NATURAL RESOURCES CONSERVATION BOARD
PRE-HEARING CONFERENCE

IN THE MATTER OF
ALBERTA TRANSPORTATION
SPRINGBANK OFF-STREAM RESERVOIR PROJECT

AND IN THE MATTER OF THE
NATURAL RESOURCES CONSERVATION BOARD
APPLICATION NO. 1701

SUBMISSIONS OF THE SR1 CONCERNED LANDOWNERS GROUP (SCLG) NOVEMBER 20, 2020

RICHARD C. SECORD
IFEOMA M. OKOYE

ACKROYD LLP
Barristers & Solicitors
1500, First Edmonton Place
10665 Jasper Avenue
Edmonton, Alberta T5J 3S9

Phone: **(780) 423-8905**
Fax: **(780) 423-8946**

File: **158693/RCS**

Counsel for the SR1 Concerned Landowners Group

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SCLG PRE-HEARING SUBMISSION ~ November 20, 2020

I. INTRODUCTION

1. The Springbank, Bragg Creek and Redwood Meadows Residents (collectively, SR1 Concerned Landowners Group ("SCLG") intends to participate in the December 2, 2020 virtual oral pre-hearing regarding the application by Alberta Transportation for approval to construct the Springbank Off-Stream Reservoir Project ("SR1" or the "Project") on the Elbow River upstream of the City of Calgary.

2. The SCLG is a group of individuals comprised of residents, homeowners and business owners in the Springbank, Bragg Creek and Redwood Meadows area who are directly affected by the proposed Project. The members of SCLG are listed in the SCLG Members List attached at **Tab 1**.

3. Upon application by Alberta Transportation for approval of SR1, SCLG organized to represent the common interests of individuals in the Springbank ,Bragg Creek and Redwood Meadows area who oppose and question the development of SR1 due to the adverse impacts the Project will have on their rights, including the adverse economic, social and environmental impacts of the Project.

4. Many of the SCLG members live and/or own lands and/or conduct business and agricultural operations on, or adjacent to, the Project Development Area ("PDA"). Other members live and/or own lands and/or conduct agricultural operations within a 5 km to 10 km radius of the PDA.

5. A map depicting SCLG members' lands that are on and/or adjacent to the PDA is attached at **Tab 2**.

6. The SCLG submits that the Springbank Off-Stream Reservoir Project is not in the public interest.

7. The SCLG will address the following issues at the Pre-Hearing Conference:

    a. Standing;

    b. Timing of Additional Work and Hearing Process;

c. Appropriate Scope and Jurisdiction of the Review;

d. Location of Public Hearing and Hearing Format;

e. Procedure to be Used at Hearing;

f. Funding; and

g. Site Visit.

II. STANDING

8. As described in the Introduction section of this submission, a significant number of individuals who comprise the SCLG own land which is on or adjacent to the SR1 Project Development Area and/or live in close proximity to the Project. Section 8 of the *Natural Resources Conservation Board Act*, R.S.A. 2000, N-3 ("*NRCBA*") gives persons "directly affected" by a proposed project an opportunity to participate in the hearing process.

9. The *NRCB Intervener Funding Process Guide* outlines that "directly affected" interveners will be interpreted by the Board on a project-by-project basis but describes individuals who may be judged as "directly affected" as: (a) adjacent property owners; (b) individuals who live or work in the vicinity of a proposed project or are able to see or hear the proposed facility or the traffic which may pass into or out of the facility; (c) individuals who would experience direct financial effects; or (d) individuals who regularly use air, water, land or living organisms what would be affected by the proposed project exposing the interveners body or health to elevated risks of adverse effects.

10. Many SCLG members may lose land to expropriation or design flooding if SR1 is approved. Members of the SCLG listed in Tab 2 will be particularly affected by the project. For some of these SCLG members the lands they stand to lose have been in their families for decades and over many generations.

11. In addition to the hazardous effects that the Project will have on the general population of persons who utilize the Elbow River for recreation and rely on its proper water management, the members of SCLG will be uniquely affected by the construction, noise, dust, proposed land use and access, groundwater impacts, lost land, adverse environmental impacts, negative business impacts, consequent decrease in the agricultural productivity of

soils in and beyond the PDA from silt deposition, the introduction and spread of noxious and invasive weed species on their agricultural production, the inevitable design floods that SR1 is aimed to address, and the risk that the experimental SR1 or any of its multiple infrastructure components will experience failure.

12. As a result of the close proximity of the Project and resulting risks of adverse effects of the Project on members of the SCLG, we submit the SCLG falls within the *NRCBA* definition of "directly affected" and should be granted standing.

III. TIMING OF ADDITIONAL WORK AND HEARING PROCESS

13. If the decision from the December 2, 2020 Pre-Hearing Conference was rendered in 14 days, that would take us to December 16, 2020. It is only when the Pre-Hearing Conference Decision is issued, that experts can be fully retained or start working on their expert reports. With the Pre-Hearing Conference Decision, the SCLG will know whether it will receive an award of advance intervener funding and this will allow the SCLG to give assurances to its experts that they will be paid for their work.

14. Once the experts engaged by the SCLG know they will be in receipt of advance funding, they will need approximately 7 to 10 weeks to finish their review of the Project application and to complete their expert reports, assuming there is no Christmas holiday in-between and assuming that the experts do not need further information requests answered.

15. With respect to a formal information request ("IR") procedure, it is the SCLG's position that such a process is necessary for the timely exchange of information. An IR procedure allows for an efficient exchange of information between Alberta Transportation and interested parties and should help to shorten the length of the oral hearing.

16. If a formal IR procedure is to be followed, we submit the following:

    a. The timeline to submit IR's be extended to commence from January 25 given the proximity of the pre-hearing to the holiday season and the fact that the SCLG are still looking to retain experts on some of the aspects of their concerns. Commencing the IR timeline from January 25, 2021 will give the experts including legal counsel enough time to review the proceeding materials and prepare their questions. It will

also allow members of the SCLG and other interveners to spend time with their families and not worry about the timelines established in this application;

b. Alberta Transportation will respond to IR's within 4 weeks after the deadline for interveners to file their information requests;

c. Intervener submissions will be due for filing 4 weeks after the completion of the IR procedure; and

d. Direction be given that the formal IR process does not preclude the SCLG from asking for further information after that deadline, as the experts may not be aware of what further information they need until they are well into their review of the application and preparation of their expert reports.

17. Alberta Transportation and its experts have been working on this application for well over three years. It is unreasonable to expect the SCLG's experts to review and critique the application in less than two months. Furthermore, these experts have other obligations and will have to incorporate this work into their busy schedules.

18. We wish to advise the NRCB that the following expert and legal counsel scheduling conflicts are known to the SCLG at this time:

a. Legal counsel (Ifeoma Okoye) and one expert (Mr. Wallis) are involved in another hearing (Alberta Utilities Commission Proceeding 25469 – Central East Transfer Out Transmission Project) scheduled to commence on March 31, 2021 and end on April 28, 2021. Counsel and the expert will not be available for during the hearing period and are not available on February 17, 2021 and March 12, 2021 when there are active steps to be taken in respect of the hearing; and

b. Legal counsel (Mr. Secord) is involved in a trial in the Court of Queen's Bench of Alberta from April 26 to May 21, 2021.

19. In light of the information set out above in this Section III, the SCLG suggests the following schedule:

Item	**Date**
Prehearing Conference	December 2, 2020

Prehearing Conference Decision	December 16, 2020
Interveners file IR's	January 25, 2021
Alberta Transportation responds to IR's	February 22. 2021
Interveners file hearing submissions	March 29, 2021
Alberta Transportation files a response to intervener submissions	April 26, 2021
Hearing commences	May 31, 2021

IV. SCOPE AND JURISDICTION OF THE REVIEW

20. It is submitted that the purpose of the hearing is to assess the environmental, social and economic impacts of the Project in relation to where the Project will be located and to decide on public interest grounds if the Project should proceed and if so, on what conditions.

21. The SCLG submits the following issues must be addressed:

    a. The need for the Project:

        i. Potential alternatives to the SR1 project and whether these alternatives have been fully and adequately considered and could support the desired outcome with fewer negative effects;

        ii. Project location; and

        iii. Decision process for selecting SR1;

    b. Socio-economic costs of SR1, including project costs analysis and benefits assessment, comparison of costs versus project alternatives;

    c. Dam design, structural integrity, and dam safety risk assessment including assessment of:

        i. Geotechnical hazards of dam and embankment failures, frequency of dam failures and mechanism of dam failure;

        ii. Risk of failure of SR1 or any of its multiple components on SCLG members' lives, health, vegetation and property;

iii. Costs of failure of SR1, or any of its multiple components, security of investments to maintain the SR1 and its components over decades and centuries; and

iv. Alberta Transportation's ability to prevent the failure of SR1, or any of its multiple components, and control of risk effects of the failures.

d. Impacts of Project on groundwater and surface water quality and quantity including groundwater modelling, water quality and geochemical considerations, and climate change impacts regarding project success;

e. Environmental and biodiversity impacts including environmentally significant areas, wetlands, impacts of SR1 on species of management concerns, wildlife, wildlife habitat, and impacts of silt deposition on soil productivity;

f. Impacts of project on aquatic resources and habitat including fish biology, population, sustainability, and habitat loss;

g. Weed Management, introduction of noxious weeds beyond project boundaries and impacts on agricultural production;

h. Air quality and dust dispersal and impacts on SCLG; and

i. Project's management, operations, and reclamation, including significant post-flood activities.

22. The SCLG submits that the above described issues are within the jurisdiction of the Board and are pertinent to the public interest decision that the Board must make.

V. LOCATION OF THE HEARING AND HEARING FORMAT

23. It is our submission that the hearing should be held virtually via Zoom or other suitable platform in light of the current COVID-19 pandemic.

24. There will be a lot of people interested in following the NRCB hearing in 2021, including many of the members of the SCLG. To relieve pressure on the number of participants logging into the Zoom or Webex link, the NRCB should also broadcast the hearing on YouTube and notify participants in advance of the start of the hearing that members of the public are welcome to observe the hearing via the YouTube live stream. In its notification

to the participants, the NRCB should also provide the link to the YouTube live stream. This is being done as we speak for the JRP Hearing into the Grassy Mountain Coal Mine hearing.[1]

VI. PROCEDURE TO BE USED AT THE HEARING

25. It is our position that the hearing should proceed like most other facility hearings that have been held by the NRCB over the past 30 years. In particular, the SCLG requests an opportunity to cross-examine all parties who are adverse in interest to the SCLG such parties who are supportive of the Project as well as any Government or Regulatory panels making presentations at the hearing. The SCLG also requests an opportunity to present evidence and written arguments on its position. The SCLG submits that written argument at the conclusion of the hearing will ensure that all the technical issues are sufficiently summarized in a manner that can assist the NRCB. The SCLG requests that parties be given at least 3 weeks from the conclusion of the evidentiary portion of the hearing to present their written argument.

VII. ADVANCE INTERVENER FUNDING

26. The SCLG is requesting advance funding for costs pursuant to section 37(1) of the *Rules of Practice of the Natural Resources Conservation Board Regulation*, Alberta Regulation 77/2005.

27. Some of the individuals who comprise the SCLG live within close proximity to the Project. Some of these individuals own land that will be lost due to SR1 design floods or will be expropriated for the Project, and many own lands or operate businesses which are adjacent to the Project. Silt disbursement from the proposed SR1 will travel beyond the PDA, particularly during release periods or drought, to the homes and lands owned and occupied by the SCLG members, resulting in adverse economic impacts and negative impacts to use and enjoyment of land, human health, soil productivity, and vegetation. Construction, noise, dust and groundwater impacts will also directly, inevitably, uniquely and seriously impact SCLG members if SR1 is approved. Furthermore, in the event that the experimental SR1 experience failure, the impacts on SCLG members would be catastrophic.

[1] See: https://www.youtube.com/watch?v=J0SrFuM53vo&list=PLFCsR4bP4FNdSbLeobgmrHnqiC_BtkWWy&index=4

28. Section 11 of the *NRCBA* allows individuals, or a group of individuals, "directly affected" by a proposed project to apply for intervener funding. As a result of the close proximity of SCLG members to the Project and resulting impacts of the Project on the SCLG members, we respectfully submit the SCLG falls within the NRCB definition of "directly affected" and therefore it should be granted intervener funding.

29. The members of the SCLG have limited knowledge of many of the technical issues related to the Project application and the hearing process. Therefore, in order to effectively participate in the hearing, they require expert advice and legal counsel. As they receive no financial benefit from the Project, they should not have to finance the cost of the experts and legal counsel. Furthermore, the members of the SCLG represent average citizens, who do not have the financial means to retain such assistance.

30. The resources which are provided through the advance intervener funding process will ultimately determine which experts the SCLG is able to retain, and ultimately this will determine the scope of the evidence which the SCLG will be able to present at a hearing.

31. The SCLG will incur many costs even if advanced intervener funding is provided. The SCLG has expended and will continue to expend tremendous voluntary contributions, a great deal of time and energy dealing with this application, and has incurred, and will continue to incur, out-of-pocket expenses. They have attended many meetings and reviewed and contributed to many documents related to the Project. They will have to take time off work to attend the pre-hearing meeting and the hearing itself. The Board's honorarium for attendance at the pre-hearing meeting and at the hearing is considerably less than what many members of the SCLG earn at their regular work. None of these activities provide a financial benefit to the members of the SCLG.

32. In order to conduct a fair hearing, the Board should hear from experts other than those presented by Alberta Transportation.

33. Without advance intervener funding, the SCLG cannot assure its experts that they will be paid for their time and expertise and therefore, cannot retain them. Given the unprecedented nature of this Project in Canada and the consequences of a failure, if it occurs, it is imperative that all aspects of this Project undergo independent expert review.

34. In general, the SCLG proposes to have experts to critique and review the Project application and EIA, note any deficiencies and the significance of those deficiencies. Specifically, the experts for the SCLG will review the following:

    a. Impacts of Project on groundwater and surface water quality and quantity including groundwater modelling, water quality and geochemical considerations, and climate change impacts regarding project success: (Dr. Jon Fennell);

    b. Impacts of SR1 on environmentally significant areas, wildlife, wildlife habitat, species of management concern, and other biodiversity concerns including, the impacts of silt deposits on soil productivity: (Mr. Wallis);

    c. Project design and safety, including review of the Project's maintenance, repair and upgrading needs over its lifetime as well as an assessment of failure causes and likelihood and consequences of these issues on members of the SCLG and downstream residents. The SR1 design is experimental in nature and requires further review to assess its safety and effectiveness: (**Geotechnical and Safety Expert not yet retained; Potential Risk Assessment Expert – Dr. Brian Zelt**);

    d. Effects of SR1 on aquatic resources including fish species, population, aquatic habitat in the Project area including but not limited to Westslope Cutthroat Trout and Bull Trout habitat, migration and breeding grounds. Implications of adverse fish impacts and the direct effects this will have on SCLG members and their recreational enjoyment of the PDA: (**Expert not yet retained**);

    e. Air quality and dust dispersal and impacts on SCLG members; (Dr. Brian Zelt); and

    f. Weed dispersal, weed management and the impacts of noxious weeds introduced by the Project on agricultural activities: (Dr. Osko).

35. In that regard, the SCLG proposes to retain experts on the following areas:

A. Water Management

Dr. Jon Fennell, M.Sc., Ph.D., P. Geol

36. The SCLG proposes to retain Dr. Jon Fennell to provide an expert opinion on hydrogeology including groundwater modelling, water quality including geochemical considerations, and a climate change impact assessment.

37. Dr. Fennell has been a practicing consultant in the natural resource sector for over 30 years. His expertise includes the analysis and development of local and regional-scale groundwater systems, mine assessment and dewatering strategies, water supply and disposal systems, and groundwater-surface water interaction.

38. SCLG questions the acceptability of Alberta Transportation's risk assessment regarding flood likelihood and is concerned that issues such as glacial till, snow melt and climate change have not been adequately assessed in this regard. Furthermore, the SCLG is concerned with the impacts of the Project in the face of drought, likely future outcomes of the Project based on precipitation records in the area, and the inadequacy of Alberta Transportation's reliance on historic flood levels without proper consideration of climate change's impact on frequency and severity of weather events, both flood and drought. The SCLG is also concerned that Alberta Transportation's projections regarding the necessary Emergency Planning Zone have not been satisfactorily assessed and that the projections will cease to be of any accuracy once the first design flood does occur. Dr. Fennel will be addressing these issues and their significance to the members of the SCLG.

39. Dr. Fennell will conduct a review, consult with legal counsel, and prepare and respond to information requests, , prepare a report and attend the hearing to provide expert evidence.

40. Dr. Fennell's *CV* is attached at **Tab 3**. Dr. Fennel's budget is attached at **Tab 4**.

B. Biodiversity

Mr. Cliff Wallis, P. Biol - Cottonwood Consulting Ltd

41. The SCLG proposes to retain Cliff Wallis of Cottonwood Consulting Ltd. to provide a biodiversity focused technical review and expert report on the Environmental Assessment and application by Alberta Transportation for development of SR1.

42. Mr. Wallis has 50 years of experience coordinating and undertaking biological surveys, ecological studies and species at risk evaluations. He will review the impacts of SR1 on environmentally significant areas, important wildlife habitat, species of management concern, other biodiversity issues including. The SCLG question Alberta Transportation's assumption that PDA lands will remain productive and that animals such as the elk population will continue to use the area. Mr. Wallis will be addressing these issues and their significance to the members of the SCLG.

43. Mr. Wallis will review the application materials, prepare and respond to information requests, prepare a report on this issue, attend the hearing to provide expert evidence and answer questions.

44. Mr. Wallis's *CV* is attached at **Tab 5**. Mr. Wallis's budget is attached as **Tab 6.**

C. Dam Design and Dam Safety Risk Assessment

Expert not yet retained.

45. The SCLG proposes to retain an expert in civil engineering, dam design, construction, and dam safety risk assessment, to provide an expert opinion on the design, safety, consequences and risks associated with the potential failure of the experimental SR1 dam design, the risks and the associated ongoing maintenance that SR1 will require well into the future.

46. Risks to members of the SCLG in communities and planned emergency response actions, both upstream and downstream from a major failure at the Project site are of great concern to the SCLG and should be carefully assessed and critiqued. As SR1 is an experimental design, the risks to SCLG members remains largely unknown. In addition to a review of the

structure sections of the Alberta Transportation application and EIA, the expert(s) will provide an analysis of impacts from likely, probable and worst-case scenarios, including the application of water incursion modeling to estimate worst-case impacts that members of the SCLG may be exposed to and will assess likelihood of dam failure.

47. The SCLG are also concerned about the operational costs to maintain SR1 in safe conditions over the decades and centuries that it will be active if the Project is approved. The SCLG is concerned that, over time, operational maintenance costs will become increasingly important to the Project's safety but will become decreasingly important to the Operator in terms of budget allocation. The expert will assess maintenance requirements for SR1 and review the most likely causes of dam failure as well as provide a quantitative risk assessment, compared to accepted individual and societal risk standards, to address the significance of these issues to the members of the SCLG.

48. The SCLG is searching for potential experts in this area and expects to retain an expert on dam safety and risk assessment. The SCLG hopes to retain one expert with expertise in assessing the design of the Project, its safety implications and conduct a risk assessment of potential hazards and extent of the impacts of the hazards should they occur. The SCLG realizes that it may be difficult to get one expert with expertise in the different aspects of this important issue. As such, Dr. Zelt may provide assistance to the design and safety engineer in assessing the risk of the dam failure. Dr. Zelt's budget indicates the cost of providing that assistance, if needed. The SCLG requests that the NRCB permit them to submit a budget for the geo-technical expert once retained and that the NRCB considers the budget in the award of advance cost. The expert(s) will review the application materials, prepare and respond to information requests, provide their findings in a written report and will attend the hearing to present evidence as to their findings.

D. Air Quality and Dust

Dr. Brian Zelt

49. The SCLG proposes to retain Dr. Brian Zelt of Zelt Professional Services Inc. to provide a professional opinion on the impacts of SR1 on air quality and the dust that will be generated and dispersed due to the Project construction and operation.

50. The SCLG question whether Alberta Transportation has adequately accounted for the effects of post-flood silt on air quality in the local area. In 2013, the silt from the flood had dozens of toxins and people we told not to breathe it or touch it. Further, SR1 silt will have some quantity of decaying organic matter - dead fish, animals, etc. Dr. Zelt will consider how these matters factor into the assessment of the Project for the public good.

51. Dr. Zelt has 30 years of experience coordinating and undertaking air quality and dust impacts assessments. He will review the impacts of SR1 on air quality and dust impacts. Dr. Zelt will review the application materials, prepare and respond to information requests, prepare a report on this issue, attend the hearing to provide expert evidence and answer questions.

52. Dr. Zelt's *CV* is attached at **Tab 7**. Dr. Zelt's budget is attached as **Tab 8**.

E. Fish Impacts

Expert not yet retained.

53. The SCLG proposes to retain a fisheries biologist expert to provide a professional opinion on the impacts of SR1 on fish populations in the Elbow River along the stretch of river which will be impacted by SR1 including but not limited to SR1's impact on Mountain Whitefish, Westslope Cutthroat Trout and Bull Trout habitat, migration and breeding grounds.

54. SCLG members are concerned that a flood, diverted into and subsequently released from the SR1 Project, will destroy the downstream aquatic ecosystem following that flood. Further, the design floods, which are inevitable, will impact fish drawn into the reservoir and leaving the reservoir. It could lead to fish entrapment. The Proponent has inadequately assessed fish impacts under the probability of a 1:100 likelihood. The expert will examine the impacts of these "1:100" floods (which have occurred twice in the last 15 years) as well as the impacts on trout during design floods and construction of the proposed Project and the impacts on the broader ecosystem. The Proponent has not completed adequate fish studies for SR1 particularly regarding release of impounded waters back into the Elbow River and the effect of such releases on the downstream aquatic ecosystem.

55. The SCLG has not retained an expert in this area. The SCLG continues to look for an expert in this area. The SCLG requests that the NRCB permit them to submit a budget for the expert once retained and that the NRCB considers the budget in the award of advance cost. The potential expert will review the application materials, prepare and respond to information requests, provide their findings in a written report and will attend the hearing to present evidence as to their findings.

F. Noxious Weeds

Dr. Terry Osko

56. The SCLG proposes to retain Dr. Osko to examine the impact SR1 will have on introduction of weeds in and beyond the PDA, necessary weed management and the impacts of noxious weeds introduced by the Project on agricultural activities, natural vegetation and wildlife in the area.

57. Dr. Osko will review the application materials, prepare and respond to information requests, prepare a report on this issue, attend the hearing to provide expert evidence and answer questions.

58. Dr. Osko's *CV* is attached at **Tab 9**. Dr. Osko's budget is attached at **Tab 10**.

G. Risk Management

Dr. Brian Zelt

59. The SCLG proposes to retain Dr. Zelt to assist in providing a professional opinion on the risks of the Project failure, delineation of the Emergency Planning Zone (EPZ) and proper risk management planning in the Project's EPZ and the impacts of the Project's failure on SCLG and downstream resident communities. As stated earlier, Dr. Zelt will work in collaboration with the Project design and safety engineer when retained, assuming that the safety engineer requires assistance in preparing the risk assessment analysis and report.

60. Dr. Zelt will review the application materials, prepare and respond to information requests, collaborate in the preparation of a report on this issue, if necessary, attend the hearing to provide expert evidence, if necessary.

61. Dr. Zelt's *CV* is attached at Tab 7. Dr. Zelt's budget is attached at Tab 8.

H. Legal Counsel

62. The members of the SCLG require specialized legal assistance with the hearing process. This application is complicated for the members of the SCLG and they require assistance to organize their intervention, prepare and present their evidence at the hearing and to cross-examine Alberta Transportation's panel of experts. In that regard they have retained Ackroyd LLP to assist them.

63. Richard Secord and Ifeoma Okoye will provide the primary legal representation for the SCLG. Richard Secord has been practising law in Alberta since 1979. He has appeared in over 120 energy, utility and environmental hearings. Ifeoma Okoye has been practicing law in Alberta since 2013 and practiced law in Nigeria from 2003 – 2005. She has appeared in over 20 energy, utility and environmental hearings. The number of SCLG members and the complicated nature and size of the Alberta Transportation application requires the active participation of two counsel. Mr. Secord and Ms. Okoye will also be assisted by junior associate, Emily Bonnell, at their firm as required.

64. Ackroyd LLP's specific involvement with the Alberta Transportation application, to date, has included the following:

    a. Explaining the process to the SCLG;
    b. Working with the SCLG to determine the issues;
    c. Contacting and retaining experts and explaining the process to them; and
    d. Preparing the submission for the Pre-Hearing Conference.

65. Ackroyd LLP's future involvement will include the following:

    a. Reviewing Alberta Transportation application, EIA and proceeding material to date;
    b. Attending the Pre-Hearing Conference;
    c. Preparing information requests and providing direction to the experts on the IR process;
    d. Assisting members of the SCLG with their submissions;

e. Assisting the SCLG with their examination-in-chief;

f. Preparing written submissions;

g. Briefing the experts for the hearing;

h. Briefing the SCLG members for the hearing;

i. Attending the hearing;

j. Cross-examination of the Alberta Transportation panel(s);

k. Cross-examination of other parties who are adverse in interest;

l. Examination-in-chief of the SCLG landowner panel

m. Examination-in-chief of the SCLG expert panel; and

n. Final argument at the conclusion of the hearing.

66. A copy of Ackroyd LLP's budget is attached as **Tab 11.**

I. Summary

67. In conclusion, the SCLG proposes to retain the following:

No.	Area	Expert/Lawyer	Budget	GST	Total
A.	Water Management	Dr. Fennell	$21,000.00	$1,050.00	$22,050.00
B.	Biodiversity	Mr. Wallis	$29,430.00	$1,471.50	$30,901.50
C.	Dam Design	Not yet retained	0	0	0
D.	Air quality and dust	Dr. Zelt	$12,000.00	$600.00	$12,600.00
E.	Fish Impacts	Not yet retained	0	0	0
F.	Noxious Weeds	Dr. Osko	$34,800.00	$1,740.00	$36,540.00
G.	Risk Assessment	Dr. Zelt	$36,000.00	$1,800.00	$37,800.00
H	Legal Counsel	Ackroyd LLP	$204,650.00	$10,232.50	$214,882.50
		Total	**$337,880.00**	**$16,894.00**	**$354,774.00**

68. It is respectfully submitted that in order to facilitate the effective participation of the SCLG the NRCB should award advance costs to the SCLG in the amount of **$177,387.00**, representing 50% of the proposed budgets for the experts and legal counsel.

69. A completed NRCB Intervener Funding Advance Award Costs Application Form is attached at **Tab 12**.

VIII. TRANSCRIPTS

70. There is a tremendous amount of interest in Alberta Transportation's project and in light of this interest, the SCLG requests that the NRCB arrange for daily transcripts from the hearing to be posted on the NRCB website.

71. The SCLG note that this was done in 2004 with respect to NRCB Application 03/01 filed by Agrium Products Inc.[2] and in 2008 with respect to NRCB Application 0602 filed by Glacier Power Ltd.[3]

72. Posting the transcripts to the NRCB website will allow interested parties, including expert witnesses, to keep up with the hearing without having to be in attendance for each day of the hearing. The daily transcripts will also be useful for counsel with respect to delivering final oral or written argument.

