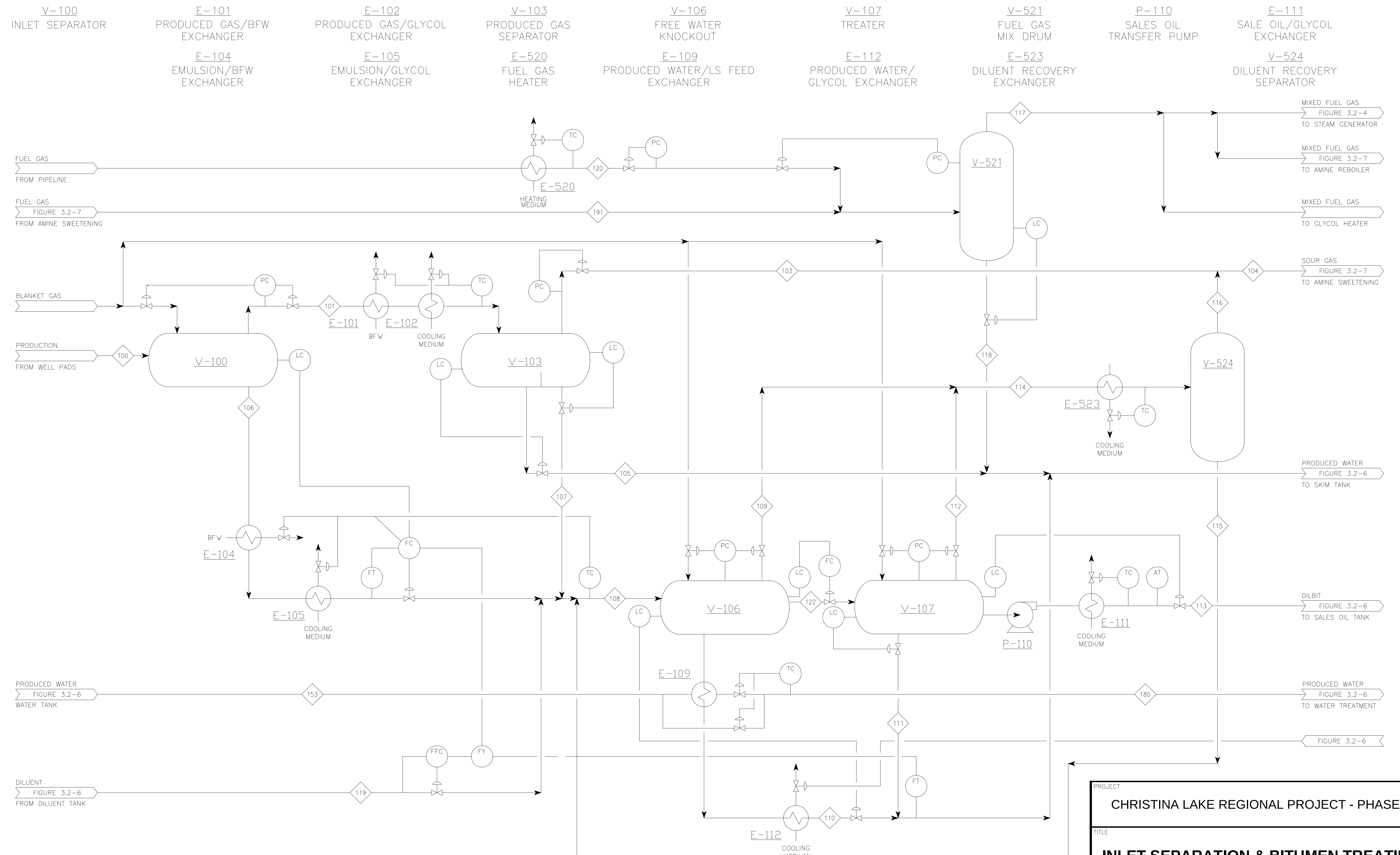
TITLE
WATER TREATMENT & STEAM GENERATION

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100	
DESIGN	PT	05/04/08
CADD	PSR	11/04/08
CHECK	SG	17/04/08
REVIEW	SG	17/04/08

FILE No. Water treatment
SCALE NTS REV. 0

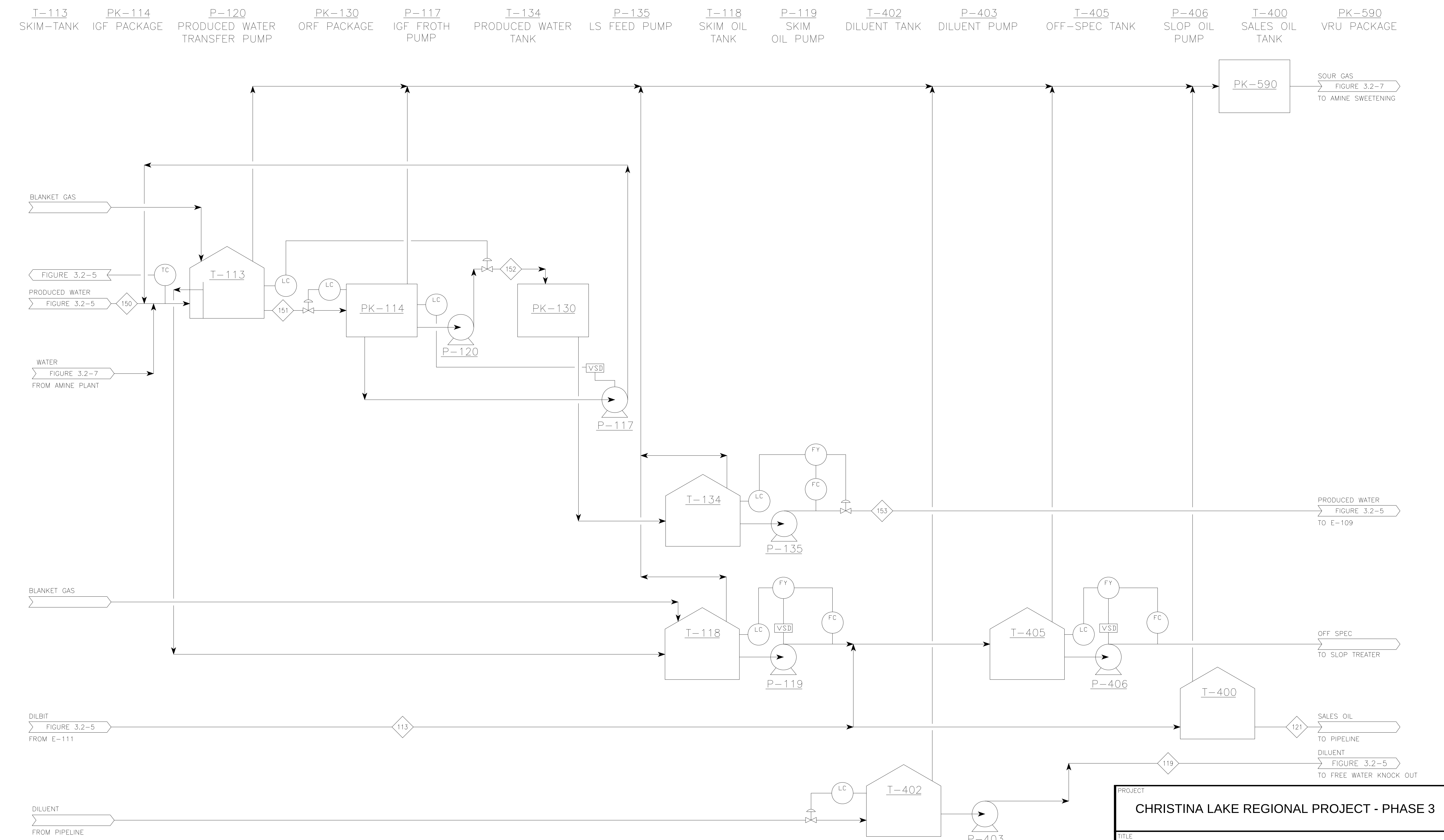
FIGURE: 3.2-4



NOTE :

1. DRAWING IS TYPICAL FOR 2 TRAINS IN EACH OF PLANTS 3A & 3B.

PROJECT	CHRISTINA LAKE REGIONAL PROJECT - PHASE 3		
TITLE	INLET SEPARATION & BITUMEN TREATING		
MEG ENERGY CORP.	PROJECT 07.1346.0009.5100		FILE No.085349-4901-3_2-5
	DESIGN PT	05/04/08	SCALE NTS REV. 0
	CADD TRE	07/04/08	FIGURE: 3.2-5
	CHECK SG	17/04/08	
	REVIEW SG	17/04/08	



NOTE :

1. DRAWING IS TYPICAL FOR 2 TRAINS IN EACH OF PLANTS 3A & 3B.

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

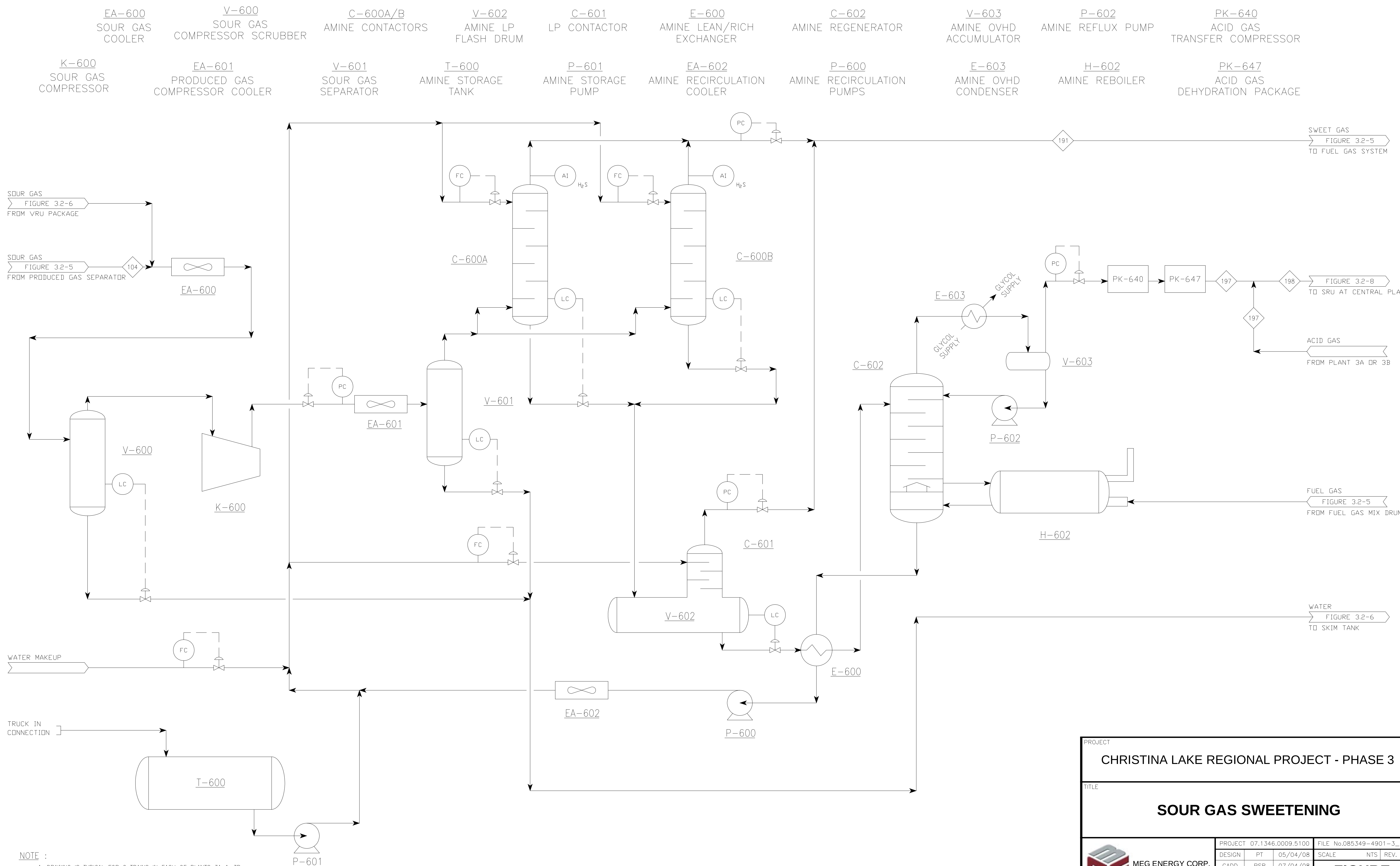
TITLE

DE-OILING

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.085349-4901-3_2-6
DESIGN	PT	05/04/08	SCALE NTS REV. 0
CADD	PSR	11/04/08	
CHECK	SG	17/04/08	**FIGURE: 3.2-6**
REVIEW	SG	17/04/08	

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-From Matrix\Fig 3.2-6_De-Oiling-085349-4901.dwg Apr 17, 2008 - 3:04pm



NOTE :

1. DRAWING IS TYPICAL FOR 2 TRAINS IN EACH OF PLANTS 3A & 3B.

PROJECT

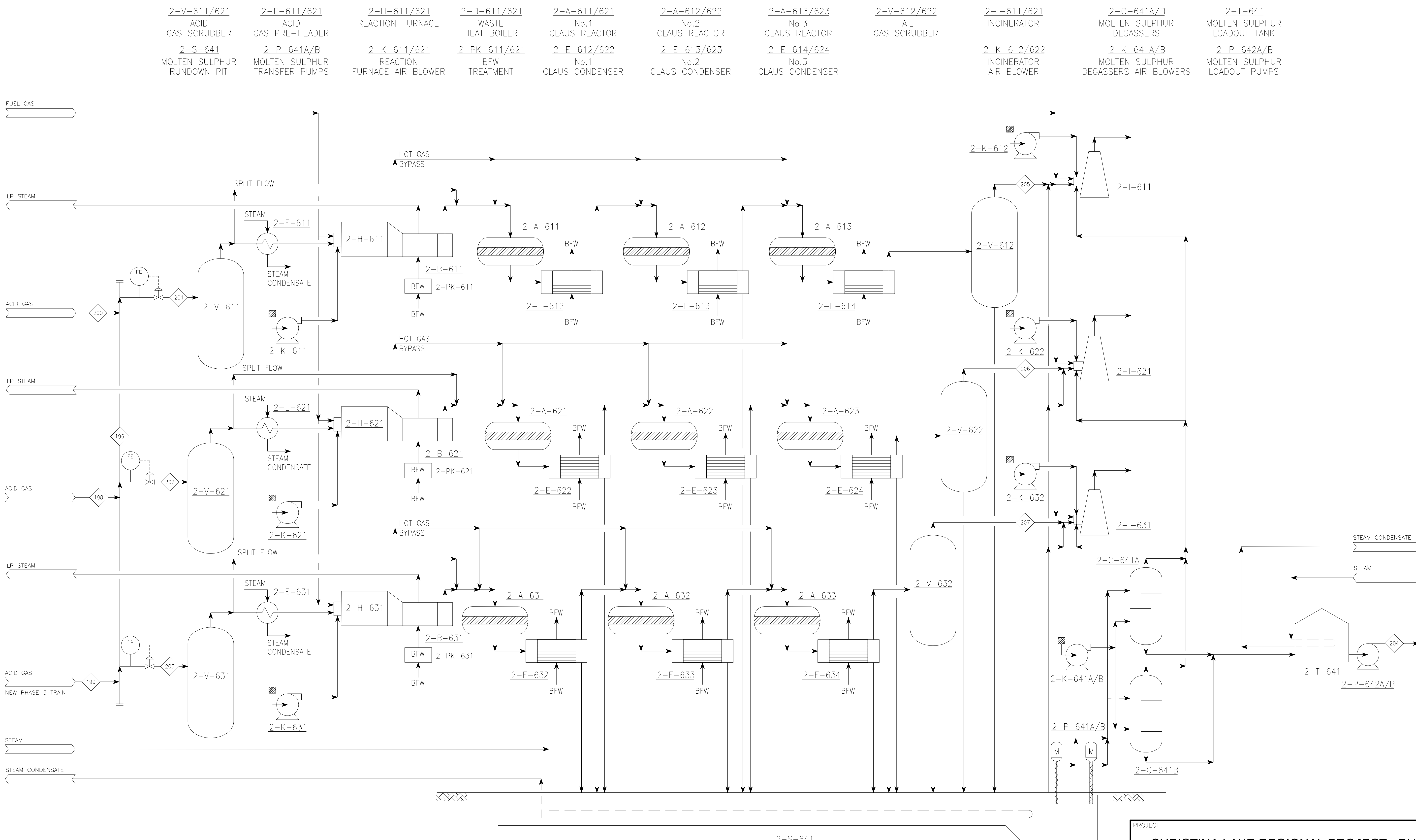
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

SOUR GAS SWEETENING

MEG ENERGY CORP.

PROJECT 07.1346.0009.5100			FILE No.085349-4901-3_2-7	
DESIGN	PT	05/04/08	SCALE NTS	REV. 0
CADD	PSR	07/04/08	FIGURE: 3.2-7	
CHECK	SG	17/04/08		
REVIEW	SG	17/04/08		



PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

CLAUS SULPHUR RECOVERY

MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		FILE No.	085349-4901
DESIGN	PT	25/01/08	SCALE NTS	REV. 0
CADD	KAN	25/01/08	**FIGURE: 3.2-8**	
CHECK	SG	18/04/08		
REVIEW	SG	18/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-From Matrix\Fig 3.2-8_Claus Sulphur Recovery-085349-4901.dwg

3.2.1.13 Chemical Consumption

A variety of chemicals will be required for operations at Plant 3A and Plant 3B. Storage and tracking of supplies and disposal of waste products will include provisions for secondary containment, leak detection and inventory reconciliation as necessary. Chemical consumption estimates are provided in Table 3.2-3.

Table 3.2-3 Chemical Consumption Estimates

Chemical	Phases 1, 2, and 2B Consumption Rate [t/d]	Phase 3 Consumption Rate [t/d]	CLRP Consumption Rate [t/d]
Hydrated lime	21.546	38.023	59.569
Magox	10.013	17.713	27.726
HCl (32%)	6.138	18.883	25.021
Caustic (50%)	11.329	31.024	42.353
Demulsifier	2.441	3.201	5.642
Reverse demulsifier	2.659	6.107	8.766
Flocculant	0.054	0.103	0.157
Coagulant	0.000	0.000	0.000
Polymer (deoiling)	0.289	1.239	1.528
O_2 scavenger	0.628	0.351	0.979
Chelant	0.415	0.681	1.096
Filming amine	0.892	2.657	3.549
Brine (salt)	6.846	0.000	6.846

HCl = hydrogen chloride; O_2 = oxygen.

3.2.1.14 Optimization

The Project design, described in this application, incorporates proven technology and related pollution prevention and waste management systems. The SAGD process is energy intensive and fuel costs are the largest operating cost component. Project design includes energy optimization and emissions reduction measures. The design has included provisions for energy efficient heat collection and transfer, resulting in a reduction in emissions and an increase in heat usage efficiency. The VRU system is designed to reduce emissions and increase energy efficiency by utilizing tank and vessel vapours as a supplemental fuel source.

3.2.1.15 Existing Facilities and Minimizing Land Disturbance

The Project footprint and existing disturbances are shown in Figure 1.2-4. The production wellpads, access roads and utility corridors have been located to optimize resource recovery while attempting to minimize land disturbances, minimize habitat fragmentation and maximize the use of previously disturbed areas. Wells on the production wellpads will be placed close together and drilled directionally, resulting in reduced land disturbances.

3.2.1.16 Overall Material Balance

The bitumen, water and steam rates will vary over the life of the Project. These variations will result from the progressive development of wells, as well as changes resulting from individual well production patterns as they mature and decline. A representative material balance for one train in a Phase 3 plant is presented in Table 3.2-4. Each Phase 3 plant will include two such trains.

3.2.1.17 Production Accounting and Measurement

Production accounting reports will be submitted to the Petroleum Registry in accordance with ERCB Directive 007 (ERCB 2007b). A Measurement, Accounting and Reporting Plan (MARP) will be prepared and submitted in accordance with ERCB Directive 042 (ERCB 2006a).

3.2.2 Field Facilities

For the purpose of this application, the Project field facilities have been described as follows:

- wellpads;
- source and disposal wells;
- pumping stations; and
- access roads, pipelines and utility corridors.

3.2.2.1 Wellpads

The Project includes 138 surface wellpads with six to ten well pairs per wellpad. Wellpad locations are influenced by subsurface drainage patterns, surface features and directional drilling limitations. Well pairs will be drilled, completed, produced and monitored using the same technology and process as for the well pairs in the previously approved phases of the CLRP. Details are provided below for clarity.

Table 3-2.4 Heat and Material Balance For Plant 3A or 3B

Stream Name		100	101	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	150	151	152	153
Description		Production From Pad	Gas From Inlet Separator	Prod. Gas From Prod. Gas Separator	Mixed Prod. Gas to Amine System	Water From Produced Gas Separator	Liquid From Inlet Separator	Recovered HC From Prod. Gas Separator	Liquid to Free Water Knockout /Treater	Produced Gas From FWKO	Cooled Prod. Water From FWKO	Prod. Water From Treater	Produced Gas From Treater	Dibit From Treating Train	Prod. Gas to Diluent Recovery Separator	Recovered Diluent to FWKO	Vapour From Diluent Recovery Separator	Mixed Gas to Steam Genarator	Liquid From Mixed Fuel Gas System	Diluent to Treating Train	Warm Fuel Gas From Pipeline	Sales Oil to Pipeline	Dilbit From Free Water Knockout	Produced Water to Skim Tank	Water to IGF Unit	Water to ORF Unit	Produced Water to Cross Exchanger
Note:			(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)
MIXTURE																											
Vapour_Fraction		0.153	1.000	1.000	1.000	0.000	0.000	0.007	0.000	1.000	0.000	0.000	1.000	0.000	1.000	0.000	1.000	1.000	0.027	0.000	1.000	0.000	0.001	0.000	0.000	0.000	0.000
Temperature	°C	177	176	58	58	60	177	60	129	129	76	129	129	65	129	50	50	50	50	10	64	65	129	77	77	77	78
Pressure	kPag	1,000	880	275	275	41	1,000	490	484	484	260	380	380	61	340	484	275	275	86	606	5,065	0	380	41	41	350	350
Molar Flow	kgmol/h	43,306	6,630	894	895	5,711	36,676	25	37,625	0	33,162	2,793	2	1,668	2	2	1	2,775	0	922	1,899	1,668	4,463	43,118	43,092	41,681	41,682
Mass_Flow	kg/h	1,043,121	122,235	15,474	15,498	102,892	920,886	3,869	1,106,191	0	597,958	50,360	85	457,788	85	61	24	45,247	0	181,338	30,853	458,613	508,233	777,377	776,327	750,905	750,905
Heat Flow	GJ/h	-11788.6	-1428.9	-77.3	-77.4	-1614.2	-10359.8	-8.2	-10892.9	0.0	-9333.9	-774.2	-0.5	-985.9	-0.5	-0.5	-0.1	-210.7	0	-398.0	-142.2	-987.4	-1700.6	-12130.7	-12122.7	-11725.4	-11713.4
GAS PHASE																											
Std_Gas_Flow	STD_m³/h	157,064	157,065	21,187	21,202	0.05	-	4	-	-	-	-	59	-	59	-	15	65,745	-	-	44,991	-	59	1	-	-	-
Molecular_Weight		18.4	18.4	17.3	17.3	22.2	-	17.5	-	-	-	-	34	-	34.1	-	38.6	16.3	-	-	16.2	-	34.1	36.5	-	-	-
Viscosity	cP	0.012	0.012	0.012	0.012	0.013	-	0.013	-	-	-	-	0.011	-	0.011	-	0.010	0.012	-	-	0.014	-	0.011	0.010	-	-	-
LIQUID PHASE																											
Std. Liquid Volume Flow	STD_m³/h	858	-	-	-	101	858	5	1,040	-	589	50	-	472	-	0.07	-	-	0	208	-	472	481	766	765	740	752
Mass_Density	kg/m3	891.18	-	-	-	980.33	891.18	819.92	907.76	-	967.92	922.5	-	930.21	-	731.54	-	-	835.36	876.76	-	930.16	890.73	966.55	966.59	966.67	973.48
Viscosity	cP	0.259	-	-	-	0.462	0.259	11.657	31.953	-	0.371	0.213	-	29.096	-	0.538	-	-	16.699	8.175	-	29.300	10.493	0.363	0.363	0.363	0.366
COMPOSITION (Mole Fraction)																											
CO2		0.0006	0.0039	0.0286	0.0286	0.0001	0.0000	0.0019	0.0000	0.0058	0.0000	0.0000	0.0056	0.0001	0.0056	0.0003	0.0213	0.0029	0.0002	0.0000	0.0036	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
H2S		0.0002	0.0010	0.0070	0.0070	0.0000	0.0000	0.0013	0.0000	0.0015	0.0000	0.0000	0.0015	0.0001	0.0015	0.0002	0.0056	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
Nitrogen		0.0001	0.0009	0.0068	0.0068	0.0000	0.0000	0.0001	0.0000	0.0013	0.0000	0.0000	0.0011	0.0000	0.0011	0.0000	0.0041	0.0069	0.0001	0.0000	0.0069	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oxygen		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Methane		0.0193	0.1255	0.9294	0.9291	0.0000	0.0001	0.0242	0.0001	0.1361	0.0000	0.0000	0.1248	0.0016	0.1248	0.0024	0.4851	0.9807	0.0321	0.0000	0.9888	0.0009	0.0007	0.0000	0.0000	0.0000	0.0000
Ethane		0.0000	0.0001	0.0007	0.0007	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0004	0.0005	0.0001	0.0000	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Propane		0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Butane		0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Butane		0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Pentane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Pentane		0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Hexane		0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0018	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Heptane		0.0000	0.0000	0.0002	0.0002	0.0000	0.0000	0.0050	0.0000	0.0001	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0038	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
n-Octane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Nonane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Decane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C11		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C12		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C13		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C14		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C15		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C20		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toluene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-Xylene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
E-Benzene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
124-MBenzene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclopentane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mcyclohexane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclohexane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O		0.9659	0.8647	0.0254	0.0254	0.9999	0.9842	0.0019	0.9594	0.5545	0.9999	0.9999	0.5651	0.0861	0.5651	0.7467	0.0308	0.0080	0.0011	0.0000	0.0000	0.0855	0.6582	0.9999	1.0000	1.0000	1.0000
EGlycol		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Bitumen		0.0139	0.0038	0.0011	0.0011	0.0000	0.0157	0.9637	0.0160	0.0014	0.0000	0.0000	0.0014	0.3600	0.0014	0.0018	0.0000	0.0003	0.9597	0.0000	0.0000	0.3617	0.1345	0.0000	0.0000	0.0000	0.0000
Diluent(OSA)		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Diluent(SCO)		0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000	0.0245	0.2991	0.0000	0.0000	0.3002	0.5520	0.3002	0.2485	0.4525	0.0001	0.0006	1.0000	0.0000	0.5516	0.2064	0.0000	0.0000	0.0000	0.0000
Liquid Sulphur		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 3-2.4 Heat and Material Balance For Plant 3A or 3B (continued)

Stream Name		180	181	182	183	184	185	186	187	188	189	191	197	198	199	200	201	202	203	204	205	206	207			
Description		Blended Produced Water	Treated Water to BFW Tank	BFW to Production /BFW Exchanger	HP Steam	Blowdown From HP Separator	LP Steam to HLS	Blowdown From LP Steam Separator	Blowdown to Disposal	Blowndown Recycle to Water Treatment	Raw Water Feed to HLS	Sweet Gas to Fuel Gas System	Acid Gas From Single Train (2 Trains Per Plant)	Total Acid Gas From Plant 3A to SRU	Total Acid Gas From Plant 3B to SRU	Total Acid Gas From Plant 2/2B to SRU	Acid Gas to SRU Train 1	Acid Gas to SRU Train 2	Acid Gas to SRU Train 3	Total Liquid Sulphur Product	Tail Gas From SRU Train 1	Tail Gas From SRU Train 2	Tail Gas From SRU Train 3	Combustion Air to SRU Train 1 (estimate)	Combustion Air to SRU Train 2 (estimate)	Combustion Air to SRU Train 3 (estimate)
Note:		(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 2)	(Note 2)	(Note 2)	(Notes 2,3)	(Notes 2,3)	(Notes 2,3)	(Note 2)	(Notes 2,3)	(Notes 2,3)	(Notes 2,3)	(Notes 2,3)	(Notes 2,3)	(Notes 2,3)
MIXTURE																										
Vapour_Fraction		0.015	0.000	0.000	1.000	0.001	1.000	0.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Temperature	oC	105	105	105	292	292	147	90	90	90	5	40	50	50	50	130	130	50	50	130	130	130	130	20	20	20
Pressure	kPag	27	380	3,000	7,600	7,565	345	270	270	270	345	275	320	320	320	30	30	30	30	170	ATM	ATM	ATM	ATM	ATM	ATM
Molar Flow	kgmol/h	52,227	52,079	52,079	41,663	10,416	2,761	7,657	4,029	3,628	4,152	875	20	41	41	33	21	47	47	34	25	56	56	10	23	23
Mass_Flow	kg/h	940,883	938,204	938,204	750,564	187,641	49,746	137,948	72,585	65,364	74,800	14,658	799	1,598	1,598	1,278	832	1,821	1,821	1,078	888	1,943	1,943	298	651	651
Heat Flow	GJ/h	-14,536	-14,527	-14,523	-9,879	-2,744	-656	-2,145	-1,128	-1,016	-1,190	-74.1	-10.8	-21.7	-22	-17	-11.3	-24.7	-24.7	-9.4	-9.5	-20.9	-20.9	0.0	0.0	0.0
GAS PHASE																										
Std_Gas_Flow	STD_m³/h	18,605	-	-	986,998	290	65,417	-	-	-	-	20,681	484	967	967	774	504	1,102	1,102	-	600	1,313	1,313	244	535	535
Molecular_Weight		18	-	-	18	18	18	-	-	-	-	17	39	39	39	39	39	39	39	-	35.0	35.0	35.0	29	29	29
Viscosity	cP	0.01	-	-	0.02	0.02	0.01	-	-	-	-	0.012	0.014	0.015	0.015	0.014	0.014	0.014	0.014	-	0.020	0.020	0.020	0.019	0.019	0.019
LIQUID PHASE																										
Std. Liquid Volume Flow	STD_m³/h	927.62	939.10	939.10	-	187.60	-	138.08	72.65	65.43	75	-	-	-	-	-	-	-	-	0.60	-	-	-	-	-	-
Mass_Density	kg/m3	954.71	954.88	955.83	-	728.30	-	965.46	965.46	965.46	1000.2	-	-	-	-	-	-	-	-	1800.00	-	-	-	-	-	-
Viscosity	cP	0.27	0.27	0.27	-	0.089	-	0.31	0.31	0.31	1.518	-	-	-	-	-	-	-	-	8.000	-	-	-	-	-	-
COMPOSITION (Mole Fraction)																										
CO2		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0144	0.6237	0.6237	0.6237	0.6237	0.6237	0.6237	0.6237	0.0000	0.5236	0.5236	0.5236	0.0000	0.0000	0.0000
H2S		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3057	0.3057	0.3057	0.3057	0.3057	0.3057	0.3057	0.0000	0.0098	0.0098	0.0098	0.0000	0.0000	0.0000
Nitrogen		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0069	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3218	0.3218	0.3218	0.7900	0.7900	0.7900
Oxygen		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2100	0.2100	0.2100
Methane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9510	0.0164	0.0164	0.0164	0.0164	0.0164	0.0164	0.0164	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ethane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Propane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Butane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Butane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Pentane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Pentane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Hexane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Heptane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Octane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Nonane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Decane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C11		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C12		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C13		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C14		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C15		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C20		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toluene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-Xylene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
E-Benzene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
124-MBenzene		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclopentane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mcyclohexane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclohexane		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0245	0.0543	0.0543	0.0543	0.0543	0.0543	0.0543	0.0543	0.0000	0.1449	0.1449	0.1449	0.0000	0.0000	0.0000
EGlycol		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Bitumen		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0011	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Diluent(OSA)		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Diluent(SCO)		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Liquid Sulphur		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Notes:

SCO Case – Bitumen Flow 75,000 BOPD at Reservoir Pressure 4000 kPag.

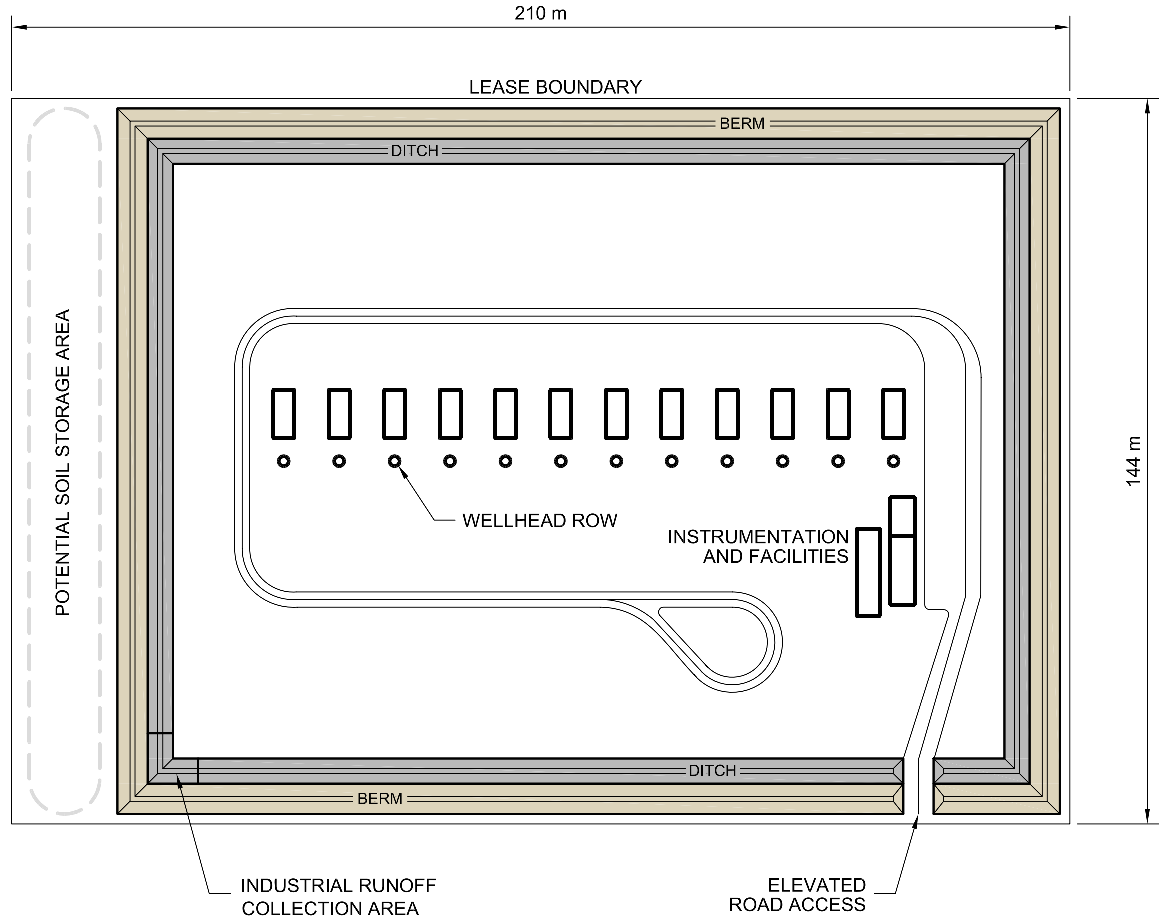
1. The Heat and Material Balance shown is for one facility train sized for 37,500 bpcd of bitumen.
2. Sulphur Recovery Unit (SRU) trains are located at the Central Plant. Sulphur Recovery is set at 96.2%.
3. SRU Train 1 = 5 t/d sulphur, SRC Trains 2 and 3 = 11 t/d sulphur (design capacities).

Drilling and Completion

MEG intends to contract the drilling program to a firm (or firms) with a proven track record drilling complex horizontal wells. The wells will be drilled with a "Measurement While Drilling" guidance system.

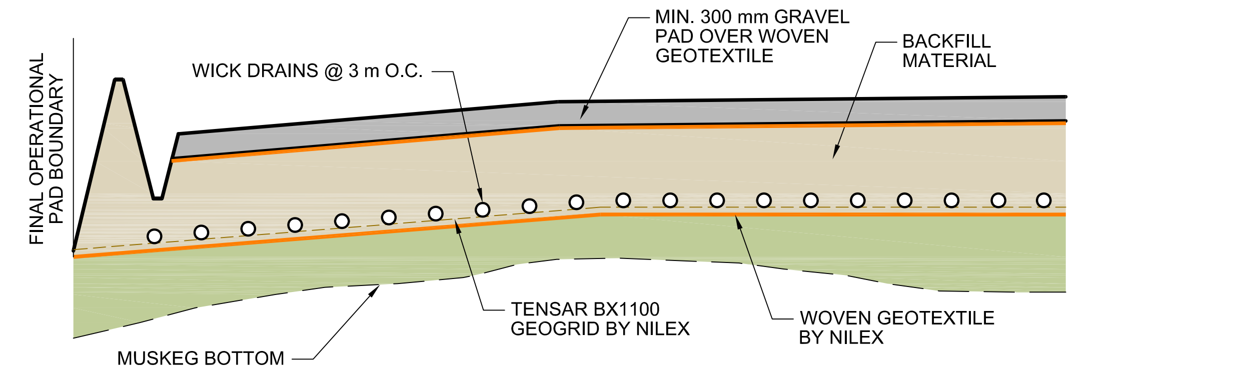
The horizontal well lengths are expected to be approximately 700 m with an inter-well spacing of about 100 m. The "toe" of the well is considered to be the furthest extent of the wellbore. The "heel" is the portion of the well where the build (bending) section meets the horizontal section. A plot plan for a typical production wellpad is presented in Figure 3.2-9.

The number of well pairs per wellpad will be optimized depending on access to resource and drilling design requirements. Over the life of the Project, as production rates decline, additional well pairs will be drilled as required to maintain production.



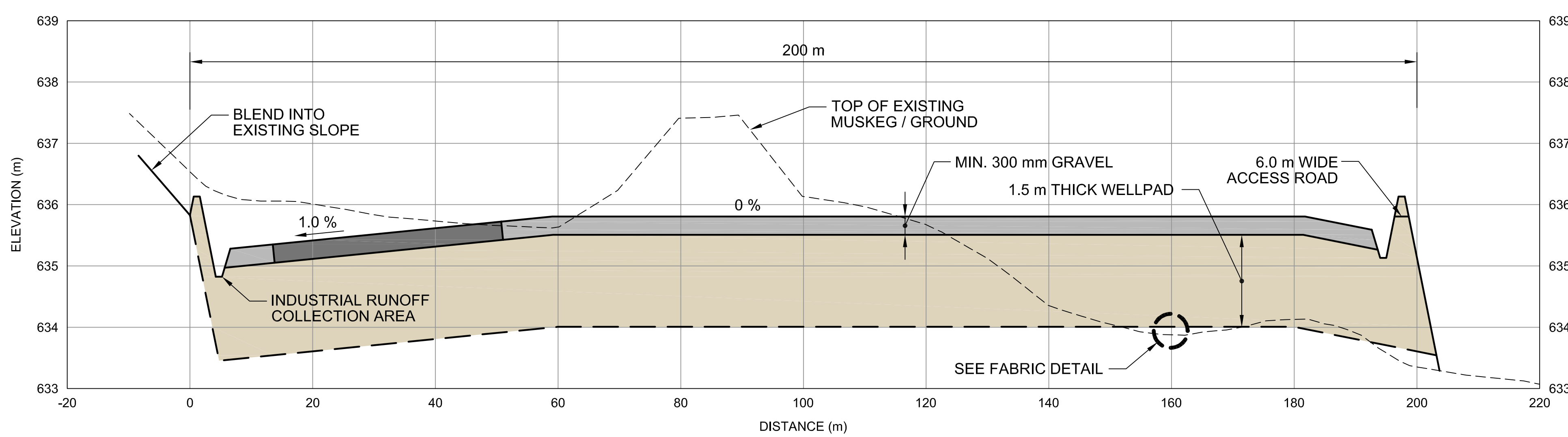
TYPICAL WELLPAD - PLAN

30 0 30
SCALE METRES



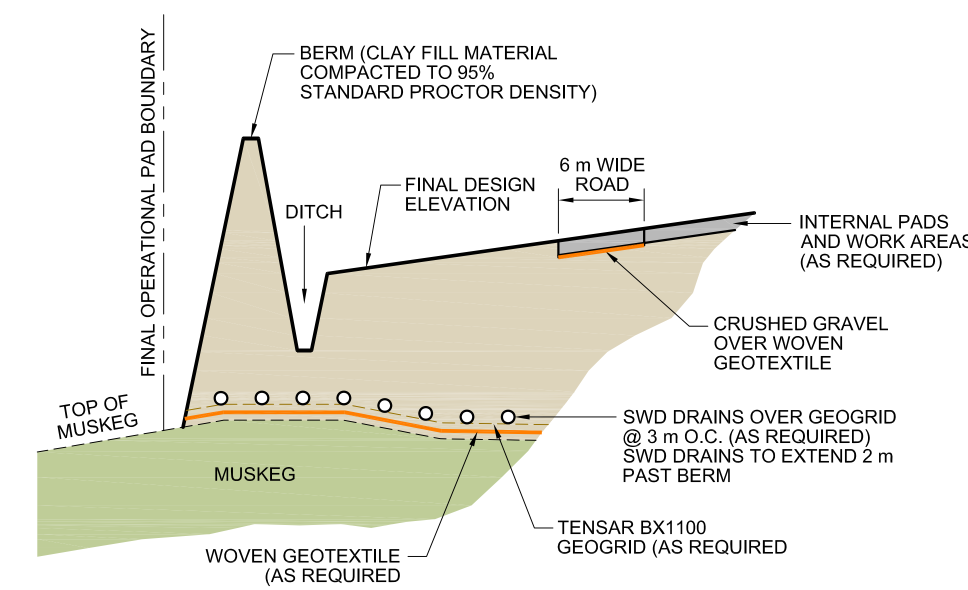
TYPICAL WELLPAD - CROSS-SECTION DETAIL

N.T.S.



TYPICAL WELLPAD - SECTION

20 0 20
HORIZ SCALE METRES
10X VERTICAL EXAGGERATION



TYPICAL FABRIC DETAIL

N.T.S.

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
TYPICAL WELLPAD PLOT PLAN

MEG ENERGY CORP.

PROJECT	07.1346.0009.9600		FILE No.	Typical Wellpad
DESIGN	DD	22/01/08	SCALE AS SHOWN	REV. 0
CADD	PSR	06/03/08	FIGURE: 3.2-9	
CHECK	DD	06/03/08		
REVIEW	SG	17/04/08		

Both the production and injection wells will be designed to have as flat a trajectory as possible. The wells will have a target separation of about 4 to 6 m between the lower production well and the upper injection well.

MEG will be using water-based drilling fluid systems. Notwithstanding potential hydrocarbon contamination from the formation, these water-based systems generate waste material largely composed of bentonite clay.

Surface holes will be pre-drilled to an approximate depth of 115 m. Surface casing will be installed in order to protect quaternary aquifers. Total waste generated from this section of the hole will be contained in near-at-hand remote sump locations. In accordance with ERCB Directive 050 (EUB 2007b), these wastes will be disposed of via mix-bury-cover method. Cement returns will be stored and buried at the remote sump locations.

Mechanical solids removal equipment will be used to recycle the fluids from the intermediate and horizontal sections of the hole. These techniques will reduce the volume of liquid requiring disposal. Disposal options for liquid waste include disposal at a licensed third-party waste disposal facility, or pump-off in accordance with ERCB Directive 050 (EUB 2007b). The selection of the final liquid waste disposal method will be determined by the analytical results of the waste sampling.

Waste reduction methods should minimize the volume of solid wastes from the intermediate and horizontal hole sections. The solid wastes from the drilling operations will be analyzed according to the requirements of ERCB Directive 050 (EUB 2007b); should the hydrocarbon levels remain below Alberta Tier I Soil and Water Quality Guidelines for Hydrocarbons (Canadian Council of Ministers of the Environment [CCME] fractions), the waste will be disposed of through mix-bury-cover. If the waste does not meet the requirements of ERCB Directive 050 (EUB 2007b) of Alberta Tier I criteria for hydrocarbons, the waste will be disposed of at an approved waste disposal facility or bioremediated within the parameters of ERCB Directive 050 (EUB 2007b). The selection of the final drilling solids disposal option will be determined from the analytical results of the waste sampling.

The drilling mud sumps will be located within reasonable proximity of the wellpads and will be separated into cells to isolate the various phases of drill mud and cuttings. The locations of the sump sites have not been selected, however, they will be on land with a good clay base. The sumps will only be constructed after adequate soil sampling has been done to ensure the base material meets the required permeability limits.

Thermal cement will be used to cement surface casing and the intermediate casing to surface.

Production

During the start-up phase, the reservoir is warmed using steam injected into both the injection and production wells. The heat will reduce viscosity of the bitumen and establish mobility of the oil between the injection well and the production well. This steam circulation phase is expected to last two to three months. Once thermal communication is established, the lower well will be placed on production and the upper well will remain on steam injection.

During normal production, 100% quality steam will be injected at a pressure below the formation's fracture pressure through the tubing strings in the injection wells. Natural gas will be injected down a coiled tubing string to act as lift gas and aid in the production of fluids.

The wellpads will each include a building to house the manifold piping valves, instrumentation and test separator. Each wellpad will also require an air package consisting of two air compressors, a wet receiver and one dryer. The piping between the individual wells and the production test building, as well as the piping between the production test building and the above-ground pipelines that leave/arrive at the production wellpad area, will be insulated. Each wellpad will have one test separator for testing the individual production streams. Individual well production testing can be achieved by operation of the separate lines and valves into the test separator manifold. The vapour and liquid streams from the test separator will be recombined after testing and will be mixed with the main production stream to either Plant 3A or Plant 3B either directly or through pumping stations.

The wellpads will be configured to collect surface runoff in one portion of the wellpad. Berms and contouring will be used to attain sufficient surface runoff containment capacity without the need of a pond. Industrial run-off will be collected, tested and released as per AENV Surface Water Quality Guidelines (1999).

Well Performance Monitoring

At steady state operations, production wells will be tested as per ERCB Directive 17 (ERCB 2007a) and ID 91-03 (EUB 1991). Daily oil, gas and water production will be pro-rated to the wells based on the plant volumes and well test data.

Bottom hole temperature data from the production wells will be obtained through the use of thermocouples. Additional temperature data will be obtained from vertically drilled observation wells. Bottom hole pressure will be monitored in the injection and production wells.

Bitumen, produced water and produced gas will be measured during well testing. Bitumen analysis will be done regularly to monitor quality from the reservoir. Produced gas will be analyzed for composition on a regular basis.

The volume and pressure of steam injected into each injection well will be continuously measured and recorded.

Casing Failure Monitoring Program

The SAGD operation will be a continuous process operated below the formation fracture pressure. As a result, the downhole tubulars are not subjected to high pressure or stresses from frequent temperature fluctuations.

Well parameters will be monitored by operations staff to ensure casing integrity. Any unanticipated changes in these parameters will be immediately investigated. These techniques will assist in identifying any potential casing performance issues.

The intermediate casing string will provide hydraulic isolation between the formation into which steam will be injected and the overlying shale. Additionally, surface casings set below the glacial till will help provide a second method of hydraulic isolation. MEG does not expect any intermediate casing failures due to diligent exercise of good casing and cementing practices.

3.2.2.2 Source and Disposal Wells

Steam generation make-up water for Phase 3 will be supplied from 12 new deviated water source wells that will target the Upper Clearwater water sands. For Plant 3A, six deviated water source wells will be drilled from the Phase 3 wellpads located at 14-20-076-04 W4M and 01-33-076-04 W4M. For Plant 3B, six deviated water source wells will be drilled from the Phase 3 wellpads located at 08-32-077-06 W4M and 07-21-077-06 W4M.

Approximately 6,678 m^3/d of Upper Clearwater water will be required as make-up water for Phase 3. Geological mapping and reservoir modelling has concluded that the Upper Clearwater water sands will supply adequate volumes of process make-up water.

Potable and utility water for Phase 3 will be supplied from new water source wells to be drilled in the vicinity of Plant 3A and Plant 3B. For Plant 3A, the potable and utility water source well will target the Empress Channel Aquifer. For Plant 3B, the potable and utility water source well will target the Empress Terrace Aquifer. Approximately 1,088 m^3/d will be required as potable and utility water for Phase 3. Additional potable and utility water source wells may be drilled at each of the Phase 3 plants (as required).

Process waste water (boiler blowdown and water treatment regeneration only) generated from Plants 3A and 3B will be routed to the disposal water tank prior to being directed to the disposal wells. The solids content of the disposal water is expected to be very low. A filter will provide protection from possible well blockage due to upset conditions.

MEG plans to dispose of process waste water generated at Plants 3A and 3B by injecting the fluids into two Class 1B disposal wells completed in the basal McMurray water sand located at 04-25-077-04 W4M and 01-35-078-05 W4M. Surface casing will be set between 40 to 90 m below surface. Intermediate casing will be set below the bitumen bearing zone. The main injection tubing will be run to the top of the disposal zone, the Lower McMurray, and will be set with a packer and protected with corrosion inhibitor as per ERCB directives. Prior to the start of injection operations, zonal isolation will be tested with temperature survey logs and cement bond logs in compliance with ERCB directives.

The proposed locations of the source and disposal wells are presented in Figure 1.2-3. Additional information regarding water source and disposal is presented in the hydrogeology section of this EIA (Volume 4, Section 5).

3.2.2.3 Pumping Stations

Five pumping stations have been identified to assist the transportation of the production to Plants 3A and 3B. Each pumping station will consist of an inlet separator, production pump, gas cooler and compressor package. The production will be separated into a liquid phase and a gas phase. The liquid phase will flow through the production pump. The gas phase will be cooled and compressed before being remixed with the liquid phase.

The gas coolers may use cooling glycol from the Phase 3 plants to recover high-grade heat from the pumping stations and return it to the plants in order to maximize energy efficiency, depending on the proximity of the pumping stations to the plants.

A typical pumping station plot plan and flow diagram are presented in figures 3.2-10 and 3.2-11 respectively.

3.2.2.4 Access Roads, Pipelines, and Utility Corridors

The Phase 3 plants will each be connected to the Central Plant and their respective wellpads, pumping stations, source wells and disposal wells. Proposed utility corridors are presented on Figure 1.2-3.

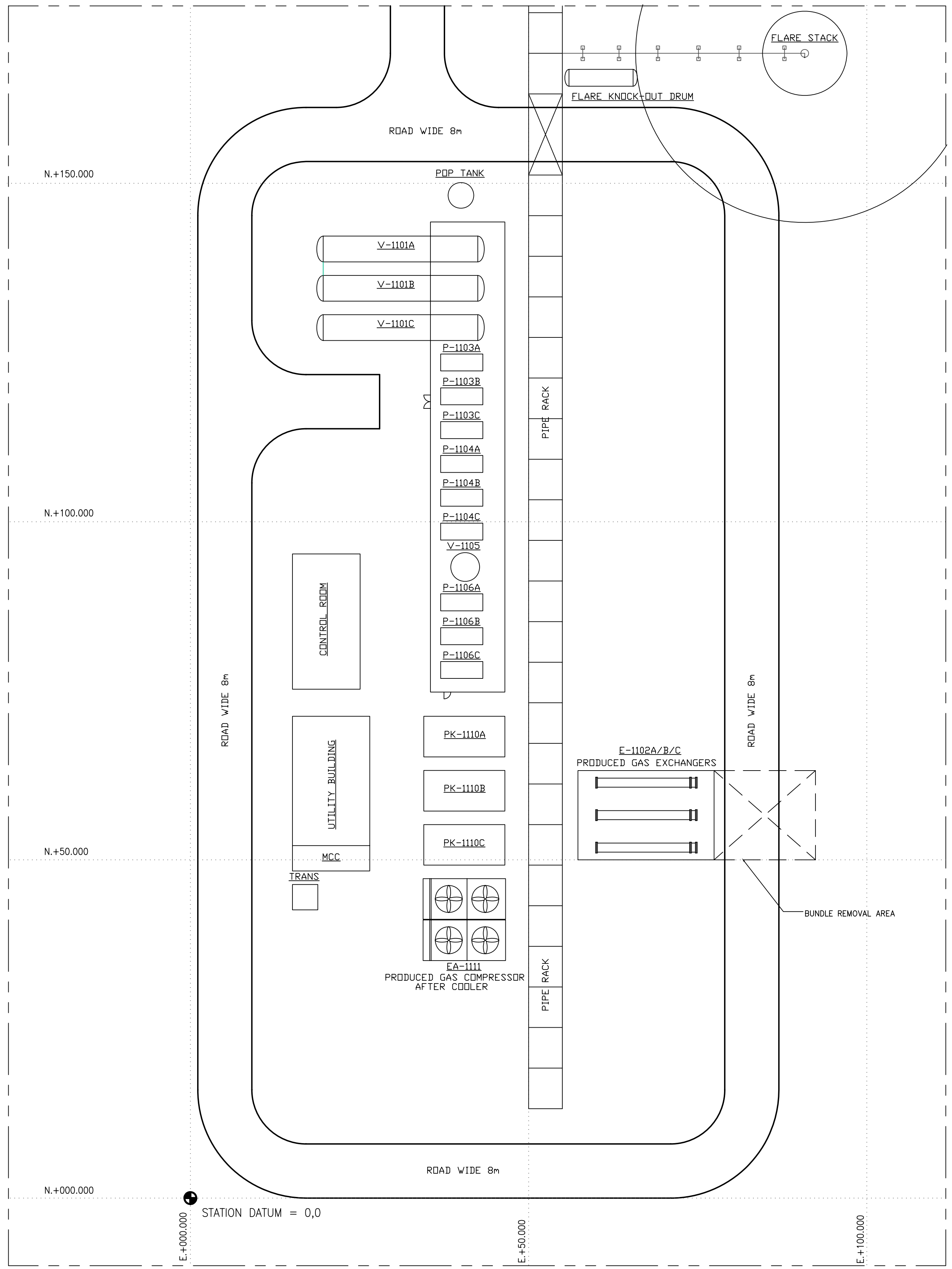
Utility corridors between the Phase 3 plants and the Central Plant will be comprised of an access road, underground pipelines, and overhead electrical and communication lines. The access roads will, where practicable, follow the underground pipeline ROW. The underground pipelines in these utility corridors will include outgoing sales oil, outgoing acid gas lines, incoming diluent and incoming natural gas supply lines. The natural gas pipelines will either connect to the Central Plant or directly to the existing pipeline infrastructure, depending on the results of detailed engineering. Natural gas metering will be conducted using either existing metering equipment or new metering equipment to be installed for Phase 3.

Interconnecting utility corridors between the Phase 3 plants and their respective wellpads and pumping stations will be comprised of an access road, aboveground pipelines and overhead electrical and communications lines. The access roads to the wellpads will be designed and constructed with ditching and culverts, as required, to maintain local surface drainage features.

The aboveground pipelines in these utility corridors will be mounted on pipe racks and will include insulated steam distribution lines, insulated production lines and lift gas supply lines. Interconnecting utility corridors between the Phase 3 plants and the pumping stations may also require insulated glycol supply and return lines. The pipe racks will include expansion loops to accommodate any thermally induced movements. The aboveground pipe racks will be oriented to accommodate wildlife movement. Local topographical features will be identified during the detailed design phase to identify areas were the pipe racks might be raised or lowered while minimizing potential liquid traps along the lines.

Interconnecting utility corridors between the Phase 3 plants and their respective water source and disposal wells will be comprised of an access road and underground pipelines. In addition, utility corridors between the Phase 3 plants and their respective water source wells will also include overhead electrical lines. The access roads will, where practicable, follow the underground pipeline ROW. The underground pipelines in these utility corridors will include either source or disposal water lines. Electrical power will be supplied to the source wells for lighting, pumping and standby heating.

