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December 10, 2007

Alberta Energy and Utilities Board
Resources Division
640 – 5 Avenue SW
Calgary, Alberta
T2P 3G4

Attention: Mr. Ken Schuldhaus
Section Leader, In Situ Oil Sands Resource
Applications

Alberta Environment
Northeast Boreal Region
Environmental Service
111, 4999 – 98 Avenue
Edmonton, Alberta T6B 2X3

Attention: Kem Singh,
Approvals Manager

Alberta Environment
Northeast Boreal Region
Environmental Service
111, 4999 – 98 Avenue
Edmonton, Alberta T6B 2X3

Attention: Mr. Mike Boyd
Regional Environmental Manager

Dear Sirs:

Re: Application for Approval of the Long Lake South Project

Nexen Inc. and OPTI Canada Inc (the Partners) are pleased to submit the following supplementary information responses as requested by the Alberta Energy and Utilities Board and Alberta Environment in the document dated October 29, 2007.

Please direct questions regarding this information to the undersigned at (403) 699-4771 by phone or by e-mail at Kris_Geekie@nexeninc.com

Sincerely,

Original Signed by

Kris Geekie

Director, Community Consultation & Regulatory Affairs
Attachment: Supplemental Information Request for the Long Lake South Project

LONG LAKE SOUTH PROJECT



Environmental
Impact Assessment (EIA)

Submitted to:

Alberta Energy and
Utilities Board
&
Alberta Environment

Additional Supplemental Information

December 2007



Guide to the Supplemental Document

Nexen/OPTI (the Partners) submitted an integrated application to the Alberta Energy and Utilities Board (EUB) and Alberta Environment (AENV) in December 2006 for approval of the Long Lake South (LLS) Project (Volume 1). This application was supported by a common Environmental Impact Assessment (EIA) Report (Volumes 2 to 5).

The Partners received a request for supplemental information from the regulators on July 25, 2007 with regard to both the Application and the EIA. [Supplemental Information Responses \(SIRs\)](#) were submitted pursuant to this request in August, 2007. A second request for supplemental information was submitted by the regulators to the Partners on October 29, 2007 with regard to the SIR Aug/07 document. The purpose of this document is to respond to this second iteration of supplemental information requests. This document references the following documents submitted by Nexen/OPTI regarding the Long Lake South Project.

Nexen/OPTI. 2006. Application for Approval of the Long Land South Project. Submitted to the Alberta Energy and Utilities Board and Alberta Environment (References as Volume and Section numbers in this document).

Nexen/OPTI. 2007. Application for Approval of the Long Land South Project Supplemental Information. Submitted to the Alberta Energy and Utilities Board and Alberta Environment. (References as SIR Aug/07 in this document).

Unless otherwise stated, the figures and tables referenced within this document are contained herein.

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General EUB Questions

1.	<p>Page 5, Section 1.2, Consultation:</p> <p>Nexen has not provided a complete list of stakeholders that have outstanding concerns. Provide an update on the status of all stakeholders, including other companies, having outstanding concerns and how these concerns are being dealt with.</p>
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Response

The Partners have continued with a proactive public consultation program since the LLS Project was filed in December 2006. These activities include, but are not limited to, the information provided in Table 1-1. This table provides a summary of the parties consulted, the organizations that have submitted Statements of Concern to AENV, the meeting dates, and correspondence including a summary of the issues or concerns.

The Partners are continuing to meet and work with these stakeholders to better understand their concerns and to seek a mutually beneficial resolution.

Table 1-1 Summary of Consultation Activities for the Long Lake South Project

Date	Stakeholder	Contact Method	Meeting Place	Subjects Discussed
21-Aug-2007	Conoco Phillips	Meeting	Conoco Phillips	Statement of Concern
6-Sept-2007	Wood Buffalo Métis Corporation	Call	N/A	General Manager calls to request overview of LLS for four Métis Presidents belonging to the Corporation including Janvier, Anzac, Fort McMurray and Fort McKay.
7-Sept-2007	Conklin Community Association , Conklin Métis Local and Conklin Municipal Officer	Meeting	Conklin Municipal Office	Meeting to provide overview of LLS and to request advice on planning an open house.
10-Sept-2007	Mikisew Cree First Nation	Call	N/A	Call was made to ensure MCFN's environmental and SEIA reviews were being executed.
10-Sept-2007	Regional Municipality	Meeting	ATC Office Fort McMurray	Project staff advises Regional Municipality of upcoming LLS open houses in Conklin, Fort Chipewyan and Anzac.
10-Sept-2007	Fort McMurray First Nation	Meeting	Long Lake Community Relations Office in Anzac, AB	Project staff and FMFN discuss how the Partners can communicate with FMFN members more frequently. FMFN to plan a newsletter.
17-Sept-2007	Willow Lake Community Association	Meeting	Anzac Community Hall, Anzac, AB	Project staff advises Anzac community of Oct. 17 open house in Anzac. Main focus on start-up

Date	Stakeholder	Contact Method	Meeting Place	Subjects Discussed
				of Long Lake facility but LLS details will also be provided.
20-Sept-2007	Fort McMurray First Nation Industry Relations Corporation	Meeting	Edmonton	LLS overview provided and described in details the supplemental submission. Winter program also described in detail.
21-Sept-2007	Heart Lake First Nation	Meeting	Nexen office, Calgary	Project staff hand deliver Long Lake and LLS winter program packages and schedules an elders meeting to review the winter program.
24-Sept-2007	Fort McMurray First Nation	Call	N/A	Project staff advised by FMFN IRC staff to set up an Elders meeting. Purpose of meeting to provide elders with a winter program and LLS update.
27-Sept-2007	Wood Buffalo Métis Corporation	Meeting	Sawridge Hotel, Fort McMurray, AB	WBMC consists of four Métis locals; Janvier, Anzac, Fort McMurray 1935 and Fort McKay. All Locals represented at meeting. WBMC does not have environmental capacity to understand EIA.
28-Sept-2007	Métis Local 1935 elders	Meeting	Super 8 Motel, Fort McMurray, AB	Meeting with Métis Local 1935 elders. Detail overview of LLS provided.
12-Oct-2007	CPDFN, FMFN review results of third party review conducted by MSES	Meeting	Nexen Office, Calgary	Purpose of meeting was to discuss both MSES' review and the Partners responses. Desired outcome was to agree on outstanding issues or concerns.
17-Oct-2007	Anzac Open House	Open House	Anzac Community Hall	The Partners provide start-up details on Long Lake and an update on LLS.
22-Oct-2007	Willow Lake Community Association	Meeting	Anzac Community Hall	Reported that the open house was held on October 17 th and the details of the open house were reviewed.
31-Oct-2007	Heart Lake First Nation	Meeting	Nexen Office, Calgary	HLFN provides details of their consultation model and participant matrix.
13-Nov.-2007	Conoco Phillips	Meeting	Conoco Phillips	Statement of Concern

2.	<p>Page 13, Section 1.8, Water Use:</p> <p>It should be noted that the water balance flow diagrams and Figure 3.4-2 (Volume 1, Section 3.4: Process Flow Diagram) appear to contradict each other. For example, the water balance flow diagrams depict the maximum make-up water case (15% reservoir retention) while Figure 3.4-2 (Volume 1, Section 3.4) shows the integration of LLS project with the Long Lake Project for a 5% reservoir retention (facility design sizing specification). In the 15% retention case, a greater volume of makeup water is required to be treated than in the 5% retention case where more produced water is returned. Is there sufficient water treatment capacity to allow the facility to operate at the 15% retention case since the facility "design size" is for the 5% case?</p>
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Response

The water treatment facility is designed to handle the maximum saline water make-up capacity.

Volume 1, Figure 3.4-2, LLS Phase 1 Block Flow Diagram, identifies a snapshot of the design basis for the facility. This is used as the basis for detailed engineering on the facility.

The water balance flow diagrams depict the maximum make-up water case, which is based on 15% reservoir retention.

The LLS facilities are designed to handle a reservoir loss varying from 5% up to 15% at full plant capacity. With a reservoir loss of 5%, the produced water coming back from the well field will be 95% of the steam production sent to the well field. This is the maximum design flowrate for the inlet separation/treating and produced water deoiling trains.

With a reservoir loss of 15%, the produced water coming back from the well field will be 85% of the steam production sent to the well field. Under this operating condition, the maximum amount of make-up saline water (8,911 t/d as identified on the SAGD Water Balance, Volume 1, Figure 3.2-2) is required by the facility. The water treatment facility is designed to handle the maximum saline water make-up capacity.

3.	<p>Page 13, Section 1.8, Water Use:</p> <p>OPTI Nexen state that <i>"The period when freshwater is required as make-up will last approximately 12 months for each SAGD phase at the LLS Project and the freshwater demand is approximately 10,000 m³/d after six or seven."</i> It is noted also that <i>"For LLS Phase 2, the freshwater requirements during start-up will be met by</i></p> <ul style="list-style-type: none">a) Maximizing the freshwater withdrawals from the freshwater source well network, normally dedicated to the Long Lake Project, and sending this additional freshwater to LLS using the POW water balance pipeline; andb) Running the LLS Phase 1 at maximum TDS operational limit and re-directing some LP condensate from LLS Phase 1 to LLS Phase 2 to be
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	used as make-up water.
	What is the capacity of the POW water balance pipeline? How do the above statements get reflected in Table 20-1 OVERALL WATER BALANCE FORECAST – LONG LAKE LEASE? Provide a breakdown of the freshwater required for the monthly volumes indicated in the year 2014 – peak year for freshwater demand. Why will brackish water use drop for the first 7 months, recognizing that use could be limited by TDS control?

Response

The produced oily water (POW) pipeline has the capacity to send up to 8,100 t/d of water from the Long Lake Project to the LLS Project. The POW line is shown in Table 9-1 (SIR Aug/07 [EUB Response 20](#), [Table 20-1](#) revised as Table 9-1 in EUB Response 9) under the Fresh Water LLS SAGD column. The maximum rate shown is 8,296 m³/d. The LP condensate line could also be used to move the additional 196 m³/d capacity, if required.

The statements a) and b) in the question are reflected in Table 9-1 in the Water Management column. Water management includes maximizing the use of saline water and fully utilizing the water balance lines between the upgrader and SAGD facilities. Water management may also include technological changes or temporary steam reduction as required. Should the bitumen from LLS Phase 2 be processed at the Long Lake upgraders, these upgraders would need to be expanded and additional water resources would be required for upgrader operation, which could temporarily be used for SAGD start-up.

Refer to Table 9-1 for the breakdown of fresh water required in the year 2014 (months 25-36).

In Month 25 (year 2014) of the LLS Phase 2 ramp-up, the blowdown of the initial SAGD wells at the Long Lake Project commences. The Long Lake SAGD wells require less steam and the Long Lake facilities require less saline water make-up. In turn, less LP condensate is produced at the Long Lake facilities, resulting in an increase in overall fresh water usage.

4.	Page 15 Update: Nexen states that <i>“excess water is either re-used... or goes to disposal.”</i> What priority/commitment is Nexen making to re-use excess produced water rather than disposing of it? If there is excess water would there still be a need for cold makeup water for steam generation purposes?
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Response

The Partners' priority is to re-use produced water. Consequently, the Partners are investing in the POW pipeline system to have the ability to re-use excess produced water between the Long Lake Project and the LLS Project. The POW pipeline has the capacity to send up to 8,100 t/d of water from the Long Lake Project to the LLS Project. Water transfers between the plants will be metered accordingly.

If there is sufficient excess POW at a particular site, there would not be a requirement for cold make-up water for steam generation purposes at that site. The excess POW would then be transferred to the other site to balance out the cold make-up water requirements between the facilities.

If the excess water cannot be used at either of the Projects, it will then be properly disposed of.

5.	<p>Figure 1-34 and 1-35:</p> <p>Nexen indicates that storm water usage will be zero. Does Nexen intend to return all storm water back into the environment? Will there be sufficient storm water retention ponds to retain fluids for testing before discharging back to the environment?</p>
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Response

Surface runoff water will be collected at the CPF in the stormwater pond. Surface runoff water will be fed into the stormwater pond by a system of drainage ditches and culverts in order to control and contain industrial runoff. The pond is designed to recover the surface water runoff from the CPF site. Although guidelines suggest that ponds ought to be designed for a 1:10 year precipitation event, the Partners have designed the pond for a 1:25 year precipitation event. As per AENV operating approval conditions, this water will only be released to the watershed once it has been tested and deemed acceptable for release.

In the event that extra standby capacity is required, the pond contents will be sampled as per AENV operating conditions and then released to the watershed through an overland discharge designed to reduce both erosion and sedimentation in the surrounding environment. If accumulated surface water does not meet regulatory requirements, it will be recycled in the process or disposed of properly.

6.	<p>SIR Response #2:</p> <p>The EUB requires produced gas from thermal in situ bitumen recovery operations to be conserved (e.g., used for fuel) and not be vented or flared, and may condition scheme approvals to reflect this requirement.</p> <p>a) Nexen is required to submit information required as per <i>EUB Directive 60 Upstream Petroleum Industry Flaring, Incinerating and Venting</i>, Section 2.8 in order to justify why the flaring of ~ 538 Mmcf of produced gas during start up is economically justified. Include in this analysis a discussion on why this gas could not be utilized as sour fuel for steam generation at the south project.</p>
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Response

The LLS Project expects to require a variance for the produced gas design. Due to the complexities of the construction and start-up of these facilities and the need to ensure

that all of the integrated components are working properly, the produced gas is expected to be treated in the upgrader six months to one year following initial start-up of LLS Phase 1. Produced gas generated during start-up of LLS Phase 1 cannot be used at the existing facilities at Long Lake as it will be in full production mode and the facilities are only sized to handle the produced gas from one SAGD phase (70,000 bpd). The flaring of produced gas is expected to be short in duration; however, the anticipated volumes exceed the guidelines outlined in EUB Directive 060.

EUB Directive 060 requires that for new bitumen sites, the flare test period is limited to the lesser of six months or until combined flared and vented volumes exceed a rolling average of 900 m³/d for any consecutive three month period. As soon as testing shows that the combined flaring and venting volumes exceed 900 m³/d, conservation is to occur as quickly as possible and must not exceed a maximum of six months after flow rate testing.

Alternatives to flaring have been investigated such as dilbit gas injection, on-site sulphur recovery, and supplemental sour fuel use to handle the flaring for the start-up period. These alternatives did not meet the economic thresholds as outlined in EUB Directive 060, due to the significant capital expenditure and limited duration. The variance would only be required for a six to 12 month period. Once the upgrader commences operation, the produced gas will be treated and conserved for the remaining 40 year lifespan of the Project.

EUB Directive 060 allows for a temporary variance to be requested from the flaring guidelines for economic reasons and/or if the duration is temporary in nature and meets certain conditions.

Comparing the least expensive option available for the start-up of the LLS Project versus the least expensive option (and current design) available for start-up of the upgrader at the Long Lake Project results in the following:

1) Lo-Cat System at LLS (system ready for SAGD start-up)

- Capex \$8,000,000
- Opex \$500,800/y

2) Amine contactor at Long Lake (system not ready for SAGD start-up)

- Capex \$7,700,000
- Opex \$43,800/y

In order to have a system in place and ready for the start-up of the LLS SAGD, the incremental cost would be \$300,000 to install and \$457,000/y to operate. Discounting this cashflow stream at 10% per annum over a conservative 15 year period yields a net present value (NPV10) of <\$626,731>. This exceeds the economic threshold outlined in EUB Directive 060 of NPV<\$50,000>.

Another alternative that was considered was using the produced sour gas stream as a fuel source in the SAGD operation. Although economical, there are three main concerns with this option:

- Burning the sour gas will increase the LLS Project SO₂ emissions;

- The metallurgy in the process units using this mixed fuel will have to be redesigned to handle the corrosion tendencies. OTSGs are designed for sweet gas service (<0.1% H₂S) and this sour gas stream is expected to contain up to 2.5% H₂S. Although this cost has not been quantified, it is expected to significantly affect the design and total installed cost of the equipment; and
- It is not current industry practice to design and operate OTSGs for sour service.

In addition, EUB Directive 060 provides for three months of flaring volume verification plus up to six months of variance after the verification. In the case of the LLS Project SAGD start-up, there is no gas volume expected for the first three months. Including the additional nine months of verification and variance allowance, up to one year of flaring allowance is permitted for the LLS Project. This is within the time period expected for the upgrader start-up.

Therefore, the Partners decided to apply for the temporary EUB Directive 060 variance to allow flaring of the produced gas stream until the upgrader is operational.

6.	b) Confirm that other than during upset conditions after start up, Nexen will have no produced gas being flared or vented at the facilities.
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Response

It is confirmed that after start-up, other than during upset conditions and shutdowns of the upgrader, no produced gas will be flared or vented at the facilities.

6.	c) Address Nexen's specific plans on how it would handle the produced gas volumes from the 2 nd LLS SAGD phase, due to no upgrader being associated with its production.
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Response

The Partners have three options that will be evaluated prior to the final design and construction of LLS Phase 2. These include:

- Sending the produced gas to an upgrader for processing similar to the current Long Lake Project scheme and the proposed LLS Phase 1 scheme. This is a viable solution in the event that additional upgrading capacity is proposed, applied for and approved.
- If LLS Phase 2 is not associated with an upgrading solution, a sulphur recovery unit can be implemented as part of the SAGD facility design.
- A final option is the expansion of one or both of the upgrader sulphur recovery units that will be operational at the Long Lake Project site.

The Partners are committed to implementing one of the above options for LLS Phase 2 in order to minimize the sulphur emissions from the facility.

7.	<p>SIR Response #5:</p> <p>Given the low pressure of the gas cap at 460 kPa and the higher bottom water pressure of ~ 2200 kPa; how does Nexen plan to successfully exploit the resources in the reservoir? What analogy does it have to draw upon since no modelling with these conditions has been performed? Provide a detailed explanation including all supporting analysis and data on how the resources within these areas will be recovered in a manner that will maximize resource recovery.</p>
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Response

With regard to bottom water, the Partners made the following statement in Section 1.1.2 of LLS Project Update (Supplemental Information, August 2007): *"In order to minimize the influence of bottom water on SAGD performance, a minimum standoff of 5 m is imposed between the producer well and the bitumen/basal water contact. In areas where no bottom water is present, the producer well is placed as low as possible."* This minimum standoff should essentially isolate bottom water from SAGD steam chambers. In addition to standoffs, the Partners have also committed to reduced well length and spacing to 650 m and 75 m, respectively, which should allow for more flexibility in placing well pairs. Shorter wells will further enhance even steam distribution and production well subcool control. If matching pressure is deemed necessary, production intake pressure will be controlled at or slightly above the bottom water pressure, which would eliminate any potential water influx from bottom water or significant steam loss into bottom water. Nexen is confident that the impact of bottom water on SAGD in LLS can be effectively eliminated or minimized. For reference, the average bottom water pressures measured across the LLS Project are 1456 kPa and 1384 kPa respectively, from west to east (Bottom Water Pressure Map, Figure 7-1). The average measured bottom water pressure from all available piezometres in LLS is approximately 1420 kPa.

As for top gas, in the west of LLS, the majority of gas cap pressures have not been depleted, averaging at 876 kPa, except for only one gas well (5-13). This well shows a pressure of approximately 460 kPa, which was due to gas depletion from a much smaller size pool (Top Gas Pressure Map, Figure 7-2 and the Net Gas Pay map [Volume 1, Figure 2.3-12]). In the east portion of the LLS project area, the gas caps are at lower pressures, averaging at 620kPa, caused by previous gas production. All the gas production wells have been shut-in since 2003.

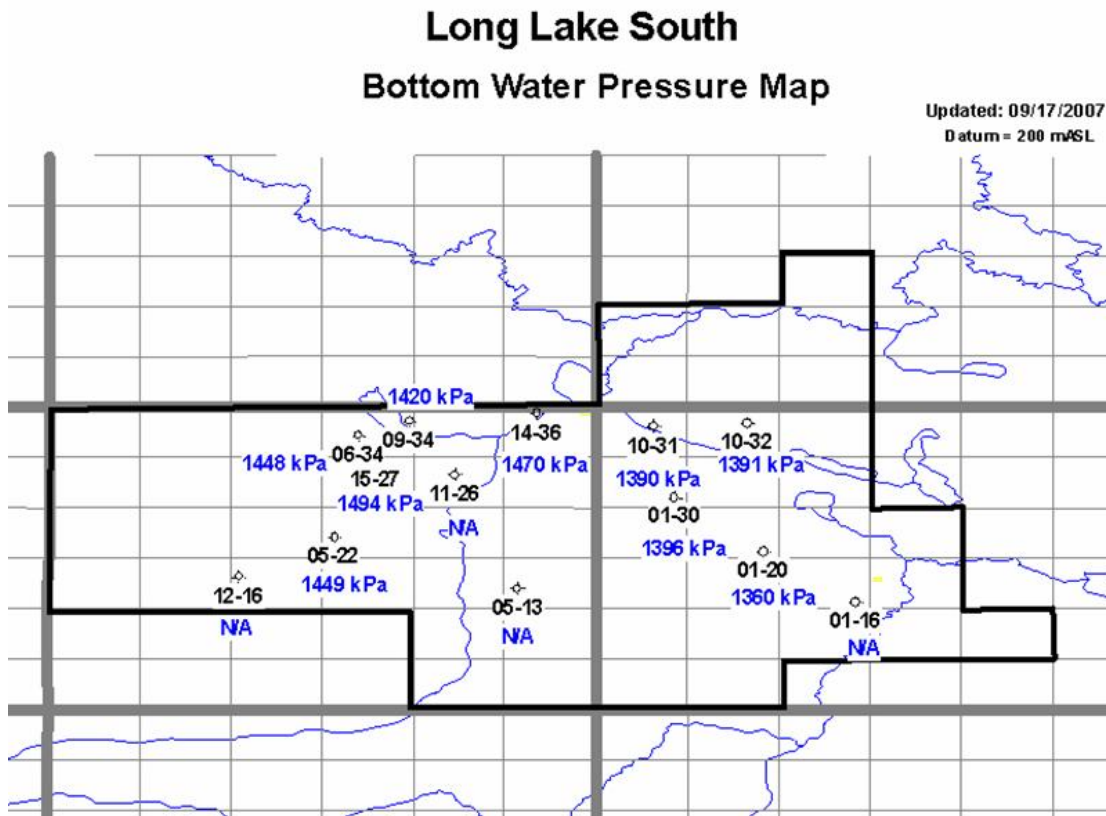


Figure 7-1 Bottom Water Pressure Map

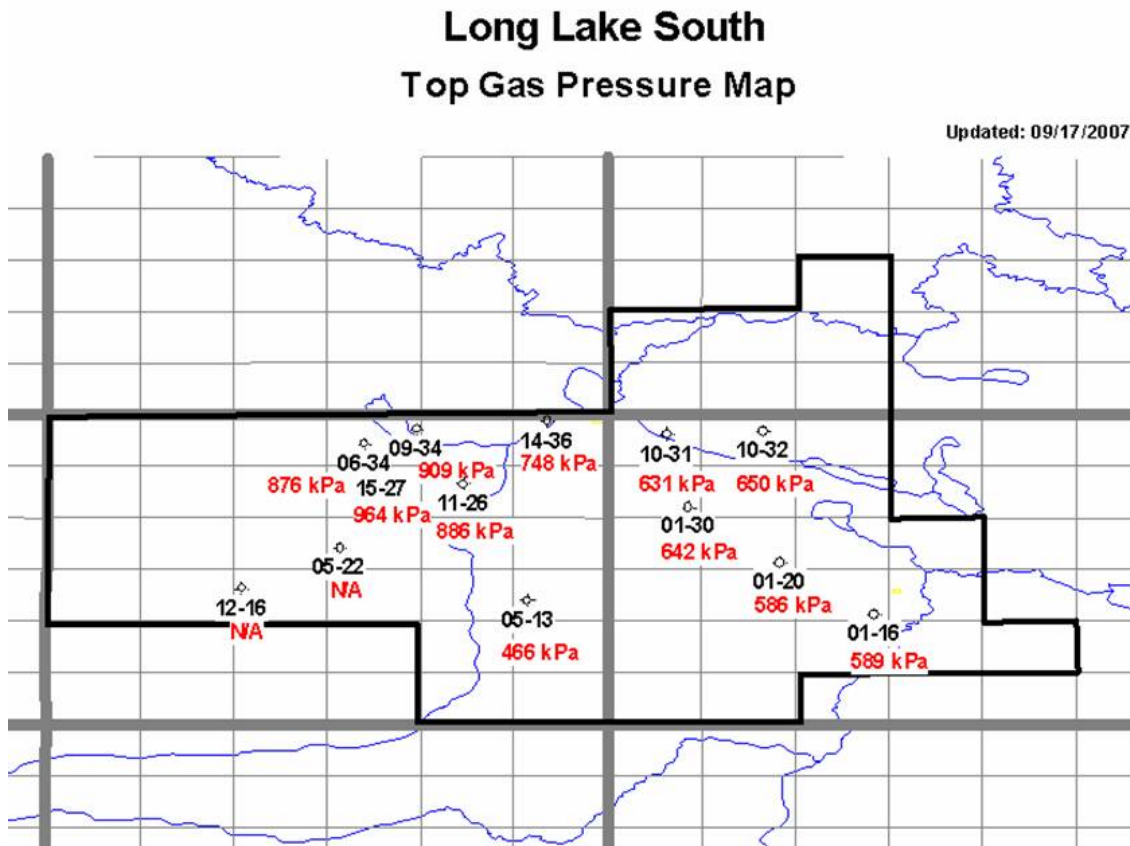


Figure 7-2 Top Gas Pressure Map

For those areas where the low pressure gas zone is in direct contact with underlying bitumen sands, the SAGD operating pressure would need to be adjusted over time to match the gas zone pressure. This is only expected to occur when a steam chamber encounters a low pressure gas zone. Reduced well spacing should allow for more bitumen to be produced prior to encountering the low pressure gas cap. In situations where the steam chamber has to balance with the bottom water pressure of approximately 1400 kPa and the top gas pressure of approximately 600 kPa, repressuring the top gas should help minimize steam loss, further extending the SAGD production life and maximizing resource recovery. The Partners are currently involved in a number of joint-industry initiatives investigating gas pool re-pressurization and are aware of other operators' re-pressurization trials.

8.	<p>SIR Response #8:</p> <p>Define the size of shale, in both the vertical and horizontal directions, that Nexen considers to be significant.</p>
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Response

Many factors should be considered to define a 'significant' shale that may impede well productivity. In general, a 2-4 m thick shale is considered significant. However, any shale "thick" enough to become a steam impediment is directly related to the shale composition and depositional setting. As a result, this thickness may vary both vertically and laterally. A thin shale with lateral continuity may be more disruptive to steam rise than a thick shale with limited lateral continuity. The location of the shale relative to well pair placement will also have an effect. If the shale is bracketed (ie. well pairs all around it), steam chambers may coalesce allowing drainage of bitumen above the shale over time.

9.	<p>SIR Response #20:</p> <p>Nexen was requested to <i>"Provide an expected monthly water balance of the SAGD facility for the initial start-up period and for the period where the upgrader is commissioned until the facility is at steady state conditions. After steady state conditions have been attained provide a yearly water balance, for the first 25 years, that shows yearly average of bitumen production, steam injection, produced water, fresh water use, saline water use, fresh water consumption (NOx, gasifier), saline water consumption (NOx, gasifier), and disposal volumes expressed in m3/calendar day rates."</i> In Nexen's response only bitumen, steam, produced water, fresh water, saline water and disposal volumes were provided. Provide the volumes of fresh water and saline water consumption for NOx and gasification processes so that the table can be balanced.</p>
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Response

The Overall Water Balance Forecast for the Long Lake Lease has been updated as per the requests in EUB Question 3, 9 and AENV Water Question 7. Table 9-1 is provided as a revision of SIR Aug/07 [EUB Response 20, Table 20-1](#). The following changes have been made with respect to the fresh water demands:

- Some optimization of the water usage between the LLS and Long Lake facilities has been included in the revised table to minimize the overall fresh water usage (up to 2000 m³/d starting in Month 22). This optimization consists of increasing the amount of saline water make-up used for steam generation at Long Lake, sending some POW from the Long Lake upgraders to LLS for steam generation at LLS, sending some LP condensate from LLS to Long Lake for use as fresh water make-up for the Long Lake upgraders.
- The start-up date for the second Long Lake upgrader has been delayed from Month 7 to Month 12 to better match the current schedule.
- The peak fresh water demand resulting from the LLS Phase 2 start-up has been reduced. The fresh water required for the start-up of LLS Phase 2 will be made available through temporary reductions in fresh water use on an overall lease

basis. These reductions will be achieved by maximizing saline water use at Long Lake and LLS and by fully utilizing the water balance lines between Long Lake and LLS. Additionally, technological changes and a temporary reduction in the steam demand may be applied as required. For example, the retrofit of the Long Lake cogens to the Dry Low NO_x technology is currently being investigated. Finally, should the bitumen from LLS Phase 2 be processed at the Long Lake upgraders, these upgraders would need to be expanded and would require additional water resources for upgrader operation. These additional water resources may be used temporarily for LLS Phase 2 start-up.

Long Lake (LLK) Project Long Lake South (LLS) Project Water Balance

		Reservoir									Makeup Water Requirements												System Losses						
Comments		Bitumen			Steam			Produced Water			Fresh Water LLK						Fresh Water LLS			Fresh Water LLK+LLS	Saline Water			Disposal Water			Misc. Losses	Stack Losses Cogen	Process Losses Upgrader
		LLK	LLS	LLK+LLS	LLK	LLS	LLK+LLS	LLK	LLS	LLK+LLS	Potable	Utilities	Upgrader	SAGD	Water Mgmt	Total	Potable	SAGD	Total	TOTAL	LLK	LLS	LLK+LLS	LLK	LLS	LLK+LLS	LLK	LLK	LLK
		(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)	(m3/cd)
Year		STEADY STATE CONDITIONS - LONG LAKE PROJECT																											
2009		11,055	0	11,055	36,553	0	36,553	31,070	0	31,070	192	1,746	3,884	1,735	0	7,557	0	0	0	7,557	6,442	0	6,442	4,102	0	4,102	138	2,853	1,292
2010		11,121	0	11,121	33,069	0	33,069	28,109	0	28,109	193	1,755	4,526	1,737	0	8,210	0	0	0	8,210	4,936	0	4,936	3,785	0	3,785	129	2,853	1,299
2011		11,134	0	11,134	33,952	0	33,952	28,859	0	28,859	193	1,757	4,375	1,737	0	8,061	0	0	0	8,061	5,313	0	5,313	3,870	0	3,870	132	2,853	1,301
Month		FACILITY RAMPUP - LONG LAKE SOUTH PROJECT																											
1	Startup of LLSP1 (2012)				35,456	3,600	39,056	30,138	900	31,038	187	1,709	3,928	1,730	0	7,554	6	3,040	3,046	10,600	6,122	0	6,122	3,981	326	4,307	143	2,853	1,261
2					35,456	7,201	42,657	30,138	1,800	31,938	187	1,709	3,928	1,730	0	7,554	12	6,070	6,082	13,636	6,122	0	6,122	3,981	652	4,633	152	2,853	1,261
3					35,456	9,841	45,297	30,138	2,460	32,598	187	1,709	3,928	1,730	0	7,554	22	8,296	8,318	15,872	6,122	0	6,122	3,981	892	4,873	159	2,853	1,261
4					35,456	9,841	45,297	30,138	2,460	32,598	187	1,709	3,928	1,730	0	7,554	22	8,296	8,318	15,872	6,122	0	6,122	3,981	892	4,873	159	2,853	1,261
5					35,456	10,525	45,981	30,138	3,579	33,716	187	1,709	3,928	1,730	0	7,554	41	7,917	7,958	15,512	6,122	0	6,122	3,981	953	4,933	161	2,853	1,261
6	Enough Produced Water returns to start saline water transition at LLSP1				35,456	13,876	49,332	30,138	6,244	36,382	187	1,709	3,928	1,730	0	7,554	61	6,688	6,749	14,303	6,122	2,229	8,351	3,981	1,257	5,238	169	2,853	1,261
7					35,456	17,015	52,471	30,138	9,188	39,325	187	1,709	3,928	1,730	0	7,554	82	4,699	4,781	12,335	6,122	4,699	10,821	3,981	1,541	5,522	177	2,853	1,261
8					35,456	20,153	55,609	30,138	12,697	42,834	187	1,709	3,928	1,730	0	7,554	103	4,661	4,764	12,318	6,122	4,661	10,783	3,981	1,826	5,807	185	2,853	1,261
9					35,456	23,292	58,748	30,138	16,538	46,675	187	1,709	3,928	1,730	0	7,554	124	4,460	4,584	12,138	6,122	4,460	10,582	3,981	2,112	6,093	194	2,853	1,261
10					35,456	25,366	60,822	30,138	19,786	49,923	187	1,709	3,928	1,730	0	7,554	130	3,961	4,091	11,645	6,122	3,961	10,082	3,981	2,296	6,277	199	2,853	1,261
11					35,456	27,441	62,897	30,138	22,501	52,639	187	1,709	3,928	1,730	0	7,554	143	3,740	3,884	11,438	6,122	3,741	9,862	3,981	2,487	6,467	204	2,853	1,261
12	Startup of Long Lake Upgrader #2	10,791	9,439	20,230	35,456	29,515	64,971	30,138	25,088	55,225	228	1,788	5,197	1,730	0	8,943	164	1,792	1,956	10,899	5,238	5,375	10,614	4,181	2,677	6,858	220	2,853	1,536
13	Complete saline water transition at LLSP1				35,456	30,562	66,018	30,138	25,977	56,115	273	1,875	6,594	1,730	0	10,472	171	0	171	10,643	4,240	7,406	11,647	4,391	2,766	7,157	233	2,853	1,837
14					35,456	31,609	67,064	30,138	26,867	57,005	321	1,967	8,084	1,730	0	12,102	178	0	178	12,280	3,204	7,664	10,868	4,625	2,863	7,488	248	2,853	2,160
15					35,456	32,655	68,111	30,138	27,757	57,894	372	2,067	9,683	1,730	0	13,853	185	0	185	14,038	2,092	7,919	10,010	4,877	2,958	7,834	263	2,853	2,507
16					35,456	33,034	68,490	30,138	28,079	58,217	375	2,072	9,772	1,730	0	13,950	188	0	188	14,138	2,030	8,014	10,044	4,891	2,994	7,884	265	2,853	2,527
17					35,456	33,413	68,869	30,138	28,401	58,539	378	2,078	9,860	1,730	0	14,047	191	0	191	14,238	1,968	8,109	10,078	4,904	3,029	7,934	267	2,853	2,546
18					35,456	33,792	69,248	30,138	28,723	58,861	381	2,083	9,949	1,730	0	14,144	191	0	191	14,335	1,907	8,203	10,110	4,918	3,064	7,983	268	2,853	2,565
19					35,456	34,013	69,469	30,138	28,911	59,048	382	2,086	9,993	1,730	0	14,192	191	0	191	14,383	1,876	8,264	10,140	4,925	3,087	8,012	269	2,853	2,575
20					35,456	34,234	69,690	30,138	29,099	59,236	384	2,089	10,038	1,730	0	14,241	191	0	191	14,432	1,845	8,298	10,142	4,932	3,100	8,032	270	2,853	2,584
21					35,456	34,455	69,911	30,138	29,287	59,424	385	2,092	10,083	1,730	0	14,290	191	0	191	14,481	1,814	8,358	10,172	4,939	3,122	8,062	271	2,853	2,594
22	Optimization of the water usage between the facilities to minimize fresh water usage				35,456	34,774	70,230	30,138	29,558	59,695	386	2,093	10,104	1,730	-500	13,813	191	0	191	14,004	2,299	8,443	10,742	4,943	3,154	8,096	272	2,853	2,599
23					35,456	35,093	70,549	30,138	29,829	59,967	386	2,094	10,125	1,730	-1,000	13,336	191	0	191	13,527	2,785	8,526	11,311	4,946	3,185	8,131	273	2,853	2,603
24					35,456	35,413	70,869	30,138	30,101	60,238	387	2,096	10,145	1,730	-1,500	12,858	191	0	191	13,049	3,270	8,583	11,854	4,949	3,206	8,155	274	2,853	2,608
25	LLK SAGD wells blowdown (note 1)				23,407	38,246	61,653	19,896	30,349	50,245	394	2,142	12,403	1,737	-3,750	12,926	197	3,040	3,237	16,163	2,000	8,401	10,401	3,889	3,465	7,353	252	2,853	2,653
26	Startup of LLSP2 (2014)	11,124	11,584	22,708	23,407	38,246	61,653	19,896																					

10.	<p>SIR Response #23:</p> <p>Nexen was asked to provide a “<i>detailed estimate on the disposal fluids chemical makeup including a discussion of the anticipated range of ph values.</i>” Nexen has provided a discussion on ph (regulated) and TDS levels and other unregulated compositions but has not provided any information on the other regulated characteristics as described in D51 for lb wells including:</p> <ul style="list-style-type: none"> ○ a pH between 6.0 and 9.0; (<i>already provided</i>) ○ a flash point greater than 60.5° C, unless <ul style="list-style-type: none"> ▪ it is an untreatable sand or crude oil/water stable emulsion, or ▪ it is an antifreeze or dehydration fluid; ○ heavy metal concentrations at or below the levels specified in Schedule 1 (of <i>Directive 51</i>); and ○ a total combined concentration of halogenated organic compounds of less than 100 mg/kg. <p>Please provide additional information as requested.</p>
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Response

As described in SIR Aug/07 [EUB Response 23](#), the chemistry of the LP blowdown stream will vary depending on the proportion of LP condensate sent to the Long Lake upgraders and the proportion of LP condensate retained at the LLS Project facilities. In addition to the anticipated blowdown chemistry data provided in Table 4.5-1 (Volume 1, Section 4.5), the following concentrations are also expected for the LLS blowdown stream:

- Flash point: the blowdown stream is not a flammable liquid; therefore the flashpoint of the blowdown will be greater than 61°C.
- Heavy metals:
 - Arsenic: 0.4 - 0.9 mg/L
 - Beryllium: 0.01 - 0.02 mg/L
 - Cadmium: 0.004 - 0.009 mg/L
 - Chromium: 0.1 - 0.5 mg/L
 - Lead: 0.2 - 1.2 mg/L
 - Mercury: 0.008 - 0.014 mg/L
 - Nickel: 0.3 - 1.7 mg/L
 - Selenium: 0.02 - 0.04 mg/L
 - Silver: 0.007 - 0.011 mg/L
 - Thallium: 0.005 - 0.010 mg/L
 - Uranium: 0.021 - 0.026 mg/L
- Halogenated organic compounds: the total combined concentration of halogenated organic compounds is currently not available. However, the Partners will ensure that the operation of the disposal wells will comply with the applicable regulations.

EPEA Application No. 001-236394
Water Act File No. 00237030

Alberta Environment (AENV) Questions

AENV Air

1.	Supplemental Information Volume, Part 2, Section 2.3 Air, SIR response #30, Pages 41 to 43. a) Will the new design development building locations/dimensions and stack locations result in larger predicted ambient concentrations for the LLS project?
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Response

Of the three new buildings listed in [Table 30-1](#) SIR Aug/07 [AENV Response 30](#), only the HP BFW BLDG (28400-BG-001) is in close proximity to an emission source. This building is near the steam generator stacks; however, with a maximum height of 9 m, it will not have an influence on dispersion given that the steam generator stacks are 30 m high. Other changes in buildings (locations or dimensions) will have a minor influence on plume behaviour from LLS sources because in most cases the building heights are slightly lower than used in the modelling.