73. As indicated in paragraph 24, the SCLG requests that the NRCB should broadcast the hearing on YouTube and notify participants in advance of the start of the hearing that members of the public are welcome to observe the hearing via the YouTube live stream. A link to the YouTube live stream should be provided on the NRCB's webpage as well.

IX. SITE VISIT

74. The SCLG submits that the NRCB panel should visit the proposed site and the surrounding area pursuant to section 44 of the *Rules of Practice of the Natural Resources Conservation Board Regulation*, Alberta Regulation 77/2005. It is the SCLG's position that this will assist the panel in understanding the area and the impacts that the Project will have on the nearby residents and landowners.

[2] http://mail.tscript.com/trans/nrcb/feb_23_04/index.htm
[3] http://mail.tscript.com/trans/nrcb/sep_22_08/index.htm

ALL OF WHICH IS RESPECTFULLY SUBMITTED THIS 20TH DAY OF NOVEMBER, 2020.

ACKROYD LLP

"Original signed by"

Per: _____

RICHARD C. SECORD & IFEOMA M. OKOYE
Counsel for the SCLG

IX. APPENDICES

1. SCLG Members List
2. Directly Affected Landowners Map and location
3. Dr. Fennell CV
4. Dr. Fennell Budget
5. Mr. Wallis CV
6. Mr. Wallis Budget
7. Dr. Brian Zelt CV
8. Dr. Brian Zelt Budget
9. Dr. Osko CV*
10. Dr. Osko Budget*
11. Ackroyd LLP Budget
12. Completed NRCB Intervener Funding Advance Award Costs, Application Form

SR1 LANDOWNERS CONCERNED GROUP
November 19, 2020

No.	Last Name	First Name	Street Address	Legal Land Description

This page has been redacted by the NRCB. The redacted content includes names and addresses of SCLG members. Parties may request access to the redacted information by contacting the NRCB. Requests should identify the information requested and the purpose for making the request.

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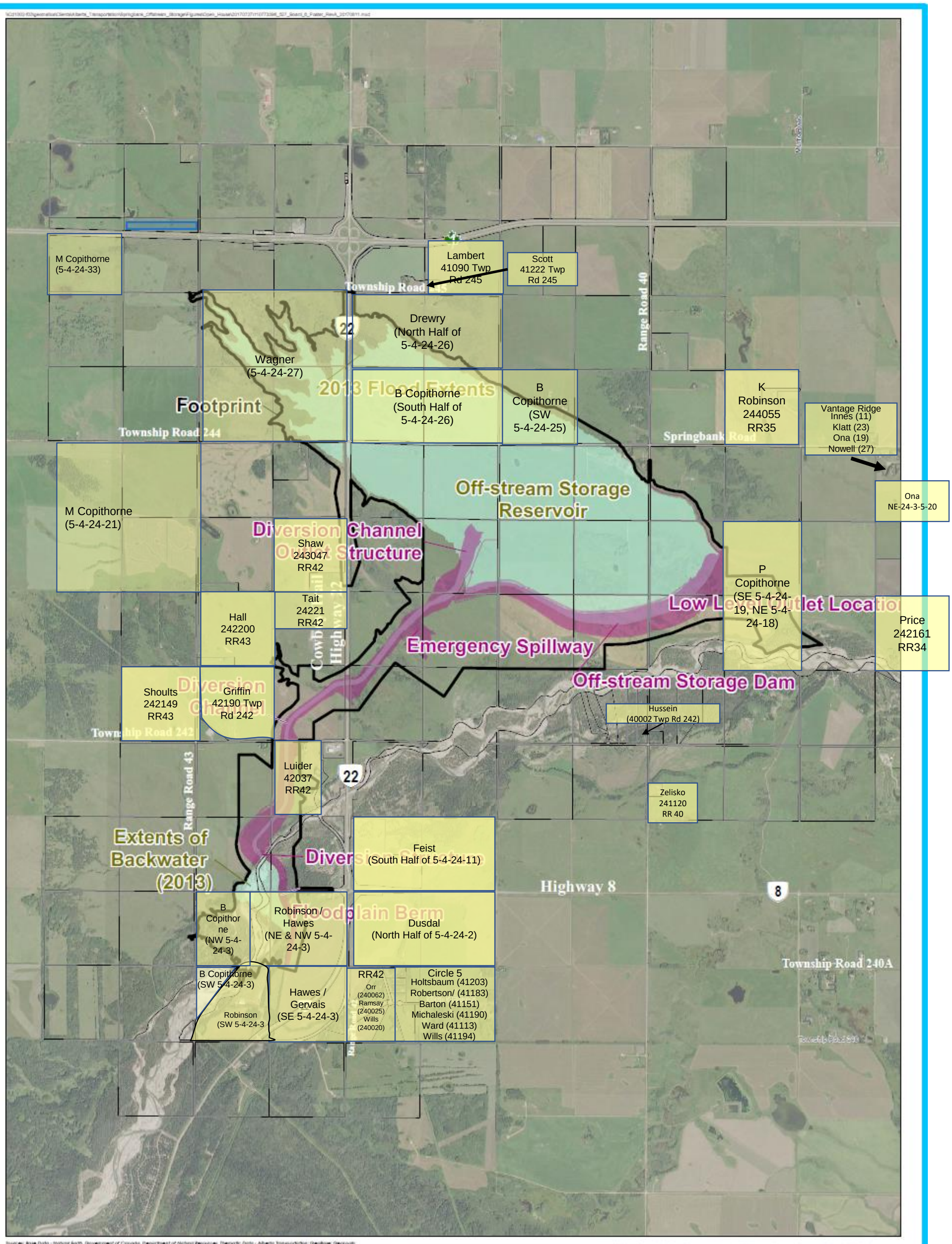


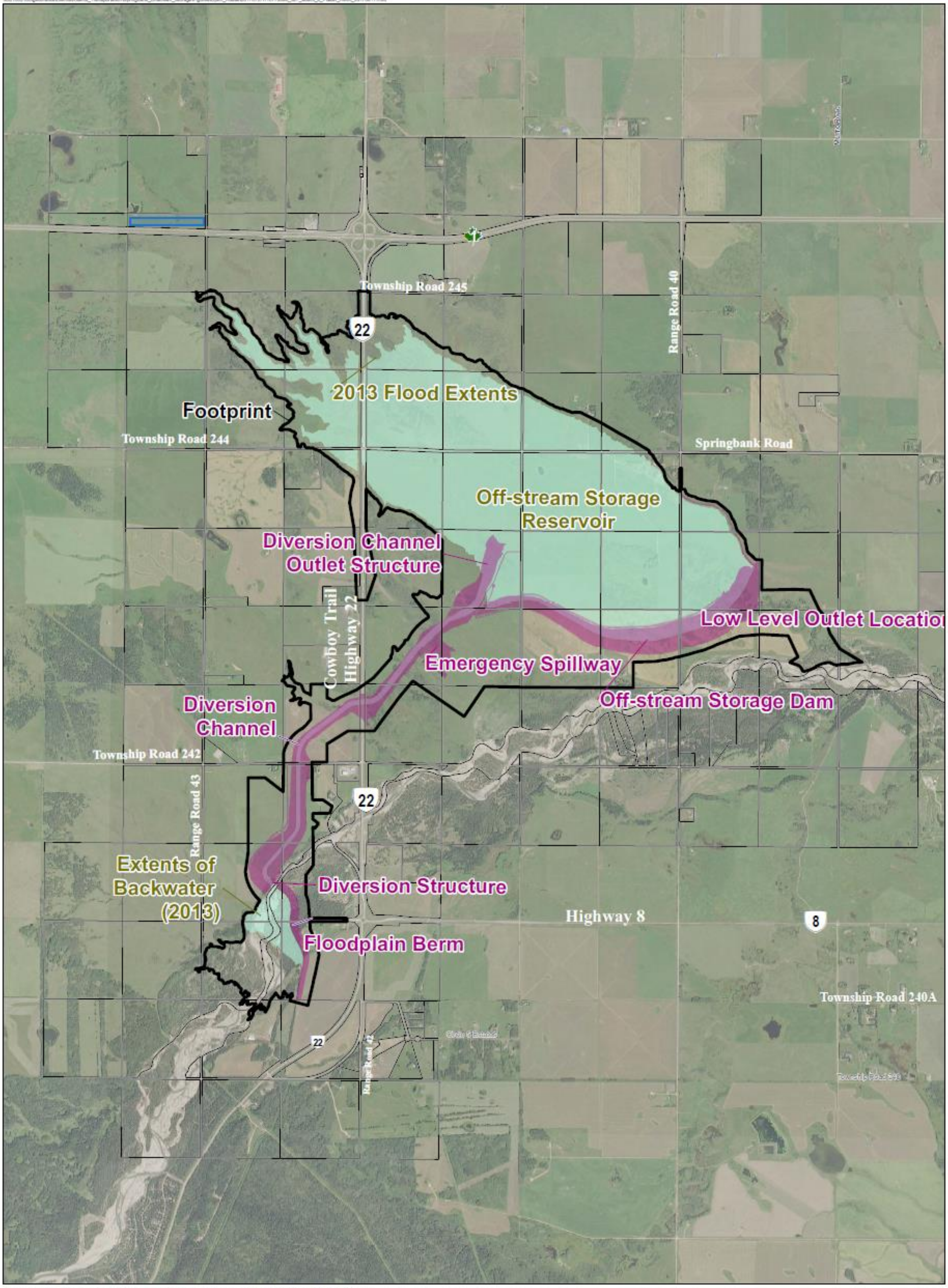
Sources: Base Data - Natural Earth, Government of Canada, Department of Natural Resources, Thematic Data - Alberta Transportation; GeoBase; Geology;
Land ownership based on titles received from Land Titles on Dec 22, 2014

Disclaimer: This map is for illustrative purposes to support this Stantec project questions can be directed to the issuing agency.

Springbank Off-stream Storage Reservoir Open House
For Information Purposes

Stantec Alberta Government

Figure 1-1



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Springbank Off-stream Storage Reservoir Open House
For Information Purposes

Stantec Alberta Government

Figure 1-1

Jonathan Fennell, M.Sc., Ph.D., P.Geol.
Hydrogeology | Geochemistry | Water Resources

Resume

SUMMARY

Dr. Jon Fennell has been a practicing consultant in the natural resource sector for over 30 years. His expertise includes the analysis and development of local and regional-scale groundwater systems, mine assessments and dewatering strategies, water supply and disposal systems, groundwater-surface water interaction assessments, implementation of monitoring and management systems, and environmental forensics including: i) remote sensing, ii) application of geophysical methods, iii) geochemical assessment & modelling, and iv) the application of stable and radiogenic isotopes to support source water tracing, chemical fingerprinting, and age-dating. He has also been involved in a number pf projects requiring expertise in climate variability and climate change assessment, including the role major tele-connections and the development of sustainable adaptation strategies. The bulk of Jon's experience is associated with various oil & gas and mineral resource development projects in Canada and abroad. Over the last decade, Jon has worked closely the Alberta Government through various initiatives to support the Water for Life Strategy and cumulative effects management in the province. A primary area of focus is developing management processes to ensure water security, and communicating the importance of data, information and knowledge as it applies to responsible development.

POSITIONS HELD

2019 to Present	Program support, Expert-in-Residence – SAIT Integrated Water Management Program
2018 to Present	Technical Advisory Committee – Oil Sands Monitoring program (Joint Alberta Environment and Parks/Environment and Climate Change Canada)
2013 to 2017	Department of Renewable Resources, University of Alberta (Adjunct position) Department of Geography, University of Lethbridge (Adjunct position)
2012 to Present	Vice President, Advisory Services (Water Security and Climate Resiliency), Principal Hydrogeologist, Geochemist, and Technical Lead) – Integrated Sustainability, Calgary
2007 to 2012	Director, Water Resources (Canada) – WorleyParsons, Calgary
2005 to 2007	Vice President, Water Resources and Principal Hydrogeologist – WorleyParsons Komex, Calgary
2003 to 2006	Member of the Canadian Management Team – Komex International Ltd., Calgary
2003 to 2007	Group Leader – Komex International Ltd., Calgary
1990 to 2005	Senior Hydrogeologist – Komex International Ltd., Calgary
1985 to 1990	Petroleum Geologist – Industry Consultant, Calgary

EXPERIENCE

Mining

Alberta Environment and Parks

Preparation of oil sands tailings pond seepage review report. Responsibilities included:

- Review of background information pertaining to oil sands produced water (OSPW) seepage research and natural bedrock groundwater discharge studies
- Review of industry-submitted EPEA compliance reports to assess current "state of affairs" regarding monitoring and OSPW detections
- Assessment of seepage management systems
- Review of geological pathways for OSPW migration
- Development of seepage risk profiles for all active tailings ponds

Alberta Environment and Parks

Provision of external expert review for the Implementation Directive for the Surface Water Body Aggregate Policy (SWBAP) for gravel mining in floodplain areas. Responsibilities include:

- Review of relevant Government of Alberta documents relating to aggregate mining in or near surface water bodies and/or floodplain environments
- Use of information from relevant policies in other jurisdictions as well as studies and research (aquatic, terrestrial, river morphology, climate risk) regarding impacts of aggregate mining in floodplain areas
- Identification of gaps regarding goals and objectives of the approval and management process
- Review of risk assessment approach to approving aggregate mines near surface water bodies, and provision of recommendations for monitoring, evaluating and reporting
- Interaction with AEP project team members and presentation of results

Blackbird Mine, Idaho, USA

Completion of a hydrogeological baseline study and associated stable isotope investigation ($\delta^{34}S$, $\delta^{18}O$, and $\delta^{2}H$) to determine the source of acid mine drainage near active underground workings. Responsibilities included:

- Review of existing geochemical data and related mineral equilibria conditions (i.e. baseline and impacted)
- Assessment of geochemical reactions leading to acid mine drainage conditions, including biogeochemical aspects.

Canada's Oil Sands Innovation Alliance (COSIA)

Completion of a tailing pond seepage risk assessment and preparation of a peer-review journal manuscript to place suspected oil sands impacts into perspective. Responsibilities included:

- Review of individual tailings ponds established at the various operating oil sands mines in the Athabasca Oil Sands region

- Application of source-pathway-receptor model in relation to calculated groundwater flow velocities, stand-off distances from receptors, and natural attenuation properties to assess risk associated with each structure
- Preparation of manuscript to place into context natural discharge of low-quality groundwater from bedrock formation versus oil sands seepage

Graymont Western US Inc.

Preliminary development of a mine dewatering and water management strategy for a large limestone quarry located in the eastern from ranges of the Rocky Mountains. Responsibilities included:

- Assessment of baseline hydrogeological and hydrogeochemical conditions in a mountain environment
- Source water fingerprinting and groundwater age-dating
- Fracture and lineament analysis using structural geology and geophysical analysis (GPR, borehole tele-viewer)
- GW-SW interaction assessment (i.e., Bow River)
- Conceptualization of dewatering strategy utilizing oriented and horizontal well technology
- Issues identification and risk analysis

Imperial Oil Ventures Ltd.

Conceptual model design for dewatering scheme in support of mine development. Responsibilities included:

- Assessment of geological conditions
- Boundary assessment
- Parameter selection and optimization
- Assessment of model results

JDS Energy & Mining

Review of mine dewatering and water treatment & disposal strategy for gold mine in Guatemala. Preparation of proposed strategy to assess mitigation strategies (e.g. back pressure system) for hot water up to 160°C entering mine and flashing upon dewatering and subsurface disposal of arsenic-laden mine waters (including transport, fate, and risk assessment).

Suncor Energy

Preparation of an AB Environment approved Groundwater Management Plan at a large oil sands mining operation. Activities included:

- The design of a cost-effective sampling schedule including rationalization of over 300 wells to establish a meaningful monitoring network of 150 wells

- Development of statistically established trigger values for response and mitigation
- Liaison with Government of Alberta during review and approval

Suncor Energy

Various projects:

- D51 disposal monitoring at the Firebag Thermal In Situ Project
- Thermal mobilization assessment
- Preparation of an oil sands mining closure strategy outlining goals, objectives, tasks, timelines, and consulting and research agencies to execute in support of Life of Mine Closure and Reclamation process
- Assistance with Fort Hills Operational Plan regarding preservation of McClelland Lake and wetland complex; review of physical hydrogeology and geochemical setting; assessment of numerical model design and output; review of cut-of wall design and mitigation system; review of adaptive management processes
- Review of Devonian – McMurray interactions at the North Steepbank mine expansion and assistance with investigation program design (including geochemical assessment)
- Completion of geophysical and porewater surveys on the Athabasca and Steepbank Rivers to determine contributions of natural discharge versus industry inputs

Syncrude Canada

Participation on expert hydrogeology panel to review Devonian investigation program for Aurora mine and assess mitigation strategies to control high risk areas (Les Gray - UBC, Carl Mendoza, - UofA, Ken Baxter - Golder, Jon Fennell - WP). Responsibilities included:

- Review of existing baseline data for active mining site
- Identification of high-risk areas to consider for future investigation and monitoring
- Participation in group workshop settings to communicate findings and accumulate input for recommendations refinement
- Participation in internal panel meetings to discuss concepts and develop final recommendation

Talisker Resources Ltd.

Review of mine water balance, dewatering strategy, impact analysis and Arsenic source-tracing (Bralorne Mine, BC) to develop mitigation system for cost-efficient water treatment (including upset conditions of higher flow rates).

Teck Resources Limited

Evaluation of stream response to groundwater interception in support of fisheries habitat offsetting at Line Creek Mine, BC. Responsibilities included:

- Baseline reconnaissance of Line Creek alluvial system and GW-SW water interactions with Line Creek

- Assessment of area springs, shallow groundwater, and creeks to determine geochemical quality and flow conditions (using drive point well technology and data logger systems)
- Completion of ground penetrating radar survey to map thickness and morphology of alluvial deposits
- Water quality fingerprinting using major ion, trace elements (in particular selenium) and stable isotopes to determine interaction of groundwater environment with Line Creek

Assessment of selenium mobilization conditions related to active mine workings and development of a conceptual (passive) mitigation strategy to offset impacts to fisheries habitat

Total E&P

Support for mine dewatering strategy. Responsibilities included:

- Development of baseline hydrogeology
- Liaison with project team and governing agencies
- Joint Panel hearing support
- Selection and phasing of depressurization wells and associated monitoring wells
- Review of deep well injection potential, including geochemical compatibilities of waters
- Development of a performance monitoring system
- Selection of pipeline route
- Preparation of a design-based memorandum with related costs of implementation and long-term operation

Geochemistry

Amoco Canada

Completion of a stable isotope study using $\delta^{34}S$, $\delta^{18}O$, $\delta^{2}H$, $\delta^{13}C$ to determine the source of anomalous groundwater sulphate concentrations (natural vs. anthropogenic)

Canadian Occidental

Completion of a stable isotope studies to determine the source of sulphate impact from two large sour gas processing facilities (Balzac and Okotoks). Responsibilities included:

- Drilling, installation, and testing of monitoring wells
- Development of a conceptual site model
- Review of site-wide geochemistry (soil and groundwater)
- Application of $\delta^{34}S$, $\delta^{18}O$, $\delta^{2}H$, and $\delta^{13}C$ isotopes to resolve natural versus anthropogenic influences

Canada's Oil Sands Innovation Alliance (COSIA)

Completion of regional geochemical assessments in NE Alberta (35,000 km^2 area) supporting the Regional Water Management Initiative. Responsibilities included:

- Collation of regional geological, hydrogeological, and geochemical data using public domain and industry information
- Assessment and interpretation of hydrogeological setting and of conceptual models
- Assessment of traditional and isotope geochemistry to determine source water chemistry to define flow path phenomena areas of aquifer interactions
- Statistical analysis of data to determine groupings and associations (PCA analysis)
- Documentation and presentation of results at various public venues

Cumulative Environmental Management Association (CEMA) and Alberta Environment (AENV)

Assessment of baseline hydrological and hydrogeological conditions and development of a regional-scale groundwater quality monitoring network (18 000 km^2 study area) located in the Athabasca Oil Sands Region of northeast Alberta. Responsibilities included:

- Refinement of conceptual hydrogeological model
- Groundwater-surface water interaction assessment
- Assessment of quality conditions and trends (including statistical analysis)
- Knowledge and data gap analysis
- Pathway identification and vulnerability assessment for sensitive receptors
- Field reconnaissance and well selection
- Isotope interpretation ($\delta^{18}O$, $\delta^{2}H$, $\delta^{13}C$, Carbon-14)
- Groundwater hydrograph analysis
- Report preparation and presentation
- Liaison with government and industry representatives

Department of Environment and Resource Management, Queensland, Australia

Lead for a hydrogeochemical assessment and water fingerprinting exercise in Great Artesian Basin aquifers of the Surat and Bowen basins to support Coal Seam Gas development and cumulative effects analysis. Responsibilities included:

- A comprehensive data and information inventory to facilitate source water fingerprinting and collation of large public-domain data sets to provide a first-of-its-kind database of water quality information
- Review of major ions, metals and trace elements, stable and radiogenic isotopes and dissolved gases to identify recharge phenomenon, cross-formational flow characteristics and distinct water types
- Statistical analysis to assess data groupings and spatial trends

East Calgary, AB

Detailed assessment of hydrogeological and hydrochemical conditions in the vicinity of residential water wells to identify locally used aquifers, variation in water quality, groundwater availability and the potential of impact from nearby sour gas production wells.

Government of Yemen

Hydrogeological and geochemical support for a regional-scale study of water supply potential in the country. Responsibilities included:

- Hydrogeological and hydrogeochemical facies mapping,
- Geochemical assessment and flow path evolution modelling,
- Groundwater flow field assessment and modelling,
- Sustainable yield evaluation
- Groundwater tracing & age dating (trace elements; stable and radiogenic isotopes)

Imperial Oil

Completion of field and bench-scale tests to determine facilitated mobility of metals, trace elements, and dissolved organics resulting from artificial ground heating around thermal in situ wells. Responsibilities included:

- Tracer experiment to determine groundwater flow velocities in a deep (>80 m) confined aquifer. Responsibilities have included:
- Drilling, installation, testing, and sampling (soil and water) from 22 deep (up to 90 m) monitoring wells at a newly established thermal in situ pad to determine baseline geochemistry and groundwater flow directions
- Completion of a tracer test (deuterated water) to determine groundwater flow velocities
- Collection of sediment samples (under anoxic conditions) for bench-scale heating experiments to determine metals mobility and related kinetics
- Review of stable isotopes in groundwater and dissolved gases to determine effects of heating from in-situ thermal wells on local geochemical conditions (inorganic and organic constituents)
- Reaction path modelling to determine processes influencing changes metals concentrations and biological activity resulting from subsurface heating
- Determination of activation energies for metals release, and the role of biogeochemical reactions in facilitating metals release
- Transport and fate modelling to determine the long-term risk of thermal mobilization of metals (and other related constituents) to the surrounding environment
- Documentation of result and liaison with client and regulatory agencies

Imperial Oil Resources

Completion of numerous isotope studies using to determine groundwater flow rates in regional confined aquifers and the source of anomalous groundwater quality conditions and dissolved gas concentrations near a large heavy oil recovery operation using:

- Assessment of $\delta^{18}O$, $\delta^{2}H$, $\delta^{34}S$, $\delta^{11}B$ and $\delta^{13}C$
- Tritium and Carbon-14 for groundwater age-dating

Imperial Oil Resources

Tritium age dating of groundwater in Norman Wells, NWT to determine vertical groundwater flow characteristics in discontinuous permafrost environment

Mobil Oil Canada

Completion of a stable isotope study to determine the source of sulphate impact from a large sour gas processing facility. Responsibilities included:

- Drilling and installation of monitoring wells
- Development of a conceptual site model
- Review of site-wide geochemistry (soil and groundwater)
- Application of $\delta^{34}S$, $\delta^{18}O$, $\delta^{2}H$, and $\delta^{13}C$ isotopes to resolve natural versus anthropogenic influences

Nexen ULC

Design and completion of bench-scale testing to determine the mobilization of metals and trace elements under applied heating. Responsibilities included:

- Conceptual design of experimental process in collaboration with AGAT lab representatives
- Assessment of frozen core samples and selection of appropriate intervals for physical (grain size, mineralogy via XRD) and chemical testing (total metals, leachable metals)
- Assessment of results from sequential batch heating experiments extending from 5-100°C for metals species released to solution
- Geochemical modelling of kinetic experiment results to determine activation energies of metals release
- Completion of attenuation experiments to determine potential for mobilized metals to re-associated with sediments under cooled conditions
- Preparation of a summary report and presentations to the client in support of AER interactions

Suncor Energy

Development of an Athabasca River reconnaissance program to identify and sample natural groundwater-surface water interaction zones discharging waters from the Cretaceous and Devonian formations. Responsibilities included:

- Planning/execution and interpretation of a marine-based geophysical program using EM31 imaging and bathymetric readings

- Development of pore water sampling program including geochemical assessment of waters and source fingerprinting (major ion, trace element, dissolved organics and stable and radiogenic isotopes)
- Interpretation of results and presentation at various venues (government, industry)

Suncor Energy

Groundwater age-dating and source area identification in support of active tailings pond seepage investigations. Responsibilities included:

- Conceptual site model design
- Review of traditional geochemistry to determine end-point water types
- Application of Tritium, $\delta^{18}O$, $\delta^{2}H$, $\delta^{34}S$, $\delta^{11}B$ to resolve geochemical setting and potential areas of seepage

Climate change (International)

Canadian International Development Agency, Catamayo, Ecuador SA

Completion of a baseline soil and groundwater study (physical and chemical) to determine the feasibility of siting an engineered wastewater impoundment for the treatment of municipal sewage treatment (project funded by CIDA). Responsibilities included:

- General site reconnaissance
- Collection of soil and groundwater samples for baseline geochemical quality assessment
- Review of watershed conditions and processes relating to baseline hydrology and hydrogeology
- Assessment of climate aspects to regarding timing and magnitude of river flows, implications of changing conditions and influence of climate cycles
- Submission of recommendations on the suitability of the proposed location and possible approaches to rectify existing limitations

Department of Environment and Resource Management, Queensland, Australia

Lead for water security assessment to assess groundwater and groundwater-dependent ecosystem risks from Coal Seam Gas development in southeast Queensland. Responsibilities included:

- Development of a multi-criteria weighting and ranking system linked with GIS to display areas of highest risk to drawdown including areas users and groundwater dependent ecosystems
- Assessment of major climate modes influencing regional water balances (ENSO, SOI)
- Facilitation of industry and government workshops to present and vet results

Department of Environment and Resource Management, Queensland, Australia

Lead for an aquifer vulnerability assessment to assess groundwater and groundwater-dependent ecosystem risks from Coal Seam Gas development in southeast Queensland. Responsibilities included:

- Development of a multi-criteria weighting and ranking system linked with GIS to display areas of highest risk to drawdown including areas users and groundwater dependent ecosystems
- Facilitation of industry and government workshops to present and vet results

Mexican Soda and Water Company, Monterrey Mexico

Lead for a groundwater evaluation project to supplement beverage making operations a large manufacturing plant in the city of Monterrey. Responsibilities included:

- Review of background geological, hydrogeological and geochemical information across a large study area centered on the Monterrey Metropolitan Area
- Assessment of structural fabric of study area including presence of major folds, faults, and other features (e.g. karst)
- Amalgamation of background data with result from Quantum Geoelectrophysics reconnaissance program to identify prospective drilling targets
- Completion of a 4C report (compare, contrast, correlate, confirm) and selection of prime drilling target for testing and evaluation

Origin Energy, Queensland, Australia

Water resources technical lead for a large-scale coal seam gas project (up to 10,000 wells) located in the headwaters of the Murray-Darling Basin and recharge area for the Great Artesian Basin. Responsibilities included:

- Development of a regional-scale groundwater monitoring system using vulnerability and risk mapping
- Design of a hydrogeological model covering a 173 000 km^2 area (using FEFLOW) to assess groundwater -surface water impacts and cumulative effects from coal seam gas development
- Incorporation of climate variability and climate change aspects to the model conceptualization to forecast natural changes and implication for project effects
- Completion of supporting Technical Report (including risk mapping, injection feasibility, model development) and Environmental Impact Statement chapter
- Liaison with the Queensland Department of Environment and Natural Resources to address needs for the required Environmental Impact Assessment

United Nations, Joint Caribbean Climate Change Partnership

Technical lead for the development of UNFCCC-sanctioned National Adaptation Plans for the countries of Guyana and Belize, with the goal of addressing multi-sector impacts from future climate change. Responsibilities include:

- Review of existing policies and studies supporting climate change adaptation
- Assessment of current adaptation plans for major economic, social, and environmental sectors
- Incorporation of IPCC (Global Climate Models) and PRECIS (Regional Climate Models) output under various RCP scenarios
- Delivery of facilitated in-country workshops for various Ministries
- Provision of recommendations to address gaps identified in current plans
- Liaison with government officials and UNDP organizers
- Completion of climate change risk assessment and options analysis to identify high-value actions
- Preparation of capacity-building plan and 10-yr strategic plan
- Risk and vulnerability assessment (including spatial aspects under various climate change scenarios – SRES and RCP)

Climate change (domestic)

Alberta Environment and Parks (AEP)

Provision of external expert review for the Implementation Directive for the Surface Water Body Aggregate Policy (SWBAP). Responsibilities include:

- Review of relevant Government of Alberta documents relating to aggregate mining in or near surface water bodies and/or floodplain environments
- Use of information from relevant policies in other jurisdictions as well as studies and research (aquatic, terrestrial, river morphology, climate risk) regarding impacts of aggregate mining in floodplain areas
- Incorporation of climate variability (ENSO, PDO) and climate change aspects to define risk to river flow characteristics as a result of future changes to temperature and precipitation regimes
- Identification of gaps regarding goals and objectives of the approval and management process
- Review of risk assessment approach to approving aggregate mines near surface water bodies, and provision of recommendations for monitoring, evaluating and reporting
- Interaction with AEP project team members and presentation of results

Alberta Innovates (AI)

Provision of water resources services for the University of Alberta led study into:

- Resolving human versus Industrial Influences on the water quality of the Lower Athabasca River
    - data synthesis

  - geophysical and geochemical assessment
  - isotope geochemistry source water fingerprinting
  - GW-SW interaction – identification and flux
  - climate implications to river flows
- Predicting Alberta's Water Future (complete estimates of groundwater recharge to Alberta's 2200 sub-basins
  - determining groundwater use projections by major sector to 2050
  - assessing baseflow contributions and groundwater stress area based on analytic element model outputs
  - projected changes to provincial water supplies based on population growth, energy extraction, food production, and land use
  - assessment of climate variability and change on provincial water balance
  - coordinate results with climate change model outputs and SWAT model outputs to generate preliminary Water Risk map for the province.

