ENERGY RESOURCES CONSERVATION BOARD
Calgary Alberta

CANADIAN NATURAL RESOURCES LIMITED	**2011 ABERCB 019 Amendment**
APPLICATIONS FOR 15	**Applications No. 1629922, 1629923,**
WELL AND 8 FACILITY	**1629924, 1629926, 1629927, 1629929, 1629930,**
LICENCES	**1629931, 1629933, 1629934, 1629935, 1629936,**
SUGDEN FIELD	**1629938, 1648948, 1648949, and 1634352**

In *Decision 2011 ABERCB 019*, Appendix 1, Summary of Conditions and Commitments (Appendix 1), page 22, under Commitments the Board included the following commitment to be met by Canadian Natural Resources Limited (CNRL) while drilling and completing the wells approved by the Energy Resources Conservation Board (ERCB):

- use a minimum of 6 m^3 of good cement returns prior to displacement of the cement from the inside of the casing string with a wiper plug

The Board had derived the wording for this commitment, in part, from page 421 of Exhibit 4.04 entered in the record at the hearing into the Applications.

CNRL wrote to ERCB staff pointing out a slight misinterpretation of its intention. It was CNRL's intention to commit to the following:

- CNRL will pump the required calculated hole volume and wait until adequate cement returns are confirmed at surface, prior to dropping the cement plug and displacing the rest of the cement from the surface casing.

The Board is of the view that the change requested is minor and will have no effect on any other person interested in the Applications and hearing and hereby orders that Appendix 1 of *Decision 2011 ABERCB 019* is hereby amended to substitute the reworded commitment.

Dated in Calgary, Alberta, on September 13, 2011.

ENERGY RESOURCES CONSERVATION BOARD

<original signed by>

G. Eynon, P.Geol.
Presiding Member

Canadian Natural Resources Limited

Applications for 15 Well and 8 Facility Licences
Sugden Field

June 28, 2011

Energy Resources Conservation Board

ENERGY RESOURCES CONSERVATION BOARD
Decision 2011 ABERCB 019: Canadian Natural Resources Limited, Applications for 15 Well and 8 Facility Licences, Sugden Field

June 28, 2011

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Calgary Alberta

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DECISION

[1] Having carefully considered all the evidence, the Energy Resources Conservation Board (ERCB/Board) hereby approves Applications No. 1629922, 1629923, 1629924, 1629926, 1629927, 1629929, 1629930, 1629931, 1629933, 1629934, 1629935, 1629936, 1629938, 1648948, 1648949, and 1634352, subject to the conditions outlined in this report and summarized in Appendix 1.

INTRODUCTION

Applications

[2] Canadian Natural Resources Limited (CNRL) has applied under Section 2.020 of the *Oil and Gas Conservation Regulations* (*OGCR*) for licences to drill 15 slant wells from 8 surface locations in Legal Subdivision (LSD) 15, Section 10, Township 61, Range 8, West of the 4th Meridian, LSD 13-10-61-8W4M, LSD 8-15-61-8W4M, LSD 15-22-61-8W4M, LSD 10-15-61-8W4M, LSD 7-22-61-8W4M, LSD 15-15-61-8W4M, and LSD 13-15-61-8W4M. The purpose of the wells would be to obtain crude bitumen containing no hydrogen sulphide from the Sparky Formation. No pipelines would be associated with the proposed wells.

[3] CNRL has also applied under Section 7.001 of the *OGCR* for approval to construct and operate eight crude bitumen batteries at the eight surface locations listed above. Each well would produce crude bitumen to its own aboveground tank. The crude bitumen produced from each well would be trucked to CNRL's heavy oil battery located at LSD 9-15-60-4W4M.

[4] The locations of the wells and facilities are illustrated in Figure 1. The wells and facilities would be located about 2.9 kilometres (km) northeast of Glendon, Alberta. The proposed wells and facilities are collectively referred to as the project.

Intervention

[5] The ERCB received objection letters from several landowners, recreational users, and cabin owners along Minnie Lake. Minnie Lake Conservation Society (MLCS),[1] an organization comprising nearly 200 members, represented these individuals at the hearing. Most of MLCS members are either permanent or temporary residents who own or occupy land adjacent to Minnie Lake. MLCS expressed concerns about the potential impact of drilling and production

[1] MLCS has applied for registration under the *Societies Act* of Alberta.

operations on Minnie Lake, including groundwater and wildlife in the area, human health, traffic and road use, public consultation, and safety.

[6] In a letter dated July 27, 2010, the ERCB notified interested parties of its decision to conduct a hearing to provide the fullest and most comprehensive method of assessing concerns with some of the technical aspects associated with the drilling and construction of the proposed wells and facilities. The main technical issue was the potential difficulty in setting and cementing surface and production casing in the slant wells so that surface water and groundwater in the area, including aquifers that might feed Minnie Lake, would not be negatively affected. Another technical issue that also arose was the potential for adverse health effects from emissions and concerns with odours emitted from heated bitumen stored at the proposed facilities.

Hearing

[7] The ERCB held a public hearing in Glendon, Alberta. The oral portion of the hearing commenced on March 8, 2011, and concluded on March 10, 2011. It was held before Board Members G. Eynon, P.Geol. (Presiding Member) and R. C. McManus, M.E.Des., and Acting Board Member J. Gilmour, LL.B. Those who appeared at the hearing are listed in Appendix 2. After receiving final submissions from all parties, the panel formally closed the hearing by a letter dated April 20, 2011.

[8] On March 8, 2011, the panel and ERCB staff viewed the proposed well sites and the relevant surrounding area, including the south and west shores of Minnie Lake, the cabins on the south side of the lake, the adjacent township and range roads and access roads, and some existing well sites in the area.

[9] The panel took a number of steps to recognize and accommodate the fact that MLCS comprised lay persons and was not represented by counsel. These steps were designed to facilitate full participation by MLCS and its witnesses in the hearing and make the hearing process as straightforward, understandable, and accessible as possible. With the agreement of all parties, one of the steps was to change the order in which ERCB and MLCS examined CNRL's witnesses. The ERCB counsel proceeded with the examination first to clarify as much information as possible for the record before MLCS examined those witnesses. A second ERCB counsel was also present throughout the hearing to answer questions from MLCS about the hearing process and related procedures. The panel also granted the MLCS request to submit written argument following the hearing so that it would not have to make oral argument immediately following the evidentiary portion of the hearing. The ERCB also delivered a copy of the hearing transcripts to its Bonnyville Field Centre for review by MLCS as it prepared its final argument.

[10] The panel received brief oral statements from two area landowners: Laddick Chorney, an experienced water well driller, provided additional groundwater information, and Sally Ulfsten, a Bonnyville area resident, expressed concern with this type of bitumen recovery project.

ISSUES

[11] The panel considers the issues respecting the applications to be

- the need for the wells and facilities,
- groundwater and surface water protection,
- odours and emissions from well site operations, and
- other matters (public consultation, traffic, impact on wildlife, property values, regulatory compliance, Koch commitment).

[12] In reaching the determinations contained in this decision, the panel has considered all relevant materials constituting the record of this proceeding, including the evidence and argument provided by each party. Accordingly, references in this decision to specific parts of the record are intended to help the reader understand the panel's reasoning relating to a particular matter and should not be taken as an indication that the panel did not consider all relevant portions of the record with respect to that matter.

NEED FOR THE WELLS AND FACILITIES

Evidence

[13] CNRL submitted that it holds valid mineral rights granted by the Province of Alberta under the oil sands leases to explore and recover heavy oil from the wells that are the subject of the applications. If the licences were not to be approved, CNRL submitted that it would be prevented from exercising the rights granted to it and that valuable bitumen reserves would remain unproduced. CNRL also submitted that production from the applied-for wells would benefit the Province of Alberta through royalty payments, the Municipal District (MD) of Bonnyville through surface lease taxes, and the local economy through annual lease rentals and employment opportunities associated with the project.

[14] MLCS recognized that there would be financial returns from operating the proposed wells, but submitted that any return would be short-term and would not constitute a net benefit to the community. It further argued that the financial profits would only benefit CNRL and its shareholders. MLCS considered the essential long-term benefits of a protected ecosystem in the Minnie Lake subbasin to be more beneficial.

Analysis and Findings

[15] The panel finds that CNRL has the necessary mineral rights to access and develop resources at the proposed wells. The panel accepts that the proposed wells are necessary for CNRL to pursue its right to recover and produce the resources, provided that it can carry out the development in a manner that is in the public interest and sufficiently protects the environment and the safety of local residents and recreational users of Minnie Lake.

[16] Furthermore, the panel is obligated to assess the public interest of any proposed development as mandated in Section 3 of the *ERCA*, which reads as follows:

> Where by any other enactment the Board is charged with the conduct of a hearing, inquiry or other investigation in respect of a proposed energy resource project or carbon capture and storage project, it shall, in addition to any other matters it may or must consider in conducting the hearing, inquiry or investigation, give consideration to whether the project is in the public interest, having regard to the social and economic effects of the project and the effects of the project on the environment.

[17] In its decision, the panel weighed the benefits of the proposed wells against the potential risks to the public and the environment, particularly with respect to Minnie Lake. The panel finds that the proposed wells are in the public interest.

GROUNDWATER AND SURFACE WATER PROTECTION

Evidence

[18] CNRL stated that the subsurface in the project area comprises unconsolidated glacial drift sediments of Quaternary age overlying older bedrock. The glacial sediments are a series of clays, silts, and sands. Several aquifers exist within the Quaternary sediments, including the Grand Centre and Sand River Formations. Most of the local water wells produce from these aquifers. The bedrock underlying the Quaternary sediments consists of marine shales of the Lea Park Formation and the Colorado Group. These shales are more than 150 metres (m) thick and are primarily impermeable. The bedrock occurs at a depth of 60-75 m in the local area but is deeper near the eastern side of Minnie Lake.

[19] MLCS asserted that Minnie Lake is unique in that hydrogeological conditions in the area warrant protection measures beyond those normally required in the Province of Alberta. CNRL stated that the ERCB requirements are adequate in protecting against groundwater contamination.

[20] The parties agreed that the Quaternary sediments could be infilling a deeper preglacial buried channel that extends to a depth of as much as 100 m. Sand units near the bottom of this buried channel can be up to 30 m thick or more. East and west of Minnie Lake and this unnamed buried channel, the sand units are generally less than 10 m thick. The evidence presented by both CNRL and Mr. Chorney suggested that this unnamed preglacial channel extends south to the Buried Beverly Channel and north to the Buried Kehiwin Channel.

[21] The parties agreed that Minnie Lake is up to 20-25 m deep and has no surface inflow or outflow through streams or rivers. They agreed that Minnie Lake is fed by groundwater from a shallow Quaternary aquifer, likely within the Sand River Formation. The parties also agreed that discharges of groundwater occur both as surface springs on the shores of Minnie Lake and directly into the lakebed. In an undertaking, CNRL estimated that the groundwater velocity in a well-sorted Quaternary sand aquifer, using the hydraulic conductivity and hydraulic gradients typical of the Empress Aquifer common in the Minnie Lake area, would be 20-30 m per year at most.

[22] The parties also agreed that the balance between evaporation from the lake's surface and groundwater recharge determines the lake level. CNRL submitted that, according to annual

observations, the water level in Minnie Lake has declined since the 1980s, following the same trend as all monitored lakes in northeastern Alberta. CNRL also noted a steady increase in both total dissolved solids (TDS) and concentrations of sodium and chloride during this period.

[23] MLCS stated its concerns about groundwater protection, given the possibility of poor quality cement jobs in the slant wells and induced fracturing from the production zone to the shallow Quaternary sediments that might create new pathways through which the fluids could migrate resulting in a negative impact to groundwater.

[24] MLCS recounted anecdotal evidence of oily substances observed in Minnie Lake, which had been reported to Alberta Sustainable Resource Development (SRD), as evidence of groundwater contamination from oilfield activity. However, MLCS noted that SRD, citing prior instances of algae and dead vegetation from the lakebed at the water's surface, did not investigate to determine the source and the nature of the reported substances. MLCS also provided visual evidence of the recreation in the area over the summer months including the use of various motorized watercraft.

[25] CNRL noted that saline groundwater is defined under the *Water Act* as water that contains more than 4000 milligrams per litre (mg/L) TDS. CNRL noted further that there are also requirements in Alberta that protect nonsaline groundwater (i.e., TDS content less than 4000 mg/L). Near the project, the base of groundwater protection (BGWP)[2] is 473-483 metres above sea level (masl). By subtracting the BGWP elevation from the known ground elevation, CNRL determined that the BGWP in the project area would be 80-120 metres below ground surface (mbgs). CNRL committed to protecting nonsaline groundwater resources by setting and cementing surface casings to a vertical depth of 130 m below the kelly bushing[3] and cementing the full length of the production casing.

[26] CNRL noted that protection of surface water bodies would be achieved, in part, through setback requirements. Any energy well or facility to be located less than 100 m from the boundary of a water body is subject to increased environmental protection and spill mitigation requirements in Section 7.10.12.1 of *Directive 056: Energy Development Applications and Schedules* and Section 8.060 of the *OGCR*. CNRL noted that all wells proposed as part of the project meet the requirements. The well centre closest to Minnie Lake at LSD 7-22-61-8W4M would be located about 180 m from the lake and the facility nearest to the lake, the constructed berm, would be located over 150 m from the lake.

[27] CNRL further indicated that it would adhere to the ERCB requirements for containing potential fluid spills, including the reporting requirements in ERCB *IL 98-01: A Memorandum of Understanding Between Alberta Environmental Protection and the Alberta Energy Utilities Board Regarding Coordination of Release Notification Requirements and Subsequent Regulatory Response*. It noted that secondary containment in the form of a metal dike or berm with an impermeable liner would surround the primary containment (i.e., the tanks) to meet the ERCB's requirements in *Directive 055: Storage Requirements for the Upstream Petroleum Industry*. CNRL indicated that a perimeter berm at all the well sites would provide additional containment capacity.

[2] BGWP: The estimated elevation at which groundwater transitions from nonsaline to saline.
[3] Kelly bushing: The elevation reference point on the rig floor a few metres above ground level.

[28] CNRL noted that it would use an environmentally benign, natural organic polymer called Q'Xan Kelzan (xanthan gum) when drilling the proposed wells. It noted that xanthan gum based drilling fluids facilitate effective borehole cleaning by building a filter cake on the borehole wall, thus stabilizing the borehole. CNRL further noted that its use also reduces friction and torque to allow for rotation and reciprocation of the casing while cementing. CNRL committed to a minimum of two bottoms-up circulations to ensure that the hole is clean. It also committed to conducting wiper trips using a stabilizer blade assembly to ensure that the hole is properly cleaned of drilling mud and cuttings and has sufficient filter cake to protect the shallow aquifers or permeable zones, minimizing the potential for bridging-off or loss of circulation. CNRL would use semirigid centralizers on every collar on both casing strings to improve cement distribution. CNRL stated that its proposed drilling program includes commitments that exceed current ERCB requirements.

[29] CNRL explained that given the thickness of the rock that has to be penetrated to reach the primary target, the Sparky Formation, the wells would have to be slant drilled. Two of the wells would be almost vertical and the other eleven wells would be steeper but inclined at less than 45 degrees. The remaining two wells would require a slightly steeper build of 50.7 and 47.8 degrees from vertical to reach the Sparky Formation.

[30] CNRL stated that it plans to achieve full cement returns to surface with both its surface and production casing strings. CNRL committed to a minimum of six cubic metres (m^3) of good cement returns prior to displacement of the cement from the inside of the casing string with a wiper plug. It further committed to running a cement evaluation log if full cement returns to surface were not achieved or the cement level dropped. CNRL stated that it would seek ERCB approval prior to commencing remedial operations. CNRL noted that it would continue cementing both surface and production casing until full cement returns are observed at surface.

[31] CNRL stated that it would use a thermal cement blend that does not exhibit a significant reduction in strength at temperatures of up to 360 degrees Celsius (^oC) and has a compressive strength of at least 3500 kiloPascal (kPa) after curing for 48 hours. This cement blend is designed for fast setting to prevent gas migration issues through the cement. CNRL stated that it would rotate and reciprocate both the surface and production casing strings during cementing to ensure adequate mud removal and cementing. CNRL committed to performing gas migration and surface casing vent flow tests within 90 days of rig release to confirm that these procedures would successfully provide hydraulic isolation.

[32] CNRL stated that the target formation is the Sparky Formation of the Mannville Group, located below the Colorado Group at depths of 350-380 mbgs in the project area. CNRL's groundwater expert, James Freeman, stated that there is no known surface or subsurface feature in the Minnie Lake area to indicate hydraulic connection between the reservoir and shallow aquifers or Minnie Lake. CNRL also confirmed that it would not conduct any form of well stimulation, including hydraulic fracturing, as part of its operations for the project. The maximum pressure to be applied to the wells (7000 kPa) would occur only during pressure testing of the casing.

[33] CNRL stated that heavy oil from the Sparky Formation would not be physically capable of rising to surface, even under the most conducive conditions (i.e., natural hydrostatic gradient, maximum reservoir pressure of about 2800 kPa, and completely uncemented casing). CNRL

determined that under those conditions, although unlikely, oil from the Sparky Formation could rise about 280 m above the target zone or about 100 m from the surface.

[34] MLCS acknowledged the absence of deep (saline) groundwater discharge features at the surface, but viewed this as insufficient evidence that fracturing of the shale formation does not occur. It believed that communication could exist between the heavy oil reservoir and the shallow Quaternary aquifers but was concerned that the proposed drilling could expand such pathways.

[35] CNRL stated that it would complete the proposed primary bitumen cold flow wells by installing a positive cavity pump (PCP) next to the casing perforations in the Sparky Formation. A continuous rod attached to a hydraulic top drive at the surface and run through production tubing from surface down to the reservoir would drive the PCP. Oil emulsion and sand would pump up the production tubing to a heated storage tank at surface.

[36] MLCS expressed concern with possible land subsidence as a result of producing hydrocarbons and sand from the Sparky Formation. CNRL referred to *Decision 2000-23: Ranger Oil Limited*, *Cold Lake Oil Sands Area*, *Primary Recovery Scheme*, where the Board indicated that it did not believe subsidence associated with cold flow production would occur. CNRL presented data showing that the volumes of fluid and sand produced from other wells in this reservoir are negligible compared to the total reservoir volume and that it would unlikely cause any noticeable subsidence at the surface. CNRL further noted that there are more than 8000 similar primary production bitumen wells in the area and that it is not aware of any associated subsidence. The MLCS groundwater expert conceded that he was not an expert in this area and the panel could largely ignore his evidence pertaining to subsidence.

Analysis and Findings

[37] The panel notes that the ERCB recognizes the societal importance of surface water and groundwater protection and that it has developed specific requirements in that regard. *Directive 008: Surface Casing Depth Minimum Requirements*, *Directive 009: Casing Cementing Minimum Requirements*, *Directive 051: Injection and Disposal Wells—Well Classifications, Completions, Logging, and Testing Requirements*, and *Directive 056* all reference the BGWP. *Directive 056* also describes ERCB setback requirements when drilling near a surface water body.

[38] The panel recognizes and acknowledges the quality of the information on the regional hydrogeology publicly available and presented at the hearing, including material from the Alberta Geological Survey, academic professionals, and a local water well drilling expert. The panel notes that it is helpful that the conditions in the Minnie Lake area are well documented. The parties agreed on the likely depth of the buried Quaternary channels that contain potential aquifers. The panel finds that the ERCB is able to protect groundwater from potential harm through the range of requirements and mechanisms currently available.

[39] The panel agrees that Minnie Lake is fed by groundwater from aquifers in contact with the lakebed as well as intermittent springs currently present at or near its shoreline. The panel notes, however, that an imbalance in the rate of aquifer recharge and surface evaporation has reduced the level of the lake by about 4 m. This imbalance has significantly reduced the volume of water and increased the TDS content of the lake over the past decade or more. The evidence presented

suggests that the gradual decrease of water levels in Minnie Lake and the corresponding increase in TDS content are consistent with the regional trend.

[40] The panel notes that ERCB requirements with respect to BGWP include cementing surface casing or the next string of casing to cover nonsaline aquifers, with regard for local conditions. The panel notes that CNRL, in response to these requirements, has committed to setting surface casing to 130 m total vertical depth, while MLCS requested that it be set to 440 masl. The panel notes that the two methods are, in fact, approximately equivalent for each of the 8 well pads' surface elevations. However, given slight differences in surface elevation at each well pad, the panel finds that in order to be more consistent, the required surface casing depth for all wells should be expressed as an elevation above mean sea level. The panel also finds that setting and cementing surface casing through the BGWP zone provides much of the required protection of local groundwater.

[41] The panel notes that the locations of the proposed well pads meet all applicable setback requirements in *Directive 056*. The panel further notes that CNRL provided mitigation measures for proposed equipment (i.e., storage tanks) within 100 m of a water body (i.e., low area and dry draw) on some of the proposed well pads. The ERCB reviewed the proposed mitigative measures for water body protection and found them acceptable as per *Directive 056* requirements. The panel further notes that CNRL consulted Alberta Environment (AENV) about the need for an approval under the *Water Act* for these sites and was advised that an approval is not required for the project. The panel notes that the proposed design of the well pads and their accompanying facilities also meet all applicable requirements in *Directive 055* with respect to the requisite containment structures. The panel finds that these requirements adequately protect against potential surface spills from the proposed operations.

[42] The panel notes that slant drilling in systems using cold heavy oil production with sand (CHOPS) is a standard and common practice developed over several decades. The panel recognizes the community's obvious concern for ensuring the satisfactory cementing of casing in boreholes that are not vertical. The panel is, however, satisfied that the ability, among others, for xanthan gum-based drilling fluid to create an impermeable filter cake in the borehole as the BGWP zone is penetrated provides another measure of groundwater protection. Further, the panel finds that using centralizers on each casing joint in addition to the lubricating and gelling properties of the drilling fluid that contribute to the rotation and reciprocation of the casing will facilitate the appropriate and required setting and cementing of both surface and production casing.

[43] The panel acknowledges the importance to the community in assuring that groundwater is protected. While the primary purpose of surface casing is well control, it has an added benefit of groundwater protection when adequately cemented. To fully verify the efficacy of the cement job, the panel requires CNRL to conduct a cement evaluation log of the surface casing in each well after drilling to total depth and provide these to the ERCB for review and approval after setting the production casing.

[44] The panel notes that the depth of the target reservoir is about 350–380 mbgs and is separated from the Quaternary aquifer bearing section by about 150–200 m of shales of the Colorado Group and Lea Park Formations. The panel finds that the presence of bitumen at depth and uncontaminated potable (nonsaline) groundwater in the shallow Quaternary section to be

evidence of the effectiveness of the intervening 150-200 m of shales as a barrier to fluid migration. The panel further notes the relatively low pressure and extremely high viscosity of the oil in the reservoir, finding it extremely unlikely that oil would flow freely through the production casing, tubing, or outside of the casing into surface sediments.

[45] The panel notes that the drilling operations, nature of the drilling fluids and additives, production casing string, production tubing, and rods and pumps, as proposed, are all common industry best practices. As such, they present no additional risk of fluid migration from the reservoir to the Quaternary groundwater zones. On the contrary, such industry best practices supplement the natural geotechnical conditions in controlling inadvertent fluid migration and protecting the groundwater.

[46] The panel again acknowledges the importance to MLCS and the community-at-large in assuring that the production casing isolates the wellbore from fluid migration between zones. To fully verify the efficacy of the cement job, the panel requires CNRL to run cement evaluation logs of the production casing in each well and provide these logs together with the surface casing cement evaluation logs to the ERCB for review and approval before perforating the wells.

[47] The panel notes that CNRL has committed and intends to follow certain practices and procedures when drilling and completing the subject slant wells (see Appendix 1). The panel's condition that CNRL provide surface and production casing evaluation logs for review by the ERCB will necessitate that CNRL meet those commitments.

[48] The panel notes that there is a lack of convincing evidence that would indicate subsidence as a result of the production operations or fracture propagation from the reservoir to the BGWP as a result of the drilling and completion processes. The panel finds, therefore, that it is highly unlikely that CHOPS drilling and operations would interfere with the stratigraphic or fluid content separation.

[49] Finally, the panel expresses its concern over the testimony of MLCS's groundwater expert. Gilles Wendling acknowledged his lack of experience with the oil and gas sector, noting that his experience with borehole drilling lies primarily in mineral exploration. The panel, therefore, concludes that he put forward opinions on subjects outside his main area of professional experience, resulting in a testimony that was neither applicable nor relevant to the circumstances of the applications. Therefore, the panel gave little weight to his testimony. The panel further cautions anyone appearing at an ERCB hearing as an expert witness to restrict comments and opinions to their area of expertise.

ODOURS AND EMISSIONS FROM WELL SITE OPERATIONS

Evidence

[50] CNRL proposes to drill 15 wells and construct and operate the associated bitumen batteries. Each well would produce oil to its own above ground storage tank located within a metal containment berm. Hydrocarbons would be heated in the tank by a gas-fired burner to allow the bitumen to flow from the tank for the purpose of trucking it to a heavy oil battery at LSD 9-15-60-4W4M. Some hydrocarbon vapours would be vented to the atmosphere from the tank vents.

[51] MLCS presented evidence on the relationship between tank temperature and the volume and constituents of emissions from the tanks. MLCS expressed concern over emissions from the proposed bitumen storage tanks and their proximity to Minnie Lake. MLCS submitted a report by Ian Johnson, *Assessment of Hydrocarbon Emissions from Heated Bitumen Storage Tanks*[4] (Johnson report), discussing the relationship between heated bitumen at different temperatures and potential air emissions. The Johnson report concluded that an increase in temperature would result in both higher rates and a more toxic hydrocarbon mixture.

[52] The Johnson report stated that the mixture of aromatic and alkylated aromatic hydrocarbons emitted from heated bitumen tanks may be potentially hazardous to human health. It presented calculated concentrations of various constituents from bitumen tank battery emissions and used dispersion modelling to predict concentrations of C_3, C_4, and C_5 at various locations. The report further noted that increasing the temperature of stored bitumen results in higher concentrations of hazardous hydrocarbon vapors in storage tanks and recognized that such emissions had been insufficiently characterized in previous air quality monitoring studies. It, therefore, recommended that storage tank temperatures be maintained as low as possible.

[53] MLCS also expressed concern about potential adverse health impacts associated with emissions from heated bitumen on vulnerable members of the public, including infants, nursing mothers, and elderly with pre-existing health conditions. It referred to CNRL's temperature set point of 80°C for the tanks and questioned if CNRL could lower it to reduce the volume and toxicity of air emissions being vented from the tanks. MLCS also raised concerns about the potential odours from bitumen tanks and questioned how CNRL would respond to resulting complaints.

[54] CNRL acknowledged that increasing the temperature of bitumen encourages more semivolatile compounds to form and be emitted from the tanks. CNRL noted, however, that the 80°C was the temperature set point at the tank burner and that the surface temperature of the oil in the tank would be about 40°C lower than the burner set point, considerably reducing the volume and range of semivolatiles emitted from the tanks. The temperature point at the burner is necessary to sufficiently heat the bitumen for its successful transfer to trucks and shipping to the heavy oil battery. CNRL stated that, in its experience, 80°C at the burner tip is an effective set point that results in minimal odours while allowing efficient transfer of the bitumen.

[55] MLCS also submitted a report by Dr. Coppock, *Toxicologic Hazards of Plumes from Produced Heavy Oil Storage Tanks*[5] (Coppock report), to provide a toxicological hazard assessment on air emissions from heated bitumen. The Coppock report reviewed the potential exposure pathways and toxicology of various chemical compounds expected to be emitted from heated bitumen tanks, as identified in the literature. The report noted that, in addition to tank battery emissions, the chemical compounds it identified in its review are also found in the exhaust of internal combustion engines and vapours from motor fuels, flares and solvent and fuel fired heating units. The report concluded that dispersion modelling does not accurately predict human and animal exposure from tank vapours. The report did not include any predicted

[4] Johnson, C. I., 2007, Technical Report, *Assessment of Hydrocarbon Emissions from Heated Bitumen Storage Tanks,* prepared for Ms. Sally Ulfsten of Ardmore, Alberta, and Mr. Brad Braun, Manager of Environment at Canadian Natural Resources Limited, Calgary, Alberta, September 21, 2007.

[5] Coppock, R.W., 2006, *Toxicologic Hazards of Plumes from Produced Heavy Oil Storage Tanks*, November 22, 2006.

exposure levels at specific distances from the proposed project to which Minnie Lake area residents might be exposed. Neither Dr. Johnson nor Dr. Coppock were called to testify at the hearing and were not, therefore, available for cross-examination.

[56] MLCS also submitted a statistical study by the Alberta Health Services (AHS) (AHS report)[6] that compared the number of cancer cases reported in the overall and rural Bonnyville areas to the number that could be expected based on the cancer rates in two reference populations: Alberta and the North Zone. The report suggested that there was no cause for immediate concern, but recommended that cancer rates in the area continue to be monitored.

[57] CNRL recognized that the AHS report was well-balanced and well-constructed, arguing that it supported Don Davies's findings that cancer incidences were not greater in Bonnyville than in the rest of the Alberta. The AHS report indentified two types of cancer whose rates were increasing faster than those of the reference populations; however, it recognized that although some cancer types were slightly more elevated than expected, the findings were not consistent across time periods and populations.

[58] MLCS provided a report, *Review of Technical Report Assessment of Hydrocarbon Emissions from Heated Bitumen Storage Tanks by C. I. Johnson*[7] (Norman report), by its witness, Ann-Lise Norman, who evaluated the Johnson report. The Norman report compared the methodologies used in the Johnson report to those in reports from Clearstone Engineering Ltd. and AENV reports cited therein. Dr. Norman concluded that Dr. Johnson's theoretical approach to determine concentrations of compounds in bitumen samples at varying distances was a more robust approach compared to the ambient air quality measurements noted in Clearstone and AENV's reports. The Norman report concluded that the theoretical approach shown in the Johnson report was appropriate under the circumstances since it characterized the air space above the heated bitumen through a detailed analytical assessment of the tank liquids.

[59] Dr. Norman further stated that although her professional preference would be to rely on actual measurements for an assessment, she preferred a modelling approach in this case due to inadequate monitoring information. She concluded that the panel, in assessing the health concerns expressed by MLCS, should rely on the methodological approach described in the Johnson report and the predicted concentrations of C_3, C_4, and C_5 benzenes.

[60] In response to odour and health concerns and evidence put forward by MLCS, CNRL submitted a report by Dr. Davies[8] (Davies report). This report assessed the potential health and odour impacts from heated bitumen emissions at the proposed facilities. This assessment examined the information in both the Coppock and AHS reports and included a health impact and an odour assessment of the proposed facilities.

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[6] Alberta Health Services, *Memorandum Re: Completion of Data Request # 2010-05CR to Natalia Tash from Amy Colquhoun*, December 15, 2010.

[7] Norman A.L., 2011, *Review of Technical Report Assessment of Hydrocarbon Emissions from Heated Bitumen Storage Tanks by C. I. Johnson September 21, 2007 Re: Several Well and Facility Applications of Canadian Natural Resources Limited for Development in the Sugden Field near Minnie Lake*, February 9, 2011.

[8] Intrinsik Environmental Sciences Inc., 2011, *RE: Canadian Natural Resources Ltd. (CNRL) Well and Facility Applications – Sugden Field Application Nos. 1629922, 1629923, 1629924, 1629926, 1629927, 1629929, 1629930, 1629931, 1629933, 1629934, 1629935, 1629936, 1629938, 1648948, 1628949, and 1634352*, February 25, 2011.

[61] The Davies report noted that the Coppock report did not constitute a "bona fide" health assessment as it did not compare toxicity levels to measured or predicted levels that human receptors may be exposed to. As a result, the Coppock report was not useful in understanding the potential human health impacts from exposure to emissions from the proposed facilities.

[62] The Davies report stated that although it disagreed with the methodology and the conclusions, the maximum predicted concentrations using the theoretical modelling approach of the Johnson report gave no obvious cause for concern.

[63] The Davies report described the AHS report as a well constructed, balanced analysis of cancer incident rates in the area, noting that the findings did not suggest any obvious increased cancer rates among urban or rural populations.

[64] The Davies report attempted to determine the risk of adverse effects on Minnie Lake area residents. It used the Coppock report and other studies to identify and characterize the chemical compounds and classes of chemicals known or presumed to be present in emissions from heated bitumen. The report then identified acute and chronic toxicity levels for the chemicals noted in the literature review and by reputable scientific and/or regulatory agencies. Finally, it used existing studies (the Johnson report, AENV's Bonnyville and LaCorey reports, and the Clearstone Engineering Ltd. report) to establish predicted or actual field monitoring data to determine a range of potential exposure levels.

[65] The Davies report concluded that the majority of measured and predicted concentrations of the examined chemicals that may be emitted from heated bitumen tanks were extremely low, ranging from undetectable to trace levels. The Davies report compared hypothetical and worst-case exposure levels to acute and chronic toxicity levels of chemicals reported to cause adverse health effects. This analysis established that, in virtually all situations, potential exposure to chemicals from bitumen tank emissions are well below levels expected to cause adverse health effects.

[66] Dr. Davies acknowledged that the air quality dataset used for the study was limited, but noted that a number of conservative assumptions were used to compensate for these limitations. Dr. Davies further explained his approach: using margin-of-difference (MOD) to compare measured and/or predicted exposure concentrations to toxicology benchmarks for compounds identified in the Coppock report and hazard quotients (HQ) and margin-of-safety (MOS) to compare to regulatory exposure limits.

[67] Dr. Davies stated that the results for all three indices showed no adverse health impacts. The report demonstrated the MOS for acute exposure scenarios, ranging from several hundred to several thousand times. The MOS for chronic exposures were somewhat lower, but still precluded adverse health impacts. The few exceptions noted were for hypothetical worst-case exposures. Dr. Davies concluded that the health impact assessment did not indicate that the health of people living near crude bitumen batteries, such as those proposed by CNRL in the Minnie Lake area, would be adversely impacted.

[68] The Norman report favoured the maximum alkylated benzene predictions determined by the Johnson report using the U.S. Environmental Protection Agency's Screen3 dispersion model. In reviewing these predictions, Dr. Davies stated that the Johnson report did not warrant debate as the maximum predicted concentrations for the alkylated benzenes was 207.4 micrograms per

m^3, which is well below the aromatic group acute exposure limit of 2000 micrograms per m^3 that alkylated benzenes would fit into.

[69] In response to MLCS's concerns with odours, the Davies report included an odour assessment based on measured and predicted values similar to the approach used in the health impact assessment. Dr. Davies converted the measured and predicted concentrations to 3-minute near peak concentrations and compared them to both the average and the full range of odour thresholds. The Davies report concluded that most measured or predicted concentrations were below applicable odour thresholds, but that some aliphatic chemical groups (C_5-C_8 and C_9-C_{16}) and aromatic groups (C_9-C_{16}) were detectable. The Davies report also concluded that the majority of measured and/or predicted concentrations of chemicals were below both average and lowermost odour thresholds at the battery fenceline and beyond. It noted, however, that individuals with a keen sense of smell might detect gasoline or creosote-like odours under sporadic poor dispersion conditions downwind and in close proximity to the battery fenceline.

[70] CNRL supported the level of regional air monitoring currently in place through the Lakeland Industry & Community Association (LICA) and did not see the need for additional monitoring. It also stated that, if MLCS had concerns about the adequacy of air monitoring around Minnie Lake, LICA would be an appropriate organization with which it could address those concerns. It further stated that LICA can provide canisters for volatile organic compounds and the appropriate training to members of the public wishing to conduct further monitoring on their own. Furthermore, LICA has a portable air monitoring station that is deployed to various locations based on public input. CNRL stated that, based on the evidence provided by MLCS, it did not see the need for additional air quality baseline studies.

[71] MLCS expressed concerns with the adequacy of the existing continuous and passive air monitoring by LICA to fully describe local air quality at Minnie Lake. MLCS also noted that LICA's closest monitoring station was unable to use data gathered from its closest monitoring station to determine risks from the proposed facilities, demonstrating the need for more comprehensive air quality studies. MLCS stated that while it had conducted discussions with CNRL on additional monitoring in the region, it had not engaged AENV or LICA in similar discussions nor had it requested sampling canisters from LICA. MLCS stated that it was willing to work with any group interested in advancing regional air monitoring, but noted that it would need to rely on third-party scientific expertise to understand both the adequacy of existing monitoring, as well as other monitoring options.

Analysis and Findings

[72] The panel believes that authorizing CNRL to proceed is in the public interest, provided that oil and gas resources in the Minnie Lake area can be developed in a manner that protects the environment and the safety and health of residents in the area. One of the most important objectives of the panel's deliberations was, therefore, to consider the potential adverse health impacts associated with emissions from heated bitumen that would result from the proposed development. The panel considered how the emissions would impact MLCS members and other members of the public that live, work, and play in the vicinity of CNRL's proposed activities.

[73] The panel notes MLCS's concerns over potential emissions from the proposed facilities. It acknowledges the importance of tank burner temperatures and the fact that the surface temperature of liquids inside the tanks can be substantially lower than the 80°C burner set point

and therefore reduce the volume and chemical complexity of emissions. The panel notes the need to maintain the bitumen at a temperature sufficient enough to permit its transfer to trucks and, ultimately, its shipment to processing facilities. The panel expects CNRL to manage burner temperatures to minimize tank emissions and potential odour complaints and promptly address any complaints. The panel finds that this operating practice presents an acceptable balance between CNRL's operating requirements and MLCS's concerns about emissions from heated bitumen tanks.

[74] The panel acknowledges the written and oral evidence characterizing the nature and dispersion of emissions from heated bitumen tanks presented by all parties. Evidence regarding such potential exposure was presented to the panel by CNRL and MLCS. The evidence included the Johnson report and references to both the Clearstone report and AENV's ambient air quality surveys of bitumen tank emissions noted in the LaCorey and Bonneville ambient air sampling studies. The evidence also included the Coppock and Davies reports, both of which claimed to assess the potential health effects of CNRL's proposed activities.

[75] The panel finds that the Coppock report provided an inventory of compounds associated with emissions from bitumen tanks, as identified in scientific literature. The Coppock report, however, failed to assess the potential health effects of those emissions on MLCS and other residents in the area. Similarly, it provided neither estimated exposure levels of compounds associated with the proposed activities nor an analysis of potential health effects that might be anticipated to occur from such ambient exposure levels. As such, the panel did not find the Coppock report useful in reaching its decision.

[76] In reaching its conclusions on potential health effects, the panel primarily relied on the written and oral evidence of Dr. Davies. The panel finds that the method he used to analyze various datasets, including associated estimates of potential exposure levels, are appropriate in this case. The panel notes that Dr. Davies's health impact assessment used the most conservative exposure levels from the various datasets that parties provided at the hearing.

[77] The panel accepts and relies upon Dr. Davies's evidence, noting that the level of safety established by a series of indices (i.e., HQ, MOD, and MOS) was demonstrated to be extremely high. Dr. Davies's evidence established to the panel's satisfaction that it is highly unlikely that area residents would experience harmful health effects from hydrocarbon compounds emitted from the bitumen storage tanks.

[78] The panel also considered the results of the AHS report that suggests there is no cause for concern regarding cancer rates in the region.

[79] Based on the evidence provided, the panel finds that the ambient exposure levels anticipated from emissions from bitumen storage tanks are well below levels expected to cause adverse health effects in MLCS members and residents of the Minnie Lake area.

[80] In considering MLCS's concerns with potential odours from the bitumen tanks, the panel relied on the analysis presented in the Davies report. The panel accepts the conclusions in this report noting that odours from the proposed facilities may be occasionally detected at locations downwind and reasonably close to the facilities. The panel also accepts that individuals with a highly sensitive sense of smell may be able to detect hydrocarbon odours in close proximity to the proposed facilities; however, given the distance of the proposed facilities from recreation

properties at Minnie Lake (i.e., not in close proximity as defined in Dr. Davies evidence), the panel finds that it is unlikely that Minnie Lake area residents would be able to detect potential odours from the bitumen tanks. The panel expects CNRL to meet its commitments to promptly address concerns with odours, through either its own internal processes or external partners such as LICA where appropriate.

[81] The panel acknowledges the importance of monitoring airsheds and that organizations have been established for the purpose of regional air monitoring. The panel acknowledges that LICA is an appropriate organization through which MLCS members and residents in the Minnie Lake area can address air monitoring concerns. The panel recommends that MLCS take advantage of all the resources LICA has to offer.

[82] The panel recognizes that AHS monitors the incidence of cancer rates throughout the Province of Alberta and that, according to evidence presented in the AHS report, there is no cause for concern in the general Bonnyville area at this time. The panel finds the work performed by AHS helpful and supports their continued monitoring efforts.

OTHER MATTERS

Evidence

CNRL Public Consultation

[83] MLCS expressed concerns about CNRL's approach to public consultation. MLCS maintained that a five-month lapse occurred during which consultation efforts with MLCS were not undertaken. MLCS submitted that communication by and with CNRL has been lacking in the areas of respect, timing, and accuracy and pointed out several errors and misrepresentations of events recorded in CNRL's submissions.

[84] CNRL submitted that it has engaged in extensive public consultation with area landowners and residents, including MLCS, since January 2008, when it began its *Directive 056* participant involvement program for the area. CNRL maintained that it complied with *Directive 056* requirements and that it made significant attempts to resolve the issues and concerns of MLCS through community consultation and mediation events, as well as ERCB and third-party facilitation and negotiation.

[85] CNRL presented evidence that it had responded to a number of MLCS's concerns through these public consultations, negotiation, and mediation processes, including the relocation of the well site from its initial proposed location at LSD 2-22-61-8W4M to LSD 15-15-61-8W4M and rerouting of the truck route to direct oilfield traffic away from occupied and recreational use areas at Minnie Lake.

Traffic

[86] CNRL submitted that it planned and adjusted all of the access routes to direct oilfield traffic to the west, away from both occupied and recreational use areas at Minnie Lake. These adjustments included avoiding the access road to Minnie Lake from Highway 660. CNRL noted

that its proposed truck route interferes the least with recreational activities at Minnie Lake and reasonably accommodates all interests, including those of CNRL.

[87] MLCS expressed concerns about traffic volumes, noise, and safety, noting that CNRL does not have final approval from the MD of Bonnyville for its proposed truck route. MLCS suggested an alternative truck route north on Range Road 483 and then east on Township Road 614, returning south to Highway 660 via Range Road 475, further east. It submitted that this alternative truck route, in its opinion, would reduce the volume of traffic past the entry of the Minnie Lake access road on Highway 660, which is already extremely busy.

[88] CNRL argued that MLCS's proposed truck route would result in greater distances travelled on local roads and would not be the best accommodation of all interests or use of designated truck routes. CNRL submitted that its proposed truck route uses existing roads and was designed in consultation with the MD of Bonnyville. With respect to traffic volume, CNRL estimated that each well should have an average of four visits per week for fluid (water, oil, and sand) hauling, one visit per day for maintenance, and two visits per week for servicing. It further stated that fluid hauling would occur 24 hours a day, seven days a week, except for pressure trucks used for well loading, which would take place during daylight hours unless an emergency occurs.

[89] MLCS requested that all site visits (i.e., trucking, inspection, and servicing) occur during normal business hours from 7:00 a.m. to 7:00 p.m. CNRL submitted that its selected truck route would not impact lakeshore cabin owners and, therefore, trucking hours did not need restricting.

Impact on Wildlife

[90] MLCS noted that Minnie Lake is located in a small valley that is a corridor for various species of wildlife that inhabit the area. It presented evidence of several species of animals and birds that frequent the area, noting that some are protected under the federal *Migratory Bird Act*. MLCS recognized that projects such as CNRL's do not require an environmental impact assessment. However, it argued that, without local intervener evidence, the ERCB's application review process would be unable to identify hazards to wildlife and means to mitigate these potential hazards. It submitted that an approval of the applications would make Minnie Lake and the surrounding area a less suitable habitat for numerous wildlife species.

Property Values

[91] MLCS submitted a study indicating that the proximity of oil and gas activities could negatively impact property values by as much as 10 per cent. MLCS submitted that the tanks proposed at the well site at LSD 7-22-61-8W4M would be visible from the lake area.

[92] CNRL submitted that there was no evidence suggesting that the proposed project would negatively impact real estate values of the lake lots around Minnie Lake. CNRL stated that additional gainful employment in the area would increase, not decrease, the overall demand for property. CNRL submitted that it had considered landowners' requirements in selecting surface locations of the wells and that none of the proposed sites, including equipment such as tanks, would be visible from Minnie Lake. CNRL further noted that it had specifically relocated the well site at LSD 2-22-61-8W4M to LSD 15-15-61-8W4M to better accommodate surface interests and eliminate its potential visual impact.

Regulatory Compliance

[93] CNRL submitted that it takes pride in the fact that its drilling and operational practices are above the industry average in complying with ERCB requirements. It testified that its compliance rate in the Bonnyville area is 92 per cent and that its overall provincial compliance rate is 90 per cent, which is above the industry average of about 81 per cent.

[94] MLCS submitted that CNRL's evidence on its compliance record contradicts its reputation in the area and provided evidence indicating that CNRL had a higher number of high-risk enforcements in the area than it had submitted. MLCS requested that several specific incidents involving CNRL operations be clarified. MLCS further noted that some local residents do not trust that CNRL would comply with applicable requirements if the project is approved.

Koch Commitment to the Arychuks

[95] MLCS submitted a letter dated December 23, 1997, from Ben Meulenbeld & Associates Ltd., an agent for Koch Exploration Ltd. (Koch), in which a commitment to Dianna Arychuk and George Arychuk was made on behalf of Koch that "no additional pads will be constructed within close proximity of Minnie Lake." Prior to the hearing, MLCS requested that the purchase and sale agreement between Koch and CNRL be disclosed to determine if the subject letter is a contract binding CNRL to the commitments within, pursuant to the terms of the purchase. CNRL objected to disclosing the agreement on the basis that it was irrelevant to the proceeding and requested confidentiality status if the document were to be produced.

Analysis and Findings

[96] The panel notes CNRL's chronology of community consultation and involvement throughout the application process and acknowledges its compliance with ERCB requirements in this respect. The panel also notes the concerns of MLCS regarding its involvement with CNRL, but recognizes the discontinuous nature of the local residents' involvement. The panel acknowledges the difficulty in achieving mutually satisfactory community engagement and is satisfied that CNRL has attempted to do so in various ways, even if unsuccessful in addressing its concerns.

[97] The panel finds that CNRL's participant involvement program meets both the intent of and requirements within *Directive 056*. The ERCB requires CNRL to comply with the specific consultation requirements in *Directive 056* and expects it to identify those parties with an interest in the proposed project, providing them with information and encouraging open dialogue about the project. The panel expects the program to be a two-way process where parties mutually seek to resolve issues in good faith and make reasonable accommodations, where possible, to address and resolve concerns or issues.

[98] In reviewing the evidence filed for this proceeding, the panel is satisfied that CNRL meets the requirements in *Directive 056* with respect to informing and consulting interested parties. The panel notes that CNRL began its participant involvement program in January of 2008 and provided information and a number of opportunities for MLCS members to understand the project and identify and discuss concerns. The panel is satisfied that CNRL engaged all interested parties, including MLCS, beyond the applicable *Directive 056* requirements. The panel also notes that CNRL held third-party facilitated public meetings and initiated opportunities to

address issues with MLCS through negotiation and mediation. CNRL's evidence supports a view that these processes resulted in reasonable modifications to the project, including relocation of a proposed pad site, rerouting access routes to reduce traffic impacts to MLCS members, and modifying the proposed timing for drilling to reduce potential noise or nuisance effects.

[99] The panel notes that in Section 2.1 of *Directive 056* it states that participant involvement does not end when a licence is issued; it must continue throughout the life of a project. The Board expects CNRL to continue engaging individuals and groups in the local community as it proceeds with development of this project, and associated projects, in the general area.

[100] The panel notes the expected level of traffic associated with the project, but also notes that CNRL committed to route that traffic away from Minnie Lake and the access road to the cottages and recreational area. The panel notes that the alternative route proposed by MLCS would simply transfer the traffic burden to other area landowners and full-time residents and increase the driving distance on public roads under the jurisdiction of the MD of Bonnyville and any associated noise and dust. The panel concurs with CNRL that its proposed truck route interferes the least with recreational activities at Minnie Lake. The panel finds that CNRL's proposed truck route is the most efficient with respect to vehicle emissions and transportation costs, noting that it was designed in consultation with the MD of Bonnyville. However, most importantly, the panel notes and acknowledges the jurisdiction of the MD of Bonnyville with respect to this issue.

[101] The panel notes the concerns of MLCS with respect to the potential impact of the project on recreation in the Minnie Lake area. The panel notes the extensive use in the area by motorized watercraft, ATVs, and snowmobiles and is unconvinced that the proposed oilfield activities, about 0.5 to 2.0 km away, will reduce enjoyment of the lake by MLCS and/or lakeside landowners.

[102] The panel notes the concerns of MLCS with respect to the potential impact of the proposed project on wildlife in the area and acknowledges the fact that an environmental impact assessment was not required for the project. The evidence provided by MLCS did not establish that the project would impact local wildlife. The panel accepts MLCS's evidence that the lake's fish population has already diminished significantly. The panel finds that this could be due to overfishing or naturally occurring changes, such as lower lake levels, reduced water volumes, and increased TDS levels, that have occurred over the past decade or more. However, a link to oilfield activity was not established. The panel notes the nature of the recreational use of the lake and is unconvinced that the proposed oilfield activities 0.5 to 2.0 km away will incrementally impact wildlife in the Minnie Lake corridor.

[103] The panel notes MLCS's argument that oil and gas activities surrounding Minnie Lake would decrease property sale values by 10 per cent, but does not agree with this supposition. Market value reflects typical market conditions for similar properties in the same general area; the sale of a property in the local area is a good indicator of market value. There was no evidence at the hearing that such a property recently sold below market value or that any of the properties surrounding Minnie Lake were sold below market value as a result of the proposed project. For these reasons, the panel rejects the notion that property values in the area would drop if the applications were approved.

[104] The panel notes CNRL's commitment to completing drilling activities outside of summer's window of recreational use from June 1 to September 5 (Labour Day) to allow enjoyment of the

lake over this peak-use period. The panel holds CNRL to this commitment as a condition of approval. While CNRL is not to conduct actual drilling operations during this period, well site construction will be permitted since the panel considers it similar to much of the agricultural activity that occurs at that time. The panel notes MLCS's assertion that some aspects of the proposed development will be visible from the lake and/or the lakeside properties. The panel conducted a site visit to the lakeside and the locations of the proposed wells and facilities before the hearing. Based on its own observations, the panel finds it unlikely that the lakeside residents will be affected visually to any significant degree by the development.

[105] The ERCB enforces compliance with all its requirements and processes under *Directive 019: Compliance Assurance* to ensure that resource activity in the province is conducted in a manner that protects public safety, minimizes environmental impact, ensures effective conservation of resources, and ensures stakeholder confidence in the province's regulatory process. The panel acknowledges CNRL's evidence on its above industry average compliance record, specifically in the Bonnyville area and throughout Alberta in general. The panel's review validates CNRL's compliance record. The panel finds that the proposed wells can be drilled in a safe manner, if all applicable ERCB requirements are followed. For these reasons, the panel is not concerned or apprehensive about CNRL's compliance with ERCB requirements in general or the decisions and directions issued by the panel on the management of this project.

[106] With respect to the December 23, 1997, letter from Ben Meulenbeld & Associates Ltd. committing, on behalf of Koch, to not drilling further in the Minnie Lake area, the panel notes that MLCS admitted that the letter did not constitute a binding legal obligation upon CNRL. The panel confirms that it received and reviewed, in confidence, the purchase and sale agreement between Koch and CNRL and determined that its contents have no bearing on the matter.

CONCLUSIONS

[107] The panel considered the main issues with the applications to be the public interest, need for the wells and facilities, surface water and groundwater contamination, the potential for health effects as a result of odours and emissions from the crude oil storage tanks, and a number of other areas, including CNRL's record with respect to public consultation on the project and regulatory compliance in general in Alberta.

[108] The panel recognizes that the proposed wells and facilities are necessary for CNRL to pursue its right to recover and produce the resources, provided that it can carry out the development in a manner that is in the public interest and sufficiently protective of the environment and public safety.

[109] The panel is confident that the totality of (1) requirements the ERCB has put in place, (2) commitments made by CNRL, and (3) conditions attached by the panel in this decision to the approval of the wells and facilities will adequately protect surface water and groundwater.

[110] The combined evidence of the expert witnesses regarding potentially adverse health effects of odours and emissions from crude oil storage tanks was convincing for the panel. Expert witnesses stated in evidence that chemicals within such emissions might be harmful in sufficient amounts and under certain conditions. However, in this case, such conditions do not

exist. In fact, the level of safety, as established by a series of toxicity indices (i.e., HQ, MOD, and MOS), was demonstrated to be extremely high.

[111] The interveners' concerns about CNRL's performance with respect to both consultation and regulatory compliance, while obviously genuine in intent, were not substantiated by the evidence. First, CNRL met all of the public consultation requirements for the project. Second, its compliance record throughout the province is, as stated, above the industry average. However, the Board expects CNRL to not only maintain this record, but attempt to continually improve upon its compliance performance and maintain ongoing consultation with the local community throughout the life of the project.

[112] Overall, the panel finds the proposed project to be in the public interest, having regard for the social, economic, and environmental effects.

Dated in Calgary, Alberta, on June 28, 2011.

ENERGY RESOURCES CONSERVATION BOARD

<original signed by>

G. Eynon, P.Geol.
Presiding Member

<original signed by>

R. C. McManus, M.E.Des.
Board Member

<original signed by>

J. Gilmour, LL.B.
Acting Board Member

APPENDIX 1 SUMMARY OF CONDITIONS AND COMMITMENTS

Conditions generally are requirements in addition to or otherwise expanding upon existing requirements and guidelines. An applicant must comply with conditions or it is in breach of its approval and subject to enforcement action by the ERCB. Enforcement of an approval includes enforcement of the conditions attached to that licence. Sanctions imposed for the breach of such conditions may include the suspension of the approval and result in the shut-in of a facility. The conditions imposed on the licence are summarized below.

The panel notes that CNRL has made certain commitments to parties involving activities or operations that are not strictly required under ERCB requirements. These commitments are separate arrangements between the parties and do not constitute conditions to the ERCB's approval of the applications. The commitments that have been given some weight by the panel are summarized below.

The panel expects the applicant to comply with commitments made to all parties. However, while the panel has considered these commitments in arriving at its decision, the Board cannot enforce them. If the applicant does not comply with commitments made, affected parties may request a review of the original approval. At that time, the ERCB will assess whether the circumstances regarding any failed commitment warrant a review of the original approval.

Conditions

The panel instructs CNRL to

- set surface casing for all wells at an elevation no shallower than 440 m above mean sea level,
- conduct cement evaluation logs of the surface casing in each well after drilling to total depth and provide them to the Board for review and approval after setting the production casing,
- run cement evaluation logs of the production casing in each well and provide them to the Board for review and approval before perforating the wells, and
- refrain from conducting drilling operations, with the exception of well site construction operations, from June 1 until after September 5 (Labour Day).

Commitments

CNRL committed to

- complete a minimum of two bottoms-up circulations to ensure that the hole is clean,
- conduct wiper trips using a stabilizer blade assembly to ensure that the hole is properly cleaned of drilling mud and cuttings and has sufficient filter cake to protect the shallow aquifers or permeable zones, minimizing the potential for bridging-off or loss of circulation,
- use semirigid centralizers on every collar on both casing strings,
- use a minimum of 6 m^3 of good cement returns prior to displacement of the cement from the inside of the casing string with a wiper plug,

- perform gas migration and surface casing vent flow tests within 90 days of rig release to confirm its procedures will successfully provide hydraulic isolation, and
- promptly address concerns with odours, through either its own internal processes or external partners such as LICA, where appropriate.

APPENDIX 2 HEARING PARTICIPANTS

Principals and Representatives	Witnesses
Canadian Natural Resources Limited P. J. McGovern	D. Blake R. Bretzlaff D. B. Davies, Ph.D., DABT, of Intrinsik Environmental Sciences Inc. E. Fouillard J. T. Freeman, M.Sc., P.Geol., of Matrix Solutions Inc. W. Nielsen B. Parker R. Zabek, P.Eng.
Minnie Lake Conservation Society	D. Arychuk C. Beaulieu M. Beaulieu A. Colquhoun, M.Sc., of Alberta Health Services W. Czuroski K. Doonanco A. L. Norman, Ph.D., P.Phys., of the University of Calgary J. Ponto, BEH(AD), CPHI(C), of Alberta Health Services J. Spasiuk A. Tash G. Wendling, Ph.D., P.Eng., of GW Solutions Inc.
Energy Resources Conservation Board staff K. W. Stilwell, Board Counsel P. M. Johnston, Q.C., General Counsel M. Alboiu, P.Ag. R. Reid, C.E.T. M. Bevan, M.Sc., P.Geol. E. Zimmerman, P.Geol. L. Jonker, C.E.T. E. Rahn, QEP	

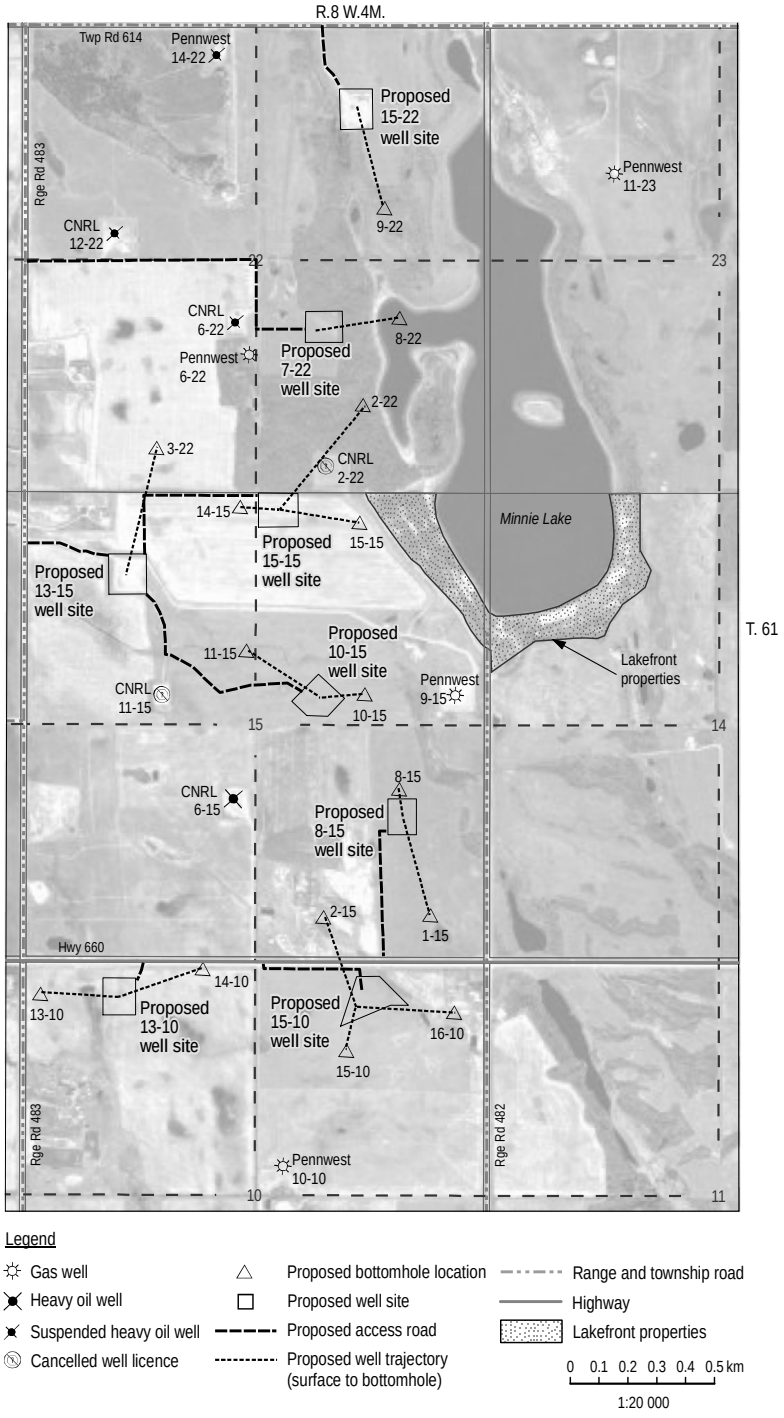

Figure 1. Project map