BRITISH COLUMBIA
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Request for Proposals
Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity

Ministry of Health Request for Proposals Number: RFP HL173

Issue date: June 28, 2012

Closing Time: Proposal must be received **before** 2:00 PM Pacific Time on: Friday August 10, 2012

GOVERNMENT CONTACT PERSON: All enquiries related to this Request for Proposals (RFP), including any requests for information and clarification, are to be directed, in writing, to the following person who will respond if time permits. Information obtained from any other source is not official and should not be relied upon. Enquiries and any responses will be recorded and may be distributed to all Proponents at the Province's option.

<<Norman Helewa, Project Manager e-mail: norman.helewa@gov.bc.ca>>

DELIVERY OF PROPOSALS:

Proposals must not be sent by mail, facsimile or e-mail. Proposals are to be submitted to the closing location as follows:

A. (8) complete hard-copies(and 1 copy on CD) must be delivered by hand or courier to:

Purchasing Services Branch
c/o 2nd Floor 563 Superior Street
Victoria, B.C. V8V 1T7
Attention: Norman Helewa

Proposal envelopes should be clearly marked with the name and address of the Proponent, the Request for Proposals number, and the project or program title.

PROPONENTS' MEETING:

☐ A Proponents' meeting **will** be held at:

Auditorium A &B - Basement *1515 Blanshard Street,* *Victoria, BC* *V8W 3C8* *From 1:00 pm – 3:00 pm PST on Friday July 13, 2012.*	Note: A summary of questions and responses will be posted on the BC Bid Website. Attendance is optional. Oral questions will be allowed at the Proponents' meeting. However, questions of a complex nature, or questions where the Proponent requires anonymity, should be forwarded in writing (via email), prior to Noon PST Wednesday, July 11th, 2012, to the Government Contact person designated above. Please note – There will be no video/teleconferencing for this meeting.

PROPONENT SECTION:

For hard-copy proposals, a person authorized to sign on behalf of the Proponent **must** complete and sign the Proponent Section (below), leaving the rest of this page otherwise unaltered, and include the originally-signed and completed page with the first copy of the proposal. **The enclosed proposal is submitted in response to the above-referenced Request for Proposals, including any addenda. Through submission of this proposal we agree to all of the terms and conditions of the Request for Proposals and agree that any inconsistent provisions in our proposal will be as if not written and do not exist. We have carefully read and examined the Request for Proposals, including the Administrative Section, and have conducted such other investigations as were prudent and reasonable in preparing the proposal. We agree to be bound by statements and representations made in our proposal.**

Signature of Authorized Representative: R Johnson	***Legal Name of Proponent*** *(and Doing Business As Name, if applicable):* SLR Consulting (Canada) Ltd.
Printed Name of Authorized Representative: Richard Johnson	*Address of Proponent:* 200 - 1620 West 8th Avenue Vancouver, BC V6J 1V4
Title: Chief Operating Officer	
Date: August 10, 2012	*Authorized Representative phone, fax or email address (if available):* Ph: 604-742-3886; Fax: 604-738-2508; rjohnson@slrconsulting.com

global environmental solutions

PRICE PROPOSAL FOR:
Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity

Ministry of Health

RFP HL173

10 August 2012
SLR Proposal No.: 201.3830

Closing Date: 10 August 2012 by 2 pm

Contact Information

SLR Consulting (Canada) Ltd.
#200 – 1620 West 8th Avenue
Vancouver, BC V6J 1V4
Phone: (604) 738-2500

Richard Johnson, Chief Operating Officer
Email: rjohnson@slrconsulting.com
Phone: 604-742-3886; Fax: 604-738-2508

10 August 2012

Purchasing Services Branch
c/o 2nd Floor 563 Superior Street
Victoria, BC V8V 1T7

Attention: Norman Helewa

Dear Mr. Helewa,

RE: Request for Proposals Number: RFP HL173
Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity - PRICE

Proponent Name:	**SLR Consulting (Canada) Ltd.**		
Contact Information:	Richard Johnson Chief Operating Officer	Phone: E-mail:	604-742-3886 rjohnson@slrconsulting.com
Address:	200 – 1620 West 8th Avenue Vancouver, BC V6J 1V4	Phone: Fax:	604-738-2500 604-738-2508

Please find enclosed a description of the proposed budget and spreadsheet outlining the cost breakdown for this above proposal.

Yours truly,

SLR Consulting (Canada) Ltd.

Richard Johnson
Chief Operating Officer

Enc: Budget description
Budget spreadsheet

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1.0 BUDGET PROPOSAL

SLR's project team provides a wealth of professional expertise that will more than meet the requirements set forth by the BC Ministry of Health's Phase 2 Human Health Risk Assessment. Below is a table showing the roles of the project team and each member's expected role in the HHRA. The table also includes each team member's charge out rate in Canadian funds.

Our proposed budget (Table 1) includes a projected budget based on the requirements in the Ministry's Phase 2 RFP. This proposed budget falls within the guidelines stipulated in the RFP. Workplans and budgetary details will be finalized in conjunction with the Ministry of Health with the award of the project. The detailed budget is attached in Table 2.

Table 1. Budget Summary

Task	Description		Labour	Disbursements
Task 1 -	Identification of Key Risk Assessment Scenarios		$	
Task 2 -	Conceptual Model Development		$	
Task 3 -	Jurisdictional Analysis		$	
Task 4 -	Review of BC Framework		$	
Task 5 -	Compilation of Key Data		$	
Task 6 -	Stakeholder Engagement - Problem Formulation		$	
Task 7 -	Classic HHRA Problem Formulation		$	
Task 8 -	Identification of Data Gaps		$	
Task 9 -	Data collection, review, QA/QC		$	s.21
Task 10 -	HHRA Report		$	
Task 11 -	Holistic RA Context for HHRA		$	
Task 12 -	Stakeholder Engagement - HHRA and Holistic RA		$	
Task 13 -	Probabilistic Risk Mitigation/Management		$	
Task 14 -	Stakeholder Engagement - Risk Mitigation/Management		$	
Subtotals			$	
Disbursement Fee (subs and disbursements)		10%		
Admin Fee (on labour)		5%		
Project Total			**$**	**888,133.05**

For budgetary purposes we made assumptions as follows for travel expenses: 15 person trips from Calgary to Ft St John @ $1000/flight, 6 person trips from Vancouver @ $1000/flight, 6 person trips from Grand Prairie @ $200/trip; total of 90 person-days in northeastern British Columbia with per diem @ $60, accommodation @ 200/night, and car rental @$40/day.

Pages 6 through 11 redacted for the following reasons:
- -
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<<Norman Helewa, Project Manager e-mail: norman.helewa@gov.bc.ca>>

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Date: August 10, 2012	*Authorized Representative phone, fax or email address (if available):* Ph: 604-742-3886; Fax: 604-738-2508; rjohnson@slrconsulting.com

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10 August 2012

Purchasing Services Branch
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V8V 1T7

Attention: Norman Helewa

Dear Mr. Helewa,

RE: Request for Proposals Number: RFP HL173
Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity - PROPOSAL

Proponent Name:	**SLR Consulting (Canada) Ltd.**		
Contact Information:	Richard Johnson Chief Operating Officer	Phone: E-mail:	604-742-3886 rjohnson@slrconsulting.com
Address:	200 – 1620 West 8th Avenue Vancouver, BC V6J 1V4	Phone: Fax:	604-738-2500 604-738-2508

SLR is proud to present a strong managerial and technical team to address your stated service needs for Human Health Risk Assessment.

The attached response will provide evidence of our capacity and capabilities. We look forward to working with you.

Yours truly,

SLR Consulting (Canada) Ltd.

Richard Johnson
Chief Operating Officer

Enc: 8 Hardcopies of the SLR Proposal
1 CD

Our mission is to be the most trusted environmental consultant in Canada.

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Appendices

1.0 WHY CHOSE SLR

SUMMARY OF KEY PROPOSAL FEATURES

Ministry of Health needs to be sure that all aspects of the Human Health Risk Assessment ((HHRA) for the Northeast BC Oil and Gas sector work can be fully and thoroughly addressed by SLR and its partners. SLR Consulting (Canada) Ltd. can readily address all aspects of risk assessment work likely to be encountered. As indicated throughout this proposal, selecting SLR as a partner gives Ministry of Health the following:

A solid risk assessment team that understands classic risk assessment and holistic risk assessment - Our risk assessment group is among the most experienced in Canada. SLR has 2 of only 4 approved professionals qualified to assess sites on behalf of the BC government for both risk-based and standards processes, one of these individuals is our project manager. Our Project Team is a group of highly experienced and respected professionals in the areas of human health risk assessment (HHRA), holistic risk assessment, stakeholder consultation and engagement. We are distinctively qualified to address the central issue of completing the Phase 2 HHRA for the British Columbia Ministry of Health.

Experience in integration of emerging approaches to risk assessment - We are actively developing holistic, integrated risk approaches (Froese and Kapustka) to address increasing stakeholder-based requirements for industries to achieve their social license to operate. Our holistic, integrated approach sets the foundation for scientifically sound environmental assessments (including risk assessments) that meaningfully address stakeholders' concerns while meeting regulatory requirements. Our holistic approach also involves consultation with multiple stakeholders from industry, government and the public in a transparent, facilitated process. In addition, the approach extends to other capitals besides human health in line with current practices in sustainable development.

Experience in risk-based remedial solutions - We are able to provide our clients with remedial options that optimize the use of limited resources yet provide lower potential liability to human health and the environment using probabilistic risk based decisions for risk mitigation/management. See our project descriptions and speak to our references.

Contaminated Sites Specialists with all the necessary experience, expertise, and capacity to address all foreseeable risk assessment data requirements- Our consulting business is built on contaminated sites work. Our technical resources in western Canada are second to none. Our team includes several risk assessment specialists (with more than 40 years of directly applicable experience), seasoned field personnel who have the technical know-how to sample all of the potentially contaminated media while comfortably working in remote areas under difficult conditions, and project managers to keep the project on track.

Expertise on oil and gas sites - Our team members are ideally suited to this project. They all have directly applicable experience and they are backed by a readily available array of technical specialists who assess and provide advice on all types of exposure pathways and media every day.

Assurance that schedules and Ministry of Health interests will be kept front and centre – SLR's ability to manage and deliver an appropriate product in a timely fashion is evidenced by repeat inclusion on major oil and gas service providers' preferred suppliers lists and top rankings on Standing Offers for entities such as Public Works, Indian and Northern Affairs, DFO, and BC Ministry of Agriculture and Lands. SLR is an approved consultant for the BC MOE, several major Canadian companies such as Canadian Tire, Bentall, various cities and districts, most financial institutions, and numerous major land developers. Evidence of our ability to address contaminated sites issues is our recent selection as the contaminated sites specialist consultant for the major Port Mann Bridge and Highway 1 project in BC.

SLR is committed to providing Ministry of Health the required resources for all aspects of the assignment, including reporting and report review, so that we will meet mutually agreed deadlines. We will maintain clear and regular communication to keep you informed of all key project aspects.

Regulatory Acceptance - We have completed several risk assessments for federal agencies such as DFO and PWGSC. In BC, with a stringent regulatory regime, in recent years we have obtained over 60 Certificates of Compliance, 15 **Risk-Based Certificates**, 10 Approval-in-Principles, 10 Determinations, 4 Soil Relocations Agreements, as well as 5 Certificates of Compliance and 7 Determinations through the MOE process.

Experience in probabilistic risk-based mitigation and management solutions - We are able to provided our clients with mitigation and management options that optimize the use of limited resources yet provide lower potential liability to human health and the environment using risk based decisions.

2.0 SOLUTIONS AND APPROACH

We have assembled a team of specialists for this proposed project that individually and collectively are experienced in working on complex risk assessment projects that benefit from multi-disciplinary and trans-disciplinary approaches. While bringing highly specialized knowledge of individual components needed to meet the Ministry of Health's goals and objectives, the SLR Team members are accustomed to working outside of the confines of their disciplines in a manner that bridges the areas between disciplines; an approach that is needed to achieve a systems perspective that looks at interactions among the societal and ecological features of the project area that in essence are the determinants of health and community wellbeing.

In the following subsections we reflect the project goals and objectives that were provided in the Request for Proposal (RFP). We follow this with an overview of the holistic approach that we and others have been developing over the years in which we adopt definitions of human health that go beyond the mere consideration of chemical exposure assessment. This is followed by detailed descriptions of the procedures our Team will undertake to accomplish the human health risk assessment to meet the objectives of the project.

2.1 Project Goals and Objectives

The goal of the proposed work is to provide the Ministry an assessment of the public health risks resulting from the oil and gas industry in northeastern British Columbia and to provide appropriate recommendations about ways to address the identified risks.

Our proposal addresses the objectives of:

1. Reviewing the significant concerns identified by stakeholders in Phase 1 and determine if the concerns can be addressed using human health risk assessment methods;

2. Evaluate existing institutional mitigation requirements that might be effective in addressing identified risks; and

3. Assist the Ministry in identifying ways to improve public health outcomes and manage significant health risks related to the oil and gas activities of the region by producing focused reports and deliverables.

Our proposed approach detailed in the next subsections is designed to meet these objectives through the application of emerging best practices for risk assessment drawn from multiple jurisdictions. In particular, our approach connects with the expressed concerns of stakeholders (Kapustka et al., 2010). This is because we embrace the Health Canada (2001) and World Health Organization (1946, 2010) perspective of well-being, which arises from a balance of physical, social, and spiritual determinants of health. Finally, we are committed to effective public communication that bridges the divide that can occur between the regulators and the general public – our reports will contain both the technical detail required by practitioners and the common language that is understandable and accessible by decision-makers and the general public.

2.2 SLR Approach

The task of performing the human health risk assessment for oil & gas activity in Northeast BC is necessarily complex. As per Section 1 of the RFP, the risk assessment must take the following elements into account:

- Multiple exposure pathways: Air Quality, Water Quantity, Water Quality, Land Quality, Food Quality;
- Multiple types of hazard incidents: Sudden Releases of Fluids, Slow Releases of Fluids, Increased Road Traffic;
- Multi-faceted provincial institutional framework: Monitoring, regulatory compliance, emergency response planning, tracking and reporting; and
- Multiple industrial activities: Exploration, drilling, chemical processing, wells, pipelines and other transportation.