Alberta Water Research Institute (AWRI)

Completion of an inventory of Alberta's water and its associated dynamics (natural and human-induced). Responsibilities included:

- The development of a partnership model including participants from Universities and Institutes in Beijing, Switzerland, Edmonton, Calgary and Lethbridge
- Completion of a complete inventory of surface water, groundwater and fossil water (glaciers and deep groundwater) to identify current and future risks to water supplies in the province
- Assessment of climate variability and change implications to provincial groundwater water resources

Apache Canada

Completion of watershed analysis and intake siting in support of a Water Act Application on Smoky Lake. Responsibilities included:

- Assessment of Smoke Lake watershed and water supply potential
- Water supply modelling to determine availability and reliability of lake water
- Review of historical flow data and determination of suitable IFN at outlet (i.e. Q80)
- Review of terrestrial, fisheries and water quality data to support water diversion strategy
- Assessment of climate variability and climate change as they apply to water availability and reliability
- Development of proposed monitoring and response plan
- Liaison with AEP and AER representative

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- Development of proposed monitoring and response plan
- Liaison with AEP and AER representative

Bellatrix Exploration Ltd.

Completion of a Water Sourcing study for Rocky Mountain asset. Responsibilities included:

- Review of existing and potential water sourcing options
- Assessment of climate change considerations in ensuring water security
- Development MCA and of GIS tool to assess and map high-value water opportunities
- Completion of a water security plan

Butte Action Committee

Preparation for, and participation in, AEP-led Surface Water Body Aggregate Policy 2017 stakeholder review workshops. Responsibilities included:

- Consultation with stakeholder group
- Review of AEP materials in advance of Airdrie workshop (AEP policies, guides, codes, risk assessment framework)
- Review of other Canadian and International policies and guides to aggregate mining near water bodies
- Review of impact studies related to aggregate mine development near surface water bodies (erosion, pit capture, infrastructure risk, fisheries and riparian area impacts)
- Assessment of climate change implications for streamflow timing and magnitude, as well as intensity, duration, and frequency of storms and related runoff, on 1:100 levels
- Documentation of questions to AEP for clarification and response to AEP questions re: climate change implications

Devon Canada

Completion of detailed studies to define baseline hydrogeological and hydrological conditions in support of a coalbed methane project in the Crowsnest Region of the eastern Rocky Mountains. Responsibilities included:

- Completion of detailed field reconnaissance program
- Establishment of a spring and water well monitoring network
- Investigation of surface water/groundwater interactions

- Review of climate variability and climate change implications for water availability and reliability
- Development of a conceptual water balance model in a mountainous area using geological and geochemical data
- Groundwater age dating of regional confined aquifers using radioactive isotopes (i.e. Tritium and Chlorine-36)
- Public and regulatory liaison

Enerplus

Completion of a Water Security Plan for the Western Canadian assets. Responsibilities included:

- Review of asset operations and water management process
- Assessment of basin water risk conditions and current mitigations in place (including climate variability and climate change)
- Source water and disposal opportunity assessment
- Development of MCA process to rank water risk profile of each asset and provide recommendations for mitigation

Hammerhead Resources

Completion of watershed analysis, flood assessment and intake siting in support of a Water Act Application on the Smoky River. Responsibilities included:

- Assessment of Smoky River watershed and water supply potential
- Review of historical flow data and assessment of Q80 and Q95
- Review of climate variability implications for river flow characteristics
- Flood assessment to determine 1:10 and 1:25 year event levels
- Review of fisheries and bank stability assessment in support of intake siting
- Development of proposed monitoring and response plan
- Liaison with AEP and AER representatives

Husky Oil Operations Ltd.

Completion of a water security plan for the Ansell asset, west-central Alberta. Responsibilities included:

- Review of project water profile and future requirements for hydraulic fracturing
- Assessment of water security in relation to changing climatic conditions
- Facilitation of risk review workshop
- Review of water source opportunities and development of MCA opportunity ranking process

Lakeland Industry and Community Association (LICA)

Assessment of the current health of two large watersheds (covering over 8500 km^2) in response to changing climatic conditions, land use practices, and increased pressure on

water resources (surface water and groundwater) by agricultural and industrial users. Responsibilities included:

- The assessment of historical multispectral satellite imagery
- Review of stream and groundwater hydrograph data
- Assessment of effects of climate tele-connections (ENSO, PDS) on basin hydrology
- Review of temporal groundwater and lake dynamics in response to changing conditions

Nexen ULC

Development of a water strategy to service the Aurora LNG project/Dilly Creek asset. Responsibilities included:

- Assessment of development trajectory with respect to water use
- Identification of feasible water supply source to accommodate up to 6.5 million m^3 per year of water
- Review of climate variability and climate change implications for water availability and reliability
- Conceptualization of water storage strategy to reduce pressure on local water sources and minimize physical footprint of development
- Development of a water conveyance strategy utilizing existing rights of way, including Class 5 cost estimation
- Liaison with Fort Nelson first Nations to facilitate development of baseline hydrology monitoring program and facilitation of a Section 10 water licence (following successful EAB appeal of previous licence)

Red Deer River Watershed Alliance (RDWA)

Assistance with development of an Integrated Watershed Management Plan to address future development in the basin. Responsibilities included:

- Groundwater inventory
- Water use patterns
- Effects of land use and climate variability and climate change on basin water balance and storage conditions
- Water quality conditions
- Risk and vulnerability assessment
- Development of beneficial management practices
- Development of a conceptual monitoring system to achieve plan goals and objectives

Shell Canada

Completion of watershed analysis and intake siting in support of a Water Act Application on Iosegun Lake. Responsibilities included:

- Assessment of Iosegun Lake watershed and water supply potential
- Water supply modelling to determine availability and reliability of supply

- Review of historical flow data and determination of suitable IFN at outlet (i.e. Q80)
- Assessment of climate variability and climate change as they apply to water availability and reliability
- Review of terrestrial, fisheries and water quality data to support water diversion strategy
- Development of proposed monitoring and response plan
- Liaison with AEP and AER representatives

Shell Canada

Support for Carmon Creek EIA and assessment of brackish water supply potential in support of heavy oil operations in the Peace River area. Responsibilities included:

- Assessment of baseline hydrogeological conditions and potential impacts from project development
- Preparation of climate change assessment for project development
- Support for SIR submissions and EIA team interactions
- Feasibility assessment of potential for deep formations to produce sustained supplies and conceptual well-field development
- Liaison with regulatory agencies
- Development of a DBM level review for a groundwater well-field development

South McDougall Flats Protection Society

Review of proposed re-zoning for aggregate mine development in historic floodplain of Little Red Deer River in Sundre, AB. Responsibilities included:

  - Review of proposed gravel pit re-zoning area
- Air photo assessment and delineation of paleo-floodplain
- Assessment of climate variability and climate changes aspects regarding river flow conditions (flood and low flow)
- Preparation of workshop materials
- Presentation at public forum re: pros and cons of gravel mining (including policy framework review)
- Support for Town Council hearing

Town of Okotoks, AB

Assistance with review of development applications and support for ensuring water security through conjunctive use strategies. Responsibilities included:

- Expert review of development applications assessing cumulative drawdown effects and provision of recommendations to manage effects
- Engagement with Town official on development of a sustainable water management strategy
- Assessment of climate variability and climate change considerations as they relate to water security

- Provision of support for AENV and Environmental Appeal Board process

Town of Okotoks

Completion of a pre-feasibility study to assess aquifer storage and recovery (ASR) and managed aquifer recharge (MAR) as a solution to water supply challenges. Responsibilities included:

- Review of regulatory setting and constraints for ASR and MAR (Canada and international jurisdictions).
- Review of ASR and MAR projects world-wide
- Assessment of local geological and hydrogeological conditions and identification of potential areas to facilitate ASR and MAR success
- Modelling to determine optimal placement of MAR system to enhance baseflow conditions
- GW-SW interaction assessment & climate impact assessment
- Preparation and presentation of pre-feasibility summary to Town Council and Mayor

Town of High River, AB

Lead for the development of a Water Sustainability Plan predicated on risk identification and alternative storage and management options for a large alluvial aquifer system. Responsibilities included:

- Concept and program design
- Execution of vulnerability mapping approach to assess risk to High River from groundwater impacts (e.g. underground storage tanks)
- Development of conceptual hydrogeological framework
- Review of groundwater–surface water interaction and climate variability effects
- Assistance with groundwater model development
- Liaison with town officials, MD Foothills official and other project stakeholders

Tsuut'ina First Nation

Completion of flood analysis (overland and groundwater) for the Redwood Meadow development on the Elbow River floodplain. Responsibilities included:

- Review of river hydrology, flood frequency, and related changes in river morphology
- Assistance with hydrological modelling to address groundwater flooding potential to existing and panned development areas
- Calculation of damage estimates associated with 5, 20,100, 200 and 500-year return periods
- Assessment of climate change aspects regarding river flow characteristics and flood risk
- Liaison with First Nations representatives, Government of AB, and Canadian Environmental Assessment Agency.

Other International

Origin Energy, Queensland, Australia

Groundwater lead for a large-scale coal seam gas project (up to 10,000 wells) located in the headwaters of the Murray-Darling Basin and recharge area for the Great Artesian Basin. Responsibilities included:

- Development of a regional-scale groundwater monitoring system using vulnerability and risk mapping
- Design of a hydrogeological model covering a 173 000 km^2 area (using FEFLOW) to assess cumulative effects from CSG development
- Completion of supporting Technical Report (including risk mapping, injection feasibility, model development) and Environmental Impact Statement chapter
- Liaison with the Queensland Department of Environment and Natural Resources to address needs for the required Environmental Impact Assessment

Texas Petroleum Company, Ecuador, SA

Completion of a baseline groundwater and surface water study in a remote and environmentally sensitive area of the Amazon basin (headwaters area) to support a helicopter-assisted drilling program for oil and gas exploration. Responsibilities included:

- Field reconnaissance to establish the suitability of proposed drilling targets
- Assessment of the suitability of local surface water and groundwater sources for drilling fluid provision (quality and quantity)
- Review of baseline soil quality, site hydrogeology, and geochemical conditions
- Development of recommendations for pit construction and site preparation.

Texas Petroleum Company, Magdalena Valley, Colombia, SA (1994)

Completion of an onsite environmental assessment of oilfield operations in support of the transfer of the Teca Nare, Cocorná, Velásques Oil Fields and the Velásquez-Galan Pipeline. Responsibilities included:

- Phase 1 site assessment of field operations
- Verification of site conditions at all well sites including soil and vegetation conditions prior to property transfer
- Assessment of baseline surface water and groundwater chemical conditions, as wells as environmental quality assessment to determine contamination from oilfield operations
- Provision of summary report including recommendations

Canadian International Development Agency, Catamayo, Ecuador SA

Completion of a baseline soil and groundwater study (physical and chemical) to determine the feasibility of siting an engineered wastewater impoundment for the treatment of municipal sewage treatment (project funded by CIDA). Responsibilities included:

- General site reconnaissance
- Collection of soil and groundwater samples for baseline geochemical quality assessment
- Review of hydrogeological conditions and processes relating to baseline conditions
- Submission of recommendations on the suitability of the proposed location and possible approaches to rectify existing limitations

Other Government

BC Ministry of Energy, Mines and Petroleum Resources

Provision of expert review support for hydraulic fracturing review process. Responsibilities included:

- Preparation of background information pertaining to water quality risks and source-pathway-receptor aspects of hydraulic fracturing operations
- Provision of recommendation regarding geochemical fingerprinting (ion ratios, isotopes, NORMs), risk assessment and mapping techniques, and monitoring
- Appearance at in-camera session to discuss water quality aspects with academic panel members including recommendations.

Alberta Utilities Commission

Provision of expert review support for a wind power application in the Provost AB area. Responsibilities included:

- Review of submitted application documents
- Research on wind vibration implications for shallow aquifer deliverability
- Submission of opinion report

Alberta Environment and Parks (AEP)

Participation on expert hydrogeology panel to development a template for groundwater management frameworks in Alberta. Responsibilities included:

- Assessment of background on Alberta groundwater resources and documents highlighting existing GMFs inside and outside of Canada
- Review of sustainability goals and challenges with groundwater management (quantity and quality)
- Review of prevailing concepts to groundwater management (i.e. surface water capture, risk and vulnerability assessment)
- Identification of data needs and required infrastructure to support cumulative effects management
- Identification of proposed indicators using DPSIR approach
- Participation in external panel and internal AEP team of hydrogeological experts to define aspects of a standardized GMF template

Alberta Environmental Monitoring Evaluation and Reporting Agency (AEMERA)

Assessment of Alberta's groundwater observation well network, including redundancy and gap analysis. Responsibilities included:

- Groundwater risk mapping
- Development of a numerical scoring scheme to prioritize monitoring wells
- Statistical and spatial analysis of provincial water chemistries using information from the Alberta water well information database
- Development of monitoring strategy including analytes and frequency to address key development activities (e.g. hydraulic fracturing, waste disposal, large-scale groundwater extractions)

Alberta Environment and Sustainable Resource Development (ESRD)

Development of a multi-attribute point-scoring system and ArcGIS tool to assist with optimal siting of provincial monitoring wells to address concerns regarding hydraulic fracturing (HF). Responsibilities included:

- Identification of key risks to groundwater resource from HF activities
- Conceptualization and construction of a subsurface risk assessment
- Identification of surface access opportunities in an ArcGIS platform to identify prime locations for monitoring in active and future development areas

Alberta Environment and Sustainable Resource Development (ESRD)

Various projects:

- Northern Athabasca Oil Sands Region groundwater monitoring program. Responsibilities included development of sampling methodology, data evaluation process and program logistics, communication to technical team comprising oil sands operators, ERCB and AEP representatives, development of an on-line visualization tool, and client liaison.
- Review of LARP management plan, supporting Groundwater Management Frameworks and supporting guidance documents re: Thermal Mobilization of Trace Elements during In Situ Developments and Groundwater Monitoring Directive.
- Preparation of summary document for Scientific Advisory Committee of the Oil sands GW working group, and Alberta Environment.

Alberta Land Use Secretariat (LUS)

Assistance with development of land planning scenarios in NE Alberta to guide future development in the Lower Athabasca Regional Plan area pursuant to the goals of the Alberta Land-use Framework. Responsibilities included:

- Presentations to the Land Use Secretariat, Regional Planning Team and Regional Advisory Council

- Development and assessment of modelled results from a cumulative effects simulator, completion of groundwater modelling over a 93 000 km^2 area (using MODFLOW)
- Development of an approach to deal with groundwater resources in the LARP area

Alberta Environment (AENV)

Technical assistance with development of a guidance framework to respond to the implications of thermal mobilization of constituents at in-situ bitumen recovery projects. Responsibilities included:

- Facilitation of team workshops to communicate the physical and chemical aspects of thermal mobilization and the risks posed by ion-situ operations
- Development of a risk-based, phased, approach to assessing thermal mobilization to address source-pathway-receptor aspects
- Development of a draft guidance document and interaction with the AEP communications team
- Support for industry and CAPP consultation meetings to review the draft guidance document

Alberta Environment (AENV)

Completion of vulnerability and risk mapping for the Lower Athabasca Regional Planning area and development of a groundwater management framework. Responsibilities included:

- Assessment of potential cumulative effects from large-scale thermal in-situ bitumen recovery operations and related activities (i.e. water withdrawal for steam generation and down-hole waste disposal
- Facilitation of technical and policy-related work sessions to engage stakeholders (operators, AENV and ERCB) directly affected by changes to provincial water management

Alberta Environment (AENV)

Development of a groundwater management framework within the South Athabasca Oil Sands area of the Lower Athabasca Planning Region. Responsibilities included:

- Completion of an inventory of existing quality and quantity issues, water supply conditions and related environmental policy
- Participation in technical and policy-related work sessions involving various stakeholder representatives

Alberta Environment (AENV)

Development of a groundwater water management framework within the mineable area of the Lower Athabasca Planning Region. Responsibilities included:

- Completion of an inventory of existing quality and quantity issues, water supply conditions and related environmental policy

- Participation in technical and policy-related work sessions involving various stakeholder representatives

Alberta Environment (AENV)

Completion of vulnerability mapping for the Lower Athabasca Regional Planning area and development of a groundwater management framework. Responsibilities included:

- Assessment of potential cumulative effects from thermal in-situ bitumen recovery operations and related activities (i.e. water withdrawal for steam generation; fluid waste injection)
- Facilitation of technical and policy-related work sessions to engage stakeholders (operators, AENV and ERCB) directly affected by changes to provincial water management

Alberta Utilities Commission (AUC)

External review of application to establish a wind farm in east-central Alberta. Responsibilities included:

- Review of project concept and environmental implications
- Assessment of completeness regarding baseline hydrogeological assessment
- Assessment of impact analysis and proposed mitigation
- Identification of gaps and provision supplemental information requests

Other Agencies

Alberta Innovates (AI)

Provision of hydrogeological services for the following University of Alberta led studies:

- Resolving human versus Industrial Influences on the water quality of the Lower Athabasca River (data synthesis; geophysical and geochemical assessment; isotope geochemistry source water fingerprinting, GW-SW interaction – identification and flux)
- Review of Arsenic in Alberta's groundwater (collation of multiple open source and private data bases, GIS platform design; correlation/cluster/factor analysis to determine source/cause/reasons(s), both physical and geochemical, for elevated concentrations, development of a risk mapping tool to identify existing and potential future high risk areas and aquifer intervals)
- Predicting Alberta's Water Future (complete estimates of groundwater recharge to Alberta's 2200 sub-basins; determining groundwater use projection by major sector to 2050; assessing baseflow contributions and groundwater stress area based analytic model outputs; project changes to provincial water supplies based on population growth, energy extraction, food production, land use, and climate variability/change; coordinate results with climate change model outputs and SWAT model outputs to generate preliminary Water Risk map for the province.

Alberta Water Research Institute (AWRI)

Preparation of a report assessing Alberta's inventory of water and its associated dynamics (natural and human-induced). Responsibilities included:

- The development of a partnership model including participants from Universities and Institutes in Beijing, Switzerland, Edmonton, Calgary and Lethbridge
- Completion of a complete inventory of surface water, groundwater and fossil water (glaciers and deep groundwater) to identify current and future risks to water supplies in the province
- Assessment of climate variability and change implications to provincial groundwater water resources

Canada's Oil Sands Innovation Alliance (COSIA)

Completion of a water disposal assessment in NE Alberta (153,000 km^2 area) supporting the Regional Water Management Initiative. Responsibilities included:

- Collation of regional geological, hydrogeological, and water production data using public domain and industry information
- Development of a multi-criteria analysis approach to assessing Injection Potential and Theoretical Injection Rates based on a system of weighted and ranked physical and chemical attributes
- Development of an ArcGIS platform to identify high-value disposal formations in relation to existing and planned in situ developments and pipelines

Canada's Oil Sands Innovation Alliance (COSIA)

Completion of oil sands industry study assessing the risks and benefits of landfills, salt caverns and disposal wells in liquid waste management. Responsibilities included:

- Participation in industry workshops
- Assessment of liquid waste management options
- Documentation and presentation of the results to industry members

Cumulative Environmental Management Association (CEMA)

Preparation of a groundwater monitoring and management plan in support of the State of the Muskeg River Watershed report. Responsibilities included:

- Assessment of baseline groundwater quantity and quality conditions in the study area
- Identification of development stresses and potential short and long-term impacts
- Identification of proposed physical, chemical and state indicators for monitoring
- Interaction in multidisciplinary team

Cumulative Environmental Management Association (CEMA)

Overview of historical, current, and planned groundwater initiatives in the Regional Municipality of Wood Buffalo. Responsibilities included:

- Interviews with relevant industry, government, academia, aboriginal, and non-governmental organization groups
- Identifying and accessing relevant studies, reports, and investigations relating to groundwater and groundwater-surface water interaction
- Development of a useable database with relevant descriptors of content and results

Petroleum Technology Alliance of Canada (PTAC)

Completion of studies and industry workshops assessing:

- Environmental net benefit of saline versus non-saline water use in unconventional oil and gas development
- The role of collaboration in unconventional oil and gas development

Other Industry

Alberta Energy Company

Preparation of an Environmental Operations Manual for all aspects of petroleum exploration and development in Alberta. Contents of the manual included environmental procedures for seismic cutline provision and reclamation, siting and construction of drilling leases and processing facilities, siting and construction of pipeline right of ways, spill response and cleanup, and site reclamation.

Amoco Canada

Review of fresh groundwater usage for steam injection. Responsibilities included assessment of historical monitoring well and lake level readings to evaluate local effects resulting from groundwater withdrawal.

Amoco Canada

Sounding Lake area monitoring program to determine effects from nearby drilling activity. Responsibilities included:

- Interviews with well-owners
- Assessment of the water delivery system
- Short-term aquifer testing
- Sample collection using ultra-clean sampling methods
- Review of the data
- Communication of results to client and owner

Amoco Canada

Completion of environmental site assessments and landfill delineation programs for gas plant divestitures. Responsibilities included:

- Installation, testing and sampling of groundwater monitoring wells
- Completion of soil sampling programs
- Assessment of the results to determine the liability cost associated with property transfer

BP Canada

Resident well sampling program to determine effects from nearby drilling programs and existing gas wells. Responsibilities included:

- Well-owner interviews
- Assessment of the well conditions and water delivery system
- Sample collection using ultra-clean sampling methods
- Data review of communication of results.

Brooks, AB

Assessment of the construction and integrity of groundwater source wells, local hydrogeological and hydrochemical conditions, groundwater usage, assessment of potential impact to local water supply wells in the event of a well failure, and development of a risk management plan.

Delcan Corporation

Conceptual design of dewatering system in support of large sewage treatment facility upgrade. Responsibilities included:

- Review of site geological conditions
- Analytical model construction to determine stand-off distances for DW wells
- Predictive outcome assessment and DW plan development

Devon Canada

Completion of detailed studies to define baseline hydrogeological and hydrological conditions in support of a CBM project in the Crowsnest Region of the eastern Rocky Mountains. Responsibilities included:

- Completion of detailed field reconnaissance program
- Establishment of a spring and water well monitoring network
- Investigation of surface water/groundwater interactions
- Development of a conceptual hydrogeological framework in a mountainous area using geological and geochemical data
- Groundwater age dating of regional confined aquifers using radioactive isotopes (i.e. Tritium and Chlorine-36).

- Public and regulatory liaison

Devon Canada

Development of a thermal mobilization risk model to support development efforts in the Jackfish and Pike oil sands developments. Responsibilities included:

- Review and evaluation of existing geochemical data including metals and trace elements
- Development of conceptual site model using existing geological picks for various identified formations
- Design of Spatial MCA approach to map risk of thermal mobilization from artificial ground heating
- Preparation of summary document and presentation at various public venues

Husky Energy Ltd.

Completion of a Water Security Plan for a 200,000 barrel per day thermal in situ oil sands operation (Sunrise(. Responsibilities included:

- Review of water supply and disposal needs for the duration of the planned project
- Risk and opportunity analysis using multi-criteria analysis to ensure viability of supply and disposal strategies
- Identification of strategies to ensure project viability and project sustainability

Pembina Pipeline Corp.