The changes in the facility design will result in a shift in the location of predicted concentrations but the overall patterns and maximum concentrations are expected to remain essentially the same. The reasoning behind this statement is that the 10 steam generator and cogen stacks are the major contributors of emissions from the LLS Project. These sources have not changed with regard to stack parameters. However, these stacks have been moved 350 to 400 m east of their original position, with the cogen stack being moved the furthest. The new design will result in a shift in the maximum predicted concentrations (from the Project) about 300 to 400 m east of the locations presented in Volume 2.

1.	b) The location of the Line Heater air emission sources (2 sources) is not shown on Figure 30-1. The number of buildings listed in Table 30-1 does not seem to match the number of buildings shown in Figure 30-1. Clarify.
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Response

The Line Heater Air Emission Sources are located on the pipeline corridor between the LLS facility and the Long Lake Project's facility and not within the LLS facility shown in SIR Aug/07 AENV Figure 30-1.

There are two discrepancies between the number of buildings listed in SIR Aug/07 [AENV Table 30-1](#) and the number of buildings shown in SIR Aug/07 [AENV Figure 30-1](#). They are as follows:

- Building 28400-BG-001, HP BFW Bldg, is shown on SIR Aug/07 [AENV Figure 30-1](#), but is not highlighted in red.
- Building 28700-BG-004A-C, Emergency Generator Bldg, is part of the Emergency Generator Package, 28700-PK-007A-C, and has not been highlighted in red on SIR Aug/07 [AENV Figure 30-1](#).

2.	Supplemental Information Volume, Part 2, Section 2.3 Air, SIR response #31b, Page 44. Provide detailed summaries of the SO ₂ air emission source calculations where the cited parts per million sulphur contents and the corresponding gas flow rates are used.
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Response

The detailed summary of the SO₂ air emission source calculations, including the cited parts per million sulphur content and the corresponding gas flow rates, are shown below.

The fuel gas rates used to calculate the SO₂ air emissions are higher than the numbers shown in Volume 1, Section 3.4.2, Heat and Material Balance. The numbers used in the calculation represent the maximum expected fuel gas rates for the cogen and the OTSG, respectively, and represent the worst case expected emissions from these sources. The values listed in Volume 1, Section 3.4.2, Heat and Material Balance, represent a snapshot of the design basis for the facility based on a summer operation case.

SO₂ Calculations

Cogen GTG

1 Cogen Unit

Fuel Gas (Sm³/d) = 2,929,274
 Conversion (kgmol/hr) = 5162

COMPOSITION	Mole Fraction	kgmol/hr of Sulphur
Fuel Gas, 50 ppmv sulphur		
H ₂ S	0.000002	0.010324
COS	0.000048	0.247774
Total Sulphur	0.000050	0.258098
-assume 100% conversion		

kg/hr of SO₂ = 16.535 kg/hr

TOTAL Metric Tons of SO₂/d = 0.397 t/d

Cogen HRSG

1 Cogen Unit

Fuel Gas (Sm³/d) = 976,570
 Conversion (kgmol/hr) = 1721

COMPOSITION	Mole Fraction	kgmol/hr of Sulphur
Fuel Gas, 73 ppmv sulphur		
H ₂ S	0.000002	0.003442
COS	0.000071	0.122185
Total Sulphur	0.000073	0.125627
-assume 100% conversion		

kg/hr of SO₂ = 8.048 kg/hr

TOTAL Metric Tons of SO₂/d = 0.193 t/d

TOTAL Cogen (HRSG + GTG) SO₂ Emissions = 0.590 t/d

OTSG's

11 Steam Generators

Fuel Gas (Sm³/d) = 7,632,439
 Conversion (kgmol/hr) = 13450

COMPOSITION	Mole Fraction	kgmol/hr of Sulphur
Fuel Gas, 50 ppmv sulphur		
H ₂ S	0.000002	0.026900
COS	0.000048	0.645594
Total Sulphur	0.000050	0.672494
-assume 100% conversion		

kg/hr of SO₂ = 43.083 kg/hr

TOTAL Metric Tons of SO₂/d = 1.034 t/d for all 11 OTSGs
0.094 t/d per OTSG

3.	<p>Supplemental Information, Part 2, Section 2.3 Air, SIR response #32, Pages 44 and 45.</p> <p>a) Provide a summary of the methodologies used to estimate the SO₂, NO_x, CO, VOC and PM_{2.5} air emissions for the continuous flares for the produced gas stream.</p>
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Response

The continuous pilot flares had a known gas composition (Table 3-1). Based on this composition, the heating value of the gas was determined (33.68 MJ/m³). Using this heating value and USEPA AP 42 emission factors (USEPA AP 42, Fifth Edition, Section 13.5 Industrial Flares), the emissions of NO_x and CO were calculated. The AP 42 emission factors for NO_x and CO are 0.068 lb/MMBtu (0.0292 g/MJ) and 0.37 lb/MMBtu (0.1591 g/MJ), respectively. Based on the volumetric flow rate of gas flared (165.6 m³/d), the emission rates are 0.0019 g/s for NO_x and 0.0103 g/s for CO. From the gas composition, it can be seen that there is zero sulphur content and thus no SO₂ emissions.

The method used to calculate total VOCs is based on California Air Toxics Emission Factors (CATEF) for flares of landfill gas. The total VOCs are the sum of the individual species that comprise the gas (Volume 2, Section 2, Appendix 2A, Table 2A.2-3 for species list). Using CATEF, an emission rate of total VOCs was calculated as 215.06 lb/MMscf of gas. For this gas composition and volumetric flow rate, the emission rate of total VOCs is 0.0066 g/s.

PM_{2.5} emissions are based on a fraction of NO_x emissions. Since natural gas is being combusted, the USEPA AP 42 Section 1.4 Natural Gas Combustion was used to estimate PM_{2.5} in relationship to NO_x. Using this section, the emission factors for an uncontrolled small boiler are 100 lb/MMscf for NO_x and 7.6 lb/MMscf for total PM. Therefore, it was assumed that PM emissions from natural gas combustion are approximately 7.6% of NO_x emissions. Note that this percentage is for total PM; assuming this value for PM_{2.5} is conservative. For the continuous pilot flare, PM_{2.5} emissions were estimated to be 0.00014 g/s (7.6% x 0.0019 g/s NO_x).

Table 3-1 Pilot Gas Composition

Species	Molar Fraction
H ₂	0.0000
NH ₃	0.0000
H ₂ O	0.0000
N ₂	0.0035
CO ₂	0.0070
H ₂ S	0.0000
C ₁	0.9875
C ₂	0.0010
C ₃	0.0005
iC ₄	0.0003
nC ₄	0.0002
iC ₅	0.0000
nC ₅	0.0000
C ₆	0.0000
C ₇ +	0.0000

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|----|--|
| 3. | b) Explain why the continuous flare emissions cited in Table 2A.2-1 (Volume 2, Section 2, Appendix 2A, Page 2A-7) show zero emissions of SO ₂ , NO _x and PM _{2.5} and very low (0.001 t/d) emissions of CO and VOC's. |
|----|--|

Response

As discussed above, the fuel to the continuous flare pilot is sweet natural gas and contains no sulphur. Therefore, there are no emissions of SO₂. Continuous flare emissions cited in Table 2A.2-1 (Volume 2, Section 2, Appendix 2A, Page 2A-7) show zero emissions of NO_x and PM_{2.5} and very low (0.001 t/d) emissions of CO and VOCs due to rounding the emission rates to three significant digits. The emission rates for these species to five significant digits are found in Table 2A.2-2 (Volume 2, Section 2, Appendix 2A, Page 2A-8).

- | | |
|----|---|
| 3. | c) Indicate the methodologies used to estimate the VOC emissions for the OTSG's, process heaters, boilers, and the Cogen. |
|----|---|

Response

The methodology used to estimate VOCs from the OTSGs, process heaters, and boilers was to use the highest emission factor from either USEPA AP 42 (USEPA AP 42, Section 1.4 Natural Gas Combustion) or CATEF for each of the 35 VOC species. Emission factors for heaters, boilers, and steam generators from CATEF were also reviewed. Since the NO_x emission factor for natural gas combustion in small boilers (USEPA AP 42 Section 1.4 Natural Gas Combustion) is 100 lb/MMscf, the maximum emission factor for total VOCs was found to be 5.5 lb/MMscf. The emission rate of total

VOCs was assumed to be 5.5% of the NO_x emission rates, which were provided by the Partners. The emission rates of the individual VOC species were estimated based on their percentage of the total VOCs emission factor of 5.5 lb/MMscf.

The methodology used to estimate the emissions for the cogen follow a similar methodology. The difference is that 45% of the emissions are based on emission factors from boilers and 55% of the emissions are derived from internal combustion of natural gas turbines. The emission factors from gas turbines are taken from USEPA AP 42 Section 3.1 Stationary Gas Turbines. The same ratio is used to estimate the total VOC emission rate.

4.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #34, Page 46.
	Indicate the expected magnitude (in kilograms) of the tank losses and fugitive emissions from the site over a one-year period as total VOC's.

Response

Table 4-1 provides the estimated total VOCs from tank/storage losses and fugitive emissions for the LLS Project for one year. The basis for these estimates is the Long Lake Project (SAGD) and field equipment. LLS has approximately twice the equipment in the field and plant as the Long Lake Project (SAGD). The total VOC estimates also include the following assumptions:

- The leak detection and repair (LDAR) program will result in fugitive emissions 50% lower than the industry average;
- The tank numbers and throughputs for each phase of LLS are the same as those of the Long Lake Project (SAGD);
- Vapour recovery systems are installed on all tanks except the pop tanks; and
- The emissions control efficiency of the vapour recovery systems is 95%. This accounts for approximately 18 days of downtime during the year.

Table 4-1 Estimated Total VOCs from Fugitive Emissions and Tank/Storage Losses

Emission Type	Source	Emissions (kg/y)
Fugitive	Plant and Field Equipment	1,600
Storage/Tank Losses	Dilbit Tanks	7,600
	Slop Tanks	1,300
	Skimming Tanks	1,300
	Pop Tanks	<10
	<i>Subtotal Tanks</i>	<i>10,200</i>
Total		11,800

* These numbers are considered conservative based on a 95% Vapour Recovery Unit (VRU) reliability. Refer to [AENV Air Response 5](#), expected VRU reliability greater than 99.95%.

5.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #38, Page 48. a) What is the expected reliability of the VRU system and what type of redundancy is there built into the compression units.
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Response

The VRU system has two compression units. Each compression unit is sized to handle 100% of the expected vapour flow from the system, rendering a compression system redundancy design of 2 x 100%. Based on the 2 x 100% compression system design, the reliability of the system is expected to be greater than 99.95% while the plant is in operation, giving an expected failure rate of once every five years.

5.	b) How did OPTI/Nexen arrive at this VRU design?
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Response

The VRU design is similar to the design used by the Partners on the Long Lake Project. This is a result of the design and operations team's experiences from the Long Lake Project design as well as their experiences on previous projects with similar VRUs.

6.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #45, Page 56. Provide air emergency response and reporting procedures, as well as the general air quality reporting routines.
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Response

In the event that an air quality exceedance is detected by on-site equipment or staff, the on-shift operator is to contact both the environmental specialist and AENV to report the issue. Should the exceedance warrant the enactment of the Emergency Management Plan, senior staff would be contacted to determine the appropriate response.

Were an air quality issue to be recorded at a WBEA monitored air quality station, the WBEA network contractor would be responsible for the immediate reporting of the issue to AENV and to all WBEA member companies.

Once the compliance exceedance has been reported to AENV, the report and reference number will be sent within 24 hours by the WBEA network contractor to each member of the WBEA network.

For general air quality reporting, the Partners will provide monthly and annual air emissions reports to AENV as part of the approval conditions. In addition, the WBEA network maintains a public website of RMWB air quality data. Data for the Partner funded Anzac station can be found at <http://www.wbea.org/content/view/57/112/>.

7.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #47a, Page 57. What project greenhouse gas emission intensity value will result from using the total LLS production of 22,260 m ³ /day and the total greenhouse gas annual emissions 8.2 Mt of CO ₂ equivalent per year cited in the original application?
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Response

The intensity value can be calculated as follows:

Bitumen production:

8.2 Mt CO₂ / 8,124,900 m³ bitumen = 1.01 t CO₂/m³ bitumen

8.2 Mt CO₂ / 51,100,000 bbls bitumen = 0.16 t CO₂/bbl bitumen

Synthetic production:

8.2 Mt CO₂ / 6,790,100 m³ synthetic = 1.21 t CO₂/m³ synthetic

8.2 Mt CO₂ / 42,705,000 bbls synthetic = 0.19 t CO₂/bbl synthetic

8.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #51, Page 59 How has OPTI/Nexen participated in Cumulative Environmental Management Association (CEMA), Wood Buffalo Environmental Association (WBEA), and Regional Aquatic Monitoring Program (RAMP)?
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Response

The Partners have and continue to be actively involved in CEMA, WBEA and RAMP with Project staff having held senior roles within all of these organizations as well as many of the associated subcommittees.

CEMA	Past Board of Directors, active member
WBEA	Past Board of Directors, active member
RAMP	Past Steering Committee Chair, active member

9.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #55, Pages 60 and 61. Justify the statement that "Air modelling indicates that building downwash is not expected ..." in light of the respective stack release heights and building peak heights outlined in Tables 2A.2.1 and 2D3-3 in the original application and the revised Table 30-1 and Figure 30-1 in the supplemental information volume.
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Response

The statement: "Air modelling indicates that building downwash is not expected and as such these emissions will not impinge on or cause visibility issues for Highway 881"

should be corrected to state “Building downwash was considered in the dispersion modelling and is expected to occur, however, it is not expected to impact visibility on Highway 881.”

10.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #61, Page 66. Confirm that Table 19-1 cited in the response should be Table 61-1.
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Response

Table 19-1 cited in SIR Aug/07 [Response 61](#) should be corrected to read Table 61-1.

11.	<p>Supplemental Information, Part 2, Section 2.3 Air, SIR response #65, Pages 70 to 72.</p> <p>Describe the procedure used to replace the missing values (values not collected due to daily calibrations and other maintenance or down times) in the 2002 Fort McMurray hourly ozone concentrations used in the ozone limiting method to convert maximum predicted NO_x concentrations to NO₂. For the various combinations of air emission scenarios (baseline case, application case and cumulative case) and the two study areas (RSA and LSA), indicate what specific hour and day during 2002 were associated with the maximum predicted 1-hour and 24-hour average NO_x concentrations outlined in Tables 65-1 to 65-3. When annual average ozone concentrations are back calculated based on the annual average NO_x and NO₂ concentrations using the ozone limiting method for the three air emission scenarios and two study areas, five differing annual average ozone concentrations result. None of these back calculated annual average ozone concentrations (ranging from ~ 5 to ~16 ppb) seem to match the annual average 2002 Fort McMurray ozone concentration (~19 ppb) based on the data available from the CASA ambient air quality monitoring data warehouse. Clarify the procedure used.</p>
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Response

The procedure used to replace missing values in the dataset is as follows:

- For single missing hours, the value from the previous hour was used;
- For three or more consecutive missing hours, values from the same time period the previous day were used; and
- For a missing day, data from the previous day were used.

The procedure used to calculate NO₂ concentrations was the Ozone Limited Method (OLM). OLM was used to convert hourly NO_x concentrations to hourly NO₂ concentrations using hourly ozone concentrations observed at Fort McMurray in 2002. Daily and annual average NO₂ concentrations were then calculated using the hourly NO₂ values. As a result of this procedure, back-calculating ozone based on annual NO_x and NO₂ values is unlikely to give a consistent annual average ozone concentration for the various scenarios modelled.

12.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #74, Pages 75 to 76 and SIR response #39a, Pages 48 to 53. a) Provide a discussion related to how the burning of syngas in the Cogen and OTSG's will exactly match the highest allowed CCME NO _x emission limits.
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Response

As stated in the SIR Aug/07 [Response 74](#) referred to above, the CCME guidelines allow for the following:

Natural gas fired cogen units: 140 g of NO_x per GJ of power output and 40 g of NO_x per GJ of heat recovery.

Solid-derived fuels: 500 g/GJ of power output and 120 g/GJ of heat recovery.

Notwithstanding a more generous NO_x allowance for the solid derived fuels, by which the syngas is classified, the Partners have adopted the lower NO_x allowances (i.e. those provided for with natural gas fired cogen) as a DLN syngas combustor research target.

Thus, the tables, which indicate the exact match of the CCME guideline with the expected output from the LLS Project reflect the research target despite the CCME guidelines, which would allow for a much higher NO_x allowance.

12.	b) Discuss the design features of the Cogen and OTSG's which allow for the facilitation of the exact match with the CCME NO _x emission limits?
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Response

As stated in AENV Air Response 12a, the exact match of the CCME guidelines is due to the syngas combustion with Dry Low NO_x (DLN) being a research target. However, the following discussion further explains the design features of the NO_x control.

There are generally two sources of NO_x formation when fuel is burned: one occurs as a result of the oxidation of nitrogen-based chemicals in the fuel ("fuel-bound NO_x"), and the other by oxidation of nitrogen in atmospheric air ("Thermal NO_x"). For LLS, there is no fuel-bound nitrogen in the fuels. Therefore, thermal NO_x is the single most important source of NO_x emission. In gas turbine combustors where fuel is burned at high pressure, thermal NO_x increases as an exponential function of combustion temperature. Reducing combustion temperature is the most effective way of reducing NO_x emissions.

Various DLN technologies have been used successfully for natural gas firing in the turbine industry. LLS will implement GE's DLN technology. The GE DLN technology is based upon pre-mixing the fuel with air to a leaner mixture and spreading the combustion in stages so as to reduce the combustion temperature. For natural gas firing, this DLN technology has been proven to reduce NO_x from 150 ppm unabated to 9-15 ppm.

Syngas is a mixture of hydrogen and carbon monoxide, and hydrogen burns with high flame temperature. Therefore, when the turbine burns syngas, NO_x emissions will be significantly higher. Unabated, the NO_x emission will be in the order of 500 ppm. Applying DLN to syngas, the biggest challenge is to pre-mix the hydrogen fuel with air. Hydrogen is a highly reactive chemical and has the potential to cause spontaneous and uncontrolled combustion. The range of pre-mixing and combustion-staging is thus considerably restricted. The DLN combustor the Partners and GE are developing is expected to release significantly higher NO_x than natural gas when burning syngas. As a minimum, the Partners aim to operate the turbine and HRSG in a range that will, as a cogen unit, comply with the CCME Guidelines.

When the LLS turbine co-fires natural gas and syngas, NO_x emission is expected to lie between that of natural gas and syngas, in direct proportion to the hydrogen content in the mixed fuel.

The HRSG duct burner deploys a combination of lower combustion temperature and longer residence time to lower the emissions of NO_x. Lower combustion temperature reduces oxidation of nitrogen and longer residence time reverses the NO_x back to elemental nitrogen and oxygen. To lower the combustion temperature, the duct burner assembly is made of vast arrays of small burners evenly distributed across the duct burner plane so that each burner produces a lower temperature flame than would be for a larger burner. The duct burners are also equipped with diffusers along both sides of the burner nozzles so as to impart a swirl which recirculates the hot burning mixture in the combustion zone to increase residence time. The HRSG duct burner is estimated to produce 40 - 60 g of NO_x per GJ of duct firing (HHV) when burning the variety of natural gas, mixed fuel gas, produced gas and syngas.

13.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #39a, Pages 48 to 53. a) Provide an explanation for why the stack outlet temperatures for the Cogen/HRSG unit burning syngas cited in Table 39-2 differ from the exit temperature used in the dispersion modelling as delineated in Table 2A.2-1 in the original application. b) Which exit temperature is correct and which one was used in the dispersion modelling?
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Response

The exit temperature that was used in the dispersion modelling of the HRSG stack was 160°C based on the original facility design. A review of the facility design led to an increase in the boiler feed water temperature, which in turn led to an increase in the HRSG stack temperature to between 185 and 187°C.

The correct temperature of the stack outlets of the Cogen/HRSG ranges from 185 to 187°C. The temperature used in modelling was 160°C. It is expected that this difference in exit temperature will have a very minor and localized impact on the predicted concentrations. Furthermore, a lower exit temperature will result in less plume rise and

thus less dispersion. Therefore, modelling with the lower stack exit temperature is more conservative.

14.	Supplemental Information, Part 2, Section 2.3 Air, SIR response 39c, Page 53. Indicate where the supporting information cited as EUB Response 4a can be found.
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Response

Refer to SIR Aug/07 [Response 39a](#) for the supporting information incorrectly cited as SIR Aug/07 EUB Response 4a.

15.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #75, Figures 75-7 (Page 86), 75-15 (Page 94) and 75-23 (Page 102) In each scenario (baseline, application and cumulative) maximum 24-hour PM _{2.5} concentrations for the local study area (LSA) are located on the extreme northern edge of the LSA boundary and are intuitively influenced by the emission sources located outside of the LSA. Justify the LSA boundary size as 100 km by 100 km instead of 25 km by 25 km and comment on the appropriateness for illustrating and discussing impacts of LLS operation on the local area. Refer to Supplemental Information Volume, Part 2, Section 2.3 Air, SIR response #100, Page 130 where OPTI/Nexen states, " <i>As the stack heights of the LLS Project are less than 50 m high and the terrain is hilly, the maximum predicted impacts associated with the LLS Project occur within 25 km.</i> "
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Response

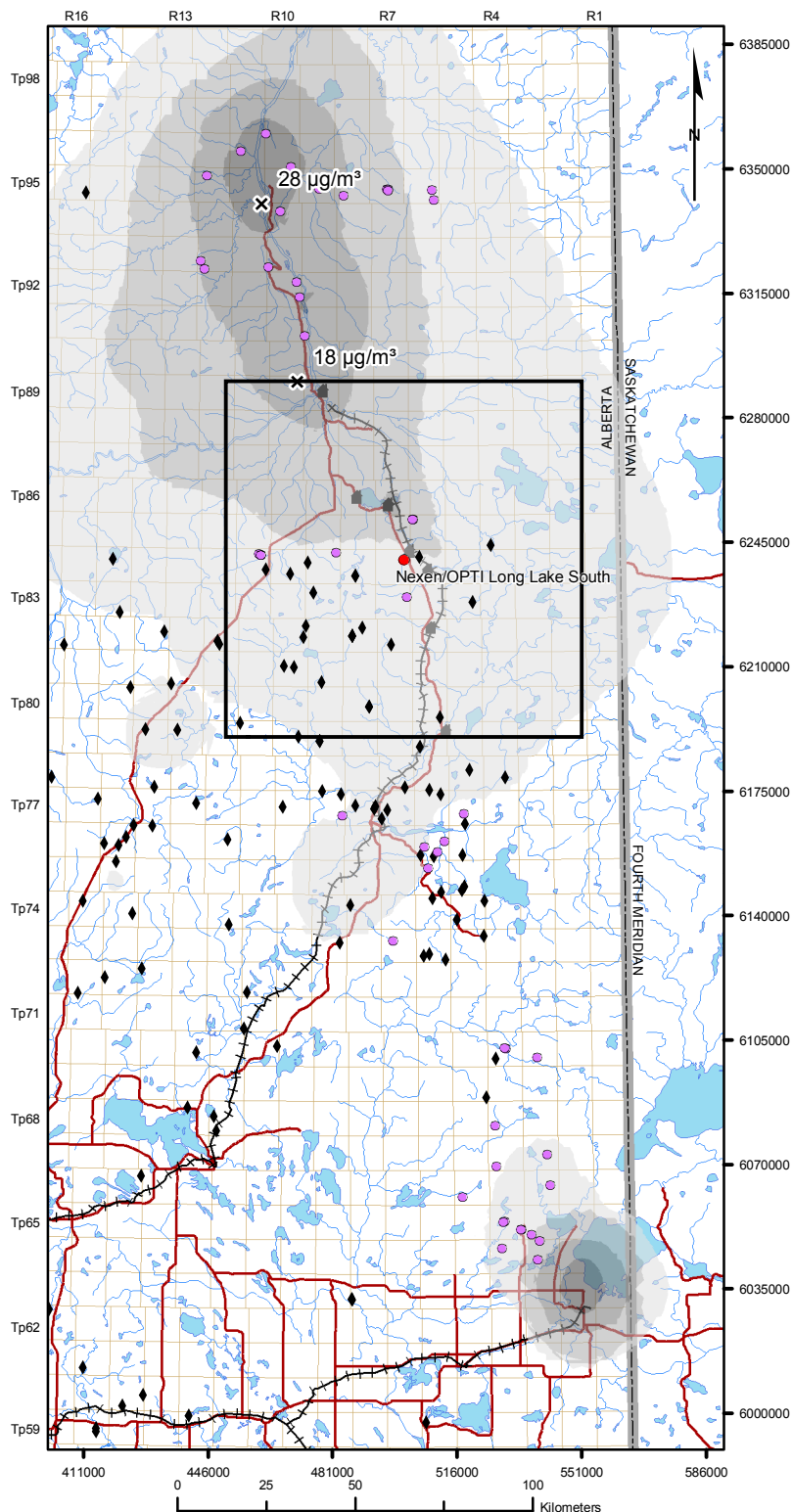
Although the potential air quality impacts associated with the LLS Project occur within 25 km, overlapping impacts are expected with other industrial emission sources in the area, primarily within 100 km. These other sources include: Petro-Canada Meadow Creek, JACOS Hangingstone, CPC Surmont, and many gas plants. If the LSA had been defined as only 25 km by 25 km then many of these sources would not have been included (see Figure 2A.1-1 in Volume 2, Section 2, Appendix 2A). A 100 km by 100 km area was required to include all of these sources in the LSA.

16.	<p>Supplemental Information, Part 2, Section 2.3 Air, SIR response #75, Figures 75-7 (Page 86) and 75-23 (Page 102)</p> <p>When comparing the baseline, application and cumulative 24-hour $PM_{2.5}$ concentration scenarios two anomalies occur:</p> <ol style="list-style-type: none">I. The first is to the NE of the LLS site where the baseline scenario indicates a contour range of 8-15 ug/m^3. On the application scenario the contour area decreases in size at that location. On the cumulative scenario the contour decreases further to indicate an area of 0 ug/m^3.II. The second is to the S/SW of the LLS site where the baseline scenario indicates a contour range of 0 ug/m^3. On the application scenario the 0 ug/m^3 contour area increases in size at that location implying a decrease in $PM_{2.5}$ concentrations at that location. Little change is noted on the cumulative scenario implying another possible decrease in $PM_{2.5}$ concentrations. <p>Intuitively one would expect the concentrations to increase as sources are added to the dispersion model. Explain these differences.</p>
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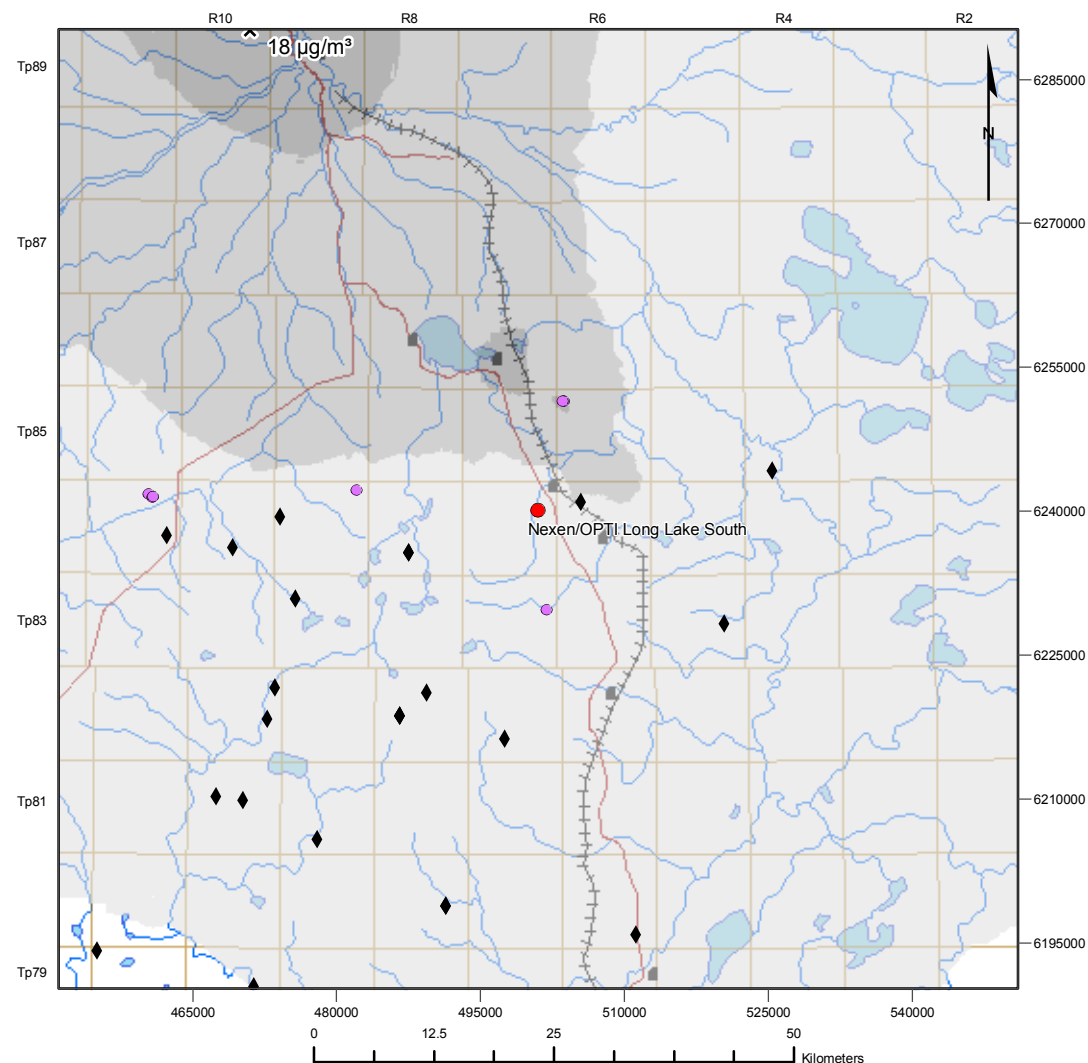
Response

The mathematical computation used to interpolate the data used to create Figures 75-7, 75-15, and 75-23 (SIR Aug/07 [AENV Response 75](#)) was incorrect and not consistent with other figures used in the report. These figures have been corrected (as Figures 16-1, 16-2 and 16-3 respectively) and there are no longer decreases in the contours. The data used in the HHRA are discrete receptors, do not rely on the mathematical interpolations, and as such have not changed.

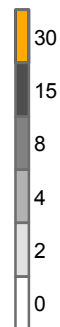
Regional Study Area



Local Study Area



Concentration (µg/m³)



Emission	
Source	PM _{2.5} (t/d)
Baseline RSA Emissions	29
Baseline LSA Emissions	2.4

Concentration	
Area	PM _{2.5} (µg/m³)
98 th Percentile RSA	28
98 th Percentile LSA	18
Guideline	30

Legend

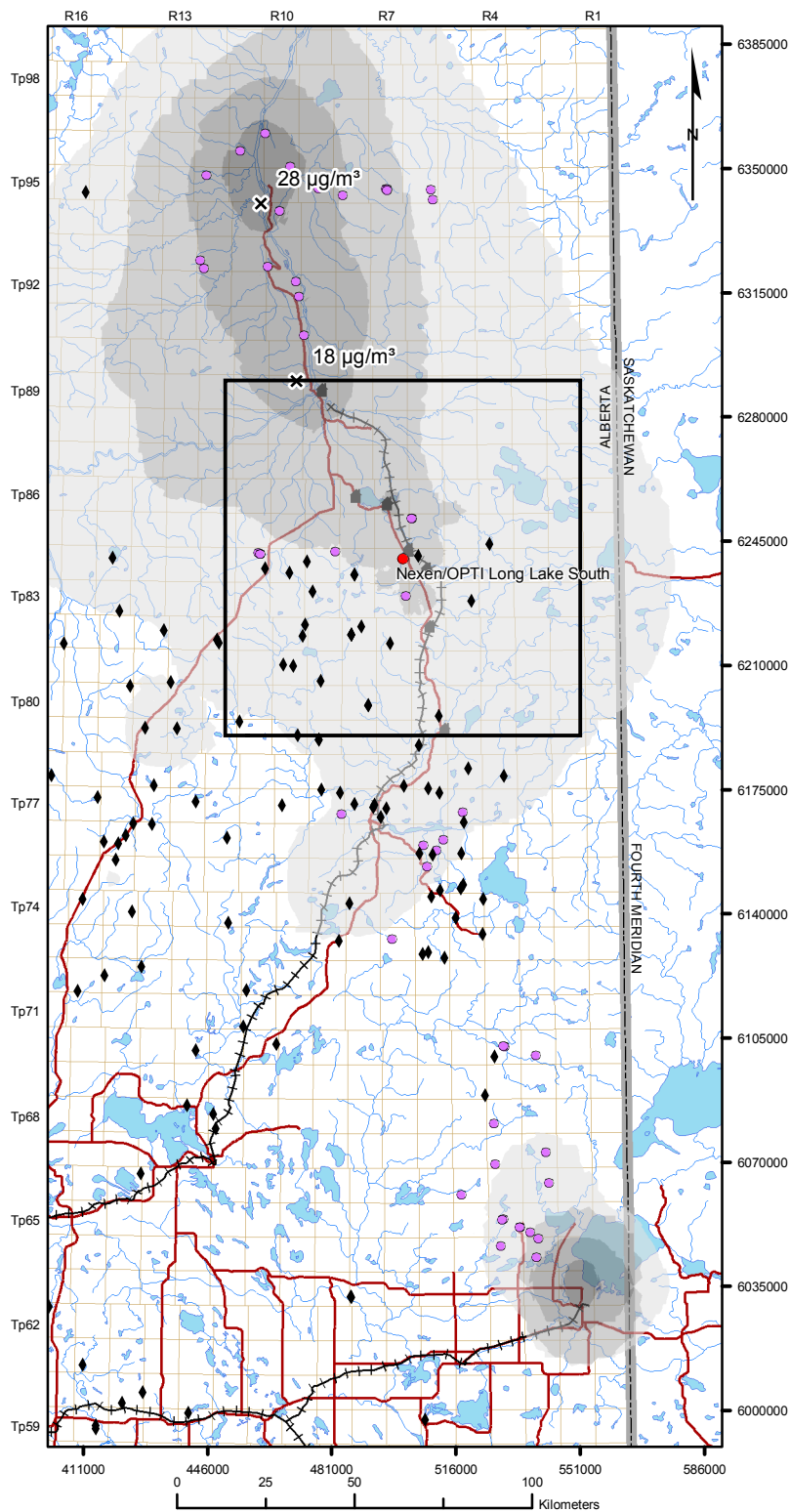
- Roads
- Railroad
- Lakes
- Waterways
- Maximum Point of Impingement
- Baseline Sources
- Long Lake South
- Gas Plants

PROJECT		Nexen/OPTI Long Lake South Project	
TITLE		Baseline Scenario 98 th Percentile 24-h PM _{2.5} Concentration	
DRAWN	NS	22/06/2007	SIR Figure 16-1
CHECKED	SBB	22/06/2007	
REVIEWED	KEP	24/06/2007	
PROJECT	W06-1092A		

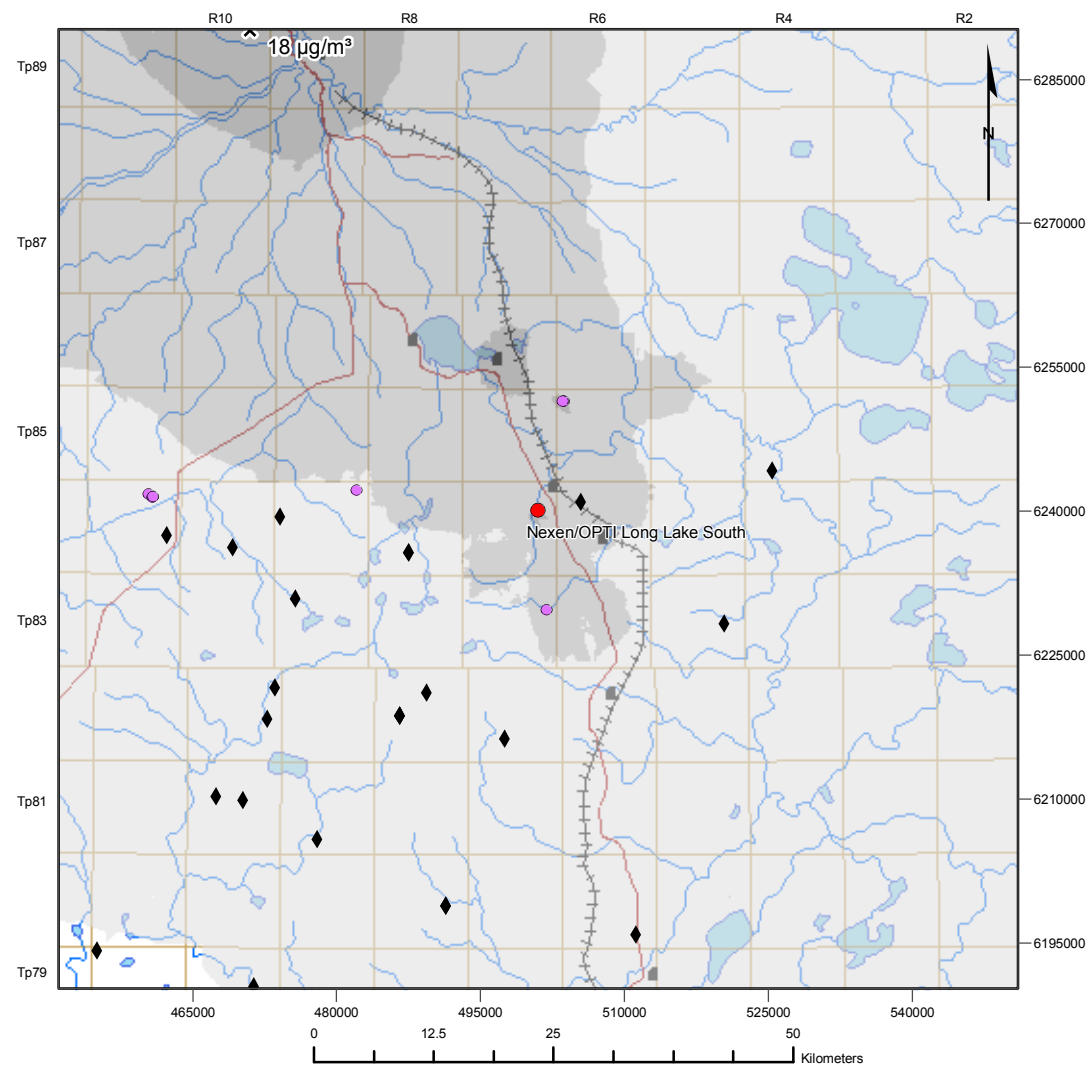


UTM Zone 12 NAD83

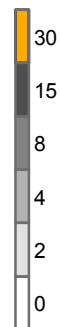
Regional Study Area



Local Study Area



Concentration (µg/m³)