EQUIPMENT LIST		
NO	EQUIP No.	EQUIP NAME
1	V-1101 A/B/C	INLET SEPARATOR
2	P-1103 A/B/C	EMULSION BOOSTER PUMP
3	P-1104 A/B/C	EMULSION PUMP
4	E-1102A/B/C	PRODUCED GAS EXCHANGERS
5	V-1105	PRODUCED GAS SEPARATOR
6	P-1106 A/B/C	PRODUCED WATER PUMP
7	PK-1110 A/B/C	PRODUCED GAS COMPRESSOR
8	EA-1111	PRODUCED GAS COMPRESSOR AFTER COOLER



0 8 16 24 32 40m.
ALL DIMENSIONS ARE IN m UNLESS NOTED OTHERWISE

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
TYPICAL PUMPING STATION PLOT PLAN

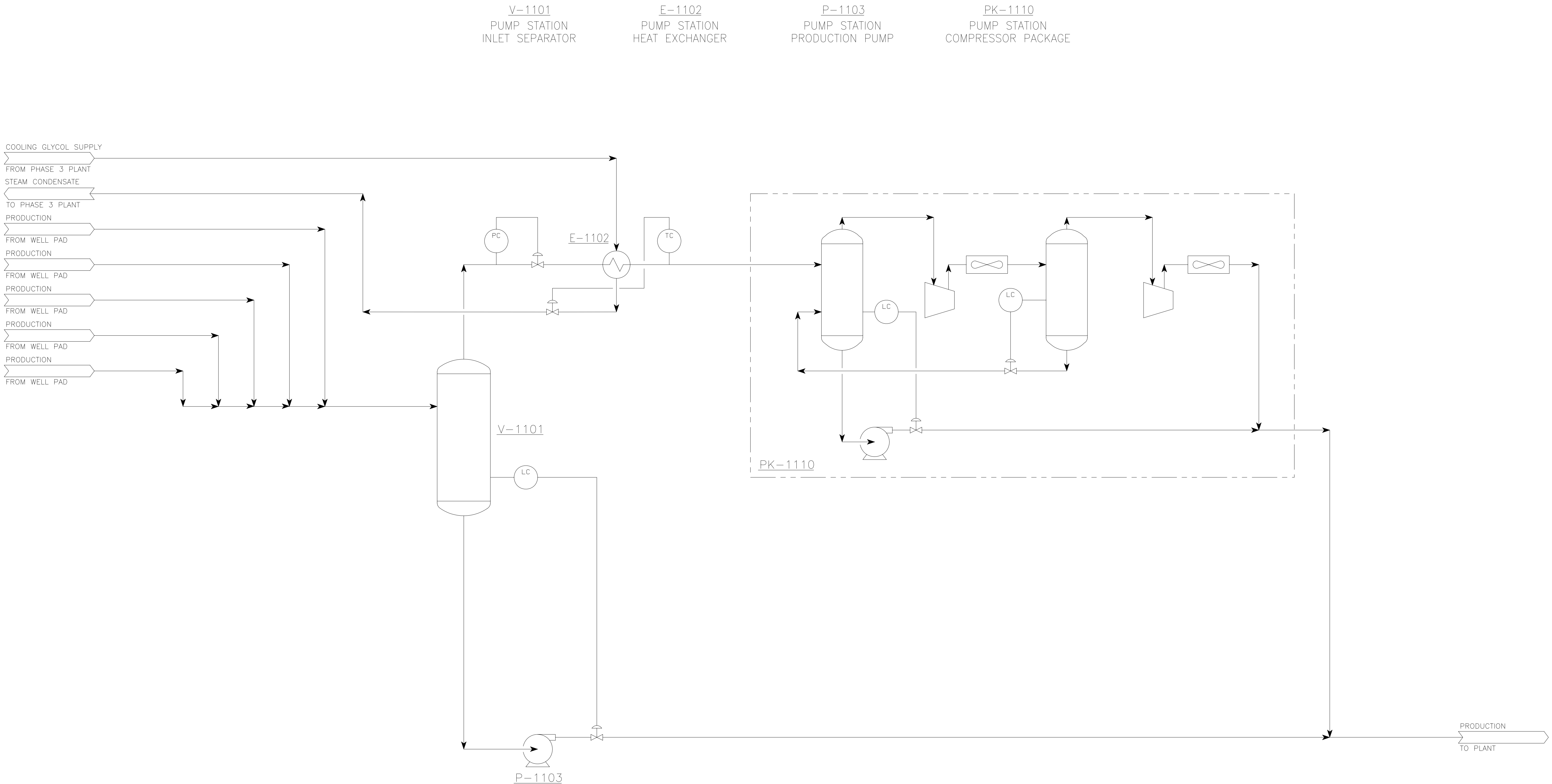
MEG ENERGY CORP.

PROJECT	07.1346.0009.5100		
DESIGN	KAN	08/01/25	
CADD	KAN	08/01/25	
CHECK	SG	17/04/08	
REVIEW	SG	17/04/08	

FILE No. 085349-4903-3_2
SCALE 1:400 REV. 0

FIGURE: 3.2-10

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-From Matrix\Fig 3.2-10_Typical Pumping Station Plot Plan-085349-4903.dwg Apr 17, 2008 - 4:54pm



PROJECT				
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3				
TITLE				
TYPICAL PUMPING STATION FLOW DIAGRAM				
MEG ENERGY CORP.	PROJECT	07.1346.0009.5100		FILE No. Pump Stn-Diagram
	DESIGN	PT	05/04/08	SCALE NTS REV. 0
	CADD	PSR	07/04/08	**FIGURE: 3.2-11**
	CHECK	SG	17/04/08	
	REVIEW	SG	17/04/08	

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\5100\5190\Vol 1-From Matrix\Fig 3.2-11_Typical Pumping Station Flow Diagram-085349-4901.dwg Apr 17, 2008 - 5:06pm

3.2.3 Offsite Services

3.2.3.1 Camps

A temporary construction camp will be required for each plant location (Plant 3A and Plant 3B) during construction. Two temporary camps will be designed to accommodate the peak construction workforce of the Project. The construction camps will not service any other clients. It is anticipated that the construction camps will each be in service for approximately 2 years.

The temporary construction camps will both be supplied by separate potable water and sewage treatment facilities, as well as recreational and leisure services. Medical and emergency services will be available to support camp population and are further detailed in Volume 6, Appendix 6-3, Section 2.4.4.

3.2.3.2 Borrow Pits

Construction materials (sand, clay and aggregate) are required for plant, wellpad, and road construction. Potential borrow areas have been identified that are expected to yield the required construction materials. Suitably sized borrow pits will be constructed within these areas; it is not expected that all of the potential borrow areas will be fully developed.

3.3 ENVIRONMENTAL MANAGEMENT AND CONTROLS

MEG has developed an integrated Environment, Health & Safety (EHS) Management System based on the International Standards Organization (ISO) 14001 management system standard. The EHS Management System reflects MEG's commitment to minimize the environmental impact and health and safety risks associated with the development and operations of oil sands projects. The system is designed to encourage continuous improvement of all aspects of EHS training, operations, incident management, corrective action and reporting.

The EHS Management System is intended to extend MEG's EHS standards to employees, contractors and affiliates. MEG employees and contractors are encouraged to assume personal responsibility for the health and safety of themselves and others, and for the protection of the environment. This personal responsibility is reinforced within the EHS Management System through the recent implementation of an electronic incident reporting and management system which tracks responsibility, follow up and corrective action for EHS non-conformances. The system also allows MEG to develop and track performance for regular management review within the organization.

Programs developed within the EHS Management System ensure continued compliance with regulations by identifying the requirements, ensuring required controls are in place and providing appropriate training, monitoring and equipment for employees and contractors. Key aspects of the EHS Management System include:

- ongoing assessment and tracking of EHS risks and aspects;
- identification and tracking of training requirements;
- emergency management planning and training;
- non-conformance and corrective action standards and systems;
- documentation and records management standards;
- periodic audits of the compliance and performance of the EHS management system; and
- regular management review of EHS compliance and performance.

3.3.1 Emergency Planning

MEG has developed a company-wide approach to emergency planning based on operations-specific hazard/risk analysis as part of the previously approved phases of the CLRP. Under the umbrella of the EHS Management System, emergency planning combines the following:

- corporate emergency notification procedures;
- facility Emergency Response Plan (ERP); and
- Standard Operating Procedures (SOPs), codes of practice and guidelines.

During the construction phase, the EHS Management System incorporates measures to address potential emergencies specific to construction activities. These temporary measures account for the increased travel to and from the site, transport and installation of heavy construction modules and equipment, ground disturbance and management of construction workforce. Issues of focus during the construction phase include:

- communications with protective and emergency service providers;
- additional medical and security personnel for the camp and facility; and
- measures to mitigate the impact of increased traffic on area roads.

MEG's emergency notification procedures outline the response to an emergency by MEG management and identify communications protocols and support for the corporation. The facility ERP, which has been registered with the ERCB, has been designed to meet ERCB Directive 71 (ERCB 2008) and CSA –Z731-03 and reflects risks specific to the CLRP. MEG's ERP addresses initial response to a variety of potential scenarios such as fires, spills and critical operating failures. Specific procedures covering the technical response to such emergencies (such as well control, facility operations, equipment repairs, etc.) are outlined in SOPs and guidelines.

3.3.2 Facility Emergency Response Plan

MEG's emergency response priorities are to protect people, property and the environment. The ERP is implemented using an alert and three emergency levels. Evaluation of the potential impacts of an incident involves consideration of a number of factors including severity of injuries, duration and response requirements; and community risk. The ERP requires that a qualitative evaluation of such factors will be conducted to establish the actual or potential severity of incidents. As per ERCB Directive 71 (ERCB 2008), MEG has developed a detailed criteria matrix for classifying incidents and a detailed response and communications plan for each level of incident.

3.3.2.1 Regional Cooperation

MEG is responsible for the management of all emergency situations relating to its operations. Should an emergency occur, MEG will activate this emergency response plan and notify appropriate municipality, provincial and federal regulatory authorities and others as required. Interactions between MEG and appropriate government authorities will depend on the tier at which an emergency is placed in the staged approach within the ERP. Appropriate authorities could include:

- ERCB;
- AENV;
- RMWB; and
- Alberta Sustainable Resource Development (ASRD).

The Project has an existing agreement with medivac services for air transport of serious cases and a registration with STARS Emergency Link Centre to assist with emergency response. MEG is engaged in ongoing discussions with a number of other oilsands operators in the Southern Athabasca Oilsands Region to develop a mutual aid support network which would involve sharing of emergency equipment, supplies and personnel.

3.3.2.2 Emergency Scenarios and Training

The facility ERP addresses potential emergency or operational upset scenarios specific to the CLRP that would require immediate response and reporting. Some examples include:

- serious injury to CLRP personnel or members of the public;
- processing plant shut down;
- major equipment or instrumentation failure;
- major spills or releases to the environment;
- fire within or near to the facilities;
- security issues such as criminal acts, or threat or act of terrorism;
- loss of well control; or
- pipeline rupture.

All personnel are provided industrial training relevant to the CLRP and are required to participate in simulated emergency situation response. Such “mock” exercises are undertaken on a periodic basis as per the ERCB Directive 71 (ERCB 2008). As per Alberta Occupational Health and Safety requirements, onsite first aid training and equipment will mitigate the risk if a medical emergency occurs where evacuation might be delayed.

3.3.2.3 Components of the Emergency Response Plan

Components of the ERP include:

- personnel and contact information;
- scenario response descriptions and classification criteria;
- logistical support information;
- recommended actions;
- resident, trapper, area industrial operators and community contact information;
- mutual aid and spill co-operative information;
- and site-specific and area maps.

The ERP Table of Contents (Table 3.3-1) is provided to illustrate the level of detail provided in the document.

Table 3.3-1 Emergency Responses Plan Table of Contents

Statistics Page	
Disclaimer	
Emergency Call Down List	
Internal Emergency Call Down List	
External Emergency Call Down List	
1.0 Immediate Actions	1.1 Man Down, Rescue And Medical Situation 1.2 Missing Or Overdue Personnel 1.3 Facility Fire/Explosion 1.4 Chemical Spill 1.5 Hydrocarbon Spill 1.6 Vehicle Incident 1.7 Building/Structural Emergencies 1.8 Radioactive Incident 1.9 Site Evacuation 1.10 Odour Complaint 1.11 Uncontrolled/Partially Controlled Well Flow 1.12 Pipeline Rupture 1.13 Bomb Threat – On Site Procedures 1.14 Riots And Picketing 1.15 Forest Fire Or Flooding - Impacting Operations 1.16 Severe Weather And Natural Disasters
2.0 Public Protection	2.1 Evacuation 2.2 Shelter-In-Place 2.3 Ignition
3.0 Corporate Governance	3.1 Policy on Environment, Health & Safety 3.2 Acknowledgement Form 3.3 Document Status And Revision Form 3.4 Management Of Change Request Form 3.5 Manual Distribution List
4.0 Overview	4.1 Introduction 4.2 Purpose Of Emergency Response Plan (ERP) 4.3 Emergency Planning Zone (EPZ) Determination 4.4 ERP Maintenance 4.5 Third Party Emergencies

Table 3.3-1 Emergency Responses Plan Table of Contents (continued)

3.3.3 Fire Management and Control

The two major fire management issues identified by MEG for the Project are wildfire and industrial fire risks. The following section addresses MEG's proposed approach to managing these risks.

3.3.3.1 Wildfire Management

The Fire Smart Wildfire Assessment System has been applied to the CLRP to assess the structures and the surrounding area for wildfire hazards. The assessment will be conducted for Plant 3A, Plant 3B and their respective production wellpads, including the electrical distribution systems, flare systems and steam piping prior to start-up.

Using the principles outlined in the Fire Smart Wildfire Assessment System, the Project will include fire reduction measures to reduce the potential risk to the CLRP from a wildfire, as well as reducing the risks of causing a wildfire. These measures include adequate building and equipment separation, tree-free power lines, flare design and the incorporation of non-combustible building materials. The fire mitigation measures will be included as part of the Project's design.

MEG will coordinate with industry operators, and the RMWB and ASRD to develop a suitable co-ordinated fire response strategy.

3.3.3.2 Industrial Fire Management

Fire detection will be an integral part of the Project's fire management system. "Fire Eye" sensors capable of detecting open flame will be installed in critical areas of the Phase 3 plants and production wellpads. In addition, combustible gas and smoke detection devices will also be located throughout the plants. All of these sensors will be tied into the process control system to allow automatic response to fire and the potential for fire within the plant processes.

The flare systems will incorporate design features to reduce the potential for starting wildfires. The flare systems will incorporate flare knockouts to ensure hydrocarbon liquids are not carried through to the flare tips. The liquid level in the flare knockouts will be monitored and accumulated liquids removed when necessary. The flare stacks will each have a continuous burning flame to ensure combustion of all hydrocarbons sent to the flare system. Flare ignition will be by an electrical igniter located at the flare tip.

Other fire reduction measures to be incorporated include:

- absence of combustible ground cover;
- adequate setback of facilities from the surrounding forest; and
- adequate building separation.

For fire suppression during the operation of the Project, a combination of wall-mounted and wheeled fire extinguishers will be located throughout Plant 3A, Plant 3B, and their respective production wellpads. Additional fire suppression equipment will be located strategically around the Project as required.

3.3.4 Water Management

MEG recognizes water management as an important part of the oilfield operations. MEG’s water management plan focuses on surface and ground water protection.

Surface runoff water will be collected at Plant 3A and Plant 3B in one of two industrial runoff ponds. The runoff water ponds will be fed by a system of drainage ditches and culverts to control and contain industrial runoff. The Phase 3 runoff ponds will be designed for a 1:25 year precipitation event. Water from the ponds will likely be reduced by evaporation. In the event that extra standby capacity is required, the pond contents will be sampled, as per AENV operating conditions, and released to the watershed through an overland discharge designed to minimize erosion and sedimentation in the surrounding environment. If accumulated surface water does not meet regulatory requirements, it will be introduced into process.

The Project will include the temporary alteration of surface runoff through the incorporation of ditches and surface runoff impoundments. The ditches will be designed to ensure that the natural drainage patterns are maintained and to avoid ponding of water along roads.

Groundwater monitoring will be conducted around Plant 3A and Plant 3B. A network of groundwater monitoring wells at CLRP has been previously installed and will be expanded for the Project. The monitoring wells will be installed in the Quaternary aquifers to better define the local groundwater flow conditions and to ensure that water quality conditions are maintained. The expansion of the groundwater monitoring well network for the Project will be finalized in consultation with AENV.

3.3.5 Air Emissions Management

The largest air emissions source for the Project will be the steam generation equipment, with minor sources including the flare system. Operations of the flare systems will be managed in accordance with ERCB Directive 060 (ERCB 2006b). As part of the detailed engineering phase, MEG will select steam generator manufacturers who can supply energy efficient units with low NO_x burners.

Vapours from tanks containing hydrocarbons will be controlled with a VRU.

Wells in the field may be depressurized to perform wellhead or downhole maintenance or adjacent drilling activities. Emissions from wells during depressurization will be minimal.

Further information regarding air emissions is presented in the air quality section of this EIA (Volume 3, Section 1).

3.3.6 Waste Management

The underlying objectives of waste management efforts are to reduce waste and to prevent soil or groundwater contamination through:

- employing waste minimization practices involving reuse, recycling, reduction and recovery of waste, where practicable;
- ensuring the integrity of primary containment devices, including any associated equipment such as valves, fittings, piping or pumps;
- providing adequate secondary containment, leak detection and weather protection for storage facilities; and
- utilizing operating procedures, maintenance practices and inspection programs to maintain the materials handling and storage facilities.

Some waste materials generated during the various stages of the Project may not be completely recycled and will be disposed of at approved facilities. These waste streams include:

- wastewater solids;
- solid and liquid waste from construction, utilities and services;
- process and oilfield wastes;

- drilling wastes;
- produced water and water treatment process wastes; and
- produced sand.

MEG will adhere to the practices and procedures identified in ERCB Directive 058 (EUB 1996a). The key standards to which MEG will model its waste management include:

- identifying, measuring and controlling waste generation;
- industry best practices for handling, storage and disposal;
- performance tracking and reporting; and
- monitoring of waste receiving facilities.

The guidelines apply to all solid and liquid waste that is generated, handled, stored and disposed of through activities resulting from the Project. Activities will be closely monitored to ensure compliance with environmental regulations and to encourage the most effective and efficient use of resources through the waste management practices of reduce, reuse, recycle and recover, where practicable.

4 SUMMARY OF THE ENVIRONMENTAL IMPACT ASSESSMENT

4.1 INTRODUCTION AND APPROACH

This section summarizes the results of the environmental and social assessment of the Environmental Impact Assessment (EIA) for the Project, including the:

- effects that could result from the Project's construction, operation and reclamation;
- residual effects of the Project, including their direction, magnitude, frequency, duration, reversibility and geographic extent;
- measures to avoid or mitigate impacts; and
- monitoring and management programs for the Project.

The assessment of the Project included the evaluation of three distinct scenarios:

- The Existing and Approved Case (EAC) includes an assessment of the cumulative effects from the existing and approved projects. The EAC represents the cumulative effects that can occur without additional regulatory approvals.
- The Project Case provides a cumulative assessment of the Project in combination with EAC in the region. The Project Case represents the effects once the Project is in operation.
- The Planned Development Case (PDC) includes a cumulative assessment of the existing and approved projects in the region, the Project and other publicly disclosed projects. Since the PDC includes planned projects, none of which have received approval to operate and some of which have yet to apply for approval, the assessment is speculative and was based on public information available in October 2007.

4.2 ASSESSMENT SUMMARY

4.2.1 Air Quality

The Project will release atmospheric emissions into the regional airshed. The air quality assessment considered how these emissions could affect local and regional air quality.

The deposition of acid-forming compounds was considered. The emissions of both sulphur dioxide and oxides of nitrogen were used to predict Potential Acid Input (PAI).

Concentrations of SO_2 and NO_2 and PAI levels were determined over the entire modelling domain, and the results were presented for both the Regional Study Area (RSA) and Local Study Area (LSA) including and excluding developed areas. Concentrations of the above compounds (excluding PAI) were determined for the selected receptors. These receptors represent the primary population centres in or near the region that could potentially experience increased concentrations due to the Project. These include one community and two locations in Alberta that are of importance to First Nations groups. In addition, concentrations were predicted at two cabins, the Operator's Residence, the Christina Lake Lodge and along the Project property boundary where persons could experience prolonged exposure to air emissions. Concentrations were also predicted at La Loche, Saskatchewan to evaluate the transboundary effects of the Project emissions.

The predicted concentrations and deposition values were compared to established AAAQOs or other criteria, as applicable. However, not all of the parameters have air quality objectives and standards against which the predicted concentrations could be evaluated. In such cases, the results of the modelling analyses were provided to other disciplines for evaluation. A summary of these evaluations has been presented in the Environmental Health section (Volume 3, Section 3) and the Air Emissions Effects on Ecological Receptors section (Volume 3, Section 4). The predicted ambient ground-level concentrations for the Existing and Approved Case, Project Case and Planned Development Case are provided in detail in Volume 3, Appendix 3-III.

4.2.1.1 Conclusions

The emission rates in the RSA associated with the Project Case are presented in Table 4.2-1. The Project is estimated to increase emissions in the RSA by 11.5% for calendar-day SO_2, 36.2% for NO_X, 36.7% for CO, 58.7% for $PM_{2.5}$, 46.1% for

VOCs and 51.9% for TRS. The Project is estimated to increase emissions in the modelling domain by 0.5% for calendar-day SO_2, 1.9% for NO_X, 2.0% for CO, 2.5% for $PM_{2.5}$, 0.1% for VOCs and 0.6% for TRS.

Table 4.2-1 Summary of Existing and Approved Case, Project Case and Planned Development Case Emissions in the Regional Study Area

Descriptions	Existing and Approved Case	Project Case	Change Due to Project [%][(a)]
SO_2 emissions [t/cd]	10.81	12.06	11.5
NO_X emissions [t/d]	26.52	36.14	36.2
CO emissions [t/d]	23.65	32.32	36.7
$PM_{2.5}$ emissions [t/d]	1.33	2.12	58.7
VOC emissions [t/d]	1.29	1.88	46.1
TRS emissions [t/d]	0.08	0.13	51.9

(a) The Project is in an airshed that has numerous other sources of emissions. Despite the mitigation measures incorporated into the Project design, the air emissions may result in changes in the ambient air quality.

The modelling results for the Project Case indicate the following:

- Regional Concentrations. The maximum predictions of 1-hour, 24-hour and annual ground-level SO_2 and NO_2 concentrations in the LSA and the RSA (outside of developed areas) are below the 1-hour, 24-hour and annual AAAQOs, as shown in Table 4.2-1.
- PAI levels. Because the PAI from the EAC already exceeds CASA PAI thresholds in the modelling domain, the SO_2 and NO_X emissions from the Project will result in an increase in the areas of PAI above 0.17 and 0.25 keq/ha/yr within both the RSA and the LSA. The 0.17 keq/ha/yr PAI isopleth is not predicted to extend into Saskatchewan. Emissions from the Project were predicted to increase PAI levels in eight of the twenty-five 1° by 1° grid cells in the modelling domain. No other grid cells, outside the two that were already exceeding the monitoring, target or critical loads in the EAC, are predicted. The grid cell in which the Project is located is centred on 56°×111° and the PAI level within this cell is expected to increase by 0.004 keq/ha/yr.
- Selected Receptors. The Project Case emissions will have a small incremental effect on the ambient ground-level concentrations at the selected receptors. Predicted concentrations of SO_2, NO_2, CO, H_2S, COS, CS_2, benzene, select VOC compounds, PAH compounds and select trace metals are below the respective AAAQOs or other criteria, as applicable. The predicted 24-hour $PM_{2.5}$ concentration is also below the AAAQO at all the selected receptors; however, the predicted peak

1-hour $PM_{2.5}$ concentration is above the AAAQO at the Maximum Property Boundary.

- Saskatchewan Receptor. Model predictions at La Loche, Saskatchewan show small increases in ambient concentrations (e.g., less than 1 µg/m³ for SO_2 and NO_2); however, these concentrations are below respective AAAQOs or other criteria, as applicable.
- Greenhouse gases. The Project is estimated to provide maximum GHG emissions of 4,537 kt/y CO_2E.

Table 4.2-2 Summary of Regional Project Case Sulphur Dioxide and Nitrogen Dioxide Predictions

Parameter	Maximum Concentration[(a)(b)] [µg/m³]	Number of Occurrences Above AAAQO[(b)(c)]	Area Above AAAQO[(b)(c)] [ha]
LSA			
1-hour SO_2	416.1	0	0
24-hour SO_2	118.6	0	0
annual average SO_2	15.6	0	0
1-hour NO_2	161.4	0	0
24-hour NO_2	46.4	0	0
annual average NO_2	6.1	0	0
RSA			
1-hour SO_2	416.1	0	0
24-hour SO_2	118.6	0	0
annual average SO_2	15.6	0	0
1-hour NO_2	161.4	0	0
24-hour NO_2	65.7	0	0
annual average NO_2	6.1	0	0

(a) Maximum 1-hour predictions exclude the eight highest 1-hour concentrations, as per the Alberta model guidelines (AENV 2003). The eight highest 1-hour predictions were not excluded from the maximum 24-hour and annual concentrations.

(b) All results exclude developed areas. Developed areas include the Project plant sites.

(c) The 1-hour, 24-hour and annual Alberta Ambient Air Quality Objectives for SO_2 are 450, 150 and 30 µg/m³, respectively. The 1-hour, 24-hour and annual Alberta Ambient Air Quality Objectives for NO_2 are 400, 200 and 60 µg/m³, respectively.

4.2.1.2 Existing and Approved Case

The Existing and Approved Case (EAC) emissions in the RSA include a total of 10.81 t/cd (10.81 t/sd) of SO_2 emissions and 26.52 t/d of oxides of nitrogen (NO_X) emissions. Within the modelling domain, the EAC includes a total of 271.30 t/cd (198.93 t/sd) of SO_2 emissions and 492.95 t/d of emissions of NO_X.

The modelling results for the EAC indicate the following:

- Regional Concentrations. The maximum predictions of 1-hour, 24-hour and annual ground-level SO_2 and NO_2 concentrations in the LSA and the RSA (outside of developed areas) are below the 1-hour, 24-hour and annual AAAQOs, as shown in Table 4.2-3.
- PAI Levels. PAI levels were predicted using the CALPUFF dispersion model in combination with background PAI values determined by AENV (Cheng 2001, 2005, Pers. Comm.). The predictions indicate that areas above 0.17 and 0.25 keq/ha/yr are possible within the RSA and LSA. In addition, twenty-five 1° by 1° grid cells, which are based on the Clean Air Strategic Alliance (CASA) critical, target and monitoring loads framework and are in the air quality modelling domain, are all classified as being sensitive to acid deposition. The PAI levels were above 0.25 keq/ha/yr in the two grid cells where the majority of approved oil sands operations are located. None of the remaining 23 grid cells had PAI levels above the 0.17 keq/ha/yr monitoring load.
- Selected Receptors. All predicted concentrations of SO_2, NO_2, CO, H_2S, COS, CS_2, benzene, select VOCs, $PM_{2.5}$, PAH compounds and select trace metals are below respective AAAQOs or other criteria, as applicable, at the selected receptors.
- Saskatchewan Receptor. All predicted concentrations of SO_2, NO_2, CO, H_2S, COS, CS_2, benzene, select VOCs, $PM_{2.5}$, PAH compounds and select trace metals are below respective AAAQOs or other criteria, as applicable, at La Loche, Saskatchewan.

Table 4.2-3 Summary of Regional Existing and Approved Case Sulphur Dioxide and Nitrogen Dioxide Predictions

Parameter	Maximum Concentration[(a)(b)] [µg/m³]	Number of Occurrences Above[(b)(c)] AAAQO	Area Above AAAQO[(b)(c)] [ha]
Local Study Area			
1-hour SO_2	283.1	0	0
24-hour SO_2	66.0	0	0
annual average SO_2	7.4	0	0
1-hour NO_2	87.9	0	0
24-hour NO_2	41.8	0	0
annual average NO_2	3.8	0	0
Regional Study Area			
1-hour SO_2	283.1	0	0
24-hour SO_2	66.0	0	0
annual average SO_2	7.4	0	0
1-hour NO_2	158.1	0	0
24-hour NO_2	65.6	0	0
annual average NO_2	5.5	0	0

(a) Maximum 1-hour predictions exclude the eight highest 1-hour concentrations, as per the Alberta model guidelines (AENV 2003). The eight highest 1-hour predictions were not excluded from the maximum 24-hour and annual concentrations.

(b) All results exclude developed areas. Developed areas include the Project plant sites.

(c) The 1-hour, 24-hour and annual Alberta Ambient Air Quality Objectives for SO_2 are 450, 150 and 30 µg/m³, respectively. The 1-hour, 24-hour and annual Alberta Ambient Air Quality Objectives for NO_2 are 400, 200 and 60 µg/m³, respectively.

4.2.1.3 Project Case

The Project is estimated to increase emissions in the RSA by 11.5% for calendar-day SO_2, 36.2% for NO_X, 36.7% for CO, 58.7% for $PM_{2.5}$, 46.1% for VOCs and 51.9% for TRS. The Project is estimated to increase emissions in the modelling domain by 0.5% for calendar-day SO_2, 1.9% for NO_X, 2.0% for CO, 2.5% for $PM_{2.5}$, 0.1% for VOCs and 0.6% for TRS.

The modelling results for the Project Case indicate the following:

- Regional Concentrations. The maximum predictions of 1-hour, 24-hour and annual ground-level SO_2 and NO_2 concentrations in the LSA and the RSA (outside of developed areas) are below the 1-hour, 24-hour and annual AAAQOs, as shown in Table 4.2-4.
- Potential Acid Input (PAI) levels. Because the PAI from the EAC already exceeds CASA PAI thresholds in the modelling domain, the SO_2 and NO_X emissions from the Project will result in an increase in the areas of PAI above 0.17 and 0.25 keq/ha/yr within both the RSA and the LSA. Also, the 0.17 keq/ha/yr PAI isopleth is not predicted to extend into Saskatchewan. Emissions from the Project were predicted to increase PAI levels in eight of the twenty-five 1º by 1º grid cells in the modelling domain. No additional grid cells exceeded the target or critical loads in the EAC as a result of Project emissions. The grid cell in which the Project is located is centred on 56º×111º and the PAI level within this cell is expected to increase by 0.004 keq/ha/yr.
- Selected Receptors. The Project Case emissions will have a small incremental effect on the ambient ground-level concentrations. Predicted concentrations of SO_2, NO_2, CO, H_2S, COS, CS_2, benzene, select VOC compounds, PAH compounds and select trace metals are below the respective AAAQOs or other criteria, as applicable. The predicted 24-hour $PM_{2.5}$ concentration is also below the AAAQO at all community receptors; however, the predicted peak 1-hour $PM_{2.5}$ concentration is above the AAAQO at the Maximum Property Boundary.
- Saskatchewan Receptor. Model predictions at La Loche, Saskatchewan show small increases in ambient concentrations (e.g., less than 1 $\mu g/m^3$ for SO_2 and NO_2); however, these concentrations are below respective AAAQOs or other criteria, as applicable.

Table 4.2-4 Summary of Regional Project Case Sulphur Dioxide and Nitrogen Dioxide Predictions

Parameter	Maximum Concentration[(a)(b)] [µg/m³]	Number of Occurrences Above AAAQO[(b)(c)]	Area Above AAAQO[(b)(c)] [ha]
LSA			
1-hour SO_2	416.1	0	0
24-hour SO_2	118.6	0	0
annual average SO_2	15.6	0	0
1-hour NO_2	161.4	0	0
24-hour NO_2	46.4	0	0
annual average NO_2	6.1	0	0
RSA			
1-hour SO_2	416.1	0	0
24-hour SO_2	118.6	0	0
annual average SO_2	15.6	0	0
1-hour NO_2	161.4	0	0
24-hour NO_2	65.7	0	0
annual average NO_2	6.1	0	0

(a) Maximum 1-hour predictions exclude the eight highest 1-hour concentrations, as per the Alberta model guidelines (AENV 2003). The eight highest 1-hour predictions were not excluded from the maximum 24-hour and annual concentrations.

(b) All results exclude developed areas. Developed areas include the Project plant sites.

(c) The 1-hour, 24-hour and annual Alberta Ambient Air Quality Objectives for SO_2 are 450, 150 and 30 µg/m³, respectively. The 1-hour, 24-hour and annual Alberta Ambient Air Quality Objectives for NO_2 are 400, 200 and 60 µg/m³, respectively.

4.2.1.4 Planned Development Case

The Planned Development Case (PDC) emissions in the RSA are projected to increase by 31.9% for calendar-day SO_2, 105.3% for NO_X, 102.4% for CO, 171.5% for $PM_{2.5}$, 470.4% for VOCs and 357.4% for TRS compared to those in the EAC. The PDC emissions within the modelling domain are projected to increase by 14.3% for calendar-day SO_2, 32.9% for NO_X, 23.5% for CO, 29.5% for $PM_{2.5}$, 28.7% for VOCs and 20.9% for TRS compared with those in the EAC.

The modelling results for the PDC indicate the following:

- Regional Concentrations. The maximum predictions of ground-level SO_2 and NO_2 concentrations in the LSA and RSA (outside of developed areas) are below the 1-hour, 24-hour and annual AAAQOs, as shown in Table 4.2-5.
- Potential Acid Input (PAI) Levels. The predictions indicate that areas above 0.17, 0.25 and 0.50 keq/ha/yr are possible within both the RSA and LSA. The PDC PAI levels are above the 0.25 keq/ha/yr critical load for sensitive ecosystems in the two 1° by 1° grid cells where the majority of approved oil sands operations are located. In addition, the

cell in which the Project is located is expected to have PAI levels above the 0.17 keq/ha/yr monitoring load. None of the remaining 22 grid cells had PAI levels above the 0.17 keq/ha/yr monitoring load.

- Selected Receptors. Predicted concentrations of SO_2, NO_2, CO, H_2S, COS, CS_2, benzene, select VOC compounds, PAH compounds and select trace metals are below the respective AAAQOs or other criteria, as applicable, at the selected receptors. The predicted 24-hour $PM_{2.5}$ concentration is also below the AAAQO at all the selected receptors; however, the predicted peak 1-hour $PM_{2.5}$ concentration is above the AAAQO at the Maximum Property Boundary.
- Saskatchewan Receptor. All predicted concentrations of SO_2, NO_2, CO, H_2S, COS, CS_2, benzene, select VOCs, $PM_{2.5}$, PAH compounds and select trace metals are below respective AAAQOs or other criteria, as applicable, at La Loche, Saskatchewan.

Table 4.2-5 Summary of Regional Planned Development Case Sulphur Dioxide and Nitrogen Dioxide Predictions

Parameter	Maximum Concentration[(a)(b)] [µg/m³]	Number of Occurrences Above AAAQO[(b)(c)]	Area Above AAAQO[(b)(c)] [ha]
LSA			
1-hour SO_2	416.3	0	0
24-hour SO_2	119.8	0	0
annual average SO_2	15.5	0	0
1-hour NO_2	161.4	0	0
24-hour NO_2	50.2	0	0
annual average NO_2	7.1	0	0
RSA			
1-hour SO_2	416.3	0	0
24-hour SO_2	119.8	0	0
annual average SO_2	15.5	0	0
1-hour NO_2	161.4	0	0
24-hour NO_2	67.8	0	0
annual average NO_2	7.1	0	0

(a) Maximum 1-hour predictions exclude the eight highest 1-hour concentrations, as per the Alberta model guidelines (AENV 2003). The eight highest 1-hour predictions were not excluded from the maximum 24-hour and annual concentrations.

(b) All results exclude developed areas. Developed areas include the Project plant sites.

(c) The 1-hour, 24-hour and annual Alberta Ambient Air Quality Objectives for SO_2 are 450, 150 and 30 µg/m³, respectively. The 1-hour, 24-hour and annual Alberta Ambient Air Quality Objectives for NO_2 are 400, 200 and 60 µg/m³, respectively.

4.2.2 Noise

4.2.2.1 Conclusions

Negligible to low magnitude impacts due to noise were predicted for the Project. The overall noise levels at all the seven receptors identified for the assessment met the Permissible Sound Level (PSL) as required by Directive 038. The amount of change expected at receptor locations is considered to be negligible for six of the receptors since people start to notice a change in noise levels of 3 dBA and the predictions were below this level. Since ERCB criteria are met and the amount of change is relatively small, the effects of Project noise at these six receptors are considered to be of negligible consequence. At the 1.5 km criteria boundary near Plant 3A, the predicted Project Case noise level was assigned a low impact magnitude. The predictions met the ERCB criteria with a level change from the EAC to Project Case of 3 dBA. The effects of Project noise are considered of low consequence as the change is considered audible but there is no dwelling at this location.

4.2.2.2 Existing and Approved Case

A review of activities near the Project indicated there are no existing and approved developments that could affect noise levels at the 1.5 km ERCB criteria boundary or at the identified receptors. The nearest energy-related development to the Project is the EnCana Christina Lake Thermal Project, which is about 12 km from Plant 3B. At this distance, the EnCana project will not affect noise levels within the Project area boundaries or at the 1.5 km criteria boundary for the Project. Any contributions to cumulative effects at distant receptors, including Conklin, Winefred Lake and Christina Lake Lodge, are expected to be well below ambient levels. Therefore the EAC focused on the CLRP Phases 1, 2 and 2B noise emissions using ERCB assessment methodology.

4.2.2.3 Project Case

The noise assessment was conducted to determine what effect existing and approved developments and the Project could have on local noise levels and at dwellings. The effects of Project noise levels were determined by:

- establishing the noise levels at specific receptors for noise caused by existing and approved projects;
- predicting the amount of sound generated by the major sources of the Project; and
- evaluating the resulting noise levels at specific receptors.

Negligible to low magnitude impacts were predicted for the Project. The overall noise levels at all seven receptors identified for the assessment met the PSL as required by Directive 038 (EUB 2007d). The amount of change expected at these locations is considered to be negligible for six of the receptors since people start to notice a change in noise levels of 3 dBA and the predictions were below this level. Since ERCB criteria are met and the amount of change is relatively small, the effects of Project noise at these six receptors are considered to be of negligible consequence.

At the 1.5 km criteria boundary near Plant 3A, the predicted Project Case noise level was assigned a low impact magnitude. The predictions met the ERCB criteria with a level change from the EAC to Project Case of 3 dBA. The effects of Project noise are considered of low consequence as the change is considered audible but there is no dwelling at this location.

4.2.2.4 Planned Development Case

Based on the nature of sound and past experience with similar projects, noise from industrial developments will typically attenuate to below background noise levels within 5 km of an activity (EnCana 2007). There are no planned energy-related developments within 5 km of the 1.5 km ERCB criteria boundary so there are no additional measurements or predictions that could be included in a future noise effects analysis. Therefore, the PDC does not differ from the Project Case and a separate PDC assessment was not completed for the Project.

4.2.3 Human Health

4.2.3.1 Conclusions

Overall, the Project is not expected to appreciably increase the risk of adverse health effects in the region. For all Chemicals of Potential Concern (COPCs), there are negligible changes between the predicted health risks under the EAC and the Project Case. Similarly, cumulative health risks associated with the Project in combination with other planned projects and activities are not expected to result in measurable health effects in the region. The changes between the predicted health risks under the EAC and PDC are generally small.

4.2.3.2 Short-Term Effects

Inhalation health risks associated with the Project air emissions on a short-term basis were evaluated by comparing maximum predicted acute or short-term air concentrations with health-based regulatory guidelines considered protective of the most sensitive individuals. With one exception, predicted acute Risk

Quotient (RQ) values did not exceed 1.0 for any of the individual COPCs and chemical mixtures under any of the three assessment cases (i.e., EAC, Project Case and PDC). This demonstrates that in most cases, predicted COPC air concentrations were less than their health-based guidelines and that the additive interactions of the COPCs are not predicted to result in health-related impacts. Therefore, health risks for these COPCs and mixtures are considered negligible.

The one possible exception involves the potential exposure of persons to maximum SO_2 concentrations along the Project fence-line. Although the predicted RQ values for the Project Case and PDC exceeded 1.0 for transient persons, the weight-of-evidence suggests that there is a low potential for health effects to occur as a result of SO_2 emissions.

4.2.3.3 Long-Term Effects

Inhalation

Inhalation health risks associated with the Project air emissions on a long-term basis were evaluated by comparing maximum predicted chronic or long-term air concentrations with health-based regulatory guidelines considered protective of the most sensitive individuals.

Predicted chronic RQ values for non-carcinogens did not exceed 1.0 for any of the individual COPCs and chemical mixtures under any of the three assessment cases (i.e., EAC, Project Case and PDC). This demonstrates that predicted COPC air concentrations were less than their health-based guidelines and the additive interactions of the COPCs are not predicted to result in health-related impacts. Therefore, health risks for these COPCs and mixtures are considered negligible.

For the carcinogens, maximum predicted Incremental Lifetime Cancer Risk (ILCR) values associated with the Project (i.e., Project Case minus EAC) and Future Emission Sources in the area (i.e., PDC minus EAC) are all less than 1:100,000 indicating that the incremental cancer risk from the Project and planned development is deemed to be "essentially negligible" (Health Canada 2004).

Multiple Pathways

Health risks associated with multiple pathways of exposure (i.e., inhalation, ingestion and dermal contact) were predicted by comparing exposure estimates with health-based oral guidelines.

In most cases, the RQ values for the non-carcinogenic COPCs and mixtures did not exceed 1.0 under the three assessment cases. The exceptions include manganese, methyl mercury, zinc, the haematological toxicants mixture, the neurotoxicants mixture and the reproductive/developmental toxicants mixture. For each of these COPCs and mixtures, the potential health risks were dominated by the predicted risks for the EAC.

Given the negligible change in health risks between the EAC and the Project Case, the Project emissions are predicted to have minimal impact on the potential health risks associated with long-term exposure in the region.

For all carcinogenic COPCs, the predicted ILCR values associated with the Project (i.e., Project Case minus EAC) and the Future Emission Sources (i.e., PDC minus EAC) were all less than 1:100,000, indicating that the incremental cancer risk is deemed to be "essentially negligible" according to Health Canada protocol (Health Canada 2004). The LCR values greater than 1.0 were predicted for the Aboriginal and community residents in the EAC assessment for arsenic, carcinogenic PAH group 1 and the stomach carcinogens mixture. However, regulators have not recommended an acceptable cancer incidence rate (or LCR) for exposure to carcinogens associated with background or "baseline" conditions. Given that an acceptable "benchmark" cancer risk level for exposure to background levels of carcinogens is not available for comparison, the "acceptability" of the potential lifetime cancer risk from a public health perspective cannot be determined following a conventional approach.

Overall, health risks in the region associated with multiple pathways of exposure to the COPCs and mixtures are considered negligible, or low in the case of arsenic, carcinogenic PAH group 1, manganese, methyl mercury, zinc, haematological toxicants, neurotoxicants, reproductive/developmental toxicants and stomach carcinogens.

4.2.4 Air Emission Effects

The air emissions effects on ecological receptors assessment considered potential effects of air emissions to aquatic and terrestrial resources. The air emissions were predicted within the air quality modelling domain (Volume 3, Section 1.2). Aquatic resources were assessed within waterbodies in the air quality modelling domain. Terrestrial resources were assessed within the Terrestrial Resources RSA.

4.2.4.1 Conclusions

Emissions from the Project were not predicted to result in additional exceedances of the critical load under the Project Case. Project-related increases in acid deposition to lakes with exceedances under the EAC were small (less than 0.6%). Therefore, emissions from the Project were predicted to have a negligible potential to affect water quality or aquatic life in regional lakes.

One additional lake 152 (P7) is predicted to exceed the critical load under the PDC. All of the lakes predicted to potentially exceed critical loads under the PDC (and the EAC) are outside of the Air Quality RSA and over 60 km away from the Project. The Project contribution to effects at this distance is negligible.

The increase in regional emissions due to the Project and subsequent changes in snowmelt pH were predicted to be too small to result in a measurable change in episodic stream acidification under the EAC. Under the PDC, the weight of evidence suggests that episodic stream acidification is unlikely.

There are no soil critical load exceedances under the Project Case or PDC. Without any soil critical load exceedances, there are no potential effects from acidifying emissions to terrestrial resources predicted.

The SO_2, NO_2 and nitrogen deposition isopleths relevant to the assessment of terrestrial vegetation and wetlands, and for wildlife habitat are localized over the Project and other developments in the RSA. There are no appreciable increases in the size of the isopleths from the EAC to the Project Case or PDC. All increases are small resulting in negligible environmental consequences.

The area above the 0.25 keq N/ha/yr is localized over the Central Plant and Plants 3A and 3B (and other planned developments in the PDC) and will have a negligible effect on vegetated areas under both the Project Case and PDC.

The project is predicted to increase ozone precursor emissions by less than 5% in the Air Quality RSA and modelling domain (Section 1.8.3, Table 1.8-22), which is too small to result in a measurable change in ground-level ozone concentrations. Under these conditions, the effect of ozone on terrestrial vegetation and wetlands is considered negligible.

4.2.4.2 Existing and Approved Case

Under the EAC, lake net PAI was above the lake-specific critical loads for 21 of the 416 lakes included in the assessment. The background lake net PAI was above the critical load for 18 of these lakes. These results suggest that a small number of lakes in the Oil Sands Region may be at risk of acidification under the EAC and under background conditions.

For the EAC, the isopleths that would be used as the basis for assessment are scattered and localized in the Terrestrial RSA. These isopleths are discontinuous and represent a very localized and small area directly associated with other in-situ projects. Within the 1,538,591 ha terrestrial RSA, the soil net PAI 0.17 keq/ha/yr isopleths for the EAC case extend over 195 ha of vegetation and 259 ha in total area (including disturbances), which is less than 1% of the terrestrial RSA. Within this area, there are no exceedances of soil critical loads for the EAC.

4.2.4.3 Project Case

Emissions from the Project were not predicted to result in additional exceedances of the critical load under the Project Case. Project-related increases in acid deposition to lakes with exceedances under the EAC were small (less than 0.6%). Therefore, emissions from the Project were predicted to have a negligible potential to affect water quality or aquatic life in regional lakes.

The increase in regional emissions due to the Project and subsequent changes in snowmelt pH were predicted to be too small to result in a measurable change in episodic stream acidification under the EAC.

There are no soil critical load exceedances under the Project Case. Without any soil critical load exceedances, there are not considered to be any potential effects from acidifying emissions to terrestrial resources.

The SO_2, NO_2 and nitrogen deposition isopleths relevant to the assessment of terrestrial vegetation and wetlands, and for wildlife habitat are localized over the Project and other developments in the RSA. There are no appreciable increases in the size of the isopleths from the EAC to the Project Case or PDC. All increases are small, resulting in negligible environmental consequences.

The area above the 0.25 keq N/ha/yr is localized over the Central Plant and Plants 3A and 3B (and other planned developments in the PDC) and will have a negligible effect on vegetated areas under both the Project Case and PDC.

The project is predicted to increase ozone precursor emissions by less than 5% in the Air Quality RSA and modelling domain (Volume 3, Section 1.2), which is too small to result in a measurable change in ground-level ozone concentrations. Under these conditions, the effect of ozone on terrestrial vegetation and wetlands is likely negligible.

4.2.4.4 Planned Development Case

Lake 152 (P7) is predicted to exceed the critical load under the PDC. All of the lakes predicted to potentially exceed critical loads under the PDC (and the EAC) are within the RSA and over 60 km away from the Project. The Project contribution to effects at this distance is negligible.

The weight of evidence suggests that episodic stream acidification is unlikely under the PDC.

4.2.5 Aquatic Resources

The assessment of Aquatic Resources has been subdivided into four components:

- Hydrogeology;
- Hydrology;
- Water Quality; and
- Fish and Fish Habitat.

There is considerable interdependency among these components on both the local and regional scale. The Aquatic Resources models and descriptions used in this EIA build upon previous environmental studies conducted in the region, including EIAs for oil sands developments and other environmental studies.

4.2.5.1 Hydrogeology

Conclusions

The hydrogeology assessment supports the following conclusions regarding potential effects to aquifers/water sands as a result of Project related activities:

- Groundwater withdrawals associated with Project make-up water demands are predicted to not adversely affect groundwater users. Drawdown in the Middle Clearwater, Upper Clearwater, and Lower

Grand Rapids water sands is interpreted to result in a long-term, low-magnitude, reversible negative effect.

- Utility water withdrawal from the Empress Channel Aquifer is predicted to result in less than 3 m of drawdown and represents a 2% decrease in productivity. An effect of this magnitude would likely be undetectable.
- Utility water withdrawal from the Empress Terrace Aquifer is not predicted to negatively affect the groundwater use of other local or regional groundwater users. Utility water withdrawal is not anticipated to affect the near surface water table because approximately 100 m of low permeability Overburden Aquifer/Aquitard sediments separate the aquifer from the near surface water table.
- With respect to water levels, wastewater disposal into the McMurray water sand is predicted to increase water sand productivity in the LSA. Increased water levels in the McMurray water sand are interpreted to result in a long-term, low-magnitude, reversible positive effect.
- Based on the results of the PDC simulations, groundwater withdrawal and wastewater injection for Planned and Publicly disclosed projects should not affect the feasibility of the Project to withdraw water from the Empress Terrace Aquifer, Empress Channel Aquifer and Upper Clearwater water sand or dispose wastewater into the McMurray water sand.
- Based on the results of the Project Case and PDC simulations, Project related groundwater withdrawal and disposal will not limit the feasibility of PDC projects in the RSA.
- Project related groundwater withdrawal is not predicted to result in detectable drawdown in the near surface water table.
- Wastewater disposal in the McMurray water sand is not predicted to affect groundwater quality in any other aquifers/water sands and will not affect surface water quality.
- Due in part to the mitigative measures incorporated into the project description and the proposed monitoring program, Project operation of surface facilities is not predicted to affect shallow groundwater quality. Groundwater will be monitored to provide early detection of any accidental releases to the environment that may occur.
- Steam injection is predicted to create heat plumes in overburden and bedrock aquifers/water sands up to 325 m downgradient of the SAGD well bores. An increased temperature in the aquifers/water sands is interpreted to be a negative effect to groundwater quality because of the possibility to alter mineral concentrations in the groundwater. The heat plumes are interpreted to represent a mid-term, high-magnitude, reversible negative effect. Given the small distance heat plumes migrate from the SAGD well bores, the effect will not negatively affect other groundwater users.

Existing and Approved Case

The Hydrogeology RSA is located within the Athabasca River Watershed. Surface elevations across the RSA range from less than 300 metres above sea level (masl) at the confluence of the Athabasca and Clearwater rivers to greater than 800 masl in the May Hills. The Project occurs within the Christina Lake Plain subdivision of the Mostoos Hills Upland Physiographic Region. Topography in the Christina Lake Plain varies from less than 520 to greater than 610 masl across the LSA.

Unconformably overlying the Precambrian basement in the LSA is Devonian and Cretaceous bedrock. The Devonian and Cretaceous sediments are separated by the Pre-Cretaceous Unconformity. Devonian bedrock includes the Elk Point Group and Beaverhill Lake Group. The overlying Cretaceous sediments include the Mannville Group (McMurray, Clearwater and Grand Rapids Formations) and the Colorado Group (Joli Fou, Viking and LaBiche Formations). Unconformably overlying the Cretaceous sediments is unconsolidated Tertiary and Quaternary deposits of the Empress, Bronson Lake, Muriel Lake, Bonnyville, Ethel Lake, Marie Creek, Sand River and Grand Centre Formations.

The stratigraphic column for the region was divided into a hydrostratigraphic interpretation of aquifers/water sands and aquitards. Aquifers/water sands in the Hydrogeology LSA that are proposed for groundwater withdrawal or wastewater disposal for the Project include the Ethel Lake Aquifer, Empress Terrace Aquifer, Empress Channel Aquifer, Upper Clearwater water sand and McMurray water sand. Other important water sands in the LSA that are not targeted as candidate water sands for the Project include the Lower Grand Rapids water sand and the Middle Clearwater water sand.

Regional groundwater flow in the overburden sediments and the Upper Cretaceous bedrock generally reflect topography with groundwater flow directed away from upland areas such as the Stony Mountain Uplands and the Mostoos Hills Upland toward topographic lows such as the Clearwater and Athabasca river valleys.

Vertical gradients within the Quaternary, Tertiary and Cretaceous sediments suggest a downward directed flow potential from ground surface to Devonian bedrock throughout most of the Hydrogeology RSA. Horizontal groundwater flow in the lowermost Cretaceous Period sediments are therefore influenced by the permeability of the underlying Devonian bedrock. Groundwater flow within the Mannville on the east side of the RSA flows east and ultimately drains to the underlying Keg River Aquifer, groundwater on the west side of the RSA flows west and ultimately drains to the Grosmont Aquifer.

Total Dissolved Solids (TDS) concentrations of groundwater generally increase with depth. Within the LSA TDS values are measured to range from 100 mg/L in the Undifferentiated Overburden up to 17,000 mg/L in the Lower Clearwater water sand. Anions and cations are also observed to evolve with depth from a meteoric-type water (calcium-bicarbonate) to formation water reflecting marine origin (sodium-chloride). The relationship between TDS, hydrochemical composition and depth is interpreted to predominantly be a function of horizontal and vertical groundwater flow patterns acting to mix meteoric water with deeper original formation water.

Groundwater withdrawal and wastewater disposal rates for projects in the RSA were compiled, sorted by hydrostratigraphic unit, and summarised over time. Industrial users nearest to the Project are EnCana Christina Lake and Devon Jackfish. According to the Alberta Environment Groundwater Information Centre (GIC) database in October 2007, there are 74 drilling records registered within the Hydrogeology LSA. These records include 44 existing or potential water wells. A field survey was conducted to verify water wells located within the MEG CLRP lease area. Of the eleven existing or potential water wells in the MEG CLRP lease area, ten were verified.

Project Case

The groundwater withdrawal and wastewater disposal rates associated with the CLRP Phases 1, 2 and 2B and the proposed Phase 3 are included in Table 4.2-6.

Table 4.2-6 Summary of Groundwater Withdrawal and Wastewater Disposal Rates for CLRP Phases 1, 2 and 2B and the Project

Descriptions	CLRP Phase 1, 2, and 2B [m^3/d]	CLRP Phase 3 [m^3/d]	CLRP Total [m^3/d]
utility water withdrawal	435 (Ethel Lake Aquifer)	1,088 (Empress Channel and Empress Terrace aquifers)	1,523
makeup water withdrawal (Upper Clearwater water sand)	2,672	6,678	9,350
wastewater disposal (McMurray water sand)	2,614	6,536	9,150

Groundwater withdrawals associated with Project make-up water demands are not predicted to adversely affect groundwater users. Drawdown in the Middle Clearwater, Upper Clearwater, and Lower Grand Rapids water sands is interpreted to result in a long-term, low-magnitude, reversible negative effect.

Utility water withdrawal from the Empress Channel Aquifer is predicted to result in less than 3 m of drawdown and represents a 2% decrease in aquifer productivity. An effect of this magnitude would likely be undetectable.

Utility water withdrawal from the Empress Terrace Aquifer is not predicted to negatively affect the groundwater use of other local or regional groundwater users. Utility water use is not anticipated to affect the near surface water table because approximately 100 m of low permeability Overburden Aquifer/Aquitard sediments separate the aquifer from the near surface water table.

Wastewater disposal into the McMurray water sand is predicted to increase water sand productivity in the LSA. Increased water levels in the McMurray water sand are interpreted to result in a long-term, low-magnitude, reversible positive effect.

Wastewater disposal in the McMurray water sand is not predicted to affect groundwater quality in any other aquifers/water sands.

Due in part to the mitigative measures incorporated into the Project description and the proposed monitoring program, project operation of surface facilities is not predicted to effect shallow groundwater quality. Groundwater will be monitored to provide early detection of any accidental releases to the environment that may occur.

Steam injection is predicted to create heat plumes in overburden and bedrock aquifers/water sands up to 325 m downgradient of the SAGD well bores. An increased temperature in the aquifers/water sands is interpreted to be a negative effect to groundwater quality because of the possibility to alter mineral concentrations in the groundwater. The heat plumes are interpreted to represent a mid-term, high-magnitude, reversible negative effect. Given the small distance heat plumes migrate from the SAGD well bores, the effect will not negatively affect other groundwater users.

Planned Development Case

Based on the results of the PDC simulations, groundwater withdrawal and wastewater injection for planned and publicly disclosed projects should not affect the feasibility of the Project to withdraw water from the Empress Terrace Aquifer, Empress Channel Aquifer and Upper Clearwater water sand or dispose wastewater into the McMurray water sand.

Based on the results of the Project Case and PDC simulations, Project-related groundwater withdrawal and disposal will not limit the feasibility of PDC projects in the RSA.

4.2.5.2 Hydrology

Conclusions

Hydrology assessment supports the following conclusions regarding potential effects to open water areas, water levels, flows, geomorphic conditions, and sediment concentrations in receiving stream as a result of Project related activities.

- Due to mitigation measures, peak flows are not expected to change significantly due to surface disturbances in the LSA. Runoff from the wellpads and plant sites will be retained in ditches and ponds and released at a controlled rate to the receiving waters. Areas disturbed by roads and pipelines will cause some increases in runoff in the immediate vicinity of the disturbance but the increase will be negligible.
- The annual predicted increase in runoff in the LSA due to the Project is less than 10% compared to the EAC. It is expected that the effects of these increases can be mitigated by flow detention measures and erosion control measures in local receiving streams.
- The predicted average annual increase in runoff due to the Project at the outlet of Christina Lake will be about 2%. This relatively small change is not expected to have a significant impact on the Jackfish River.
- The mitigation measures will ensure that Project facilities will have minimal effects on sediment yields and suspended sediment concentrations in receiving streams, lakes, ponds, wetlands and peatlands.
- Any increased sediment runoff from access roads and pipeline corridors will be dispersed and filtered by the adjacent upland and muskeg terrain. This will result in negligible impacts on the sediment concentrations in receiving streams.