Provision of expert legal support to review source and cause of industrial chemical contamination at an operating gas plant. Responsibilities included:

- Review of existing site investigations, procedures, and documentation
- Assessment of efficacy of investigations and protocols (field and laboratory)
- Development of conceptual model to explain presence and movement of sulfolane in bedrock deposits
- Review of risk assessment findings and provision of recommendations to close data and information gaps

Imperial Oil Resources

Support for re-licensing of supply wells for oilfield injection using Alberta Environment "Water Conservation and Allocation Guideline for Oilfield Injection" and "Groundwater Evaluation Guideline." Responsibilities included:

- Completion of field-verified surveys
- Review of site geological conditions
- Acquisition and interpretation of aquifer test data
- Assessment of groundwater/surface water interaction
- Determination of long-term sustainable yield using analytical solutions.

Imperial Oil Resources

Hydrogeological lead for a large oil sands mine EIA (Kearl Oil Sands Mine Project). Responsibilities included:

- Analysis and interpretation of water well information and chemical data
- Defining Quaternary stratigraphy
- Temporal water level assessment to determine potential impact to regional groundwater quality and quantity arising from mine development and dewatering
- Support at Joint Panel hearing

Imperial Oil Resources

Design and implementation of dewatering program for large process water ponds. Responsibilities included:

- Review of site geological conditions
- Installation of dewatering wells
- Acquisition and interpretation of aquifer test data
- Design of dewatering system using appropriate theoretical calculations and analytical modelling solution
- Development of dewatering plan and associated performance monitoring

Imperial Oil Resources

Completion of a regional groundwater investigation and development of a regional-scale ground water monitoring network (per EPO 95-07 requirements) in a multi-layer inter-till aquifer system in east-central Alberta. Responsibilities included:

- Assessment and interpretation of Quaternary stratigraphy
- Interpretation of seismic line data and geophysical borehole log analysis
- Regional groundwater flow mapping
- Geochemical facies mapping
- Assessment of regional arsenic concentrations, trends, and potential connection to thermal in situ development activities
- Groundwater age-dating and stable isotope analysis ($\delta^{18}O$, $\delta^{2}H$, $\delta^{34}S$, $\delta^{11}B$ and $\delta^{13}C$: dissolved constituents and gases)
- Preparation of investigation report to address EPO questions (i.e. source and cause of groundwater quality issues)
- Liaison with regulators during investigation and EPO closure process

Imperial Oil Resources

Completion of an environmental liability assessment to determine the cost of decommissioning, abandoning and restoring the area currently occupied by the Norman Wells field. Responsibilities included:

- Completion of a Phase 1 audit of production facilities and supporting infrastructure (i.e. wellheads, pipelines, satellites, batteries and former refinery)
- Design and implementation of a late Fall field program to sample a statistically sufficient number of locations to generate realistic liability costing for field shutdown and closure
- Generation of a summary report
- Assistance with design of liability costing model and summary reporting

Imperial Oil Resources

Development and implementation of a site characterization program at a former refinery and battery (circa 1930s) located approximately 160 km south of the Arctic Circle. Responsibilities included:

- The design and installation of a monitoring network in discontinuous permafrost
- Assistance in development of assessment programs to generate Tier II criteria in support of a human health and ecological risk assessment

Imperial Oil Resources

Cold Lake area monitoring program (Arsenic Investigation – 30 private residents). Responsibilities included:

- Interviews with well-owners
- Assessment of the water delivery system
- Sample collection using ultra-clean sampling methods
- Review of the data
- Communication of results to client, well owner and Alberta Environment

Imperial Oil Resources

Completion of an environmental liability assessment and costing exercise in support of the sale of the Judy Creek field to PenGrowth Corp. to statistically sample a sufficient number of facilities to generate realistic liability cost for property transfer. Responsibilities included:

- Completion of Phase 1 audits of production facilities and supporting infrastructure (i.e. wellheads, pipelines, satellites, and batteries), design and implementation of winter field program to sample facilities to generate realistic liability cost for property transfer

Imperial Oil Resources

Completion of a groundwater modelling study to determine the sustainable yield of a major deep freshwater aquifer in the Cold Lake area. Responsibilities included:

- The provision of hydrogeological support for model conceptualization and design
- Input parameter selection
- Evaluation and communication of results

Imperial Oil Resources

Development and implementation of a regional groundwater quality monitoring network covering an area of 1,200 km^2. Responsibilities included:

- Regular interaction with environmental regulatory agencies and the local landowners
- Installation, testing and sampling of deep (up to 230 m) monitoring wells to assess potential impact to confined aquifers due to production well casing failures
- Design, implementation and interpretation of aquifer tests in support of groundwater remediation programs
- Development of cost-effective approaches towards restoring water quality conditions in deep aquifers influenced by heavy hydrocarbons and associated production fluids

Imperial Oil Resources

Preparation of an AB environment approved Incident Response Plan to deal with groundwater quality issues identified during routine monitoring activities at a large heavy oil recovery scheme. Responsibilities included:

- Design of a cost-effective sampling schedule including rationalization of a 200 well monitoring network to provide a meaningful network of approx. 100 wells
- Development of statistical limits for response and mitigation actions

Japan Canada Oil Sands (JACOS)

Execution of hydrogeological section of an expansion EIA for the Hangingstone Thermal In Situ Oil Sands project. Responsibilities included:

- Development of baseline hydrogeology, EIA sections, and SIR responses
- Liaison with project team and governing agencies
- Stakeholder consultation with First Nations and 3PC

Japan Canada Oil Sands (JACOS)

Completion of a water supply project in support of a heavy oil recovery scheme using Alberta Environment "Water Conservation and Allocation Guideline for Oilfield Injection" and "Groundwater Evaluation Guideline." Responsibilities included:

- Assessment of geophysical logs and EM survey results
- Design and implementation of field programs
- Step test and constant rate test data acquisition and analysis
- Well screen selection and well design
- Well efficiency assessment

- Use of pertinent analytical equations to predict effect of long-term pumping

Petro-Canada

Completion of detailed regional and local baseline studies, and cumulative impact assessment, to establish regional and local hydrogeological and geochemical characteristics in support of a 30,000 bbl/d heavy oil recovery expansion (MacKay River Project). Responsibilities included:

- Defining Quaternary stratigraphy
- Temporal water level assessment to determine potential impact to regional groundwater quality and quantity arising from bitumen recovery operations
- Development of a numerical groundwater model to assess long-term effects of water withdrawal and waste disposal to support project activities
- Completion of climate change assessment formed part of the assessment for project design

Petro-Canada

Conceptualization and design of field program to assess water supply and water disposal for two major heavy oil projects (>30,000 bbl/d). Responsibilities included:

- Selection of drilling locations based on geophysical reconnaissance
- Implementation of field programs
- Step test and constant rate test data acquisition and analysis
- Well efficiency assessment
- Well screen selection and well design
- Use of pertinent analytical equations

Petro-Canada

Review of fresh groundwater use for a water flood project. Responsibilities included interpretation of historical monitoring well data to determine the effects of the groundwater withdrawal from the local aquifer.

Petro-Canada

Assessment of long-term effects of industrial water supply wells used for a water flood scheme. Responsibilities included a review groundwater chemistry and well hydraulic data to determination sustainable production rates.

Petro-Canada

Completion of an environmental operations audit and subsequent industrial landfill delineation to determine the source area of possible groundwater contamination. Responsibilities included completion of a comprehensive intrusive landfill delineation and soil sampling program to determine the extent and volume of landfill contamination.

Petro-Canada

Completion of an industrial landfill delineation project to determine possible sources of groundwater contamination. Responsibilities included completion of a magnetometer survey, follow-up excavation and soil sampling near a decommissioned landfill to determine the presence, extent and volume of residual landfill material.

Procor

Review of operational history of a salt cavern storage facility including an assessment of groundwater quality near the large brine storage ponds and the potential for impact to the Regina Aquifer.

Shell Canada

Development of Groundwater Management Plan and annual monitoring support at Shell's Muskeg River Mine. Responsibilities included:

- Review of site-wide groundwater monitoring network for applicability to EPEA Approval requirements (including gap analysis
- Routine monitoring and reporting per EPEA requirements
- Selection of indicator suites to facilitate routine monitoring, evaluation, and reporting
- Identification of locations with water quality concerns
- Development of approach to statically assessing and responding to data excursions and trends
- Preparation of the GMP for consideration and acceptance by AEP

Shell Canada

Support for Carmon Creek EIA and assessment of brackish water supply potential in support of heavy oil operations in the Peace River area. Responsibilities included:

- Assessment of baseline hydrogeological conditions and potential impacts from project development
- Preparation of climate change assessment for project development
- Support for SIR submissions and EIA team interactions
- Feasibility assessment of potential for deep formations to produce sustained supplies and conceptual well-field development
- Liaison with regulatory agencies
- Development of a DBM level review for a groundwater well-field development

Shell Canada

Development of a regional-scale ground water monitoring network in a multi-layer aquifer system in the Peace River region of Alberta. Responsibilities included:

- Assessment of Quaternary stratigraphy

- Interpretation of seismic line data
- Geophysical borehole log analysis
- Geochemical facies mapping and solution chemistry analysis

Shell Canada

Assistance with the development and construction of an induced infiltration groundwater supply system for the Shell Caroline Gas Plant industrial water supply project. Responsibilities included:

- Drilling and installation of large diameter water production wells
- Borehole geophysical logging and interpretation
- Sand quantification testing and analyses to determine sediment production volumes prior to pipeline construction
- Liaison with client and local landowners

Suncor Energy

Lead subsurface specialist for a multi-criteria decision analysis and life-cycle value analysis in support of a regional brine management strategy in the Athabasca Oil Sands area. Responsibilities included:

- Development of a holistic weighting and ranking approach to address triple-bottom-line assessment of treatment and disposal options for liquid and solid waste streams originating from oil sands mining and in situ assets located across a 30 000 km^2 area
- Facilitation of, and participation in, workshops to assess viable options for treatment and disposal including Class 4 costing
- Development of a constraints mapping approach (vulnerability, risks and opportunities) using ArcGIS to assist in management and disposal options for liquid and solids waste streams

Suncor Energy

Review of existing water supply for Steepbank and Millennium mine operations and development of contingency supply options. Responsibilities included:

- Review of past water resource evaluations
- Development of geophysical investigation program and interpretation of results
- Assessment of contingency water supply (groundwater and operations water)
- Client consultation and liaison with Alberta Environment
- Implementation of horizontal well technology to provide a secure supply of water for continued operations

Union Pacific

Supervision of supply well installation for the Ferrybank water flood scheme and completion of extensive aquifer test to determine the local effects of water withdrawal from the target aquifers.

Various Gas Plants, Batteries and Refineries (AB, SK, BC)

Completion of piezometer network design at numerous operating facilities to assess the potential impact to local groundwater quality resulting from industrial activities and extent of contaminant migration from known source areas (Imperial Oil, Amoco/BP, Shell, Mobil, Canadian Occidental); and, provision of hydrogeological services in support of a gas plant decommissioning (ongoing). Responsibilities include:

- Well installation, testing and sampling
- Involvement in a site-specific risk assessment (ecological and human health)
- Development of sampling protocols
- Assessment of cost-effective remediation techniques to address various contaminant situations in both soil and groundwater

Various Oil and Gas Facilities (AB, SK)

Completion of environmental operations audits and development of waste management plans at numerous oil and gas facilities (Amoco, Petro-Canada, Shell). Responsibilities included:

- Review of historical operations files (spill reports, waste handling procedures, EUB and AENV records)
- Completion of site inspections & historical air photo interpretation

HEARINGS / APPEALS / PANEL EXPERIENCE

McQuiston Gravel Pit, Butte AB (2019-present): Clearwater County re-zoning

Crouch Gravel Pit, Sundre AB (2019-2020): EAB appeal

Phelan Gravel Pit, Fort Assiniboine AB (2016-2019): EAB appeal hearing

BC Scientific Hydraulic Fracturing Review Panel (2018): assessment of water quality issues and presentation to panel members

South McDougall Flats Protection Society (2017): support for re-zoning hearing

Town of Black Diamond (2013): EAB appeal

Town of Okotoks vs. Sandstone Springs Development (2011): EAB appeal

Queensland Government, Dept. of Energy, Resources, and Mine (2010): hydrogeology panel for assessing implication of coal seam gas development

Total Joslyn North Mine – Joint Panel hearing

Imperial Oil Kearl Mine, Athabasca Oil Sands: Joint Panel hearing

Suncor Voyageur, Athabasca Oil Sands: Joint Panel hearing

BlackRock Ventures, Cold Lake: ERCB hearing

Imperial Oil Mahkeses Expansion, Cold Lake: ERCB hearing

EDUCATION

Ph.D. (Geochemistry) – University of Calgary, 2008

M.Sc. (Physical Hydrogeology and Isotope Geochemistry) – University of Calgary, 1994

B.Sc. (Geology: hard rock, sedimentology, mineralogy, structural, geochemical) – University of Saskatchewan, Saskatoon, 1985

REGISTRATIONS / AFFILIATIONS / BOARDS

APEGA (P.Geol. – Alberta)

EGBC (P.Geo. – British Columbia)

APEGS (P.Geo. P.Eng. – Saskatchewan)

NAPEG (P.Geol. – Northwest Territories and Nunavut)

National Ground Water Association (NGWA)

International Association of Hydrogeologists (CNC)

Canadian Water Resources Association (CWRA)

Sustainable Energy Development Program (Univ. of Calgary) – External Advisory Board

Bow River Basin Council (Calgary), Board of Directors (2008-2013), Chair of Monitoring and Modelling committee (2008 to 2012), Member of Legislation and Policy Committee (2006-2011), Member of Integrated Watershed Management Group (2007 to 2010)

SPECIFIC TECHNICAL EXPERTISE / SPECIALIST COURSES

Training Certificates

WHMIS

Petroleum Safety Training

Transportation of Dangerous Goods

ISO 9001:2000 (Management Responsibilities)

Analytical Experience

ICP-MS, GC-MS, Ion chromatography (LC-MS, HPLC, IC)

SEM, XRD (bulk and clays), XRF, EDS and Synchrotron Light (XANES, and EXAFS)

Isotope ratio mass spectrometry (IRMS)

Solid-phase extraction, Alumina fraction, and sequential soil extraction

Toxicity identification evaluation for metals and organics

Selection of appropriate inorganic or organic analytical techniques based on Standard Methods

Statistical analysis (e.g. population testing, trend analysis, control charting, PCA, HCA, spatial analysis)

Multi-criteria analysis (MCA) for decision support

Vulnerability and risk mapping

Climate change analysis (models, tele-connections, impacts to land, water, biodiversity)

Risk assessment (human and ecological)

PUBLICATIONS / PRESENTATIONS

Publications

Fennell J. and Aciszewski T (2019). Current knowledge of seepage from oil sands tailings ponds and its environmental influence in northeastern Alberta. Science of the Total Environment, 686, p. 968-985.

Birks S.J., **Fennell J.W.**, Gibson J.J., Yi. Y., Moncur M.C., and Brewster M. 2019. Using regional datasets of isotope geochemistry to resolve complex groundwater flow and formation connectivity in northeastern Alberta, Canada. Applied Geochemisty, 101 (2019), p. 140-159.

Hatala R., **Fennell J.,** and Gurba G. 2018. Advances in the realm of Hydrogeophysics: The emerging role of Quantum Geoelectrophysics in Aquifer Exploration. Can. Soc. of Expl. Geoph., RECORDER October Focus - Hydrogeophysics: the Past, Present, and Future. Vo. 43, No. 6, p. 32-36.

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Fennell J., 2018. Predictions, perceptions and the precautionary principle: responding to climate change in a realm of uncertainty. Canadian Water Resources Association, Water News, Fall/Winter 2018. Vo. 37, No. 2, p. 6-9.

Fennell J., 2018. Water, Peace, and Global Security: Canada's Place in the World We Want (Sandford and Smakhtin, eds.), Groundwater and Canada's Future – Moving data and information to knowledge and security. Prepared for the United Nations University, Institute for Environment, Water and Health, 17 pp.

Fennell J. 2018. Poison Well: Chasing arsenic in Alberta's groundwater. Water Canada, January/February 2018, p. 20-21.

Fennell J. 2017. Let's make a deal: Canada's vital role in the Columbia River Treaty. Water Canada, September/October 2017. p. 42-43.

Faramarzi M., K. Abbaspour, V. Adamowicz, W. Lu, **J. Fennell**, A. Zehnder and G. Goss 2017. Uncertainty based assessment of dynamic freshwater scarcity in semi-arid watershed of Alberta, Canada. *Journal of Hydrology: Regional Studies*, 9, p. 48-68.

Fennell J. 2015. Disposal in the unconventional oil and gas sector: Challenges and solutions. American Assoc. of Petroleum Geologists, *Environmental Geosciences*, Vol. 22, No. 04, December 2015, p. 127-138.

Fennell J. and O. Keilbasinki 2014. Water, food, and our climate: Is California a harbinger of things to come? *WaterCanada*, July/August 2015, p. 24-25.

Fennell J. and O. Keilbasinki 2014. Water without Borders: What is Canada's role in water security? *WaterCanada*, November/December 2014, p. 50-51.

Gibson J.J., **J. Fennell**, S.J. Birks, Y. Yi, M. Moncur, B. Hansen and S. Jasechko 2013. Evidence of discharging saline formation water to the Athabasca River in the northern Athabasca oil sands region. *Canadian Journal of Earth Sciences*, 50, p. 1244 - 1257.

M.S. Ross, A.S. Santos Pereira, **J. Fennell**, M. Davies, J. Johnson, L. Sliva, and J.W. Martin 2012. Quantitative and Qualitative Analysis of Naphthenic Acids in Natural Waters Surrounding the Canadian Oil Sands Industry. *Environmental Science and Technology*, 46, p. 12796 – 12805.

Fennell J. 2011. Total Water Management – a new and necessary paradigm. Environmental Science and Engineering Magazine, May/June edition.

Fennell J., Klebek M. and Forrest F. 2011. An approach to managing cumulative effects to groundwater resources in the Alberta Oil Sands. World Heavy Oil Congress proceedings, March 2011.

Fennell J. 2010. Protecting water supplies in CSG development. *Water Engineering Australia*, Vo. 4, No. 6, September 2010.

Fennell J. 2008. Effects of Aquifer Heating on Groundwater Chemistry with a Review of Arsenic and its Mobility. Ph.D. thesis, Department of Geoscience, University of Calgary.

Fennell J. Zawazki A. and Cadman C. 2006. Influence of natural vs. anthropogenic stresses on water resource sustainability: a case study. *Water Science and Technology*. Volume 53, No. 10, p 21-27.

William L.B., M.E. Wieser, **J. Fennell**, I. Hutcheon, and R.L. Hervig 2001. Application of boron isotopes to the understanding of fluid-rock interactions in a hydrothermally stimulated oil reservoir in the Alberta Basin, Canada. *Geofluids*, Vol. 1, p. 229-240.

Kellett R., **J. Fennell**, A. Glatiotis, W. MacLeod, and C. Watson 1999. An Integrated Approach to Site Investigations in Permafrost Regions: Geophysics, Soils, Groundwater, and Geographical In-formation Systems. ARCSACC Conference, Edmonton '99.

Gilson E.W., R. Kellett, **J. Fennell**, P. Bauman, and C. Sikstrom 1998. High Resolution Reflection Seismic and Resistivity Imaging of Deep Regional Aquifers for Stratigraphic Mapping. CSEG Conference.

Fennell J. and Bentley L. 1997. Distribution of Sulphate and Organic Carbon in a Prairie Till Setting: Natural versus Industrial Sources. *Water Resources Research*, Vol. 34, No. 7, p. 1781-1794.

Fennell J. and Sevigny J. 1997. Effects of Acid Conditions on Element Distribution Beneath a Sulphur Base Pad (Acid Mobilization Study). Publication submitted to the Canadian Association of Petroleum Producers (CAPP).

Fennell J. 1994. Source and Distribution of Sulphate and Associated Organics at a Sour Gas Plant in Southern Alberta. M.Sc. thesis, Department of Geology and Geophysics, University of Calgary.

Hayes B., J. Christopher, L. Rosenthal, G. Los, B. McKercher, D. Minken, Y. Tremblay, and **J. Fennell** 1994. *Atlas of the Western Canadian Sedimentary Basin – Chapter 19: Cretaceous Manville Group*. Canadian Society of Petroleum Geologists and Alberta Research Council, ISBN 0-920230-53-9.

Presentations / Lectures

COSIA Oil Sands Innovation Summit, June 2019 Calgary AB: Fact or fiction – the truth regarding tailings pond seepage in Canada's oil sands (response to a Free Trade Agreement Challenge)

CWRA Alberta Branch conference, April 2019 Red Deer: Flooding, climate change, and the need for a precautionary approach.

University of Calgary, Sustainable Energy Development Program. February 2019, Decision support processes and tools in sustainable energy development projects.

Mine Water Solutions, June 2018. Total Water Management: Canada's contribution to sustainable mine development.

Canadian Water Resources Association, April 2018, Red Deer, AB. Arsenic and Alberta's Groundwater: the where and why.

Southern Alberta Institute of Technology (water Initiative), February 2018, Calgary AB. Risky business: understanding Alberta water security

Canadian Society of Unconventional Resources (CSUR), January 2018, Calgary AB. Managing through nature's extremes: ensuring water security for successful UCOG operations.

SEAWA, Nov 2017, Medicine Hat AB. Hydrology of riparian areas: the need for protection and preservation.

CWRA National Conference, June 2017, Lethbridge AB. Climate change, the Columbia River Treaty, and considerations for a successful re-negotiation.

Thermal mobilizations and the regulatory response, May 2017, Calgary AB. CHOA forum.

National Ground Water Association, March 2017, Denver CO. Advances in the realm of hydrogeophysics: the role of Quantum Geoelectrophysics in groundwater exploration

Haskayne School of Business IRIS series, Feb 2017. Following the molecules: the importance of water to Canada's future.

BRBC-CEAC, Feb 2017, Cochrane AB, GW-SW interaction and the implication for development in riparian lands.

Watertech, April 2017, Banff AB. Arsenic in Alberta's Groundwater: the where and why; Isotopes and Geochemistry:

National Ground Water Association, Hydrogeophysics for deep groundwater exploration, March 2017, Denver CO. Advances in the realm of Hydrogeophysics: the role of Quantum Geoelectrophysics in Groundwater Exploration

Haskayne School of Business CPC IRIS seminar series, February 2017, Calgary AB. Following the molecules: the importance of water in Canada's future.

Bow River Basin Council/Cochrane Environmental Action Committee Collaborating for Healthy Riparian Lands Engagement Workshop, February 2017, Cochrane AB. Groundwater-Surface water interaction and the implications of human development in riparian lands.

Watertech, April 2016, Banff AB. Predicting Alberta's Groundwater Future & An Integrated Approach to Resolving Complex Hydrogeological Settings.

Canadian Water Resources Association (CWRA), April 2016, Edmonton AB. Natural discharge and its role in Athabasca River water quality.

Canada's Oil Sands Innovation Alliance (COSIA) Water Forum, March 2016, Calgary AB. Natural discharge and its role in Athabasca River water quality.

Canadian Association of Petroleum Geologists (CSPG), March 2016, Calgary AB. Climate, water availability, and the success of Western Canada's Energy Development & Natural discharge and its role in Athabasca River water quality.

Underground Injection Control (GWPC), February 2016, Denver CO. Disposal in the unconventional oil and gas sector: challenges and solutions.

AGAT Environmental Series, Jan/Feb 2016. Calgary and Edmonton, AB. Climate, water availability and the success of Western Canada's energy industry.

International Water Conference, November 2015, Orlando FL. Disposal in the unconventional oil and gas sector: challenges and solutions.

Chemistry Industry Association of Canada, October 2015, Edmonton AB. Water Sustainability: and its importance to successful industry.

EnviroAnalysis, July 2015, Banff AB. Thermal mobilization and Arsenic: implication for the oil sands.

WaterTech, April 2015, Kananaskis AB. Smart Monitoring to address challenges of Unconventional Gas development and an approach to mapping risk related to thermal mobilization of constituents.

Canadian Water Resources Association, April 2015, Red Deer AB. Water, Energy and Canada's Future (keynote address)

Underground Injection Council, February 2015, Austin TX. Monitoring to address challenges of Unconventional Gas development (invited speaker)

National Ground Water Association, Groundwater monitoring for Shale Gas developments workshop, November 2014, Pittsburgh PA. Smart monitoring to address the challenges of Unconventional Gas Development (invited speaker)

Canadian Water Resources Association, June 2014, Hamilton ON. Water disposal in the Oil Sands: challenges and solutions and What is Water Security and Why is it Important.

Water Management in Mining, May 2014, Vancouver BC. Total Water Management: a necessary paradigm for sustainable mining.

CSPG GeoConvention May 2014, Calgary AB. Water disposal in the Oil Sands: challenges and solutions; Placing the risk of thermal mobilization into perspective; What is Water Security and Why is it Important?

WaterTech, April 2014, Banff AB. Water disposal in the Oil Sands: challenges and solutions and Placing the risk of thermal mobilization into perspective.

Canada's Oil Sand Innovation Alliance (COSIA), March 2014, Edmonton AB. Water disposal in the Oil Sands: challenges and solutions and Placing the risk of thermal mobilization into perspective.

International Assoc. of Hydrogeologists, GeoMontreal 2013, October 2013, Montreal QC. The role of subsurface heating in trace element mobility.

Oil Sands Heavy Oil Technology 2013, July 2013, Calgary AB. The role of subsurface heating in trace element mobility.

Watertech, April 2013, Banff AB. The role of subsurface heating in trace element mobility.

International Assoc. of Hydrogeologists World Congress 2012, September 2012, Niagara ON. Session Chair for Hydrogeological Issues in the Oil Sands and presenter: i) Oil Sands overview – economic and environmental setting; ii) Framing groundwater vulnerability in the oil sands: an approach to identify and discern; and iii) Climate: a driving force affecting water security in the oil sands

Water in Mining 2012, June 2012, Santiago Chile. Total Water Management: a necessary paradigm for sustainability.

BCWWA 2012 Annual Conference, April 2012, Penticton BC. The role of inventory, dynamics, and risk analysis in water management: a case study.

WaterTech, April 2012, Banff AB. Plenary Session. Bringing context to the oil sands debate: understanding the role of nature and its environmental effects.

BCWWA Hydraulic Fracturing Workshop, Fort St. John BC, March 2012. Keynote address: Striking a Balance – water resource management versus economic development (keynote address).

CONRAD 2012, March 2011, Edmonton AB. Bringing context to the oil sands debate: understanding the role of nature and its environmental effects.

Alberta Irrigation Projects Assoc., November 2011, Lethbridge AB. Managing what we have: a review of Alberta's water sources, volumes and trends (invited speaker).

Alberta Innovates Technology Talks, November 2011, Calgary AB. Dynamics of Alberta's Water Supply: a review of supplies, trends and risks.

Red Deer River Watershed Alliance Annual General Meeting, October 2011, Red Deer AB. Water in the Red Deer: volumes, patterns, trends and threats.

Land and Water Summit, October 2011, Calgary AB. Total Water Management: a necessary paradigm for water security.

CEMA Groundwater Working Group, June 2011, Fort McMurray AB. Groundwater in the oil sands: facts, concepts and management processes.

CWRA Alberta / Alberta Low Impact Development Annual Conference, April 2011, Red Deer AB. A Review of Alberta's Water Supply and trends.

WaterTech, April 2011, Banff AB. Managing what we have: a review of Alberta's water supply.

