Part A

Project Introduction

SOUTHERN PACIFIC
RESOURCE CORP.

TABLE OF CONTENTS

List of Tables

List of Figures

A. PROJECT INTRODUCTION

A.1 PROJECT INTRODUCTION

Southern Pacific Resource Corp. (STP) is proposing to expand its oil sands development located approximately 40 km northwest of Fort McMurray in the Athabasca Oil Sands area (Figure A.1.1). The STP McKay Thermal Project – Phase 2 (herein referred to as Phase 2) is designed to be an expansion of the company's existing STP McKay Thermal Project – Phase 1 (Phase 1).

STP is currently constructing Phase 1, a Steam Assisted Gravity Drainage (SAGD) project on its McKay oil sands leases located in Township 91, Ranges 14 & 15, West of the 4th Meridian (Figure A.1.2). Phase 1 is expected to commence circulation and subsequent steam injection in the 2nd quarter of 2012. Phase 1 consists of a central processing facility (CPF), well pads, borrow pits, water source wells, observation wells, a water treatment plant, access roads and construction and operations camps. It is located on the west side of the MacKay River and was designed to produce 1,908 m^3/d (12,000 bpd) of bitumen. Within this application the use of the words "McKay", "MacKay" and "Mackay" are all correct. STP has chosen "McKay" for its SAGD Project.

Phase 2, which will have a CPF on the east side of the MacKay River, is designed to process an additional 3,816 m^3/d (24,000 bpd) of bitumen for approximately 25 years. Over the life of the Phase 2 Project a number of well pads, borrow pits and access roads will be required to maintain production. The total combined design capacity of the STP McKay Thermal Project (Phase 1 and Phase 2) will be 5,724 m^3/d (approximately 36,000 bpd).

Since 2007, STP has been actively conducting exploration programs to delineate bitumen resources on its McKay oil sands leases. Exploration conducted to date includes a 211 km high resolution 2D seismic survey, a 28 km Electrical Resistivity Tomography (ERT) survey, a 5.1 km^2 3D seismic survey and 90 stratigraphic test wellbores. The exploratory activity conducted to date demonstrated to STP that there are sufficient bitumen reserves on the McKay leases to expand production by 24,000 bpd to 36,000 bpd.

STP has identified a Project Area for Phase 2 that overlaps and expands upon the approved Phase 1 Project Area (Figure A.1.2). The Project Area is comprised of an area that will support all stages of development for the entire life cycle of both Phase 1 and Phase 2 and encompasses approximately 17 sections of land. STP is confident that the Project Area contains significant bitumen resources that are able to supply both Phase 1 and Phase 2 facilities for approximately 25 years. The Project Area is located on Oil Sands Leases No. 7407030888, 7407080270 and

7407050222 (Figure A.1.2). The Project Area for the Phase 2 Project includes the following lands:

- Sections 7, 8, 9, 10, 15, 16, 17, 18, 21, 22, 25, 26, 27, 34, 35, and 36 Township 91, Range 14,W4M; and
- Section 12 Township 91, Range 15, W4M.

STP has also identified a Development Area that expands upon the approved Phase 1 Development Area (Figure A.1.2). The Development Area encompasses approximately seven sections of land which have detailed delineation (greater than eight wells per section) of the bitumen resource that is adequate for the accurate placement of well pads and infrastructure. The locations of the first eight well pads and infrastructure required for the Initial Development of Phase 2 (3,816 m^3/d or 24,000 bpd) have been finalized (Figure A.1.3). Additional future replacement wells are presented as conceptualized potential locations that will be subject to revisions as additional geological understanding is gained to refine and optimize the detailed design. The Development Area includes the following lands:

- Sections 7, 8, 9, LSD 4, 5, 12 and 13 of Section 10, LSD 4, 5, 12 and 13 of Section 15, Sections 16, 17, 18, LSD 1 to 4 of Section 21 and LSD 4 of Section 22 Township 91, Range 14, W4M; and
- East half of Section 12, Township 91, Range 15, W4M.

A.2 PROJECT PROPONENT

STP is the applicant, operator and 100% working interest owner of Phase 2. STP is a Calgary-based heavy oil and oil sands exploration, development and production company. The company is publically traded on the Toronto Stock Exchange under the ticker symbol “STP”. Assets include an average 87% working interest in 436 square miles of oil sands leases in the Athabasca and Peace River oil sands region. STP also has a 100% working interest in the STP-Senlac Thermal Project, a heavy oil project using SAGD technology as the primary method of recovery. The STP-Senlac Thermal Project is designed to process approximately 5,000 bpd of heavy oil and was one of the first SAGD projects implemented North America. STP also has a thermal project in the Peace River oil sands called the STP-Red Earth Thermal Project. The STP-Red Earth Thermal Project is currently in a pilot project phase, with facilities constructed to test various cyclic steam stimulation (CSS) production techniques.

A.3 PROJECT OVERVIEW

The Phase 2 Project will use proven SAGD technology to recover bitumen from oil sands resources located approximately 190 metres below the surface. Planned facilities include a number of wells, well pads and associated infrastructure (e.g. roads, powerline, pipelines) and a Central Processing Facility (CPF). The CPF has been designed such that construction can occur in two distinct stages with a bitumen production capacity of 1,908 m^3/d (12,000 bpd) per stage. These stages are referred to as Phase 2A and 2B. At the CPF, the bitumen will be cleaned and diluted with hydrocarbon diluent. The bitumen condensate mix (dilbit) will be delivered via pipeline to an upgrader for refining into synthetic crude and other petroleum products.

The Phase 2 Project life at a design capacity of 3,816 m^3 (24,000 barrels) of bitumen per day is approximately 25 years. The facility will be designed to produce the steam required for 3,816 m^3/d at an average steam oil ratio (SOR) of 3.5. Reserves within the Project Area are up to 61.2 Mm3 (385.2 Mbbl) which results in an average reserve life of 25 years based on the expanded capacity of 5,724 m^3/d (36,000 bpd).

The workforce needed to operate the Phase 2 Project is forecast to be 51 people. STP proposes to transport the operations employees from Fort McMurray to the site. Once on site, the workforce will be housed in a camp constructed for the Phase 2 Project. Phase 2 operations will be integrated with the existing Phase 1 operations. Further details of the development plan are provided in Part B – Project Description.

The estimated footprint for the life of Phase 2 will be 488.1 ha. The Initial Development and Future Development components of Phase 2 are listed in Table A.3.1 and are shown on Figure A.1.3.

Table A.3.1 Project Components

Facility	Area (ha)
Initial Development (increases production by 24,000 bpd)	
CPF and Cogen Facility	28.8
CPF Soil Storage	16.2
Well Pad 201	7.1
Well Pad 202	7.9
Well Pad 203	6.7
Well Pad 204	4.9
Well Pad 205	7.1
Well Pad 206	6.8

Table A.3.1 Project Components	
Facility	**Area (ha)**
Well Pad 207	7.1
Well Pad 208	7.1
Utility and Access Corridor	24.5
Operators Camp	2.8
Borrow Pit #1	19.2
Borrow Pit #2	10.3
Borrow Pit #3	6.5
Sub-total Initial Development	**163**
Future Development (maintains production at 36,000 bpd)	
Well Pads (x24)[(1)]	156.9
Utility and Access Corridor	75.5
Borrow Pits	92.7
Sub-total Future Development	**325.1**
Total Development	**488.1**

(1) Additional future pads will be identified based on results of future exploration

Following approval, it is anticipated that procurement and civil work for Phase 2 will commence in the second half of 2013. Major facility construction is planned to begin in the first quarter of 2014 and will continue until the plant is commissioned at the end of 2014. The development schedule for Phase 2 is included as Figure A.3.2.

A.4 PROJECT NEED AND ALTERNATIVES

A.4.1 PROJECT NEED

Oil industry projections show that conventional crude production opportunities are declining. As such, the need for additional heavy oil and bitumen production will increase in order to meet continental demand. Phase 2 will recover bitumen from the McMurray Formation of the Athabasca oil sands deposit utilizing the in-situ SAGD process. The oil sands reserves in the Project Area will be sufficient to produce approximately 5,724 m^3/d (36,000 bpd) of bitumen for approximately 25 years.

Phase 2 will be a positive addition to the Alberta economy, both during construction and operations. Some of the Phase 2 Project highlights are as follows:

- the total Project construction and operation costs over the life of the Phase 2 Project will be approximately $1.27 billion;
- Phase 2 will contribute an estimated $550 million in royalties to the Alberta Provincial Government;
- Phase 2 will contribute an estimated $2.6 million annually in municipal property taxes;
- Phase 2 will employ a full time work force of approximately 51 people; and
- during construction, Phase 2 will provide 2,220 person years of on and off-site employment.

A.4.2 ALTERNATIVES

A.4.2.1 Bitumen Recovery Technology Alternatives

At the time of this application, bitumen is commercially produced from the Athabasca oil sands area using open pit mining and in-situ (thermal) methods. In-situ methods will be used for this Project as surface mining is only feasible when the overburden above the bitumen bearing formation is less than 100 metres in thickness, and the depth of the bitumen resource targeted by Phase 2 is greater than 100 m.

There are two in-situ recovery technologies currently commercially applied in the province: Cyclic Steam Stimulation (CSS) and Steam Assisted Gravity Drainage (SAGD). While CSS has been commercially successful in certain reservoirs, SAGD is a better fit for the McKay resource due to its higher recovery factors and superior performance in clean, shallow (low pressure) sands. SAGD has been selected as the technology of choice for the Phase 1 Project, and has been successfully applied at the nearby Suncor MacKay River Project.

Industry is currently investigating a number of potential extraction technologies, several of which are in the pilot test stage. STP believes that until such time that an alternative recovery technology has been shown to be both commercially successful and superior to existing recovery methods, SAGD will be the most appropriate extraction technology for Phase 2. STP plans to monitor the progress of developing technologies for potential future applications as warranted.

A.3.2.2 Fuel Source Alternatives

Natural gas is the fuel of choice for the Phase 1 Project and will also be the choice for the Phase 2 Project. Natural gas is a clean burning fuel which is readily available utilizing the existing natural gas delivery infrastructure at the Phase 2 location. While alternative fuels such as bitumen, coal, and petroleum coke were identified as potential options, the capital and operating costs associated with transporting and using these fuel sources while minimizing emissions makes these options prohibitive.

A.3.2.3 Water Supply Alternatives

For the Phase 1 Project an extensive evaluation of water potential in all formations was conducted within a 15 km radius of the Development Area. The initial evaluation was primarily focused on the potential for saline water. There is no source of saline water available within the area of investigation. STP identified the Empress Formation as the most feasible water source and has since advanced and tested wells at 08-08-091-14W4 and 16-08-091-14W4 and 15-08-091-14W4 into the formation. The tests confirmed adequate delivery and volume to supply the majority of the water requirements for Phase 2.

A.3.2.4 Water Treatment Alternatives

Evaporator / Crystallizer – Drum Boiler Technologies have been selected for Phase 2 to match with the technologies selected for the existing Phase 1 Project, no alternative technologies were considered for the Phase 2 Project. STP believes that the Evaporator – Drum Boiler combination is the best available water treatment / steam generation technology available. This technology combination is superior to the other commercially proven alternative (Warm/Hot Lime Softening coupled with once through steam generators (OTSGs) as lower disposal water volumes are achievable with this configuration. It also provides superior energy efficiency without additional capital cost.

A.5 PROJECT REGULATORY APPROVAL PROCESS

This document comprises the application for approval of Phase 2 and meets provincial requirements under the *Oil Sands Conservation Act*, the *Environmental Protection and Enhancement Act* and the *Water Act*.

A.5.1 NAME OF APPLICANT

The name and address of the applicant for Phase 2 is:

Southern Pacific Resource Corp.
Suite 1700, Bow Valley Square II
205 – 5th Avenue SW
Calgary, AB T2P 2V7

Correspondence concerning this application should be directed to the above address to the attention of:

Name: Mr. Vince Parsons, Senior Environmental & Regulatory Advisor
Phone: (403) 984-5335
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E-Mail: info@shpacific.com

A.5.2 EXISTING OPERATIONS AND APPROVALS

STP currently holds the following approvals for the STP McKay Thermal Project – Phase 1:

- *Environmental Protection and Enhancement Act* (EPEA) Approval No. 255245-00-00;
- EPEA Approval No. 287052-00-00 for the wastewater treatment plant;
- *Oil Sands Conservation Act* Approval No. 11461B (as amended);
- *Water Act* Licence No. 00262149-00-00 to divert 419,750 m^3 per year of water from the McKay Channel Empress Formation and 43,000 m^3 from the stormwater retention pond;
- *Hydro and Electric Energy Act* Approval No. U211-107;
- *Hydro and Electric Energy Act* and *Electric Utilities Act* Industrial System Designation Order No. U2011-223; and
- numerous public lands dispositions for development on public lands.

A.5.3 EXPANSION ACTIVITIES AND APPROVALS/AMENDMENTS

This application is an integrated submission to the Energy Resources Conservation Board (ERCB) and Alberta Environment & Water (AENV). STP is seeking approval for the following:

ERCB Approval:

- amend the *Oil Sands Conservation Act* Approval No. 11461C to expand the Project Area and Development Area; approval to construct and operate Phase 2 of the Project which will include a central processing facility, well pads and associated well pairs with a production capacity of 3,816 m^3/d of bitumen, all in accordance with the *Oil Sands Conservation Act* and the *Oil Sands Conservation Regulation*; and
- construct and operate a distribution and gathering pipeline system within the Phase 2 Project development area in accordance with the *Pipeline Act.*

AENV Approval:

- amendment to the existing EPEA Approval No. 255245-00-00, in accordance with the Alberta *Environmental Protection and Enhancement Act* to construct and operate Phase 2 including facilities to recover and treat bitumen and processed water;
- amendment to the existing EPEA Approval No. 255245-00-00, in accordance with the Alberta *Environmental Enhancement and Protection Act*, to construct and operate the cogeneration facility;
- amendment to the existing EPEA Approval No. 255245-00-00, as required under the *Conservation and Reclamation Regulations*, to develop, operate and reclaim the central processing facility, well pads and associated infrastructure of Phase 2; and
- a water diversion licence for the water supply pursuant to Part 4 of the *Water Act*.

A.5.4 ADDITIONAL APPROVALS ASSOCIATED WITH THE APPLICATION

STP will file separate applications for those parts of Phase 2 that are legislated under various other statutes. Provincial application and approval requirements applicable to Phase 2 which will be submitted under separate cover are:

- surface rights requirements pursuant to the *Public Lands Act*;
- site surface disturbance clearance pursuant to the *Historical Resources Act*;
- production and injection well drilling licenses issued pursuant to the *Oil and Gas Conservation Act*;
- facility licenses under *Directive 56: Energy Development Applications and Schedules* (ERCB 2011);
- Measurement and Reporting Procedures under Directive 76: Operator Declaration Regarding Measurement and Reporting Requirements (ERCB 2009)
- construction and operation of the sewage treatment plant pursuant to the *Environmental Protection and Enhancement Act*;
- development Permits pursuant to the *Municipal Government Act*, from the Regional Municipality of Wood Buffalo for construction and operation of Phase 2 and related infrastructure;
- cogeneration facility approval as per Part 2 Section 11 of the *Hydro and Electric Energy Act* to be filed with the Alberta Utilities Commission; and
- electrical power interconnections issued pursuant to the *Electrical Utilities Act*.

A.6 APPLICATION GUIDE AND DESCRIPTION

The application for approval to the ERCB and AENV has been integrated in accordance with ERCB and AENV guidelines to facilitate an efficient review of the application by the regulatory review agencies and the public. The ERCB application and EIA for Phase 2 is found in three volumes consisting of the following components:

Volume I

- Part A – Project Introduction
- Part B – Project Description
- Part C – EIA Methodology
- Part D – Environmental Impact Assessment
- Part E – Conceptual C & R Plan
- Part F – Stakeholder Consultation
- Appendix I – Terms of Reference Concordance Table
- Appendix II – Project Team
- Appendix III – Glossary and Acronyms
- Appendix IV – References
- Appendix V – Consultation

Volume II

- Consultant Report #1 – Air Quality
- Consultant Report #2 – Aquatic Resources
- Consultant Report #3 – Groundwater
- Consultant Report #4 – Historical Resources
- Consultant Report #5 – Human Health

Volume III

- Consultant Report #6 – Hydrology
- Consultant Report #7 – Noise
- Consultant Report #8 – Socio-Economic
- Consultant Report #9 – Soil and Terrain
- Consultant Report #10 – Vegetation and Wetlands

- Consultant Report #11 – Wildlife

In accordance with *the Guide to Preparing Environmental Impacts Assessment Reports in Alberta* (AENV 2011) the approval applications have been provided as a separate stand-alone volume separate from the EIA. The approval applications are included in one binder consisting of the following components:

- EPEA and Water Act Application
- Appendix A – Air Quality
- Appendix B – Existing Approvals
- Appendix C – Water Act Application Form
- Appendix D – Consultation
- Appendix E – Conceptual C & R Plan

A.7 REGIONAL SETTING

Phase 2 is located 40 km northwest of Fort McMurray and 40 km southwest of the community of Fort McKay. The nearest residences to the proposed development are located in both of these communities.

Phase 2 lies within the Central Mixedwood Subregion of the Boreal Forest Natural Region in northern Alberta. The Project Area is bisected by the MacKay River and its tributaries which provide breeding and migratory habitats for numerous species of waterbirds. A majority of the Project Area is located in nearly level to level organic plateaus comprised of shallow to moderately thick organic deposits. Bog and fen organic communities occupy significant portions of the area. Vegetation consists of a variety of mixed stands including aspen, balsam poplar, paper birch, white spruce, jack pine and balsam fir. Understory vegetation consists primarily of shrubs and forbs such as prickly rose, low-bush cranberry, bunchberry, wild sarsaparilla and dewberry. The western portion of the Project Area is within the Wabasca-Dunkirk Caribou Management Zone and provides habitat for a broad range of mammals, birds and amphibians.

A.8 SUMMARY OF STAKEHOLDER CONSULTATION

STP has had ongoing dialogue with local and regional stakeholders since 2007 regarding the environmental and social aspects of SAGD development in the McKay Area. Consultation successfully took place on STP McKay Thermal Project – Phase 1, for which approval was received in late 2010. STP is now planning to develop the STP McKay Thermal Project – Phase 2, and began consultation in the winter of 2010.

Stakeholder groups consulted to date for Phase 2 have included affected landowners, local government, non-government organizations, special interest groups, other operators, government regulators, communities, and Aboriginal groups. Following project approval, STP will continue to work in an open and inclusive manner with all communities and stakeholders impacted by its operations. Details of STP's public consultation activities, for Phase 2, are provided in Part F.

A.9 SUMMARY OF ENVIRONMENTAL, HISTORICAL RESOURCES AND SOCIO-ECONOMIC IMPACT ASSESSMENTS

Environmental Impact Assessment (EIA) is a process, and not just a document or report. An environmental impact assessment report is only one part of the EIA process. Beanlands and Duinker (1983) define an environmental impact assessment as a *"process or set of activities designed to contribute pertinent environmental information to project or program decision-making. In doing so, it attempts to predict or measure the environmental effects of specific human activities or do both, and to investigate and propose means of ameliorating those effects."*

Three phases within the environmental impact assessment are recognized:

- the environmental baseline study phase;
- the interpretive, predictive and evaluative phase (*i.e.*, the preparation and review of an environmental impact assessment report); and
- the post-construction assessment phase (*i.e.*, monitoring).

For Phase 2, the environmental impact assessment process is currently in the midst of the second stage of the EIA. Baseline environmental studies for Phase 2 have been completed. This application forms the initial stages of the second phase of the EIA process, that is, the preparation of the EIA report. Upcoming government and public review of this application will complete the second phase of the EIA process. Should the proposed project be approved, environmental monitoring during SAGD development operations will constitute the third stage of the EIA.

The Application and EIA has been prepared to fulfill the requirements specified in the Terms of Reference, as well as the environmental information requirements prescribed under the EPEA and Regulations, the *Oil Sands Conservation Act* (OSCA) and federal legislation which applies to Phase 2. However, consistent with the iterative nature of environmental assessment, this Application also addresses issues identified by government review agencies and directly-affected stakeholders during the collection of baseline environmental information and preparation of the EIA report.

The scope of Phase 2 for the purposes of the EIA includes all phases (construction, operation, decommissioning and reclamation) of the in situ SAGD oil extraction operations and the associated facilities and infrastructure required to carry out these activities.

The Phase 2 EIA report has addressed impact concerns by identifying Valued Environmental Components (VECs). VECs for Phase 2 are those environmental attributes associated with the proposed project development, which have been identified to be of concern either by directly-affected stakeholders, government or the professional community. VECs have been identified within each of the following disciplines:

- Air Quality;
- Aquatics;
- Groundwater;
- Historical Resources;
- Human and Wildlife Health;
- Hydrology;
- Noise;
- Socio-economic;
- Soil and Terrain;
- Vegetation and Wetlands;
- Wildlife;
- Greenhouse Gases; and
- Land and Resource Use.

The EIA Terms of Reference for Phase 2 states "The Study Area for the EIA report shall include the Project Area as well as, the spatial and temporal limits of individual environmental components outside the Project Area boundaries where an effect can be reasonably expected. The Study Area includes both the Local and Regional Study Areas."

Spatial boundaries are established based on the zone of the Phase 2 Project influence, beyond which the potential environmental, cultural and socio-economic effects of Phase 2 are expected to be non-detectable. VEC-specific boundaries are established for both a Local Study Area (LSA) for Project-specific effects, and a Regional Study Area (RSA) for cumulative effects.

The Phase 2 Project EIA considers the following assessment scenarios:

- **Baseline Case**, which includes existing environmental conditions and existing projects or "approved" activities;

- **Application Case**, which includes the Baseline Case plus Phase 2; and
- **Planned Development Case (Cumulative Effects)**, which includes the "Application Case" combined with past studies, existing and anticipated future environmental conditions, existing projects or activities, plus other "planned" projects or activities.

Based on the methodology included in Part C, the EIA for Phase 2 focused on the effects that Phase 2 would have on the identified VECs in combination with other activities in the region over the anticipated economic life of Phase 2.

Based on the input received during the public consultation program, advice from regulatory agencies, and the professional community participants that worked on Phase 2, STP is confident that the methodology and approach used to conduct the EIA has enabled a comprehensive and accurate assessment of the effects of Phase 2.

A summary of the EIA has been provided in this section along with STP's commitments for mitigation and monitoring.

A.9.1 AIR QUALITY

The potential effects of Phase 2 on air quality at nearby receptors are discussed in Section D.1 and Consultants Report #1 (CR #1).

The air quality Local Study Area (LSA) and regional study area (RSA) were chosen based on the location of major regional industrial emission sources and the expected spread of project concentration and deposition contours. For Phase 2, maximum concentrations are expected to occur within 5 km of the main emission sources and decrease with increasing distance beyond this point. The air quality LSA is a 50 km by 50 km square centred approximately on STP's proposed Project. The air quality RSA is about 270 km by 305 km.

A number of potential VECs were identified during the issue scoping process as they relate to potential human or ecosystem health effects. The air quality VECs include:

- sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), particulate matter ($PM_{2.5}$), hydrogen sulphide (H_2S), specific volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs);
- ozone (O_3);
- odour and visible plumes;
- potential acid Input (PAI) and eutrophication (nitrogen deposition); and
- greenhouse gas (GHG) Emissions.

Continuous emission sources at Phase 2 include five steam boilers, three cogeneration units, a utility boiler, and a glycol heater. Flare stacks are used for emergency only. Modelling was done using the CALMET/CALPUFF model, and was conducted according to Alberta Environment (2009). Modelling results indicate that there are no exceedances of the AENV Alberta Ambient Air Quality objectives (AAAQOs) for SO_2, NO_x and CO concentrations predicted at any location for the three assessment scenarios.

Results of the modeling indicate that the Canada Wide Standard for predicted $PM_{2.5}$ would be exceeded at the overall regional Maximum Point of Impingement (RSA-MPOI) for all three assessment scenarios. Modelling also indicated that the 1-hour predictions would exceed the AAAQOs at the RSA-MPOI and the 24-hour predictions would exceed the AAAQOs at the LSA-MPOI and RSA-MPOI for all three assessment scenarios. The Phase 2 Project contributions to $PM_{2.5}$ concentrations are negligible to minimal in the Application Case at all locations, including the LSA-MPOI.

For H_2S there were exceedances of the H_2S 1-hour and 24-hour objectives predicted at the RSA-MPOI for all three assessment scenarios. There were also exceedances of the 24-hour objectives predicted at the LSA-MPOI for the Planned Development Case (PDC). These concentrations stem from emissions from the mining areas north of Fort McMurray. Model predictions demonstrated there were no exceedances of 1-hour or 24-hour AAAQOs at or immediately beyond the Phase 2 fence line where the project most influenced predictions. Phase 2's relative contribution was negligible at nearby receptors, with the exception of the Phase 2 Operations Camp where the absolute increase in predicted concentrations was small.

Specific VOCs and PAHs were also included in the air assessment. No exceedances of AAAQOs were predicted with the exception of benzo(a)pyrene for the RSA-MPOI, and at Fort McMurray and Fort McKay for all three assessment scenarios. For all compounds modeled, the absolute contribution of Phase 2 at locations outside the LSA was negligible. In the PDC case, the 1-hour concentration for carbon disulphide (CS_2) exceeded AAAQOs at the RSA-MPOI located in the mining area north of Fort McMurray. Project emissions of CS_2 have negligible impact at all special receptor locations and MPOIs.

Photochemical models (CALGRID and CMAQ) can be used to predict the secondary formation of O_3 based on precursor emissions and meteorological conditions. Both CALGRID and CMAQ models indicated a negligible change in regional O_3 concentrations with the addition of Phase 2.

The predicted maximum air concentrations for compounds were compared with established odour thresholds. As odour can be perceived within a short time span, the air concentration used in the comparison was based on a three-minute averaging period converted from the 9^{th} highest hourly predictions. The predicted 3-minute maxima for NO_2, C9-C18 aliphatics, CS_2, and

acetaldehyde, which are located in the mining area of the RSA, exceed the mean odour threshold in all three assessment scenarios. Hydrogen sulphide odour threshold exceedances were also predicted at two receptor locations in all three assessment scenarios. However, the frequency of these exceedances was less than 0.5%. Project emissions do not contribute to new occurrences of odour at any of the special receptors or the LSA and RSA MPOIs.

Water vapour in plumes from Project combustion sources will be visible under some meteorological conditions. Visible plumes were predicted to occur about one-quarter of the time, half of them in winter when the daylight hours for viewing plumes are shorter, and most of them during night-time conditions. Most visible plumes were higher than the top of the tree canopy. Most plumes were less than 1 km in length; almost all of the longest plumes were predicted to occur before sunrise or after sunset.

CALPUFF was used to estimate the deposition of PAI that would occur for the assessment scenarios. Precursor emissions include NO_x and SO_2. The maximum predicted PAI value in the RSA is approximately 3.8 keq/ha/yr, and in the LSA is 0.40 keq/ha/yr in both the Baseline Case and Application Case. Small incremental areas (4 ha) with deposition above 0.25 keq/ha/yr were predicted around the STP central processing facility. The model results indicate that Phase 2 increased the area within relevant deposition isopleths by 1% or less in the RSA and by 7% in the LSA. In the PDC, the maximum predicted PAI value in the RSA increases to approximately 4.1 keq/ha/yr. The maximum predicted PAI in the LSA increases to 0.41 keq/ha/yr for the planned development case. The PAI predictions are largely driven by emissions from sources beyond the LSA, as evidenced by the regional maxima in the mining area north of Fort McMurray.

Deposition of nitrogen can lead to eutrophication in water bodies or changes in growth rates of terrestrial vegetation and its calculation includes both wet (removal in precipitation) and dry (direct contact with surface features) processes. Results of the modeling indicate that the regional maximum predicted nitrogen deposition is 59 kg/ha/yr. The most sensitive ecosystems in the region may be affected by as little as 8 kg/ha/yr of deposited nitrogen. The area above this threshold under baseline conditions is 3,478 km^2 in the RSA and 69 km^2 in the LSA. For the Application Case the regional maximum predicted nitrogen deposition is unchanged from baseline case (59 kg/ha/yr) and the area above the 8 kg/ha/yr threshold is 3,492 km^2 in the RSA and 72 km^2 in the LSA (up to 5% increase from baseline). Results of the modeling indicate that the regional maximum predicted nitrogen deposition is 5% greater than baseline (62 kg/ha/yr). The area above the 8 kg/ha/yr threshold is 4,944 km^2 (42% increase from baseline) in the RSA and 152 km^2 in the LSA (120% increase from baseline). The increases in maximum deposition and area affected are due to regional growth of SAGD facilities and the mining areas to the northeast of the LSA.

It is the design intent that the Phase 2 flare stack be used as an emergency system, with any normal process vents being processed through the steam boilers. According to AENV (2009a), the impact due to emergency and upset conditions must be considered in environmental assessments for air quality. Emergency flaring would occur in the scenario of multiple failures resulting in blockage of flow in the vapour recovery unit (VRU) suction. In the event of a VRU blockage the VRU gas volumes will be bypassed to the flare stack. The predicted maximum 1-hour SO_2 concentration is 387 µg/m^3, which is well below the hourly AAAQO for SO_2.

With mitigation, the effects of Phase 2 on air quality VECs are predicted to be low impact for the Application Case and low to moderate impact for the PDC.

In order to reduce potential impacts of Phase 2 on air quality, STP will:

- design Phase 2 so there is no continuous flaring other than pilot and purge gas;
- include liquid knockout facilities, pilot/purge gas, continuous monitoring, and burner management in the emergency flare system;
- install a vapour recovery system; and
- utilize low NO_x emissions technology.

In order to verify that the mitigation measures have been effective STP will:

- test H_2S content in produced gas and estimating SO_2 emissions from the produced gas flow rate;
- determine GHG emissions by measuring gas composition and fuel use;
- undertake manual stack surveys as commonly required in EPEA Approvals; and
- install passive monitors to determine SO_2 and H_2S concentrations.

A.9.2 AQUATIC RESOURCES

The potential effects of Phase 2 on aquatic resources are discussed in Section D.2 and Consultants Report #2 (CR #2).

The aquatics LSA encompasses a portion of the upper MacKay River watershed. The MacKay River watershed within the LSA contains the MacKay River (sixth-order stream), one fourth-order stream, and a series of third- and lower-order streams and small beaver ponds. The RSA includes the watercourses of the LSA plus the mainstem of the MacKay River downstream to its confluence with the Athabasca River.

The aquatic resources Baseline Case consists of a description of surface water quality, fish resources, aquatic habitat, (physical conditions, sediment quality, and benthic invertebrate

communities), first for the watercourses within the LSA, followed by the watercourses that comprise the RSA.

Watercourses within the LSA have water quality that:

- is generally characteristic of coloured brown-water systems with a median true color level ranging from 172 TCU to 282 TCU and median concentrations of DOC ranging from 36.2 mg/L to 54.2 mg/L;
- is hard with median concentrations ranging from 62.2 mg/L to 153 mg/L;
- generally have circumneutral pH and pH is generally consistent across seasons;
- has high concentrations of total dissolved solids (TDS) (median values ranging from 158 mg/L to 306 mg/L) and conductivity (median value ranging from 127 µS/cm to 306 µs/cm) consistent with concentrations and levels in regional baseline watercourses in the Athabasca oil sands region (RAMP 2011);
- is generally consistent median concentrations of total suspended solids (TSS) ranging from 4 mg/L to 8 mg/L;
- is classified as mesotrophic to eutrophic based on spring total phosphorus and total nitrogen concentrations (Dodds et al. 1998); and
- has ionic composition dominated by calcium and bicarbonate.

The analysis of Fish and Wildlife Management Information System (FWMIS) data indicates a high probability of first to sixth order streams containing small-bodied fish in the LSA. Baseline fish inventories were conducted at ten watercourses in the LSA. A total of 854 fish, comprising 11 species, were captured in watercourses in the LSA. The majority of fish captured were northern redbelly dace (30%), finescale dace (13%), slimy sculpin (13%), brook stickleback (11%) with fewer white sucker, lake chub, pearl dace, longnose dace, trout-perch, northern pike, and longnose sucker captured. A total of 15 fish species are documented in the MacKay River (the RSA), which is the only sixth order stream in the watershed.

The watercourses in the LSA have mostly run morphology. Vegetation bordering the sampled watercourses comprises grasses and shrubs with some muskeg and immature to established deciduous or mixed forest. Where beaver ponds are present, large areas of vegetation have been flooded. Instream vegetation is minimal in larger watercourses, but smaller tributaries and dammed pools have high amounts of instream vegetation.

The VECs evaluated in the aquatic resource assessment include surface water quality and fish resources. Potential impacts can occur due to:

- surface disturbance and construction activities;

- instream construction activities;
- changes in surface water quality;
- changes to surface flow rates and levels;
- improved or altered access to fish bearing waterbodies;
- changes in surface water quality affecting fish health, including fish tainting; and
- acidifying emissions.

Construction, reclamation and decommissioning of the Phase 2 Project may give rise to increased sediment loading in watercourses and waterbodies. These activities may have consequent effects on water quality, aquatic habitat and fish populations. With strict implementation of mitigation measures, potential impacts of surface disturbance activities are predicted to have a Low Impact within the LSA and RSA.

There are 28 potential watercourse crossings in the Phase 2 Project area with three crossings situated on watercourses with fish and fish habitat. Direct changes and physical loss of aquatic habitat may occur during instream construction works, such as watercourse crossing sites (roads or utilities) by the direct disturbance of the streambed, banks or riparian areas. With strict implementation of mitigation measures including constructing clear span crossings over those watercourses with fish or fish habitat, potential impacts of instream construction activities are predicted to be low.

Discharge of Project-affected water to natural watercourses, accidental spills of hydrocarbons, chemicals and waste products, and changes in shallow groundwater quality may negatively affect surface water quality, and may give rise to resultant changes to aquatic habitat and fish populations. With strict implementation of mitigation measures, potential impacts to aquatic resources through changes in surface water quality and discharge of Project-affected water into natural watercourses are predicted to be low.

Changes to surface water flow rates could result from surface disturbance activities altering natural run-off and drainage patterns, surface water withdrawal activities, release of process affected waters to natural waterbodies, and changes in the amount of shallow groundwater reporting to surface water. With mitigation the potential impacts to aquatic resources through changes in surface water flow rates are predicted to be low.

Improved access and increased workforce in the area as a result of the Phase 2 Project could increase fishing pressure and fish harvest in local fish-bearing waterbodies and watercourses. This could, in turn, result in a decreased abundance of sportfish if fishing pressure and/or fish harvest were not appropriately managed. While many fish populations in the RSA, particularly the MacKay River, are sensitive to angling pressure, and while the workforce may potentially

catch additional fish, it is expected that the mitigation and management measures will mean that these effects of increased angling on LSA fish populations will be low.

Changes in water quality have the potential to affect the health of fish and other aquatic organisms. With implementation of mitigation measures, potential impacts to fish health through potential changes in water quality are predicted to be low.

With the exception of three lakes to the northeast of Fort McMurray, predicted PAI values at all lakes are below Alberta's Clean Air Strategic Alliance (CASA) target level of 0.25 keq H+/ha/yr (AEP 1997) for the Baseline and Application cases. PAI values for fourteen lakes exceed critical load values in both the Baseline and Application Cases; there are no lakes that exceed the critical load value in just the Application Case. The residual (after mitigation) effects of Phase 2 in the Application Case and Planned Development Case on surface aquatic resources through acidifying emissions are assessed as Low Impact.

In order to reduce potential impacts of Phase 2 on aquatic resources, STP will:

- require earthworks contractors to utilize an effective sediment control plan;
- implement sediment control measures such as those described in the Alberta Code of Practice for Watercourse Crossings (AENV 2000) for earthworks which take place within or in close proximity to watercourses;
- carry out surface disturbance activities in close proximity to watercourses during periods of relatively low surface runoff in late fall, winter and early spring, when possible;
- maintain a 50 m buffer between disturbance sites and watercourses except at stream crossings and diversions;
- minimize the time interval between clearing/grubbing and subsequent earthworks, particularly at or in the vicinity of watercourses or in areas susceptible to erosion;
- utilize slope grading and stabilization techniques, such as contouring slopes to produce moderate angels and ditching above the cutslope, where relevant;
- where required, utilize surface runoff collection systems to direct surface runoff from disturbed areas into settling impoundments/sumps for removal of settleable solids;
- undertake progressive disturbance and reclamation to reduce the amount of disturbed area at any given time;
- where necessary, utilize interim erosion/sediment control measures until long-term protection can be effectively implemented;
- construct clear span crossings on watercourses with fish and fish habitat in accordance with the Department of Fisheries and Oceans (DFO) Alberta Operational Statement for Clear Span Bridges;

- design and construct all watercourse crossings in compliance with the Alberta Code of Practice for Watercourse Crossings (AENV 2000);
- construct all storage tanks, except boiler feed water and source water tanks, with secondary containment and leak detection equipment to minimize the occurrence of product leaks;
- raise awareness among the STP Phase 2 Project workers of the existing Alberta Sustainable Resource Development (ASRD) regulations for the species found in the study area lakes; and
- discouraging fishing by Phase 2 Project employees within the LSA.

In order to verify that the mitigation measures have been effective, STP will:

- conduct routine audits and associated surface aquatic resources monitoring during construction periods; and
- effects monitoring will be carried out in accordance with the conditions of the EPEA approval.

A.9.3 GROUNDWATER

The potential effects of Phase 2 on groundwater are discussed in Section D.3 and Consultants Report #3 (CR #3).

The hydrogeology LSA includes a buffer around the proposed Phase 2 Project area. The LSA is intended to include the extent of the Phase 2 Project related impacts beyond which the potential effects of Phase 2 are expected to be non-detectable.

The RSA defined for the hydrogeology assessment extends between townships 87 and 94 and range 19 East to the Athabasca River. The RSA boundaries were selected based on major hydrologic-hydrogeologic features, such as the Athabasca River, which is a regional groundwater discharge feature and was selected as the southern and eastern boundary. The RSA also includes sufficient distances where measureable effects associated with the Phase 2 Project are not anticipated, but where residual effects from Phase 2 have potential to interact cumulatively with the residual effects of other projects.

Components of the Phase 2 Project that have been identified as having the potential to affect groundwater resources include:

- groundwater withdrawal;
- operation of surface facilities; and

- steaming and production.

Potential impacts were assessed for the following resources;

- surface water bodies and wetland areas;
- shallow drift aquifers;
- Empress Aquifer; and
- Grand Rapids Aquifers.

The region is underlain by an unconformable sequence of Quaternary, Cretaceous and Devonian sediments on the Precambrian crystalline basement. Regional Quaternary deposits are divided into two units; undifferentiated drift deposits that blanket the region and buried channel deposits. Cretaceous units include the La Biche, Viking and Joli Fou of the Colorado Group and the Grand Rapids, Clearwater and McMurray formations of the Mannville Group. Devonian units present in the RSA include the Woodbend, Beaverhill Lake and Elk Point groups; of these, the Beaverhill and Woodbend Groups subcrop beneath the pre-Cretaceous unconformity. There are bitumen deposits in the Cretaceous McMurray Formation, which are the subject of the SAGD operations assessed for Phase 2.

Regional aquifers include the Empress Formation, the Cretaceous Viking, Grand Rapids 3, 4 and 5 sands and the Devonian Beaverhill Lake - Cooking Lake aquifer system. Within the RSA, the permeable portions of the undifferentiated glacial drift and water saturated portions of the McMurray aquifer are interpreted as forming only localized aquifers. The Base of Groundwater Protection is established at an elevation of 287 masl at the Project (ERCB 2011) and the Clearwater Formation is identified as the deepest protected groundwater unit. Thus key units from a hydrogeological point of view that underlie the Phase 2 Project are the Quaternary glacial drift and buried channels and the Grand Rapids Formation. Other units were not considered in detail as they are either below the Base of Groundwater Protection or do not underlie the Phase 2 Project.

A total of 164 water well records are on file with AENV within the RSA. Of these records, roughly one third are for observation or monitoring wells and another third are for industrial wells. Only 22 records were identified for domestic wells and the use of the remaining wells is unknown. The nearest domestic water well is approximately 13 km to the west of the Phase 2 Project. Active groundwater production from the Empress Formation within the RSA is occurring at licensed Suncor wells located in Township 93 Range 12. Suncor's allocations from the Empress Formation total 1,213,904 m^3 annually. STP has a license for Phase 1 in the amount of 419,750 m^3 annually from the Empress Formation. No other withdrawals appear to be currently allocated from the Empress Formation within the RSA.

The VECs for hydrogeology are water quantity (water levels) and/or water quality. The assessment evaluates the following:

- effects of the groundwater withdrawals on water quantity;
- effects of the surface facilities on water quality; and
- effects of the production and injection wells on water quality.

STP plans to obtain water for Phase 2 from the Empress Formation. Pumping of groundwater from a water supply well causes the formation pressure to decrease. This decrease in pressure spreads outwards over time as a cone of pressure in the potentiometric surface. The reduction in formation pressure could reduce available production for other wells that are completed in the same formation and could also alter seepage from or discharge to hydraulically-connected surface water bodies or other aquifers.

A numerical groundwater flow model was prepared to complete the assessment of potential impacts due to groundwater production from the Empress Formation. The model predicted that:

- In the Empress Formation for the Application Case, the percent reduction in groundwater level was calculated as 14% at the STP source wells and 7% at the Suncor source wells therefore the potential effects of withdrawal on groundwater quantity in the Empress Formation are rated as low.
- In the Empress Formation for the PDC, the percent reduction in groundwater level is calculated as 26 % near the STP source wells and 10 % at the Suncor source wells therefore the cumulative effects related to effects of groundwater withdrawals on groundwater quantity (water levels) in the Empress Aquifer are rated as moderate.
- In the Grand Rapids for the Application Case, the percent reduction in groundwater level associated with the Phase 2 Project production was estimated as 3 % for the Grand Rapids 5 Aquifer and 6 % for the Grand Rapids 4 Aquifer. The potential effects of withdrawal on groundwater quantity in the Grand Rapids Aquifers were rated as low.
- In the Grand Rapids for the PDC, the percent reduction in groundwater level was estimated at 9 % for the Grand Rapids 5 Aquifer and 17 % for the Grand Rapids 4 Aquifer. Cumulative effects related to effects of groundwater withdrawals on groundwater quantity in the Grand Rapids Aquifers were rated as low.
- In the shallow drift aquifers for the Application Case, the model predicted a maximum drawdown of 15 m near STP and 14 m at Suncor. The percent change in drawdown could be of high magnitude in the area immediately around STP, whereas at Suncor the incremental increase in drawdown due to Project effects is likely low. The only groundwater wells indicated completed within the surficial drift for domestic use are

Suncor wells where Project effects are anticipated to be low. Potential effects of groundwater withdrawals on groundwater quantity in the shallow drift aquifers are rated as low.

- In the shallow drift aquifers for the PDC, maximum drawdowns vary from 0 to 24 m near STP and up to 15 m near Suncor. The only groundwater wells identified as completed within the surficial drift for domestic use are Suncor wells; the cumulative effects to these wells are anticipated to be low. Cumulative effects related to effects of groundwater withdrawals on groundwater quantity in the shallow drift aquifers are rated as low.

Groundwater flux to the MacKay River is calculated as 0.01 m^3/s for the Baseline Case and 0.003 m^3/s for the Application Case. Thus the groundwater units are expected to continue to provide recharge to the MacKay River at a reduced rate. Relative to the mean seasonal flow of the MacKay River, which is 2.46 m/s, the baseline recharge represents only 0.5% and any reduction in this amount would be quantitatively negligible. Potential Project effects related to groundwater withdrawals on water quantity in surface water bodies and wetland areas were rated as low.

For the PDC, the groundwater flux to the MacKay River is calculated as -0.02 m^3/s which indicates the potential for a shift in the hydraulic relationship between the MacKay River and underlying groundwater units with the MacKay River now supplying recharge to the groundwater units. Relative to the mean seasonal flow of the MacKay River, which is 2.46 m/s, this loss from the MacKay River is negligible. Cumulative effects related to effects of groundwater withdrawals on water quantity in surface water bodies and wetland areas are rated as low.

The CPF is located in an area that is anticipated to have intervals of sand underlain by clay rich deposits. Groundwater flow rates are anticipated to be variable; up to four metres per year within the sands, but generally slow within the clay rich deposits. It is expected that the sand will be removed and/or covered with compacted material which will reduce infiltration and allow runoff control to the storm water pond, which would facilitate the control of any surface contamination. With mitigation, the potential effects of surface facilities on groundwater quality are rated as low.

Thermal changes along the well bore of the injection wells have the potential to locally alter groundwater chemistry in non-saline aquifers due to the response of geologic materials to heating along the well bore. In addition, potential accidental releases due to casing failure have the potential to impact groundwater quality of non-saline aquifers underlying the Project.

Groundwater monitoring will be implemented to enable detection of any effects to groundwater quality in non-saline aquifers. Potential Project effects related to operation of the production/injection wells on groundwater quality are rated as low.

Industry best practices and regulatory requirements associated with the production and injection wells relate to their construction, operating pressures and operational monitoring. As a result of these measures, casing failure and leakage into a non-saline aquifer during operations should not occur. Therefore it is determined that there is no potential Project impact on groundwater quality in non-saline aquifers.

In order to reduce the potential impact to groundwater resources STP will:

- develop a spill response plan to mitigate effects in the event of upset conditions;
- develop a groundwater monitoring program to and enable early detection of any effects to groundwater quality and quantity;
- implement a Groundwater Response Plan in the case that monitoring identifies a change in groundwater quality; and
- in the event of a material change in water levels implement mitigative actions such as reducing pumping rates in one or more of the water source wells, adding more source wells to modify the drawdown distribution, completing water source wells in other aquifer units or utilizing alternative water sources.

In order to monitor the effectiveness of the mitigation measures STP will:

- monitor water quality in non-saline aquifer units, *i.e.*, shallow drift aquifers, Grand Rapids Aquifers and the Empress Aquifer in locations near well pads; and
- monitor water levels in the water source wells in addition to monitoring wells installed within the shallow drift aquifers, Grand Rapids Aquifers and Empress Aquifer.

A.9.4 HISTORICAL RESOURCES

The potential effects of Phase 2 on historic resources are discussed in Section D.4.

The assessment of Historical Resources included:

- review of existing records;
- creation of a predictive model; and
- ground reconnaissance.

The Phase 2 Project is location within Borden Blocks HfPa and HfPb. No previously recorded archaeological sites are located within these Borden Blocks. No historic or paleontological sites have been previously recorded within proximity of Phase 2. There are no sections with Historic Resources Values (HRVs) within proximity of Phase 2.

A model of archaeological potential was developed to determine the relative ranking of terrain features in terms of potential to identify precontact archaeological sites and was used to provide a focus for field assessment. Overall, the footprint for the initial development is located on areas of low and low to moderate potential although some areas of high potential are present.

During the ground reconnaissance, locations of limited exposure, deep sediments or high archaeological potential were assessed by visual inspection and the excavation of 194 shovel tests in order to evaluate the presence and/or nature of surface and subsurface cultural deposits. Assessment included the Initial Development footprint and selected areas of moderate to high archaeological potential within proximity of the Phase 2 footprint. Overall, the archaeological potential was observed to be low to moderate.

During the course of the assessment, no archaeological, historic or palaeontological sites were identified and no previously recorded sites were revisited. The Historical Resource Impact Assessment (HRIA) recommends that Alberta Culture and Community Spirit (ACCS) grant STP clearance under *Historical Resources Act* for the proposed STP McKay Thermal Project – Phase 2 initial footprint.

A.9.5 HUMAN AND WILDLIFE HEALTH

The potential effects of Phase 2 on human and wildlife health are discussed in Section D.5 and Consultants Report #5 (CR #5).

The Human Health Risk Assessment (HHRA) describes the nature and significance of the potential short-term (*i.e.*, acute) and long-term (*i.e.*, chronic) health risks posed to people exposed to the Chemicals of Potential Concern (COPCs) emitted or released from the Phase 2 Project. The Screening Level Wildlife Risk Assessment (SLWRA) addresses the same components with respect to effects on wildlife. The HHRA and SLWRA examine the potential health risks attributable to the Phase 2 Project in combination with existing, approved and planned emission sources in the region.

The HHRA and SLWRA focused on the potential health risks associated with chemical concentrations in the LSA and RSA which are consistent with the Air Quality Study Areas.

The COPCs for Phase 2 were identified through the development of a comprehensive inventory of chemicals that could be emitted by the Phase 2 Project and to which people might be exposed. In general, the COPCs that were included in the HHRA include:

- PAHs;
- petroleum hydrocarbon (PHC) fractions;
- reduced sulfur compounds (RSCs);
- (VOCs; and
- criteria air contaminants (CAC).

The HHRA was structured to characterize the potential health risks to people who reside in the area over the long-term. The following exposure pathways were included in this HHRA:

- inhalation of air;
- inhalation of dust;
- ingestion of soil (inadvertent);
- ingestion of water;
- ingestion of local above-ground plants (including fruit and vegetables);
- ingestion of local below-ground plants (root vegetables);
- ingestion of local traditional plants (Labrador tea and cattail);
- ingestion of local fish;
- ingestion of local wild game;
- ingestion of water while swimming;
- dermal contact with water; and
- dermal contact with soil.

The chemical emissions from the Phase 2 Project are not expected to result in adverse health effects in the region. For most of the COPCs, the magnitude of the differences in predicted health risks between the Baseline and Application Cases is negligible. The key findings of the HHRA are as follows:

- Acute Inhalation Assessment - The potential short-term health risks associated with Phase 2 and other emissions sources were evaluated through the comparison of predicted air concentrations (10-minute, 1-hour, 8-hour or 24-hour) against health-based exposure limits. Overall, there were minimal changes between the Baseline and Application Cases, indicating that the Phase 2 emissions are not anticipated to have an impact on human health in the area.

- Chronic Inhalation Assessment - Predicted risks associated with continuous, long-term inhalation of the COPCs were evaluated through the comparison of predicted annual average air concentrations with health-based exposure limits. No exceedances of health-based exposure limits were predicted in the chronic inhalation assessment. All incremental lifetime cancer risks were predicted to be less than 1.0 in 100,000, indicating that the cancer risks associated with Phase 2 are negligible.
- Chronic Multiple Pathway Assessment - The potential long-term health risks associated with exposure to the COPCs via multiple pathways of exposure were evaluated for permanent and seasonal residents in the area. In all instances, potential risks were determined to be negligible. All incremental lifetime cancer risks associated with exposure via multiple pathways of exposure were predicted to be less than 1.0 in 100,000, suggesting that the cancer risks associated with the Phase 2 are negligible.

In the SLWRA, the inhalation and ingestion exposure pathways were assessed. The results of the SLWRA indicate that the overall risks posed to wildlife health will be negligible. Therefore, no impacts to wildlife populations are expected based on estimated wildlife exposures to predicted maximum acute and chronic air concentrations and predicted maximum soil and surface water concentrations.

Mitigation of potential impacts to human and wildlife health due to the Phase 2 Project relies on appropriate mitigation of impacts to air quality (Section A.9.1), aquatic resources (Section A.9.2), and groundwater (Section A.9.3).

Monitoring programs for human and wildlife health are a function of monitoring programs to be implemented by STP for the Phase 2 to air quality (Section A.9.1), aquatic resources (Section A.9.2), and groundwater (Section A.9.3) programs.

A.9.6 HYDROLOGY

The potential effects of Phase 2 on hydrology are discussed in Section D.6 and Consultants Report #6 (CR #6).

The proposed Phase 2 Project lies within the Central Mixedwood subregion of the Boreal Forest, in the MacKay River watershed along the mainstem of the MacKay River, near the mouth of Thickwood (Birchwood) Creek.

The LSA used for the hydrology assessment is defined as the land of potential development and surrounding areas which may be affected by direct runoff from the Phase 2. The RSA focuses on these lands, as well as the area in which stream flows and water levels could be affected by

Phase 2. The RSA is limited to this area, as potential impacts to the MacKay River downstream of this area are anticipated to be negligible.

The baseline data collection and review included:

- seasonal measurements of water levels, widths, depths, and velocities at eight sites within the LSA over a three year period to quantify local flow characteristics;
- record hourly water level fluctuations at five sites;
- regional climatic characteristics such as air temperature, precipitation, and evaporation;
- regional hydrology characteristics including an assessment of flows in the streams which drain the RSA as well as an analysis of runoff and flows from gauges in the vicinity of the RSA;
- local hydrology data including hydrography, snow depths and densities, water levels and streamflow; and
- streamflow and water level simulations using the Hydrologic Simulation Program – FORTRAN (HSPF).

Three VECs related to hydrology have the potential to be impacted by Phase 2 including:

- runoff volumes and streamflows;
- water levels and surface areas; and
- channel morphology and sediment concentrations.

Surface disturbances from existing and approved developments can cause changes to surface runoff characteristics of the natural environment. Specifically, changes in surface drainage patterns and changes in the runoff coefficients can affect the runoff volumes, peak flow rates, and timing of peak flows in the local streams. Changes in runoff volumes were estimated assuming a worst case condition of the disturbed areas being directly connected to the drainage networks in the watersheds and that the estimated runoff coefficients for each disturbance type are applicable for all runoff events. The predicted changes in runoff volumes, peak flows and minimum flows in these small tributaries will be imperceptible in the downstream Birchwood Creek and MacKay River due to the much greater flows in these streams. Drainage control around the disturbed areas will be utilized in order to reduce the potential for impacts due to Phase 2 surface disturbances.

Annual peak water levels and surface areas in the streams may change slightly due to changes in annual peak flow. These changes will be imperceptible compared to natural variability. Minimum water levels and surface areas may be slightly higher due to increased minimum flows; however, zero flows will still occur in most of these small watersheds.

Sediment concentrations in streams have the potential to increase due to increases in streamflow or from sediment introduced to the stream from disturbances. Sediment concentrations in the streams in the LSA are not expected to increase due to changes in the surface runoff characteristics because in most cases the runoff will not increase. Even in watersheds where increases in runoff may occur, changes in the flow regime due to surface disturbances are very small and would not have a perceptible impact on sediment concentrations.

With mitigation, the residual and cumulative effects of the proposed Project on hydrology are estimated to have a low impact rating.

In order to reduce potential impacts of Phase 2 on hydrology, STP will:

- maintain existing drainage patterns and prevent water from being transferred from one watershed to another by using drainage control structures such as culverts and ditches;
- maintain vegetative buffers between disturbance areas and watercourses with defined channels;
- utilize sediment control during construction where runoff may potentially flow directly into watercourse with defined channels;
- control runoff from well pads and prevent runoff from entering watercourses with defined channels;
- direct run-on from upstream of well pads and plant site around the disturbances and back into their original pathways; and
- reclaim surface disturbances once they are no longer required.

In order to verify that the mitigation measures have been effective, STP will:

- conduct routine visual inspections to ensure that the access road drainage culverts are working as intended to maintain the natural surface drainage patterns;
- conduct sediment monitoring during the construction of stream channel crossings to ensure that sediment from construction sites does not adversely impact the downstream channels; and
- record water volumes used or pumped from the stormwater retention pond.

A.9.7 NOISE

The potential effects of Phase 2 on noise levels at nearby receptors are discussed in Section D.7 and Consultants Report #7 (CR #7).

The documents which relate to the Permissible Sound Levels (PSLs) for the Noise Impact Assessment (NIA) are the ERCB Directive 038 on Noise Control (2007) and the Alberta Utilities Commission (AUC) Rule 012 on Noise Control. Both documents specify that new or modified facilities must meet a PSL-Night of 40 dBA at 1,500 m from the facility fence-line if there are no closer dwellings. The PSLs at a distance of 1,500 m are a L_{eq}Night of 40 dBA and an L_{eq}Day of 50 dBA as there are no dwellings closer.

The results of the noise modeling indicated Baseline Case noise levels associated with Phase 2 (with the average ambient sound level of 35 dBA included) will be below the ERCB Directive 038 PSL of 40 dBA L_{eq}Night for all surrounding theoretical 1,500 m receptors. The noise levels without the Ambient Sound Level (ASL) were more than 5 dBA below the PSL at all but one location.

The Application Case noise levels associated with Phase 1 and Phase 2 (with the average ambient sound level of 35 dBA included) will be below the ERCB Directive 038 PSL of 40 dBA L_{eq}Night for all surrounding theoretical 1,500 m receptors. The noise levels without the ASL are modeled to be more than 5 dBA below the PSL at most locations.

For both the Baseline Case and Application Case, the dBC – dBA sound levels are projected to be less than 20 dB at most locations. There are some locations with values greater than 20 dB, resulting in the possibility of low frequency tonal noise. The dominant low frequency noise sources are the gas turbine exhaust stacks. These tend not to be specifically tonal in nature. They tend to have a more broadband low frequency quality. As such, the possibility of a low frequency tonal component (as specified by ERCB Directive 038 and AUC Rule 012) is low. In addition, there are no residential receptors nearby to express concerns for the low frequency noise. As a result, no additional noise mitigation is required.

The results of the noise modeling indicated that no additional operation factors need to be incorporated into Phase 2 and specific additional noise mitigation measures are not required. In accordance with ERCB's Directive 38, STP will utilize the following measures to mitigate potential impacts due to construction noise:

- conduct construction activity between the hours of 07:00 and 22:00;
- advise nearby residents of significant noise-causing activities and the Phase 2 Project's construction schedule;
- ensure all internal combustion engines are fitted with appropriate muffler systems;
- take advantage of acoustical screening from existing on-site buildings to shield dwellings from construction equipment noise; and
- limiting vehicle speeds, at all times, in the Project Area.

As per ERCB Directive 038, post-commissioning noise monitoring is not required. If, however, a noise complaint is filed with the ERCB or STP, STP will conduct a comprehensive sound level survey in accordance with the requirements of ERCB Directive 038.

A.9.8 SOCIO-ECONOMIC

The potential effects of Phase 2 on socio-economic resources are discussed in Section D.8 and Consultants Report #8 (CR #8).

The SEIA addresses the human environment with and without the Phase 2 Project. The key socio-economic issues considered in the analysis fall into the following categories:

- employment effects;
- regional and provincial economic benefits;
- population effects;
- effects on regional infrastructure and services; and
- traditional land use effects.

Phase 2 will create positive economic and fiscal effects on the Socio-Economic Regional Study Area (RSA) consisting of the RMWB and the nearby First Nation communities. Phase 2 will create 300 person years of engineering employment, 2,220 person years of construction employment, 51 operations positions and 70 person years of employment for ongoing drilling. STP will also pay municipal property taxes, provincial and federal corporate income tax and provincial royalties.

The effects of Phase 2 on many regional services and infrastructure will be muted due to the continued use by STP of construction and operations strategies that rely on on-site work camps, supported during operations by a fly-in-fly-out (FIFO) worker commute program. The long-term resident population effect of Phase 2, estimated at around 75 people, will have a marginal effect on regional services and infrastructure. In addition, various mitigation and management measures are and will be taken by STP to address the effects of its project and oil sands development in general.

In order to reduce the potential impacts on housing, transportation, municipal infrastructure and social infrastructure STP will:

- house construction workers associated with Phase 2 in on-site camps and if, during peak periods, the on-site accommodation needs exceed availability open camps near the project site will be used;
- have a dedicated on-site operations camp;

- offer in-camp services to mitigate the effects of its camp-based workforce on regional service providers, including:
  - basic first responder medical capability on site during operations and onsite medical response during construction;
  - onsite security staff during construction; and
  - recreational opportunities.
- provide onsite water supply and wastewater treatment system;
- employ a fly-in-fly-out program and bussing operations workers from the Fort McMurray Airport to the project site during operations;
- schedule construction truck traffic (including oversized loads), commodity deliveries and material deliveries during off-peak hours;
- lead a TIA Industry Group, in updating a Traffic Impact Assessment and a Functional Planning Review as per Alberta Transportation's guidelines
- become a member of the OSDG and therefore be supportive of OSDG efforts to work with municipal and provincial planners and home builders to facilitate the timely development of residential land and dwellings;
- be open to working with the Government of Alberta and other stakeholders as the AOSA CRISP moves forward with implementation;
- put in place additional project-related measures to mitigate effects on regional social infrastructure, including:
  - developing and implementing an emergency response plan which includes the required personnel, procedures and equipment resources (e.g., vehicles, fire response, medical response, and rescue);
  - maintaining explicit and enforced camp and workplace policies with regards to the use of alcohol, drugs, and illegal activities; and
  - providing employees with access to the company's confidential employee assistance plan, which provides support for families and individuals who may experience difficulty dealing with personal, family, or work-life issues that can affect one's health and well-being.
- support local community initiatives (e.g. financial and in-kind contributions to social groups, education institutions, and health care providers), where appropriate; and
- cooperate with service providers, government, and industry to assist in addressing effects of its project and oil sands development in general by:
  - communicating its development and operational plans with the appropriate agencies; and

- working with the provincial and municipal governments on the implementation of relevant planning initiatives, where appropriate (*e.g.*, LARP, AOSA CRISP, RMWB's MDP).

In order to enhance the positive and minimize the adverse effects of Phase 2 on traditional land use and culture STP will:

- undertake progressive reclamation, giving priority to lands of Aboriginal importance, whenever possible;
- discourage camp residents from fishing, hunting, and driving recreational vehicles on traditional lands;
- promote cultural diversity awareness to STP employees and contractors regarding respect for traditional resource users, traplines, cabins, trails and equipment;
- provide access to trappers and traditional users across the project area;
- compensate trappers directly affected by the project, according to industry standards;
- consider entering into beneficial agreements with First Nations whose traditional land uses are directly affected by the project;
- participate in regional multi-stakeholder planning and research initiatives that incorporate consideration for the long-term sustainability of effective traditional land use; and
- continue to work with Aboriginal communities in the region to ensure that their concerns with respect to traditional land use and culture are continually considered during project planning and operation.

In order to verify that the mitigation measures have been effective STP will continue to consult with main stakeholders. No other monitoring other than ongoing consultation is required.

A.9.9 SOIL RESOURCES

The potential effects of Phase 2 on soil and terrain are discussed in Section D.9 and Consultants Report #9 (CR #9).

The LSA for the soils and terrain baseline study was selected to evaluate soils and terrain potentially impacted by the development of Phase 2. The RSA consists of an area delineated on the basis of potential regional effects to soils, including those related to existing and planned activities in the area and to regional air emissions from Phase 2 in combination with adjacent existing, approved and future planned oil sands operations.

Baseline soil data was used to determine the potential environmental effects that Phase 2 may have on soil resources in the survey and proposed development areas, and to assist in preparation

of a Conservation and Reclamation Plan with appropriate site mitigation and monitoring activities designed to achieve reclamation success.

A total of 1,072 soil inspection sites have been recorded within or adjacent to the LSA to date, including 66 soil profiles sampled. Of that total, 902 were located within the LSA, which covers the area where soils may potentially be impacted by the Phase 2 Project. There were two levels of soil survey intensity completed within the LSA: survey intensity level (SIL) 2 (majority of lease area including the Future Development footprint with one inspection for every 5-15 ha) (MSWG 1981), and survey intensity levels greater than one inspection per 1 ha (SIL1) on the Initial Development footprint as required for a Pre-Disturbance Assessment (AENV 2009).

The soil resource VECs chosen for the assessment include:

- soil quality;
- soil biodiversity; and
- terrain.

The analysis of soil quality VEC considers changes that may occur in soil physical, chemical and biological properties and soil quantity due to soil profile disturbance, erosion and accidental releases. The potential effect to soil biodiversity VEC considers the effects of Phase 2 on the spatial distribution of soil patterns and potential changes in soil diversity and ecological integrity. The potential effects to the terrain VEC is discussed in terms of the potential changes in slope classes.

During Project construction, potential impacts to the soil resource will be limited to the proposed areas of disturbance. Soil salvage, transport, storage (long term and short term) and replacement may have an environmental effect with respect to soil quality. With utilization of the soil salvage and handling procedures discussed in the conceptual Conservation and Reclamation Plan (Part E), the effects on the soil resource for all three assessment scenarios are rated as low impact.

The potential impacts of wind and water erosion on soil quality are of concern throughout development and final reclamation. The loss of soil via erosion during soil salvage, soil storage, and after soil replacement is a potential impact. The risk of erosion to surface soils is greatest during the soil salvage and storage stages of site construction, and during the soil replacement phase of the reclamation process. With utilization of the soil salvage and handling procedures discussed in the conceptual Conservation and Reclamation Plan (Part E), the effects on the soil resource for all three assessment scenarios are rated as low impact.

Impacts to soil quality caused by accidental releases and operational incidents within the development footprint have the potential to alter chemical and physical attributes of soils. This includes (but is not limited to); equipment failures, line failures, tank releases; and surface releases from operations activities. Accidental releases may occur as one time releases or as cumulative releases that occur over longer periods of time. With the appropriate environmental management plans in place (Section B.9), accidental releases and subsequent clean up will result in a low impact on soil quality.

In order to reduce potential impacts of Phase 2 on soil and terrain STP will:

- salvage topsoil using best management practices including the supervision of salvage activities by a qualified individual;
- implement progressive reclamation on areas that are no longer in use;
- salvage subsoil from the plant site and well pads for use in reclamation;
- during construction, pad over areas of deep organic soil and then when reclaiming areas where the pad is removed, decompact the underlying organic material, or in areas where the pad is left in place decompact the pad and cover with 40 cm of salvaged peat (or other appropriate soil)
- store soil in a manner that minimizes soil loss or degradation through erosion;
- stockpile subsoil, topsoil and organic material separately;
- decompact all replaced soil profiles during reclamation to reduce potential growth and productivity restrictions;
- revegetate all reclaimed lands upon completion of soil placement to minimize soil loss via erosion (wind and water) and minimize the likelihood of weed infestations; vegetation establishment will occur through natural regeneration or, where required, through re-seeding or re-planting;
- apply for reclamation certification on fully reclaimed lands; and
- implement a corporate spill response plan.

In order to verify that the mitigation measures have been effective, STP will:

- salvage and replace soil under the direct supervision of a qualified individual;
- monitor landscape characteristics and features to ensure appropriate drainage is maintained;
- monitor stockpiled or recently replaced soil material for potential erosion issues;
- monitor topsoil quality (*i.e.*, admixing) and quantity (depths) on reclaimed areas; and

- assess vegetation communities after reclamation to determine if the appropriate seral communities are established.

A.9.10 VEGETATION, WETLANDS AND RARE PLANTS

The potential effects of Phase 2 on vegetation, wetlands and rare plants are discussed in Section D.10 and Consultants Report #10 (CR #10).

The physical extent of the LSA is sufficient in size to capture potential effects to VECs that will result from direct disturbance and also, changes to vegetation outside the Phase 2 footprint as a result of alterations to physical components such as water quantity.

The RSA includes an 8 km buffer around the LSA. The RSA was defined to ensure that it captured the furthest extent that Phase 2-specific effects are anticipated to act in combination with effects from other past, existing and anticipated future projects and activities.

The assessment of Phase 2 effects on vegetation and wetland resources was based on six VECs including:

- terrestrial vegetation (ecosites, rare plants, forest resources);
- wetlands;
- old growth forests;
- non-native and invasive species;
- traditionally used plants; and
- biodiversity.

In total, 445 vegetation species were observed including 254 vascular plants, 90 bryophytes and 101 lichens while, 22 ecosite phases were mapped within the LSA, six of which are considered to be of limited distribution. None of the ecosite phases of limited distribution will be completely removed from the LSA and a proportion of each are expected to be re-established during reclamation. Reclamation will be aimed at the establishment of pre-disturbance ecosite phases. With the implementation of mitigation measures, Phase 2 is predicted to have Low Impact on ecosite phases found within the LSA.

Nine vegetation species which are on the Alberta Rare Plant Tracking and Watch List were observed within the LSA. Of these, one was a vascular plant, one was a bryophyte, and seven were lichens. In addition, one rare plant community was observed within the LSA. Development of Phase 2 will remove two of the rare lichens identified (*Cladina stygia*, and *Usnea scabiosa*) but will not disturb the rare plant community. Both rare lichens are not identifiable in the field and as such reports of abundance and distribution of these species is at

best incomplete (Natureserve 2009). Reclamation activities will focus on the re-establishment of ecosites where rare plant occurrences were noted. In time, as these reclaimed ecosites begin to function like mature ecosite phases, it is expected that the potential for these sites to support rare plants will increase. With the implementation of mitigation measures, Phase 2 is predicted to have Low Impact on rare plants.

Based on the Alberta Wetland Inventory Classification System, 13 wetland types were identified which occupy approximately 54.4% of the LSA. Five of these wetlands are considered to be of limited distribution. None of the wetland types of limited distribution in the LSA will be completely removed from the LSA. Reclamation will incorporate the establishment of wetlands. With the implementation of mitigation measures, Phase 2 is predicted to have Low Impact on wetlands.

Portions of the STP LSA and RSA have been recently burned by wildfire. Consequently, much of the vegetation in the burned areas is in early succession stages. Phase 2 will result in the removal of 0.38% (2.8 ha) of old growth in the LSA. The amount of old growth and ecosite phases with the potential to support old growth forests that are to be removed from the Phase 2 Project footprint is negligible and will not have an effect on the ability for these forests to regenerate after Phase 2 Project closure. There will be no difference in the development of old age class forests with or without Phase 2.

The biodiversity potential class for the LSA is high given that high rich areas, on average, cover 43.1% of the LSA, and high diversity areas, on average, cover 57.6% of the LSA. Measures taken to mitigate for the reduction in area of terrestrial vegetation, wetlands, old growth forests, and non-native and invasive species will effectively mitigate for potential Project effects on biodiversity. As well, a re-vegetation plan which aims at re-establishment of pre-disturbance ecosite phases would result in a negligible effect on long term biodiversity (overall species richness, diversity and evenness). Long term impacts on community and landscape level biodiversity in the LSA and the RSA following mitigation are negligible given no ecosite phase will be lost or added from the LSA or RSA as a result of implemented mitigation measures. Because Phase 2 will be developed in phases with sequential reclamation occurring throughout the life of Phase 2, the actual maximum expected biodiversity impact is likely less than anticipated.

The vegetative species identified as valuable for medicinal, food, technology, and other purposes have been listed, and ranked. In total, 81 of 131 vegetation species valued by Aboriginal groups in the region for food, medicinal use, and other uses were documented as occurring in the LSA. The distribution of ecosite phases which support Traditional Environmental Knowledge (TEK) vegetation will be accessible in both the LSA and the RSA following removal of ecosite phases

by the Phase 2 Project footprint. With the implementation of mitigation measures, the Phase 2 Project impact on ecosite phases is expected to be low in the LSA and the RSA.

Acid effects on vegetation are not often considered directly because effects on soil and water occur earlier and are more easily measured and acid input usually affects vegetation indirectly through changes in soil or water chemistry. The impact of Phase 2 with respect to potential soil acidification is negligible at the local and regional scale for the PDC assessment. Consequently, PAI isopleths are not considered to pose a potential impact to vegetation (which is linked to soil types and condition) within the LSA or RSA. Accordingly, the impact rating for PAI is low.

In order to reduce potential impacts of Phase 2 on vegetation and wetlands, STP will:

- implement re-vegetation programs that aim at the reestablishment of healthy ecosite phases removed by development;
- preserve habitat adjacent to the development footprint by minimization of the area required for construction and operation;
- seed stockpiled topsoil with a suitable species mix to ensure long term stability of the piles, and control of invasive or noxious weeds;
- where natural regeneration is insufficient plant select with tree, shrub and forb seedlings with the aim of re-establishing baseline ecosite phases, and providing structure for enhancing biodiversity;
- use best practice construction and reclamation to mitigate erosion, maintain drainage patterns, and preserve the integrity of wetland areas outside the Phase 2 footprint;
- where appropriate remove fill material placed over organics with the aim of re-establishment of wetlands;
- consider salvaging and direct placing soil salvaged from areas identified as being high or very high biodiversity;
- reclaim borrow areas to wetlands, or transition area ecosite phases, where possible;
- utilize opportunities to direct place peat materials from peatland areas scheduled for development with the aim of maintaining those materials as a living peat substrate and a propagule source for wetland revegetation;
- allow Aboriginal groups the opportunity to provide input into the development of mitigation and monitoring plans with the aim of facilitating re-establishment of vegetation used for medicinal, food and other uses; and
- perform fill planting in areas where there is poor survival of seedlings.

In order to verify that the mitigation measures have been effective, STP will:

- monitor reclaimed sites to assess the success of reestablishment of ecosite phases removed by the footprint;
- perform survival, growth and health assessment surveys to monitor the success of revegetation efforts;
- conduct a rare plant survey on any new development areas not included in this assessment;
- monitoring and maintenance of drainage control structures to ensure water flow and flow patterns are maintained in wetlands adjacent to the development footprint;
- monitoring of reclaimed wetlands until reclamation certification is achieved in order to ensure healthy wetlands are being created;
- ensure regular site inspections are being conducted to identify if non-native and invasive (noxious) vegetation species are establishing;
- complete post revegetation surveys on revegetated sites to assess success and to allow for adaptive management strategies for subsequent stages of revegetation.

A.9.11 WILDLIFE

The potential effects of Phase 2 on wildlife are discussed in Section D.11 and Consultants Report #11 (CR #11).

The LSA was used to account for the direct and indirect effects of the Project on wildlife. Most baseline wildlife surveys were conducted within the LSA to evaluate the effects of the Phase 2 Project on wildlife and wildlife habitat although several wildlife surveys (owls, amphibians, and breeding birds) were also conducted on STP's south lease located approximately 5 km south of the LSA. An RSA was established for most wildlife VECs which included the area within 8 km of the LSA. This area was selected because it represents the approximate diameter of a moose home range in northeastern Alberta and includes the home ranges of other selected wildlife VECs. To assess cumulative effects on woodland caribou, the RSA was extended to 30 km beyond the LSA. This distance was selected because it represents the average diameter of one caribou home range in northeastern Alberta.

The wildlife assessment focused on seven species selected as VECs including:

- amphibians - Canadian toad;
- birds - Cape May warbler, Sandhill crane;
- ungulates - woodland caribou and moose;

- beaver; and
- predators - Canada lynx.

An additional 44 special status species whose ranges overlap with the Project, and for which there was suitable habitat, were also considered.

The Project has the potential to affect wildlife in a number of ways, including direct and indirect habitat loss, habitat fragmentation, altered movement patterns, and increased mortality. Effects on habitat availability may be either direct (*e.g.*, vegetation clearing) or indirect (*e.g.*, avoidance of habitat due to sensory disturbance).

Ecosite phases for the LSA were grouped into broader wildlife habitat classes based on their vegetation species composition, moisture regime, topographic position, and general value to wildlife. Because of the varying importance of young and mature/old forests for wildlife, stand age was also incorporated into the habitat classes. Twelve habitat types representing 23 ecosite phases along with several classes of water bodies and anthropogenic disturbances were identified in the LSA.

Existing habitat types in the LSA form a fairly heterogeneous landscape providing habitat for a variety of boreal wildlife including moose, Canada lynx, snowshoe hare, American marten, fisher, greater yellowlegs, ruby-crowned kinglet, Tennessee warbler, Swainson's thrush, boreal chorus frogs, and wood frogs. Lowland shrub and lowland treed habitats typically have lower wildlife diversity than other habitat types but may provide critical habitat for woodland caribou (ASRD and Alberta Conservation Association 2010). Lowland treed, deciduous/mixedwood and lowland shrub were the most common habitat types comprising 29.9%, 26.5% and 19.2% of the LSA, respectively. Overall, most of the LSA (60.5%) was classified as having moderate to moderate-low wildlife biodiversity.

With mitigation, the impact to habitat availability, wildlife movement, wildlife mortality risk and health and Wildlife Abundance was considered low for all VECs except moose and caribou. The impact to wildlife mortality and abundance was considered low for moose in the Application Case but moderate for the PDC. The impact to habitat availability, wildlife movement, wildlife mortality risk and health and Wildlife Abundance was considered moderate for caribou in both the Application Case and PDC.

In order to reduce potential impacts of Phase 2 on wildlife STP will:

- Schedule site preparation and construction activities for fall and early winter to avoid disruption of nesting birds, in accordance with the *Migratory Birds Convention Act* (Regulation 12:1). If site clearing cannot be accomplished during this period nest

searches will be conducted by a wildlife biologist prior to clearing, and appropriate setbacks distances maintained;

- develop an annual Caribou Protection Plan;
- avoid development on mature and old-growth forest as much as possible to minimize impacts on species dependent on this habitat, including woodland caribou and old-growth forest birds;
- make effort to maintain an effective wildlife movement corridor along the MacKay River valley by prohibiting development within 100 m of the river and where possible minimizing development within 250 m of the river;
- avoid riparian areas and water bodies, where possible, to preserve habitat for amphibians, water birds, and many other species. Vegetated buffers will be retained around watercourses and water bodies to protect the watercourse, allow wildlife movement, and provide habitat for amphibians and water birds;
- implement an Access Management Plan to reduce disturbance of wildlife and minimize the creation of packed snowmobile trails in winter. This Plan will include, but will not be limited to, the following:
  - restrict recreational use of snowmobiles and ATVs in the LSA by project employees;
  - restrict hunting or harassment of wildlife by Project employees in the LSA; and
  - consultation with First Nations to maintain access to the LSA for traditional land uses.
- participate in the Alberta Biodiversity Monitoring Initiative (ABMI) to assist with monitoring regional cumulative effects on biological resources;
- implement a Waste Management Plan to minimize the attraction of bears and other predators to the area, which could increase mortality rates of bears and ungulates, as well as potentially endanger site personnel. STP will adhere to the Best Management Practices for Camps, Fences and Barriers as described in the Bear Smart: Best Management Practices for Camps (ASRD 2004), and ensure waste is stored in secure wildlife-proof containers;
- implement an Emergency Spill Response Plan in the event of accidental spills. Environmental consequences of spills will be minimized by restricting fuel storage and use to designated areas at least 100 m from water bodies and watercourses;
- enforce low speed limits along all access roads, and posting signs at wildlife crossings to minimize vehicle-wildlife collisions. Vehicles will yield to all wildlife crossing access roads;
- place wildlife crossing structures, in locations that maximize the chances of use, to facilitate wildlife movement;

- conduct pre-construction surveys to identify important wildlife areas and trails, to facilitate the correct placement of wildlife crossings;
- mark wildlife crossings to prevent wildlife-vehicular collisions;
- breaks will be placed in the snow piled during road clearing to allow for wildlife crossing;
- become a member of the ACC, and will provide the Committee with any pertinent data collected during the monitoring program;
- reclaim sites progressively as discussed in Part E; and
- identify areas of induced access (winter roads and seismic lines) that are no longer required and initiate reclamation to offset some of the adverse effects on woodland caribou.

In order to verify that the mitigation measures have been effective STP will:

- develop a wildlife monitoring program to be put in place during operations and decommissioning phases of the Phase 2 Project.

A.9.12 GREENHOUSE GAS

The potential effects of Phase 2 on greenhouse gas and climate change are discussed in Section D.12 and Consultants Report #12 (CR #1).

A greenhouse gas (GHG) is any gas that contributes to potential climate change. Common GHGs include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). GHGs absorb heat radiated by the earth and subsequently warm the atmosphere, leading to what is commonly known as the greenhouse effect. Phase 2 greenhouse gases will be produced largely by combustion of natural gas and produced gas in the steam generators and cogenerators.

The emission estimates of CO_2, CH_4, and N_2O are based on emission factors and estimated fuel consumption rates. At full operation, Phase 2 will generate 1.09 Mt/yr of CO_{2e}. The direct greenhouse gas emissions for Phase 2, based on an estimated project life of 25 years with consideration for construction and decommissioning, was estimated as 27.4 Mt of CO_{2e} during the Phase 2 lifetime. Indirect emissions include electricity purchases; however, an estimate for purchased electricity was not available, therefore, indirect greenhouse gas emissions were not calculated.

The GHG emission intensity is defined as the amount of GHG emissions generated per barrel of bitumen produced, on an annual average basis. The greenhouse gas emission intensity was calculated using the maximum annual production. At full build-out, Phase 2 is expected to

generate 1,092 kt of CO_{2e} for a theoretical lifetime production of 219 MMbls (million barrels) of bitumen – a GHG operations emission intensity of 125 kg CO_{2e} per barrel of produced bitumen.

A.9.13 LAND AND RESOURCE USE

The potential effects of Phase 2 on land and resource use are discussed in Section D.13.

The lands within the LSA are administered by Alberta Sustainable Resource Development (SRD). The Phase 2 development is located within the Regional Municipality of Wood Buffalo in the Athabasca Oil Sands region. The Phase 2 Project is located outside the boundaries of existing sub-regional integrated resource plans (IRP). Portions of the West Side Athabasca River caribou range and a key moose zone are found within the Phase 2 Project Area (Figure A.1.1). These resource management initiatives were taken into consideration when assessing the potential impacts to wildlife (Section D.11 and CR #11).

STP has identified other surface and subsurface land and resource users located within their lease area. The land and resource use VECs include:

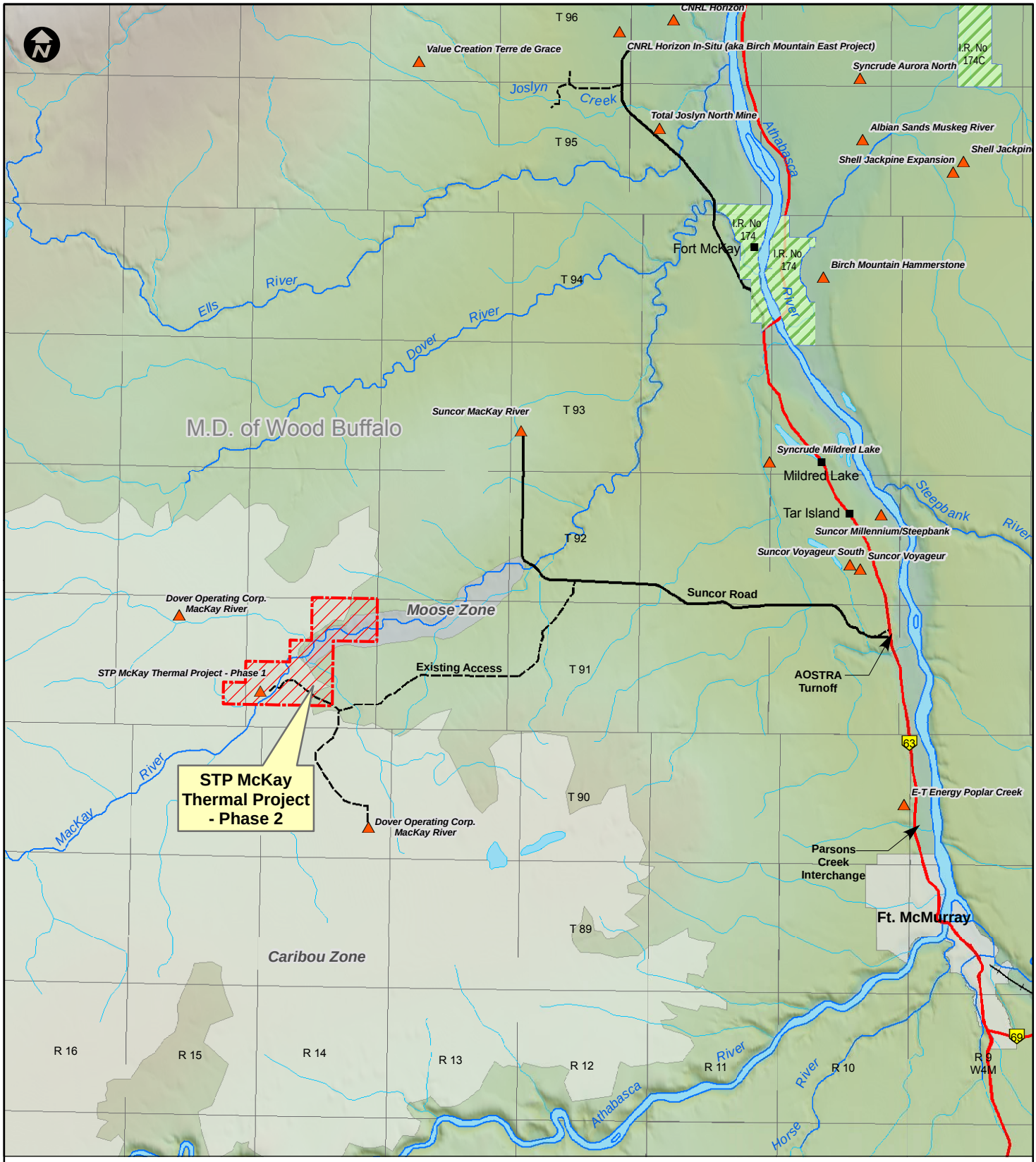
- oil sands leases;
- petroleum and natural gas licences;
- metallic and industrial mineral leases;
- forestry resources;
- public lands surface dispositions;
- sand and gravel resources;
- infrastructure;
- trapping resources;
- fishing resources; and
- hunting resources.

In order to mitigate potential impacts to land and resource users, STP will:

- apply to ASRD for surface dispositions required to support Phase 2;
- notify other industrial users of development plans that have potential to impact other resource development;
- continue with existing Trappers Compensation Program;
- develop and implement an annual fire control plan based upon ASRD's *Firesmart Guidebook for the Oil and Gas Industry* (2008). The fire control plan, when deemed to be required, will:

- provide contact information for STPs McKay Thermal Project, adjacent industrial partners, and community and provincial fire response;
- specify fuel types and fire risk levels;
- list permanent and temporary worksites that are occupied during fire season, providing type of worksite and maximum number of workers;
- specify firefighting equipment and its location, as required for the worksite/activity as per the *Forest and Prairie Protection Act;*
- specify location of any exterior sprinkler systems and/or water reservoirs;
- specify location and type of any industrial hazards not typical to a thermal project;
- provide a map of evacuation/access routes and evacuation staging areas;
- specify specific mitigation requirements, including clearing/thinning requirements; and
- require that all contractors be given orientation on the fire control plan.

Development of Phase 2 will have a low impact on land and resource use. STP has identified potential land and resource users within the LSA and through their ongoing stakeholder consultation program will continue to mitigate impacts to these users. STP will work cooperatively and jointly with other resource users to mitigate resource and land use conflicts.



Legend

- Existing or Proposed Facility
- Project Area
- First Nations
- Caribou Zone
- Moose Zone

0 4 8 16
Kilometres

REF: Geobase, 2011.

SOUTHERN PACIFIC RESOURCE CORP.

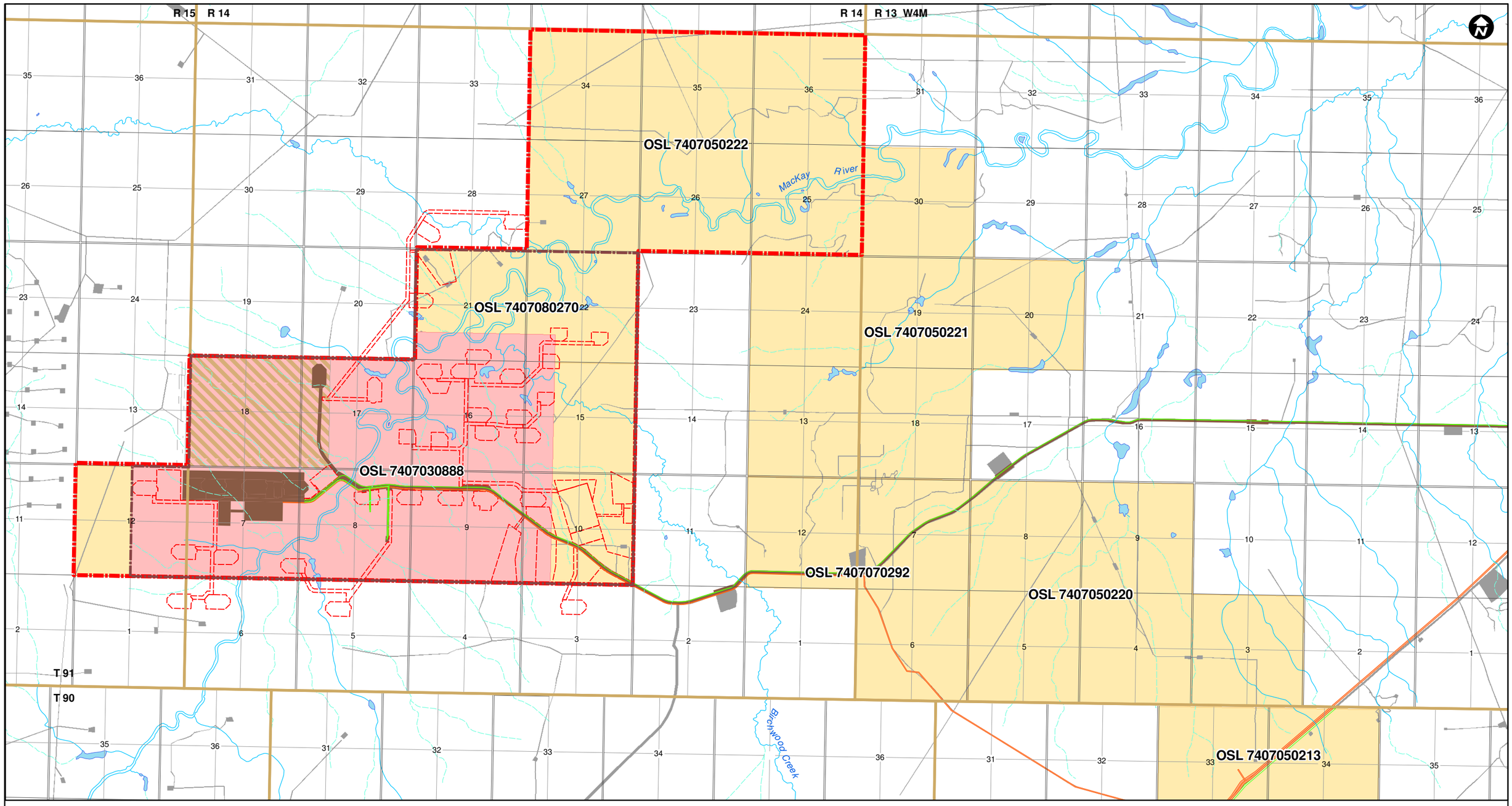
STP McKay Thermal Project - Phase 2

TITLE:

Project Location

DRAWN:	JDC
CHECKED:	KY
DATE:	Oct 31/11
PROJECT:	10-037

FIGURE: **A.1.1**



Legend

Phase 1
- Approved Project Area
- Approved Development Area
- Existing Development Footprint

Phase 2
- Proposed Project Area
- Proposed Development Area
- Proposed Development Footprint

- Existing Disturbance
- Existing Power and Communication Lines
- Existing Pipeline

0 0.5 1 2
Kilometres

REF:David Loucks Consulting Drifter Projects Ltd., 2011; NHC (Hydrology) 2010, Hatfield (Land use) 2011

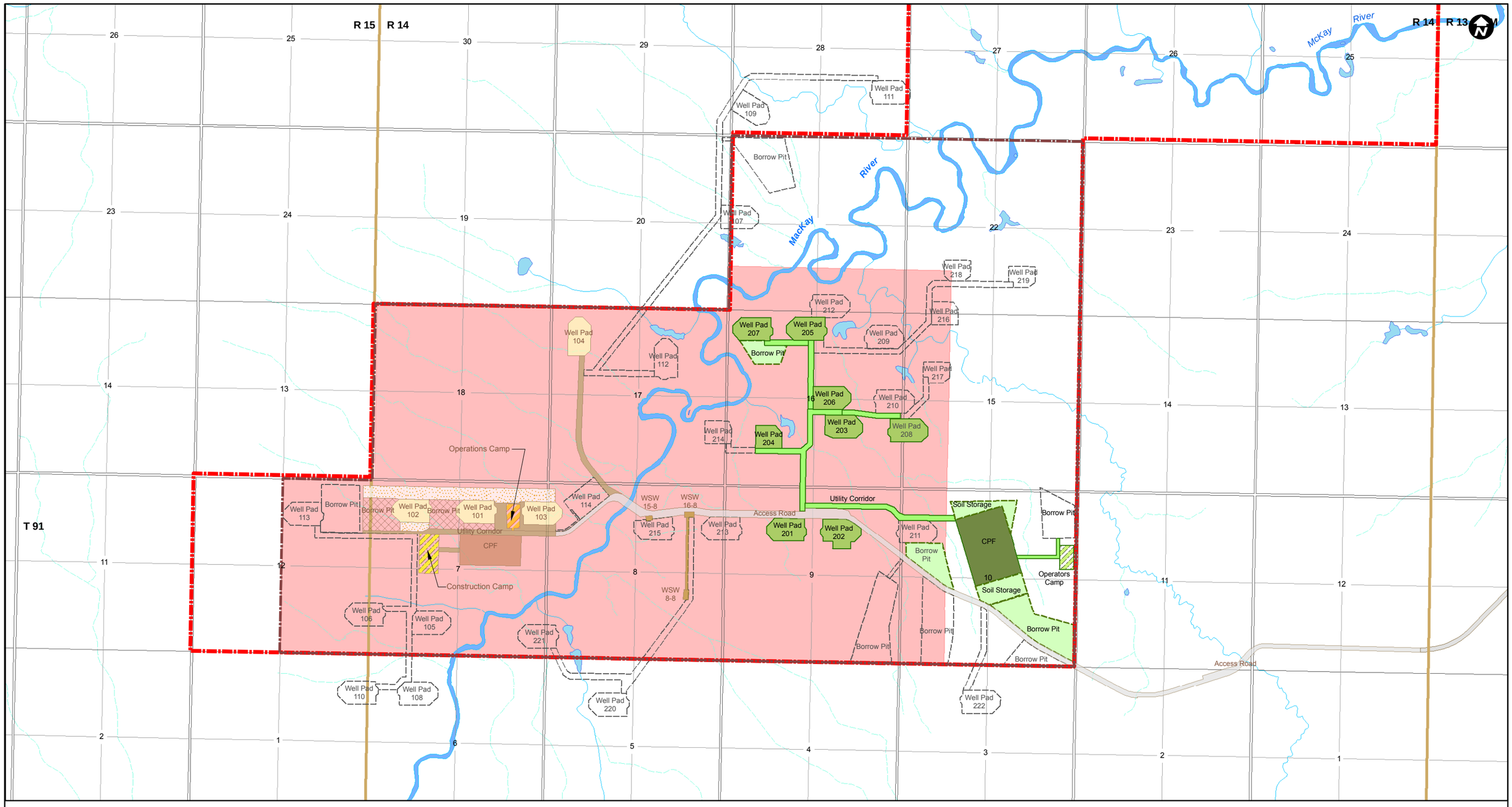
SOUTHERN PACIFIC RESOURCE CORP.

STP McKay Thermal Project - Phase 2

TITLE:
STP Oil Sands Leases and Regional Development

DRAWN:	PS
CHECKED:	KY
DATE:	Oct 17/11
PROJECT:	10-037

FIGURE: **A.1.2**



Legend

Existing Phase 1 Development

- Approved Project Area
- CPF
- Well Pad
- Utility Corridor
- Borrow Pit
- Construction Camp
- Operations Camp
- Soil Storage
- Access Road
- Water Source Well

Proposed Phase 2 Development

- CPF
- Operations Camp
- Utility Corridor
- Well Pad
- Borrow Pit
- Proposed Project Area
- Proposed Development Area
- Future Development

0 0.5 1 2
Kilometres

REF:David Loucks Consulting Drifter Projects Ltd., 2011; NHC (Hydrology) 2010,

SOUTHERN PACIFIC RESOURCE CORP.

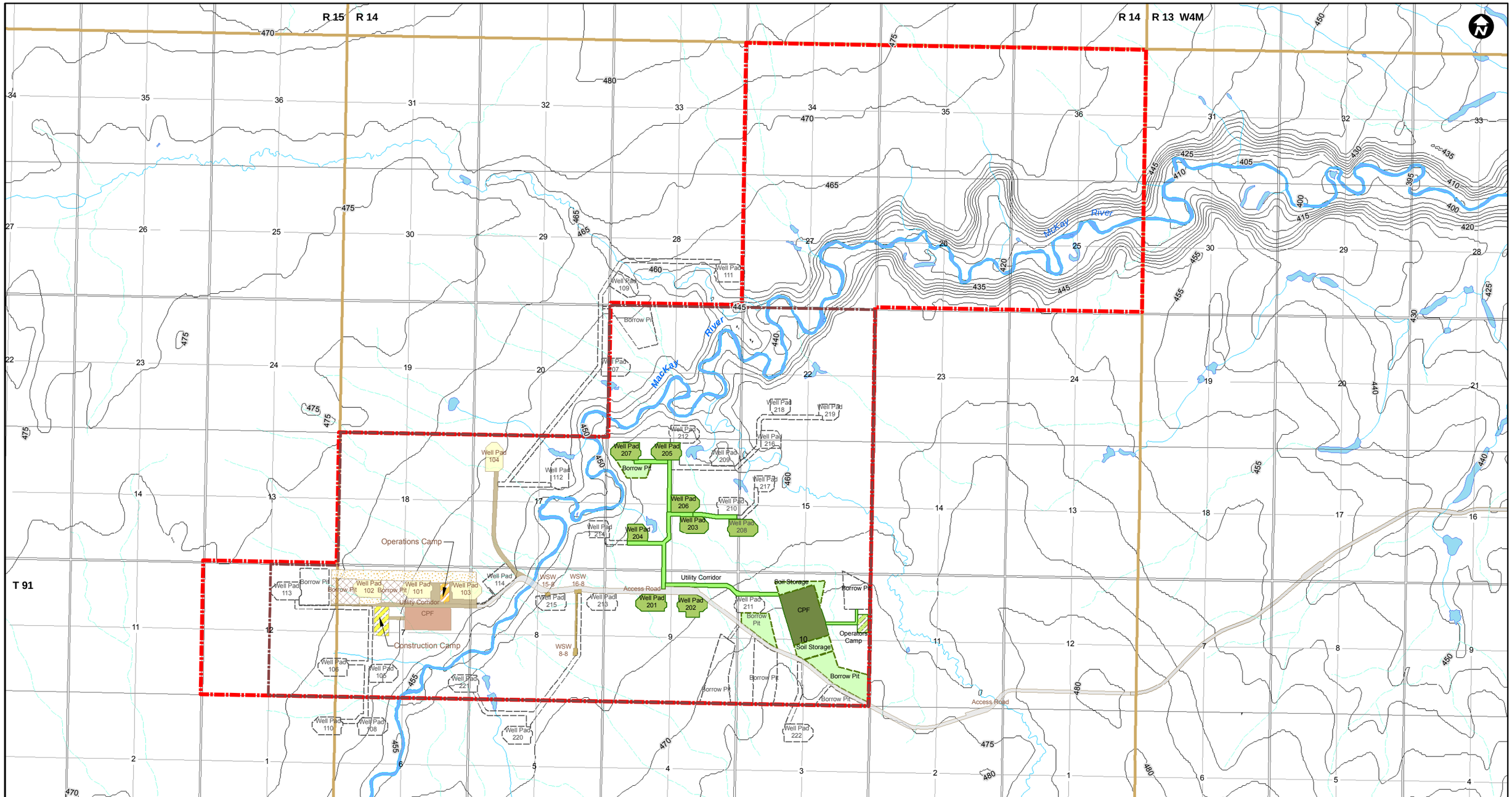
STP McKay Thermal Project - Phase 2

TITLE:

Development Area and Disturbance Footprint

DRAWN:	PS
CHECKED:	KY
DATE:	Oct 17/11
PROJECT:	10-037

FIGURE: **A.1.3**



Legend

Existing Phase 1 Development

- Approved Project Area
- CPF
- Well Pad
- Utility Corridor
- Borrow Pit
- Construction Camp
- Operations Camp
- Soil Storage
- Access Road
- Water Source Well

Proposed Phase 2 Development

- CPF
- Operations Camp
- Utility Corridor
- Well Pad
- Borrow Pit
- Proposed Project Area
- Future Development

Contour (5m interval)

0 0.5 1 2
Kilometres

REF:David Loucks Consulting Drifter Projects Ltd., 2011; NHC (Hydrology) 2010, Geobase (Topography),2011

SOUTHERN PACIFIC RESOURCE CORP.

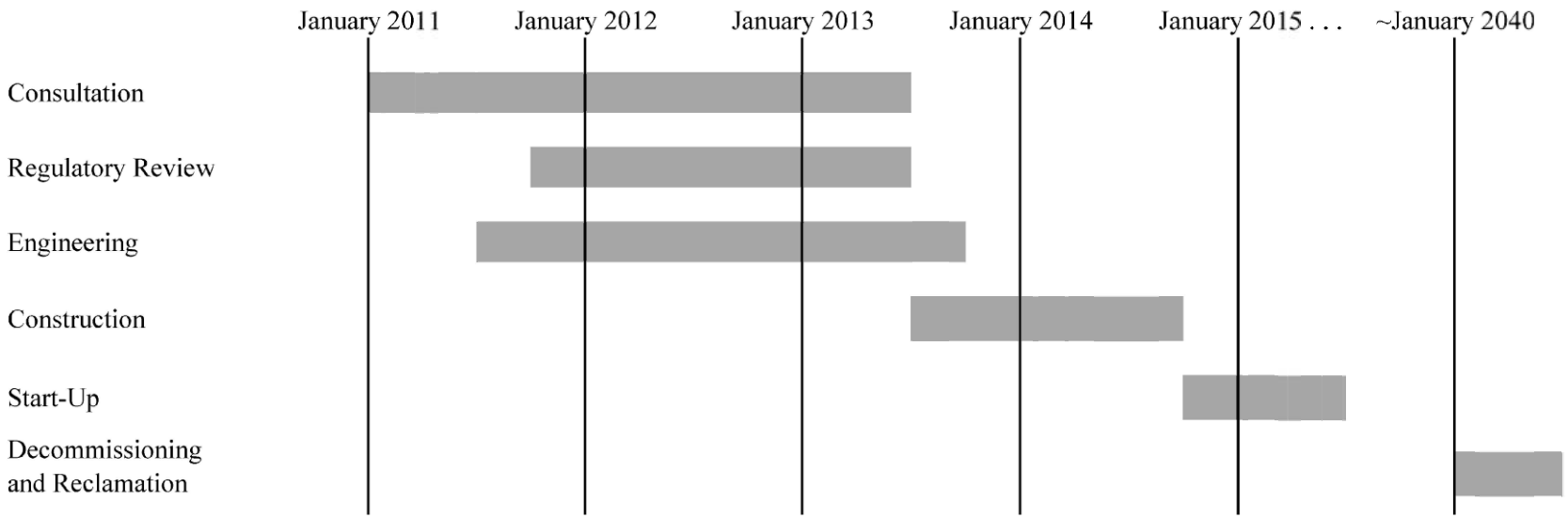
STP McKay Thermal Project - Phase 2

TITLE:

Topography in the Project Area

DRAWN:	PS
CHECKED:	KY
DATE:	Oct 17/11
PROJECT:	10-037

FIGURE: **A.3.1**



REF: Southern Pacific Resource Corp., 2011.

SOUTHERN PACIFIC RESOURCE CORP.

STP McKay Thermal Project - Phase 2

TITLE: **Project Development Schedule**

DRAWN:	JDC
CHECKED:	KY
DATE:	Oct 17/11
PROJECT:	10-037

FIGURE: **A.3.2**