In addition there will be other elements which will be identified through the risk assessment process itself.

SLR proposes to address the complexity of the assessment of human health risks and risk mitigation by integrating three different approaches to risk assessment. The three different risk assessment approaches are:

- Classic human health risk assessment (Section 2.2.1);
- Holistic risk assessment (Section 2.2.2); and
- Probabilistic risk assessment – risk mitigation and risk management (Section 2.2.3).

The key tasks to achieve the goals are:

1. Identification of Key Risk Assessment Scenarios Raised by Community Concerns.

2. Preliminary Conceptual Model development

3. Jurisdictional Analysis.

4. Review of BC Statutory, regulatory and policy framework.

5. Compilation of Key Data for Exposure Assessment from current studies, databases, and other sources, including industry.

6. Stakeholder Engagement for Framework (Classic HHRA Problem Formulation, Holistic RA framework discussion) / Conceptual Model development

7. Preparation of the Classic HHRA Problem Formulation.

8. Identification of Data Gaps

9. Collection of Additional Information related to Data Gaps.

10. Completion of Classic HHRA

11. Holistic RA Context for HHRA

12. Stakeholder Engagement for HHRA and Holistic RA

13. Probabilistic Risk Mitigation/Management related to risks identified in HHRA.

14. Stakeholder Engagement for Risk Mitigation/Management.

2.2.1 Classic Human Health Risk Assessment

The HHRA will incorporate four phases: problem formulation, exposure assessment, effects assessment (also called the toxicity assessment), risk characterization and uncertainty analysis as outlined in following sections.

Each of the above components of the assessment is discussed in detail below.

Problem Formulation

The problem formulation phase will develop an understanding of the existing regional conditions and use this understanding to identify components that should be the focus of the risk assessment. This phase will identify chemicals of potential concern, receptors of concern and/or receptor populations and exposure pathways resulting in refining a conceptual model for the region. The problem formulation phase will consist of the following:

- All media (e.g. soil, groundwater) chemistry results will be compiled and collectively reviewed. Chemicals in excess of the applicable regulatory standards will be evaluated as chemicals of potential concern (COPCs) in the applicable media. Screening the chemicals that exceed the CCME generic and matrix standards both for human and ecological receptors;
- A regional reconnaissance focusing on the identification of receptors, pathways and impacts;
- Evaluation human receptor populations to include exposure through dermal, oral, or inhalation pathways;
- Evaluation of ecological receptor exposure pathways (for modelling food consumption) such as direct contact; and
- Iteration and refinement of the preliminary conceptual model for human receptors representing the potentially complete risk scenarios.

The problem formulation will identify potential human receptors of concern in the region and the pathways by which the receptors may be exposed to the identified COPCs.

Exposure Assessment

This component of the risk assessment will be conducted to determine exposure point concentrations and to quantify chemical intakes for the complete exposure pathways identified for each of the receptor groups. Contaminant concentrations in surface soil, sediment, surface water, vapour and groundwater will be included and used to estimate exposure concentration to selected receptors. The human health exposure assessment phase consists of quantifying the exposure to the receptor populations using the environmental effects concentration value for each chemical. The frequency of exposure, quantity of chemical and type of activity during

exposure are all used to help quantify the exposure by calculation of the chemical dose. Non-cancer and cancer intake doses will be quantified using Health Canada (2004) intake equations.

Toxicity Assessment

Human health effects assessment will use published Health Canada and EPA references to quantify the effect of each chemical dose. Different criteria are used for carcinogens (slope factors) and non-carcinogens (reference doses).

The Toxicity Assessment component of the risk assessment, consisting of an extensive review of various literature sources, will be conducted for the identified COPCs. Toxicity reference values for the COPCs will be determined.

Risk Characterization

Risk Characterization will be conducted to estimate risks to potential human and ecological receptors posed by the presence of the COPCs in the environmental media at the Site.

Risks to human receptors will be quantified by combining the exposure intakes estimated in the exposure assessment for complete exposure pathways with the toxicity reference values compiled in the toxicity assessment. Risk estimates will be compared to CCME criteria to determine if the COPCs pose a threat to human health. Human health hazard quotients and incremental lifetime cancer risks will be calculated for separate and combined exposure pathways. These will be compared to Health Canada's benchmark levels of HQ $\leq$ 0.2 and ILCR $\leq$ 1E-05.

Uncertainties will be discussed focussing on the major assumptions that could affect the risk assessment conclusions and will note the areas of greatest uncertainty.

2.2.2 Holistic Risk Assessment

Systems perspectives inform us that societies and ecological systems are interconnected and dynamic. Expanding the context for the way classic risk assessments are done with elements of holistic (or integrated) risk assessment adds value specifically in addressing the concern of stakeholders.

An integrated assessment process provides the technical consistency needed to align the focus of the assessment with the concerns of stakeholders. This approach requires constructive, iterative dialogue among stakeholders to identify the entities they value and to reach consensus regarding how the status and risks to those entities will be evaluated.

The approach SLR is proposing to meet the goals and objectives of the Ministry has been developed to combine the elements of Problem Formulation of a classic risk assessment (Section 2.2.1) with those of an integrated risk assessment such that additional features of Problem Formulation will include:

- Identifying the concerns of stakeholders;
- Create a project-specific conceptual model;
- Explicitly stating what is to be assessed;
- Identify what is to be measured so that an assessment can be made;

- Defining the quality of data required to reach a meaningful assessment;
- Detailing the analysis needed to evaluate the information; and
- Establishing the processes that ensure the quality of the assessment.

We understand that in Phase 1 of this project key stakeholders were engaged in the process to identify their concerns. The stakeholders included local communities, local and regional governments, first nations, non-government organizations, regulators (BC Oil and Gas Commission (OGC)), ministry representatives (Ministry of Health, Ministry of Energy and Mines, Ministry of the Environment, Ministry of Forests, Lands and Natural Resource Operations and Ministry of Aboriginal Relations and Reconciliation), Northern Health Authority, the oil and gas industry, and the general public.

We will develop a stakeholder map consistent with the guidance offered in the ASTM Standard (E2348) on Consensus Based Environmental Decision-making (ASTM 2010) to illustrate interrelationships and to build on the stakeholder engagement work completed by The Fraser Basin Council in Phase 1. We will extend the stakeholder engagement work as needed and revisit contacts already engaged in Phase 1 as a means of creating a project-specific conceptual model for Phase 2, the HHRA.

The conceptual site model obtained using the approach of classic human risk assessment will be refined using pictorial and narrative descriptions of how the project (in this case the broad aspects of the oil and gas industrial activity) fits within the social and ecological landscapes of the area. The conceptual site model will be used as a tool for effective communication with stakeholders and will guide the next phase of the risk assessment (e.g., exposure assessment, toxicity assessment). The conceptual model represents an agreed representation of how the project fits within the ecological and social landscapes and it highlights linkages between oil and gas related activities and the various concerns identified by stakeholders.

This proposed approach shifts away from narrowly focused approaches that ignore the interrelationships that are central to the dynamics of human interactions among different groups and with their environment. In short, we create a dynamic conceptual model that informs the remainder of work for risk assessment that respects the dynamic aspects of community and ecological processes that contribute to human health and community wellness.

While we are not proposing to complete a holistic risk assessment for this project, using principles of holistic assessment combined with the classical risk assessment will allow for the assessment to be performed in a manner that reflects the complexity of the ecological and societal setting and explicitly addresses the goals and objectives of the Ministry based on stakeholder participation. Additional information on Holistic Risk Assessment is in Appendix A.

2.2.3 Probabilistic Risk Assessment - Risk Mitigation/Management Framework

Probabilistic risk assessment will be used in two areas: to develop exposure estimates and to develop the risk mitigation and management framework.

Classical risk assessment uses single values or “point estimates” of specific parameters (i.e., concentration in a medium, amount of medium breathed, etc.) to generate a single estimate of exposure and risk based on various assumptions. Health Canada’s guidance document on screening risk assessment mentions that determinist risk assessment identifying risks that exceed acceptable level(s) recommended by regulatory agencies may not reflect a true

exceedance of acceptable risk, but rather point to the need for a more detailed risk assessment using a probabilistic approach. Probabilistic approaches take into account all available information considering the probability of their occurrence and express the risk as a distribution of values, with a probability assigned to each value.

A probabilistic approach may be used to refine the exposure analysis based on the quality of the data available (e.g. ambient air quality, sediment quality, vegetation quality) and/or on the results of the risk characterization. Incorporating probabilistic risk assessment methods will increase realism and reduce the uncertainties associated with the classic risk assessment.

The mitigation/management framework contextualizes risk analysis into a wider context. SLR's approach will be carried out in 3 stages. Stage 1 is concerned with identification of risk scenarios with a view of established risk endpoints determined by the HHRA. The outcomes of Stage 1 will be a documented set of risks scenarios, a risk register and a set of risk matrices. Stage 2 is concerned with a more detailed analysis and evaluation of the most significant set of risks identified from Stage 1. The output of Stage 2 includes a set of probabilities and consequences associated with each significant risk and a set of risk mitigation/management measures with recommendations for improving public health outcomes. Finally, Stage 3 relates the findings from the previous two stages and compares these outcomes with current environmental management practices of the BC government and other jurisdictions in order to determine where these practices could be enhanced in order to manage human health risk for oil and gas development in northeast British Columbia. Additional information on this framework is in Appendix B.

2.3 Project Risk Management Strategy

The key to effective Project Management of this project will be management of a large quantity of information and efficiency in delivering this effectively. The project manager will manage the scope of work and be the main point-of-contact for MOH throughout the work program.

Regularly scheduled communication via email, telephone, or other medium between CCSP and SLR throughout the duration of the project will form the basis of ensuring that project scope and budgets are managed and controlled.

A typical Project Life cycle consists of: pre-project activities; project implementation; and post-project activities. During each project phase there are a number of areas that must be addressed in order to mitigate potential risk. SLR has developed the following project management checklist to ensure that key project requirements are completed. This is a preliminary list only and will be adapted and changed as the project develops.

Pre-Project Activities:	Project Implementation:	Post-Project Activities:
☐ Site Visit	☐ Project Team Orientation	☐ Budget vs. Actual Review
☐ Budget Review	☐ Health & Safety Tailgate Meeting	☐ Project Evaluation
☐ Project Scheduling	☐ Project Scheduling & Deliverables	☐ Project Closure Report
☐ Project Planning	☐ Budget vs. Actual Review	☐ Final Invoicing & Project Closure
☐ Communication Plan	☐ Scope Changes	☐ Client Feedback
☐ Project Team Selection	☐ Scope Changes Authorization	☐ Post Project Assessment
☐ Sub-Contractors Selection (SCM)	☐ QA/QC	☐ Future Work Programs
☐ Health & Safety Plan	☐ Interim Progress Report	☐ Other
☐ SLR Contract Initiation	☐ Client Feedback	
☐ Authorization to Proceed	☐ Progress Billing	
☐ Project/Job Set-up	☐ Meetings & Discussions	
☐ Permits & Approvals	☐ Other	
☐ Other		

Risk analysis is a process of identifying, analyzing, and responding to project risks. The goal of successful risk management is to resolve the risks before they occur. It also must be balanced within the goals of the project, budget constraints, and the objectives of CCSP.

Risk analysis is not an individual responsibility but is the responsibility of the overall project team and the project proponents. At each phase of the project, a project team meeting will be conducted to discuss potential environmental risks, engineering risks, and Health and Safety risks.

Potential areas that will require ongoing risk analysis will be:

1. Changes in project scope if unforeseen subsurface conditions and contaminants are identified.

2. Changes in contractor plan.

3. Potential changes in the Provincial regulatory standards over the term of the project.

4. Soil and sediment transportation issues.

5. Laboratory Turn-Around-Time issues.

6. Changes in the soil receiving site requirements.

7. Technical hurdles.

SLR's team of technical experts will be consulted for any human health risk assessment issues..Upon the award of a project, SLR will organize a kick-off meeting that will include all parties involved with the project. The goal of the meeting would be to assess the proposed work schedule, review the project milestones, and ensure that all parties involved understand everyone's roles, schedule, and objectives. Potential project risks will be evaluated at this stage of the project. Following the meeting, SLR will revise the project schedule as necessary and include mutually acceptable milestones.

A communications plan will be developed between the SLR project team and the rest of the project proponents. At minimum this will outline requirements for information exchange between any contractors and the environmental team. The communication plan will act as a binding agreement and will compel all project proponents to carry through with deliverables and allow everyone the opportunity to provide input. The communication plan assures that all opportunities/disadvantages are identified; helps keep communication focussed, and prevents unwanted surprises. It also sets up a system for documenting changes in scope.

The SLR project team has been organized so that communication flows from the field staff to the project manager in an efficient and meaningful manner. The project manager will be the main point of contact for MOH. The project manager will draw on the knowledge of the senior technical experts.

3.0 WORKPLAN

The Workplan is detailed according to the Key Tasks. The schedule is shown in Figure 1.

3.1 Key Tasks

The Workplan to complete the key tasks are described below.

Task 1 - Identification of Key Risk Assessment Scenarios Raised in Ministry of Health HHRA Phase 1.

Complete evaluation of the Phase 1 report and Compendium of Stakeholder concerns is required to develop an overall perspective of the concerns of community stakeholders regarding oil and gas activities in the region. Stakeholders were asked for input regarding their concerns: those now need to be put into context within an HHRA framework.

Concurrent task - Form Stakeholder Committee

Stakeholder consultation was initiated in Phase 1 of the Ministry's HHRA. It is very important to continue the engagement throughout Phase 2. This ensures a transparent process in setting out the terms of the detailed HHRA. Forming a Stakeholder Committee adheres to the Consensus Based Environmental Decision-making process in which stakeholders (broadly defined as community members, First Nations, Metis, government, regulatory, non-government) are partners in environmental management decision-making processes.