World Heavy Oil Congress 2011, March 2011, Edmonton, AB. An approach to managing cumulative effects to groundwater resources in the Alberta Oil Sands.

Engineers Australia, August 2010, Brisbane Qld. CSG development in Australia: an approach to assessing cumulative effects on groundwater (invited speaker).

Joint IAH/AIG meeting, July 2010, Melbourne Vic. Assessing the effects of coal seam gas development on water resources of the Great Artesian Basin (invited speaker).

18th Queensland Water Symposium, June 2010, Brisbane Qld. A cumulative effects approach to assessing effects from coal seam gas development on groundwater resources (invited speaker).

WaterTech, April 2010, Lake Louise AB. Regional Groundwater Monitoring Network Implementation: Northern Athabasca Oil Sands Region.

University of Calgary, December 2009, Calgary AB. What's happening to our water? A review of issues and dynamics.

CSPG Gussow Conference, October 2009, Canmore AB. Water sustainability in the Alberta Oil Sands: managing what we have (invited speaker).

Bow River Basin Council, Legislation and Policy Committee Groundwater Licensing Workshop, March 2009, Calgary AB. Groundwater: the hidden resource

BlueWater Sustainability Initiative, January 2009, Sarnia ON. Planning approaches and forensic tools for large-scale regional monitoring initiatives.

CWRA Technical luncheon session, October 2008, Calgary, AB. Water sustainability in a growing Alberta.

Bow River Basin Council, September 2008, Calgary AB. Basin Monitoring and Management Approaches.

IAH/CGS GeoEdmonton08, Edmonton AB. Coordinator and Chair of Groundwater Development Session.

North American Lake Management Society (NALMS) 2008, Lake Louise AB, Coordinator and Chair of Climate Change Effects to Lakes, Reservoirs and Watersheds section.

EcoNomics™ Luncheon, May 2008, Calgary AB. Water Sustainability in the Hydrocarbon Industry.

WaterTech, April 2008, Lake Louise AB. Effects of climate and land cover changes on basin water balances.

CWRA Annual Conference, April 2008, Calgary AB. Role of climate change and land cover on water supply sustainability.

Bow River Basin Council, March 2007, Calgary AB. Forest Hydrology and the effects of Climate Change.

ALMS/CWRA, October 2006, Lethbridge AB. Reservoir Maintenance Workshop. Climate tele-connections and their effects on basin water supplies

Bow River Basin Council, June 2006, Calgary AB. Groundwater sustainability: the invisible resource (Climate change and basin sustainability)

Engineering Institute of Canada, May 2006, Ottawa ON. CCC2006 Land use and climate change effects at the basin scale.

International Water Association, Watershed and River Basin Management Specialists Group Conference, Calgary, AB, 2005. Basin Water Management Strategies.

Burgess Shale Geoscience Foundation, August 2004 and 2005, Field BC. Water in a Changing Climate: understanding and adapting.

C-CAIRNS, October 2005, Victoria BC, Climate and Fisheries Impacts, Uncertainty and Responses of Ecosystems and Communities, Effects of Climate and the PDO on Hydrology of a Major Alberta Watershed.

North American Lake Management Society, November 2004, Victoria BC. Climate Change and Effects on Water Resources.

Canadian Institute Conference, June 2004, Calgary AB. Water Management Strategies for the Oil and Gas Industry: The challenge and approach

Canadian Society of Petroleum Geologists, Gussow Conference, March 2004, Canmore AB. Understanding the Effects of Natural and Anthropogenic Forcings on Basin Water Resources.

Alberta Environment and EUB, April 2003, Elk Point AB. Climate and Land Use Change Effects on Basin Water Resources in the Lakeland Region - East-central Alberta.

Joint CGS/IAH Conference, June 2001, Calgary AB. A Multidisciplinary Approach to Resolving Complex Hydrogeologic Systems.

Aquatic Toxicity Workshop, October 1996, Calgary AB. Use of site characterization and contaminant situation ranking to focus a risk assessment evaluation at a decommissioned sour gas plant and associated landfill.

Joint GAC/MAC Conference, April 1995, Waterloo ON. Use of geochemical modelling and stable isotopes to determine the source of groundwater quality impacts near a sour gas processing facility.

Joint GAC/MAC Conference, Edmonton AB, 1994. Assessment of depression-focused recharge as a mechanism for variable groundwater and soil chemistry.

GasRep Conference, Calgary AB, 1994. Use of stable isotopes to determine the source of water quality impacts near a sour gas processing facility.

3. EXPERT/CONSULTANT

Name: Dr. Jon Fennell (B.Sc. Geology; M.Sc. Hydrogeology & Isotope Geochemistry; Ph.D. Trace Element Geochemistry)

Mailing/Email Address: j.fennell61@gmail.com

Telephone Number: 587-891-5831

Services to be Performed:

- Hydrogeology (documentation review, including groundwater modelling),
- Water quality (documentation review, including geochemical considerations), and
- Climate change impacts (documentation review and assessment regarding project success)

Total Fees and Disbursements: (attach accounts)

Breakdown of Accounts

a) Preparation of submission _56_ hrs x $ _300_ /hr $ _16,800_____

b) Attendance at hearing _12_ hrs x $ _350_ /hr $ _4,200_____

c) Costs of drafting, administrative services, etc. (if applicable, attach a separate breakdown) ____ hrs x $ _____ /hr $ _____

d) Total disbursements $ _____

TOTAL CLAIM RESPECTING EXPERT/CONSULTANT ACCOUNT(s) $ _21,000 (not including GST)_ (line 3)

Please transfer total to Section 6 – Line 3 (Page 21)

* Note: Personal services already compensated for by others in the form of hourly employment or regular salary will not be compensated for in a cost award (See Intervener Funding Process Guide, Costs of an Expert, Page 15)

CLIFF WALLIS, P. BIOL.
SUMMARY

Cliff Wallis is a Professional Biologist, registered in the province of Alberta, who has 50 years' experience coordinating and undertaking biological surveys since the late 1960s. Cliff graduated from the University of Calgary in 1972 with a B.Sc. (with distinction) in Botany and Zoology. After working with Alberta Parks conducting biophysical inventories and planning parks, he established Cottonwood Consultants Ltd. in 1978. He has a diverse background in protected area systems planning, tourism projects, ecological studies, species at risk evaluations, environmentally significant features identification, protected area planning, environmental assessment, ecological restoration and interpretive planning. He has published numerous consulting and government reports as well as several articles in scientific and popular journals. Cliff holds an Authenticating Wetland Professional designation related primarily to Alberta's Wetland Policy in the field of wetland science.

Cliff has worked in a variety of Canada's Ecozones including the Boreal Shield, Taiga Shield, Taiga Plains, Prairies, Northern Arctic and Montane Cordillera and internationally in the grasslands of Inner Mongolia, the deciduous woodlands of Chongqing in SW China and the tropical and montane forests of Cameroon. He is conversant with vegetation, physical features, and wildlife identification and evaluation. Cliff coordinated or assisted on most of the environmentally significant area studies done to date in southern Alberta as well as a provincial overview. He conducted a variety of field studies on vascular and non-vascular plants, fish, amphibians, reptiles, birds and mammals, as well as on-line literature searches and extensive searches of archival material in government files, museums and universities.

Cliff has conducted field work and provided expert testimony to regulatory bodies on transmission lines, solar and wind farms, highways, pipelines, coal mining, natural gas fields, and dams. He worked on projects which have integrated protection and development of sensitive biophysical resources, including species at risk. He provided expert opinion to the Alberta Utilities Commission for transmission line, solar, and wind power projects; to the Alberta Energy Regulator (and its predecessors) for gas and oil projects; and to the Alberta Court of Queen's Bench in Edmonton related to pipelines and Environmentally Significant Areas.

Cliff served on the Alberta Caribou Committee, including its Research Subcommittee, from 2005-2012, providing advice on woodland caribou recovery planning to the Deputy Minister of Alberta Sustainable Resource Development. He was an environmental sector representative on the Standard Development Group for the 2019 Forest Stewardship Council National Forest Standard for Canada. He serves on the boards of the Milk River Management Society, Alberta Wilderness Association and Forest Stewardship Council (Canada) in addition to chairing the steering committee of the Great Plains Conservation Network. He currently serves on the task force making recommendations to Alberta's Minister of Environment and Parks regarding caribou and sub-regional planning in northwestern Alberta.

Of particular note are Cliff's involvement with hundreds of species at risk studies and status assessments in the Grasslands, Foothills, Mountains, Boreal Forest and Aspen Parkland; environmental assessment of the Trans-Canada Highway Twinning in Banff National Park; conservation analyses in western North America, including SW Alberta and its Montane Natural Subregion; field surveys of 1000s of wetlands in Alberta; numerous ecological land classifications and environmentally significant areas studies in Alberta (including the Calgary area) and BC; constraints analyses for energy developments; monitoring pipeline construction and vegetation restoration; capacity building for nature reserve managers in Inner Mongolia; and providing training on monitoring, environmental assessment and biodiversity protection, including species at risk, for the City of Chongqing in southwest China.

CLIFF WALLIS, P. BIOL.

PROJECT INVOLVEMENT

Species at Risk: Rare Plants of the Boreal Forest, Parkland, and Grassland; Trans-Canada Highway Twinning -- Banff National Park; Piping Plover; National Historic Sites; Rare Plants Monitoring, Oldman River Region; Rare Plants and Wildlife of Sand Hills; Western Blue Flag; Daishowa FMA; Foothills Grassland; Onefour; PFRA Pastures; Wainwright Dunes; numerous subdivision applications, Calgary; City of Chongqing, Alberta Caribou Committee

- field surveys to identify and monitor rare plant and wildlife habitats, population size, and management problems; literature surveys to determine status; includes surveys and analysis as part of environmental assessment of development projects; workshops on approaches to species at risk management; advocacy for species at risk protection

Significant Features Analyses: Many Springs; Saskatoon Mountain; Coal Valley; Calgary Region; Oldman River Region (including Crowsnest Pass and M.D. of Pincher Creek); Red Deer Region; Palliser Region; Southeast Region; David Thompson; Lloydminster; Bow-Canmore Corridor; County of Newell; M.D. of Kneehill; Foothills Model Forest

- field/literature studies to determine significant landscape, fish, wildlife and vegetation features—Aspen Parkland, Boreal Forest, Grasslands, Rocky Mountains, Foothills

Resource Management Planning/Environmental Impact Assessment: Battle Lake; Beauvais Lake, Dinosaur and Cypress Hills; Dalinor Nature Reserve, Inner Mongolia; Trans-Canada Highway Twinning; Medicine Hat/Hatton; Suffield Shallow Gas; Access Pipeline

- collection and analysis of data for protected area management and environmental impact assessment of developments; participatory approaches to planning; training of protected area managers; appearance before regulatory boards and Court of Queen's Bench

Restoration (Reclamation) Planning and Implementation: Ross Creek; Pointe-aux-Pins Creek; Coal Valley; Milk River Canyon; Dinosaur Provincial Park; Norman Wells

- field studies and literature review; field implementation (site preparation; planting, monitoring) for coal, pipeline, and oil and gas developments

Systems Planning: Grasslands; Aspen Parkland; Red Deer River Corridor; and Southwestern Alberta Montane and River Valleys; Provincial Parks System

- literature/field studies to determine park potential and to analyze theme representation

Ecological/Biophysical Inventories: Kootenay Plains; Kazan Upland; Milk River; Bow Valley; Saskatoon Island; Young's Point; Coal Valley; Grizzly Ridge; Shepard Drainage; Lakeland, Yoho National Park; Waterton Lakes National Park, Frank Lake, Bearspaw, Edworthy; includes surveys and analysis as part of environmental assessment of development projects

- field studies of wetlands, wildlife, vegetation, and landscapes

Regulatory Processes: Alberta Utilities Commission on transmission line, substation, solar and wind projects; Energy Resources Conservation Board/AEUB on coal, shallow gas and coalbed methane projects; FEARO on Oldman River Dam and Pine Coulee Dam Project (joint review panel with NRCB), Express Pipeline (joint hearing with National Energy Board) and Suffield Encana Shallow Gas project (joint hearing with Energy Resources Conservation Board and CEAA); Court of Queen's Bench regarding Corridor Pipelines and ESAs; Surface Rights Board for Komant Property--Enbridge Woodlands Pipeline; and Bashaw Sour Oil and Pembina Pipeline projects (Alberta Energy Regulator)

- provided expert testimony on environmental impacts and managed expert panels

CLIFF WALLIS
SELECTED PUBLICATIONS

Pinel, H. & C. Wallis. 1972. A botanical investigation in the Drumheller area. Blue Jay 30: 169-194.

Kondla, N., H. Pinel, C. Wallis, & C. Wershler. 1973. Avifauna of the Drumheller area, Alberta. Canadian Field-Naturalist 87: 377-393.

Wallis, C. & K. Van Tighem. 1973. Young's Point-ecological survey. Alberta Parks Division, Edmonton.

Wallis, C. 1976. Milk River Canyon resource evaluation. Alberta Parks Division, Edmonton.

Wallis, C. and C. Wershler. 1978. Coal Valley wildlife monitoring program-1978 study. Luscar Ltd. Edmonton.

Wallis, C. and C. Wershler. 1979. Milk River Canyon: high plains survivor. Nature Canada 8: 36-45.

Wallis, C. and C. Wershler. 1981. 1980 Coal Valley Mine--wildlife monitoring program and habitat reclamation review. Luscar Ltd. Edmonton.

Wallis, C. & C. Wershler. 1981. Natural history inventory & assessment in the Many Springs area, Bow Valley Park. Alberta Energy & Natural Resources, Fish & Wildlife Division, Calgary.

Wallis, C. 1982. An overview of the Mixed Grasslands of North America. Pages 195-208 in Grassland ecology & classification symposium proceedings. B.C. Ministry of Forests Publication R28- 82060.

Wallis, C. & C. Wershler. 1984. Kazan Upland Resource Assessment for ecological reserves planning in Alberta. Alberta Energy & Natural Resources Report T/54, Natural Areas Technical Report No. 12. Public Lands Division, Edmonton.

Wallis, C., C. Bradley, M. Fairbarns, J. Packer & C. Wershler. 1986. Pilot rare plant monitoring program in the Oldman Regional Plan area of southwestern Alberta. Alberta Forestry Lands & Wildlife Technical Report T/148.

Wallis, C. and L. Allen. 1987. Assessment and monitoring of rare plants in Alberta, Canada. Pages 579-586 in "Conservation and management of rare and endangered plants, proceedings of a California conference on the conservation and management of rare and endangered plants". California Native Plant Society, Sacramento, California.

Cottonwood Consultants Ltd. 1987-89. Environmentally Significant Areas in the Oldman River Region (7 Counties and MDs). Resource Evaluation and Planning, Alberta Forestry, Lands and Wildlife.

Wallis, C.A. 1987. Critical, threatened and endangered habitats in Alberta, pp. 49-63, in, Proceedings of the workshop on endangered species in the prairie provinces by Geoffrey L. Holroyd et al. Provincial Museum of Alberta Natural History Occasional Paper No. 9, Edmonton, AB.

Wallis, C. 1987. What is successful reclamation--the public's perception. Pages 107-110 in "Reclamation targets for the 1990s, proceedings of a symposium". Alberta Society of Professional Biologists/Canadian Society of Environmental Biologists, Edmonton.

Achuff, P., J. Godfrey and C. Wallis. 1988. A systems planning natural history framework and evaluation system for Alberta Recreation and Parks. Prepared by Kanata Heritage Research and Interpretation, Calgary for Alberta Recreation and Parks, Edmonton.

Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Municipality of Crowsnest Pass. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.

Sweetgrass Consultants Ltd. 1989. Environmentally significant areas of the County of Paintearth. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.

Godfrey, J. and C. Wallis. 1989. An evaluation of the Ministry of Recreation and Parks'

conservation-outdoor recreation system and identification of candidate areas for the Mixed Grassland, Northern Fescue Grassland, Foothills Grassland, Central Parkland, Foothills Parkland, and Rocky Mountain Montane Biogeographical Zones. Prepared by Kanata Heritage Research and Interpretation, Calgary for Alberta Recreation and Parks, Edmonton.

Cottonwood Consultants Ltd. 1990. Bow/Canmore Corridor environmental issues analysis. Alberta Tourism, Edmonton.

Wallis, C. 1990. Reconnaissance survey of saline wetlands and springs in the grassland-parkland region of eastern Alberta. Prepared by Cottonwood Consultants, for World Wildlife Fund Canada, Toronto.

Smith, W. and C. Wallis. 1991. An exploration of the alternatives to the Oldman Dam Project, southern Alberta. Prepared for Friends of the Oldman River, Calgary and Oldman Dam Environmental Assessment Review Panel, Vancouver.

Wallis, C. 1992. Communications plan for Antelope Creek Ranch. Prepared by Cottonwood Consultants, Calgary, for Antelope Creek Habitat Development Area, Brooks.

Sweetgrass Consultants Ltd. 1994.Preliminary inventory of Environmentally Significant Areas within the Foothills Model Forest. Prepared by Sweetgrass Consultants Ltd., Calgary, AB for Foothills Model Forest, Hinton, Alberta.

Ecological Stratification Working Group. 1995. A national ecological framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. (Cliff Wallis was a regional contributor)

Cottonwood Consultants Ltd. 1995. Gwich'in Territorial Park, Biophysical Inventory. Prepared for Gwich'in Tribal Council, Inuvik.

Avens Associates Ltd. 1996. Mount Pelly Territorial Park, Archeological Survey and Biophysical Inventory. Prepared for NWT Department of Economic Development and Tourism.

Bradley, C. and C. Wallis. 1996. Prairie ecosystem management: an Alberta perspective. Prairie Conservation Forum, Occasional Paper 2, Lethbridge, Alberta.

Sweetgrass Consultants Ltd. 1997. Environmentally Significant Areas of Alberta. Volumes 1, 2 and 3. Prepared by Sweetgrass Consultants Ltd., Calgary, AB for Resource Data Division, Alberta Environmental Protection, Edmonton, Alberta.

Wallis, C. and C. Wershler. 1997. Waterton Lakes National Park, Ecological Land Classification (Wildlife Component) 1995-96. Prepared by Cottonwood Consultants Ltd. Calgary, Alberta for Canadian Heritage, Waterton Lakes National Park, Alberta.

Cottonwood Consultants Ltd. 1999. American White Pelican, California Gull, Caspian Tern, Double-crested Cormorant, Great Blue Heron and Ring-billed Gull Colony Surveys -- Alberta 1998. Prepared for Ducks Unlimited Canada, Edmonton.

Cottonwood Consultants Ltd. 2000. Vegetation Assessment for Reclamation Planning, Imperial Oil Site (Norman Wells). Prepared for Komex International, Calgary.

Wallis, C. and C. Wershler. 2001. Natural History Inventory, 2000, Grizzly Ridge Wildland Provincial Park. Prepared for Alberta Environment, Valleyview.

Alberta Sustainable Resource Development. 2002. Surveys of Plant Species Potentially at Risk, Foothills Fescue Grassland. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report, Edmonton, AB.

Sweetgrass Consultants Ltd. 2006. Environmentally Significant Areas of City of Medicine Hat Properties. Prepared by Sweetgrass Consultants Ltd. for Police Point Nature Center/Grasslands Naturalists.

Wershler, C. and C. Wallis. 2010. Innisfail Ecospace Inventory. Prepared for the Town of Innisfail by Sweetgrass Consultants Ltd., Calgary.

Sweetgrass Consultants Ltd. 2017. Nose Hill Park Bird Monitoring, 2006 and 2015. Prepared by Sweetgrass Consultants Ltd., Calgary for City of Calgary Parks.

Wallis, C. 2019. A Continental (Great Plains) Approach to Grassland Conservation. America's Grasslands Conference, August 2019, Bismarck, North Dakota, USA (in press).

CLIFF WALLIS

ACHIEVEMENTS, AWARDS

- Cliff Shaw Award, Saskatchewan Natural History Society, 1972
- Governor-General's Canada 125th Anniversary Medal, 1992
- Prairie Conservation Award, World Wildlife Fund, 1992
- Peggy Thompson Award, Alberta Society of Professional Biologists, 1993
- J.B. Harkin Medal, Canadian Parks and Wilderness Society, 1997
- Douglas H. Pimlott Award, Canadian Nature Federation (now Nature Canada), 2003
- “Ernie” Award, Alberta Wilderness Association, 2004

THIS DIPLOMA CERTIFICATE

IS TO CERTIFY THAT

Clifford A. Wallis

having complied with the requirements of the
Professional and Occupational Associations Registration Act of Alberta
on March 1, 1991
is admitted and registered as a member of the

ALBERTA SOCIETY OF PROFESSIONAL BIOLOGISTS

and is entitled to practice Professional Biology
within the province of Alberta using the title of

PROFESSIONAL BIOLOGIST

In witness whereof the seal has been hereto affixed
this 17 day of December 1991.

Al Kennedy
President

Registrar

COTTONWOOD
CONSULTANTS LTD.
615 Deercroft Way S.E.
Calgary, AB T2J 5V4 CANADA
phone and fax: (403) 271-1408
email: deercroft@shaw.ca

October 26, 2020

Ms. Ifeoma Okoye
Ackroyd LLP
1500 First Edmonton Place, 10665 Jasper Avenue
Edmonton AB Canada T5J 3S9

Dear Ms. Okoye:

RE: Budget—Springbank SR1

The following is my proposed budget regarding a biodiversity focused technical review and report preparation regarding the following project.

> NRCB APPLICATION NO. 1701 ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT

PREHEARING REVIEW, CONSULTATION, AND INFORMATION REQUESTS

Review of documentation, information requests, and consultations with other experts, clients, and counsel.

Review of Documentation: 45 hours X $270/hour = $12,150
Preparation of Information Requests: 12 hours X $270/hour = $3240
Field Visit: 4 hours X $270/hour = $1080

*SUBTOTAL: **$16,470** plus GST*

FILING EVIDENCE AND ANSWERING INFORMATION REQUESTS

Responses to information requests and preparation of a written report based on the review of existing documentation and information requests. This includes GIS work.

Professional Time: 40 hours X $270/hour = $10,800

*SUBTOTAL: **$10,800** plus GST*

TESTIFYING AT THE ORAL HEARING/MONITORING PROCEEDING

I am estimating a further 8 hours for hearing preparation, attendance at hearing/monitoring transcripts (presuming no travel required), testifying, and assistance with cross-examination.

Professional Time: 8 hours X $270/hour = $2160

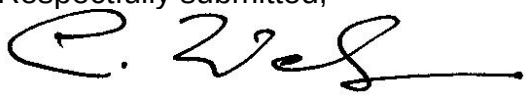
*SUBTOTAL (HEARING WORK): **$2160** plus GST*

ANTICIPATED EXPERT FEES TOTAL: $29,430 plus GST

I will focus my evaluation on impacts to areas of environmental significance, important wildlife habitat, species of conservation concern, and other matters that may arise related to biodiversity. My evidence will include literature citations, GIS mapping and expert opinion based on over 50 years of field experience, including environmentally significant area and ecological evaluations in the Calgary area.

Please let me know if you need any additional information. My CV is attached.

Respectfully submitted,



Cliff Wallis, P. Biol.
President, Cottonwood Consultants Ltd.

Zelt Professional Services Inc.
397 Banister Drive
Okotoks, Alberta, CANADA T1S 1W2

t:403.995.2122 info@zeltpsi.com
f:403.995.2122 www.zeltpsi.com

Brian W. Zelt, Ph.D.

Brian is president of an independent company with over 30 years of consulting experience in air dispersion modelling. Brian currently applies his knowledge and experience in the fields of air dispersion modelling, risk assessment, surface water dispersion modelling and application programming. A brief summary of his qualifications is listed below:

- Professional member of the Association of Professional Engineers and Geologists of Alberta (APEGA) and British Columbia (APEGBC)
- Has extensive background in the applied fields of turbulence and dispersion modelling with experience authoring air quality and surface water quality dispersion models, and using other regulatory dispersion models. He is active in the development of new modelling techniques and tools for dispersion modelling of hazardous pollutants, sour gas, pipelines, risk assessment and non-routine flaring for the Alberta government.
- He is co-author of the regulatory models: AERflare (flaring and incinerator air dispersion modelling for AERMOD), ABflare (flaring and incineration air dispersion modelling for CALPUFF) and AERH2S (Emergency planning zones for sour gas). He has also developed and coauthored the development of ZZArisk for the calculation of quantitative risk calculations for public safety risk from toxic gas, pipelines and other hazards.
- Has knowledge of oil and gas operations and equipment, thermodynamics and combustion for the estimation of emissions
- Has experience as an expert witness for the AER, AUC and Queen's Bench
- Has experience in environmental and human health risk assessment techniques including probabilistic and discrete methodologies
- Graphic arts, graphing, mapping and GIS - communicating complex and technical information in layman-accessible formats
- Has extensive background in computer application and database programming. Languages include C/C++, fortran, awk, visual-basic, VB for Microsoft applications, PHP, MYSQL, jscript, TeX/LaTeX and assembler languages.

Brian W. Zelt

Education

PhD, Mechanical Engineering, University of Alberta, 1992
BSc, Mechanical Engineering, University of Alberta, 1984

Affiliations

Professional Engineer, Association of Professional Engineers and Geologists of Alberta (APEGA), British Columbia (APEGBC)
Air and Waste Management Association (AWMA)
Canadian Prairie and Northern Section of AWMA (CPANS)
American Chemical Society
Canadian Chemical Society

Awards

Gilpin Award for Research Excellence
Alberta Oil Sands Technology and Research Authority Scholarship
Gulf Canada Ltd. Graduate Scholarship
NSERC Undergraduate Summer Research Award
Dean's Research Award

Experience

2002- **Zelt Professional Services Inc.** **Calgary, Alberta**
President
Air quality modelling and assessment; public safety risk assessment; regulatory review and expert testimony; computer programming; probabilistic model formulation; surface water quality dispersion modelling; human health and environmental exposure risk assessment; communication of technical information, business graphics and presentation

1998-2001 **E2 Environmental Alliance Inc.** **Calgary, Alberta**
Zelt Professional Services Inc. (Partnership)
Director, Air Quality Services
Air quality modelling and assessment; human and ecological risk assessment; surface water quality modelling; probabilistic model formulation; statistical analysis, time series analysis; Windows C^{++} computer programming.

1993-1998 **Environmental Management Associates (EMA), Golder Associates Ltd.** **Calgary, Alberta**
Ecological and Human Health Risk Assessment, Exposure Modelling Specialist
Water quality modelling; atmospheric dispersion modelling; risk assessment; environmental noise modelling; probabilistic model formulation; statistical analysis; time series analysis; computer programming; industrial graphics art;

1992 **Spicer Corp.** (contract) **Kitchener, Ontario**
Design/Program user interface for retail version of graphics software

1992 **Toxcon Consulting Ltd** (contract) **Edmonton, Alberta**
Health risk assessment modelling for Water Treatment plant

1992 **University of Alberta** (contract) **Edmonton, Alberta**
Developed a three-dimensional flexible linkage robot simulation program

1990 **Toxcon Consulting Ltd** (contract) **Edmonton, Alberta**
Toxic gas dispersion modelling for new landfill

Brian W. Zelt

PROJECT RELATED EXPERIENCE - RISK ASSESSMENT

2019

AllHazards-SkyStone, Assorted operators — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

2018

AllHazards-SkyStone, Assorted operators — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

Hazard Review, EPCOR — **AB, Canada**

Hearing: hazards and setbacks potentially impacting EPCOR proposed operations from nearby sour gas battery.

