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Proceedings of the regional peer review for the evaluation of a Fisheries Risk Assessment Tool (FRAT) for the Mackenzie Gas Pipeline

November 27-29, 2013

Winnipeg, MB

Chairperson: Kevin Hedges
Editor: Don Cobb

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A Canadian Science Advisory Secretariat (CSAS) peer review meeting was held from November 27-29, 2013 in Winnipeg, Manitoba to evaluate elements of the Fisheries Risk Assessment Tool (FRAT). The tool is designed to evaluate potential risks to commercial, recreational or aboriginal fisheries and their supporting habitats from sediment resulting from construction and operation of stream crossings, utilizing the Mackenzie Gas Project as the tool development platform. Additional meeting objectives were to: examine the current version of the FRAT and recommend changes to risk and fish consequences criteria and specific input variables and algorithms; recommend additional elements that could be built into the FRAT in order to strengthen or even expand its capability as an assessment tool; and examine the applicability of the FRAT approach within a broader context.

Two research documents were prepared for the meeting, one describing the FRAT design and the other discussing approaches to determining the fate of sediment once it enters a stream, and these documents guided the discussions. The relevance of the FRAT in light of changes to the *Fisheries Act* and Fisheries Protection Program was discussed. Participants included Fisheries and Oceans Canada (DFO) Science, Fisheries Protection Program, academia and engineering and biological consultants with expertise in linear development and risk assessment.

This Proceedings report summarizes the relevant discussions and presents the key conclusions reached at the meeting. The Science Advisory Report and two supporting Research Documents resulting from this advisory meeting are published on the DFO CSAS Website.

Compte rendu de la réunion régionale d'examen par les pairs concernant l'évaluation d'un outil d'évaluation des risques liés aux pêches pour le gazoduc de la vallée du Mackenzie

SOMMAIRE

Une réunion d'examen par les pairs du Secrétariat canadien de consultation scientifique (SCCS) s'est tenue à Winnipeg, au Manitoba, du 27 au 29 novembre 2013 afin d'évaluer les éléments de l'outil d'évaluation des risques liés aux pêches. L'outil a été conçu pour évaluer les risques potentiels pour les pêches commerciales, récréatives ou autochtones et l'habitat qui les soutient par rapport à la sédimentation découlant de la construction et de l'exploitation de traversées de cours d'eau, en utilisant le projet de la vallée du Mackenzie en tant que plateforme d'élaboration de l'outil. La réunion visait également à : examiner la version actuelle de l'outil et recommander des modifications aux critères liés aux risques et aux conséquences pour le poisson ainsi qu'à certains algorithmes et variables d'entrée; recommander d'autres éléments à intégrer à l'outil afin de renforcer ou même d'accroître ses capacités en tant qu'outil d'évaluation; et examiner l'applicabilité de la méthode de l'outil dans un contexte plus général.

Deux documents de recherche ont été préparés pour la réunion. Le premier décrit la conception de l'outil d'évaluation des risques liés aux pêches, et le deuxième traite des démarches pour déterminer le sort des sédiments une fois qu'ils entrent dans un cours d'eau. Ces documents ont orienté les discussions. La pertinence de l'outil à la lumière des changements apportés à la Loi sur les pêches et du Programme de protection des pêches a fait l'objet de discussions. Les participants étaient, notamment, des représentants des Sciences de Pêches et Océans Canada (MPO), du Programme de protection des pêches et du milieu universitaire, ainsi que des consultants du domaine du génie et de la biologie experts en matière de projets linéaires et d'évaluation des risques.

Le présent compte rendu résume les discussions pertinentes et présente les conclusions importantes tirées de la réunion. L'avis scientifique et les deux documents de recherche à l'appui qui découlent de la présente réunion de consultation sont publiés sur le site Web du SCCS du MPO.

INTRODUCTION

The impetus for the development of the Fisheries Risk Assessment Tool (FRAT) was the proposed Mackenzie Gas Project (MGP) which called for the development of gas production fields and buried gathering pipelines in the Mackenzie Delta, a buried natural gas liquids (NGL) pipeline between Inuvik and Norman Wells, and a buried gas pipeline along the Mackenzie Valley to a location in Alberta where it would connect with the existing Alberta system (Figure 1). The proposed pipeline routes crossed 643 identified streams. In anticipation of the increased regulatory workload associated with the Project, Fisheries and Oceans Canada (DFO) wanted a tool to optimize and streamline the process of pipeline stream crossing application review and, later, construction and operations inspection requirements.