Task 2 - Preliminary Conceptual Model development

This conceptual model is a representation of the oil and gas activities in relation to the ecological, social, and geographical setting in the region of Northeast British Columbia. The model may be pictorial, schematic, flow-chart, or any combination of these that allows the stakeholders to create a common mental model of the issues of concern. The preliminary development of the conceptual model is important at the outset of Phase 2 as it 1) establishes the context for the role of the stakeholder committee, and 2) it helps focus the project team in beginning the jurisdictional analysis and regulatory review. The Key Risk Assessment Scenarios from Task 1 will be addressed and put into context via the preliminary conceptual model.

Task 3 - Jurisdictional Analysis.

The jurisdictional scan report is essentially a review of other studies on human health issues from oil and gas activities. A multi-pronged approach to this analysis will be required to ensure thoroughness while remaining focused on relevant issues. A strategy for identifying and prioritizing studies and reports will be developed prior to embarking on the analysis.

Task 4 - Review of BC Statutory, regulatory and policy framework.

This review provides context for the current oil and gas activities in the region. If the review is structured in the context of the regional conceptual model, it is possible that gaps in the statutory, regulatory and policy framework can be understood and evaluated, with the intention of improving the frameworks toward healthier public policy.

Task 5 - Compilation of Key Data for Exposure Assessment from current studies, databases, and other sources, including industry.

The conceptual model will identify issues of concern that will be associated with specific exposure pathways and scenarios. We can begin compiling data for the Classic HHRA approach from existing sources. Tasks 6 and 7 must be completed in parallel with the existing data compilation, because the tasks inform each other – we don't necessarily know which data we need unless we know what we have, and we don't know whether the data we have is appropriate until we evaluate how we will use it.

Participating organizations and other parts of government have considerable data that is available for exposure analysis. However, the availability, quality, resolution and currency of data for items vary throughout the Province. Appendix C lists various data sources for review.

SLR will contact Ministry of Health and partner Ministries/Organizations (MoE, MEM, OGC, NHA) for further discussions with regard to data requirements and the specific availability of the data.

Task 6 - Stakeholder Engagement for Framework (Classic HHRA Problem Formulation, Holistic RA framework discussion) / Conceptual Model development

A workshop-based activity in which the framework for the risk assessment activities is constructed. The conceptual model needs to be revisited and refined with sufficient detail to explicitly state the key human health issues that will be addressed. Very important for stakeholder committee involvement at this stage to begin to understand the context developed from Tasks 3, 4 and 5.

<u>Define terms of reference for HHRA in context of Holistic framework</u>

This puts the specific pathways we will examine in the HHRA in the context of the five capitals of the holistic framework (Appendix A, Figure 1). By doing this together with the Stakeholder committee, it ensures there will be no surprises in exactly what will be addressed in the HHRA, and that other concerns (for example, traffic) are not un-important, but that they are outside of the scope of this particular Ministry study.

Task 7 - Preparation of the Classic HHRA Problem Formulation.

Here we follow the guidance as outlined in Health Canada and Environment Canada to ensure we are approaching the HHRA in a predictable and defensible manner. The Problem Formulation guides the team through formal screening exercises to evaluate whether specific receptors, pathways, and chemical contaminants will be retained for evaluation in the HHRA.

<u>Include refining Conceptual Model</u>

Once again, iterating the conceptual model is important at this stage. It may appear redundant, and it may not require great effort to accomplish, however, it is important to re-ground the assessment team to the same mental picture of the human health issues in the regional context and what exactly we are addressing.

Task 8 - Identification of Data Gaps

Completion of Tasks 5 through 7 will inform the team on which areas of the HHRA assessment lack sufficient data, or data of appropriate quality, to carry out the assessment. A thorough evaluation of the data needs for each exposure scenario that is carried through the Problem Formulation is required to evaluate whether sufficient data is already in-hand.

Task 9 - Collection of Additional Information related to Data Gaps.

The team will need to assess the available options for addressing data gaps. Options include targeted collection of field data and modelling methods to generate simulated data to fill certain requirements. A Data Quality Assurance plan will be developed to guide any data collection or modelling efforts to ensure that any new data would fulfil requirements.

Task 10 - Completion of Classic HHRA

The classic HHRA is comprised of exposure assessment, toxicity assessment, and risk characterization. Depending on the HHRA terms of reference from Task 6 and the outcome of the Problem Formulation and data evaluations, the assessment team will evaluate the best approaches for doing these calculations: deterministic or probabilistic approaches will be considered.

Task 11 - Holistic RA Context for HHRA

It is very important to continue to bring the context of the HHRA back into the overall perspective of the five capitals of community wellbeing. Once again, the conceptual model allows the HHRA results to be reported in the context that the stakeholder committee and assessment team developed. Deliberately bringing the results back into the context of that model is a fundamental aspect of the holistic approach.

Task 12 - Stakeholder Engagement for HHRA and Holistic RA

Workshop format discussion with stakeholder committee to discuss results from the HHRA, including a discussion of recommendations. Task 12 will lead into defining the basis for Task 13: for those issues that show unacceptable risks or risk ranges, evaluation of the causes of those risks can inform policy development toward mitigating the risks.

Task 13- Probabilistic Risk Mitigation/Management related to risks identified in HHRA.

Variations of cause-consequence assessment can be used to evaluate specific scenarios from the HHRA. There are a number of modeling approaches that may be possible, therefore, a team-based analysis will be required to evaluate the viability of each approach. The outcome anticipated for this task is to generate a contextual analysis within the holistic framework that can be used to inform policies that are practicable, meaningful to stakeholders, and protective of public health.

Task 14 - Stakeholder Engagement for Risk Mitigation/Management.

Discussion with stakeholder committee to evaluate the results of the risk mitigation and management evaluation. The stakeholder committee is the first round of dialogue towards

developing meaningful policy in the region. Ultimately, the continued engagement of the stakeholder committee through each of these activities is the foundation of the holistic approach to environmental management and community wellbeing.

3.2 Deliverables

As described in our detailed methodology above, and within the overall context of an integrated approach to the risks to human health from the oil and gas industry, SLR will focus on the primary pathways of exposure (air quality, water quality and quantity, land and food quality), risks posed through environmental issues and events such as incidents, fluid releases and increased traffic with regard to possible impacts on health via the identified pathways, and the Province's institutional framework (monitoring and compliance, regulation and enforcement, communication, emergency response planning and tracking and reporting) with respect to oil and gas operational issues (exploration and drilling, processing, wells and pipelines and transportation and traffic).

As outlined in Section 3.2.1 of the Ministry of Health RFP, SLR will provide deliverables in this Phase 2 of the HHRA as follows:

- The SLR team will provide a **jurisdictional scan report** of past and current studies and reports related to human health risk in relation to oil and gas activity in northeastern British Columbia, and will provide details on the context for these studies and reports within SLR's overall holistic integrated framework. We will undertake the review immediately upon award of the contract, as we expect the review to provide significant information and guidance for developing the detailed approach to the HHRA;

- SLR will describe the final approach used for the HHRA and supporting rationale for its development. The approach will be informed by the jurisdictional review, by methods and procedures from similar studies (e.g. WISSA 2006), by facilitated workshops with stakeholders (industry, government, community groups, etc) and by the SLR team professional input. The HHRA will be inclusive of the significant public health risks identified and documented in the Phase 1 report, related to air, water, land and food. SLR will use the human health risk assessment framework as described in Section 2.3.1 to carry out and complete the risk assessments and the human health risk assessment;

- SLR will provide detailed HHRA reports, classic and holistic, based on our detailed framework and workplan;

- SLR will review BC statutory, regulatory and policy frameworks that protect the health of the population, and as appropriate will develop recommendations that may improve the protection of human health in northeastern BC. The report will a) identify where current statutes, regulations and policies are sufficient or exceed the necessary level for managing human health risk; b) identify gaps where statutes, regulations and policies do not currently exist for managing human health risk and c) identify where current statutes, regulations and policies may benefit from a change to enable improved management of human health risks with respect to oil and gas activities*;*

- SLR will provide a report detailing recommendations that come out of the risk analysis and subsequent HHRA as described in Sections 2.2.2 and 2.2.3. A gap analysis at the

end of the HHRA will be instrumental for recommendations of data needs to improve efforts to monitor and manage the health of the population in northeastern BC; and

- As described throughout this proposal, stakeholder engagement will take a significant role in SLR's approach to addressing human health impacts due to oil and gas activities in NE British Columbia. All stakeholder engagement activities will be recorded and memorandum summarizing the findings of each stakeholder meeting will be completed.

3.3 Summary of Work Plan

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4.0 STAKEHOLDER AND COMMUNICATIONS PLAN

As part of the ongoing study and further to the input and feedback from various stakeholder groups collected in Phase 1, SLR recognizes the importance of and interest expressed for continued stakeholder involvement going forward into Phase 2 of the study for the purpose of showing transparency and aligning process with expectations.

In conjunction with the human health risk assessment and comprehensive scientific review of evidence, SLR intends to engage key stakeholders in a brainstorming workshop to prioritize concerns, identify activities required for collecting results and partner with them in the process of collecting the results. Subsequent sessions may need to be held for the sake of follow up and reporting as part of the overall process so stakeholders are engaged and informed throughout the process to ensure that expectations are aligned with the outcomes produced from the study.

4.1 Stakeholder Committee

A stakeholder committee using the CBED model will be created for Phase 2 of the study to ensure that representation from the various key stakeholder groups have ongoing involvement as the study proceeds. Part of the creation of this committee would include a review of those who were engaged or involved in Phase 1 and defining criteria to ensure that representation was balanced and inclusive. A terms of reference for the committee will be drafted at the outset of committee development to define their specific role and expectations in this project phase. We anticipate initially that the role of the committee would be to provide feedback on various components of the study, input into the process and communicate progress back to their counterparts.

Key stakeholder groups would include local communities, local and regional governments, First Nations, Métis, landowners, non-government organizations, regulators (BC Oil and Gas Commission (OGC)), ministry representatives (Ministry of Health, Ministry of Energy and Mines, Ministry of the Environment, Ministry of Forests, Lands and Natural Resource Operations and Ministry of Aboriginal Relations and Reconciliation), Northern Health Authority, the oil and gas industry, and the general public.

For purpose of Phase 2, we would expect that the committee would be involved in meetings between 2-4 times as part of the engagement process.

4.2 Communication Plan

Table 2 outlines the communication plan for this project.

Table 2. Communication Plan

Proponent	Activity	Communication Method
SLR	Establishing detailed contacts list of Ministry of Health (MOH), Oil and Gas firms, stakeholders, partners, team members	Email, telephone and corporate address
SLR	Distributing contacts list	Email or post as preferred
SLR, MOH, Stakeholder Engagement Team	Establish a bi-monthly schedule for project updates to the MOH, establish schedule and communication method for communicating project progress to stakeholders	Email, preferred method of communication
SLR	Document project meetings	Email or preferred
SLR; Stakeholder Engagement Team	Engage stakeholders and establish schedule for stakeholder workshop and risk assessment exercises	Email, telephone, post. Central venue for workshops
SLR, Stakeholder engagement Team	Communicate project workplans and project progress to stakeholders	Preferred method of communication
SLR, Stakeholder Engagement Team	Communicate all stakeholder activities, meetings, interviews, open houses, workshops or other activities to all stakeholders	Preferred method of communication
SLR	Final Reporting	Hard copies, digital copies. Preferred method of communication, publication of final reports on Ministry website and other Government of BC venues.
SLR	Contacts updates	Email, preferred method of communication

The SLR management team will manage the communication to the Ministry of Health, partners and subcontractors and stakeholders centrally.

A master list of MOH, industry firms, partners and subcontractors, stakeholders and team members will be created and maintained by SLR. This list will be made available to all relevant parties and will be available and distributed upon request. The goal with the contact list is to ensure that there is transparency of participants, of team members and affected stakeholders. Contact information including email addresses, phone numbers and cell phone numbers will be included as well as the preferred method of receiving information from the project team (especially for stakeholders). Updates to the contact list (additional stakeholders, amendments to project team, etc.) will be managed by SLR and communicated in a timely manner to the full distribution list.[1]

A regular schedule of progress reports will be drawn up by the management team and the Ministry of Health, as well as a distribution list for those progress reports and the preferred method of receiving progress reports. Project reports would include updates to the project, changes to workplans, project team members, progress on data collection, analysis, reporting and budget reporting. Meetings for the project or stakeholder engagement activities will be documented and minutes will be distributed in a timely manner. The progress reports will be issued to the appropriate parties according to the schedule.

Stakeholder engagement activities will be scheduled early in the project and will be communicated regularly through preferred channels to stakeholders. Every effort will be made to ensure that any meetings, open houses, interviews or workshops will be held in a central and accessible location for most stakeholders. Documentation of stakeholder engagement activities and outcomes will be sent out to all members on the distribution list and will be made available upon request. In addition information requests, information received (e.g. letters) etc., will be tracked in a log to ensure follow up and commitments are met and relationships maintained.

The format of the final project deliverables will be determined with the award of the project and the publication and distribution of hard and electronic copies will be made available to the distribution list and the general public.

[1] Privacy Act issues will be taken into consideration in development of any distribution lists.

5.0 QUALIFICATIONS AND EXPERIENCE

5.1 Corporate Background

SLR Consulting (Canada) Ltd. is a multi-disciplinary consultancy providing worldwide environmental sciences, engineering expertise and high-value advisory services through a network of offices in Canada, the U.K., Australia, New Zealand, South Africa and the USA.

SLR was formed in September 2007 from a corporate merger between SEACOR Environmental Inc. (an 18 office Canadian consultancy since 1991) and SLR Holdings Limited (a U.K. consultancy since 1995 with 16 offices in the UK and 7 offices in the USA).

The head office for Canada is located at 200-1620 West 8th Avenue, Vancouver, BC, VJ6 1V4. Within North America, SLR has 26 offices (18 in Canada / 8 in the US). Our regional centres can deliver our complete range of services. Consistent with SLR's "one company" philosophy, staff knowledge sharing and international collaboration facilitate our global services. We draw on the required expertise wherever it may lie within the company to solve specific local technical issues.