Emission	
Operator	PM _{2.5} (t/d)
Application RSA Emissions	30
Application LSA Emissions	3.3

Concentration	
Area	PM _{2.5} (µg/m³)
98 th Percentile RSA	28
98 th Percentile LSA	18
Guideline	30

Legend

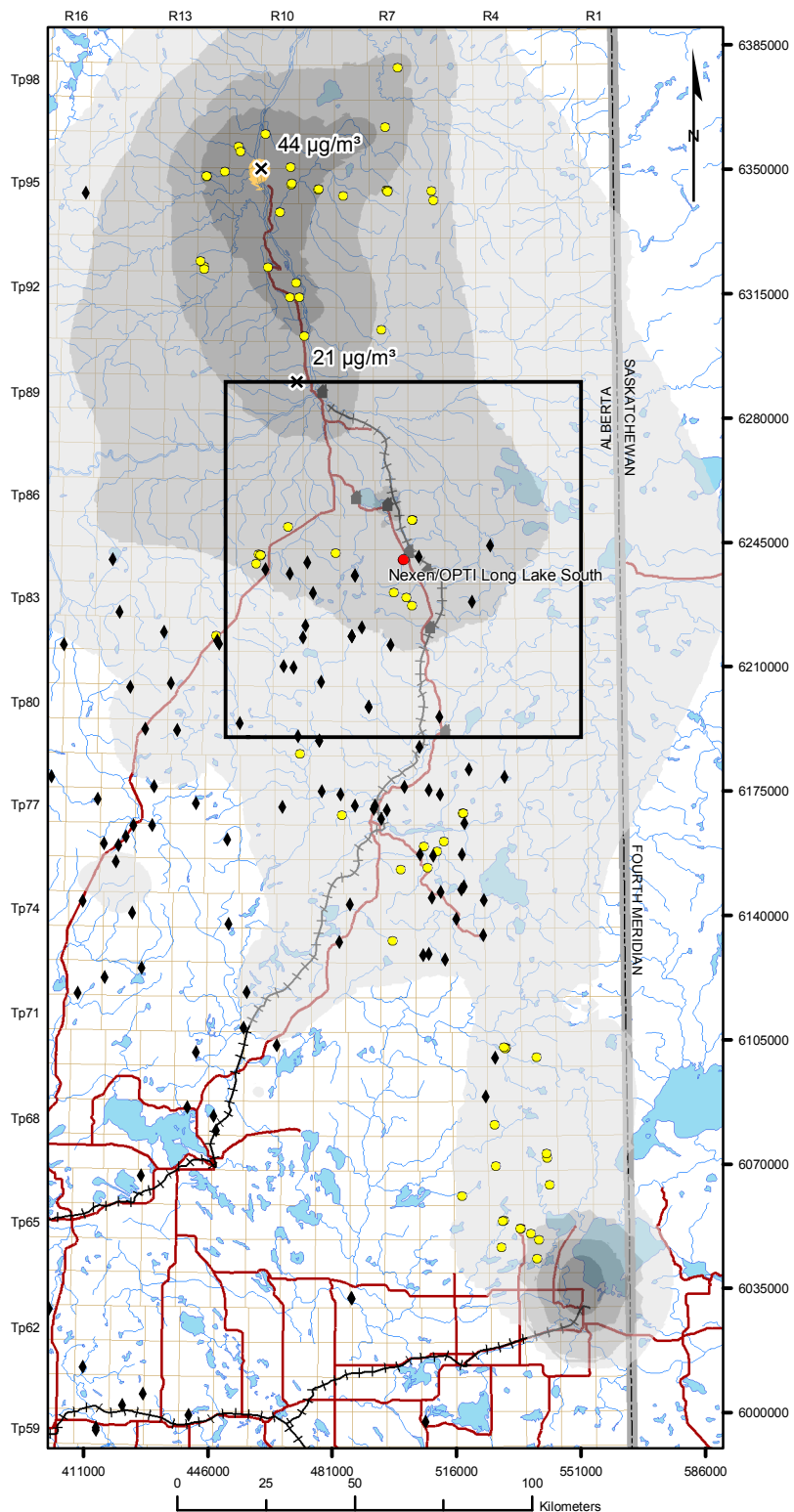
- Roads
- Railroad
- Lakes
- Waterways
- Maximum Point of Impingement
- Application Sources
- Long Lake South
- Gas Plants

PROJECT				Nexen/OPTI Long Lake South Project	
TITLE					
Application Scenario 98 th Percentile 24-h PM _{2.5} Concentration					
DRAWN	NS	22/06/2007	SIR Figure 16-2		
CHECKED	SBB	22/06/2007			
REVIEWED	KEP	24/06/2007			
PROJECT	W06-1092A				

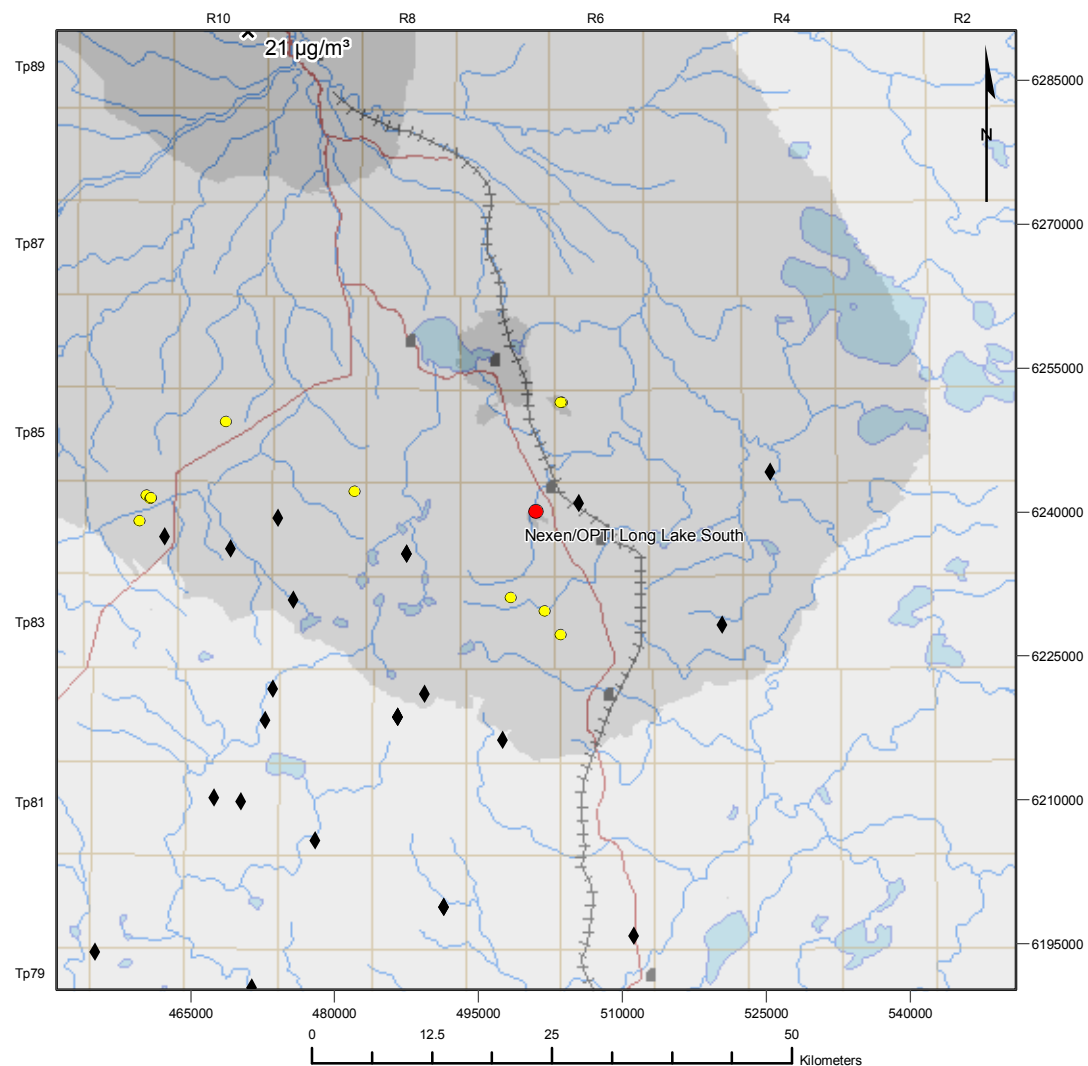
Focus Area

UTM Zone 12 NAD83

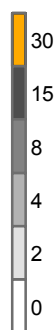
Regional Study Area



Local Study Area



Concentration
($\mu\text{g}/\text{m}^3$)




Emission	
Operator	PM _{2.5} (t/d)
Cumulative RSA Emissions	38
Cumulative LSA Emissions	4.2

Concentration	
Area	PM _{2.5} ($\mu\text{g}/\text{m}^3$)
98 th Percentile RSA	44
98 th Percentile LSA	21
Guideline	30

Legend

- Roads
- Railroad
- Lakes
- Waterways
- Maximum Point of Impingement
- Cumulative Sources
- Long Lake South
- Gas Plants

PROJECT				Nexen/OPTI Long Lake South Project
TITLE				
Cumulative Scenario 98 th Percentile 24-h PM _{2.5} Concentration				
DRAWN	NS	22/06/2007	SIR Figure 16-3	
CHECKED	SBB	22/06/2007		
REVIEWED	KEP	22/06/2007		
PROJECT	W06-1092A			



UTM Zone 12 NAD83

17.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #79, Pages 105. A 0.8% of 1-hr exceedance is cited. This value is cited as 0.7% in the original document Volume 2 Table 2.9.5. Clarify this data discrepancy.
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Response

As is written in Volume 2, Section 2, Table 2.9-5, the 1-hr exceedance value in SIR Aug/07 [AENV Response 79](#) should be corrected to read 0.7%.

18.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #80, Page 109. Confirm that the substance names included in Figure 80-1 and Figure 80-2 titles should be PM _{2.5} .
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Response

The substance names included in SIR Aug/07 [AENV Response 80](#), [Figures 80-1](#) and [80-2](#) should be PM_{2.5}.

19.	Supplemental Information, Part 2, Section 2.3 Air, SIR response #91, Page 127 OPTI/Nexen has indicated that during upset scenario #2 the flare stream will be 39.27% C5+ and in vapour form after the knock out tank. a) What are the temperature and pressure conditions utilized in the modelling to arrive at this vapour phase flow.
-----	--

Response

The temperature and pressure conditions utilized in the modelling to arrive at this vapour phase flow are as follows:

- Temperature: 100°C
- Pressure: 96 kPa abs

19.	b) What measures will be implemented to prevent liquid carryover into the flare stream?
-----	---

Response

The following safeguards have been included in the design to prevent liquid carryover into the flare system:

- The flare knockout drum will be sized to meet the EUB Directive 060 requirements of 300 micron diameter and larger liquid particle removal. The design will be based on the lowest density hydrocarbon liquid that could enter the vessel;
- The flare line from the flare knockout drum to the flare stack will be sloped back to the flare knockout drum to ensure no liquids can accumulate in the line;
- The flare knockout drum will also be sized to ensure that it has sufficient holding capacity so that the High-High Liquid Level is not reached;
- To ensure the High-High Liquid Level is not reached, there will be 2 x 100% pumps that will turn on automatically and lower the level in the flare knockout drum. A separate guided wave transmitter will be used to turn the pumps on and off;
- If the pumps fail to lower the level in the drum a High Liquid Level audible alarm will sound warning operations that the level in the flare knockout drum is increasing; and
- For a final backup safety feature to ensure liquids are not carried over there are two magnetostrictive level transmitters on separate bridles that will trigger a plant shutdown when they reach their High-High Liquid Level setpoint.

20.	<p>Supplemental Information, Part 2, Section 2.3 Air, SIR response #93, Page 127</p> <p>OPTI/Nexen states, <i>"The program will follow the general guidelines outlined in the CCME Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks and CAPP's Best Management Practice for Management of Fugitive Emissions from Upstream Oil and Gas Facilities."</i></p> <p>Provide a specific list of the guidelines OPTI/Nexen will follow from these documents.</p>
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Response

The "Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks" (CCME 1993) was originally written to target fugitive VOC emissions from chemical plants and refineries. The CAPP "Best Management Practice for Management of Fugitive Emissions from Upstream Oil and Gas Facilities" was published in January 2007.

Since there is no equivalent document for oil sands facilities (besides the CAPP BMP) it is appropriate to use the CCME code of practice as a guide for the development of a site-specific LDAR program.

As per the CCME and CAPP's the Partners are committed to:

- Developing a plan for fugitive VOC emissions reductions within six months of operation (CCME, Section 3.1.1);
- Implementing a Leak Detection and Repair (LDAR) program that will be applied to pipe sizes greater than or equal to 1.875 cm nominal diameter (CCME Section 2.1.5) for all components in hydrocarbon service;
- Adopting a leak definition of 10,000 ppm (CAPP, Section 3.2.2), or visible emissions when screening using an optical infrared method;
- Screening pressure relief valves that have vented to the atmosphere for leaks within 24 hours of the event (CCME, Section 3.3.1);
- Conducting annual leak surveys an inventory of components and their leak status (CCME, Section 4.2.1);
- Repairing leaking components as soon as practicable (CAPP, Section 3.2.2);
- Maintaining total leak frequencies at no more than 2% and a leak frequency of pump/compressor seals that will be less than 10% of the total number of pumps/compressors or three pumps/compressors, whichever is greater (CCME, Section 3.3.4);
- Repairing a leak within 45 days of its detection if it is determined to pose a health, safety, or environmental concern (CAPP Section 3.2.9); and
- Targeting, assessing and monitoring leak-prone equipment appropriately (CAPP Appendix 1).

References:

CCME. 1993. Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks. October 1993

CAPP. 2007. Best Management Practice for Management of Fugitive Emissions from Upstream Oil and Gas Facilities. January 2007.

21.	<p>Supplemental Information, Part 2, Section 2.3 Air, SIR response #100, Page 130</p> <p>OPTI/Nexen states, <i>“However, given the size of the RSA (190 km x 400 km), this precise spacing could not be applied for the full domain, as the number of receptors would be extremely high (46,200 receptors), which the model cannot handle.”</i></p> <p>The Alberta Environment Air Quality Model Guideline specifies, “It is best to run the model twice, first with the coarse grid to determine the areas of impact, and then with the finer grid in the vicinity of the impacted area to obtain the maximums.” Provide reasoning for not running the model with a finer grid for the areas where maximum concentrations occur.</p>
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Response

The approach taken was deemed to be sufficient based on professional judgement and previous experience with conducting dispersion modelling for large study areas in northeast Alberta. Consequently, the Partners are satisfied that the receptor spacing approach taken adequately identifies the maximum predicted concentrations associated with the LLS Project.

The Alberta Environment Air Quality Model Guideline states that 20 m receptor spacing should be run in the general area of maximum impact. This suggested approach was not taken, as the maximum predicted concentrations associated with the LLS Project occur within 250 m from the facility. At that distance from the Project, the receptor spacing is 50 m, which is deemed sufficient.

A finer grid (20 m) would be appropriate if the maximum occurred in an area of the modelling grid with coarser spacing (500 m) as the maximum concentration might then have been captured.

AENV Water

1.	<p>Supplemental Information, Part 1, Update Section 1.5, Page 7.</p> <ul style="list-style-type: none">a) Clarify the number and location of any new changes to or additional watercourse / wetland crossings arising from the separation of the power right-of-way and pipeline right-of-way in the LLS Project Update.b) Describe the additional provincial and federal approvals that will be required for the crossings indicated in 1a. above (e.g. Provincial - <i>Water Act</i> / <i>Pipeline Act</i> or Federal - <i>Fisheries Act</i> / <i>Navigable Waters Protection Act</i>).c) Describe the proponent's plan to obtain the approvals indicated in 1b. above.d) Described the results of fish habitat assessments or studies that have been conducted in the areas of the new pipeline right-of-way watercourse crossings and/or wetland crossings (indicated in 1a. above) including, but not limited to, the new Robert Creek crossing and areas where any well pads or other facilities have been re-located in the LLS Project Update.e) Describe the additional provincial and federal approvals that will be required for the crossings indicated in 1d. above (e.g. Provincial - <i>Water Act</i> / <i>Pipeline Act</i> or Federal - <i>Fisheries Act</i> / <i>Navigable Waters Protection Act</i>)f) Describe the proponents plan to obtain the approvals indicated in 1e. above.
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Response

The discrepancy between the number of crossings identified in the EIA and the Project Update occurred as more information was made available. The location and number of watercourse crossing related to the LLS project will be identified when the route selection is finalized. Once watercourse crossings have been identified, appropriate approvals and notifications will be submitted to the appropriate regulators prior to the commencement of construction activities. A site visit to each crossing location will be conducted by a Qualified Aquatic Environmental Specialist (QAES) prior to submission of any applications. Submission for approvals will be made under the following acts for approval where applicable:

- *Fisheries Act* (Department of Fisheries and Oceans (DFO));
- *Navigable Waters Protection Act* (Transport Canada); and
- *Water Act* (AENV).

The information provided for approvals and notifications will be compiled into a single report and will include the following details:

- Channel characteristics
 - Flow levels
 - Channel width, pattern, and confinement
 - Riparian vegetation and bank stability
 - Substrate composition
- Fish and fish habitat potential
 - Habitat cover present
- Historic fisheries information
 - Search of existing government databases
- Information on restricted activity periods
- Recommended crossing methods and techniques and appropriate contingencies
- Recommended mitigation measures
- Photo documentation of existing site characteristics

2.	Supplemental Information, Part 1, Section 1.8.1, Page 13
	Potable water demand for the LLS project excludes potable water for the construction camp.
	a) Confirm the location of the camp.

Response

The current plan for housing the LLS construction workforce is to utilize the camp located at the Long Lake Project.

2.	b) Provide an estimate of potable water demand for the camp including the duration of the demand.
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Response

Up to 2,200 workers are anticipated for the construction of each phase of the LLS Project. This corresponds to an approximate potable water demand of 440 m³/d. This water demand will be met with the existing/licensed Long Lake potable water infrastructure, which includes a Quaternary source well located at 13-31-085-06 W4 and a reverse osmosis treatment system.

3.	<p>Supplemental Information, Part 1, Update Section 1.8.1, Page 14.</p> <ul style="list-style-type: none">a) Describe the proponent's back-up plan for obtaining fresh water for start-up and commissioning purposes, as described in the LLS Project Update, if fresh water is not available from the Long Lake Project as the proponent has planned.b) Describe the proponent's plan for obtaining fresh water for any on-going operations, maintenance, repairs, flushing or other uses that may be required for the project facilities during the lifetime of the project.c) Describe the regulatory approvals, licenses and proponent's water management plan required to accommodate the proponent's back-up plans described in a. and b. above.
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Response

A separate fresh water infrastructure will not be constructed for the start-up and commissioning of LLS, therefore there is no back-up plan. As described in [AENV Water Response 7](#), the Partners are planning to temporarily divert the required fresh water from the existing/licensed fresh water allocated to the Long Lake project, and supplement, if required, by a Temporary Diversion License under the Water Act. For the LLS start-up, if the request for additional fresh water for the Long Lake upgraders (total of approximately 14,000 m³/d) is denied, the Partners would use the currently approved total of 9,000 m³/d of fresh water to start-up the LLS project.

Fresh water will not be required for any on-going operations, maintenance, repairs, flushing, etc. since LP condensate produced at the LLS facilities will be used as utility water for the LLS project.

4.	<p>Supplemental Information, Part 1, Update Section 1.8, Page 14</p> <p>It is noted that 40,000 mg/L TDS "represents the upper limit that can be handled in the LLS process without exceeding the equipment specifications." The McMurray Formation east of the bitumen edge is described as the selected aquifer for the saline make-up water in the project update. This aquifer has an upper TDS limit of 45,000 mg/L (Table 1-6, Page 16) while the previously-selected Clearwater B aquifer has an upper TDS limit of 35,000 mg/L.</p> <ul style="list-style-type: none">a) Discuss the implications on non-saline water usage should this aquifer have a TDS of 45,000 mg/L.
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Response

A total of nine source wells have been drilled in the McMurray Formation east of the bitumen edge in Townships 84-85 and Ranges 3-6 W4M. Refer to Table 4-1 (below) for specifics regarding location, type and TDS concentrations of wells in the McMurray Formation. Lower salinities were encountered to the east of the area explored. TDS concentrations in excess of 40,000 mg/L were noted in two wells located just east of the bitumen edge (Range 6); however, these two wells are not located within the proposed area for the development of the McMurray well field. Within the proposed area for the development of the McMurray well field, the average and maximum TDS concentrations were 34,000 mg/L and 41,000 mg/L, respectively; these values are within the equipment specifications.

Table 4-1 Location, Type & TDS Concentrations of Wells in the McMurray Formation

Operator	Location	Well Type	TDS (mg/L)	Comment
Suncor	07-30-084-03-W4M	Disposal	22,000	
Nexen/OPTI	06-12-084-04-W4M	Source	27,000	
Nexen/OPTI	11-15-084-04-W4M	Source	34,900	
Nexen/OPTI	03-14-084-05-W4M	Source	41,300	
Nexen/OPTI	10-36-084-06-W4M	Source	54,400	Outside of the proposed McMurray water source development area
Nexen/OPTI	10-13-085-05-W4M	Source	38,200	
Nexen/OPTI	11-20-085-05-W4M	Source	37,000	
Nexen/OPTI	15-28-085-05-W4M	Source	40,200	
Nexen/OPTI	10-26-085-06-W4M	Disposal	54,800	Outside of the proposed McMurray water source development area
Within proposed McMurray water source development area:			minimum 22,000	
			maximum 41,300	
			median 34,371	

4.	b) Explain how the updated project water balance has accounted for the change in aquifer selection.
----	---

Response

The LLS Project water balance has been designed for a saline groundwater TDS of 40,000 mg/L. The water balance has not been affected by the aquifer selection; rather, groundwater exploration has focused on finding aquifers with TDS less than 40,000 mg/L.

5.	<p>Supplemental Information, Part 1, Update Section 1.8, Page 14</p> <p>Bitumen production for the Long Lake Project is given as 33,390 m³/d for the SAGD and 22,260 m³/d for the upgrader.</p> <p>a) Provide information on what will be done with the excess bitumen production at full operations.</p>
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Response

The LLS Phase 2 bitumen production has not been designated to an upgrader in this application. The Partners will explore alternatives for upgrading this production. Future upgrading facilities will be dealt with in either an amendment or a separate application to be submitted at a later date.

5.	<p>b) Confirm that there will be no additional water resources required for the processing of this excess capacity.</p>
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Response

As described in the application, no additional water is required for processing the bitumen within the SAGD facility. If the Partners choose to expand the upgrading capacity, additional water will be required. However, the LLS Phase 2 bitumen production has not been designated to an upgrader in this application. Future upgrading facilities will be dealt with in either an amendment or a separate application to be submitted at a later date.

6.	<p>Supplemental Information, Part 1, Update Section 1.8, Page 14</p> <p>In this section of the LLS Update, it is indicated that the water use strategy has been updated, and that the LLS Project is using only saline groundwater for all industrial uses, except for commissioning and start-up purposes. In the proponent's response to Supplementary Information Request No. 116, it is indicated that surface water (fresh water) will be drawn from regional lakes for construction, dust control and drilling for approximately 4 years.</p> <ul style="list-style-type: none">a) Explain this inconsistency between Section 1.8 of the LLS Project update, any other part of the proponent's project submissions to Alberta Environment to-date, and the proponent's response to Supplementary Information Request No. 116.b) Describe the detailed plan for transporting this surface water to the end-use sites, including transportation method and associated infrastructure required (e.g. truck and road / water intake and pipeline) and any provincial and federal regulatory approvals required.
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Response

The SIR Aug/07 [Project Update Section 1.8](#) refers to commissioning and start-up while SIR Aug/07 [AENV Response 116](#) refers to construction.

Water withdrawal from the surface water sources will be through the use of tandem axel water trucks during the drilling aspect of the Project. These trucks are equipped with pumps and tanks capable of hauling up to 16 m³ of water at a time. In the winter, the trucks will access the water sources on ice roads. In the summer, trucks will access surface water sources by all weather access roads.

Water withdrawals require a Temporary Water Diversion License as per the Alberta Water Act. Withdrawals must follow the DFO "Freshwater Intake End-of-Pipe Fish Screen Guidelines."

With regard to water use and transportation during construction efforts, water will be obtained from surface water ponding that is created during civil activities at the CPF. As the soils are stripped and removed, surface depressions are created that catch water during precipitation events. This water is typically collected in temporary catchment areas on the periphery of the site. These catchments hold water prior to being discharged to the environment and are also the source for construction dust control and soil compaction efforts. On occasion this water may be used for SAGD drilling instead of local surface waterbodies.

With the use of trucks to transport water to and from the surface water sites the only infrastructure required is the truck itself which supports a pump and intake hose along with proper screening. No pipelining is required for the above mentioned efforts to occur.

7.	<p>Supplemental Information, Part 2, Section 1.5 Water Use, SIR Response #20, Page 16</p> <p>A <i>Water Act</i> Application (File No. 00237030) was made to Alberta Environment (AENV) under Sections 37(1) and 50(1) of the <i>Water Act</i> (WA) for the diversion and use of groundwater and plant site surface water management. The diversion and use of non-saline groundwater includes 140,890 cubic metres of groundwater per annum for the administration buildings.</p> <p>Table 20-1 (Supplemental Information, Part 2, Following Page 16) presents an overall water balance forecast for the Long Lake Lease. A peak freshwater demand of 26,347 m³/cd is identified for Month 31 with a steady state requirement of 13,244 m³/cd in Year 2025.</p> <ol style="list-style-type: none"> Table 3.2-1 (Page 130) in Volume 1 of the Application gave the expected case and high case fresh water demand as 10,275 m³/d and 14,299 m³/d, respectively. This information was superseded in the Supplemental Information. Explain why the updated steady state and peak water demands shown in Table 20-1 (and noted above) are so much higher than the initial values from the Application. Provide details on where the additional freshwater supply will be obtained, and evidence that the source will meet demand; and Provide a table showing the quantity of freshwater that is being allocated to the various components of Long Lake Project (i.e. Long Lake SAGD, Upgrader and LLS SAGD) over the life of the project (include all phases).
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Response

[EUB Response 9, Table 9-1](#) (revised SIR Aug/07 [EUB Response 20, Table 20-1](#)) depicts the predicted fresh water demands for the two projects combined: the Long Lake Project and the LLS Project. This table has been revised with explanations for the changes outlined in EUB Response 9.

Long Lake Project

- The Long Lake Project (1 SAGD + 2 Upgraders) has received scheme approval based on a fresh water demand of 9,000 m³/d. The Long Lake fresh water requirements are primarily required for the operation of the Long Lake upgraders. Some fresh water is also used for utilities and for the pilot plant boiler. Fresh water withdrawals of 7,220 m³/d have already been licensed under the Water Act and an application has been submitted to secure the balance of the 9,000 m³/d.
- Since the approval of the Long Lake Project in 2003, detailed engineering studies have been completed and indicate an increase in the Long Lake upgrader fresh water demand from 9,000 m³/d to approximately 14,000 m³/d. A Long Lake Project update will be submitted to the regulators under separate cover to present the increased water demand at Long Lake, the Partners' plans to source this additional fresh water, and an evaluation of associated potential impacts.

LLS Project

- The LLS Project does not require fresh water for steam or utilities during steady-state operations. Water make-up requirements will be supplied from saline source wells.
- The LLS Project will require some fresh water for start-up (average of 5,300 m³/d for 12 months). The Partners are planning to temporarily divert the required fresh water from the licensed fresh water allocated to the Long Lake Project, and supplement, if required, with a Temporary Diversion License under the Water Act. For the LLS start-up, if the request for additional fresh water for the Long Lake upgraders (total of approximately 14,000 m³/d) is denied, the Partners would use the currently approved total of 9,000 m³/d of fresh water to start-up the LLS project.
- The LLS Project requires up to 390 m³/d of potable water. A Water Act groundwater diversion application will be submitted once the source well(s) has been drilled and tested.

The impacts related to the temporary use of fresh water for start-up and the small withdrawals for potable water were not submitted in the LLS EIA because they will be non-detectable for the following reasons.

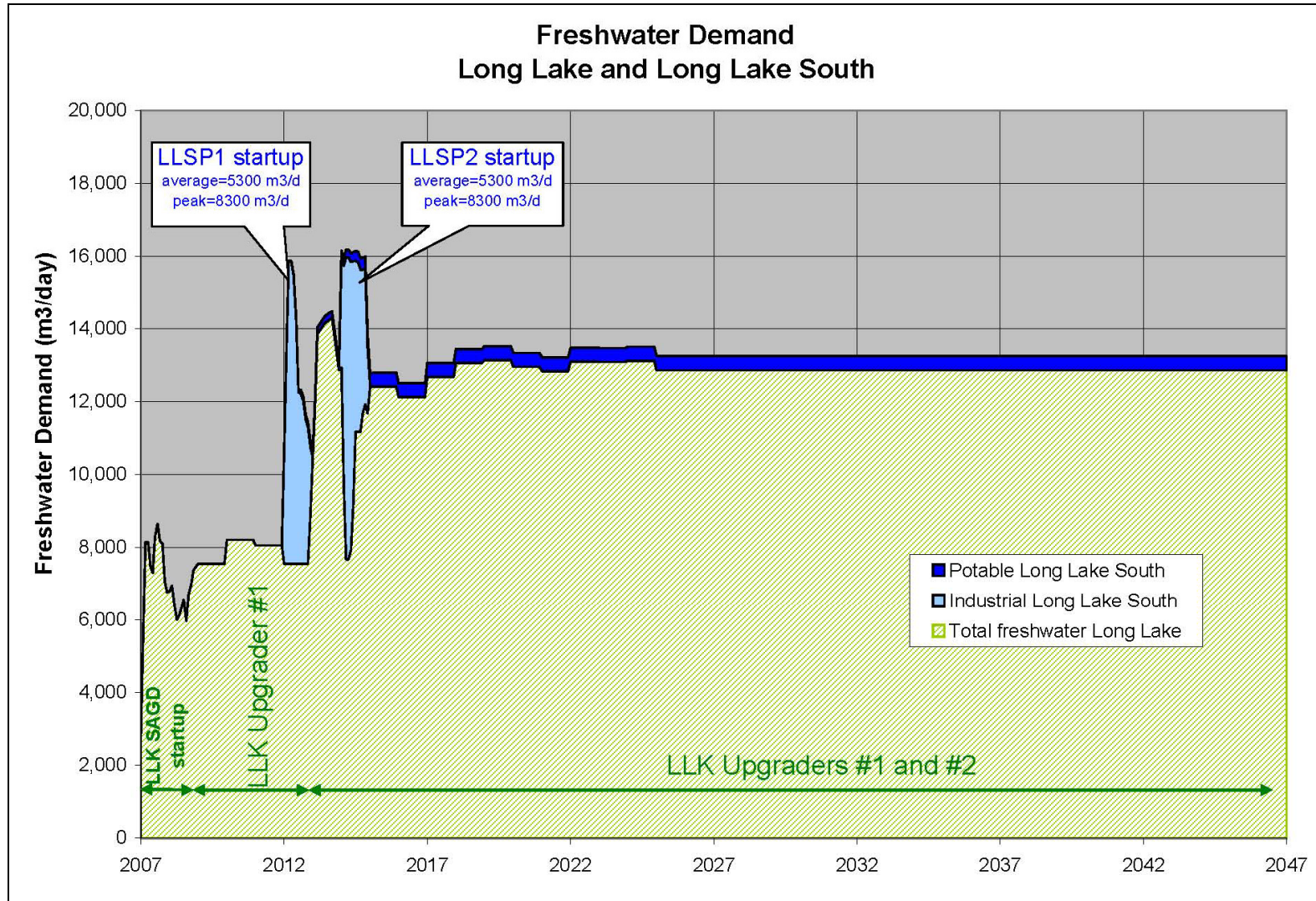
LLS potable source wells

Potable water (390 m³/d) will be sourced from a local sand and gravel aquifer (Quaternary formations) for the LLS Project. This shallow aquifer is localized and, as such, drawdowns due to the LLS source well(s) will be contained within the local extent of this aquifer. There are no existing users for this aquifer in the LLS area. There will be no cumulative effects with Quaternary source wells in Anzac or at the Long Lake or the CPC Surmont projects because of the local nature of the aquifer. Induced drawdowns into the underlying Lower Grand Rapids Aquifer will be non-detectable because of the shales contained in the Upper Grand Rapids; therefore, the LLS potable source wells will not impact other users of the Lower Grand Rapids Aquifer.

LLS use of fresh water for start-up

As shown in Figure 7-1, an average of 5,300 m³/d of fresh water is required for 12 months during start-up of LLS Phase 1 and LLS Phase 2 (peak of 8,300 m³/d), while the overall fresh water for the combined LLS and Long Lake Projects is approximately 14,000 m³/d at steady-state. As illustrated in Figure 7-1, the fresh water required for the LLS start-up is equivalent to extending the fresh water requirements for Long Lake by one year (41 years instead of 40 years). The cumulative impacts due to the LLS and Long Lake projects will be nearly identical in magnitude and in duration to the impacts due to the Long Lake Project. The cumulative impacts due to the Long Lake Project have already been studied in the 2003 Long Lake EIA for a total fresh water demand of 9,000 m³/d. The cumulative impacts due to the Long Lake Project for the increased fresh water demand (total of approximately 14,000 m³/d) will be presented under separate cover in a project update for the Long Lake Project. This Long Lake Project update will also discuss monitoring and possible mitigation measures if required.

Figure 7-1 Fresh Water Demand Long Lake and LLS



8.	<p>Supplemental Information, Part 2, Section 2.5 Wastewater, SIR Response #103, Page 131 (TOR 3.4.3)</p> <p>Provide a Wastewater Management Plan to address site runoff, groundwater protection, and wastewater discharge, including, but not limited to, the following:</p> <ul style="list-style-type: none">a) Provide the source and quantity of each wastewater stream from the existing and proposed facilities.b) Provide the design of facilities that will handle, treat, store and release each of the wastewater streams.
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Response

There are two proposed wastewater streams for the LLS Project: boiler blowdown and sanitary wastewater effluent.

Boiler blowdown (industrial wastewater) will be pipelined to an EUB licensed disposal well. The boiler blowdown facilities include a tank, a pump, a pipeline and control systems. The anticipated blowdown water quality will require no chemical treatment before injection. The boiler blowdown volume is expected to be approximately 3,300 m³/d per phase.

Effluent from the sanitary wastewater treatment facility will be handled at an on-site facility designed to treat the effluent to environmental release criteria. Effluent will be discharged through a pipeline to the stormwater retention pond, and ultimately will be released to the environment. Sanitary wastewater treatment technology will be determined based on AENV discharge quality requirements identified in the LLS Project approval. The sanitary wastewater volume discharged to the stormwater pond is expected to be 32 m³/d during operations.

8.	<p>c) There is no Table 3.3-5 provided in Volume 1, Section 3. Indicate the correct table to be referred to. Table 3.4-5 does not specify the types and quantities of chemicals used in water and wastewater treatment for Phases 1 and 2. Specify this information, including any PRI, PSL1, PSL2 or ARET substance used for both water and wastewater treatment for Phases 1 and 2.</p>
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Response

The chemical usage for boiler feedwater treatment has been estimated in Volume 1, Section 3.4.9, Table 3.4-4 and is based on the expected brackish water, produced water, and blowdown water compositions. The ultimate usage will be adjusted to account for the actual conditions as the plant is operated. Table 3.4-5 provides the NPRI, PSL1, PSL2 or ARET designations of these chemicals.

Potable water treatment chemical requirements will be dependant on source water quality, and may include but not be limited to the following AENV and NSF certified drinking water treatment chemicals:

- Sodium hypochlorite (ARET)
- Potassium permanganate
- Anti-scalant (for cleaning)

The sanitary wastewater treatment facility does not require the addition of chemicals.

8.	d) Provide the options considered for treatment, wastewater management strategies and reasons including water quality and environmental considerations for selecting the preferred options (consider Alberta Environment's Industrial Release Limits Policy when determining whether either technology or water quality standards will define acceptable release limits).
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Response

With regard to the boiler blowdown, the Partners considered the option of using evaporator/crystallizer technology. This system is extremely energy intensive and is not considered economically feasible for projects that have access to suitable deep well disposal zones. The Partners continue to evaluate opportunities to increase the recycle rate within the LLS facilities, thus reducing the volume of blowdown sent to disposal.

Potential impacts of deep well injection for Industrial wastewater are discussed in detail in Volume 3, Section 5.6.3.

With regard to the sanitary wastewater effluent, the Partners will select a wastewater treatment package based on operability and ability to meet AENV discharge guidelines. No other options were considered. Effluent discharged from the wastewater treatment plant will be held in the stormwater storage pond for polishing and ultimately released to the environment. Strict adherence to AENV regulations regarding discharge quality will be ensured by the daily attendance of a certified operator.

The LLS Project will not discharge process water to the surface. In the event of a release to surface (spill), the comprehensive spill response program developed by the Partners will be implemented.

8.	e) Discuss the discharge of aqueous contaminants (quantity, quality and timing) beyond plant site boundaries and the potential environmental effects of such releases.
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Response

It is not anticipated that any contaminants will be discharged to surface. Boiler blowdown will be disposed of in deep wells and the impacts associated with this activity are discussed in Volume 3, Section 5.6.3.