2017

Sour Gas, SEM CAMS — **AB, Canada**

Sour gas plume dispersion and hazard assessment for on-site high pressure acid gas piping

LNG refueling station, Gaz Metro — **QC, Canada**

Quantitative risk assessment of risk associated with the operation of an LNG refueling station in Quebec. Modelling using PHAST/SAFETI.

Quantitative Risk Assessment, EPCOR — **AB, Canada**

Calculation of individual risk from pipeline and EPZ calculations of sour gas battery.

Hazard Review, EPCOR — **AB, Canada**

Review of hazards and setbacks potentially impacting EPCOR proposed operations from nearby sour gas battery.

AllHazards-SkyStone, ConocoPhillips — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

AllHazards-SkyStone, Predator — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

2016

GazMétro Solutions Transport — **Quebec, Canada**

Quantitative risk assessment of four natural gas transmission pipelines in Quebec with investigation of uncertainties of primary influences: pipeline incident rate (including review of PHMSA and NEB databases); thermal hazards; flash fires; building infiltration and explosions. Using SAFETI/PHAST modelling tools.

AllHazards-SkyStone, PennWest — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

AllHazards-SkyStone, Chinook — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

2015

Ackroyd LLP, ATCO pipeline — **Alberta, Canada**

Critical review assessment of ATCO's proposed natural gas pipeline adjacent to proposed senior's house development. Hazard and risk assessment using ZZArisk.

Alberta Energy Regulator, Pembina Pipeline — **Alberta, Canada**

Expert reviewer on behalf of AER of Pembina Pipeline Fox Creek to Edmonton, during hearing and preparation of materials supporting decision report.

AllHazards-FirstResponse, ConocoPhillips — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

AllHazards-FirstResponse, PennWest — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

AllHazards-FirstResponse, Chinook — **B.C., Canada**

Several different fields: calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

Ackroyd LLP, TAMA Power — **Alberta, Canada**

Critical review assessment of TAMA power assessment of proposed power plant and use of anhydrous ammonia. Risk calculations and modelling using ZZArisk.

2014

AllHazards-FirstResponse, ConocoPhillips — **B.C., Canada**

Calculation of hazard distances for jet flames, fire balls, distance to LFL/2 for pipelines, wells.

AllHazards-Spectra Energy — **Alberta, Canada**

Determine heat radiation and flammability limits for the proposed pipeline to support consultation and involvement processes. Modelling using PHAST and ZZArisk.

AllHazards-ConocoPhillips, Risk Tools Development — **Alberta, Canada**

Development of risk analysis tools (programming) for calculating hazard distances for jet flames, fire balls, distance to LFL/2. Modelling using PHAST and ZZArisk.

GazMétro Solutions Transport — **Quebec, Canada**

Quantitative risk assessment of a proposed LNG transport comparison to alternative fuels transport including CNG, propane, hydrogen and diesel. Risk of flammability, over pressure explosion, toxicity and fireball. Modelling using PHAST and ZZArisk. In association with Alp & Associates Inc.

2013

Natural Gas Pipeline, ENMAX — **Alberta, Canada**

Quantitative risk assessment of natural gas fuel pipeline to Calgary Energy Centre. Flammability, jet fire and fireball risk calculations using ZZArisk model. In association with Alp & Associates Inc

Sour Gas Well/Pipeline — **Alberta, Canada**

Sour oil and gas operations associated with Grizzly Resources Ltd Well and Sinopec Daylight Energy Ltd pipeline risk assessment using ZZArisk model Expert testimony at hearing. Concentrations and EPZ distances were calculated using CALPUFF and ERCBH$_2$S.

GazMétro Solutions Transport — **Cornwall, Canada**

Quantitative risk assessment of a proposed LNG distribution station for Robert Transport in an industrial location. Risk of flammability, over pressure explosion, toxicity and fireball. In association with Alp & Associates Inc.

Suncor, Equipment Failure EPZ — **Alberta, Canada**

Emergency response planning zone and dispersion calculations for the Suncor Energy at the base plant near Fort McMurray. Due to equipment failure, sour gas could potentially be emitted during repair. Concentrations and EPZ distances were calculated using CALPUFF and ERCBH$_2$S.

2012

Shepard Energy Centre, ENMAX — **Calgary, Canada**

Qualitative risk screening assessment and quantitative risk assessment of Shepard Energy Centre (in construction) using natural gas fueled turbine generators, steam turbine generator, aqueous ammonia storage, and hydrogen storage. Dispersion modelling for calculation of ERPG distance, probability of lethality mapping and risk calculations. In association with Alp & Associates Inc.

2011

Robert Transport, GazMétro Solutions Transport — **Mississauga, Canada**

Quantitative risk assessment of a proposed LNG distribution station for Robert Transport in an industrial location. Risk of flammability, over pressure explosion, toxicity and fireball. In association with Alp & Associates Inc.

Calgary Energy Centre, ENMAX — **Calgary, Canada**

Comparative quantitative risk assessment of changing operations from anhydrous ammonia to aqueous ammonia. Dispersion modelling for calculation of ERPG distance, probability of lethality mapping and risk calculations. In association with Alp & Associates Inc.

2010

ERCBrisk Model — **Alberta, Canada**

Co-authoring software for the Alberta Energy Resources Conservation Board for the calculation of sour gas toxicity risk from wells (point sources) and pipeline leaks (linear sources). Building upon the toxicity assessment software ERCBH2S. In association with PSAQM Inc.

2003-2009

ERCBH2S Model — **Alberta, Canada**

Co-authoring software for the Alberta Energy Resources Conservation Board for the calculation of sour gas public safety, a model to calculate H2S emergency response planning zone distances for public safety. In association with PSAQM Inc.

Parsons Lake, ConocoPhillips/Salmo — **NWT, Canada**

Surface water quality modelling and risk assessment of a historical slumping of drilling fluids contamination and potential release to nearby Parsons Lake.

2002 and before

Peer Review
Nanasivik-Human Health Risk Assessment, — **Alberta, Canada**

The Human Health and Ecological Risk Assessment Nanisivik Mine, (for CanZinco Ltd., by Jacques Whitford Environmental Limited, January, 2003) was reviewed with respect to data quality and methodology. The underground zinc-lead mine was located on the Borden Peninsula on northern Baffin Island. The risk assessment review included recalculation and assessment of the determination of risk based soil remediation concentrations.

Human Health Risk Assessment, BlackRock — **Alberta, Canada**

A human health risk assessment was developed to assess the impacts of the SAGD heavy oil project in northeastern Alberta. A multi-media exposure assessment of PAHs and arsenic were developed based on USEPA methods. Potential impacts of phenols and arsenic in the domestic groundwater wells was investigated.

Human and Ecological Health Risk Assessment, Agrium — **Alberta, Canada**

A human and ecological health risk assessment was developed to assess the impacts of the proposed gypsum stack (settling pond) expansion. A multi-media exposure assessment of fluorides was developed based on USEPA methods. Impacts due to fluoride and particulate ($PM_{2.5}$ and PM_{10}) emissions were assessed by incremental risk analysis.

Human Health Risk Assessment, Burnco — **Alberta, Canada**

Assessment of human health impacts from a proposed gravel pit operation near Wabamun Lake. Noxious chemicals included fugitive dust, $PM_{2.5}$, metals, silica, PAH from the proposed development, nearby developments

and background air quality. Impacts due to particulate ($PM_{2.5}$ and PM_{10}) emissions were assessed by incremental risk analysis.

Human Health Risk Assessment, Lafarge — **Alberta, Canada**

Assessment of human health impacts from a proposed gravel pit operation near Calgary. Noxious chemicals included fugitive dust, $PM_{2.5}$, metals, silica, PAH from the proposed development, nearby developments and background air quality in the Calgary region. Project included expert testimony at an EUB Appeal Board hearing.

Toxicity Review, Salmo — **Alberta, Canada**

Literature review of fish toxicity to selected metals.

Human Health Risk Assessment, BlackRock — **Alberta, Canada**

Screening level human health risk assessment for BlackRock Ventures Inc. for a SAGD heavy oil project in northeastern Alberta. The assessment examined reasonable maximum exposures to industrial emissions in the Cold Lake area. Literature review and qualitative multipathway exposure for effects of PAHs and acid deposition.

Risk Assessment Training — **Alberta, Canada**

A delegation of professors from Chinese universities were trained on the Canadian perspective of environmental issues related to the oil and gas development. An overview of ecological and human health risk assessment issues, practices and modelling methods were presented. (1-d course)

City of Calgary Landfill — **Alberta, Canada**

Peer review of a risk assessment prepared for a food industry adjacent to a landfill in Calgary. The risk assessment was reviewed and explained to City officials for their decision to allow the development

Goodfish Lake, ToxCon — **Alberta, Canada**

Review and reassessment of gas migration through basement slab and grade slab concrete into above structures. Gas migration resulting from PERC and landfill contamination.

Lead Paint Exposure, ToxCon — **Alberta, Canada**

Estimate of human health and wildlife exposure and risk assessment from soils contaminated with lead paint below a historic bridge. The contamination resulted from years of exposure to lead gasoline emissions and chips of paint from sand blasting (cleaning) of the structure.

Cyanide Spill, EuroGold — **Turkey**

Hazardous gas assessment involving the estimation of cyanide spill emission rates to the atmosphere and heavy gas dispersion assessment for a human health risk and consequence analysis for a proposed gold mine.

Performance Assessment — **Alberta, Canada**

Project management of the performance assessment of the closure plan for Syncrude. Wildlife, vegetation, forestry, soils and water resources impacts were modelled and predicted through a GIS based framework. A flexible closure planning protocol was developed to co-ordinate and direct closure planning based on company goals and policies and environmental risk.

Ecological / Human Health Risk Assessment — **Alberta, Canada**

An on-site, off-site and regional analysis of exposure for an ecological and human health risk assessment. The ecological analysis was performed probabilistically and examined the risks based on observed and predicted concentrations in waterbodies, soils and vegetation. The exposure assessment model included contaminant flows from the on-site landforms, through wetlands, rivers and seepage discharges to the Athabasca River. A river dispersion model was created to predict dilution zones and exposure concentrations for various release configurations. Risks to ecological subpopulation receptors were determined through a probabilistic risk assessment. Risks to humans were assessed based on on-site and off-site impact exposure scenarios.

Dust Dispersion Exposure Modelling — **Vancouver, B.C.**

Exposure problem formulation, dust dispersion modelling and expert consulting on the dispersion of dust from a landfill site in the greater Vancouver regional district for a human health risk assessment. U.S. EPA dispersion model techniques were applied and emissions were calculated based on field sampling and emission factor estimates.

Dust Dispersion Exposure Modelling — **Eastern Ontario, Canada**

Dust dispersion modelling using fundamentals and the U.S. EPA dispersion models (ISC, SCREEN and FDM) for a human health risk assessment of fugitive dust emissions from the hazardous waste pile of an electro-arc furnace flue dust pile at a steel recycling plant.

Decision Analysis — **Voisey Bay, Newfoundland**

Technical direction for the development of a probabilistic decision analysis model to assess the mine development options based on environmental impacts, costs and consequences. Preparation of presentation materials.

Preliminary Risk Assessment of Water Discharges — **Northern Ontario, Canada**

Preliminary ecological risk assessment of water discharges of heavy metals for Placer Dome and Environment Canada. The screening level assessment was performed deterministically to determine worst-case risks to ecological receptors.

Preliminary Risk Assessment of Seepage Water Discharges — **Alberta, Canada**

Preliminary risk assessment of the seepage water discharges from fine tailings sites was analyzed probabilistically. The exposure model was developed probabilistically using C++ code and examined aquatic biota, fish tissue and osprey as receptor endpoints.

End-Cap Lake Water Quality — **Alberta, Canada**

The potential effects on aquatic biota and plant and fish tissue concentrations were determined in a risk assessment framework for Syncrude Canada Ltd. Assisted in the assessment by performing probabilistic fate and exposure model calculations to determine water quality concentrations and plant and fish tissue concentrations.

Crab Orchard — **Chicago, USA**

Screening level and later detailed ecological risk assessment on this superfund site following the EPA guidelines. This project involved screening multiple chemical contaminants, multiple sites and multiple

receptors. The initial assessment was performed deterministically because of limited data and the large scope of the calculations. A probabilistic assessment of risk was conducted to put problem sites and deterministic risks into perspective.

Performance Assessment **Alberta, Canada**

Performance assessment investigating three land reclamation scenarios using generic landscapes for Syncrude and Suncor. Surface water quality and seepage water was modelled for each of the three landscapes and exposure calculations were performed to assess potential off-site impacts. The assessment was performed probabilistically using steady state seasonal modelling and Monte Carlo time series transient modelling. Code was developed in C++ to do the calculations with greater efficiency and speed than typical spreadsheet assessments.

Rossdale Water Intake
Health Risk Assessment, ToxCon **Alberta, Canada**

Probabilistic formulation of a health risk assessment model for contaminant exposure through consumption and use of Edmonton drinking water produced at the Rossdale Water Treatment plant in Edmonton, Alberta. The analysis included a probabilistic pathway analysis of compounds from drinking water to a lifetime averaged human receptor. This analysis was combined with an Alberta Research Council dispersion study to calibrate spill masses, into the stormwater sewer system, that would generate LOAEL/NOAEL level doses and Canadian drinking water chronic guideline concentrations.

Brian W. Zelt

PROJECT RELATED EXPERIENCE - AIR QUALITY MODELLING

2020

Well Test Flaring, Shell Upstream — **Shpirag, Albania**

Investigation of SO_2 concentrations downwind of well test flaring at several locations. Air dispersion modelling using ABflare, AERflare and CALPUFF.

Natural Gas Venting, Gas Liquid — **AB, Canada**

Investigation of the issues related to natural gas venting. Hazard modelling using HGsystems.

Flaring, Flare Tech — **AB, Canada**

Modelling for flare design using AERflare and AERMOD.

2019

Industrial Metals, LAM — **MA, Canada**

Review of air quality monitoring in reference to emissions from metals recycling facility emissions and monitoring study.

Natural Gas Venting, Gas Liquid — **AB, Canada**

Investigation of the issues related to natural gas venting. Hazard modelling using HGsystems.

Swan Hills Treatment Centre, Renewal — **Alberta, Canada**

SIR and air quality dispersion modelling using CALMET/CALPUFF for PCB, dioxins, furans and criteria pollutants.

Compressor Pack Vent, Compass Engg — **AB, Canada**

Investigation of the air toxics related to compressor packing leakage and venting of raw process gas (Egypt). Hazard modelling using HGsystems.

Chlorine, Alberta Environment Parks — **AB, Canada**

Investigation of concentrations related to accidental release of chlorine. Modelling was conducted using HGsystems (near field) and CALPUFF (far-field) using site-specific meteorological data.

PSV Venting, Pembina — **B.C., Canada**

Investigation of air toxics from individual PSV venting at plant site. Modelling was performed using HGsystems (near field) and AERMOD (far field).

CO2 Venting, Gas Liquid — **AB, Canada**

Investigation of hazard zones surrounding the venting of CO2. Modelling was conducted using HGsystems.

CO2 Venting, Gas Liquid — **AB, Canada**

Investigation of hazard zones surrounding the venting of CO2 and ammonia. Modelling was conducted using HGsystems.

Hydrogen Venting, Gas Liquid — **AB, Canada**

Investigation of hazard zones surrounding the venting of H2. Modelling was conducted using HGsystems.

NOx Compressor Station, Vesta Energy — **AB, Canada**

Investigation of NOx from a compressor station. Modelling using AERflare and AERMOD.

2018

Brine pond, AtlasBA — **AB, Canada**

SCREEN3 and AERMOD dispersion modelling of area source emissions from brine pond of propylene.

Facility Upgrade 1, Everdell — **AB, Canada**

Facility upgrade with addition of NOx sources. Dispersion modelling for AER approvals using AERMOD.

Facility Upgrade 2, Everdell — **AB, Canada**

Facility upgrade with addition of NOx sources. Dispersion modelling for AER approvals using AERMOD.

Facility Upgrade, Gold Creek — **AB, Canada**

Facility upgrade with addition of NOx sources. Dispersion modelling for AER approvals using AERMOD.

Sour Gas Well Flaring, Shell — **Shpirag, Albania**

Air quality dispersion modelling in complex terrain using the CALMET/CALPUFF dispersion models for well test flaring. CTSG processing of terrain.

Sour Gas Flaring, Matrix — **AB, Canada**

Air quality dispersion modelling in complex terrain with CTSG processing using the CALMET/CALPUFF dispersion models for regular flaring.

Flaring Heat Intensity, Matrix — **AB, Canada**

Review of ground level heat intensity calculation methods and calculations for several flares.

Flaring Screening Level — **AB, Canada**

Screening level sour gas flaring calculations

Husky Hastings Coulee, Update — **Alberta, Canada**

Facility update air dispersion modelling for NOx and SO2 continuous, upset and emergency flaring. Using AERflare, ABflare, CALPUFF/CALMET.

2017

Mervin Compressor Station, Husky — **Saskatchewan, Canada**

Facility update air dispersion modelling for NOx continuous. Using AERMOD.

Brian W. Zelt

Propane & Mercaptan Bullet PSV, AtlasBA — **Carolina, USA**

Heavy gas air dispersion modelling for emergency PSV venting from propane and ethyl-mercaptan bullets. SLAB model.

Mercaptan Bullet PSV, AtlasBA — **Arizona, USA**

Heavy gas air dispersion modelling for emergency PSV venting from ethyl-mercaptan bullets. SLAB model.

Sour Gas, SEM CAMS — **AB, Canada**

Sour gas plume dispersion and hazard assessment for on-site high pressure acid gas piping

MD Greenview, AER — **AB, Canada**

Air dispersion modelling of all industrial and commercial SO2 and NOx sources for the MD Greenview, AB using CALPUFF. Comparison of predicted concentrations to monitoring data.

Venting, Tuxla — **AB, Canada**

Air dispersion modelling of venting to determine ground level concentrations greater than LFL.

Venting-Flare, Tuxla — **AB, Canada**

Air dispersion modelling of venting at flare stack A to determine if ignition could result by nearby flare stack B.

Carmon Creek, CNRL — **AB, Canada**

Air dispersion modelling in support of APEA application of the heavy oil Carmon Creek project at Peace River. Dispersion modelling of facility and regional emissions using CALPUFF.

Industrial Metals, LAM — **MA, Canada**

Air dispersion modelling and emissions review of metals recycling facility emissions and monitoring study.

2016

Husky Hastings Coulee — **Alberta, Canada**

Facility update air dispersion modelling for NOx and SO2 continuous, upset and emergency flaring. Using AERflare, ABflare, CALPUFF/CALMET.

Sour Gas Well Testing, Shell — **Shpirag, Albania**

Air quality dispersion modelling in complex terrain using the CALMET/CALPUFF dispersion models for well test flaring.

Kineticor 1-15, Compressor Station — **Saskatchewan, Canada**

Air dispersion modelling for NOx and SO2 using AERMOD, AERflare.

Husky Ram River Gas Plant — **Alberta, Canada**

Approval renewal air dispersion modelling for NOx and SO2 continuous, upset and emergency flaring. Using AERflare, ABflare, CALPUFF/CALMET.

Wisconsin Rapids — **Wisconsin, USA**

Review of meteorology and creation of AERMOD ready met dataset for hazard/risk screening. In association with Alp & Associates.

Generic Incinerator Model — **Sulphur Experts, Alberta**

Development of a reverse engineered dispersion model from first principles to provide estimates of stack height to meet ground level maximum concentrations for given incinerator conditions. Development of revised model with reverse calculations and AERMOD.

2015

Major Hazards Study — **Canada**

Review of meteorology and creation of AERMOD ready met datasets for 6-locations across Canada for hazard/risk screening: Quebec, Ontario, Manitoba, Saskatchewan, Alberta, BC.. In association with Alp & Associates.

Flare Assessment, RockEast — **Saskatchewan, Canada**

Flaring assessment using AERflare.

Alder Flats Phase II Gas Plant, Bellatrix — **Alberta. Canada**

NOx air dispersion for expansion project at Alder Flats. In association with Keywest Projects.

Provost Flare Assessment, RockEast — **Saskatchewan, Canada**

Flaring assessment using AERflare.

Boundary Lake, Flare Assessment, Venturion — **Alberta, Canada**

Flaring assessment using AERflare.

Gas Plant 5-16 Flare Assessment, Venturion — **Alberta, Canada**

Flaring assessment using AERflare.

2014

Husky, Moose Mountain — **Alberta, Canada**

Non-routine air quality dispersion modelling for advanced blowdown scenarios for planned and unplanned blowdowns. Dispersion modelling using ABflare and CALMET/CALPUFF.

Suncor, Flare Upgrade — **Alberta, Canada**

Air quality dispersion modelling using SLAB, CALPUFF and AERmode to determine potential hazards for workers operating at stack height on a operational flare and also being impacted from emissions from a nearby operational twin flare.

Tuxla — **Alberta, Canada**

Air quality dispersion modelling using SLAB, ZZArisk and AERflare to determine potential of ignition of a vented release being ignited from a nearby flare.

Connorsville — **Alberta, Canada**

Air quality dispersion modelling using AERflare.

Swan Hills Treatment Centre, Renewal — **Alberta, Canada**

Air quality dispersion modelling using CALMET/CALPUFF for PCB, dioxins, furans and criteria pollutants.

Update Stack Top Temperature
SO_2 Modelling, Kaybob South Plant 3 — **Alberta, Canada**

Air quality dispersion modelling in complex terrain using the CALMET/CALPUFF dispersion models for stack top temperature reduction of the facility incineration. In Association with Sulphur Experts.

Sour Gas Well Testing, Shell — **Shpirag & Molisht,Albania**

Air quality dispersion modelling in complex terrain using the CALMET/CALPUFF dispersion models for well test flaring and incineration.

Update, Sour Gas Well Testing, Petromanas — **Molisht,Albania**

Air quality dispersion modelling in complex terrain using the CALMET/CALPUFF dispersion models for well test flaring and incineration. Calculation of emergency planning distances using ERCBH2S.

Rheaume Engg. — **Alberta, Canada**

Air quality modelling using AERflare

Ceno, Sturgeon Lake, Behr Engg. — **Alberta, Canada**

Air quality modelling using AERflare

Encana, AERflare modelling — **Alberta, Canada**

Air quality modelling using AERflare

Manitok, AERflare modelling — **Alberta, Canada**

Air quality modelling using AERflare

Ferguson SO_2, DeeThree Exploration — **Alberta, Canada**

Air quality modelling for the Ferguson 01-21 Sour Oil Battery, DeeThree Exploration Ltd. Air dispersion modelling AERMOD and CALPUFF in complex terrain for three incinerators. In association with Keywest Project Ltd.

Alder Flats, NOx, Bellatrix Exploration — **Alberta, Canada**

Air quality modelling for the Alder Flats 10-09 gas plant, Bellatrix Exploration Ltd. Air dispersion modelling AERMOD in complex terrain compressor station. In association with Keywest Project Ltd..

2013

Sour Gas Flaring, — **Omers, Alberta**

Air quality dispersion modelling in complex terrain using the CALMET/CALPUFF dispersion models for well test flaring and AERMOD. Also using AERflare in development.

Stack Top Temperature
SO_2 Modelling, Kaybob South Plant 3 — **Alberta, Canada**

Air quality dispersion modelling in complex terrain using the CALMET/CALPUFF dispersion models for stack top temperature reduction of the facility incineration. In Association with Sulphur Experts.

Sour Gas Well Testing, Petromanas — **Molisht,Albania**

Air quality dispersion modelling in complex terrain using the CALMET/CALPUFF dispersion models for well test flaring and incineration. Calculation of emergency planning distances using ERCBH2S.

Odours, AER — **Alberta, Canada**

Air quality modelling for odours associated with oil and gas operations in the Peace River region of Alberta. Dispersion modelling using CALMET/CALPUFF and investigation of possible sources of odours from regular emissions from tanks, flaring and heaters associated with well pad battery and tanks. Expert testimony at a hearing.

Shell-Carmon Creek — **Alberta, Canada**

Air quality modelling for the Shell Carmon Creek. EIA is a re-evaluation of the 2009 Shell Carmon Creek project using CALPUFF/CALMET. In association with Worley Parsons.

2012

ERCBflare Update — **Alberta, Canada**

Furthering the development of ERCBflare and as an update to the screening capability (as opposed to ABflare) flare source and dispersion model. Co-authored a flare source model for short-term steady and transient flares, taking into account energy balance, flare efficiency, flare assist. User interface, spreadsheet modules, interface for AERMOD using AERSCREEN methodology. Terrain processing following AERmap and land use processing following AERSURFACE, allowing for screening and site-specific refined meteorology processing using AERMET. User guide. In association with ERCB.

Incinerators, Petromanas — **Albania**

Air dispersion modelling at two locations in the foothills like terrain of Albania. SO_2 modelling for well test incineration of waste gases at unknown rates and concentrations.

Update to Incinerators, Petromanas — **Albania**

Air dispersion modelling at two locations in the foothills like terrain of Albania. SO_2 modelling for well test incineration of waste gases at unknown rates and concentrations.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 03-05, Dispersion modelling and report for Barrick Energy. Modelling using ERCBflare, CALPUFF and AERMOD.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 03-05b, Dispersion modelling and report for Barrick Energy. Screening of 30 well test flares for scoping. Modelling using ERCBflare and AERMOD.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 6-21, Dispersion modelling and report for Barrick Energy. Modelling using ERCBflare and AERMOD.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 15-6, Dispersion modelling and report for Barrick Energy. Modelling using ERCBflare and AERMOD.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 2-31, Dispersion modelling and report for Barrick Energy. Modelling using ERCBflare and AERMOD.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 9-31, Dispersion modelling and report for Barrick Energy. Modelling using ERCBflare and AERMOD.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 13-3, Dispersion modelling and report for Barrick Energy. Modelling using ERCBflare and AERMOD.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 7-6, Dispersion modelling and report for Barrick Energy. Modelling using ERCBflare and AERMOD.

Well Test Flaring, Barrick Energy — **Alberta, Canada**

Well 12-5, Dispersion modelling and report for Barrick Energy. Modelling using ERCBflare and AERMOD.

Aitken Creek, Rheame Engineering — **NE, BC, Canada**

Facility flaring and incinerator dispersion modelling. Modelling using AERMOD. In association with Sirius Consulting Inc.

Baseline Update, Shell Canada — **Alberta, Canada**

Peace River Complex baseline SO_2 dispersion modelling update. Modelling using CALPUFF.

Moose Pad1, Husky — **Alberta, Canada**

Update of NOx modelling for Husky Moose Mtn. Pad1 facility in complex terrain. Modelling using CALMET/CALPUFF.

2011

ABflare — **Alberta, Canada**

Development of ABflare flare source and dispersion model. Co-authored a flare source model for short-term steady and transient flares, taking into account energy balance, flare efficiency, flare assist. User interface, stand-alone fortran modules, extension to CALPUFF, and user guide. In association with ERCB, PSAQM Inc. and Exponent Inc.