SLR is organized along business sector and technical discipline lines so that we have both the market sector understanding and technical expertise to provide in depth, on point consulting services. SLR provides the following specialized services in the oil and gas sector:

- Exploration process and strategy (e.g., geology, capital allocation, play fairway, prospect evaluation)
- Acoustic and vibration monitoring, modeling, and consulting
- Hydrology and hydrogeology
- Air permitting, compliance, and emissions management
- Ambient air and meteorological monitoring
- Compliance management and environmental field operations
- Environmental impact assessment
- **Human health risk assessment**
- Oil spill prevention and response planning
- Project permitting
- Project Management
- Safety and environmental management systems
- Site remediation and restoration
- Social engagement and stakeholder relations
- Waste management strategy, technology and modeling services
- Water and wastewater treatment and compliance.

In addition to the above technical services, SLR has developed a structured social engagement approach, based on social science principles, to assist proponent in the oil and gas sector in securing and maintaining a social licence to operate. The approach developed by SLR is based on these fundamentals:

- Social engagement involves listening to stakeholders. This often means modifying project design to accommodate local concerns
- Early engagement is critical to a successful project outcome. It is difficult to change a project if stakeholder comments are received after design decisions have been made
- Holistic approach to the environment, society, and petrotechnical analysis. This approach allows field development decisions to be informed by the demands of society and the environment

We help proponents to be authentic in dealings with the public. Risks are identified and supported with explanations as to what actions are being taken to reduce the risk and mitigate any potential impacts.

5.2 Risk Assessment and Toxicity Division

SLR's North American Risk Assessment and Toxicology division (RA Group) consists of twelve individuals located in Calgary, Victoria, Vancouver, and in the states of California, Oregon and Washington. Individuals in the RA Group have a wide range of degrees in toxicology, chemistry, biology, soil science, pharmacology, zoology, ecology and environmental engineering. The RA Group maintains numerous professional affiliations with organizations such as the Society for Risk Analysis (SRA), the Society of Environmental Toxicology and Chemistry (SETAC), and the Society of Toxicology (SOT). Two of the Canadian Risk Group members are Approved Professionals for Risk Assessment and Standards Assessment on the BC Ministry of Environment's (BC MOE) Roster of Approved Professionals, presently a list of nine individuals with the credentials to prepare or review contaminated site investigations and risk assessments and make decisions/recommendations regarding the adequacy of remediation to BCMOE.

The group has more than 100 years combined experience in conducting human health risk assessments, as well as in the development of risk management plans. As part of a full-service consulting company, the RA Group has the support of the diverse talent pool of environmental professionals who augment our services in areas such as site characterization, vapour intrusion modeling and hydrogeological modeling to predict contaminant transport, and remedial design.

SLR has been providing risk assessment services to our Canadian clients since the early 1990's, when risk assessment began to be recognized as a remedial approach in Canada. We have conducted risk assessments across the country on behalf of industry, municipal and federal government agencies, and utility companies. Regulatory review and approval (federal and provincial) of numerous risk assessments has been conducted, including by Health Canada, Environment Canada, BCMOE, the Ontario Ministry of Environment, Alberta Environment, Manitoba Conservation, the Saskatchewan Ministry of Environment and Nova Scotia Environment.

HHRAs completed by SLR have included assessment of both non-carcinogenic and carcinogenic substances including metals, organometals, polycyclic aromatic hydrocarbons, volatile organic compounds, petroleum hydrocarbons, perfluorinated alkyl compounds,

polychlorinated biphenyls, dioxins and furans, pesticides and herbicides from exposure through multiple media and pathways. The risk assessment group is experienced in all aspects of quantitative human health risk assessment, including Problem Formulation, Exposure Assessment, Toxicity Assessment, Risk Characterization and Uncertainty Analysis. HHRAs have been conducted using both federal and provincial (various provinces) recommended risk assessment methods and guidance, including Health Canada's 2007 and 2009 Preliminary Quantitative Risk Assessment guidance (PQRA), United States Environmental Protection Agency's (USEPAs) Risk Assessment Guidance for Superfund, and various provincially recommended methods. The RA Group has also completed many public health risk assessments which included the development of de novo approach to assess potential risks to public health.

5.3 CMR Consulting Inc.

SLR will engage Critical Management Resources (CMR Consulting Inc.) to supplement our resources for stakeholder engagement. CMR Consulting Inc. develops strategies and provides direction to improve on organizational and corporate performance. CMR Consulting Inc. works closely with clients to understand their unique business challenges and engages in designing and implementing creative solutions. Along with numerous strategic, management and communications services, they provide highly qualified and respected leadership in Active Stakeholder Engagement - the process of relationship management by involving people who may be affected by the decisions of an organization. The process strives to align mutual interests, reduce risk, and advance economic, social and environmental performance. http://cmrconsulting.ca/home/

5.4 Green Analysis Ltd.

SLR will engage Dr. Andrew McGoey-Smith to supplement our resources for probabilistic risk mitigation/management. Green Analysis Ltd. is a scientific services company registered in the Province of Alberta. Its sole proprietor is Dr Andrew McGoey-Smith. Green Analysis specializes in provided risk and decision analysis, and simulation modelling solutions to clients in the oil sands, oil and gas, mining, power, Carbon Capture and Sequestration, pipeline and risk management industries. Founded in 2010, Green Analysis has provided solutions to: analysing technical risk for a new oil sands facility in Alberta, public safety risk of a new pipeline for a CO2 Sequestration facility in Saskatchewan, ranking selenium management options in terms of R&D potential for coal mining in the Elk Valley of BC, a public safety risk assessment of a legacy crude oil pipeline in Edmonton, Alberta, analysing water balance requirements for a new oil sands facility in Alberta, and modelling the relative cost of carbon storage for capture, pipeline, enhanced oil recovery and sequestration components for different levels of CO2 purity.

5.5 Project Team and Roles

Dr Ken Froese will be project director and Ms Cindy Ott will be project manager. Dr Froese gained extensive experience as technical risk assessment lead for oil sands EIAs in 2005 through 2007, and was the human health risk assessment expert witness for two regulatory hearings on oil sands projects in 2006. He has been developing, writing, and presenting on the human health aspects of the holistic assessment approach and is a thought leader in the field. Ms Cindy Ott has extensive large-scale project coordination and management experience in HHRAs. She has conducted reviews of policies, regulations and international best practices for the risk assessment and air quality.

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Company's ability to maintain unbiased objectivity in serving its other clients. In instances where potentially conflicting situations may be created, agreements may be entered into if all the parties involved have full knowledge of the potential conflict and consent to the arrangements in advance. The contract will contain a statement documenting that the responsible SLR employee has made the disclosure and obtained the consent from all parties that is necessary. The SLR Conflict of Interest Policy by Corporate Human Resources intended to guide company and employee conduct, is provided in Appendix E.

All employees and contractors of SLR are expected to observe the highest ethical standards in the conduct of Company business and to avoid involvement in any situation (business, social, personal or otherwise) wherein a conflict of interest exists, could exist, or may appear to exist. In spite of this, SLR employees understand that it is in everyone's best interest to conduct assessments in an objective and scientifically-based fashion so that policy can be developed which industry is able to meet, and overall environmental stewardship can be improved.

5.7 Recent Relevant Experience

Project summaries demonstrating SLR requisite experience are provided in Appendix F. SLR and our key personnel named to this project have worked on relevant and similar type projects for much of the last decade, in particular in recent years (Table 5).

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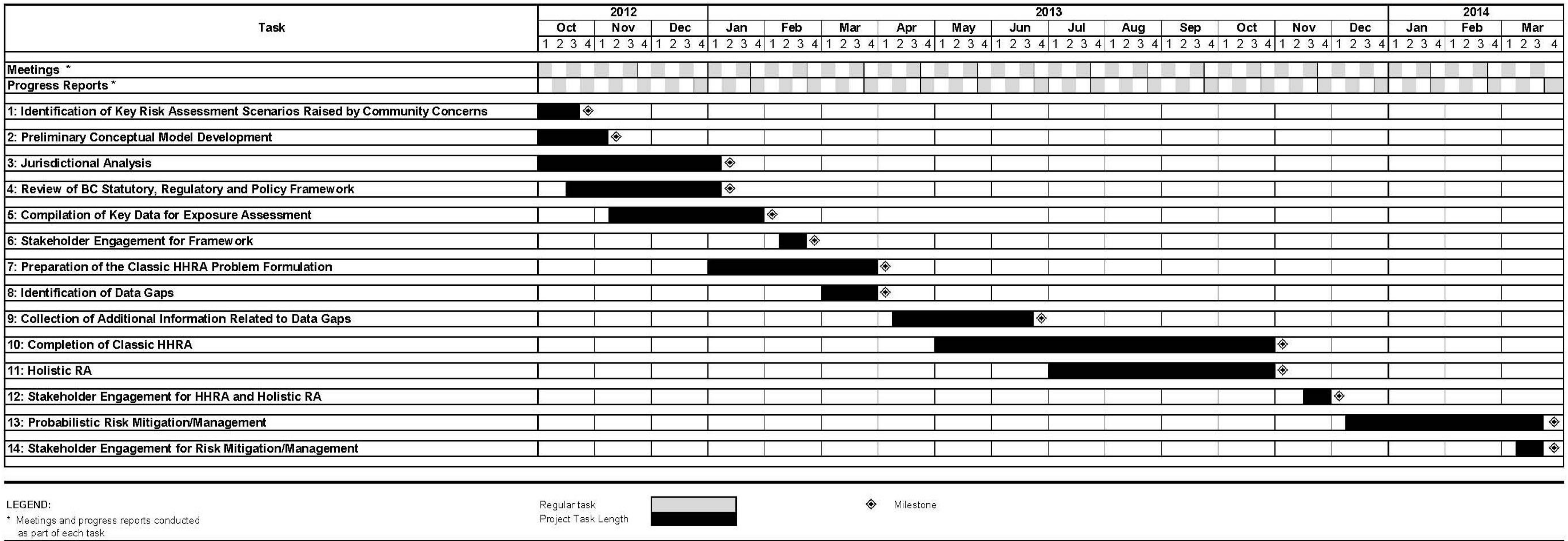
6.0 SCHEDULE

Upon award of this project, the project team will undertake the following activities in addition to bi-weekly project meetings with the Ministry. The proposed schedule is in Figure 1.

Figure 1. Project Schedule

Phase II: Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity



7.0 PROJECT AND QUALITY MANAGEMENT

SLR enforces mandatory quality control on all project work – ranging from initial review of selected investigation options and pricing, through to senior review of report contents. Key components of the project and quality management approach are generally described below.

7.1 Project Management Communication

Weekly email updates to the MOH and monthly progress reports outlining key activities.

SLR Team members or alternates will be available for phone discussion.

Updates from field staff are provided to the SLR Project Manager on a daily basis during field program.

7.2 Cost Control

Day to day cost control and tracking will be monitored with our Deltek Vision accounting system. Deltec Vision provides our Project Managers a robust and flexible tool that is linked directly to our accounting system. These systems allow for up-to-date access to projects in a centralized location and provide on-demand reports, and budgetary items.

SLR Project Manager will review the actual versus estimated and approved costs on a minimum weekly basis.

Potential work not considered part of the defined scope of work will be discussed with the Provincial Health Services Authority immediately. No extra work will be conducted until written approval is granted.

7.3 Quality Assurance

To verify alternative options have been considered, and that selected options are cost effective and feasible, work plans and sampling plans will be reviewed by the SLR Project Manager.

All reports issued by SLR will have senior review by an Approved Professional.

Our rigorous mandatory health & safety procedures will help meet quality requirements.

If field work is performed, field work will be conducted in accordance with SLR's procedures that have been verified as acceptable to the BC MOE. This includes sampling equipment, methodology and frequency of sampling (including duplicate selection etc.).

Any samples collected for analysis will be submitted to the laboratory under appropriate chain-of-custody within prescribed holding time, so that analytical data is not compromised. Blind field duplicate samples will be used to confirm results. Only laboratories with CALA accreditation will be used and they will adhere to standard laboratory QA/QC protocols suitable to the BC MOE.

All correspondence and reporting having senior and peer review, including from staff who are not contributor to the report.

7.4 Develop Detailed Project Plan

Communication with the client Project Manager is included to review scope of work, and discuss issues and results.

Work schedule issued to all team members at the commencement of the project.

Schedule and budget reviewed by a SLR Project Manager once per week.

7.5 Challenges, Modifications and/or Unknowns

Technical and scientific challenges may also arise while completing this risk assessment. These issues relate to the various phases of the risk assessment: Data collection and analysis, exposure assessment, toxicity assessment and risk characterization.

It is anticipated that data will have been collected over long and short periods using a variety of methods and not spatially distributed in an even manner. Chemical analysis methods and detection limits have changed over years and some data may not be available. In identifying the key COPCs and exposure concentrations (point, range, probability), SLR will draw on a combination of statistical methods and expertise in the evolution of chemical analysis methods to critically assess the usability of the data. Reference data will be sought to aid in the selection of COPCs related to oil and gas activity.

During the estimation of exposure, intake values (e.g. ingestion rate, exposure frequency) have a significant effect on the overall outcome of the risk assessment. Based on Phase 1 data, provincial and federal guidance, and other available community-specific data, every effort will be made to customize intake values to accurately represent local populations.

Toxicity information for many chemicals is often limited. It is anticipated that the toxicity assessment may require critical toxicity assessment for compounds without toxicity reference values available from Canadian or other jurisdictions. If no toxicity data is available for particular COPCs, they will be highlighted for potential future assessment.

Use of the deterministic approach, to quantitatively characterize risks as a single value (HQ or ILCR) often results in overestimation of risks. This classical approach attempts to reflect the variability in exposure point concentrations, or variability in toxicity amongst individuals, by using conservative estimates of these factors. The overestimation of risk is a frequent challenge that may be addressed using a probabilistic approach and the refinement of specific populations and exposure intake values.