Existing and Approved Case

Climate variables characterized in the Hydrology Baseline study include air temperature, precipitation, evaporation and evapotranspiration because these are the primary factors affecting the baseline hydrology. The main source of the climate data is the Environment Canada Atmospheric Environment Service. Hydrologic variables characterized in this baseline study include stream flows, lake water levels, basin water yields and basin sediment yields. The records for the stream flow and lake level monitoring stations, operated by the Water Survey of Canada (WSC), were the primary source of hydrologic data.

The key mean annual climate and hydrology parameters estimated for the LSA and RSA are as follows:

- air temperature (LSA): 0.33°C;
- air temperature (RSA): 0.01°C;
- precipitation (LSA): 473 mm;
- precipitation (RSA): 493 mm;
- runoff (LSA): 66 mm;
- runoff (RSA): 68 mm;
- lake evaporation (LSA and RSA): 597 mm;
- evapotranspiration (LSA and RSA): 325 mm; and
- basin sediment yield (LSA and RSA): 0.008 to 0.18 mm.

Project Case

Due to the mitigation measures, peak flows are not expected to change significantly due to surface disturbances in the LSA. Runoff from the wellpads and plant sites will be retained in ditches and ponds and released at a controlled rate to the receiving waters. Areas disturbed by roads and pipelines will cause some increases in runoff in the immediate vicinity of the disturbance but the increase will be negligible.

The annual predicted increase in runoff in the LSA due to the Project is less than 10% compared to the EAC. It is expected that the effects of these increases can be mitigated by flow detention measures and erosion control measures in local receiving streams.

The predicted average annual increase in runoff due to the Project at the outlet of Christina Lake will be about 2%. This relatively small change is not expected to have a significant impact on the Jackfish River.

The mitigation measures will ensure that Project facilities will have minimal effects on sediment yields and suspended sediment concentrations in receiving streams, lakes, ponds, wetlands and peatlands.

Any increased sediment runoff from access roads and pipeline corridors will be dispersed and filtered by the adjacent upland and muskeg terrain. This will result in negligible impacts on the sediment concentrations in receiving streams.

Planned Development Case

The Project Case determined that the effects on flows and water levels in rivers and streams and on the water balance of lakes would be very small and localized. Considering the small effects determined in the Project Case and that the addition of a limited number of developments within the LSA under the PDC, the Project is not expected to contribute further to effects for the PDC on rivers, streams and lakes in the LSA or the RSA.

4.2.5.3 Water Quality

Conclusions

Sediment-associated chemical inputs from stormwater ponds associated with surface water runoff and potential spills related to the operation of surface facilities were the only valid pathways linking Project-related activities to water quality effects. The potential effects of air emissions on water quality are evaluated in Volume 3, Section 4.

The Water Quality assessment conclusions are summarized below:

- All site facilities and associated pipelines will be constructed to comply with all regulatory guidelines and practices, which are anticipated to minimize the potential for spills. Pipelines and storage areas will be inspected and maintained on a routine basis. Emergency spill procedures will be in place for rapid spill containment and clean-up. Therefore potential effects on water quality from spills will be minimized.
- Treated domestic wastewaters will be recycled as non-potable water for a variety of uses for the Project whenever possible. Discharge to wetlands is expected to occur occasionally. Nutrients are expected to be consumed and dissolved organics degraded before the effluent will reach any surface waters outside the wetlands receiving the discharge. Therefore, no effects are expected from treated wastewater releases n water quality of nearby waterbodies and watercourses.
- Predicted groundwater withdrawals and changes in runoff quantities by the Project will not result in changes to stream flows and lake levels. Therefore changes to water quality are not expected.

- Based on the anticipated management of runoff and controlled release rates, no effects are anticipated on water quality from sediment-associated chemical inputs.

Existing and Approved Case

Water quality data from waterbodies and watercourses in the Project area were summarized to characterize pre-development baseline water quality. Samples were collected from 17 waterbodies and nine watercourses including Christina Lake, Winefred Lake, Winefred River, seven unnamed waterbodies and eight unnamed watercourses. Samples were analyzed for a detailed list of water quality parameters. Samples from eight other unnamed waterbodies were analyzed to evaluate acid sensitivity. Historical data from Christina Lake, Winefred Lake and the Christina River were used to supplement data collected during these baseline surveys.

Waterbodies and watercourses in the LSA and the RSA generally have high concentrations of humic material originating from surrounding muskeg and peat bogs, resulting in elevated colour values. Concentrations of Total Suspended Solids (TSS) are usually low in these waters. Major ion concentrations are generally low to moderately low as indicated by conductivity values and total dissolved solids concentrations. These waters are often soft, but have alkalinity levels indicating that they are not sensitive to acid deposition. Nutrient concentrations are variable indicating the trophic status of waterbodies and watercourses likely range from oligotrophic to eutrophic.

Metal concentrations were generally below guidelines, with the exception of total iron and manganese, both of which often had concentrations above aesthetic human health guidelines. Occasionally, total chromium, copper, iron, thallium, aluminum, silver and zinc concentrations were greater than guidelines for protection of aquatic life. Concentrations of organic compounds were usually below detection limits; however, summer and fall concentrations of total phenolics were often greater than the aquatic life guideline. These exceedances can be attributed to natural factors and do not indicate that water quality has been compromised.

Some seasonal variability was observed in the waterbodies sampled, although the available data are insufficient for a detailed assessment of seasonal patterns in water quality. Dissolved oxygen concentrations were lower during spring and pH values were slightly elevated in the summer and fall. Conductivity values measured during spring were generally higher than summer and fall values. Based on this limited data set, it was not possible to detect any seasonal trends in the metal concentrations.

Project Case

Sediment-associated chemical inputs from stormwater ponds associated with surface water runoff and potential spills related to the operation of surface facilities were the only valid pathways linking Project-related activities to water quality effects. The potential effects of air emissions on water quality are evaluated in Volume 3, Section 4.

Treated domestic wastewaters will be recycled as non-potable water for a variety of uses for the Project whenever possible. Discharge to wetlands is expected to occur occasionally. Nutrients are expected to be consumed and dissolved organics degraded before the effluent will reach any surface waters outside the wetlands receiving the discharge. Therefore, no effects are expected from treated wastewater releases n water quality of nearby waterbodies and watercourses.

Predicted groundwater withdrawals and changes in runoff quantities by the Project will not result in changes to stream flows and lake levels. Therefore changes to water quality are not expected.

Based on the anticipated management of runoff and controlled release rates, no effects are anticipated on water quality from sediment-associated chemical inputs.

Planned Development Case

The PDC assessment was completed in consideration of only those effects pathways that were found valid in the assessment of the Project Case and where a potential interaction with one or more planned developments in combination with other existing and approved developments could occur.

The classification of effects for the Project Case indicated potential effects to water quality would be negligible. Consequently, none of the effects from the Project were considered to operate cumulatively with predicted effects from other developments for water quality. Therefore, the results of the PDC assessment are identical to those for the Project Case Assessment.

4.2.5.4 Fish and Fish Habitat

Conclusions

The potential effects of the Project on Fish and Fish Habitat were evaluated by considering potential changes to fish habitat, fish health, fish abundance and fish habitat diversity.

The potential pathways linking Project activities to fish habitat effects are: changes in water levels and stream flows; changes in channel regime or geomorphic conditions; changes in water quality conditions; changes in the accessibility of watercourses; and watercourse crossing construction. Potential effects of the Project on fish and fish habitat were evaluated by taking into account the results of the Hydrogeology, Hydrology and Water Quality assessments. The linkage between changes in stream flows and fish habitat was considered to be valid for the Jackfish River at the outlet of Christina Lake; the direction of the effect was considered neutral. Direct changes to habitat, increased sediment deposition, and changes in benthic invertebrate communities were considered to be valid linkages for watercourse crossing construction; the direction of the effect was considered to be negative and negligible in magnitude. All other changes to fish habitat pathways identified in the linkage analysis were considered to be invalid.

The potential pathways linking Project activities to fish health effects are: increased suspended sediment; spills; chemical inputs from surface runoff and/or wastewater discharge; and acidification due to air emissions. For each identified pathway, the linkage was not considered to be valid.

The potential pathways linking Project activities to changes in fish abundance are changes in fish habitat, water quality or fishing pressure. The assessment concluded that there are no effects on fish habitat or water quality based on the identified linkages. The pathway for increased fishing pressure was also not considered to be a valid linkage.

The potential pathways linking Project activities to changes in fish and fish habitat diversity are changes in fish habitat, fish health and fish abundance. The assessment predicted no potential effects on fish habitat, fish health and fish abundance based on the linkages identified.

Existing and Approved Case

Christina Lake

Christina Lake was rated as providing moderate to high potential for spawning, nursery, rearing, feeding and overwintering for sport fish, suckers and forage fish. Christina Lake has historically been a high quality sport fishing destination, with walleye and pike being the primarily targeted species. Christina Lake contains habitats that would be considered critical or sensitive, including known spawning sites for walleye, and suspected spawning sites for lake whitefish, cisco, burbot and white sucker. Arctic grayling is listed as a sensitive species (ASRD 2005) and may use the lake for overwintering, nursery, rearing and feeding. The overall diversity of fish and fish habitat in Christina Lake was ranked as high.

Winefred River

The habitat use potential for sport fish and suckers at Site WC 5-07 was rated high for rearing and feeding, and moderate for spawning and overwintering. The habitat use potential for forage fish species was rated high for all life stages. The overall diversity ranking for Winefred River was moderate.

“Sawbones Creek”

The habitat use potential for spawning, nursery, rearing and feeding in “Sawbones Creek” ranged from negligible to low to moderate for sport fish and suckers, with the highest habitat suitability found in the lower reaches. The habitat use potential for sport fish and sucker overwintering ranged from nil to low; the 2004 winter field survey indicated that overwintering habitat within “Sawbones Creek” was primarily limited to the lower reaches. For forage fish, the habitat use potential in all reaches of “Sawbones Creek” was considered to moderate to high for spawning, nursery, feeding and rearing, and low to moderate for overwintering.

The lower reach of “Sawbones Creek” contains habitats that would be considered critical or sensitive, including spawning sites for walleye and northern pike. This watercourse, and especially the bay into which it flows (“Sawbones Bay”), are known to provide spawning habitat for walleye in the spring. This lower reach also likely provides nursery, feeding and rearing habitat for these species, as well as white sucker. The overall diversity of fish and fish habitat for “Sawbones Creek” was ranked as low.

Unnamed Waterbodies

Fifteen unnamed waterbodies were assessed for fish and fish habitat. The waterbodies ranged in size from 3.7 to 271 ha. Most of the waterbodies were relatively shallow (i.e., less than 2.5 m in maximum depth), with the exception of four waterbodies that had maximum depths that ranged from 3 to 4.1 m (WB 1-07, WB 2-04, WB 5-04 and WB 11-04).

The unnamed waterbodies were assessed as having nil to moderate habitat use potential for spawning, nursery, rearing and feeding for sport, sucker and forage fish species. Overwintering habitat was limited in all waterbodies, i.e., nil to low for sport fish and suckers, and low to moderate for forage fish species (species tolerant of low dissolved oxygen concentration). All of the unnamed waterbodies assessed had overall diversity ratings of very low to low.

Unnamed Tributary to the East Shore of Christina Lake

The habitat use potential in the unnamed tributary to the east shore of Christina Lake for spawning, nursery, rearing and feeding ranged from nil–low to moderate for sport fish and suckers, with the highest habitat suitability found in the middle (Site WC 7-04) and upper (Site WC 10-04) reaches. The habitat use potential for overwintering ranged from nil–low to low for sport fish and suckers. For forage fish, the habitat use potential in all reaches of the unnamed tributary to the east shore of Christina Lake was considered moderate to high for spawning, nursery, feeding and rearing and low to moderate for overwintering. The overall diversity of fish and fish habitat was ranked as very low.

Unnamed Watercourses

Seven unnamed watercourses were assessed within the LSA. With the exception of WC 2-07 that was characterized by the absence of a defined bed and banks, all of the unnamed watercourses were relatively uniform, with low-gradient channels. One site (WC 1-07) was a tributary to Bohn Lake, three sites (WC 2-07, WC 14-04 and WC 15-04) were tributaries to Christina River, two sites (WC 3-07 and WC 4-07) were tributaries to an unnamed waterbody, and the other site (WC 6-07) was a tributary to Winefred Lake.

At several of the unnamed watercourses (WC 1-07, WC 3-07, and WC 4-07) habitat use potential for sport fish species, such as northern pike, was rated as high for rearing and feeding, moderate for spawning and nil to low for overwintering. Generally, the habitat use potential for sucker species was rated as moderate for rearing and feeding, nil for spawning and nil to low for overwintering, with the exception of WC 2-07, WC 14-04 and WC 15-04. Similarly, habitat use potential for forage fish species was moderate to high for spawning, nursery, rearing and feeding and low for overwintering, with the exception of WC 2-07, WC 14-04 and WC 15-04. Habitat use potential at WC 2-07, WC 14-04 and WC 15-04 was rated as nil to low for sport fish, suckers and forage fish species.

Benthic Invertebrates

Overall, benthic invertebrate abundances in streams and rivers were variable, ranging from high (more than 50,000 organisms/m^2) to low (less than 5,000 organisms/m^2) in the upstream reach of the Christina River during the first four years (2002 through 2005) of the Regional Aquatics Monitoring Program. Mean richness was low to moderate during these surveys. Depositional sites in the Christina River were generally dominated by midges, ostracods and tubificid worms (Oligochaeta: Tubificidae). Depositional sites in tributaries to Christina Lake were characterized by moderate benthic invertebrate abundances and moderate taxonomic richness. Common taxa were ostracods, fingernail clams (Sphaeriidae), snails (Gastropoda) and midge larvae.

Benthic invertebrates were sampled at two sites in Christina Lake, three unnamed waterbodies and two watercourse sites in the unnamed tributaries to Christina Lake. Mean total abundance and richness were higher in the unnamed tributaries than in Christina Lake and the unnamed waterbodies. Ostracods and roundworms were the dominant groups in Christina Lake, while fingernail clams, amphipods, oligochaete worms and midges were the dominant groups in the unnamed waterbodies. Dominant groups found in the unnamed tributaries included ostracods, fingernail clams, and snails. Sampling conducted in Christina Lake in 1969 indicated that midge larvae dominated the benthic community, while the 2004 sampling conducted in the lake showed ostracods and roundworms to be the dominant groups, with midges occupying second or third place in terms of abundance and percent composition. Differences in sampling methods may have contributed to these differences.

Benthic invertebrates were sampled at two unnamed waterbodies (WB 2-07 and WB 3-07), Winefred Lake, an unnamed watercourse (WC 4-07) and the Winefred River. Mean total abundance and richness values were higher in the watercourses than in the waterbodies. Midges, fingernail clams and amphipods, were the dominant groups in the unnamed waterbodies; amphipods and midges were the dominant groups identified from Winefred Lake. Ostracods were the dominant invertebrates in the unnamed watercourse samples, followed by midges; EPT (Ephemeroptera, Plecoptera and Trichoptera) taxa, dominated by mayflies (Ephemeroptera), were the dominant groups at the Winefred River site, followed by midge larvae.

Project Case

The potential effects of the Project on Fish and Fish Habitat were evaluated by considering potential changes to fish habitat, fish health, fish abundance and fish habitat diversity.

The potential pathways linking Project activities to fish habitat effects are: changes in water levels and stream flows; changes in channel regime or geomorphic conditions; changes in water quality conditions; changes in the accessibility of watercourses and watercourse crossing construction. Potential effects of the Project on fish and fish habitat were evaluated by taking into account the results of the Hydrogeology, Hydrology and Water Quality assessments. The linkage between changes in stream flows and fish habitat was considered to be valid for the Jackfish River at the outlet of Christina Lake; the direction of the effect was considered neutral. Direct changes to habitat, increased sediment deposition, and changes in benthic invertebrate communities were considered to be valid linkages for watercourse crossing construction; the direction of the effect was considered to be negative and negligible in magnitude. All other changes to fish habitat pathways identified in the linkage analysis were considered to be invalid.

The potential pathways linking Project activities to fish health effects are: increased suspended sediment; spills, chemical inputs from surface runoff and/or wastewater discharge; and acidification due to air emissions. For each identified pathway, the linkage was not considered to be valid.

The potential pathways linking Project activities to changes in fish abundance are changes in fish habitat, water quality or fishing pressure. The assessment concluded that there are no effects on fish habitat or water quality based on the identified linkages. The pathway for increased fishing pressure was also not considered to be a valid linkage.

The potential pathways linking Project activities to changes in fish and fish habitat diversity are changes in fish habitat, fish health and fish abundance. The assessment predicted no potential effects on fish habitat, fish health and fish abundance based on the linkages identified.

Planned Development Case

Cumulative effects can only be evaluated with respect to potential effects from other developments that are predicted to overlap in time and space with potential residual impacts from the Project. The results of the Project Case assessment indicate that there were no overall environmental consequences of any potential impacts on fish habitat, fish health, fish abundance and fish and fish habitat diversity from the Project.

Consequently, none of the effects from the Project were considered to operate cumulatively with effects from other developments for fish and fish habitat. Therefore, the results of the PDC assessment are expected to be the same as under the Project Case.

4.2.6 Terrestrial Resources

The assessment of potential effects of the Project and planned developments on Terrestrial Resources considers the impacts of four specific components in the Terrestrial study areas:

- Soil and Terrain;
- Terrestrial Vegetation, Wetlands and Forestry;
- Wildlife; and
- Biodiversity.

These individual component assessments were then considered in an integrated fashion to evaluate effects on Terrestrial Resources as a whole. This section provides the conclusions of the assessments, with detailed information presented on those Terrestrial Resources components where low, moderate or high environmental consequences were predicted as a result of the Project and planned developments. In addition, a listing is made where negligible impacts were predicted on Terrestrial Resources components.

4.2.6.1 Soil and Terrain

Conclusions

Potential changes to land capability were rated as having a negligible environmental consequence, positive direction since an equivalent land capability for forestry is predicted to be returned following reclamation. Loss/alteration of organic soil units was rated as a low environmental consequence (negative direction) due to the loss of organic soil (748 ha, 2% of the LSA). Loss/alteration of mineral soil units was rated as a negligible environmental consequence (positive direction) due to the increase in mineral soils (728 ha, 2% of the LSA).

Existing and Approved Case

In the RSA, the most common soil parent material types were organic and mineral materials. The soil orders present on these parent materials included Organic, Luvisolic, Gleysolic and Brunisolic. Forest capability ratings ranged from Class 2 (high) on Luvisols developed on morainal materials to Class 5 (non-productive) in Organic soils developed on fens and bogs. Soil map unit specific critical loads related to acid deposition were presented for the RSA and show the 30 year mid-case critical load is the PAI load where there is predicted to be a 50% change from baseline conditions to either the base cation to aluminum ratio (BC:Al), base cation to hydrogen ratio (BC:H) or base saturation after 30 years of exposure.

Similar to the RSA, the LSA was dominated by organic and mineral parent materials. Mineral soils found in the LSA were Luvisols developed on both morainal and glaciofluvial material, Gleysols developed on morainal and glaciofluvial material and Brunisols, developed on glaciofluvial parent material. Glaciofluvial and morainal materials are the most dominant upland parent materials. Soil map units were mostly complexes of organic and mineral soils, reflecting the varied topography. The most common soil map units were McLelland organic soil map unit (13,220 ha, 38% of the LSA) and on uplands the Kinosis map unit (3,353 ha, 10% of the LSA). Due to the large extent of Organic soils, only 13% (4,760 ha) of the LSA was rated as suitable (moderate and low capability) for forestry (Classes 2 and 3), with the remainder being rated as either conditionally productive (Class 4; 6,547 ha, 19% of LSA) or non-productive (Class 5; 20,524 ha, 60% of LSA).

The mineral soils were rated generally as fair reclamation suitability and most mineral soils have a low risk to wind and water erosion. Soil series rated with a high wind erosion risk are Sutherland, Mildred and Winefred soils (3,503 ha or 10%) because of the coarse textured material. Mildred and Dover soil series are rated as having a moderate risk to water erosion and account for 2,928 ha or 9% of the LSA. The remainder of the LSA is rated as having low or negligible risk to wind and water erosion.

Project Case

The reconstructed landscape, developed as part of the reclamation process, has more uplands than the EAC. The indirect effects of terrain changes for the Project were assessed in other sections including vegetation, wildlife, hydrology and visual aesthetics.

The effects of the Project on soils were assessed for permanent loss of soils and changes in forest capability.

The environmental consequence was examined in the context of the LSA for the Project Case. Potential changes to land capability were rated as having a negligible environmental consequence, positive direction since an equivalent land capability for forestry is predicted to be returned following reclamation. Loss/alteration of organic soil units was rated as a low environmental consequence (negative direction) due to the loss of organic soil (748 ha, 2% of the LSA). Loss/alteration of mineral soil units was rated as a negligible environmental consequence (positive direction) due to the increase in mineral soils (728 ha, 2% of the LSA).

Planned Development Case

The PDC only examined negative direction low environmental consequences identified in the Project Case assessment. Results included organic soil loss, which was rated as a low environmental consequence (negative direction) due to the small area 4% of RSA that would be affected.

4.2.6.2 Terrestrial Vegetation, Wetlands and Forestry

Conclusions

Terrestrial vegetation and wetlands resources will primarily be affected through surface disturbances associated with construction of the Project, which will affect a total of 1,718 ha of previously undisturbed areas in the LSA. Progressive reclamation (e.g., of pipelines) will minimize the extent of the surface disturbances at any one time. Total disturbance in the RSA and LSA for both the EAC and Project Case are shown in Table 4.2-7. A breakdown of disturbance by Project component is provided in Table 4.2-8. Overall, the Project is predicted to have a low environmental consequence on terrestrial vegetation and wetlands in the LSA, as a result of construction, operation and reclamation activities and a negligible effect in the RSA.

Table 4.2-7 Total Disturbance Areas

	LSA [ha]	RSA [ha]
Existing and Approved Case	3,109	103,750
Project Case	4,827	105,438
Change Due to Project	1,718	1,688

Table 4.2-8 Project Components and Disturbance Areas

Project Component	Soil Disturbed [ha]	Vegetation Disturbed [ha]
plants and camps	232	232
wellpads	468	468
pipelines (above and below ground)	84	333
access roads and ROW	281	281
borrow areas	550	550
associated components (power supply, fuel gas pipelines, source and disposal wells)	41	164
Total Disturbance	**1,656**	**2,028**
Existing disturbances[a]	287	310
Net New Disturbance[b]	**1,369**	**1,718**

[a] Existing disturbances includes the activities completed on the development area prior to the development of the Project.

[b] Net new disturbance is the total disturbance minus the existing disturbance.

Existing and Approved Case

The RSA encompasses an area of 1,538,591 ha and is situated primarily within the Central Mixedwood, Lower Boreal Highlands and Dry Mixedwood natural subregions (Natural Regions Committee 2006). Of the total RSA area, 28% (424,953 ha) is classified as terrestrial and 41% (623,348 ha) as wetlands. Existing disturbances (i.e., urban areas, industrial development, roads, seismic lines, well sites and clearings) and cutblocks account for 103,750 ha (7%) of the RSA, while the remaining 386,540 ha (25%) of the RSA is classified as burn, lakes and rivers. The dominant vegetation class in the RSA is represented by the burn landcover class followed by the treed bog/poor fen.

Six Key Indicator Resources (KIRs) were identified and evaluated at the RSA level including: coniferous jackpine; riparian communities; peatlands; productive forest; rare plant potential and traditional plant potential. Riparian communities account for 7% (100,863 ha) of the RSA, while peatlands cover 623,348 ha (41%). There are 442,911 ha (29%) of potentially productive forest within the RSA. Areas of high rare plant potential within the RSA amount to 358,985 ha (23%) and there are 314,185 ha (20%) of high traditional plant potential areas.

The LSA is located within Townships 76 to 78, Ranges 4 to 6, west of the 4^{th} Meridian. The LSA falls completely within the Central Mixedwood Natural Subregion (Natural Regions Committee 2006). Wetlands occupy the largest portion of the LSA (18,814 ha or 55%), while terrestrial vegetation accounts for 27% (9,300 ha) of the LSA. Peatlands, (i.e., bogs and fens) are the predominant wetlands type found within the LSA (19,596 ha). Non-vegetated units represents 1,207 ha (4%) of the LSA, while existing disturbances account for 3,109 ha (9%).

In total, 589 vascular and non-vascular species (including epiphytes) were identified within the LSA. This includes 63 woody species (trees and shrubs), 173 forbs, 67 graminoids, 133 bryophytes, and 153 terrestrial lichens and epiphytes. Mean species richness for vascular plants was highest on dogwood balsam poplar-white spruce (e2), and wooded swamp (STNN) vegetation types. Of the wetlands vegetation types, the wooded fen with internal lawns and islands of forested peat plateau (FTNR) and shrubby swamp (SONS) had the highest number of bryophyte species. Mean terrestrial lichen and epiphytic species richness and diversity was highest in the dogwood balsam poplar-white spruce (e2) ecosite phase.

There were nine rare vascular plant species, twenty rare bryophyte species and 51 rare or unranked lichen species found within the LSA. The relatively high number of rare lichens documented within the LSA is partly because the distribution and abundance of lichen flora in Alberta is poorly known, especially in northern and eastern regions. Seven of the nine vascular plant species were located in wetlands, while the other two species were found in upland sites (lichen jack pine[a1], dogwood balsam poplar-white spruce [e2] and horsetail white spruce [f3] ecosite phases). The shrubby fen (FONS) supported the greatest number of rare plants. The majority of rare bryophytes were also found in wetlands, with the shrubby fen (FONS) wetlands type containing the greatest number of rare bryophytes. The treed bog (BTNN) wetlands type supported the highest number of rare or unranked lichen species, followed by the lichen jack pine (a1) ecosite phase, the Labrador tea–subhygric black spruce-jack pine (g1) ecosite phase and the treed fen (FTNN) wetlands type.

Seventeen non-native and native invasive species (or “weeds”) were found within the LSA. Three species were identified as noxious under the Alberta *Weed Control Act* and two others were classified as nuisance weeds. The remaining species were classed as other non-native or native invasive species. These species were mainly found to occur in natural clearings, open wetlands and disturbed sites, such as cutlines, wellsites and rights-of-way.

Nine KIRs were identified and evaluated at the LSA level including: lichen jackpine (a1) communities; riparian communities; old growth forests; peatlands; patterned fens; rare and special plant communities; productive forests; rare plant potential and traditional plant potential.

Riparian communities account for 4% of the LSA (1,327 ha) and are primarily comprised of wetlands vegetation units such as shrubby and wooded fens (FONS ad FTNN), as well as marshes (MONS, MONG). Peatlands are the dominant vegetation unit in the LSA, covering 19,596 ha (57%). Of these, patterned fens (FOPN and FTPN) represent 2% (609 ha) of the LSA. Within the LSA, there is 7,239 ha (21%) potentially productive forested land. Old growth forest accounts for 828 ha (2%) of the LSA and lichen jack pine stands encompass 1% (478 ha) of the LSA. There are 10,199 ha (30%) of high rare plant potential and 2,891 ha (8%) of high traditional plant potential within the LSA.

Project Case

The Terrestrial Vegetation, Wetlands and Forestry assessment for the effects of the Project considered changes in terrestrial plant community types, non-forested vegetation types and forestry, indirect effects of dust and all KIRs (i.e., lichen jack pine (a1) communities, wetlands including peatlands, patterned fens, riparian communities, productive forests, old growth forests, rare and special plant communities, rare plants and traditional use plants).

For the Project Case, the key effects on terrestrial vegetation, wetlands and forestry as determined for the Project include:

- loss of wetlands area (including peatlands);

- loss of patterned fens; and
- loss of old growth areas.

Losses to these resources in the LSA are considered to be of low environmental consequence because of the relatively small proportion being affected by the Project. Although the magnitude of loss is rated as low, the effects are considered to be long-term and irreversible. Peatlands are not currently reclaimable; adaptive management and ongoing research will guide MEG towards the best reclamation practices. Old growth may re-establish on reclaimed land, although not within the period that defines the far future. Nonetheless, the potential exists for the reclaimed landscape to support old growth forests beyond the timeframe of post reclamation which is represented by 80 years following initial reclamation.

Negligible or no effects were predicted for the Project Case on the following:

- lichen jack pine (a1) communities;
- forested areas;
- terrestrial vegetation;
- riparian areas;
- productive forests;
- areas with high rare plant potential;
- areas with high traditional use plant potential; and
- areas of vegetation communities affected by dust.

In general, the reclaimed landscape will see an increase in terrestrial vegetation, riparian communities, productive forests and areas of high traditional plant potential and a decrease in wetlands (including peatlands), patterned fens, lichen jack pine communities, old growth forests and areas of high rare plant potential. Terrestrial vegetation and wetlands resources will primarily be affected through surface disturbances associated with construction of the Project, which will affect a total of 1,718 ha of previously undisturbed areas in the LSA. Progressive reclamation (e.g., of pipelines) will minimize the extent of the surface disturbances at any one time. Overall, the Project is predicted to have a low environmental consequence on terrestrial vegetation and wetlands in the LSA, as a result of construction, operation and reclamation activities and a negligible effect in the RSA.

Planned Development Case

An assessment of the potential effects on Terrestrial Vegetation, Wetlands and Forestry was carried out for the PDC when the effect to an environment component under the Project Case was predicted to be low, moderate or high. The total loss or alteration of terrestrial vegetation and wetlands in the PDC will be 186,592 ha or 12% of the RSA. This includes 94,630 ha of terrestrial vegetation and 43,839 ha of wetlands. Following reclamation, wetlands and old growth forest will decrease in area. Thus, the predicted environmental consequences for effects on terrestrial vegetation and wetlands in the PDC is considered to be negative and moderate for old growth forest and wetlands (peatlands).

4.2.6.3 Wildlife

Conclusions

Residual effects of the Project ranged from negligible to high in the LSA, and from negligible to moderate in the RSA. Effects to wildlife abundance from direct mortality due to interactions with infrastructure, site clearing, removal of nuisance wildlife, and sensory disturbance were predicted to have a negligible to low environmental consequence for all KIRs, at both the LSA and RSA scales, with the single exception that the effect of hunting/predation/trapping had a moderate environmental consequence on woodland caribou, moose and black bears in the LSA.

Direct habitat loss through site clearing and indirect habitat loss through sensory disturbance and fragmentation during construction and operations were predicted to have a negligible to low environmental consequence at the LSA and RSA for most KIRs. Black bears had a moderate environmental consequence for site clearing and a high consequence for sensory disturbance at the LSA. Woodland caribou were assigned a moderate environmental consequence due to indirect habitat loss at the LSA level. The overall loss of high-quality habitat due to the Project during construction and operations ranged from negligible to high environmental consequences at the LSA scale. The percent of high-quality habitat lost ranged from 0 (black-throated green warbler) to 38.4% (black bear) of the LSA. These operational losses resulted in high and moderate environmental consequences for black bear and woodland caribou, respectively and low or negligible consequences for all other KIRs. Population Viability Analysis for Project case indicated a very small reduction in both carrying capacity and population for all three KIRs analyzed (moose, woodland caribou, black bear) (Volume 5, Appendix 5-V).

Environmental consequences after reclamation resulted in habitat gains (i.e., post reclamation habitat availability compared to habitat availability at EAC) for most KIRs, except barred owl, Canada lynx and moose, which did not regain all habitat lost prior to reclamation.

Effects of barriers to movement were considered low for all KIRS except Canadian toad, which had negligible effects.

Existing and Approved Case

Baseline wildlife surveys were conducted within the lease area and the Terrestrial Resources LSA during 2004 and 2007. Surveys completed included an ungulate aerial survey, early and late winter track count surveys, a nocturnal owl call survey, a browse-pellet group transect survey, a bat survey, spring and fall waterfowl and waterbird aerial surveys, a raptor ground survey, a breeding bird survey, a beaver/muskrat survey and nocturnal amphibian call surveys and carnivore monitoring stations (baited cameras).

Incidental wildlife observations are reported and particular note was made of special status species (i.e., species listed nationally or provincially). Assistants from Chipewyan Prairie Dene First Nations (CPDFN) and Conklin took part in a number of the scientific programs, and their experience identifying other wildlife sign contributed to the efficiency of the studies.

Ungulate aerial surveys have been conducted on the lease area from 2004 to 2007. Woodland caribou were observed in 2006 and 2007, and caribou sign has been observed in other years. Five moose were observed in 2004 for an estimated population density of 0.07 moose/km^2. Results in subsequent years have resulted in lower densities; 0.01 moose/km^2 in 2006, 0.03 moose/km^2 in 2005 and 0.02 moose/km^2 in 2007. Results from aerial surveys also show low deer observation densities.

Winter track surveys conducted in 2004 and 2007 indicated that there was a moderate to high abundance of woodland caribou within the lease area compared to other studies conducted within the Oil Sands Region. Moose track density was average compared to other studies conducted within the Oil Sands Region. Deer, wolves, coyotes, lynx, red fox, fisher/marten, weasels, mink, snowshoe hares, wolverines and red squirrels were all observed during the track surveys. No cougar, bear or river otter tracks were observed.

Photographic bait stations were set up in all four seasons in 2007 to improve baseline data on small to medium carnivore species. Several carnivores were photographed at the cameras, including fisher, marten, lynx, coyote, wolf, red fox, bear and one weasel of uncertain species. Fisher were found to respond to the bait stations far more often than marten, indicating that they are probably the more abundant of the two species in the area. In addition, photographs of deer, moose and caribou were captured by the stations, including 19 caribou.

Beaver density was low in the lease area at 0.17 active lodges/km of tributary and no inactive lodges/km of tributary. Muskrat density was high for the Oil Sands Region with 22 push-ups observed (2.06 push-ups/km).

During the bat survey, one adult male little brown bat was captured along a treed fen cutline (FTNN-cutline). Species identified from the echolocation monitoring included *Myotis* spp., hoary bat, red bat and big brown/silver-haired bat. One bat (unknown spp.) was observed incidentally within the lease area during the baseline surveys. Overall, the level of bat activity and capture success was low compared to previous studies in the region.

Four species of owls were heard during the owl call playback survey. The boreal owl was the most abundant followed by the great gray owl, barred owl and great horned owl.

During the breeding bird survey, 253 bird observations were recorded comprising 27 species. The ruby-crowned kinglet was the most commonly detected songbird, followed by the gray jay, yellow-rumped warbler, dark-eyed junco and the Tennessee warbler. Species richness was moderate overall, with the highest richness occuring within the blueberry jack pine-aspen (b1), Labrador tea-subhygric black spruce-jack pine (g1) and the shrubby swamp (SONS) ecosite phases/wetlands types. Species diversity was highest in the treed fen (FTNN) and the low-bush cranberry aspen-white spruce (d2) ecosite phases/wetlands types.

Boreal chorus frogs, wood frogs, western (boreal) toads and Canadian toads were observed within the lease area incidentally and during baseline surveys. Boreal chorus frogs and wood frogs were almost ubiquitous, occurring in most ecosite phases. Western toads were located in all wetlands types. Frogs, western toads and Canadian Toads were observed within a variety of waterbody types including lakes, ponds, rivers, creeks, standing water and along disturbed cut-lines.

Important wildlife areas occurring within the LSA were identified. The Project is located within the Christina Caribou Area, a designated caribou range within Alberta. Additionally, Christina Lake has been identified as a Significant Natural Feature and lies adjacent to the Project. Christina Lake provides important waterfowl nesting and furbearer habitat. No important moose areas occur within the vicinity of the Project. Potential seasonal movement of woodland caribou has been identified using winter track and pellet surveys conducted for the Devon Jackfish Project (Devon 2004). Based on aerial surveys track counts and photographic surveys in the general area, North-south movement appears to occur between caribou wintering areas within peatland complexes north of Christina Lake (i.e., within and adjacent to the LSA) and spring calving/summer habitats south of Christina Lake.

Twenty six species of special concern (i.e., 'Sensitive', 'May Be At Risk', 'At Risk', 'Undetermined', 'Accidental/Vagrant') (ASRD 2005) were recorded within the lease area. These included the woodland caribou (federally listed as 'Threatened'; COSEWIC 2007), Canada lynx, fisher, red bat, Canadian toad, western (boreal) toad (federally listed as 'Special Concern'; COSEWIC 2007) and several bird species. Of the special status species observed within the lease area, the woodland caribou is listed as 'At Risk' and the Canadian toad and wolverine as 'May Be At Risk' provincially. The remaining species are all listed as 'Sensitive', 'Undetermined' or 'Accidental/Vagrant' provincially (ASRD 2005).

Project Case

The wildlife assessment for the effects of the Project considered changes to wildlife abundance (i.e., interactions with infrastructure, direct mortality during site clearing, removal of nuisance wildlife, increased vehicle/wildlife collisions, increased predation/hunting/trapping and sensory disturbance), habitat loss (i.e., site clearing, sensory disturbance and fragmentation) and barriers to movement. The assessment was conducted for ten KIRs: woodland caribou, moose, black bear, fisher, Canada lynx, beaver, barred owl, black-throated green warbler, yellow rail and Canadian toad.

Residual effects of the Project ranged from negligible to high in the LSA, and from negligible to moderate in the RSA. Effects to wildlife abundance from direct mortality due to interactions with infrastructure, site clearing, removal of nuisance wildlife, and sensory disturbance were predicted to have a negligible to low environmental consequence for all KIRs, at both the LSA and RSA scales, with the single exception that the effects of hunting/predation/trapping had a moderate environmental consequence on woodland caribou, moose and black bears in the LSA.

Direct habitat loss through site clearing and indirect habitat loss through sensory disturbance and fragmentation during construction and operations were predicted to have a negligible to low environmental consequence at the LSA and RSA for most KIRs. Black bears had a moderate environmental consequence for site clearing and a high consequence for sensory disturbance at the LSA. Woodland caribou were assigned a moderate environmental consequence due to indirect habitat loss at the LSA level. The overall loss of high-quality habitat due to the Project during construction and operations ranged from negligible to high environmental consequences at the LSA scale. The percent of high-quality habitat lost ranged from 0 (black-throated green warbler) to 38.4% (black bear) of the LSA. These operational losses resulted in high and moderate environmental consequences for black bear and woodland caribou, respectively and low or negligible consequences for all other KIRs. Population Viability Analysis for Project case indicated a very small reduction in both carrying capacity and population for all three KIRs analyzed (moose, woodland caribou, black bear) (Volume 5, Appendix 5-V).

Environmental consequences after reclamation resulted in habitat gains (i.e., post reclamation habitat availability compared to habitat availability at EAC) for most KIRs, except barred owl, Canada lynx and moose, which did not regain all habitat lost prior to reclamation.

Effects of barriers to movement were considered low for all KIRS except Canadian toad, where these effects were predicted to be negligible.

Planned Development Case

The PDC assessment consisted of habitat suitability and fragmentation modelling to determine direct and indirect habitat loss and landscape habitat patch juxtapositions within the RSA. It also included Population Viability Analysis (PVA) to quantify effects on regional wildlife populations and Linkage Zone Analysis (LZA) to address regional effects on wildlife movement.

Woodland caribou, black bear and moose were selected for PVA analysis because they are species of special management concern, their populations are wide-ranging, and sufficient information on their life histories exists to conduct a PVA. Based on PVA, the resulting reduction in carrying capacity was 11% for black bear, 8% for moose and 13% for woodland caribou. Under the assumptions used in PVA analysis, although habitat loss affects carrying capacity, extinction risk remains very low for moose and black bear. However, woodland caribou are at high risk of extirpation in the RSA. The woodland caribou PVA indicates that the risk of extirpation is approximately the same for the EAC and PDC assessments (i.e., with or without the Project). Overall, the effects of combined regional developments on wildlife abundance were predicted to be low for moose, moderate for black bear and high for caribou.

The effects of combined regional developments on wildlife were assessed by quantifying the habitat unit losses for each KIR. Total PDC habitat losses ranged from 6.1% for Canadian toad to 24.1% for black-throated green warbler compared to the EAC. Overall, the effects of direct and indirect habitat loss (i.e., site clearing, sensory disturbance, fragmentation) were negligible to low in magnitude, long-term in duration, high in frequency and regional to beyond regional in geographic extent. As a result, high environmental consequences resulted for black-throated green warbler, barred owl and black bear. Moderate consequences are predicted for moose, Canada lynx, beaver and woodland caribou.

Based on the LZA, fractured caribou habitat in the RSA will increase 8.4% from EAC conditions as a result of the PDC (Volume 5, Appendix 5-V). Planned developments are predicted to have a low impact overall because overall connectivity of caribou habitat within the RSA is retained in the PDC.

4.2.6.4 Biodiversity

Conclusions

The assessment was conducted on biodiversity in the LSA and RSA using the biodiversity potential of ecosystems developed from wildlife, fish and plant species data. After reclamation, there will be a negligible negative effect on biodiversity due to the Project.

Existing and Approved Case

Biodiversity was assessed using several indices that reflect biodiversity values and that could be quantified from available vegetation and wildlife information for the Oil Sands Region. Although an emphasis was placed on the ecosystem and landscape levels, all levels of biological organization (genes, species, ecosystems and landscapes) are interrelated and effects at one level will have a cascading effect on all other levels.

Presence/absence, abundance, distribution, habitat specificity, demographics and population structure (e.g., sex ratio, age ratio) data were collected and discussed in detail for fish (Volume 4, Appendix 4-V), plants (Volume 5, Appendix 5-II) and wildlife (Volume 5, Appendix 5-IV) at the species-level. In total, 589 vascular and non-vascular species were identified in the LSA including nine rare vascular plant species, twenty rare bryophyte species and 51 rare or unranked terrestrial lichen and epiphytic species. The shrubby fen (FONS) wetland supported the greatest number of rare plants. Woodland caribou populations are in a state of decline in the region, and are listed as ‘At Risk’ provincially (ASRD 2005) and ‘threatened’ nationally (COSEWIC 2007).

The ranking process provides an ecosystem-level evaluation of biodiversity potential for the RSA and LSA. Although the biodiversity rankings indicate that certain classes are generally more important to biodiversity conservation, even classes ranked low or moderate for biodiversity potential provide niche habitats for a broad range of plant and wildlife species and contribute to life cycles and ecological processes. While the biodiversity ranking system is an effective and quantitative assessment of relative biodiversity potential, ecosystems are variable and connected systems, involving complex relationships among land cover classes and individual species. Areas ranked as having high biodiversity potential make up 23% of the RSA and 19% of the LSA. Moderate biodiversity potential areas comprise 33% of the RSA and 17% of the LSA. Areas ranked low for biodiversity potential areas make up 43% of the RSA and 64% of the LSA.

The landscape-level analyses indicate that the RSA and LSA contain a diverse mosaic of habitat patches of varying biodiversity potential, which are fragmented by human disturbance. At the RSA level, treed bog/poor fen (17% of the RSA), treed fen (15%), and burns (21%) are the dominant land cover classes. At the LSA scale, wooded bog (BTNN, 23%), wooded fen (FTNN, 13%), and human disturbances (14%) dominate the landscape. Habitat loss and fragmentation is the prevalent landscape change in several human-dominated regions of the world, and it is increasingly becoming recognized as a major cause of declining biodiversity (Terborgh 1989; Noss and Cooperrider 1994). Core area measures are useful for identifying the habitat that is available for species sensitive to proximity to edge and disturbance. The core area of natural areas makes up 70% of the RSA and 20% of the LSA. However, forested core area comprises only 33% of the RSA and 10% of the LSA. Core area for old growth forest patches is difficult to measure at the RSA scale, but makes up less than 1% of the LSA. Maintenance of habitat diversity (composition, structure and function) in the Oil Sands Region will promote ecosystem resilience and preserve current levels of biodiversity.

Project Case

The assessment was conducted on biodiversity in the LSA and RSA using the biodiversity potential of ecosystems developed from wildlife, fish and plant species data. After reclamation, there will be a negligible negative effect on biodiversity due to the Project.

Planned Development Case

Biodiversity was not assessed for the PDC because Project effects on biodiversity were predicted to be negligible after reclamation.

4.2.7 Traditional Land Use

Literature reviews and interviews indicated that the Project location is situated in a region in which traditional land use activities have occurred in the past, and continue to occur. Regarding resource development in the region, First Nations are concerned about the loss, and fragmentation of wildlife habitat, as well as their ability to continue a traditional hunting and harvesting activities on the land. Water quantity and quality within the region is an important concern for First Nations. Local Aboriginals indicated concerns about the potential for contaminants to enter water sources, or the food change through air emissions, waste water discharge from the Project, or potential defoliants used to maintain rights-of way. Issues for trappers included perceived increase in human activity due to development, which in turn affects animal populations and movement. Additionally, trappers are concerned about the future of trapping as a result of increased resource development in the region. MEG is currently arranging interviews with the Chipewyan Prairie First Nation, Fort McMurray First Nation, Heart Lake First Nation, Métis in Conklin and Chard, as well as with other potentially affected trappers, in order to determine their traditional knowledge and traditional land uses within the RSA.

At the time of this submission, MEG recently received permission to use the information contained in the CPDFN TLU and Beaver Lake studies and had completed interviews with three trappers and is arranging interviews with the remaining three trappers within the LSA. This information, as well as all other permitted sources, will be used in the TLU assessment of the Project which will be submitted as an update to this Application.

MEG is currently arranging interviews with the Heart Lake First Nation, Chipewyan Prairie Dene First Nation, Fort McMurray First Nation and Beaver Lake, as well as with the Métis groups in Conklin and Chard. Interviews and mapping sessions will be conducted with elders from each of the aboriginal groups in order to gather baseline data, such as locations for hunting, trapping, plant harvesting, fishing, as well as locations of cabins, burial sites, and other ceremonial or culturally important sites. In addition to the interviews and mapping sessions, elders will have the opportunity for a site visit, during which time additional information may be collected. Information from the interviews will be recorded. Once this baseline information is collected, it will be included in the analysis of potential impacts on the traditional land uses of the respective aboriginal group.

4.2.8 Resource Use

4.2.8.1 Conclusions

Site clearing activities, facility and infrastructure development and increased workforce and population are principal effects from the Project on environmentally significant areas. Effects from site clearing activities and facility and infrastructure development are expected to be negligible. The effects of an increased workforce during construction and operations phases on ESAs are also expected to be negligible.

Effects on resource use are moderate for aggregate resources and negligible for forestry, berry picking and hunting. Effects are low for trapping. The Project will have positive effects on non-consumptive recreation and on public resource use.

4.2.8.2 Existing and Approved Case

The additional effects of approved projects will result in changes from baseline (2007) conditions (Volume 6, Appendix 6-II), as follows:

- increased use of existing access routes and the construction of new access for each new project will increase access to consumptive and non-consumptive use of resources in the area;
- workforce and population increases, over time, will lead to increasing resource use by the public, such as recreation, hunting and fishing;
- aggregate resources in the area will be used, as materials are needed for infrastructure and development for new projects. New discoveries of aggregates will mitigate this impact; and
- forestry resources in the areas of each approved project will also be impacted by site clearing of merchantable timber, but timber salvage and the reclamation of forest communities will mitigate this impact.

4.2.8.3 Project Case

Site clearing activities, facility and infrastructure development and increased workforce and population are principal effects from the Project on environmentally important areas. Effects from site clearing activities and facility and infrastructure development are expected to be negligible. The effects of an increased workforce during construction and operations phases on ESAs are also expected to be negligible.

Agricultural activity will not be affected because there is no agricultural activity occurring within the LSA. Effects on resource use are moderate for aggregate resources and negligible for forestry, berry picking and hunting. Effects are low for trapping. The Project will have positive effects on non-consumptive recreation and on public resource use.

Overall Project Case effects are negligible for ESAs, and neglible to low for resource use and resource users and moderate for aggregate resources.

Effects will be mitigated during reclamation (i.e., for berry habitat, forests and wildlife habitat) and recycling (i.e., for aggregate resources).The mitigation of effects of planned projects in the RSA will mainly occur on a project by project basis. However, MEG will also address mitigations on a regional scale through participation in multi-stakeholder working groups including CEMA and Regional Issues Working Group (RIWG). It is expected that projects will reclaim habitats to an equal or greater capability of key resource uses, and that projects will employ standard mitigation practices such as consultation with specific resource users who have interests in project areas, such as Forest Management Agreement (FMA) holders.

4.2.8.4 Planned Development Case

Effects within the PDC are considered for effects on environmentally important areas. The PDC impacts are expected to be low for site clearing and facility and infrastructure development impacts on the ESAs. The PDC impacts will also be low for population-driven effects on environmentally important areas throughout the RSA.

Site clearing and facility and infrastructure effects within the PDC were considered for forestry, hunting, trapping, berry picking, aggregate resources and non-consumptive recreation. Population-driven effects were also considered on resources that the public will use throughout the RSA (hunting, fishing, berry picking and other recreation). PDC effects for all existing, approved, and planned projects including the Project were determined to be low for ESA, low for public resource use and trapping, and high for aggregate resources.

4.2.9 Visual Resources

4.2.9.1 Conclusions

The effect of an aesthetic disturbance can vary greatly depending on the sensitivity of the existing landscape and the observer. Overall, the effects of the Project on visual resources are predicted to be negligible.

4.2.9.2 Existing and Approved Case

The EAC landscape was rated based on scenic quality, user sensitivity and visibility (USDI 1986). These factors were combined to give a landscape aesthetic value rating. The resulting ratings for each key viewpoint are summarized in Table 4.2-9.

Five key viewpoints were used to rate the EAC landscape. Viewpoint 1 is located on Secondary Highway 881, Viewpoints 2 and 3 are located on the shore of Christina Lake near Conklin, Viewpoint 4 is located on Christina Lake about 4 km from the east end and Viewpoints 5 and 6 are located on Winefred and Bohn lakes respectively. Photos documenting the existing conditions at some of the viewpoints can be found in Volume 6, Appendix 6-IV. Detailed tables for the rating of scenic quality and user sensitivity for each group of viewpoints can be found in Volume 6, Appendix 6-V.

Table 4.2-9 Existing and Approved Case Aesthetic Summary

Viewpoint	Scenic Quality	Sensitivity	Visibility[(a)]	Landscape Rating
VP-1 Secondary Highway 881, facing east	low	low	background	low
VP-2 Jackfish River Bridge, facing northeast	low	medium	background	low
VP-3 Wassassi Day Use Area, facing northeast	low	medium	background	low
VP-4 Christina Lake, facing east	low	low	background	low
VP-5 Winefred Lake, facing northwest	low	low	foreground	low
VP-6 Bohn Lake, facing south	low	low	background	low

(a) Foreground/middleground = 0 to 7 km (distance of the Project from viewpoint), background = more than 8 km (USDI 1986a).

4.2.9.3 Project Case

The effect of an aesthetic disturbance can vary greatly depending on the sensitivity of the existing landscape and the observer. The viewshed model used to determine the visible area of the Project Case provides a very conservative estimate of visibility. The viewshed model is more accurate for cleared areas than it is for forested areas and therefore the visible area calculations are over-represented due to the forested landscape.

At locations where disturbances are visible and sensitive observers are likely to be present, the potential for an effect exists. At key locations along public transportation routes, close to existing communities, and locations with recreational potential, viewpoints were created and modelled.

The Project disturbances included cleared vegetation, new facilities and visible plumes. However, the plumes are the only visible feature of the Project from the key viewpoints, and they are predicted to be visible under rare conditions only. Overall, the effects of the Project on visual resources are predicted to be negligible.

4.2.9.4 Planned Development Case

Due to lack of information, the assessment of the PDC was limited to a determination of the probable effects based on the nature of the other developments and the results of the EAC and Project Case assessments. In this context the environmental consequence of the other developments was determined to be negligible and reversible. The overall combined effects of the Project and other PDC developments on visual aesthetics are expected to be negligible and reversible.

4.2.10 Historical Resources

4.2.10.1 Conclusions

No new historical resource sites were identified in the Project LSA as a result of the current study. The Historical Resources Impact Assessment (HRIA) included recommendations to ATPRC that *Historical Resources Act* clearance should be issued for the Project. Any development that occur outside the assessed HRIA footprint may require further assessment, as determined by ATPRC.

At present, 129 precontact historical resources have been previously recorded in the RSA. However, a sample size of 98 precontact historical sites was used for the impact assessment due to a lack of recorded information on 31 of the sites.

It should be noted that in the case of both prehistoric and historic sites in the RSA, none of the sites are located within the boundaries of the Project, and as such, do not require further study. No impacts to any of the archaeological or historical sites will occur due to development of the Project.

Although the combined effects of regional development on historical resources are seen as potentially important, the developments of the Project, as proposed, will contribute no predicted additional effects.

4.2.10.2 Existing and Approved Case

The Project HRIA was completed under Historical Resources Permit No. 2007-250, issued by Alberta Tourism Parks, Recreation and Culture (ATPRC) to Vincent Balls. Predicted areas of high and moderate potential were identified for field investigations based on development plans, topographic feature analysis and regional archaeological site distribution patterns. Areas to be assessed were further refined based on observations made during field investigations.

No new historical resource sites were identified in the Project LSA as a result of the current study. The HRIA included recommendations to ATPRC that *Historical Resources Act* clearance should be issued for the Project. Any development that occur outside the assessed HRIA footprint may require further assessment, as determined by ATPRC.

4.2.10.3 Project Case

A qualitative and quantitative assessment has been conducted of the effects of the Project in combination with existing, approved and planned regional developments. This assessment was based on the predictive model, which incorporates both known resources in the region and a structured, GIS-based consideration of regional landform potential.

The distribution of historical resources within the RSA established for the Project reflects more than 35 years of inventory conducted within this region. Most of these investigations have been completed in connection with proposed oil sands (mining and in-situ) developments, pipelines, transmission utility corridors, provincial campgrounds surveys, as well as a large scale regional survey based out of the Lac La Biche area. At present, 129 precontact historical resources have been previously recorded in the RSA. However, a sample size of 98 precontact historical sites was used for the impact assessment due to a lack of recorded information on 31 of the sites.

It should be noted that in the case of both prehistoric and historic sites in the RSA, none of the sites are located within the boundaries of the Project, and as such, do not require further study. No impacts to any of the archaeological or historical sites will occur due to development of the Project.

Although the combined effects of regional development on historical resources are seen as potentially important, the developments of the Project, as proposed, will contribute no predicted additional effects.

4.2.10.4 Planned Development Case

The Project would contribute to cumulative effects to a resource if it was identified to have an impact on the resource.

As no new historical resources sites were identified for the Project LSA and the potential for the identification of historical resources is considered low, the Project will not contribute to cumulative effects of the development of the RSA.

No direct negative effects on historical resources have been identified for the Project. Indirect negative effects related to the Project are predicted to be negligible to low. As no historical resources were identified during the Project, it is recommended that no mitigation with respect to cumulative effects be required.

4.2.11 Socio-Economics

4.2.11.1 Conclusions

The Project will contribute to economic growth in Alberta, including to the GDP, employment, income and government revenues. The construction phase effects are greater, but temporary, while the operations phase effects will endure for 27 years. MEG's initiatives are intended to encourage and facilitate the participation of Aboriginal populations in the LSA, including in Conklin, Chard, the CPDFN reserve and the Heart Lake reserve, as well as Aboriginals living elsewhere in the LSA and RSA. These initiatives should enable these populations to see Project benefits as well. There are, however, at least short-term constraints as a result of generally poorer educational levels, little job experience among the currently unemployed and community and individual social challenges among Aboriginal populations that will take some time to overcome. Further, the LSA currently has a small population relative to workforce requirements of large projects, thus it must be expected that Project benefits will leak into the RSA, the rest of the Alberta economy and beyond for lack of local capacity to meet demands for labour, goods and services.

The anticipated population growth resulting from the Project is comparatively small relative to both the EAC and the PDC, but has some potential to put pressure on selected elements of social and physical infrastructure and services, particularly in the smaller communities such as Chard, Conklin and the CPDFN reserve if economic growth encourages in migration. Affordable housing, traffic volumes and safety and competition for labour and services will likely prove challenging over the near to medium term.

4.2.11.2 Existing and Approved Case

The following describes the socio-economic conditions in a RSA and a LSA. These two study areas encompass communities that could be affected by the Project primarily due to their proximity to it. These communities are also likely to benefit through employment and procurement opportunities and through company community investments. Information contained in this report includes descriptions of population demographics and trends, labour force characteristics, the local economy, and social and physical infrastructure of study area communities.