Prior to this Canadian Science Advisory Secretariat (CSAS) peer review, the FRAT consisted of a geophysical database that characterizes physical attributes of the river valley and channel in the vicinity of a crossing, plus a fisheries database that characterizes the fisheries resources and habitat in the stream. Algorithms were developed to quantitatively estimate sedimentation hazard likelihood and fisheries sensitivity, which were coupled in a qualitative risk matrix that assigned an overall risk rating to each stream crossing.

This CSAS review of the FRAT was undertaken to evaluate the current version of the FRAT and to make recommendations for future improvements of the tool. Two research documents were prepared for the meeting. The first described the development of the tool (Porter and Mochnacz 2014), including attributes and algorithms used to estimate sediment volumes at crossings, fish consequences based on fish presence and habitats at crossing locations, and the combined risk score from these two components of the tool. The second document (Burge et al. 2014) provided a discussion on approaches to examine the spatial and temporal fate of sediment once it has entered the watercourse. This document addressed concerns raised in relation to impacts on CRA fishes and their habitats downstream of the crossing location. During the meeting, each of the attributes of the FRAT was examined for its appropriateness in the FRAT, and special consideration was given to the relevance of the tool in light of recent changes to the *Fisheries Act* and the Fisheries Protection Program.

PRESENTATIONS

The Chair welcomed participants and presented an overview of the CSAS process, rules of participation at CSAS meetings and expected outcomes and products of the meeting.

Genesis of the FRAT

Presenter - Don Cobb

The genesis of the FRAT was briefly described, after which followed a discussion about the focus of the FRAT, and broader application of the approach to fisheries risk assessment. There was also a lengthy discussion about the relevance of the tool given the recent changes to the *Fisheries Act* and Fishery Protection Program (FPP). It was concluded that the FRAT was still relevant and could assist proponents and DFO FPP assessors in dealing with the Mackenzie Gas Pipeline.

FRAT Design

Presenter – Michael Porter

The working paper describing the FRAT design and the presentation focused on the Sediment Risk Model aspects (Porter and Mochnacz 2014).

Abstract

Development of the Fisheries Risk Assessment Tool was carried out by BGC Engineering Inc. (BGC) and Fisheries and Oceans Canada (DFO) between 2005 and 2010. The objective of the FRAT was to explore methods to facilitate a prioritization of pipeline stream crossing applications on the proposed Mackenzie Gas Project according to an overall risk rating, thereby providing an objective means for allocating review effort and improving the timely review of development applications. The hazards considered in the FRAT were limited to the potential for stream sedimentation under natural conditions and during and following pipeline construction activities. The consequences considered in the FRAT were limited to potential localized impacts to fishes and fish habitat as a result of stream sedimentation.

Additionally, it was believed that the FRAT could facilitate the storage and retrieval of relevant terrain, watercourse and fisheries data for each proposed pipeline crossing, improve communication between DFO and the proponent, and encourage the use of best practices for pipeline routing, design, construction, and operation. While the focus of the FRAT was the Mackenzie Gas Project, it was hoped that ultimately a modified version of the FRAT could be applied across Canada to streamline DFO's regulatory process for other pipeline watercourse crossings.

This draft working paper comprises four main sections:

- background information on the objectives and development of the FRAT;
- review of risk assessment methods and rationale for the methods used to combine sediment hazard and fish consequence within the FRAT to arrive at estimates of risk;
- additional description of the rationale for the selection and numerical values assigned to geophysical attributes used in the sediment hazard ratings; and
- opportunities to further improve the FRAT.

Discussion

The discussion that followed led to a conclusion to simplify the sediment risk component by removing some attributes (e.g., landslides and surface erosion). A number of discussions took place summarized as follows: the current FRAT does not take into account cumulative effects, only sediment volume/year; the Universal Soil Loss equation can be applied to the north with some minor modifications (e.g., ice-rich permafrost); incorporation of stream power to account for retention time of sediment at the crossing and downstream. It was noted that many of the concepts were developed independently, so perhaps a better approach is to begin with the consequences model first and flush out the main consequences, then tailor the Hazard Model to those consequences. It was concluded that removal of landslides and surface erosion would simplify the FRAT and not result in a loss of sensitivity of the score.