8.0 TIME COMMITMENTS REQUIRED OF MINISTRY

As specified in the RFP, the Ministry will be involved in bi-weekly meetings, typically as conference calls. We anticipate these meetings will last ½ to 1 hr, occasionally requiring a longer dialogue as we refine strategies and specific HHRA plans.

We anticipate requesting representation from the Ministry for each of the stakeholder committee meetings (between 2 and 4 meetings over the 18 month project), and at the first hazard assessment workshop.

Various ministries will be required to communicate with the project team in the compilation of the data in their various ministries. This will vary according to the amount of data at the ministry and the format of the data. An average of 1 week for each data package is estimated.

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10.0 GENERAL SERVICE AGREEMENT DECLARATION

SLR Consulting (Canada) Ltd. (SLR) agree that should our proposal be successful SLR will enter into a Contract with the Province in accordance with the terms of the General Service Agreement with no modification.

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APPENDIX A

Holistic Risk Assessment

APPENDIX A

Holistic Risk Assessment

Systems perspectives inform us that ecological systems and societies are interconnected and dynamic. Expanding the context for the way that environmental assessments are done (Kapustka et al. 2010, Briggs 2008, Figure 1) adds value specifically in relating the questions asked and addressed to the values and goals of local stakeholders.

The current approach is generally segmented along technical disciplinary lines. While this approach generally meets the objectives that have been defined by law, it generally does not address the critical systems relationships that tend to be at the heart of stakeholders concerns about projects.

A different approach, namely a holistic and integrated assessment process provides the technical consistency needed to align the focus of an assessment with the concerns of stakeholders. The new approach requires constructive, iterative dialogue among stakeholders to identify the entities they value and to reach consensus regarding how the status and predictions of those entities will be evaluated.

Transparency and respect for alternative views are needed to develop agreed decision criteria to understand the current status of ecological and social conditions and interpret the predicted conditions that would occur under various scenarios (existing and future conditions) pertaining to the oil and gas industry of the region.

The approach SLR is proposing to meet the goals and objectives of the Ministry has been developed to incorporate the elements of Problem Formulation described in guidance from several jurisdictions (Environment Canada 201; US EPA 1998). The approach is sufficiently flexible that it can be applied to new projects, retrofitted to evaluate past or existing projects and has been used for both legacy site assessments and strategic risk. The central features of Problem Formulation are:

- Identifying the concerns of stakeholders;
- Create a project-specific conceptual model;
- Explicitly stating what is to be assessed;
- Identify what is to be measured so that an assessment can be made;
- Defining the quality of data required to reach a meaningful assessment;
- Selecting the methods to be used to gather relevant information/data;
- Detailing the sampling and analysis need to obtain and evaluate the information; and
- Establishing the processes that ensure the quality of the assessment.

We understand that in Phase 1 of this project key stakeholders were engaged in the process to identify their concerns. The stakeholders included local communities, local and regional governments, first nations, non-government organizations, regulators (BC Oil and Gas Commission (OGC)), ministry representatives (Ministry of Health, Ministry of Energy and Mines, Ministry of the Environment, Ministry of Forests, Lands and Natural Resource Operations and Ministry of Aboriginal Relations and Reconciliation), Northern Health Authority, the oil and gas industry, and the general public.

We will develop a stakeholder map consistent with the guidance offered in the ASTM Standard (E2348) on Consensus Based Environmental Decision-making (ASTM 2010) to illustrate interrelationships and to build on the stakeholder engagement work completed by The Fraser Basin Council in Phase 1. We will extend the stakeholder engagement work as needed and revisit contacts already engaged in Phase 1 as a means of creating a project-specific conceptual model for Phase 2, the HHRA.

Conceptual models consist of pictorial and narrative descriptions of how the project (in this case the broad aspects of the oil and gas industrial activity) fits within the social and ecological landscapes of the area. Generalized guidance on the construction of conceptual models is found in some regulatory documents, but more comprehensive guidance is available in ASTM (2009).

We use the project specific conceptual model for effective communication among stakeholders and to guide the design and analysis of the assessment. As a communications tool, the conceptual model represents an agreed representation or mental model of how the project fits within the ecological and social landscapes and it highlights linkages between industrial activities and the various concerns identified by stakeholders.

We have extended the general method to produce conceptual models that incorporate the non-linear relationships that exist in complex systems. This method shifts away from narrowly focused approaches that ignore the interrelationships that are central to the dynamics of human interactions among different groups and with their environment. In short, we create a dynamic conceptual model that informs the remainder of work for a holistic integrated assessment that respects the dynamic aspects of community and ecological processes that contribute to human health and community wellness.

Sustainability assessments can provide useful insights into human health and community wellness risk assessments. By evaluating each aspect of sustainability (ecological, social, and economic) in the context of their relationships to one-another, a fundamentally holistic evaluation of the industrial effect(s) can be accomplished. The approach differs substantively from the classical discipline-driven assessments in that the interrelationships are identified in advance of any data being gathered (existing information or new studies).

Sustainability is a quest of humans to maintain their social, cultural, and economic communities into the future so that future generations will have equitable opportunities to thrive and enjoy overall well-being. The richness, or well-being, of any community derives from cultural heritage, ethnicity, individual health and wellness, and diversity of talents. This can be measured in many ways: one viable mechanism arises from western society's understanding of public health and the broad set of factors that determine the quality of the public well-being. These are defined as Determinants of Health[1], and have been described by the World Health Organisation[2], Health Canada[3], and others. One aspect of well-being is wealth as defined in Financial Capital, but this only captures one aspect of the human condition. In addition, a community's well-being can be measured in terms of Human Capital, Social Capital, Physical Capital, and Natural Capital. Capital is defined as a qualitative or quantitative stock that can be tapped for human needs. Sustainability requires approximately equitable quantities of different capitals. A case can be made that too much emphasis has been placed on Financial Capital and this has led to disregard for sustained maintenance of the other capitals that constitute sustainability.

There is an emerging recognition that to ensure progress toward sustainability a new paradigm is required, one that considers economies to be nested within a social structure, which in turn is embedded in an ecological system. This mental model is informed by the sciences that at the local level seek to portray a community, a project, or a policy within a socio-ecological landscape – the vibrancy or richness of the sociological aspects in the long run is wholly dependent on the dynamics of the ecological system.

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1 Determinants of public health include income and social status, education and literacy, physical environment, social support networks, genetics, gender, and health services, among others.

2 http://www.who.int/hia/evidence/doh/en/index.html (accessed May 2012)

3 http://www.phac-aspc.gc.ca/ph-sp/determinants/index-eng.php#determinants (accessed May 2012)

The ecological relationships, the interconnectedness of an ecological setting from different perspectives can be evaluated more thoroughly. A perspective can be narrowly focused on short-term local conditions most closely linked to human interests or a perspective may be more expansive, extending to global interests spanning multiple generations or the perspective may lie anywhere in between these spatial and temporal scales. Regardless of the spatial and temporal scales, whether acknowledged or not, the status of the human condition and prospects for a different plight are wholly dependent on dynamics of the ecological setting. Most importantly, there is growing recognition that people subjected to stresses (e.g., poverty, fear, or other psychological conditions) increase their susceptibility to chemical and physical hazards. We have developed an approach that conceptually and computationally assesses the balance of the five capitals of sustainability (Figure 1).

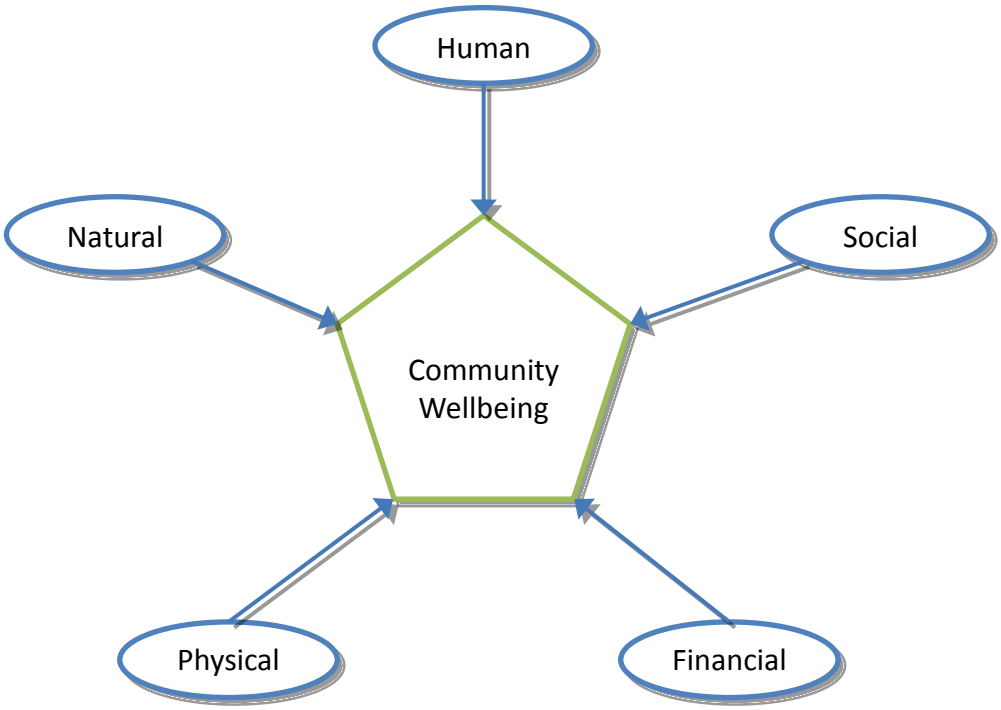

Figure 1. Five capitals of community wellbeing and sustainability.

The human health risk assessment will be performed in a manner that reflects the complexity of the ecological and societal setting and explicitly addresses the goals and objectives of the Ministry based on stakeholder participation in the Phase 1 report. We will use the established guidance of Health Canada, but will extend the methods to include the more robust evaluations required to include the dynamics of the systems that determine the health and community wellbeing of the Region. This includes construction of causal scenarios (e.g., bowtie diagrams described below) to depict critical hazards in relation to drivers and consequences. We will also use computational tools that incorporate uncertainties into the calculations of risk for the various hazard-consequence relationships.

Finally, SLR is committed to delivering reports that are both technically solid and accessible to those outside the risk assessment community. This is reflected in our communications plan described in detail below. The Phase 2 modelling, stakeholder engagement and final reports will all be completed within the timeframe and budget specified by the Ministry of Health.

APPENDIX B

Probabilistic Risk Mitigation/Management

APPENDIX B

Probabilistic Risk Mitigation/Management

B.1 Risk Mitigation/Management Framework

The mitigation/management framework which contextualizes risk analysis into a wider context and how it relates to the operations and responsibilities of government is ISO 31000. SLR's approach will be carried out in 3 stages. Stage 1 is concerned with identification of risk scenarios with a view of established risk endpoints determined by the HHRA. The outcomes of Stage 1 will be a documented set of risks scenarios, a risk register and a set of risk matrices. Stage 2 is concerned with a more detailed analysis and evaluation of the most significant set of risks identified from Stage 1. The output of Stage 2 includes a set of probabilities and consequences associated with each significant risk and a set of risk treatment measures with recommendations for improving public health outcomes. Finally, Stage 3 relates the findings from the previous two stages and compares these outcomes with current environmental management practices of the BC government and other jurisdictions in order to determine where these practices could be enhanced in order to manage human health risk for oil and gas development in northeast British Columbia.

B.2 Definition of Risk

There are many definitions of risk used in risk assessment. We start by using the definition of risk from Kaplan and Garrick (1981) which is used by practitioners of quantitative risk assessment in the chemical process and nuclear power industries. Here risk is defined by the triple relationship (in mathematical notation):

$$R = \{P, C|H\}$$

where R denotes risk, *P* denotes the probability, *C* consequences and *H* hazard. Therefore, risk is the probability of consequences (not always adverse), given the presence of a hazard. In Stage 1, we identify the hazards associated with the oil and gas industry that can impact human health.

Also discussed in Kaplan and Garrick's original paper is the concept of risk scenario and the importance of uncertainty to risk analysis. A risk scenario refers to a sequence of risks which for example could be consequences associated with a spill which could propagate through air, water and into the ground thus impacting humans from three exposure pathways. Also, a spill from a facility, pipeline or truck could affect human health depending on the magnitude of the spill, whether or not the spill is a sudden or continuous release or how toxic the substance is that was spilled. Finally, uncertainty is important. Uncertainty arises because of the nature of spills, which are probabilistic in time and scale. Also, uncertainty arises in consequence because exposure is a random process, as is the process of uptake in the food chain which depends on a series of random factors.

In summary, the quantitative definition of risk answers 3 basic questions (Bedford and Cook 2001):

- What can happen?
- How frequently does it happen?
- What is the impact on human health, were an adverse event to happen?

The risk analysis which will be carried out in Stage 1 establishes the set of significant risk scenarios. A qualitative estimation of the probability and consequences to human health are also performed at this time. Stage 2 is concerned with a more quantitative estimation of the probability and consequences of risks to human health. The probabilities are estimated in Stage 2 by using methods from Chemical Process Quantitative Risk Assessment (AIChE 2000). The consequences

or impacts to human health are estimated by using classical HHRA which is based on a combination of monitoring data and mathematical models.

B.3 SLR Risk Assessment and Management Methodology

The task of performing the human health risk assessment for oil & gas activity in NE BC is necessarily complex. As per Section 1 of the RFP, the risk assessment must take the following elements into account:

- Multiple exposure pathways: Air Quality, Water Quantity, Water Quality, Land Quality, Food Quality;
- Multiple types of hazard incidents: Sudden Releases of Fluids, Slow Releases of Fluids, Increased Road Traffic;
- Multi-faceted provincial institutional framework: Monitoring, regulatory compliance, emergency response planning, tracking and reporting; and
- Multiple industrial activities: Exploration, drilling, chemical processing, wells, pipelines and other transportation.

In addition there will be other elements which will be identified through the risk assessment process itself.