The RSA includes:

- the Regional Municipality of Wood Buffalo (RMWB), including Fort McMurray and Anzac;
- Lakeland County;
- the Beaver Lake Cree Nation's Beaver Lake reserve;
- the Fort McMurray First Nation reserves (FMFN) (Reported as Gregoire Lake IR 176 and Gregoire Lake IR 176a by Statistics Canada);
- the Town of Bonnyville; and
- the City of Cold Lake.

The LSA includes:

- the Hamlet of Conklin;
- the Hamlet of Chard;
- the Chipewyan Prairie Dene First Nation (CPDFN) reserve (Reported as Janvier IR 194 by Statistics Canada);
- the Town of Lac La Biche; and
- the Heart Lake First Nation reserves.

Both study areas fall within the boundaries of the Wood Buffalo-Cold Lake Economic Region, which also includes the MD of Bonnyville No. 87 and St. Paul County.

The estimated population of the RSA in 2006 was 76,265, while the population in the LSA was 3,750. Both populations tend to be young; the median age is on average 5 years younger than Alberta's. Thirteen percent of the population of the RSA is aboriginal and 48% of the population of the LSA is aboriginal. Each study area has shadow populations that are not accounted for in official census and were estimated to be 20,049 and 3,571 in the spring of 2007 in the RSA and LSA, respectively.

Overall, labour market participation is higher in the study areas than in the province as a whole, however, unemployment rates vary from 4.5 to 7.5 % depending on the community. First Nation on-reserve populations tend to have much higher unemployment rates, where jobs tend to be seasonal in nature. Median incomes and average earnings are considerably lower in areas of the RSA where populations tend to have lower educational levels. The data provides evidence of a significant wage gap between low and high income earners in the RSA (and the LSA). Rising housing costs in study area communities has become a critical concern, prompting the development of a regional affordable housing task force.

Resource based industries, such as oil and gas, and forestry, employ almost one quarter of workers in study area communities. Ninety-eight percent of major projects in the RSA are oil sands or pipeline projects in the oil and gas industry. Labour for trade related occupations in the oil and gas industry is in very high demand in the RSA and in the province as a whole. As such, the shadow population has continued to rise as employers recruit labour from out of study area and out of province locations. Much of this population is accommodated in work camps and other temporary housing. Planning and funding mechanisms are largely in place to manage challenges of a rapidly growing population.

4.2.11.3 Project Case

The Project will contribute to economic growth in Alberta, including to the GDP, employment, income, and government revenues. The construction phase effects are greater, but temporary, while the operations phase effects will endure for 27 years. MEG's initiatives are intended to encourage and facilitate the participation of Aboriginal populations in the LSA, including in Conklin, Chard, the CPDFN reserve and the Heart Lake reserve, as well as Aboriginals living elsewhere in the LSA and RSA. These initiatives should enable these populations to see Project benefits as well. There are, however, at least short-term constraints as a result of generally poorer educational levels, little job experience among the currently unemployed and community and individual social challenges among Aboriginal populations that will take some time to overcome. Further, the LSA currently has a small population relative to workforce requirements of large projects, thus it must be expected that Project benefits will leak into the RSA, the rest of the Alberta economy and beyond for lack of local capacity to meet demands for labour, goods and services.

The anticipated population growth resulting from the Project is comparatively small relative to both the EAC and the PDC, but has some potential to put pressure on selected elements of social and physical infrastructure and services, particularly in the smaller communities such as Chard, Conklin and the CPDFN reserve if economic growth encourages in migration. Affordable housing, traffic volumes and safety and competition for labour and services will likely prove challenging over the near to medium term.

4.2.11.4 Planned Development Case

The PDC includes developments that are proposed, but not yet approved in the RMWB and Lac La Biche County. These projects would likely draw from the communities within Lac La Biche County and would rely on the same pool of workers, supplies and services as the Project.

The total estimated capital costs of identified PDC developments is $152 billion. Available information on PDC developments are presented in Table 4.2-10.

Table 4.2-10 Major Projects in the Socio-Economic Study Areas

Type of Project	Number of Projects		Total Cost [$Millions]		Range of Proposed Construction Schedules	
	RSA	LSA	RSA	LSA	RSA	LSA
infrastructure	12	1	1,523.8	12.1	2006 to 2013	2006 to 2007
institutional	9	0	244.3	0	2006 to 2009	n/a
mining	3	0	185.6	0	-	n/a
oil sands	31	3	79,082.0	2,025.0	2000 to 2012	2000 to 2009
pipelines	11	0[a]	67,868.0	0	2006 to 2010	n/a
residential	18	1	937.6	5.7	2006 to 2008	n/a
recreation	3	0	212.0	0	2006 to 2008	-
Total	**87**	**5**	**150,053.3**	**2,042.8**	**2006 to 2013**	**2000 to 2009**

[a] Pipelines may pass through the LSA.

n/a = Npt applicable.

- = information not provided.

Source: Alberta Employment Immigration and Industry, Inventory of Major Alberta Projects, November 2007.

Major projects in the LSA are:

- completion of paving of Highway 881 north and south of Conklin ($12.1 million);
- Devon Canada Corp. Jackfish SAGD Oil Sands Project Phase 2 (construction planned to begin in the third quarter of 2008) ($600.0 million);
- EnCana FCCL Oil Sands Ltd.. Christina Lake Thermal Project under construction until 2009 ($575.0 million);
- the proposed Statoil Hydro Canada Ltd. Kai Kos Dehseh SAGD Project near Conklin ($850.0 million); and
- proposed affordable housing unit development in Conklin and Chard by the Wood Buffalo Housing and Development Corporation ($5.7 million however this figure also includes development in Anzac and Fort Chipewyan as well).

Additionally, as listed in Volume 2, Section 4, there are many other developments in the RSA that have been publicly disclosed.

Many of the potential socio-economic effects identified in this assessment have necessarily been discussed in general terms. Extending this assessment to cover effects of the PDC must also be a fairly theoretical exercise. The following description of potential PDC effects is therefore constrained in scope to relatively broad observations.

Potential cumulative socio-economic effects from the PDC will be both negative and positive. The creation of well paid construction and operations related employment, some of which will go to LSA and RSA workers and some of which may encourage departed people to return to their home communities is a benefit overall, to individuals and to their families. In addition, increased population, higher disposable incomes and increased opportunities for developing businesses to supply the oil sands sector will all contribute to economic growth and diversification in the LSA as a whole.

With time, there should be increased synergies among oil sands developers with regard to planning and implementing education, training and employment programs with local education authorities, stimulating diversification and growth of local businesses and co-ordination on such issues as traffic. This represents efficiencies in achieving the objective of enhancing economic benefits common to oil sands projects, particularly for Aboriginal populations. As experience with meeting requirements for this and other oil sands projects on the part of workers and businesses in the LSA, as well as the RSA, grows, capacity of workers and businesses to access and realize economic benefits is further enhanced. It is noted that increased capacity can be put to use in other parts of the economy as well.

There will be increased property taxes payable as a result of the planned developments, including as a result of indirect and induced effects on employment and businesses. In addition there will be incremental provincial revenues from the planned developments and their employees. Increased government revenues can be used to respond to expected increases in population and wealth, and government services for all improved.

In general, economic development in the oil sands is increasingly being planned in a context of improved understanding of effects, respect for Aboriginal culture, community self determination, sharing of industry learning and resources, and improvement of government services – the capacity to ensure that non-renewable resource extraction benefits local communities increases with every project proposed and developed.

There is also potential for negative cumulative effects. There is, in the longer term, a limit to how much land can be released to development, how much population can increases in response and how many alternative economic activities can become available without effects on traditional resources, activities and values.

As population and incomes increase, so will demands on municipal services and infrastructure as new residents move to the LSA. Although property taxes will pay for services and current planning is adequate to meet forecast needs over the medium term, the study area populations will continue to grow comparatively quickly.

There will be increasing demand for housing as new residents move to LSA. To date, the private and public sector responses have been adequate; however, there is a growing concern regarding affordable housing and some evidence that the tight labour market is constraining building.

Traffic volumes can be expected to continue to grow, creating delay and more importantly safety concerns, particularly on Highway 881, which has recently been improved. Projected traffic flows are predicted to be well within increased capacity.

In the LSA and RSA, as well as in the province as a whole, PDC developments can be expected to create additional demand for construction workers and supplies, contributing to current and anticipated labour shortages, potential increases in construction costs and possible delays not only to developments themselves, but to all other sectors of the economy.

4.3 MITIGATION

This section outlines the mitigation measures planned for the Project and those employed for the CLRP. These measures are assumed to have been incorporated into the Project design for the subsequent linkage and effects analyses.

4.3.1 Air Quality

The Project has incorporated compliance with all of the relevant provincial and federal emissions guidelines into the process design and equipment selection. A summary is provided below:

- the new steam generators and associated facilities at the Project will be in compliance with Canadian Council of Ministers of the Environment (CCME) *National Emission Guidelines for Commercial/Industrial Boilers and Heaters* (CCME 1998, Website), where applicable;
- when produced gas and natural gas are used to fire steam generators, the Energy Resources Conservation Board (ERCB) sulphur recovery guidelines will be met (EUB ID 2001-3; EUB 2001b);
- flaring will be minimized for the Project (e.g., upset/emergency conditions, start-up and commissioning) and continuous flaring will be limited to flaring at the Central Plant Site, Plant 3A and Plant 3B; and
- above-ground storage tanks will conform to *Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Above Ground Storage Tanks* (CCME 1995).

4.3.2 Noise

Several facility design features for the Project will provide noise mitigation and have been considered in the noise assessment of the Project Case. These measures include the following:

- building attenuation, where components of the processing equipment are housed in buildings;

- buildings and tanks are included in the acoustic model as structural barriers; and
- some fixed equipment with manufacturer-provided noise ratings have noise control incorporated to meet *Alberta Occupational Health and Safety Act* (OHSA) design requirements.

4.3.3 Human Health

No additional mitigation measures are required in addition to those planned for Air Quality and Aquatic Resources.

4.3.4 Aquatic Resources

Mitigation measures are consistent with regulatory guidelines and best management practices. Aquatic resources mitigation measures are designed to:

- minimize possible changes to groundwater quantities, levels, flows and quality;
- minimize possible changes to water levels and flows, erosion potential and possible changes to basin sediment yield and runoff sediment loading to receiving streams;
- reduce the potential for spills and releases that may contaminate runoff and surface waters; and
- avoid adverse effects on fish and fish habitat.

4.3.4.1 Groundwater

Groundwater Withdrawal

Groundwater utilization for the Project will be reduced by recycling produced water. The Project plans to operate at a minimum 90% recycle rate during steady state operations. By incorporating water recycling into the process the source water demand is reduced. By decreasing the water demand the potential environmental effects associated with groundwater withdrawal are mitigated.

The potential for make-up water withdrawals to effect domestic use aquifers, existing water well users and surface water bodies has been effectively mitigated by selecting a water source that occurs below thick shales.

To minimize overlapping drawdown between the Project and other projects in the region, the utility water and make-up water demands will be sourced from aquifers that are not used by the other nearby projects. The water source was selected to supply Project make-up water demands because it is not utilized by the two nearest oil sands projects. Similarly, the water sources that will supply the utility water demand for Plant 3A and Plant 3B were selected to minimize potential interference effects.

Groundwater Quality

MEG will utilize drilling and casing best practices to ensure the protection of groundwater resources (Section 3.2.2.1).

The SAGD operation will be a continuous process operated below the formation fracture pressure. As a result, the downhole tubulars are not subjected to high pressure or stresses from frequent temperature fluctuations.

Well parameters will be monitored by operations staff to ensure casing integrity. Any unanticipated changes in these parameters will be immediately investigated. These techniques will assist in identifying any potential casing performance issues.

The intermediate casing string will provide hydraulic isolation between the oil sands, into which steam will be injected, and the overlying shale. Additionally, surface casings set below the glacial till, will help provide a second method of hydraulic isolation. MEG is confident that its rigorous casing and cementing practices will prevent any intermediate casing failures.

Surface holes will be pre-drilled using a surface hole rig and surface casing will be installed at all wells to the bottom of the Quaternary zone. The surface casing will isolate Quaternary aquifers from subsequent drilling activity. Thermal cement will be used to cement the conductor pipe, the surface casing and the intermediate casing to surface.

MEG plans to dispose of fluids by injecting into Class 1B disposal wells completed in the McMurray Aquifer. Surface casing will be set to the bottom of the Quaternary zone. Intermediate casing will be set below the bitumen bearing zone. The main injection tubing will be run to the top of the disposal zone, the Basal McMurray water sand, and will be set with a packer and protected with corrosion inhibitor as per ERCB directives. Before disposal operations begin, zonal isolation will be tested with temperature survey logs and cement bond logs in compliance with ERCB directives.

4.3.4.2 Surface Water and Fisheries

Facilities and Camp Sites

To minimize effects on receiving streams, lakes, ponds and wetlands from changes in runoff, natural drainage patterns, sediment concentrations, suspended sediment concentrations and basin sediment yields, the following mitigation measures will be designed and implemented as part of the overall water management plan for the Project. The management plan will include the following:

- Wellpads and potential borrow pits will have a minimum setback of 100 m from waterbodies to minimize effects on local flow patterns and streamflows.
- All disturbed areas, including the plant sites, access roads, borrow pits and wellpads will be reclaimed, graded and re-vegetated to facilitate natural drainage. All road crossing culverts will be removed and natural drainage will be restored.
- The perimeter of the plant and camp sites will be bermed to retain all runoff predicted for the 1 in 25-year flood event. Grading and conveyance will be provided to direct the runoff generated at the sites to stormwater retention/detention facilities. As a conservative measure, the EIA has been completed assuming the captured water will be discharged back to the watershed at controlled release rates.
- Swales or ditches around the wellpads will be designed to have adequate capacities to carry the estimated runoff volumes generated from a 1 in 25 year flood event.
- Berms or curbs will be placed around process equipment and tanks to contain spills, if any.
- Silt fences or similar best management practices will be used to contain sediment runoff during construction of all roads, drainage ditches and pipelines.
- Retained water will then be discharged back to the watershed at controlled release rates, subject to compliance with regulatory requirements for water quality.
- All disturbed areas including the plant sites, borrow pits, wellpads and other operational areas will be reclaimed, and revegetated to reduce the potential for erosion and surface sediment runoff. All road crossing culverts will be removed and the disturbed bank areas stabilized and revegetated to reduce the potential for stream bank erosion.

To minimize potential effects to water quality in receiving streams, the following measures will be implemented:

- Surface runoff will be tested and discharged back to the environment in accordance with the applicable regulatory requirements. In the event that run off waters do not meet discharge requirements will be introduced into the process.
- Management practices, contingency plans, and emergency response plans will be implemented to prevent and address leaks and spills.
- Storage sites for fuels, lubricating oils, chemicals or other hazardous materials will be set back at least 100 m from any waterbody or watercourse.
- Washing, maintaining and refuelling of vehicles will be undertaken at least 100 m from any waterbody or watercourse.
- Waste will be managed using environmental management practices that meet or exceed existing regulatory guidelines. MEG's corporate Environmental Health & Safety (EHS) Management System includes specific programs for spill response and waste management, as well as emergency planning (Section 3.3).

Roads and Pipelines

A number of mitigation measures will be implemented to minimize effects to watercourse crossings and aquatic resources by:

- Drainage culverts will be installed at all watercourses and at low points along all access roads to maintain natural flow patterns and eliminate potential flow impediment or flooding potential. This will minimize potential ponding on the upstream side of the road and prevent "drying out" of wetlands areas on the downstream side.
- In muskeg areas where the water table is close to the ground surface, the use of filter fabric will be considered as a base for access road construction where feasible. This will improve water drainage through the access road thereby minimizing the effects on surface and shallow groundwater drainage patterns.
- Wherever practicable, roads and steam/production pipelines will follow a common corridor. Above-ground pipelines will be elevated on piles that will be designed to span small watercourses. This will minimize the effects on local drainage patterns.
- Silt fences or similar best management practices will be used to contain sediment runoff during construction of all roads, drainage ditches and pipelines.

- Minimizing the amount and duration of instream work, completing the work at low or no flow conditions and separating the work site from flowing water will result in minimal disturbance of the watercourse while constructing the watercourse crossing.
- Applying water and sediment control through the use of silt fencing around disturbed areas, re-establishing a vegetative cover as soon as practical and directing local road runoff away from the crossing location into the adjacent vegetation.
- Designing and installing, where practicable, clear-span bridges to prevent disturbance to the active stream channel at each road watercourse crossing and to minimize sediment from entering the water.
- Designing and installing above-ground pipelines to avoid disturbance to the active stream channel at each pipeline watercourse crossing and to minimize sediment from entering the water.
- For underground pipelines, bored creek crossings will be used where practicable to avoid working in the watercourse.
- Following guidelines for design and construction practices of watercourse crossings as outlined in the *Alberta Water Act, Code of Practice for Watercourse Crossings* (AENV 2001b and *Code of Practice for Pipeline and Telecommunication Lines Crossing a Waterbody* (AENV 2001c).
- Designing watercourse crossings requiring a culvert for fish passage, and regularly maintaining culverts to ensure fish passage.
- Following guidelines for design and construction practices outlined by the DFO Operational Statement for clear-span bridge crossings where applicable (DFO 2007).
- Following guidelines for design and construction practices outlined by the DFO Interim Operational Position Statement for pipeline crossings in the Prairies Area (DFO 2006).

4.3.5 Terrestrial Resources

Many of the available mitigation options are common to all terrestrial components (e.g., by reclaiming an area, the soil will be replaced; therefore, plant communities will become established along with wildlife habitat). Mitigation measures apply to the various aspects of the Project as described below.

4.3.5.1 Construction

Mitigation measures that will minimize the effects of the Project to Terrestrial Resources during construction include:

- Clearing will be conducted during the winter period (September 1 through April 15) to avoid the main breeding, nesting and calving seasons for wildlife.
- During the April 15 through July 15 period, MEG will attempt to concentrate construction activities on existing cleared areas. Construction activities will follow the timing restrictions outlined in the annual Caribou Protection Plans for the Project.
- As demonstrated by the proposed Project footprint, pre-planning will promote the use of common corridors and shared access with other proponents in the LSA when practicable.
- Whenever practicable, existing Rights-of-Way (ROW) will be used for access and installation of any new infrastructure to minimize direct habitat loss. MEG will use existing lines that are starting to regenerate only when other reasonable options do not exist.
- Areas for facilities, well sites, multi-wellpads, ROW and exploration wellpads will be sized as small as reasonably practicable.
- To minimize barriers to wildlife movements, where practicable, welded pipe will not remain on the ground or on skids for more than three days during pipeline construction, or, welded pipe shall have 10-m-wide gaps spaced every 500 m if the top of the pipe is greater than 0.75 m above the ground.
- Any open trenches or ditches will have 10-m-wide breaks or crossing points at least every 500 m.
- Where snow or debris berms are necessary, these berms will not exceed 0.75 m heights.
- Areas of relatively undisturbed vegetation will be left intact to allow passage and movement of wildlife around the development areas.
- Pre-construction surveys will be undertaken to determine the location of wildlife above-ground pipeline passages with respect to pipeline height, well-used game trails, high-quality habitat, riparian areas and topography. MEG will optimize the location of above-ground pipeline crossing structures to ensure adequate passage for wildlife. MEG will take into consideration the Alberta Caribou Committee (ACC) guidelines regarding above-ground pipelines.
- Where two pipelines run together and are low enough for animals to cross over, they will have approximately 50 cm spacing between them. This has been shown to allow deer to jump both pipes, while moose are still able to step in between them.
- When a small gas pipeline or fibre-optic cable runs along with an above-ground pipeline, they will not hang more than a few centimetres below the main pipeline.

- Natural woody vegetation will be allowed to grow back along the edge of cleared pipeline and power line ROW where practicable, while accommodating safety and pipeline monitoring concerns, to reduce lines of sight. Additionally, human access will be restricted on pipelines through the use of a variety of techniques including line blocking with available timber and flagging, excluding traditional access routes. Access management will be conducted in consultation with Alberta Sustainable Resource Development (ASRD).
- Where wind-rows are necessary, they will be intermittent so that wildlife movements along access routes are not blocked.
- New clearing for wellpads will involve the salvage of merchantable timber. If a site is located on a slope that requires levelling, the procedure will include:
  - salvaging of available "A" horizon if present on the edge of the well site;
  - the "B" horizon will be salvaged and stored in a separate area of the site;
  - the site will be levelled to allow access to the drilling rig; and
  - after abandonment of the well, the wellpad will be re-contoured to blend with the original conditions and topsoil will be replaced.
- All work will be kept within surveyed ROW and within approved development areas.
- Every reasonable effort will be made to reduce disturbance to the forest cover root mat (i.e., duff layer) during pipeline construction to promote accelerated revegetation along ROW (e.g., mulchers and hand slashing).
- Adequate water movement will be maintained where all-weather roads cross peatland areas by using culverts or other drainage techniques as deemed appropriate. Natural drainage patterns will be maintained by ensuring appropriate spacing and number of culverts at watercourse or wetlands crossings as described in Hydrology (Volume 4, Section 5.2).
- Persons holding traplines in the Project area will be notified regarding clearing and construction within their trapline.
- Merchantable timber will be salvaged where practicable, except where ASRD permits otherwise. No tree clearing will occur unless approved by regulatory authorities.
- Alberta Sustainable Resource Development, Fish and Wildlife will be contacted to assist in removal of hibernating black bears if they are accidentally disturbed.
- Wellpad and source and disposal well access will follow seismic line clearings wherever reasonable.

- Native vegetation will be preserved where practicable.
- Soil handling, management and storage procedures will be implemented as summarized in the Conservation and Reclamation (C&R) Plan (Section 6). Pre-development assessments will be done before the development of each facility to mitigate critical habitat for rare plants and wildlife habitat.

4.3.5.2 Operations

Specific mitigation measures designed to minimize the effects of the Project during operations are listed below:

- Dust control will be undertaken on roads during dry conditions in the spring, summer and fall.
- Wooded buffers will be maintained as appropriate to reduce noise.
- A weed control program will be used in the Project area to control nuisance and noxious weeds.
- Access to the CLRP facilities will be restricted to authorized personnel only.
- Signage will be used on the main access road to deter non-project traffic and to increase awareness of wildlife issues, at the start of both the access road to the Plant Sites and utility corridors.
- Beaver dams will be removed from culverts as required.
- All food wastes will be stored in bear-proof containers followed by transport off-site.
- MEG will have third-party contractors design the transmission lines, to use of raptor-safe construction standards for transmission lines to Avian Powerline Interaction Committee (APLIC 1996) or comparable requirements.
- MEG staff and contractors will be instructed and educated to discourage wildlife feeding.
- A nuisance wildlife management plan will be implemented in co-operation with local trapline holders and ASRD Fish and Wildlife.
- MEG will submit annual Caribou Protection Plans (BCC 2001).
- Recreational use of All Terrain Vehicles (ATVs) by MEG staff and contractors will be prohibited on-site.
- All personnel working at the site will participate in a site orientation that includes education and awareness about species of concern (i.e.,

woodland caribou), expected behaviour and practices while operating within wildlife habitat.

- MEG will ensure that, except as authorized, all employees and contractors entering the Project area are prohibited from possessing: firearms, bows, pets and any motorized recreational vehicle. However, MEG recognizes the constraints in minimizing use of firearms and bows by local residents.
- Speed limits will be put in place for all access roads and speeding will not be tolerated.
- Personnel contravening MEG's operating practices will be disciplined.
- MEG will employ environmental monitoring staff to ensure that mitigation measures committed to are carried out in the field. MEG is committed to training and development of environmental monitors from the local area.

4.3.5.3 Reclamation

The key mitigation methodology to minimize residual effects on Terrestrial Resources is reclamation. The Project C&R Plan is detailed in Section 6.

4.3.6 Visual Resources

To reduce the effect of the Project on the visual aesthetics, mitigation strategies have been planned for the Project, including:

- the use of existing ROW and clearings to minimize footprint and vegetation disturbance; and
- using and maintaining a vegetated buffer between the Project and potential viewpoints to reduce the aesthetic impact of land clearing.

Regional aesthetic effects will be mitigated in the long-term by the cessation of emissions, decommissioning/removal of facilities and reclamation of developed areas.

4.3.7 Historical Resources

MEG will encourage avoidance of indirect impacts by increasing the awareness of Project personnel on historical resources and encouraging avoidance of any identified historical resources locations during development.

4.3.8 Socio-Economics

MEG supports the efforts of public and civil society agencies and organizations to meet the needs of Alberta residents through the taxes and royalties generated by its projects. MEG also directly supports communities near its projects in northeastern Alberta through its community investment and donation programs and its education and training activities. Finally, MEG is a participant in various regional initiatives established to address regional socio-economic issues associated with oil sands development, including:

- Regional Infrastructure Working Group (RIWG);
- Southern Athabasca Oil Sands Producers (SAOP);
- Willow Lake Traffic Working Group; and
- Lac La Biche Industry Committee.

MEG intends to continue its involvement with these groups during the construction and operation of the Project.

MEG will implement the following measures to mitigate potential negative effects and enhance Project benefits.

4.3.8.1 Traffic

MEG recognizes that the Project, especially during its construction phase, will result in traffic increases on Highway 881. MEG will co-operate with the Royal Canadian Mounted Police (RCMP) and other provincial and local traffic authorities (including Alberta Infrastructure and Transportation) to ensure the potential negative effects of Project traffic increases are minimized. MEG will use a combination of some or all of:

- fly-in fly-out (on rotational employment schedules for out-of-area workers);
- van- and/or bus-based transport from nearby communities; and
- privately owned transportation (again as practicable and preferred for some workers) to move construction and operations workers to site.

Final construction and operations phase workforce rotational and transportation arrangements will be developed as human resource planning and implementation are advanced, with the aim of minimizing traffic to the extent practicable.

In response to traffic concerns in the LSA, the Willow Lake Traffic Working Group was created to address highway safety, traffic movement and general highway conditions on Highway 881. This working group (which now includes MEG, OPTI Canada Inc./Nexen Canada Ltd., ConocoPhillips Canada, Devon Canada Corporation and Petrobank Energy and Resources) has support from Alberta Infrastructure and Transportation and the Fort McMurray RCMP. The group keeps area residents informed of movements (including oversized loads and the timing of shift changes) on Highway 881 and any delays that might be expected as a result (Long Lake Project 2007, Website).

4.3.8.2 Health and Emergency Services

The Project will follow the Alberta Occupational Health and Safety Code for High Hazard Isolated Sites (Government of Alberta 2006) will regards to staffing. It is anticipated that the majority of medical problems arising on site can be dealt with by these staff. The Project also has an existing agreement with medivac services for air transport of serious cases and a registration with STARS Emergency Link Centre to assist with emergency response.

MEG is committed to ensuring a healthy and safe workplace for its employees. Workplace programs intended to enhance the health and safety of its employees include:

- safety orientations and ongoing job-specific training;
- hazard identification and non-conformance processes; and
- an Occupational Health and Safety Standard (OHSAS 18001) compatible health and safety management system.

4.3.8.3 Education and Training

MEG supports education and training initiatives designed to enhance the uptake of employment and other career opportunities for people in the LSA specifically, but also in the RSA. MEG has been working closely with its stakeholders to encourage their members to undertake training that will qualify them for both construction and operations jobs with the Project. MEG supports the training presented through the Trades in Motion program in both Conklin and Chard. MEG is also working with the appropriate agencies and training institutions to facilitate apprenticeship training in trades on the Project. MEG has financially supported training for people in the LSA to obtain certificates needed for employment in winter projects. MEG is engaged with Portage College through the President's Aboriginal and Resource-Based Industry Advisory Committee to identify training equipment for industry and facilitate training through the industry. MEG maintains regular and ongoing contact with Keyano College to ensure that institution is aware of training needs related to employment opportunities with the Project.

MEG continues to support education within the schools in the local communities through Stay in School initiatives, financially assisting special events and offering to engage in in-class activities with students.

4.3.8.4 Local Opportunities

MEG is committed to providing employment and business opportunities for people within both the LSA and RSA with emphasis on First Nations and Métis people. Opportunities do, however, have requirements related to qualifications, quality, cost, availability (schedule) and demonstrated interest. MEG's practice with respect to local opportunities is to:

- provide opportunities in co-operation with other developers in the area;
- encourage job skills training and education; and
- ensure all interested persons have access to employment opportunities with MEG.

To ensure access to employment opportunities is realized, MEG has established a system in co-operation with local community agencies through which employment opportunities are advertised and information is made available. Arrangements have been made whereby interested people can drop off resumes at a location in each community. MEG visits these locations on a regular basis to pick up deposited resumes. These are then provided by MEG to contractors engaged in the Project to ensure they are aware of people available for employment. MEG maintains ongoing communications with contractors to follow up on local hiring practices. MEG requires each contractor to demonstrate efforts to hire local people whenever practicable.

MEG is a signatory to the Chipewyan Prairie Dene First Nation (CPDFN) Industrial Relations Corporation (IRC) agreement. This agreement formalizes a process by which MEG and the IRC work together during the development of the Project and addresses employment and contracting opportunities with MEG for local people and businesses.

MEG has a system established with Heart Lake First Nation (HLFN), Beaver Lake First Nation, Fort McMurray First Nation (FMFN) and Métis locals in Conklin and Chard to ensure members review information on MEG's employment and contracting opportunities. MEG provides this information on a regular basis to the Métis Nation of Alberta Region One in Lac La Biche. MEG participates on the Lac La Biche Industry Committee to address employment and business opportunities with the Project. MEG holds information sessions in local communities to provide information on current and future employment and contracting opportunities.

MEG is a signatory to the Athabasca Tribal Council (ATC) All Parties Core Agreement which has as one of its objectives the enhancement of First Nations' opportunities for participation in the oil and gas sector.

MEG reached agreement with the FMFN-IRC to become an Associate Member effective April 1, 2005.

MEG has signed a Consultation Agreement with HLFN to provide ongoing consultation relating to the Project, including employment area business opportunities.

MEG has reached agreement with Beaver Lake First Nation to provide ongoing consultation including employment and business opportunities.

MEG has established consultation agreements with the Conklin Resource Development Advisory Committee (CRDAC). This committee is a joint initiative between Conklin Métis Local 193 and the Conklin Community Association. In addition to ongoing consultations, the CRDAC provides a focus for addressing local employment and contracting.

MEG will use an open bid process for most of its contracts. Sole sourcing will be considered only for very specialized goods and services. MEG has established an ongoing consultation process with each of its stakeholder groups to ensure that interested workers and businesses in the study areas are kept informed about and considered for economic opportunities. Through these consultations, MEG has established a data base on each local business which details the nature of goods and services provided and the capacity of the businesses to provide services. Each business is invited to pre-qualify as a potential contractor. When contract opportunities arise, appropriately qualified local businesses are provided with Request for Proposals and follow-up is maintained during the proposal process.

MEG discusses future Project planning with each stakeholder group to ensure they are aware of the goods and services that will be needed as the Project develops its various phases. This is intended to assist stakeholder groups to consider new businesses they may want to develop to meet MEG's business needs.

MEG has signed business agreements with some of its stakeholders to ensure a process for conducting ongoing business relationships. Information sessions are held periodically in each community to ensure interested local businesses have an opportunity to discuss their opportunities with MEG representatives and to get information on upcoming business and employment opportunities.

Work placement will be offered to power engineering students from local colleges to assist them in acquiring work experience credits they require to be certified.

MEG monitors progress in developing business and employment opportunities by maintaining a database and requiring contractors to report regularly on the number of LSA, RSA and Aboriginal workers hired and businesses contracted.

4.4 MONITORING

MEG Energy Corp. (MEG) has committed to undertaking numerous monitoring programs in relation to the Christina Lake Regional Project – Phase 3 (the Project). Monitoring programs will be implemented for aspects of the Project which have been predicted to have an effect on the environmental and social resources in the Project area, including: air quality, aquatic resources, terrestrial resources and social resources.

In general, these programs build on the monitoring programs currently proposed for the approved Christina Lake Regional Project Phase 2 (CLRP) (Golder 2007; Matrix 2007) and MEG's participation in various regional initiatives. A full description of the Project's planned monitoring programs is found in Volume 2, Appendix 2-V.

5 PUBLIC CONSULTATION

5.1 INTRODUCTION

MEG is committed to developing and maintaining a constructive dialogue with all relevant stakeholders associated with the Project. This consultation is designed to be ongoing, from initial planning through to eventual decommissioning and reclamation. MEG recognizes the need for, and importance of, effective and transparent communication with all affected stakeholders to ensure the Project's social, environmental and economic sustainability. Further, MEG recognizes and accepts the responsibility of working within the differing perspectives of the various groups of stakeholders as reflected by their cultural heritages and world views.

5.2 GOALS AND OBJECTIVES

MEG's Public Consultation program has been prepared in accordance with the ERCB Directive 056: Energy Development Applications and Schedules (EUB 2007c) that focus on:

- building a healthy working relationship with the various stakeholders through early and ongoing consultation;
- facilitating public understanding of the proposed Project and potential impacts, both positive and negative, on the stakeholders;
- enhancing MEG's understanding of stakeholder priorities, issues and concerns related to the proposed development and other developments in the area;
- implementing issue discussion and conflict resolution to maximize the opportunity for mutually acceptable solutions; and
- promoting ongoing and effective communication between stakeholders and MEG.

Within these guidelines, the goals established for MEG's public consultation process are:

- to develop and maintain long-term mutually-beneficial relations with key stakeholders;
- to enhance public understanding of the Project;

- to involve Project-affected individuals and groups in the overall planning, design and implementation process of the Project to identify areas of concern (potentially negative impacts) that should be addressed;
- to maximize, where possible, the positive impacts (social, economic, environmental); and
- to assist MEG with the Project planning, development and implementation process.

This overall consultation process is based on the following set of guiding principles:

- consultation should be conducted in an open, transparent and respectful manner;
- consultation should be undertaken in a manner that is deemed to be most effective by the stakeholder;
- opportunities to participate and to exchange information should be provided in a timely and culturally (community) sensitive manner throughout the entire consultation process;
- stakeholders should be informed in a timely manner of the outcomes and decisions arising from their recommendations and input; and
- relationships with stakeholders, throughout the life of the Project, should provide opportunities for continual identification and implementation of meaningful, mutually beneficial and sustainable practices and solutions.

5.3 CONSULTATION PROGRAM SCOPE

MEG has designed the public consultation program to be as inclusive as possible. As per the Canadian Association of Petroleum Producers (CAPP) Stewardship Initiative (CAPP 2004), stakeholders are defined as, “People with an interest in industry activities”. The CAPP initiative states that stakeholders may include nearby landowners, municipalities, Aboriginal communities, recreational land users, other industries, environmental groups, governments and regulators. As indicated in the CAPP Guide for Effective Public Involvement (CAPP 2003), public consultation is necessary when:

- there is public interest in a project;
- the scale or type of project activity is perceived to be significant;
- those affected (stakeholders) expect to be involved in the process; and
- there is a regulatory requirement.

ERCB Directive 056 (EUB 2007c) requires that all stakeholders with an interest in the land within 1.5 km of the proposed Project area be contacted. However, MEG's Public Consultation plan has considered a much larger consultation area that more appropriately meets the needs of both the Project and the affected stakeholders. The plan requires that all affected stakeholders be contacted; however, different types of communication tools are used depending on the individual situation. Additionally, there are key stakeholders in the region who historically have been active participants in project-planning in the area. MEG's consultation plan includes contact with these stakeholders. Contact has been made in person, through organized meetings and through telecommunications. All contact with stakeholders has been recorded in a database developed to monitor and record the details of stakeholder consultation for the Project.

5.3.1 Consultation Plan Development

MEG has developed a consultation and communication plan to guide its activities in the oil sands region. The plan promoted consistent communication and consultation activities with interested and potentially affected stakeholders. The plan was first implemented in the fall of 2003 and will be in effect throughout the duration of the entire Project.

Groups and individuals within the oil sands region determined to have a direct interest in the Project were identified and a process for communication with each was established. A media plan outlining how information would be shared with the public and how announcements of key activities would be accomplished was prepared. A consultation database was developed to:

- record all meetings with communities, groups and individuals;
- record all telecommunication contacts with individuals;
- record all issues/concerns received and responses made;
- record outcomes and participants of open houses and information sessions; and
- record mitigative measures undertaken.

In addition to this consultation database, a detailed report of each meeting with stakeholders was prepared and is on file. This process will continue for all Project consultation activities.

5.3.2 Stakeholder Identification

MEG identified several stakeholder groups relative to the Project as indicated in Table 5.3-1.

Table 5.3-1 Stakeholders

Stakeholder Group	Stakeholder Sub-Groups and Individuals
Government Agencies	• ERCB; • AENV; • Alberta Sustainable Resource Development; • Canadian Environmental Assessment Agency (CEAA); • Fisheries and Oceans Canada (DFO); and • Transport Canada.
Stakeholders with an Interest in the land on or near the Project	• Registered fur management leaseholders (Trappers); • Regimel Operations: BP Energy Company, Canadian Natural Resources Ltd., Conoco-Phillips, Devon Canada, EnCana Corporation, JACOS, KNOC, Nexen Canada Ltd., OPTI Canada Inc., Paramount Energy Operating Corp., Petro-Canada Oil and Gas, Petrobank, Signalta Resources Limited, StatoilHydro Canada, Stone Petroleum Ltd., SuperNova Resources Ltd., Superman Resources Inc., Talisman Energy Inc., Universal Gas Inc.; and • Pipeline Companies including: Access Pipelines, TransCanada Pipelines Limited, Enbridge Inc., AltaGas Ltd.
Aboriginal Stakeholders	• Athabasca Tribal Council (ATC); • Chipewyan Prairie Dene First Nation (CPDFN) Chipewyan Prairie Dene First Nation Industrial Relations Corporation (CPDFN-IRC) Fort McMurray #468 First Nation Industrial Relations Corporation (FMFN-IRC); • Heart Lake First Nation; • Beaver Lake First Nation; • Chard Métis Local #214; • Conklin Community Association (CCA); • Conklin Métis Local #193; • Métis Nation of Alberta (MNA) Region 1.
Regional and Municipal Governments	• RMWB, Planning and Development; • RMWB, Community Services Department, Community Liaison Officers, Conklin and Chard; and • Lac La Biche Community Futures.
Regional Service Providers	• Chipewyan Prairie Dene First Nation-based service providers; • Chard-based service providers; • Conklin-based service providers; • Heart Lake First Nation-based service providers; and • MNA Region 1;
Special Interest Groups	• Athabasca Regional Issues Working Group (RIWG);

5.3.3 Memberships in Associations

In addition to direct consultation with affected stakeholder groups, MEG has become a member of several regional and local organizations to further facilitate ongoing consultation and relationship with the local community. MEG has joined or is in the process of joining:

- Athabasca Regional Issues Working Group (RIWG);

- Southern Athabasca Oil Sands Producers (SAOP);
- Regional Aquatics Monitoring Program (RAMP);
- Cumulative Environmental Management Association (CEMA); and
- Wood Buffalo Environmental Association (WBEA).

Since October 2004, MEG has been a member of the Athabasca Tribal Council (ATC) All Parties Core Agreement. In addition, since July 2004 MEG has been a Full Member of the Chipewyan Prairie Dene First Nation Industrial Relations Corporation (CPDFN-IRC). Since April 2005 MEG has been an Associate Member of the Fort McMurray #468 First Nation Industrial Relations Committee (FMFN-IRC).

5.4 CONSULTATION

5.4.1 Summary of Consultation

Table 5.4-1 provides a detailed summary of consultations held with regional stakeholder groups. Ongoing consultations with each group will be periodically updated throughout the Project regulatory process.

Table 5.4-1 Summary of Stakeholder Consultations

Contact	Activities
Energy Resources Conservation Board (ERCB)	• Ongoing discussions, teleconferences, emails and meetings.
Alberta Sustainable Resource Development (ASRD)	• Ongoing discussions, teleconferences, emails and meetings.
Alberta Environment (AENV)	• Ongoing discussions, teleconferences and meetings with AENV staff.
Registered Fur Management Leaseholders (Trappers)	• Information Sessions: November 27/07 Lac La Biche and November 28/07 in Conklin for trappers to discuss Project consultation process/ impacts/issues/concerns/trapper compensation process. Subsequent meetings have taken place with individual trappers.
Forestry Lease Holder	• Ongoing discussions, teleconferences and emails.
Subsurface Leaseholders	• Multiple telecommunications and meetings with community consultation personnel from other SAGD producers in the general Project study area, including Devon Canada, EnCana, Conoco-Phillips, JACOS, OPTI/Nexen, PetroCanada, Petrobank, KNOC, CNRL and StatoilHydro Canada to discuss MEG's Project planning, to share ideas and information on community needs and initiatives, and to coordinate supportive services to the communities (e.g., training and employment initiatives).
Pipeline Companies	• Ongoing telecommunications, emails and meetings.
Athabasca Tribal Council (ATC)	• Ongoing meetings.

Table 5.4-1 Summary of Stakeholder Consultations (continued)

Contact	Activities
Chipewyan Prairie Dene First Nation (CPDFN)	• October 23/07 contact with CPDFN IRC to discuss establishing a consultation process for Project. • Meeting November 6/07 with CPDFN IRC to discuss update on business opportunities for First Nation contractors, social priorities and Project Consultation Process. • Meeting November 12/07 with Band leaders and joint venture and local businesses to discuss business opportunities with MEG's. Meeting requested to discuss trapper safety on traditional trap lines. • Meeting January 8/08 with CPDFN Consultation Committee to discuss Project public disclosure, TOR, consultation committee, draft action plan. • Meeting January 22/08 with CPDFN Consultation Committee to discuss agreement for Memorandum of Understanding (MOU) negotiations, TOR/TEK/Heritage Study, Consultation framework and Elders' monitoring roles. • Meeting February 5/08 with CPDFN Consultant to draft Elements of Protocol and Cooperation Agreement and MOU. • Meeting February 19/08 with CPDFN Consultation Committee to discuss MOU, TLU, Capacity Building, Elements of Consultation and Cooperation Protocol Agreement.
Fort McMurray #468 First Nation Industrial Relations Corporation (FMFN-IRC)	• Meeting November 6/07 in Fort McMurray with FMFN-IRC to discuss IRC Agreement and Public Disclosure Document for Project. • Contact January 7/08 with FMFN-IRC to schedule a future meeting.
Chard Métis Local #214	• Meeting November 6/07 with Board and Elders to discuss Local structure, Social Priorities, Project Consultation Process and SAOP Open House invitation. • Meeting January 23/08 with Local Board, Elders and Consultants to discuss Project Public Disclosure, TOR, and social priorities for community. • Meeting February 20/08 with Local Board, Elders and Consultants to discuss social priorities budget, Action Plan for Project created and planned Workshop Agenda. • Workshop March 12/08 for Local Board, Elders and Consultants to provide information on Project process.
Heart Lake First Nation (HLFN)	• October 4/07 meeting with HLFN Consultation Office to discuss MEG's Consultation Agreement, and Project Public Disclosure. • Meeting November 7/07 with HLFN Consultation Office to discuss Project consultation process. • December 4/07 contact with HLFN Consultation Office to discuss concern from Band leadership re: business opportunities, hiring of Economic Development Officer, and social priorities workplan. • Meeting December 10/07 with HLFN Consultation Office to discuss Business Opportunities for HLFN community, new hire Economic Development Officer strategy, social priorities for community and Project consultation process. • Meeting February 21/08 with HLFN Consultation Office and Economic Development Officer to discuss process for Project and update on economic development strategy and business opportunities. • Meeting to discuss MEG's support of HLFN's TLU for incorporation into the Project assessment. • Information Workshop March 13/08 with HLFN Consultation Office and Elders Committee to provide information on Project consultation process.

Table 5.4-1 Summary of Stakeholder Consultations (continued)

Contact	Activities
Beaver Lake First Nation (BLFN)	• Meeting November 15/07 with BLFN Consultation Office to discuss BLFN Agreement and funding request. Negotiations to be continued. • Meeting February 21/08 with BLFN Consultation Office to discuss TLU, next steps in Project consultation process.
Conklin Métis Local 193 Conklin Community Association (CCA)	• Meeting November 8/07 with Métis Local 193 President to discuss meeting to plan consultation process for Project, community priorities and business opportunities. • Meeting November 20/07 with Métis Local 193 Board and Consultant to discuss consultation process, capacity development for community, short and long term goals for the community, Project consultation process – starting in January 08, a letter was to be sent to Government regarding the merging of the CCA and Métis Local 193. • Meeting November 28/07 with Métis Local 193 Board and Consultant to discuss TLU study, Consultant's role, drafted Action Plan and Work plan for Project consultation, as well as TOR. • Meeting January 16/08 with Métis Local 193 Board and Consultant to discuss Project, TOR, Action Plan, and TLU.
Métis Nation of Alberta (MNA) Region 1, Lac La Biche	• Meeting October 23/07 with MNA Region One Leadership to discuss follow up to concern raised of capacity to deal with all applications from Industry – letter to be sent to Government for clarification on consultation and resources for capacity. Project Public Disclosure provided. • October 24/08 received MNA Region One letter to Alberta Government Re: Capacity, Resources and Consultation.
Regional Service Providers	• Several meetings and communications with CPDFN-IRC to identify range and scope of goods and services available and the preferred process for engaging with CPDFN service providers. • Several meetings with CPDFN-IRC to address matters related to specific contracts awarded for services for MEG's Project by their service providers. • Several meetings and communications with individual Chard service providers relative to the range and scope of services available and on matters arising from individual contracts for services awarded. • Several meetings and communications with Conklin-based service providers to identify range and scope of services available and ongoing involvement in contracts awarded for service. • Meetings and communications with FMFN-IRC to identify range and scope of services available. • Meeting and communication with HLFN to identify range and scope of services available. • Meetings with MNA Region One in Lac La Biche to identify range and scope of services available. • Compiled a database of regional and local service companies and made it available to the Project's General Contractor together with information on contact persons in communities for provision of employees, good and services.
Special Interest Groups	• Attended regularly scheduled Regional Issues Working Group (RIWG) Committee and Board of Director meetings and participated in RIWG activities.

5.4.2 Community Consultation

In the Fall of 2007, formal communications regarding the Phase 3 expansion were initiated with identified community groups in the study region and consultation activities with all stakeholders were intensified as of January 2008. MEG's model of consultation will ensure that the process continues throughout the lifespan of the Project as development and implementation is undertaken. Following is a description of the consultation process that has been instituted with each community group:

5.4.2.1 Chipewyan Prairie Dene First Nation

Two meetings were held with the Chipewyan Prairie Dene First Nation (CPDFN) consultation committee to establish a process and plan for the Project's public consultations. These meetings resulted in a draft consultation action plan being developed. A protocol for ongoing consultation will be discussed and finalized jointly by CPDFN and MEG. A budget has already been established for this consultation process. Future meetings will address the identification of major themes and their resolution, as well as community, social and economic development.

5.4.2.2 Heart Lake First Nation

A consultation process for the Project has been agreed upon with Heart Lake First Nation (HLFN) Consultation Office. Meetings have been held with the Elders Committee to discuss the Project and the process of consultation to be implemented. An information workshop has been held with the Elders and consultation office to establish an understanding of the EIA procedure and the regulatory requirements of the Project application. Future meetings will address issues identification and resolution together with social and economic development initiatives for the HLFN. Meetings addressing business development opportunities related to the Project development have been initiated and are ongoing.

5.4.2.3 Beaver Lake First Nation

Meetings have been held with Beaver Lake First Nation (BLFN) Intergovernmental Affairs and Industry Relations group. A joint action consultation plan has been agreed upon. A consultation and monitoring agreement has been signed between MEG and the BLFN. This agreement provides for consultation and monitoring processes, financial considerations and economic development together with a dispute resolution process.

5.4.2.4 Fort McMurray First Nation

MEG is an Associate Member of the Fort McMurray First Nation IRC. Information on the Project has been provided to the IRC. Plans are being made to develop and implement a consultation process for the Project.

5.4.2.5 Conklin Métis Local #193 and Conklin Community Association

Information on the Project has been provided to both the Conklin Community Association (CCA) and the Conklin Métis Local 193. Several meetings have been held with the Conklin Métis Local 193. A consultation action plan has been developed and agreed upon. MEG has participated in meetings to establish a Conklin Resource Development Advisory Committee (CRDAC) through which the Métis Local 193 and CCA would jointly create a window of interface for industry to ensure the vested interests of the community are addressed. Future meetings will address issues identification and management, community information and involvement, together with social and economic development initiatives.

5.4.2.6 Chard Métis Local #214

Two planning meetings have been held with the Chard Métis Local #214 to introduce the Project and to establish the consultation process with MEG. A consultation action plan has been developed and agreed to, while a consultation memorandum of understanding is now being prepared jointly. An information workshop has been held with the Chard Métis Local #214 and Elders to establish understanding of the EIA and the regulatory requirements of the Project application. Future meetings will address issues identification and management, together with social and economic initiatives for this Métis community.

5.4.2.7 Métis Nation of Alberta Region One

Meetings have been held with the Métis Nation of Alberta (MNA) Region One to introduce the Project and to discuss business opportunities associated with the CLRP. Future meetings to further the consultation process are anticipated.

5.4.2.8 Area Trappers

MEG held two consultation sessions with trappers potentially affected by the Project, one in Lac La Biche and one in Conklin. At these meetings, MEG presented information on the Project and discussed potential impacts with each trapper. Trappers were invited to provide input on ways in which impacts could be managed. Follow up meetings with a number of individual trappers have occurred and MEG will continue consultation with these potentially affected individuals.

5.4.2.9 Themes of Interest

The general themes of interest identified by stakeholders to date include the following areas:

- Culture and Traditional Resource Use;
- Environment;
- Employment, Training and Business Opportunities (Economic Benefits); and
- Regional and Community Infrastructure.

While these themes have been overarching and common to the majority of the groups consulted, MEG's consultation process has been designed together with the stakeholders to be responsive to individual interests within each of these areas. For example, CPDFN have expressed concerns regarding their traditional lands in the area around Winefred Lake. Their concerns are that development will affect their sacred sites, hunting rights and traditional uses. The CPDFN people hunt animals in the area for food and pick berries and medicinal herbs for ceremonies. Heart Lake First Nation has expressed concerns regarding the future of their youth and what will be left for them in the future after development is finished. Elders are particularly concerned about impacts to traditional food sources including fish and moose and the relationship between development on the land and its effects on the water.

MEG's consultation process is a dynamic process, with themes of concern being identified on an ongoing basis. Table 5.4-2 lists the themes identified to date by community representatives in regards to the Project, as well as an outline of MEG's proposed response and/or mitigation.

Table 5.4-2 Themes Identified In Public Consultation

Themes Discussed	Focus Of Interest	Issues/Comments	Response And/Or Actions Taken
Culture and Traditional Land Use	**The effects of the Project on current and future traditional uses of the lands in the traditional areas of Aboriginal communities.**	The Project will affect the current and future traditional uses of these lands by Aboriginal communities, including medicinal plants. How will MEG avoid or mitigate these affects? How will MEG ensure that berry-picking, trapping, hunting, and fishing continue as a way of life for the Aboriginal communities in the area? How will the potential impacts on traditional, current and future uses of the land be addressed?	MEG has undertaken extensive surveys for rare and traditional plants within the Project area and will use this information to guide project development where practicable. As part of it's ongoing collaboration with community stakeholders, MEG is committed to incorporating traditional knowledge into the project design. MEG's has developed a number of wildlife mitigations (Volume 5, Section 3) as well as a monitoring and habitat enhancement program to minimize impacts to wildlife (Volume 5, Section 8).
	Protection of archeological and other sites	How will MEG identify, respect and protect Aboriginal historical sites throughout the construction and operations phases of the Project?	As part of the EIA, MEG undertook historical resources assessment of the Project area (Volume 6, Section 5). The study identified no archeological/historical sites within the Project area. However, MEG continues to work with community stakeholders to collect traditional/historical knowledge within the Project area. MEG is committed to incorporating local historical knowledge into project design where practicable.
	Access to the land	How will MEG ensure that traditional access to land is not denied?	MEG is committed to ensuring that traditional users and other resource users will continue to have access to the land within the Project area. New access roads may allow increased year-round access to parts of the Project area that may have been difficult previously. MEG will continue to work with traditional users of the land, particularly trappers, to balance land use requirements with access and safety considerations.

Table 5.4-2 Themes Identified In Public Consultation (continued)

Themes Discussed	Focus Of Interest	Issues/Comments	Response And/Or Actions Taken
Environment	**Air quality**	How will project emissions affect the health of people and animals in the region?	MEG has undertaken air emissions and health assessments (Volume 3) to ensure that Project emissions do not result in health risks to local people, plants or wildlife. MEG's assessments indicated that health risks from the Project are negligible.
		How will MEG address impacts affected by wind patterns in the area?	MEG's air modeling methods took into account local wind patterns and resulting emissions effects. These considerations were incorporated in the health risk assessment (Volume 3, Section 3).
		How will plant emissions affect haze or cause air odours?	MEG has committed to building modern, energy-efficient facilities with low NO_x and sulphur recovery equipment to minimize the production of acidifying emissions. As part of the EIA, MEG has completed a visual impact assessment of the plant emissions in the context of the local landscape (Volume 6, Section 4). Visual impacts of the Project were generally predicted to be negligible
	Water	How will MEG's Project affect drinking water?	An extensive groundwater assessment was undertaken for the Project (Volume 4, Sections 4.1, 5.1 and 6.1). The assessment predicted that the Project would have no impacts on drinking water in the Project area. MEG will expand its network of groundwater monitoring wells within the Project area in order to detect and manage any potential shallow groundwater contamination issues.
		Is freshwater being used for the operation of the Project?	No surface water will be used for Project operations. Steam generation makeup water will be from a non-potable water source. Potable water will be used at the Project as drinking and utility water.
	Sulphur dioxide and salt disposal	How will MEG dispose of a) sulphur dioxide; and b) salt?	MEG's plants will employ sulphur recovery equipment to minimize emissions of this gas. Recovered sulphur will be loaded and trucked offsite for safe disposal. All brine (salt) waste will be disposed of by deep well injection and will not be allowed to enter the surface environment.

Table 5.4-2 Themes Identified In Public Consultation (continued)

Themes Discussed	Focus Of Interest	Issues/Comments	Response And/Or Actions Taken
Environment (continued)	**Traffic and impact on wildlife**	How will MEG deal with impacts caused by Project traffic?	MEG has incorporated a number of mitigations in Project design to minimize impacts to wildlife (Volume 5, Section 3). The wildlife assessment (Volume 5, Sections 4.3, 6.3 and 7.3) predicts that traffic does negatively impact wildlife, although the impacts are generally predicted to be low. MEG is developing a traffic management strategy for the Project that will include the use of buses, air transport and strict controls on Project access roads. A wildlife sighting program has been implemented along MEG's access roads to promote awareness, reporting and GIS recording of wildlife movements across the Project site allowing for improved planning and scheduling of activities. MEG plans to monitor wildlife within the Project area to ensure effective management strategies including rules preventing staff and contractors from hunting or trapping.
	Cumulative effects	How will MEG mitigate the Project's overall contribution to cumulative effects from industry development within the region?	Air quality within the regional study area will meet or exceed air quality guidelines, this includes cumulative contributions from planned developments. MEG participates on a monthly basis in a number of regional multistakeholder efforts to ensure that industry is working collaboratively to effectively manage cumulative impacts of development and operations. MEG will operate a number of monitoring programs during operations to track and respond to any identified problems with air, water or land in the local study area. MEG's objectives in designing the Project include reducing impacts on lands possessing traditional resource use value (as defined by local Aboriginal communities) and working to utilize existing footprints, to the extent practicable, avoiding further disturbance and additional habitat fragmentation.

Table 5.4-2 Themes Identified In Public Consultation (continued)

Themes Discussed	Focus Of Interest	Issues/Comments	Response And/Or Actions Taken
Environment (continued)	**Monitoring of environmental impacts and mitigating actions**	How will MEG monitor on-going impacts related to the Project?	MEG will have a number of ongoing monitoring programs to ensure environmental integrity, including: – Groundwater monitoring – Wetlands monitoring – Air quality monitoring – Wildlife monitoring – Soils monitoring – Monitoring water levels in groundwater wells MEG is working with local communities and other producers active in the Southern Athabasca Oilsands area, to meet with local communities on a regular basis to report on regional environmental monitoring. MEG is committed to involving local community members in the monitoring process.
	Reclamation	How will MEG reclaim the lands occupied during and upon completion of the Project?	MEG has developed a detailed conservation and reclamation plan for the Project (Volume 1, Section 6) which outlines MEG's approach to reclamation. Upon completion of various phases of the Project, MEG will work collaboratively with stakeholders and ARSD to ensure reclamation meets applicable regulatory standards and end land use goals of stakeholders.
Employment, Training and Business Opportunities (Economic Benefits)	**Procurement of goods and services from local businesses** **Local hiring for construction phase and permanent positions for the Project operations**	How will MEG ensure that local businesses are given a fair opportunity to bid on and be awarded contracts?	MEG has established a procurement policy for contracting local services. An internal database is being developed of local service providers to help them pre-qualify for contracts.
	Provision of education and training to help local people obtain employment **Cumulative impact on local goods and service providers**	How will MEG involve local people and service providers during the construction and operations phases of the Project?	MEG has hired a Community Affairs Manager to be based at the Project site and responsible for linking local service providers with MEG personnel and contractors to increase local workforce participation. MEG is working with local communities to identify goods and services that will be needed in this Phase 3 Project and to help develop capacities in these communities to participate.