Fisheries Protection Program and the *Fisheries Act*

Presenter - Ernie Watson

A client perspective (FPP), and the new *Fisheries Act* was presented. This included new definitions of terms used in the new *Fisheries Act* (e.g., Permanent Alteration, Commercial, Recreational and Aboriginal fisheries). Permanent now means any alteration that impacts a life history function of habitat during one year. Participants discussed the development of risk matrices, and how the proponents will assess their level of risk before approaching DFO on crossings, i.e. a self- assessment. If the FRAT were to become a public tool, there would need to be caveats and detailed instructions. The tool would also increase consistency, assuming it adequately captures the information in a way that can be applied consistently by different users, and that the information base is adequate. Under the new *Fisheries Act*, FPP is only concerned with when they have to make a decision under the Act.

Fate of Sediment

Presenter - Leif Burge

The fate of sediment working paper (Burge et al. 2014) was presented.

Abstract

This paper provides a review of processes involved in the transport and deposition of river sediment as the foundation for the development of a sedimentation algorithm to be incorporated into the Fisheries Risk Assessment Tool (FRAT). The FRAT contains algorithms for sediment entering stream channels due to natural processes and pipeline construction activities. The fate of sediment once it enters stream channels is not part of the current version of the FRAT. Sedimentation may be investigated in one of two ways: a forward physical approach or an inverse morphological approach. The first involves using known physics to predict sedimentation. The second is an inverse problem that uses the observed properties of the stream channel to infer sediment transport and depositional processes. This paper first reviews the forward physical approach through the introduction of the energy terms that are known to drive sediment transport and the terms that resist entrainment. Sediment in rivers is transported in two modes: as bedload and as suspended load. Bedload is coarse material and is defined as the material that moves in contact with the bed. No universally applied bedload transport function exists after more than one hundred years of research. However, a number of approaches to bedload transport have been investigated and are introduced. Suspended sediment is defined as the material that is transported within the water column. Fundamentally, deposition of suspended sediment occurs when the fall velocity of the sediment is greater than the turbulent eddies suspending the sediment within the water column. The inverse approach, using channel morphology to provide information on the antecedent condition of the channel is discussed along with a description of channel patterns. Literature on sedimentation related to pipeline construction and the fate of sediment introduced to northern rivers are introduced. The final section discusses measurable variables for the development of a sedimentation algorithm.

Discussion

A discussion ensued about how to handle data poor situations and downscaling to smaller watersheds. The issue of linking the biological consequences and the geohazards side is not there yet. Participants concluded a flow chart that simplifies the upfront part of the tool is needed; this would make it more user friendly for industry. Also it was concluded that we don't need to look at all fish (diversity), but only the most sensitive ones. It was concluded that a sediment fate model would be an important new component to the current FRAT.

Michael Porter then reviewed the algorithms of the sediment risk model (bank erosion, landslides, surface erosion, graded material and trenching). There was a discussion about ways to simplify this aspect, without losing any sensitivity around the scoring. It was concluded that a re-worked sediment algorithm could have fewer attributes, and that landslides and bank erosion would not likely be directly relevant to the pipeline/sediment issue, or would be covered under surface erosion. The conclusion was reached that the sediment risk component of the tool would be simplified, but remained flexible.

Fish Consequences model

Presenter - Don Cobb

An overview of the fish consequences model was presented. There was a discussion about fish diversity, and it was concluded that although diversity is a useful attribute in some applications, it added no value to the FRAT, since if you are impacting one or more sensitive fish species, you would be causing serious harm to fish (the death of fish or a permanent alteration to, or destruction of, fish habitat) regardless of how many other species were present. It was agreed to remove the diversity attribute from FRAT. Also it was agreed concluding the discussion that the fish consequence needs to be significantly modified.

Productivity-State response curves

Presenter - Doug Watkinson

The Productivity-State response curves related to sediment pathways of effects were presented. The discussion that followed led to the concept of revamping of the FRAT front piece, such that a decision tree was used to simplify those cases where there were no CRA species, or where activities were not going to introduce sediment, or where streams were not sediment sensitive.

FPP flowcharts

Presenter - Ernie Watson

The FPP flowcharts were presented. The discussion that followed concluded that the FRAT would fit into the flowchart as a tool for industry to determine if there would be impacts. The tool would be best fitted to large complex projects. Turning it into an online tool with all the required provisos would be an eventual outcome.