As mentioned in the introduction, SRL's approach to the risk assessment is top-down, systematic, flexible, scientific and rigorous. It conforms to recent international standards and practices of risk management (IOS 2009a and 2009b), chemical process risk assessment (AIChE 2000) and human health risk assessment (Briggs, 2008) and also involves consultation with multiple stakeholders from industry, government and the public in a transparent, facilitated process. In addition, the approach is extendable to include other capitals besides human health in line with current practices in sustainable development.

Following the principles laid down by the ISO Risk Management Standard affords development of a framework which not only provides the context and aids in development of a structure for risk assessment but also fosters the integration of "… the process for managing risk into the organization's overall governance, strategy and planning, ..., management, reporting processes, policies, values and culture".

SLR's approach also conforms to the ISO Risk Management Standard by including not only risk assessment but also risk treatment, including risk mitigation with the purpose of improving public health outcomes.

The ISO Risk Management framework partitions risk management into several steps (Figure 2).

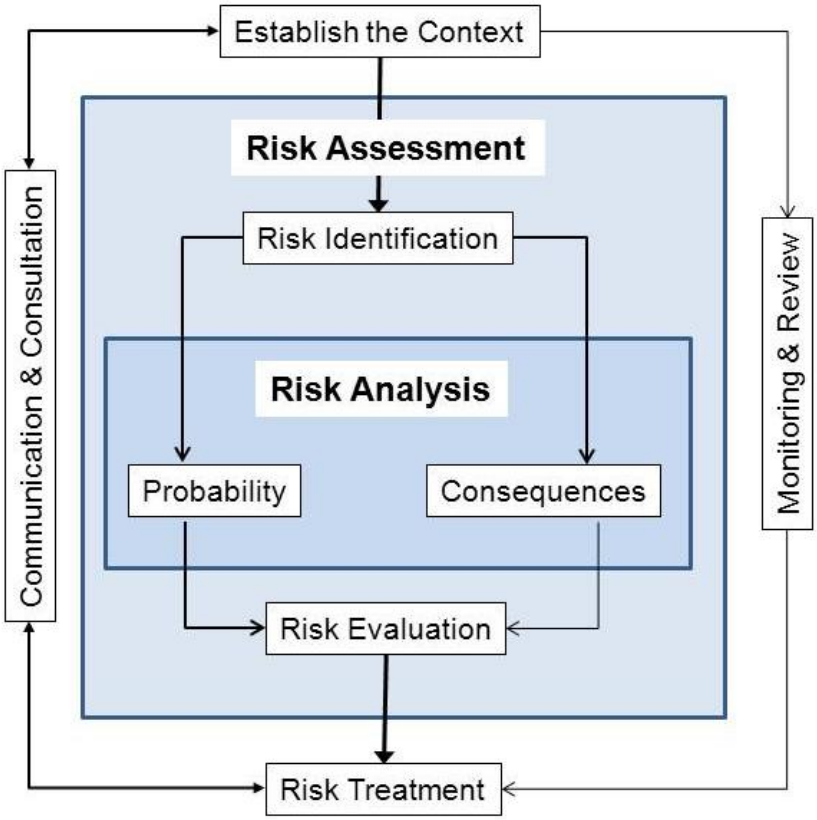

Figure 2. ISO risk management process.

B.3.1 Stage 1: Scenario Identification and Qualitative Risk Estimation

Stage 1 is will identify risk scenarios of the oil and gas industry related to public health. The method used to identify risk scenarios will be bow-tie analysis. A bow tie diagram describes and analyzes the pathways of a risk scenario from causes to consequences (Figure 3, below). As such, it relates causes on the left to the primary hazard event (the knot) and then to risk endpoints on the right through exposure pathways. In the example shown in Figure 3, the primary (top level) hazard event is a pipeline spill. There is a set of 7 causes shown on the left of the figure. Using standard chemical process risk terminology, a spill may be classified as being a 'leak' or a 'rupture'. There are several different definitions of these terms. The US Department of Transportation defines a rupture as leading to $50,000 worth of damage and smaller spills being a leak. ERCB defines a rupture in terms of the size of spill arising from a complete severing of the pipeline. Regardless of the exact definition, a rupture refers to a large volume, suddenly released whereas a leak is smaller and usually released over a long timescale. Once release of the spill occurs, the fate and transport of the chemical contaminants determine the impact on human health as shown on the right of the figure. The spill may be released into ground or water and also evaporation could occur and therefore the air is contaminated. Depending on the transportation through air and water, the contamination could reach the food and water supply. If so, this could have a significant impact on human health because of exposure to humans.

For HHRA, through construction of the set of bow ties, the set of all primary hazards have to be identified and the set of exposure pathways have to be identified for each hazard event. The structure of the bow tie is similar to a fault tree (on the left) and event tree (on the right), except that gates are not set at the nodes on the right and no probability values are elucidated at the nodes. Therefore, it cannot be used for quantitative probability estimation. However, the bow ties can be used in Stage 2 where probability estimation will be performed.

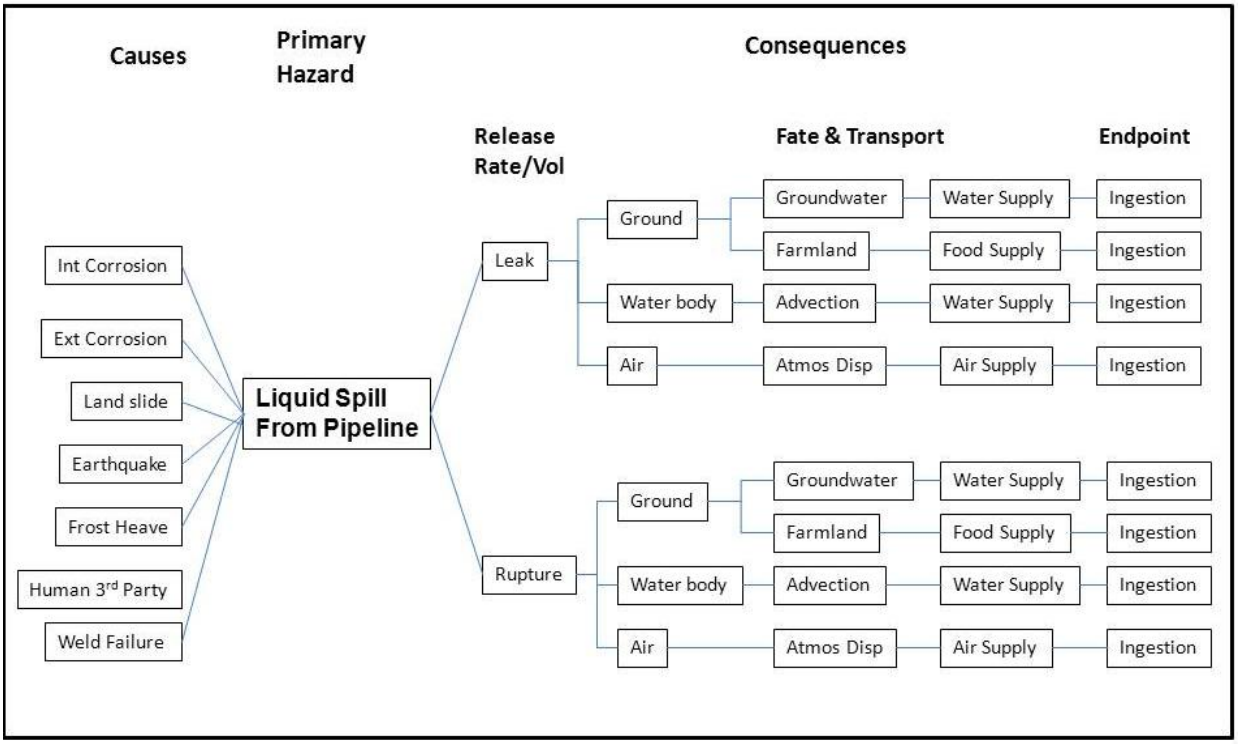

Figure 3. Bow Tie Diagram.

Bow tie diagrams will be constructed in facilitated brainstorming sessions with stakeholders. First, the knot will be identified representing a primary hazard event. Then the causes leading to the primary hazard event will be determined including multiple secondary causes. For example, impurities can cause corrosion which in turn leads to pipeline failure which is a cause of a chemical spill. Then, events arising out of the primary cause will be determined including an exhaustive list of exposure pathways for each primary event. Finally, the risk endpoints will be determined. It is the facilitator's job to limit endpoint and exposure pathways to only those endpoints pertinent to human health. Figure 3 shows an example bow tie diagram for a liquid chemical spill from a pipeline. In this case, causes of a pipeline spill were collected from the Alberta Energy Resources Conservation Board (ERCB) database.

To ensure an exhaustive set of risk scenarios for the oil and gas industry distributed over the NE BC region, the identification of all proposed industrial sites will be made. Then, for each industrial site, a taxonomy of all activities and infrastructure that could impact human health will be made. These may include:

- Chemical process plants;
- Pipelines;
- Exploration wells;
- Injection wells for disposal;
- Pumping wells;
- Transportation routes (road and rail); and
- Supporting Infrastructure.

The activities and infrastructure will include all phases of the engineering lifecycle: exploration, construction, commissioning operation, de-commissioning, and reclamation and closure.

Also, factors which could influence risk scenarios include the following:

- Fate and transport of contaminants through air, water (both groundwater and surface water), land and soil;
- Bio-accumulation of contaminants in the food supply, both plants and animals;
- Volume and time scale of releases (both large sudden releases and slow continuous releases);
- Quality and quantity of water bodies affected by contamination;
- Increased traffic on roads, leading to increased vehicle collisions and consequent injuries, hazardous chemical spills and possible fatalities;
- Geographic location of spill sites with respect to location of human receptors in settlements – individual houses, towns, cities and aboriginal communities; and
- Geographic location of spill sites, human receptors and exposure pathways.

B.3.2 Stage 2: Quantitative Risk Analysis

Stage 2 is concerned with quantitative risk estimation. Probability estimation is performed using two methods used routinely in Chemical Process Risk Analysis, specifically Fault Trees and Event Trees. This analysis links causes of a primary hazard event such as a chemical spill from a process facility to a particular risk endpoint. The analysis takes into account all exposure pathways from the hazard event to the endpoint.

In this stage, a semi-quantitative analysis of risks to human health from the presence of the oil and gas industry is developed for the region by building on the results from Stage 1. Using the definition of risk as the probability of consequences, given the presence of a hazard, this analysis comprises conducting a probability analysis using techniques from the chemical process industries and conducting a consequence analysis using classical human health analysis.

Though the risk framework has been devised primarily to look at chemical exposures, there is nothing in the framework that precludes consideration of other stressors. Data required for quantifying risk posed by non-chemical stressors includes an appropriate measure of magnitude or intensity of the stressor that a receptor could experience. These data can be described with uncertainty and used in Monte Carlo simulations. Knowledge about the intensity of the stressor, the response profile of human receptors to the stressors (equivalent to a chemical concentration-response relationship) can be expressed as the probability of an adverse effect occurring.

The description of data requirements will follow from the Problem Formulation stage that considers the linkages of stressors to receptors. Empirical evidence and modeled scenarios will be used to analyze the risks associated with the stressors.

B.3.3 Probability Analysis

The probability analysis starts with the set of risk scenarios as elucidated with the set of bow tie diagrams from Phase 1. Each bow tie describes the set of causes leading to a primary hazard event which in turn lead to consequences endpoints through a set of exposure pathways. Now the left side of each bow tie is converted into a Fault Tree diagram.

A Fault Tree is used to identify and analyze factors that can contribute to the hazard event (top event). Events are connected by “OR” and “AND” gates so that probabilities of specific causes are computed using Boolean algebra (Bedford and Cooke, 2001). Figure 4 shows Fault Tree for vehicle collisions.

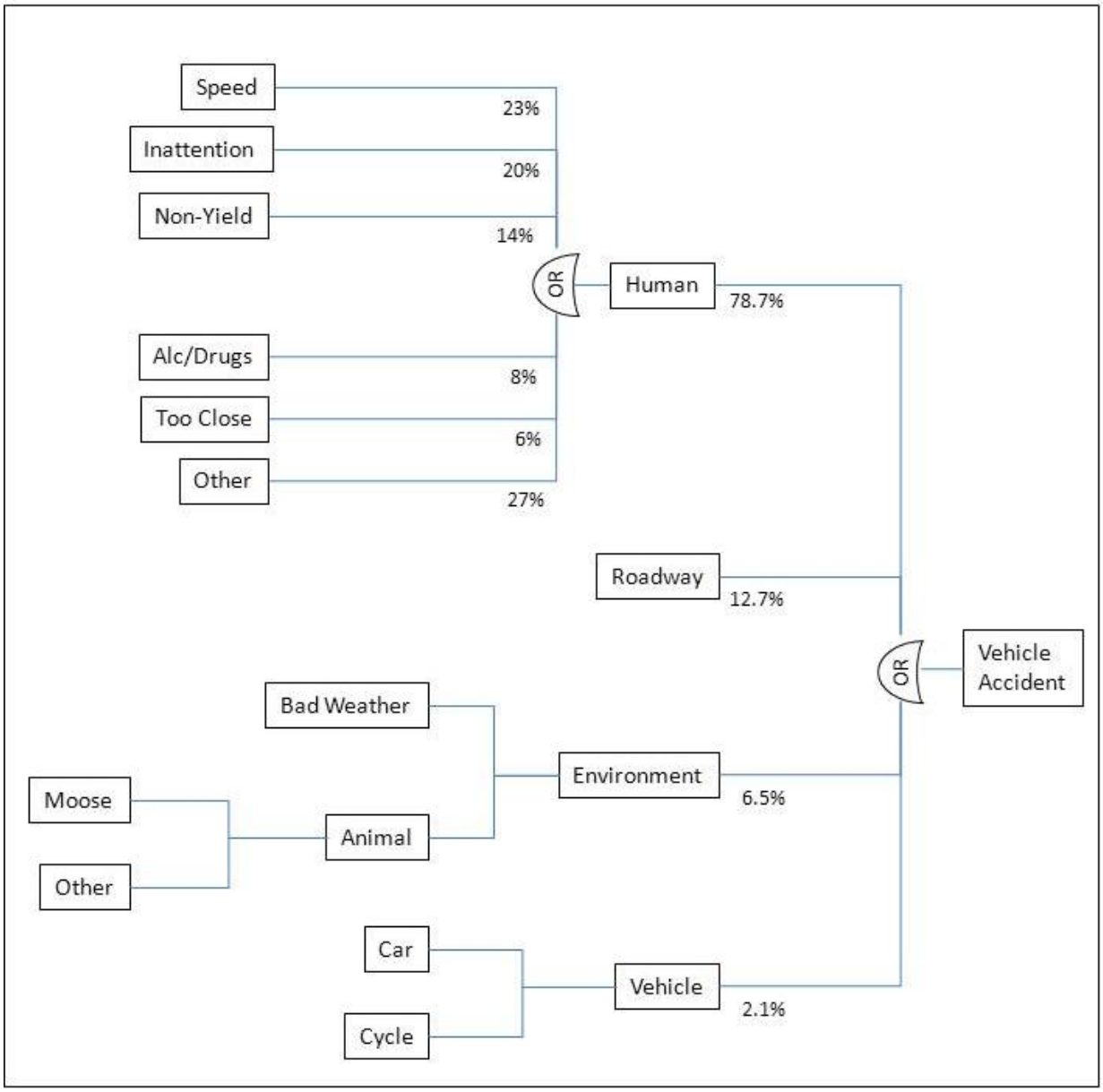

Figure 4. Fault Tree Diagram for Vehicle Collisions

An Event Tree is used to compute the probability of risk endpoint events from the primary hazard event. Risk endpoints for a chemical process which impact human health could be human ingestion of contaminated drinking water from a chemical spill of hazardous material.