Table 5.4-2 Themes Identified In Public Consultation (continued)

Themes Discussed	Focus Of Interest	Issues/Comments	Response And/Or Actions Taken
Employment, Training and Business Opportunities (Economic Benefits)		How will MEG plan for education and training programs to provide required skills for employment within the Project scope?	For the operational phase, MEG is completing the design of a framework to collaborate with stakeholder communities to develop a well-qualified workforce that can participate actively in all aspects of the Project. In addition, MEG has and will continue to be involved in the development and implementation of partnerships with other industry leaders as well as public and private educational institutions such as Keyano College's Environmental Monitoring Program and Portage College's Power Engineering Program.
		How can MEG respond to the increasing demands of industry in all aspects of business needs?	MEG is working with local communities to identify ways in which it can assist and compliment educational programming within their communities.
			Through consultation with stakeholder communities, MEG is providing in-kind services to assist with the development of business plans and business models to encourage and assist local groups pursue and create businesses that meet new market niches.
Regional and Community Infrastructure	**Emergency response planning**	How will MEG establish an Emergency Response Plan (ERP) for the Project?	MEG has developed a detailed ERP (Volume 1, Section 3) and has a continuous improvement system to constanly revise this plan with operational experience. Since its initial development, the ERP has been revised to include greater clarity on communications with community stakeholders.
			MEG has and will continue to work with local communities on emergency response planning.
	Emergency contacts	How will MEG manage its chain of communications in the event of an emergency?	MEG has established procedures to notify and engage local communities in emergency situations.
	Traffic and impact to people	How does MEG plan to deal with impacts caused by site traffic?	MEG has attempted and will continue to work (through the Community Relations Manager and others) to hire locally wherever possible, reducing the flow of outside traffic and limiting the size of camps which require employee commuting to areas far outside the local region.
			MEG is also an active member of working groups dealing with traffic issues on Highway 881 that links the Project site to Lac La Biche to the south and Highway 63 to Fort McMurray to the north.

Table 5.4-2 Themes Identified In Public Consultation (continued)

Themes Discussed	Focus Of Interest	Issues/Comments	Response And/Or Actions Taken
Regional and Community Infrastructure	**Security and policing**	How will MEG facilitate safe travel on Highway 881 as well as the Conklin – Janvier area through the construction and operation of the Project?	MEG recognizes that industrial and recreational use and access of the area will likely increase over time. MEG worked with local communities and other industrial operators in the creation of a successful case for upgrading Highway 881. MEG established a security checkpoint on the Project road from Highway 881, leading to the Project site. Despite the fact that other industry, community and government partners utilize this road, MEG solely maintains the security operations which include the monitoring of vehicular speed. MEG communicates advance notice to all appropriate authorities and personnel of oversized load deliveries to site. In addition, MEG maintains regular contact and communication with the local RCMP detachment. MEG will work with local communities on the best options for reducing potential traffic conflicts and promoting safe operations. Camps at the Project site will reduce community traffic during construction. MEG will advise communities of the timing of construction activities and work to identify and address issues arising from the presence of work crews in the area. Contractors and staff will be required to adhere to MEG's safe highway driving standards and be educated to recognize and respect the needs of the communities.
	Infrastructure	How will MEG engage in the development of community infrastructure such as housing, health, sewage, etc.?	MEG has advised the communities in consultation meetings that the financial requirements for such infrastructure and commitments are the responsibility of government and municipal agencies. MEG and other industry members are committed to providing advocacy and in-kind support to enhance the capacity of the communities to seek out and obtain improvements in local infrastructure from the appropriate authorities. MEG is working with the communities through its Consultation and Procurement Groups and the Community Relations Manager to increase the participation of the local workforce and service sector in construction and operations. This in turn will inject capital into the local economy that can provide for or complement infrastructure needs.

Table 5.4-2 Themes Identified In Public Consultation (continued)

Themes Discussed	Focus Of Interest	Issues/Comments	Response And/Or Actions Taken
Regional and Community Infrastructure	**Balance between economic benefits and potential negative impacts**	How will MEG achieve a balance between providing economic benefits and potentially adversely impacting the communities as a result of this industrial development?	MEG will continue to advance the progress achieved to date by working closely with local communities to anticipate and mitigate potential adverse affects and conflicts. MEG will continue to work with the local communities and associations to define mutually beneficial opportunities. MEG has developed and is enforcing, in collaboration with local communities, a code of conduct for employees working in the area. This includes policies regarding drug and alcohol abuse, the use of recreational vehicles, etc. Community Relations personnel associated with the Project will ensure issues are identified and resolved together with local communities in a timely manner.

5.4.3 Advertising and Promotion

As a first step to advancing the Project, a Public Disclosure document was released in the fourth quarter of 2007. The proposed TOR for the Project EIA was sent to AENV on September 26, 2007. Public notification of these documents was placed in the following newspapers:

- Conklin Nakewin News;
- Fort McMurray Today;
- Lac La Biche Post;
- Alberta Sweetgrass;
- Bonnyville Nouvelle;
- Cold Lake Sun;
- Edmonton Journal;
- Edmonton Sun; and
- Calgary Herald.

Copies of both documents were made available for viewing at local and regional centers in northern Alberta (Table 5.4-3). Copies were also mailed to stakeholders listed in MEG's public consultation database. Additionally, visits by MEG personnel were made to these centres to ensure receipt of the documents, to review the content with stakeholders and to advise on the process required to provide input.

Table 5.4-3 Locations for Viewing Public Disclosure Document and the Draft Terms of Reference

Community	Location
Edmonton	Regulatory Approval Centre (RAC), AENV
Fort McMurray	Fort McMurray Public Library
Hamlet of Conklin	Conklin Community Association (CCA)
Lac La Biche	Lac La Biche Public Library

5.5 ONGOING CONSULTATION

Consistent with MEG's corporate policy and stakeholder desire, MEG will continue communication and consultation with stakeholders as the Project proceeds through application, approval, construction, operation, reclamation and eventual decommissioning.

Copies of application documents that have been or will be submitted to the ERCB and to AENV will be provided to agencies, organizations and information depositories in Alberta. Further advertisements to notify the public about the application will be placed with local media. Current information will be available as it is made available on MEG's website.

MEG will also present the information to local communities through a process agreed to by each community, taking into account different levels of involvement and timeliness appropriate to each group of stakeholders. Regular consultation will continue with stakeholders most affected by the Project. Communication with all interested parties will be ongoing. This continuing consultation will ensure an effective flow of information to stakeholders and to the public-at-large. Consultation activities will include:

- information sessions and meetings with local and regional groups;
- presentations to municipal organizations and regional groups concerned with infrastructure, economic development, environmental management, education and training and employment;
- meetings and discussions with stakeholder representatives to ensure the close working relationships already established are maintained or extended;

- continued involvement in regional working groups that focus on regional resource development and relationships to environment, economy and society in the region;
- promoting awareness of the Project in a timely manner through appropriate means; and
- continuing community meetings with leaders, organizations, trappers, contractors, educational institutions, Elders, and other parties that have been or may be identified.

6 CONSERVATION AND RECLAMATION PLAN

6.1 INTRODUCTION

Information in this Conservation and Reclamation (C&R) Plan was prepared to meet the Terms of Reference (TOR) issued for the Project (AENV 2008), as summarized in Table 6.1-1.

The C&R Plan will follow the general outline and practices described herein. Activities completed annually and those planned for the following year will be reported to Alberta Environment (AENV) in a detailed C&R Annual Report.

Table 6.1-1 Terms of Reference Concordance Table

TOR Section	Terms of Reference	Location TOR Addressed
3.10 Conservation and Reclamation	[A] Provide a conceptual reclamation plan for the Project that considers: (a) any existing Conservation and Reclamation Plan.	[A] a) Volume 1, Section 6 Conservation and Reclamation Plan
	(b) pre-development information with respect to land capability, vegetation, commercial forest land base by commercialism class, forest productivity, recreation, wildlife, aquatic resources, aesthetics and land use resources	b) Volume 1, Section 6 Conservation and Reclamation Plan Volume 6, Section 4.3 Existing and Approved Case
	(c) integration of operations, decommissioning, reclamation planning and reclamation activities. Discuss anticipated timeframes for completion of reclamation stages and release of lands back to the Crown including an outline of the key milestone dates for reclamation and how progress to achieve these targets will be measured;	c) Volume 1, Section 6, Conservation and Reclamation Plan
	(d) constraints to reclamation such as timing of activities, availability of reclamation materials and influence of natural processes and cycles;	d) Volume 1, Section 6.6 Detailed Conservation and Reclamation Plan
	(e) post-development land capability with respect to the following: i) self-sustaining topography, drainage and surface watercourses representative of the surrounding area, ii) pre-development traditional use with consideration for traditional vegetation and wildlife species in the reclaimed landscape, iii) wetlands; iv) self-sustaining vegetation communities representative of the surrounding area and reforestation and forest productivity; and v) reforestation and forest productivity;	e) Volume 1 Section 6.5 Equivalent Capability
	(f) a revegetation plan for the disturbed terrestrial and aquatic areas. Identify the species types that will be used for seeding or planting, and the vegetation management practices to be used. Outline how the disturbed areas will be returned to a state capable of supporting a self-sustaining vegetative community capable of ecological successions equivalent to pre-disturbance conditions. Discuss factors such as biological capability and diversity and end land use objectives;	(f) Volume 1, Section 6.6.9 Revegetation Plan

Table 6.1-1 Terms of Reference Concordance Table (continued)

3.10 Conservation and Reclamation (continued)	(g) reclamation material salvage, storage areas and handling procedures;	(g) Volume 1, Section 6.6.3 Topsoil and Subsoil Salvage; Volume 1 Section 6.6.5 Soil Stockpiling
	(h) reclamation material replacement indicating depth, volume and type;	(h) Volume 1, Section 6.6.8 Soil Replacement Plan
	(i) pre-development and final reclaimed site drainage plans;	(i) Volume 1, Section 6.6.6.2 Water Management Plan; Volume 1, Section 6.6.7 Facility Decommissioning Closure and Site Contouring
	(j) integrating surface and near-surface drainage within the development area; and	(j) Volume 1, Section 6.6.10 Component-Specific Revegetation and Reclamation Plans
	(k) promotion of biodiversity.	(k) Volume 1, Section 6.5.2 Biodiversity
	[B] Provide: (a) a conceptual ecological land classification (ELC) map for the post-reclamation landscape considering potential land uses and how the landscape and soils have been designed to accommodate future land use; and	(a) Volume 1, Section 6.6.9 Revegetation Plan
	(b) a discussion of any uncertainties related to the conceptual reclamation plan.	(b) Volume 1, Section 6.6.9 Revegetation Plan

6.2 CONSERVATION AND RECLAMATION OBJECTIVES AND KEY ACTIVITIES

The objective of the MEG C&R Plan is to outline how the Project will be reclaimed to an equivalent land capability following Project operation. This C&R Plan presents measures to mitigate impacts and outlines proposed monitoring programs to ensure that mitigation is successful.

The end land use objective, after final reclamation and site decommissioning, is to return forest capability and wildlife habitat capability to a level similar to that of pre-disturbance conditions.

The C&R Plan describes the general and Project-specific environmental protection measures to be implemented during development to minimize potential impacts identified in the Project Application and Environmental Impact Assessment (EIA). A series of environmental protection measures have been developed to address potential impacts. The areas disturbed by Project activities will be progressively reclaimed to minimize impacts such as soil erosion 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.

MEG is committed to conservation of the resources in the area of the Project through development of only those areas required for successful construction and operation of the Project. MEG is also committed to following the *C&R Codes of Practice for Alberta* (AENV 1995c) for the Project, as follows:

- clean-up and remediate contaminants, or dispose of contaminants, to meet AENV requirements;
- re-contour the site to be compatible with the end land use, provide proper drainage and stability, and control erosion;
- do not use topsoil 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 soil amendments to meet reclamation objectives;
- use approved revegetation seed mixes that are compatible with the intended end land use;
- control noxious weeds; and
- where required, use native species or mixtures that will allow the establishment of native species.

Additionally, MEG will maintain an effective stakeholder consultation and participation program, including discussions on development and reclamation of the Project.

6.3 PROJECT DESCRIPTION

The Project will involve surface disturbances related to the following components:

- plants and camps;
- wellpads;
- pipelines (above and below ground);
- access roads and ROW;
- borrow areas; and
- associated components (including power supply, fuel gas pipelines, water source wells, and disposal wells).

Details on the Project design and components are provided in Section 1, and Section 3. The design of the Project footprint has incorporated engineering and environmental considerations in an effort to use existing disturbances and Rights-Of-Way (ROW), where possible, to limit new disturbance and avoid environmentally sensitive areas. Project construction is expected to begin in 2010 for Phase 3A and in 2012 for Phase 3B.

Table 6.3-1 summarizes the distribution of soil and vegetation disturbances among facility types.

Table 6.3-1 Project Components and Disturbance Areas

Project Component	Soil Disturbed [ha]	Vegetation Disturbed [ha]
plants and camps	232	232
wellpads	468	468
pipelines (above and below ground)	84	333
access roads and ROW	281	281
borrow areas	550	550
associated components (power supply, fuel gas pipelines, source and disposal wells)	41	164
Total Disturbance	**1,656**	**2,028**
Existing disturbances[(a)]	287	310
Net New Disturbance[(b)]	**1,369**	**1,718**

(a) Existing disturbances includes the activities completed on the development area prior to the development of the Project.

(b) Net new disturbance is the total disturbance minus the existing disturbance.

6.3.1 Siting and Route Selection

Criteria for locating and routing for the various Project components included the following:

- existing topographical (slopes, breaks), biophysical (soil, vegetation, wildlife) and hydrological conditions;
- avoidance of steep slope areas;
- ensuring that Project components are a minimum of 100 m away from features such as waterbodies;
- sub-surface oil sands resource target;
- locating pipelines, roads and power lines on existing disturbance, where practicable;

- engineering characteristics of pipelines and Project components; and
- avoiding wetlands where practicable.

6.3.2 Contamination Assessment

Based on the results of the Phase I Environmental Site Assessment (ESA), a Phase II ESA may be completed (AENV 2001a). Where applicable, an assessment of existing contamination will be conducted prior to construction (Phase I, II as per AENV 2001a).

6.4 EXISTING AND APPROVED CASE

Information on the existing biophysical environment as well as the potential environmental effects associated with the Project is provided in the following sections of the EIA:

- Air Quality in Volume 3, Section 1;
- Noise in Volume 3, Section 2;
- Health in Volume 3, Section 3;
- Hydrogeology in Volume 4, Appendix 4-II;
- Hydrology in Volume 4, Appendix 4-III;
- Water Quality in Volume 4, Appendix 4-IV;
- Fish and Fish Habitat in Volume 4, Appendix 4-V;
- Soil and Terrain in Volume 5, Appendix 5-I;
- Terrestrial Vegetation and Wetlands, and Forestry in Volume 5, Appendices 5-II and 5-III;
- Wildlife in Volume 5, Appendices 5-IV and 5-V;
- Biodiversity in Volume 5, Appendix 5-VI;
- Resource Use in Volume 6, Appendix 6-II; and
- baseline information on the physiography and geology of the Christina Lake area is provided in Hydrogeology Volume 4, Appendix 4-II.

The information in this C&R Plan is provided for the Terrestrial Resources LSA. This LSA is described in Volume 2, Section 1.4.4.

6.4.1 Terrestrial Mapping Approach

The approach to mapping terrestrial disciplines differs between the Existing and Approved Case (EAC) and far-future scenarios as follows:

- the EAC describes existing soils, vegetation and wetlands, wildlife habitat and biodiversity that can be mapped fairly accurately; and
- the Far-Future scenario describes the expected terrestrial ecosystem 80 years following reclamation.

Information on the EAC conditions for both soil and vegetation are illustrated in Figures 6.4-1 to 6.4-3.

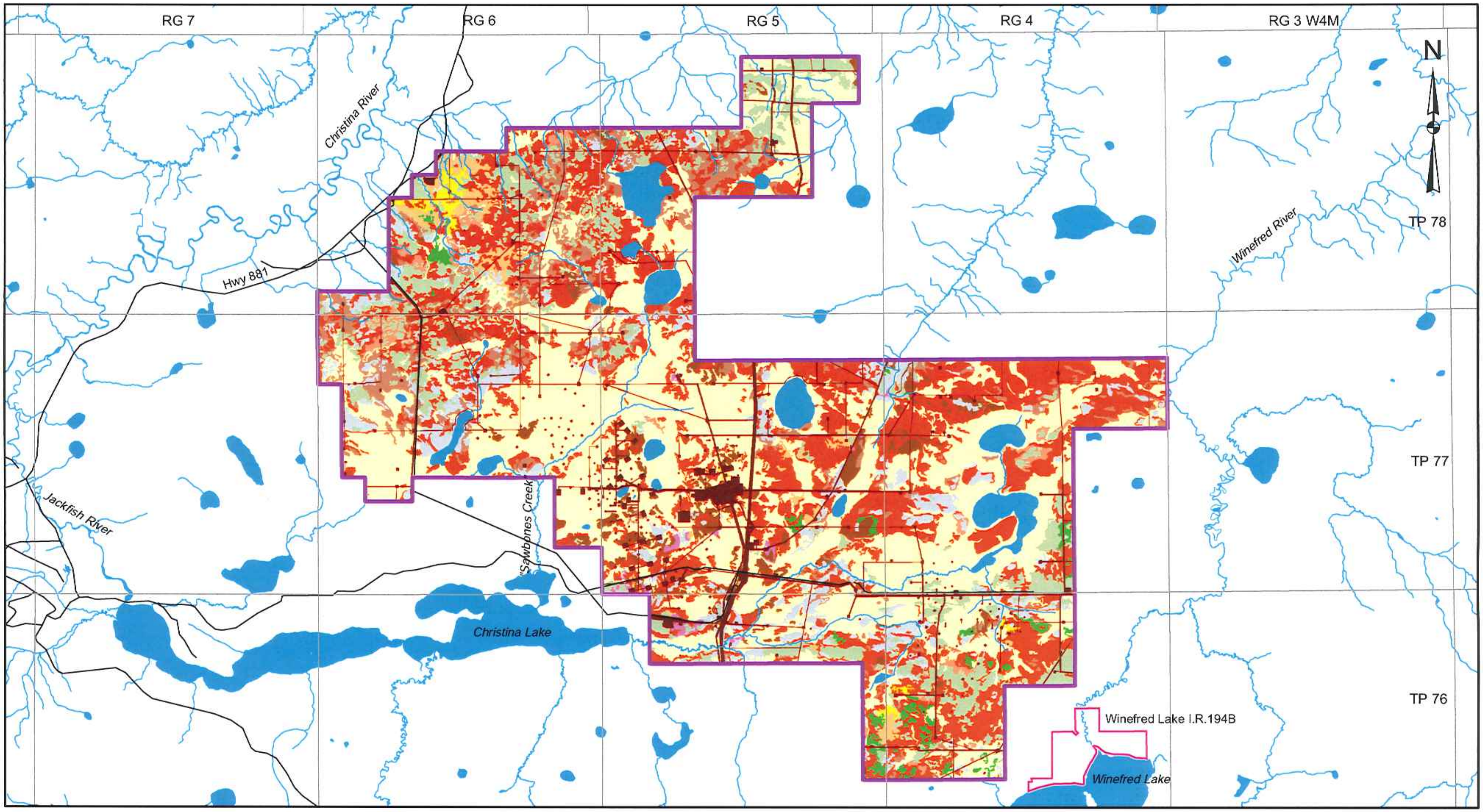
6.5 EQUIVALENT CAPABILITY

MEG is committed to restoring equivalent capability for the reclaimed site, as per AENV requirements. The following sections compare the anticipated pre-disturbance and reclamation land capability changes for soil, vegetation, wildlife and biodiversity. Landforms and vegetation communities may not be identical to pre-disturbance conditions after reclamation, but the land capability of reclaimed areas will be equivalent to that of pre-disturbance conditions, as is required under the EPEA. Opportunities to enhance land capabilities and to consider multiple end land uses will be adaptively managed during the life of the Project in consultation with regulators and stakeholders.

6.5.1 Land Capability for Forestry

A discussion of the predicted changes in land capability for forestry due to the Project is discussed in Volume 5, Section 6.1 (Soil and Terrain) and summarized in Table 6.5-1. Figure 6.4-3 shows both the land capability classification in the LSA for the baseline case and the far-future land capability classification. The predicted effects of development and reclamation are that some areas originally classified as Class 4 (conditional productive) or Class 5 (non-productive) will be reclaimed to Class 3 (low) capability (Leskiw 2006).

I:/CLIENTSMEG/07-1346-0009/mapping/mxd/C&R_Plan/lsa_bl_dsoil.mxd



LEGEND

- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- INDIAN RESERVE
- OPEN WATER
- RIVER OR STREAM
- ROADWAY

DISTURBED

- EXISTING AND APPROVED DISTURBANCE
- EXISTING AND APPROVED LINEAR DISTURBANCE

DOMINANT SOIL MAP UNITS

- BITUMOUNT
- CHATEH
- DOVER
- ELLS RIVER
- KINOSIS
- LIVOCK
- MILDRED
- MCLELLAND
- MUSKEG
- SUTHERLAND
- WINEFRED

NOTE

Unnamed watercourse locally known as "Sawbones Creek"

REFERENCE

Digital data obtained from AltaLIS Ltd. (June 2004), Veritas DGC Inc. (July 2004), Alberta Pacific Ltd. (April 2004), Pearson Timberline Ltd. (April 2004), used under license.
Projection: UTM Zone 12 Datum: NAD 83

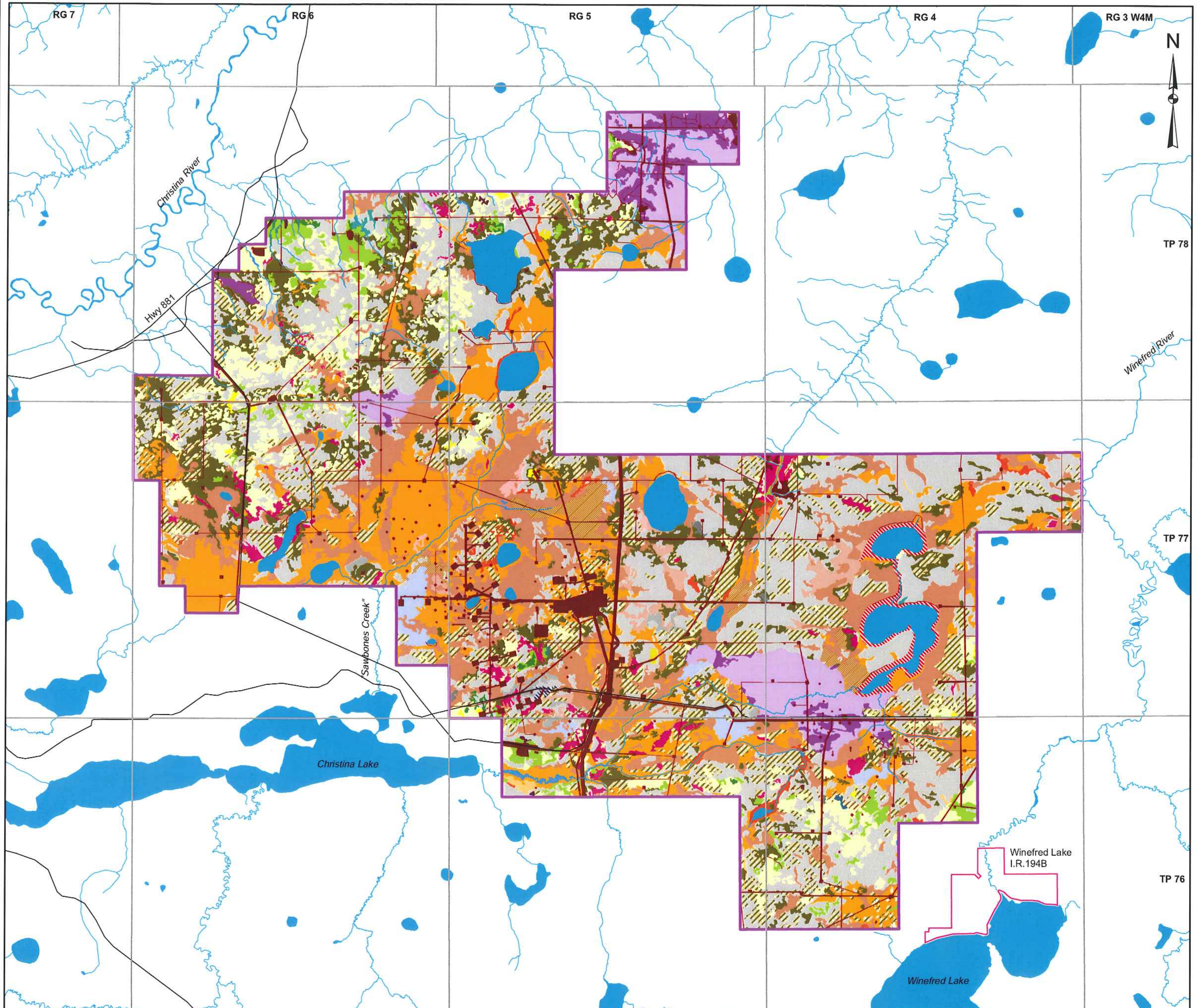
5 0 5
SCALE 1:200,000 KILOMETRES

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
DOMINANT SOIL MAP UNITS IN THE LOCAL STUDY AREA

MEG ENERGY CORP.

PROJECT No. 07-1346.0009.9170			SCALE AS SHOWN	REV. 1
DESIGN	BL	11 Jan. 2008	FIGURE: 6.4-1	
GIS	ZB	06 Mar. 2008		
CHECK	DD	17 Apr. 2008		
REVIEW	IGG	17 Apr. 2008		



LEGEND

- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- INDIAN RESERVE
- OPEN WATER
- RIVER OR STREAM
- ROADWAY

DISTURBED

- EXISTING AND APPROVED DISTURBANCE (THE MAJORITY OF SEISMIC LINES WITHIN THE LSA HAVE NOT BEEN SHOWN IN ORDER TO CLEARLY PRESENT THE RELEVANT DETAILS OF THIS MAP)

ECOSITE PHASE/WETLANDS TYPE

- FORESTED BOG (BFNN)
- OPEN BOG (BONN)
- WOODED BOG WITH INTERNAL LAWNS (BTNI)
- WOODED BOG (BTNN)
- BURNED UPLAND (BUu)
- BURNED WETLANDS (BUw)
- CUTBLOCK (CC)
- FORESTED FEN (FFNN)
- GRAMINOID FEN (FONG)
- SHRUBBY FEN (FONS)
- PATTERNED FEN (FOPN)
- WOODED FEN WITH INTERNAL LAWNS (FTNI)
- WOODED FEN (FTNN)
- WOODED FEN WITH FORESTED ISLANDS (FTNR)
- WOODED PATTERNED FEN (FTPN)
- MARSH (MONG)
- SHRUBBY SWAMP (SONS)
- WOODED SWAMP (STNN)
- SHALLOW OPEN WATER (WONN)
- LICHEN JACK PINE (a1)
- BLUEBERRY JACK PINE-ASPEN (b1)
- BLUEBERRY ASPEN WITH BIRCH (b2)
- BLUEBERRY ASPEN WITH SPRUCE (b3)
- BLUEBERRY WHITE SPRUCE-JACK PINE (b4)
- LABRADOR TEA-MESIC JACK PINE-BLACK SPRUCE (c1)
- LOW-BUSH CRANBERRY ASPEN (d1)
- LOW-BUSH CRANBERRY ASPEN-WHITE SPRUCE (d2)
- LOW-BUSH CRANBERRY WHITE SPRUCE (d3)
- DOGWOOD BALSAM POPLAR-ASPEN (e1)
- DOGWOOD BALSAM POPLAR-WHITE SPRUCE (e2)
- DOGWOOD WHITE SPRUCE (e3)
- HORSETAIL WHITE SPRUCE (f3)
- LABRADOR TEA-SUBHYGRIC BLACK SPRUCE-JACK PINE (g1)
- LABRADOR TEA/HORSETAIL WHITE SPRUCE-BLACK SPRUCE (h1)

NOTE

Unnamed watercourse locally known as "Sawbones Creek"

REFERENCE

Digital data obtained from AltaLIS Ltd. (June 2004), Veritas DGC Inc. (July 2004), Alberta Pacific Ltd. (April 2004), Pearson Timberline Ltd. (April 2004), used under license.
Projection: UTM Zone 12 Datum: NAD 83

4 0 4

SCALE 1:120,000 KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

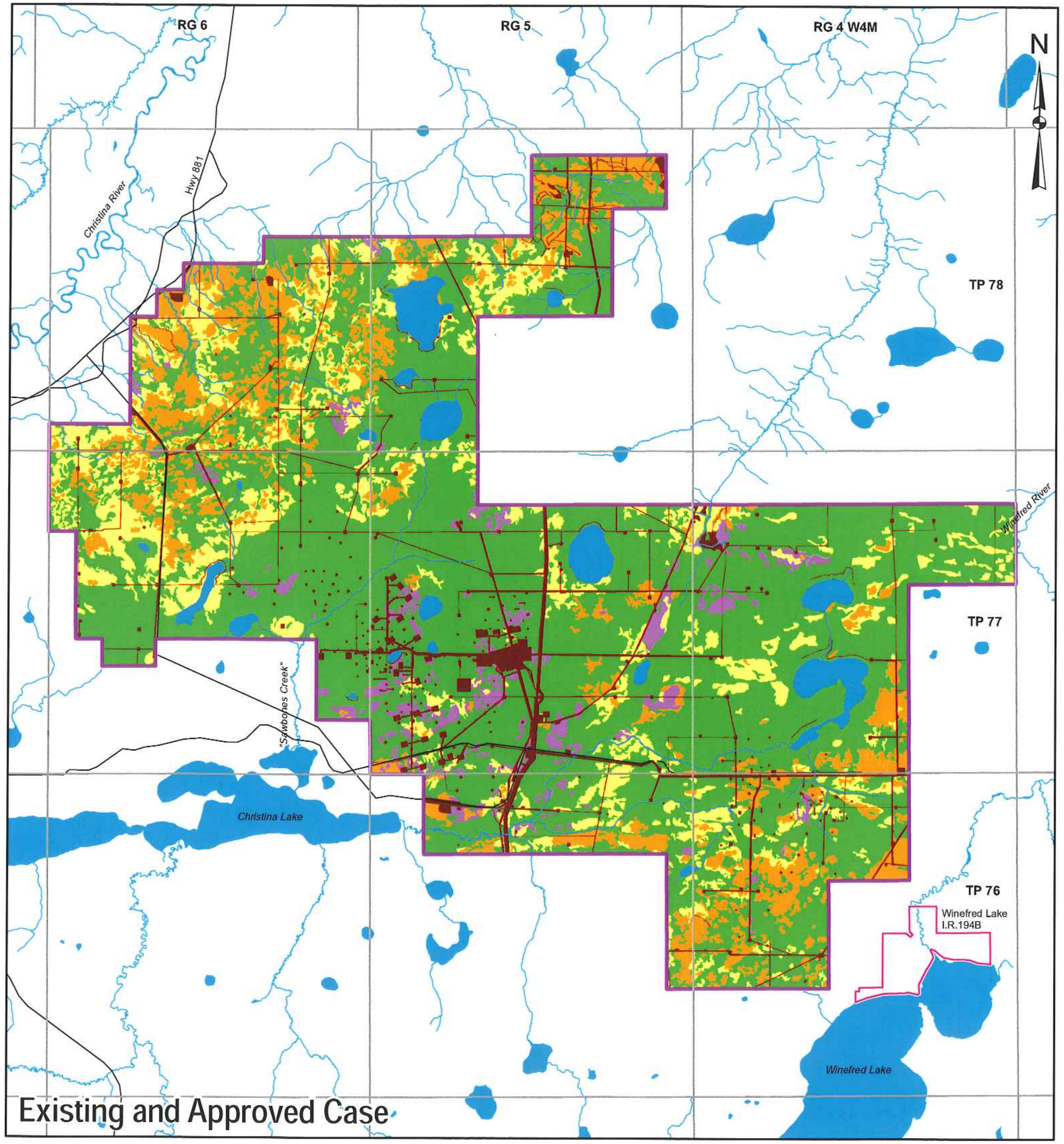
TITLE

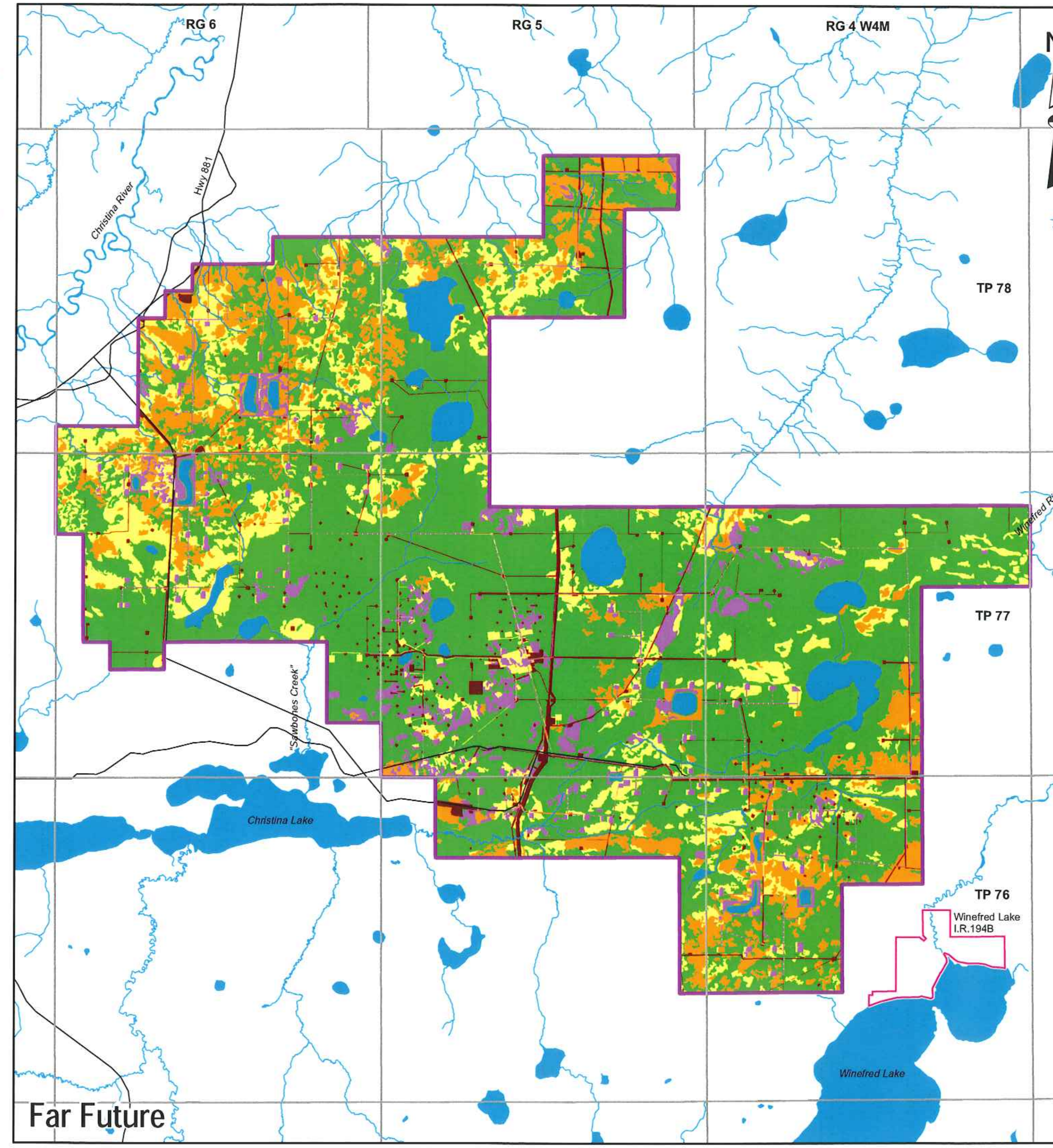
TERRESTRIAL VEGETATION AND WETLANDS RESOURCES IN THE LOCAL STUDY AREA

MEG ENERGY CORP.

PROJECT No. 07-1346-0009.9170			SCALE AS SHOWN	REV. 0
DESIGN	BL	08 Jan. 2008	FIGURE: 6.4-2	
GIS	ZB	06 Mar. 2008		
CHECK	DD	17 Apr. 2008		
REVIEW	IGG	17 Apr. 2008		

I:/CLIENTS/MEG/07-1346-0009/mapping/mxd/C&R_Plan/lsa_bl_ecosite_11x17.mxd





LEGEND

- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- INDIAN RESERVE
- OPEN WATER
- RIVER OR STREAM
- ROADWAY

DISTURBED

- EXISTING AND APPROVED DISTURBANCE
- EXISTING AND APPROVED LINEAR DISTURBANCE

FOREST LAND CAPABILITY

- MODERATE CAPABILITY (2)
- LOW CAPABILITY (3)
- CONDITIONALLY PRODUCTIVE (4)
- NON-PRODUCTIVE (5)

8 0 8

SCALE 1:160,000 KILOMETRES

NOTE

Unnamed watercourse locally known as "Sawbones Creek"

REFERENCE

Digital data obtained from AltaLIS Ltd. (June 2004), Veritas DGC Inc. (July 2004), Alberta Pacific Ltd. (April 2004), Pearson Timberline Ltd. (April 2004), used under license.
Projection: UTM Zone 12 Datum: NAD 83

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

LAND CAPABILITY FOR FOREST ECOSYSTEMS IN THE LOCAL STUDY AREA: EXISTING AND APPROVED CASE AND FAR FUTURE SCENARIO

MEG ENERGY CORP.

PROJECT No. 07-1346-0009.9170		SCALE AS SHOWN	REV. 0
DESIGN	BL	11 Jan. 2008	
GIS	ZB	06 Mar. 2008	
CHECK	DD	17 Apr. 2008	
REVIEW	IGG	17 Apr. 2008	

FIGURE: 6.4-3

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Table 6.5-1 Summary of Predicted Forestry Capability Class Changes Following Reclamation in the Local Study Area

Forest Ecosystems Land Capability Class	Existing and Approved Case		Loss/Alteration Due to Project		MEG Total Closure (Phase 1, 2 and 3)		Far Future		Net Change Due to the Project [(a)]	
	Area [ha]	% of LSA	Area	% of LSA	Area [ha]	% of LSA	Area	% of LSA	Area	% of LSA
class 1 (high)	0	0	0	0	0	0	0	0	0	0
class 2 (moderate)	3,650	11	380	1	3,676	11	3,659	11	9	<1
class 3 (low)	1,110	3	79	<1	1,844	5	1,778	5	668	2
class 4 (conditionally productive)	6,547	19	332	1	6,409	19	6,445	19	-102	-<1
class 5 (non-productive)	20,524	60	698	2	19,785	58	19,928	58	-596	-2
disturbance	1,324	4	168	<1	1,254	4	1,156	3	-168	-<1
water	1,207	4	0	0	1,395	4	1,395	4	188	1
Total	**34,362**	**100**	**1,656**	**5**	**34,362**	**100**	**34,362**	**100**	**n/a**	**n/a**

(a) Net change is calculated as the difference between the Existing and Approved Case and Far Future.

(b) MEG total closure is the total area of reclamation of Phases 1, 2 and 3.

6.5.2 Biodiversity

6.5.2.1 Biodiversity Potential

A discussion on the EAC and Project Case biodiversity is presented in Volume 5, Sections 4.4 and 6.4, and Appendix 5-VI. One of the goals of reclamation is to maintain similar composition, abundance and distribution of all ecosite phases and wetlands types in the Project area. Reclamation plans for Project components will consider the surrounding ecosite phases and wetlands types in an effort to maintain similar biodiversity potential. However, some types, such as peatlands, are difficult to reclaim so specific mitigation is required to maintain these types on the landscape.

Techniques are not currently available to reclaim peatlands (i.e., bogs and fens) if these areas are subjected to severe soil disturbance. Therefore, developments are planned to minimize soil disturbance in peatlands, maximizing the retention and recovery of biodiversity potential. Areas of peatlands disturbed by pipelines and minimal disturbances are expected to naturally regenerate to the pre-disturbance conditions as long as there has been a minimal amount of material added or removed. For example, an aboveground pipeline in a wooded fen (FTNN), where peat material remains largely undisturbed, would remain as a fen and be expected to regenerate as a wooded fen (FTNN) over time. The biodiversity potential of these areas, particularly high-ranked wooded peatlands, would be altered following disturbance but would have the potential to support native flora and fauna as ecological succession progresses following reclamation.

The areas within wetlands that are disturbed by the Project construction may be reclaimed to various ecosites, including blueberry (b), Labrador tea-mesic (c) and low-bush cranberry (d). The culverts, and associated fill material installed across roads to maintain connectivity within wetland areas will be removed, and sections of the roadway planted to the Labrador tea-subhygric (g) ecosite. The adjoining wetlands, many of which have high or moderate biodiversity potential, will be maintained. Wellpads located within wetlands types may be planted to blueberry (b), Labrador tea–mesic (c) or Labrador tea–subhygric (g) ecosites that have low biodiversity potential, but should provide local habitat diversity without compromising the existing wetlands.

Project components located in terrestrial upland areas will be reclaimed and planted to correspond with the surrounding ecosite. For example, a reclaimed wellpad or road in a low-bush cranberry aspen (d1) ecosite phase would be planted to a low-bush cranberry (d) ecosite.

The feasibility of enhancing biodiversity using special reclamation procedures will be discussed with regulators. These procedures may include spreading topsoil unevenly over disturbed areas, creating transition zones between uplands and wetlands to mimic the natural variability in the existing landscape and creating micro-hummocky surfaces that enhance moisture diversity, which can increase local habitat diversity.

6.5.2.2 Heterogeneity and Fragmentation

The reclaimed vegetation types expected to be established through reclamation and natural succession are intended to mimic existing landscape ecosystems. There will be relatively small changes in the abundance and distribution of vegetation types (landscape heterogeneity) as wetlands are converted to upland vegetation classes that may alter local species distributions. Habitat fragmentation, particularly from existing and Project-related linear disturbances, will be reduced as reclamation activities are completed and connectivity between undisturbed natural patches is restored.

6.5.3 Wildlife Habitat

Ecosystems re-established on disturbed lands will be self-sustaining and capable of maturing naturally, to provide suitable habitat for resident and migratory wildlife species. The C&R Plan aims to establish diverse upland wildlife habitats compatible with such areas in surrounding ecosites. Some wetlands habitats directly affected by the Project will shift to terrestrial habitats (predominantly mixedwood) and to early successional habitats from mid-successional habitats. Reclamation is predicted to increase available habitat (moderate/high and high-quality habitat) for most wildlife species in the LSA. Exceptions include moose (-26 ha), Canada lynx (-175 ha) and barred owl (-179 ha). (Volume 5, Section 6.3). In the Far Future, the largest increases in high-quality habitat will be for Canadian toad (650 ha), woodland caribou (488 ha) and beaver (273 ha).

6.6 DETAILED CONSERVATION AND RECLAMATION PLAN

The C&R Plan for the Project is presented below, and has been prepared in accordance with current C&R approval conditions outlined in AENV Approval No. 212127-00-01. Final end land uses within this plan have incorporated recommendations from regulators and other interested shareholders with consideration of guidelines from Oil Sands Region multi-stakeholder committees (e.g., CEMA). MEG will hold meetings with Alberta Sustainable Resource Development (ASRD) and AENV reclamation staff prior to commencing reclamation activities, to ensure that the best site specific reclamation plans are implemented.

This detailed C&R plan is organized in the sequence of construction and reclamation activities including:

- timber salvage;
- vegetation clearing;
- topsoil and subsoil salvage;
- borrow pits;
- soil stockpiling;
- facility operation including a water management plan;
- facility closure decommissioning and site contouring;
- soil replacement;
- revegetation; and
- monitoring.

6.6.1 Timber Salvage Plan

6.6.1.1 Merchantable Timber

MEG will work with Alberta-Pacific Forest Industries Inc. and its contractors to ensure that all merchantable timber is salvaged. Tree species are considered merchantable when they have a stump height following 15/10 utilization standards for deciduous trees and 15/11 utilization standards for coniferous trees (Government of Alberta 1999). Details on the estimated volumes of merchantable timber are provided in Table 6.6-1.

Table 6.6-1 Estimated Total and Merchantable Timber Volume to be Cleared by the Project

Dominant Forest Cover Type	Leading Species	Coniferous Volume [m^3]		Deciduous Volume [m^3]	
		Total	Merchantable[(a)]	Total	Merchantable[(a)]
Merchantable Species					
deciduous	Aw	15,914	15,914	54,712	54,712
	Bw	431	408	1,277	1,238
Total Deciduous		**16,345**	**16,321**	**55,989**	**55,951**
coniferous	Pj	26,209	26,017	2,133	2,122
	Sw	1,066	1,066	154	154
Total Coniferous		**27,275**	**27,083**	**2,287**	**2,276**
mixedwood	Aw	1,628	1,628	1,376	1,376
	Bw	112	110	51	50
	Pj	102	102	33	33
	Sw	371	371	141	141
Total Mixedwood		**2,213**	**2,211**	**1,601**	**1,599**
Total Merchantable Species		**45,833**	**45,616**	**59,877**	**59,826**
Non-Merchantable Species[(b)]					
coniferous	Lt	2,658	417	187	28
	Sb	14,818	1,902	1,058	126
mixedwood	Sb	193	114	122	40
Total Non-Merchantable Species		**17,669**	**2,433**	**1,366**	**194**

(a) Merchantable timber volume has been estimated by limiting Alberta Vegetation Inventory (AVI) data to trees 12 m and over, to approximate a 15/10 or 15/11 utilization standard.

(b) For non-merchantable species (Lt and Sb), while there is a merchantable volume from trees of sufficient size (shown), it is assumed that this volume is not merchantable due to species utility to forest operators.

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

The planned disturbance has been minimized as part of the Project design. Vegetation clearing will follow specific AENV requirements, as follows:

- merchantable timber will be salvaged as directed by AENV and ASRD;
- woody debris will be disposed of as directed by AENV and ASRD;
- to protect nesting migratory birds, tree and brush clearing activities will not occur between April 15 and July 15, unless otherwise authorized;
- between July 15 and August 30 nest sweeps will be conducted prior to clearing;
- drainage control measures will be installed to manage runoff to minimize erosion and sedimentation on disturbed and adjacent land; and
- there will be no clearing from April 15 to July 15 for caribou calving season.

6.6.1.2 Non-Merchantable Timber

Non-merchantable timber will be harvested, mulched and mixed into stockpiled peat materials.

6.6.2 Vegetation Clearing

Land will be cleared in accordance with the Timber Management Regulations and the Forest and Prairie Protection Act Regulations (Government of Alberta 2001) as they apply to site clearing, debris disposal and on-site firefighting equipment.

Where practicable, vegetation removal activities will occur on frozen or dry ground conditions to minimize impacts. Should the construction schedule require work in areas that are neither dry nor frozen, MEG proposes the following mitigation measures:

- Low Ground Pressure (LGP) mulching equipment will mulch and walk down brush, tamarack and black spruce creating as little disturbance as possible to the top of the litter layer; and
- Preparation will begin with a feller buncher clearing the area of all salvageable timber. Mulchers will stump/grub/mulch all non-merchantable timber and brush to prepare the area for grading.

Vegetation clearing will not be done during the closed period for nesting birds to avoid the nesting and fledging period or the caribou calving period (April 15 to July 15).

All merchantable timber salvaged will be documented in a C&R database and the results for each year will be summarized in the MEG Annual C&R Report.

Disturbance related to underground fuel gas, water source and disposal pipelines will be reclaimed immediately following construction.

6.6.3 Topsoil and Subsoil Salvage

Topsoil in the Project area essentially consists of duff (LFH, Om) and Ah/Ae horizons on the Luvisolic, Brunisolic and Gleysolic soils (Kinosis, Bitumount, Chateh, Dover, Ells River, Kinosis, Livock, Mildred, Sutherland and Winefred series) and peat (Of, Om horizons) in the shallow organic soils (Muskeg, Mariana, Hartley and McLelland series). All suitable topsoil (LFH/Om plus Ae and/or AB horizons) will be salvaged on upland mineral soils. Typical topsoil depths for upland soils range from 15 to 25 cm. Gleysols, peaty gleysols and shallow organic soils topsoil depths typically range from 20 to 40 cm. Surface soil and subsoil salvage depths for each facility type are included in Appendix 1-I.

The topsoil soil salvage plan for the Project includes the following:

- Mineral soil salvage: for any facilities (plant sites and wellpads) (Figure 6.6-2) constructed on mineral soil, topsoil salvage will consist of LFH/Om plus Ae horizon, which generally averages 15 to 25 cm in depth. This material will be stored at the nearest stockpile location (Figure 6.6-3).
- Peat salvage: peat will be salvaged to a maximum depth of 40 cm for wellpads developed on deep peatlands (greater than 40 cm of peat) (Figure 6.6-4). The remaining peat will be left in place. No peat will be salvaged for roads constructed on deep peatlands as the roads will float on the peat for stability. On the plant sites, all peat will be salvaged.
- Where road and infrastructure corridors are constructed on mineral soil, all topsoil will be salvaged. For shallow organic soils, up to 40 cm of peat will be salvaged.

The subsoil (B horizon) salvage plan consists of the following:

- up to 30 cm of suitable B horizon (subsoil) rated Fair to Good for reclamation suitability will be salvaged on facilities constructed on upland mineral soil;
- up to 30 cm of subsoil may be salvaged on access roads if needed as part of the overall project subsoil balance; and

- B horizon rated as Poor reclamation suitability (very sandy texture) may be salvaged pending site needs.

The volume of surface soil available and required for the Project is summarized in Table 6.6-2. There is a surplus of surface soil available due to high volumes of peat-mineral mix available from borrow pit development. All salvaged surface soil will be replaced at the time of reclamation. The volume of B horizon (subsoil) available and to be replaced for the Project is summarized in Table 6.6-3. There will be sufficient topsoil available for reclamation over the life of the Project. The subsoil salvaged at each facility will be replaced at the time of reclamation.

The topsoil salvage depths for each facility are illustrated in Appendix 1-I.

Table 6.6-2 Topsoil Balance for the Project

Project Component	Area [ha]	Mineral Topsoil Available [m^3]	Peat/Mineral Mix Available [m^3]	Total Topsoil Available [m^3]	Topsoil Required[a] [m^3]	Balance (+/-) [m^3]
plant sites[b]	232	297,000	1,161,000	1,458,000	580,000	878,000
wellpads[c]	468	386,000	1,009,000	1,395,000	1,170,000	225,000
roads[d]	281	103,000	0	103,000	702,500	-599,500
associated disturbances (pump station, disposal and source well)	41	35,000	80,000	115,000	102,500	12,500
borrow areas[e]	550	569,000	3,885,000	4,454,000	0	4,454,000
pipelines[f]	84	0	0	0	0	0
Total	**1,656**	**1,390,000**	**6,135,000**	**7,525,000**	**2,555,000**	**4,970,000**

(a) Topsoil replacement depths assumed to be 25 cm (2,500 m^3/ha). See Appendix 1-I for topsoil salvage depths per map unit for each project component.

(b) All mineral topsoil and peat will be salvaged on the plant site.

(c) Wellpads will salvage a minimum depth of 40 cm for deep peats.

(d) Roads will have no salvage in deep peat (>40 cm).

(e) Borrow volumes include 569,500 m^3 of A horizon and 3,885,500 m^3 of peat. Borrow pits will be turned to shallow ponds for waterfowl habitat and the ponds will have no reclamation material replacement.

(f) Pipeline/power line construction soil salvage and replacement is immediate and therefore is not calculated in balances.

Table 6.6-3 Subsoil (B Horizon) Balance for the Project

Project Component[(a)]	Area [ha]	B Horizon Available [m^3]	B Horizon to Replace[(a)] [m^3]
plant sites	232	385,000	385,000
wellpads	468	553,000	553,000
roads	281	158,000	158,000
associated disturbances (disposal and source well)	41	54,000	54,000
borrow areas	550	795,000	795,000
pipelines[(b)]	84	0	0
Total	**1,656**	**1,945,000**	**1,945,000**

(a) B horizon replacement volumes will be the same as the B horizon volume salvaged for each facility.

(b) Pipeline/power line construction soil salvage and replacement is immediate and therefore is not calculated in balances.

6.6.4 Borrow Pits

Construction of development facilities, wellpads and roadways will require borrow fill material. A number of potential borrow pits have been identified within the Project footprint (Figure 6.1-1). Significantly more borrow area has been identified in the assessment than is likely to be required for development, in an effort to be conservative in the assessment of terrestrial impacts. Borrow pits will be located to minimize the overall impact and to make maximum use of the available resource. MEG will salvage materials for re-use, where practical, from wellpads and roadways as they are abandoned.

Potential borrow pits have been identified in the Project footprint (Section 1, Figure 1.2-3) to provide the projected 795,000 m3 of sand and clay required for Project construction.

Borrow pits will be reclaimed when they are exhausted of useful borrow material. Because of the uncertainty in borrow recovery, it is difficult to provide a schedule of borrow reclamation and these areas may be reclaimed independently of adjacent wellpads.

6.6.5 Soil Stockpiling

Wherever possible, rather than creating new clearings, MEG will use existing nearby disturbances to store reclamation material (i.e., existing Oil Sand Exploration [OSE] delineation drilling disturbances, and former conventional gas wellsites) which will reduce the Project footprint.

The soil stockpile shape will fit in a location available on the development areas approximately 5 m from adjacent forested ecosite phases for full-size stockpiles. Silt fences may be used around the base of reclamation material piles to prevent erosion and loss of soil. Reclamation material will not be used for any construction activities.

Topsoil salvaged during road construction will be relocated to existing soil storage sites. Where storage capacity is available, priority will be given to storing this material within wellpad soil stockpiles. Soil stockpiling at retired borrow pits may be considered as an option to minimize new clearing for storage.

Long-term stockpiles will be seeded as required with a native seed mix suitable for the Central Mixedwood Natural Subregion to control erosion and minimize weed development. The ASRD approved seed mix used on the MEG leases is summarized in Table 6.6-4. Weed control will be as per the weed management in Forestry Operations Directive 2001-06 (ASRD 2001).

Long-term stockpile sites will be documented in the Annual C&R Report submitted to AENV. The sites will be staked or otherwise marked in the field and accurately recorded on as-built drawings.

Table 6.6-4 Native Seed Mix Suitable for Soil Stockpiles (4 kg/ha)

Common Name	Scientific Name	Percentage
awned wheat grass	*Agropyron unilateral*	20
nodding brome	*Bromus anomalus*	15
Rocky Mountain fescue	*Festuca saximontana*	15
Canadian wild rye	*Elymus canadensis*	15
tufted hair grass	*Deschampsia caespitosa*	15
june grass	*Koelaria macrantha*	5
tickle grass	*Agrostis scabra*	5
fowl bluegrass	*Poa palustris*	10

6.6.6 Facility Operation

6.6.6.1 Weed Control

MEG will implement a weed management program as per the Weed Management in Forestry Operations Directive 2001-06 (ASRD 2001). The standards of practice will include:

- limiting soil disturbance to only those areas required for construction and operation of the Project;
- cleaning equipment to ensure all equipment and vehicles are free of weed seeds and plant parts before arriving on the job site;
- restricting the use of straw bales for erosion control to prevent introduction of weeds;
- using approved native seed mix for any revegetation activities; and
- addressing weed infestations on Project areas.

6.6.6.2 Water Management Plan

For wellpads, no measures to control or direct natural drainage around the outside edge of the wellpad will be required. The wellpad will be slightly domed in cross-section and is designed to allow lease run-off to naturally drain to one corner. Around the edge of the wellpad, a 1 m berm will be constructed to collect and disperse runoff from a corner of the wellpad (Figure 6.6-3).

Surface water management for the other components of the Project will consist of the following features:

- maintaining natural surface drainage patterns;
- installation of culverts, berms and industrial runoff ponds; and
- constructing any required stream crossings for pipelines and telecommunications lines in accordance with AENV's Code of Practice (AENV 2001c).

Volume 1, Section 3.3.4 provides further details on the Water Management plans and controls for the Project.

6.6.7 Facility Decommissioning Closure and Site Contouring

A facility Decommissioning Plan will be developed during the operational phase that will be specific to the Project and will outline the methodology to be used to effectively and safely decommission the facilities. The final detailed reclamation schedule sequence will be developed with the decommissioning plan.