RAKgas, Sulphur Experts — **United Arab Emirates**

Air dispersion modelling for incineration of SO_2 and stack top temperature reduction options on the coast of the UAE in complex terrain. Modelling using CALMET/CALPUFF. In association with Sulphur Experts.

Oldman Gas Plant, Peyto — **Alberta, Canada**

Air dispersion modelling for NOx in complex terrain. Modelling using CALMET/CALPUFF.

Ammonia Destructor, Syncrude — **Alberta, Canada**

Syncrude is adding of new process equipment for the destruction of ammonia and emissions of SO_2. Various iterations of stack heights, locations and 3D modelling for on-site worker safety at cat-walk elevations. Accounting for local and regional emissions. Modelling using CALMET/CALPUFF.

Tank Odours, Suncor — **Alberta, Canada**

Suncor is investigating possible upset emission scenarios of vapours from tanks from the south tank farm and accounting for the new vapour recovery unit. Odour modelling using CALMET/CALPUFF.

Moose Pad1, Husky — **Alberta, Canada**

Husky is preparing emergency flare management plans for Moose Pad1 facility. Blowdown modelling of high SO_2 emissions in complex terrain. Modelling using CALMET/CALPUFF.

Flare Model, CNRL — **Alberta, Canada**

SO_2 modelling using CALMET/CALPUFF.

Harmattan, Taylor Engineering — **Alberta, Canada**

Update on NOx emissions modelling for the Harmattan gas plant for the addition of new equipment. Modelling using AERMOD.

Edson Oil & Gas Battery, Crocotta Energy — **Alberta, Canada**

Crocotta is adding equipment at the Edson Oil & Gas battery, requiring modelling for NOx in complex terrain. Modelling using CALMET/CALPUFF.

BurntTimber, Shell — **Alberta, Canada**

Stack top temperature reduction assessment and air dispersion modelling of SO_2 from acid gas incineration. Modelling using CALMET/CALPUFF. In association with Sulphur Experts.

GoldCreek, Progress Energy — **Alberta, Canada**

Emergency Planning Zone calculations using ERCBH2S.

2010

Rainbow Lake, Husky — **Alberta, Canada**

Air dispersion modelling for updated facility design for NO_x and SO_2. In association with PSAQM Inc.

South Monias Gas Plant, Shell — **Alberta, Canada**

Air dispersion modelling for dense gas CO_2 venting. In association with Sirius Consulting Inc.

NuVista 2 — **Alberta, Canada**

Revised facility design air dispersion modelling for revised facility design including NOx and flaring of SO_2. In association with PSAQM inc.

Brian W. Zelt

BDR Innes — **Saskatchewn, Canada**

Air dispersion modelling for revised facility design including NOx and flaring of SO_2. In association with PSAQM inc.

Excelsior — **Alberta, Canada**

SIR responses from application. In association with PSAQM inc.

Crocotta — **Alberta, Canada**

Air dispersion modelling for revised facility design including NOx and flaring of SO_2. In association with PSAQM inc.

Sinclair — **Alberta, Canada**

Air dispersion modelling for revised facility design including NOx and flaring of SO_2. In association with PSAQM inc.

Obed — **Alberta, Canada**

Air dispersion modelling for revised facility design including NOx and flaring of SO_2. In association with PSAQM inc.

Ranata — **Alberta, Canada**

Air dispersion modelling for revised facility design including NOx and flaring of SO_2. In association with PSAQM inc.

NuVista — **Alberta, Canada**

Air dispersion modelling for revised facility design including NOx and flaring of SO_2. In association with PSAQM inc.

McMullen — **Alberta, Canada**

Air dispersion modelling for revised facility design.

Eaglesham — **Alberta, Canada**

Air dispersion modelling of SO_2 from acid gas incineration. In association with PSAQM inc.

Donnelly — **Alberta, Canada**

Air dispersion modelling of SO_2 from acid gas incineration. In association with PSAQM inc.

Kakut — **Alberta, Canada**

Air dispersion modelling of SO_2 from an incinerator. In association with PSAQM inc.

CanSup — **Alberta, Canada**

Air dispersion modelling of SO_2 from an incinerator. In association with PSAQM inc.

2009

South Saskatchewan River Basin-Land Use Planning — **Alberta, Canada**

Air dispersion modelling and expert advice support for land use planning. In association with Alces Group.

Suncor VRU — **Alberta, Canada**

Air dispersion for Suncor VRU capacity increase. Dispersion modelling of emergency vent containing H_2S emissions. In association with Worley Parsons.

Suncor Ponds — **Alberta, Canada**

Updated air dispersion modelling of odour emissions from ponds. Flaring emission using hourly emissions and hourly source characteristics using CALPUFF. In association with Clearstone Engineering.

Husky McMullen Thermal Conduction — **Alberta, Canada**

Air quality modelling for a proposed pilot facility. In association with Matrix Environmental Solutions.

Chemical Fire/Risk — **Kansas, USA**

Air dispersion modelling for support of risk calculations. In association with PSAQM Inc.

Suncor Energy, Bighorn — **Alberta, Canada**

Well completion air dispersion modelling in complex terrain. In association with PSAQM Inc.

Atco Gas, Harmattan Gas Plant — **Alberta, Canada**

Update to NO_x and SO_2 modelling with the addition of and removal of: COGEN, engines and heaters. In association with PSAQM Inc.

Apache Energy — **Alberta, Canada**

Well test flaring modelling in complex terrain with well test flaring monitoring plan. In association with PSAQM Inc.

Laurus Energy — **Alberta, Canada**

Air quality modelling for a proposed pilot facility. In association with Matrix Environmental Solutions.

Shell-Carmon Creek — **Alberta, Canada**

Air quality modelling for the Shell Carmon Creek. EIA is a re-evaluation of the 2008 Shell Carmon Creek project using CALPUFF. In association with Matrix Environmental Solutions.

Husky, Hastings Coulee — **Alberta, Canada**

Air quality modelling for a facility renewal application including NO_x and SO_2 concentrations. . In association with PSAQM Inc.

Husky, Thompson Lake — **Alberta, Canada**

Air quality modelling for a facility renewal application including NO_x and SO_2 concentrations. . In association with PSAQM Inc.

Talisman, Narraway — **Alberta, Canada**

Air quality modelling in complex terrain for SO_2 concentrations related to a flare test for a new well. . In association with PSAQM Inc.

Excelsior — **Alberta, Canada**

Air quality modelling the Fort McMurray oil sands using new extraction technologies. In association with Matrix Environmental Solutions.

Swan Hills, Synergia — **Alberta, Canada**

Air quality modelling for update of facility emissions of SO_2 and vented H_2S. In association with PSAQM Inc.

Suncor — **Alberta, Canada**

Air quality modelling for incomplete combustion of waste gases to flare systems. Modelling H_2S and SO_2 concentrations using hourly variable inefficiency in response to meteorology. In association with Clearstone Engineering.

Minnow — **Alberta, Canada**

Air dispersion modelling and monitoring plans for well test flaring at two independent locations. In association with PSAQM Inc.

Kakut, BDR Engineering — **Alberta, Canada**

Air Quality modelling for updated facility of NO_x and SO_2. In association with PSAQM Inc.

Swan Hills, Synergia — **Alberta, Canada**

Air quality modelling for update of facility emissions of SO_2 and vented H_2S. In association with PSAQM Inc.

Syncrude — **Alberta, Canada**

Air quality modelling in relation to additional boiler emissions and modelling near-field NOx and CO. In association with Clearstone Engineering.

Syncrude — **Alberta, Canada**

Air quality modelling in relation to stack diversion resulting from equipment failure. In association with Clearstone Engineering.

2008

Shell-Carmon Creek — **Alberta, Canada**

A re-evaluation of the 2006 Shell Carmon Creek project using a completely re-designed facility. The air quality modelling used the CALPUFF modelling system. In association with DMLeahey and Matrix Environmental Solutions.

JACOS-Update — **Alberta, Canada**

Update on the proposed expansion of the JACOS SAGD operations. Air quality modelling was performed using the AERMOD model.

McMullen,Husky — **Alberta, Canada**

Air quality modelling for a proposed SAGD pilot facility. This air quality modelling report was prepared for the proposed Husky Energy Inc. McMullen Thermal Pilot Plant. The McMullen facility is located in northern Alberta, approximately 50 km northeast of Grande Prairie. The heavy oil battery is being proposed to test the potential of the reservoir and production methods. The oil plant has a licenced capacity of 160 m3/d of bitumen and will have sulphur emissions of 0.218 t/d. Modelling was performed using the CALPUFF modelling system for three proposed site locations. In association with Matrix Environmental Solutions.

Kakut, Galleon Energy Inc. — **Alberta, Canada**

This air quality modelling report was prepared for the proposed Galleon Energy Inc. Kakut Gas Plant with information supplied by BDR Engineering Ltd. The Kakut facility is located in northern Alberta, approximately 50 km northeast of Grande Prairie, along the eastern edge of the Saddle Hills. The oil battery is being expanded to process sour gas. The gas plant has a licenced inlet gas capacity of 480 103m3/d with a sulphur inlet of 0.65 t/d. Nitrogen dioxide (NO2) and sulphur dioxide (SO2) emissions from facility were modelled in the study area surrounding the facility using the USEPA-CALPUFF model.

Big Horn, Talisman — **Alberta, Canada**

Air quality modelling in complex terrain for a flare emissions during a well clean up. Modelling was performed using CALPUFF model. In association with PSAQM.

Ram River, Husky — **Alberta, Canada**

Air quality modelling for a facility change of emissions including NO_x and benzene emissions. Air quality modelling was performed using the AERMOD model in complex terrain. In association with PSAQM.

Ram River, Husky — **Alberta, Canada**

Meteorological review and assessment of on-site monitoring tower and sodar data. In association with PSAQM Inc.

PetroCanada, Wilson Ck — **Alberta, Canada**

Air quality modelling for continuous, upset and emergency flaring at PetroCanada Wilson Ck. Facility. In association with PSAQM Inc.

Innes, Saskatchewan — **Alberta, Canada**

Air quality modelling for battery at Innes, Saskatchewan. In association with PSAQM Inc.

PetroCanada, Peppers — **Alberta, Canada**

Air quality modelling using the ISCST model at the PetroCanada, Peppers facility. SO_2 flaring. In association with PSAQM Inc.

2007

Sawn Lake, Andora — **Alberta, Canada**

Andora Energy Corporation is proposing to construct the Sawn Lake SAGD Demonstration Project approximately 115 km northeast of Peace River. The demonstration Project will be located at 15-21-091-12 W5M or 7-30-091-12 W5M. The Project has a low pressure (LP) flare to dispose of sour produced gas and burns sweet fuel gas to produce steam in two once-through steam generators. In association with PSAQM.

ConocoPhillips — **Alberta, Canada**

Air quality modelling in support of legal claims regarding emissions from a sour oil pipeline leak near a farm house and cattle. In association with PSAQM.

JACOS, Renewal — **Alberta, Canada**

Air quality modelling in support of the JACOS renewal application and expansion. Air quality modelling was performed using the pre-approved ISCST model. In association with PSAQM.

Moose Mountain, Husky — **Alberta, Canada**

Air quality modelling in the complex terrain of the Rocky Mountain eastern slopes at three mountain top oil/gas pads. 3D wind fields were modelled using CALMET with 2003,2004 and 2005 RUCii data. Modelling included short-term upset flaring in connection with various duration pipeline blowdown scenarios. Modelling also considered flaring for various well cleanup emission scenarios. In association with PSAQM.

Prince George, PBEC — **Alberta, Canada**

Air quality modelling for the relocation of the Pacific BioEnergy Corporation (PBEC) wood pellet manufacturing facility in Prince George, British Columbia. Modelling focused on stack particulate emissions. Modelling used the UNBC CALMET configuration and the CALPUFF model. In association with SEACOR.

RAM Update, Husky — **Alberta, Canada**

Air quality modelling updates for the RAM renewal application to AENV. Modelling of SO2 and NOx using the AERMOD model included equipment changes. In association with PSAQM.

Vero-Sakwatamau, Talisman Energy — **Alberta, Canada**

Air quality modelling for compressor engine and heater NO_x emissions using the ISCST model. In association with PSAQM.

Orion Update, Shell — **Alberta, Canada**

Air modelling update to Orion EOR EIA for as built equipment and emissions. Modelling included both SO_2 and NO_x emissions using the CALPUFF model.

Harmattan Gas Plant, Taylor — **Alberta, Canada**

Air quality modelling for the renewal application of the Harmattan gas plant and compressors. Modelling included comparisons of CALPUFF (using MM5 meteorology), AERMOD (using MM5 meteorology and AENV screening data) and ISCST (using MM5 meteorology and AENV screening data). In association with PSAQM.

N-SOLV, Hatch Energy — **Alberta, Canada**

Air quality modelling for the N-Solv approval application to AENV included modelling using the ISCST model using AENV screening meteorology. In association with PSAQM.

PC Nordegg, PetroCanada — **Alberta, Canada**

Air quality modelling using CALMET/CALPUFF using 2002 MM5 data for a temporary flaring permit to EUB. In association with PSAQM.

Synergia Polygen — **Alberta, Canada**

Air Quality modelling for a pilot approval application to AENV for an in-situ coal gasification facility. Air quality modelling included CALPUFF/CALMET modelling using 2002 MM5 meteorological data in relatively flat terrain for upset and emergency flaring scenarios. In association with PSAQM.

Eaglesham, Galleon Energy — **Alberta, Canada**

Air quality modelling for a facility expansion. Modelling included CALPUFF/CALMET modelling using 2002 MM5 meteorological data for emissions of SO_2 and NO_x. In association with PSAQM.

Fugitive Odour, Suncor — **Alberta, Canada**

Air quality modelling of fugitive/odour emissions using CALMET/CALPUFF. Wind fields were created using surface stations in the Fort McMurray oil sands area and available upper air data. Local detailed terrain and landuse were digitized into the model. Modelling calculations included back-calculation for source emissions. In association with PSAQM and Clearstone Engineering.

Fugitive Odour, Syncrude — **Alberta, Canada**

Air quality modelling of fugitive/odour emissions using CALMET/CALPUFF. Wind fields were created using surface stations in the Fort McMurray oil sands area and available upper air data. Local detailed terrain and landuse were digitized into the model. Modelling calculations included back-calculation for source emissions. In association with PSAQM and Clearstone Engineering.

PC5-20, PetroCanada
PC9-05, PetroCanada
PC9-17, PetroCanada
PC5-11, PetroCanada — **Alberta, Canada**

Complex terrain modelling using CALPUFFF and 3D windfields for several well locations located in the Eastern Slopes. 3D windfields created using RUCII (2003, 2004) interpolation. In association with PSAQM.

Golden, Focus Energy Trust Resources — **Alberta, Canada**

The air quality modelling supported the review of the flaring at the battery to ensure compliance with Alberta Energy and Utilities Board (EUB) Directive 60. Modelling was conducted using CALPUFF/CALMET using 2002 MM5 meteorology. In association with PSAQM.

Benjamin, Husky — **Alberta, Canada**

Air quality modelling the Rocky Mountain eastern slopes complex terrain. Modelling supported the review of the flaring that the Benjamin well site and battery flaring scenario blowdowns. Modelling included various comparisons of multiyear results in complex terrain and sub-hourly emission duration estimates compared to hourly and continuous emissions. In association with PSAQM.

NuVista — **Alberta, Canada**

Air quality modelling for expansion and renewal application for NO_x modelling. Modelling included both AERMOD and CALPUFF modelling using MM5 2002 meteorology. In association with PSAQM.

Primewest — **Alberta, Canada**

Air quality modelling using AERMOD of the Primewest compressor station expansion and renewal. Modelling included NO_x emissions. In association with PSAQM.

2006

Olds, BDR — **Alberta, Canada**

In association with PSAQM.

Brian W. Zelt

AMD Update, Shell — **Alberta, Canada**

Preparation of an air quality monitoring station description report following the AENV-AMD.

Sylvan Lake — **Alberta, Canada**

Update.In association with PSAQM.

Pouce Coup — **Alberta, Canada**

Update 2. In association with PSAQM.

Twining, BDR — **Alberta, Canada**

In association with PSAQM.

Pouce Coup — **Alberta, Canada**

Update 1. In association with PSAQM.

ConocoPhillips — **Alberta, Canada**

Air quality strategic planning. Support for ConocoPhillips strategic planning for developments in the Fort McMurray oil sands area.

Twining Gas Plant, EOG Resources — **Alberta, Canada**

Air quality modelling in complex terrain using the AERMOD model for NO_x emissions using the PVRM and OLM models for NO_2 conversion. In association with PSAQM.

Donnely, Gas Plant — **Alberta, Canada**

Update. Air Quality modelling of SO2 and NOx for Licence renewal. Modelling included Aermod, CalPUFF and ISCST3. In association with PSAQM.

Savanna Creek, Petro-Canada
PC5-20, PetroCanada
PC5-10, Petro-Canada
PC10-25, Petro-Canada
PC5-33, Petro-Canada
Getty, Petro-Canada
Sullivan, Petro-Canada
West Limestone, Petro-Canada
Trap Creek, Petro-Canada — **Alberta, Canada**

Complex terrain modelling using CALPUFFF and 3D windfields for several well locations located in the Eastern Slopes. 3D windfields created using RUCII (2003, 2004) interpolation. In association with PSAQM.

2005

Donnely, Gas Plant — **Alberta, Canada**

Update. Air Quality modelling of SO_2 and NO_x for Licence renewal. Modelling included Aermod, CALPUFF and ISCST3. In association with PSAQM.

Pigeon Lake Acidification, Fairborne Community — **Alberta, Canada**

'Back of the envelope' scoping and modelling demonstrating magnitude of potential acidification of potential sour well test flaring and impacts on nearby Pigeon Lake.

Marten Hills, Gas Compressor, AltaGas — **Alberta, Canada**

Air quality modelling for a facility licence renewal of NO_x emissions near elevated terrain. In associate with PSAQM.

Rainbow Lake, Husky — **Alberta, Canada**

Air quality modelling and assessment of facility emissions and upset flaring near elevated terrain. Development of alternative strategies for upset flaring. In association with PSAQM.

Swalwell, Gas Compressor, EOG Resources — **Alberta, Canada**

Air quality modelling and assessment of facility NO_x emissions. In association with PSAQM.

Pouce Coupe, Acclaim Energy — **Alberta, Canada**

Air quality and stack height assessment for NO_x and SO_2 emissions. In association with PSAQM.

Hussar, Gas Compressor, Husky — **Alberta, Canada**

Air quality modelling for NO_x for license renewal. In association with PSAQM.

Peace River, Carmon Creek EIA, Shell — **Alberta, Canada**

Air quality modelling, emission estimation and assessment for the Peace River Complex (Cyclic Steam) facility expansion for the Carmon Creek EIA. In association with DML.

Ram River, Application, Husky — **Alberta, Canada**

NO_x and SO_2 modelling in complex terrain for license renewal of the Husky Ram River Facility. CALPUFF complex terrain modelling was completed using 3D windfield modelling. In association with PSAQM.

Incinerator/Flaring, EUB — **Alberta, Canada**

Programming and user-interface development of spreadsheet tools for EUB for assessment of incinerators and flares. Application development for public submissions of applications for incinerators and flaring. In association with PSAQM.

Upset Flaring, CAPP — **Alberta, Canada**

3D windfield modelling and CALPUFF complex terrain modelling of upset flaring. Several locations across Alberta. Providing scenario modelling and technical advice for development of upset flaring guidelines for Alberta. In association with PSAQM.

2004 and Before

Panther River II, Suncor — **Alberta, Canada**

Complex terrain dispersion modelling of a well completion flare scenario. CALPUFF was configured and applied in a screening model. Air monitoring design was completed. 3D windfield modelling was also complted. In association with PSAQM.

Legal, Hydrogen Chloride — **Alberta, Canada**

Screening level emissions and air quality modelling predictions of a hydrogen chloride spill.

Brian W. Zelt

Expert Witness, Ammonia Release — **Alberta, Canada**

Screening level emissions and air quality modelling predictions of an ammonia release. Provided expert witness evidence in criminal court regarding short-term exposure modelling for an ammonia release.

Incinerator, Questor — **Albania**

Albanian meteorology was processed for a screening level assessment of various incinerator designs in complex terrain using the ISCST3 model.

Stuart Lake, Husky — **Alberta, Canada**

Air quality modelling using the Aermod model for a gas plant registration in simple terrain.

Panther River, Suncor — **Alberta, Canada**

Complex terrain dispersion modelling of a well completion flare scenario. Aermod was configured and applied in a screening mode. Air monitoring design was completed.

Incinerator Optimization, Husky — **Alberta, Canada**

Complex terrain modelling of SO_2 using Aermod, Calpuf, ISCST3, RTDM, Screen3, and Screen2. Meteorological data sets for Aermod were summarized into screening data sets for comparison to the other listed models and for optimization of the incinerator stack temperature in complex terrain.

Toxic Gas Modelling, Legal — **Alberta, Canada**

Toxic gas modelling of an ammonia release. Near source modelling using the dense gas SLAB model.

SLAB (Dense Gas) Model Modification, EUB — **Alberta, Canada**

Thermodynamic and physical modifications developed by Michael Zelensky were programmed within the USEPA SLAB program. These program modifications will be released as the hazard and evacuation zone planning tool for the Alberta Energy and Utilities Board (EUB) for planning hydrogen sulphide pipelines and wells in Alberta.

Tucker Project EIA, Air Quality, Husky — **Alberta, Canada**

Air Quality modelling in simple and intermediate terrain using the CalPUFF model. Acid deposition modelling. Meteorological data review and emissions inventory preparation and estimation. Model verification and preparation of report.

Monitoring Review, Tolko — **Alberta, Canada**

Review of air quality monitoring and preparation of annual air quality and meteorological summary reports.

NOx/Ozone Environmental Review
TransCanada/Environment Canada — **Alberta, Canada**

Literature review of environmental effects of NOx and ozone in relation to strategies for NOx controls for gas turbines. Review of impacts from Selective Catalytic Reduction (SRC). Review of: ozone monitoring in Alberta; ozone regulations in USEPA/Canada; ozone and NOx photochemistry. Technical writing/editing.

Orion EOR Project EIA, Air Quality, BlackRock — **Alberta, Canada**

Air Quality modelling in simple and intermediate terrain using the CalPUFF model. Acid deposition modelling. Meteorological data review and emissions inventory preparation and estimation. Model verification and preparation of report.

Aerosol Assessment, Toxcon — **Alberta, Canada**

An integral component of the investigation on potential health effects from a new house carpet powder, the distribution of fine particles were analyzed. Distribution statistics and graphics were developed and a report was prepared.

Air Quality Modelling Training — **Alberta, Canada**

A delegation of professors from Chinese universities were trained on the Canadian perspective of environmental issues related to the oil and gas development. An overview of meteorology, air quality modelling issues, emissions estimation and practical examples were presented. (1-d course)

Lochend Sour Gas Well Modelling,
City of Calgary — **Alberta., Canada**

Modelling of combusted and uncombusted H_2S and SO_2 from the proposed Lochend sour gas well near Calgary. A detailed investigation of dense gas effects using the SLAB model was prepared. A far field model using neutrally buoyant gas was prepared using the ISC model.

Hub Oil Fire Review, Komex — **Alberta, Canada**

A review and report on the meteorology and probable plume path for the first few hours of the Hub Oil Refinery fire in 1998.

Maxhamish Air Quality Permit, Salmo — **Ft. Liard, B.C., Canada**

Air quality modelling in simple and complex terrain for the Maxhamish Gas plant in northern B.C. Emissions, modelling and report were prepared for the B.C. Permit to Operate. (ISC)

Lubicon Lake, Sorrel Environmental — **Alberta, Canada**

As a part of the Lubicon Lake lands claim process, the settlement (village) at Lubicon Lake will be moved. The air quality impacted by sources within 20km was modelled using the ISC model in complex terrain. Emission estimates included plant, battery and fugitives from well-heads.

Air Quality Modelling, Amoco — **Alberta, Canada**

An update to Wolf Lake SAGD operations resulted in a need to update the air quality modelling for Amoco's permit. SO_2 and NO_x modelling of steam generators, co-generation and field flares. (ISC).

EIA, Suncor Energy — **Alberta, Canada**

Management of the air quality task of the EIA for the Project Millennium oil sands mine and facilities expansion. Meteorological data set preparation and quality assurance based on site data from two meteorological towers. Emissions inventory preparation for the Millennium project and greater oil sands area. Air quality model development (ISCBE configuration and CALPUFF), calibration and use.

Brian W. Zelt

Noise Assessment,
Diavik Diamond Mines — **Northwest Territories, Canada**

A preliminary noise assessment was completed for Diavik Diamond Mines which included three separate noise assessments: aircraft noise assessment based on the aircraft types and frequency of traffic; general mine operation noise levels were estimated based on literature noise spectrum and were modelled using a modified version of NoiseCalc sound program.

Cyanide Spill, EuroGold — **Turkey**

Hazardous gas assessment involving the estimation of cyanide spill emission rates to the atmosphere and heavy gas dispersion assessment for a human health risk and consequence analysis for a proposed gold mine. Estimation of toxic gas concentrations in the direction of a nearby village.

Gazoduc, TransQuebec and Maritime Pipeline — **Quebec, Canada**

Two complex terrain air quality dispersion modelling assessments of compressor stations along the proposed TransQuebec and Maritime pipeline. The USEPA ISC model was applied using five-year meteorological data sets.

Air Quality Monitoring,
Newport Petroleum — **Saskatchewan, Canada**

Responsible for the design, implementation and environmental management of an air quality monitoring program for a new sour gas plant. Monitoring results from two trailers were analyzed to assess the likely hood of air quality problems reported at residential locations were resulting from the sour gas plant or from oil field operations.

Leak Detection/Emission Estimation
Union Carbide Canada — **Alberta, Canada**

Estimation of VOC and speciation emissions from the proposed Union Carbide Prentiss polyethylene plant expansion. Greenhouse gas emission inventory was also prepared.

Air Quality Modelling ,
Weldwood Canada — **Alberta, Canada**

Dispersion modelling using the ISC model in complex terrain for Weldwood Canada, Hinton mill for their license renewal. A review and detailed comparison of monitoring air quality data and meteorological data was completed in preparation for modelling.

Landfill Gas Dispersion
City of Windsor — **Ontario, Canada**

Technical direction and model configuration of the air quality modelling of landfill gases for the City of Windsor proposed elevated landfill.

Registration, Canadian 88 — **Alberta, Canada**

Nitrogen dioxide (NO_x) emissions summary was prepared from plant operations information and a screening level air quality model for NO_x was developed. A registration was prepared for a renewal for a Permit to Operate.

Air Quality Modelling,
Saskatchewan Wheat Pool — **British Columbia, Canada**

Technical direction of the ISC modelling for particulates, NO_x and SO_2 at the proposed SWP-Cargill grain terminal at Robert's Bank. Preparation of report graphics of the modelling results.

Clean Air Act Permit,
CS Resources Ltd — **Western Saskatchewan, Canada**

Air quality dispersion modelling for the Senlac Thermal Project and preparation of the Clean Air Act operating permit. The Alberta Environment air quality dispersion models were used in the assessment of heavy oil plant emissions from steam generators, flares and other sources of SO_2 and NO_x.

Wolf Lake Heavy Oil EIA — **Northeastern Alberta, Canada**

Air quality dispersion modelling using Alberta Environment and U.S. EPA dispersion models was used in this EIA amendment to determine air quality impacts as a result of the increased emissions for the Wolf Lake and Primrose operations. Plant site steam generators, processing equipment and field flares were included in the assessment of SO_2, NO_x and VOC concentrations. Greenhouse gas calculations and ozone precursor concentrations for ozone generation potential were included in the assessment for the EIA and AEUB approval.

Air Quality
Scoping Assessment, EIA — **Buenos Aires, Argentina, SA**

A scoping and issues assessment of the emissions and air quality resulting from port and ship traffic for the Hidrovia project in Buenos Aires. The EIA was a part of international project for approval of dredging of 3400 km of rivers in South America. Potential industrial related emission increases were scoped including dust and diesel emissions.

Dust Dispersion
Exposure Modelling — **Vancouver, British Columbia**

Exposure problem formulation, dust dispersion modelling and expert consulting on the dispersion of dust from a landfill site in the greater Vancouver regional district for a human health risk assessment. U.S. EPA dispersion model techniques were applied and emissions were calculated based on field sampling and emission factor estimates.

Air Quality Assessment, Ford — **Buenos Aires, Argentina, SA**

Air quality modelling around the Ford assembly and painting buildings to assess the ground level concentrations of hazardous fumes from rooftop vents.

Odour and Noise Assessment — **Alberta, Canada**

As a result of public complaints about odours adjacent to a gas compressor station and well battery, continuous H_2S and meteorological sampling was conducted. A noise survey was performed on the plant operations. The monitoring results were assessed and recommendations for remediation were supplied.

Dust Dispersion Exposure Modelling — **Eastern Ontario, Canada**

Dust dispersion modelling using fundamentals and the U.S. EPA dispersion models (ISC, SCREEN and FDM) for a human health risk

assessment of fugitive dust emissions from the hazardous waste pile of an electro-arc furnace flue dust at a steel recycling plant.

Complex Terrain Dispersion Modelling — **Western British Columbia, Canada**

Complex terrain dispersion modelling in a screening assessment for the design of a regional air quality monitoring plan in the Kitimat valley for Alcan, Methanex and Eurocan. The US EPA- ISC model was used in a screening level assessment of the emissions from three industrial source groups and included air quality estimates of TRS, NO_x, SO_x, TSP and fluorides. Recommendations were made as to the siting of the ambient air quality monitoring stations.

Long-Term Monitoring — **Western Saskatchewan, Canada**

Long-term air quality management including the assessment of air quality monitoring results, and preparation of regular reports of static and continuous monitoring results to the provincial government.

Primrose Commercial Development — **Northeastern Alberta, Canada**

The Primrose Commercial Development is the first expansion phase from the pilot study of the steam injection oil sands recovery project by Amoco. Air dispersion of slightly sour gas from 33 flared annulus gas oil production well stacks was performed using the Alberta Environment *SEEC* model for SO_2. NO_2 dispersion calculations were performed for the commercial development steam generators and existing plant operation equipment using the Alberta Environment *SEEC* model.

Air Quality Modelling for Monkman Area Gas Development — **Northeastern British Columbia, Canada**

Complex terrain air modelling using Alberta Environment and U.S. EPA air quality models for an environmental impact assessment of the gas development and expansion in the Sukunka and Bullmoose valleys, and Monkman gas field.

Progress Gas Expansion — **Northwestern Alberta, Canada**

Air quality modelling and permit preparations for a number of existing and expansion stacks and flares. The Alberta Environment air quality models were used in the analysis.

Landfill Gas Dispersion — **Edmonton, Alberta**

Gas contaminant dispersion estimates for the proposed Aurum Landfill site, using a modified ERCB computer model (PLUMES2) and the Wilson/Zelt computer model (SHELTER/EXPOSURE).

Indoor Air Quality Investigation in Drayton Valley — **Edmonton, Alberta**

Time series analysis of data from indoor monitoring equipment recording concentrations of contaminants in residential houses downwind of several pulp mills near Drayton Valley, Alberta. Programming of several analysis packages and graphical generation of analysis results provided insight for meaningful interpretation of the data.

Occupational Health and Safety & Alberta Public Safety Service Grants — **Edmonton, Alberta**

Development and programming of two state of the art dispersion models (SHELTER and EXPOSURE) which run on an IBM PC computer. The models predict concentrations and concentration fluctuation levels downwind of sources and predict indoor/outdoor toxicity and mortality estimates based on the gas lethality. Supervision of an experimental plume dispersion study in a water channel simulation of an atmospheric boundary layer. Co-ordination and preparation of reports and presentations.

Brian W. Zelt

Publications

Zelensky,M.J, B.W.Zelt. 2019. Consequences of using Pseudo-Science to Determine Pseudo-Parameters for Flares, A&WMA's 112th Annual Conference & Exhibition, Quebec, June 25-28, 2019. (AERflare)

Zelensky,M.J, B.W.Zelt. 2018. Pseudo-Source Parameters for Flares: Derivation, Implementation and Comparison, in publication J.AWMA. (AERflare)

Zelt, B., R.D. Shaw, H.R. Hamilton. 1996. Oil Sands Reclamation Performance Assessment Framework. Presented to The Geotechnical Society of Edmonton, Risk Assessment in Geotechnical & Geo-Environmental Engineering, 2nd Annual Symposium, Coast Terrace Inn, Edmonton, Alberta, April 2, 1996.

Zelt, B. 1995. Concentrations Fluctuations in Health Risk Assessment. Presented at the 1995 CPANS Annual General Meeting and Technical Conference, June 6 and 7 at the Edmonton Conference Centre.

Yee, E., Wilson, D.J. and B.W. Zelt. 1993. Probability Distributions of Concentration Fluctuations of a Weakly Diffusive Passive Plume in a Turbulent Boundary Layer, *Boundary-Layer Meteorology.* 64:321-354.

Wilson, D.J., B.W. Zelt and W.E. Pittman. 1991. Statistics of Turbulent Fluctuation of Scalars in a Water Channel, Technical Report for Defence Research Establishment Suffield, DSS Contract W7702-9-R143/01-XSG.

Bara, B.M., D.J. Wilson and B.W. Zelt. 1990. Concentration Fluctuations in a Water Channel Simulation of a Ground Level Release, *Atmospheric Environment, 26a (6): 1053-1062*.

Wilson, D.J. and B.W. Zelt. 1990. The Influence on Non-linear Human Response to Toxic Gases on the Protection Afforded by Sheltering-in-Place. Presented at the OECD/UNEP Workshop on Emergency Preparedness and Response, Boston.

Wilson, D.J. and B.W. Zelt. 1988. Measured Probability Distributions and Moments of Concentration Fluctuations in a Laboratory Plume. Presented at the EURASAP meeting on Modelling Concentration Fluctuations in the Atmosphere, April 1988, Brunel Univ., England. (Refereed abstract).

Zelt, B.W., D.J. Wilson and B. Bara. 1987. Correcting Turbulent Concentration Measurements for Detector Spatial Resolution, Proceedings of the 11th Canadian Congress of Applied Mechanics. (refereed extended abstract).

Zelt, B.W. 1986. Abstract: Predicting the Dispersion of Gas Plumes, Graduate Research Symposium, University of Alberta.

Technical Reports

ABflare: A Refined Air Quality Dispersion Model for Evaluating Non-Routine Flaring for Sour Gas Facilities, User Guide, for AER and PTAC. 2014.

AERflare: A Model for Temporary Flaring Permits, Non-Routine Flaring and Routine Flaring Air Dispersion Modelling for Sour Gas Facilities. Alberta Energy Regulator, User Guide, Version 2.01. 2014

ERCBH2S: A Model for Calculating Emergency Response and Planning Zones for Sour Gas Wells, Pipelines, and Production Facilities, Volume 3: User Guide, Version 1.2, 2012

Non-Routine Flaring Management: Modelling Guidance, for Alberta Environment. 2012.

Alliance Pipeline 1999. Environmental Inspectors Reporting System (USA) - User Guide to UsEIRS. Salmo Consulting Inc.

Alliance Pipeline 1999. Environmental Inspectors Reporting System (Canada) - User Guide to CanEIRS. Salmo Consulting Inc.

Alliance Pipeline 1999. Canadian Environmental Commitments Database (CanCommit) - User Guide. Salmo Consulting Inc.

Golder Associates Ltd. 1994. User's Manual-PrePo: WASP Pre and Post-Processor. Version 1.0.

Toxcon Consulting Ltd. 1992. The Rossdale Drinking Water Intake Health and Environmental Impact Assessment for the City of Edmonton, Prepared by Toxcon Consulting Ltd.

Toxcon Consulting Ltd. 1990. Public Health Impact Assessment: Edmonton Waste Management Centre, Final Report Vol. 1, for the City of Edmonton Environmental Services, Prepared by Toxcon Consulting Ltd., July 1, 1990,

Toxcon Consulting Ltd. 1990. A Residential Indoor Air Quality Investigation in Drayton Valley, Alberta, Conducted by Toxcon Consulting Ltd., June 6, 1990.

Zelt, B.W. and D.J. Wilson. 1990. User's Manual for EXPOSURE-1 and SHELTER-1 Software for Toxic Gas Exposure Hazard Estimates, University of Alberta Department of Mechanical Engineering Report 74 for Alberta Occupational Health and Safety Research Grant 86-62-RB.

Wilson, D.J. and B.W. Zelt. 1990. Technical Basis for EXPOSURE-1 and SHELTER-1 Models for Predicting Outdoor and Indoor Exposure Hazards from Toxic Gas Releases, University of Alberta, Department of Mechanical Engineering Report 72.

Presentations/Seminars

Zelt, B.W., Zelensky,M.J. 2007, CPANS: EUBH2S Updates. CPANS/AWMA Luncheon Seminar

Zelt, B.W., Zelensky,M.J. 2006, CPANS: Incinerator and Flaring spreadsheet tools. CPANS/AWMA Luncheon Seminar

Zelensky, M., Neilson, G., Zelt, B.W. 2003. New EUB Tools for Calculating Sour Gas Emergency Planning Zones. CPANS/AWMA Luncheon Seminar

Zelt, B.W. 1997. Guest lecturer for contaminant and fate modelling and the EIA assessment processing Alberta. University of Calgary, Environmental Engineering.

Zelt, B., R.D. Shaw and H.R. Hamilton. 1996. Oil Sands Reclamation Performance Assessment Framework, Presented to The Geotechnical Society of Edmonton, Risk Assessment in Geotechnical & Geo-Environmental Engineering, 2nd Annual Symposium, Coast Terrace Inn, Edmonton, Alberta, April 2, 1996.

Zelt, B. 1995. Concentrations Fluctuations in Health Risk Assessment. Presented at the 1995 CPANS Annual General Meeting and Technical Conference, June 6 and 7 at the Edmonton Conference Centre.

Zelt, B.W. 1991. Model development and verification of concentration fluctuations in a laboratory water channel, Graduate Seminar, Carleton University, Ottawa.

Wilson, D.J. and B.W. Zelt. 1991. Exposure and Shelter Hazard Assessment PC Software, Alberta Occupational Health and Safety Heritage Grant Program.

Zelt, B.W. 1989. The Joy of TeX -- An introduction technical typesetting using the TeX program. Graduate Seminar, University of Alberta, Edmonton.

Zelt, B.W. 1985. Concentration Fluctuations in a Laboratory Plume, Graduate Seminar, University of Alberta, Edmonton.

3. EXPERT/CONSULTANT

Name: Dr. Brian Zelt (B.Sc. Mechanical Engineering; PhD. Mechanical Engineering)

Mailing/Email Address: brian@zeltpsi.com

Telephone Number: 403-995-2122

Services to be Performed:

- Primary scope of work is to review the air and dust modelling and mitigation application information, advice and if necessary, provide a report to support the group's intervention. If no report is required, I will provide counsel with support regarding cross examination of Alberta Transportation witnesses in these areas.

Breakdown of Accounts for this area of work

a) Review of materials, preparation of submission _40_ hrs x $ _150_ /hr $ _6,000.00_____
b) Hearing prep and responding to information requests _ 24 hrs x $150/hr $3,600.00
c) Attendance at hearing _16_ hrs x $ _150_ /hr $ _2,400.00_____
c) Costs of drafting, administrative services, etc. (if applicable, attach a separate breakdown)
____ hrs x $ _____ /hr $ _____
d) Total disbursements $ _____

TOTAL CLAIM RESPECTING THIS ASPECT OF WORK $ _12,000 (not including GST)_

Risk Assessment (to be performed in collaboration with a geotechnical dam engineer, if required)

- If required, I may provide risk assessment of dam breach, failure, inundation including assessment of the EPZ in conjunction with a geotechnical dam engineer. The cost for providing this risk assessment is $36,000 for a minimum of additional 6 weeks of work. The cost includes reviewing materials, preparing information requests and responding to information requests, and collaborating in the preparation and submission of a risk assessment report.

TOTAL CLAIM RESPECTING RISK ASSESSMENT WORK (IF REQUIRED) $36,000.00 (NOT INCLUDING GST)

TOTAL BUDGET: $48,000.00.

* Note: Personal services already compensated for by others in the form of hourly employment or regular salary will not be compensated for in a cost award (See Intervener Funding Process Guide, Costs of an Expert, Page 15)

CIRCLE T CONSULTING
www.circletconsulting.ca
Land Stewardship Through Innovation
Box 339 • Vegreville • Alberta • T9C 1R3 • Ph: 780•632•3387

TERRY OSKO, Ph.D., P.Ag.

EDUCATION

Ph.D., Wildlife Ecology and Management, University of Alberta, 2003.
M.Sc., Wildlife and Rangeland Resources, University of Alberta, 1993.
B.Sc., Agriculture, (Animal Science and Grazing Management) University of Alberta, 1990.

EXPERIENCE

Circle T Consulting, Inc.

Operated a consulting business focusing on renewable resource management since 1994.
Relevant activities:

- Project management, including soliciting/acquiring funding, managing budgets, sourcing equipment and other resources, attracting participating researchers, hiring and directing employees, planning and coordinating logistics, and regular reporting
- Developing, coordinating, and executing applied research programs for:
  - Energy-related construction and reclamation best practice development in boreal upland and wetland environments.
  - Long term vegetation responses to industrial disturbance, reclamation treatments, and wildlife grazing
  - Wildlife habitat studies
- Communicating study results, producing best practice documents and guides for operations on wetlands and forests
- Developing forest reclamation monitoring protocols
- Reclamation of disturbances in boreal wetland and upland environments
- Forested land management, including wildlife, soils, weed management, industrial effects, integrated land management
- Rangeland vegetation surveys and management plans
- Biophysical data collection and synthesis for monitoring and resource management
- Networking to establish collaborative projects
- Collaborating with government agencies, industry partners, 1st Nations groups, NGOs
- Pre-disturbance land assessment and clubroot management surveys on agricultural land
- Preparing evidence, appearing as an expert witness at the Alberta Surface Rights Board

Waskwei Creek Farms

With my family, I have operated a small farm since 1998.

- Managed breeding stock, developed feeding programs, and administered animal health programs for white-tailed deer and beef herds
- Managed records of herd inventories, disease surveillance, and genetics
- Retailed meat and antler products via farm-direct marketing
- Established pasture and hay crops; produced, harvested, and marketed hay
- Established balsam poplar stool beds and produced cuttings for reclamation planting
- Feeder cattle production and marketing

Volunteer Activities

- Provide leadership to organization of local community events
- Served on boards of community or charitable organizations
- Assist those in need through the Society of St. Vincent de Paul

Expert Consultant Budget

Name of expert consultant being retained:

Terry Osko, Ph. D., P. Ag.

What specific areas of this issue is the expert consultant responsible for?

-Review of noxious weed and invasive species risks to flood control area and adjacent lands
-Review of potential increase in weed management costs to adjacent landowners.
-Review of potential contingencies and mitigation options to prevent weed proliferation and dispersal to adjacent lands.

Provide breakdown of the specific activities the expert consultant will be performing by way of the following categories:

Prehearing review, consultation and information requests, evidence report research and preparation: < 130 > hours

Filing evidence and answering information requests: < 10 > hours

Testifying at the oral hearing: < 8 > hours

Monitoring proceeding in person or by way of transcripts: < 14 > hours

Final argument and reply submissions: < 12 > hours

Anticipated expert fees: < [174] > hours x $< [200.00] > = $34,800.00

Tab 11 - Legal Counsel Budget

The specific activities which counsel has completed and will be completing are outlined at paragraphs 64 and 65 of the SCLG Pre-Hearing Submissions.

Senior counsel, Richard Secord and Ifeoma Okoye, will be responsible for completing the outlined activities. Junior counsel, Emily Bonnell, will be assisting senior counsel with some of the outlined activities.

Anticipated legal fees are as follows:

COMPONENT	LAWYER	RATE	HOURS	TOTAL
Work Prior to and including Pre-Hearing				
Work prior to Pre-Hearing (including meeting with clients and experts, providing direction, corresponding with clients, communicating with opposing counsel)	RCS	$550/hr	28	$15,400.00
Work prior to Pre-Hearing (including meeting with clients and experts, researching and retaining experts, communicating with experts, advising clients, and providing direction to junior counsel, reviewing and revising pre-hearing submissions)	IMO	$350/hr	45	$15,750.00
Work prior to Pre-Hearing (providing research, communicating with clients as needed, research potential dam safety engineers, preparing initial drafts of the pre-hearing submissions and other tasks as needed)	ELB	$200/hr	20	$4,000.00
Attend Dec 2 Pre-Hearing	RCS	$550/hr	5	$2,750.00
Attend Dec 2 Pre-Hearing	IMO	$350/hr	5	$1,750.00
Sub-Total (estimated time up to pre-hearing)				**$39,650.00**
From Pre-Hearing up to Hearing				
Review draft hearing submissions and draft expert reports, review draft IRs and responses to IRs)	RCS	$550/hr	30	$11,000.00
Preparation of landowners and group's Hearing Submissions, review draft expert reports, correspondence with experts and clients re submissions and reports, prepare IRs and obtain responses to IRs)	IMO	$350/hr	40	$14,000.00

Assist in preparation of landowners' submissions, and preparation of IRs and IR responses)	ELB	$200/hr	30	$6,000.00
Hearing Preparation (prepare examination-in-chief and cross)	RCS	$550/hr	90	$49,500.00
Hearing Preparation (prepare examination-in-chief and cross)	IMO	$350/hr	90	$31,500.00
Sub-Total (Pre-Hearing to Hearing estimate)				**$112,000.00**
Hearing Time (Assuming the hearing takes 10 days to complete)				
Attend Hearing (5 days), assuming 8 hour/ day hearing	RCS	$550/hr	40	$22,000.00
Attend Hearing (5 days), assuming 8 hour per day hearing	IMO	$350/hr	40	$14,000.00
Sub-total (hearing time estimate)				**$36,000.00**
Argument				
Review transcripts, prepare written argument and reply argument	RCS	$550/hr	15	$8,250.00
Review transcripts, prepare written argument and reply Argument	IMO	$350/hr	25	$8,750.00
Sub-total (argument)				**$17,000.00**
Sub-total				$204,650.00
GST				$10,232.50
Total:				**$214,882.50**

Disbursements will be in addition to the above.

SCLG Pre-Hearing Submissions Tab x

APPLICATION FORM

Intervener Funding Advance Award of Costs

STEP 1 – GENERAL CONSIDERATIONS IN FILING YOUR APPLICATION

To help the NRCB process your application, please be as thorough as possible in providing the information requested in the attached format. A properly completed form will speed up the processing.

Your Request for an Advance Award of Costs must be submitted to the Board and to the project applicant by the date specified by the Board.

There is no guarantee that any or all of your costs will be awarded. You must first qualify for costs (see the Intervener Funding Process Guide) and then only reasonable costs will be awarded.

STEP 2 – YOUR MAILING INFORMATION

NRCB Application No: 1701 Applicant: Alberta Transportation

Name(s) of Intervener(s) *(attach a list if necessary)*

See SCLG Pre-Hearing Submissions Tab 1

Note: Attach written authorization by "directly affected" individuals or groups of individuals where a formal association has been requested to represent their concerns and outline specific impacts to be addressed.

Was a group or coalition formed to intervene in this application? Yes X No

If yes, name of group: SR1 Concerned Landowners Group

Name of intervener or group representative: Karin Hunter

Mailing and email address and local telephone number for intervener or group:

Ackroyd LLP, 15TH Floor First Edmonton Place, 10665 Jasper Ave, Edmonton, AB, T5J 3S9

iokoye@ackroydlaw.com; 780-412-2716

Has a copy of this request (with supporting documentation) been sent to the proponent or its lawyer?

Yes_____ No Provided to NRCB as pre-hearing submissions

STEP 3 – JUSTIFICATION OF CLAIM – See SCLG Pre-Hearing Submissions s. VII

Attach the following information:

- describe the extent to which the intervener will be undertaking on the intervener's own behalf the preparation and presentation of the submission;
- the controls the intervener has in place for the expenditure of any advance funding received;
- the reasons why funds are required in advance;
- a detailed forecast of the total cost of the intervention, the amount that you expect to claim in any final claim for costs and the amount of advance funding sought; and,
- a detailed description of the information that you intend to include in your submission and how such information may assist the Board in assessing the social, economic or environmental effects from the reviewable project.

STEP 4 – ELIGIBILITY FOR FUNDING - See SCLG Pre-Hearing Submissions s. II

Provide detailed evidence to support your claim as to why you are or may be "directly affected" by the proposed application. Attach this information to your claim.

It is recommended that interveners review the NRCB's Intervener Funding Process Guide. Submissions should identify detectable effect on the directly affected party and evidence of an uninterrupted chain of cause and effects between the proposed project and the individual or group of individuals. Effects noted should not be trivial in nature.

STEP 5 – THE DETAILS OF YOUR REQUEST FOR AN ADVANCE AWARD OF COSTS

1. INTERVENER

	Honoraria	Expenses
a) Forming a group *	$ _____	$ _____
a) Preparing a submission *	$ _____	$ _____
b) Attending a hearing (½ days x $50)	$ _____	$ _____
(For pre-hearing only. Intervener costs for attending the hearing will be submitted when hearing timelines are established)		
Subtotals	$ _____	$ _____

**** The SCLG is not requesting an advance award of honoraria for its members at this time but will submit a request for intervener honoraria including group formation costs in the final cost claim.**

TOTAL PERSONAL CLAIM OF INTERVENER	
Subtotals A + B = $2,150.00	$ (line 1)
Please transfer total to Section 6 – Line 1 (Page 21)	

** Normally the total of these two amounts will not exceed $500*

2. LAWYER

Name: Richard C. Secord and Ifeoma M. Okoye

Mailing/Email Address:

Ackroyd LLP, 15TH Floor First Edmonton Place, 10665 Jasper Ave, Edmonton, AB, T5J 3S9

Telephone Number: 780-423-8905

TOTAL FEES & DISBURSEMENTS FOR LAWYER'S SERVICES
Breakdown of Lawyer's Account

See SCLG Pre-Hearing Submissions Tab 11.

a) Fees for preparation of submission	_____hrs x $_____/hr	$ _____
b) Fees for attendance at hearing	_____hrs x $_____/hr	$ _____
c) Disbursements		$ _____

TOTAL CLAIM RESPECTING LAWYER'S ACCOUNT

$ _____
(line 2)

Please transfer total to Section 6 – Line 2 (Page 21)

** claimed legal costs should be for legal services only (See Intervener Funding Process Guide, Legal Costs, Page 14)*

3. EXPERT/CONSULTANT

Name: See SCLG Pre-Hearing Submissions Tabs 4, 6, 8, and 10.

Mailing/Email Address: *(where there is more than one expert or consultant, please attach additional information)*

Telephone Number: _____

Services to be Performed: *(attach work specifications for each consultant/expert)*

Total Fees and Disbursements: *(attach accounts)*

Breakdown of Accounts

a) Preparation of submission	____hrs x $_____/hr	$ _____
b) Attendance at hearing	____hrs x $_____/hr	$ _____
c) Costs of drafting, administrative services, etc. (if applicable, attach a separate breakdown)	____hrs x $_____/hr	$ _____
d) Total disbursements		$ _____

TOTAL CLAIM RESPECTING EXPERT/CONSULTANT ACCOUNT(s)

$ _____
(line 3)

Please transfer total to Section 6 – Line 3 (Page 21)

** Note:* *Personal services already compensated for by others in the form of hourly employment or regular salary will not be compensated for in a cost award (See Intervener Funding Process Guide, Costs of an Expert, Page 15)*

4. WITNESS FEES –
(for persons who appear at a hearing to give evidence but who are not interveners making a claim under Step 5, Item 1c)

a) Meeting with a lawyer _____witnesses x_____½ days at $50 $ _____

b) Attendance at a hearing to give evidence _____witnesses x_____½ days at $50 $ _____

TOTAL CLAIM RESPECTING WITNESS(ES) FEES

$ _____
(line 4)

Please transfer total to Section 6 – Line 4 (Page 21)

5. INTERVENER VOLUNTARY CONTRIBUTION – See SCLG Pre-Hearing Submissions s. VII

Specifically, Ms. Karin Hunter, Mr. Ian Dowsett, and Mr. Klepacki have spent extensive amount of time coordinating and gathering information for the group. Ms. Hunter has volunteered over 200 hours in reviewing Alberta Transportation's information materials, contacting residents in the area, gathering and documenting a summary of their concerns. Ms. Hunter is largely instrumental in generating the SCLG members list attached at Tab 1 of SCLG Pre-Hearing Submissions. Mr. Dowsett and Mr. Klepacki have also spent over 100 hours reviewing the Alberta Transportation's materials, meeting with Ms. Hunter, other residents and counsel, as well as contacting potential experts to fully understand the issues. They have also incurred out of pocket costs, which have not been tabulated at this time.

6. SUMMARY OF FUNDING REQUESTED
(please transfer totals from preceding sections to the appropriate lines below)

See Section I of the SCLG Pre-Hearing Submissions.

Intervener(s)	(from line 1)	$ TBD
Lawyer	(from line 2)	$ 214,882.50
Expert(s)/Consultant(s)	(from line 3)	$ 139,891.50
Witness(es)	(from line 4)	$ 0.00

7. TOTAL AMOUNT OF INTERVENER FUNDING REQUESTED –

See SCLG Pre-Hearing submissions Section I

Total Request (total of lines 1-4)	=	$ 354,774.00
Total amount sought as an advance award	=	$ 177,387.00

PLEASE SEND YOUR COMPLETED APPLICATION AND COPIES OF SUPPORTING DOCUMENTS DIRECTLY TO THE NRCB AND THE PROPONENT:

1) **Natural Resources Conservation Board**
   19th floor, 250 – 5 Street SW
   Calgary, AB T2P 0R4

   Email: **laura.friend@nrcb.ca**
   Phone: **(403) 297-8269** **Toll-Free:** **310-0000**

2) **The proponent's lawyer, if any, or to the proponent at its business address**