8.	f) Provide the aquifers for the disposal of wastewaters, including the following information: <ul style="list-style-type: none">i. formation characterization,ii. hydrodynamic flow regime,iii. water quality,iv. chemical compatibility,v. containment potential within the disposal zones, andvi. injection capacity;
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Response

As discussed in Volume 1, Section 4.5.2.1, wastewater resulting from SAGD operations for the LLS Project will be injected into the Keg River Aquifer. The bottom water of the McMurray Formation will be used as a back-up disposal zone to the Keg River Formation. The characterization, hydrodynamic flow regime, water quality, chemical compatibility, containment and injection capacity of these formations have been described in Volume 1, Section 4.5.2, and are summarized below:

i. formation characterization

As discussed in Volume 3, Section 5.5.2.2, the Keg River Formation belongs to the Elk Point Group and consists of a succession of dolomite, argillaceous dense limestones and evaporites. Reef complex buildups are a common feature of the formation. Within the LSA, the Keg River Formation consists of anhydrite and dolomite and occurs between 68 and 103 masl and ranges in thickness from 62 to 107 m.

ii. hydrodynamic flow regime

According to the geologic map of Alberta (Hamilton 1999), the Middle Devonian (which includes the Elk Point Group Keg River Formation) outcrops within the Clearwater River valley, 50 km from the proposed wastewater injection location (Volume 3, Section 5.4.2.3). As discussed in Volume 3, Section 5.5.3.12, Bachu (1997) and Bachu et al. (1993) describe that the regional flow direction within the Keg River Aquifer is southwest to northeast where the Prairie Aquiclude is present. Beyond the dissolution edge of the Prairie Aquiclude, the groundwater flow regime becomes local and is mainly controlled by variations in topography and density. Within the LSA, the groundwater flow direction is expected to be

towards the northeast where the Keg River Aquifer is thought to outcrop and the groundwater flow within the Keg River Formation likely discharges within the Clearwater River valley.

iii. water quality

Four groundwater samples were collected during a 181 hour pump test at 103/09-28-085-06 W4M (Golder 2004). Based on the water analyses results, the Keg River Formation water at this location is of a sodium-chloride type, with TDS values ranging from 33,000 to 37,400 mg/L.

iv. chemical compatibility

To date, detailed chemical compatibility assessments have not been completed. However, based on the results of the long-term injection test completed at 103/09-28-085-06 W4M, “the injectivity of the disposal zone did not appear to be adversely affected by the nature of the injection fluids, including the actual SAGD pilot plant wastewater” (Golder 2004). Further, the 103/09-28-085-06 W4M disposal well has been successfully used for more than two years of pilot plant operations to dispose of produced water from the SAGD wells and blowdown from the pilot boiler.

v. containment potential within the disposal zones

The Keg River Formation is overlain by more than 350 m of Devonian and Cretaceous rocks that include the Prairie Aquiclude, Watt Mountain Aquitard, McMurray Bitumen/Shale Aquitard, Clearwater Cap Rock Aquitard, Clearwater Aquitard and the Colorado Group Aquitard where present. Further, the Keg River Formation is also more than 200 m below the base of groundwater protection within the LLS Project area. Finally, the disposal zone isolation was evidenced during the 29-day injection test conducted at the Keg River disposal well 103/09-28-085-06 W4M. During this test, pressures did not build up in a basal McMurray well located on the same pad as the Keg River disposal well. An assessment of the potential effects of wastewater injection on groundwater resources is discussed in Volume 3, Section 5.6.3.

vi. injection capacity

The experience gained by the Partners at Long Lake indicates that the injection capacity of disposal wells completed in Keg River Formation varies considerably, from almost nil to 3,000 m³/d. This injection capacity cannot be inferred prior to the testing of individual wells since the disposal interval permeability depends on fracture and vug development of the disposal interval. As stated above, the Keg River Formation is the preferred formation for disposal. However, should the injection capacity of the disposal wells drilled into the Keg River Formation be insufficient for the LLS Project disposal requirements, the bottom water of the McMurray Formation would be used for disposal of the LLS disposal fluids (back-up formation). The experience gained by the Partners at Long Lake indicates that the injection capacity of disposal wells completed in the bottom water of the

McMurray Formation is consistent from well to well and is in the order of 1000 to 1500 m³/d.

REFERENCE

Golder Associates Ltd (Golder). 2004. Groundwater Disposal Investigation – Keg River Formation, Long Lake Project. Prepared for Nexen Canada Ltd., Calgary Alberta, September 2004.

8.	g) Provide the wastewater disposal alternatives. Furthermore indicate the regulatory approvals required for discharging the effluent into the environment during the construction period as indicated in 4.5.1 of Volume 1.
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Response

Volume 1, Section 4.5 describes options for deep well injection of the boiler blowdown. Options include the Keg River and Basal McMurray formations. The Partners are committed to minimizing the volume of industrial wastewater being discharged from the facility and will evaluate opportunities to optimize the operation through the acquisition of production data or through ongoing research and development of waste minimization technologies.

An application will be filed with the Municipal approval engineer for the construction and operation of a wastewater treatment facility based on both the AENV approval and EPEA. During construction, the wastewater treatment plant will discharge treated effluent directly to the environment. This discharge will adhere to all regulations regarding effluent quality. Upon construction of the stormwater pond the effluent from the wastewater treatment plant will be rerouted to the pond for polishing and eventual discharge to the environment.

8.	h) Provide the current and proposed monitoring programs.
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Response

Refer to [AENV Water Response 21c](#) for further information regarding the water monitoring program.

A comprehensive surface and groundwater monitoring plan will be developed after approval of the LLS Project and completion of source and disposal well drilling and testing. The plan will expand upon the existing wetlands and groundwater monitoring program developed for the Long Lake Project. This program includes but is not limited to the following:

Surface water

- Monitoring of lakes, and rivers both within and outside the potential area of impact for levels/flow, chemistry, etc.; and
- Monitoring of culverts to ensure surface drainage and hydraulic function is maintained.

Groundwater

- Establishing a monitoring network at the time of licensing of individual source wells for the entire Long Lake lease source well field; and
- Establishing a shallow groundwater monitoring network to detect surface or subsurface spills of industrial products.

Vegetation

- Establishing vegetation monitoring sites in order to monitor changes to surface hydrology, vegetation growth and vegetation diversity.

8.	i) Provide the non-saline water and sewage treatment systems that will be installed for both the construction and operation stages. Specify the source and quantity of withdrawal from the source water wells for non-saline water. Specify the type and location of the facility to which sewage is to be disposed by truck from the temporary storage tanks.
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Response

During the construction and operation of the LLS Project, the Partners will employ a variety of potable and wastewater treatment systems. The technology selected will be dependant on the phase of the Project and the number of workers on-site. Options for potable water include:

- Trucking from an approved facility (e.g. Long Lake, Anzac); and/or
- Treatment of shallow well water using a potable water treatment facility.

Sanitary wastewater options include:

- Trucking of wastewater to an approved facility (e.g. Long Lake, Anzac); and/or
- Treatment at a wastewater treatment facility capable of meeting the discharge criteria outlined in the LLS Project Approval to Operate.

For discussions of volumes refer to [AENV Water Response 10](#).

9.	<p>Supplemental Information, Part 2, Section 2.5 Wastewater, SIR Response #105, Page 134</p> <p>Although expected sewage volumes have been given, no locations were provided or described for the expected sewage discharges. Please, provide locations and descriptions of expected sewage discharge locations.</p>
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Response

The treated sewage effluent will be discharged to the stormwater runoff pond. The effluent discharged to the stormwater runoff pond will comply with AENV regulations for discharge of wastewater effluent to the environment. The stormwater pond will periodically be discharged to receiving environment at WB-18 in the SW ¼ and SE ¼ of 25-84-7 W4M.

10.	<p>Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #106, Page 135 and TOR 3.4.2.</p> <p>a) Provide a Water Management Plan that discusses construction, operation and reclamation phases of the complete LLS project (Phases 1 and 2) and demonstrates consideration of factors including, but not limited to</p> <ul style="list-style-type: none">i. site drainage and anticipated annual runoff volumes,ii. road and well pad runoff,iii. containment,iv. erosion/sediment control,v. slumping areas,vi. groundwater protection,vii. groundwater seepage,viii. non-saline water,ix. produced water, andx. flood protection.
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Response

The Partners will develop a site-specific water management plan that will follow the outline described below in Table 10-1.

Table 10-1 Outline of Site-Specific Water Management Plan

No.	Consideration Factor	Construction	Operation	Reclamation
1	Site drainage and anticipated annual runoff volumes	Drainage and control plans. Temporary storage. Testing and pump off procedures.	Maintenance and monitoring. Pump off testing and reporting. Culvert monitoring.	Self sustaining drainage. Sediment controls during earthworks.
2	Road and well pad runoff	Erosion control, sediment monitoring. Testing and pump off procedures.	Maintenance and monitoring. Pump off testing and reporting. Culvert monitoring.	Self sustaining drainage. Culvert removal. Sediment controls during earthworks.
3	Containment	Temporary detention areas. Secondary containment permeability testing.	Maintenance and monitoring. Pump off testing and reporting.	Self sustaining drainage.
4	Erosion/sediment control	Temporary erosion and sediment control measures. Standard procedures for construction.	Final grading, revegetation, engineered surface materials. Flood controls.	Self sustaining drainage. Culvert removal. Sediment controls during earthworks.
5	Slumping areas	Fill and compaction testing. Slope stability. Surface water controls.	Surface water and controls. Stockpile monitoring, recontouring and vegetation.	Self sustaining drainage.
6	Groundwater protection	Spill tracking and cleanup. Site compaction.	Shallow groundwater monitoring program. Spill tracking and cleanup.	Self sustaining drainage.
7	Groundwater seepage	Temporary dewatering of excavations.	Shallow groundwater monitoring program. Site drainage management.	Self sustaining drainage.
8	Potable water	Volume and quality tracking. Temporary treatment facility or trucking.	Quality testing. Metering and reporting.	Not applicable.
9	Utility water	Not applicable.	Metering and reporting. Conservation, awareness and reuse.	Not applicable.
10	Construction water	Volume and quality tracking. Compaction and dust control. Hydrostatic pressure testing.	Not applicable.	Not applicable.
11	Produced water	Not applicable.	Metering and reporting. Recycle.	Not applicable.
12	Flood protection	Temporary erosion and sediment control measures. Standard procedures for construction.	Final grading, revegetation, engineered surface materials. Culvert maintenance. Pond level management.	Self sustaining drainage. Culvert removal. Sediment controls during earthworks.
13	Monitoring Programs and Reporting	Sediment and erosion. Initial groundwater monitoring. Water course monitoring during in stream activities.	Shallow groundwater, surface water, wetlands, aquifer, and disposal monitoring.	Shallow groundwater, surface water, and wetlands.

10.	b) Clarify the sources and quantities of water to be used during construction, operation and reclamation for: Non-saline water, Utilities, Toilets, Drilling, Construction, Dust Control and finishing ponds. Furthermore, 4.4.1 of Volume 1 indicates that there will be no water withdrawals from surface water features, but SIR 116a indicates that surface water will be drawn from regional lakes for construction and drilling activities. Explain this inconsistency between 4.4.1 and response 116a.
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Response

Potable water for construction staff will be provided by an on-site portable water treatment facility supplied by one or more shallow groundwater wells, or will be trucked from an approved facility in Anzac or Ft. McMurray. The construction work force will be housed at the existing Long Lake construction camp and will utilize the approved potable water and wastewater treatment facility already approved.

Fresh water required for dust control and construction activities will be withdrawn for a short duration of time and the withdrawals are managed through an approval process governed by AENV. Where possible construction and drilling water requirements will be met by utilizing water which collects in project ditching and depressions created by the earthworks activities.

Volume 1, Section 4.4.1 is corrected to state no water withdrawals from surface water features for the purpose of steam injection. Further discussions on water use and estimated volumes are provided in Table 10-1.

Table 10-1 Non-saline Water

Water	Construction	Operation	Reclamation
Non- saline	Potable water will be supplied by an on-site treatment plant utilizing shallow water wells drilled near the CPF or trucked water.(approximately 200 m ³ /d). Water source wells will be drilled and licensed, post approval, under the Water Act.	Potable water will be supplied by on-site treatment plant (approximately 390 m ³ /d) utilizing shallow wells drilled near the CPF. Water source wells will be drilled and licensed, post approval, under the Water Act.	Staff involved in reclamation activities will utilize temporary camp accommodations with self contained potable water and wastewater storage facilities.
Utilities	N/A	N/A Note: Low pressure condensate (a distillate of the saline boiler feed water) will be used.	N/A
Toilets	Potable water will be supplied by on-site treatment plant or trucked water. Wastewater volumes at the LLS Project are expected to be less than 200 m ³ /d as construction staff will be housed at Long Lake camp.	Wastewater will be treated at an on-site facility and discharged to the stormwater pond, approximately 32 m ³ /d.	Staff involved in reclamation activities will utilize temporary camp accommodations with self contained potable water and wastewater storage facilities.
Drilling	N/A	400 m ³ /SAGD horizontal well	N/A
Construction	10,650 m ³ for dust control and compaction.	N/A	N/A

11.	<p>Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #108, Page 135</p> <p>a) Describe the plans for obtaining all regulatory approvals and landholder's consent for use of the land required for the saline water source wells in the Unnamed Creek watershed.</p>
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Response

Saline water source wells are licensed by the EUB and a typical process for the approval of a well is presented below:

A hydrogeologist will identify a prospective location and will determine if the potential well site has any Petroleum and Natural Gas (P&NG) rights assigned to it. If the location

is deemed acceptable, a legal survey will be conducted, and a public standing report will be ordered to determine if there are any surface rights holders or restrictions on the identified land. Post-review, an environmental field report will be prepared and an application for a surface disposition will be submitted. After appropriate consultation with potentially affected stakeholders has been conducted, a well license will be applied for. Once approved, construction of the well site and drilling will commence.

11.	b) Describe any roads, pipelines and transportation routes planned for the Unnamed Creek area, including any watercourse / watershed crossings and the additional provincial and federal approvals that will be required for these crossings.
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Response

In the event that roads, pipelines and/or transportation routes are required for the unnamed Creek area, site visits will occur at each proposed crossing location to determine the appropriate crossing method. Site visits at each crossing location will be conducted by a Qualified Aquatic Environmental Specialist prior to submission of the appropriate applications. Based on the proposed crossing methods for each location, authorization and notification will be submitted under the *Fisheries Act* (DFO), the *Navigable Waters Protection Act* (Transport Canada) and the *Water Act* (Alberta Environment). Work will not commence until the proper authorizations have been received.

Typical crossing methods related to this Project will include both roads and pipelines. The following section outlines the various types of crossings typically associated with pipelines and roads:

Pipelines

Trenchless Crossings

The trenchless crossing method refers to a crossing in which there is no disturbance of the bed and banks of a waterbody. Trenchless crossing methods include horizontal bores, horizontal punches, and directional drills. Any method that results in the surface disturbance of the bed or bank of a waterbody is not a trenchless crossing method and would be defined as an isolated or an open cut crossing.

Isolated Crossings

The isolated crossing method isolates the construction area from the main watercourse to prevent construction materials and sediment from entering the watercourse outside of the isolated area. This type of crossing method typically involves dewatering the isolated construction area into a well vegetated area.

Open Cut Wet Crossings

Under this method, the stream is not diverted during construction. A trench is excavated perpendicular to the direction of flow, the pipe/telecommunication line is installed and backfilled while the stream continues flowing through the site. Sediment and pollutant runoff can impact downstream habitats, however, impacts to downstream habitats may be mitigated by rapid completion and monitoring by qualified aquatic environmental scientists.

Roads

Ice/Snowfill Bridges

Ice and snowfill bridges are two methods used for temporary winter access in remote areas. Ice bridges are constructed on larger watercourses that have sufficient stream flow and water depth to prevent the ice bridge from coming into contact with the stream bed or restricting water movement beneath the ice. Snowfills, however, are temporary stream crossings constructed by filling a stream channel that is dry or frozen to the bottom with clean compacted snow.

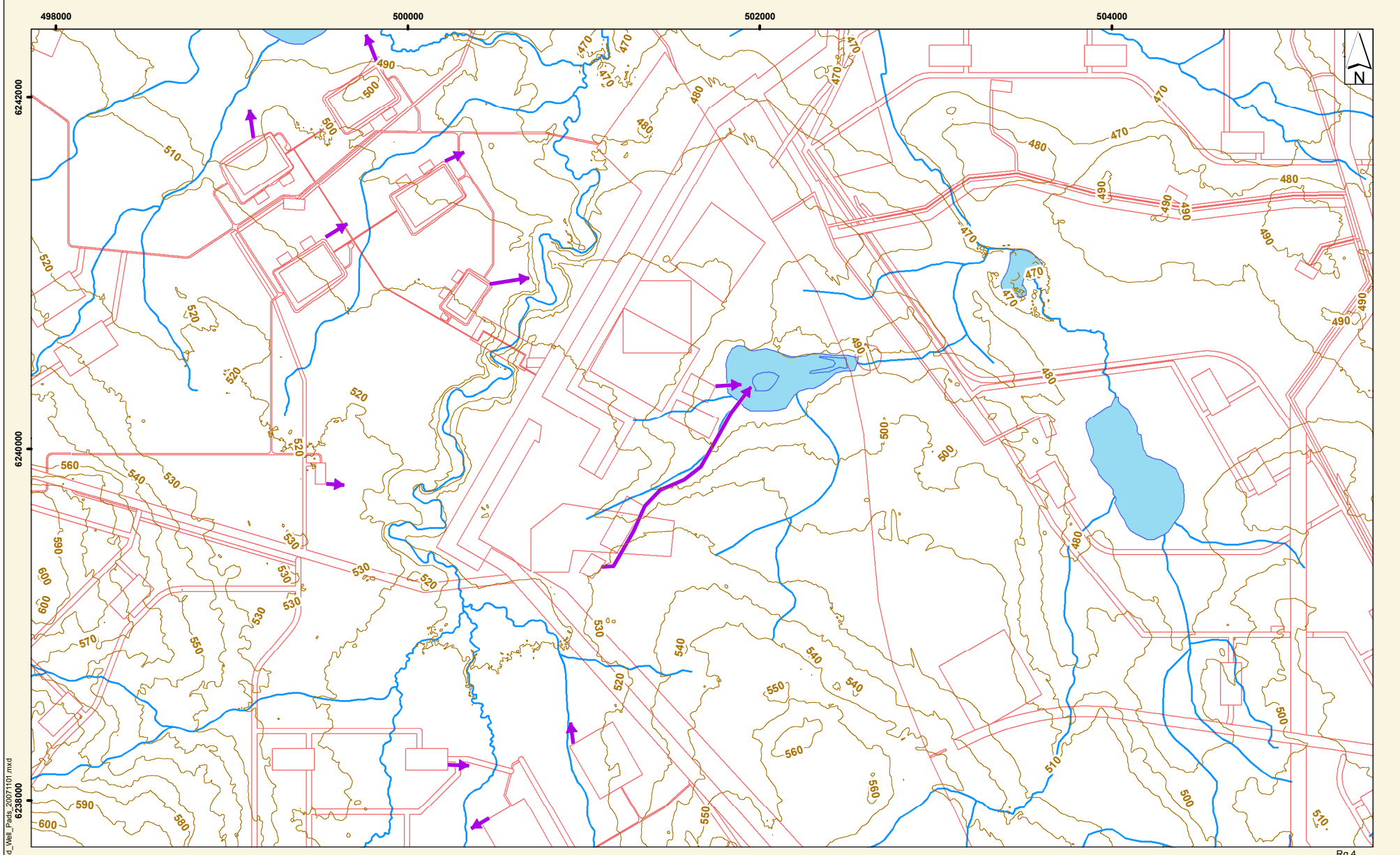
Clear Span Bridges

Clear span bridges are small-scale bridge structures that completely span a watercourse without altering the stream bed or bank, and that are a maximum of two lanes wide. Clear-span bridges are often preferred to culverts as no structures are placed on the stream bed or banks.

12.	<p>Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #111, Page 137</p> <p>a) Figure 111-1 does not provide all discharge points for well pad run-off containment units or facility run-off ponds. Provide this information, including topographical map with surface features.</p>
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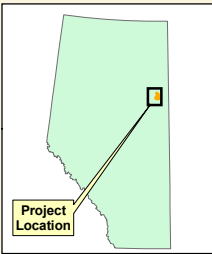
Response

The discharge points and drainage patterns from the Project's initial 5 well pads are presented in Figure 12-1. Other pads presented on Figure 12-1 are conceptual at this time; therefore, discharge points will be established in the future prior to construction.



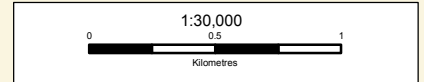
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Legend

- CONTOUR
- LAKE
- DISCHARGE LOCATION
- FOOTPRINT
- RIVER



LONG LAKE SOUTH PROJECT
A JOINT VENTURE BETWEEN
OPTI CANADA INC. & NEXEN INC.

DISCHARGE POINTS FOR PONDS AND WELLS PADS

Date: November 2007	File No.:	Fig. No.: 12-1
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12.	b) Provide the names of the surface water features associated with each release point, as well as what is known about each feature.
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Response

The surface water features associated with the Project and specific release points are presented in Figure 12-1. The majority of watercourses and waterbodies in the Project area are not officially named. For the purpose of the Project's aquatic assessments, each watercourse and waterbody was assigned a specific designation (i.e. Waterbody 18 (WB-18)).

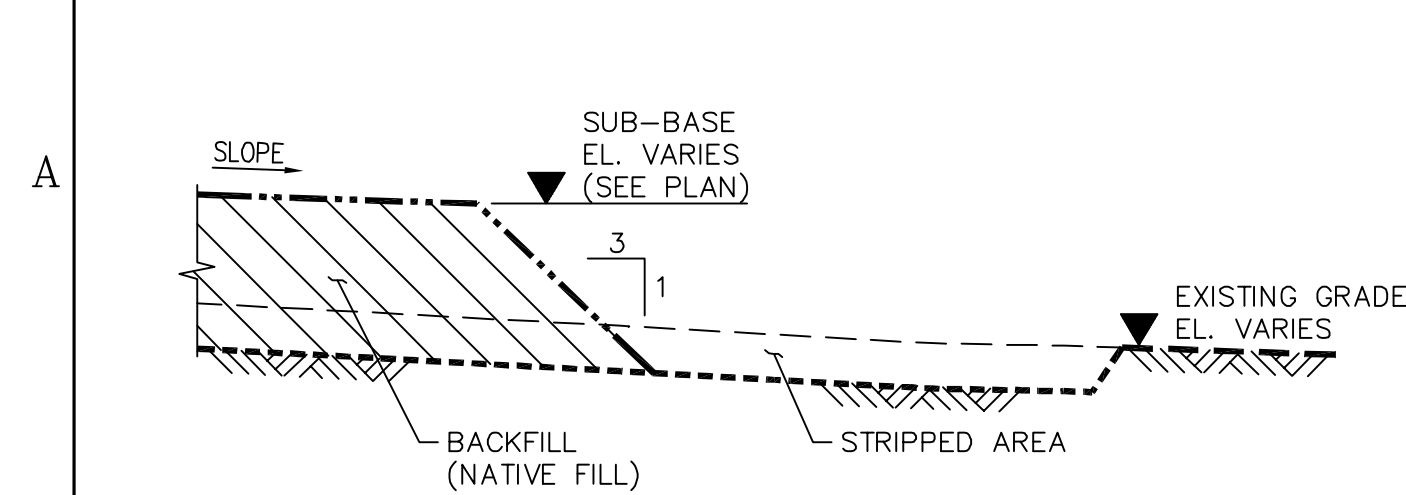
12.	c) Clarify the water collection, sampling, control and release mechanisms associated with all runoff collection ponds. Provide clear and specific indication of all details requested. Further, provide information regarding any aerosol effect assessment undertaken in relation to the spray irrigation release mechanism.
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Response

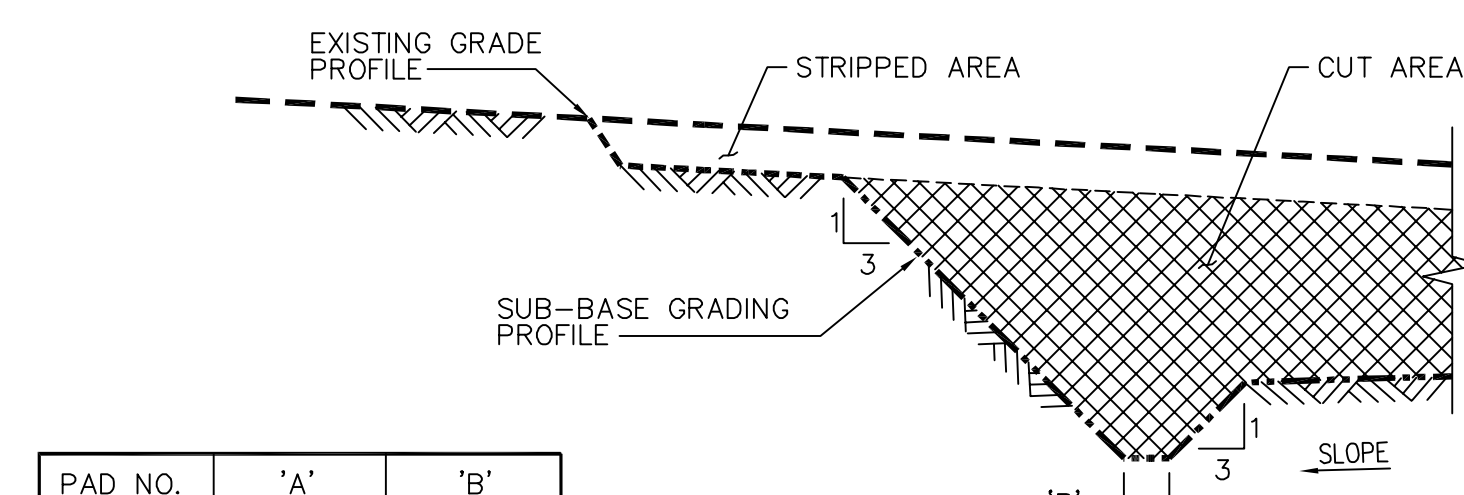
Well pads, runoff containment, and associated discharge facilities or structures will be engineered based on site-specific conditions. Figure 12-2 shows typical engineering design details for stormwater outfall control structures. In general terms, water will be discharged through a control structure (valved pipe) to an engineered outfall designed to control velocities and reduce erosion.

Prior to release, the runoff will be tested to ensure it meets AENV guidelines for discharge. Based on the designs shown in Figure 12-2, no erosion, hydraulic, or aerosol effects are expected. No spray irrigation is anticipated.

Note that Figure 12-2 is based on final engineering for the Long Lake Project. Similar specification will be developed for the LLS Project well pads during detailed engineering.



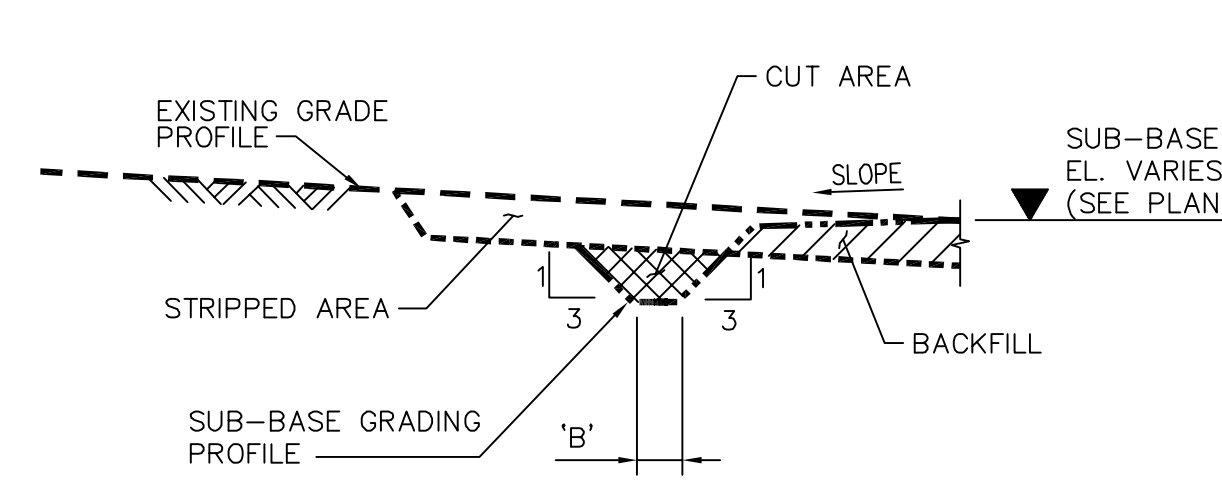
TYPICAL SUB-BASE SECTION IN FILL



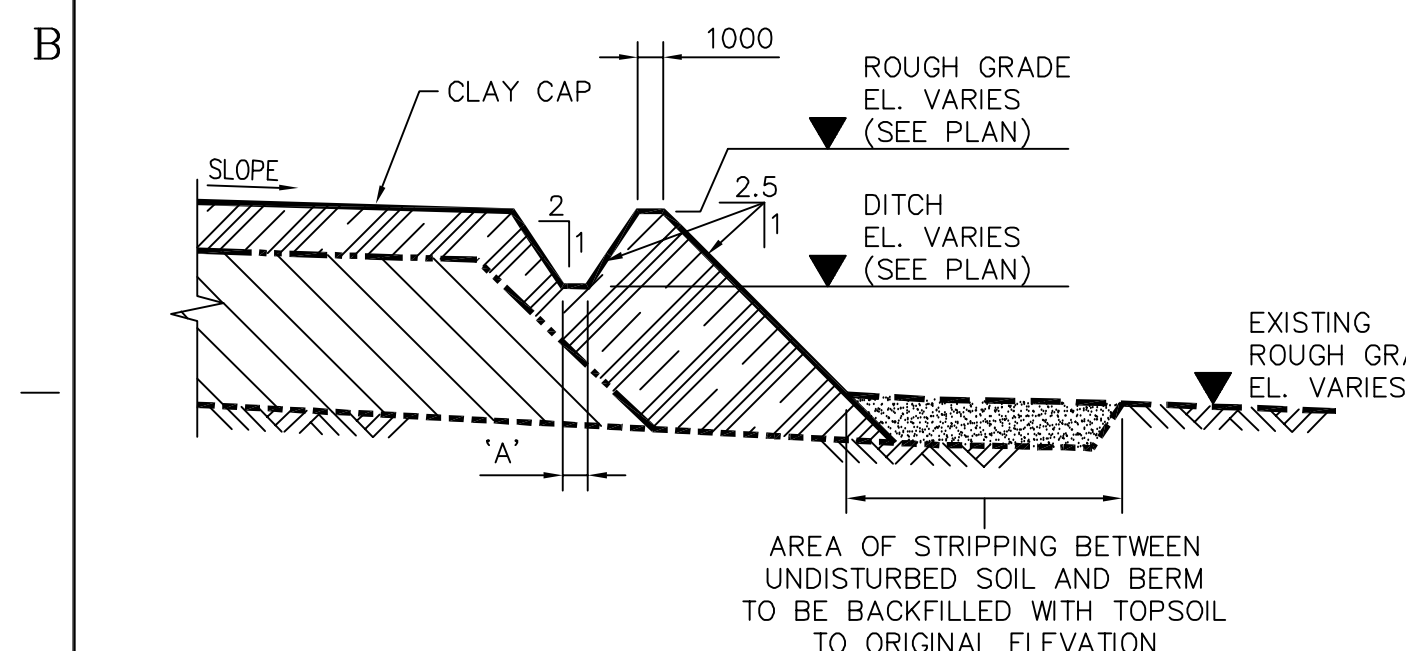
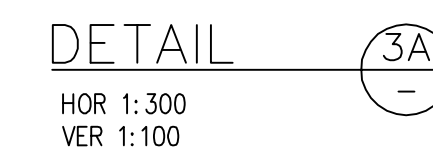
TYPICAL SUB-BASE DITCH/BERM SECTION IN CUT



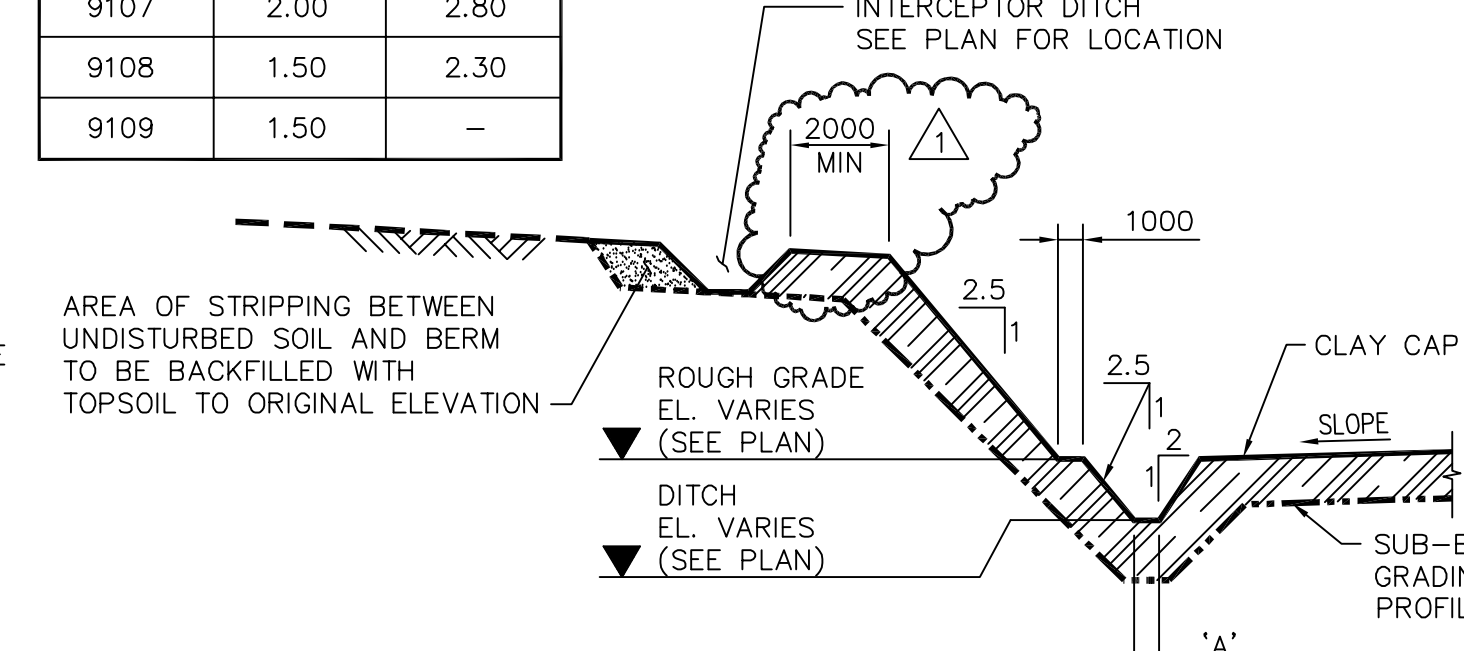
PAD NO.	'A'	'B'
9102	2.50	3.30
9103	1.00	1.80
9104	3.00	3.80
9105	1.00	1.80
9106	1.50	2.30
9107	2.00	2.80
9108	1.50	2.30
9109	1.50	—



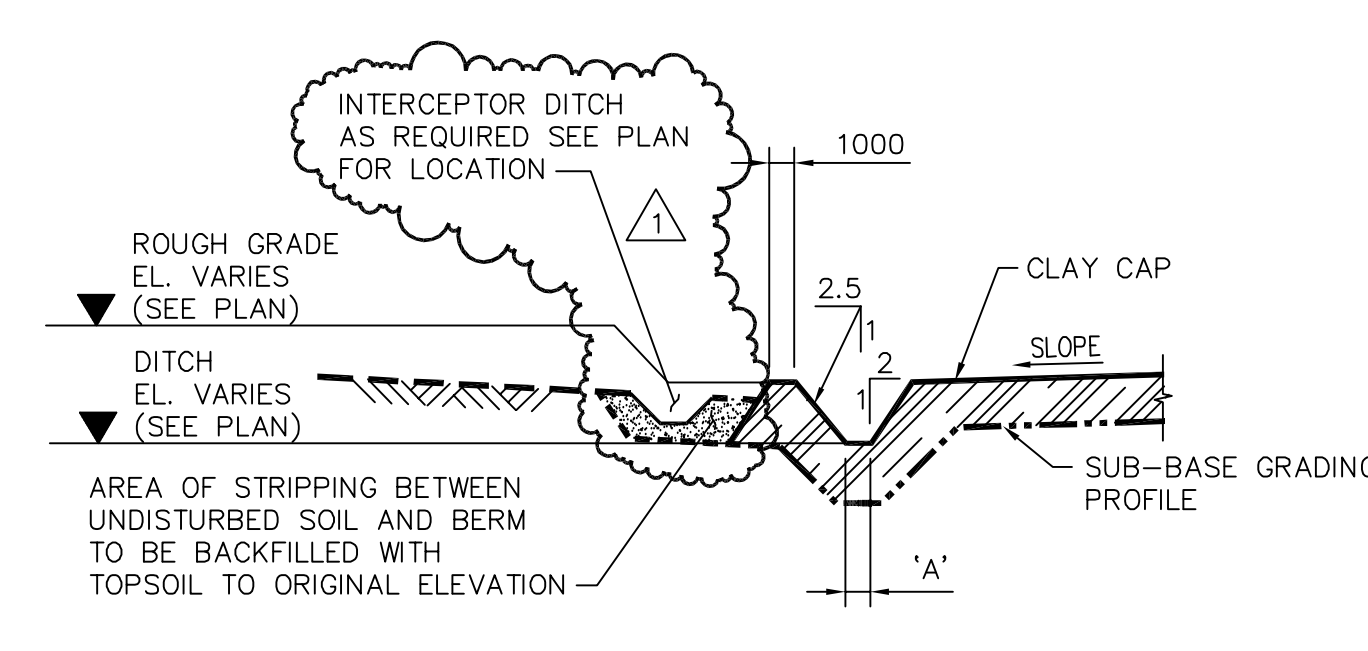
TYPICAL SUB-BASE DITCH/BERM SECTION IN CUT/FILL



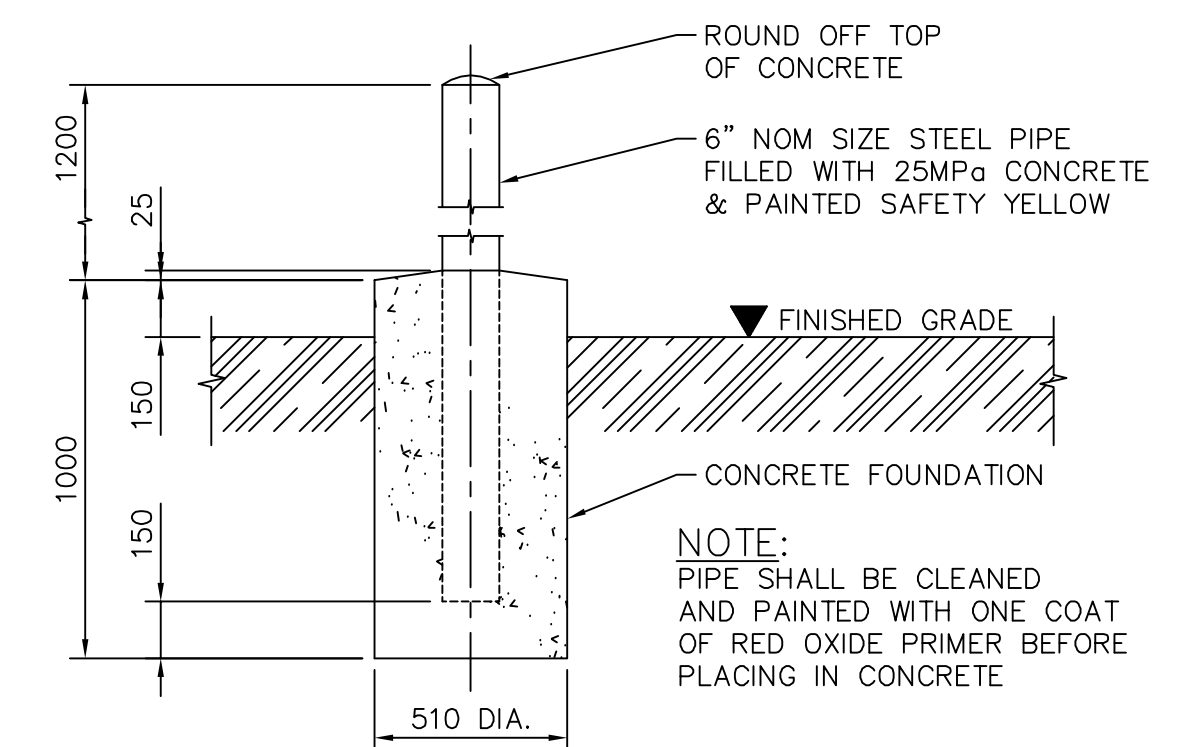
TYPICAL ROUGH GRADE DITCH/BERM SECTION IN FILL



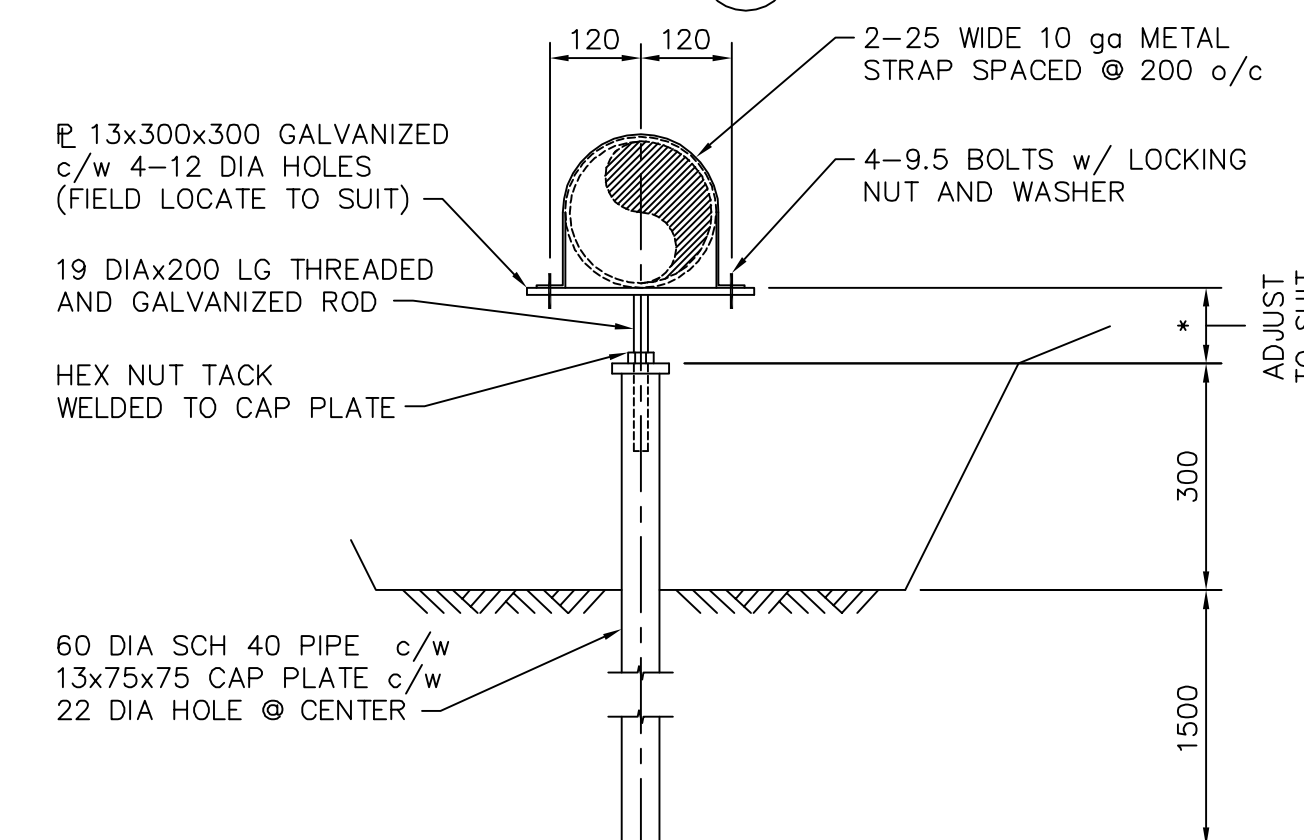
TYPICAL ROUGH GRADE DITCH/BERM SECTION IN CUT



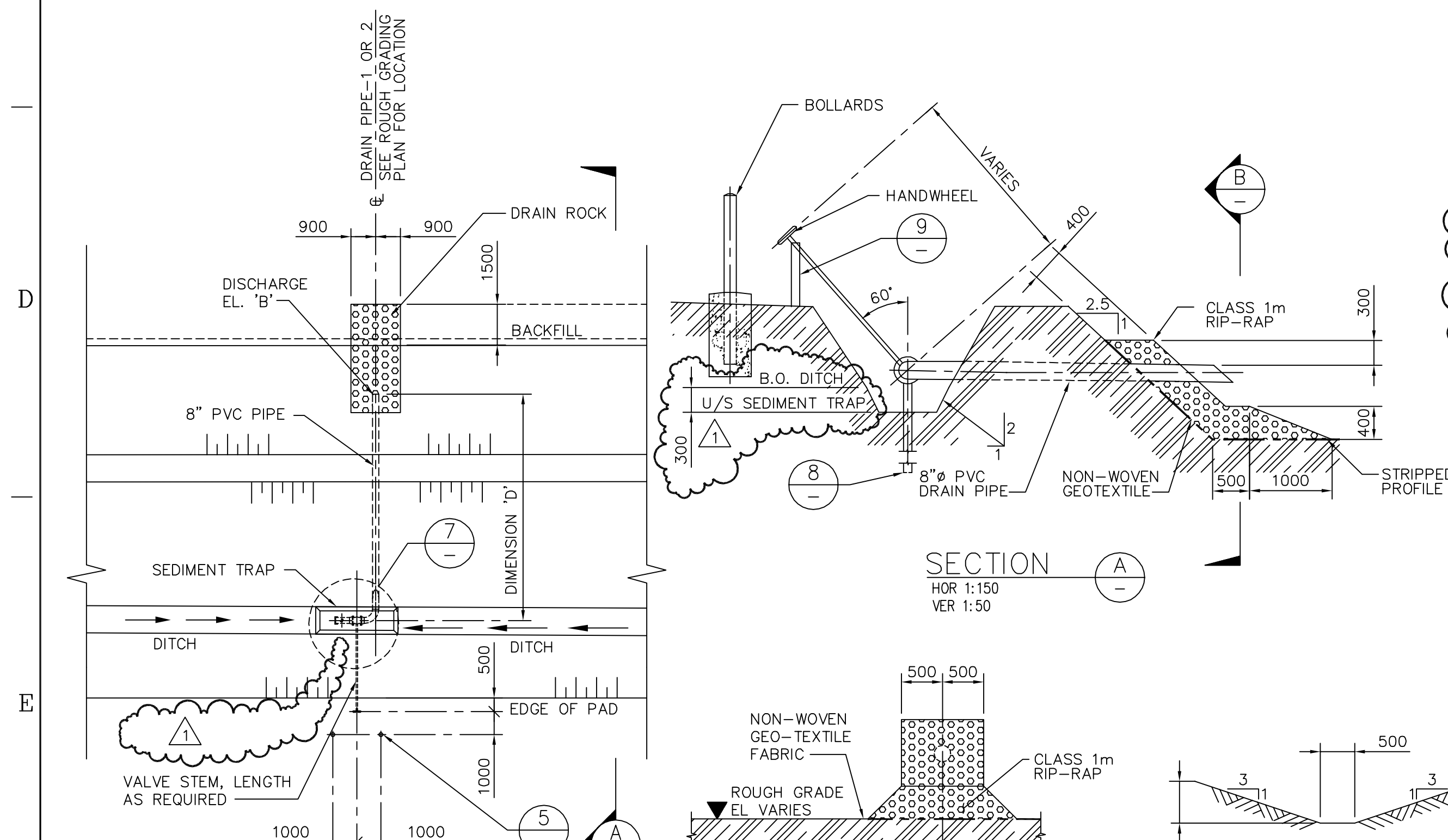
TYPICAL ROUGH GRADE DITCH/BERM SECTION IN CUT/FILL



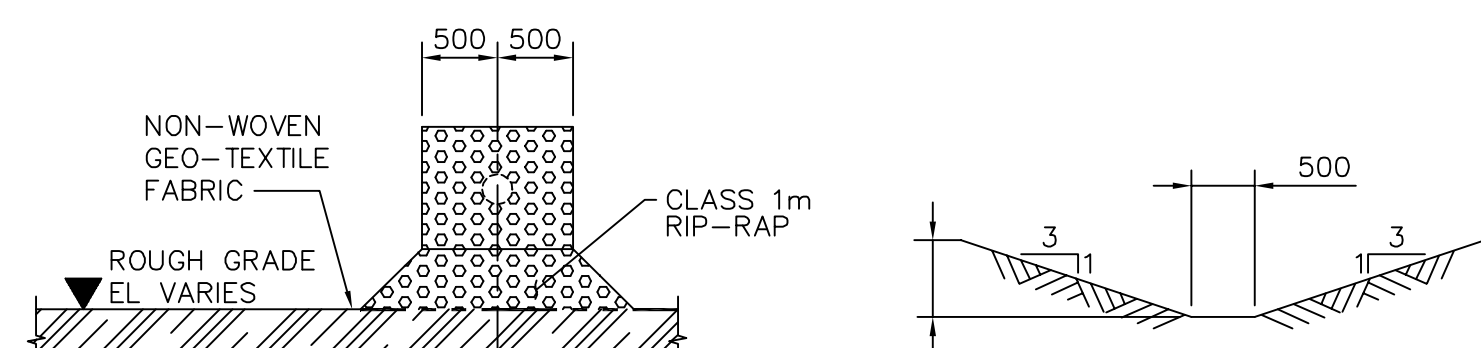
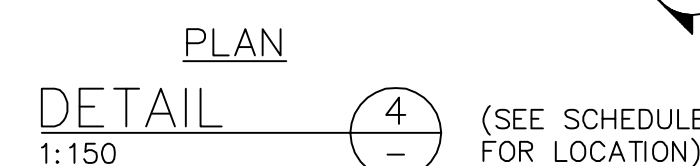
TYPICAL BOLLARD DETAIL



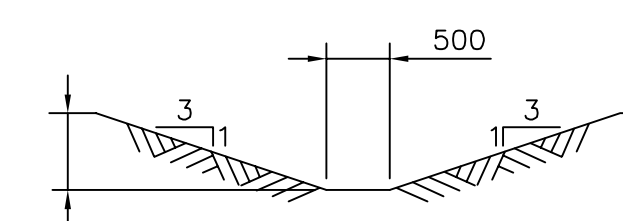
TYPICAL VALVE/PIPE SUPPORT
IN SEDIMENT TRAP



SECTION _____ (A)
HOR 1:150
VER 1:50



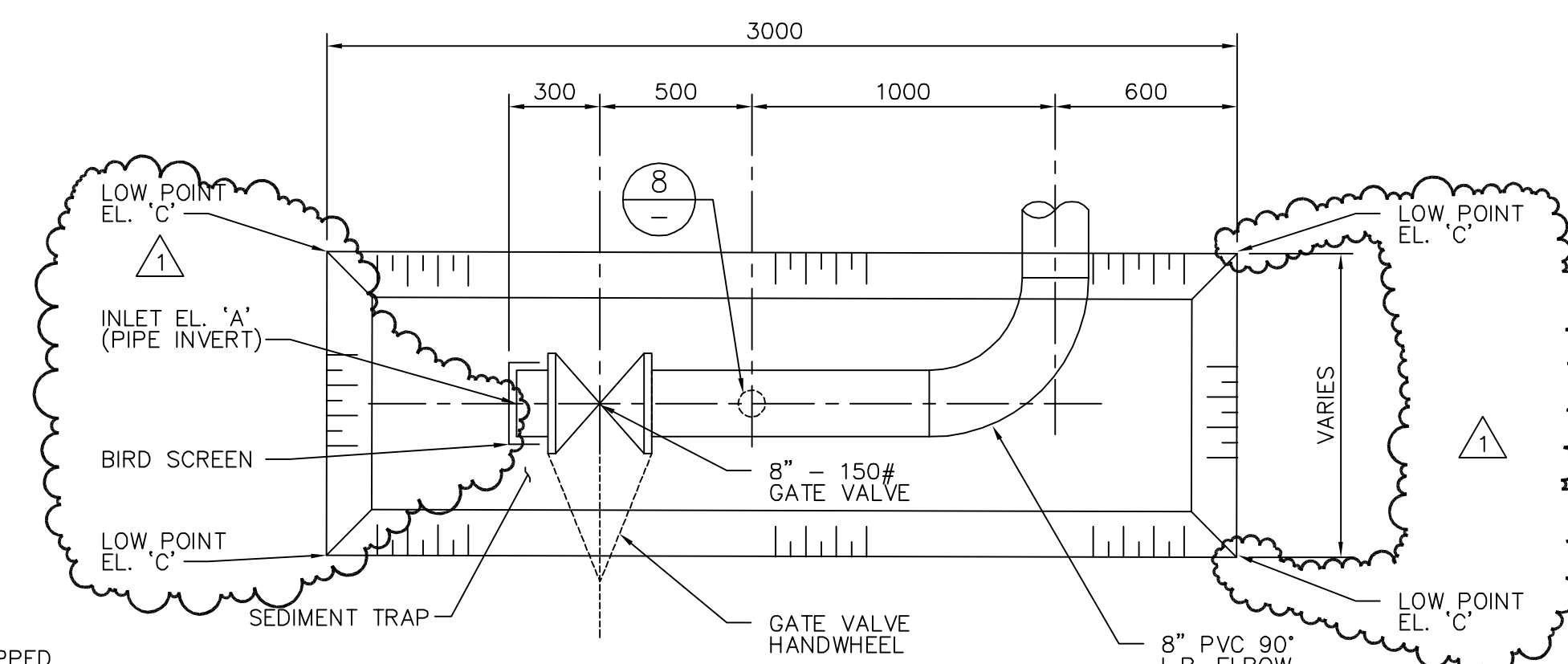
SECTION 1:50 (B)



TYPICAL INTERCEPTOR DITCH DETAIL

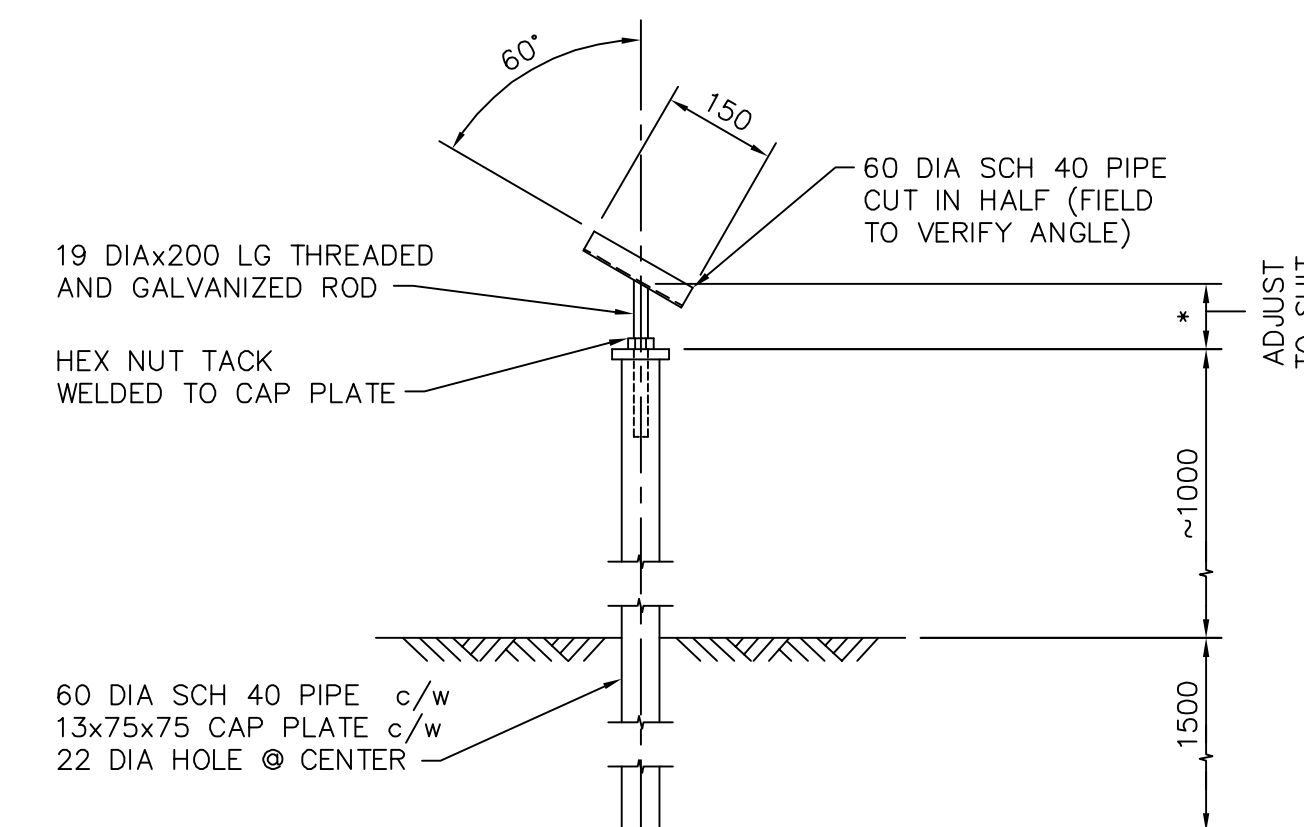
DETAIL 6

1:30






DETAIL 7
1:20 -

8"Ø PVC DRAIN PIPE SCHEDULE											
DRAIN PIPE-1						DRAIN PIPE-2					
PAD NO.	INLET EL. 'A'	DISCHARGE EL. 'B'	LOW POINT EL. 'C'	DIMENSION 'D'	DRAWING NO.	PAD NO.	INLET EL. 'A'	DISCHARGE EL. 'B'	LOW POINT EL. 'C'	DIMENSION 'D'	DRAWING NO.
9102	482.965	482.765	482.865	14m (NOM.)	9102-10B-004	9102	482.785	482.585	482.685	14m (NOM.)	9102-10B-004
9103	482.850	482.710	482.750	14m (NOM.)	9103-10B-004	9103	—	—	—	—	—
9104	481.520	481.420	481.420	14m (NOM.)	9104-10B-004	9104	—	—	—	—	—
9105	479.385	479.285	479.285	14m (NOM.)	9105-10B-004	9105	479.385	479.285	479.285	14m (NOM.)	9105-10B-004
9106	485.380	485.100	485.280	15m (NOM.)	9106-10B-004	9106	485.380	485.080	485.280	14m	9106-10B-004
9107	486.910	486.710	486.810	14m (NOM.)	9107-10B-004	9107	486.910	486.710	486.810	14m (NOM.)	9107-10B-004
9108	488.845	488.645	488.745	10m (NOM.)	9108-10B-004	9108	—	—	—	—	—
9109	486.800	486.600	486.700	10m (NOM.)	9109-10B-004	9109	—	—	—	—	—



TYPICAL VALVE HANDWHEEL SUPPORT



F	DWG. NO.	REFERENCE DRAWINGS	REV		DATE	BY	CHK'D	APP'D	CLIENT APP'D	ENGINEER AND PERMIT STAMPS	DRAWING ISSUE RECORD								BY	DATE	Colt Engineering Corporation				
			△		DATE1					<div>*This drawing is prepared solely for the use of the contractual customer of Colt Engineering ("Colt") and Colt assumes no liability to any other party for any damages or losses contained in this document.</div>	ISSUE							DESIGNED			PROJECT				
			△		DATE2						REVIEW AND COMMENTS								DRAWN						
			△		DATE3						APPROVAL								CHECKED						
			△		DATE4						TENDER								PROCESS CK.						
			△		DATE5						CONSTRUCTION									MECH. CK.					
			△		DATE6						REFERENCE									ELECT. CK.					
			△		DATE7															I/C CK.					
			△		DATE8															COLT APP.					
																		CLIENT APP.			JOB NO.	SCALE	DWG. NO.	SHT SHNO	

13.	<p>Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #113, Page 140</p> <p>a) The response states that “for smaller tributaries, the quantification of impact is less meaningful.” With small order tributaries, surface area disturbances will be proportionately greater. Have these smaller order tributaries been characterized or is the statement that “flows may commonly be at or near zero” based on general and not site-specific observations?</p>
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Response

Pads will be placed in areas with minimal surface flows. Additionally, pads will be designed to incorporate site-specific drainage features. The statement “flows may be at or near zero” is a generalization based on the authors extensive experience and field observations in the region. Monitoring will be conducted in areas downstream of the pad location discharge points in order to assess the affects of pad placement on stream flows.

13.	<p>b) Will land use changes in smaller order tributary catchments alter the runoff volumes and erosive potential of these tributaries?</p>
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Response

Construction activities resulting in land use changes in smaller order tributaries are not expected to alter runoff volumes or change the erosion potential of these tributaries. Developments will be constructed using engineering controls and best management practices (i.e. erosion and sediment controls) designed to minimize the potential to effect the catchment areas. Monitoring programs during construction and operation will be implemented.

14.	<p>Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #115, Page 141</p> <p>Provide maximum annual withdrawal quantity for non-saline water. Provide specific details as to proposed location of the two water source wells, including aquifer zones.</p>
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Response

The non-saline water referred to in SIR Aug/07 [AENV Response 115](#) is the LLS Project’s potable water requirements. The EUB Response 9 (Table 9-1) provides the annual withdrawal quantities for the LLS Project’s potable water demands (382 m³/d).

The potable water will be sourced from a local sand and gravel aquifer (Quaternary formations). The precise location of these wells is unknown, however they are expected to be located in close proximity to the LLS CPF area.

15.	Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #116, Page 141 a) Specify which regional lakes the surface water will be drawn from. b) Provide an assessment of the seasonal, short-term and long term hydrologic effect of the proposed withdrawal for these purposes.
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Response

For surface water withdrawal no lakes can be specified at this time. Approvals for withdrawals from specific waterbodies will be requested on an as-need basis.

If the Partners require the use of surface water for construction or drilling activities, the temporary water withdrawal will be applied for pursuant to the Alberta Water Act and would be screened in accordance with DFO intake regulations. At the time of application, AENV will assess the potential impacts associated with the diversion request and will regulate the licensed volume, duration, and location of the diversion.

Effects associated with any temporary diversion are short-term, and the diversion limits provided under the Water Act license are designed to maintain the waterbodies' ecological function within its natural variation. Thus, any small periodic diversions would have minor short-term effects that would be negligible in the long-term.

16.	Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #118, Page 142 The surface water features associated with runoff release points (Figure 111-1) have not been clearly identified or defined. Identify and define these surface water features.
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Response

The discharge of stormwater and pad water has the potential to affect receiving waters through the introduction of sedimentation and other toxic or anthropogenic substances.

Changes in sedimentation levels in watercourses and waterbodies are often the result of silt and clay particles being released into the aquatic environment via surface water runoff. Runoff water flowing over a disturbed area collects and transports silt and clay particles that contribute to the sediment loading of surface water. Sedimentation reduces overall fish habitat quality by filling the interstitial spaces in the gravel, rock or

sand, leaving substrate unsuitable for spawning and/or causing the smothering of fish eggs.

The introduction of toxic or anthropogenic substances into watercourses and waterbodies may result in changes to surface water quality. Elevated concentrations of foreign substances may result in changes in fish behavior (e.g., predator avoidance, spawning, feeding) and physiology (e.g., respiration, sensory mechanisms). Water quality alterations may also result in adverse affects on fish tissue quality (e.g., chemical burdens, tainting).

Runoff water will be collected and tested prior to release. In the event that treated water does not meet release criteria, it will be trucked to the CPF and re-used in the process or disposed of properly. Post-approval, assessments of receiving waterbodies will be conducted to determine fish habitat potential prior to any Project-related releases taking place.

Refer to the [AENV Water Response 12](#) and [Figure 12-1](#) for additional information regarding discharge structures.

17.	Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #119, Page 143 a) Provide details of fish survey of the 20 ha pond, including the timing and level of effort of the survey.
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Response

The 20 ha pond (WB-18) was sampled in May 2006 and February 2007. The investigations included a detailed assessment of fish habitat in both the pond and its outlet area. Additionally, water quality samples were collected during the winter for detailed analysis.

During the May 2006 trip a multi-panel gill net and two baited minnow traps were set for a period of 24 hours and no fish were captured. A series of beaver impoundments located in the outlet region (ranging from 1 to 4 metres in height) were observed and may impede the migration of fish during open water periods.

During the winter investigation (February 2007), three baited minnow traps and a baited setline were deployed for a period of 22 hours. Fish were not captured during these efforts. Water quality characteristics were recorded at various locations on the pond. Dissolved oxygen levels were recorded at or below 2.0 mg/L throughout the lake, which are far below the AENV guidelines for the protection of aquatic life (i.e. 5.0 mg/L).

The lack of fish captured in the pond, combined with the presence of several large potential barriers to fish migration (e.g., beaver impoundments) and a lack of dissolved oxygen, indicate that the unnamed WB-18 provides marginal fish habitat. It is unlikely that the fish habitat will be affected by stormwater discharge and/or treated effluent from

the wastewater treatment plant. WB-18 will be included in the LLS Project wetlands monitoring program.

17.	b) The statement that the pond area will diminish and dry up more frequently than present, but that higher runoff rates will likely compensate for the decrease in drainage area appear contradictory. If the pond is strongly linked to groundwater, why will the pond diminish and dry up more frequently than present? Provide clarification.
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Response

The groundwater linkage referred to in [Section 3.8 of the SIR Aug/07 Project Update](#) refers to muskeg drainage.

Although the LLS Project will impede the natural flow to WB-18, changes to water levels in WB-18 are not expected to occur as a result of Project activities. The discharge of stormwater from the CPF will maintain the hydraulic regime of the drainage.

18.	<p>Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #121, Page 144</p> <p>a) In this response, the proponent anticipates 30 to 40 crossings. In Table 125-1, the proponent indicates there are approximately 52 watercourse or wetland crossings for the project. Explain this inconsistency.</p> <p>b) Provide the total number of crossings for this project by type, i.e. watercourse, wetland/ephemeral, road and pipeline (above and below ground) for the project, based on current project information.</p> <p>c) Provide characteristics of the morphology, flow, and aquatic habitat quality of each watercourse reach.</p>
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Response

The original 30 to 40 crossings were based on watercourses only. The number of crossing (52) is based on the combination of watercourses and wetlands. The total number of crossings will be determined once the LLS Project design and siting have been finalized.

Crossing assessments will be conducted by a QAES and a report submitted to the appropriate authorities (DFO, AENV) outlining channel characteristics and aquatic habitat.

Refer to [AENV Water Response 11](#) for additional information regarding crossing techniques.

18.	d) Explain the potential cumulative impact of crossing activities in terms of sedimentation, diversion and disturbance of surface water and in Sub Watersheds 2, 4 and 5.
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Response

In the event that roads and pipelines are required to cross any watercourses in the Project area, a series of best management practices will be followed to ensure impacts related to the crossings are mitigated and no environmental impact is observed over time. The potential crossing types that may be required include pipelines (trenchless, isolated or open cut) and bridges (clear span or temporary ice/snow fill). The following are examples of typical mitigation measures that could be conducted at all proposed crossing locations:

- Sediment and erosion control measures will be installed on-site prior to construction and will be left in place until vegetation at the crossings is re-established;
- Exposed soils will be re-vegetated using native seed mixes;
- Precautions will be taken to minimize disturbances to streambeds and banks;
- An experienced construction supervisor and a QAES will be on-site during construction to ensure regulatory compliance;
- Equipment will be cleaned, fueled and serviced at an appropriate distance away from watercourses to protect against the release of deleterious substances; and
- Disturbed ground will be re-contoured to the original bed and bank profile characteristics.

Additional site-specific mitigations may be required for crossing locations as a result of QAES assessments conducted prior to submission of the appropriate applications. The same standards are expected to be adhered to by all other operators in the area; therefore, it can be assumed that no cumulative effects related to crossings will result.

19.	Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #122, Page 147 Describe the regulatory approvals required (e.g. Alberta Water Act, Alberta Environmental Protection and Enhancement Act, etc.), if any, for this proposed use of the pond, and the proponent's plan to obtain these approvals.
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Response

To maintain the pre-existing hydraulic regime of the area and ensure the viability of the watershed, stormwater from the LLS Project will be discharged to SW ¼ and SE ¼ of

25-84-7 W4M (WB-18). Water which would have naturally flowed to WB-18 will be interrupted by the construction and operation of the LLS Project CPF. Consequently, it was the desire of both the Partners and AENV to ensure stormwater collected on-site was returned to its natural watercourse. No additional approvals should be required for this scheme, however, it is anticipated that conditions within the approval to operate will define water quality parameters that must be met before discharge of stormwater to the environment is permitted.

20.	Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #123, Page 148 a) Indicate all of the well pads that cannot be set back 100 m from a water body for both Phase 1 and Phase 2 of project.
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Response

In the initial well pads for Phase 1, Pad 5 is proposed to be located approximately 90 m from the nearest watercourse. This pad will be engineered to ensure that proper runoff containment occurs. The other four initial well pads are set back more than 100 m from any waterbody.

Beyond these initial well pads for Phase 1, which includes all Phase 2 well pads, placement is conceptual. The actual placement of these pads will depend on final geological analysis and surface features. All attempts will be made to set these pads back at least 100 m from all waterbodies.

20.	b) Discuss additional measures that will be implemented to protect those water bodies/watercourses that cannot meet the 100 m setback distance.
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Response

The initial five well pads of the Project have had detailed engineering conducted and have been located both in consideration of environmental features and to optimize resource recovery. Pads can be moved a certain amount to avoid surface features, but may not always be set back 100 m from a watercourse. In the event that a pad cannot be located outside a 100 m setback, a series of design mitigations will be implemented to ensure that watercourses and waterbodies in close proximity remain protected. Examples of typical mitigation measures include:

- Vegetated buffers located between pads and watercourses and waterbodies;
- Berms designed to contain pad runoff and to ensure that surface waters are not permitted to freely flow into the surrounding environment; and
- Vegetation to assist in erosion control.

21.	Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #124, Page 149 a) Confirm that the monitoring program covering the LLS Project area includes water bodies located in Sub Watersheds 2, 4 and 5.
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Response

The LLS Project wetlands monitoring program may include, but not be limited to, waterbodies located in Sub Watersheds 2, 4 and 5. Post-approval, details of this monitoring program will be developed in conjunction with AENV and the program will target areas of potential impact as well as background reference locations.

21.	b) Explain why the monitoring program does not include changes in water levels due to drilling, construction and start-up activities.
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Response

Withdrawals of small amounts of water from local waterbodies are monitored through the permitting process by AENV, and volumes withdrawn are intended to be within the natural variation of the waterbody.

Upon approval of the LLS Project, the wetlands monitoring program that already exists on the Long Lake lease will be expanded to include sites related to the LLS Project.

21.	c) Describe in more detail the monitoring program for changes associated with surface water diversions or disturbances.
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Response

Surface water monitoring for the LLS Project will include local and regional lakes, rivers and wetland areas and will complement and expand the existing Long Lake monitoring plan. This plan has been approved and implemented as part of monitoring requirements for the Long Lake Project. Monitoring locations will be downstream of discharge and diversion points. Included is an outline of the major components of the Long Lake wetlands monitoring program:

1. SURFACE WATER HYDROLOGY

The Surface Water Hydrology Monitoring program includes the following the Aspects:

- Gregoire River streamflow monitoring both upstream and downstream of the project area;
- Lake Level Monitoring at Five Lakes; and
- Data Analysis.

2. WATER QUALITY

The Surface Water Quality Monitoring program includes the following aspects:

- Ongoing Seasonal Water Quality Sampling Conducted on Waterbodies and Watercourses;
- Water Quality Analysis including a full parameter list consisting of conventional parameters, major ions, nutrients, metals and selected organic parameters;
- Sampling methods consistent with previous surveys in the Long Lake Development Area conducted by the Regional Aquatics Monitoring Program RAMP); and
- Data Analysis.

3. WETLANDS VEGETATION

The Wetlands Vegetation Monitoring program including the following the Aspects:

Pre-field evaluations conducted to establish monitoring protocols will include the following:

- Determinations of wetlands to be monitored;
- Aerial Photograph Interpretation; and
- Study design and plot establishment.

Field Assessments will include data collection related to the following topics:

- Vegetation;
- Site and Soils;
- Surface Water Depth;
- Water Quality Data;
- Photo Monitoring; and
- Culvert characteristics.

4. COMMUNITY INVOLVEMENT

Summary of community involvement related to monitoring program activities.

5. REPORTING REQUIREMENT

Annual third party reporting of all results including interpretation and recommendations to AENV.

22.	Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #126, Page 150 a) Provide annual volumes from each source.
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Response

Groundwater sources for the LLS Project include:

- Potable water demand (Quaternary deposits): 141,000 m³/y (386 m³/d);
- Saline water industrial demand (McMurray Formation): 6,505,000 m³/y (17,822 m³/d); and

- Fresh water industrial demand (transfer of water from Long Lake): 1,935,000 m³ in 2012 and 2014 (5,300 m³/d).

For further information regarding surface water withdrawals, refer to SIR Aug/07 [Response 116b](#).

22.	b) Provide annual volume of each wastewater stream.
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Response

Wastewater sources for the LLS Project include:

- Industrial wastewater: 6,656 m³/d (approximately 2.4 million m³/y) sent to deep well disposal; and
- Sanitary wastewater: 32 m³/d (11,680 m³/y) treatment plant effluent discharged to stormwater pond.

22.	c) Provide type and quantity of chemicals used in wastewater treatment, including industrial wastewater treatment.
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Response

It is not anticipated that sanitary wastewater or the industrial wastewater will require any type of chemical treatment. The sanitary wastewater treatment plant will employ ultraviolet disinfection prior to discharge to the stormwater pond. The industrial wastewater (boiler blowdown) will meet the EUB criteria for deep well disposal.

22.	d) Provide the design details for the non-saline water and sewage treatment systems for both the construction and operation stages.
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Response

Construction Potable Water and Wastewater Treatment Plants:

LLS construction staff will be housed in the existing Long Lake construction camp and will utilize existing approved water and wastewater treatment facilities and infrastructure.

On-site potable water needs during construction will be met utilizing either trucked water from an approved facility, or a small portable (skid mounted) reverse osmosis treatment facility with raw water provided by a shallow source well located near the CPF.

Sanitary wastewater produced at the LLS Project during the construction will be trucked off-site for treatment at an approved facility, or treated on-site in a portable (skid

mounted) wastewater treatment plant utilizing an activated sludge style facility to achieve the discharge criteria outlined in the AENV approval for the LLS Project.

Operations Potable Water and Wastewater Treatment Plants:

Detailed design of the potable water and wastewater treatment facilities is ongoing and will be developed in accordance with all applicable regulations. Potable water treatment technology will be dependant on the source water quality. As no water wells have been drilled to support this use in advance of the Project being approved, it is difficult to provide details on the facility design.

The Long Lake Project utilizes a reverse osmosis potable water treatment system with storage and distribution contained in a single area. Disinfection is achieved through the injection of sodium hypochlorite.

The wastewater treatment plant for the administration building at LLS will be a skid mounted activated sludge style plant designed to achieve the discharge criteria as outlined in the AENV approval to operate.

LLS construction staff will be housed in the existing Long Lake construction camp and will utilize existing approved water and wastewater treatment facilities and infrastructure.

23.	<p>Supplemental Information, Part 2, Section 2.6 Water Supply & Management, SIR Response #128, Page 152</p> <p>Provide detailed plan and implementation program for the protection of surface water addressing:</p> <ul style="list-style-type: none">I. a surface water monitoring program to assess the performance of water management systems.II. water quality monitoring program for metals and other relevant substances.
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Response

Surface water quality monitoring for the LLS Project will include local and regional lakes, rivers and wetland areas and will complement and expand the existing approved Long Lake monitoring plan. The parameters for water quality analysis generally include the following: conventional parameters, nutrients, total metals and polycyclic aromatic hydrocarbons. These parameters are consistent with previous surveys conducted in the region for RAMP.

24.	<p>Supplemental Information, Part 2, Section 2.7 Water Quality, SIR Response #137, Page 157</p> <p>OPTI/Nexen have stated that only a small number of deep wells had Formation Imaging (FMI) logs run and therefore the dataset for observing fractures in the Devonian and post Keg River section is small. From the small amount of information that is available, fracturing is present, but appears to be infrequent.</p> <p>a) Extent and potential significance of fracturing in the area is currently unknown. Once operating, explain how OPTI/Nexen would be able to detect lack of containment within the disposal or production interval as a result of fracturing.</p>
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Response

Although fractures have been observed through the disposal intervals of the disposal wells in which FMI logs were run, the disposal interval (within the Keg River Formation) is vertically contained by the thick (in the order of 200 m) Devonian sequence of shales and carbonates, which stratigraphically overlies the Keg River Formation. Further, the Keg River Formation is significantly underpressured in the general area of LLS, which indicates regional vertical confinement.

The disposal wells to be completed in the Keg River Formation will be licensed under EUB Directive 051 and, as such, the disposal wellhead pressures will be maintained below 90% of the fracture parting pressure (FPP). Therefore, existing fractures will not propagate due to disposal operations.

24.	<p>b) If lack of containment within these zones is detected, explain OPTI/Nexen's mitigation plan for dealing with this situation.</p>
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Response

The Partners' plan for dealing with containment is to operate at 90% of the fracture parting pressure (FPP) and, therefore, existing fractures will not propagate due to disposal operations.

25.	<p>Supplemental Information, Part 2, Section 2.7 Water Quality, SIR Response #145, Page 166</p> <p>The percent change in groundwater flux is calculated during winter conditions when groundwater contributions would be at their maximum. Define the change in groundwater flux during summer conditions.</p>
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Response

The LLS Project water demand is not expected to vary seasonally and the groundwater withdrawal effect over the entire Gregoire River watershed is estimated to peak at approximately 690 m³/d (Volume 3, Section 6.8.2.1). The estimated mean monthly flows on the Gregoire River at its mouth in June, July and August are 6.49 m³/s, 5.76 m³/s and 5.62 m³/s, respectively (Volume 3, Table 6.7-11). Therefore, the predicted groundwater withdrawal effect represents 0.1% of the estimated mean monthly flows on the Gregoire River during summer months.

26.	<p>Supplemental Information, Part 2, Section 2.7 Water Quality, SIR Response #149, Page 168</p> <p>It is well understood that every ecological parameter cannot be measured within the framework of an impact assessment. However, how were sampling locations in the Local Study Area selected? For example, were areas subject to potential impacts specifically targeted? Did the sampling program focus on more sensitive surface water features?</p>
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Response

Sampling locations within the LSA were chosen to reflect the range of characteristics observed in the watercourses and waterbodies in proximity to the majority of LLS Project activities. The study reaches chosen reflect the different types of watercourses and waterbodies in the area; therefore, data collected represent the general aquatic environment in the LSA. The information collected during the period of pre-disturbance is considered baseline information and will be used as background for future LLS Project monitoring requirements.

Future monitoring for the LLS Project will be conducted in areas potentially impacted by LLS Project activities (i.e. watercourses, waterbodies and wetlands) during construction, operations and closure. The results of this monitoring will be compared to the conditions observed at baseline to aid in determining impacts and required mitigations. Monitoring changes in the aquatic environment continually will allow the Partners to adaptively manage and mitigate Project effects over time.

27.	<p>Supplemental Information, Part 2, Section 2.7 Water Quality, SIR Response #150, Page 169</p> <p>It is well understood that every ecological parameter cannot be measured within the framework of an impact assessment. However, how were sampling locations in the Regional Study Area selected? For example, were areas subject to potential impacts specifically targeted? Did the sampling program focus on more sensitive surface water features?</p>
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Response

Sampling locations in the RSA were chosen to reflect the various types of watercourses and waterbodies located within close proximity to the majority of LLS Project activities. Similar to [AENV Water Response 26](#), the specific study reaches chosen reflect the different types of watercourses and waterbodies in the area, therefore data collected represent the general aquatic environment in the RSA.

28.	<p>Supplemental Information, Part 2, Section 2.7 Water Quality, SIR Response #157, Page 173</p> <p>a) Comment on the low number of TSS samples taken and whether this represents an adequate baseline data set for this important water quality parameter.</p>
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Response

Total suspended solids (TSS) were collected during the spring and fall field programs related to the LLS Project. The collection of TSS during the spring represents a period in which levels are expected to be elevated due to increased surface water runoff at the time of freshet. Inversely, sampling during the fall represents a period of low flow where TSS levels are expected to be lower. More important than collecting TSS data during baseline studies is the collection of this data prior to periods of construction activity, for use during construction monitoring.

The Partners are committed to conducting TSS monitoring in the periods of pre-disturbance prior to Project activities. TSS monitoring will be incorporated within routine analysis as a component of any ongoing monitoring programs.

28.	b) This response provides a definition of the phenols group of compounds. Explain the rationale for frequent exclusion of phenols from water quality analysis.
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Response

At the time that baseline data were collected, the phenols group of compounds was excluded from water quality analysis as phenols are commonly found in the natural environment. In accordance with current industry practice and regulatory requirements, the Partners are committed to sampling for phenols during the pre-development assessment in order to establish baseline levels that will be utilized during ongoing monitoring programs.

29.	Supplemental Information, Part 2, Section 2.7 Water Quality, SIR Response #158, Page 174 Sewage releases, although treated, will represent an increase to naturally occurring water quality parameter exceedences. Provide the rationale for concluding that sewage projected releases will not induce further exceedences of water quality guidelines.
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Response

It is not predicted that the stormwater and wastewater discharge to WB-18 will have an adverse effect on the overall water quality of the waterbody and the downstream receiving watercourses and waterbodies based on quantities and release standards. The predicted daily volume of the effluent releases is approximately 32 m³/day. Prior to release, sewage will be treated and held in the proposed stormwater runoff ponds. Effluent will be tested prior to release using approved sampling protocols and will only be released once water quality of a pond is within the stringent regulatory guidelines provided by AENV. The wetlands monitoring program will incorporate WB-18 and its associated drainage to ensure that water quality is maintained.

30.	<p>Supplemental Information, Part 2, Section 2.7 Water Quality, SIR Response #166a., Page 179 (Response provided in SIR #120a)</p> <ul style="list-style-type: none">a. Justify why Lake 11 is not included as one of the future monitoring sites, when the prediction showed (application scenario) it will have a critical load exceedance.b. Discuss whether OPTI/Nexen will include other lakes (Push-Up Lake, Unnamed Lake 1, Lake 170, and Lake 287) that have critical load exceedances under baseline conditions in future monitoring programs.
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Response

A surface water monitoring program for the LLS Project will be developed post-Project approval with input from AENV and may include, but not be limited to, the requirement to monitor Lake 11. The monitoring program will target areas of potential impact from LLS Project activities as well as background reference locations.

At present, Push-Up Lake is a component of the Long Lake Project's wetlands monitoring program, and Unnamed Lake 1, Lake 170, and Lake 287 are components of the RAMP acid sensitive lakes monitoring program, in which the Partners participate.

31.	<p>Supplemental Information, Part 2, Section 2.8 Hydrogeology, SIR Response #167, Page 179</p> <p>Part of the issue not addressed in this response relates to the incomplete characterization of baseline groundwater quality in the various Quaternary units. A baseline hydrochemical characterization of each hydrostratigraphic unit would serve as a point of reference in the event of a release of contaminants. If a spill or subsurface release were to occur, the proponent would be able to assess the resulting changes in groundwater quality by comparison to the baseline data set. How will the proponent characterize baseline groundwater quality prior to operation?</p>
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Response

As described in Volume 3, Section 5.8.1, a network of groundwater monitoring wells will be installed at the LLS Project CPF in order to obtain pre-start-up data for groundwater levels, flow conditions and groundwater quality. A minimum of three sampling events of the groundwater monitoring well network will be conducted prior to commencing operations.

32.	Supplemental Information, Part 2, Section 2.8 Hydrogeology, SIR Response #177, Page 186 a) Does the heat transport model account for the effects of multiple well casings at a well pad?
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Response

The one-dimensional heat transport model implicitly accounts for multiple wells by implementing a continuous and infinite length heat source aligned perpendicular to the groundwater flow direction. This heat source is analogous to an infinite length of well casings with zero space between each heat source. In reality there will be a finite number of wells on each well pad and therefore the analysis is conservative.

32.	b) If the direction of groundwater flow is aligned parallel to the arrangement of wells at a pad, are the effects of multiple well casings additive?
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Response

The model implicitly includes the additive effects of multiple well casings by conservatively assuming that the groundwater surrounding the well casing reaches the same temperature as the steam.

33.	Supplemental Information, Part 2, Section 2.8 Hydrogeology, SIR Response #182, Page 192 The response to SIR #182 is the same as the response to SIR #181, yet does not seem to address the SIR Response #. Is this an editorial error?
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Response

An editorial error occurred. SIR Aug/07 [AENV Question 182](#) and the correct response are provided below:

182.	Volume 3, Section 5.5.3.8, Page 5-25 (TOR 4.7.5.3). <i>Discuss the potential for vertical hydraulic connectivity between the McMurray Formation and Quaternary deposits within the Gregoire Channel. Discuss the potential for pressure transmission across hydrostratigraphic units, and mitigation measure that could be implemented to minimize such effects.</i>
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As discussed in Section 5.5.3.8, the hydraulic head within the Gregoire Channel is generally 100 m greater than the hydraulic head in the underlying McMurray Aquifer suggesting that an aquitard exists between the Gregoire Channel and McMurray Aquifer. The predicted change in hydraulic head at the base of the Gregoire Channel Aquifer due to the proposed groundwater withdrawal from the McMurray Aquifer is less than 4 m (Volume 3, Figure 5.6-9) and was rated as a low magnitude impact (Volume 3, Table 5.6-2). As described in Volume 3 Section 5.8.2, the Partners have an extensive groundwater monitoring network within the Gregoire Channel Aquifer and McMurray Aquifer (Volume 3, Table 5.8-2) to monitor the potential changes in hydraulic head and potential pressure transmission between the aquifers.

34.	Supplemental Information, Part 2, Section 2.8 Hydrogeology, SIR Response #183, Page 192
	Describe mitigative design features for operating areas of the project should the surficial geological unit possess high hydraulic conductivities.

Response

The LLS CPF will be constructed in an upland area with naturally occurring clay till. As discussed in Volume 3, Section 5.6.1, the uppermost clay till unit in the region is expected to be the Grand Centre Formation. Mitigative strategies that will be used at the CPF will include:

- Flowlines and storage tanks will be located above ground to facilitate leak detection;
- Storage tanks will be designed to meet EUB Directive 055;
- Best management practices will be adhered to throughout the LLS Project to meet industry standards; and
- A groundwater monitoring program will be implemented (Volume 3, Section 5.8.1) to facilitate early detection of groundwater quality changes and to initiate an incident specific groundwater response plan. This plan will implement remediation and/or risk management strategies where necessary (Volume 3, Section 5.8.5).

35.	Supplemental Information, Part 2, Section 2.8 Hydrogeology, SIR Response #195, Page 197 The response to SIR #195 is the same as the response to SIR #194, yet does not seem to address the question. Do the higher chloride concentrations in the Gregoire Channel Aquifer indicate possible connectivity between the underlying bedrock units?
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Response

An editorial error occurred. SIR Aug/07 [AENV Question 195](#) and the correct response are provided below:

195.	<i>Volume 3, Section 5D1, Appendix 5D, Table 5D1.0-1 (TOR 4.7.5.2). Sodium and chloride concentrations in the Gregoire Channel Aquifer appear to be elevated relative to concentrations in the remaining overburden units. Discuss the possible reasons for this.</i>
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The higher chloride concentrations in the Gregoire Channel Aquifer do not indicate possible connectivity between the Gregoire Channel Aquifer and the McMurray Formation. Higher sodium and chloride concentrations within the Gregoire Channel Aquifer are interpreted to be primarily associated with groundwater mixing between groundwater from the shallow Undifferentiated Overburden Aquifer/Aquitard and from the Lower Grand Rapids Aquifer (Volume 3, Section 5.5.3.8 and Figure 5.5-45).

36.	Supplemental Information, Part 2, Section 2.8 Hydrogeology, SIR Response #200, Page 225 Provide similar commentary for wells WM QCH 2-32S and VWP 342, comparing simulated versus observed drawdowns.
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Response

As described in Volume 3, Appendix 5E, Section 5E-3.25, water level data collected during operational pumping from well WS QCH 02-32 in the Gregoire Channel Aquifer were used for the model transient calibration of the channel deposits. The water level data used in the calibration were:

- Monitoring well MW QCH 2-32S that is screened at approximately the same elevation as the pumping well and located approximately 80 m from the pumping well (approximately 130 m below ground surface);

- Vibrating wire piezometer VWP 10-29/342 located at a distance of approximately 850 m from the pumping well at an elevation of approximately 342 masl (approximately 130 m below ground surface);
- Vibrating wire piezometer VWP 10-29/381 located at a distance of approximately 850 m from the pumping well at an elevation of approximately 381 masl (approximately 91 m below ground surface); and
- Vibrating wire piezometer VWP 10-29/423 located at a distance of approximately 850 m from the pumping well at an elevation of approximately 423 masl (approximately 49 m below ground surface).

As discussed in Volume 3, Appendix 5E, Section 5E-3.25 and illustrated in Volume 3, Figure 5E 3.2-9, the calibrated model was interpreted to overestimate the predicted drawdown compared to the observed drawdown at the shallower observation points (VWP 10-29/423 and VWP 10-29/381) and therefore was considered conservative for the purpose of an EIA. The calibrated model was interpreted to underestimate the predicted drawdown compared to the observed drawdown at deeper observation points (VWP 10-29/342 and MW QCH 2-32S). This underestimate of predicted drawdown within the deeper part of the Gregoire Channel Aquifer was not considered significant to the conclusions of the EIA as the LLS Project is not proposing to pump groundwater from the Gregoire Channel Aquifer.

37.	<p>EIA Report, Volume 3, Section 5, Appendix 5E, Numerical Model</p> <p>Concern exists about the long term sustainability of the non-saline and saline sources of groundwater that will be utilized by the leaseholders in the area for their SAGD and processing operations, and about the combined cumulative effects of this use on the environment. The following question deals with OPTI/Nexen Long Lake Numerical Model (EIA Volume 3, Section 5, Appendix 5E) and other information provided by OPTI/Nexen.</p> <p>The Introduction to Appendix 5E identifies the current model as being an updated version of the Golder 2004 model and that it was constructed and calibrated to forecast potential impacts. Under the Model Calibration Section (5E-3), 4 hydrostratigraphic units are identified including “a pumping test of a Lower Grand Rapids Aquifer.” The Calibration Results section (5E-3.2.3) indicates that the source well (WS GR 6-18), located at LSD 6-18-85-6-W4, which was pumped at 1350 m³/d, was used to calibrate the model.</p> <p>a) Provide the reference for the Golder 2004 model as it is not referenced in Section 5E-5 and background on which areas of the former model were updated in the current groundwater flow model; and</p>
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Response

As described in Volume 3, Appendix 5E, the numerical model used in the hydrogeology impact assessment was an update of an existing model that was developed in 2004 and is described in the following reference:

Golder Associates, Nov. 2005. *Long Lake Project Groundwater Flow Model Update and Calibration*. Submitted to Nexen Canada Ltd.

The most significant model updates included:

- Geologic surfaces and isopachs were adjusted for a number of hydrostratigraphic units contained in the model. Data sources used to map both thickness and structure for each hydrostratigraphic unit are detailed in Volume 3, Appendix 5E, Section 5E-2.5.1;
- As described in Volume 3, Appendix 5E 2.3.2.3, transfer boundary conditions were assigned to the Lower Grand Rapids and McMurray Aquifer model layers to simulate the effects of regional-scale aquifer support groundwater flow; and
- The simulated topographic surface was refined in the areas of the river valleys (Volume 3, Appendix 5E, Section 5E-2.3.2.3).

Once the groundwater model was constructed, the model was calibrated through a trial and error process to obtain a representative estimate of hydraulic parameters. Model calibration was based on the results of exploration and testing programs and operational history from a number of oil sands projects in the region. The project team has experience building and calibrating numerical groundwater models at these projects to assess hydrogeologic impacts related to proposed make-up water withdrawals. As detailed in Volume 3, Appendix 5E, Section 5E-3.1, this background experience from the region was supplemented using five Project-specific calibration targets:

- pre-development groundwater elevations;
- a pumping test of the Clearwater B Aquifer;
- a pumping test of the Grand Rapids Aquifer;
- Gregoire Channel Aquifer pumping; and
- A McMurray Aquifer pumping test.

The results of these Project-specific calibration targets were used in conjunction with the project team's experience to select the calibrated model hydraulic parameters listed in Volume 3, Appendix 5E, Table 5E3.2.

37.	<p>b) Based on the information provided in Appendix 5E, the following information is noted:</p> <ul style="list-style-type: none">the WS GR 6-18 source well was tested at the highest rate of all the existing Grand Rapids source wells (1300 m³/d) and was used to calibrate the model. Specific test rates of the other 16 Grand Rapids wells include: 360, 400, 450, 650, 680, 700, 800, 850, 890, 900, 1000, 1040 and 1100 (3 wells) and 1220 m³/d.In the case of the Clearwater Formation, it is noted that measured water levels of WS CLW 06 -30 are calibrated to the simulated water levels of WS CLRW 6-31 (Figure 5E3 2-6). <p>Discuss the reliability of the model given the limited number of source wells used to calibrate the model.</p>
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Response

Based on the results of the model calibration and the team's experience in the region, the model was deemed suitable for conservatively assessing the potential impacts of the proposed groundwater withdrawal.

Gregoire Channel Aquifer: the model calibration is considered conservative as described in response to [AENV Water Response 36](#).

Grand Rapids Aquifer: the model calibration target described in Volume 3, Appendix 5E, Section 5E-3.2.3 suggested an aquifer hydraulic conductivity and specific storage of 8.5×10^{-5} m/s and 2×10^{-5} 1/m, respectively. In order to obtain more conservative prediction simulations that were used for the impact assessment, the Grand Rapids Aquifer was assigned hydraulic conductivity and specific storage values of 2×10^{-5} m/s and 2×10^{-6} 1/m, respectively (Volume 3, Appendix 5E, Table 5E3.2). The assigned hydraulic conductivity value is slightly less than the geometric mean (2.3×10^{-5} m/s) of the compiled hydraulic conductivity measurements (Volume 3, Section 5.5.3.5, Figure 5.5-33 and Appendix 5C).

Clearwater B Aquifer: As described in Volume 3, Appendix 5E, Section 5E-3.2.2, the match between the simulated and measured drawdown at WS CLW 06 -30 and WS CLRW 6-31 is excellent (Volume 3, Appendix 5E, Figure 5E3 2-6). The assigned hydraulic conductivity value (5×10^{-6} m/s) is slightly less than the geometric mean (5.6×10^{-6} m/s) of the compiled hydraulic conductivity measurements (Volume 3, Section 5.5.3.6, and Appendix 5C).

McMurray Aquifer: The model calibration target described in Volume 3, Appendix 5E, Section 5E-3.2.4 suggested an aquifer hydraulic conductivity and specific storage of 5×10^{-5} m/s and 3×10^{-6} 1/m, respectively. In order to obtain more conservative prediction simulations that were used for the impact assessment, the McMurray Aquifer was assigned hydraulic conductivity values that ranged between 5×10^{-7} m/s and 5×10^{-5} m/s (as described in Volume 3, Appendix 5E, Section 5E-2.3.2.2) and a specific storage value of 3×10^{-6} 1/m, respectively (Volume 3, Appendix 5E, Table 5E3.2). The geometric

mean of the compiled hydraulic conductivity measurements (1.9×10^{-5} m/s; Volume 3, Section 5.5.3.8) falls within the assigned range of hydraulic conductivity values.

38.	<p>EIA Report, Volume 3, Section 5, Appendix 5E, Numerical Model</p> <p>Table 5E3.1 (Section 5E-3.2.1) identifies the Grand Rapids Formation wells used to calibrate the model. Review of the Grand Rapids Formation information indicates that 63 of the 88 simulated heads are more than 5 m higher than the measured head, and 43 of the 88 simulated heads are more than 10 m higher than the measured head.</p> <p>a) Given this variability, provide information to show that this model accurately reflects the Grand Rapids Formation's ability to provide fresh water over the life of the project.</p>
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Response

The simulated productivity of the Lower Grand Rapids Aquifer is more sensitive to the assigned hydraulic conductivity value than to the simulated steady state water table distribution. Therefore, when assessing if the model is a conservative representation of the productivity of the Lower Grand Rapids Aquifer, it is important to compare the assigned hydraulic conductivity value to the measured values.

As described in Volume 3, Section 5.5.3.5, the Partners have drilled and tested an extensive network of Lower Grand Rapids Aquifer water supply wells and monitoring wells. In total, hydraulic parameters for the Lower Grand Rapids Aquifer have been estimated from pumping tests at 39 locations within the LSA (listed in Volume 3, Appendix 5C). The representative range of hydraulic conductivity values is 1.7×10^{-6} m/s to 9.9×10^{-5} m/s and the geometric mean of these estimates is 2.3×10^{-5} m/s. Because such a large number of hydraulic conductivity measurements have been made, the Partners are confident that the geometric mean is representative of the aquifer. The model is considered to be a conservative estimate of the aquifer productivity because the simulated hydraulic conductivity of the Lower Grand Rapids Aquifer (2.0×10^{-5} m/s) is less than the geometric mean.

The Partners have an extensive monitoring network in place (Volume 3, Section 5.8.2) to monitor water level response in the Lower Grand Rapids Aquifer due to planned groundwater pumping associated with the Long Lake Project. This program will provide additional insight into aquifer productivity and an opportunity to validate the model predictions many years before the LLS Project is commissioned.

38.	b) In the event that the Grand Rapids Formation is not capable of meeting the demand for fresh water, what options are available for OPTI/Nexen to meet their fresh water requirements, as identified in Table 20-1 (SIR Response, Part 2, Following Page 16)?
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Response

Table 9-1 (EUB Response 9) is a revised version of Table 20-1.

As discussed in [AENV Water Response 7](#), the LLS Project will have non-detectable impacts on the groundwater resources. In the event that the Grand Rapids Formation is not capable of meeting the fresh water demand for the Long Lake Project (Table 9-1), possible mitigation measures include drilling additional source wells and increasing source well spacing.

39.	<p>EIA Report, Volume 3, Section 5, Appendix 5E, Numerical Model</p> <p>Nexen identifies the general locations of the source wells on the Long Lake, Long Lake South and Surmount project areas. The Golder Associates Long Lake Phase 1 Well Network Design Modeling figures indicate that the combined withdrawal by the Long Lake and Surmont projects will create water level declines over an area of approximately 2500 km².</p> <p>Provide updated simulation results of the cumulative effect (drawdown) of groundwater production from the Quaternary/Channel deposits and the Grand Rapids and Clearwater Formations and surface water sources after 5, 10, 20, 30 and 40 years.</p>
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Response

As discussed in [AENV Water Response 7](#), the LLS Project will have non-detectable impacts on the fresh groundwater resources. The cumulative impact assessment on fresh groundwater resources has already been conducted in the 2003 Long Lake EIA for a Long Lake fresh water demand of 9,000 m³/d. This cumulative impact assessment will be updated, under separate cover, in the project update for Long Lake that will consider the increased Long Lake upgrader fresh water demand to a total of approximately 14,000 m³/d.

Updated simulations of the cumulative effect of groundwater production from the Quaternary/Channel deposits, Grand Rapids and Clearwater formations will be presented in the Long Lake project update.

40.	EIA Report, Volume 3, Section 5, Appendix 5E, Numerical Model
	Drawdown in the Grand Rapids Formation is predicted to be less than 1 m at the north end of the Long Lake lease and at least 30 m on the Surmount lease after 20 years of production (Long Lake and Surmont lease). Provide the background and reason why this significant difference in drawdown exists within the same aquifer unit?

Response

The simulated distribution of drawdown after long periods of pumping (20 years in this case) is dependant on the rate of simulated induced recharge. In areas where the Colorado Group Aquitard is present (i.e. at the CPC Surmont Project; Volume 3, Figures 5.5-7 and 5E2.3-15), the induced recharge is limited by the low vertical permeability of the Colorado Group Aquitard. In areas where the Colorado Group Aquitard is not present (e.g. at the Long Lake Project; Volume 3, Figures 5.5-7 and 5E2.3-15) the potential induced recharge is greater because it is not limited by the low vertical permeability of the Colorado Group Aquitard. As a result, it is expected that for a similar pumping rate, the magnitude and spatial extent of drawdown in the Lower Grand Rapids Aquifer would be greater in regions where the Colorado Group Aquitard was present compared to areas where the Colorado Group Aquitard was not present. In addition to induced recharge from the ground surface, the Grand Rapids Aquifer outcrops into the Christina and Gregoire rivers in the vicinity of the Long Lake Project. Thus, these rivers were simulated as constant head boundaries (heads are constant through time; groundwater discharge into the rivers varies through time). There are no rivers incised into the Grand Rapids Aquifer in the vicinity of the CPC Surmont Project.

Because both the Christina and Gregoire rivers and Colorado Group Aquitard are explicitly included in the numerical model, the simulation results are consistent with the distribution of variable induced recharge in the region.

41.	EIA Report, Volume 3, Section 5, Appendix 5E, Numerical Model
	Table 1 - Final Simulated Well Rates identifies three (3) source wells completed within the Grand Rapids Formation that produce saline groundwater.
	Provide chemical analyses and a discussion why these wells produce saline groundwater while adjacent wells produce non-saline groundwater.

Response

Total dissolved solids (TDS) concentrations for the Lower Grand Rapids Aquifer are reported in Table 41-1 (below) for 44 locations within the Long Lake general area. These TDS concentrations were calculated from laboratory-measured values for electrical conductivity (EC) of groundwater samples collected at the end of 3-day constant rate pumping tests for source wells, or at the end of well development for monitoring wells.

The TDS concentrations presented in Table 41-1 range from 623 mg/L to 7,560 mg/L (Lower Grand Rapids Aquifer in the Long Lake general area). The variability of the Grand Rapids TDS in the Long Lake general area is consistent with the observed variability in the Grand Rapids TDS at other SAGD projects (e.g. Devon Jackfish Project; Devon, 2006). The mechanism for this variability is unknown, but it is hypothesized to be a result of variable recharge rates of meteoric waters and, therefore, variable rates of flushing of connate waters over geologic time scales.

Devon Canada Corporation, 2006. "Application for Approval for the Devon Jackfish 2 Project". Submitted by Devon ARL Corporation to Alberta Energy and Utilities Board and to Alberta Environment, September 2006.

Table 41-1 TDS Concentrations within the LSA - Lower Grand Rapids Aquifer

Well Location	Well Name	Well type	Total Dissolved Solids Concentration (mg/L)
01-21-085-06 W4M	WS GR 1-21-85-6	Source	1690
01-27-085-06 W4M	WM GR 1-27-85-6	Monitoring	712
01-27-085-06 W4M	WS GR 1-27-85-6	Source	1180
01-34-085-06 W4M	WS GR 1-34-85-6	Source	1560
01-34-085-06 W4M	WM GR 1-34-85-6	Monitoring	1660
05-01-085-06 W4M	WS GR 5-1-85-6	Source	1470
06-08-085-06 W4M	WS GR 6-8-85-6	Source	3630
06-18-085-05 W4M	WS GR 6-18-85-5	Source	1050
06-19-085-06 W4M	WS GR 6-19-85-6	Source	751
06-26-086-07 W4M	WM GR 6-26-86-7	Monitoring	947
07-23-085-06 W4M	WS GR 7-23-85-6	Source	5770
07-23-085-06 W4M	WM GR 7-23-85-6	Monitoring	7560
07-26-086-07 W4M	WS GR 7-26-86-7	Source	859
07-36-085-07 W4M	WS GR 7-36-85-7	Source	689
08-01-086-07 W4M	WM GR 8-1-86-7	Monitoring	1940
08-01-086-07 W4M	WS GR 8-1-86-7	Source	2140
08-17-085-06 W4M	WS GR 8-17-85-6	Source	1450
08-17-085-06 W4M	WM GR 8-17-85-6	Monitoring	1770
09-25-085-06 W4M	WS GR 9-25-85-6	Source	6840
09-28-085-06 W4M	WS GR 9-28-85-6	Source	1430
10-11-085-06 W4M	WS GR 10-11-85-6	Source	3620
10-21-085-06 W4M	WS GR 10-21-85-6	Source	1810
10-21-085-06 W4M	WM GR 10-21-85-6	Monitoring	2190
11-02-086-07 W4M	WM GR 11-2-86-7	Monitoring	3880
11-20-085-05 W4M	WS GR 11-20-85-5	Source	711
11-29-084-06 W4M	WS GR 11-29-84-6	Source	5650
11-29-084-06 W4M	WM GR 11-29-84-6	Monitoring	6010
11-32-084-06 W4M	WS GR 11-32-84-6	Source	3300
11-32-084-06 W4M	WM GR 11-32-84-6	Monitoring	4240
11-36-085-06 W4M	WS GR 11-36-85-6	Source	1800
12-03-085-06 W4M	WS GR 12-3-85-6	Source	4280
12-19-085-05 W4M	WS GR 12-19-85-5	Source	2350
15-25-085-07 W4M	WS GR 15-25-85-7	Source	1180
15-25-085-07 W4M	WM GR 15-25-85-7	Monitoring	1480
15-28-085-06 W4M	WS GR 15-28-85-6	Source	1500
15-28-085-06 W4M	WM GR 15-28-85-6	Monitoring	1510
16-09-086-07 W4M	WM GR 16-9-86-7	Monitoring	1150
16-25-084-07 W4M	WM GR 16-25-84-7	Monitoring	2230
16-25-084-07 W4M	WS GR 16-25-84-7	Source	2510
16-27-084-07 W4M	WM GR 16-27-84-7	Monitoring	1770
16-27-084-07 W4M	WS GR 16-27-84-7	Source	1830
16-29-085-06 W4M	WS GR 16-29-85-6	Source	623
16-33-085-06 W4M	WM GR 16-33-85-6	Monitoring	1450
16-33-085-06 W4M	WS GR 16-33-85-6	Source	1460

Note: TDS concentrations calculated from values of electrical conductivity (EC)

AENV Aquatics

1.	Supplemental Information, Part 1, Update Section 3.8.2, Page 67
	a) There is mention of a potential hydrological impact on Waterbody 18 (WB-18). Describe this potential hydrological impact.

Response

Potential environmental changes to WB-18 involve a possible decrease in surface water runoff from the up-slope area near the proposed CPF location. Stormwater runoff from the CPF will be collected in ponds and tested to ensure that it meets water quality guideline levels prior to being released. The surface water runoff and collection pond discharge will maintain water levels in WB-18.

1.	b) Describe the location of WB-18, as it is not referenced on any maps in the original EIA, nor this Project Update and Supplemental Information.
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Response

The location of WB-18 is in the SW ¼ and SE ¼ of Section 25-84-7 W4M.

1.	c) Describe the connectivity of WB-18 to other watercourses and waterbodies within the LSA and describe the potential for fish migration and seasonal use of WB-18 between the sampling periods described in this section (i.e. Mid-May to mid- February). (Information provided should not include “habitat potential,” as this is already described in Fig 3.8-1. Evaluate the potential for fish to migrate into and inhabit WB-18 during the late spring and summer seasons.)
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Response

WB-18 is a small wetland surrounded by typical grasses and shrubs. The outlet to WB-18 passes through a culvert under Highway 881 and flows into a small tributary of approximately 450 m in length prior to joining the watercourse that connects Horse Lake (WB-3) to Kinosis Creek. The tributary flows in an easterly direction and is characterized by a series of beaver impoundments with dams ranging from 1 to 4 m in height. Flows through the culvert are low but are not considered a barrier to fish migration. The potential exists for fish to move between the tributary and WB-18; however, given the small size of the tributary, the measured dissolved oxygen (DO) and presence of large beaver dams, fish migration through the area is likely to be minimal.

Refer to AENV Water Response 17 for additional information on sampling details.

1.	d) Describe the potential for fisheries impact related to the above-mentioned potential hydrological impact on WB-18 by the LLS Project, and if necessary, discuss monitoring and mitigation strategies.
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Response

Changes to fish and fish habitat in WB-18 are likely to be minimal. Any surface water runoff from the CPF that would normally flow into the waterbody will be collected and tested before it is returned to the watershed. Hydrologic functioning of this waterbody is predicted to be maintained.

2.	EIA Report, Volume 3, Section 8.6.1, Page 8-48. Specific indicators are used because they are able to signal environmental changes that may be caused by project related activities. Brook stickle backs are found throughout the area, but as stated in the application they can survive where no other species can. It is unlikely, unless under the most catastrophic event that their population status would be affected. Pike were found in such small numbers and in only in two waterbodies. Clarify the choice of indicators.
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Response

Brook stickleback are common in the area and provide a food source for locally important sport fish such as northern pike. Information collected on brook stickleback can be used to assess the status of lower trophic levels and the productivity of an aquatic system.

Northern pike are found throughout northern Alberta, and are an important sport fish and a vital member of the upper trophic level in the aquatic community. Because they are common in many waters south of Fort McMurray, it is important to consider their potential for inhabiting waters in the LSA. The absence of northern pike in many of the field surveys does not diminish its value for use as an indicator. Evaluating the potential for important northern pike habitat (e.g., spawning habitat) is an important indicator when the likelihood of the species occurring in the area is high.

3.	EIA Report, Volume 3, Section 8.6.2 Page 8-48. a) Clarify how changes in the indicators will be predicted in light of the very small sample sizes. b) What will changes be based upon given no population estimates or any other information that can be used was collected in sufficient quantity for comparison purposes over time? c) Explain what future fisheries work will be proposed to collect this population information?
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Response

Predictions about population level changes were made using a conservative approach with the assumption that suitable fish habitat would support a fish community. Rather

than the number of indicator species present, the focus of the baseline assessment is species' presence/absence. It is therefore assumed that species' presence over time indicates overall habitat quality.

The Partners will support current aquatic monitoring programs in the area (Volume 3, Section 8.8) and will fulfill all approval monitoring conditions.

4.	EIA Report, Volume 3, Table 8.4-1, Page 8-6. No fisheries information was collected in the unnamed tributary in proximity to the area of greatest disturbance. How and when will this information be collected?
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Response

A representative selection of watercourses were chosen to characterize streams in the area and were not intended to provide site-specific details for Project development. Site-specific fish and fish habitat assessments are required under the regulations and will be completed prior to the occurrence of any construction activities. Furthermore, the Partners intend to follow Best Management Practices (BMPs), which are designed to mitigate potential changes to the aquatic environment.

5.	EIA Report, Volume 3, Section 8.6.3, Page 8-49. The report indicated that over-wintering habitat for large-bodied as well as forage fish was limited. Will culverts be sized appropriately to allow passage of the smaller forage fish?
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Response

Watercourses large enough to have overwintering potential for smaller forage fish will not likely be crossed with a culvert. Rather, a bridge designed to maintain flows will be installed. Were culverts to be employed, they would be sized to adequately ensure channel morphology is maintained and fish movement is not restricted.

6.	EIA Report, Volume 3, Section 8.7, Page 8-60. The proponent states since impacts to fish and fish habitat from the LLS project are negligible or localized, there will be no cumulative impacts of the project since no new projects are planned for the area. Cumulative effects should also consider how this project increases impacts in combination with projects already in area. Provide a cumulative effects assessment.
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Response

The method used for cumulative impact assessment is consistent with current oil sands SAGD project applications and is described in the Impact Assessment Approach (Volume 2, Section 1.3). The baseline condition of the LSA (Volume 3, Section 8.5) characterizes the fish and fish habitat under the influence of existing projects in the area.

Additional environmental changes associated with the LLS Project (above and beyond current projects in the area) are included in the Impact Assessment and Mitigative Measures section (Volume 3, Section 8.6). Therefore, the impact assessment considers changes in the environment associated with the project in combination with other existing activities in the area.

AENV Terrestrial

1.	<p>Supplemental Information, Project Update, Section 1.5, Page 7</p> <p>According to the project update, OPTI/Nexen plans to use two utility corridors, one 138 metres wide and a second 100 metre ROW, instead of the original planned 280 metre wide ROW. It is noted that this will result in less overall disturbance to the land. Identify all mitigation measures to be implemented to reduce impacts to wildlife movement.</p>
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Response

The Partners have attempted to use existing and/or parallel existing ROWs. With the revised pipeline routing, the two ROWs are separated by an adequate buffer over 1.5 km wide. As stated in the SIR Aug/07 Project Update, the new pipeline ROW follows a more direct route between the facilities, which results in a 12% decrease in overall disturbance.

The assessment included in the SIR Aug/07 Project Update, which includes the new pipeline routing, did not identify any changes to impact ratings. The ROWs referenced above include buried pipelines and transmission lines. There are no above ground pipelines within these two ROWs that will block wildlife movements. ROWs through forested landscapes may act as barriers to some wildlife species depending on their width. The two new ROW configurations reduce the width from the initial plan of 280 m to 100 m and 138 m, therefore reducing the impact to wildlife movements. Other mitigation could include visual breaks such as slash piles or access controls to reduce hunting pressure.

2.	<p>Supplemental Information, Part 2, Section 2.1, SIR Response #1, Page 25.</p> <p>OPTI/Nexen has indicated that additional infill wells will be required to maximize resource recovery. Discuss the intent to apply for these additional infill wells within the Phase 1 Initial Development Area and to provide updated environmental assessment and cumulative effects assessment information.</p>
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Response

The additional wells that will be required have already been accounted for in the impact assessment. These wells are classified as future development wells. The initial wells on the five well pads will be sufficient to produce enough bitumen to fill the facility capacity. Once the initial wells begin to decline, the sustaining wells will be brought on stream to supplement the production and keep the facility running at capacity.

Prior to when these wells are required for production, these sustaining wells will be applied for within the current regulatory framework. All of the required information will be provided at that time.

3.	<p>Supplemental Information, Part 2, Section 2.1, SIR Response #2, Page 25.</p> <p>OPTI/Nexen has indicated that there are difficulties with locating road crossings in the same right-of-way as above ground pipelines.</p> <ul style="list-style-type: none">a) Provide additional discussion on the difficulties of crossing above ground pipelines, thereby making it desirable or necessary to develop additional ROWs for roads and pipelines.b) Discuss why multiple corridors to each pad are shown in Section 1, Figure 1.3.
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Response

The above ground pipelines (flowlines) are continuously sloped to either the well pads or CPF for process considerations and operability. The emulsion line must be drained in the event of a plant upset so the bitumen does not set-up in the line. The steam line must be sloped and free of pockets to prevent slugging. The low points of the lines require truckout locations to facilitate draining in the event of a shut-down. These truckouts require access and to minimize these locations, they are designed to be either on the well pads or in the CPF area. In order to maintain the slopes on these flowlines and prevent pocketing of the lines, road bridges would be required at flowline crossings. The high cost of the bridges and the large amount of borrow material required to build up the roads for construction and module access dictates that the number of flowline crossings be minimized.

The reason for multiple ROWs is that the flowlines are designed to the shortest possible route due to both process conditions and high costs. This shortest route also requires the crossing of Robert creek with a flowline bridge. The roads to the well pads are designed to make maximum use of existing ROWs, disturbances and existing infrastructure such as the existing bridge across Robert Creek. As the new flowline bridge and the existing road bridge are coming into the well pad area from different directions, there is no opportunity to share the same or adjacent ROWs. Note that the majority of the main access road to the pads makes use of existing ROWs.

3.	<p>c) Provide a discussion of the relative environmental/landscape effects of an increased number and overall distance of narrower ROWs as opposed to fewer but wider ROWs which is a more common industry practice.</p>
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Response

As previously stated, the Partners have attempted to use existing and/or parallel existing ROWs. With the revised pipeline routing, the two ROWs are separated by an adequate buffer over 1.5 km wide. As stated in the SIR Aug/07 Project Update, the new pipeline

ROW follows a more direct route between the facilities which results in a 12% decrease in overall disturbance. The assessment included in the Sir Aug/07 Project Update, which includes the new pipeline routing, did not identify any changes to impact ratings.

4.	<p>Supplemental Information, Part 2, Section 2.2, SIR Response #17, Page 34</p> <p>Wick drains will be put in place to ensure water flow beneath the well pads.</p> <ul style="list-style-type: none">a) Confirm that these wick drains will provide sufficient flow to maintain the viability of existing undisturbed wetlands in the area.b) What mitigative measures will be put in place should drainage to these surrounding areas be affected?c) Will wick drains also be used to augment normal culvert structures and ensure a more natural laminar flow across roads within wetlands?
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Response

To reiterate the response provided to the initial supplemental question regarding wick drains (SIR Aug/07 [AENV Response 17](#)), “the prefabricated drainage composite (wick drain) is proposed to aid in drainage below pads built on peat.” The horizontal wick drain is not intended to ensure water flow beneath the pad.

The Partners understand the need to maintain water flows in certain fen complexes and have included design considerations to ensure this. Water flows around SAGD pads will primarily be managed by surface ditching around the pads while wick drains will aid in the overall area drainage. Access roads that have the potential to affect water flows will be constructed using a combination of culverts, rock drains and wick drains to maintain the local flow patterns. The final selection of drainage products (culverts alone, culverts in conjunction with wick drains, rock drains, etc) will be based on site-specific drainage considerations and cannot be generalized in this response.

Drainage products are available that greatly exceed the natural hydraulic conductivity of fens. Post construction, water levels and drainage patterns will be assessed and mitigated if required. For example, if flows are identified as being restricted, additional drainage materials may be retrofitted into the road bed. If excess drainage is noted, backfilling and partial plugging of drainage products has shown to be an effective method of flow restriction.

5.	<p>Supplemental Information, Part 2, Section 2.2, SIR Response #18, Page 35.</p> <p>The response provided did not address whether the borrow source in the CPF area is sufficient to meet the needs of the LLS project.</p> <ul style="list-style-type: none"> a) Provide a discussion regarding the amount of borrow/aggregate material needed for the life of the LLS project, and how much the currently proposed borrow excavation area in the CPF area can provide. b) Provide a material balance and discuss how a potential shortage of material will be addressed.
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Response

The estimated quantity of borrow for the construction of the LLS Project is 363,000 m³ as shown in Table 5-1. After construction of the two LLS Project phases it is estimated that an annual usage of 70,000 m³/y of borrow will be required for the construction of sustaining well pads/access roads. The borrow source within the CPF can support this requirement based on current geotechnical studies, which have estimated the borrow volume to be over 4,000,000 m³.

The aggregate material requirements for gravel and granular resources requirements are discussed in Volume 5, Section 13.8.3 and in SIR Aug/07 [Response 10](#).

The amount of estimated borrow required for the life of the LLS project is located in the Table 5-1.

Table 5-1 Estimated Borrow Required for the LLS Project

Long Lake South Area	Estimated Net Borrow Requirements (+ indicates excess cut, - indicates borrow required)
Phase 1 CPF	-405,000 m ³
Phase 1 Well pads	-5,000 m ³
Phase 1 Other (Laydown, Roads, etc)	+52,000 m ³
Phase 2 CPF	+820,000 m ³
Phase 2 Well pads	-850,000 m ³
Phase 2 Other (Laydown, Roads, etc)	+25,000 m ³
Total Development Borrow	-363,000 m ³
Sustaining Well pads	-70,000 m ³ /yr

6.	Supplemental Information, Part 2, Section 2.2, SIR Response #19, Page 35. <i>OPTI/Nexen states, "Salvage of suitable subsoil will be conducted along mineral soil portions of the access roads." Discuss OPTI/Nexen's rationale for not salvaging subsoil under organic soils.</i>
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Response

The Partners plan to salvage subsoil from Organic soils as it is most often very wet or saturated. Conducting salvage of wet subsoils can result in compaction and rutting, admixing of peat and the subsoil, and can increase the potential for release of sediment into the saturated zone of a wetland environment. The Partners are committed to having a professional agrologist on-site during all soil salvage activities.

7.	Supplemental Information, Part 2, Section 2.2, SIR Response #20, Page 36. <i>OPTI/Nexen states, "Updated figures for actual stockpile locations will be provided in the pre-disturbance assessment (PDA) reports which will be submitted to AENV/ASRD. Stockpile locations for future well pads and access roads will be determined on a site-specific basis, and will be provided as part of the PDA reports for those facilities."</i> <ul style="list-style-type: none">a) Confirm that sufficient space has been accounted for in the project layout design to accommodate all the soil storage needs for the project.b) Discuss whether the area needed for soil storage has been accounted for in the overall disturbance footprint. Provide an update to the disturbance footprint information if necessary.
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Response

Sufficient space has been accounted for in the Project layout design to accommodate the soil storage needs for the Project. As stated in the SIR Aug/07 [Response 20](#), the actual location of these stockpiles will be confirmed in the PDA reports.

8.	Supplemental Information, Part 2, SIR Response #22, Page 36 <ul style="list-style-type: none">a) Explain how stockpiling of peat as described in SIR Response #22 will maintain the viability of the peat.b) If the method described in a) cannot maintain the peat in a viable condition, explain what other stockpiling methods are being explored by OPTI/Nexen.
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Response

The Partners are investigating how to promote frozen conditions to maintain viability. Because of the low rate of decomposition and anoxic conditions in peatlands, many plant parts, especially seeds and pollen, are preserved in peat for thousands of years

(Peatland Restoration Guide 2003). Thus, storing peat in similar conditions may preserve viability of the diaspores.

At this time, consideration is being given to a two lift peat salvage where the initial lift will consist of the surface 10-20 cm (which has a higher concentration of viable diaspores), and a subsequent lower lift of 20-30 cm, for a total of 40 cm. Each lift would be stored and replaced separately during reclamation.

The Partners will consult with Alberta Sustainable Resources and Development (ASRD) and AENV, and will participate with other regional operators in research to identify options for peat stockpiling and reclamation.

9.	Supplemental Information, Part 2, Section 2.2, SIR Response #25 a), Page 38. The response did not provide specific details on successes and failures associated with reclamation of organic soils to wetland ecosites as requested. Provide the requested information.
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Response

Most of the published research on peatland reclamation in Canada relates to reclamation of peatland areas where commercial peat harvesting has been carried out. Reclamation of commercially harvested peatland areas has successfully been carried out, mostly in Eastern Canada. The Peatland Restoration Guide summarizes some of the results from research and experience, and provides detailed guidelines and procedures for carrying out peatland reclamation for harvested sites. The two main objectives to the approach are:

- Re-establishing a plant cover dominated by peatland species including Sphagnum mosses; and
- Re-wetting harvested sites by raising and stabilizing the water table near the surface.

The Guide provides details on reclamation principles, reclamation planning, surface preparation, plant collection and spreading, straw application, fertilization, drainage management, monitoring and troubleshooting. A summary (including successes and failures) of large-scale reclaimed peatland sites in Canada is provided in Appendix A of the Guide.

It is not clear to what degree the techniques presented in the Guide are applicable to the reclamation of SAGD pads on Organic soils in Alberta; some of the differences in the SAGD situation are:

- Construction of pad on top of the peat;
- The need to dig down into the pad and peat to abandon wells;
- Possible different depths of peat removed (harvested) or salvaged; and
- Different climatic conditions in Northern Alberta than in Eastern Canada.

A brief discussion of some of the peatland reclamation issues, as well as reclamation protocol development and research trials, are contained in a research proposal document submitted to ASRD. When it becomes available, this research will provide valuable information for revising reclamation techniques for pads on Organic soils.

As mentioned in the SIR Aug/07 [Project Update \(Section 3.9\)](#), the Partners are active participants of the CEMA Reclamation Working Group and currently have demonstration plots on the Long Lake lease. The Partners are also active participants of the In-Situ Reclamation Research Group with AI-Pac and the University of Alberta, which is presently evaluating the next phase of reclamation research regarding peatland sites. In addition, the Partners are investigating revised construction and reclamation methods for sites developed on deep peat as described in the SIR Aug/07 [Project Update \(Section 3.9.3\)](#).

References

Quinty, F. and Rochefort L. 2003. Peatland Restoration Guide 2nd Edition. Canadian Sphagnum Peat Moss Association, St. Albert, Alberta. <http://peatmoss.com/pm-restguide.php>

Vitt, D.H. and Kelman Wieder. Undated. Development of Scientific Protocols for Oil and Gas Pad Reclamation in Peatlands of Boreal Alberta.

10.	Supplemental Information, Part 2, SIR Response #205, Page 228
	In Part 2, Figure 59-2, Page 64, the area covered by isopleths >0.5 Keq H ⁺ /ha/y is much larger than the area covered by the +0.5 PAI isopleths in Part 2, Figure 209-1, page 232.
	a) If the data used to produce the PAI isopleths for the soil acidification assessment, shown in Figure 209-1, Page 232, are the same as the data provided for the air dispersion modelling shown in Figure 59-2, Page 64, why do the figures appear visually different, with different scales?

Response

The same data were used to generate SIR Aug/07 [AENV Figures 59-2](#) and [209-1](#). However, [Figure 59-2](#) was created to depict the general air quality areas of concern within the air RSA, covering an area of 400 km x 200 km, whereas [Figure 209-1](#) was created to specifically determine the areas impacted by acidification within the terrestrial RSA (i.e., 80 km x 70 km). More specifically, the differences are caused by the data interpolation methods used to create the contours. For the soil acidification assessment, it was important to focus on a smaller area than that used for the air assessment, which required the use of a smaller interpolation grid spacing (i.e., 100 m). The air assessment did not require such a refined focus as the criteria are based on maximum predicted concentrations and not on specific areas. The interpolation grid spacing used for the air assessment was 1000 m.

These data interpolation methods lead to visual differences that do not impact the soil acidification assessment or the air assessment.

10.	b) Comment on any changes to the soil acidification assessment should Figure 209-1 change.
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Response

There are no changes to SIR Aug/07 [AENV Figure 209-1](#); therefore, there are no changes to the assessment presented in SIR Aug/07 [AENV Response 209b](#).

11.	<p>Supplemental Information, Part 2, SIR Response #206, Page 228</p> <p>The answer states that “Key mitigation includes monitoring soils, evaluating trends in soil data, and emission control.” Mitigative measures generally do not include monitoring or evaluating trends. Discuss potential active mitigative measures OPTI/Nexen could use should soils within the LSA boundary become acidified by ongoing activities in the area.</p>
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Response

The Partners will adhere to all provincial and federal emissions standards, and will uphold the principles of the Acid Deposition Management Framework, which indicates emission control as the mitigative measure should acidification of soil in the RSA be determined.

The Acid Deposition Management Framework indicates that monitoring and trend analysis are key to understanding if a statistically relevant change in soil reaction is occurring. Should a statistically relevant change in soil reaction be determined, industry and regulators would evaluate the cumulative sources of emissions to determine appropriate emissions controls for individual industry operations. The Partners, as part of the cumulative industry emission profile, will be part of any monitoring, trend analysis and potential emission reduction, as deemed necessary for the regional reduction of emissions.

12.	<p>Supplemental Information, Part 2, SIR Response #209a, Page 230 and SIR Response #214a, Page 234</p> <p>Based on Part 2, Figures 59-1, 59-2 and 59-3 on Pages 63, 64 and 65, it appears that the PAI isopleth exiting the Terrestrial RSA on Figure 209-1, Page 232 and Figure 214-1, Page 236 can be attributed to the construction of the Long Lake South Project.</p> <p>a) The responses to Questions 209a. and 214a. assume that the soils outside of the Terrestrial RSA are at a medium to low sensitivity. What is the reasoning behind assuming that the soils outside the Terrestrial RSA have a critical load $>0.40 \text{ KeqH}^+/\text{ha/y}$?</p>
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Response

The methodology recommended by the Acid Deposition Management Framework and outlined in the TOR, includes using the critical loads modelled for soils (Abboud, S.A., L.W. Turchenek and L.A. Halsey, 2002). The Acid Deposition Management Framework recommends using the Mid-CV Case modelled for 50 years to determine appropriate modelled critical loads. The modelled critical loads are used to interpret the potential for acidification for developments that have lifespans of 30 to 50 years. Using this methodology, none of the Alberta Oil Sands Environmental Research Program (AOSERP) soils (which are the soils mapped in the local and regional study areas, and to the east of the RSA) have a 50 year Mid-CV Case critical load below $0.40 \text{ Keq H}^+/\text{ha/y}$. Therefore, the soils inside and outside the terrestrial RSA will have Mid-CV Case critical loads ranging from 0.4 to $1.1 \text{ keq H}^+/\text{ha/y}$. Using CASA generic critical load definitions, these correspond to moderate to low sensitivity to acidification.

SIR Aug/07 [AENV Response 209b](#) indicated that the PAI concentrations modelled to the east of the RSA are less than the lowest critical load assigned to any soil in the AOSERP mapped area, in the Mid-CV case, for a 50 year time frame. Therefore, potential acidic inputs east of the RSA will not exceed the Mid-CV case critical load of those soils.

Reference

Critical Loads of Acid Deposition on Soils in the Athabasca Oil Sands Region, Alberta. Prepared for NO_x-SO₂ Management Working Group, Cumulative Environmental Management Association. Prepared by Alberta Research Council, AMEC Earth & Environmental Limited and University of Alberta. Edmonton, Alberta.

12.	b) Provide documentation that the soils outside the Terrestrial RSA (specifically to the east) have a critical load >0.40 KeqH ⁺ /ha/y, and that the geographic extent of the acidification impact is in fact regional only.
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Response

Table 12-1 is an excerpt from Abboud et al. (2002). The 50 year Mid-CV Case is recommended by the Acid Deposition Working Group, as representative of the timeframe for most oil sands developments.

Table 12-1 50 Year Critical Loads for AOSERP Soil Series by Mid-CV Case

Soil Series	Mid-CV Case
Algar Lake	0.40
Bayard	0.70
Bitumont	0.50
Buckton	1.10
Chipewyan	1.10
Conklin	1.10
Dalkin	1.10
Dover	1.10
Firebag	0.55
Fort	0.90
Gipsy	1.10
Gregoire	0.50
Hartley	1.10
Horse River	1.10
Joslyn	1.10
Kearl	0.80
Kinosis	1.00
Legend	1.10
Livock	1.10
Mamawi	1.10
Marguerite	0.40
Mariana	1.10
McLelland	1.10
McMurray	1.10
Mikkwa	0.80
Mildred	0.40
Muskeg	0.65
Namur	1.10
Ruth Lake	1.10
Steepbank	0.40
Surmont	1.10
Wabasca	1.10

Source: Abboud et al. (2002)

- * Values represented in Volume 4, Section 9, Table 9.3-5 as 1.10 or as 0.10 were identified in the original source work as greater than 1.0 and less than 0.09, respectively. A specific value has been assigned in Volume 4, Section 9, Table 9.3-5 to allow for GIS assessment against PAI values.

The AOSERP soils are found to the east of the RSA and 50 year mid-CV Case critical loads for those soils can be assumed to be reflected by the soils listed in Table 12-1.

The assessment of impact is based on the intersection of the soil critical load and PAI levels predicted to exceed those critical loads. The areas where PAI exceeds the mid-CV case critical load are limited to within the RSA as the PAI levels decline below 0.40 Keq H⁺/ha/y (the lowest modeled critical load of any soil in the AOSERP soil series) in the east portion of the RSA and are less than 0.17 Keq H⁺/ha/y at the eastern edge of the RSA.

Reference

Abboud, S.A., L.W. Turchenek and L.A. Halsey. 2002. Critical Loads of Acid Deposition on Soils in the Athabasca Oil Sands Region, Alberta. Prepared for NO_x-SO₂ Management Working Group, Cumulative Environmental Management Association. Prepared by Alberta Research Council, AMEC Earth & Environmental Limited and University of Alberta. Edmonton, Alberta.

13.	Supplemental Information, Part 2, Figure 209-1, Page 232 and Figure 214-1, Page 236. a) The 0.5+ PAI isopleth, as shown on Figure 209-1, may be greater than the low (0.5+) soil sensitivity to acidification. Why are the soils encompassed by the 0.5+ PAI isopleth not shown as soils at risk for potential acidification? b) If these areas should be listed at risk for potential acidification, should the soil impact rating tables in Volume 4 be adjusted? If so, adjust these tables as necessary.
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Response

The GIS analysis of PAI and critical load uses the intersection of the specific PAI levels in each polygon and the specific critical load assigned to the soil in that polygon. Although the map indicates the PAI is 0.5+, the PAI levels mapped in the polygons within that isopleth are primarily 0.5, with some values of 0.7 and 0.9 keq H⁺/ha/y. Therefore, the analysis is specific and able to identify areas where a soil's critical load is or is not exceeded by PAI within the isopleths. There are soils underlying the 0.5 Keq H⁺/ha/y isopleth that have critical loads higher than the actual PAI numbers, and therefore, are not considered at risk. For instance, there are areas of Buckton, Kinosis and McClelland soils, all having critical loads of 1.0 and 1.1, which are not exceeded by the PAI levels between 0.5 and 0.9 keq H⁺/ha/y which are included in the 0.5 Keq H⁺/ha/y isopleth.

Soils with critical load exceeded by PAI levels in the 0.5 Keq H⁺/ha/y isopleths are of the Steepbank, Muskeg and Algar Lake soil series.

No adjustment to Table 9.7-3 (Volume 4, Section 9) is needed as these areas are not listed as at risk for potential acidification.

14.	<p>Supplemental Information, Part 2, SIR Response #210, 211, Page 233</p> <p>a) The reasoning behind the changes in perceived versus stated final impact ratings is unclear. For example, following the methodology in Table 1.3-3: Impact Criteria of LLS Project EIA, Volume 2, Section 1.3.5, Page 1-10, the Environmental Impact for Loss of Landforms would be moderate (medium magnitude, long-term duration, local extent), but a Final Impact Rating in Table 9.7-3: Impact Classification for Soils in the Application Scenario, Volume 4, Section 9.7.10, Page 9-52, is listed as low to moderate. Another example is that following the criteria provided, Acidification would have an Environmental Impact of Low (low magnitude, long-term duration, regional extent), but the Final Impact Rating is listed in table 9.7-3 as negligible.</p> <p>b) Provide detailed rationale behind each of the final impact rating changes as observed in Table 9.7-3, or re-state the impacts based on the impact criteria methodology provided. The determination of the percentage of each soil type impacted as a result of the project is based on the area in the LSA of that particular soil type expressed as a percentage of the total LSA, which includes disturbed areas, other soil types and areas occupied by water bodies. Provide a table showing the impacts to each soil type identified within the LSA expressed as a percentage of that specific soil type's total area in the LSA.</p>
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Response

Final impact ratings are based on the consolidation of the seven impact assessment criteria (direction, geographic extent, magnitude, duration, frequency of occurrence, permanence and confidence) listed in Volume 2, Section 1.3.5. In addition, qualitative assessments based on best professional judgment were used when environmental objectives or quantitative predictions are not feasible (e.g., reclamation of wetlands or potential acidification). Therefore, there are no changes to the final impact ratings for each parameter.

With regard to soils and terrain, it is important to note that the impact ratings are applied to residual impacts, after mitigation has been applied and the reclamation criteria of the day have been met, and that all impacts were considered to be reversible. Further, impact ratings are not an end in themselves; rather they provide a system to evaluate impacts, so that Project-planning can be focused on areas of greatest potential concern.

Table 14-1 illustrates the area of the soil series on the footprint as a percentage of that soil series area in the LSA.

Table 14-1 Soil series on the footprint as a percentage of the series' total in the LSA

Soil Series	Total area of soil series in the LSA (ha)	Soil series potentially impacted by the revised (Update) footprint	
		Total area (ha)	Percentage %
Algar Lake	120	43	36
Bitumount	114	20	18
Dover	205	29	14
Kinosis	4313	1036	24
Mildred	318	66	21
McLelland	400	63	16
Moonshine	52	4	8
Muskeg	1161	391	34
Stream Channel	811	73	9
Surmont	737	79	11
Steepbank	306	35	11

15.	Supplemental Information, Part 2, Section 2.10, SIR Response #217, Page 237-2, & Project Update, Section 3.4, Page 63 Table 217-1 lists rare plant species that could potentially be found in the region which have not been identified in the LSA. Reference is made to additional rare plant surveys that are being done to support the impact assessment for the revised footprint. Provide the results or a schedule for providing these results.
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Response

Additional field surveys for rare plants were conducted June 11 to 17 inclusive and July 23 to 29, 2007. The rare plants identified during these surveys are included in Table 15-1.

Table 15-1 Rare Plants and Mitigation Strategies in the LSA

Species	Provincial Rank	Global Rank	Mitigation
<i>Chrysosplenium iowense</i>	S3	G3	Transplanting to suitable adjacent area.
<i>Cladonia gracilis</i>	S?	G5?	Collection of propagules for dispersal in adjacent suitable areas.
<i>Carex backii</i>	S2	G4	Collection of seed for dispersal in adjacent suitable areas.
<i>Carex houghtoniana</i>	S2	G5	Collection of seed for dispersal in adjacent suitable areas.
<i>Chrysosplenium tetrandrum</i>	S3	G5	Transplanting to suitable adjacent area.
<i>Diphasiastrum sitchense</i>	S2	G5	Transplanting to suitable adjacent area.

16.	<p>Supplemental Information, Part 2, Section 2.10, SIR Response #219, Page 242.</p> <p>Review of Table 10.5-1 from the original application, as cited in the response, shows 25 ecosites with a total area in the LSA of 19,405 ha. Fourteen of the ecosites each represent one percent or less of the LSA. In aggregate, these 14 ecosites represent less than eight percent of the LSA. As well, 1 percent of the LSA would be an area of 194 ha. Several ecosites listed as representing 1 percent of the LSA are actually less than 194 ha in extent (i.e. b2, b3, b4, c1, k1, k3). These ecosites are considered vegetation communities of limited distribution, and yet have not been assessed.</p> <p>a) In response 219 a), the total ecosite area in the LSA is identified as 18,620 ha, whereas Table 10.5-1 identifies the total area as 19405 ha. Clarify whether the responses provided for SIR Response # 219 utilized the 19405 ha area. If not, provide an update to the response.</p>
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Response

SIR Aug/07 [AENV Response 219a](#) made reference to 18,620 ha as the total area of the LSA. The 18,620 ha represents the total area of ecosite phases in the Central Mixedwood Subregion within the LSA. The remaining 785 ha represent ecosite phases of the Lower Boreal Highlands Subregion within the LSA. The total area for ecosite phases in the LSA from the original application is 19,405 ha, and the response provided for SIR Aug/07 [AENV Response 219](#) utilized the 19,405 ha area. Therefore, no update is required.

16.	<p>b) Considering 1 percent of the total LSA is 194 ha and a number of ecosites of limited distribution as identified above have not been assessed, provide an updated assessment of effects that includes all ecosites of limited distribution.</p>
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Response

As requested, an updated assessment based on a definition of communities of limited distribution as less than or equal to one percent was conducted. The final impact rating has not changed from that in the original assessment. Details of the reassessment are as follows:

In Volume 4, Table 10.5-1, Page 10-17, several ecosite phases that are less than 194 fall in the 1% category due to rounding conventions. As redefined in the question, evaluating communities of limited distribution from the original application to be all those ecosite phases (still excluding Lower Boreal Highland ecosite phases) of 1% or less would include ecosite phases a1, b1, b2, b3, b4, c1, d3, e3, f1, f3, k1, k3 and l1. This would render 13 ecosite phases of a possible 25 ecosite phases of the Central Mixedwood Subregion to be of limited distribution.

At closure, ten of the ecosite phases (a1, b1, b2, b3, b4, c1, d3, e3, f1, and f3) will be reclaimed to equivalent land capability with reclamation strategies to establish successional trajectories to return to equivalent ecosite phases. The remaining three ecosite phases, k1, k3 and l1, are wetlands which at closure will be reclaimed to upland h1 ecosite phases. Therefore, the assessment for these three wetlands still remains low (less than one percent change in the LSA). The overall impact rating remains low for the reassessment.

17.	<p>Supplemental Information, Part 2, Section 2.10, SIR Response #221, Page 243.</p> <p>Volume 4, Table 10.3-1 and 11.4-5, suggests that any impact that is measurable above natural variation is rated as low, moderate, or high. An accumulation of small independently insignificant effects can result in incremental changes over time. Provide additional discussion as to why impacts rated as low, which are defined as measurable above background levels in Table 10.3-1 and 11.4-5, have not been considered in the cumulative effects assessment within the regional study area.</p>
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Response

The Partners reiterate response provided for SIR Aug/07 [AENV Response 221](#). The Partners agree that if a “low” impact from one project overlaps in time and space with a “low” impact from another project then the cumulative effects of these impacts should be assessed. As there are no publically disclosed projects within the LLS Project terrestrial RSA, a quantitative cumulative assessment cannot be conducted. The Partners acknowledge that other future activities such as exploration wells and seismic lines may occur within the RSA; however, as there are no proposed footprints available for these activities, only a qualitative assessment of these cumulative effects is possible.

18.	<p>Supplemental Information, Part 2, SIR Response #225, Page 245-246</p> <p>In Section 3 of the project update, OPTI/Nexen makes a commitment to meeting the reclamation criteria of the day and notes that the reclamation of sites originally developed in deep peat to upland landforms is no longer acceptable. OPTI/Nexen has outlined its participation on a variety of multi-stakeholder groups working to explore alternate construction and reclamation approaches to minimize impacts to wetlands.</p> <ul style="list-style-type: none">a) What, if any, revisions to current wellpad design and construction practices will OPTI/Nexen be implementing immediately as a consequence of this change in expectation?b) Are there workable, cost-effective, ideas and solutions currently being put into practice by other companies that might be adopted and/or shared? If so, provide a brief description.
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Response

At present there are no planned revisions to the current well pad design and construction practices. Well bore integrity and well pad stability are the main concerns with well pad design and construction. Any well pad instability could result in the shifting of surface facilities, resulting in potential damage to infrastructure and possible safety concerns. It is therefore imperative that the site be designed and constructed in a manner that maintains surface facility integrity.

Currently, the Partners are engaged with several working groups including CEMA - Reclamation Working Group, the In-Situ Working Group - comprised of Southern SAGD Producers, and a five year collaborative study with other Industry partners, AI-Pac, and the University of Alberta. This study is assessing various reclamation practices in the Fort McMurray region. These groups continue to study wetland reclamation activities and the findings will be integrated into future well pad designs. With no present research data to support the successful re-establishment of deep peats, the Partners will continue to reclaim peat well pads to the proposed transitional upland sites.

19.	<p>Supplemental Information, Part 2, Vegetation, SIR Response #228, Page 247</p> <p>As noted in the original SIR Response # and OPTI/Nexen's EIA, riparian areas provide travel corridors and transition zones between the upland and wetland, waterbody or watercourse. In response, OPTI/Nexen refers to the 100 metre buffer placed around wetlands, waterbodies and watercourses to delineate riparian areas and indicates that these areas will be reclaimed to upland habitat. OPTI/Nexen also quotes the C&R plan and notes their commitment to reclaiming to the criteria of the day as well as minimizing erosion and sedimentation with respect to federal and provincial regulations.</p> <p>The answer provided seems to indicate that OPTI/Nexen will reclaim riparian habitat within the 100 metre buffer to upland habitat and will simply provide erosion and sedimentation control in the area of watercourse crossings for roads and pipelines.</p> <ul style="list-style-type: none">a) Is this interpretation of the answer accurate?b) Given the importance of riparian transition zones for both fish and wildlife values, discuss how appropriate it is to return riparian habitat to upland habitat.c) Identify any easy and cost-effective measures that might be put in place to more closely approximate the riparian rather than upland habitat function, and/or to speed the recovery of riparian habitat.
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Response

To clarify, the 100 m buffer adjacent to watercourses/bodies is not meant to indicate actual riparian areas but was used as a conservative tool for the purposes of the assessment. Both riparian areas and upland areas may occur within this buffer.

Riparian areas are vegetated lands adjacent to streams, rivers, lakes and wetlands where the vegetation and soils are strongly influenced by the presence of water. One of the goals of reclamation is to reclaim land to similar pre-disturbance soils, terrain (including moisture conditions) and vegetation conditions. Therefore, upland areas will be returned to upland conditions and riparian areas will be reclaimed to conditions similar to the immediately adjacent riparian area, and not the adjacent upland area.

In addition, the Partners will undertake both mitigation and reclamation measures in riparian areas as required by Alberta reclamation criteria. Practices will also abide by all riparian specific regulatory guidelines such as those described in the Alberta Codes of Practice for pipeline and road crossings, and DFO operational statements. Mitigation measures for riparian habitat are presented in Volume 3, Section 8.6.3.3 (Fish and Fish Habitat section).

Examples of cost effective measures to restore riparian habitat include:

- Matching reclaimed area streambank profiles to pre-disturbance/adjacent riparian conditions;
- Revegetating to match pre-disturbance/adjacent riparian ecosite phases; and
- Planting stakes (cuttings) and erosional control matting.

Additionally, monitoring will be conducted to determine the success of reclamation and to identify if additional remedial measures are required.

20.	Supplemental Information, Part 2, Vegetation, SIR Response #229, Page 248
	<ul style="list-style-type: none">a) Identify potential mitigation for Meadow Bitter Cress impacts should the final well pad site location require the removal of this rare plant.b) What monitoring will be implemented by OPTI/Nexen to ensure that the mitigation strategy is successful?

Response

Should the final well pad site location impact Meadow bitter cress, the Meadow bitter cress will be transplanted to appropriate undisturbed adjacent areas.

Transplant monitoring of the Meadow bitter cress will entail inspecting for transplant success twice during each of the first two growing seasons after transplantation.

21.	<p>Supplemental Information, Part 2, Vegetation, SIR Response #232, Page 249</p> <p>Cumulative environmental effects are defined as those “effects likely to result from the project in combination with other projects or activities that have been or will be carried out.” (<i>Canadian Environmental Assessment Act</i>).</p> <p>The response to the original SIR Response # indicated that the disturbances are “pre-project anthropogenic disturbances.” This would seem to fit well within the CEEA definition as “projects or activities... that have been carried out.” Based on the definition, the 6% change in disturbance should be assessed “in combination” with the “projects or activities that have been or will be carried out.”</p> <p>a) Provide an updated cumulative effects assessment. b) Provide a response to Question 232b.</p>
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Response

Pre-Project anthropogenic disturbances such as existing well pads, roads, and historic seismic lines are included in the baseline and therefore are presented as part of the application case. The Partners reiterate the response provided for SIR Aug/07 [AENV Response 221](#). As there are no publicly disclosed projects within the LLS Project terrestrial RSA, a quantitative cumulative assessment cannot be conducted. The Partners acknowledge that other future activities such as exploration wells and seismic lines may occur within the RSA; however, as there are no proposed footprints available for these activities, only a qualitative assessment of these cumulative effects is possible. Because pre-Project anthropogenic disturbances are included in the application case, they are therefore incorporated in the qualitative cumulative effects assessment.

Also, final impact ratings are based on the consolidation of impact assessment criteria (direction, geographic extent, magnitude, duration, frequency of occurrence, permanence and confidence) listed in Volume 4, Section 10.3. Qualitative assessments based on best professional judgment are used when environmental objectives or quantitative predictions are not feasible (e.g., reclamation of wetlands or potential acidification). Therefore, there are no changes to the final impact ratings for each indicator.

22.	<p>Supplemental Information, Part 2, Section 2.11, SIR Responses #234 and 237, Pages 250 and 252.</p> <p>It appears from response 234 that OPTI/Nexen do not intend to conduct additional wildlife surveys within the LSA during project construction and operation. The project schedule indicates that construction will begin in Q2 of 2008 (EIA Volume 1, Figure 1.6-1). However response 237 indicates that clearing will not be conducted during May 1 through August 15.</p> <p>a) Clarify this apparent discrepancy.</p>
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Response

The timing of construction will ultimately depend on both regulatory approval and the Partners' Project sanctioning. Thus, the timelines described in the application for construction activities will vary. The Partners are committed to adhering to the guidelines that limit clearing from May 1 through August 15.

22.	<p>b) Describe wildlife surveys that will be completed as part of the pre-disturbance assessment process to avoid direct conflicts with wildlife such as disturbances to active nests, dens, or amphibian hibernacula.</p>
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Response

Wildlife surveys will not be conducted as part of the pre-disturbance assessments. Clearing is not currently scheduled to occur during the bird nesting season; therefore, no disturbance of active nests will occur during the clearing activities. However, if clearing is required during spring, a survey for nesting birds will be conducted, to meet the requirements of the Migratory Birds Convention Act. As clearing is scheduled to take place during the winter months, pre-disturbance surveys for mammal dens or amphibian hibernacula would be ineffective.

23.	<p>Supplemental Information, Part 2, Wildlife, SIR Response #236, Page 251</p> <p>Breeding bird surveys indicated that “Most of the ecosite phases and cover categories had enough replicates (greater than 3) to ensure that species diversity is representative of the local and regional study area (British Columbia Ministry of Lands, Environment and Parks).”</p> <p>a) Provide a list of ecosite phases and cover categories for which replicates were 3 or less.</p> <p>b) Provide a table identifying these and cross-referencing them to their presence in the project LSA. Provide a discussion about the implications of insufficient data for these ecosites in the regional area to permit an assessment at the LSA level.</p>
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Response

Ecosite phases and habitat types for which replicates were three or less are shown in the Table 23-1:

Table 23-1 Ecosite Phase Replicates

Ecosite Phase/Cover Category	Number of Replicates	Total Area (ha)	Percent of LSA (%)
a1 (lichen jack pine)/jack pine habitat type	3	34	0.2
l1 (marsh)	0	14	0.07

Bird communities selected as indicators in the assessment included the old growth forest bird community and the mixedwood forest bird community. Therefore, low sampling intensity within the jack pine and marsh ecosite phases has no implication on the assessment. In addition, these ecosite phases make up an extremely minor component of the LSA (48 ha, 0.27% in total), as noted above. These habitats are restricted in area in the LSA, and are not physically impacted by the LLS Project (Volume 4, Biodiversity Table 12.6-1).

24.	<p>Supplemental Information, Part 2, Wildlife, Section 2.11, SIR Response #240, Page 254.</p> <p>Table 11.4-5, as cited in the response, does not include quantitative criteria for environmental impact ratings. Provide quantitative data or empirical studies that demonstrate the range of natural variability considered in comparing project impacts to natural background variation.</p>
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Response

Boreal forest natural variability has been altered by human activities during the last century (e.g., forest harvesting, fire suppression, resource extraction, and recreation), but these impacts are not well understood or documented (Miyanishi 2001; Okland 2003). Quantitative data or empirical studies that document the range of natural variability for the boreal forest are rare (Simberloff 2001; Kuuluvainen 2002) and are well beyond the scope of this assessment. In the absence of quantitative data or empirical studies, ratings for impacts on wildlife for the Project are based on professional opinion.

References

Kuuluvainen, T. 2002. Disturbance and dynamics in boreal forests: Defining the ecological basis of restoration and management of biodiversity. *Silva Fennica* 36(1): 97-125.

Miyanishi, K., and E.A. Johnson. 2001. Comment – A re-examination of the effects of fires suppression in the boreal forest. *Canadian Journal of Forest Research* 31(8): 1462-1466.

Okland, T., K. Rydgren, R. H. Okland, K.O Storaunet, and J Rolstad. 2003. Variation in environmental conditions, understorey species number, abundance and composition among natural and managed *Picea abies* forest stands. *Forest Ecology & Management* 177(1-3): 17-37.

Simberloff, D. 2001. Management of boreal forest biodiversity – A view from the outside. *Scandinavian Journal of Forest Research* Supplement 3: 105-118.

25.	<p>Supplemental Information, Part 2, Wildlife, SIR Response #243, Page 255</p> <p>As stated, a cumulative effects assessment (CEA) considers the impacts of the LLS Project with other existing, approved, planned, and potential projects in the region. In Table 1.3-2 of Volume 2, the proponent indicates that at the time of the assessment the details (and footprints) of future projects in the RSA that would overlap with the LLS project spatially or temporally had not been developed or released, although, oil and gas exploration, seismic activity and forestry are identified as likely uses.</p> <p>For wildlife, impact predictions are presented with regard to habitat losses identified using Habitat Evaluation Procedures (HEP) Habitat Suitability Indexes (HSI).</p>
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	<p>Predictions are presented as the project's incremental influence. For example, the potential impact to caribou use of the area is identified as an 11% loss of habitat in the LSA and a 17% decline at application and 9% decline at baseline in the LSA caribou population. CEA is intended to allow the assessment of effects likely to result in combination with other existing, approved or planned projects in the region. The provision of only the incremental influence of the project limits the reviewer's ability to assess cumulative impacts, particularly if an explicit CEA is not provided.</p> <p>Provide a CEA of the project for wildlife that provides an assessment of effects likely to result in combination with other existing, approved, and planned projects in the region.</p>
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Response

In the application case all existing and approved projects in the wildlife RSA are included. At the time of the wildlife assessment, no additional projects in the RSA were publicly disclosed and as such a quantitative CEA analysis was not conducted.

26.	<p>Supplemental Information, Part 2, Wildlife, SIR Response #244, Page 256</p> <p>A 29% increase in small patches, less than 1 ha in size, is presented, indicating a significant increase in habitat fragmentation.</p> <p>a) Is this an artifact of the analyses (e.g. slivers, data issues)? If not, what is the source of this 29% increase and how might it be mitigated?</p>
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Response

Habitat fragmentation is mainly a result of small patches in the closure scenario (caused by reclamation assumptions) and less by slivers and data issues. Based on present reclamation technology and abilities, the closure scenario assumes that wetland ecosite phases (i, j, k and l) will be reclaimed to ecosite phase h1 from disturbances such as roads, well pads and plant infrastructure. Therefore, whenever a wetland patch is intersected by such a development, at reclamation it will be split into two or more wetland patches with a strip of upland (i.e., ecosite phase h1) in between. This creates a large number of small ecosite phase patches in the closure scenario.

However, on a broader scale, these smaller patches should combine into continuous forest cover that may be suitable for different wildlife species. Therefore this 'functional' fragmentation will probably not impact wildlife movement significantly as individuals should be able to cross these thin upland strips. The increased interspersed of habitat in some cases could also be beneficial to wildlife populations (Debinski et al 2001; Luoto 2004).

Habitat fragment mitigation includes utilizing existing ROWs, coordinating integrated land management with other land users, and, where possible, avoiding wetland habitats.

References

Debinski, D.M., C. Ray, and E.H. Saveraid. 2001. Species diversity and the scale of the landscape mosaic: do scales of movement and patch size affect diversity? *Biological Conservation* 98(2): 179-190.

Luoto, M., R. Virkkala, R.K. Heikkinen, K. Rainio. 2004. Predicting bird species richness using remote sensing in boreal agriculture-forest mosaics. *Ecological Applications* 14(6): 1946-1962.

26.	<p>This level of fragmentation is also reflected in the project update in the Biodiversity section (Section 3.6, Page 64) in the increased number of ecosites and reduced mean patch size. This is accompanied by a 52% increase in linear features. The presence and maintenance of movement corridors is critical to the management of wildlife across the region.</p> <p>b) How will OPTI/Nexen ensure wildlife connectivity is maintained?</p>
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Response

As stated in Volume 4, Section 11.4.3, the greatest barriers to wildlife movements are above ground pipelines, infrastructure and wide linear corridors, while roads and thinner corridors are permeable to many wildlife species (Rail et al 1997; Forman et al 2003), including caribou (Wolfe et al 2000; Dyer et al 2002). In most cases the increased linear features of the Project in the LSA are predicted to have negligible to low impacts on wildlife connectivity (see Volume 4, Section 11.7.2).

For those areas where connectivity barriers from above ground pipelines have been identified, wildlife crossing points will be provided, either through the use of natural features or by constructing crossing structures. Existing access or utility corridors will also be used where practicable and linear corridor widths will be minimized.

References

Dyer, S.J., J.P. O'Neill, S.M. Wasel, and S. Boutin. 2002. Quantifying barrier effects of roads and seismic lines on movements of female woodland caribou in northeastern Alberta. *Canadian Journal of Zoology* 80: 839-845.

Forman, R.T.T., J. Bissonette, A. Clewenger, C. Cutshall, V. Dale, L. Fahrig, C. Goldman, K. Heanue, J. Jones, D. Sperling, F. Swanson, T. Turrentine, and T. Winter. 2003. *Road ecology: Science and Solutions*. Island Press, Washington D.C. 481 pp.

Rail, J.F., M. Darveau, A. Desrochers, and J. Huot. 1997. Territorial responses of boreal forest birds to habitat gaps. *The Condor* 99: 976-980.

Wolfe, S.A., B. Griffith, and C.A Gray Wolfe. 2000. Response of reindeer and caribou to human activities. *Polar Research* 19(1): 63-73.

26.	c) Identify potential movement corridors in the LSA and RSA.
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Response

A wildlife movement corridor can be defined as “a strip of habitat that connects two or more larger patches of habitat and through which an organism will likely move over time” (Fischer & Fischenich 2000). In the boreal forest, wildlife movements are not restricted by topography as in mountainous regions. Therefore, use or travel along defined corridors by wildlife is due primarily to habitat preference. This makes movement corridors difficult to identify without long-term survey data.

Movement in the LSA of wide-ranging species (black bear, moose and caribou) will likely occur within highly suitable habitat. Connectivity barriers within this habitat from above ground pipelines, for each wide-ranging species, are identified in Volume 4, Section 11, Figures 11.7-18b, 11.7-19b and 11.7-20b.

References

Fischer, R.A. and J.C. Fischenich. 2000. *Design recommendations for riparian corridors and vegetated buffer strips*. US Army Engineer Research and Development Center. Vicksburg, MS.

26.	d) Provide a map illustrating current connectivity in the area.
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Response

Volume 4, Section 11, Figures 11.7-18a, 11.7-19a and 11.7-20a depict baseline connectivity for black bear, moose and caribou. Low-impact seismic lines (less than three metres) were excluded from the analysis as these likely have minimal influence on wildlife movements and habitat connectivity.

26.	e) How is OPTI/Nexen integrating with other proponents to ensure connectivity and movement corridors are maintained across the area?
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Response

The Partners collaborate with other land users in the LSA to minimize the combined disturbance footprint, density of linear features, and cumulative habitat loss. This includes coordinating with AI-Pac regarding the timing and location of timber harvesting and using existing access or utility corridors where practicable.

AENV Health

1.	<p>Supplemental Information, Part 2, Health, SIR Response #246, Page 257</p> <p>The proponent states that <i>“there have been no changes made to the LLS Project that would have a material impact on the air assessment or the human health risk assessment.”</i></p> <p>a) Does this statement remain true in light of SIR response #30b?</p>
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Response

For the reasons discussed below, the statement that the changes made to the LLS Project will not have a material impact on the air assessment or human health risk assessment remains true.

Of the three new buildings listed in SIR [AENV Response 30, Table 30-1](#), only the HP BFW BLDG (28400-BG-001) is in close proximity to an emission source. This building is near the steam generator stacks. However, with a maximum building height of 9 m, it will not influence dispersion given that the steam generator stack is 30 m high. No other changes in buildings (locations or dimensions) will influence plume behaviour from the LLS sources.

The steam generators and cogen stacks are the major contributors of emissions from the LLS Project. The stack parameters of these sources have not changed. The stacks have been moved 350 to 400 m east of their original position, with the cogen stack being moved the furthest. No additional buildings or changes to existing buildings will influence the behaviour of the plumes from these stacks. The result of the new design will be a shift in the maximum predicted concentration (from the Project) slightly east of the current maximum predicted location.

2.	<p>Supplemental Information, Part 2, Health, SIR Response #248, Tables 248-1 and 248-2, Page 258-259</p> <p>a) Illustrate how fish consumption rates for the First Nations Receptor were calculated using the dataset from Wein (1989).</p>
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Response

The original reference to Wein (1989) in SIR Aug/07 [AENV Response 248, Table 248-3](#) was incorrect. Instead, the footnote reference of Wein (1989) should be correct to read:

Fish consumption rates were based on Health Canada's ingestion rates for Canadian First Nations Populations together with the frequency of consumption

reported by Fort McKay Environmental Services Ltd. (FMES) for the community of Fort McKay (Health Canada 2004; FMES 1996).

The FMES (1996) reported that people aged 19 to 54 years consume fish, including white fish, northern pike, trout, grayling, walleye, yellow perch, lingcod, gold eye and sucker, 85 days of the year. This equates to a frequency of 23% (i.e., 85 days in 365 days). On this basis, the Health Canada fish ingestion rate of 220 grams per day for an adult was adjusted to a value of 51 grams per day that is specific to the Fort McKay area (as provided in SIR Aug/07 [AENV Response 248, Table 248-3](#)). The assumed consumption rates are consistent with the recent Alberta Health and Wellness study of arsenic risks in the Wood Buffalo Region (AHW 2007).

References

AHW (Alberta Health and Wellness). 2007. Assessment of the Potential Lifetime Cancer Risks Associated with Exposure to Inorganic Arsenic among Indigenous People Living in the Wood Buffalo Region of Alberta. Prepared by Cantox Environmental Inc. March 2007.

FMES (Fort McKay Environmental Services Ltd.). 1996. A Survey of the Consumptive Use of Traditional Resources in the Community of Fort McKay. Completed for Syncrude Canada Ltd. May 23, 1997.

Health Canada. 2004. Federal Contaminated Site Risk Assessment in Canada. Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Environmental Health Assessment Services Safe Environments Program. Ottawa, Ontario. September 2004. ISBN 0 662-38244-7.

3.	<p>Supplemental Information, Part 2, Health, SIR Response #249, Page 261</p> <p>a) Explain how the calculation of meat tissue concentrations would be indicative to the health of wildlife and consequently that wildlife was “adequately assessed in the HHRA”? Especially in light of the fact that a discussion of wildlife health was not undertaken, and only the health of humans who consume game was assessed.</p> <p>b) Discuss the impacts to wildlife health once the project and other projects in the area are in operation.</p>
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Response

The calculated meat tissue concentrations were not intended to be indicative of wildlife health in the region. Rather, meat tissue concentrations were used in the HHRA for human consumption purposes.

Wildlife health will be addressed through the Partners’ participation in the Alberta Biodiversity Monitoring Initiative and the wildlife monitoring program that is currently being conducted by Dr. Samuel Wasser from the University of Washington. Dr. Wasser’s study team specializes in the development and application of noninvasive tools for monitoring wildlife over large landscape areas. Dr. Wasser’s team pioneered

methods to acquire stress and reproductive hormones, as well as DNA from scat, which allows them to monitor the physiological health of wildlife, as well as their abundance and distribution.

The wildlife monitoring study area is located southwest of the LLS Project, with a control area to the east. Once complete, the study findings will be shared with all interested parties. The monitoring program will provide a comprehensive regional context on potential impacts to wolf, moose and caribou for which a regional mitigation plan can then be developed.

4.	<p>Supplemental Information, Part 2, Health, SIR Response #254, Page 265</p> <p>The proponent was asked to provide evidence to support the conclusion that metals will not be emitted by the project. In response, the proponent noted a paper by Chao et al. (1999). They state: <i>"The study found all metals to be below detection levels...The study concluded that the USEPA had incorrectly identified natural gas combustion as a source of metal emissions...The Partners will not have emissions data from the burning of syngas until operations commence at the Long Lake upgrader."</i> While the proponent has one paper from 1999 that disagrees with AP 42, the USEPA still endorses the use of AP 42 for natural gas. Furthermore, even if a substance is below the detection limit that does not necessarily mean that it is not being emitted and contributing to existing concentrations in the region. It is also our understanding that depending on the source of natural gas it may or may not contain metals.</p> <p>a) Provide substantive evidence to support the assertion that the burning of syngas and natural gas will not contain metals.</p> <p>b) If this evidence can not be obtained, update the HHRA to include assessment of metal emissions using the US EPA emission factors from AP 42 for natural gas.</p>
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Response

In addition to the Chao et al. citation, the following references also support the assertion that the combustion of syngas or natural gas will not emit metals into the environment:

- Bateman (2005) from the Bay Area Air Quality Management District makes the following comments in a memorandum to his engineering staff: "AP 42 emission factors for metal emissions are not used because they are based on a small number of tests and have poor EPA data rating";
- The Danish National Environmental Research Institute (NERI) reports that for gas turbines, stationary engines and combustion sources fired with natural gas, the heavy metal emission factors are reported as 0 mg/GJ. (http://www2.dmu.dk/1_Viden/2_miljoe-tilstand/3_luft/4_adabei/tables/emf_stat_combustion_hm_pah_2005.html);

- Under the general terms and conditions of Alberta natural gas transportation tariffs (e.g., Nova Gas Transmission Ltd.), “gas ... shall be free ... from dust, gums, crude oil, contaminants, impurities or other objectionable substances which will render the gas unmerchantable, cause injury, cause damage to or interfere with the operation of the facilities” (NGTL 2007); and
- As well, the ERCB (1982) stated that: “In 1970, the Board’s chemical laboratory conducted a study into the mercury content of natural gas, and found that such contamination, while common in other parts of the world, is essentially absent in Alberta natural gas samples”.

In light of the weight of evidence provided by these references, it is the Partners’ view that metals will not be emitted as a result of the combustion of natural gas.

References

Bateman, B. 2005. Memorandum to Engineering Staff. Subject: Emission Factors for Toxic Contaminants from Miscellaneous Natural Gas Combustion Sources. September 7, 2005.

ERCB. 1982. Sour Gas Processing in Alberta. A review of Evidence Presented at Recent ERCB hearings respecting the Impacts and Surveillance of Sour gas Plants. ERCB Report 82-D. April 1982.

NGTL (Nova Gas Transmission Ltd.), 2007. Gas Transportation Tariff.

5.	Supplemental Information, Part 2, Health, SIR Response #255d, Page 267
	Maximum Point of Impingement (MPOI) acute air concentrations were not evaluated in the assessment as requested.
	a) Assess the MPOI as part of the HHRA.

Response

To determine the maximum ground level non-CAC (i.e., non-criteria air contaminant) air concentrations that an individual may be exposed to in the immediate vicinity of the Project, air dispersion modelling was conducted using a refined receptor grid. A 3 km x 3 km grid, centred on the facility, with 50 m grid spacing was used in the air model. This grid size incorporates the maximum point of impingement (MPOI) for the VOC and PAH species. Modelling was conducted using CALMET/CALPUFF, and 1-h, 24-h and annual maximum concentrations were predicted for all non-CAC chemicals of potential concern (COPC). Maximum predicted air concentrations for the criteria air contaminants (i.e., MPOI for SO₂, NO₂, and PM_{2.5}) were discussed in Volume 2, Sections 2.6 and 2.7.

The MPOI assessment only considered air concentrations for the shorter averaging periods (1-h and 24-h), for the reason that transient persons are not expected to be in the vicinity of the project area for prolonged periods of time.

Consistent with the original HHRA, background air concentrations (when available) were added to the predicted air concentrations for the three development cases. These air concentrations were then compared against the acute health-based guidelines summarized in SIR Aug/07 [AENV Response 258](#). Also consistent with the work completed in support of the SIR Aug/07 supplemental responses, chemicals for which limited data are available were excluded from the acute health risk assessment. These include: 1,3-butadiene; 2-chloronaphthalene; benzaldehyde; and the benzo(a)pyrene group.

The acute concentrations for the remaining COPCs are summarized in Table 5-1.

Table 5-1 Acute concentration ratios at the fenceline maximum points of impingement

COPC	Averaging Time	Concentration Ratios		
		Baseline	Application	Cumulative
2-Methylnaphthalene	24-hr	6.0E-08	3.0E-06	3.0E-06
Acetaldehyde	1-hr	6.7E-03	6.8E-03	6.8E-03
Acrolein	1-hr	1.5E-01	5.3E-01	5.4E-01
Benzene	24-hr	9.9E-02	9.9E-02	1.0E-01
Dichlorobenzene	1-hr	1.4E-05	1.5E-05	1.5E-05
Ethylbenzene	24-hr	7.4E-04	7.4E-04	7.5E-04
Formaldehyde	1-hr	5.7E-01	8.0E-01	8.0E-01
Hexane	1-hr	5.8E-02	5.8E-02	8.6E-02
Naphthalene	1-hr	1.7E-03	3.4E-03	3.4E-03
Propylene Oxide	1-hr	4.3E-07	8.0E-06	8.0E-06
Toluene	1-hr	7.8E-04	1.5E-03	1.5E-03
Xylenes	1-hr	1.0E-03	1.0E-03	1.4E-03
Aromatic C17-C34	24-hr	3.7E-09	4.8E-08	4.8E-08
Acenaphthene group	24-hr	2.8E-06	9.9E-06	9.9E-06
Hexane group	1-hr	8.7E-02	8.7E-02	1.3E-01

As shown, all concentration ratios were less than 1.0, indicating that short-term air concentrations were less than applicable health-based guidelines for all COPCs at the fenceline MPOI. In light of these findings, individuals exposed to short-term air concentrations at the fenceline MPOI are not expected to suffer any adverse health effects.

6.	<p>Supplemental Information, Part 2, Health, SIR Response #256, Page 268-269</p> <p>The proponent was asked to <i>“provide evidence that a screening for the multi-media exposure pathway based solely on persistence and bioaccumulation using DSL criteria is adequate...”</i> The proponent provided a justification, however did not provide any evidence. The proponent states: <i>“To screen COPCs based on toxicity alone would miss COPCs that are perhaps less hazardous but highly bioaccumulative or persistent.”</i> Alternatively it could be said that using a screen accounting for bioaccumulation may lead to screening off of COPCs that are not highly persistent but are highly toxic (from an oral ingestion perspective). Furthermore, the proponent states that AHW may have “misunderstood” or taken the Health Canada statement “out of context”. The Health Canada statement clearly notes that the criteria are simply part of a categorization program, and do not preclude the potential for toxicity. Nor do they indicate whether this methodology should be applied to risk assessment. The proponent states that <i>“the fate and persistence screening used in the HHRA is likely more conservative than a toxic potency screen on its own”</i>. As such, to use only these criteria to screen compounds off of a HHRA would seem to be inappropriate.</p> <p>a) For the multimedia assessment include a toxicity screening in addition to the biaccumulation/persistence screening.</p> <p>b) Update the human health risk assessment.</p>
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Response

The Partners stand by the original approach for determining which compounds are assessed through multiple routes of exposure, however, as requested, the results of the toxic potency screening are presented in Table 6-1. A compound's toxic potency is calculated by dividing its predicted annual average air concentration by its oral exposure limit (or the toxicological reference values, TRV). A compound's relative toxic potency is calculated by dividing the summed toxic potency of the emissions profile by the compound's individual toxic potency. The toxic potency screen shown in Table 6-1 is based on predicted Project-related air concentrations (annual averages) at a cabin location near the LLS Project.

According to the results, benzene, propylene oxide, dibenz(a,h)anthracene, benzo(a)pyrene, acrolein, naphthalene, indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, formaldehyde and xylenes would be assessed through multiple routes of exposure (i.e., they comprise greater than 99% of the emissions' profile cumulative oral toxic potency).

The health risk assessment team believes that the use of the toxic potency screen for identifying chemicals that are assessed through multiple routes of exposure is inappropriate. For example, the results of the toxic potency screen suggest that compounds such as propylene oxide, acrolein, formaldehyde, xylenes and benzene should be of primary concern with respect to possible impacts through non-inhalation related exposure pathways. However, these compounds are considered to be volatile and are not expected to concentrate or accumulate in the environment.

The Partners stand by the HHRA's original use of the screening criteria to select COPCs that were assessed through multiple routes of exposure. Based on the evidence provided, the Partners do not believe that the HHRA needs to be updated.

Table 6-1 Oral toxic potency screen to determine COPC assessed through multiple routes of exposure

COPC	Air Concentration (ug/m ³) (A)	Oral TRV (ug/kg/day) (B)	Source of TRV	Assessed in original HHRA?	Toxic Potency (A/B)	Relative Potency (%)	Cumulative Potency (%)
Benzene	1.80E-03	0.0322	Health Canada	No	5.59E-02	75.0	75.0
Propylene Oxide	2.28E-04	0.041667	EPA	No	5.47E-03	7.3	82.3
Dibenz(a,h) anthracene	1.78E-05	0.003909	B(a)P TEF	Yes	4.55E-03	6.1	88.4
Benzo(a) pyrene	1.77E-05	0.0043	Health Canada	Yes	4.11E-03	5.5	94.0
Acrolein	9.20E-04	0.5	EPA	No	1.84E-03	2.5	96.4
Naphthalene	1.11E-02	20	EPA	No	5.54E-04	0.7	97.2
Indeno(1,2,3-cd) pyrene	1.78E-05	0.043	B(a)P TEF	Yes	4.14E-04	0.6	97.7
Benzo(b) fluoranthene	1.76E-05	0.043	B(a)P TEF	Yes	4.10E-04	0.5	98.3
Formaldehyde	6.10E-02	200	EPA	No	3.05E-04	0.4	98.7
Xylenes	6.10E-02	200	EPA	No	3.05E-04	0.4	99.1
Fluoranthene	1.88E-05	0.086	B(a)P TEF	Yes	2.18E-04	0.3	99.4
Benzo(k) fluoranthene	1.76E-05	0.086	B(a)P TEF	Yes	2.05E-04	0.3	99.7
Chrysene	1.78E-05	0.1433333	B(a)P TEF	Yes	1.25E-04	0.2	99.8
Benzo(g,h,i) perylene	1.76E-05	0.215	B(a)P TEF	Yes	8.21E-05	0.1	99.9
Benzo(a) anthracene	1.78E-05	0.86	B(a)P TEF	Yes	2.07E-05	0.0	100.0
Benzaldehyde	8.57E-04	100	EPA	No	8.57E-06	0.0	100.0
Phenanthrene	3.78E-05	8.6	B(a)P TEF	Yes	4.40E-06	0.0	100.0
Pyrene	1.88E-05	4.3	B(a)P TEF	Yes	4.37E-06	0.0	100.0
Ethylbenzene	2.28E-04	100	EPA	No	2.28E-06	0.0	100.0
Fluorene	1.88E-05	8.6	B(a)P TEF	Yes	2.19E-06	0.0	100.0
Anthracene	1.79E-05	8.6	B(a)P TEF	Yes	2.08E-06	0.0	100.0
2-Methylnaphthalene	5.86E-06	4	B(a)P TEF	No	1.47E-06	0.0	100.0
Acenaphthene group	3.64E-05	60	EPA	No	6.06E-07	0.0	100.0
Dichlorobenzene	3.78E-05	90	EPA	No	4.20E-07	0.0	100.0
Toluene	1.88E-05	80	EPA	No	2.35E-07	0.0	100.0
Aromatics C17-C34	5.87E-07	30	CCME	Yes	1.96E-08	0.0	100.0
Benzo(e) pyrene	2.52E-08	2.15	B(a)P TEF	Yes	1.17E-08	0.0	100.0
2-Chloronaphthalene	1.29E-09	80	B(a)P TEF	Yes	1.62E-11	0.0	100.0
1,3-Butadiene	1.21E-06	NA		No	0.00E+00	0.0	100.0
Acetaldehyde	3.19E-03	NA		No	0.00E+00	0.0	100.0
Hexane group	5.78E-02	NA		No	0.00E+00	0.0	100.0
					7.45E-02	1.00E+00	

Notes: Shaded cells identify those COPCs that make up greater than 99% of the emissions profile's cumulative potency
 TRV = Toxicological Reference Value
 B(a)P TEF = derived from "Benzo(a)pyrene toxic equivalency factor"
 NA = No oral TRV available

7.	<p>Supplemental Information, Part 2, Health, SIR Response #257, Page 270</p> <p>The proponent was asked to provide a HHRA for hydrogen sulphide. This was not done. The proponent states: <i>"The air assessment indicates that hydrogen sulphide will not be emitted in appreciable amounts due to the use of vapor recovery and an LDAR program. As a result, hydrogen sulphide was not considered to be a COPC with respect to the LLS Project."</i></p> <p>While the emissions may be minimal, it is still necessary to provide a HHRA that takes in to account hydrogen sulphide to better characterize the conclusion that health effects will be negligible.</p> <p>a) Provide the updated assessment or a commitment to complete this assessment before operation of the project.</p>
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Response

The total H₂S emissions are estimated to be approximately 0.54 t/y for the Project. This estimate is based on a produced gas H₂S content of 230 ppm and includes fugitive emissions and storage losses.

The SCREEN3 model was used to calculate H₂S concentrations for each phase of the LLS Project based on a fugitive emission rate of 0.24 t/y per phase. It was assumed that 0.05 t/y (10% of 0.54 t/y) is emitted from all well pads. The well pads were not modelled because they are distant from each other and from the CPF, and the resultant H₂S air concentrations would be lower than those predicted for either phase of the LLS Project. For the purposes of calculation, a volume source height of 4 m was assumed to represent the top of a tank or pipe rack and initial vertical and horizontal dimensions of 2 m were assumed to represent initial dilution. The rural option was used to represent the increased turbulence due to the nearby tree canopy and the facility structures. The full meteorology option, flat terrain, and maximum off-site 1-h concentration for off-site were predicted. The maximum predicted 1-h H₂S concentration is 12.2 ug/m³ and occurs at the Project fenceline. Table 7-1 presents the results of the SCREEN3 modelling.

The maximum predicted hourly H₂S concentration (12.2 ug/m³) is less than the odour-based Alberta Ambient Air Quality Objective of 14 ug/m³ and ATSDR's (2006) health-based exposure limit of 98 ug/m³. Based on the results of the SCREEN3 model, H₂S emissions from the LLS Project are not expected to result in adverse health effects.

Table 7-1 Maximum Downwind H₂S Concentrations Associated with Fugitive emissions from the LLS Project

Emission Source	H ₂ S Emission Rate (t/y)	Maximum Downwind H ₂ S Concentration (ug/m ³)	Distance to Maximum (m)
LLS Phase 1	0.24	12.20	500
LLS Phase 2	0.24	12.20	500
Well Pads	0.05	N/A	N/A
Total	0.54	N/A	N/A

Reference

ATSDR (Agency for Toxic Substances and Disease Registry) 2006. Toxicological Profile for Hydrogen Sulfide. Atlanta, GA: US Department of Health and Human Services, Public Health Service. July 2006.

8.	<p>Supplemental Information, Part 2, Health, SIR Response #263d, Page 312</p> <p>The proponent states: “A HHRA was not conducted for the construction phase...The air assessment was based on the assumption that peak emissions will occur during operations, and not construction.”</p> <p>a) Provide evidence for this statement.</p> <p>b) Discuss potential impacts to human health that takes in to account the construction phase.</p>
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Response

Emissions from construction equipment were not considered in the air assessment as the maximum air quality impacts are associated with normal operation emissions. To demonstrate the magnitude of transient construction emissions relative to operation emissions, the following assessment was conducted.

Table 8-1 provides a comparison of the construction and operation phases of the Project. The construction emission estimates are based on emissions factors and assumes that all construction equipment will be operating concurrently for 10 hours per day. This method was used to estimate construction emissions as it takes into account a high level of conservatism and represents a worst-case construction emission scenario. It should also be noted that construction emissions tend to be very localized and that not all equipment will be concurrently operating in the same vicinity.

The ratio of construction emissions to operation emissions shows that construction emissions are considerably less than that of operation emissions. As such, a detailed HHRA of construction emissions was not required for this assessment.

Table 8-1: Comparison of Construction Phase and Operation Phase Emissions

Contaminant	Construction Phase Emission Rate (t/d)	Operations Phase Emission Rate (t/d)	Ratio of Construction to Operation
SO ₂	0.04	7.24	0.01
NO _x	0.61	13.38	0.05
CO	0.61	11.38	0.05
PM _{2.5}	0.04	0.88	0.04
VOC	0.09	0.97	0.10

9.	Supplemental Information, Part 2, Health, SIR Response #266g, Page 322
	Confirm that OPTI/Nexen plans to provide an updated HHRA which will include measured soils and vegetation prior to the start-up of its LLS project.

Response

The Partners plan to collect soils and species of vegetation known to be consumed by humans prior to start-up of its LLS Project. The collection and analysis of both soils and plants will be consistent with other sampling programs conducted in the region.

AENV Noise

1.	<p>Supplemental Information, Part 2, Noise, SIR Response #283, Page 333</p> <p>The proponent states in SIR 283 that as no noise complaints were received by the community office or hotline during the construction of the Long Lake Project and that the community of Anzac is further away from the Long Lake South Project, noise complaints are not expected to be an issue.</p> <p>a) Confirm that the nature of construction noise for the Long Lake South Project will be comparable to that which took place for the Long Lake Project, with respect to sound levels, durations and schedules.</p>
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Response

The construction activities at the LLS project are expected to be comparable to the Long Lake Project with respect to sound levels, durations and schedules. Additionally the LLS Project is approximately 10 km further from the Hamlet of Anzac than the Long Lake Project. As no noise complaints were received from the residents of Anzac for the Long Lake Project, the Partners do not anticipate that noise resulting from LLS construction activities will be audible in the hamlet.

The Partners will strive to minimize noise impacts on receptors (trappers) whom are most proximal to the construction.

1.	<p>b) It is not clear whether any communication with respect to construction noise has taken place with owners of the hunter-trapper cabins that have been identified as sensitive noise receptors. Please clarify.</p>
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Response

Consultations with all stakeholders will be ongoing throughout the life of the Project. Trappers and affected stakeholders are routinely contacted and meetings were held to discuss the LLS Project and its related impacts. Noise resulting from construction and operation of the facility and potential mitigations were discussed. The process for identifying issues is ongoing and mitigation will be developed on an individual basis.

2.	Supplemental Information, Part 2, Noise, SIR Response #277, Page 331. Provide a copy of the ATCO 1999 report containing noise emission information.
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Response

The full reference for ATCO 1999 is:

ATCO Power & Concor Pacific Environmental Technologies Inc. (ATCO). 1999. Muskeg River Cogeneration Project Application and Environmental Impact Assessment. Application to Alberta Energy and Utilities Board and Alberta Environment.

This document is publicly available.

3.	Supplemental Information, Part 2, Noise, SIR Response #284, Page 332-334 The proponent states that the noise impact pile drivers cannot be effectively mitigated at the source and pile driving will occur during both day and night time. a) Clarify how this response can be reconciled with the statement made in Volume 2, Section 3.7.2.2 of the EIA, " <i>if construction activities are scheduled between the hours of 20:00 and 07:00, they will be limited as much as possible to "quiet" operations</i> " as well as with EUB recommendations for construction noise which were also stated in this section.
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Response

It is the desire of the Partners to minimize, where practicable, the impact of the Project on the community and all stakeholders. If an activity such as pile driving were to be identified as having an adverse night time noise impact on stakeholders, the Partners would work to address and mitigate this issue.

4.	Supplemental Information, Part 2, Noise, Section 2.15, SIR Response #286 b), Page 336. Describe briefly the mechanisms for community members to provide complaints (noise) regarding the Long Lake Project. Indicate if local residents are informed in advance of scheduled noise events and also explain how this applies to trapper cabins.
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Response

The Long Lake Community Office operates a "Hotline" which is routinely updated with activities pertaining to the ongoing construction and operation of the Long Lake Project.

Information is provided regarding traffic (non-dimensional loads), noise causing activities (pile driving, steam releases, etc.) and other activities which have the potential to affect the community.

Additionally individual stakeholders who may be more directly effected (e.g. trappers) by an activity are contacted directly by Project staff to discuss the activity and develop any mitigations necessary to ensure minimal impact to their way of life.

The Long Lake Community Office has also developed a community complaint form which can be completed by concerned community members. Issues can be addressed either through a written response from Project staff or a response provided at a community meeting.

Long Lake staff attend the Willow Lake Community Association (Anzac) meetings and, on an as-needed basis, provide information to the community regarding Project status. Issues that have been identified will be addressed through ongoing consultation with stakeholders in the region.

5.	EIA Report, Volume 2, Section 3.7.2.2, Page 3-12
	a) Clarify the meaning of the statement in Volume 2, Section 3.7.2.2 of the EIA, <i>"specific night-time operations deemed acceptable to nearby residents may be modified as the construction operations proceed."</i>

Response

The statement in Volume 2, Section 3.7.2.2 should be corrected to read "specific night-time operations deemed **unacceptable** to nearby residents may be modified as the construction operations proceed."

The revised statement indicates that night time construction activities will be modified, where practicable, to minimize noise.

AENV Other / Errata

1.	Concordance Table, Table 1.10-3, TOR Section 2.3, Page 32. The development schedule provided in Section 1.6 does not contain all the items listed in TOR 2.3. Update the schedule to provide this information.
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Response

As per Section 2.3 of the TOR, the components pertaining to the development schedule include:

- o) pre-construction;
- p) construction;
- q) operation;
- r) decommissioning;
- s) reclamation and closure;
- t) timing of key construction, operational and reclamation activities and the expected duration of each for the life of Phase 2;
- u) a detailed schedule for any reclamation and related activities envisaged during the first decade of operations; and
- v) the key factors controlling the schedule and uncertainties.

The timing of pre-construction (EIA baseline studies and public consultation), construction, and operation phases of the Project are clearly delineated in Volume 1, Section 1.6. While no specific timeline for reclamation has been prepared in advance of the LLS Project approval, it is anticipated that SAGD well pads will have a production life of approximately 10 to 12 years, after which abandonment and reclamation activities will be assessed. Reclamation will occur incrementally so as to minimize the amount of Project footprint developed and in operation at any one time. As the recoverable resource provides for approximately 40 years of operation, it is the Partners' expectation that CPF facilities will be decommissioned some time following well decommissionings to approximately the year 2050 as outlined in the Conservation and Reclamation Plan (Volume 1, Section 5).

The key factors contributing to the uncertainty of the Project development schedule include weather and business considerations such as Project sanctioning and market conditions, as well as the duration of the Approval process.

2.	<p>Concordance Table, Table 1.10-3, TOR Section 2.5(d), Page 33.</p> <p>As per 2.5(d) of the TOR, the proponent is to provide a summary of the regional, provincial or national objectives, standards or guidelines which have been used by OPTI/Nexen in the evaluation of any predicted environmental impacts. The proponent indicated that information required from TOR 2.5(d) was located in Section 1.9 of Volume 1 of the EIA. This information is not provided in Section 1.9 of Volume 1 of the EIA.</p> <p>Provide the information required as per TOR 2.5(d).</p>
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Response

As stated in Volume 1, Sections 1.9.1 and 1.9.2, both the Project application and EIA were made pursuant to the Alberta Oil Sands Conservation Act, the Alberta Environmental Protection and Enhancement Act, and the Water Act. Additional permits and approvals will be requested under various other statutes, which are listed in Volume 1, Section 1.9.3.

Discipline-specific regional, provincial and national objectives, standards and guidelines are found throughout the EIA. Typical regulations and guidelines include, but may not be limited, to those provided in Table 2-1 below.

Table 2-1 Summary Of Regulations And Guidelines

Topic	Alberta Regulation/Guideline
Air	1) AENV Ambient Air Quality Guidelines 2) AENV [1989]2006: Air Monitoring Directive 3) CCME: Canada-Wide Standards for Particulate Matter (PM) and Ozone 4) AENV Continuous Emissions Monitoring Guidelines 5) EUB Directive 039: Revised Program to Reduce Benzene Emissions from Glycol Dehydrators 6) EUB Directive 060: Upstream Petroleum Industry Flaring, incinerating, & Venting
Noise	1) EUB Directive 038: Noise Control
Health	1) Government of Alberta: Public Health Act
Hydrogeology	1) AENV November 2003: Water For Life Strategy 2) AENV February 2003: Groundwater Evaluation Guideline 3) AENV 2006: Water Conservation and Allocation Guideline 4) EUB Directive 044: Requirements [...] of Water Production [...] Above the Base of Groundwater
Hydrology	1) EUB Bulletin-2006-11 Water Recycle (EUB IL 89-5) 2) AENV 1999: Surface Water Quality Guidelines for Use in Alberta
Water Quality	1) Health Canada: Guidelines for Canadian Drinking Water Quality 2) Health Canada: Guidelines for Canadian Recreational Water Quality 3) CCME, 1999: Protocols for Deriving Water Quality Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) 4) CCME, 1999: A Protocol for the Derivation of Water Quality

Topic	Alberta Regulation/Guideline
	Guidelines for the Protection of Aquatic Life
Fish and Fish Habitat	1) AENV Water Act 2) DFO Federal Fisheries Act 3) Transport Canada's Navigable Waters Protection Act
Soils	1) AENV Tier 1 & 2 Soil and Groundwater Remediation Guidelines 2) AENV Tier 2 Eco-Contact Guideline Derivation Protocol 3) AENV October 2005: Code of Practice for Land Treatment of Soil Containing Hydrocarbons 4) AENV April 2007: A Guide to Reclamation Criteria for Wellsites and Associated Facilities - Forested Lands in the Green Area Update 5) AENV Report # ESD/LM/00-2: Acceptable Salinity, Sodicity and pH Values for Boreal Forest Reclamation 6) AENV May 2001: Salt Contamination Assessment & Remediation Guidelines 7) AENV October 2005: Code of Practice for Land Treatment of Soil Containing Hydrocarbons 8) Government of Alberta: Soil Conservation Act 9) Government of Alberta, 1985: Manual on Soil Conservation and Pipeline Construction
Vegetation	1) Government of Canada: Species At Risk Act (SARA) 2) Government of Alberta: Weed Control Act 3) Alberta Sustainable Resource Development, April 2006 Alberta Forest Management Planning Standard 4) Alberta Sustainable Resource Development, Directive 20
Wildlife	1) Government of Canada: Species At Risk Act (SARA) 2) Government of Alberta: Wildlife Act 3) Boreal Caribou Committee, September 2001: Strategic Plan and Industrial Guidelines for Boreal Caribou Ranges in Northern Alberta
Biodiversity	1) Government of Alberta: Sustaining Alberta's Biodiversity 2) Environment Canada, 1995: Canadian Biodiversity Strategy 3) Alberta Biodiversity Monitoring Program, December 2006: Vertebrate and Invertebrate Species Codes 4) Alberta Biodiversity Monitoring Program, March 2007: Aquatic Field Data Collection Sheets: Streams and Wetlands 5) Alberta Biodiversity Monitoring Program, March 2007: Terrestrial Data Collection Field Sheets 6) Alberta Biodiversity Monitoring Program, March 2007: Stream and Wetland Field Data Collection Protocols 7) Alberta Biodiversity Monitoring Program, March 2007: River and Lake Field Data Collection Protocols; etc.
Land & Resource Use	1) Government of Alberta: Public Lands Act

Topic	Alberta Regulation/Guideline
SEIA	1) Alberta Energy and Utilities Board, September 1991: Directive 023: Guidelines Respecting an Application for a Commercial Crude Bitumen Recovery and Upgrading Project
Historical Resources	1) Government of Alberta, 2000: Historical Resources Act 2) Government of Canada: Bill C-29
Traditional Use/Traditional Ecological Knowledge	1) Government of Alberta, September 1, 2006: Alberta's First Nations Consultation Guidelines on Land Management and Resource Development 2) Government of Alberta, May 16, 2005: Appendix A to the Government of Alberta's First Nations Consultation Policy

3.	Concordance Table, Table 1.10-3, TOR Section 3.5.1, Page 37. Section 3.4.10 of the EIA does not address all of the items related to TOR 3.5.1. Indicate where this information is found.
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Response

Section 3.5.1 of the TOR refers to the management of waste streams. Additional references for this section are:

- Volume 1 Section 4.6
- Volume 1 Section 3.3.1.4
- Volume 1 Section 3.4.3.4
- Volume 1 Section 4.5.1
- Volume 1 Section 4.5.2

Additional details regarding the management of waste streams are also provided in:

- SIR Aug/07 [EUB Response 5](#)
- SIR Aug/07 [EUB Response 6](#)
- SIR Aug/07 [AENV Response 105](#)
- SIR Aug/07 [AENV Response 131](#)
- SIR Aug/07 [AENV Response 183](#)

4.	Concordance Table, Table 1.10-3, TOR Section 3.5.2, Page 38. Indicate where information requested in TOR Section 3.5.2b) is found.
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Response

Refer to Volume 1, Section 4.6 and [AENV Other SIR Response 3](#) (above) for specifics regarding the Project's waste management. The Partners have not characterized each of the major waste streams in accordance with Alberta Environment's User's Guide for Waste Managers as this Project, and therefore these waste streams, are regulated

under the EUB waste handling guidelines. Based on the EUB waste handling codes, outlined in Table 4-1, the major waste streams are classified as follows:

It should be noted that none of the major waste streams are classified under the Alberta User Guide for Waste Managers.

Table 4-1 Major Waste Streams

Major Waste Stream	EUB Waste Code	AENV Users Guide
Spent Lime	SLGPRO	Not classified
Wastewater Regeneration Liquids	SLGPRO	Not classified
Deep-well Disposal Water	WSTMIS	Not classified
Sanitary Fluids	WSTMIS	Excluded

5.	Concordance Table, Table 1.10-3, TOR Section 3.5.2, Page 38. 3.5.2d) asks for the location, nature and amount of on-site hydrocarbon storage. Indicate where the requested information is found.
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Response

Hydrocarbon storage is detailed in and on the updated plot plan ([Figure 1-33](#) of the SIR Aug/07 Project Update).

6.	Concordance Table, Table 1.10-3, TOR Section 4.7.2.3, Page 45. The referenced locations in the EIA report for many of the clauses in this section appear to be incorrect. Ensure that the correct referenced locations are provided.
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Response

The concordance table (Table 1.10-3) regarding TOR Section 4.7.2.3 should be corrected to include the following referenced locations in the EIA:

Concordance Table 1.10-3, Updated Section 4.7.2.3 of the TOR

<p>4.7.2.3 Impact Assessment & Mitigation</p>	<p>Discuss the following:</p> <ul style="list-style-type: none"> a) the significance of any changes for the regional landscape, biodiversity, productivity, ecological integrity, aesthetics and the future use of the regional landscape area; b) the predicted cumulative impact of acidifying emissions to local and regional soils resulting from Phase 2, with reference to local studies, current guidelines and management objectives for acidifying emissions consistent with the latest acid deposition management framework; c) the implications of environmental effects on ecosystem sustainability and regional management, including: <ul style="list-style-type: none"> i. any constraints or limitations to achieving vegetation restoration based on anticipated soil conditions, ii. an assessment of soil types for reclamation suitability and the approximate volume of suitable soil materials for reclamation, iii. the potential for soil erosion and measures to minimize the effects of any such erosion, and iv. any other issues that will affect the soil capability of the Study Areas or the reclaimed landscape and the mitigation measures proposed; d) an estimate of the effects of surface disturbance on geological features and soils, including: <ul style="list-style-type: none"> i. the type and extent of changes to the pre-disturbance topography, and ii. an assessment and maps of the pre- and post-disturbance land capability and resiliency of the Phase 2 Area and a description of the impacts to land capability resulting from Phase 2; e) the environmental effects of proposed drilling methods and summarize waste treatment methods consistent with EUB G50 guidelines, locations, area required and environmental impacts of drilling over the life of Phase 2; f) the potential for casing failures, including assessment of impacts and possible remediation options. Identify measures to reduce the environmental risks from casing failures (e.g., monitoring); and g) the potential for changes in the ground surface during operations (e.g., ground heave and ground subsidence). Summarize applicable experience with surface heaving and subsidence and the factors involved in their occurrence. Describe the environmental implications of any terrain changes during the steaming and recovery operations. Identify any activities that may cause soil contamination and describe mitigative actions. 	<p>Volume 4, Sections 9.7.6, 9.7.8, and 12.4.3</p> <p>Volume 4, Section 9.8.2</p> <p>Volume 4, Section 9.8.1, 9.8.2 and Volume 10, Section 10.6.4</p> <p>Volume 4, Section 9.4.4</p> <p>Volume 4, Section 9.4.6</p> <p>Volume 4, Section 9.7.1, 9.7.6</p> <p>Volume 4, Section 9.7.6, 9.7.7, Figures 9.4-4 and 9.7-1</p> <p>Volume 1, Sections 3.3 and 4.6</p> <p>Volume 1, Section 3.3.1.3, 3.3.1.5, 3.3.2.2, and 3.3.4.</p> <p>Volume 1, Section 3.1.2 and Volume 4, Section 9.7.5</p>
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7.	<p>In Appendix A of Volume 1 of the EIA, the definition of "Footprint" includes reference to the "Husky Tucker development". Please indicate whether this reference is correct or not. If this reference is incorrect,</p> <ul style="list-style-type: none">a) indicate the correct reference and provide the revised text of this definition; andb) indicate all other references to the Husky Tucker development, if any, or any other project, if any, that are to be corrected in the EIA and/or August 2007 Supplemental Information Volume.
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Response

In Volume 1, Appendix A of the EIA, the definition of "Footprint" should be corrected to read "The area occupied by surface facilities associated with the proposed Long Lake South development, resulting in surface disturbance. This term can apply to a central plant, well pads, roads, pipelines and other corridors." No other reference to the Husky Tucker development or any other project need be corrected in the EIA.