At the end of a facility's life, the following general procedures will be undertaken to ensure that decommissioning and reclamation meets AENV approval requirements:

- all facilities constructed for the Project, including buildings, equipment and foundations will be removed;
- wells will be abandoned in compliance with ERCB Directive 020 (EUB 2007a), which includes cutting off the casing 1 m below final contour elevation and sealing them with a welded steel plate;
- Project sites will be remediated as required to meet AENV soil contamination standards of the time;
- all decommissioning garbage and debris will be removed from the Project area; and
- areas to be reclaimed will be re-contoured to blend with the surrounding landscape.

Sites will be assessed at abandonment and the results will be used to develop a remediation plan. At the completion of these activities in a particular area, the goal will be to create a level to undulating surface to blend into the surrounding topography. Further mitigation plans will include:

- The removal of gravel and culverts before re-contouring. A level to undulating surface (0 to 5% slope) will be created using the existing fill material and stockpiled soil.
- Road and wellpad surfaces will be ripped, as required, to alleviate compaction before placing topsoil or peat/mineral mix. If soils are excessively wet, ripping operations will be postponed until conditions are dry enough to ensure that the soils will fracture when ripped.
- Subsoils will be chisel plowed and harrowed, or disc-ripped to smooth the surface topsoil replacement unless otherwise directed by AENV.
- Salvaged subsoil and then topsoil will be placed over the disturbed site once all initial re-contouring is completed. Topsoil and subsoil replacement will be postponed when soils are excessively wet or during high winds if soil drifting occurs to prevent soil structure damage or topsoil erosion.

6.6.8 Soil Replacement Plan

The goal of soil replacement is to reconstruct soils, at a minimum, to an equivalent pre-disturbance land capability for forestry. The topsoil replacement plan by facility is as follows:

- Wellpads and roads constructed on fens and bogs: salvaged topsoil will be placed an average of 20 to 25 cm thick over surfaces to be reclaimed.

- Plant sites, wellpads, source and disposal wells and roads constructed on mineral soil: soil replacement will consist of replacing the same depth of mineral topsoil (LFH/Om plus Ae horizons) from reclamation material stockpiles that existed previously on-site. It is estimated that an average of 20 to 25 cm of topsoil will be replaced.

All salvaged subsoil will be replaced (Table 6.6-3).

6.6.9 Revegetation Plan

The objective of the revegetation program will be to directly establish a range of plant species that are compatible with the site conditions, while ensuring that an equivalent land capability is achieved. Revegetation of disturbed areas will follow reclamation material placement.

Revegetation objectives relevant to wellpads access roads are consistent with the Oil Sands Vegetation Reclamation Committee (OSVRC) (OSVRC 1998). They include:

- the utilization of native woody stemmed reclamation species common to the region;
- the establishment of a diverse range of plant species to re-create the level of biodiversity common to the predevelopment area; and
- the establishment of a viable plant community capable of developing into a self sustaining cover of species suitable for commercial forestry, wildlife habitat and traditional land uses, with possibilities for recreation and other end land uses.

Revegetation planting will follow the Guidelines for Reclamation to Forest Vegetation in the Alberta Oil Sands Region (OSVRC 1998) and the new Guideline for Wetland Establishment on Reclaimed Oil Sand Leases (CEMA 2007). These documents identify target ecosite phases that can be established on reclaimed landscapes and provides recommendations for successful reclamation procedures to meet the primary end land use objectives, which are the establishment of stands of commercial forest and the establishment of wildlife habitat.

Tree and shrub stock will be locally sourced. Weed control programs will be implemented as required to ensure optimum plant material establishment. Starter fertilizer may be applied as recommended from soil testing.

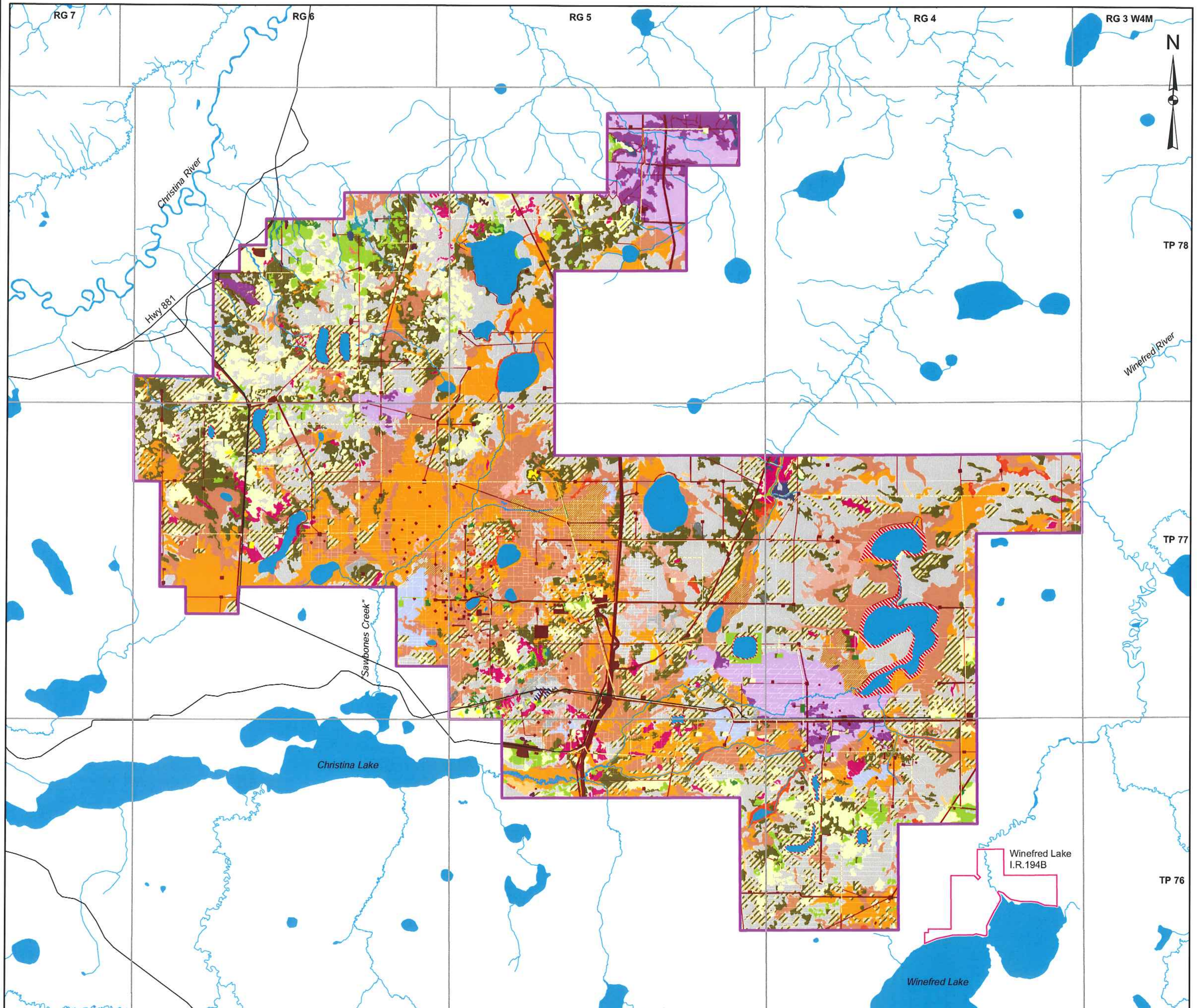
Reclaimed sites may not resemble the target ecosystem, since future variations in site factors (e.g., climate, soil development, soil moisture, management) may change the composition of the future forest.

MEG will adapt the revegetation plan, as applicable, should an updated version of the guidelines for reclamation be issued. Additionally, MEG will collaborate with industry peers to share results of reclamation monitoring from other operator's and consultation with regulators to develop specific planting densities for Project revegetation. Table 6.6-5 summarizes the proposed planting prescriptions.

Table 6.6-5 Planting Prescriptions

Soil Capability and Moisture Regime	Ecosite Phase/Wetlands Type Planting Prescription	Tree Species (Total Density of 1,800 to 2,200 Stems/ha)	Shrub Species (Total Density of 500 to 700 Stems /ha)
4-3, mesic to xeric	b1- blueberry jack pine-aspen (white birch)	jack pine (50%), aspen (30%), white birch (10%), black spruce (10%) 4 to 5 m spacing	blueberry, Labrador tea, bay willow, bog cranberry
3-2, subxeric, submesic	b2- blueberry, aspen (white birch)	aspen (80%), white birch (15%), white spruce (5%) 4 to 5 m spacing	blueberry, bearberry, Labrador tea, green alder
3-2, subxeric, submesic	b3-blueberry, aspen-white spruce	aspen (55%), white spruce (40%), white birch (5%) 4 to 5 m spacing	blueberry, bearberry, Labrador tea, green alder
2-4, mesic to subhygric	c1-Labrador tea-mesic-jack pine-black spruce	jack pine (70%) black spruce (30%), 4 to 5 m spacing	Labrador tea, blueberry, bog cranberry
2-3, mesic	d1-low-bush cranberry aspen	aspen (70%), white spruce (20%), balsam poplar (5%), white birch (5%) 4 to 5 m spacing	low-bush cranberry, green alder, rose, bog cranberry, willow
2-3, mesic	d2- low-bush cranberry aspen-white spruce-black spruce	aspen (50%), white spruce (30%), black spruce (10%), white birch (10%) 4 to 5 m spacing	low-bush cranberry, green alder, rose, bog cranberry
2-3, mesic	d3- low-bush cranberry white spruce	white spruce (80%), balsam fir (10%), white birch (5%) aspen (5%), 4 to 5 m spacing	rose, low-bush cranberry, Canada buffaloberry, green alder, bog cranberry
4 - 5, hygric	g1-Labrador tea-hygric black spruce jack pine	black spruce (90%), jack pine (10%) 4 to 5 m spacing	Labrador tea, blueberry
4 - 5, hygric	FONS, FOPN, FTNI, FTNN, FTPN, BTNN, SONS, STNN	tamarack-black spruce natural regeneration	natural regeneration

Details on the pre-development and post-development vegetation ecosite phases/wetlands types within the LSA is shown in Figures 6.4-2 and 6.6-1, respectively. Figure 6.6-2 outlines the conceptual reclamation succession of a Boreal Forest mixedwood stand. Conceptual drawings of a wellpad and construction and reclamation of a wellpad on peat, mineral soils and requiring cut and fill are depicted in Figures 6.6-3 to 6.6-6.



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LEGEND

- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- INDIAN RESERVE
- OPEN WATER
- RIVER OR STREAM
- ROADWAY

DISTURBED

- EXISTING AND APPROVED DISTURBANCE
  (THE MAJORITY OF SEISMIC LINES WITHIN THE LSA HAVE NOT BEEN SHOWN IN ORDER TO CLEARLY PRESENT THE RELEVANT DETAILS OF THIS MAP)

ECOSITE PHASE/WETLANDS TYPE

- FORESTED BOG (BFNN)
- OPEN BOG (BONN)
- SHRUBBY BOG (BONS)
- WOODED BOG WITH INTERNAL LAWNS (BTNI)
- WOODED BOG (BTNN)
- BURNED UPLAND (BUu)
- BURNED WETLANDS (BUw)
- CUTBLOCK (CC)
- FORESTED FEN (FFNN)
- GRAMINOID FEN (FONG)
- SHRUBBY FEN (FONS)
- PATTERNED FEN (FOPN)
- WOODED FEN WITH INTERNAL LAWNS (FTNI)
- WOODED FEN (FTNN)
- WOODED FEN WITH FORESTED ISLANDS (FTNR)
- WOODED PATTERNED FEN (FTPN)
- MARSH (MONG)
- JACK PINE-TAMARACK COMPLEX (Pj-Lt Complex)
- SHRUBBY SWAMP (SONS)
- WOODED SWAMP (STNN)
- SHALLOW OPEN WATER (WONN)
- LICHEN JACK PINE (a1)
- BLUEBERRY JACK PINE-ASPEN (b1)
- BLUEBERRY ASPEN WITH BIRCH (b2)
- BLUEBERRY ASPEN WITH SPRUCE (b3)
- BLUEBERRY WHITE SPRUCE-JACK PINE (b4)
- LABRADOR TEA-MESIC JACK PINE-BLACK SPRUCE (c1)
- LOW-BUSH CRANBERRY ASPEN (d1)
- LOW-BUSH CRANBERRY ASPEN-WHITE SPRUCE (d2)
- LOW-BUSH CRANBERRY WHITE SPRUCE (d3)
- DOGWOOD BALSAM POPLAR-ASPEN (e1)
- DOGWOOD BALSAM POPLAR-WHITE SPRUCE (e2)
- DOGWOOD WHITE SPRUCE (e3)
- HORSETAIL WHITE SPRUCE (f3)
- LABRADOR TEA-SUBHYGRIC BLACK SPRUCE-JACK PINE (g1)
- LABRADOR TEA/HORSETAIL WHITE SPRUCE-BLACK SPRUCE (h1)

NOTE

Unnamed watercourse locally known as "Sawbones Creek"

REFERENCE

Digital data obtained from AltaLIS Ltd. (June 2004), Veritas DGC Inc. (July 2004), Alberta Pacific Ltd. (April 2004), Pearson Timberline Ltd. (April 2004), used under license.
Projection: UTM Zone 12 Datum: NAD 83

4 0 4

SCALE 1:120,000 KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

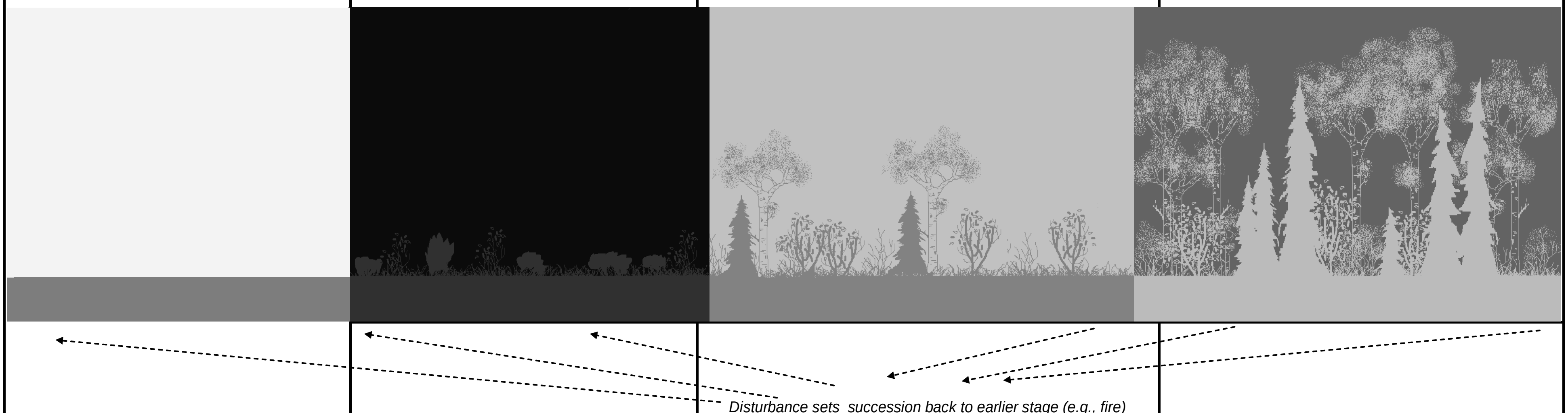
TITLE

TARGET RECLAMATION ECOSITE PHASES/WETLANDS IN THE LOCAL STUDY AREA

MEG ENERGY CORP.

PROJECT No. 07-1346-0009.9170			SCALE AS SHOWN	REV. 0
DESIGN	BL	08 Jan. 2008	FIGURE: 6.6-1	
GIS	ZB	06 Mar. 2008		
CHECK	DD	17 Apr. 2008		
REVIEW	IGG	17 Apr. 2008		

Disturbance	Pioneer species (Stand construction)	Seral stages (Stem exclusion/Understorey establishment)	Climax (Stable Seral Stage)
Identifying and mitigating conditions that may limit vegetation growth is important for successful reclamation. Limiting factors may include the following parameters: Soil chemical properties (pH, EC, SAR), texture, bulk density and slopes.	Early successional species provides initial cover. Generally, grasses, forbs and shrubs dominate in the early succesional stage. These species have rapid growth rates, short life spans and shade intolerance. Resources (e.g., light, water and nutrients) are abundant relative to other stages.	Increasing shade intolerance as replacement continues. Competition for resources results in self thinning. Increases in woody species and understorey establishment.	A relatively stable plant community dominated by plants that are suitable the environment.



Each stage of succession creates the conditions for the next stage of development. Temporary plant communities are replaced by more stable communities until an equilibrium is established between plants and the environment.

Time (direction of succession)

REFERENCE

MARTIN, J AND T. GOWER. FORESTRY FACTS: FOREST SUCCESSION.
DEPARTMENT OF FOREST ECOLOGY AND MANAGEMENT.
UNIVERSITY OF WISCONSIN WEBSITE
HTTP://FOREST.WIXC.EDU/EXTENSION/PUBLICATIONS/78.PDF

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

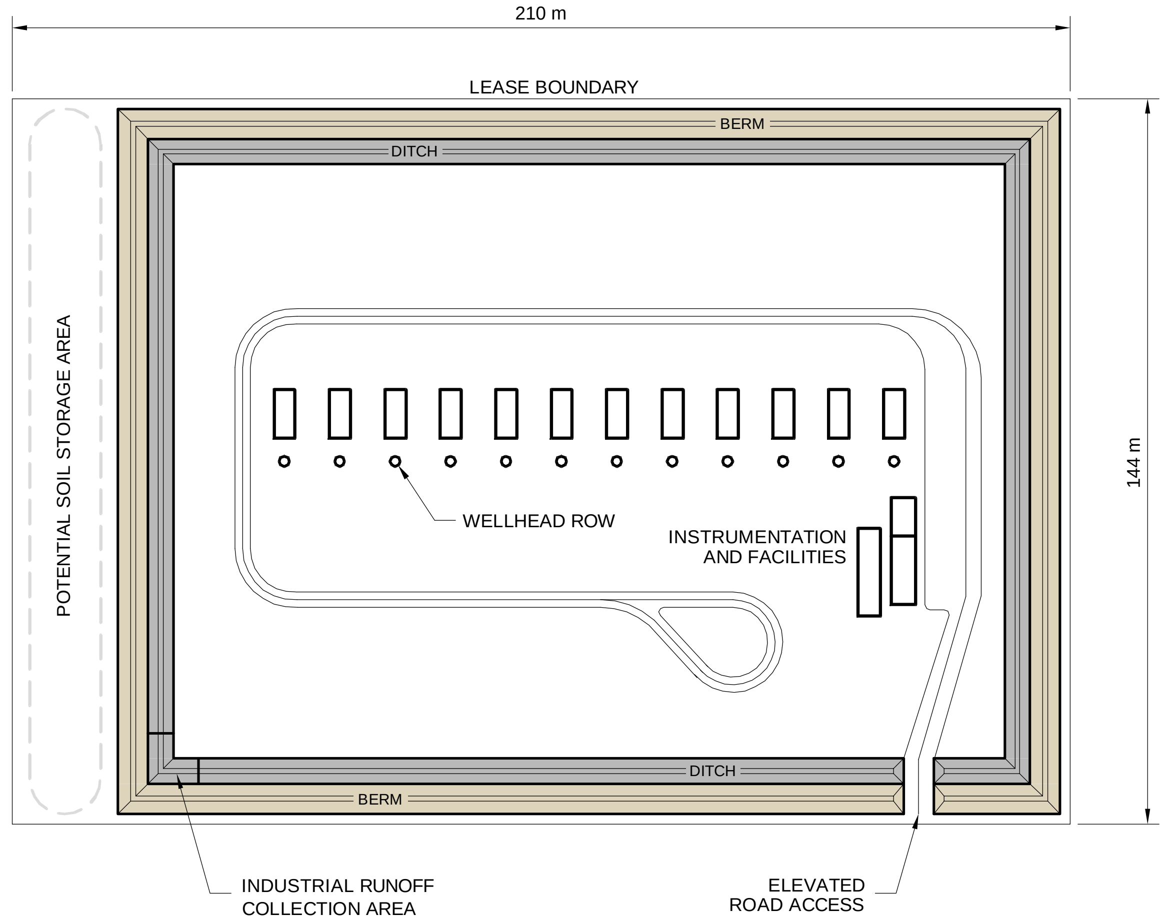
TITLE

CONCEPTUAL RECLAMATION SUCCESSION OF A BOREAL FOREST MIXEDWOOD STAND

MEG ENERGY CORP.

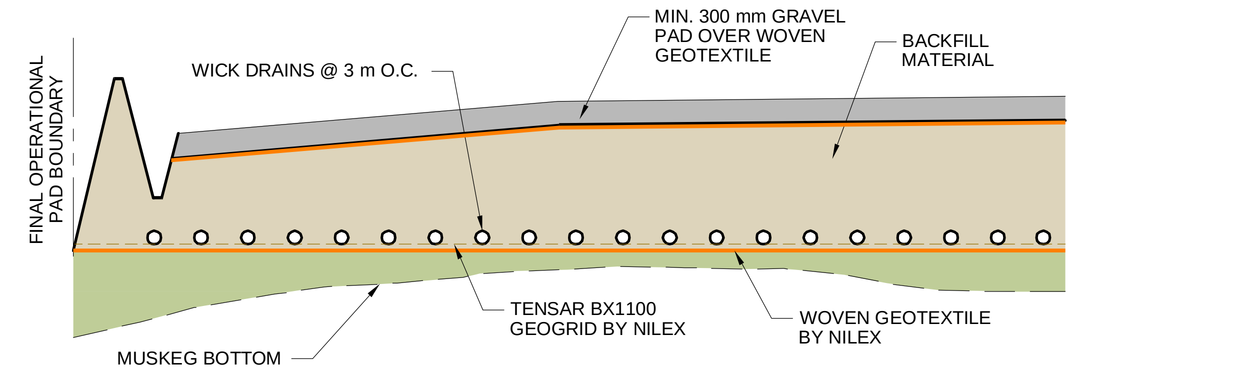
PROJECT	07.1346.0009.9600		FILE No.	Concept reclam-rev
DESIGN	BL	11/01/08	SCALE NTS	REV. 0
CADD	PSR	27/03/08		
CHECK	DD	27/03/08		
REVIEW	IGG	17/04/08		

FIGURE: 6.6-2



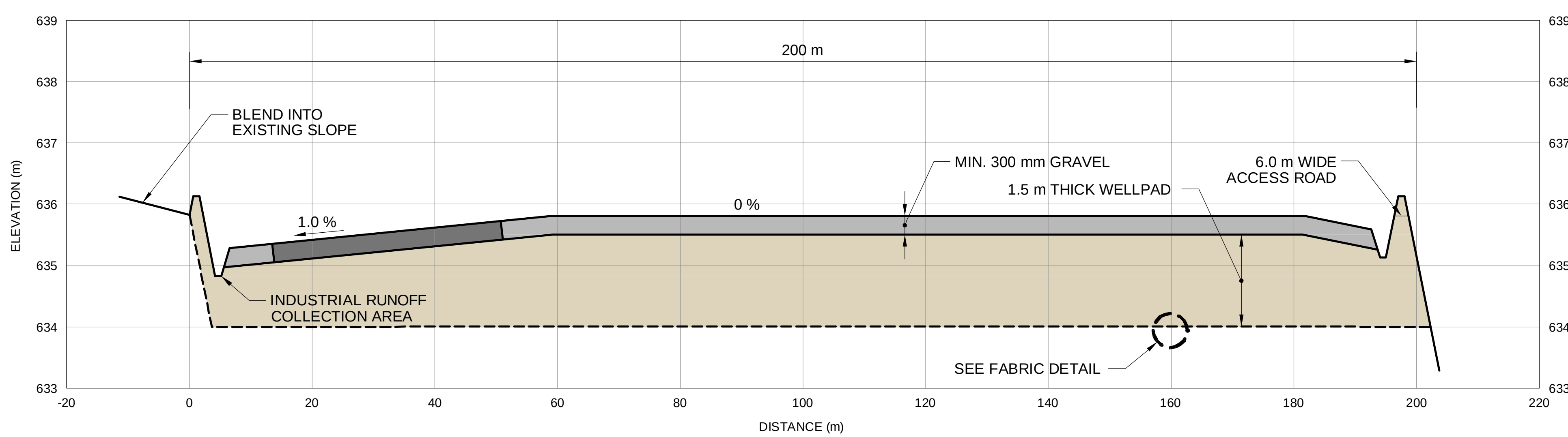
TYPICAL WELLPAD - PLAN

30 0 30
SCALE METRES



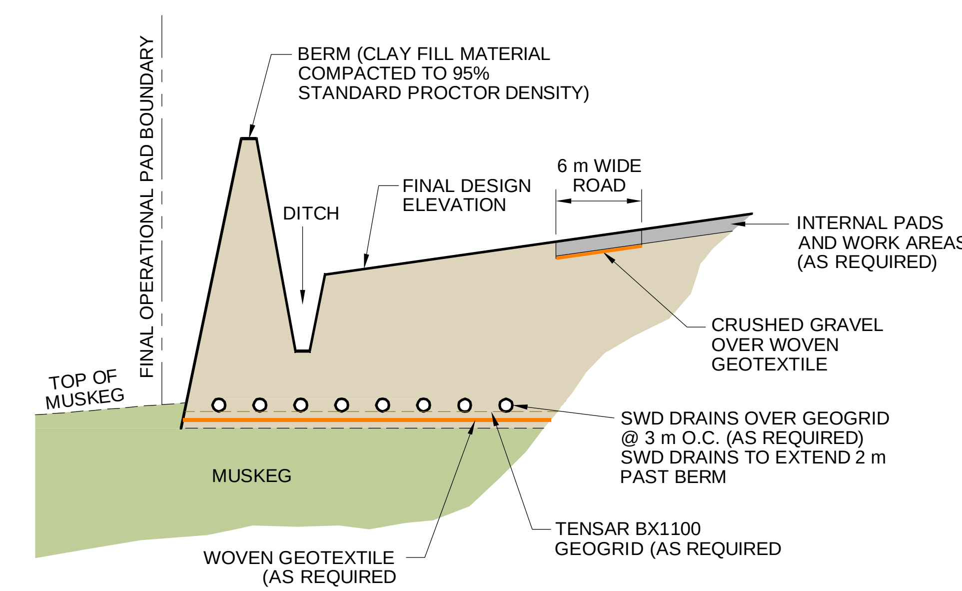
TYPICAL WELLPAD - CROSS-SECTION DETAIL

N.T.S.



TYPICAL WELLPAD - SECTION

20 0 20
HORIZ SCALE METRES
10X VERTICAL EXAGGERATION



TYPICAL FABRIC DETAIL

N.T.S.

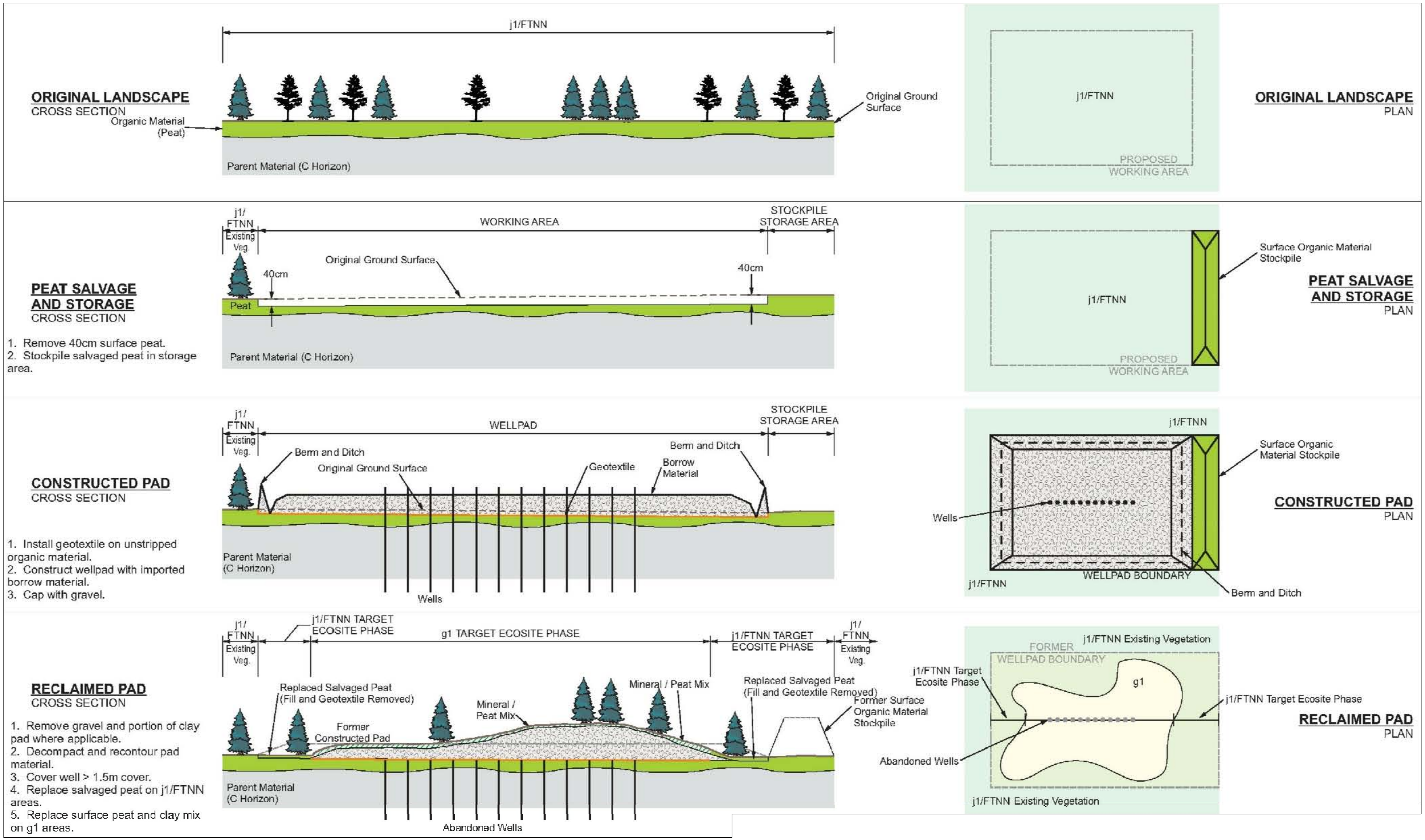
PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
TYPICAL WELLPAD ON PEAT

MEG ENERGY CORP.

PROJECT	07.1346.0009.9600		FILE No.	Typical Wellpad-peat
DESIGN	DD	22/01/08	SCALE AS SHOWN	REV. 0
CADD	TRE	27/03/08	FIGURE: 6.6-3	
CHECK	DD	27/03/08		
REVIEW	IGG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\9600\Appendix 5-VII-C+R Plan\Fig 6.6-3_Typical wellpad on Peat.dwg Apr 17, 2008 - 3:23pm



LEGEND:

- Lt Tamarack
- Sb Black Spruce
- g1 Labrador Tea-subhygric Black Spruce-Jack Pine Ecosite Phase
- j1/FTNN Treed Fen Ecosite Phase

*Not to scale

*Drawings are conceptual for basepads and actual construction will be conducted according to engineering drawings.

PROJECT

CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE

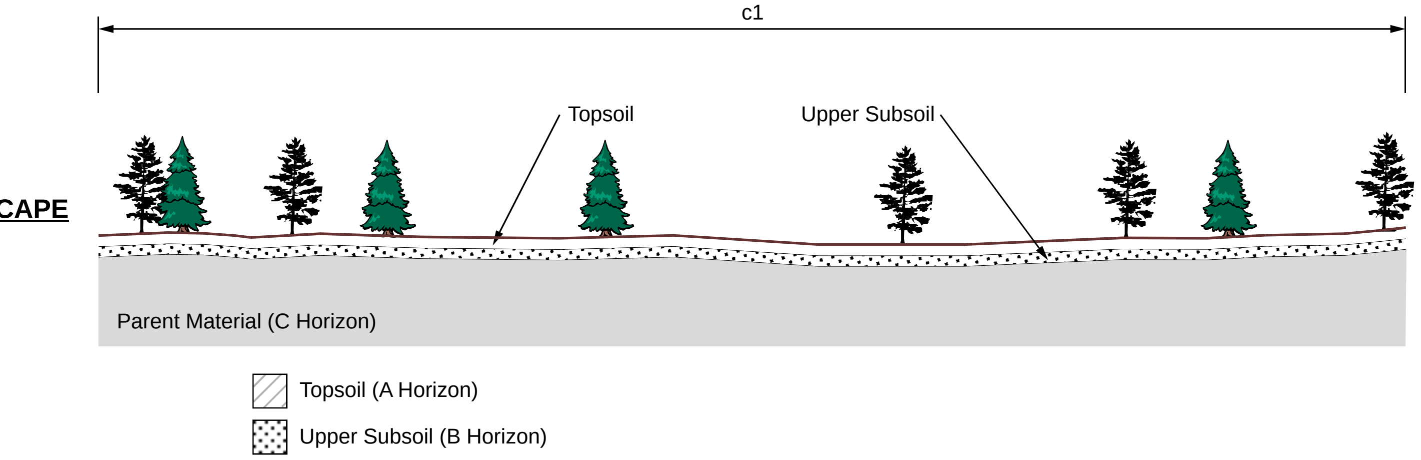
CONCEPTUAL DRAWING OF CONSTRUCTION AND RECLAMATION OF WELLPAD ON PEAT

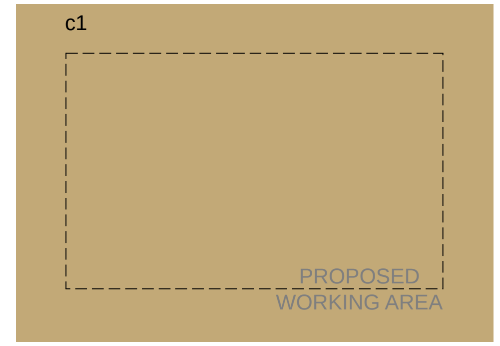
MEG ENERGY CORP.

PROJECT	07.1346.0009.9600		FILE No.	Construct-WP+peat
DESIGN	BL	01/02/08	SCALE AS SHOWN	REV. 0
CADD	TRE	27/03/08	FIGURE: 6.6-4	
CHECK	DD	27/03/08		
REVIEW	IGG	17/04/08		

L:\2007\1346 Oil Sands\07-1346-0009-MEG EXPANSION\9600\Appendix 5-VII-C+R Plan\Fig 6.6-4_Conceptual-Construction+Reclamation of Wellpad on Peat.dwg Apr 17, 2008 - 4:44pm

ORIGINAL LANDSCAPE
CROSS SECTION

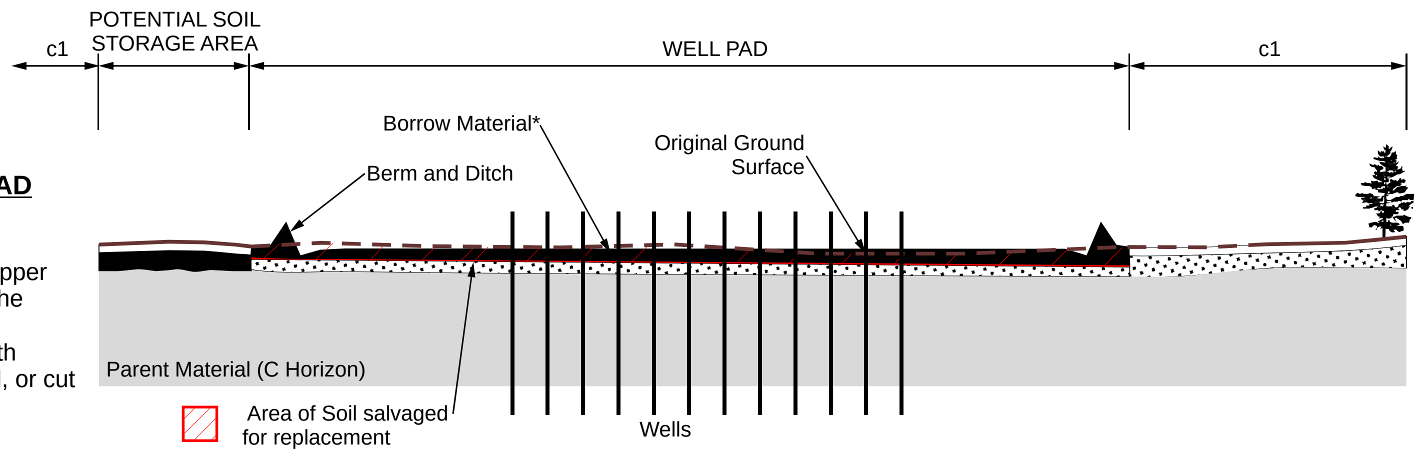




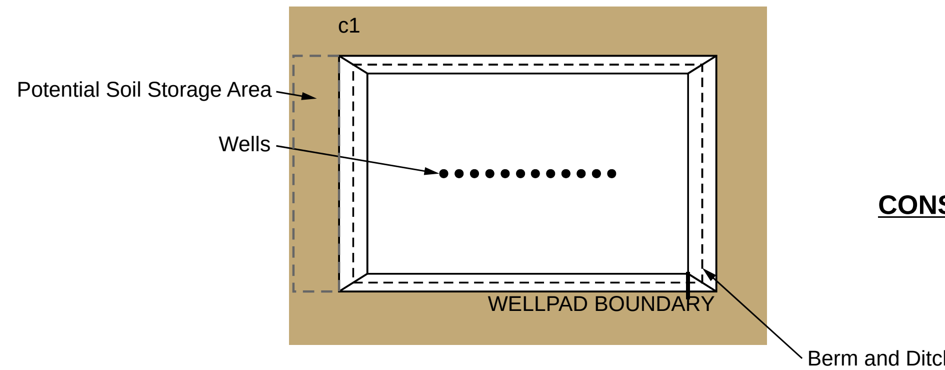
ORIGINAL LANDSCAPE
PLAN

CONSTRUCTED PAD
CROSS SECTION

1. Salvage topsoil and upper subsoil and stockpile in the storage area.
2. Construct well pad with imported borrow material, or cut and fill if required.
3. Cap pad with gravel.



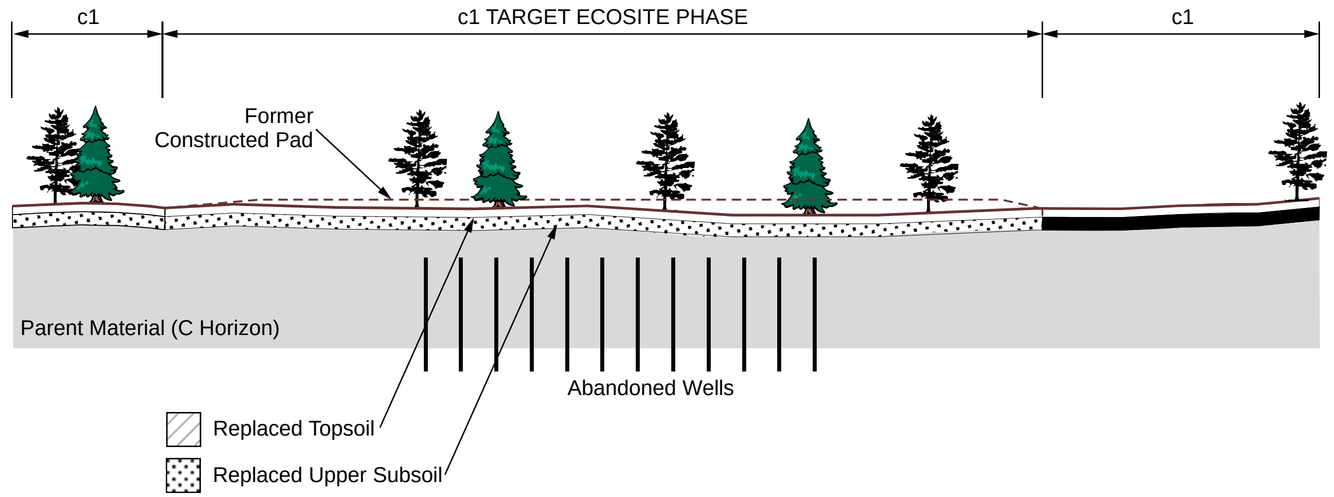
*Borrow material may be required for well pad construction.

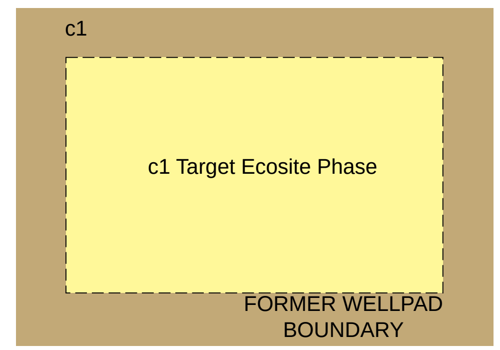


CONSTRUCTED PAD
PLAN

RECLAIMED PAD
CROSS SECTION

1. Remove gravel and borrow material.
2. Abandon well with > 1.5m cover.
3. Decompact and recontour subsoil material.
4. Replace upper subsoil and topsoil.
5. Revegetate as indicated in Vegetation Prescription.





RECLAIMED PAD
PLAN

LEGEND:

Sb (Black spruce)
Pj (Jack pine)
c1 Labrador Tea mesic Jack Pine - Black Spruce

*Not to scale
*Drawings are conceptual for basepads and actual construction will be conducted according to engineering drawings.

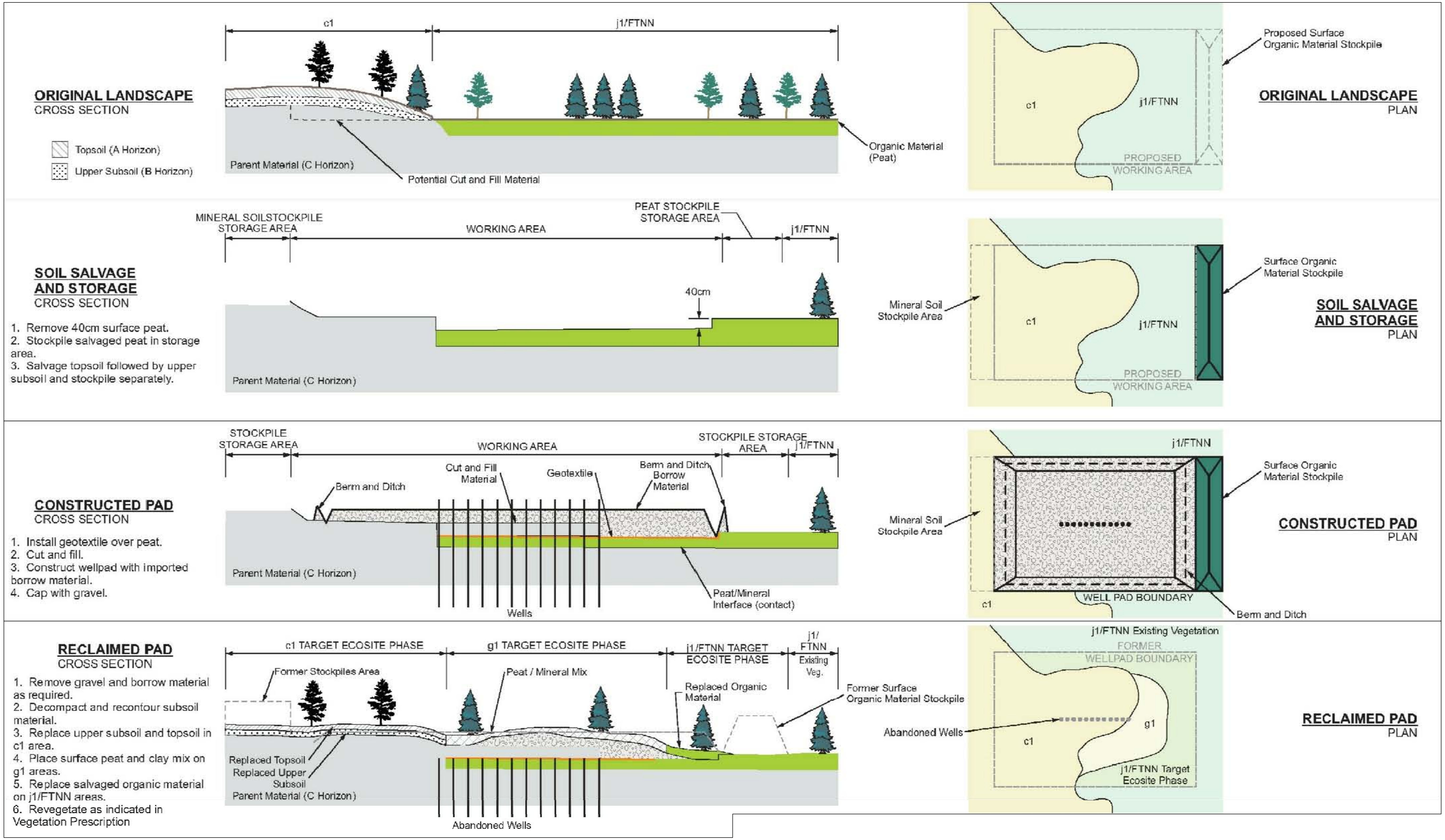
PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
CONCEPTUAL DRAWING OF CONSTRUCTION AND RECLAMATION OF WELLPAD ON UPLAND MINERAL SOIL

MEG ENERGY CORP.

PROJECT	07.1346.0009.9600		FILE No.	UL-Mineral Soil
DESIGN	BL	01/02/08	SCALE AS SHOWN	REV. 0
CADD	TRE	27/03/08		
CHECK	DD	27/03/08		
REVIEW	IGG	17/04/08		

FIGURE: 6.6-5



LEGEND:

PjJack Pine	c1Labrador Tea-mesic Jack Pine - Black Spruce Ecosite Phase
LtTamarack	g1Labrador Tea-subhygric - Black Spruce - Jack Pine Ecosite Phase
SbBlack Spruce	j1/FTNNTreed Fen Ecosite Phase

*Not to scale
*Drawings are conceptual for basepads and actual construction will be conducted according to engineering drawings.

PROJECT
CHRISTINA LAKE REGIONAL PROJECT - PHASE 3

TITLE
CONCEPTUAL DRAWING OF CONSTRUCTION AND RECLAMATION OF WELLPAD REQUIRING CUT AND FILL

MEG ENERGY CORP.

PROJECT	07.1346.0009.9600		FILE No.	Wellpad+Cut-Fill
DESIGN	BL	01/02/08	SCALE AS SHOWN	REV. 0
CADD	TRE	27/03/08	FIGURE: 6.6-6	
CHECK	DD	27/03/08		
REVIEW	IGG	17/04/08		

6.6.10 Component-Specific Revegetation and Reclamation Plans

6.6.10.1 Plant Sites and Wellpads

Plants 3A and 3B are located within upland areas that will be planted to upland ecosites - blueberry (b), Labrador tea-mesic (c), low-bush cranberry (d) ecosites. Wellpads located in upland and wetlands types will be replanted mainly to transitional ecosites - Labrador tea-subhygric (g) and Labrador tea–mesic (c) ecosites. Final end land uses will be confirmed after consultation with provincial regulators and stakeholders.

6.6.10.2 Access Roads and Power Line Rights-of-Way

Access roads and ROW reclamation will follow the requirements outlined in the publications *Environmental Protection Guidelines for Roadways* (AENV 2000b) and *Environmental Protection Guidelines for Electric Transmission Lines* (AENV 1995b). As described in the Facility Closure Plan (Section 6.6.7), all equipment will be removed from the ROW and gravel will be removed from roads or covered with suitable subsoil materials. Salvaged reclamation material (mineral or peat) will be replaced on the disturbed areas following the reduction of subsoil compaction. Padded road bases in organic soil areas will be re-contoured into a discontinuous series of uplands areas to allow return to normal hydrological function. The discontinuous roadbed will also limit vehicle access.

6.6.10.3 Borrow Pits

For the purpose of this C&R Plan, it is assumed all borrow sites will be excavated to the full extent and will be depressions at the time of reclamation. Following recontouring to establish a more natural and stable landscape extending slightly below the water line, borrow pits will be allowed to fill with water and integrated into the regional drainage regime. Efforts will be made to develop shallow transitional wetlands at the edges of borrow pits. Areas around the pond will be revegetated to an appropriate species mix. Reclaimed borrow areas are expected to provide opportunities for increased waterfowl use potential and possibly Canadian toad potential and landscape diversity in the area.

6.6.10.4 Seismic Lines and Pipelines

Seismic lines and pipelines are expected to naturally regenerate to pre-disturbance conditions, since the soils will not be disturbed (seismic) or will be replaced immediately following construction (pipelines). MEG is proposing to implement a direct revegetation approach only on areas where erosion potential is possible. Viable root propagules and seed remaining as part of the soil structure/seed bank will germinate and grow if competition from other vegetation is not too intense. MEG will maintain an adaptive management approach to determine the most suitable reclamation practice necessary to re-establish native vegetation along these disturbances.

6.6.10.5 Wetlands Reclamation

Various MEG facilities are located within peatland areas comprised of fens and bogs. Since water movement is critical in maintaining the biological integrity of fens, MEG will apply the following principles in constructing facilities on fen ecosites:

- Areas of the Project constructed in fens and bogs will be situated on pads designed to float. Fen integrity will be maintained by installation of a woven geotextile material and covered with fill material. This will create a stable base for facilities roads or wellpads.
- Culverts will be installed periodically along the Project roads in fens where necessary to allow water movement across the area.
- MEG will monitor the condition of the surrounding fens to evaluate any additional actions that may be required to maintain the ecological integrity of these features.

MEG will follow the principles outlined in the Guideline for Wetland Establishment on Reclaimed Oil Sands Leases Revised (2007) Edition (CEMA 2007) to meet the goal of replacing wetlands on disturbed wetlands. MEG recognizes the challenges associated with reclaiming fens and bogs. This is an issue that effects all developments within the region and therefore needs to be addressed as a regional initiative. MEG is willing to participate in future research efforts in this regard.

The reclamation concept for MEG wellpads constructed on peat is to return as much of the wellpad as possible to a wetlands. This will be accomplished by removing approximately half of the original wellpad material to allow the buried peat to naturally re-establish into a wetlands (Figure 6.6-4).

6.7 WASTE MANAGEMENT AND CONTINGENCY PLANS

The guidelines for the handling, storage and disposal of wastes will follow MEG's Spill Response and Reporting and Waste Management Plan (Appendices 1-II and 1-III). Components of the plan are described below.

6.7.1 Spill Prevention

MEG's procedures are designed to prevent spills or releases of fuel, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides or other chemicals. All accidental spills will be immediately reported to the Environmental Manager and Operations Supervisor and any spills will be immediately cleaned up. Refuelling and servicing of equipment will be conducted at least 100 m away from any watercourse.

Wellpads will be designed to contain spills on-site. Runoff water from these sites will be held on-site until testing indicates it is suitable to discharge to drainage systems (EUB 1996).

6.7.2 Disposal of Oilfield Waste

All oilfield waste must be handled in accordance with the requirements contained in ERCB Directive 058 "Oilfield Waste Management Requirements for the Upstream Petroleum Industry" (EUB 1996a), with the exception of drilling wastes, which must be handled in accordance with ERCB Directive 050 "Drilling Waste Management" (EUB 2007b). Oilfield waste will be hauled to an approved Class I facility. Non-hazardous solid/stackable waste will be disposed of at an approved Class II landfill.

6.7.3 Disposal of Non-Oilfield Waste

Liquid wastes, sludges and unstackables that are not suitable for disposal in MEG's disposal wells or Class II landfill will be removed off site to an appropriate disposal facility. Construction waste and domestic waste will be hauled to the Regional Municipality of Wood Buffalo Municipal Landfill. Management of wastes is governed by the Waste Control Regulation (AEP 1996) under the EPEA. MEG will attempt to recycle and salvage waste streams as appropriate.

6.7.4 Contingency Plans

6.7.4.1 Rutting and Admixing

The contingency plans for wet soils will be initiated when working on undisturbed topsoil. Traffic will be restricted to developed roadways and wellpad areas during wet conditions to protect undisturbed areas. Mitigation measures will be implemented to avoid Activity will shut down if rutting and admixing which can occur when soil horizons are crossed.

6.7.4.2 Soil Erosion

Soil erosion will be prevented or controlled, as required, through implementation of erosion control measures such as planting a seed mix on soil stockpiles, installation of coconut matting following topsoil replacement and/or creating adequate drainage to minimize water erosion.

6.7.4.3 Reclamation of Compacted Areas

Areas receiving gravel treatment and vehicular traffic will be subject to considerable loads over the Project life. These areas will become compacted compared to the adjacent lands. To ensure adequate reclamation of these areas during the decommissioning phase of the Project, MEG will ensure that these areas are deep ripped or subsoiled and graded before topsoil is replaced.

6.7.4.4 Fire Prevention

Fire prevention and control plans associated with the Project are detailed in Volume 1, Section 3.3.3. With respect to possible slash burning activities, burning permits will be obtained from the appropriate municipal or forestry authority before cleared brush and slash is burned. No unauthorized open fires will be permitted.

MEG intends to use slash as roll back on short-term disturbances (i.e., pipelines, temporary access roads) and also, mulch slash associated with clearing activities for Project components. This mulch is used as an amendment in reclamation. Burning of slash is not expected to occur; however, if burning of slash was to be required, it would not be permitted if the fire hazard is high or extreme. If burning is delayed, slash would be stored along the edges of ROW, in natural clearings, at cutline intersections, or in approved push-outs. Burning would only be permitted once the fire hazard is low and with appropriate forestry authorization as per ASRD.

6.8 CONSERVATION AND RECLAMATION MONITORING

The objectives of the C&R monitoring program are to evaluate the success of C&R activities over time and to adjust or modify activities, where necessary. 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; and
- re-establishment of wildlife habitat.

The reclamation objectives will be met through regular site inspections, implementation of additional reclamation over time, evaluation of the monitoring program results for all reclaimed areas, best practices, program adaptation from key learnings from industry peers and new reclamation information applicable to boreal forest areas. Where practical, MEG will integrate monitoring programs for the Project into MEG's established monitoring programs, which are summarized in Volume 2, Appendix 2-V.

MEG will include biodiversity, wildlife monitoring and habitat enhancement programs as components of its C&R monitoring activities. Monitoring wildlife use of both natural and reclaimed areas within the LSA will provide information on the success of re-establishing wildlife habitat on reclamation areas as well as on the measures taken 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. The diversity of wildlife use will tend to increase over time as the vegetation cover increases, through revegetation activities as well as natural colonization of shrub and tree species from the Project area.

MEG will prepare and submit to AENV an Annual C&R Report summarizing the previous year's activities in terms of development activities, assessments completed on facility areas to be constructed in the following year, reclamation activities, reclamation monitoring, wildlife monitoring, habitat enhancement activities and planned activities for the following year.

7 REFERENCES

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GLOSSARY

3D Seismic	A remote sensing tool that uses sound waves to image the subsurface.
Abiotic	Non-living factors that influence an ecosystem, such as climate, geology and soil characteristics.
Aboriginal People	The descendents of the original inhabitants of Canada. Pursuant to the Canadian Constitution Act, 1982, and Schedule B of the Canada Act, 1982, (Chapter 11, Section 35) Aboriginal peoples includes the Indian, Inuit and Métis peoples of Canada. The Constitution does not define membership in individual groups.
Abscission	The separation of part of a plant from the main plant body - most commonly, the falling of leaves or the dropping of fruit.
Acid Cation	Hydrogen ion or metal ion that can hydrolyse water to produce hydrogen ions (e.g., ionic forms of aluminum, manganese and iron).
Acid Neutralizing Capacity (ANC)	The equivalent capacity of a solution to neutralize strong acids. Acid Neutralizing Capacity can be calculated as the difference between non-marine base cations and strong anions.
Acid Pulse	Acid pulse (or episodic acidification) refers to a rapid drop in pH in surface waters over a short period.
Acidification	The decrease of acid neutralizing capacity in water, or base saturation in soil, caused by natural or anthropogenic processes. Acidification is exhibited as the lowering of pH.
Acidophillic	Acid loving, as in a plant which prefers acidic soils
Admixing	The dilution of topsoil with subsoil, spoil or waste material, with the result that topsoil quality is reduced. Admixing can result in adverse changes in topsoil texture, poor soil aggregation and structure, loss of organic matter and decrease in friability.
Aeolian	Sedimentary deposits arranged by wind, such as sand, silt and other loose substrates in dunes.
Air Shed	The geographic area requiring unified management to achieve air pollution control.