Participants discussed and devised a flow chart (Figure 1) which would simplify the work required for many stream crossings. Only if the proponent ended up at the part 2 FRAT box on the flow chart would the full FRAT, including sediment and fish consequences components, be triggered. The fish consequences would include key species, their life stages/history and timing and habitats.

The fish consequence model was discussed in light of the revised FRAT flow chart. A re-design of the current fish consequences component is required. Also there will be further advice sought from FPP once the new policies are further developed, including decisions about connectivity of a non-fish bearing stream to CRA supporting streams.

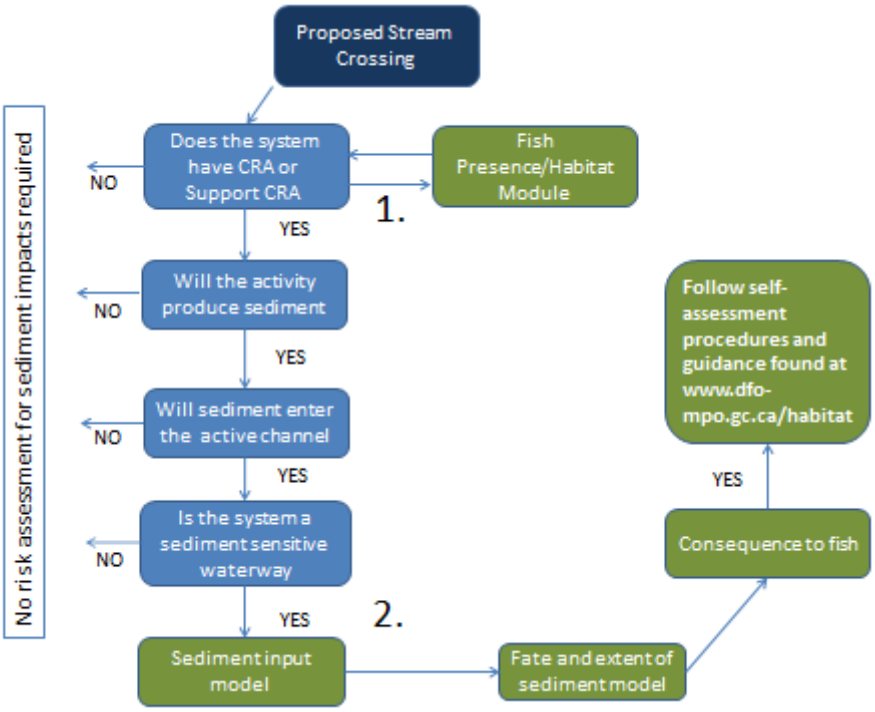

Figure 1. Proposed hierarchical approach to determine level of assessment for risk assessment sediment and fish consequences.

DRAFTING OF THE SAR

In plenary, the group reviewed an annotated outline of the SAR that was prepared by the Chair. Recommendations were made regarding the wording and content of the various sections, notably for the Introduction, Sources of Uncertainty and Conclusion. The group agreed that the Chairs would distribute the meeting proceedings and SAR to the group for final review prior to publishing them through CSAS.

SOURCES OF INFORMATION

Burge, L.M., Guthrie, R.H., and Chaput-Desrochers, L. 2014. Hydrological factors affecting spatial and temporal fate of sediment in association with stream crossings of the Mackenzie Gas Pipeline. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/029. v + 37 p.

Porter, M., and Mochnacz, N. 2014. Methods and geophysical attributes for the Fisheries Risk Assessment Tool. DFO. Can. Sci. Advis. Sec. Res. Doc. 2014/030. v + 16 p.

APPENDIX 1: TERMS OF REFERENCE

Increasing northern development will place significant pressure on the Fisheries Protection Program of DFO for regulatory review of development proposals pursuant to the fisheries protection provisions of the *Fisheries Act*. Large linear developments like the Mackenzie Gas Pipeline will cross many water courses, potentially impacting fish and habitat that supports commercial, recreational or aboriginal fisheries. DFO's Fisheries Risk Assessment Tool (FRAT) was developed to allow users to prioritize pipeline stream crossings according to the risk of adverse impact, from sedimentation, to fish and fish habitat that support commercial, recreational or aboriginal fisheries. Several consultant reports have been produced which describe the current state of the FRAT and recommendations for future work. To address a need for transparent, consistent, risk-based assessment tools in the Fisheries Protection Program, Science is proposing to continue development and improvement of the FRAT, ensuring a scientifically rigorous final tool. A peer review meeting is proposed to assess both the sediment risk and consequences to fish and fish habitat models of the FRAT. This will bring both river hydrologists/geomorphologists and fisheries scientists together to examine the tool for the purpose of reviewing the current input variables, risk scoring methods and algorithms used to calculate overall risk.