Not only is the event tree used to compute probabilities of risk endpoints occurring but also it can be used to identify mitigating measures which can reduce risk either by reducing the probability of occurrence or magnitude of consequences. The probability of a critical endpoint is calculated by multiplying the probabilities at each node. The node probabilities are estimated from a variety of sources. The frequency of leaks and ruptures can be obtained from regulatory agencies (Alberta, 2007). The spill cleanup probability depends on the pipeline engineering supervisory control and data acquisition system as described in the system document.

Although the probability analysis is concerned with the likelihood of an adverse event occurring, the probability is expressed in terms of a frequency: frequency of adverse events per year. For

pipelines, the probability is expressed in terms of the number of adverse events per km per year. Usually the underlying assumption is that the time between spill events are distributed uniformly in time. In the probability calculations, modifications are made according to factors such as date of construction, chemical composition of contents, temperature of contents, use of cathodic protection, internal and external coatings, etc.

B.3.4 Uncertainty Analysis

Classical human health risk assessment is usually deterministic in nature: quantities such as dose-response are expressed as a single numbers. This type of analysis is simplistic because it ignores the effect of uncertainty. Multiplying mean values together for other factors such as fate and transport, bioaccumulation and dose-response in a human health risk assessment can result in mean endpoints which are often in error by several orders of magnitude. This situation can be easily remedied by using a probabilistic risk approach and a Monte Carlo Simulation engine (Bedford and Cooke, 2000). By quantifying uncertain modelling inputs with probability distribution functions instead of single numbers, a probabilistic endpoint can be estimated. The effort required to perform a probabilistic calculation of human health risk endpoints is aided considerably by using a simulator such as GoldSim (GoldSim, 2012). Furthermore GoldSim has the added advantage of a diagrammatic approach to calculation which can be used in risk communication with stakeholders. With a probabilistic risk calculation it is important that uncertain inputs to a simulation are quantifies correctly. SLR risk professionals have expertise in eliciting probabilistic inputs from stakeholders, including those without training in probability theory. Also, where data exist, probability distributions will be fit using parametric statistical tests such as the Kolmogorov-Smirnov test using software such as Crystal Ball.

The risk endpoints calculated in the Monte Carlo Simulation are no longer single numbers, rather they are probability distribution functions themselves. These distributions reflect a range in values and a likelihood for each number in the range. Of particular importance are endpoints of large magnitude since they have the largest impacts on human health, even though these events may be very rare. In popular culture rare, large magnitude events have become known as “Black Swans’ (Taleb, 2007). An example of a Black Swan would be the crash of the worldwide financial system in the wake of the US banking crisis of 2008 or recent flooding in BC’s Fraser Valley during 2012.

APPENDIX C

Data Sources

APPENDIX C

Data Sources

Data from the following sources will be compiled:

Ambient air quality:

- There is data available at www.bcairquality.ca, other limited specific area data would be available to the successful contractor from the Ministry of Environment.
- Oil and gas (O&G) related source emissions (quantity and quality) to air: Permittee discharge data from major point sources under the Environmental Management Act.

Surface water quality:

- Water quality monitoring data from the Ministry of Environment.
- Some additional data is available through Federal/Provincial water quality program at http://ec.gc.ca/eaudouce-freshwater/Default.asp?lang=En&n=95862893-0
- O&G related effluents (quantity and quality) released to surface water: Ministry of Environment has some permittee data from major point sources under the Environmental Management Act.
- Search MOE Site Registry for sites in the area and obtain reports with surface water quality information

Groundwater quality:

- Limited information exists on groundwater quality with the exception of a few observation wells and limited source water studies.
- There may be useful data from major water purveyors who are required to sample under the Drinking Water Act.
- There are six new observation wells (with quality sampling) that will be coming online in the Peace.
- Alberta operates a similar observation well network adjacent to the NE with similar O&G development and this data may also be useful.
- O & G related releases (quantity and quality) to groundwater water: The Oil and Gas Commission (OGC) has frequency and volume data written incidents and site specific reports for drilling waste disposals.
- Search MOE Site Registry for sites in the area and obtain reports with groundwater quality information

Soil Quality:

- Ministry of Environment manages baseline soil mapping and soil survey data collected primarily during the 1960's to 1990s, as well as other terrestrial ecosystem information (TEI) (including surficial material mapping, terrestrial and predictive ecosystem mapping and sensitive ecosystem inventory).
- Our BCSIS (soil site information) database does contain site and soil horizon information, and soil lab analysis results for selected points. Neither the mapping nor the BCSIS data were collected for the purpose of determining deposition in the soil of air-borne or other contaminants. Available soil (or other TEI) mapping data (GIS data), scanned maps and the BCSIS dataset can find and access this data via Ministry of Environment web page at: http://www.env.gov.bc.ca/tei/access_tei.html.
- Search MOE Site Registry for sites in the area and obtain reports with soil quality information

Sediment Quality:

- Search MOE Site Registry for sites in the area and obtain reports with sediment quality information

Vegetation Quality:

- Some information is available on the Schedule A's and B's done under the Agricultural Land Commission's Delegation Agreement with the OGC and within Certificate of Restoration on applications.

Fish Tissue Quality:

- Most fish tissue studies in the NE were done as part of impact assessments for proposed resource extraction (namely mining). MOE has limited data for the Northeast.
- Search MOE Site Registry for sites in the area and obtain reports with fish tissue quality information

Livestock Quality:

- Limited passive monitoring information would be made available to the successful contractor.

Pages 79 through 183 redacted for the following reasons:
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APPENDIX E

Conflict of Interest Declaration

Conflicts of Interest

POLICY

All employees and contractors of SLR are expected to observe the highest ethical standards in the conduct of Company business and to avoid involvement in any situation (business, social, personal or otherwise) wherein a conflict of interest exists, could exist, or may appear to exist.

Any employee suspecting, or having knowledge of, a possible infraction of this policy should immediately bring the matter to the attention of his or her supervisor, to personnel at the next level of management, or to the Human Resources Manager. The confidentiality of the individual reporting any infraction will be preserved to the fullest extent possible.

Organizational

No contract will be negotiated or executed if the interests of the particular customer are of such a nature as to compromise or threaten the Company's ability to maintain unbiased objectivity in serving its other customers. In instances where potentially conflicting situations may be created, agreements may be entered into if all the parties involved have full knowledge of the potential conflict and consent to the arrangements in advance. The contract file should contain a statement documenting that the responsible SLR employee has made the disclosure and obtained the consent from all parties that is necessary hereunder.

Personal

SLR employees are expected to refrain from any private business, professional activity or from having any direct or indirect financial interest which would place them in a position where there is a conflict between their private interests and their legal, fiduciary, and moral responsibilities to the Company. Employees must not accept monetary or other forms of payment in addition to normal salary or expenses for duties which they perform in the course of their employment. In their interactions with others, all employees are expected to act in the best interest of the Company and not for their own private advantage. They must not engage in any private or professional activity or enter into any financial transaction which involves the direct or indirect use of inside information - (information that has not become public information) - gained through their position with the Company to further a private interest or for private gain for themselves or another person or entity. They must not use their position in the Company in any way to induce or pressure another person or entity.

Employees must not hold positions, such as director, officer, employee, partner, consultant or any other position in any business or professional enterprise, that interfere with the performance of their duties as officers or employees of the Company or that involve obligations that may conflict with the interests of the Company.

Former Employment
New employees should not remove from their former place of employment any information that is or might be considered as proprietary by that employer, including but not limited to books, equipment, data tapes/drives, computer printouts, disks or notes generated while in the course of that employment, or any items which may have been purchased or produced by the former employer for the performance of the employee's work. Prospective employees who are employed at the time they are seeking employment with SLR should cooperate fully with their existing employer and continue to perform their work diligently until their termination of employment.

Current Employees
During employment with SLR, employees may from time to time work with intellectual property and information which is confidential or proprietary to SLR.

The term "intellectual property" as used above means:

- patents, copyrights, trademarks and designs, whether or not registered;
- ideas, discoveries, inventions, formulae, calculations, techniques, configurations, processes, know-how and trade secrets; and
- expressions of such intellectual property in tangible form, including research, prototypes, data, analyses, flow charts, drawings, specifications, plans, devices, apparatus, software, financial statements and forecasts, customer and supplier lists, business plans and marketing strategies.

Any intellectual property which an employee conceives of or reduces to practice during employment with SLR which is within the scope of employment, or relates to SLR's business or demonstrably anticipated business will be the sole and exclusive property of SLR. In order to confirm such ownership by SLR, employees agree not to assert any moral rights they may have or may acquire in respect of such intellectual property and will provide waivers of any such moral rights from time to time as requested by SLR.

From time to time and even after employees cease to be SLR employees, SLR may require reasonable assistance to confirm SLR's ownership of, and rights in, intellectual property which may have been developed during employment with SLR, including any applications for patents, trademarks, copyright and other registrations. All employees agree to provide this assistance without charge at the reasonable request of SLR.

All employees will maintain the confidentiality of all confidential information known to them both during and after employment with SLR, unless such Confidential Information becomes generally known or available to the public without breach of confidentiality obligations. Employees will only use the confidential information for the benefit of SLR or its affiliates and not for their personal benefit or the benefit of any third party, including any competitor of SLR.

All items containing confidential information prepared by or which come into possession during employment with SLR are the property of SLR and are to be returned to SLR should employment with SLR cease for any reason.

APPENDIX F

Select Project Summaries

project

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Chevron Refinery Foreshore Human Health and Ecological Risk Assessment

Location	Burnaby, BC, Canada
Client	Chevron
Business Sector	Energy - Oil & Gas
Services	Human Health and Ecological Risk Assessment
Additional Information	Project Duration: May 2010 - Ongoing Project Value: $200,000

PROJECT BACKGROUND

Non-aqueous phase liquid (NAPL) seeps were observed on the north slope of the refinery towards Burrard Inlet. A Stage II PSI identified seeps at the base of the rip rap and interim remedial measures were installed. Monitoring of the porewater, sediment, and surface water resulted in some chemical concentrations above standards for human and ecological health.

PROJECT OBJECTIVES

The project objectives were to describe how people and ecological receptors might be exposed to contaminants present in environmental media (air, sediment, groundwater, surface water and seafood) and what the potential health risks might be to people who use the foreshore. The risk assessment also supported the design and implementation of remediation measures.

SERVICES PROVIDED

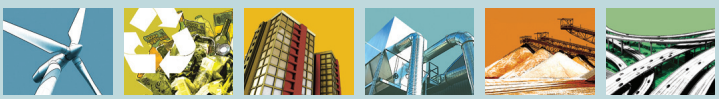
SLR undertook the following works:

- Identification of contaminants of concern in all environmental media for all potential human and ecological receptors
- Identification of all potential human and ecological receptors of concern and their respective exposure pathways;
- Modeled concentrations of chemicals in seafood and dietary risk assessment;
- Development of the site conceptual model;
- Preparation of technical reports and fact sheet suitable for public presentation
- Consultation with BCMOE and Fraser Health Authority.

HIGHLIGHTS

- Ongoing monitoring of sediment, surface waste, groundwater and vapour
- Submission of Problem Formulation Reports to BC MOE and Fraser Health Authority
- Update of Problem Formulation Reports based on monitoring results
- Derivations of risk-based management targets to guide remediation design

Team members (named in this proposal)
Cindy Ott, M.Sc., P.Ag., GeoL., P.Chem.
Celine Totman, M.Sc., R.P.Bio.
Kirstin Webster, M.E.T., B.I.T.
Barbara Glijer, M.Sc., P.Chem.



project

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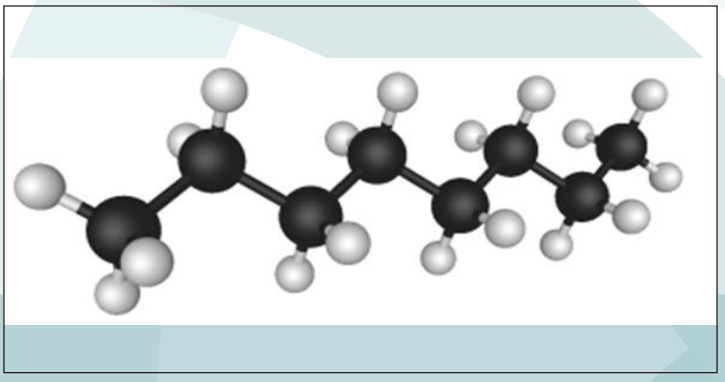


Air Monitoring Plan for Unplanned Petroleum Release for Public Health Risk Assessment

Location	Various in BC, Canada
Client	Confidential Major Oil and Gas Company
Business Sector	Energy - Oil & Gas
Services	Public Health
Additional Information	Project Duration: 2012 - Ongoing Project Value: $40,000

PROJECT BACKGROUND

As expansion continues to occur in the oil and gas industry, public and governmental concern is surfacing over the implications of potential spills to public health. One of the major oil and gas transportation company recognized the need for increased diligence and retained SLR to create an Air Monitoring Plan (AMP) which can be used in the event of an unplanned product release.

PROJECT OBJECTIVES

The air monitoring plan was designed to obtain accurate and reliable air concentration data to screen against acute public exposure criteria, inform evacuation planning and conduct acute human health risk assessment.

SERVICES PROVIDED

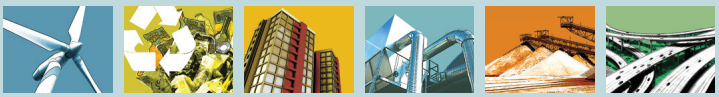
SLR undertook the following works:

- Air monitoring guidelines: Jurisdictional search of air monitoring policies & plans, public health assessment plans, and emergency response plans.
- Petroleum Product Review: Representative petroleum product mixtures were reviewed with respect to their composition, physical and chemical properties, and toxicity to select chemicals of potential concern. 21 COPCs were selected for inclusion in the monitoring plan.
- Air monitoring plan and decision logic tree: An air monitoring plan for urban and remote scenarios was created along with a decision logic tree for monitoring ambient air.
- Ambient Air Criteria: Criteria were selected to conduct public health risk assessment based on real-time air-sampling data, and to plan public evacuation.

HIGHLIGHTS

- Logistical: The AMP was required to be general enough to accommodate a variety of potential spill scenarios and specific enough to be useful on the ground.
- Scientific: Development of a *de novo* air monitoring plan for public health based on risk assessment framework and toxicology.

Team members (named in this proposal)
Cindy Ott, M.Sc., P.Ag., GeoL., P.Chem
Phil Folkersen, IHT
Kirstin Webster, M.E.T., B.I.T.
Celine Totman, M.Sc., R.P.Bio



project

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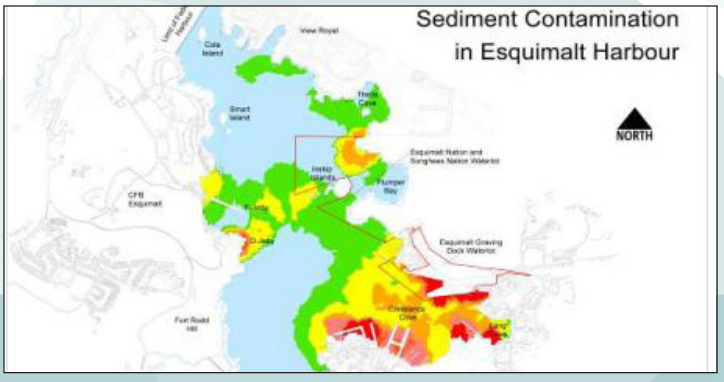


Esquimalt Harbour Human Health Risk Assessment

Location	Victoria, BC, Canada
Client	Public Works and Government Services Canada (PWGSC) and Department of National Defence (DND)
Business Sector	Government Services
Services	Human Health and Ecological Risk Assessment
Additional Information	Project Duration: 2007 - Ongoing Project Value: $600,000

PROJECT BACKGROUND

Esquimalt Harbour has been used for heavy industrial ship building and maintenance since the late 1800s, and is the home port for Canada's western naval fleet. Harbour sediments are contaminated with metals, organometals, PAHs, PCBs, and dioxins and furans. Numerous stakeholders (DND, PWGSC, Environment Canada, Health Canada, View Royal Residents, and First Nations residents) have concern over the potential risks these contaminants pose to human and ecological users of the Harbour.

PROJECT OBJECTIVES

The goal of the harbour-wide risk assessment was to determine if potential risks were present from direct exposure to the sediment or from consumption of seafood harvested from Esquimalt Harbour.

SERVICES PROVIDED

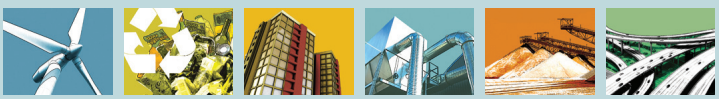
SLR undertook the following works:

- Collected hundreds of seafood (crab, bivalves, shrimp, fish), sediment and surface water samples from locations throughout the harbour, and conducted a thorough COPC screening for hydrocarbon, PCB, and metals contamination in all media.
- Assessed the results of the chemical concentrations to estimate exposure scenarios

HIGHLIGHTS

- The HHRA included exposure estimates and risk characterizations for a variety of human receptors: Adult and child residents and First Nations, and military personnel. Complete pathways associated with harvest and consumption of seafood, swimming, beachcombing and diving were evaluated
- First Nations consumption frequency of seafood was carefully evaluated from numerous sources and three consumption scenarios were evaluated including individual seafood items, and two combined seafood basket
- Fisheries and Oceans Canada issued a consumption advisory for crab and fish caught in the harbour based on the risk assessment activities carried out by SLR
- Results were presented during Public Open Houses

Team members (named in this proposal)
Sam Reimer, M.Sc., P.Ag.
Celine Totman, M.Sc., R.P.Bio
Mark Stelljes, Ph.D.



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Human Health Risk Assessment, Westridge Delivery Line Release

Location	Burnaby, BC, Canada
Client	Kinder Morgan Canada Inc.
Business Sector	Energy - Oil & Gas
Services	Human Health Risk Assessment
Additional Information	Project Duration: Oct 2007 - Feb 2010 Project Value: $60,000

PROJECT BACKGROUND

SLR was retained by KMC to complete an HHRA of oil contamination (hydrocarbons polycyclic aromatic hydrocarbons (PAHs) and metals) resulting from Westridge delivery line oil spill, which occurred in the residential neighbourhood of Westridge, Burnaby BC, in July 2007. The oil was dispersed to the residential neighbourhood via aerial deposition and overland flow onto the surrounding roads and residential properties. Oil travelled through the storm drain system and entered the foreshore through several shorelines and two submerged sewer outfalls.

PROJECT OBJECTIVES

The HHRA was conducted to determine the potential for residual soil contamination, as well as associated contamination present in groundwater and soil vapour, to pose a risk to human health.

SERVICES PROVIDED

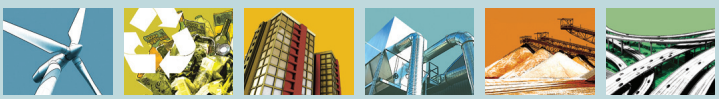
SLR undertook the following works:

- Reviewed all existing data [soil, groundwater, ambient air, oil characterization analysis, correspondence from Fraser Health Authority (FHA) and other regulators, site plant]
- Completed site visits and reviewed remediation status
- Provided recommendations with respects to data set, implication of long term liability and supporting rationale for a risk assessment
- Completed an HHRA including modeling of indoor and outdoor air concentrations and characterization of cancer and non-cancer risks
- Conducted an Endpoint Assessment to address all exposure media listed by FHA (soil, groundwater, soil vapour, ambient air, indoor air, grass, garden and fruit trees, hard surfaces, food fish and beaches).

HIGHLIGHTS

- A Site-wide approach was used to ensure the protection of all individuals with the potential to be exposed to residual contamination associated with the crude-oil release.
- The results of the endpoint assessment indicate that all public health endpoints had been met.

Team members (named in this proposal)
Cindy Ott, M.Sc., P.Ag., GeoL., P.Chem
Sam Reimer, M.Sc., P.Ag.



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Shell Groundbirch Impact Assessment

Location	Northeastern, BC, Canada
Client	Shell
Business Sector	Energy - Oil & Gas
Services	Human Health & Ecological Risk Assessment

PROJECT BACKGROUND

The Groundbirch Project is an unconventional gas production project in Northeast British Columbia. The IA was required as per Shell corporate policy and is not a regulatory requirement. It was aimed to provide Shell with the level of information required to make risk management and Project design/planning decisions.

PROJECT OBJECTIVES

The objective of the Groundbirch IA was to identify, analyze, and frame key environmental, social and health issues, and impacts associated with the Project in a level of detail that enables strategic Project decisions, policies, and adaptive management measures.

Team members (named in this proposal)
Lawrence A. Kapustka, Ph.D.
Kenneth L. Froese, Ph.D.

SERVICES PROVIDED

SLR undertook the following works:

- **Community Health:** Evaluated human health effects from the Project through exposure to disease from human or animal vectors, increased risk of injury, changes to the socio-cultural environment, or perceived risk mechanisms. Examined the capacity of existing systems and services to address these potential community health impacts.
- **Local and Regional Environmental Health:** Evaluated chemical, biological, and physical factors in the natural and built environment that affect human or animal health, as well as environmental quality (air, water, land) and how environmental changes may impact human and/or animal health
- **Labour and Infrastructure/Services:** Evaluated the capacity and preparedness of existing community infrastructure and services to handle the increased demand associated population influx
- **Risk Analysis:** Conducted a qualitative risk analysis of air exposure pathways for human health
- **Literature Review:** Provided an in-depth review of peer-reviewed and government research on environmental health from conventional and unconventional oil and gar activities including drilling, flaring, and hydraulic fracturing

HIGHLIGHTS

- **Novel approach:** The development was viewed as an interaction of two systems - the Groundbirch Project activities and the Peace River Regional District (PRRD). With this approach, the Project's potential effects on the PRRD was evaluated along with the how current conditions or trends in the region may affect the Project's ability to move forward.

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Del Bonita Holistic, Integrated Social &Environmental Risk Assessment

Location	Alberta, Canada
Client	Shell Canada
Business Sector	Energy - Oil & Gas
Services	Risk/Impact Assessment
Additional Information	Project Duration: 2012 - Ongoing Project Value: $100,000

PROJECT BACKGROUND

Shell is proposing to develop a Liquid Rich Shale (LRS) Play in southwest Alberta. The integrated social and environmental impact assessment is intended not only to assess the sociological and environmental consequences of the Project, but also to develop the contours of Shell's social contract with stakeholders. Phase 1 included the development of the Conceptual Site Model, Terms of Reference and Implementation Plan for the Project.

PROJECT OBJECTIVES

The objective of the project is to obtain not only regulatory approval, but also a social licence to operate. This is defined as either earning stakeholder support or sufficient acceptance that they decide not to object to the project going forward.

SERVICES PROVIDED

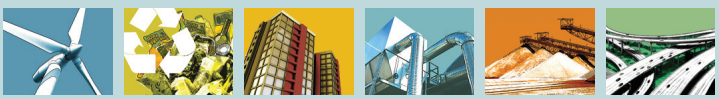
SLR undertook the following works:

- Developed detailed Term of Reference for integrated assessment
- Completed a scoping exercise to identify range of issues likely to be raised by stakeholders
- Developed framework for stakeholder engagement (Consensus-Based Environmental Decision making)
- Developed framework for sustainability assessment (ecological, social and economic in the context of their relationships to one-another)
- Described the human and natural capital potentially affected by the project (e.g. social cohesion, health services, community profiles, air quality, water quality)
- Developed a detailed road map of the assessment methodology (e.g. data quality objectives, sampling and analysis plan, GoldSim modeling, assessment and measurement endpoints).

HIGHLIGHTS

SLR will complete stakeholder engagement and prepare CSM, TOR, Implementation Plan, Cost and Schedule such that Shell can proceed toward full implementation with solicitation of proposals for subcontract work by January 2013.

Team members (named in this proposal)
Lawrence A. Kapustka, Ph.D.
Kenneth L. Froese, Ph.D.
Gaëlle Eizlini



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Alaskan Tundra Risk Assessments

Location	Prudhoe Bay, Alaska, US
Client	British Petroleum (BP)
Business Sector	Industry
Services	Human Health and Ecological Risk Assessment
Additional Information	Project Duration: 2006 - Ongoing Project Value: $600,000 annually

PROJECT BACKGROUND

As part of an order issued by USEPA Region 10, BP is required to evaluate and cleanup over 2,800 solid waste management units (SWMUs) in the Prudhoe Bay Oilfield. The oilfield is located in a tundra ecosystem on the Arctic coastal plain in northern Alaska. Most of the SWMUs were created during the exploration and development of oil resources.

PROJECT OBJECTIVES

The primary objective was to evaluate, cleanup and close contaminated sites. Given the large number of potential sites requiring evaluation, SLR developed several approaches to streamline human health and ecological risk assessment. One approach involved grouping sites with similar conceptual site models (i.e., chemical, histories, settings) to reduce the number of individual risk assessments that would be needed to support management decisions. Another approach involved developing a tiered human health and ecological risk evaluation framework that could be widely applied to a number of different sites.

SERVICES PROVIDED

SLR undertook the following works:

- Historical data review, habitat surveys at multiple SWMUs, development and implementation of an approach to group sites based on conceptual site model similarities, identification of generic ecological terrestrial and aquatic screening levels, and development of site-specific target levels for three mammalian species, five avian species, and four aquatic receptors relevant to the North Slope.
- Developed a tiered risk assessment framework that can be applied to multiple types of SWMUs.
- Characterized natural background concentrations of metals in the environment.
- Multiple reports have been submitted and others are being prepared

HIGHLIGHTS

- Development of site-specific risk-based screening concentrations for Alaskan mammals, birds, and subsistence use receptors
- Portfolio-based risk assessment approach enabled similar source areas to be grouped and evaluated together.
- Conducted a barium bioavailability study in soil relevant to mammalian reports
- Delineated habitat surrounding 40 reserve pits and two landfills

Team members (named in this proposal)
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Amanda Bailey, M.S.
Jeff Peterson, Ph.D.