Albedo	The ratio of reflected solar radiation to the total incoming solar radiation received at the surface.
Alberta Ambient Air Quality Guidelines	A document established under Section 14 of the Environmental Protection and Enhancement Act (EPEA). The guidelines are part of the Alberta air quality management system.
Alberta Ambient Air Quality Objective (AAAQO)	Alberta Ambient Air Quality Objectives are guidelines established for release of air compounds. The AAAQOs form an integral part of the management of air quality in the province and are used for reporting the state of the environment, establishing approval conditions, evaluating proposed facilities with air emissions, assessing compliance near major air emission sources and guiding monitoring programs.
Alberta Energy and Utilities Board (EUB)	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. Effective January 1, 2008, the Alberta Energy and Utilities Board (EUB) has been realigned into two separate regulatory bodies: • the Energy Resources Conservation Board (ERCB), which regulates the oil and gas industry, and • the Alberta Utilities Commission (AUC), which regulates the utilities industry.
Alberta Environment (AENV)	Provincial ministry that looks after the following: 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 Surface Water Quality Objectives (ASWQO)	Numerical concentrations or narrative statements established to support and protect the designated uses of water. These are minimum levels of quality, developed for Alberta watersheds, below which no waterbody is permitted to deteriorate.

Alberta Sustainable Resource Development (ASRD)	Alberta Ministry responsible for administering the development of Alberta's forests, public lands, and fish and wildlife resources.
Alberta Vegetation Inventory (AVI) (AEO 1991)	A GIS mapping system and digital forest inventory. It includes tree species, height, canopy closure, stand age, site conditions. and non-commercial vegetated and nonvegetated cover types.
Alberta Wetlands Inventory (AWI)	A digital wetlands inventory and GIS mapping system that includes wetlands class, amount of vegetation cover, presence or absence of permafrost, presence or absence of internal lawns, and internal lawn and vegetation cover type.
Alkalinity	A measure of water's capacity to neutralize an acid, expressed as an equivalent of calcium carbonate It indicates the presence of carbonates, bicarbonates and hydroxides and less significantly, borates, silicates, phosphates and organic substances.
Alleles/Allelic Diversity	One member of a pair or series of genes that occupy a specific position on a specific chromosome/the variety, distribution and abundance of different alleles within a population.
Alluvial	Soil or earth material which has been deposited by running water, as in a riverbed, floodplain, or delta.
Ambient Noise	The pre-existing sound environment of a location, before the introduction of, or in absence of, noise from a specific source which also affects the sound environment of that location.
Ambient Sound Level	Background sound level: the sound level that is present in the acoustic environment of a defined area. Ambient sound can include sources from transportation equipment, animals and nature.
Anchor Ice	A sheet of ice that adheres on the bottom of streams or channels when water flows on top of it.
Anion	A negatively charged ion.
Anthropogenic	Pertaining to the influence of human activities.
Aquiclude	An impermeable stratum or material that acts as a barrier to the flow of groundwater.

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.

Aquitard A material of very low permeability between aquifers.

ArcGIS An integrated collection of Geographic Information System (GIS) software products for building a complete GIS. ArcGIS enables users to deploy GIS functionality wherever it is needed in desktops, servers, or custom applications; over the Web; or in the field.

Argillaceous Applied to rocks or substances composed of clay minerals, or having a notable proportion of clay in their composition.

Artesian A condition in a confined aquifer when the water level of a well that penetrates the unit is above the ground surface. A well drilled into such a unit would flow without requiring a pump.

Aspect Aspect is the orientation of a slope by compass points and indicates if a slope is exposed to the north, south, east or west or any point between.

At Risk Any species known to be 'At Risk' after formal detailed status assessment and designation as 'Endangered' or 'Threatened' in Alberta.

Attenuation (Noise) The process by which a compound is reduced in concentration over time, through adsorption, degradation, dilution and/or transformation. A reduction or diminishing of noise level.

B Horizon A subsoil horizon characterized by one of: (1) an enrichment of clay, iron and aluminum, or humus (Bt or Bf); (2) a prismatic or columnar structure that exhibits pronounced coatings or stainings associated with significant amounts exchangeable sodium (Bn or Bnt); (3) an alteration by hydrolysis, reduction or oxidation to give a change of colour or structure from the horizons above or below, or both (Bm).

Background An area not influenced by chemicals released from the site under evaluation.

Bankfull Depth The maximum depth of a channel within a riffle segment when flowing at a bank-full discharge.

Bankfull Width	The width of the stream, measured at the water surface elevation corresponding to the bankfull discharge. For undisturbed streams with a wide floodplain, this is equivalent to channel width.
Basal Water Sands	A water-saturated sand unit occurring at the lowest portion of a stratigraphic unit.
Base Cation	An alkali or alkaline earth metal cation ($Ca2+$, $Mg2+$, $K+$, $Na+$).
Baseline	A surveyed or predicted condition that serves as a reference point to which later surveys are coordinated or correlated.
Basic Sound Level	The allowable sound level at a residential location, as defined by the current Alberta Energy and Utilities Board (EUB) Directive 038 with the inclusion of industrial presence based upon dwelling unit density and proximity to transportation noise sources.
Basin	A geographic area drained by a single major stream; consists of a drainage system comprised of streams and often natural or man-made lakes.
Bed Slope	The inclination of the river channel bottom.
Bedrock	The body of rock that underlies gravel, soil or other surficial material.
Benthic Invertebrates	Invertebrate organisms living at, in or in association with the bottom (benthic) substrate of lakes, ponds and streams.
Berm	Containment wall or barrier, usually constructed from clay, but can also be cement or other man-made, impermeable material (also called dikes).
Bins	Sub-divisions of wildlife Resource Selection Function (RSF) model output values.
Bioconcentration	A process where there is a net accumulation of a chemical directly from an exposure medium into an organism.
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.

Biodiversity Ranking	The relative contribution of an ecosite phase/wetlands type to the overall biological diversity of an area.
Biotic	The living organisms in an ecosystem.
Bioturbation	The disruption and mixing of sand and mud by animals such as worms, that live at or near the sediment water interface. Bioturbation is sometimes an indicator of the salinity of the water body that the sediment was deposited in.
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.
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.
Borden Block	Map units of 10' latitude by 10' longitude used to facilitate site designation.
Boreal Forest	The northern hemisphere, circumpolar, tundra forest type consisting primarily of black spruce and white spruce with balsam fir, birch and aspen.
Boreholes	A hole advanced into the ground by means of a drilling rig.
Borrow Pit	A bank or pit from which sand or clay is taken for use in filling or embanking. Often used in the construction of roads.
Bowen Ratio	The ratio of sensible heat flux to latent heat flux.
Brackish Water	See Saline Water.
Brine	Water that contains high concentrations of soluble salts with a mineralization greater than 100,000 mg/L total dissolved solids.

Brown-Water System	Freshwaters with elevated colour and dissolved organic carbon concentrations.
Brunisolic Soil	An order of soils whose horizons are developed sufficiently to exclude the soils from the Regosolic order, but that lack the degrees or kinds of horizon development specified for soils of the other orders. These soils, which occur under a wide variety of climatic and vegetative conditions, all have Bm or Btj horizons.
Bryophyte	A member of the plant order Bryophyta, including the mosses, liverworts, and hornworts.
Buffer	A transition zone between areas managed for different objectives.
Buffer Zone	The area of land between the project footprint and Local Study Area boundaries.
Buffering Capacity	The ability of a system to accept acids without the pH changing appreciably.
Calendar-day	Stream-day multiplied by a service factor for planned and unplanned downtime. Production rate based on operating 365 day per year.
CALPUFF	A non-steady Lagrangian Gaussian Puff Model containing modules for complex terrain effects, overwater transport interaction effects, building downwash, wet and dry removal, and simple chemical transformation.
Canopy	An overhanging cover, shelter or shade. The tallest layer of vegetation in an area.
Canopy Disturbance	An opening in the forest canopy, from natural or unnatural causes.
Capability (land)	An evaluation of land performance that focuses on the degree and nature of limitation imposed by the physical characteristics of the land unit on a certain use, assuming a management system.
Carbonaceous Biochcemical Oxygen Demand (CBOD)	Carbonaceous biochemical oxygen demand is a measure of the quantity of oxygen consumed by microorganisms during the breakdown of organic molecules such a cellulose and sugars into carbon dioxide and water.
Carcinogen	An agent that is reactive or toxic enough to act directly to cause cancer.

Carnivore	Any order of mammals that feed chiefly on flesh or other animal matter rather than plants.
Catchment Area	The area of land from which water finds its way into a particular watercourse, lake or reservoir (Also termed "catch basin" or "watershed."
Cation	A positively charged ion.
Channel	The bed of a stream or river.
Channel Regime	The morphological characteristics, including cross-section, longitudal slope and sinuosity, of a watercourse that is in long-term equilibrium.
Chi-Square Analysis	A statistical test to determine if the patterns exhibited by data could have been produced by chance.
Chlorophyll a	A green photo-sensitive pigment that is essential for the conversion of inorganic carbon (e.g., carbon dioxide) and water into organic carbon (e.g., sugar).
Chlorosis	A yellowing of leaf tissue due to a lack of chlorophyll, generally caused by poor drainage, damaged roots, compacted roots, high alkalinity or nutrient deficiencies in the plant.
Class Area	The area of a particular habitat quality class within the study area.
Closed Canopy	Assemblages of trees with tops sufficiently close to each other that there is very little visible sky from the position of the forest floor.
Closure	The point after shutdown of operations when regulatory certification is received and the area is returned to the Crown.
Coefficient of Variation	Standardized index of the variability of a value relative to the mean value.
Colluvial	A heterogeneous mixture of material that as a result of gravitational action has moved down a slope and settled at its base.
Community	Plant or animal species living in close association or interacting as a unit.
Complex Structure	A stand of trees with a high variation in heights but with no distinct tree layers.

Concentration	Quantifiable amount of a substance in environmental media.
Concordance Table	A table that serves as a cross-reference between regulated requirements and location of documented compliance.
Conductivity	A measure of the capacity of water to conduct an electrical current.
Configuration	The location and arrangement of landscape elements.
Coniferous	These are cone-bearing trees with no true flower (e.g., white spruce, black spruce, balsam fir, jack pine and tamarack).
Connectivity	A measure of how connected or spatially continuous a corridor or matrix is.
Consolidated Frequency Analysis (CFA)	A computer program for deriving flood flow frequencies.
Contaminants	A general term referring to any chemical compound added to a receiving environment in excess of natural concentrations. The term includes chemicals or effects not generally regarded as "toxic", such as nutrients, colour and salts.
Contouring	Process of shaping the land surface to fit the form of the surrounding land.
Corridor	A travel route allowing animals to migrate from one faunal region to another.
Criteria (water quality)	The standards against which water quality is measured.
Critical Load	A quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur.
Cross Stratification	Inclined sedimentary beds that form in sand dunes.
Crown Closure	The ground cover area covered by a vertical projection of the tree crowns onto the ground for each identified storey.
Crust Lichen	Lichen with a hard upper surface and attached closely to the substrate.

Cumulative Effects	The effects of one project with consideration of current conditions, other existing projects, other approved projects and typically, other planned projects.
Cumulative Environmental Management Association (CEMA)	An association of oil sands industry, other industry, regional community representatives, regulatory agencies and other stakeholders designed to develop systems to manage cumulative effects associated with developments in the Oil Sands Region.
Cutblock	Previously forested area that has been harvested for timber and is presently regenerating at various stages of regrowth.
Cutline	A cleared right-of-way, often used in forestry or seismic work.
dBA	A decibel value which has been A-weighted, or filtered to match the response of the human ear.
dBC	A decibel value which has been C-weighted, or filtered to highlight low frequency content.
Decibel (dB)	A decibel value which has been A-weighted, or filtered to match the response of the human ear.
Deciduous	Tree species that lose their leaves at the end of the growing season.
Decommissioning	The act of taking a processing plant or facility out of service and isolating equipment to prepare for routine maintenance work, suspending or abandoning.
Department of Fisheries and Oceans (DFO) (now Fisheries and Oceans Canada)	Federal department responsible for policies and programs in support of Canada's economic, ecological and scientific interests in oceans and inland waters; for the conservation and sustainable utilization of Canada's fisheries resources in marine and inland waters.
Deposit	Material left in a new position by a natural transporting agent such as water, wind, ice or gravity, or by the activity of man.
Depressurization	The process of reducing the pressure in geological formation.
Detection Limit	The lowest concentration that can be reported by an analytical laboratory with a specified confidence level.
Detrended Correspondence Analysis (DCA)	An ordination technique used to visually determine species and site relationships.

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.
Diameter at Breast Height (DBH)	The diameter of a tree 1.37 m above the ground surface.
Dilbit	Diluted bitumen created by adding lighter fraction hydrocarbons to bitumen.
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.
Discharge	In a stream or river, the volume of water that flows past a given point in a unit of time (i.e., m^3/s).
Dispersion Model	A set of mathematical relationships used to describe the rise and subsequent dispersion of a plume as it is transported by the wind. These relationships are given coded names (e.g., SCREEN3 and CALPUFF) and are computer modeled.
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).
Disturbance	An event that causes a sudden change from the existing pattern, structure and/or composition in an ecological system or habitat.
Diversity	The variety, distribution and abundance of different plant and animal communities and species within an area.
Dose	A measure of integral exposure. Examples include: (1) the amount of chemical ingested; (2) the amount of a chemical taken up; and (3) the product of ambient exposure concentration and the duration of exposure.
Dose Response	The quantitative relationship between exposure of an organism to a chemical and the extent of the adverse effect resulting from that exposure.
Drake	A male duck.

Drawdown	A reduction in the height of the water table.
Drill Core	A cylinder of rock taken by a specialized drill bit similar to a hole saw, that can be analysed for various rock and fluid properties.
Echolocation	High frequency sounds (25 to 120 kHz) produced by bats that are beyond the range of human hearing (20 Hz to 25 kHz). These sounds are produced with great intensity. Echoes resulting from sound returning from objects in the bat's environment provide information to the bat.
Ecodistrict	A broad subdivision of the landscape based on differences in landscape pattern, topography and dominant soils.
Ecological Area	As part of the hierarchical classification system outlined in the Field Guide to Ecosites of Northern Alberta, a broad climatic region within the green zone of Alberta.
Ecological Land Classification (ELC)	A means of classifying landscapes by integrating landforms, soils and vegetation components in a hierarchical manner.
Ecosite	Ecosite is a functional unit defined by the moisture and nutrient regime. It is not tied to specific landforms or plant communities, but is based on the combined interaction of biophysical factors that together dictate the availability of moisture and nutrients for plant growth.
Ecosite Phase	A subdivision of the ecosite based on the dominant tree species in the canopy. On some sites where the tree canopy is lacking, the tallest structural vegetation layer determines the ecosite phase.
Ecosystem	An integrated and stable association of living and non-living resources functioning within a defined physical location. For the purposes of assessment, the ecosystem must be defined according to a particular unit and scale.
Edaphic	Referring to the soil. The influence of the soil on plant growth is referred to as an edaphic factor.
Edge	Where different plant communities meet in space on a landscape; and where plant communities meet a disturbance. An outer band of a plant community that usually has an environment significantly different from the interior of the plant community.

Effluent	Stream of water discharging from a source.
Electrical Conductivity	The capability of a solution to transmit an electrical current. A capability closely related to the concentration of salts in soils.
Electrofishing	A 'live' fish capture technique in which negative (anode) and positive (cathode) electrodes are placed in the water and an electrical current is passed between the electrodes. Fish are attracted (galvano-taxis) to the anode and become stunned (galvano-narcosis) by the current, allowing fish to be collected, measured and released.
Energy Resources Conservation Board (ERCB)	An independent, quasi-judicial agency of the Government of Alberta. The purpose of the ERCB 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.
Endangered	A species facing immediate extinction or extirpation.
Entrenchment Ratio	The ratio of the width of the flood-prone area to the surface width of the bankfull channel, which is used to describe the degree of vertical containment of a river channel.
Environmental Effect	Any change that may cause positive or negative effects to land, air, water, living organisms (including people), cultural, historical or archeological resources.
Environmental Impact	The net change, positive or negative, to land, air, water, living organisms (including people), cultural, historical or archeological resources.
Environmental Impact Assessment (EIA)	A review of the effects that a proposed development will have on the local and regional environment.
***Environmental Protection and Enhancement Act* (EPEA) (Alberta)**	Provincial act created to support and promote the protection, enhancement and wise use of the environment.
Environmental Setting	A surveyed or predicted condition that serves as a reference point to which later surveys are coordinated or correlated.
Eolian	A designation of rocks and soils whose constituents have been carried and laid down by wind.

Ephemeral	A phenomenon or feature that lasts only a short time (e.g., an ephemeral stream is only present for short periods during the year).
Epilimnetic	Localized in the surface layer of a waterbody.
Epilimnion	A freshwater zone of relatively warm water in which mixing occurs as a result of wind action and convection currents.
Epiphyte	A plant that grows upon another plant, but is neither parasitic on it nor rooted in the ground.
Equivalent Land Capability	The ability of land to support various land uses after reclamation is similar to the ability that existed prior to any activity on the land, but the ability to support individual land uses will not necessarily be equal after reclamation.
Ericaceous	Plant species belonging to the heath family (Ericaceae) and typically prefer acid soil.
Erosion	The process by which material, such as rock or soil, is worn away or removed by wind or water.
Escarpment	A cliff or steep slope at the edge of an upland area. The steep face of a river valley.
Estuarine	Formed or deposited in an estuary; estuarine muds: or growing in, inhabiting, or found in an estuary; an estuarine fauna.
Euphotic	The upper surface layer of a body of water where sufficient light penetrates to allow photosynthesis to occur.
Eutrophic	The nutrient-rich status (amount of nitrogen, phosphorus and potassium) of an ecosystem.
Eutrophication	Excessive growth of algae or other primary producers in a stream, lake or wetlands as a result of large amounts of nutrient ions, especially phosphate or nitrate
Evaporation	The process by which water is changed from a liquid to a vapour.
Evaporation, Potential	The maximum amount of water that can be evaporated from a surface (e.g., ground, vegetation) if surface moisture is not limited.
Evaporite	A sediment that is deposited from aqueous solution as a result of extensive or total evaporation.

Evapotranspiration	The process by which water is transmitted as a vapor to the atmosphere as the result of evaporation from any surface and transpiration from plants.
Existing and Approved Case	The Environmental Impact Assessment case that includes existing environmental conditions as well as existing and approved projects or activities.
Facies	A distinctive group of characteristics that distinguish one group from another within a stratigraphic unit; e.g. contrasting river-channel facies and overbank-flood-plain facies in alluvial valley fills.
Fauna	An association of animals living in a particular place or at a particular time.
Fen	A peat-forming wetland. Fens are defined from other peat wetlands by the source of water, which is contributed primarily by flowing surface or underground spring water versus solely from rain (such as bogs). As such, they tend to be more mineral rich than other peat wetlands. Fens can be dominated by grasses, shrubs or trees.
Field Facilities	The surface equipment and pipelines required to deliver steam to the wells and transport fluids to the central plant.
Fish Habitat (*Fisheries Act*)	Spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly to carry out their life processes.
Flark	Wet and sparsely vegetated parts of patterned fens.
Fluvial	Relating to a stream or river.
Fluvial Sediment	Sediment generally consisting of gravel and sand with a minor fraction of silt and rarely clay. The gravels are typically rounded and contain interstitial sand.
Foliose	Having a leaf-like thallus loosely attached to a surface, as certain lichens.
Footprint	The proposed development area that directly affects the soil and vegetation components of the landscape.
Forage Fish	Small fish that provide food for larger fish (e.g., longnose sucker, fathead minnow).

Forb A broad-leaved herb that is not a grass.

Forest A growth of trees and underbrush covering a tract of land.

Forest Cover Type Primary stand groupings based on the percent composition of coniferous or deciduous species. Forest cover type can be deciduous, coniferous or mixedwood. Also, regenerating and selective harvest stands are included as a forest cover type.

Forest Fragmentation The change in the forest landscape, from extensive and continuous forests.

Forest Productivity A measure of forest growth based on the volume of wood fibre added to the landbase annually (i.e., mean annual increment) or the rate at which trees grow in height over a given period of time as defined by a timber productivity rating or site index value.

Forest Succession see Succession.

Formation A geologic unit of distinct rock types that is large enough in scale to allow its mapping over a region.

Fossiliferous Contains fossils or the remains of plants and animals.

Fragmentation The process of reducing size and connectivity of stands of trees that compose a forest.

FRAGSTATS A spatial pattern analysis software program used to quantify the areal extent and spatial configuration of patches within a landscape. The analysis is done using categorical spatial data (e.g., plant communities).

Frequency Analysis A statistical procedure involved in interpreting the past record of a hydrometeorological event to occurrences of that event in the future.

Freshet A flood resulting from a spring thaw resulting from snow and ice melts in rivers.

Fry The early stage of development for the fish from hatching until it is one year old.

Fuel Gas Gas used as fuel for the various pieces of equipment. Fuel gas can be purchased gas or a mixture of purchased gas and treated produced gas.

Fugitive Emissions	Substances emitted from any source except those from stacks and vents. Typical sources include gaseous leakage from valves, flanges, drains, volatilization from ponds and lagoons, and open doors and windows. Typical particulate sources include bulk storage areas, open conveyors, construction areas or plant roads.
Furbearer	Mammals that have traditionally been trapped or hunted for their fur.
G Test	A statistical test which tests for a significant difference between sampled and expected frequencies of occurrence. Otherwise known as a likelihood ratio test.
Gathering System	The pipelines and other equipment needed to transport oil, gas or both from wells to a central point.
Genetic Diversity	The range of possible genetic characteristics found within a species and amongst different species (e.g., variations in hair colour, eye colour and height in humans).
Geographic Information System (GIS)	Computer software designed to develop, manage, analyze and display spatially referenced data.
Geomorphic	The natural evolution of surface soils and landscape over long periods.
Geomorphology	The science of surface landforms and their interpretation on the basis of geology and climate. That branch of science which deals with the form of the earth, the general configurations of its surface and the changes that take place in the evolution of landforms.
Glacial Till	Unsorted and unstratified heterogeneous mixture of clay, silt, sand, gravel and boulders deposited directly by a glacier without subsequent reworking by water from the glacier.
Glaciofluvial	Sediments or landforms produced by melt waters originating from glaciers or ice sheets. Glaciofluvial deposits commonly contain rounded cobbles arranged in bedded layers.
Glacolacustrine	Relating to the lakes that formed at the edge of glaciers as the glaciers receded. Glaciolacustrine sediments are commonly laminar deposits of fine sand, silt and clay.
Gleysolic Soil	A great group of soils in the Gleysolic order. A Gleysol has a thin (less than 8 cm) Ah horizon underlain by mottled grey or brownish grey material, or it has no Ah horizon.

Graminoid	Grasses and grass-like plants such as sedges and rushes.
Graupel	Precipitation that forms when supercooled droplets of water condense on a snowflake.
Groundtruth	Visiting locations in the field to confirm or correct information produced from remote sources such as interpreted aerial photographs or classified satellite imagery.
Groundwater	That part of the subsurface water that occurs beneath the water table, in soils and geologic formations that are fully saturated.
Groundwater Level	The level below which the rock and subsoil, to unknown depths, are saturated.
Groundwater Mounding	An area of a groundwater system featuring an increased groundwater surface elevation above the baseline condition for that area.
Groundwater Recharge	Water that enters the saturated zone by a downward movement through soil and contributes to the overall volume of groundwater.
Groundwater Velocity	The speed at which groundwater advances through the ground; the average linear velocity of the groundwater.
Guild	A set of co-existing species that share a common resource.
Habitat	The place or environment where a plant or animal naturally or normally lives or occurs.
Habitat Fragmentation	Reduction of extensive, continuous tracts of habitat into smaller, more isolated patches.
Habitat Generalist	Wildlife species that can survive and reproduce in a variety of habitat types (e.g., red-backed vole).
Hardness	Measure of the calcium and magnesium concentrations in water.
Hazard	A condition with the potential for causing an undesirable consequence.
Hazardous Waste	Any waste material that presents a potential for unwanted consequences to people, property and the environment.

Head	The energy, either kinetic or potential, possessed by each unit weight of a liquid; expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed.
Herb	A vascular plant (forb or graminoid) without a woody stem.
Heterogeneity	Consisting of parts that are unlike each other. For example, the variety and abundance of ecological units (e.g., ecosite phases and wetlands types) comprising a landscape mosaic.
Historical Resources Impact Assessment (HRIA)	A review of the effects that a proposed development will have on the local and regional historic and prehistoric heritage of an area.
Home Range	The area that an animal traverses as part of its annual travel patterns.
Hydraulic Conductivity	Is a measure of how easy water can flow through a porous material.
Hydraulic Head	The elevation, with respect to a specified reference level, at which water stands in a piezometer (a pipe in the ground used to measure water elevations/or a small diameter observation well) connected to the point in question in the soil. Its definition can be extended to soil above the water table if the piezometer is replaced by a tensiometer (instrument used to measure moisture content of soil). The hydraulic head in systems under atmospheric pressure may be identified with a potential expressed in terms of the height of a water column. More specifically, it can be identified with the sum of gravitational and capillary potentials, and may be termed the hydraulic potential.
Hydric	Soil moisture conditions where water is removed so slowly that the water table is at or above the soil surface all year.
Hydrogeology	The study of the factors that deal with subsurface water (groundwater) and the related geologic interactions with surface water.
Hydrology	The science of waters of the earth, their occurrence, distribution, and circulation; their physical and chemical properties; and their reaction with the environment, including living beings.
Hydrometric Station	A station where measurement of hydrological parameters is performed.

Hydrostratigraphic Unit	A formation, part of a formation, or group of formations in which there are similar hydrologic characteristics allowing for grouping into aquifers or confining layers.
Hygric	Soil moisture conditions where water is removed slowly enough to keep the soil wet for most of the growing season. Permanent seepage and mottling are present and possibly weak gleying.
Hypereutrophic	Trophic state classification for lakes characterized by very high productivity and nutrient inputs (particularly total phosphorus).
Hypolimnion	The deep, cold layer of a lake lying below the metalimnion (thermocline) during the time a lake is normally stratified.
Inclined Heterolithic Stratification	Inclined beds of alternating mud and sand that are deposited on the sides of channel bars.
Infaunal	Animals living within the sediment.
In-Situ	Latin for “in place”. As used here, refers to methods of extracting deep deposits of oil sands using wells to recover the resources with less impact to the land, air and water than for oil sands mining.
Interbedded Sand and Mud	Alternating beds of sand and mud deposited during times of strong water flow and negligble water flow.
Internal Lawn	Wet depresssional areas within bog or fen wetlands types that are absent of trees and contain species adapted to wetter conditions than the surrounding treed habitat.
Invasive Species	A species that has moved into an ecosystem and reproduced so successfully that it has displaced the original structure of the community.
Isopach Map	A geological map of subsurface strata showing the various thicknesses of a given formation underlying an area.
Isopleth	A line on a map connecting places sharing the same parameter (e.g., ground-level concentration)
Key Indicator Resources (KIRs)	Environmental attributes or components identified as a result of a social scoping exercise as having legal, scientific, cultural, economic or aesthetic value.

Keystone Species	A species that is of particular importance to community integrity and function, without which significant changes to the community would occur.
Lacustrine	Sediment that have been transported or deposited by water or wave action. Generally consisting of stratified sand, silt or clay deposited on a lake bed or moderately well sorted and stratified sand and coarser material.
Land Capability	The ability of the land to support a given land use, based on an evaluation of the physical, chemical and biological characteristics of the land, including topography, drainage, hydrology, soils and vegetation.
Land Capability Class	A land capability class assigned to an area according to the criteria outlined in Land Capability Classification System for Forest Ecosystems in the Oil Sands, 3rd Edition, as amended.
Land Classification	The classification of specific bodies of land according to their characteristics or their capabilities of use.
Land Cover Class	A vegetated or non-vegetated map unit defined here at the regional study area level and classified from LANDSAT 5 satellite imagery.
Land Status Automated System (LSAS)	An online government database containing Alberta Surface Public Land and Crown Mineral dispositions and activities. Includes information about land restrictions and reservations.
LANDSAT 5	A specific satellite or series of satellites used for earth resource remote sensing. Satellite data can be converted to visual images for resource analysis and planning.
Landscape	A heterogeneous land area with interacting ecosystems that are repeated in similar form throughout. From a wildlife perspective, a landscape is an area of land containing a mosaic of habitat patches within which a particular "focal" or "target" habitat patch is embedded.
Landscape Structure	The spatial relations among a landscape's component parts including composition; the presence and amount of each patch type without being spatially explicit; and landscape configuration, the physical distribution or spatial character of patches within a landscape.
Leaf Area Index (LAI)	The ratio of leaf area to soil surface area.

Leakance	A property of a leaky layer. Expressed as K' divided by b', where K' refers to the hydraulic conductivity of the leaky layer confirming an aquifer in units of length/time and b' refers to the thickness of the leaky layer in units of length.
Lichen	Any complex organism of the group Lichenes, composed of a fungus in symbiotic union with an alga and having a greenish, gray, yellow, brown, or blackish thallus that grows in leaflike, crustlike, or branching forms on rocks, trees, etc.
Lift Gas	Gas injected into the reservoir to help it flow from the well.
Lignin	A complex polymer occurring in plant cell walls making the plant rigid.
Linear Corridor	Roads, seismic lines, pipelines and electrical transmission lines, or other long, narrow disturbances.
Listed Species	Species that are provincially or federally identified as potential species of concern.
Lithic	Consolidated bedrock within the control section below a depth of 10 cm. The upper surface of a lithic layer is a lithic contact.
Lithofacies	A rock or sediment with specific lithologic or textural characteristics.
Littoral Zone	The zone in a lake that is closest to the shore. It includes the part of the lake bottom, and its overlying water, between the highest water level and the depth where there is enough light (about 1% of the surface light) for rooted aquatic plants and algae to colonize the bottom sediments.
Local Study Area (LSA)	Defines the spatial extent directly or indirectly affected by the project.
Lognormal	Of, relating to, or being a logarithmic function with a normal distribution.
Long Range Sustained Yield Average (LRSYA)	The sums of Mean Annual Increment (MAI) for all forest cover types in a study area. LRSYA is an estimate for the sustained yield or expected annual growth of the coniferous and deciduous fibre in a study area.

Low Frequency Noise (LFN)	Where a clear tone is present below and inclusive of 250 Hz. Low frequency noise can be determined by subtracting the overall C-weighted from the overall A-weighted sound level, or as the overall C-weighted sound level by itself.
Lowest Observed Adverse Effect Level (LOAEL)	In toxicity testing, it is the lowest concentration at which adverse effects on the measurement end point are observed.
Lowland Areas	Areas with ground slopes of less than 0.5% and typically poorly drained.
Luvisol	An order of soils that have eluvial (Ae) horizons, and illuvial (Bt) horizons in which silicate clay is the main accumulation product. The soils developed under forest or forest-grassland transition in a moderafe to cool climate.
Macrophytes	Plants large enough to be seen by the unaided eye. Aquatic macrophytes are plants that live in or in close proximity to water.
Main Canopy	A well-defined, uppermost layer of trees within a forest.
Make-Up Water	The water required to supplement recycled produced water for steam production.
Marsh	A non-peat-forming, nutrient-rich wetlands characterized by frequent flooding and fluctuating water levels.
Mature Forest	A forest with a multi-layered, multi-species canopy dominated by large overstorey trees and accumulations of downed woody debris.
May be at Risk	Any species that ‘May be at Risk’ of extinction or extirpation and is therefore a candidate for detailed risk assessment.
Mean Patch Size	The average size of habitat patches within the study area.
Meander	A randomized search pattern used in rare plant surveys to cover the range in micro-habitat variation within a larger ecosystem unit.
Media	The physical form of the environmental sample under study (e.g., soil, water, air).
Merchantable Timber	A forest area with potential to be harvested for production of lumber/timber or wood pulp. Forests with a timber productivity rating of moderate to good.

Mesic	A moderate soil moisture regime value whereby water is removed somewhat slowly in relation to supply. Available soil water reflects climatic inputs.
Mesotrophic	Trophic state classification for lakes characterized by moderate productivity and nutrient inputs (particularly total phosphorus).
Meteoric Water	That which occurs in or is derived from the atmosphere.
Micro-Habitat	A small-scale surface in the landscape that has its own unique surface properties different from surrounding surfaces.
Mineral Soil	Soils containing low levels of organic matter. Soils that have evolved on fluvial, glaciofluvial, lacustrine and morainal parent material.
Mitigation	The elimination, reduction or control of the adverse environmental effects of the project.
Mitigative Measures	Procedural, locational and timing constraints and methods employed to address project-related impacts.
Mixedwood	A terrestrial forest type that is an assemblage of both deciduous and coniferous tree species.
Mixing Height	The depth of surface layer in which atmospheric mixing of emissions occurs.
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.
Moisture Regime	The relative moisture supply at a site available for plant growth.
Monitoring	Repetitive measurement of specific environmental phenomena to document change primarily for the purpose of: a) testing impact hypotheses and predictions and b) testing mitigative measures.
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.

Multistorey	Forest stands where two or three storeys exist and each storey is significant, clearly observable and evenly distributed.
Muskeg	A soil type comprised primarily of organic matter. Also known as bog peat prevalent in northern Canada.
Native Plant	Plant species that naturally occur in a given area.
Native Species	Species that are known to be historically present in a given area.
Natural Region	The highest level in Alberta's ecological classification hierarchy; defined broadly on the basis of climate, topography, landforms and soil.
Natural Subregion	A division of the natural regions of Alberta. Areas within a natural subregion have a similar climatic regime, which is characterized by modal vegetation distinct for that subregion.
Necrosis	Death of cells and living tissue.
Nitrophillic	Nitrogen-loving plant species.
No Observed Adverse Effect Level (NOAEL)	In toxicity testing, it is the highest concentration at which no adverse effects on the measurement end point are observed.
Non-Condensable Gas	A substance that exists in a gaseous form under reservoir pressure and temperature.
Non-Native Plant	An introduced plant that has been brought over from another ecosystem by man and has established itself within its new environment.
Non-Sport Fish	Large fish which is not caught for food or sport (e.g., longnose sucker, white sucker).
Non-Vascular Plant	Plants that do not possess conductive tissues (e.g., veins) for the transport of water and food.
NO_x	A measure of the oxides of nitrogen comprised of nitric oxide (NO) and nitrogen dioxide (NO_2).
Nutrient Regime	The relative supply of nutrients available for plant growth at a given site.

Nutrients Substances (elements or compounds), such as nitrogen or phosphorus, that are necessary for the growth and development of plants and animals.

Oil Sands A sand deposit containing a heavy hydrocarbon (bitumen) in the intergranular pore space of sands and fine grained particles.

Oil Sands Region The Oil Sands Region includes the Fort McMurray – Athabasca Oil Sands Subregional Integrated Resource Plan (IRP), the Lakeland Subregional IRP and the Cold Lake – Beaver River Subregional IRP.

Old Growth Forest An ecosystem distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulations of large dead woody material, number of canopy layers, species, composition, and ecosystem function. Old growth forests are those forested areas where the annual growth equals annual losses. Mean annual increment of timber volume equals zero. They can be defined as those stands that are self-regenerating (i.e., having a specific structure that is maintained).

Oligotrophic Trophic state classification for lakes characterized by low productivity and low nutrient inputs (particularly total phosphorus).

Ombrogeneous Bog A mineral-poor, acid, peat-forming plant community that derives all its water and dissolved nutrients, from rainfall.

Ombrotrophic Wetlands which receive all water and nutrients from direct precipitation.

Organic Soil Soils containing high percentages of organic matter (fibric and humic inclusions).

Organics Organic compounds (organics) include chemicals consisting of chains or rings of carbon atoms, such as hydrocarbons, phenols, PAHs and naphthenic acids.

Orthophoto A digital image of an aerial photograph.

Outlier A data point that falls outside of the statistical distribution defined by the mean and standard deviation.

Outwash	A glaciofluvial sediment that is deposited by meltwater streams emanating from a glacier.
Overburden	Material below the soil profile and above the bituminous sand.
Overstorey	Those trees that form the upper canopy in a multi-layered forest.
Overwintering Habitat	Habitat used during the winter as a refuge and for feeding.
Ozone (O_3)	Ozone is 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.
Parasequence	a series of related layers of sediment bounded by shales that were deposited in deeper water.
Patch	An area that is different from the area around it (e.g., vegetation types, non-forested areas). This term is used to recognize that most ecosystems are not homogeneous, but rather exist as a group of patches or ecological islands.
Patterned Fen	Peatlands that display a distinctive pattern due to alterations between open wet areas (flarks) and drier shrubby to wooded areas (strings).
Peat	A material composed almost entirely of organic matter from the partial decomposition of plants growing in wet conditions.
Peatland Complex	Within a given area, a mixture of bog and fen wetlands types have formed usually as a result of variation in groundwater flow regimes.
Peatlands	Areas where there is an accumulation of peat material at least 40 cm thick. These are represented by bog and fen wetlands types.
Permafrost	Permanently frozen ground (subsoil).
Permeability	The capacity of porous rock, sediment, soil or a medium for transmitting a fluid, generally measured in Darcy [D] or millidarcy [mD].
Permissible Sound Level	The allowable overall A-weighted sound level of noise from energy industry sources, as specified by the EUB Directive 038, which may contribute to the sound environment of a residential location.

Petrophysical Well Logs Charts produced by measuring various physical properties of rocks or sediments in a well bore.

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.

Phosphorus The key nutrient influencing plant growth in lakes; total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form.

Photochemistry The reaction that proceeds with the absorption of light.

Phytotoxic Toxic or poisonous to plants or plant tissue.

Phytotoxic Metals Metals in concentrations toxic to plants.

Piezometer A pipe in the ground in which the elevation of water levels can be measured, or a small diameter observation well.

Pixel The basic unit of digital imagery data. Shortened from “picture element”. The intensity of each pixel corresponds to the average “brightness” measured electronically by the sensor.

Planned Development Case (PDC) The Planned Development Case includes the Project Case components and planned developments that have been publicly disclosed at least six months prior to submission of the Environmental Impact Assessment.

Plant Community A group of interacting plant species that exist within a defined space and time.

Plant Community Type As part of the hierarchical classification system outlined in the Field Guide to Ecosites of Northern Alberta, this ecological unit represents the lowest level taxonomic unit of the ecosite classification system. These units are subdivisions of an ecosite phase based on differences in understorey species composition.

PM_{10} Airborne particulate matter with a mean diameter less than 10 µm (microns) in diameter. This represents the fraction of airborne particles that can be inhaled into the upper respiratory tract.

$PM_{2.5}$ Airborne particulate matter with a mean diameter less than 2.5 µm (microns) in diameter. This represents the fraction of airborne particles that can be inhaled deeply into the pulmonary tissue.

Polycyclic Aromatic Hydrocarbon (PAH) A chemical by-product of petroleum-related industry. Aromatics are considered to be highly toxic components of petroleum products. PAHs, many of which are potential carcinogens, are composed of at least two fused benzene rings. Toxicity increases along with molecular size and degree of alkylation of the aromatic nucleus.

Polygon The spatial area delineated on a map to define one feature unit (e.g., one type of ecosite phase).

Population A collection of individuals of the same species that potentially interbreed.

Population Sink A habitat within which reproductive and mortality rates should result in population declines. However, populations may be maintained in such habitat by immigration from nearby habitats that are more productive. The term was introduced by Pulliam (1988).

Pore The void space between sediment particles.

Porewater Water filling the void space between sediment particles.

Porosity The percentage of the bulk volume of a rock or soil that is occupied by pores, whether isolated or connected.

Potential Acid Input (PAI) A composite measure of acidification determined from the relative quantities of deposition from background and industrial emissions of sulphur, nitrogen and base cations.

Produced Gas Gas co-produced with the bitumen.

Productive Forest Forests on lands with a capability rating of equal to or greater than three and stocked with enough trees to meet the standards of a merchantable forest.

Progradation When a shoreline moves seaward as the result in increased sediment supply or a drop in sea level.

Project Case The EIA case including the project that is the subject of the application, existing environmental conditions, and existing and approved projects or activities.

Puff Splitting	As the effluent puff is carried away from the source by the wind, it will disperse and break apart into smaller puffs, which in turn will break apart into even smaller puffs.
Rare Plant Community	Plant communities that are described as unusual, uncommon, of limited extent or encountered infrequently.
Rare Plant Potential	A ranking system used to determine and map the likelihood of finding rare plants or the relative abundance of rare plant species among different vegetation types or land cover classes within the landscape.
Rare Plants	A native plant species found in restricted areas, at the edge of its range or in low numbers within a province, state, territory or country.
Raster	A graphic structure where the data is divided into cells on a grid. An example would be a computer screen where an image is represented by horizontal lines of coloured pixels. Shapes are represented by cells of the same colour or content adjacent to each other.
Rating Curve	In hydrology, it typically refers to a curve showing the relation between the discharge of a river or stream and the water level in the stream.
Recharge /Discharge Area	Areas that either contribute (recharge) or take away (discharge) to/from the overall volume of groundwater in an aquifer.
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, including the construction of stable landforms, drainage systems, wetlands, soil reconstruction and addition of nutrients. This provides the basis for natural succession to mature ecosystems suitable for a variety of end uses.
Reclamation Certificate	A certificate issued by an Alberta Environment, Conservation and Reclamation Inspector, signifying that the terms and conditions of a conservation and reclamation approval have been complied with.

Reference Concentration (RfC)	For a specific chemical that is conceptually equivalent to an air quality objective, and is expressed in μg/m^3. It is an exposure limit that is established for chemicals which are locally acting (e.g., irritant chemicals), whose toxicity is dependent solely on the air concentration and not on the total internal dose received via multiple exposure pathways.
Regional Aquatics Monitoring Program (RAMP)	The RAMP was established to determine, evaluate and communicate the state of the aquatic environment in the Athabasca Oil Sands Region.
Regional Issues Working Group (RIWG)	A group that works to promote the responsible, sustainable development of resources within the Regional Municipality of Wood Buffalo.
Regional Study Area (RSA)	Defines the spatial extent related to the cumulative effects resulting from the project and other regional developments.
Regional Sustainable Development Strategy (RSDS)	A regulatory framework for balancing development of Alberta's oil sands resources with protection of the environment.
Regosol	The only great group in the Regosolic order. The soils in the group have insufficient horizon development to meet the requirements of the other orders.
Relative Abundance	The proportional representation of a species in a sample or a community.
Remediation	The process of planning for, investigating and potentially managing or removing the effects of chemical substances on the environment, including soil or groundwater effects.
Replicate	Duplicate analyses of an individual sample. Replicate analyses are used for measuring precision in quality control.
Resistivity	A measure of how much a material resists the flow of electricity.
Richness	The number of species in a biological community (e.g., habitat).
Rights-of-way	The strip of land over which a power line, railway line, road, etc., extends
Riparian	Refers to terrain, vegetation or simply a position next to or associated with a stream, floodplain or standing waterbody.

Risk	The possibility of injury, loss or environmental incident created by a hazard. The significance of the risk is determined by the probability on an unwanted incident and the severity of the consequences.
Rough Broken	An area having steep slopes and many intermittent drainage channels, but usually covered with vegetation.
Runoff	The portion of water from rain and snow that does not infiltrate into the ground, or evaporate.
Saline Water	Water with total dissolved solids between 1,000 and 10,000 mg/L.
Scale	Level of spatial resolution.
Scavenging	Removal of a pollutant from the air through chemical or physical processes such as dry deposition or washout by precipitation
Secondary Canopy	A well-defined, layer of trees beneath the main canopy within a forest.
Secure	A species that is not 'At Risk', 'May be at Risk', or 'Sensitive'.
Sedge	Any plant of the genus Carex, perennial herbs, often growing in dense tufts in marshy places. They have triangular jointless stems, a spiked inflorescence and long grass-like leaves which are usually rough on the margins and midrib. There are several hundred species.
Sediment	Solid material that is transported by, suspended in, or deposited from water.
Sediment Yield	The amount of sediment transported by a stream system that may be measurable at a particular location. Usually expressed in volume or weight per unit of time.
Sedimentation	The process of the deposition of suspended particles carried by water, wastewater or other liquids, by gravity. It usually occurs through a reduction in the velocity of the liquid below the point which it can transport the suspended material.
Sensitive	Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.

Sensory Disturbance	Visual, auditory, or olfactory stimulus which creates a negative response in wildlife species.
Sentinel Species	Species that can be used as an indicator of environmental conditions.
Shadow Population	The people who live in work camps, campgrounds or hotels in the Athabasca Oil Sands Region.
Shannon's Evenness Index (SHEI)	Distribution of area among or within patch types in the landscape.
Shoreface	The portion of the ocean or lake bottom that affected by wave action.
Shredder Insect	A herbivorous or detritivorous aquatic insect that chews or gorges vascular plants, decaying plant material or woody material as a food source.
Sink Habitat	A habitat within which reproductive and mortality rates should result in population declines. However, populations may be maintained in such habitat by immigration from nearby habitats that are more productive. The term was introduced by Pulliam (1988).
Sinuosity	The ratio of the thalweg length (i.e., the line connecting the deepest points along a stream) to valley length, for a specific reach of a river or stream system. This is, in essence, a ratio of the stream's actual "running" length to its down-gradient length.
Site Index	The average height of undamaged, dominant and co-dominant trees in a stand at a standard (reference) age that have been free-growing since reaching breast height.
Snag	A naturally occurring, standing dead or dying tree often missing a top or most of the smaller branches.
Soil Heat Flux	The soil heat flux constant is a function of the surface properties and is used to compute the flux of heat into the soil.
Soil Horizon	A layer of mineral or organic soil material approximately parallel to the land surface that has characteristics altered by processes of soil formation. A soil mineral horizon is a horizon with 17% or less total organic carbon by weight. A soil organic horizon is a horizon with more than 17% organic carbon by weight.

Soil Nutrient	A chemical element or compound found in the soil that is essential for plant growth.
Soil Series	The basic unit of soil classification in the Canadian System of Soil Classification and consists of soils that are essentially alike in all major profile characteristics except the texture at the surface.
Solar Radiation	The principal portion of the solar spectrum that spans from approximately 300 nanometres (nm) to 4,000 nm in the electromagnetic spectrum. It is measured in W/m2, which is radiation energy per second per unit area.
Sound Power	The rate of acoustic energy flow across a specified surface, or emitted by a specified sound source. Units W (Watt).
Spawning	The reproductive stage of adult fish which includes fertilization and deposition of eggs.
Special Concern (Vulnerable)	A species is of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Special Plant Community	Communities that are suspected to be rare or unique but are differentiated from known rare plant communities in that there is less information known about them, and currently, are not included on ANHIC's Preliminary Ecological Community Tracking and Watch List.
Species	A taxonomic grouping of genetically and morphologically similar individuals that actually or potentially interbreed and are reproductively isolated from all other such groups.
Species Abundance	The number of individuals of a particular species within a biological community (e.g., habitat).
Species Composition	The number and abundance of species found within a biological community.
Species Distribution	Where the various species in an ecosystem are found at any given time. Species distribution varies with season.
Species Diversity	A description of a biological community that includes both the number of different species and their relative abundance. Provides a measure of the variation in number of species in a region.
Species Richness	The number of different species occupying a given area.

Spectral Signature	The unique characteristics in solar reflectance of a particular land classification unit based upon multi-spectral satellite imagery.
Sphagnum	A genus of peat-forming moss.
Sport Fish	Large fish caught for food or sport (e.g., northern pike, Arctic grayling).
Stand	A group of trees occupying a specific area and sufficiently uniform in composition, age, arrangement and condition so that it is distinguished from trees in adjoining areas.
Stand Age	The number of years since a forest has been affected by a stand-replacing disturbance event (e.g., fire or logging) and has since been regenerating.
Stand Density	The relative closure of a forest canopy.
Stand Structure	The various horizontal and vertical physical elements of the forest. The physical appearance of canopy and subcanopy trees and snags, shrub and herbaceous layers and downed woody material.
Standard Deviation (SD)	A measure of the variability or spread of the measurements about the mean. It is calculated as the positive square root of the variance.
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.
Stomata	Microscopic pores found on the under side of leaves.
Stomatal Closure	The movement of stomata guard cells to slow or prevent gas exchange between the plant and its environment.
Storativity	The volume of water an aquifer releases from or takes into storage due to pressure change.
Stratify	Layering of lakes into two or more non-mixing layers; in summer, typically a layer of warmer, less dense water lies on a cooler, denser layer; in winter, typically a layer of very cold (<4°C), less dense water overlies warmer, denser water (approximately 4°C).
Stratigraphy (Historical)	The succession and age of strata of rock and unconsolidated material. Also concerns the form, distribution, lithologic composition, fossil content and other properties of the strata.

Stream Flow	The movement of surface water in a stream channel, usually measured in cubic metres per second (m^3/s).
Stream-Day	Maximum daily production rate (design capacity) for equipment. Takes into account non-operational time due to plant turnarounds, and/or emergencies. Calculated based on 93% plant availability.
Study Area	The geographic limits within which an impact to a key indicator resource or social component is likely to be significant.
Subhydric	Soil moisture conditions where water is removed slowly enough to keep the water table at or near the surface for most of the year; organic and gleyed mineral soils are present as well as permanent seepage less than 30 cm below the surface.
Subhygric	Soil moisture conditions where water is removed slowly enough to keep the soil wet for a significant part of the growing season. There is some temporary seepage and possible mottling below 20 cm.
Submesic	Soil moisture conditions where water is removed readily in relation to supply. Water is available for moderately short periods following precipitation.
Subsoil	The stratum of weathered material that underlies the surface soil, including one or more of the following: (i) that portion of the B horizon left after salvage of upland surface soil; (ii) the C horizon of an upland soil; (iii) underlying parent material at an upland location that is rated good, fair or poor; and (iv) mineral material below an organic layer at a location other than upland, that is rated good, fair or poor.
Subxeric	Soil moisture conditions where water is removed rapidly in relation to supply. Soil is moist for short periods following precipitation.
Succession	A series of dynamic changes by which one group of organisms succeeds another through stages leading to a climax community.
Supernatant	The liquidor clear fluid above a precipitate or sediment
Synthetic Crude Oil	A mixture of hydrocarbons, similar to crude oil, derived from upgrading bitumen from oil sands.

Taxa	A group of organisms of any taxonomic rank (e.g., family, genus, or species).
Thallus	A simple vegetative body undifferentiated into true leaves, stem and root, ranging from an aggregation of filaments to a complex plantlike form.
Thalweg	A line extending longitudinally along a watercourse following the deepest portion of the channel.
Threatened	A species likely to become endangered if limiting factors are not reversed.
Threshold Chemicals	Chemicals that act via a threshold mechanism of action require a minimal concentration level to produce adverse effects. Below this specific threshold level, there is no potential for adverse effects to occur.
Threshold Limit Value (TLV)	The air concentration of a chemical below which workers may be repeatedly exposed day after day, without any occurrence of health effects. Threshold limit values are recommended occupational exposure limits designed to control potential adverse effects associated with workplace exposure.
Till	Sediments laid down by glacial ice.
Topsoil	Ae, Ah, Ahe, Ahj and gleyed and weakly gleyed versions of these horizons are usually considered to be part of the topsoil.
Total Dissolved Solids (TDS)	The total concentration of all dissolved compounds solids found in a water sample.
Total Recoverable Hydrocarbons	A term that refers to total petroleum hydrocarbons recovered using a solvent-specific extraction procedure.
Total Reduced Sulphur (TRS)	A term used to collectively describe hydrogen sulphide and mercaptans.
Total Suspended Solids (TSS)	The amount of suspended substances in a water sample.
Toxic	A substance, dose or concentration that is harmful to a living organism.

Toxicity The inherent potential or capacity of a material to cause adverse effects in a living organism.

Toxicity Reference Value (TRV) The maximum acceptable dose (per unit body weight and unit of time) of a chemical to which a specified receptor can be exposed. Also referred to as exposure limit.

Traditional Ecological Knowledge (TEK) Knowledge and understanding of traditional resource and land use, harvesting and special places.

Traditional Land Use (TLU) Activities involving the harvest of traditional resources such as hunting and trapping, fishing, gathering medicinal plants and travelling to engage in these activities.

Traditional Plant Potential A ranking system used to determine and map the relative abundance of traditional use plant species among different vegetation types or land cover classes within the landscape.

Traditional Resources Plants, animals and mineral resources that are traditionally used by indigenous populations.

Traditional Use Plants Plants used by aboriginal people of a region as part of their traditional lifestyle for food, ceremonial, medicinal and other purposes.

Training Site A group of selected satellite imagery pixels used to define the spectral signature of a particular map unit for land classification purposes.

Transmissivity The product of the average coefficient of hydraulic conductivity (or permeability) and the thickness of the aquifer. Consequently, transmissivity is the rate of flow under a hydraulic gradient equal to unity through a cross-section of unit width over the whole thickness of the aquifer.

Transpiration The transfer of water from soil and plant surfaces to the air.

Treater A vessel in which oil is treated for the removal of sediment and water using heat, chemicals and/or electricity.

Trophic Pertaining to part of a food chain, for example, the primary producers are a trophic level just as tertiary consumers are another trophic level.

Turbidity	An indirect measure of suspended particles, such as silt, clay, organic matter, plankton and microscopic organisms, in water.
Understorey	Trees or other vegetation in a forest that exist below the main canopy level.
Ungulate	Belonging to the former order Ungulata, now divided into the orders Perissodactyla and Artiodactyla, and composed of the hoofed mammals such as horses, cattle, deer, swine and elephants.
Upland	Areas that have typical ground slopes of 1 to 3% and are better-drainage.
Upset Conditions	An acute time period within which usual conditions become highly unfavourable; severity and duration may vary.
Vascular Plant	Plants possessing conductive tissues (e.g., veins) for the transport of water and food.
Volatile Organic Compounds (VOC)	Volatile Organic Compounds include aldehydes and all of the hydrocarbons except for ethane and methane. VOCs represent the airborne organic compounds likely to undergo or have a role in the chemical transformation of pollutants in the atmosphere.
Water Sand	A water-saturated sand unit occurring within a geological formation.
Water Table	The shallowest saturated ground below ground level – technically, that surface of a body of unconfined groundwater in which the pressure is equal to atmospheric pressure.
Water Yield	Runoff, including groundwater outflow that appears in the stream, plus groundwater outflow that leaves the basin underground. Water yield is the precipitation minus the evapotranspiration.
Waterbody	A standing body of water such as a lake or pond.
Watercourse	A flowing body of water such as a river, stream or creek.
Watershed	The entire surface drainage area that contributes water to a lake or river.
Weeds	Plants that are defined as controlled weeds, nuisance weeds, or noxious weeds by the Weed Control Act, as amended.
Wellbore	Also borehole. The hole drilled by the bit (can be cased or open).

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.
Wind Shear	A difference in wind speed and/or direction over a relatively short distance in the atmosphere.
Windrose	Graphic pie-type representation of frequencies of wind directions and speeds over a period of time (e.g., one year) for a meteorological station.
Xeric	Soil moisture conditions where water is removed very rapidly in relation to supply. Soil is only moist for a very short time following precipitation.
Young of the Year (YOY)	Fish at age 0, within the first year after hatching.