Objectives

The objective of this meeting is to evaluate elements of a risk assessment tool that can help evaluate potential risks to commercial, recreational or aboriginal fisheries and their supporting habitat from sediment resulting from construction and operation of stream crossings, utilizing the Mackenzie Gas Pipeline as the tool development platform. Additional meeting objectives are to:

a) Recommend changes to risk and fish consequences criteria and specific input variables and algorithms.

b) Recommend additional elements that could be built into the FRAT in order to strengthen or even expand its capability as an assessment tool.

c) Examine the applicability of the FRAT approach within a broader context.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Participation

- Fisheries and Oceans Canada (DFO) (Science and Fisheries Protection Programs)
- Other invited experts (e.g., hydrology, engineering)

APPENDIX 2: MEETING PARTICIPANTS

Cam Barth	North/South Consultants Inc.
Leif Burge	SNC-Lavalin Inc.
Don Cobb	Fisheries and Oceans Science
Margaret Docker	University of Manitoba
Richard Gervais	Fisheries and Oceans Fisheries Protection Program
Haitham Ghamry	Fisheries and Oceans Science
Kevin Hedges (Chairperson)	Fisheries and Oceans Science
Neil Mochnacz	Fisheries and Oceans Science
Michael Porter	BGC Engineering Ltd.
Jim Reist	Fisheries and Oceans Science
Richard Remnant	North/South Consultants Inc.
Michael Rennie	Fisheries and Oceans Science
Chantelle Sawatzky (Rapporteur)	Fisheries and Oceans Science
Doug Watkinson	Fisheries and Oceans Science
Ernest Watson	Fisheries and Oceans Fisheries Protection Program
Rob Young	Fisheries and Oceans Science

APPENDIX 3: AGENDA

Day 1 November 27

8:30-8:50	Welcome and Introductions–Dr. Rob Young, Division Manager, AARD Introduction to the CSAS process–Dr. Kevin Hedges, chairperson
8:50-9:10	Genesis of the FRAT–Don Cobb (DFO)
9:10-9:50	Sediment Risk Model–Mr. Michael Porter (P. Eng. BGC Engineering)
9:50-10:10	FRAT: a client perspective–Fisheries Protection Program–tba
10:10-10:30	COFFEE
10:30-12:00	Engineering sediment risk: review of general design and input variables– all
12:00-1:30	LUNCH (on your own NOTE: FWI cafeteria is closed)
1:30-2:30	Engineering sediment risk (cont'd): review of algorithms and assigning level confidence
2:30-3:00	Fate of sediment (spatial and temporal aspects)–Working Paper - Leif Burge (P Eng. SNC Lavalin Environment)
3:00-3:15	COFFEE
3:15-4:15	Engineering sediment risk (cont'd)–discussion and Science Advice
4:15-4:30	Day 1 wrap-up–Chairperson

Day 2 November 28

8:30-8:50	Day 1 summary, discussion/outstanding issues, plan for Day 2–Chairperson
8:50-9:20	Fish consequences model–overview–tba
9:20-10:15	Fish consequences: review of general design and input variables–all
10:15-10:30	COFFEE
10:30-12:00	Fish consequences (cont'd): review of algorithms–all
12:00-1:30	LUNCH (on your own)
1:30-2:30	Fish consequences model (cont'd)–discussion and recommendations
2:30:3:00	Combining Sediment Risk and Fish consequences–all
3:00-3:15	COFFEE
3:15-4:00	Combining Sediment Risk and Fish consequences - all
4:00-4:15	Wrap-up of day 2–Chairperson

Day 3 November 29

8:30-9:00	Day 2 summary, outstanding issues and Science Advice Report–Chairperson
9:00-10:00	Review of SAR wording - all
10:00-10:15	COFFEE
10:15-11:45	Review of SAR wording and recommendations
11:45	Meeting wrap-up and adjourn–Chairperson