ABBREVIATIONS

°	Degree
°C	Temperature in degrees Celsius
%	Percent
%OM	Percent Organic Matter
≥	More than or equal to
<	Less than
>	More than
±	Plus or minus
≤	Less than or equal to
2-D	Two dimensional
3-D	Three dimensional
AAAQO	Alberta Ambient Air Quality Objectives
AAC	Annual Allowable Cut
AADT	Annual Average Daily Traffic Counts
AAFRD	Alberta Agriculture, Food And Rural Development
ACGIH	American Conference of Governmental Industrial Hygienists
AEII	Alberta Employment, Immigration and Industry
AENV	Alberta Environment
AEP	Alberta Environmental Protection
AGL	Above Ground Level
AHW	Alberta Health and Wellness
AICc	Akaike's Information Criterion
Al	Aluminum
Albian Sands	Albian Sands Energy Inc. (Muskeg River Mine)
Al-Pac	Alberta-Pacific Forest Industries Inc.
AMAH	Alberta Municipal Affairs and Housing
ANC	Acid Neutralizing Capacity
ANC_{lim}	Critical value for acid neutralizing capacity
ANC_{org}	Weak Organic Acids
ANHIC	Alberta Natural Heritage Information Centre
ANOVA	Analysis of Variance
ANPC	Alberta Native Plant Council
AOSERP	Alberta Oil Sands Environmental Research Program
AOSP	Athabasca Oil Sands Project
AP	Aquifer Productivity

AQS	Air Quality Monitoring Station
ARC	Alberta Research Council
AREA_CV	Patch Size Coefficient of Variation
AREA_MD	Patch Size Median
AREA_MN	Patch Size Mean
AREA_SD	Patch Size Standard Deviation
ARHA	Aspen Regional Health Authority
ASIR	Age-Standardized Incidence Rates
ASMR	Age-Standardized Mortality Rates
ASRD	Alberta Sustainable Resource Development
ATC	Athabasca Tribal Council
ATC-APCA	Athabasca Tribal Council - All Parties Core Agreement
atm	Atmosphere
ATPRC	Alberta Tourism, Parks, Recreation and Culture
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	All-terrain vehicle
AVI	Alberta Vegetation Inventory
Aw	Aspen (Populus Tremuloides)
AWI	Alberta Wetlands Inventory
B	Bog
BC	Base Cation
BC MWLAP	British Columbia Ministry of Water, Land and Air Protection
BC/Al	Base Cation/Aluminum
BC/H	Base Cation/Hydrogen
BCF	Bioconcentration Factors
BFW	Boiler Feedwater
Bhp	Brake-horsepower
BLFN	Beaver Lake First Nation
BMC	Benchmark Concentration
BMD_{05}	Benchmark Dose
$BMDL_{05}$	Benchmark Dose Confidence Limit
BMI	Body Mass Index
bpcd	Barrels per calendar day
bpd	Barrels per day
Bs	Shallow Bog
BS&W	Basic Sediment and Water
BSE	Bovine Spongiform Encephalopathy

BSL	Basic sound level
BSOD	Biological Species Observation Database
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BU	Burn/Partial Burn
Bw	White Birch (Betula Papyrifera)
bw/d	Body weight per day
C	Coniferous
C&R	Conservation And Reclamation
C,C&R	Closure, Conservation And Reclamation
C_1	Methane
C_2	Ethane
C_3+	Hydrocarbon molecules with more than three carbon atoms
C_7	Heptane
Ca	Calcium
CA	Class Area
Ca^{2+}	Calcium base cation (particle)
$CaCO_3$	Calcium carbonate
CadnaA	Computer Aided Noise Attenuation
CAI_AM	Core Area Index Area Weighted Mean
Cal/Kg·°C	Calories per Kilogram degrees Celcius
Cal/m·sec·°C	Calories per metres seconds degrees Celcius
CAPP	Canadian Association of Petroleum Producers
CARB	California Air Resources Board
CASA	Clean Air Strategic Alliance
CBOD	Carbonaceous Biochemical Oxygen Demand
CC	Clearcut Modifier
CCA	Conklin Community Association
CCIS	Canadian Climate Impact Scenarios
CCME	Canadian Council of Ministers of the Environment
CEA	Cumulative Effects Assessment
CEAA	*Canadian Environmental Assessment Act*
CEC	Cation Exchange Capacity
CEMA	Cumulative Environmental Management Association
CEPA	*Canadian Environmental Protection Act*
CFSA	Child and Family Services Authority
CGCM2	Canadian Global Coupled Model – Version 2
CH_4	Methane

CHA	Cardiovascular Hospital Admissions
CHTD	Canadian Historical Temperature Database
CICS	Canadian Institute for Climate Studies
Cl	Chloride
CL	Clearing
CLI	Canada Land Inventory
CLRP	Christina Lake Regional Project
cm	Centimetre
cm^2	Square centimetre
CNIT	Core Needs Income Threshold
CNS	Central Nervous System
CO	Carbon monoxide
CO_2	Carbon dioxide
CONRAD	Canadian Oil Sands Network for Research and Development
COPC	Chemicals of Potential Concern
COPD	Chronic Obstructive Pulmonary Disease
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPDFN	Chipewyan Prairie Dene First Nation
CST	Central Standard Time
CWS	Canada-Wide Standards
d	Day
D	Deciduous
DAWS	De-Aromatized White Spirit Vapours
dB	Decibel, a measure of sound power
dBA	A-weighted decibels
dBC	C-Weighted decibels
dbh	Diameter at Breast Height
DCA	Detrended Correspondence Analysis
DEM	Digital Elevation Model
Devon	Devon Canada Corporation
df	Degrees of Freedom
DFO	Fisheries and Oceans Canada (Note: formerly Department of Fisheries and Oceans Canada)
dis	Disturbed
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOE	Department of the Environment
DOW	Dangerous Oilfield Waste

DQRA	Detailed Quantitative Risk Assessment
DST	Drill Stem Test
DW	Drinking Water
E	East
E	Eolian
e.g.	For example
EAC	Existing and Approved Case
EC	Effect Concentration
EC	Electrical Conductivity
Eco-SSLs	Ecological Soil Screening Levels
ECS	Early Childhood Services (Education)
EDI	Estimated daily intake
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIFAC	European Inland Fisheries Advisory Commission
ELC	Ecological Land Classification
EMS	Emergency Medical Services
EnCana	EnCana Corporation
ENN_CV	Euclidean Nearest Neighbour Median
ENN_MD	Euclidean Nearest Neighbour Coefficient of Variation
ENN_MN	Euclidian Nearest Neighbour Distance
ENN_SD	Euclidean Nearest Neighbour Standard Deviation
EPCM	Engineering, Procurement and Construction Management
EPEA	Alberta *Environmental Protection and Enhancement Act*
ERA	Ecological Risk Assessment
ERCB	Energy Resources Conservation Board
ERP	Emergency Response Plan
ESA	Environmentally Significant Area
ESAR	East Sise of the Athabasca River Caribou Range
ESD	Emergency Shut Down
ESL	Effects Screening Level
ESP	Exchangeable Sodium Percentage
ESR	Environmental Setting Report
ESRI	Environmental Systems Research Institute
EST	Eastern Standard Time
et al.	Group of authors
EUB	Alberta Energy and Utilities Board

F	Fluvial
F	Statistical Test Using F Distribution To Determine If Significant Differences Between 2 Means
Fb	Balsam Fir (Abies Balsamea)
FB	Fractional bias
FCSS	Family and Community Support Services
Fg	Glaciofluvial
FLE	Full Load Equivalent
FMA	Forest Management Agreement
FMES	Fort McKay Environmental Services Ltd.
FMFN	Fort McMurray First Nation
FMFN-IRC	Fort McMurray First Nation – Industrial Relations Corporation
FMU	Forestry Management Unit
FPAC	Forest Products Association of Canada
FPTCCCEA	Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment
FRAC_MN	Mean Patch Fractal Dimension
FWKO	Free Water Knock Out
FWMIS	Fish and Wildlife Management Information System
g	Grams
g/bhp-hr	Grams per brake horsepower-hour
g/d	Grams per day
g/L	Grams per litre
$g/m^2/d$	Grams per square metres per day
g/s	Grams per second
GCM	Global Climate Models
GCM	General Circulation Model
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIC	Groundwater Information Center
GIS	Geographic Information System
Golder	Golder Associates Ltd.
GPS	Global Positioning System
GSA	Geological Study Area
H:V	Ratio of Horizontal Length (H) to Vertical Length (V) for a Specific Slope
H^+	Hydrogen Ions
H_2O	Water
H_2S	Hydrogen sulphide

H_2SO_4	Sulfuric acid
ha	Hectare
HC	Health Canada
HCO_3	Bicarbonate
HEC	Human Equivalent Concentration
HEMP	Human Exposure Monitoring Program
HHRA	Human Health Risk Assessment
HLFN	Heart Lake First Nation
HLS	Hot Lime Softener
HMW	High Molecular Weight
HNO_3	Nitric acid (gas)
HQ	Hazard Quotient
HRSG	Heat Recovery Steam Generator
HS	Habitat Suitability
HS&E	Health, Safety and Environment
HSDB	National Library of Medicine's Hazardous Substances Data Bank
HSI	Habitat Suitability Index
Husky	Husky Energy
Hwy	Highway
Hz	Hertz
i.e.	That is
ID	Improvement District
ID	Interim Directive
IJI	Interspersion/Juxtaposition
ILCR	Incremental Lifetime Cancer Risk
Imperial Oil	Imperial Oil Resources Ventures Limited
INAC	Indian and Northern Affairs Canada
IPCC	Intergovernmental Panel on Climate Change
IPCS	International Programme on Chemical Safety
IPM	Individual PAH Method
IR	Indian Reserve
IR	Ingestion Rate
IRC	Industry Relations Corporation
IRIS	Integrated Risk Information System
IRP	Integrated Resource Plan
ISC3	Industrial Source Complex Model, Version 3
ISO	International Organization for Standardization

ISQG	Interim Sediment Quality Guidelines
JEMA	Jackpine Expansion Mining Area
K	Carrying Capacity
K	Degrees Kelvin
K	Potassium
keq	Kiloequivalent – equal to 1 kmol of hydrogen ion (H^+)
keq N/ha/yr	Kiloequivalent of nitrogen per hectares per year
keq/ha/yr	Kiloequivalent per hectares per year
kg	Kilogram
kg-ww	Kilogram in wet weight
kHz	Kilohertz
KIRs	Key Indicator Resources
km	Kilometre
km/hr	Kilometre per hour
km^2	Square kilometre
kmol	Kilomole
K_{ow}	Octanol-water partition coefficient
kPa	Kilopascals
kW	Kilowatt
L	Litre
L/d	Litre per day
L/ha/yr	Litre per hectare per year
L/kg	Litres per kilogram
LAI	Leaf Area Index
LC50	Lethal Concentration 50
LCR	Lifetime Cancer Risk
LEC	Lowest Effective Concentration
L_{eq}	Equivalent continuous sound level
LFg/M	Glaciofluvial and Glaciolacustrine Over Moraine
LFH	Litter, Fibric and Humic
LFN	Low Frequency Noise
Lg	Glaciolacustrine
LGP	Low Ground Pressure
LICA	Lakeland Industry and Community Association
LMW	Low Molecular Weight
LOAEL	Lowest Observed Adverse Effect Level
Log	Base 10 logarithm

-log	Negative logarithm
Log K_{ow}	Logarithmic octanol-water partition coefficient
LP	Low Pressure
LRSYA	Long Run Sustained Yield Average
LSA	Local Study Area
LSD	Legal Subdivision
Lt	Tamarack (Larix Laricina)
LZA	Linkage Zone Analysis
m	Metre
M	Moraine
M.D.	Municipal District
m/s	Metres per second
M1	Morainal – Fine Textured
M2	Morainal – Coarse Textured
m^2	Square metres
m^3	Cubic Metre
m^3/cd	Cubic metres per calendar day
m^3/d	Cubic metre per day
m^3/ha	Cubic metres per hectare
m^3/min	Cubic metres per minute
m^3/mol	Cubic metres per mole
m^3/s	Cubic metres per second
m^3/sd	Cubic meters per stream day
m^3/y	Cubic metres per year
M^4/s^3	SI unit for Buoyancy Flux
MA DEP	Massachusetts Department of Environmental Protection
MAC	Maximum Accepatable Concentration
MAI	Mean Annual Increment
masl	Metres above sea level
max.	Maximum
mb	Millibar
mbgs	Meters below ground surface
mbKB	Meters below Kelly Bushing
mbsl	Meters below seal level
mbtc	Meters below top of casing
MCC	Motor Control Centre
MDL	Method detection limit
MEG	MEG Energy Corp.

meq/L	Millequivalent per litre
Mg	Magnesium
mg	Milligrams
mg/kg	Milligrams per kilogram
mg/kg BW/day	Milligrams per kilogram body weight per day
mg/kg/ww	Milligrams per kilogram in wet weight
mg/L	Milligrams per litre
mg/m^2/yr	Milligram per square metre per year
Mg/m^3	Milligrams per cubic metre
Min	Minimum
MJ/m^3	Megajoules per cubic metre
MJ/s	Megajoules per second
mKB	Meters from the Kelly bushing
mm	Millimetre
MM	Mesoscale Model
mm/yr	Millimetre per year
MMBTU/hr	Million British Thermal Units per hour
mmHG	Millimetres of mercury
MN	Mean Patch Size
MNA	Métis Nation of Alberta
mod1	Alberta Vegetation Inventory (AVI) Data Field for Codes Representing Conditions or Treatments Providing Additional Information About the Origir or Condition of the Cover Type
MOU	Memorandum of Understanding
MPOI	Maximum Points of Impingement
MPRL	Maximum Permissible Risk Level
MPS	Mean Patch Size
MRL	Minimum Risk Level
MSC	Meteorological Service of Canada
MSDS	Material Safety Data Sheet
MSI	Municipal Sustainability Initiative
MST	Mountain Standard Time
MW	Megawatt
N	North
N	Fen
N	Nitrogen
n	Number of samples
N/A and n/a	Not applicable

n/d	No data
N_2	Nitrogen Gas
N_2O	Nitrous Oxide
Na	Sodium
NAD	North American Datum
NAIT	Northern Alberta Institute of Technology
NCAR	National Center of Atmospheric Research
NCG	Non-Condensable Gas
ng/g	Nanograms per gram
Ng/m^3	Nanograms per cubic metre
NH_4	Ammonia
NHA	Nunee Health Authority
Ni	Nickel
NLHR	Northern Lights Health Region
NLRHA	Northern Lights Regional Health Authority
NLSD	Northern Lights School Division
NO	Nitric oxide (gas)
NO_2	Nitrogen dioxide (gas)
NO_3^-	Nitrate (particle)
NOAEC	No Observable Adverse Effect Concentration
NOAEL	No Observed Adverse Effect Level
NOEL	No Observed Effect Level
NO_X	Oxides of nitrogen (NO, NO_2) (gas), or all nitrogen species (e.g., NO_X, N_2O, NO_3)
NP	Number of Patches
NPV	Net Present Value
Ns	Shallow Fen
NSD	Northland School Division
NSMWG	NO_x/SO_x Management Working Group
NTP	National Toxicity Program Chemical Repository
NTS	National Topographic Survey
NWT	Northwest Territories
O_2	Oxygen (gas)
O_3	Ozone
OEHHA	Office of Environmental; Health Hazard Assessment
OLDCON	Old Coniferous
OMOE	Ontario Ministry of the Environment
ORF	Oil Removal Filter

ORP	Oxidation Reduction Potential
OSCA	*Oil Sands Conservation Act*
OSE	Oil Sands Exploration
OSHA	Alberta Occupational Safety and Health Act
OSVRC	Oil Sands Vegetation Reclamation Committee
OSWWG	Oil Sands Wetlands Working Group
OTSG	Once Through Steam Generator
P	Phosphorous
Pa	Pascal
PACE	Preparation for Academic and Career Education
PAH	Polycyclic Aromatic Hydrocarbon
PAI	Potential Acid Input
PDA	Project Development Area
PDC	Planned Development Case
PDD	Public Disclosure Document
PDF	Probability Density Function
PEL	Probable Effects Level
Pers. Comm.	Personal Communication
PG	Pasquill-Gifford
PHC	Petroleum Hydrocarbon
PID	Pressure Induced Drawdown
Pj	Jack Pine (Pinus Banksiana)
PM	Particulate matter
PM_{10}	Particulate matter with nominally smaller than 10 µm in diameter
$PM_{2.5}$	Particulate matter with nominally smaller than 2.5 µm in diameter
POI	Point of Impingement
ppb	Parts per billion
PPC	Plume Path Coefficient
ppm	Parts per million
ppmv	Parts per million by volume
ppmw	Parts per million by weight
PQRA	Preliminary Quantitative Risk Assessment
PR	Patch Richness
PRMA	Pierre River Mining Area
PSL	Permissible Sound Level
PST	Pacific Standard Time
PSU	Pennsylvania State University

Pt	Platinum
pTDI	provisional Total Daily Intake
PVA	Population Viability Analysis
P-value	The Probability of Quantifying the Strength of the Evidence Against a Null Hypothesis
Q	Quarter (i.e., three months of a year)
QA/QC	Quality Assurance/Quality Control
RAMP	Regional Aquatics Monitoring Program
REL	Reference Exposure Level
RELAD	Regional Lagrangian Acid Deposition Model
RfC	Reference Concentration
RfD	Reference Dose
RFMA	Registered Fur Management Areas
Rge, Rg or R	Range
RHA	Respiratory Hospital Admissions
RIC	Resources Inventory Commitee
RIVAD/ARM3	Regional Impact in Visibility and Acid Deposition/Acid Rain Mountain Mesoscale Model
RIVM	Netherlands National Institute of Public Health and the Environment
RIWG	Regional Issues Working Group
RMWB	Regional Municipality of Wood Buffalo
ROC	Receiver Operating Characteristic
ROW	Rights-of-Way
RQ	Risk Quotients
RSA	Regional Study Area
RsC	Risk-specific concentration
RsD	Risk Specific Dose
RSDS	Regional Sustainable Development Strategy for the Athabasca Oil Sands
RSF	Resource Selection Function
RV	Recreational Vehicle
RWG	Reclamation Working Group
S	South
S	Sulphur
s/cm	Light soaking time in seconds (s) per 1 centimetre
SAC	Strong Acid Cation
SAF	Slurry-at-face
SAGD	Steam Assisted Gravity Drainage
SAGP	Steam Assisted Gravity Push

SA_{org}	Strong Organic Acids
SAR	Sodium Adsorption Ratio
SARA	*Species At Risk Act*
SAS	Statistical Analysis System
Sb	Black Spruce (Picea Mariana)
SCA	Soil Correlation Area
Sd	Standard Deviation
SDI	Simpsons' Diversity Index
SE	Standard Error
SEIA	Socio-Economic Impact Assessment
SETG	Socio-Economic Task Group
SEWG	Sustainable Ecosystems Working Group of CEMA
SF	Slope Factor
SHEI	Shannon's Evenness Index
Shell	Shell Canada Limited
SI	Suitability Index
SK	Saskatchewan
SLERA	Screening-Level Ecological Risk Assessment
SLWRA	Screening-Level Wildlife Risk Assessment
Sm^3	standard cubic metre
SO_2	Sulphur dioxide
SO_4	Sulphate
SO_4^{2-}	Sulphate (particle)
SOPs	Standard Operating Procedures
sp.	Unknown Species (Singular)
spp	Multiple Species
spp.	Unknown Species (Plural)
Sq. Ft.	Square feet
SQG	Soil Quality Guidelines
SRES	Special Report on Emissions Scenarios, by the Intergovernmental Panel on Climate Change
SRU	Sulphur Recovery Unit
ssp.	Subspecies
SSWC	Steady-State Water Chemistry
Statoil	StatoilHydro Canada Ltd.
STEL	Short-term Exposure Limit

Suncor	Suncor Energy Inc. (Lease 86/17, Steepbank, Millennium, Voyageur, Firebag)
Sw	White Spruce (Picea Glauca)
SWWG	Surface Water Working Group of CEMA
Synenco	Synenco Energy Inc.
t/cd	Tonnes per calendar day
t/d	Tonnes per day
t/sd	Tonnes per stream day
TASA	Terrestrial Air Study Area
TC_{05}	Tumourigenic Concentration
TCA	Tolerable Concentration in Air
TCEQ	Texas Commission on Environmental Quality
TCU	True Colour Unit
TD_{05}	Tolerable Dose
TDGR	Transportation of Dangerous Goods Regulations
TDI	Tolerable Daily Intake
TDS	Total Dissolved Solids
TE	Total Edge
TEEM	Terrestrial Environmental Effects Monitoring Program of WBEA
TEF	Toxic Equivalency Factor
TEK	Traditional Ecological Knowledge
Temp.	Temperature
The Project	Christina Lake Regional Project – Phase 3
TK	Traditional Knowledge
TKN	Total Kjeldahl nitrogen
TLU	Traditional Land Use
TLV	Threshold Limit Values
TN	Total Nitrogen
TOC	Total Organic Carbon
TOR	Terms of Reference
TOXLINE	National Library of Medicine's Toxicology Literature Online
TP	Total Phosphorus
TPR	Timber Productivity Rating
TRS	Total Reduced Sulphur
TRV	Toxicity Reference Value
TSS	Total Suspended Solids
TWA	Time Weighted Average
TWINSPAN	Two-Way Indicator Species Analysis

Twp. Or Tp	Township
U.S.	United States
U.S. EPA	United States Environmental Protection Agency
UCLM	Upper Confidence Limits of the Mean
UL	Tolerable Upper Intake Levels
URE	Unit Risk Estimates
USGS	United States Geological Survey
UTF	Underground Test Facility
UTM	Universal Transverse Mercator
V	Vanadium
VEC	Valued Ecosystem Component
VOC	Volatile Organic Compound
VRU	Vapour Recovery Unit
vs.	Versus
W	West
W/m^2	Watts per square metre
W4M	West of the Fourth Meridian
WAC	Weak Acid Cation
WBEA	Wood Buffalo Environmental Association
WBNP	Wood Buffalo National Park
WDS	Water Data System
WF	Windfall
WHO	World Health Organization
WMU	Wildlife Management Unit
WRS	Western Resource Solutions
wt	Weight
wt%	Weight Percentage
yr	Year
z_0	Roughness Length
λ	Rate of increase
µg/d	Micrograms per day
µg/kg	Micrograms per kilogram
µg/kg/d	Micrograms per kilogram per day
µeq/L	Microequivalent per litre
µg/g	Micrograms per gram
µg/kg bw/d	Micrograms per kilogram body weight per day
µg/L	Micrograms per litre

μg/m^3	Micrograms per cubic metre
μg/m^3/yr	Micrograms per cubic metre per year
μm	Micron or Micrometre
μPa	Micropascal
μS/cm	Microsiemens per centimetre

APPENDIX 1-I

TOPSOIL/SUBSOIL SALVAGE DEPTHS OF FACILITIES

Table 1 Topsoil/Subsoil Salvage Depths of Facilities

Project Components / Facilities	Soil Map Unit	Area [ha]	Average Topsoil/Peat Depth [cm]	Average B Horizon (Subsoil) Depth [cm]
borrow areas	BMT	5	25	50
	DOV	66	15	29
	ELS	17	30	0
	KNS	104	20	30
	MIL	25	25	35
	SUT	33	22	28
	WNF	34	20	27
	MLD1m-U	15	80	0
	MLD2	8	213	0
	MLD3	24	213	0
	MUS1m-U	62	69	0
	MUS2	125	213	0
	Disturbance	34	0	0
Total Area		**550**		
Plant sites 3A and 3B	BMT	8	25	50
	ELS	32	30	0
	KNS	80	20	30
	MIL	4	25	35
	SUT2	5	22	28
	MLD1m-U	3	80	0
	MUS1m-U	1	69	0
	MUS2	53	213	0
	Disturbance	14	0	0
Total Area		**200**		
pump stations	BMT	2	25	50
	DOV	2	15	29
	KNS	1	20	30
	MIL	4	25	35
	MLD1m-U	1	40	0
	MLD2	1	40	0
	MLD3	1	40	0
	MUS1m-U	5	40	0
	MUS2	3	40	0
	Disturbance	2	0	0
Total Area		**20**		
roads	BMT	11	25	50
	CHT	1	20	29
	DOV	4	15	29
	ELS	2	30	0
	KNS	12	20	30
	LVK	0	27	23
	MIL	9	25	35
	SUT	3	22	28
	WNF	4	20	27
	MLD1m-U	8	0	0
	MLD2	14	0	0
	MLD3	21	0	0

Table 1 Topsoil/Subsoil Salvage Depths of Facilities (continued)

Project Components / Facilities	Soil Map Unit	Area [ha]	Average Topsoil/Peat Depth [cm]	Average B Horizon (Subsoil) Depth [cm]
roads (cont'd)	MUS1m-U	15	0	0
	MUS2	28	0	0
	MUS3	3	0	0
	Disturbance	146	0	0
Total Area		**281**		
source water wellpads	BMT	1	25	50
	ELS	1	30	0
	KNS	2	20	30
	SUT	0	22	28
	MLD1m-U	1	40	0
	MLD2	0	40	0
	MUS1m-U	4	40	0
	MUS2	3	40	0
	Disturbance	4	0	0
Total Area		**15**		
water disposal wellpads	BMT	1	25	50
	KNS	2	20	30
	MLD	0	40	0
	MUS	2	40	0
	Disturbance	0	0	0
Total Area		**6**		
SAGD wellpads	BMT	21	25	50
	CHT	6	20	29
	DOV	11	15	29
	ELS	9	30	0
	KNS	76	20	30
	LVK	1	27	23
	MIL	36	25	35
	SUT	11	22	28
	WNF	4	20	27
	MLD1m-U	22	40	0
	MLD2	32	40	0
	MLD3	75	40	0
	MUS1m-U	32	40	0
	MUS2	86	40	0
	MUS3	4	40	0
	Disturbance	40	0	0
Total Area		**468**		

APPENDIX 1-II

SPILL RESPONSE AND REPORTING

SPILL RESPONSE AND REPORTING

1.0 INTRODUCTION

Spills are one of the most common environmental incidents encountered by staff and contractors. Prompt and appropriate spill response is critical to mitigating environmental impacts. Complete spill reporting is key to identifying the causes of spills and preventing future spills. This spill response and reporting procedure applies to all spills on MEG property, whether involving MEG personnel or contractors.

2.0 SPILL RESPONSE

(1) Ensure **safety** of personnel. Move away from the area if necessary. The first person to notice the spill or leak should move to a safe area in order to evaluate the situation without exposing him or herself. This is not required if the nature of the spill is known and is minor.

(2) **Eliminate** all ignition sources.

(3) **Notify** the Operations Coordinator and Shift Supervisor. Get help for all but very minor spills.

(4) **Identify** whether or not the situation is an emergency. Leaks that can immediately be cleaned up by operations and/or maintenance personnel are not considered emergencies. Refer to the Emergency Response Plan for further clarification and information. If in doubt, treat the situation as an emergency.

Identify the spill to the extent possible. Do so without being at risk. This includes identifying: a) the type of material spilled; b) the size of the spill and whether it has stopped; *c) whether two chemicals are involved in the leak and could react with one another*; and d) any unusual features such as foaming, odour, fire, etc.

Identify the material spilled. Is it flammable, combustible, toxic and volatile, toxic or corrosive and non-volatile, or an oxidizing agent? The Material Safety Data Sheet (MSDS) will provide some information on safe handling of the product.

(5) **Plan** how to contain and clean up the spill or leak. Procedures for the containment and clean-up of common types of spills and leaks are included in the Emergency Response Plan.

(6) **Obtain** the appropriate spill control materials. There is a spill response trailer at Christina Lake, which contains the following materials:

Spill Response Trailer Contents	
sorbent pads	wheel barrow
2 x 4 foot sorbent socks	shovels
bags of loose absorbent material	poly bags
collapsible berm	pump
floating boom	yellow ‘danger’ tape
fire extinguisher	traffic cones
flashlight	buckets
	PPE – boots, nitrile gloves, disposable coveralls

(7) Put on appropriate **personal protective equipment**. This can include respirators, gloves, goggles, etc., as needed (refer to the MSDS, if available).

(8) **Stop the source** of the spill or leak. This can include turning off a valve, patching a leaky hose, draining a tank, or up-righting a container of liquid.

(9) **Contain** the spill to prevent further damage. This can include using appropriate absorbent/containment materials such as absorbent pads, socks and/or booms, or other suitable equipment.

(10) **Clean up** the spill using the appropriate sorbent materials and equipment. Remember, sorbents are primarily suited for cleaning up small spills and the residues left over after a large spill.

(11) **Dispose** of contaminated materials properly. Contaminated spill control materials and disposable personal protective clothing may have to be disposed of as hazardous waste. Contaminated tools and non-disposable personal protective equipment should be safely decontaminated. *Contact the Environmental Manager for information regarding contaminant disposal and/or decontamination*

(12) **Retain records**. Take photos. File an incident report (see below).

3.0 SPILL REPORTING

Documentation of spills is critical, not only to help with clean-up of each spill, but also to allow for compilation and analysis of spill causes and trends.

3.1 Internal MEG Reporting

MEG requires that all spills be reported, including those inside secondary containment systems. To fully understand environmental risks, even small spills must be reported as they may be indicative of a potential for a larger spill.

Report all spills under 10 L to the Environmental Manager and Operations Supervisor within 24 hours. Complete an Incident Report.

Immediately report all spills greater than 10 L to the Environmental Manager and the Operations Coordinator in person, by email, or by telephone. Photos of the spill can assist in communicating the nature and extent of the spill.

Complete incident reporting paperwork within 48 hours.

What to report:

- the date and time of the spill, or the time period over which the spill occurred ,
- the location of the spill,
- the volume, duration, frequency and rate of release, if known,
- what was spilled,
- a detailed description of the circumstances leading to the release (e.g., leaking tank, dripping valve, etc.),
- the steps or procedures which were taken to minimize, control or stop and clean up the release,
- your name,
- Alberta Environment reference number,
- Meg Energy Phase 1 Approval No. 10159
- Meg Energy Phase 1 Licence No. F37114
- identified immediate and root causes of spill, and recommended corrective actions

3.2 External Reporting

Shift Supervisors are responsible for reporting spills to regulatory agencies. If in doubt, contact Alberta Environment and/or the EUB Field Office for clarification of reporting requirements. The 'Failure to Report' is a serious offence.

3.2.1 Refined Product Releases – reportable to AENV

Any spill, release or emergency involving refined petroleum products/chemicals/holding pond liquids that may cause, is causing or has caused an adverse effect to the environment must be immediately reported to AENV.

The release of refined substances is reportable when:

• The release has caused, is causing or may cause an adverse effect;
• The substance is classified as toxic, prohibited, or restricted by CEPA and is released to the environment in any quantity;
• The release is into a watercourse or into the groundwater or surface water in any quantity; and/or
• The release falls under the *Transportation of Dangerous Goods Regulation under the Transportation of Dangerous Goods Act*, 2001 (Canada). See below.

TDG Class	Reportable TDG Quantities
1.	Any quantity that could pose a danger to public safety or 50 kg
2.	Any quantity that could pose a danger to public safety or any sustained release of 10 minutes or more
3.	200 L
4.	25 kg
5.1	50 kg or 50 L
5.2	1 kg or 1 L
6.1	5 kg or 5 L
6.2	Any quantity that could pose a danger to public safety or 1 kg or 1 L
7	Any quantity that could pose a danger to public safety An emission level greater than the emission level established in section 20 of the *Packaging and Transport of Nuclear Substances Regulations*
8	5 kg or 5 L
9	25 kg or 25

To be reportable to AENV, the release must be into the environment. For example, a spill that is fully contained within a building, including odours, is not considered a release into the environment (it is reportable internally to MEG, however). If there is any possibility of odours venting from the building into the environment, AENV should be notified.

Shift Supervisor to Report Immediately
Releases must be reported to AENV, at the first available opportunity, as soon as MEG knows about the release. Reports can be made by phoning 1-800-222-6514 (toll-free, 24 hours-a-day).

Retain the reference number provided by Alberta Environment when the call is made.

Within seven (7) days, a written report must be provided to AENV, as described below.

Written Reports

MEG is responsible to provide a written report directly to AENV (not the EUB) within seven (7) days of any oral report of an unrefined or refined product release, only if it has caused, is causing, or may cause an adverse effect on the environment.

If the release is fully contained on site or there are no adverse effects, then a written report is not required. Under the *Release Reporting Regulation*, the written report must include the following information, where reasonably available:

- the date and time of the release, or the time period over which the release occurred, if known;
- the location of the release;
- the duration, frequency and rate of release, if known;
- the composition of the material released (e.g., crude oil, produced water, sour gas condensate, etc.) including concentration of key components and amount released, if known;
- a detailed description of the circumstances leading to the release (e.g., leaking tank, dripping valve, etc.);
- the steps or procedures which were taken to minimize, control or stop the release;
- the steps or procedures which will be taken to prevent a similar release from occurring;
- the status of the remediation program (e.g., remediated, under active remediation or to be remediated);
- the remediation plan and schedule of implementation, if required, and;
- where appropriate, information regarding landowner notification.

Written reports can be faxed to (780) 427-3178 or mailed to:

Alberta Environment
Environmental Response Centre
111 Twin Atria Building
4999 – 98 Avenue
Edmonton, AB T6B 2X3

3.2.2 Unrefined Product Releases – reportable to EUB

The release of substances regulated by the EUB (e.g., unrefined products such as conventional crude oil, LPG, diluent, condensate, synthetic crude, sour gas, produced water, and other produced fluids), pipeline breaks and incidents involving oilfield wastes are to be **immediately reported orally to the appropriate EUB Field Centre if:**

- **the release is in excess of 2 m^3 on lease or any release off lease;**
- **there is any release from a pipeline; and/or**
- **the release, on or off lease, of any size, may cause, is causing, or has caused, an adverse effect.**

NOTE: Adverse effect is defined as "impairment of or damage to the environment, human health or safety, or property". Where this has occurred, the operator is required to notify the appropriate EUB Field Centre.

For the purpose of reporting, MEG uses the following guidelines to assess whether the release may cause, is causing or has caused an adverse effect:

- there is any third party impact (off lease), e.g., vegetation damage;
- there is any unrecovered spilled substance likely to contaminate surface or ground water;
- groundwater and/or surface water is contaminated;
- the release or spill has potential for offsite odour complaints; or
- there is a toxic or flammable release to air going offsite.

NOTE: It is MEG's responsibility to inform any private individuals whose lands may be affected by the release. MEG must notify the landowner of any release that occurs off a lease site, migrates off a lease site, or occurs on an easement or right-of-way.

The appropriate EUB Field Centre for Christina Lake Regional Project is:

Bonnyville Field Centre
PO Box 5169
4903 - 51A Street
Bonnyville, AB T9N 2G4

Phone: (780) 826-5352 *
Fax: (780) 826-2366
Email: bonnyville.fieldcentre@eub.ca

Written Reports

MEG is responsible to provide a written report directly to AENV (not the EUB) within seven (7) days of any oral report of an unrefined or refined product release, as described in section 4.2.1 above. Written reports will be completed by the Environmental Manager.

4.0 RESPONSIBILITY

4.1 Site Personnel

- Initiating the emergency response plan, if and when appropriate
- Controlling and containing spill
- Reporting internally to Operations Coordinator and Shift Supervisor
- Maintaining documentation of spill, including notes and photos (if possible)
- Notifying external agencies orally (AENV, EUB, RCMP, WCSS) as necessary
- Investigating causes of minor spills and ensuring appropriate follow-up is conducted

4.2 Environmental Manager

- Written reporting to external agencies (AENV, EUB, RCMP, Alberta Public Safety Services) as necessary
- Notifying MEG management personnel
- Participating in emergency response, as required
- Providing advice on spill cleanup and site remediation, as required
- Investigating causes of major spills and ensuring appropriate follow-up is conducted
- Recording and tracking of spills and spill follow-up

5.0 REFERENCES

AENV *A Guide to Release Reporting*

EUB Reporting Criteria (IL 98-1), *Memorandum Of Understanding (MOU) Between Alberta Environmental Protection and the EUB On Release Notification Requirements For The Upstream Oil And Gas Industry*

EUB Reclamation and Decontamination Guidance (IL 98-2), *Suspension, Decontamination, and Surface Land Reclamation of Upstream Oil and Gas Facilities.*

5.1 Records

EHS Incident Report, including photos

Waste Manifests, if applicable

Emergency Response Records where appropriate (see Emergency Response Plan)

APPENDIX 1-III

WASTE MANAGEMENT PLANS

NON-OILFIELD WASTE MANAGEMENT

1.0 INTRODUCTION

MEG will manage wastes effectively. MEG Energy will make every effort to minimize waste generation and to identify feasible recycling opportunities. When waste cannot be eliminated or recycled, MEG will determine an appropriate method for disposal. Disposal methods will comply with all applicable legislation.

This procedure applies to non-oilfield wastes generated by MEG.

2.0 WASTE LEGISLATION

In Alberta, management of wastes is governed by the Waste Control Regulation (Alta. Reg. 192/96) under the Alberta Environmental Protection and Enhancement Act. Waste management facilities must be approved by Alberta Environment (AENV). Requirements are described in the Alberta User Guide for Waste Managers (AENV, 1996).

Non-hazardous waste will be stockpiled for later re-use, transported to approved recycling facilities, or disposed of in approved landfills.

3.0 WASTE CHARACTERIZATION

MEG's non-oilfield waste can generally be classified as follows:

- Office waste (paper, ink cartridges, etc.)
- Residence/camp waste (food scraps, wastewater, plastic bags/containers, cardboard containers, glass and aluminum, etc.)
- Construction waste (wood, metal, glass, etc.)

4.0 WASTE MANIFESTING AND TRACKING

Formal manifesting of domestic waste and other non-hazardous wastes is not required by legislation. Where possible and appropriate, MEG will track wastes and recyclables from the point of origin to the point of recycle/disposal, and will retain appropriate documentation.

5.0 WASTE HANDLING

Using the hierarchy of "reduce, reuse, recycle", domestic waste should be handled as follows:

Office Waste

Most office waste should be recycled: paper and cardboard will be stored together, and plastic and metal should be segregated. All recyclable materials can be stored in the same waste bin (paper can be shredded, if needed, and cardboard boxes should be flattened) and hauled to a reputable recycler.

Toner cartridges should be recycled.

Non-recyclable material will be placed in a closed dumpster (can be combined with camp waste).

Camp Waste

The ASRD 'BearSmart' guidelines must be followed. Food scraps will be placed in a closed, bear-proof dumpster. The dumpster will be emptied regularly to ensure food odours are kept to a minimum.

Recyclable waste (paper, cardboard, plastic, aluminum and glass containers, etc.) from residences/camps should be segregated and placed in the recycling bins, where available.

Construction Waste

Construction waste will be reused on-site, if possible. If not, scrap metal, cables, pallets and other wood waste, and used pipe insulation will be segregated and stored neatly in designated areas until being hauled away by a contractor for reuse/recycling.

Storage areas must be clearly marked. Combustible materials must be segregated in accordance with instructions from site safety personnel.

Any materials that cannot be hauled away for reuse or recycling will be sent to an appropriate, approved disposal facility.

No materials will be buried or burned on site.

6.0 RESPONSIBILITY

Each individual is responsible for ensuring that the waste they generate in daily activities is minimized, and that wastes are deposited in appropriate receptacles.

The Environmental Manager, in Calgary, is responsible for ensuring that appropriate tools and information are available to residence and operations staff to allow them to properly manage non-hazardous wastes.

The Camp Manager is responsible for management of camp wastes at Christina Lake

Kiewit/WorleyParsons Joint Venture is responsible for management of construction wastes at Christina Lake, including informing employees and contractors of their responsibilities associated with waste management.

7.0 REFERENCES

Waste Control Regulation (Alta. Reg. 192/96)

Alberta User Guide for Waste Managers (AENV, 1996)

Non-oilfield Waste Management.doc

OILFIELD WASTE MANAGEMENT, STORAGE AND TRANSPORT

1.0 INTRODUCTION

Operating wastes are unwanted substances that result from the operation of a wellsite, oil and gas battery, compressor station, crude oil treatment facility, pipeline, gas gathering system, or other related facilities. If not properly managed, waste can be a major contributor to environmental degradation.

All reasonable efforts must be taken to minimize the production of waste by reducing volumes, recovering as much as possible, recycling, and/or re-using materials.

When waste is generated, it is the responsibility of MEG Energy Corp. to ensure that it is identified, characterized, handled, treated and disposed of in a responsible manner.

2.0 WASTE LEGISLATION

All waste generated by the upstream oil and gas industry is regulated by the EUB. A waste management facility may be EUB or AENV-approved, depending on the types of wastes that are accepted. Some AENV-approved facilities will accept a mix of oilfield and non-oilfield waste, while the EUB facilities will only accept upstream oilfield wastes.

All oilfield wastes must be handled in accordance with the requirements contained in EUB Directive 058 “Oilfield Waste Management Requirements for the Upstream Petroleum Industry”, with the exception of drilling wastes which must be handled in accordance with EUB Directive 050 “Drilling Waste Management” (see MEG Environmental Management Guideline (in development)).

The EUB will actively enforce the oilfield waste management requirements. EUB Directive 064 “Requirements and Procedures for Facilities” provides a guide to the expectations and consequences for non-compliance relating to waste management.

In general, MEG, as the generator of the waste, has the following responsibilities:

- To ensure that all regulatory requirements regarding the disposal of wastes are followed;

- To consider waste minimization alternatives when appropriate;
- To ensure that oilfield wastes are properly characterized;
- To ensure that appropriate treatment and disposal practices are utilized;
- To understand the capabilities and limitations of various waste treatment and disposal methods;
- To maintain accurate and complete waste documentation and manifesting;
- To correctly inform waste carriers and receivers of the properties of the oilfield waste; and
- To obtain the required approvals and operational permits for any on-site handling, treatment and disposal method.

In general, oilfield waste facilities are specifically excluded from requiring an approval under the Alberta Environmental Protection and Enhancement Act (EPEA). Some waste facilities may be part of a larger site (as is the case with MEG's SAGD facility) and will be subject to the requirements of the EPEA Approval.

AENV has published a *User Guide for Waste Managers* to assist people in understanding waste management requirements. The guide includes information on characterizing waste, phone numbers, etc.

3.0 WASTE CHARACTERIZATION

Waste generators are responsible for characterizing and classifying all generated wastes.

Waste characterization is the assessment of the physical, chemical, and toxicological properties of a waste. Waste characterization will determine transportation requirements for the waste, and the most appropriate disposal/management options to minimize potential environmental consequences associated with the waste.

Once the oilfield waste has been characterized, it can be classified as either a Dangerous Oilfield Waste DOW or Non Dangerous Oilfield Waste non-DOW. This will depend on chemical properties such as flammability, spontaneous combustion, toxicity, etc. Some wastes will require testing to determine their classification. Others are "typical" and can be easily defined.

Properties of common wastes are summarized in Newalta's 'Oilfield Waste Management Requirements for the Upstream Petroleum Industry' booklet. (see attached scans) The classification of waste is based on criteria outlined in the federal

Transportation of Dangerous Goods Regulations (TDGR). Once the waste has been classified, it is MEG's responsibility to determine the best method of treatment and disposal, as well as the placarding and manifesting requirements.

If in doubt about the characterization of a waste, request additional information from Newalta.

Contact:

Barry McDonald
Supervisor, Waste Management Systems
Newalta
cell phone 403-998-2133
bmcdonald@newalta.com

4.0 WASTE MANIFESTING

Dangerous oilfield waste (DOW) transported on public roads in Alberta must be manifested. The EUB Alberta Oilfield Waste Manifest is used when the shipment occurs entirely within Alberta (see the exceptions listed below). For shipment out of Alberta, the federal waste manifest must be used. Waste shipments out of Alberta are not anticipated. Examples of completed Alberta manifests are attached. MEG Energy Corp. does not have (or require) a waste generator number due to changes in regulatory requirements.

The manifest documents provide detailed information to first responders in the event of an incident and serve as a tool for confirming that shipments of DOWs are properly handled, transported, and disposed.

EUB manifests are not required for the following:

- When the quantity of DOW being transported is less than 5 kg or 5 L,
- When the oilfield wastes are treated/disposed on-site,
- When the DOW is transported from one MEG site to another MEG site (in this case, appropriate placarding, shipping documents, emergency response contacts, and a description of waste volumes/amounts is required).

The blue copy of the manifest must be retained and filed on site for two years. The yellow copy must be sent to the Environmental Manager in Calgary, who will forward them to Newalta. The transporter will take all other copies.

5.0 WASTE TRACKING

Oilfield waste generators are responsible for tracking their wastes from "cradle to grave". Accordingly, a waste tracking system must be implemented to ensure that waste quantities, characteristics, and final treatment/disposal methods are known. The tracking system must provide all of the information required for the EUB's oilfield waste disposition report.

The EUB conducts audits of waste disposition reports of selected companies each year. The following information must be maintained:

- Types and quantities of disposed oilfield wastes,
- Points of waste generation, and
- Specific disposal methods used.

Newalta will complete waste tracking for MEG and provide an annual tracking report.

6.0 WASTE STORAGE

Waste storage refers to the temporary storage of oilfield produced wastes at a MEG-operated facility. These wastes are typically stored at a main or central facility until sufficient quantities exist for transportation to a recycling or disposal facility. On-site storage of wastes requires identification, classification, and segregation of different waste types.

Wastes should be segregated in the following way:

- Domestic (office and residence/camp)
- Industrial DOWs
- Industrial non-DOWs (these should be further separated if they are incompatible or if the non-DOW is recyclable)

In Alberta, wastes stored in above ground or underground storage tanks must comply with the requirements outlined in EUB Directive 055 Storage Requirements for the Upstream Petroleum Industry. The Alberta Fire Code may also apply.

Used lube oil should be stored separately from other liquid wastes to facilitate recycling.

MEG's oilfield waste may only be stored for up to one year.

Waste bins are used on-site to collect used filters and oily rags. Newalta must be contacted, before the bins are full, to remove the waste. The number of bins required at the facility, and the frequency of bin pick-up, will be determined once the facility has been operating for sufficient time to identify typical waste volumes.

Bulk oily waste, liquids and solids are stored in the ecology pit. See environmental procedure ' Ecology Pit Storage and Transfer' (under development).

7.0 RESPONSIBILITY

The Operators in the field are responsible for ensuring that waste minimization is actively practiced, that oilfield wastes are properly handled, that waste carriers satisfactorily perform their work, and that accurate and complete waste documentation and manifesting are maintained. It is not the responsibility of the waste carrier (transporter) to ensure that waste is identified correctly or disposed of appropriately.

The Environmental Manager, in Calgary, is responsible for ensuring that oilfield wastes are properly characterized, that appropriate treatment and disposal practices are utilized, and that field staff have the information required to complete the waste documentation and manifesting correctly.

Newalta has been contracted to provide waste management advice and services to MEG.

8.0 REFERENCES

Alberta Environmental Protection and Enhancement Act

- Waste Control Regulation (AR 129/93)
- Activities Designation Regulation (AR 211/96)

Alberta Environment

- Alberta User Guide for Waste Managers, 1995

Alberta Energy and Utilities Board

- Directive 055 Storage Requirements for the Upstream Petroleum Industry, 2001
- Directive 058 Oilfield Waste Management Requirements for the Upstream Petroleum Industry, 1996
- Directive 064 Requirements and Procedures for Facilities, 2005

Oilfield Waste Management.doc

SUGGESTED MANIFEST FORMAT – DOW

Shipping/Name Description of Waste	Waste Code	TDGA/ PIN	Class	Packing Group
Corrosive Liquid, N.O.S. (technical name)	ACID	1760	8	II
Non-regulated Liquid (boiler blowout water)	BLBDWT	NA	NA	NA
Sodium Hydroxide, Solution	CAUS	1824	8	II
Corrosive Liquid, N.O.S.	CAUS	1760	8	II
Caustic Alkali Liquid, N.O.S. (technical name)	CAUS	1719	8	II
Solids Containing Flammable Liquid, N.O.S.	SOILCH	3175	4.1	II
Solids Containing Flammable Liquid, N.O.S. (petroleum crude oil)	SOILCO	3175	4.1	II
Non-regulated Solid (soil produced water)	SOILPW	NA	NA	NA
Solids Containing Flammable Liquid, N.O.S. (lubricating oils)	SOILRO	3175	4.1	II
Environmentally Hazardous Substance, Liquid, N.O.S. (identify contaminant)	CORINH	3082	9	III
Petroleum Crude Oil	COEMUL	1267	3	II
Non-regulated Solid (cement)	CEMENT	NA	NA	NA
Non-regulated Liquid (sump material)	SUMPGL	NA	NA	NA
Solids Containing Flammable Liquid, N.O.S. (petroleum crude oil)	SUMPIN	3175	4.1	II
Non-regulated Liquid (KCl sump material)	SUMPKC	NA	NA	NA
Environmentally Hazardous Substance, Liquid, N.O.S. (identify contaminant)	FLBWSW	3082	9	III
Environmentally Hazardous Substance, Solid, N.O.S. (lube oil filters)	FILLUB	3077	9	III
Solids Containing Flammable Liquid, N.O.S. (filtered petroleum crude oil)	FILPWT	3175	4.1	II
Solids Containing Flammable Liquid, N.O.S. (petroleum crude oil)	FRCSND	3175	4.1	II

EUB Listed Common Wastes

This list identifies only the most common waste types. Refer to EUB Directive 58, or contact the intended Newalta facility for assistance regarding those wastes not listed.

Waste Name	Oilfield Class	N or D
Acid Solutions (unneutralized)	DOW	D
Boiler Blowdown Water (unless containing Cr, V, or other additives)	N-DOW	N
Caustic Solutions (unneutralized, spent)	DOW	D
Caustic Solutions (unneutralized, spent)	DOW	D
Caustic Solutions (unneutralized, spent)	DOW	D
Contaminated Debris and Soil (chemical/solvent)	Testing Required (flash point, leachate, toxicity)	D
Contaminated Debris and Soil (crude oil/condensate)	Normally N-DOW (depending on flash point and BTEX)	D
Contaminated Debris and Soil (produced/saltwater)	N-DOW	N
Contaminated Debris and Soil (refined fuels/oils)	Testing Required (flash point, leachate)	D
Corrosion Inhibitor/ Oxygen Scavenger Solutions	DOW	D
Crude Oil/Condensate Emulsions (residuals after treatment)	Normally N-DOW (depending on flash point, BTEX)	D
Cement Returns	N-DOW	N
Drilling Sump Materials (gel chem)	Normally N-DOW	N
Drilling Sump Materials (hydrocarbon)	Normally N-DOW (depending on flash point, BTEX)	D
Drilling Sump Materials (KCL)	N-DOW	N
Filter Backwash Liquids (gas sweetening)	DOW	D
Filters – Lube Oil	Drained – N – DOW Undrained – DOW	D
Filters – Produced/Process Water	DOW	D
Frac Sand – Non-Radioactive	Normally N-DOW (depending on flash point, leachate)	D

EUB Alberta Energy and Utilities Board

Alberta Oilfield Waste Manifest

Manifest No. 277785

A) GENERATOR (CONSIGNOR) — PROVINCIAL ID. NO. (GENERATOR NO.): Not applicable	**B) TRANSPORTER (CARRIER)** — PROVINCIAL ID. NO. (CARRIER NO.): ABC 1408
COMPANY NAME: MEG Energy Corp. — OPERATOR CODE (GENERATOR): 0Z9C	COMPANY NAME: Newalta Corporation — CITY: Calgary — PROV: AB
ADDRESS: 10flr, 734 – 7 Ave SW	ADDRESS: 9611 – 44 St SE — POSTAL CODE: T2C 2P7
CITY: Calgary — PROV: AB — POSTAL CODE: T2P 398	DATE: October 31, 2005 — UNIT NO: 3107 — TELEPHONE: 236-2203 — FAX: 236-9711
SOURCE SITE LOCATION: 4-16-77-05W4	Certification - I declare that I have received wastes as offered by the Generator in PART A for delivery to the Intended Receiver and that the information contained in PART B is correct and complete.
BATTERY/FACILITY CODE: — OPERATOR CODE (FACILITY):	NAME (PRINT): Driver's name — SIGNATURE: Driver's signature
INTENDED RECEIVER: Newalta Corporation	**C) RECEIVER (CONSIGNEE)** — PROVINCIAL ID. NO. (RECEIVER NO.):
ADDRESS: Box 1001	COMPANY NAME: — CITY: — PROV:
CITY: Elk Point — PROV: AB — POSTAL CODE: T0A 1A0	ADDRESS: — POSTAL CODE:
RECEIVING SITE LOCATION: 03-15-55-06W4M — BATTERY/FACILITY CODE: ODP2	RECEIVING SITE LOCATION: — BATTERY/FACILITY CODE: — OPERATOR CODE:

WASTE CODE	N or D	SHIPPING NAME/DESCRIPTION OF WASTE	CLASS	TDGA/PIN	PACKING GROUP	QUANTITY SHIPPED	UNITS	CONTAINER NO.	CONTAINER TYPE	HANDLING CODE	QUANTITY RECEIVED	UNITS	OIL %	WATER %	SOLID %	HAND CODE	TRANS DECON
SLGGLY	N	NON REGULATED LIQUID (SOIL/GLYCOL)				2	M3	01	bulk	03							
SOILCH	N	NON REGULATED SOILS (SOIL/GLYCOL)				2	M3	1	bulk	03							

SPECIAL HANDLING/EMERGENCY INSTRUCTIONS: In case of emergency, call (403) (24 hrs.)

IF HANDLING CODE "02" OR "21" SPECIFY:

DATE SHIPPED: February 28, 2007 — SCHEDULED ARRIVAL DATE: February 28, 2007

DATE RECEIVED:

Certification - I declare that the information in PART A is correct and complete.

FAX: Rep's Fax # — CELLULAR: Rep's Cell #

NAME OF AUTHORIZED PERSON (PRINT): Company Rep — SIGNATURE: Rep's Signature — TELEPHONE: (403) 337-3511 — 24 HOUR EMERGENCY NO: 24 Hour Emergency #

IDENTIFY DISCREPANCIES BETWEEN WASTE RECEIVED AND DETAILS LISTED IN PART A (USE ATTACHMENTS IF NECESSARY)

D) GENERATOR (CONSIGNOR): COMPLETE UPON RECEIPT OF MANIFEST FROM RECEIVER

EXPLANATION OF REASON FOR DISCREPANCIES NOTED BY RECEIVER (IF ANY), AND WHAT CORRECTIVE ACTION HAS BEEN TAKEN (Use attachments if necessary):

Certification - I declare that the information contained in PART C is correct and complete.

NAME OF AUTHORIZED PERSON (PRINT): — TELEPHONE:

NAME OF AUTHORIZED PERSON (PRINT): — SIGNATURE: — DATE: — TELEPHONE:

SIGNATURE:

EUB Alberta Energy and Utilities Board

Alberta Oilfield Waste Manifest

Manifest No. 277785

A) GENERATOR (CONSIGNOR) — PROVINCIAL ID. NO. (GENERATOR NO.): Not Applicable

COMPANY NAME: MEG Energy Corp. — OPERATOR CODE (GENERATOR): 0Z9C

ADDRESS: 10flr, 734 – 7 Ave SW

CITY: Calgary — PROV: AB — POSTAL CODE: T2P 398

SOURCE SITE LOCATION: 4-16-77-05W4

BATTERY/FACILITY CODE: — OPERATOR CODE (FACILITY):

INTENDED RECEIVER: Newalta Corporation

ADDRESS: Box 1001

CITY: Elk Point — PROV: AB — POSTAL CODE: T0A 1A0

RECEIVING SITE LOCATION: 03-15-55-06W4M — BATTERY/FACILITY CODE: ODP2

B) TRANSPORTER (CARRIER) — PROVINCIAL ID. NO. (CARRIER NO.): ABC 1408

COMPANY NAME: Newalta Corporation — CITY: Calgary — PROV: AB

ADDRESS: 9611 – 44 St SE — POSTAL CODE: T2C 2P7

DATE: October 31, 2005 — UNIT NO: 3107 — TELEPHONE: 236-2203 — FAX: 236-9711

Certification - I declare that I have received wastes as offered by the Generator in PART A for delivery to the Intended Receiver and that the information contained in PART B is correct and complete.

NAME (PRINT): Driver's name — SIGNATURE: Driver's signature

C) RECEIVER (CONSIGNEE) — PROVINCIAL ID. NO. (RECEIVER NO.):

COMPANY NAME: — CITY: — PROV:

ADDRESS: — POSTAL CODE:

RECEIVING SITE LOCATION: — BATTERY/FACILITY CODE: — OPERATOR CODE:

WASTE CODE	N or D	SHIPPING NAME/DESCRIPTION OF WASTE	CLASS	TDGA/PIN	PACKING GROUP	QUANTITY SHIPPED	UNITS	CONTAINER NO.	CONTAINER TYPE	HANDLING CODE	QUANTITY RECEIVED	UNITS	OIL %	WATER %	SOLID %	HAND CODE	TRANS DECON
SLGGLY	D	Environmentally Hazardous Substance, Liquid NOS ~~(soil/glycol/lead)~~	9	UN3082	111	2	M3	01	bulk	03							
SOILCH	D	Environmentally Hazardous Substance, Solid NOS (soil/glycol/lead)	9	UN3077	111	2	M3	1	bulk	03							

SPECIAL HANDLING/EMERGENCY INSTRUCTIONS: In case of emergency, call (403) (24 hrs.)

IF HANDLING CODE "02" OR "21" SPECIFY:

DATE SHIPPED: February 28, 2007 — SCHEDULED ARRIVAL DATE: February 28, 2007

DATE RECEIVED:

Certification - I declare that the information in PART A is correct and complete.

NAME OF AUTHORIZED PERSON (PRINT): Company Rep — SIGNATURE: Rep's Signature

FAX: Rep's Fax # — CELLULAR: Rep's Cell #

TELEPHONE: (403) 337-3511 — 24 HOUR NO: 24 Hour Emergency #

IDENTIFY DISCREPANCIES BETWEEN WASTE RECEIVED AND DETAILS LISTED IN PART A (USE ATTACHMENTS IF NECESSARY)

D) GENERATOR (CONSIGNOR): COMPLETE UPON RECEIPT OF MANIFEST FROM RECEIVER

EXPLANATION OF REASON FOR DISCREPANCIES NOTED BY RECEIVER (IF ANY), AND WHAT CORRECTIVE ACTION HAS BEEN TAKEN (Use attachments if necessary):

Certification - I declare that the information contained in PART C is correct and complete.

NAME OF AUTHORIZED PERSON (PRINT): — TELEPHONE:

SIGNATURE:

NAME OF AUTHORIZED PERSON (PRINT): — SIGNATURE: — DATE: — TELEPHONE: