FRAMEWORK OF THE PROVINCE OF BRITISH COLUMBIA'S WRITTEN SUBMISSION TO THE COHEN COMMISSION, OCTOBER 17, 20011

MANDATE:

- The Cohen Commission is a federal inquiry and the Terms of Reference clearly focus on the policies, practices and procedures of the Department of Fisheries and Oceans (DFO), therefore any recommendations from the Commissioner should focus on DFO**.**
- There is no mention of aboriginal rights and title in the Terms of Reference, therefore the Commissioner should make no findings or rulings on the law in that regard.

RECOMMENDATIONS:

- DFO should fulfill its Acton Plan regarding MSC Certification of BC Sockeye ;
- DFO should continue to support the Integrated Salmon Dialogue Forum or a similar process after March 2012;
- DFO should continue to support the Monitoring and Compliance Panel after Mar 2012
- The Fraser River sockeye fishery should be inclusive; all interested parties should be involved in the management of the fishery;
- The federal government should introduce new fisheries legislation (e.g a new *Fisheries Act;*)

CAUSES FOR THE DECLINE OF FREASER RIVER SOCKEYE SALMON

The weight of evidence suggests that:

- the long-term decline in the productivity of Fraser River sockeye is likely attributable to factors related to marine conditions and climate change, and that marine conditions in the Strait of Georgia and Queen Charlotte Sound were likely to be the primary factors for the poor returns in 2009 (Technical Report 6);
- the long-term decline in productivity is likely driven by mechanisms that operate on larger, regional spatial scales, e.g. climate driven oceanographic changes. This is based on findings that most Fraser and non-Fraser stocks in Canada and the USA have shown a decrease in productivity, especially over the last decade. (Technical Report 10);
- recent declines Fraser River sockeye are unlikely to be the result of changes in freshwater environment. Technical Report 3 reviewed changes to the freshwater environment resulting from human activities such as mining, logging, hydroelectricity, urbanization and agriculture in arriving at the above conclusion, (Technical Report 3) This is consistent with the June 2010 workshop. (Exhibit 573, Section D, Selbie et al);
- gravel removal, forestry, urbanization, municipal waste water, pulp and paper effluent and mining effluent, and hydro and water temperature, did not contribute significantly to either the long-term decline in productivity of Fraser River sockeye or the poor run in 2009. (Technical Reports 6, 10, 3 and others, and testimony at those respective hearings); and
- it is unlikely that diseases or sea lice from aquaculture farms contributed to either the long term decline of productivity of Fraser River Sockeye salmon or the poor run in 2009. (various Technical Reports and expert testimony in the Aquaculture and Disease hearings).

COMMISSION OF INQUIRY INTO THE DECLINE OF SOCKEYE SALMON IN THE FRASER RIVER

In the matter of Her Excellency the Governor General in Council, on the recommendation of the Prime Minister, directing that a commission do issue under Part I of the *Inquiries Act* and under the Great Seal of Canada appointing the Honourable Bruce Cohen as Commissioner to conduct an inquiry into the decline of the sockeye salmon in the Fraser River

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WRITTEN SUBMISSION OF THE PROVINCE OF BRITISH COLUMBIA

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October 17, 2011

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Cohen Commission– Concise Summary of

the Written Submission of the Province of BC

Mandate:

1. This is a federal inquiry and the Terms of Reference clearly focus on the policies, practices and procedures of DFO, and the Commissioner is directed to consider recommendation with respect to the policy and practice report from DFO. Therefore any recommendations from the Commissioner should focus on should focus on DFO.
2. There is no mention of aboriginal rights and title in the Terms of Reference and therefore the Commissioner should make no findings in that regard. This is a very complex and controversial area of the law and this Commission is not the proper forum to make any findings or rulings concerning aboriginal rights and title.

Recommendations:

3. The Province makes five recommendations:

    - DFO fulfill its Acton Plan re: MSC Certification of BC Sockeye ;
    - DFO should continue to support the ISDF or a similar process after March 2012;
    - DFO should continue to support the Monitoring and Compliance Panel after March 2012
    - The Fraser River sockeye fishery should be inclusive; all interested parties should be involved in the management of the fishery;
    - The federal government should introduce new fisheries legislation (e.g. a new Fisheries Act;)

Causes for the Decline of Fraser River Sockeye Salmon: Technical Reports 6, 10, 4 and 3

4. The Commission should accept the key conclusions of Technical Report 6 and find that the weight of evidence indicates that the decline of Fraser river sockeye Salmon is likely attributable to factors operating in the marine environment and to climate change.

5. In particular, the report and evidence of Peterman (Technical Report 10) demonstrates that the declines since the 1980s occurred in stocks originating over a much larger area than just the Fraser River system and are not unique to it.

6. In turn, this suggests that large-scale phenomena such as oceanographic changes are likely involved.

7. Marmorek said that the debate between the Gulf of Alaska and Strait of Georgia did not affect his conclusions. This is consistent with the evidence pointing to causation in the ocean. The Province takes the view that it is not important to isolate the Strait of Georgia (Salish Sea), Queen Charlotte Sound, or to look to the Gulf of Alaska; these bodies of water need to be considered together.

8. Testimony with respect to harmful algal blooms is also consistent with the likely role of ocean effects.

9. Technical Report 9 focuses on climate change. Michael Healey's article (*Exhibit 1320, The cumulative impacts of climate change on Fraser River sockeye salmon (Oncorhynchus nerka*) and implications for management) points out, climate change can also affect sockeye at other life stages, not just during their spawning runs. This was also adverted to in the hearings on water and temperature.

10. The weight of evidence is consistent with the conclusions of Technical Reports 3 and 6. Freshwater ecology is NOT likely the cause of the apparent decline of Fraser sockeye.

11. Marmorek's first conclusion looks to the overall pattern of change in productivity of both Fraser and non-Fraser stocks and section 4.1 of his report.

12. The reasoning in Technical Report 4 emphasizes that ocean weather patterns are important; that the weather in Queen Charlotte Sound is especially important; and that there was a "perfect storm" in Queen Charlotte Sound in 2007. Migrating Fraser River sockeye salmon met extreme temperatures and even more extreme salinity/density and wind anomalies.

13. The testimony of Parsons and Irvine agreed that what happens to sockeye in the Gulf of Alaska is critically important and very incompletely understood.

14. Harmful algal blooms are one aspect of marine conditions consistent with Marmorek's conclusions on the causal role of marine conditions.

15. Technical Report 9 shows that climate change may have contributed not only to the overall decline, but also to the returns in 2009-10.

16. Michael Healey's article emphasizes the role of climate change. Healey states that Fraser River sockeye face a tenuous future. Marmorek also relied on the Healey paper in his testimony on climate change.

17. Technical Report 3 is relied on by Marmorek.

18. Nelitz's testimony explains why each of the following factors urbanization, mining, logging, hydroelectricity and agriculture, is not likely responsible for the overall decline of Fraser River sockeye populations.

19. The Pacific Salmon Commission workshop also independently found that freshwater factors did not explain the decline in Fraser River sockeye salmon.

Aquaculture and Disease Synopsis

20. Farmed salmon is a significant industry in British Columbia. It comprises 39 percent of the total value of all seafood exports from BC, (worth $348.1 million in 2009), and directly and indirectly creates 6,000 jobs.

21. Until December, 2010, the Province regulated the Aquaculture Industry. The regulatory structure was a world-class program, and other jurisdictions looked to how British Columbia ran their program. The Provincial program involved numerous inspections on escapes, sea lice, fish health as well as general compliance with the regulatory structure.

22. Since December, 2010, the Federal Government has regulated the Aquaculture Industry, although the Province is still involved by issuing land tenures.

23. The way Salmon Aquaculture is practiced in BC creates a low overall risk to the environment, and the disease incident data from the audits as well as the Salmon Farmer's association database shows that it is unlikely that aquaculture caused the long term decline of productivity in Fraser River Sockeye Salmon or the poor run in 2009.

24. Dr. Kent was retained by the Commission to tender a report on disease which could impact Sockeye Salmon. As a result, he subjectively identified six diseases that he thought posed a potential high risk to Sockeye salmon stocks. They are:
    a. Infectious hematopoietic necrosis virus
    b. Vibrio (Listonella) anguillarum
    c. Aeromonas salmonicida (furunculosis)
    d. Renibacterium salmoninarum (Bacterial Kidney Disease)
    e. Ichthyophthirius multifiliis (Ich) or White Spot; and
    f. Parvicapsula minibicornis.

25. The incidence levels of these diseases at salmon farms were reviewed by Dr. Noakes. He noted that the farms vaccinate against most of these diseases. In cases where there are no vaccinations against some of these diseases, the incidence levels along the out-migration route are very rare, and as a result are unlikely the cause of the long term decline in productivity, or the poor 2009 run.

26. With respect to sea lice, a prophylactic treatment called “Slice” has been used as a management tool to control the sea lice numbers. As a result, the lice levels on farms are very low, and is also unlikely the cause of the decline in productivity, or the poor 2009 run.

27. The Aquaculture Coalition has raised infectious salmon anaemia (ISA) as an issue in the proceedings, and relies upon non specific symptoms of sinusoidal congestion in Dr. Marty’s pathology reports. ISA is a disease that has never been diagnosed by any qualified individual in British Columbia despite extensive screening and polymerase chain reaction testing (PCR). Of the approximately 4,700 tests conducted, all have been negative for the disease. In any event, ISA does not cause disease in sockeye salmon.

28. The Aquaculture Coalition has also raised plasmacytoid anaemia as a potential cause of the poor 2009 run relying upon what they say is one diagnosis of plasmacytoid anaemia along the out-migration route. The Province says *loma salmonae* was found in this instance based upon a correct interpretation of the records (i.e. not plasmacytoid anaemia). Even so, with respect to sockeye salmon, plasmacytoid anaemia has not been shown to cause mortalities in lab studies.

29. Dr. Miller has identified a novel genomic signature associated with mortality in certain conditions. This genomic signature has been identified in smolts, so is not caused by salmon farms along the out-migration route.

Synopsis on Related Evidentiary Hearing Topics

30. The environment is a diffuse subject that cuts across may different areas of constitutional responsibility, some federal, some provincial. It is a constitutionally abstruse matter which involves considerable overlap and uncertainty. The principles of federalism and cooperative federalism include recognition that there is an inevitable overlap in rules made, and the task of maintaining the balance in practice falls primarily to governments.

31. The Province has provided concise submissions highlighting provincial perspectives and the role of provincial witnesses with respect to the Riparian Areas Regulation (urbanization), pulp and paper and mining effluent, municipal

wastewater, gravel removal, logging, and hydro, water flow and temperature. They came from different ministries, geographic areas, and backgrounds.

32. They included a riparian areas coordinator (working with both federal and local governments and professional associations as well as the public and their professionals), two biologists with expertise on effluent monitoring, a water regulator working on a joint committee dealing with sediment removal applications where a provincial agency charged with public safety is the proponent (Emergency Management BC (EMBC)), forestry scientist with broad experience including the important long-running (33 years) Carnation Creek project, a professional forester with an extensive history of work on forest planning and practices policy and legislation and professional responsibility, a long time water manager who is a professional engineer, and the director of Environmental Sustainability and Strategic Policy Division for the Ministry of Environment who has led public consultation on the Water Act Modernization process.

33. None of the provincial topics, individually or collectively, is responsible for the 20-year decline of Fraser River sockeye salmon or the collapse in 2009.

34. Accordingly, the Province generally does not make extensive discussions or submissions on the evidence, nor does it make recommendations, either with respect to matters of provincial jurisdiction (outside of the commission's mandate) nor, in the circumstances. of matters within federal jurisdiction or of DFO budgets, policies and practices.

35. In particular, provincial witnesses were not called on the topics of habitat management and enforcement, and the province did not play an active role in those hearings.

36. Although the evidence and approach differs from topic to topic, a number of themes emerge from the provincial submissions.

37. First, the Commission hearings reflect a snapshot in time. The issues and processes are ongoing, whether the subject is the ongoing development of monitoring practices, ongoing work on professional reliance, ongoing approvals of municipal wastewater plans and federal wastewater regulations, and ongoing science and monitoring of the mountain pine beetle and other habitat issues.

38. Secondly, the 1990s were a time of active engagement and improvement in environmental matters, with key critical results in such areas as pulp mill effluents and forest practices.

39. Thirdly, the 21st century has seen moves by all government towards a more stream-lined results based approach to regulation. This seems unlikely to change any time soon.

40. Fourthly, inter-governmental cooperation may not always work smoothly, and governments may not always see eye to eye, but the federal and provincial witnesses on these topics generated good models of respectful cooperation.

41. While the topics and the hearings tend to focus on “problem-solving” and “problems”, it is important to look at the success stories. For example, Paul Higgins testified with enthusiasm about the agreement between BC Hydro the St’at’mic and the Province of BC concerning various operations of BC hydro ; the SLIPP project and the fish water management tool; the ongoing WAM consultation are examples where cooperation by - in some cases governments and First Nations - is paying dividends.

42. Turning to the individual topics, a concise summary of some of the highlights follows.

Urbanization: the RAR

43. Although many topics could fall within the overarching theme of freshwater urbanization effects, PPR 14 addressed the RAR as a topic to do with physical habitat impacts through development and other land uses. DFO witness Michael Crowe rejected the characterization of the RAR as an example of "privatization". The panel agreed that the professional reliance model can work.

44. Stacey Wilkerson, the Province's RAR coordinator since 2007, described the operation of the RAR as providing guidance to selected local governments on riparian setbacks. Michael Crowe said that the RAR serves as a surrogate for a DFO review and approval process. The province does a lot of spot checks and monitoring.

45. The recent *Yanke* decision is discussed in the context of what happens when governments are not happy with the report of a qualified educational professional (QEP). In terms of the question of whether the Commission should consider making recommendations about modernization of the Fisheries Act, the Yanke decision reminds us that elaborate policy provisions and collaboration can be undermined since policy will not be legally enforceable. Furthermore, since the *Fisheries Act* is a compliance tool for the riparian area, improvements in the system of enforcement will benefit the riparian area covered by the RAR.

Pulp and Paper and Mining Effluents

46. PPR 15 sets out the basic framework of regulation with respect to municipal wastewater, pulp and paper and mining effluent disposal practices pursuant to section 36 of the *Fisheries Act* and various pieces of federal and provincial

regulation. Provincially the Environment Management act, together with the Pulp and Paper Mill Liquid Effluent Regulations, as well as the *Water Act*, the *Fish Protection Act*, and parts of the Mining Act and associated regulations are the primary sources of provincial regulation.

47. There are 7 operating pulp mills and 7 active metal mines in the Fraser River watershed.

48. The evidence shows there have been major improvements in pulp mill effluents since 1992.

49. Technical Report 3 concluded that impacts of mining on sockeye salmon are likely small. With one exception none of the mines are in close proximity to habitat occupied by juvenile sockeye salmon.

Municipal Wastewater

50. The Municipal wastewater hearings consisted of a scientific panel (including EC and Peter Ross of DFO) and Panel No. 45, consisting of EC's James Arnott, who is coordinating on new federal regulations with the Canadian Council of Ministers of the Environment (CCME), together with a witness from Metro Vancouver, since the commission selected a focus on greater Vancouver wastewater issues. The provincial role in municipal wastewater includes participation in the CCME, including the Canada-Wide Strategy (Exhibit 1058), as well as giving ministerial approval to the Metro Vancouver Liquid Waste Management plan. Both the 2011 ministerial approval and the forthcoming federal regulation are major milestones on this issue.

51. Consistent with the Technical Reports, Metro Vancouver asserts that the impact of sockeye are negligible, given the detailed standards and process that it meets.

52. The Province makes brief reference to the concerns raised about emerging contaminants by Ross and in Technical Report 2, as well as Marmorek's suggestion that it "would not be that hard" to screen or them.

Gravel Removal

53. There is little evidence linking Fraser River sockeye to gravel removal in the Fraser River Gravel Reach. Gravel removal is a part of the Province's flood protection strategy. Emergency Management BC (EMBC) makes decisions with respect to public safety and the need to undertake specific sediment removal projects as one component of a comprehensive approach to manage flood risk. It is a public safety issue and is not within the scope of the Commissioner's Terms of Reference.

54. DFO defers to the Province on matters of public safety.

55. DFO scientist Dr. Laura Rempel's evidence indicated on a number of occasions that river type sockeye are over emphasized in the context of gravel mining and in the context of the PPR. The Province submits that the Commissioner should not place much reliance on the PPR insofar as it relates to Fraser River sockeye or the purported impacts of gravel removal on Fraser River sockeye.

56. In recent years there have been discussions between DFO and the Province about a long term plan for gravel removal. Matters including March 2010 correspondence from Dr. Michael Church are being followed up by DFO and the Province.

Logging and Forestry

57. While Technical Report 3 identifies various forestry practices that may impact sockeye salmon, the Commission's evidence occupied one day only. Peter Tschaplinski has conducteds research on fish-forestry impacts, watersheds, and stream ecosystems since 1979. Ian Miller is a professional forester who has worked on forest planning and practices legislation and policy under both the *Forest Practices Code of BC Act* and the *Forest and Range Practices Act (FRPA)* in Victoria since the mid-1990s. DFO witness Peter Delaney was involved with the implementation of the Forest Practices Code in the mid-1990s and from 1997 to 2005 held the position of Chief, Habitat Policy, including being DFO's representative on joint committees developed under the Forest and Range practices Act.

58. The Province is making extensive submissions on Technical Reports 3 and 6. There is no evidence that freshwater ecology has caused or is causing the decline of Fraser River Sockeye salmon. Moreover, the Province's submissions include comprehensive monitoring data collected province-wide demonstrating a marked improvement in post-harvest stream conditions and levels of fish habitat protection from 1995 to the present compared with pre-1995 forestry management outcomes. Accordingly, the Province submits that there is no basis for a finding that forestry practices have caused that decline. In these circumstances, the Commissioner should focus any findings of fact and policy or budgetary recommendations on the federal government, and not the Province.

59. Ian Miller's evidence reflected his personal zeal on the topic of professional reliance.

60. Peter Tschaplinski's research on the mountain pine beetle and on riparian areas confirms the view of Technical Reports 3 and 6 that forestry is not a cause of the 20-year decline nor of the 2009 collapse.

Hydro, Water Flow and Temperature

61. PPR 21 generally sets out an accurate overview of the existing water licensing scheme as it relates to Fraser River sockeye.

62. The PPR Regulation of Water Uses in the Fraser Watershed, 18 August 2011, (PPR 21) generally sets out an accurate overview of the existing water licensing scheme (paras 23 – 53) as it relates to Fraser River sockeye.

63. Over 44,000 water licenses have been issued in the Province and over half of those are domestic licenses for small water withdrawals for domestic purposes. Water withdrawals for domestic purposes are not required to be licensed.

64. Some licenses, mainly the newer licenses, and large volume licenses have an instream flow requirements and monitoring requirements.

65. The Province does not require licenses for groundwater extraction at this point but it does regulate aspects of groundwater extraction with respect to well design and siting. The Province has mapped and classified 960 aquifers and it operates 145 wells to monitor groundwater levels.

66. There was no evidence that the existing water licensing scheme has caused a long term decrease in productivity of Fraser River sockeye or the collapse in 2009.

67. The Province has a drought response plan (which involves DFO, and which was used in the 2009 drought). There are some measures which the comptroller of water rights and regional water managers may use with respect to existing water licenses and there are measures available under the Fish Protection Act to deal with instream flow issues during drought conditions.

68. The Province is undertaking a *Water Act* modernization process (WAM) which proposes, amongst other things, to contain instream flow requirements and to require licensing of groundwater extractions of large volumes and all extractions in priority areas. The Province has undertaken considerable province wide consultation with respect to WAM since 2009. The Minister has recently advised that there will be further consultation on draft legislation in 2012.

69. There are two major hydroelectric projects in the Fraser watershed that have the potential to impact Fraser River sockeye, BC Hydro's Bridge Seton Power Project near Lillooet and Rio Tinto Alcan's Kemano Power Project. There was no evidence presented which indicated that these projects were the cause of the long term decrease in productivity of Fraser River sockeye or that they led to the collapse of the 2009 run.

70. There are also five small hydro projects or independent power projects (IPP) in the Fraser watershed. There was no evidence that these projects led to the

decline in productivity of Fraser River sockeye or that they led to the collapse of the 2009 run.

Concluding Points

71. In concluding this concise summary of the Province's submission, the Province refers to several positive highlights. First, during the water hearings BC Hydro's Paul Higgins, during cross-examination by Brenda Gaertner for FNC, clearly expressed his enthusiasm for the process that lead to the St'at'mic Agreement with BC Hydro and the Province of BC (Exhibit 1861). It was evident that he found his participation transformative.

72. Secondly, the evidence during the water hearings showed that multi-stakeholder engagement on BC Hydro's Water Use Planning, although expensive, was also successful.

73. Thirdly, Jason Hwang brought up another good news story during the water hearings. Exhibits 1968-71 were entered by consent. First Nations, federal fisheries scientists, and provincial scientists and water managers have implemented an award-winning fish water management tool that has transforms instream management in the Okanagan.

74. Fourthly, the Shuswap Lake Integrated Planning Process is an outstanding example of federal provincial and local government participation, including some participation by First Nations to date and the hope of more during implementation.

INTRODUCTION

These are the submissions of the Province of British Columbia to the Cohen Commission, a federal commission of Inquiry into the decline of sockeye salmon in the Fraser River.

First, the Province would like to thank the Commissioner for the opportunity to participate in this inquiry, a federal inquiry established pursuant to the *Inquiries Act*

As a general comment it is our view that the Commissioner has succeeded in conducting an inquiry that has, in many respects, encouraged broad cooperation amongst stakeholders. While there may be some exceptions, the vast majority of the hearings have had that broad cooperation and we commend the Commissioner and Commission Counsel for fostering that environment.

It is interesting to note that the trigger for establishing this federal Commission of Inquiry was the very poor run of Fraser River Sockeye in 2009 of approximately 1.9 million sockeye. That was followed by a record run of approximately 34 million sockeye in 2010 and now it seems that the 2011 run is over 5 million, notwithstanding a pre-season estimate of about 3.1 million. While the last two years have more positive returns, it does not take away from the challenges facing the Fraser River sockeye fishery.

The sockeye fishery does contribute to the provincial economy, but that contribution has been declining over recent years; however the 2010 fishery reversed that trend. Various annual reports of the BC Seafood Industry over the past 15 plus years (Exhibits 504, 505, 506, 510 and 507) provide some indication of the landed value and wholesale value of the sockeye fishery. Further the preliminary landed value of the 2010 sockeye fishery was estimated to be approximately $90 million; and in the past about three quarters of the sockeye landed value has been attributable to Fraser River Sockeye.

It is clear from the evidence that the Fraser River sockeye fishery is very complex. While there have been a significant number of studies on Pacific salmon and Fraser River sockeye over the years, the evidence in this Inquiry has shown that there are many unknowns, especially about what happens to Fraser River sockeye in the marine environment.

Many groups, with often varying interests, are involved in the Fraser River sockeye fishery including, First Nations, commercial fishers, recreational fisheries, and environmental groups. The federal government, and more particularly the Department of Fisheries and Oceans (DFO), is charged constitutionally with managing the fishery. There are, as evidenced in the testimony, differing views amongst many of the groups who are interested in the Fraser River sockeye fishery. All of this makes the management of the fishery more challenging, yet this points to the need for all parties who have an interest in the Fraser River sockeye fishery to work together for the common goal of having a sustainable fishery now and for future generations. This theme of an inclusive fishery and involvement of all interested parties in the management of the fishery will be expanded upon in the Province's discussion of suggested recommendations.

The Province's main submissions focus on the mandate of the Commissioner; the causes for the decline of Fraser River sockeye, and recommendations and these are briefly set out below:

Mandate

- This is a federal inquiry and the Terms of Reference clearly focus on the policies, practices and procedures of DFO, and therefore any recommendations from the Commissioner should focus on DFO.
- There is no mention of aboriginal rights and title in the Terms of Reference and therefore the Commissioner is not required to, nor should he, make findings in that regard or any rulings or interpretations with respect to the existing law.

Causes for the Decline of Fraser River Sockeye Salmon

The weight of evidence suggests that:

- the long-term decline in the productivity of Fraser River sockeye is likely attributable to factors related to marine conditions and climate change, and that marine conditions in the Strait of Georgia and Queen Charlotte Sound were likely to be the primary factors for the poor returns in 2009 (Technical Report 6);
- the long-term decline in productivity is likely driven by mechanisms that operate on larger, regional spatial scales, e.g. climate driven oceanographic changes. This is based on findings that most Fraser and non-Fraser stocks in Canada and the USA have shown a decrease in productivity, especially over the last decade. (Technical Report 10);

- recent declines Fraser River sockeye are unlikely to be the result of changes in freshwater environment. Technical Report 3 reviewed changes to the freshwater environment resulting from human activities such as mining, logging, hydroelectricity, urbanization and agriculture in arriving at the above conclusion, (Technical Report 3). This is consistent with the June 2010 workshop. (Exhibit 573, Section D, Selbie et al);
- gravel removal, forestry, urbanization, municipal waste water, pulp and paper and mining effluents, hydro and water flow and temperature did not contribute significantly to either the long-term decline in productivity of Fraser River sockeye or the poor run in 2009. (Technical Reports 6, 10, 3 and others, and testimony at those respective hearings); and
- it is unlikely that diseases or sea lice from aquaculture farms contributed to either the long term decline of productivity of Fraser River Sockeye salmon or the poor run in 2009. (various Technical Reports and expert testimony in the Aquaculture and Disease hearings).

Recommendations

- That DFO carry out all of the steps in its Acton Plan with respect to fulfilling the conditions regarding MSC Certification of BC Sockeye (Ex 159);
- That DFO continue to support the Integrated Salmon Dialogue Forum (ISDF) or a similar process beyond March 2012;
- That DFO continue to support the Monitoring and Compliance Panel beyond March 2012;
- That the Fraser River sockeye fishery should be inclusive; all interested parties should be involved in the management of the fishery; and
- That the federal government introduce new fisheries legislation (e.g. a new Fisheries Act).

A last point with respect to the recommendations that the Commissioner chooses to make – the recommendations should be practical and implementable and take into account the existing and future fiscal realities. If this Commission is to be effective and make a difference to the future sustainability of the Fraser River sockeye fishery, then, it is submitted, its recommendations have to be realistic.

Mandate

<u>Terms of Reference</u>

The Commissioner is directed, in the Terms of Reference:

> "A. to conduct the inquiry without seeking to find fault on the part of any individual, community or organization, and with the overall aim of respecting conservation of the sockeye salmon stock and encouraging broad cooperation among the stakeholders,"

As mentioned in the Introduction, we believe that, for the most part, the Commissioner has conducted the inquiry in a manner which has encouraged broad cooperation among the stakeholders. In addition, notwithstanding the Commissioner's Ruling on Interpretation of Terms of Reference, dated September 15, 2010, we are not aware of any individual community or organization being given a notice under the *Inquiries Act* with respect to a possible finding of fault.

The Commissioner is further directed in the Terms of Reference

> "B. to consider the policies and practices of the Department of Fisheries and Oceans (the "Department") with respect to the sockeye salmon fishery in the Fraser River – including the Department's scientific advice, its fisheries policies and programs, its risk management strategies, its allocation of Department resources and its fisheries management practices and procedures, including monitoring, counting of stocks, forecasting and enforcement,"

A significant portion of the hearing has focused on the policies and practices of the Department of Fisheries and Oceans ("DFO") with respect to the sockeye salmon fishery in the Fraser River.

The Commissioner is further directed:

> "C. to investigate and make independent findings of fact regarding

I. the causes for the decline of Fraser River sockeye salmon including, but not limited to, the impact of environmental changes along the Fraser River, marine environmental conditions, aquaculture, predators, diseases, water temperature and other factors that may have affected the ability of sockeye salmon to reach traditional spawning grounds or reach the ocean, and

II. the current state of Fraser River sockeye salmon stocks and the long term projects for those stocks, and,"

There have been various technical science reports as well as testimony which have dealt with the various issues outlined in the above paragraph.

The Commissioner is finally directed:

"D. to develop recommendations for improving the future sustainability of the sockeye salmon fishery in the Fraser River including, as required, any changes to the policies, practices and procedures of the Department in relation to the management of the Fraser River sockeye salmon fishery,"

We would note here that there is a particular focus with respect to any changes to the policies, practices and procedures of DFO in relation to the management of the Fraser River sockeye salmon fishery.

It is clear from the above that the focus of this inquiry, a federal inquiry, is into the policies, practices and procedures of DFO with respect of the Fraser River sockeye salmon fishery. In addition, other federal departments are, by necessity, included in this review, especially Environment Canada given its jurisdiction over certain matters under section 36 of the *Fisheries Act*.

There is no mention in the Terms of Reference to consider the policies, practices or programs of any provincial ministry or of considering recommendations to the policies, practices and procedures of any provincial ministry insofar as they may relate to the Fraser River sockeye salmon fishery. This is not surprising as this is a federal inquiry directed by the Governor in Council. Further, this clearly suggests that the focus of the Commissioner's consideration and recommendations should be directed to DFO and other federal departments as required. An example of this approach is seen in the Habitat Management hearings when, on April 4, 2011 Commission Counsel, Brock Martland stated the following at page 44, lines 40 – 46)

> "As you appreciate, Mr. Commissioner, this is a federal Commission of Inquiry and the terms of reference obviously focus, and in particular, on DFO and the federal government. As will be apparent, in particular in this PPR, the focus is very much on DFO and the Federal Government."

Therefore we submit that the Commissioner should consider DFO policies, practices and procedures, findings of facts and recommendations with respect to the sustainability of the Fraser River sockeye salmon fishery in light of these specific Terms of Reference. Further as set out below we submit that as the Terms of Reference do not mention aboriginal rights and title or treaty rights, the Commissioner should not make any findings in respect of these matters.

Aboriginal and Treaty Rights Considerations

There has been much testimony during these hearings with respect to First Nations issues and Aboriginal fishing as they relate to Fraser River sockeye. There have been separate hearings on:

- Perspectives on the Aboriginal and treaty rights framework
- Aboriginal world view, cultural context and traditional knowledge
- Aboriginal Fishing

It is fair to say that Aboriginal law is a complex, dynamic, evolving, controversial and contentious area of the law. This is confirmed by the various submissions filed and oral arguments made in the Aboriginal and Treaty Rights Framework hearings on October 26, 2010.

One particular point we wish to make at this point is in respect of the Paper prepared by Dr. Harris, The Recognition and Regulation of the Aboriginal Fraser River Sockeye Salmon Fisheries (Exhibit 1135). We submit that the Commissioner should give little or no weight to the section entitled “Indian Reserves and Fisheries” (pages 25 – 31). This is because Dr. Harris omitted to refer to the two leading Supreme Court of Canada decisions on the point *R v. Nikal* [*1996] 1 S.C.R. 1013* and *R v. Lewis* [*1996] 1 S.C.R. 921.* The basis for this omission seems to be that he disagrees with at least some of the findings of fact of the Supreme Court of Canada. (Transcript June 27, 2011 from pages 23 -33 and particularly page 25 line lines 12 and 13). We submit that the findings of the Supreme Court of Canada in the unanimous decisions in *Nikal* and *Lewis* in this regard should be preferred.

Notwithstanding the numerous days of hearing on Aboriginal fisheries issues, the Commissioner’s Terms of Reference do not contain any reference to Aboriginal rights and title. The province refers to its written submission on this matter dated October 19, 2010 (Exhibit C for Identification) , and the province’s oral submissions of October 26, 2010 at pages 13 -19. The province reiterates that the Commissioner is not required to, nor should he, make findings with respect to the state of the law concerning Aboriginal rights and title with respect to fisheries, given the evolving state of the law, the various cases before the Supreme Court of Canada, as well as differences in opinion as to the state of the existing law. This Commission of Inquiry is not the forum to rule on such issues; those matters are better left to the courts.

This is not to say, however, that First Nations issues should not be considered with respect to any recommendations concerning the future sustainability of the Fraser River sockeye salmon fishery. Clearly they have to be considered. The evidence from First Nations witnesses is that First Nations have a long history and an interest in and connection to Fraser River sockeye. Further, the DFO is involved in many consultations with First Nations with respect to fisheries and fisheries management.

How First Nations should be involved in the management of Fraser River sockeye and fisheries in general is a matter for which there has also been considerable testimony. One of the issues that DFO faces is how to have effective and efficient consultations with First Nations and involve First Nations in fisheries management given the complexity of the fishery, the numbers of First Nations involved in the Fraser River sockeye fishery and the varying interests of those First Nations - be they coastal, lower Fraser River, or upper Fraser River First Nations.

However, there are other groups who have interests in the Fraser River sockeye fishery including commercial fishers, recreational fishers and non-government environmental organizations. Any recommendations with respect to the management of the Fraser River sockeye fishery must, we submit, include these stakeholders.

The Province has suggested a number of recommendations and a number of these focus on the need to involve all who have an interest in the Fraser River sockeye fishery.

RECOMMENDATIONS:

The Province proposes the following recommendations:

1. That DFO carry out all of its "Action Plan" in regard to the Marine Stewardship Council (MSC) certification of Fraser River sockeye (Exhibit 159) so that the various conditions that are attached to the MSC certification of Fraser River sockeye be fulfilled;

2. That DFO continue to support the Integrated Salmon Dialogue Forum (ISDF) or a similar process beyond March 2012;

3. That DFO continue to support the Monitoring and Compliance Panel ,established pursuant to the ISDF process, beyond March 2012;

4. That any fisheries management processes for Fraser River sockeye include all parties who have an interest in the fishery. The fishery and the management of the fishery should be as inclusive as possible, and

5. That the federal government introduce new fisheries legislation (e.g. a new *Fisheries Act*).

1. That DFO carry out all of its Action Plan in regard to the MSC certification of the Fraser River sockeye (Exhibit 159) so that the various conditions that are attached to the MSC certification of Fraser River sockeye be fulfilled.

    - The testimony of Rob Morley (Vice-President, Canadian Fishing Company) on March 1, 2011 at pages 89-91 emphasized the importance of MSC certification to access foreign markets.
    -
    - In her testimony on Friday, September 23, 2011, Deputy Minister, Claire Dansereau indicated that DFO is "…. working with industry to ensure that our fisheries are MSC certified or third party certified in some way" (September 23, 2011, page 3, lines 15-18).

    - The DFO Action Plan for fulfilling the various conditions attached to MSC certification of BC sockeye salmon is Exhibit 159.

    - Sue Farlinger, RDG, Pacific Region, DFO, testified that the Action Plan is being implemented by the department and she indicated that DFO will be able to fulfill those conditions over the five years within departmental resources (September 26, 2011, page 18 – lines 20-33).

    - DFO presented a summary of key MSC certification deliverables and their status for sockeye as of May 30, 2011 (Exhibit 969).

- There was an audit meeting between MSC representatives and DFO in June 2011, however, DFO has not yet provided the audit report to the Commission but it has agreed to do so upon receipt of that audit report. (Farlinger, September 26, 2011, page 18 – lines 34-46).

- The Surveillance Report on British Columbia Commercial Sockeye Salmon Fisheries (October 2011), which was sent out to participants on Friday October 14, 2011 reports on the status of the conditions attaching to MSC certification. In general that report states that some conditions have been met, others are expected to be met within two years, the analysis of some conditions is deferred until the next surveillance and additional action by DFO is recommended for some conditions.

- Given the importance of MSC certification to the economic viability of the fishery, being accessed to foreign markets, it is crucial that DFO fulfill the various commitments set out in the Action Plan and therefore the Commissioner should include in his recommendations the need for DFO to fulfill its commitments under the Action Plan notwithstanding any fiscal constraints that may arise in the future as a result of budget reductions.

2. That DFO continue to support the Integrated Salmon Dialogue Forum (ISDF) or a similar process beyond March 2012;

    - A number of Exhibits were entered with respect to the ISDF and the MSC panel including:

        Exhibit 392 – Framework for the Integrated Salmon Dialogue Forum

        Exhibit 393 – Making Peace and Decisions in the Salmon Fishery – Module 1: Opening the Lenses

        Exhibit 393A - Making Peace and Decisions in the Salmon Fishery – Module 2: Partnership Driven Collaboration: Basic Concepts and Context

        Exhibit 393B - Making Peace and Decisions in the Salmon Fishery – Module 3: Reaching Outcomes: The Four Stages of Good Process

        Exhibit 393 C - Making Peace and Decisions in the Salmon Fishery – Module 4: Applying Participation Driven Collaboration to Fisheries Issues in Community Based Peacemaking Circles

        Exhibit 429 – Strategic Framework for Fisheries Monitoring and Catch Reporting in the Pacific Fisheries

        Exhibit 855 – Charting Our Course: Fishery Monitoring in the Pacific Region - A Strategy for Improved Confidence and Support (Final Report)

Exhibit 863 – A Practical Guide to Collaborative Fisheries Governance

Exhibit 864 – Evolving a New Framework for Decision Making in Salmon Fisheries - Drivers and Directions

- Wayne Saito commented on the value of the ISDF process as an opportunity to hear from all interested parties and attempt to reach consensus before making policy decisions and generally commented favourably on the ISDF process, including the work of the M&C panel (February 3, 2011, pages 90 – 99)
- The witnesses on the Panel (May 12, 2011), Grand Chief Ken Malloway (Sto:Lo), Peter Sakich, Chair of the Commercial Salmon Advisory Board, and Colin Masson (DFO) all express support for the continuation of the ISDF process.
    - Grand Chief Malloway, page 72 – Lines 7-16 and lines 42-47, page 73, line 1.
    - Colin Masson, page 72 – lines 18-23 and page 73 – lines 3-12.
    - Peter Sakich, page 72 – lines 25-34, page 73 – lines 14-19.
- Ms. Farlinger also referred to the important role of ISDF in her testimony on September 22, 2011, at page 20 – lines 19-30 and September 23, 2011, at page 84 – lines 26-29.
- Colin Masson noted, in support of the ISDF process, the views of the RDG to the effect that there were some issues that DFO cannot do alone and DFO needed to work with those affected. (May 12, 2011, page 67 – lines 5-10).
- Malloway, Sakich and Masson also agreed with the description of the ISDF process in paragraph 18 of PPR 12, Fishery Monitoring and Catch Reporting for Commercial and Aboriginal Fraser River Sockeye Salmon Fisheries. March 17, 2011, as a "..collaborative and inclusive opportunity for all interested to work together towards a fully integrated sustainable salmon fishery." (May 12, 2011, page 65 – lines 35-47 and page 66 – lines 1-11).
- In addition, Exhibit 1922: Report on Plans and Priorities 2011 – 2012 at page 1, bottom bullet states:

    > "Strengthening engagement in key partnerships including renewal of departmental consultation framework, especially its aboriginal dimension"

- Ms. Dansereau spoke to this in her evidence on Friday, September 23, 2011, where she indicated that DFO was a partnership based organization and that part of modernizing the fishery was to ensure that the region and all of the DFO's areas are "working actively and ensuring we have the best engagement strategies and partnership relationship." (page 49 – lines 2-13).

3. That DFO continue to support Monitoring and Compliance Panel, established pursuant to the ISDF process, beyond March 2012.
    - There was also support from the May 12, 2011 panel members, Grand Chief Ken Malloway, Peter Sakich and Colin Masson, for the Monitoring and Compliance Panel and a continuation of its work.
        - Testimony of Grand Chief Malloway, Peter Sakich and Colin Masson on May 12, 2011, pages 71-73.
        - Masson specifically noted that "but I am a full supporter of the Monitoring and Compliance Panel. I think it's only really begun to scratch the surface. I think that I have vision this group could do more than we have touched on today. I think it's really useful for the department and for the resources and for the participants." (May 12, 2011 page 73, lines 5 – 12).
    - The DFO document, Exhibit 429 - Strategic Framework for Fisheries Monitoring and Catch Reporting in the Pacific Fisheries, was informed by Exhibit 855 charting our course and (Masson, May 12, 2011, page 14 – lines 6-11).
    - Fish reporting and catch monitoring are key aspects of managing a fishery; this was referred to by various witnesses throughout the hearing, for example:
        - Colin Masson (May 12, 2011, page 15 – lines 1-14);
        - Sue Farlinger, (September 23, 2011, , page 78 – lines 38-45, page 79 – lines 1-5 and page 84 – lines 14-25);
        - Technical Report at page 7, Fraser River Sockeye Fisheries, Harvesting and Fisheries Management, at page 1 Executive Summary, Catch Monitoring Programs states that there is substantial room for improvement in Catch Monitoring Programs. Karl English, the lead author of Technical Report 7 later revised his recommendation in regard to this slightly to refer to "… consistently good monitoring across sectors". (April 15, 2011 page 86, lines 28 - 33).
    - Various witnesses, including experts, have identified the need for improved catch monitoring. The M & C Panel provides an opportunity, a collaborative approach involving representations from all interested groups, to work towards improving the monitoring process.
    - Ms. Dansereau commented that to achieve sustainable aquatic systems, DFO needs to have a good compliance and enforcement program. (September 23, 2011, page 50 – lines 13-15). An improved monitoring process would increase compliance.
    - Ms. Farlinger, stated that a very strong catch monitoring system is better for fish management and it's better for conservation and "..very much

better in terms of improving the trust and collaboration between groups." (September 23, 2011, page 78 – lines 37-45).

- Farlinger went on to say that one aspect of collaboration "..is a common understanding of information and trust and reliability in the information that is provided from all sources, not just the science that comes from the Department and outside the Department, but the monitoring and peoples' confidence in each others' numbers." (September 23, 2011, page 78 – lines 46-47 and page 79 – lines 1-5).
- In answering a question concerning the relationship between effective catch monitoring and sustainability, Mr. Masson replied "Effective catch monitoring is a key component of effective fisheries management and research management." May 12, 2011 page 71, lines 34 -47) Both Mr. Sakich and Grand Chief Malloway agreed with the relationship between effective catch monitoring and sustainability (May 12, 2011, page 71 – lines 34-47 and page 72 – lines 1 &2).

4. That any fisheries management process for Fraser River sockeye should include all parties who have an interest in that fishery. The fishery and the management of the fishery should be inclusive as possible.

    - First Nations, commercial harvesters, recreational harvesters, non-government organizations, and government have an interest in a well managed sustainable fishery.
        - Joseph Becker, a member of the Musqueam Fisheries Commission stated that "Fish are the responsibility of everyone who participates in the fishery." He went on to say that all user groups should be involved in a management regime so that " .. there will be fish for the future, for our grandchildren".. (December 13, 2010, page 10, lines 7 -23).
    - Ms. Dansereau referred to the importance of this issue in her testimony in answer to questions about Exhibit 1922: Report on Plans and Priorities 2011/2012, and the priority of "modernizing fisheries". She indicated this is an exercise that the DFO had been involved in for a number of years and stated "it's ensuring that we have the most up-to-date policies to allow people who fish and the people who live off the fishery the best, to provide them with the best policies to ensure they can be economically prosperous." (September 23, 2011, page 48 – Lines 15-32).
    - In addition, with respect to the bottom bullet on page 1 of Exhibit 1922, which reads:

        "Strengthening engagement and key partnerships including the renewal of departmental consultation framework especially its aboriginal dimensions."

Ms. Dansereau stated:"…. We are a partnership based organization in all of the, I guess, claimed or partner groups whether it's commercial fishery or First Nations. We know, through experience over time, that the only way for us to do bullet no. 1, modernizing the fishery, is to do it through proper consultation and partnership. So one of our regions in all of our areas are working actively and ensuring we have the best engagement strategies and partnership relationship." (September 23, 2011, page 49 – lines 2-12).

- In regard to involving all who have an interest in the fishery and specifically on the topic of implementation of the WSP, Ms. Farlinger stated that:

  > "… all the people that are affected by the implementation of the policy need to be involved in the decision is something we have accomplished to a great extent through the annual management of the fishery and the integrated harvest planning committee and all the various processes that lead up to that.
  >
  > I do think we have some work to do in tying together aboriginal participation in the integrated processes which we are working on. But I certainly think that we are living with the principle that all people that will be affected by this directly or indirectly will be exposed to the question and have opportunities to input into the decisions that come about as a result of it." (September 23, 2011, page 86 – lines 21-36).

- The Province has promoted the ISDF and the Monitoring and Compliance Panel as initiatives that should continue because they do, or at least provide the opportunity to, involve all who have an interest in the fishery. Processes or initiatives that bring together all interested parties, if well managed, have the opportunity to improve relationships and build trust. That is necessary if the various parties are to work together to ensure an effectively managed and sustainable Fraser River sockeye fishery in the future.

- The IHPC is another multi-party process that brings together all of the parties who have an interest in the Fraser River Sockeye fishery. Testimony from a number of witnesses suggests that First Nations need to be better represented on the IHPC. This in turn brings up the issue of effective Tier 1 (amongst First Nations) and Tier 2 (First Nations and DFO) processes on which there has been considerable testimony. There is a real need for effective and efficient Tier 1 and Tier 2 processes. This puts an onus on both DFO and First Nations.

- The Province wishes to bring to the Commissioner's attention a few examples of processes that have involved various interested parties , including government , First Nations, and industry, namely

- Thompson River Partnership monitoring process as described in Exhibit 1040. That process, which includes representatives from the provincial government, the federal government, local government, First Nations and industry, has coordinated both required and voluntary monitoring of the lower Thompson River and Kamloops Lake for a number of years.
- Shuswap Lake Integrated Planning Process (SLIPP) Exhibit 1014 and related testimony June 8, 2011, pages 61 – 65)
- The Okanagan Fish/Water Management Tool - Exhibits 1968 - 1971, which Jason Hwang referred to as "..an example of something we call a "fish water " management tool that's been very beneficial for fish, as well as for other uses of water." (Sept 16, 2011, page 29 lines 46, 47 and page 30 lines 1 – 3).

5. That the federal government introduce new fisheries legislation (e.g. a new Fisheries Act).

- Exhibit 1930 – Fisheries and Oceans Canada, Corporate Business Plan 2011/2012 at page 11 under the heading of Management of Fisheries includes the following:

  "Bring forward a new Fisheries Act".

- Ms. Dansereau stated that a new Fisheries Act had been introduced twice in the past five years but did not proceed through the processes in parliament. She indicated that DFO would be looking at provisions to see whether more consultation would be required on some and then determining when would be the right time to bring in a new Fisheries Act. (September 26, 2011, lines 31-47).
- David Bevan, on answering the question about whether a new Fisheries Act would deal with the *Larocque* situation, indicated that there was a section in previous drafts that allowed for fish management agreements. (September 26, 2011, page 25 – lines 1-31).
- The Fisheries Act is over 140 years old and yet, notwithstanding the 25 Commission Reports and studies over the last 30 years, there have not been significant changes to the Fisheries Act resulting from all those reports. Instead there have been numerous policy directions, reviews and new policies instituted but the underlying Fisheries Act and any shortcomings which may result given the passing of 140 years have not been dealt with. In fairness, the federal government has attempted to introduce new fisheries legislation twice in the past five years, but those bills have not been passed into legislation. (Dansereau, September 26, 2011, page 24, lines 43 – 45).

TOPIC: CAUSES FOR THE DECLINE OF FRASER RIVER SOCKEYE SALMON

CUMULATIVE IMPACT ANALYSIS, MARINE ECOLOGY, CLIMATE CHANGE, AND FRESHWATER ECOLOGY

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OVERVIEW:

The Province submits that the Commission should accept the key conclusions of Technical Report 6, Data synthesis and cumulative impact analysis and find that the weight of evidence indicates that the apparent decline of Fraser River Sockeye Salmon is likely attributable to factors operating in the marine environment and to climate change.

This submission will highlight the evidence and transcripts of David Marmorek's testimony.

It will also highlight the evidence of other Technical Reports that were relied upon by Marmorek and support his conclusions.

In particular, the report and evidence of Peterman (Technical Report 10, Fraser River sockeye salmon production dynamics) demonstrates that the declines since the 1980s have occurred in stocks originating over a much larger area than just the Fraser River system and are not unique to it.

In turn, this suggests that large-scale phenomena such as oceanographic changes are likely involved.

Marmorek said that the debate between the Gulf of Alaska and Strait of Georgia did not affect his conclusions. This is consistent with the evidence pointing to causation in the ocean. The Province takes the view that it is not important to isolate the Strait of Georgia (Salish Sea), Queen Charlotte Sound, or to look to the Gulf of Alaska; these bodies of water need to be considered together. Testimony with respect to harmful algal blooms is also consistent with the likely role of ocean effects.

The Province will also refer to the evidence of Scott Hinch with respect to climate change. Technical Report 9, Effects of climate change on Fraser River sockeye salmon focused on climate change and en route mortality of adult sockeye. The Province notes that as Michael Healey's article (*Exhibit 1320, The cumulative impacts of climate change on Fraser River sockeye salmon (Oncorhynchus nerka) and implications for management*) points out, climate change can also affect sockeye at other life stages, not just during their spawning runs. This was also adverted to in the hearings on water and temperature.

The weight of evidence is consistent with the conclusions of Technical Report 3, Evaluating the Status of Fraser River Sockeye Salmon and Role of Freshwater Ecology in their Decline and spherically freshwater ecology is NOT likely the cause of the apparent decline of Fraser sockeye. (Given the life history of lake-rearing sockeye which migrate quickly down the Lower Fraser, the conclusion of Technical Report 12, Fraser River Sockeye Habitat Use in the Lower Fraser and Strait of Georgia, it is no surprise that this is not a likely factor.)

Finally, the Province submits that the independent conclusions of the 2010 SFU review also support these conclusions.

TECHINICAL REPORT 6 - CUMPULATIVE IMPACT ANALYSIS:

David Marmorek, president of ESSA Technologies and adjunct professor at the School of Resource Management at SFU, testified as the lead author for ESSA, the author of s Report 6 (*Exhibit 1896, Technical Report 6, Fraser River sockeye salmon: data synthesis and cumulative impacts; Exhibit 1575, Addendum to Technical Report 6, Implications of Technical Reports on Salmon Farms and Hatchery Diseases for Technical Report 6 (Data Synthesis and Cumulative Impacts); Exhibit 1897, Technical*

Report 6, Fraser River sockeye salmon: data synthesis and cumulative impacts, ERRATA – Sept. 13, 2011). He was qualified as an expert in aquatic ecology, including the effects of human activities on aquatic ecosystems, fish habitats and fish populations; environmental impact and ecological risk assessment; adaptive management, experimental design, decision analysis and modelling and technical facilitation of interdisciplinary workshops*. (Marmorek, September 19, 2011, p. 3, l. 39 – p. 4, l. 36; Exhibit 566, Curriculum Vitae of David Marmorek*). The latter role reflected his work with both the Commission's workshops and the PSC June 2010 workshops at SFU *(Marmorek, September 19, 2011, p. 87, l. 43 – p. 88, l. 34).*

Techinical report described a 6 step process, including an independent statistical analysis in support of the synthesis of evidence (*Marmorek, September 19, 2011, p. 9, ll. 36–39)* about what sets of stressors might have affected which life history stages and ultimately overall lifecycle productivity *(Marmorek, September 19, 2011, p. 7, l. 14 – p. 8, l. 1).*

MARMOREK CONCLUSIONS:

Marmorek's first conclusion relies on Peterman and Dorner (Technical Report 10):

> 4 A Sure. So the first is that before attributing
> 5 causality, you need to look at the overall pattern
> 6 of change in sockeye productivity within both
> 7 Fraser and non-Fraser stocks. In section 4.1 in
> 8 our report summarizes the work from Peterman and
> 9 Dorner and others, Skip McKinnell and so on, about
> 10 what that pattern is. Because that's I think the
> 11 first conclusion.
>
> (*Marmorek, September 19, 2011, p. 8, ll. 4-11)*

Section 4.1 commences with the following analysis of Peterman and Dorner:

> The large spatial extent of similarities in productivity patterns that we found across populations suggests that there might be a shared causal mechanism across that large area. Instead, it is also possible that the prevalence of downward trends in productivity across sockeye stocks from Lake Washington, British Columbia, Southeast Alaska, and the Yakutat region of Alaska is entirely or primarily caused by a coincidental combination of processes such as freshwater habitat degradation, contaminants, pathogens, predators, etc., that have each independently affected individual stocks or smaller groups of stocks. However, the fact that declines also occurred outside the Fraser suggests that

> mechanisms that operate on larger, regional spatial scales, and/or in places where a large number of correlated sockeye stocks overlap, should be seriously examined in other studies, such as the ones being done by the other contractors to the Cohen Commission. Examples of such large-scale phenomena affecting freshwater and/or marine survival of sockeye salmon might include (but are not limited to) increases in predation due to various causes, climate-driven increases in pathogen-induced mortality, or reduced food availability due to oceanographic changes. Further research is required to draw definitive conclusions about the relative influence of such large-scale versus more local processes.

(Exhibit 1896, Technical Report 6, Fraser River sockeye salmon: data synthesis and cumulative impact, p. 38)

The second conclusion stresses marine ecology and climate change along the coastal migration and migration to rearing areas. See Stage 3 in the Executive Summary and the paragraphs on McKinnell (marine conditions) and Hinch (climate change).

On marine conditions:

> McKinnell et al. (2011) investigate how **marine conditions** along the coast may potentially have affected Fraser River sockeye salmon over recent decades and the 2005 brood year (2009 returns) in particular. The **physical conditions** examined include wind, river discharge, salinity, temperature, water density, and water column stability. The primary **biological conditions** examined were the timing and magnitude of chlorophyll production. Broad scale climate drivers can influence river discharge and wind regimes, which may then influence the salinity of coastal waters. Salinity and temperature interact to affect water density, water column stability and therefore surface mixing, which impacts the productivity of the surface layer and its potential to increase in temperature. Fraser sockeye salmon are negatively affected by warmer and less productive ocean conditions. McKinnell et al. (2011, Sections 6.1, 6.2) explore the oceanography and climate of the Strait of Georgia and Queen Charlotte Strait/Sound.

(*Exhibit 1896, Technical Report 6, Fraser River sockeye salmon: data synthesis and cumulative impact, p. 58)*

On climate change:

> **Climate change** could potentially have driven broad scale changes to the entire ecosystem (Hinch and Martins, 2011). It is plausible that climate change may have contributed to changes in the timing, magnitude, patterns, trends and variability in physical and biological habitat conditions along the coast. The potential impacts to sockeye salmon could be direct, such as increases in sea surface temperature, or indirect, such as changes in predation, disease, or food abundance and quality.

(*Exhibit 1896, Technical Report 6, Fraser River sockeye salmon: data synthesis and cumulative impact, p. 58)*

During the hearing, Marmorek discussed the second conclusion on marine conditions interacting with climate change as factors that may be responsible for the declines in overall Fraser sockeye productivity:

> 12 The second one is in terms of the primary
> 13 factors responsible for the long-term declines in
> 14 overall Fraser sockeye productivity and the 2009
> 15 low returns. So we concluded, first of all, that
> 16 marine conditions interacting with climate change
> 17 during the coastal migration stage were the likely
> 18 primary factors for the long-term decline over the
> 19 last 20 years in Fraser River sockeye
> 20 productivity, and that marine conditions were
> 21 likely to be the primary factor responsible for
> 22 the poor returns in 2009 in both the Strait of
> 23 Georgia and Queen Charlotte Sound.
> 24 With respect to the returning run of spawners
> 25 from the mouth of the Fraser back to the spawning
> 26 ground, climate change and en route mortality has
> 27 definitely affected harvest and escapement, but
> 28 not productivity measured as recruits-per-spawner,
> 29 because that recruitment already includes harvest
> 30 and en route mortality. It's basically escapement
> 31 plus harvest plus en route mortality. So that did
> 32 not affect the overall trends in sockeye
> 33 productivity.
> 34 Other possible primary factors in the

productivity declines include predation on adult
sockeye as they come back to the mouth of the
Fraser and climate change in the early life
history stage from egg to smolt.
We were not able to draw any conclusion on
diseases because of lack of data on the exposure
of Fraser sockeye to diseases, and disease
transmission from aquaculture we concluded was
either unlikely or a possible primary factor
depending on which of the two aquaculture reports
one uses as evidence.
All the other factors we considered to be
unlikely to be primary factors responsible for the

overall decline in productivity.

(*Marmorek, September 19, 2011, p. 8, l. 12 – p. 9, l. 1)*

The Executive Summary at Stage 1 states as follows with respect to freshwater factors:

> ***Stage 1: Incubation, Emergence and Freshwater Rearing***
>
> With the exception of **climate change**, which we consider to be a *possible* factor, and **pathogens** (for which *no conclusion is possible* due to data gaps), it is *unlikely* that the other factors considered for this stage, taken cumulatively, were the *primary* drivers behind long term declines in sockeye productivity across the Fraser Basin. These factors included **forestry**, **mining**, **large hydro**, **small hydro, urbanization, agriculture, water use, contaminants, density dependent mortality, predators,** and effects of **Lower Fraser land use** on spawning and rearing habitats. We feel reasonably confident in this conclusion because juvenile productivity (which integrates all stressors in this life history stage except over-wintering in nursery lakes) has not declined over time in eight of the nine Fraser sockeye stocks where it has been measured. We would be even more confident if more stocks had *smolt* enumeration rather than *fry* estimates (only Chilko and Cultus stocks have smolt estimates). Though not primary drivers of the Fraser sockeye situation, each of these factors may still have had some effects on some Fraser stocks in some years (the data are insufficient to reject that possibility). We suspect, based on qualitative

> arguments alone, that **habitat** and **contaminant** influences on Life Stage 1 were also not the *primary* drivers responsible for productivity declines occurring to most non-Fraser stocks assessed by Peterman and Dorner (2011). However, given the absence of any exposure data and correlation analyses for non-Fraser stocks, it is not possible to make conclusions on the relative likelihoods of factors causing their declining productivities. None of the factors considered for Stage 1 are likely to have been much worse in 2005 and 2006 for Fraser sockeye stocks, sufficient to have significantly decreased egg-to-smolt survival in the salmon that returned in 2009. Similarly, none of these factors are likely to have been much better in 2006 and 2007, sufficient to have substantially improved egg-to-smolt survival in the salmon that returned in 2010.

(*Exhibit 1896, Technical Report 6, Fraser River sockeye salmon: data synthesis and cumulative impact, pdf p. 6)*

Technical Report 6 noted that the duration of potential exposure is much less in Stage 2, Smolt Migration (*Exhibit 1896, Technical Report 6, Fraser River sockeye salmon: data synthesis and cumulative impact, p. 50; Exhibit 1897, Errata Sheet for Exhibit 1896, Technical Report 6).* This is a major reason for the conclusion that it is unlikely that freshwater ecology is a driver (*Exhibit 1896, Technical Report 6, Fraser River sockeye salmon: data synthesis and cumulative impact, pp. 53-55; table 4.3–1)*

Marmorek testified that Freshwater habitat factors were not a primary factor. For example:

> 2 many of the freshwater habitat factors, though
> 3 they may well have contributed to changes in some
> 4 stocks in some years -- so, for example, delayed
> 5 density dependence appears to have been
> 6 responsible for some declines and productivity in
> 7 the Quesnel sockeye stock in some years, but was
> 8 not a primary factor responsible for the overall
> 9 decline across all the stocks.

(Marmorek, September 19, 2011, p. 9, ll. 2-9)
See also Marmorek's testimony (at *Marmorek, September 19, 2011, pp. 42-43)* quoted below with respect to Technical Report 3.

The final conclusion was to acknowledge data gaps (and resultant recommendations):

> 10 And finally, there are many gaps in existing

> information which make this whole process
> difficult, so both assessing the exposure as well
> as the correlation of those exposures with changes
> in productivity as well as having life-stage
> specific survival and condition information. So
> that led to some of the recommendations that we
> have.

(Marmorek, September 19, 2011, p. 9, ll. 10-17)

Marmorek used a weight of evidence approach. He reviewed the retrospective ecological risk assessment approach *(Exhibit 1896, Technical Report 6, Fraser River sockeye salmon: data synthesis and cumulative impacts, pp. 22-24 and Fig. 3.3-3)* at *(Marmorek, September 19, 2011, p. 14, l. 19 – p. 15, l. 46).*

> … can you explain how you
> applied that weight-of-evidence approach to this
> tree?
> A Sure. So it basically takes those questions that
> I just outlined and goes through asking whether a
> given factor or hypothesized stressor passes
> various tests. So the first case is, is the
> mechanism plausible? In almost all of the cases
> in all the reports, the answer to that was yes.
> The only exception was in the Noakes report. He
> felt it was not plausible that waste from salmon
> farms could have an effect.
> Then we moved to the exposure question, which
> I just described, for contaminants, and here we're
> addressing are there data by which you can assess
> changes in exposure over time or over space? For
> many of the hypthesized stressors, we didn't have
> exposure data, and I should say for one of them we
> had no data, and that was for pathogens. So no
> conclusion was possible.
> So the middle box, there, when it comes to
> exposure, we had exposure data but it wasn't
> likely that the fish actually got exposed to those
> stressors. That would be the case for something
> like mining or small hydro where there were so few
> mines or small hydro facilities within the Fraser
> basin that it's very unlikely that sockeye
> spawning and rearing habitats were exposed.
> So if you get past that set of questions, you
> then follow the "Yes" box and you come down to,

> 31 okay, so it looks like there was some exposure.
> 32 Is there any correlation or consistency? I ran
> 33 through an example earlier for contaminants where,
> 34 in general, the answer to that was no. There was
> 35 not consistency in the change in the stressor and
> 36 the change in productivity.
> 37 Now, in some cases, we got through that box
> 38 and down to, yes, it looks like there was some
> 39 correlation that was consistent with the
> 40 hypothesis, and so we moved down to the bottom box
> 41 and "Other Evidence". So that's where the climate
> 42 changes and changes in marine condition ended up
> 43 being either possible or likely factors for some
> 44 of the life history stages. They got all the way
> 45 down to the bottom box.
> 46 The predators, as far as returning adult
> 47 salmon, there was some exposure data that looked
>
> 1 some predators had increased over time, and so it
> 2 looked like it might be possible but there really
> 3 weren't good correlation analyses. So we ended up
> 4 at the bottom without enough evidence to say
> 5 anything other than it was a possible factor.

(Marmorek, September 19, 2011, p. 16, l. 1 – p. 17, l. 5)

See also questioning by Mr. Lowes and the Commissioner on *September 20, p. 62, l. 31 – p. 67, l. 4.*

Marmorek has a better understanding of what occurs in the freshwater life cycle stages along the Fraser (adult life stage 5) (*Marmorek, September 19, 2011, p. 20, ll. 1-33*) than in the North Pacific:

> 30 couple of years. We really don't know very much
> 31 about what they're exposed to and what happened to
> 32 them until they start coming home.

We will review below the evidence on harmful algal blooms: Marmorek references this topic at section 4.7, page 88 but says it should have been included at page 55 as well in *Marmorek, September 19, 2011, p. 24, ll. 9–16*

He notes that his analysis provided some support for Jim Irvine's work on chlorophyll in Queen Charlotte Sound, concluding: "So it's pretty similar outcome to Jim, different type of analysis” *(Marmorek, September 19, 2011, p. 26, ll. 46-47).*

However, the emphasis by Beamish on the Strait of Georgia does not affect Marmorek's conclusions:

> 1 Q And in this inquiry, we had some reports prepared
> 2 by Dr. Beamish and others of his group and they
> 3 were entered into evidence in July, in our
> 4 hearings in July. Have you read those reports?
> 5 A Yes.
> 6 Q All right. And do those reports change any of
> 7 your conclusions?
> 8 A No. The main conclusion that's relevant here is
> 9 that marine conditions have a significant effect
> 10 -- marine conditions during the coastal migration
> 11 stage have a significant effect on declines in
> 12 Fraser sockeye productivity, and that's consistent
> 13 with what reports by Dr. Beamish and his
> 14 colleagues found.
> 15 Whether that mortality occurs in the Strait
> 16 of Georgia which Dr. Beamish is mostly focused on
> 17 or in Queen Charlotte Sound, which Dr. McKinnell
> 18 focused more on, doesn't affect our conclusion.

(Marmorek, September 19, 2011, p. 27, ll. 1–18)

Climate change and marine conditions can overlap:

> 30 "climate change" on that table, and we've heard a
> 31 lot about both of those. Are they mutually
> 32 exclusive or do they actually overlap in some
> 33 ways?
> 34 A They overlap in a lot of ways, and that's
> 35 discussed in Technical Report 9, I believe, by
> 36 Scott Hinch and Eduardo Martins, so they talk
> 37 about how climate change can affect conditions in
> 38 the ocean in terms of food availability.
> 39 Also Technical Report 4 talks about past
> 40 changes in marine conditions and temperature, and
> 41 looks at future changes in marine temperatures
> 42 with climate change and discusses how some of the
> 43 extreme past temperature years look a lot like the
> 44 expected future years, say in 2080.
> 45 So what we have is overlap there where
> 46 climate change is likely to increase temperatures,
> 47 and increased temperatures are likely to be bad
>
> 1 for food production and changing the kinds of

2 predators that sockeye are used to, all of which
3 is not good for Fraser River sockeye.
4 Now, for Alaska sockeye, a little increase in
5 temperature can be a good thing.
6 Q Thank you. Now, the next life stage is 4, which

(Marmorek, September 19, 2011, p. 28, l. 30 – p. 29, l. 6)

At *Marmorek, September 19, 2011, p. 31, l. 32 – p. 32, l. 37*, addressing the Addendum *(Exhibit 1575, Addendum to Technical Report 6, Implications of Technical Reports on Salmon Farms and Hatchery Diseases for Technical Report 6 (Data Synthesis and Cumulative Impacts)*), Marmorek explains that he did not choose between Dill and Noakes. That issue is addressed in a separate section of the province's submissions.

Marmorek's evidence in questions by Commission Counsel acknowledges data limitations and the role of possible contributors (eg. contaminants) and possible overlapping on synergistic effects.

Nonetheless, Maramorek was an excellent witness and his conclusions should be accepted. The alternative is to be is to be left with nothing but pure speculation.

The Province takes the position that the Commission has no jurisdiction to make recommendations on Provincial budgeting issues. Accordingly the Province will refrain from making submissions on federal budgeting issues, including Marmorek's report on science.

TECHNICAL REPORT 10 - FRASER RIVER SOCKEYE PRODUCTION DYNAMICS (PETERMAN AND DORNER)

The gist of Dr. Peterman's major conclusion is that the spatial scale of the hypothetical causal mechanism needs to correspond to the scale of productivity changes in sockeye, which is much more widespread than the Fraser River. In fact, many non-Fraser stocks both in Canada and the USA also show a decrease in productivity, especially over the last decade and often also a period of decline in the late 1980s or early 1990s. Thus, declines since the late 1980s have occurred over a much larger area than the Fraser River and are not unique to it. This is a very important new finding.

This points to mechanisms that operate on larger, regional spatial scales, such as climate-driven oceanographic changes.

47 Q Okay. All right. So what do the shared

1 productivity patterns that we see in your time
2 trends tell us about causal mechanisms, anything?
3 DR. PETERMAN: Well, as I hinted at before, to us, and

Brigitte might want to jump in here, but to us it seems like there's a much greater chance that there's some shared trend across these populations to varying extents, than that there's some near coincidence of independently operating factors causing a downward trend in productivity of all these stocks simultaneously. It's possible that there's a coincidence. We can't deny that. But it seems unlikely over such a large spatial scale that that would happen.
So it seems like there would be processes operating on a larger scale that would be affecting these populations simultaneously. And these could be things such as oceanographic patterns driven by climatic processes. And in fact I'll just stop there at that one, because there is evidence, other evidence that's been published by many people, including my own group, that shows there is some spatial coherence, some spatial positive covariation among populations in their productivity. But what's been documented before in the literature has not been to this large of a spatial extent. It's never been looked at before.
so there's something that's changed. In our analyses that we published in 2002, we saw a much more constrained positive correlation spatially, but being published in 2002 we had data only up to the late 1990s. Now we've got almost another decade of data where from what you've seen here, appears there is much stronger trends than in the past, and the downward trends.
So that idea of some kind of large scale climate-driven, perhaps, oceanographic processes might have explained this. But I should re-emphasize that you can take a magnifying glass to these trends that we've been looking at and you can say, well, actually they're not the same; they're different. For instance those Central Coast populations had an increase in productivity in the mid-1990s, late 1990s, whereas the Fraser stocks generally did not, although there's a few exceptions there. The Fennell did. And you could say, well, they're not the same. Sure. But I'd

say, and all hypotheses should be, why is it that

on average they all had lower productivity at the end of the period than at the start. I think there is a trend that we should be looking at, and those who are testing hypotheses about various mechanisms should be taking into account this very large spatial pattern that seems to be shared. So just to get back to this coincidence idea. It is possible that you could argue, for instance, well, contaminants have become so pervasive that now they affect all these populations from Washington right through to Southeast Alaska. Sure, that's possible, but I bet that when you hear from Dr. MacDonald in his study, you'll probably find that, well, the contaminant levels are different in different watersheds, and in different estuaries, and in different coastal systems. So that may be the case. It may be the case that pathogens are widespread and it's affecting all of these populations now, and we have no evidence of that, of course, in our analysis. So it could again be a mere coincidence. The same with predators, any of these types of mechanisms are conceivable. But to us, until we see the data, we would suggest that people take a close look at the large-scale pattern as the defining characteristic of what it is they're trying to explain these trends with. It should be a phenomenon that's got a large spatial scale.

So if I could, could we go back to just looking at that Harrison case. This is a very important clue we have. So it's Figure 9 on page 49, please, Mr. Lunn. Yes, it's the lower right corner. If you could just blow up that one, please.

I mentioned this in passing before. So this is the Kalman filter time series again of productivity estimates, and it turns out that that Harrison stock might provide a clue as to what is different about the stocks that are going down from those that are staying constant in productivity, or even going up.

The Harrison fish, unlike all the others in the Fraser, are sockeye that go to sea as fry. They don't overwinter in a lake. So they also apparently rear for two to three months in the

1 Fraser River estuary before going into the Strait
2 of Georgia proper.
3 They're also there in the Strait of Georgia
4 longer. Dick Beamish has found them in the
5 northern strait as late as September when most of
6 the other sockeye from the Fraser River, the
7 smolts, are gone.
8 And then there's one tantalizing hint of
9 evidence that the Harrison juveniles go to sea via
10 the Strait of Juan de Fuca, the south of the
11 island, rather than going through the north. But
12 it's important to note that despite that
13 observation, everyone will jump on that and say,
14 oh, they're going a different route, so that must
15 be -- they've exposed themselves to something
16 completely different. Well, don't forget, the
17 West Coast of Vancouver Island stocks, Great
18 Central and Sproat Lake, as well as the Washington
19 Lake stock, showed a completely different pattern.
20 Those latter three stocks, Washington, Great
21 Central and Sproat, showed a decreasing time trend
22 in productivity, not an increasing time trend in
23 productivity like Harrison. So maybe it's not
24 what goes on, on the West Coast of Vancouver
25 Island.
26 I'm talking too much probably, so go ahead.

[emphasis added]

(Dr. Peterman, April 20, 2011, p. 31, l. 47 – p. 34, l. 26)

PETERMAN CONCLUSIONS:

Dr. Peterman's lengthy answer was followed by another lengthy answer as to mechanisms that he could rule out. Apart from a caveat about a massive disease outbreak – ruled out by others-- , the key mechanism that could be ruled out, from the Province's point of view, was a freshwater event.

27 Q That's fine. Can you rule out any mechanisms
28 based on your work?
29 DR. PETERMAN: Well, I guess, based on what we've seen,
30 yes, we probably can, but very few mechanisms can
31 we rule out. I would say that life stage
32 comparison and analysis that we had for the nine
33 sockeye stocks in the Fraser system for which we

have juvenile abundance data showed that in seven out of the nine cases where we had some decreasing time trend in productivity, most of those showed a decrease in the juvenile-to-adult stage, but not in the juvenile-to -- or pardon me, to the spawner-to-juvenile stage. So that suggests to us that there is probably little effect of what goes on in freshwater on that overall time trend in productivity, with one exception, and that is a hypothesis that perhaps the juveniles of the Fraser sockeye are picking up something in freshwater, like a parasite, or virus, or bacterial disease, that doesn't manifest itself as mortality until the fish get out to sea after

they're enumerated as juveniles. So that's possible. But again, we can't speak to that. That will be up to others who are investigating that pathogen hypothesis.
So with that caveat, we'd say that it seems unlikely again over the large spatial extent that we've seen these decreases in productivity that it would be due to shared variation in freshwater processes, because it would -- those freshwater processes would have to occur in all those stocks, from Lake Washington right up through Southeast Alaska, to the same extent and at more or less the same time.
So again it's possible that there's been some outbreak of some disease that we don't -- or some pathogen that we don't know about, leading to disease and mortality, but we doubt it, based just what I'm -- based on the spatial scale, and just being an ecologist and knowing how different these watersheds are.
In fact, just as an aside, those of you who haven't heard this before, the stock assessment biologists in the past often used watershed-specific parasites to identify which stock was which in the mixed stock catch. So they would pick up the fish, they'd sample the fish and say, oh, look, here are these fish. They have this particular parasite. It's only found in this lake and not in the other lakes, so we know that's lake "X". So again, that's just a bit of an aside, saying how likely is it we're going to have the

> 32 same pathogens all along the coast, operating
> 33 simultaneously. Okay.
> 34 So that's the first hypothesis I think we
> 35 can, if not rule out, put at a very low
> 36 probability, is this is a freshwater event.
> [emphasis added]

(Dr. Peterman, April 20, 2011, p. 34, l. 27 – p. 35, l. 32)

Dr. Peterman then turned to delayed density dependence at lines 37 to 1, and, apparently by definition, en route mortality (lines 2 to 32).

(Dr. Peterman, April 20, 2011, p. 35, l. 37 – p. 36, l. 32)

MARINE EFFECTS:

TECHNICAL REPORT 4: THE DECLINE OF FRASER RIVER SOCKEYE SALMON *ONCORHYNCHUS NERKA* (STELLER, 1743) IN RELATION TO MARINE ECOLOGY:

Difference from the other Technical Reports

This report was written by an international team from the North Pacific Marine Science Organization (PICES), an international, intergovernmental organization created by Convention in 1992. Its members are Canada, Japan, People's Republic of China, Republic of Korea, the Russian Federation, and the US; the Secretariat is in Canada. The report format is slightly different; there are, for example, no recommendations. It was written before the others were, and did not go through the same workshop process or reviews of early drafts. No changes were made after the three reviews included here (basically, PICES retained control). The large 2010 Fraser sockeye returns were not known to the authors.

The report is unlike the others in that much of it is an exhaustive and historical overview of the life of sockeye salmon in the ocean (the historical part is fascinating, including the ironic quotes from earlier “experts” that introduce each chapter). This part is very detailed. What they are trying to do is summarize what we know about each factor that affects sockeye once they hit the ocean, migrate past Vancouver Island and up the side of North America, enter the Gulf of Alaska, feed and grow, and then do it all in reverse. For each factor that affects sockeye, the authors look at what we know about it historically, and whether that factor could have changed significantly, and at the right time, to cause the poor returns in 2009. It is a “bottom up” examination of the interconnections between climate, the ocean, and the fish at each oceanic life-history stage, and to what extent these connections can explain Fraser River sockeye abundance. Because the low return in 2009 was an extreme event, the PICES

approach was to look for potentially relevant extremes in the oceanic environment.

A lack of knowledge about marine ecology

As noted by Dr. Marmorek, we know little about the sockeye's life at sea:

- Pacific sockeye occupy a lot of different habitats during their life cycle, and each is like a bead in a chain linked together by migrations. The least well known of these are associated with their life at sea.
- A long time at sea: total ocean phase of about 25 months is the most common among sockeye salmon in the Fraser River.
- There is no observation system for Fraser River sockeye salmon on the high seas (beyond the continental shelf).
- In the Strait of Georgia since 1997, research and monitoring has focused on *coho and chinook* salmon in July and September after many sockeye salmon postsmolts have left the area (that is, we haven't been looking for sockeye).
- During the period of interest to the Commission, there are virtually no observations of Fraser River sockeye salmon during about 75% of their life at sea, and the value of coincidental samples taken during their emigration from the Strait of Georgia is debatable.
- Ocean-going studies of salmon by Canadians were significantly reduced in scope after the late 1960s (disbanding of the Fisheries Research Board of Canada).
- The first trans-Pacific winter survey for *any* Pacific salmon was conducted by the Fisheries Agency of Japan, but not until 1996.
- Observations are not made routinely at the time and space scales of the fish. As a consequence, when salmon survive or die at greater than average rates, the scientific community is at a loss to understand why. The observation system is simply not designed to answer this question.

By the time the Technical Report 4 reaches the Discussion section, it reveals a great deal about the struggle to understand sockeye in the ocean. The conclusion is that, if most of the mortality in the 2009 sockeye run took place when the 2007 smolts went to sea, **Queen Charlotte Strait and Sound are more likely to have been where the mortality happened, not the Strait of Georgia**. The main message, that harm is most likely in the ocean (where we know the least about sockeye) still stands. Peterman and Dorner (Technical Report 10) tend to go along with Queen Charlotte Sound, but suggest the important changes in ocean condition extend even further north, to Alaska.

Why Queen Charlotte Sound?

If the damage is in the ocean, is it happening in the Strait of Georgia or in Queen Charlotte Sound? (Note: for simplicity, we say "Queen Charlotte Sound", but in fact the weather pattern described here also includes the more southerly Queen Charlotte Strait). Based on occurrence of extreme climatic events, these authors lean toward Queen Charlotte Sound. Sockeye postsmolts caught in DFO summer surveys of Queen Charlotte Sound in 2007 had the smallest mean size since sampling began in the late

1990s. The extreme events in Queen Charlotte Sound in summer 2007 (prolonged southeast winds, high freshwater discharge, high surface temperatures) did not have equivalent extremes in the Strait of Georgia, nor on the west coast of Vancouver Island or the U.S. mainland. So, if the extreme mortality of Fraser River sockeye from the 2007 ocean entry year *was* caused by an equivalent oceanic extreme, the more likely location is Queen Charlotte Sound (*Exhibit 1291, Technical Report 4, Marine ecology - Fish, p. xii)*

In the Strait of Georgia, water sampling has been going on for many years at four lighthouse stations. Conditions in 2007 were not extreme at any of the four stations. The abundance of icthyoplankton (fish larvae) in the Strait of Georgia in the last week of April of 2007 was no different from that found during the same week from 2008 to 2010. May and June average sea surface temperatures at Chrome Island (one of the light stations) were not significantly different between 2007 and 2008 (*Exhibit 1291, Technical Report 4, Marine ecology - Fish,* p. 103).

In contrast to the Strait of Georgia, an extremely poor ocean environment developed in Queen Charlotte Sound prior to and during the 2007 Fraser sockeye out-migration. The surface waters of Queen Charlotte Sound were warmer in August of 2007 than in any other August from 1982 to 2010.

The majority of the Harrison River sockeye would have spent the summer of 2007 in the Strait of Georgia, where they were found in September sampling to be rather abundant. This suggests that the Strait of Georgia was not the location of mortality of the 2009 returns. Harrison River sockeye salmon likely avoided the fate of the other stocks in 2007 by their normal habit of delaying migration from the Strait of Georgia and/or by emigrating via Juan de Fuca Strait to the west coast of Vancouver Island (*Exhibit 1291, Technical Report 4, Marine ecology - Fish,pp. 136-137)*

Important excerpts

“Slow decline” may not be the best way to describe Fraser sockeye productivity since around 1990. For most Fraser sockeye stocks, it is more like an abrupt downward shift, starting in 1992. An abrupt drop in Fraser sockeye productivity in 1992 suggests a relatively large-scale coastal influence that was strongest on stocks that migrate through Queen Charlotte Sound and Strait (*Exhibit 1291, Technical Report 4, Marine ecology - Fish, p. 145).*

Johnstone Strait has probably always been the main northward migratory pathway past Vancouver Island, rather than Juan de Fuca (*Exhibit 1291, Technical Report 4, Marine ecology - Fish, p. 18)*.

With a doubling of atmospheric CO2, the area of acceptable thermal habitat in the North Pacific is predicted to decrease to zero in summer and decline sharply in winter (in other words, salmon are going to be pushed north by climate change). (*Exhibit 1291, Technical Report 4, Marine ecology - Fish, p. 49)*

SUMMARY OF TECHNICAL REPORT 4:

Technical Report 4 is presented in a historical way that means the reader has to follow the logical argument very closely, but can still be boiled down into a fairly clear message. The poor return in 2009 could be linked to an unusual weather pattern in Queen Charlotte Sound in 2007.

Here is the reasoning.

First, ocean weather patterns are important.

The winter of 1991/92 (around the time when many experts agree the "downturn in Fraser salmon" was getting started), saw the onset of what has been called a "persistent el Niño." There were dramatic changes in the west coast ocean ecosystem, and strange things happened, including the return of sardines to the west coast of British Columbia after more than 45 years (there is now a substantial sardine fishery here). The authors of Technical Report 4 consider the reappearance of sardines a proxy for "a persistent oceanographic change that is not fully understood."

Jumping ahead to the "2009 sockeye collapse", the 2006/07 el Niño and an anomalous spring/summer climate in 2007 generated a very atypical coastal ocean in 2007, one that could have been detrimental to Fraser River sockeye salmon growth and survival. The most severe oceanic effects happened not in the Strait of Georgia, but further north, in Queen Charlotte Sound and Strait.

Key arguments for "ocean effects" make use of the data for Chilko Lake sockeye, one of the few stocks for which we have smolt production data (that is, we know how many young fish are actually coming out of the freshwater environment into the marine one). "Since the 1960s, infrequent years of very high numbers of smolts emigrating from Chilko Lake, such as occurred in 2007 and again in 2008, have routinely failed to reach even average postsmolt survival, suggesting that some fraction of the incremental mortality of this stock in the ocean is related to their own abundance. At 77 million, the emigration in 2007 was twice the previously observed maximum. Despite this, the 2009 return year will be the lowest recorded age-1.x postsmolt survival for this stock."

Although the authors seem to accept the view that "most of the damage to sockeye happens at sea," they hedge this with reference to the Chilko Lake stock, one of the few stocks for which DFO still counts smolts (recall the urging of other Project authors to go back to counting smolts). For Chilko sockeye, attributing all of the variation in total survival to ocean effects doesn't hold up. In fact, over the history of observations of the Chilko Lake population, variation in returns per spawner appears to be almost equally shared by freshwater and marine (postsmolt) effects.

Second, the weather in Queen Charlotte Sound is especially important.

Although the distribution of immature Fraser River sockeye salmon at sea is poorly known (because so few tags have been recovered from these fish), some postsmolts are known to follow the continental shelf. If *all* of them have this behaviour, it would place greater numbers of immature salmon in the western Gulf of Alaska by the end of the postsmolt migration. This means they have to go through Queen Charlotte Sound.

Sockeye salmon emigrating from rivers in the southern part of their range, like Fraser sockeye, have lower growth rates and lower average marine survival than sockeye in Southeast Alaska. The initial period of their postsmolt migration may be a "race" north to better feeding conditions in coastal Alaska. The evidence for this is that the fastest migration speeds are found in the southernmost populations. The exception offers further confirmation of this theory: the age-0.x ecotypes from the Harrison River have evolved a very different strategy of delaying migration to the continental shelf until autumn, when the food supply "catches up".

Third, the "Perfect Storm" was in Queen Charlotte Sound in 2007.

In 2007, a cool spring delayed the snow melt. Then came rapid warming in late May, followed by an intense spring storm in early June that brought heavy rain on top of the deep snow. As a consequence, the summer of 2007 featured extreme discharge by Central and North coast rivers. Discharges from the Wannock River into Rivers Inlet (eastern Queen Charlotte Sound) and the Klinaklini River (eastern Queen Charlotte Strait), for example, were the highest values ever recorded for the month of July. In the Fraser drainage, the situation was not as extreme: The northern part of the Fraser River drainage was exposed to this phenomenon but it led to high rather than extreme discharge, while the highest weekly discharge in the Fraser River itself ranked 23rd in the record dating back to 1913.

The end result was an unusual layer of low salinity (less salty) water in Queen Charlotte Strait/Sound in the summer of 2007.

One consequence of this large volume of freshwater on the surface was that the plankton bloom in 2007 was the latest in the record since 1998. The plankton are necessary as food for euphausid shrimp, which are, in turn, food for young sockeye. The relatively fresh ocean surface layer was "captured" in Queen Charlotte Sound by the most extreme southeasterly wind pattern in summer since 1948.

An example of how important that bloom is: since 1998, when satellite ocean colour monitoring began, marine survival of Chilko Lake sockeye salmon has been highly correlated with the date of onset of biological production – the plankton bloom - in Queen Charlotte Strait/Sound.

The upshot of all these weather coincidences is that **Fraser River sockeye salmon migrating through the Queen Charlotte Strait/Sound region in 2007 met extreme**

temperatures, and even more extreme salinity/density and wind anomalies. The delayed spring in Queen Charlotte Strait/Sound, when combined with the incremental metabolic cost of migrating through a warm surface layer, with potentially lower prey densities in the fresher water, probably combined to reduce growth and survival.

Fourth, Sockeye salmon postsmolts caught in DFO summer surveys of Queen Charlotte.
Sound in 2007 had the smallest mean size since sampling began in the late 1990s.

In contrast to Queen Charlotte Sound, the extreme hydrographic and wind events that occurred in 2007 did not have equivalent extremes in the Strait of Georgia, nor on the west coast of Vancouver Island or the U.S. mainland. If the extreme mortality of age- 1.x Fraser River sockeye salmon from the 2007 ocean entry year was caused by an oceanic extreme, the more likely location is Queen Charlotte Strait/Sound.

TESTIMONY OF DRS. PARSONS AND IRVINE ON JULY 8, 2011, PANEL NO. 52:

Both scientists are excellent; Parsons is an oceanographer/ocean ecologist, while Irvine is a salmon biologist. These are very different fields, and both are crucial to understanding what happens to salmon all along their journey from lake to ocean and back, but they use completely different tools and language. We need both kinds of evidence, but the scientists may not always communicate well. Parsons used a medical analogy while trying to describe the kind of research that still needs to be done, which might be extended as follows: Parsons and Irvine have some training and experience in common, but they're still as far apart as, say, a psychiatrist and a dermatologist.

But, roughly speaking, they agree on a lot, even if they do not see eye to eye on the importance of volcanic eruptions, or have the same slant on what kind of research we need to do. What happens to Fraser sockeye (and other sockeye, and other salmon species) in the Gulf of Alaska is critically important and very incompletely understood Here, for example, an exchange between Ms. Baker and Dr. Parsons:

"Is there much literature on the trophodynamics of salmon in the sea to explain that period of time?" "No. That is the problem, because it is expensive to go out and study salmon once they're widely distributed. It can be done much easier in a place like the Strait of Georgia. But once they get out into the ocean, there are no studies, basically."
(Dr. Parsons, July 8, 2011, p. 89, l. 40–47)

The two scientists certainly agree on the flimsiness of conclusions based solely on correlations, and on paying more heed to rigorously peer-reviewed papers than to grey literature. They would likely also agree there is no obvious anomaly, anywhere in the life cycle, that can explain the poor returns in 2009 (the volcano theory only purports to explain the high return in 2010).

If there is a bottom line for this panel's testimony, it might be Dr. Irvine's statement, "To have really anomalously low survivals as we did for the 2007 ocean entry year fish, it would have to be some sort of major catastrophe occurring at some specific location, and there's no evidence of that. So my presumption would be that it would be a cumulative effect of subnormal conditions at multiple life history phases of the fish. It is exactly the sort of thing that you expect to see occasionally in times of climate change." (*Dr. Ivrine, July 8, 2011, p. 94, l. 40 – p.96, l. 4)*

Getting food in the Gulf of Alaska

The problem with correlations aside, the volcano theory does rely heavily on correlations between satellite imagery of ocean colour (=chlorophyll), kind of zooplankton produced, amount of iron in the water (both before and after a significant event like an eruption), and ultimate returns of salmon. A lot of assumptions have to be made about where the salmon actually are, and where they are feeding (that data gap again). Dr. Parsons puts it this way: "Can they get enough of the right food to grow fast enough, and that is the period which I've been talking about in the Gulf of Alaska. That is the period which simply has not been covered to any great extent in the documents that I have seen. If they do not get the right food, they're going to fall off that growth curve and be subject to further predation. But if they can stay on that steep curve, you're going to get a good harvest." (*Dr. Parsons, July 8, 2011, p. 89, ll. 10-39)*

Irvine puts it slightly differently, and he is not convinced by the volcano theory: "What we noticed was that in years when there was a relatively high production of chlorophyll in early April, that the survival of the out-migrating smolts was relatively high *(Dr. Irvine, July 8, 2011, p. 86, ll. 22-25)*. So what we did is we just did a simple correlation, so this is not cause and effect. This is simply a correlation (*Dr. Irvine, July 8, 2011, p. 86, ll. 31-33*) . . . correlations like this have a tendency to break down." (*Dr. Irvine, July 8, 2011, p. 88, ll. 13-14*)

Variations in survival

Irvine provides a very good summary of the ups and downs of salmon survival at various points in their life history, including examples of the really astonishing range for each: "So the point I want to make is that there's mortality that occurs at each life history stage, and it is not constant through time." He then gets specific about how different sources of mortality can add up or mean nothing at all, using the 2007 and 2008 ocean entry years of Fraser sockeye (bust and subsequent boom). (*Dr. Irvine, July 8, 2011, p. 92, ll. 4-6)*

"So what's happened here is that the ocean survival of the 2007 ocean entry year fish was abysmal, even though the freshwater survival was incredible. So we had huge freshwater survivals for both of these years, but only in the one case (2008) did they survive well in the ocean . . . Fresh water is really the main reason why the Chilko

sockeye returned in huge numbers in 2010. So I have to differ with Dr. Parsons a little bit on that one. The low returns for Chilko in 2009 occurred despite huge freshwater survivals, and they were caused by anomalously low ocean survivals, or at least smolt-to-adult survivals, and the good returns in 2010 were the result of high freshwater survivals. Their ocean survivals were in fact just average." (*Dr. Irvine, July 8, 2011, p. 93, l. 30 – p. 94, l. 33)*

Dr. Parsons believes the volcano affected 2008 fish selectively, and disagrees with McKinnel's objections to the volcano theory. Dr. Irvine says, "But when I look at the salmon results - and I'm more of a fish person than an oceanographer - it doesn't quite line up." (*Dr. Parsons, July 8, 2011, p. 100, l. 6)*

Dr. Parsons rebuts: "It really depends where the different stocks of salmon are located in the Gulf of Alaska. We do not have a lot of information on this, but Blackbourn published a paper in the late '80s. Welch and myself published a paper more recently. In both those papers, we indicate that different stocks of salmon go to very specific locations in the Gulf of Alaska." In other words, Fraser sockeye, in 2008, went to a good spot: "Well, they ended up in different locations where maybe there was a physical difference in the water mass and, going back to my theory, that the diatoms were very rich in that region but 500 miles away where the other stock was located, they did not get the same effect. We do not have that information. We need that information." (*Dr. Irvine, July 8, 2011, p. 101, l. 34 – p. 102, l. 30)*

Research recommendations

Dr. Parsons: "What we need from someone is to be able to go out without the expense of a research vessel, which is incredibly expensive, collect salmon, get the exact position of those salmon from PDS system, bring it back and have the salmon identified by genetic analysis." (To see if there are good and bad locations for feeding). *(Dr. Parsons and Dr. Irvine, July 8, 2011, p. 103, ll. 38–43)*

Irvine: "Our understanding of Fraser sockeye is far better than almost any other salmon species or group of species in the North Pacific. So certainly within Canada, Fraser sockeye is where we have got the most knowledge. But what we haven't done in my view is utilize the information that's been gathered . . . One of the projects that I'm really keen on is basically a retrospective examination of scale- growth patterns." "Let's not forget about these huge stores of data that haven't been properly analyzed and samples as in the scales that haven't been properly examined." *(Dr. Irvine, July 8, 2011, p. 104, ll. 35 – 44; p. 106, ll. 3 –40)*

And then something of a bombshell about competition with pink salmon: "To me, the biggest issue with Fraser sockeye, with the possible exception of climate change, is enhancement in Asia. It is the production of pink salmon from the Soviet Union. This is a huge -- I've been there and I've seen the incredible, the exponential increases in the

numbers of pink salmon that are being released into the marine environment." *(Dr. Irvine, July 8, 2011, p. 105, ll. 2 –27)*

The importance of ocean temperature was raised: "So these two documents read together, one could conclude that, for example, salmon stocks that migrate up the West Coast of Vancouver Island, perhaps Fraser River, Fraser -- I'm sorry, Harrison Lake sockeye, perhaps some of the Columbia River fish have a higher survival rate in cooler water, in cooler water years than in warmer water, warmer water years?" *(Dr. Irvine, July 8, 2011, p. 119, ll. 9–16)*

DR. PARSON'S NEW EXHIBITS

Without getting into detail, it is useful to have an idea what these three additional papers, submitted recently to the Commission by Dr Parsons, tell us about one of the big questions that bedevils biologists, namely, "where do the sockeye go when they go offshore?" That question keeps coming up whenever "ocean conditions" are brought up as a cause of decline, specifically, ocean conditions that affect adult rather than juvenile sockeye.

Exhibit 1893: Blackbourn, Sea Surface Temperature and the Pre-Season Prediction of Return Timing in FRSS, 1987

This is the oldest paper (1987). It presents a model that shows a logical relationship between sea surface temperature (SST) and the time at which Fraser sockeye will show up on the spawning grounds. The model suggests that sockeye feed in different parts of the Gulf of Alaska, depending on whether it was a warm winter or a cold one. The big advantage of the model is that you could make predictions without having to tag a lot of juveniles (this includes old-fashioned physical tags as well as satellite tags, which are very expensive), then either recapture them in the Gulf to find out where they went or, in the case of satellite tags, download their movements. The point for Dr Parsons would likely be that the location of each stock in the Gulf can be estimated by looking at SST, so if some huge event occurs (like the volcano and subsequent iron-fertilization of some areas), you can make a correlation with productivity of those particular stocks.

Exhibit 1892: Welch and Parsons, d(13)C-d(15)N Values as Indicators of Trophic Position and Competitive Overlap for Pacific Salmon, 1993

This one is a little more recent (1993). They figured out that each Pacific salmon species eats slightly different things (so each occupies a different "trophic level" or step on the food chain). That enabled them to say which species could potentially compete with the other species; sockeye, for example, are most likely to compete with pinks and coho. Chum do not seem to compete much with any of the other species, probably because their diet is chiefly jellyfish.

Exhibit 1894: MacKenzie, et al, Locations of Marine Animals Revealed by Carbon Isotopes, 2011 [Scientific Reports] goes further with the idea of locating salmon oceanic feeding grounds based on carbon isotopes and sea surface temperatures. The paper is on Atlantic salmon in Europe, and compares locations for different populations of this one species. They conclude you can locate feeding grounds for any marine animal if you have tissue samples and records of SST. They also showed that different populations of Atlantic salmod feed in different oceanic locations (something Welch and Parsons identified in their 1993 paper, for Fraser sockeye).

Implications: These exhibits show that we are getting a handle on where different salmon species go once they leave Vancouver Island, right down to where individual populations might feed. That is important for understanding the oceanic black box, especially when so many scientists suspect "the ocean" as being a major problem for declining sockeye, but have so few data. This line of investigation may help significantly. One could even argue that, when one Fraser sockeye stock "does better" than others (eg. Harrison River sockeye), it might not just be because it takes a different migration route along the coast of Vancouver island, or encounters more feed in the Strait of Georgia. Maybe it also feeds in a better neighbourhood in the Gulf of Alaska.

HARMFUL ALGAL BLOOMS

This is a summary of the evidence presented on August 17th with respect to the Marine Environment, Part 2.

Dr. Rensel testified that harmful algae blooms ("HAB") likely contributed to the mortality of the sockeye salmon in 2009. In May, 2007 there was an early bloom, which had never been seen before and which coincided with the peak of the out migration of the juvenile salmon. His research has prompted increased interest in the issue.

The Commission qualified Dr. Rensel as an expert in the areas of algal-zooplankton (and other areas at Paragraph 3 of his Affidavit.) The bulk of his testimony went in by way of affidavit. (*Exhibit 1363, Affidavit #1 of Jack Rensel, Aug 17 2011; Dr. Rensel, August 17, 2011, p. 4, ll. 18-40)*

Dr. Rensel's paper is Exhibit 1359, Rensel et al, FRSS Marine Decline and Harmful Blooms of Heterosigma akashiwo, 2010. The paper is based on research from the Chilko salmon, as it provides the only available survival data.

The harmful algae blooms (or "HABs") originate in the sediment in shallow bays where the algae overwinter as cysts. They then move at the dictates of wind and wave.

Dr. Rensel works at the University of Washington and primarily studies the area of Puget Sound. Dr. Rensel has observed a major increase worldwide in HAB's, including

some novel species being identified. In terms of intensity and extent, coastal waters are the most affected (*Dr. Rensel, August 17, 2011, p. 7, l. 38 – p. 8, l. 9).*

Dr. Rensel did not agree with the summary on Exhibit 73, PSC - Synthesis of Evidence from a Workshop on the Decline of Fraser River Sockeye, June 15-17, 2010 of the List of Available Hypotheses for the decline of the Fraser River sockeye salmon in 2009. What is missing, in his view, is the fundamental recognition that there is likely no single cause of the decline. In addition, at the workshop, groups voted on the likely causes, and the votes reflected the bias of those scientists. *(Dr. Rensel, August 17, 2011, p. 10, l. 7 – p. 11, l. 21)*

Dr. Rensel and Dr. Beamish (marine climate change theorist and an expert on the Strait of Georgia) agree that their respective theories are subsets of the same theory. Dr. Beamish hypothesizes that it is an overall change in marine conditions while Dr. Rensel's evidence shows that those changes also increase the extent of harmful algae blooms. In addition, the changes in the marine environment also deleteriously affect the fish so that there is in effect a "1-2-3 punch": juvenile salmon are subject to the HAB, then there is poor food production in the ocean (so the fish aren't eating well), and these are further complicated by the poor conditions in the Gulf of Alaska.

One problem with ascribing mortality to HAB in B.C. is that because of the cooler waters, the fish typically sink to the bottom and are unlikely to surface after death. As a result, it is not possible to count the dead fish (*Dr. Rensel, August 17, 2011, p. 15, ll. 1-38).*

The difficulty with HAB is that there is a "chicken and egg" effect. There can be indirect HAB effects, which are sub-lethal: HAB weaken the fish and other circumstances can take advantage of the fish's weakened condition. For example, the toxins in the algal blooms can produce hydrogen peroxide which precipitates changes to the gills in the fish.

In 2007, there was a very early and prolonged high discharge of water from the Fraser River. There was then a sunny period. The increased temperature resulted in increased growth in the algae. (*Dr. Rensel, August 17, 2011, p. 17, ll. 1-44).*

Overlaying this event was an increase in temperature over time linked to climate change. (*Dr. Rensel, August 17, 2011, p. 18, ll. 25-31).*

HAB can be identified from the air by their unique color.

Acoustic tagging can also be used to identify HAB, but this practice is more costly.

The costs of monitoring HAB are initially minimal. One would need to set up a program, establish the protocols and chain of custody. There are costs associated with sampling.

There is a proposed coordinated effort between UBC and Nanaimo. (*Dr. Rensel, August 17, 2011, p. 19, l. 40 – p. 20, l. 32).*

CLIMATE CHANGE EFFECTS ON FRASER SOCKEYE

TECHNICAL REPORT 9 – EFFECTS OF CLIMATE CHANGE ON FRASER RIVER SOCKEYE SALMON

Caveats and definitions

1. Ocean research lags behind research on freshwater life stages.
2. The picture is complicated by stock-specific patterns ("Fraser sockeye" is actually many genetically distinct stocks).
3. The report mentions all life stages but only provides detail on adult effects, namely en route mortality and pre-spawn mortality. This is, coincidentally, the authors' expertise.
4. In- river adult effects are the most studied because easiest to study.
5. Definitions: mortality during Fraser River migrations is called en route mortality. Death before spawning when it happens on spawning grounds, is termed pre-spawn mortality.

Temperature effects: a reasonable argument

1. Section 1.5.1 is the most compelling, and shows a gradual changes since 1950s – changes in rainfall, melt, flow and temp. Note again that these freshwater changes are easier to detect than marine changes because of decadal fluctuations in the marine environment.
2. Most stocks of Pacific salmon now encounter warmer rivers during their spawning migration than in any time since records have been kept. In the Fraser River, water temperatures in the summer have increased at a rate of 0.33 C per decade since the 1950s and **the river is now ~ 2.0 C warmer than 60 years ago**. **Water temperatures in 13 of the last 20 summers have been the warmest on record.** *(Dr. Martins, March 9, 2011, p. 1, ll. 22-35; Dr. Hinch, March 8, 2011, p. 7, l. 36 – p. 9, l. 35)*
3. The cumulative impacts of climate change across life stages will be much greater than the impacts on individual stages, and will also carry forward to the next generation, potentially leading to a downward spiral of productive capacity". There may be a bleak future for Fraser River sockeye salmon, in which most of its habitats become inhospitable.

4. En route loss is increasing, and reflects the coping of each stock with higher river temperatures.
5. Further evolutionary change may already be restricted in populations that have historically experienced high temperatures (i.e., can't all be fixed by evolution). The authors think that much of the among-stock patterns in en route loss (Figure 2.7) reflect stock-specific abilities to cope with warming rivers and high river temperatures.
6. Thermal conditions have been one of the largest environmental challenges that migrating adult Fraser River sockeye salmon have had to deal with over the past 20 years. See also *Dr. Hinch and Dr. Martin, March 9, 2011, p. 11, l. 1 – p. 12, l. 44; Dr. Hinch, March 8, 2011, p. 6, l. 27 – p. 7, l. 35*

Complexity

1. Survival of returning adults has very likely decreased - but not in all stocks.
2. En route mortality is stock-specific with Summer-runs having the greatest thermal tolerance. So, the classic genetic diversity argument applies here: there are many different stocks, some of which cope better than others.
3. Post-smolts are affected indirectly by warmer sea surface temperature.
4. There is considerable uncertainty in predicting how organisms with complex life histories such as Pacific salmon will cope with or adapt to changes in climate. Predicting the responses of Fraser River sockeye salmon, and Pacific salmon more generally, to future climate change will require a much better understanding than we currently have of how evolutionary and ecological mechanisms interact in shaping such responses.
5. It is all linked: temperature has many effects that can harm sockeye. For example, the spread of exotic species (e.g. smallmouth and largemouth bass) that may prey on fry and smolts at higher rates under climate warming;
6. Section on early migration of late runs is an example of complexity: Although the genesis of the early migration phenomenon seems to, in part, be in the open ocean, coastal processes appear to further influence migration timing.
7. There is also only ~ 4-7 ^{o}C difference between a stock's optimum temperature and its upper lethal temperature (*Dr. Hinch, March 8, 2011, p. 9, l. 45 – p. 14, l. 16).*

Any clues for 2009 vs 2010 returns?

1. Inter-annual variability in climate conditions has contributed to the extreme variation in the abundance of returning adults that were observed in 2009 (much lower than average) and 2010 (much higher than average). Note that the years that those cohorts went to sea were characterized by unusually warm (2007) and cool (2008) sea surface temperatures.
2. Preliminary results from a 2009 in-river telemetry study found that few of the adult sockeye salmon that were tagged in July survived to reach spawning grounds.
3. In other words, temperature change may have contributed not only to the overall decline, but also to last two runs huge difference in returns.

THE CUMULATIVE IMPACTS OF CLIMATE CHANGE – HEALEY ARTICLE

(Exhibit 1320 – Healey, Cumulative Impacts of Climate Change, May 26, 2011)

The Healey article reinforces the evidence stressing climatic change as a driver of the overall decline.

The species of Pacific salmon are economically, culturally, and ecologically important throughout their North Pacific range. Because of this, the effects of climate change on Pacific salmon are of major concern to resource managers *(Exhibit 1320, Healey, Cumulative Impacts of Climate Change, May 26 2011, page 718).*

Because of their commercial and cultural importance, sockeye salmon in the Fraser River are among the best studied of Pacific salmon *(Exhibit 1320, Healey, Cumulative Impacts of Climate Change, May 26 2011, page 719)*.

The wealth of information on this species provides insights about the likely effects of climate change. Fraser River sockeye are thus a useful model population for understanding the effects of climate change *(Exhibit 1320, Healey, Cumulative Impacts of Climate Change, May 26 2011, page 719)*.

The commentary below refers to the cross-examination of Dr. Beamish*, July 7, 2011, p. 63, l. 33 – p. 67, l. 43*

It is possible that the freshwater and marine habitats of salmon are expected to warm by 2–5 °C or more over the next century, perhaps earlier. As Fraser River sockeye salmon are particularly heat sensitive, this degree of warming will have uncertain but potentially devastating effects on salmon and their ecosystems *(Exhibit 1320, Cumulative Impacts of Climate Change, May 26 2011, p. 719)*.

Healey is developing a qualitative model, emphasizing the cumulative effects of climate change on successive stages in the life cycle of Fraser River sockeye salmon *(Exhibit 1320, Cumulative Impacts of Climate Change, May 26 2011, p. 719)*. This means Healey is not doing a mathematical analysis or statistical analysis – he is just thinking this through.

On page 729 *(Exhibit 1320, Cumulative Impacts of Climate Change, May 26 2011)*, Healey describes the cumulative effects model in relation to historic norms by going through the different life stages and trying to build on what we know about each life stage. He explained that smolts will enter a warmer, less productive coastal ocean where trophic relationships have been disrupted by physical changes that will likely not match the change in smolt migration timing. In essence, this point states that availability of the food that is necessary for these sockeye smolts to grow quickly will not be as well matched with their ocean entry times. Consequently, they will grow slower.

Healey went on to discuss zooplankton and to say the species available will be less suitable as food for young salmon. As a result, postsmolt growth will be slower, further compromising an already low survival rate because of their small size at ocean entry. He assumes that, while still in freshwater, smolts will already be smaller at ocean entry; therefore, there are concerns about the dominant zooplankton in the warmer waters causing growth problems for sockeye *(Exhibit 1320, Cumulative Impacts of Climate Change, May 26 2011, p. 729)*.

In the same paragraph, Healey stated that ocean acidification may also compromise the abundance of important prey such as pteropod mollusks. Ocean acidification is a consequence of global warming in which we are already seeing. The ocean has a basic pH so it is not in the acid range. The hydrogen ion content is increasing which is reducing the pH and we are observing some acidification in the world oceans and scientists are concerned about that.

Healey then moved on to raise concern about how suitable thermal habitats for salmon in the North Pacific will be pushed north by global warming *(Exhibit 1320, Cumulative Impacts of Climate Change, May 26 2011, p. 729)*. Dr. Welch commented the recent global warming models do not show anything qualitatively different from the early models. Welch agreed with Healey “completely”:

> Q Point 6 then, he moves on to say that:
>
> Poor growth in coastal waters will carry forward into the oceanic phase. Suitable thermal habitats in the North Pacific will be pushed north by global warming so that fish will be concentrated into a smaller area of ocean and feeding competition will be greater.
>
> I think we heard something about that in the last couple of days.
> DR. BEAMISH: Well, actually Dr. Welch is the expert on it. He's been writing about that. Dr. McKinnell also wrote about it. I don't think the two of them necessarily agree, but they're beside me here.
> Q Dr. Welch, do you care to comment?
> DR. WELCH: Could you rephrase the question again?
> Q Well, the concern is that:
>
> ...suitable thermal habitats in the North Pacific will be pushed north by global

warming...

DR. WELCH: Yeah, I've reviewed a recent paper for one of the journals where the authors looked at the most recent group of global warming models and they all indicate that projections from the original models are still consistent. There might be a 10- or 20-year difference in the time that a temperature reaches into the Bering Sea instead of the North Pacific, but they're not showing anything qualitatively different from the early models.

MR. PROWSE: Now at page 730, Mr. Lunn.

Q After going through another several steps in the analysis, he says:

If global warming can be stopped before a critical stage is reached, the Fraser River system will eventually settle into a new regime of production. However, on the basis of present evidence, it seems doubtful that the new regime would involve substantial commercial production of salmon. Indeed, it seems more likely that many Fraser River sockeye populations will be extirpated, and those that remain will be in a tenuous position.

So, Dr. Welch, can you shed hopeful perspectives on that statement?

DR. WELCH: Unfortunately no. I agree with him completely.

[emphasis added]

(Dr. Welch, July 7, 2011, p. 67, l. 44 – p. 69, l. 4)

Dr. McKinnell commented Healey's paper is preliminary as there are complexities in how climate and ocean interact and affect *salmon (Dr. McKinnell, July 8, 2011, p. 70, ll. 1–13).*

Marmorek, in the cross-examination by Tim Dickson on September 20, 2011, also discussed the effect of climate change. Marmorek referred to Healey as well as the American Fisheries Society recommending protection of biodiversity in face of climate changes:

14 Q All right. And so the point I want to focus on is
15 that if we cannot prevent climate change, we
16 cannot prevent some adverse changes in marine
17 conditions and it becomes crucial that we protect
18 the ability of sockeye to adapt to these changes;
19 would you agree with that?
20 A Yes, I think that's correct and to the degree that
21 you can maintain diverse life histories and
22 diverse habitats that potentially create across
23 all the stock conflicts greater resilience to
24 those varying conditions caused by climate change
25 and perhaps other actions. In the paper by Mike
26 Healey he lists a bunch. I think that paper has
27 been circulated before.
28 Q Yes, I think so. And that is the point that I
29 want to drive to, that in the face of such things
30 as climate change, we -- it becomes more and more
31 important to protect biodiversity. Diversity,
32 genetically and of life histories and habitat,
33 broad portfolio of stocks; do you agree with that?
34 A Yes, I agree with it and so do lots of others.
35 There's a whole session on that at the American
36 Fisheries Society conference earlier this month
37 and that was one of the key recommendations.

(Marmorek, September 20, 2011, p. 101 ll. 14–37)

SUMMARY ON CUMULATIVE IMPACT ASSESSMENT ON MARINE EFFECTS AND CLIMATE CHANGE

There are many plausible mechanisms that could impact Fraser River sockeye salmon. The commission's task is to make findings about the causes for the 20-year decline of Fraser River sockeye salmon. David Marmorek was a compelling witness, as were Randall Peterman and Scott Hinch. When their evidence is considered, it can lead only to the conclusion that the cause of the 20-year decline is part of a very large-scale phenomenon. Salmon declines are not peculiar to the Fraser basin, but extend well beyond it. Large-scale phenomena such as climate-driven oceanographic changes are the likely cause.

TECHNICAL REPORT 3 – FRASER RIVER FRESHWATER ECOLOGY AND STATUS OF SOCKEYE CONSERVATION UNITS

Sections of Table 20 of Technical Report 3 (page 111) are summarized in section 4 (section 4.3 in particular) of the same report. This table contains results from an analysis of spatial data, a summary of the state of the science, and a summary of the authors understanding on how stressors and habitat changes may impact populations. *(Nelitz, March 14, 2011, p. 18, ll. 21-38)*

Overall assessment of the effect of forest harvesting, mountain pine beetle, and road construction in contributing to the recent decline of Fraser River sockeye salmon:

> 39 Q All right. And so again the analysis is to go
> 40 through something that may be recognized in the
> 41 literature and elsewhere as having either effects,
> 42 has affected other species, or has affected
> 43 sockeye or whatever the case may be. And then in
> 44 most cases you then end up with your quantitative
> 45 analysis that leads to the general conclusions
> 46 that are in Table 19 and in your report that you
> 47 already expressed.
>
> 1 MR. NELITZ: Yes.

(Nelitz, March 14, 2011, p. 18, l. 39 – p. 19, l. 1)

Forest Harvesting has not had a significant impact at the population level:

> 2 Q So dealing with Table 20, "Forest Harvesting" is
> 3 the first subject you deal with, and it's
> 4 something, as you say, that there are a variety of
> 5 plausible mechanisms, and this is a study that has
> 6 been studied, and that is the subject of
> 7 regulation by DFO and by others; is that right?
> 8 MR. NELITZ: Yes.
> 9 Q And the conclusion in (7) is that:
> 10
> 11 Contrasting conditions do exist among CUs but
> 12 a multiple regression analysis does not
> 13 support the hypothesis that forest harvesting
> 14 has had a significant impact on Fraser
> 15 sockeye salmon population parameters.
> 16
> 17 So that is a statement of your conclusion with
> 18 respect to this important variable, and again the
> 19 emphasis in part is on the word "population",
> 20 right?
> 21 MR. NELITZ: Yes, that's correct.

(Nelitz, March 14, 2011, p. 19, ll. 2–21)

The Mountain Pine Beetle does not explain the decline:

> 22 Q And with respect to the "Mountain Pine Beetle",
> 23 your report shows pretty dramatic incursion of
> 24 mountain pine beetle for those of us living in the
> 25 Lower Mainland who may not see it and experience
> 26 it on a daily basis, is that right, and over time.
> 27 MR. NELITZ: Yes. Certainly in terms of the proportion
> 28 of land areas that have a potential to influence
> 29 sockeye habitats, in some cases the level of
> 30 disturbance was quite high. And it's a recent,
> 31 relatively recent phenomena, kind of mid-2000s.
> 32 Q Right. And so part of the issue here is that
> 33 because the effects are recent, they haven't --
> 34 well, in part perhaps because the effects are
> 35 recent, when you're looking back over a 20-year
> 36 decline that you're trying to explain, the more
> 37 recent effects haven't had any quantitative
> 38 results yet.
> 39 MR. NELITZ: In terms of our assessment of the data,
> 40 essentially looking at the trend in the decline,
> 41 and the pattern of increase in mountain pine
> 42 beetle, they don't coincide. The timing of those
> 43 things don't coincide. Correct.

(Nelitz, March 14, 2011, p. 19 ll. 22–43)

Road density does not impact salmon populations:

> 44 Q All right. And then "Roads" is a third topic that
> 45 you deal with, and again there are well-recognized
> 46 mechanisms by which roads and road density can
> 47 impact fish habitat; is that correct?
>
> 1 MR. NELITZ: That's correct.
> 2 Q But again the conclusion on page 112 under item
> 3 (7) is that:
> 4
> 5 Contrasting conditions do exist among CUs but
> 6 a multiple regression analysis does not
> 7 support the hypothesis that road density has
> 8 had a significant impact on Fraser sockeye
> 9 salmon population parameters.
> 10
> 11 So that was your conclusion, again the emphasis on

12 the word "population".
13 MR. NELITZ: Yes.

(Nelitz, March 14, 2011, p. 19, l. 44 – p. 20, l. 43)

Agriculture and urbanization do not account for the decline:

14 Q And then turning to Table 21, with respect to
15 "Agriculture", on the strength of the effect at
16 item (2), so that's on page 113, it says:
17
18 The strength of the impact is expected to be
19 generally low for all habitat types.
20 Although agriculture and urbanization has the
21 potential to strongly affect spawning
22 streams, none of the watersheds have high
23 levels of these land uses.
24
25 Maybe you could explain that to me. Are we really
26 saying that most of the CUs we're looking at are
27 in the Upper Fraser, is that why?
28 MR. NELITZ: Well, the CUs range from CUs that are in
29 the Lower Mainland to the headwaters of the
30 Fraser. If you want me to explain these
31 statements, I think the first sentence is just a
32 generalization about across all habitat types, the
33 nursery spawning migration, that it's relative to
34 other stressors generally considered low.
35 Q Okay.
36 MR. NELITZ: As impacts across those habitat types and
37 CUs. However, if there is the potential for a
38 strong link, our belief is that it's most likely
39 to be realized on the spawning habitats, which is
40 what the second sentence is referring to. But
41 again that, as we've through our assessment on
42 those spawning habitats, the level of stress is
43 relatively low.
44 Q All right. So when you actually, so you do the CU
45 analysis and when you look at the CUs which you're
46 trying to get contrast out of, for most of the CUs
47 it's relatively low, compared to other stressors.

1 MR. NELITZ: Yes.

(Nelitz, March 14, 2011, p. 20, l. 14 – p. 21, l. 1)

Migration corridors are not the site of the cause of the decline:

12 Q All right. And then the last sentence says:
13
14 Migration corridors are bordered by extensive
15 urban and agricultural land use, but these
16 appear to have little impact on migration
17 activities.
18
19 So can you explain that?
20 MR. NELITZ: Well, it's partly referring to the
21 mechanisms of effect, given what we're looking at.
22 So our belief is that migration corridors tend to
23 be larger rivers, Fraser, say, Quesnel, Chilko,
24 things like that, and so the larger the river, the
25 less likely it is that a physical disturbance in a
26 riparian zone is going to either block passage,
27 say, for example, or increase temperatures
28 significantly, relative to other factors that are
29 influencing those migration corridors.

(Nelitz, March 14, 2011, p. 21, ll. 12–29)

High levels of water use have not had a significant impact on sockeye populations:

30 Q And with respect to "Water Use", again the
31 conclusion at item (7) on page 114 is that there
32 are contrasting conditions but the:
33
34 ...multiple regression analysis does not
35 support the hypothesis that higher levels of
36 water use have had a significant impact on
37 Fraser sockeye salmon population parameters.
38 Water use varies substantially among CUs but
39 declines in sockeye salmon abundance have
40 occurred in both high and low water use
41 areas.
42
43 So because you don't get that differentiation,
44 then you conclude that it's not having the
45 differential impact of the population level.
46 MR. NELITZ: Yes, that's correct.

(Nelitz, March 14, 2011, p. 21, ll. 30–46)
The estimated effect of mines is weak:

47 Q And with respect to "Mines", so at 113, item 2,

1 basically there are well-recognized hazards of
2 mines, but the expectation and the strength of the
3 estimated effect is generally weak because there's
4 a low level of activity, and secondly because
5 there are prohibitions under the ***Fisheries Act***
6 which are acceded to. Is that a fair summary of
7 that part?
8 MR. NELITZ: Yes.

(Nelitz, March 14, 2011, p. 21, l. 47 – p. 22, l. 8)

Small Hydro has not impacted sockeye salmon populations:

9 Q All right. And then Table 22 continues the
10 analysis for a "Small hydro", "Large hydro" and
11 Log storage". And on the "Small hydro", basically
12 you don't -- item (7) says not applicable, and I
13 gather that's because as stated in items (1) and
14 (2) there are no, or there are few operational
15 IPPs that have impacted thus far.
16 MR. NELITZ: That's correct.

(Nelitz, March 14, 2011, p. 22, ll. 9 –16)

Large Hydro has had historical impact but cannot explain the 20-year decline:

17 Q And with respect to "Large hydro", which again is
18 well-recognized and I think has historically been
19 a problem, your conclusion really is at item (5),
20 that:
21
22 The Bridge-Seton and Nechako projects have
23 both been in operation since the 1950s. Both
24 have had known historical impacts on
25 migrating sockeye salmon (direct mortality of
26 smolts and adults at Bridge-Seton, and
27 thermal stress on adults at Nechako). For
28 both projects mitigation measures have been
29 enacted with apparent success so survival
30 should have improved in recent years relative
31 to historical conditions.
32
33 So that sort of summarizes the situation there.
34 MR. NELITZ: Yes.

(Nelitz, March 14, 2011, p. 22, ll. 17–34)

Marine survival is not likely to be the result of Log Storage:

35 Q And for "Log storage" the item (4) tells us that
36 there could be impacts, both on out-migrating
37 smolts, and migrating adults. And then concludes
38 that:
39
40 Given the weakness of the expected response,
41 declines in marine survival of sockeye salmon
42 are not likely to be the result of log
43 storage activity.
44
45 MR. NELITZ: That's correct.

(Nelitz, March 14, 2011, p. 22, ll. 35–45)

This evidence confirms Marmorek's analysis of freshwater effects.

1 memories, is the Table E-1, where the Pacific
2 Salmon Commission set out their various
3 hypotheses. If we could turn, then, to your
4 report, exhibit -- at page 36, Exhibit 1896.
5 Sorry, I'm at the last page. It's the last -- the
6 second-last page of the executive summary. The
7 pages are not numbered, unfortunately, Mr. Lunn.
8 It's right at the very beginning. It's a section
9 that's titled, Recommendations for Research,
10 Monitoring and Synthesis. There we go.
11 And here I'm just noting that under this
12 section you start off by saying:
13
14 Researches at the Cohen Commission workshop
15 agreed with the [Pacific Salmon Commission]
16 report,
17
18 and it goes on, and that's really part of your
19 conclusion with your report, now, they're
20 consistent? I guess that's my main question is:
21 Would you agree that both the Pacific Salmon
22 Commission report from June 2010 and your paper
23 have very similar conclusions?
24 A Yes, I would. I think the only distinction is
25 that we had more information, particularly on non

Fraser stocks, and also had some more information on marine conditions which slightly changed but didn't radically change the conclusions.
Q Thank you. And the membership at the Pacific Salmon Commission workshop and the scientists that worked on the -- your ESSA report, you'll agree that those are different scientists, despite the fact that you were at the Pacific Salmon Commission, the scientists at the Pacific Salmon Commission were different than the people who worked on the ESSA report?
A Yes, they are different. However, I think it's important to note that our report is a synthesis of the technical reports done by all of the Cohen Commission researchers. So I actually think of our team is including all the people who worked on those reports as well.
Q Right. And so you'll agree that despite the different scientists that were involved, they came to a very similar outcome?
A Yes. I think there's, as you would expect them on scientists, you know, some interesting arguments

between was Queen Charlotte Sound or Strait of Georgia more important in 2007, but in general people agree.
Q Okay. Thank you. I'd like to now just ask some questions about the stage 1 of your report, and I've got just a couple of questions. We'll just walk through the lifecycles, as you've put them out.
If we could move to -- back in the two pages, Mr. Lunn, to the start of the executive summary, Stage 1. One more page, please. Thank you. So here, with respect to Stage 1, you state that -- basically, you say that climate change is a possible factor with respect to the causes of decline for Stage 1, and you talk about climate change throughout the report. So I'm just wondering, what's your definition of climate change? What do you mean when you say climate change is a possible factor?
A Okay, so there's two questions there. So my definition of climate change would be the increase in greenhouse gases and associated changes in both

> 23 temperatures and circulation in the ocean and
> 24 other factors driven by that increased amount of
> 25 heat in the atmosphere. And here we were
> 26 following or synthesizing the work that Scott
> 27 Hinch and Eduardo Martins had done in their
> 28 climate change report in which they noted that
> 29 temperature changes could have both positive and
> 30 negative effects on incubation emergence in
> 31 freshwater rearing. And so we carried that
> 32 through as a possible factor. It had exposure in
> 33 the sense that temperatures have been shown to be
> 34 increasing, certainly in the Fraser, and other
> 35 data showed temperature increases in many
> 36 tributaries, so it remained a possible factor.
> 37 Q So when you say "climate change", are you seeing
> 38 that as increased variability, or are you seeing
> 39 that as an increased general temperature rising?
> 40 A Certainly both occur. With climate change in this
> 41 context, for this specific section, we were
> 42 relating it more to increases in temperature,
> 43 because that's what Scott Hinch and Eduardo
> 44 Martins had referred to.
> 45 Q All right. Would you agree that climate change
> 46 manifests itself in a variety of factors, then?
> 47 A Absolutely.
>
> *(Marmorek, September 19, 2011, p. 43, l. 1 – p. 44, l. 47)*

JUNE 2010 WORKSHOP

As Marmorek's report stated in the quote immediately above, the June 2010 workshop reinforces the conclusion that the likely cause of the 20-year decline was not changes in freshwater ecosystems.

Nelitz was familiar with most of the authors of Section D of *(Exhibit 573, Appendix C to Peterman et al, Synthesis of Evidence from a Worskshop on the Decline of FRS, Jun 15-17)*, the PSC workshop:

> 6 Q And, Mr. Commissioner, if Mr. Lunn, could you
> 7 please bring up Exhibit 573. So I'm not sure
> 8 whether -- I want to refer to the Selbie
> 9 information. It may be, on my copy I had a
> 10 reference at page 67, does that make sense? So
> 11 Selbie is at Section "D", item 12. Yes, thank
> 12 you.

13 MR. LUNN: That's what you're looking for?
14 MR. PROWSE: Yes, thank you.
15 Q Yes. So in your report you have referenced your
16 work on the Selbie paper, and first of all, who
17 are the researchers? If we can just turn back to
18 the beginning of that section. Sorry, the two
19 pages before the chart which you brought up. Yes.
20 So are you familiar with the authors of this
21 report and just what their expertise is and where
22 they work?
23 MR. NELITZ: Many of them, yes.
24 Q And can you tell us what they are, just give us a
25 quick overview?
26 MR. NELITZ: Mike Bradford, research scientist focused
27 on habitats for salmon across B.C.; Merran Hague,
28 a modeller in research support for other
29 researchers at DFO; Erland McIsaac was my
30 supervisor for my Master's, again a sockeye
31 habitat researcher, looking at stressors such as
32 forestry; Dave Patterson, dealing with water
33 temperatures in the main stem Fraser on migration
34 of sockeye.
35 Q And Daniel Selbie?
36 MR. NELITZ: I haven't met Daniel, so I don't know him.
37 I know another person on our team spoke with
38 Daniel as part of our work, but I can't really
39 speak to a lot of what he does.
40 Q All right. And are all these authors with DFO?
41 MR. NELITZ: As far as I know, yes.

(*Nelitz, March 14, 2011, p. 14, ll. 6-41)*

Nelitz report accepted their findings:

42 Q All right. And so you in your report summarize
43 their findings and basically accept their
44 findings, and then go beyond them in terms of
45 having better data and doing further analysis; is
46 that correct?
47 MR. NELITZ: That's correct.

1 And you explain that you thought it was important
2 for you to recognize that work going forward.
3 MR. NELITZ: Absolutely.
4 Q And so turning then to the table that's two pages
5 in, Figure 1. So the paragraph tells us that an:

6
7 Absence of a link between land-use and
8 population trends is not unexpected.
9
10 So that was the key conclusion they came to, and
11 that they came to, is that right, one of them?
12 MR. NELITZ: There is a latter part of this report that
13 I think better characterizes some of their
14 conclusions in terms of it's unlikely that
15 freshwater influences are explaining the declines,
16 but this certainly summarizes this piece of that
17 work.
18 Q All right. And the reference to the next sentence
19 says:
20
21 Sockeye salmon are likely less vulnerable to
22 such habitat changes compared to coho salmon
23 because sockeye often spawn in lake-buffered
24 streams, and compensatory (and variable)
25 mortality in the lake may mask spawning
26 ground impacts.
27
28 So I guess there's two parts of that sentence.

(Nelitz, March 14, 2011, p.14, l. 42 – p. 15, l. 28)

Nelitz explained the importance of “lake-buffered streams”:

29 You've referred in your report to the lake30
buffered streams? Sorry, the lake, yes, it does
31 say "lake-buffered streams. So can you explain
32 the importance of the lake buffering and lake33
buffered streams?
34 MR. NELITZ: Certainly. So this is a big piece of our
35 work, in that when we assessed impacts on spawning
36 habitats, we discriminated between two general
37 locations of spawning, so we identified those
38 locations that were downstream of lakes, because
39 of this issue that lakes can buffer upstream
40 disturbances. And then we also identified
41 locations that were tributary, spawning tributary
42 to lakes or other tributary rivers.
43 So it's the idea that lakes, if there's a
44 disturbance in a headwater upstream of the lake,
45 that whether it's sediment, whether there are
46 temperature impacts or flow impacts, given the

47 large volumes of these lakes, that if sediment

1 comes in, that it will settle out before being
2 passed through the lake outlet. Similarly,
3 temperatures, if there's heating effects that come
4 into a lake, that given the large surface areas of
5 lakes and the exposure to climate, that those
6 factors are going to overwhelm any kinds of
7 disturbance that might have occurred due to
8 disturbance upstream. So it's recognizing that
9 lakes can have a buffering capacity, or a buffer
10 against impacts, upstream impacts.

(Nelitz, March 14, 2011, p.15, l. 29 – p. 16, l. 10)

Nelitz carried the analysis beyond that of the PSC authors:

11 But certainly I'd say that we went one step
12 further than what Selbie did, and we
13 quantitatively discriminated between those lake14
buffered streams and the tributary ones, and
15 whereas they just did a yes/no categorization.
16 And ours was at a much finer scale than that.
17 Q And can you explain that, that can you just
18 amplify what you just said. In what respects was
19 yours then at a much finer scale, and how does
20 that --
21 MR. NELITZ: They essentially looked at is the CU or
22 the stock lake-buffered or not. So it's kind of a
23 yes or no, a binary discrimination. Whereas we
24 looked at a continuum from zero to one. So fully
25 lake buffered being a one; zero lake buffering on
26 the spawning habitats being zero. And so we had
27 the full continuum represented.
28 Q All right. And your conclusion nonetheless was
29 that there wasn't a variable impact in each case?
30 MR. NELITZ: So this was not important in helping us,
31 so this variable was not important in helping us
32 understand the patterns of the decline across the
33 CUs.
34 Q All right. So it didn't get to the population
35 type level.
36 MR. NELITZ: That's correct.

(Nelitz, March 14, 2011, p.16, ll. 11–36)

The fact that sockeye rear in lakes is also important:

> 37 Q And the next sentence talks about:
> 38
> 39 Moreover, lakes, with larger dilution
> 40 volumes, and more varied habitat, may further
> 41 buffer sockeye from land use impacts during
> 42 rearing, relative to streams.
> 43
> 44 I'm not sure whether you've covered that in your
> 45 last answers or not.
> 46 MR. NELITZ: I think it's related. So the sentence
> 47 before was talking about spawning habitat, so
>
> 1 spawning downstream of lakes. This is talking
> 2 about rearing juveniles within lakes. So
> 3 similarly there will be some buffering of some of
> 4 the upstream impacts, though certainly that the
> 5 potential for an effect is greater there than on
> 6 the downstream spawning.
>
> *(Nelitz, March 14, 2011, p.16, l. 37 – p. 17, l. 6)*

He supported the PSC conclusions that there is no evidence to suggest that freshwater habitat caused the decline in salmon productivity :

> 7 Q All right. And then below Figure 6, Mr. Lunn, is
> 8 the heading "Conclusions". Yes. is this the
> 9 paragraph that you were referring to earlier?
> 10 MR. NELITZ: Yes.
> 11 Q So the phraseology they've used is that:
> 12
> 13 We were unable to find any quantitative
> 14 evidence to support the hypothesis that the
> 15 declines in the productivity of Fraser
> 16 sockeye salmon were related to changes in
> 17 freshwater habitat conditions in the natal
> 18 and nursery environments.
> 19
> 20 So that goes to your main point; is that correct?
> 21 MR. NELITZ: Yes.

(Nelitz, March 14, 2011, p. 14, l. 6 – p. 17, l. 21)

CONCLUSION ON FRESHWATER ECOLOGY

The evidence is clear that change to freshwater ecosystems is not the likely cause of the 20-year decline of Fraser River sockeye salmon that the Commission is tasked to consider.

Nelitz examined a variety of plausible mechanisms but was correct in concluding that none of them could explain the 20-year decline.

CONCLUSIONS: MARINE ECOSYSTEM CHANGE AND CLIMATE CHANGE ARE THE LIKELY CAUSES FOR THE 20-YEAR DECLINE.

The Commission commissioned a number of technical reports to examine the scientific issues confronting the commission in its quest to report on the 20-year decline in sockeye salmon productivity, in light of the disastrous returns in 2009. While there are many uncertainties in the science, it is also true that sockeye salmon is one of the most studied fish in the world. The evidence here points conclusively to the geographic area about which the least is known – the ocean, where salmon spend at least half their lives -- and the science about climate change. Michael Healey's 2011 paper effectively updates the climate change issue and confirms its importance in all life stages of the sockeye salmon.

With respect to freshwater ecology, the Commission's report and the June 2010 workshop are both consistent with the conclusion that it is climate change in the marine environment that is the likely cause of the decline: not freshwater issues.

The facts also generate the conclusion that neither aquaculture nor disease is the likely cause of the decline. The spatial scale and extent point to a broader and bigger phenomenon than salmon farming.

TOPIC: CAUSES FOR THE DECLINE OF FRASER RIVER SOCKEYE SALMON

AQUACULTURE AND DISEASE

SUBMISSIONS OF THE PROVINCE

Technical Reports considered in these submissions:

- 1- Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon (Dr. Kent's Report)
- 1A – Assessment of the potential effects of diseases present in salmonid enhancement facilities on Fraser River sockeye salmon (Dr. Stephen's report)
- 5A - Summary of Information for Evaluating Impacts of Salmon Farms on Survival of Fraser River Sockeye Salmon (Dr. Korman's report)
- 5B – Examination of relationships between salmon aquaculture and sockeye salmon population dynamics (Dr. Connor's report)
- 5C- Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation (Dr. Noakes Report)
- 5D – Impacts of salmon farms on Fraser River sockeye salmon; results of the Dill Investigation (Dr. Dill's report)

Exhibits considered in these submissions:

1. Exhibit 558, Genomic Signatures Predict Migration and Spawning Failure in Wild Canadian Salmon
2. Exhibit 1449, Technical Report 1, Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon
3. Exhibit 1471, Publicly Available PCR Test Results for ISAV in BC Farmed Salmon, 2003-2010
4. Exhibit 1488, Experimental Transmission of a Plasmacytoid Leukemia of Chinook Salmon
5. Exhibit 1512, Hypothesis - Genomic Data Indicate a Potentially Novel Disease
6. Exhibit 1536, Technical Report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation
7. Exhibit 1540, Technical Report 5D, Impacts of salmon farms on Fraser River sockeye salmon: results of the Dill investigation
8. Exhibit 1543, Technical report 5A, Summary of Information for Evaluating Impacts of Salmon Farms on Survival of Fraser River Sockeye Salmon
9. Exhibit 1545, Technical report 5B, Examination of relationships between salmon aquaculture and sockeye salmon population dynamics
10. Exhibit 1549, List of Province of British Columbia Databases Provided to Dr. Korman

11. Exhibit 1551, The Abuse of Power: the Pervasive Fallacy of Power Calculations for Data Analysis
12. Exhibit 1555, Relationship of Farm Salmon, Sea Lice and Wild Salmon Populations
13. Exhibit 1556, Effects of Parasites from Salmon Farms on Productivity of Wild Salmon
14. Exhibit 1557, Sea lice dispersion and salmon survival in relation to salmon farm activity in the Broughton Archipelago
15. Exhibit 1560, 2009 Annual Report Fish Health Program
16. Exhibit 1565, Provincial Codes for Disease, Farms Names, Histology
17. Exhibit 1616, Summary on Closed-Containment Aquaculture Activities in BC, December 2010
18. Exhibit 1617, Special Legislative Committee on Sustainable Aquaculture
19. Exhibit 1666, Aquatic Animal Health Division Canadian Food Inspection Agency, Record of Decisions
20. Exhibit 1671, Fish Health Program 2006
21. Exhibit 1675, Affidavit #2 of Dr. Gary Marty, Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, Affirmed April 26, 2011
22. Exhibit 1678, Histopathology FHAS 2006-2010, showing data sorted for Province Dr. Marty
23. Exhibit 1685, Histolopathology (sic), Virology, Husbandry, Bacterial, Environment, etc. 2004- 2007
24. Exhibit 1805, Perspective on the Technical Challenges Associated with Closed System Aquaculture for Grow-out of Salmon in BC
25. PPR 20, Aquaculture Regulation in British Columbia

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I. AQUACULTURE

OVERVIEW

1. Prior to December 2010, the Province regulated the Aquaculture Industry, and employed staff in Courtenay, Victoria, Nanaimo, Campbell River, and Abbottsford to do so. This regulatory structure was a world-class program, and other jurisdictions looked to how British Columbia ran it's program.

2. Since December 2010, the Federal Government has regulated the Aquaculture Industry, although the Province is still involved by issuing land tenures.

3. Farmed salmon is a significant industry in British Columbia. It comprises 39 percent of the total value of all seafood exports from BC (worth $348.1 million in 2009) and directly and indirectly creates 6,000 jobs. These are well-paying jobs, and many of these jobs are in small communities. A significant number of these jobs are staffed by members of the Aboriginal community.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, pp. 11-12)

4. The way Salmon Aquaculture is practiced in British Columbia creates a low overall risk to the environment.

HISTORY OF THE FORMER PROVINCIAL PROGRAM

5. Pacific salmon farming first occurred in British Columbia in the 1970s. By 1986, there were 70 farms operating in BC, many of them concentrated along the Sunshine Coast. By 1988, there were 101 different salmon-farming companies operating in British Columbia, many of which were growing Atlantic salmon.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 9)

6. Various concerns were raised by a number of stake-holders including Commercial Fishers, Aboriginal Groups as well as Environmental Groups. As a result, on October 31, 1986 the British Columbia Government tasked David Gillespie with conducting the first inquiry into aquaculture in BC (the "Gillespie Report"). The Gillespie Report made a number of recommendations related to government support for the industry; information and education; First Nations involvement in the industry; fish marketing and processing; the marine environment; user conflicts and siting; referrals and advertising; production plans and diligent use; land tenure; and the provincial agency approval system. In 1987, the Provincial Government accepted Gillespie's recommendations and initiated an action plan.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 10)

7. In 1988, British Columbia and Canada signed a Memorandum of Understanding on Aquaculture Development which set out their various responsibilities. British Columbia would issue licenses with input from Canada and would cooperate with Canada in a number of areas including:

    a. Research and Development
    b. Education and Training
    c. Compliance and Inspection; and
    d. Creation and administration of a management committee.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, pp. 13-14)

8. Canada would retain responsibility for issuing permits for wild brood stock and eggs (including importations), as well as regulation of therapeutic drugs.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, pp. 13-14)

9. In the 1990s, significant consolidation of the industry took place, such that by 1997, there were 79 active farms operated by 16 salmon-farming companies. By 2008, there were 17 companies operating 136 salmon farms in British Columbia marine waters. By 2011, four main companies dominated finfish aquaculture on the British Columbia coast, holding 130 tenure licences, not all of which are in active operation at any one time. Those four companies are Mainstream Canada, Marine Harvest Canada, Grieg Seafood BC, and Creative Salmon Company. Creative Salmon is a Canadian company which raises Chinook salmon; the other three companies are Norwegian, and raise Atlantic salmon.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 10)

10. In the 1990s, a number of reviews were conducted to improve the regulation and management of the Aquaculture Industry. In 1995, the Provincial Government asked the British Columbia Environmental Assessment Office to conduct a review of the adequacy of current methods and processes used by the ministries regulating and managing salmon aquaculture operations. The British Columbia Environmental Assessment Office released its review, entitled the Salmon Aquaculture Review in 1997. This report, which found that aquaculture as practiced in British Columbia presented a low overall risk to the environment, provided 49 recommendations, most of which were accepted and implemented.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, pp. 14-15)

11. As a result of the Salmon Aquaculture Review, Fish Health Management Plans were included as a condition of License for all salmon farming operations.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 16)

12. The Province‘s regulatory regime for finfish aquaculture continued to develop through the early 2000s:

- In 2000, the Province announced a relocation initiative to move fish farms that were determined to be in environmentally unsuitable areas;
- Escape regulations were developed to address Atlantic salmon escapes from fish farms;
- A Fish Health Auditing and Surveillance Program was initiated;
- The *Finfish Aquaculture Waste Control Regulation* was developed in 2002;
- In 2003, a sea lice monitoring program was developed for the Broughton Archipelago, which was then expanded in 2004; and
- Fish Health Management Plans became a required element of licences in 2003.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, pp. 16-17)

13. In 2009, *Morton v. British Columbia (Agriculture and Lands),* 2009 BCSC 136 was decided, and found that the Province did not have constitutional jurisdiction to regulate marine finfish aquaculture. As a result of this decision in December, 2010 the Federal Government took over regulation of all aquaculture operations in British Columbia.

14. The transition to the Federal program is complete. During the transition, the Province assisted the Federal government to make the turnover as smooth as possible.

DESCRIPTION OF THE PROGRAM THE PROVINCE RAN

FISH HEALTH MANAGEMENT - DISEASES

15. Prior to December, 2010, the Province ran a comprehensive health management program for salmon aquaculture in British Columbia out of its offices in Courtenay and Abbotsford, British Columbia.

16. The objectives of the Provincial Fish Health Program were to monitor and minimize the risks of disease in farmed fish; to ensure access to accurate and verifiable data on the disease status of cultured salmon; and to facilitate public and agency confidence that aquaculture health management in British Columbia occurred at a high standard.

(Exhibit 1560, 2009 Annual Report Fish Health Program, p. 5)

17. All salmon aquaculture and commercial facilities reported site-specific information to the BC Salmon Farmers database, including mortality, causes of mortality and Fish Health Events. From that database, quarterly reports of industry's fish health status were submitted to government and posted for public viewing.

(Exhibit 1560, 2009 Annual Report Fish Health Program, p. 5)

18. As regulator, the Province conducted regular and frequent inspections. For example, 116 Fish Health Audits were conducted in 2009.

(Exhibit 1560, 2009 Annual Report Fish Health Program, p. 13)

19. During each Fish Health inspection, fresh silver carcasses (fish that recently died) were collected and tested by the Animal Health Branch in Abbotsford British Columbia. In 2009 alone 585 carcasses were sampled from the farms and tested by a Board Certified Veterinary Pathologist.

(Exhibit 1560, 2009 Annual Report Fish Health Program, p. 14)

OTHER INSPECTIONS

20. In addition to Fish Health Audits, the Province mandated reporting of fish escape data, and monitored harvest values, stocking activity data and medicated feed information. These inspections occurred at every farm once a year.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, pp. 35-37)

21. The Province used the data collected during inspections to prepare an annual report on industry compliance. The 2009 report states the Province found generally high levels of compliance with both the Ministry of Agriculture and Lands requirements as well as for Ministry of Environment requirements.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 39)
(Exhibit 1560, 2009 Annual Report Fish Health Program, pp. 35-37)

SEA LICE AUDITS

22. In addition to the Fish Health Program, the Province monitored sea lice levels. Under this program, industry lice counts were conducted a minimum of once a month within most coastal subzones and were increased to twice monthly if the trigger level of three motile lice per fish was reached at any time. During the outmigration of wild salmon (March 1-June 30), if a farm reached the trigger level, the lice management strategy required additional action to be adopted (medication or harvest).

(Exhibit 1560, 2009 Annual Report Fish Health Program, p. 34)

23. Twenty five percent of active Atlantic salmon farms were selected each quarter for audit, with the exception of the time period of the smolt outmigration. At this time, 50% of active farms were audited for sea lice levels.

(Exhibit 1560, 2009 Annual Report Fish Health Program, p. 35)

WHAT THE PROVINCE STILL HAS JURISDICTION OVER

24. Since the transition, the Province retains jurisdiction over siting decisions. The guidelines are set as follows:

- **At least 1 km in all directions from a First Nations reserve, unless consent is received from the First Nation (append consent letter).**
- **At least 1 km from the mouth of a salmonid-bearing stream determined as significant in consultation with DFO.**
- **At least 1 km from herring spawning areas designated as having "vital", "major" or "high" importance.**
- **At least 300 m from intertidal shellfish beds that are exposed to water flow from a finfish farm and which have regular or traditional use by First Nations, recreational, or commercial fisheries.**
- **At least 125 m from all other wild shellfish beds and commercial shellfish growing operations.**
- **An appropriate distance from the areas of "sensitive fish habitat" as determined by DFO.**
- **An appropriate distance from areas used extensively by marine mammals, as determined by DFO.**
- **At least 30 m from the edge of the approach channel to a small craft harbour, federal wharf or dock.**
- **At least 1 km from ecological reserves smaller than 1000 ha or approved proposals for ecological reserves smaller than 1000 ha.**
- **Not within a 1 km line of sight from existing federal, provincial or regional parks or marine protected areas (or approved proposals for these).**
- **Not infringing on the riparian rights of an upland owner, without consent, for the term of the tenure licence.**
- **Not in areas that would pre-empt important Aboriginal, commercial or recreational fisheries as determined by the province in consultation with First Nations and DFO.**
- **Not in area of cultural or heritage significance as determined in the *Heritage Conservation Act*.**
- **Consistent with approved local government bylaws for land use planning and zoning.**

- **At least 3 km from any existing finfish aquaculture site, or in accordance with local area plan or Coastal Zone Management Plan.**
- **Consistent with objectives contained in the applicable Integrated Management of Aquaculture Plan(s)**

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 45)

25. These guidelines are merely an initial screening tool to weed out sites and further assessment is conducted pursuant to the *Canadian Environmental Assessment Act*. An initial land tenure was for 5 years.

26. Mr. Thompson described this process in his evidence:

> 15 Q Mr. Thomson or Mr. Last, would you care to respond
> 16 to some of those concerns?
> 17 MR. THOMSON: I'll take it. I think that what's clear
> 18 here is that this is a siting criteria that they
> 19 use in the initial screening. It does not
> 20 indicate that this is the only criteria being used
> 21 to apply to the decision as to whether or not a
> 22 licence will be granted or not. That'll go
> 23 through an assessment by biologists -- I mean, the
> 24 process has changed since the ***Morton*** decision, but
> 25 certainly prior to the ***Morton*** decision, we go
> 26 through an assessment by Habitat biologists and an
> 27 assessment, quite often, the ***Canadian***
> 28 ***Environmental Assessment Act***. So it's not that
> 29 the screening criteria are the only things that
> 30 are being applied in order to determine if the
> 31 site can be licensed or not.
> 32 But, having said that, certainly it would be
> 33 an area that the Department would seek to review
> 34 those siting criteria for additional input given
> 35 that they are from 1997, now that we have taken
> 36 over the primary management control of the
> 37 aquaculture industry.

(Thomson, August 30, 2011, p. 18, ll. 15–37)

27. These requirements, the Province submits, are appropriate and reasonable to manage risks.

MANAGEMENT OPTIONS

CLOSED CONTAINMENT

28. The Aquaculture Coalition and the Conservation Coalition have suggested that aquaculture farms should be moved to closed containment sites immediately. The Province supports the development of the technology generally, but submits the technology is currently in the research and development stage, and no conclusion can be drawn regarding whether the technology is viable yet.

29. Closed containment was described in the PPR as:

> Closed-containment is a term used to describe a range of technologies that attempt to restrict and control interactions between farmed fish and the external aquatic environment with the goal of minimizing impacts and creating greater control over factors in aquaculture production. Closed – containment introduces a range of new complexities, including CO_2 build up, waste management, siting and installation and energy requirements.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 108, para. 3)

THE PROVINCE'S WORK ON CLOSED CONTAINMENT

30. The development of closed containment as an alternative to conventional net pens aligned with the Province's goal for the development of an aquaculture sector that is economically, environmentally and socially sustainable.

(Exhibit 1616, Summary on Closed-Containment Aquaculture Activities in BC, December 2010)

31. This is an area that the Province considered in the course of a number of reviews. In 2005, the Legislative Assembly appointed the bipartisan Special Legislative Committee on Sustainable Aquaculture to inquire into and make recommendations

with respect to sustainable aquaculture in British Columbia. This report, which came out in 2007, recommended that there be a transition to closed containment within 5 years.

(Exhibit 1617, Special Legislative Committee on Sustainable Aquaculture)

32. To work towards this goal, the Province funded several pilot projects. Specifically the Province provided financial and in-kind support for closed containment projects and specifically worked on projects with:

    a. Future Sea (to develop marine based bag systems);
    b. Agri-Marine/ Cedar (pump ashore system);
    c. Marine Harvest Salt Spring Pilot (evaluation of Future Sea bags under the Provincial Pilot Project Technology Initiative); and
    d. Namgis First Nations Land-Based Atlantic Salmon Re-circulating Aquaculture System Pilot Program (ongoing).

(Exhibit 1616, Summary on Closed-Containment Aquaculture Activities in BC, December 2010)

33. The Province also reviewed proposals from proponents and provided comment from funding agencies if that funding agency was asked to fund a project.

34. During the transition to the federal regulatory regime, the Province encouraged the federal government to seriously consider the aquaculture-specific recommendations in the Special Committee on Sustainable Aquaculture. While the Province no longer has regulation of aquaculture, the work it did to meet the goals of the Special Committee on Sustainable Aquaculture increased the knowledge about the technologies.

(Exhibit 1617, Special Legislative Committee on Sustainable Aquaculture)

WORK ON CLOSED CONTAINMENT BY OTHER PARTIES

35. In 2008, DFO's Canadian Science Advisory Secretariat ("CSAS") reviewed approximately 40 closed containment systems around the world, and found none were producing Atlantic salmon exclusively, and that there was a significant failure rate within these systems. The Aquaculture PPR suggested the reasons for failure included mechanical breakdown, poor fish performance, management failure, declines in market price and inadequate financing.

(Exhibit 1616, Summary on Closed-Containment Aquaculture Activities in BC, December 2010)
(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 108-109)

36. In 2008, The Coastal Alliance for Aquaculture Reform ("CAAR") also did a study entitled "Global Assessment of Closed System Aquaculture". CAAR found the most consistent and notable success to date in commercial scale closed systems for food fish production have been achieved using species tolerant of high density conditions that command a premium market price. The Worley Parson's expert report introduced by the Salmon Farmer's Association noted that this is still the case, and that there are no examples of commercial production of market size Atlantic salmon in closed systems to date.

(Exhibit 1805, Perspective on the Technical Challenges Associated with Closed System Aquaculture for Grow-out of Salmon in BC, p. 3)
(Exhibit 1616, Summary on Closed- Containment Aquaculture Activities in BC)

37. In 2009, the Pacific Salmon Forum released a report which called for a detailed assessment of containment technology.

(Exhibit 1616, Summary on Closed- Containment Aquaculture Activities in BC)

38. In 2010, a "Feasibility Study of Closed-Containment options for the British Columbia Aquaculture Industry" was published. The report compared net pen technology with closed containment, land-based "re-circulating Aquaculture

System (“RAS”)”. The report found RAS was marginally viable from a financial perspective and presents a higher level of risk compared to net pen systems.

(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p. 109-110)

39. Another report from Save our Salmon asserted that land based closed containment is technically and economically feasible. Marine Harvest in collaboration with CAAR has started a real world pilot project to test the feasibility of RAS technology. It is unknown if this project will continue, however.

(Exhibit 1616, Summary on Closed- Containment Aquaculture Activities in BC)
(PPR 20, Aquaculture Regulation in British Columbia, July 28, 2011, p.110, paras 228-229)

40. The British Columbia Salmon Farmers Association has been a global leader in the application of RAS and currently 65% of their smolts are raised using this technology. This is very encouraging.

(Exhibit 1805, Perspective on the Technical Challenges Associated with Closed System Aquaculture for Grow-out of Salmon in BC, p. 1, para. 3 & p. 4, para. 6)

CONCLUSION ON VIABILITY

41. It is clear that research into closed containment systems for the entire life cycle of Atlantic Salmon is preliminary, and that all interested parties are investigating whether this technology can be implemented to raise Atlantic Salmon. At this stage, it is too early to determine if closed containment technology is viable on a commercial scale, and no conclusion can be made at this time on this point.

(Exhibit 1805, Perspective on the Technical Challenges Associated with Closed System Aquaculture for Grow-out of Salmon in BC, p. 5, para. 4)

FALLOWING

42. Another management option to reduce the impact of farmed salmon on natural ecosystems that has been suggested is fallowing. There is no evidence to support that fallowing is an effective management tool.

43. Ms. Morton published an article entitled “Sea lice dispersion and salmon survival in relation to salmon farm activity in the Broughton Archipelago”. This paper showed that fallowing had no effect on population level survival.

(Exhibit 1557, Sea lice dispersion and salmon survival in relation to salmon farm activity in the Broughton Archipelago)

44. This paper was put to Dr. Saksida and Dr. Jones for this proposition, and they agreed that fallowing had no effect.

37 Q Thank you. Now, if we could turn to Exhibit 1557,
38 that is Provincial Tab 18. On page 155, second
39 column in the middle of the page, started at:
40
41 Based on escapement data, there were no
42 significant differences in survival that
43 corresponded to sea-louse abundance in
44 juvenile salmon mortality on the migration
45 route containing active farms relative to
46 unexposed populations north of the Broughton
47 Archipelago.

74
PANEL NO. 61
Cross-exam by Ms. Callan (BCPROV)
September 6, 2011
And then if we could then look 1 up to page 149
2 under the heading "Escapement and survival
3 analysis" it says:
4
5 Survival among rivers, based on escapement
6 data, was highly variable, and there was no
7 detectable difference in mean survival for

the Broughton Archipelago relative to the central coast.

And then it goes on after a little bit:

...only the Embly (sic) River clearly corresponds to the fallow migration route. That population experienced very poor survival, with a 90% decline, although it was subject to fallow intervention.

Would you agree that this research indicate that following or moving to closed containment specifically may not have any effect on wild salmon survival? This is actually anyone can answer this question, but I guess we'll start with Dr. Saksida.

DR. SAKSIDA: Okay. It's actually an interesting study because it does show that Embley, which went past fallow farms, actually had poorer returns than the Wakeman-Kingcome, which apparently, according to the theory in the paper, went through the area where there's farms. So it basically counters most of the other papers that have been written, saying that fallowing -- to me, that fallowing actually made a difference. It actually didn't make any difference in this paper.

Q Dr. Jones, do you want to add anything?

DR. JONES: Well, a little bit. I think to me what this result highlights is the uncertainty with which we can conclude at a population level that sea lice are having an effect, whether it's in chum salmon in this case, or in any other species. There's been a number, many studies that have identified that at the individual fish level, sea lice are -- have the potential to be harmful, and the factors that influence the harm at an individual fish level vary widely. They can be the size of the fish, the condition of the fish, the number of sea lice, on and on and on, many

factors.

But there's always been a gap in our

> 3 understanding when it comes to translating those
> 4 individual effects into population level effects,
> 5 and we haven't been able to identify very clearly
> 6 exactly what population effects as a result of
> 7 salmon are -- or salmon lice are, nor have others
> 8 who have tried. For example, the Norwegians have
> 9 a multiyear study on the impacts of salmon lice on
> 10 wild salmon, and they conclude that whether with
> 11 sea trout or Arctic char or Atlantic salmon, that
> 12 more work is still needed to understand population
> 13 level effects. And I think that this document in
> 14 front of us now highlights that uncertainty.

(Dr. Saksida and Dr. Jones, September 6, 2011, p. 73, l. 37 – p. 75, l. 14)

45. This paper was also put to Ms. Morton, and she agreed that in this paper she could not find any positive effect on survival with fallowing in this paper. She thought this result may be linked to the salmon farms using prophylactic Slice treatment.

> 18 Q Mr. Lunn, if we could have page 155, the second
> 19 column in the middle. Yes. So this is on the
> 20 left-hand side of the page in the middle:
> 21
> 22 Based on escapement data...
> 23
> 24 So this statement says:
> 25
> 26 Based on escapement data, there were no
> 27 significant differences in survival that
> 28 corresponded to sea-louse abundance and
> 29 juvenile salmon mortality on the migration
> 30 route containing active farms relative to
> 31 unexposed populations north of the Broughton
> 32 Archipelago.
> 33
> 34 MS. MORTON: Yes, that's correct.
> 35 Q And then on page 149 under the heading "Escapement
> 36 and Survival Analysis", so the first sentence
> 37 there:
> 38
> 39 Survival among rivers, based on escapement

40 data, was highly variable, and there was no
41 detectable difference in mean survival for
42 the Broughton Archipelago relative to the
43 central Coast. ...only the Embly River
44 clearly corresponds to the fallow migration
45 route. That population experienced very poor
46 survival, with a 90% decline, although it was
47 subject to fallow intervention.
76
PANEL NO. 62
Cross-exam by Mr. Prowse (BCPROV)
September 8, 2011
So that 1 -- is it correct?
2 MS. MORTON: Yes. And I really appreciate you bringing
3 up this paper, because this speaks to the
4 integrity of my work. I found a finding here that
5 runs contrary to what I generally have found and
6 put out, but you need to understand that when I
7 began studying sea lice, the salmon farms were not
8 treating prophylactically. They were not treating
9 to protect the pink salmon and the chum salmon of
10 the Broughton. And the average number of lice was
11 11. And in the years after that, it was still
12 extremely high. By the time I did this work,
13 which included 87 plankton tows in the dead of
14 winter, 20 minutes for each, I looked at 9000 fish
15 live in the months between March and May, and the
16 average number of lice was .3. And so what the
17 farms had done is they had used a chemical to
18 drive the lice numbers down. If I felt that that
19 chemical was going to work forever on lice and if
20 I felt that was the only problem with salmon
21 farms, then I would be relieved and be able to go
22 back to studying whales.
23 But this paper should bring to this court the
24 fact that when I find something that does not
25 support my basic belief about this industry, I
26 will publish it, as well.

(Morton, September 8, 2011, p. 75, l. 18 – p. 76, l. 26)

46. In her oral evidence, Ms. Morton referred to an earlier paper she authored on fallowing that came to seemingly contrary results using the 2002 returns of Pink salmon. However, Dr. Marty examined whether fallowing was a useful management tool in his PNAS paper entitled “Relationship of farm salmon,

sea lice, and wild salmon populations" (Exhibit 1555) and found at page 5 "[a]dult pink salmon returns the previous fall are a good predictor of sea lice prevalence in the spring, but farm sea lice numbers are not a good predictor of wild salmon survival." In coming to this conclusion, he noted that farm source sea lice numbers were greater during the juvenile pink salmon outmigration in March 2000 than 2001 providing no intimation of record high adult returns in 2001 vs. the 97% population collapse in 2002. He also examined the coordinated fallowing hypothesis from Morton's paper and disagreed with it stating: "among several hypotheses to explain these changes in sea lice prevalence the strength of the relationship between L. *salmonis* on wild and farm fish best supports the hypothesis that the decrease in 2003 was a result of the precipitous decline of the parent generation in 2002 (16) and fewer numbers of lice per returning fish."

47. As a result, it is submitted that fallowing has no effect on population level survival and should not be recommended as a management option.

II. DISEASES

48. Disease has been a prominent issue in these proceedings. There are a number of diseases that Dr. Kent identified as high risk diseases for Fraser River Sockeye Salmon. They are:

    a. Infectious hematopoietic necrosis (IHN)
    b. *Vibrio (Listonella) anguillarum*, vibriosis
    c. *Aeromonas salmonicida,* furunculosis
    d. *Renibacterium salmoninarum,* bacterial kidney disease
    e. *Ichthyophthirius multifiliis,* Ich or White Spot
    f. *Parvicapsula minibicornis*

INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS (IHN)

49. Infectious hematopoietic necrosis virus (IHNV) is a well recognized endemic pathogen that is lethal to sockeye salmon in freshwater. It also occurs in marine waters in British Columbia and has caused several outbreaks in pen-reared Atlantic salmon, although none since 2003.

(Exhibit 1449, Technical Report 1, Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon, p. 6, para. 2)
(Exhibit 1536, Technical Report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation, p. 2, table 6)

50. When sockeye enter seawater they becomes less susceptible to the virus and fewer mortalities occur. Dr. Kent testified on this point and said this effect is likely related to a lower concentration of the pathogen in sea water, their increased size and lower susceptibility to disease in the marine environment.

6 Q Would you agree that sockeye, once they enter
7 seawater, are not as susceptible to IHN as
8 compared to when they're in the freshwater, as
9 smolts and fry?
10 DR. KENT: Yes, I would agree with both that as relates
11 to their size susceptibility, and probably -- and
12 certainly, from what we know about where IHN
13 concentrations of IHN in spawning grounds, etc
14 cetera, I would assume that they're also going to
15 be exposed to less virus in the marine environment
16 than they would in freshwater. So they have two
17 things going for them in the marine environment;
18 they're larger at that time, and they're also
19 going to be less -- I would -- I'm not a
20 virologist - Dr. Garver could probably expand on
21 this - but I'm pretty confident that there's much
22 lower concentration of IHN virus in the marine
23 environment than there is in the freshwater
24 environment.

(Dr. Kent,, August 22, 2011, p. 107, ll. 6-24)
(Exhibit 1449, Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon, p. 6, para. 2)

51. Dr. Kent was somewhat ambivalent on whether IHN was a high or moderate risk in seawater and thought it could go either way. His reasoning seemed to rely upon the likelihood of particularly virulent strains appearing in British Columbia waters. The other panel members testified that the particularly virulent strain Dr. Kent was referring to has never been identified in British Columbia.

(Dr. Kent, August 22, 2011, p. 108, ll. 29 – 41)

IHN IN AQUACULTURE

52. Since IHN is an endemic disease which has been in British Columbia waters for many years, the next logical question to consider is how does the presence of aquaculture facilities increase the risk of IHNV transmission to sockeye migrating past them?

53. This is a valid risk to consider because Atlantic salmon are particularly susceptible to IHNV (even in saltwater.)

54. The aquaculture farms have taken precautionary management approaches to prevent transmission of this disease to the farms. For several years all Atlantic salmon in British Columbia have been vaccinated against IHNV as well as many other endemic pathogens. This program has been quite successful and as a result no outbreaks have occurred since 2003.

(Dr. MacKenzie, August 31, 2011, pp. 36-37)
(Exhibit 1536, Technical report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation, p. 25, table 6)

55. Given sockeye salmon's increased resistance to the disease in saltwater and continued vaccination programs by the aquaculture companies, the Province submits that the risk of IHN being transmitted to wild fish is low.

VIBRIO (LISTONELLA) ANGUILLARUM, VIBRIOSIS

56. *Vibrio (Listonella) anguillarum* is one marine bacterium that can cause vibriosis in smolts shortly after their entry to sea water. It can cause severe disease in pen-reared Atlantic salmon although results are less definitive for wild salmon.

(Exhibit 1449, Technical Report 1, Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon, p. 9)

VIBRIO IN AQUACULTURE

57. Despite the serious effects of *vibriosis* on Atlantic salmon, the incidence of this disease is quite low on the British Columbia salmon farms.

58. Table 6 of Dr. Noakes' report shows only very few instances of *vibriosis* ,with only four findings since 2004 across all farms.

Disease	2002	2003	2004	2005	2006	2007	2008	2009	2010
Vibrio	2	1	1	0	0	0	2	0	2

59. In such circumstances, the Province submits, that vibriosis as it relates to fish farms is not likely to be the cause of the declines in Fraser River Sockeye salmon.

AEROMONAS SALMONICIDA (FURUNCULOSIS)

60. *Aeromonas salmonicida* causes a bacterial disease called furunculosis in both wild and cultured fishes and affects Pacific salmon more severely than Atlantic salmon.

FURUNCULOSIS IN AQUACULTURE

61. Salmon farms are not a significant source of furunculosis. Dr. Kent testified that the fish on the farms are vaccinated for this disease.

> 4 DR. KENT: No. I don't know where the source of his
> 5 data are, but I have no reason to disagree with
> 6 that. There is a vaccine for furunculosis. It's
> 7 used with Atlantic salmon, and therefore -- in
> 8 general, with that efficacious vaccine being
> 9 available, we would expect to see less
> 10 furunculosis on the farms.
> 11 I put this furunculosis as a high pathogen --
> 12 or *aeromonas salmonicida* as a pathogen of concern
> 13 that would be one that you would be looking for in
> 14 the fish. I'm not saying that we -- I didn't
> 15 allude to any relationship with farms being the
> 16 source of this. I'm just putting that as a
> 17 general risk. We know furunculosis occurs in
> 18 hatcheries and occasionally in wild fish, and when
> 19 it does occur, it can be very lethal to fish,

> 20 including sockeye. So therefore that's why I
> 21 included it in my high risk.
>
> *(Dr. Kent, August 23, 2011, p. 4, ll. 4-21)*
> *(Exhibit 1536, Technical report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation, p. 24, para. 2)*

62. The incidence of this disease on the aquaculture farms is quite low across the Province.

Disease	2002	2003	2004	2005	2006	2007	2008	2009	2010
Furunculosis	6	12	10	3	1	3	5	6	10

63. Dr. Noakes came to the opinion that salmon farms were not a significant source of furunculosis. He reviewed the salmon farmer's database and noticed that of the overwhelming majority of the instances of furunculosis were on the west coast of Vancouver Island. On page 28, para 2 of his report he stated:

> A few more cases of furunculosis have been reported on farms but since 2003 most of the furunculosis cases have been from farms located on the west coast of Vancouver Island (9/10 in 2010, 6/6 in 2009, 4/5 in 2008, 2/3 in 2007, 8/10 in 2004 and 5/12 in 2003) and not from farms located in the main migration route followed by Fraser River sockeye salmon.

(Exhibit 1536, Technical report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation, p. 28, para. 1)

64. In such circumstances, the Province submits that furunculosis from fish farms is unlikely the cause of decline of Fraser River sockeye salmon.

RENIBACTERIUM SALMONINARUM (BACTERIAL KIDNEY DISEASE; "BKD")

65. *Renibacterium salmoninarum* is a bacterium that causes bacterial kidney disease ("BKD"). It is prevalent in Chinook salmon throughout the northwest, and Sockeye salmon are susceptible to it. Atlantic salmon raised in net pens are less susceptible.

(Exhibit 1449, Technical Report 1, Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon, p. 9)

BKD IN AQUACULTURE

66. Dr. Noakes did an extensive analysis regarding where and when various BKD outbreaks occurred at farms, and evaluated whether the instances of BKD were responsible for the low 2009 returns. At page 31 of his report, he found only one outbreak of BKD along the migration route for out-migrating smolts in 2007. As a result, Dr. Noakes does not think BKD is responsible for the low 2009 returns

> The 2007 and 2008 information is of particular interest given the huge difference in returns of Fraser River sockeye in 2009 and 2010. With only one farm (Bennett Point) along the main migration path of Fraser River sockeye reporting a BKD FHE, it would be unreasonable (in the extreme) to suggest that BKD from salmon farms contributed to the significant decline in sockeye returns in observed 2009.

(Exhibit 1536, Technical report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation, p. 31, para. 1)

67. Dr. Noakes also thought BKD was not responsible for the longer term decline, noting the overall decline in BKD instances in the relevant areas. At page ii of Dr. Noakes report, he opines:

> Since 2003, there has been a significant decline in the number of farms reporting BKD in BC Fish Health Area 3 (the main migration route for Fraser river sockeye salmon) with an average of 6 farms per years since 2006. In 2006, 3 farms from northern Queen Charlotte Strait, 2 farms from the Broughton, and 1 farm the Sechelt area reported BKD fish health events. Of the 20 cases of BKD reported between 2007 and 2009, 17 were from farms in the Jervis/Sechelt/Salmon inlets area with only 1 farm in each of the 3 years being located within the main migration route for Fraser River sockeye salmon.

(Exhibit 1536, Technical report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation, p. ii, para. 5)

68. Accordingly, while Chinook farms are susceptible to BKD outbreaks, it does not appear that BKD from fish farms are responsible for the longer term declines of sockeye salmon returns, and was not responsible for the low 2009 return.

ICHTHYOPHTHIRIUS MULTIFILIIS, ICH OR WHITE SPOT

69. *Ichthyophthirius multifiliis, (“*Ich”) is a serious freshwater disease that affects a number of freshwater species. The parasites cause severe damage to the skin and gills, often killing fish by asphyxiation due to the tissue reaction. Ich can cause high mortality in salmonids including wild stocks of sockeye salmon.

(Exhibit 1449, Technical Report 1, Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon, pp. 12-13)

ICH IN AQUACULTURE

70. This is a freshwater disease, so marine finfish aquaculture has no impact on this disease.

PARVICAPSULA MINIBICORNIS

71. *Parvicapsula minibicornis ("Parvicapsula")* is a parasite that infects sockeye in brackish water. There have been numerous recent reports of a high prevalence of infection in adult sockeye as well as out-migrating smolts. *Parvicapsula* infection is chronic and targets the glomeruli of kidneys, reduces swimming ability, and compromises osmoregulation (maintaining salt balance in the body).

(Exhibit 1449, Technical Report 1, Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon, pp. 14-15)

72. Infection is more severe in sockeye adults suffering pre-spawning mortality compared to successful spawners.

(Exhibit 1449, Technical Report 1, Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon, p. 15)

73. This myxozoan parasite is a significant risk to sockeye in brackish and freshwater.

PARVICAPSULA IN AQUACULTURE.

74. This is a parasite confined to brackish water (and not present at aquaculture farms), so aquaculture has no impact.

(Dr. Hinch, March 9, 2011, p. 9, ll. 21-32)

DATA GAPS

75. All authors of the Disease and Aquaculture reports agree that one of the key knowledge gaps is the lack of information about disease in juvenile sockeye salmon in the marine ecosystem. This information is needed to better understand the relationship between disease on fish farms and Sockeye salmon.

III. ISSUES RAISED BY THE AQUACULTURE COALITION

76. In addition to the diseases Dr. Kent identified as high risk, the Aquaculture Coalition has identified a number of other diseases that they feel are of concern. They are:

    a. Infectious Salmon Anaemia
    b. Miller's Genomic Signature
    c. Plasmacytoid Leukemia; and
    d. Sea Lice

77. The Province disagrees with the Aquaculture Coalition's position on these diseases.

INFECTIOUS SALMON ANAEMIA (ISA)

78. The Aquaculture Coalition suggests that Infectious Salmon Anaemia is in British Columbia and that it arrived via imported eggs from other jurisdictions. Their argument is based upon egg import requirements and the presence of "sinusoidal congestion" or "hemorrhage" lesions noted in various pathology records created by Dr. Gary Marty.

79. The Province disputes that ISA is in British Columbia, noting each group of imported eggs goes through a number of tests as the fish develop. In all fish tested the results were negative for ISA.

80. The Province also disputes that Dr. Marty ever diagnosed ISA in British Columbia or found what he considered to be a "suspect case".

81. Dr. Dill wrote about the potential for ISA in BC in his report at pages 24-25:

> [ISA] "is an important viral disease of farmed Atlantic salmon in some parts of the world (Europe and Chile in particular). No records of it can be found in the BCMAL or BCSFA records, and according to M. Sheppard (pers comm.) there have been "no suspect cases of ISA in BC since sampling began in 2003". However, in his diagnostic reports on dead fish collected from salmon farms Dr. Gary Marty (fish pathologist with BCMAL) reports "classic symptoms of ISA" (see BCP002864), which according to the World Organization of Animal Health (OIE) should make any one of these what they call a "suspect case". These classic symptoms", according to the BCMAL document, are sinusoidal congestion of the liver and interstitial hemorrhage/congestion of the kidney."

(Exhibit 1540, Technical Report 5D, Impacts of salmon farms on Fraser River sockeye salmon: results of the Dill investigation)

82. However, Dr. Dill is not an expert in disease and confirmed in evidence that he would defer to a fish health professional on issues of diagnosis and disease.

> 3 Q And you would not consider yourself to be an
> 4 expert on fish disease or fish health?
> 5 DR. DILL: I do not.
>
> 13 Q And would you agree that you're not an expert on
> 14 diagnosing disorders such as infectious salmon
> 15 anemia or infectious salmon anemia virus and would
> 16 have to defer to another expert?
> 17 DR. DILL: I certainly would on diagnosis, yes.
>
> *(Dr. Dill, August 25, 2011, p. 72, ll. 3-5 & 13-17)*

All of the fish health professionals questioned on this point disagreed with Dr. Dill, and accordingly on this point Dr. Dill's opinion should be given no weight.

83. The Province submits that the presence of one or two non-specific symptoms is not the same as a diagnosis of disease or reportable suspicion of a

disease. In order for a disease to be diagnosed, all contextual and surrounding information must be considered as well as whether any symptoms or test results are pathognomonic for the disease. A diagnosis can only be made by an appropriately qualified individual. To take the Aquaculture Coalition's position would be like concluding that any patient presenting with a dry cough was suffering from SARS.

SINUSOIDAL CONGESTION AND HEMORRHAGE/CONGESTION LESIONS

84. The lesions at issue are sinusoidal congestion and interstitial and kidney hemorrhage/congestion. These lesions are described by Dr. Marty in his database as follows:

> Sinusoidal congestion (liver); SSC is a nonspecific result of sinusoidal damage. In BC Atlantic salmon, sinusoidal congestion is an uncommon feature of infection with viral hemorrhagic septicemia virus (VHSV) and *Listonella anguillarum*. Sinusoidal congestion is one of the classic lesions associated with infectious salmon anemia virus (ISAV) infection, but ISAV has never been identified in British Columbia.
>
> Hemorrhage/congestion (interstitial, kidney); HEM probably is a nonspecific result of endothelial damage; HEM is often associated with VHSV and bacterial infections. Renal congestion and hemorrhage is one of the classic signs of infectious salmon anaemia (ISA), but ISAV has never been isolated from fish in BC.
>
> *(Exhibit 1549- 217, BC Fish Health Database – BCP002864)*

85. Dr. Marty disagrees with the Aquaculture Coalition and testified that sinusoidal congestion or hemorrhage/congestion are not specific lesions, and the mere presence of one or both of these lesions alone is not enough to suggest a diagnosis of Infectious Salmon Anaemia.

> 27 Q And Dr. Marty, there's reference in some of your
> 28 reports to sinusoidal congestion. Can you
> 29 describe what this is and if you would consider
> 30 the presence of sinusoidal congestion of
> 31 haemorrhaging, or both, enough to found a

32 diagnosis of infection salmon anaemia?
33 DR. MARTY: Sinusoids are the special name for
34 capillaries in the liver. Congestion is just
35 expansion of the size of the capillaries by blood
36 cells. So sinusoidal congestion is just
37 engorgement of the capillaries in the liver.
38 Sometimes this can appear as distinct, round, foci
39 that can actually be seen by the fish health
40 technicians in the field. So they submit that to
41 me, I make a diagnosis, and I have a standard
42 comment that I use, that I discussed before. And
43 based on the information that is shown here on
44 this exhibit, I can be very confident that even
45 though in Europe this might be a concern for ISAV,
46 I can be very confident in British Columbia that
47 ISAV is not the cause.

(Dr. Marty, August 31, 2011, p. 58, ll. 27-47)
(Exhibit 1675, Affidavit #2 of Dr. Gary Marty, Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, Affirmed April 26, 201, paras 13, 31-38)

86. Dr. Marty was specifically questioned about Dr. Dill's comments regarding ISA and testified that he disagreed with Dr. Dill on this point, and noted that, in each of the cases Dr. Dill identified, an ISA-specific polymerase chain reaction ("PCR") test was also ordered and each of these tests came back negative for ISA.

(Dr. Marty, August 31, 2011, p. 59, l. 1 - p. 61, l. 20)

87. Dr. Kent, when posed this question, agreed with Dr. Marty that the presence of the sinusoidal congestion and/or hemorrhage/congestion alone or in combination was not sufficient to warrant a diagnosis of ISA, as they are non-specific lesions that are not pathognomonic for ISA.

42 Q And if I could go up to the chart, which is just a
43 straight arithmetical preparation from the
44 documents below, if I suggest to you that there
45 are some 1,100 references in document 2864 to ISA,
46 to classical signs -- classical signs of ISA, what
47 do you say about that?

38
PANEL NO. 55
Cross-exam by Mr. McDade (AQUA)
August 23, 2011
DR. KENT: I'd like to hear -- I'd like to hear how this diagnosis of what they mean by classical signs of ISA lesions are. Who came up with assigning this to say these are ISA-like lesions? Did Dr. Marty call these ISA-like lesions?
Q Yes, I think he did. If we could go back to 2864. If we could go to the abbreviation section, and if we go to say, "HEM", and if we could scroll over to see what it says there on that cell. Again I think we have that same problem [as read]:

HEM is often associated with VHSV and bacterial infections.

And then he says [as read]:

Renal congestion and haemorrhage is one of the classic signs of infectious salmon anaemia, ISA, but ISAV has never been isolated from fish in B.C.

Do you see that?
DR. KENT: Yeah, I see that. Thank you. Thanks for clarifying that ISA has not been seen in B.C.
Q Right. But these are classic ISA lesions, are they not?
DR. KENT: They're not pathognomonic for ISA.
Q How do you know that?
DR. KENT: How do we know it's not pathognomonic?
Q How do you know that?
DR. KENT: I know it's not pathognomonic for ISA because haemorrhage and congestion of visceral organs could be caused by a variety of different pathogens and non-infectious agents. So it's not pathognomonic for ISA.
Q But it could be ISA.
DR. KENT: It could be ISA, sure.
Q Right.
DR. KENT: It's a histopathological change that's not inconsistent with ISA. So just jumping to saying that it's ISA-like lesions is really

42 misrepresentation of a histopathological report,
43 because there are many other causes of these non44 specific lesions.
45 Q But those are Dr. Marty's words.
46 DR. KENT: He list ISA as one of the causes and he also
47 -- you notice his first thing is a non-specific

39
PANEL NO. 55
Cross-exam by Mr. McDade (AQUA)
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1 result of endothelial damage.
2 Q All right. And, actually, yes, if we go down
3 there. Can we go down to SES -- "SSC", sorry,
4 sinusoidal congestion. Again, if we could look at
5 what it says at the end of that. Again Dr. Marty
6 said "Classic lesion of ISA".
7 DR. KENT: Also, I would -- it is a classic lesion of
8 ISA, but let's talk about a pathogen that we know
9 occurs in B.C., it's a classic lesion of
10 *vibriosis*, as well, too.
11 Q So for each of these samples, one would want to
12 test for either disease.
13 DR. KENT: Yes, of course.

(Dr. Kent, August 23, 2011, p. 37, l. 42 – p. 39, l. 13)

88. Earlier on in these proceedings, Ms. Morton reported this issue to the Canadian Food Inspection Agency (“CFIA”). The CFIA investigated this matter thoroughly and concluded in all of the 35 cases Ms. Morton submitted there was no risk for ISA. Their salient findings were:

> All cases were evaluated as NO RISK for ISA. It is recommended that this information also be communicated to BCMAL and the companies that provided additional information.

(Exhibit 1666, Aquatic Animal Health Division Canadian Food Inspection Agency, Record of Decisions, p. 3)

89. Dr. Marty gave evidence on the Fish Health Auditing and Surveillance Program testing he oversaw and noted that, over the last few years, the

Province examined 4,726 fish for ISA using PCR testing and that none of the test results were positive for ISA. The Breakdown of results for ISA is as follows:

Year	# Positive	#Negative
2003	0	648
2004	0	675
2005	0	586
2006	0	644
2007	0	763
2008	0	588
2009	0	585
2010	0	237
TOTAL	0	**4,726**

(Exhibit 1471, Publicly Available PCR Test Results for ISAV in BC Farmed Salmon, 2003-2010)

90. Dr. Sheppard testified that these results gave the Province 95% confidence every quarter that ISA was not in British Columbia waters, and this was compliant with the standards required by the OIE. Specifically, Dr. Sheppard testified:

> 37 DR. SHEPPARD: Ms. Callan, if I may add, on the note of
> 38 -- on the precautionary note, the program, the
> 39 Audit and Surveillance Program is very
> 40 precautionary in following the requirements and
> 41 expectations of the international community, the
> 42 World Organization for Animal Health, the OIE. In
> 43 their manual of disease detection tests, I think
> 44 it may be chapter 1.14, that chapter speaks to
> 45 freedom of infection, and it's accepted by the
> 46 World Organization and leading experts,
> 47 virologists, veterinarians, be they federal or
>
> 58
> PANEL NO. 59
> Cross-exam by Ms. Callan (BCPROV)
> August 31, 2011
> 1 provincial or private, there's agreement that
> 2 British Columbia has freedom of infection of a

> number of these exotic pathogens that Dr. Marty just mentioned.
> So the program is designed with a confidence of 95 percent at a two percent prevalence. I don't want to get into the statistics, because I'm not a statistician. But it's designed every quarter to test for this in a meaningful manner to continue to support that we have freedom of those infections.
> Now, over time, of course, if you start looking at historical information, that confidence, intuitively, you can tell that confidence level rises from 95 percent upward, because each quarter we continue to not find it. In addition, the two percent prevalence intuitively can fall, get more toward one percent or even less than one percent because, again, each quarter we continue to not find it. So this is why, I think, the independent epidemiological studies have supported that the program currently as it's designed should provide the public confidence and the international confidence for trade out of B.C. and out of Canada, that we have freedom of infections.
>
> *(Dr. Sheppard, August 31, 2011, p. 57, l. 37 – p. 58, l. 26)*

91. As a result of this information, the Province submits the Commission should come to the conclusion that ISA is not present in British Columbia, and the Province of British Columbia has competently run a regulatory program to monitor and ensure that ISA does not enter BC waters through human activities.

ISA AND THE EFFECT OF AQUACULTURE ON SOCKEYE SALMON

92. Even if ISA were in British Columbia, it is not a disorder that affects sockeye salmon. Dr. McWilliams testified to this point and stated:

> Q And you've worked on ISAV, then?
> DR. MacWILLIAMS: Yes, I did that during my Master's

47 thesis work. And infectious anaemia virus is --

22
PANEL NO. 55
In chief by Mr. Martland
August 22, 2011
1 has just been shown to cause natural infections in
2 marine farmed Atlantic salmon. Under experimental
3 conditions they have -- certain labs, including
4 mine, have been able to experimentally infect
5 using a high dose of a very pathogenic strain of
6 the virus and cause disease in other species. In
7 my case it was rainbow trout or Oncorhynchus
8 genus.
9 And but work done on Pacific salmon has shown
10 that Pacific salmon are relatively resistant to
11 the disease. You can infect them with a high dose
12 of a strain in very unnatural conditions in a
13 laboratory, and you can -- but most Pacific salmon
14 species, they weren't able to cause disease. They
15 were able to just have application of the virus,
16 but the fish did not actually get sick.
17 So it is important to note that Atlantic
18 salmon are the only species that have ever shown
19 natural infection in a wild environment.

(Dr. MacWilliams, August 23, 2011, p. 21, l. 45 – p. 22, l. 19)

93. In such circumstances, ISA from aquaculture facilities is not a risk to sockeye salmon in British Columbia because;

i. It is not in British Columbia; and

ii. Even if it were, ISA does not cause disease in sockeye salmon.

MILLER'S GENOMIC SIGNATURE

94. Dr. Miller was the lead author of a paper which identified a unique genomic signature that is associated with salmon mortality and was published in Science Magazine in January, 2011 (the "Science Paper").

(Exhibit 558, Genomic Signatures Predict Migration and Spawning Failure in Wild Canadian Salmon)

95. This research is clearly important and could have important implications for sockeye management now and in the future. It may (or may not) have uncovered evidence of a novel parvovirus which has never been identified in fish before.

96. This research is ongoing. No firm conclusions have yet emerged, although there are a number of interesting hypotheses surrounding what causes the genomic signature and whether or not it is predictive in all circumstances.

97. A number of people gave evidence in regards to this ongoing research. They were:

a. Dr. Hinch
b. Dr. Miller
c. Dr. Garver; and
d. Dr. Marty

DR. HINCH'S EVIDENCE

98. Dr. Hinch was a coauthor of this Science Paper and testified March 8 and 9, 2011. He was the lead person dealing with the telemetry systems, collecting

the telemetry data, supervising graduate students involved in the paper, and was also involved in writing the paper.

(Dr. Hinch, March 9, 2011, p. 3, ll. 30-36)

99. Dr. Hinch testified there was a stock effect. Scotch Creek correlated with the genomic signature; however Late Shuswap, Adams and Chilko did not.

(Exhibit 558, Genomic Signatures Predict Migration and Spawning Failure in Wild Canadian Salmon, p. 215, fig. 2)
(Dr. Hinch, March 9, 2011, p. 16, ll. 16-23)

100. As of March 9, 2011, Dr. Hinch testified that no virus had been identified and the existence of a virus was still only a hypothesis.

(Dr. Hinch, March 9, 2011, p. 6, ll. 19-28)

101. Dr. Hinch also testified that there were a number of alternative hypotheses for the presence of the genomic signature which included:

a. Stress,
b. Inflammatory Responses,
c. Greater demand for energy,
d. Shifting metabolic pathways, and
e. Rapid maturation and resulting desire to reach the spawning grounds faster.

(Dr. Hinch, March 9, 2011, p. 6, l. 42 – p. 8, l. 43)

102. Dr. Hinch testified that he collected additional samples for destructive sampling and further detailed analysis. The fish samples were killed by a blow to the head.

(Dr. Hinch, March 9, 2011, p. 10, ll. 15-33)

DR. MILLER'S EVIDENCE

103. Dr. Miller testified on August 24-25, 2011, and was qualified by the Commission as an expert in the areas of molecular genetics, immunogenetics and functional genomics with a specialty in salmon. She was the lead author of the Science Paper and has been involved with this research for several years.

104. She does not consider herself to be an expert in virology. She is collaborating with Dr. Garver who is an expert in virology.

(Dr. Miller, August 24, 2011, p. 2, ll. 15-33)

105. Several years ago, using functional genomics, Dr. Miller discovered a genomic signature that showed an association with spawning success in some of the studies that she conducted.

106. In the ocean tagging study, Dr. Miller found an association in the unsupervised analysis but not in the supervised analysis. The unsupervised analysis results for the mortality-related signature were based on 10 fish, of which 6 showed a correlation with mortality and 4 did not.

(Dr. Miller, August 24, 2011, p. 63, l. 16 – p. 64, l. 45)

107. Dr. Miller confirmed that there were differing effects amongst different stocks in the freshwater studies, and confirmed that Scotch Creek did correlate but Chilko and Late Shuswap did not. She thought it may have something to do with differing tolerance for water temperatures.

(Dr. Miller, August 24, 2011, p. 67, l. 14 – p. 68, l. 20)

108. Between the time Dr. Hinch and Dr. Miller testified, Dr. Miller had done some preliminary work which suggested a novel parvovirus may have been found. She has now, with the assistance of Dr. Garver, identified 50% of the parvovirus genome. With 50% of the gene sequence identified, Dr. Miller does not think that the sequence could be related to chance alone.

(Dr. Miller, August 24, 2011, p. 75, ll. 10 – 26)

109. Dr. Miller and Dr. Garver are now conducting challenge work to look at prevalence rates and infectibility. Some of the work will involve smolts that tested positive for this genomic signature in the marine environment.

27 Q And at this point have you done any histopathology
28 to determine if the genomic signature or
29 parvovirus is associated with disease?
30 DR. MILLER: That again is something that we're going
31 to concentrate on with the disease challenge work.
32 We have done a little bit of histology, taking
33 some fish that were parvovirus positive from --
34 that were sampled from smolts sampled in the
35 marine environment. The thing to recognize is
36 that when we sample fish in the marine
37 environment, at the time that we're sampling them,
38 we're sampling live fish. We're not sampling at
39 the time of death.
40 And I am not a histologist, but from what I
41 understand of histology, the histology will become
42 a lot stronger and more powerful and easier to
43 detect if you're sampling fish at a later state of
44 -- at the latest state of disease. And most -- a
45 lot of histology that's done in concert with
46 disease, but not all - Gary Marty has a study on
47 herring that looked at wild herring - has
76
PANEL NO. 56
Cross-exam by Ms. Callan (BCPROV)
August 24, 2011
1 concentrated on fish that -- moribund fish, or
2 fish that are sampled close to death.
3 So when he -- he processed these, we only
4 looked at about ten or 12 samples and he didn't

5 see anything that -- that through histopathology
6 was really conclusively suggested that there was a
7 histological feature that would be associated with
8 mortality.

(Dr. Miller, August 24, 2011, p. 75, l. 27 – p. 76, l. 8)

110. At this point, the genomic signature appears to affect different fish in different ways. In her paper, some affected fish had one biological pathway up-regulated while other affected fish had the same pathway down-regulated. As a result, at this point in their research they cannot predict which effect or symptom the fish will have; this will require some more detailed studies. Dr. Miller described the complexity as follows:

43 Q Now, I understand you had some complex results and
44 in seven of the 40 biological processes some were
45 at the same down-regulated and up-regulated?
46 DR. MILLER: That means you really can't describe, you
47 really can't prescribe which direction the pathway

PANEL NO. 56
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1 goes. That is quite common in microarray studies
2 that, you know, sometimes it's very clear what
3 your directional. But what you have to understand
4 about -- about the technique is there are genes
5 that can be negative effectors and genes that can
6 be positive effectors of a pathway. So you can
7 have a gene that actually when it's turned on,
8 it's turning the pathway off. Right? And then
9 you can have other genes that when it's turned on,
10 it's turning the pathway on. So it is quite
11 complex.
12 So when you get this -- when you get this
13 mixed pattern where it's not really clear that
14 most of the genes are being stimulated, then you
15 have to go and say, okay, what's the effector of
16 each of these genes? What do they do, and is it
17 that you have ones that are being, you know,
18 turned off are actually the repressor. So it can

19 be quite complicated.
20 We didn't go into that detail here and most
21 people don't. Most people simply show which ones
22 are obviously being activated and deactivated, and
23 that's what we've done.

(Dr. Miller, August 24, 2011, p. 71, l. 43 – p. 72, l. 23)

111. Early on in Dr. Miller's research she thought plasmacytoid leukemia might be involved, based on the presence of brain lesions (optic tumours). The Aquaculture Coalition suggests this is the case, and that plasmacytoid leukemia is caused by aquaculture farms (which the Province disputes).

112. Dr. Miller seems to have abandoned the plasmacytoid leukemia hypothesis after histology tests conducted by Dr. Marty determined the lesions were hemorrhagic, and probably caused by concussion or blunt force trauma.

4 Q Okay. If we turn to page 11 of this presentation,
5 just reading the title at the top, it says:
6
7 Strong Linkages of Genomic and Brain Tumour
8 Data With Plasmacytoid Leukemia caused by the
9 Salmon Leukemia Virus.
10
11 Now, you've just clarified that these weren't
12 brain tumours. Did you find any linkages between
13 these what you thought were tumours and the
14 mortality-related signature?
15 DR. MILLER: Okay. The answer is no, but you have to
16 understand that at the time that we were
17 dissecting these brains for looking in the optic
18 lobes, in order to do microarrays, we have to take
19 RNA from an entire brain and so all of our studies
20 that delineate this signature would have used up
21 all of the brains. And so when we went to look
22 for evidence of plasmacytoid leukemia in these
23 brains, we had to sample brand new brains. So we
24 followed this up with a study that where we had
25 scored individual brains for whether or not they
26 contained these lesions, which turned out to be,
27 according to Gary Marty, according to a sample

28 size of about 12 fish, that turned out to be
29 haemorrhages and from that, we determined that our
30 signature was not correlated with the presence of
31 these lesions.

(Dr. Miller, August 24, 2011, p. 28, ll. 3-30)

113. Dr. Miller confirmed that the samples that were used in her early research were not histology grade samples, and that the brain lesions or suspected optic tumours were a sampling artefact of blunt force trauma caused by the method used to kill the fish.

28 Q I understand that his conclusion was that they --
29 the lesions were related to blunt force trauma.
30 DR. MILLER: You're talking about the brains.
31 Q That's right.
32 DR. MILLER: So we sent in 2009 when we first observed
33 what we thought were abnormalities in the brain,
34 we had histological slides made of those. Those
35 were from -- the slides were made in our Fish
36 Health group. They took one -- they took two
37 slices from the middle of the brain, and made
38 slides into them -- or made them into slides.
39 They took 12 brains total. All of those brains
40 came from the spawning grounds.
41 You know, one of the issues is that when
42 we're doing our genomics, as I said before, we're
43 doing the genomics and we use the whole brain. So
44 and the other thing is that when we're doing --
45 when we're doing the dissections or even the
46 collections, we don't collect histology-grade
47 brains. We collect this -- these samples for

1 doing RNA work, and the kinds of the chemicals one
2 uses for that are different from the kinds of
3 chemicals you would use for histology.
4 So the only reason I'm bringing that up is

5 that those were the only brains that we had that
6 were collected in -- that were either collected in
7 a chemical and never frozen, which you can't
8 freeze if you're going to do histology, or they
9 were collected in histology chemicals. So
10 although we'd seen these what we thought was
11 anomalous in smolts and in other -- in other
12 points along the migration, the only samples we
13 had available to run histology on were spawning
14 ground samples.
15 And so Dr. Marty got 12 brains that we had
16 classified according to whether or not they
17 contained these what we thought again were
18 lesions. And when he read those slides, he
19 concluded that they were likely arising from
20 haemorrhages and they were likely arising from
21 haemorrhages from as a sampling artefact, as an
22 artefact of the handling of the fish.

(Dr. Miller, August 24, 2011, pp. 26-27; p. 28, ll. 4-31; p. 73, l. 28 – p. 74, l. 22)

114. Dr. Miller also was unaware that Dr. Kent had revised his thinking on plasmacytoid leukemia. In recent years the symptoms of disease that he thought that were associated with plasmacytoid leukemia were found to be associated with *Nucleospora* (not a virus) and as a result Dr. Miller doesn't really know where to go with that theory given the new information that plasmacytoid leukemia may not be caused by a retrovirus.

(Dr. Kent, August 23, 2011, pp. 4-6)
(Exhibit 1512, Hypothesis - Genomic Data Indicate a Potentially Novel Disease, p. 3)

DIAGNOSTIC TOOLS

115. The Province anticipates that a party may recommend that a diagnostic tool be created from the genomic signature identified by Dr. Miller. The Province thinks that at this early stage of research a diagnostic tool based on the genomic signature would be inadvisable, and should not be recommended.

116. At this point, no consistent pattern for prevalence of the genomic signature in a particular tissue has been established. Dr. Miller testified:

> 18 Q So you have this additional information on the
> 19 mortality-related signature in other tissues and
> 20 you said also for other returning years and other
> 21 lifecycles?
> 22 DR. MILLER: Yes, in 2005, we profiled gill, liver and
> 23 brain tissue in all the same fish, and we observed
> 24 the mortality-related signature in each of those
> 25 tissues, but interestingly, very different
> 26 prevalence rates in different tissues and
> 27 individuals didn't necessarily contain that
> 28 signature in all tissues. In fact, it was more
> 29 common for them to contain the signature in only
> 30 one or two tissues.

(Dr. Miller, August 24, 2011, p. 6, ll. 18-30)

117. Neither Dr. Miller nor Dr. Garver thought of developing a diagnostic tool to determine which particular individual fish would die. Dr. Miller explained that there is a continuum of intensity of effects on the individual fish, and if a particular fish has the genomic signature they may not have a lethal effect.

> 11 Q Okay. So for this purpose of my next set of
> 12 questions, it's going to be about determining
> 13 whether or not a diagnostic test can be derived
> 14 from this, because I'm anticipating my friends
> 15 might recommend that we could try to test for
> 16 these fish using the genomic signature. So that's
> 17 going to kind of form where I'm going.
> 18 So essentially 40 percent of the time you
> 19 would be -- you would be incorrect if you tried to
> 20 predict based on this test?
> 21 DR. MILLER: "Forty percent of the time you would be
> 22 incorrect", I think there's something that is in
> 23 the *Science* paper that I need to explain. And
> 24 that is that what we found with this signature,
> 25 and it makes obvious sense when you think about
> 26 it, is that the individuals on the extremes of
> 27 this signature, the individuals that are most

28 highly affected, which are those on this -- on
29 this figure that would be way to the left-hand
30 side, as you go on this, on this almost continuous
31 gradient, you have individuals that are highly
32 affected, individuals that are something in the
33 middle that don't really have any effect and, you
34 know, have -- and then you have individuals on the
35 other side.
36 If you envision this as individuals having
37 exposure to a flu bug, and having the flu, and
38 having pneumonia, right. So you have a very
39 different probability of survival if you have
40 pneumonia than if you simply were exposed to the
41 flu bug. And this could be, it doesn't even have
42 to be a disease scenario. If you had individuals
43 that were starving and you were nutritionally
44 deprived, and some that were well fed, you would
45 only expect that there would be an effect on
46 survivorship on the ones that are starving, not
47 the ones that are just nutritionally deprived.

PANEL NO. 56
Cross-exam by Ms. Callan (BCPROV)
August 24, 2011
1 And so this is the way that we have looked at
2 this data, and others have, as well, in other
3 kinds of studies. What we're looking for are the
4 physiological extremes. And so you're absolutely
5 right, there is no predictive power for fish that
6 are intermediate in this signature.

(Dr. Miller, August 24, 2011, p. 65, l. 8 – p. 66, l. 6)

118. Dr. Garver agreed that you would not use the genomic signature for a diagnostic tool that was incorrect 40% of the time, and thought a better tool would be a biomarker or something that is definitely linked to the virus.

20 Q Okay. Now, in this case where the ocean-tagging
21 studies only predicted 60 percent of the time, is
22 this data that you would find suitable to create a
23 diagnostic test from?
24 DR. GARVER: Well, like I said, you have to identify

25 that signature to ensure that it is definitively
26 just to that virus. For a diagnostic answer, you
27 have ensure specificity and sensitivity. So in
28 other words you want to ensure that you have no
29 false positives, and to do that, you need a
30 specific biomarker for that virus.
31 So if you're able to identify a specific
32 signature for virus A, then, yes, you could use a
33 genomic profile to diagnose that. But typically,
34 if you know what the agent is, you're going to
35 seek the agent, you're going to look for the
36 agent. You're not going to use genomics as a
37 diagnostic. You potentially could, but why would
38 you if you know what virus you're looking for,
39 you're going to look for the virus.

(Dr. Miller, August 24, 2011, p. 66, ll. 20-39)

DR. MILLER'S GENOMIC SIGNATURE AND IMPACT FROM AQUACULTURE

119. Dr. Miller's genomic signature has been found in sockeye smolts so it is unlikely to have originated at aquaculture facilities.

12 Q Now, of course everyone's been very curious about
13 your work, and that includes my client, the B.C.
14 Salmon Farmers Association. And is it true to
15 characterize the discussions you've had with the
16 B.C. Salmon Farmers generally, and maybe more
17 specifically with Mary Ellen Walling, the
18 Executive Director of the Salmon Farmers
19 Association, that you've indicated to the
20 association that the data you have to date doesn't
21 point to a strong involvement of salmon net pens
22 in the transmission of the virus to migrating
23 salmon?
24 DR. MILLER: We have no direct data on aquaculture
25 fish. However, the finding that fish are leaving
26 the river with the highest prevalences of this
27 would stand to suggest that a lot of the
28 transmission of this virus - and I'm talking the
29 virus right now, but one could say the signature,
30 as well - because the highest prevalence of the

> signature is also in freshwater, seems to emanate out of the freshwater environment. That doesn't mean that there couldn't be transfer in a marine environment, but it does mean that we don't have data pointing to that.
>
> *(Dr. Miller, August 24, 2011, p. 81, ll. 12-35)*

120. Regardless, the salmon farms have provided samples to Dr. Miller and hopefully her results will be available in the future to establish whether the genomic signature is found at the aquaculture facilities.

PLASMACYTOID LEUKEMIA/MARINE ANAEMIA

121. The Aquaculture Coalition submits that plasmacytoid leukemia is the cause of the decline of Fraser River sockeye salmon productivity based on what they say is the finding of symptoms of plasmacytoid leukemia in one farm along the migration route in 2007. The Province disagrees, and says there is no merit to this theory.

122. The Aquaculture Coalition tries to merge the findings of Miller's genomic signature with plasmacytoid leukemia. The Province says they are two separate issues and should not be confused with each other.

123. The Aquaculture Coalition also argues that the number of diagnoses of plasmacytoid leukemia should be higher and should be based on the number of reports of the "ISH" lesion in Dr. Marty's database.

MERGER OF DR. MILLER'S GENOMIC SIGNATURE WITH PLASMACYTOID LEUKEMIA

124. The Province disputes both of these theories, and says there is no merit to them. Dr. Miller testified several years ago she thought the genomic signature may be plasmacytoid leukemia due to the finding of brain lesions. The issue of brain lesions was abandoned after it was discovered the brain lesions were a result of the fish being sacrificed via a blow to the head. Without the presence of cancer cells in the brain, the idea of plasmacytoid leukemia has no merit.

PLASMACYTOID LEUKEMIA MAY NOT BE CAUSED BY A VIRUS

125. Plasmacytoid leukemia originally was thought to be associated with a retrovirus called salmon leukemia virus but a retrovirus was never isolated or sequenced. In later studies, the fish that presented with the clinical signs of plasmacytoid

leukemia were all infected with the parasite *Nucleospora* (i.e. not a retrovirus). Therefore *Nucleospora* is the only identified organism known to cause plasmacytoid leukemia.

27 DR. KENT: Okay, so as I discussed yesterday -- and I
28 probably need to reiterate this a bit again today,
29 because it's a complicated story. We were looking
30 at fish, let's say, starting in the late 1980s,
31 early 1990s, that had histological presentation
32 which we described as plasmacytoid leukemia, an
33 excessive proliferation of immature plasma cells -
34 it's a white blood cell type - in chinook salmon
35 from certain - and farms - and that was the fish
36 that we did our work on, on isolating viruses,
37 cell-free transmission, basically collecting the
38 evidence that was most suggestive of a viral
39 ideology.
40 That work was done in the early 1990s. After
41 that, we continued to see fish that presented with
42 that histological change, basically lesions, the
43 proliferation of white blood cells that fit that
44 diagnosis. In further cases, almost all those
45 were infected with a parasite called *Nucleospora*
46 *salmonis*. We didn't continue to look for viruses
47 after the early 1990s. The virologist I was
5
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1 working with, Dr. Bill Eaton, who was at Malaspina
2 College at the time, he left Malaspina around that
3 time and basically the work actually specifically
4 looking at the virus was gone.
5 However, we continued to see, through the
6 '90s, fish with lesions that -- from chinook farms
7 and occasionally in wild fish that had changes
8 consistent with that. Dr. Stephen might be able
9 to address when the last -- a little bit more. He
10 did a lot of survey work on the condition of
11 farms, so maybe he might be able to add a little
12 bit to that.

(Dr. Kent, August 23, 2011, p. 5, ll. 2-12)

A FINDING OF AN “ISH” LESION DOES NOT JUSTIFY A DIAGNOSIS OF PLASMACYTOID LEUKEMIA

126. The Aquaculture Coalition argues that Marine Anemia should be suspected anytime the “ISH” lesion is found in BCMAL’s documents. ISH is described by Dr. Marty as follows:

> Interstitial (hematopoietic) cell hyperplasia (kidney); ISH is evidence of increased demand for erythrocytes or white blood cells somewhere in the body. In Chinook salmon, this lesion is often associated with the clinical diagnosis of "Marine anemia".

(Exhibit 1565, Provincial Codes for Disease, Farms Names, Histology, worksheet “FH Histopath abbrev”, row 30)

127. The Aquaculture Coalition again misunderstands what this statement indicates, and claims that plasmacytoid leukemia is present whenever the ISH lesion is identified. In making their argument, the Aquaculture Coalition created a chart of all the times an “ISH” lesion was found in the caudal kidney without consideration of severity. Dr. Saksida testified that ISH lesions are required to be found <u>in two different organs</u>, in addition to other clinical symptoms, before a diagnosis of plasmacytoid leukemia can be made:

> 38 Q My next and final question is as to - and I'll
> 39 mispronounce it - plasmacytoid leukemia: (a) can
> 40 you clarify how it was diagnosed in the '90s
> 41 versus today; and (b) is there a difference
> 42 between plasmacytoid leukemia and marine anaemia?
> 43 DR. SAKSIDA: They're actually synonymous. Basically
> 44 when we call it marine anaemia, it's just the
> 45 common name for plasmacytoid leukemia.
> 46 Q All right.
> 47 DR. SAKSIDA: The way it was diagnosed in the '90s is
>
> 1 very -- is no different than is diagnosed now.
> 2 The gold standard is histology so you have to have
> 3 an increase of blast cells in two organs. One is
> 4 usually the kidney and it either is in the liver
> 5 or the heart or the brain is usually the second.
> 6 So you have to have interstitial hyperplasia in
> 7 two organs, plus you have to have the clinical
> 8 signs of the swollen kidney and enlarged spleen
> 9 and pale gills.

(Dr. Saksida, September 6, 2011, p. 109, l. 38 – p. 110, l. 9)

128. Additionally, ISH is another common non-specific lesion. Ms. Morton failed to remove from her chart findings of "ISH lesions" where another disease was identified as the cause of the lesion. Dr. Marty addressed this problem in Ms. Morton's chart regarding Atlantic salmon during the Province's examination of Dr. Marty.

> 35 Q Dr. Marty, if we could turn back to Exhibit 1549
> 36 and BCP002864 for your answer on whether or not
> 37 ISH symptoms are -- what your thoughts are on ISH
> 38 symptoms being addressed in marine anaemia.
> 39 DR. MARTY: Okay. What I've done is ask Mr. Lunn to go
> 40 ahead and just collapse the spreadsheet and sort
> 41 the ISH scores from most severe to least severe.
> 42 And what he's done here is highlighted, there are
> 43 actually no severe cases, a score of 3, but he has
> 44 23 cases with a score of 2. Now, if you go down
> 45 the "Cause of Death" list on all of these, you'll
> 46 see that there is, for example, "HRS", Heart
> 47 *Renibacterium salmoninarum* or bacterial kidney
> 1 -- you go down the
> 2 row and there's several "RS"s. There's one "BHM"
> 3 on line 37, but if you look over at the "KRS"
> 4 line, there's actually a severe kidney, this is
> 5 bacterial disease.
> 6 Keep going down further, every one has a
> 7 cause of death that's either "RS", there are a few
> 8 that are "PS", which is *Piscirickettsia salmonis*.
> 9 Dr. Sheppard mentioned that those are two causes
> 10 that can cause ISH. So in this case we have a
> 11 cause of death for every one of these fish, and so
> 12 we don't need to use the diagnosis of marine
> 13 anaemia at all, and in fact these are not marine
> 14 anaemia like, that would not be an appropriate way
> 15 to designate them because we have another cause of
> 16 death instead of marine anaemia.

(Dr. Marty, August 31, 2011, p. 64, l. 35 – p. 65, l. 16)

129. Dr. Marty did not diagnose plasmacytoid leukemia in these fish because they did not have the diagnostic features of plasmacytoid leukemia. Dr. Kent agreed and stated in his evidence:

> 46 Q Yes. Now, if we could go back to the Pacific Tab,
> 47 these would be Chinook salmon. And if you could
>
> 34
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> 1 scroll across to the ISH column, which is I think
> 2 the AT column. Yes. So if you could highlight
> 3 the AT column, Mr. Lunn. Do you see that there,
> 4 Dr. Kent?
> 5 DR. KENT: Yeah, I see that.
> 6 Q And so fish-by-fish, you'll see that there's an
> 7 indication in the ISH column of marine anaemia.
> 8 DR. KENT: No, that's not right.
> 9 Q Well, the symptoms associated with marine anaemia.
> 10 DR. KENT: Interstitial hyperplasia of the kidney can
> 11 be caused by a vast number of organisms, including
> 12 plasmacytoid leukemia, or referred to as marine
> 13 anaemia. When we -- when we worked with this
> 14 disease and came up with a diagnosis, a diagnosis
> 15 for plasmacytoid leukemia would require seeing a
> 16 proliferation of immature lymphocytes,
> 17 particularly plasma cells. It's pretty difficult
> 18 to differentiate by histopathology in other organs
> 19 that go beyond the tissues where hemopoieses
> 20 occurs, that is when blood formation occurs.
> 21 So the kidney in fish is where blood is
> 22 formed. It's basically equivalent to our bone
> 23 marrow. So you could have a hyperplasia,
> 24 increased numbers of cells in the blood forming
> 25 organ, which would be the kidney interstitium,
> 26 caused by a vast number of organisms. When we
> 27 make a diagnosis of marine anaemia is when we see
> 28 these immature cells, basically a leukemia-like
> 29 condition occurring in organs outside of blood
> 30 forming organs.
> 31 So that would not be inconsistent with marine
> 32 anaemia, but would not be pathognomonic for marine

33 anaemia.

(Dr. Kent, August 23, 2011, p. 33, l. 46 – p. 34, l. 33)

THE LONE ALLEGED FINDING OF PLASMACYTOID LEUKEMIA ON THE MIGRATION ROUTE IN 2007

130. There then is the issue of the finding of plasmacytoid leukemia in one farm. This is also disputed by the Province.

131. The Audit that the Aquaculture Coalition has focused on was from Exhibit 1685, Histolopathology, Virology, Husbandry, Bacterial, Environment, etc. 2004- 2007, worksheet "3 Histology", l. 58. Data in this worksheet were entered by fish health technicians that summarized Dr. Marty's work for the fish health veterinarian. The relevant Audit is P.3-24.

132. Despite having an opportunity to do so, the Aquaculture Coalition did not put this to Dr. Marty—the person most knowledgeable about Exhibit 1685. Had counsel done so, this issue would have been clarified.

133. The entry for Audit P.3-24 states, "Loma salmonae; 23 of 24 had hematopoietic hyperplasia compadible (sic) with marine anaemia, but no direct evidence..."

134. Dr. Marty's spreadsheet does not include a diagnosis of marine anemia/plasmacytoid leukemia for any of the fish in this Audit (Exhibit 1678, Histopathology FHAS 2006-2010, showing data sorted for Province Dr. Marty, worksheet "Pacific", ll. 114-137, col. J).

135. The only cause of death that Dr. Marty assigned was *Loma salmonae*. The "FarmDx" assigned by the provincial fish health veterinarian, and not shown by Mr. McDade during the hearings, was "Loma" (Exhibit 1685, Histopathology, Virology, Husbandry, Bacterial, Environment, etc. 2004- 2007, worksheet "18FarmDx", cell F78), which is the microsporidian parasite *Loma salmonae*.

136. To summarize, the provincial audit reported a farm diagnosis of "*Loma salmonae*". The provincial audit did not diagnose "marine anemia" because there was "no direct evidence" of marine anemia/plasmacytoid leukemia.

137. The farm veterinarian did not report a "fish health event" for plasmacytoid leukemia because the fish did not have plasmacytoid leukemia. Even if the fish had plasmacytoid leukemia, however, it probably would not have been reported as a "fish health event" because there is no known treatment for plasmacytoid leukemia.

(Exhibit 1671, Fish Health Program 2006, p. 25, para. 5)

EFFECT OF PLASMACYTOID LEUKEMIA ON SOCKEYE SALMON

138. Plasmacytoid leukemia is a disease which primarily affects Chinook salmon. It doesn't seem to affect Atlantic salmon. With respect to sockeye salmon, even when sockeye salmon are injected with a tissue homogenate of a diseased Chinook salmon, no mortalities were observed.

(Exhibit 1488, Experimental Transmission of a Plasmacytoid Leukemia of Chinook Salmon)

139. The Aquaculture Coalition says that all of the Chinook salmon farms were removed from the outmigration route in 2008, and this is a factor why sockeye returns have improved. This is incorrect, and there were similar numbers of Chinook salmon farms in 2007 and 2008. Therefore there is no merit to this theory.

SEA LICE

140. The Conservation Coalition and Aquaculture Coalition identified sea lice as an issue in these proceedings. Largely, the experts agree that based on the available evidence sea lice themselves are not the cause of decline for Fraser River sockeye salmon, but disagree whether sea lice could act as a vector for diseases.

141. Neither Dr. Korman nor Dr. Connors could find a correlation between sea lice levels on the farms and sockeye salmon productivity. Both experts opined that a larger number of overlapping years to analyze would be required to draw firm conclusions.

(Exhibit 1543, Technical report 5A, Summary of Information for Evaluating Impacts of Salmon Farms on Survival of Fraser River Sockeye Salmon)
(Exhibit 1545, Technical report 5B, Examination of relationships between salmon aquaculture and sockeye salmon population dynamics)

142. Dr. Dill was generally unhappy with the number of available years for the purposes of his analysis, but agreed that based on the available data there was no evidence of a direct harmful effect on the system:

> "The Connors analysis failed to find a significant relationship between the number of lice in the farms during the spring migration period and survival of Fraser sockeye. This was true for both the larger *Lepeophtheirus* (including gravid females) and the smaller *Caligus* that, on a per parasite basis, are considered less pathogenic (Boxshall & Defaye 2006). So although there is evidence from field sampling that lice produced on the farms in the Discovery Islands are infecting wild sockeye juveniles, and lice are known to have deleterious effects on salmonid hosts elsewhere (Europe, the Broughton Archipelago), there is no evidence of a direct harmful effect in this system….":

(Exhibit 1540, Technical report 5D, Impacts of salmon farms on Fraser River sockeye salmon: results of the Dill investigation, p. 23, para. 3)

143. In oral evidence Dr. Dill agreed that 8-10 years worth of data would be required to draw a conclusion.

> 45 Q Dr. Dill, now I understand that you are of the
> 46 opinion that you need more data. How many more
> 47 years of data would you require to come to the
>
> 79
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> Cross-exam by Ms. Callan (BCPROV)
> August 26, 2011
> 1 conclusion that there is no correlation between
> 2 salmon and sockeye returns, and specifically,
> 3 farmed Atlantic salmon?
> 4 DR. DILL: Well, that's where we could do, I think, the
> 5 kind of power analysis that probably would agree
> 6 is valuable. It's the sort of situation where you
> 7 can look at your estimated effect size and predict
> 8 how many data points you would need to reject a
> 9 null hypothesis. I can only guess at that. I
> 10 would, you know, say perhaps eight to ten years
> 11 might be sufficient. Four or five, which is what
> 12 we have now, is certainly not.

(Dr. Dill, August 26, 2011, pp. 78, l. 45 – p. 79, l. 12)

144. In the Broughton Archipelago, where more years of farm sea lice data are available, farm salmon lice numbers were not significantly associated with pink salmon productivity during adult return years 2001-2009 (9 years).

(Exhibit 1555, Relationship of Farm Salmon, Sea Lice and Wild Salmon Populations, Abstract)

145. Dr. Noakes opined that sea lice were likely not the cause of the decline of Fraser River sockeye salmon.

> There is no significant correlation between the number of sea lice on farmed salmon and the return of Fraser River sockeye salmon. The average number of lice (*Lepeophtheirus salmonis*) on farmed salmon has decreased from approximately 3 lice/fish in 2004 to

between 1.0 lice/fish (annual mean) and 0.5 lice/fish (the April-June average- the time period when juvenile sockeye salmon are migrating past the salmon farms) in 2010.

(Exhibit 1536, Technical report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation, p. ii, para. 4)

146. In oral evidence Dr. Noakes noted he believed the results were stronger than Dr. Korman believed because, over two years, both the low end and high end of the range of sockeye salmon productivity were observed and balance out.

15 Q And my last question is for Dr. Noakes. Can you
16 tell me what you meant by your comment at page 7
17 paragraph 3 and specifically [as read]:
18
19 Not surprisingly, Connors' 2011 found that
20 the data from the 2005 brood year, the 2009
21 returns, exerted a high degree of leverage
22 that observation significantly influenced the
23 results and would by itself tend to
24 exaggerate any negative association. Also,
25 Connors' 2011 elected to not include data
26 from the record 2010 returns of Fraser River
27 sockeye salmon in his analysis for a variety
28 of reasons. Like 2009, I would fully expect
29 the 2010 return data would exert significant
30 positive leverage that would tend to reduce
31 the association between and among the various
32 factors?
33
34 DR. NOAKES: Yes, first of all, in terms of not
35 including the 2010, there are reasons why that
36 wasn't done. We don't have the five-year-olds and
37 we don't have an exact number. We know it was
38 very large. So not including that particular data
39 point is understandable, as I say, for a variety
40 of reasons.
41 But the reason I say the 2005 and talk about
42 the leverage on the 2010 is it goes back to a
43 point where I made before where we may have a
44 short time series, but we have a time series which
45 includes the highest and the lowest values that

46 we've ever seen in terms of returns to the Fraser
47 in terms of sockeye. So what happens is when you

1 have a data point which is far away from the mean,
2 it's like a lever on a wheelbarrow. The further
3 away you get from the wheel, the easier it is to
4 lift it up. So when you have data points that are
5 far away from the mean, they exert high -- it's
6 called high leverage on the relationship. So a
7 data point that's particularly low will tend to
8 pull the relationship towards that point, the way
9 the statistical estimation procedure works. So a
10 data -- for instance, the 2009 would tend to
11 exaggerate a negative effect whereas the 2010,
12 because you've got an exceptionally high, it would
13 counter-balance that. Essentially what it would
14 do is it would tend to pull the relationship in
15 the other direction because it's exerting high
16 positive leverage in terms of that. So as I say,
17 it's quite powerful to have those two points
18 there, even though they only have a few years of
19 data. It gives us extremely high contrast.
20 Q And Dr. Connors?

(Dr. Noakes, August 26, 2011, p. 80, l. 15 – p. 81, l. 20)

COMPETING PNAS PAPERS

147. Most of the research to date regarding sea lice from salmon farms and their effects on wild fish has been on pink salmon. Generally speaking, sockeye salmon are believed to be more resistant to sea lice than pink salmon because they are larger when they enter sea water.

148. When Technical Reports 5A-5D were prepared, the most recent paper on whether sea lice levels affected pink salmon populations was authored by Dr. Marty and Dr. Saksida (Exhibit 1555, Relationship of Farm Salmon, Sea Lice and Wild Salmon Populations). This paper concluded that there was no correlation between numbers of sea lice on the farms and Pink salmon returns (lice numbers were counted under the direction of licensed veterinarians and audited for accuracy by Provincial veterinarians). In the middle of the Disease and Aquaculture hearings, another paper authored by Dr. Krkosek, Dr. Connors, Ms. Morton and Dr. Dill came to contrary conclusions using the same data (Exhibit 1556, Effects of Parasites from Salmon Farms on Productivity of Wild Salmon).

149. The Province submits that the Commission should rely upon the paper of Dr. Marty et al. and not the Krkosek et al. paper.

150. In the Marty paper, sea lice numbers in March were estimated in 2000 to be 9.1 million (slightly greater than the amount in March 2001, which was 7.5 million.)

(Dr. Connors, August 26, 2011, p. 66)
(Exhibit 1555, Relationship of Farm Salmon, Sea Lice and Wild Salmon Populations, p. 2, fig. 1)

151. The only criticism leveled at this paper was by Dr. Dill who stated at page 11 of Exhibit 1540 (Technical Report 5D, Impacts of salmon farms on Fraser River sockeye salmon: results of the Dill investigation), “Most recently, Marty et al. (2010) failed to find a relationship between lice levels on farmed fish in the

Broughton and pink salmon survival; however, their analysis had a very small probabilities of being able to detect such an effect (it had what statisticians call low power), and was flawed in other ways as well."

152. However, Dr. Dill's criticism is flawed. Hoenig wrote a paper entitled "The Abuse of Power: the Pervasive Fallacy of Power Calculations for Data Analysis" (Exhibit 1551) which was put to the Project 5 panel and which resulted in a lively discussion at pages 49-54 of the August 26, 2011 transcript. Essentially, the Hoenig paper stands for the proposition that one should not do a post hoc power analysis and should only do this type of analysis before starting an experiment. On page 70 the Province put to the panel that Dr. Dill's analysis was the exact type of analysis which was criticized by Hoenig. The panel accordingly testified:

> 9 Q So my next set of questions will be to try to
> 10 parse out some of the differences between your
> 11 paper and Dr. Marty's paper. So you've reviewed
> 12 Dr. Marty's PNAS paper on sea lice where they
> 13 reported no relationship between lice levels on
> 14 farmed fish and -- in the Broughton and pink
> 15 salmon survival levels. Now, I understand that in
> 16 at least Dr. Dill's opinion in his report at page
> 17 11 at paragraph 2, that the analysis had a very
> 18 small probability of being able to detect such
> 19 effect. It had what statisticians call low power;
> 20 is that correct?
> 21 DR. DILL: So where (indiscernible - microphone off)?
> 22 Q It's page 11, para 2.
> 23 MR. LUNN: (Indiscernible - microphone off).
> 24 Q I'm referring to Dr. Dill's technical report. So
> 25 5D.
> 26 DR. DILL: Yes, I believe that's correct.
> 27 Q Okay. Now, I put it to you that this is the type
> 28 of analysis of low statistical power that was
> 29 criticized in Hoenig's paper?
> 30 DR. DILL: It is that sort of post hoc analysis.
> 31 Q Dr. Noakes, did you want to add anything?
> 32 DR. NOAKES: That's correct, it is the same analysis
> 33 that was criticized by Dr. Hoenig.
> 34 Q And I won't get into the debate we had before

35 lunch, but I take it that amongst the panel
36 there's differences of opinion between whether or
37 not that type of analysis is correct?
38 DR. CONNORS: I certainly don't disagree with the paper
39 that Hoenig wrote. I mean, I haven't gone through
40 it in detail, but I think the general criticisms
41 of post hoc power analysis where you use an
42 observed effect and ask whether or not it matters,
43 I believe, you know, believe in general with that
44 statement, yeah.
45 DR. NOAKES: Yeah, I would -- I think -- there are many
46 -- certainly there are many people that don't
47 believe in doing post hoc analysis, power
71
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1 analysis. The power analysis should be done when
2 you're planning an experiment, rather than after
3 the fact. You deal with that in terms of
4 significance and testing and creating an
5 appropriate hypothesis to test.

(Dr. Noakes and Dr. Dill, September 26, 2011, p. 70, l. 9 – p. 71, l. 5)

153. The panel also agreed that anytime you have a 1:1 analysis with non-significant findings there will be low power. The Province submits that in such circumstances the “power analysis” criticisms are unfounded and accordingly should be disregarded.

8 Q Okay. Now, at page 2 of Dr. Hoenig's paper he
9 says [as read]:
10
11 Because of the one-to-one relationship
12 between P values and observed power, non13
significant P values always correspond to low
14 observed powers.
15
16 Do you agree with this statement and anyone can
17 jump in and feel free to comment on that.
18 DR. NOAKES: I certainly agree with that statement.
19 Q And I take it from your nodding, Dr. Korman, that
20 you do?

21 DR. KORMAN: Yes, it's common result.
22 Q And Dr. Connors also nodding?
23 DR. CONNORS: Yes, correct.
24 Q Okay. And Dr. Dill is also nodding.

(Dr. Noakes and Dr. Korman, August 26, 2011,p. 71, ll. 8 – 24)

154. In the Krkosek paper on the same issue however, years 1990-2000 were excluded from the analysis because there were no farm sea lice data for those years. Dr. Connors (a coauthor) agreed that this assumption was a key one, and if lice were in fact abundant their results would change because the 2000 and 2001 pink salmon returns were very high. Dr. Connors testimony was:

24 Q Okay. And Dr. Dill is also nodding.
25 Now, in your paper which is Provincial Tab 9
26 and Exhibit 1556, the missing data was just
27 ignored for the purposes of it and wasn't counted
28 in the conclusion. I put it to you that that's a
29 key assumption and without this assumption, you
30 wouldn't have reached the same conclusion. And
31 specifically to help you, I've just got a quote
32 from page 3 of your study which says:
33
34 If lice were present but at a regionally
35 negligible abundance before 2000, then there
36 would likely be little change to the results.
37 However, if lice were in fact abundant and
38 infestations of wild juvenile salmon occurred
39 in the 1990s, the estimated effect of lice on
40 wild salmon survival would likely be
41 diminished due to high salmon returns in
42 those years.
43
44 Do you agree with that statement?
45 DR. CONNORS: Yes, I agree with that statement. I
46 think the important thing to note here is that
47 that doesn't say that if we had information that

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1 went back then that these results wouldn't hold,
2 or these patterns wouldn't hold. We have to make
3 an assumption or in this case we have to, you
4 know, leave that data out because we don't have
5 that data for this analysis. Now, we go on to
6 detail a possibility or a plausible scenario which
7 has been demonstrated elsewhere whereby a regional
8 host threshold might be passed, but again, that's
9 simply some speculation given some of the
10 available information and so we felt the most
11 rigorous way to do this was to treat that as
12 missing data and use those reference populations,
13 as well as information back through time, to
14 better estimate all the other aspects of our model
15 and better isolate any potential influence or
16 correlation with sea lice on farmed salmon.

(Dr. Connors, August 26, 2011, p. 71, l. 24 – p. 72, l. 16)

155. Dr. Noakes added that this assumption was akin to setting the lice levels to zero. Dr. Connors disagreed. The effect however is to exclude several years with high pink salmon returns which is submitted to be similar.

17 DR. NOAKES: I think you're correct though in the sense
18 that by setting those to zero, you're not
19 significantly different than the analysis that you
20 had in the first Krkosek paper and where they
21 explicitly assumed that it was. I mean,
22 essentially setting them to zero is implicitly
23 having that assumption that lice were a problem
24 before that time.
25 DR. CONNORS: That's a really important point. We did
26 not set it to zero. That would be assuming that
27 there were no lice on farmed salmon during that
28 time. We simply omitted that data from the
29 analysis, which is different than setting farmed
30 -- the number of lice on farmed salmon - our
31 covariate - to zero during that time period.

(Dr. Noakes and Dr. Connors, August 26, 2011, p. 72, ll. 17-31; p. 73)

156. This assumption which resulted in an effective number of lice prior to 2001 being zero does not accord with the observations of lice levels from experts in the field prior to 2001. The day before the second PNAS paper was published, Dr. Johnson was asked about whether there were sea lice in the 1990s on the farms in British Columbia, and what his thoughts were with respect to whether assuming there were sea lice prior to 2001 was better than assuming there were none. Dr. Johnson stated that there were more sea lice in the 1990's, and it is more difficult now to find sea lice in sufficient quantities to do scientific studies:

> 27 Q Okay. Now, I'm just going to turn to an issue
> 28 with respect to sea lice in the 1990s. Several
> 29 scientific papers without access to provincial or
> 30 federal or farm sea lice data, for example,
> 31 Brendan Connors' 2011 paper, which is set out at
> 32 Provincial Tab 14, claim that sea lice
> 33 infestations of wild salmon began in 2001. In
> 34 contrast, another scientific paper that had access
> 35 to the provincial sea lice data published by Dr.
> 36 Marty in 2011 claimed that farm-sourced sea lice
> 37 probably infested juvenile pink salmon many years
> 38 before the pink salmon were first examined for sea
> 39 lice in 2001. Which one of these assumptions best
> 40 fits your experience with sea lice in British
> 41 Columbia during the 1990s?
> 42 DR. JOHNSON: As I mentioned, in the 1990s, sea lice
> 43 were always present on salmon farms at levels
> 44 which made it worthwhile going to the salmon farms
> 45 to collect sea lice. Now, it's extremely
> 46 difficult to do sea lice research in B.C., because
> 47 it's often difficult, unless you go to wild fish
>
> 104
> PANEL NO. 55
> Cross-exam by Ms. Callan (BCPROV)
> August 22, 2011
> 1 when they're returning, to get sufficient sea lice
> 2 from a salmon farm to conduct any sorts of studies
> 3 on sea lice.

(Dr. Johnson, August 22, 2011, p. 103, l. 27 – p. 104, l. 3)

157. Dr. Saksida agreed and stated:

> 29 Q Now, I understand the major difference between the
> 30 two papers involves assumptions made in order to
> 31 run a mathematical model. In your paper you
> 32 assume there were slightly higher lice levels
> 33 before 2001 when SLICE became available, and the
> 34 Connors, Dill, Krkosek and Morton PNAS paper
> 35 excluded these years from the analysis. Do you
> 36 have any thoughts on which assumption more
> 37 accurately reflects biological reality at the
> 38 Broughton Archipelago before 2001?
> 39 DR. SAKSIDA: Having been a veterinarian for several of
> 40 the sites in the '90s, I would say that our
> 41 assumption is more valid that there was sea lice
> 42 on farmed salmon prior to 2000.
>
> *(Dr.Saksida, September 6, 2011, p. 68, ll. 29–42)*

INTERNAL INCONSISTENCIES

158. As well, further diminishing the utility of Exhibit 1556, were internal inconsistencies. Dr. Saksida discussed this at page 69:

> 4 Q Okay. Well, I understand upon a review of Exhibit
> 5 1556, that there is some internal inconsistencies,
> 6 and specifically two different measures are used
> 7 for coho and pink salmon. The best of the four
> 8 alternative models for coho salmon is considered
> 9 to be the worst of the four models for pink
> 10 salmon.
> 11 DR. SAKSIDA: If you move down to the -- I think it's
> 12 Table 1 or Table 2, if you just scroll down.
> 13 Yeah, that page. You can see -- actually, I think
> 14 it's Table 2. I'm not a statistician, but I think
> 15 what is being referred to that I think he used
> 16 that "KAIC" to determine which is the best model.
> 17 And it looks like for pink salmon it's model
> 18 number 2, which assumes that basically no lice
> 19 prior to 2003, if there was no farm data.
> 20 Whereas, in coho, the best model is model number
> 21 1, which indicated -- is using the same data or
> 22 assumptions we made, which assumes large numbers
> 23 of -- if you basically zoom out and go down, you
> 24 can see model 1 has a high estimate of sea lice
> 25 abundance, and that one is the one that seems to
> 26 explain the coho salmon, whereas model 2, which
> 27 has a very low estimate of sea lice abundance on
> 28 farm fish appears to be the best model for the
> 29 pink salmon…
>
> *(Dr. Saksida, September 6, 2011, p. 69, ll. 4-29)*

159. Dr. Saksida was also concerned regarding how mortalities were considered for the purposes of the paper.

> 30 However, there's some issues with even
> 31 mortality estimates for the coho salmon, since
> 32 most of the data that's been available to date has
> 33 shown that coho salmon are actually highly
> 34 resistant to sea lice infections. There is a
> 35 paper from Stewart Johnson and Larry Albright
> 36 that was published in 1992 that did an

37 experimental, basically a lab study, and they
38 found that coho were actually more resistant to
39 sea lice infections than either Atlantic salmon or
40 chinook salmon.
41 Then, and I know, I understand that Craig Orr
42 has problems with lab-based studies. There was a
43 study done in the field by Nagasawa, Ho and
44 Nagasawa, in Japan where they actually exposed
45 coho salmon and rainbow trout in farms. They put
46 them in, in the fall, just as the chum were coming
47 back and these fish basically became -- or the
70
PANEL NO. 61
Cross-exam by Ms. Callan (BCPROV)
September 6, 2011
1 fish became infected from the lice from the
2 returning fish. The interesting fact is that it
3 was rainbow trout that became infected and the
4 coho only became infected several months later,
5 and it was only the pre-adults -- oh, it was the
6 adult motile stages.
7 So his conclusion in that paper was that in
8 fact coho are highly resistant to sea lice, to
9 *Leps salmonis*, the salmon louse, and the only way
10 they actually became infected in this study was
11 through cohabitation, through the motiles moving;
12 he suggested it was the motiles moving from the
13 rainbow trout to the coho. And as a veterinarian
14 who has worked with coho, chinook and Atlantic
15 salmon, I can tell you I have never had to write a
16 prescription or had to treat either chinook or
17 coho for the salmon louse.

(Dr. Saksida, September 6, 2011, p. 69, l. 30 – p. 70, l. 17)

160. With all of these factors considered, as well as the fact that none of the authors in the Krkosek paper are fish health professionals, the Province submits that Dr. Marty et al. paper should be preferred over Krkosek et al. paper. The finding that even the most susceptible salmon species (pink salmon) does not show any population level effects with changing sea lice levels should be accepted by the Commission.

(Dr. Noakes, August 29, p. 82, l. 10 – p. 83, l. 11)

SEA LICE AS A VECTOR

161. Dr. Noakes thought there was the potential for sea lice to act as a vector, but thought there were more effective means of transmission based on information he learned from Dr. Garver. He addressed this point by saying:

> There is also the potential for sea lice to act as vectors for other pathogens (for instance, BKD or IHN) that may cause disease in sockeye salmon (Barker et al. 2009; Nese and Enger 1993). It is certainly possible to isolate a pathogen such as IHN from sea lice and to cause a disease through injection but disease agents have evolved more effective modes of transmission (K. Garver, pers. comm.). For instance, IHN can spread very effectively through water- much more effective and efficiently than using sea lice as a vector (K. Garver, pers. comm..). Thus, the transfer of disease through via a sea lice vector is unlikely to be of significance at a population (salmon) level.

(Exhibit 1536, Technical report 5C, Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation, p. 20, para. 2)

162. Dr. Dill thought lice might be playing a role as pathogen vectors even if they were only attached for a short time before being shed.

(Exhibit 1540, Technical Report 5D, Impacts of salmon farms on Fraser River sockeye salmon: results of the Dill investigation, p. 23, para 3; p. 29)

163. This point was put to both experts and they both agreed that it was possible, although no one had demonstrated it had an impact.

> 26 Q Yes. Also, elsewhere in your report, Dr. Noakes,
> 27 I won't take you to it, although I can, you
> 28 acknowledge that sea lice have the potential to
> 29 serve as vectors for other pathogens, indeed, you
> 30 give the example with respect to BKD or IHN; is
> 31 that right?

DR. NOAKES: Could you repeat that question, sorry?
Q Sure. It probably wasn't very clear. Page 20 of the report may situate that discussion within the same report.
DR. NOAKES: This doesn't look like...
Q So you'll read the paragraph near the top, "There is also the potential", you write:

There is also the potential for sea lice to act as vectors as for other pathogens (for instance, BKD or IHN) that may cause disease in sockeye salmon.

DR. NOAKES: Yeah, that's correct. There's two ways that that could happen, and it comes from conversations with fish health experts. One is

that they are physically attached to the outside of the lice, and the possibility is that they are somehow -- they have contracted or consumed or have the pathogen inside them and then transfer.
Q Okay. Dr. Dill, do you have any comment on that?
DR. DILL: I think I summarized it -- I know I summarized in my report a number of studies which have shown at least the potential for sea lice to act as vectors of various kinds of viruses and bacteria. I'm not sure that Dr. Noakes wants to suggest that the disease agents involved a vector or vectoring as a means of transmission. I think it's probably just an accidental consequence of their being either present on the surfaces of the lice or in their bloodstream. The potential is there. No one has demonstrated that it has a major impact.
However, I would say that since the lice are actively looking for a host, it could be a very effective means of transmission, because they're looking for another salmon, and so it's a more directed and less kind of a random process.
DR. NOAKES: I think the point I'm making in my report is that it's certainly possible that the pathogens have developed by themselves very effective means

of infecting fish. So, for instance, they don't need lice to actually do the transmission. And there's some evidence, for instance, in the Great Lakes where sea lamprey have transferred disease to fish, as well. So I mean, there's always a possibility of a number of organisms in the ocean transferring disease. But I think primarily the diseases themselves have come up with pretty effective ways of transmission.
I wasn't here for the disease panel, but certainly with my conversations with Dr. Garver and others that, for instance, IHN is very effectively transferred through water. So it wouldn't rely, and it probably wouldn't be a significant contribution at the population level for sea lice to be transferring IHN to fish. It's very effective in terms of transmitting through the water.

(Dr. Noakes and Dr. Dill, August 25, 2011, p. 100, l. 26 – p. 101, l. 43)

164. Dr. Saksida was also asked about the potential for sea lice to act as a vector for transferring disease from farm salmon to sockeye salmon and opined that transmission was more likely to occur through direct water transmission than through lice as a vector.

Q All right, thank you. Next, Dr. Orr -- Michael Price spoke of lice as a vector - I think it was Mr. Price. Dr. Saksida, do you have a comment about lice as a vector of pathogens?
DR. SAKSIDA: Again, most of the research that has been done has been lab-driven research. I think Simon Jones has actually been involved in some of those with VIU, so he can probably speak to that point better than I could. He's more familiar with the research. But from my understanding, that sea lice are more of a mechanical vector than an actual, true vector for transmission of disease. It looks like they may, when a motile stage, a larger louse is attached to a fish, if there's another -- and they're diseased. If they're heavily diseased, this louse may actually pick up the virus or the bacteria, swim to the next host,

35 and there is potentially a transmission.
36 However, I did state earlier that most of the
37 diseases that they've investigated are water-borne
38 transmission, so again, if the fish are close
39 enough to be -- have a louse swim between them,
40 they're probably more likely to get exposed from
41 water-borne exposure than sea lice.

(Dr. Saksida, September 6, p. 26, ll. 18 – 41)

THE EFFECT OF SEA LICE FROM AQUACULTURE ON SOCKEYE

165. No demonstrable effect on sockeye salmon productivity has been found by any of the experts who examined the numbers of sea lice on salmon farms and sockeye salmon returns.

166. Pink salmon which are thought to be more susceptible to sea lice than sockeye have been extensively analyzed and if one accepts Marty's paper over Krkosek's paper, it is clear than even this "indicator species" of salmonid is not showing any effect from sea lice at a population level. Accordingly, the Province submits that the Commissioner should find that sea lice are not a factor in the decline of Fraser River Sockeye salmon.

IV. CONCLUSION

167. While there have been a number of disease risks identified for sockeye salmon, to date there has been insufficient evidence to conclude that the observed declines in Fraser River sockeye salmon are caused by diseases originating in, or amplified by, open-net aquaculture facilities.

168. Dr. Miller's research has identified DNA in sockeye salmon that might be a novel parvovirus, and it may or may not cause disease in sockeye. This research should continue, to establish whether or not the parvovirus causes

disease, where it occurs as well as its origin, so that management can adequately be informed about the risks and respond appropriately.

EFFECTS ON THE FRASER RIVER WATERSHED/URBANIZATION: The Riparian Areas Regulation (RAR)

PANEL 42 – Stacey Wilkerson (FLNRO), Michael Crowe (DFO), and Corino Salomi (DFO)

June 8, 2011

OVERVIEW:

Stacey Wilkerson (FLNRO Riparian Areas Regulation (RAR) coordinator) testified in a panel with two DFO Habitat employees. Under section 12 of the *Fish Protection Act* (BC), the RAR provides directives to selected local governments to protect riparian areas in their zoning and land use bylaws and related permitting processes in accordance with the regulation or to a level of protection that meets or exceeds that established in these directives. DFO was involved in developing the RAR model and remains involved with implementation. The RAR facilitates an inter-governmental cooperation agreement involving three levels of government.

RAR is also an ongoing example of results-based regulation using a professional-reliance approach.

The provincial success story in the SLIPP (Shuswap Lake Integrated Planning Process) was acknowledged by the DFO witnesses.

TECHNICAL REPORT CONTEXT:

Technical Report 3 shows no causal link between freshwater ecology and the decline in Fraser River sockeye productivity. Accordingly, the Province submits there is no basis for finding that the Riparian Areas Regulation (which allows the provincial government to establish directives for local governments for the protection of riparian areas) has caused or contributed to the decline.

PPR CONTEXT:

PPR 14 (Freshwater Urbanization Impacts and Management, May 11, 201) deals with the Riparian Area Regulation at pages 20 to 32.

At paragraph 2, the PPR notes that, "Although many topics could fall within this overarching theme of freshwater urbanization effects, for the purposes of the commission's hearings on this theme, this PPR addresses the following topics: a. Physical habitat impacts through development and other land uses;". Provincial witnesses were called in the following week on topics stated in paragraph 4 to be excluded from this PPR, and are dealt with in separate parts of this submission on

logging and effluents. No provincial witness was called on PPR 14 topics b (non-point source contaminants) or c (sedimentation).

The federal management approach to the RAR is dealt with at page 15, para 29, in the context of OHEB and by Figure 1 at page 27. Implementation is described at pages 28 to 32, with reference to Compliance Monitoring at pages 29 to 32, and Qualified Environmental Professionals (QEPs) at page 32.

Corrections were made at *Wilkerson, June 8, 2011, p. 29, l. 41 – p. 30, l. 36*

Reference is made to the award-winning SLIPP program at pages *Wilkerson, June 8, 2011, pp.* 38-39. Like the Fish/ Water Management Tool, this is a "good news" story that is worthy of consideration, but not canvassed within the hearing time available.

The issue of QEP compliance is discussed in paragraphs 58 and 59. One of the documents referred to in these two paragraphs is marked as Exhibit 1009.

KEY DOCUMENTS:

Exhibit 1004: The Riparian Areas Regulation

Exhibit 1007: Riparian Areas Regulation Implementation Guidebook

Exhibit 1008: Protocol for Management of Riparian Area Regulation Variances Between the Department of Fisheries & Oceans and the Ministry of Environment

Exhibit 1009: Compliance with the Riparian Areas Regulation (RAR): Report on Monitoring Activities for Assessments Submitted in 2007 (Draft)

KEY TESTIMONY:

Stacey Wilkerson started as the RAR coordinator for the Province in 2007. Her CV (*Exhibit 1000, Curriculum Vitae of Stacey Wilkerson)* describes her background in biology (M. Sc. And B. Sc. with distinction) with primary areas of study including aquatic and terrestrial ecology, conservation biology, ecological methods, and alternative forest practices. Her role includes liaison with DFO, local governments, collaborating with Professional Associations on issues related to professional reliance, and implementing a monitoring plan that assesses compliance with the RAR. Her direct evidence with Commission counsel is found at *Wilkerson, June 8, 2011, pp. 29-50.*

The purpose of the RAR is to provide directives to local governments in their zoning and land use bylaws and related permitting processes to protect riparian areas in accordance with the regulation or to a level of protection that meets or exceeds that established in these directives. (*Wilkerson, June 8, 2011, p. 30, l. 45*). Roles and

responsibilities are set out in Exhibit 1007, Riparian Areas Regulation Implementation Guidebook (*Wilkerson, June 8, 2011, p. 34, ll. 5-8*)

The RAR is an example of federal-provincial cooperation around the science and at the design state of the development of the process (*Crowe, June 8, 2011, p. 31; Exhibit 1005, The technical basis of zone of sensitivity determinations under the detailed assessment procedure of the RAR; Wilkerson, June 8, 2011, p. 31, l. 43 – p. 32, l. 5*); including providing funding for compliance monitoring (*Wilkerson, June 8, 2011, p. 43, l. 24 – p. 44, l. 8*).

The RAR is a professional reliance model (*Wilkerson, June 8, 2011, p. 32, l. 36 – p. 33, l. 20*).

The monitoring strategy for RAR is ongoing. In 2007, the Province monitored every report submitted to date to develop a compliance monitoring framework. Thereafter it has followed the framework. (*Wilkerson, June 8, 2011, p. 4, l. 20 – p. 42, l. 8*).

A qualified environmental professional (QEP) must follow a methodology when carrying out an assessment even though they are independent.

42 Q What is the Assessment Method Schedule used for?
43 How does that work?
44 MS. WILKERSON: This is the methodology that a
45 qualified environmental professional must follow
46 when carrying out a Riparian Areas Regulation
47 assessment. So it describes or proscribes how a

1 qualified environmental professional, we call them
2 QEPs, how they would establish the setback and
3 then it provides a set of mitigative measures that
4 must be used to maintain the integrity of that
5 setback. So these measures include assessments
6 around danger trees, wind throw, slope stability,
7 encroachment prevention, storm water management,
8 floodplain concerns and sediment and erosion
9 control.
10 Q Okay. Perhaps you can explain how the QEP works
11 within the Riparian Areas Regulation. What is the
12 theory of this Regulation?
13 MS. WILKERSON: Well, it's a professional reliance
14 model. And that means that before a proponent is
15 able to develop, they need to hire an independent
16 qualified professional to undertake an assessment
17 according to this methodology and then that
18 assessment comes to the province, DFO and the
19 local government before they can get their

20 development approval.

(Wilkerson, June 8, 2011, p. 32, l. 42 – p. 33, l. 20)

The QEP will decide whether a Simple Assessment or Detailed Assessment will be used on a site, unless the local government has already adopted the Simple Assessment in its bylaw (*Wilkerson, June 8, 2011, p. 36, ll. 38-43*).

After the assessment by a QEP, DFO may approve or allow a variance for a project depending if there will be a HADD:

31 Q Okay. So if we can just understand how this
32 works. If a development applicant wants to do a
33 project, they look to the Riparian Areas
34 Regulation, they have a QEP who will come in and
35 either use a Simple or Detailed Assessment to
36 determine if there will be any HADD. And if it
37 looks like there's going to be a HADD, they need
38 to go to DFO for a variance on this project to
39 allow it to be built in compliance with the
40 ***Fisheries Act***; is that right?
41 MR. CROWE: Well, if they can comply with the SPEA,
42 essentially --
43 Q The SPEA is what?
44 MR. CROWE: Streamside Protection Enhancement Area. So
45 once a Simple or Detailed Assessment is completed,
46 it'll determine essentially the line that the
47 development should be set back from, from the

1 water body. And that zone between the water and
2 the setback is defined as the SPEA, streamside
3 protection and enhancement area. So DFO has
4 agreed that if an assessment methodology is
5 completed appropriately and development can stay
6 outside the SPEA, there will, therefore, not be a
7 HADD. So it's a surrogate for our review and
8 approval process.

(Crowe, June 8, 2011, p. 35, l. 31 – p. 36, l. 8)

The Province does not have the actual power to reject a QEP's certified but unsatisfactory assessment unless there are significant errors. However, if the local governments have not approved the development, then the Province can attempt to persuade the local government not to accept the report by informing it of the inaccuracies or incompleteness. (*Wilkerson, June 8, 2011, p. 38, l. 41 – p. 39, l. 25*)

The RAR prohibits a local government from allowing a development unless it has received a certified QEP assessment report. This report sets out the setbacks or the SPEAs to be applied and the assessment methods that were used. However, the RAR does not prescribe how the riparian areas protection should be implemented and does not require a monitoring program.

> 11 Q Okay. But it doesn't provide any requirement that
> 12 the local government monitor to ensure that the
> 13 QEP assessment report has been correctly
> 14 implemented --
> 15 MS. WILKERSON: No.
> 16 Q -- or anything like that?
> 17 MS. WILKERSON: No.
>
> *(Wilkerson, June 8, 2011, p. 39, l. 26 – p. 40, l. 17)*

Dealing with difficult QEPs is part of Ms. Wilkerson's role (*Wilkerson, June 8, 2011, p. 45, l. 8 – p. 49, l. 52*). In this context, the Province draws to the Commissioner's attention the language of the Yanke decision (*Yanke v. Salmon Arm (City)*, 2011 BCCA 309). See the Discussion below. The province is now considering whether to change the RAR to address these difficulties.

Mr. Crowe commented that the RAR could be an effective tool to protect riparian areas.

> 6 ... But I wanted to focus on that
> 7 part of where there's not a political will, would
> 8 you agree with me that RAR amounts to
> 9 deregulation?
> 10 MR. CROWE: I don't know if I would say deregulation.
> 11 As I said, before RAR, we relied on land
> 12 development guidelines to provide guidance for
> 13 development, and we had referral systems for
> 14 trying to capture and comment on development
> 15 projects.
> 16 One of the things I complimented RAR about
> 17 was actually providing a regulatory standard for
> 18 development and I do stand by that agreement --
> 19 that statement that I think it is -- it's not
> 20 deregulation, it's actually an increase in
> 21 regulation. My problem with it is actually how
> 22 it's implemented and some of the mechanisms within
> 23 the regulation.
> 24 Sure, there's clearly elements that I
> 25 disagree with, such as the transference of some
> 26 authorities to QEPs to make these decisions, so I
> 27 would say ultimately I would not call it a

> deregulation. I would say it has the potential to be a very powerful and effective tool to protect riparian areas. But what I would add to that is, though, I think it needs to be strengthened in some areas as we've spoken to earlier.
>
> *(Crowe, June 8, 2011, p. 83, ll. 6–32)*

The three witnesses on the panel agreed professional reliance model can work if the government can ensure compliance.

> MR. CROWE: What I would say is - and I will try to keep this short - is that a professional reliance model can work. The challenge in an ecological context where we're dealing with such complicated environments, both from sort of an ecological prospective as well as regulatory, is there's a great deal of uncertainty. It's not impossible, if an individual is left to his own, to apply judgments or discretions that may not necessarily always result in the best outcome ultimately in terms of environmental protection. My opinion is that the role of government is to provide a level playing field, ensure compliance, and that there is a role to ensure that standards are met by all elements of society. I clearly believe professional reliance has its place. I truly believe that government, one of its roles is to ensure that business is conducted in a fair and accurate manner.
>
> Q Mr. Salomi, do you have any comments, or would you agree with this statement?
>
> MR. SALOMI: I don't think I have any further comments to add to that.
>
> Q Ms. Wilkerson, do you have anything you'd like to add about compliance in terms of being able to watch industry and hold them to account under the RAR regulation?
>
> MS. WILKERSON: Well, I agree with what Mr. Crowe has said. From my experience with RAR is that many people are willing to comply and "do the right things" is often how they put it. But when it comes down to those individuals that basically require the hammer in order to comply with what they're supposed to do, there are going to be

1 those individuals, and we do run into that. So in
2 those situations, we are a little bit more
3 challenged.
4 Q Right. And so do you think that perhaps -- I'm
5 just trying to think of possible solutions or
6 recommendations. Would you agree that perhaps
7 maybe the QEP course should be made mandatory
8 under the Regulations for instance?
9 MS. WILKERSON: I don't know if that -- I mean, most of
10 the QEPs that I'm aware of have taken the course.
11 It tells them how to do it. I guess we're talking
12 about some ideological things that it's not going
13 to teach.
14 Q Right. So, then, perhaps something like spot
15 checks or actual enforcement provisions through
16 RAR would be a better option.
17 MS. WILKERSON: Yeah, and we do do a lot of spot checks
18 and monitoring, but it is the enforcement piece
19 that becomes an issue.

(Crowe, Salomi, and Wilkerson, June 8, 2011, p. 83, ll. 6–32)

The Province deals with individual landowners and larger developers and their professional advisers:

24 MS. WILKERSON: Right. So by developer we're talking
25 about either the landowner, which is generally the
26 case, or it could be a larger developer. It's a
27 little more difficult to address with developers
28 because it sort of is a one-time deal for them.
29 You know, if this is the landowner, this is the
30 only time they're going to do a Riparian Areas
31 Regulation assessment and so with a QEP, you know,
32 if they continue to do them, we can sort of
33 provide an education that way. With developers
34 it's a little more difficult.
35 So some of the strategies we've used through
36 our compliance monitoring it's an opportunity to
37 talk to the developer and sort of explain this
38 amenity that's on their property and how they can
39 take care of it. So it's a stewardship approach.
40 A lot of times with a developer, if they haven't
41 implemented the RAR, you know, they've missed
42 something in the assessment report that's really
43 key and they don't really understand it. So we
44 try to get QEPs when they're going out and doing

45 these assessments to actually talk to the
46 developers. We found that QEPs had done reports
47 and never spoken with a landowner, which was, you

1 know, fairly shocking to us. So that's something
2 that we've really focused on in the QEP course;
3 make sure you talk to the developer and let them
4 know, you know, why this is important.
5 If they're having significant issues when we
6 go out with compliance monitoring, then that's
7 when we would look at enforcement, I guess, under
8 local government bylaw or the ***Water Act*** or the
9 ***Fisheries Act***. However, with compliance
10 monitoring, there's the odd situation that we have
11 come across that we've been quite concerned about
12 but for the most part, as was discussed earlier,
13 the really big issues we tend to find through
14 complaints. So if something fairly egregious has
15 happened, we tend to hear about it before we
16 monitor.

The Province is now addressing the effectiveness of the RAR:

17 Q Okay. Then we've been talking about compliance
18 monitoring. Has the province done anything to
19 understand the effectiveness o f the regulation?
20 Has there been any effectiveness monitoring or
21 assessment?
22 MS. WILKERSON: We are currently developing the
23 effectiveness monitoring plan as part of the
24 overall provincial effectiveness monitoring
25 strategy so we're fitting the RAR monitoring sort
26 of within that methodology. We've currently got a
27 contractor who's looking at ways that we could
28 develop an effectiveness monitoring plan for the
29 RAR.

(Wilkerson, June 8, 2011, p. 48, l. 24 – p. 49, l. 29)

There has been significant progress since 2007. In addition to this panel's evidence, Jason Hwang advised that while he still has concerns about the RAR, they are less than in 2007. (*Hwang, September 16, 2011, p. 95, ll. 22-26)*.

ISSUES:

Is the RAR a primary factor in the long term decline of productivity of Fraser River sockeye salmon or the collapse of the 2009 run?

SUBMISSIONS/DISCUSSION

1. The RAR is not a primary factor in the long term decline of productivity of Fraser River sockeye or the collapse of the 2009 run.

The various Technical Reports do not identify effluents as a possible or likely primary driver for long term decline in productivity of Fraser River sockeye.

Specifically, Technical Report 6 states that it is unlikely that other freshwater factors were the primary drivers than long term decline in productivity of Fraser River sockeye. (Executive Summary, Stage 1, Stage 2, Stage 3 and Stage 5.

Technical Report 3 further states that the recent declines in Fraser River sockeye salmon productivity are unlikely the result of changes to the freshwater environment including human activities (Executive Summary, pages iii and vi).

2. A discussion of the *Yanke* decision follows.

Yanke v. Salmon Arm (City), 2011 BCCA 309 at paragraphs 69, 73 – 75, 80. The Province brought this appeal on the basis that the interpretation of the RAR is of considerable public importance, and the decision of the chambers judge resulted in considerable difficulties in its interpretation (para 7). The Court of Appeal recognized that the legislative framework that governed the case "is part of a cooperative effort between federal, provincial and local governments to preserve and enhance fish habitat". . The provisions at issue regulate and restrict the use of land adjacent to watercourses.

DFO was not a party and did not present argument. At paragraph 22, the Court of Appeal commented on DFO's jurisdiction. The Court of Appeal found that it was not correct to say that the regulation prohibits development "in the absence of express authorization" by DFO. "Rather, whether or not a proposed development can proceed will depend on whether it is anticipated that it will cause a "harmful alteration disruption or destruction of natural features, functions and conditions that support fish life processes in the riparian assessment area" commonly referred to as a "HADD")."

At paragraphs 19 and 26, the Court of Appeal found that certain of the elaborate provisions, such as in the RAR Implementation Guidebook, were outside of the provincial regulation and hence not legally enforceable. Unless and until the regulation is changed, therefore, the "difficulties with its administration" will remain.

The Court also addressed two arguments of the Province intended to protect fish habitat where a QEP erred:

> [69] A final issue that was argued on this appeal should be addressed briefly. The Attorney General takes the position that the process leading up to the City's resolution was flawed because Mr. Rublee's report was faulty in two respects: in respect of the high water mark used to define the streamside protection and enhancement area, and in respect of his ability to give an opinion under s. 4(2)(b)(iii)(A) of the regulation.

As to the first error by the QEP, the court said:

> [73] The chambers judge said this about the issue:
>
> [54] The Attorney General of British Columbia on behalf of MOE picks fault with one aspect of Mr. Rublee's report and questions the accuracy of his certification that he followed the assessment methods. The issue relates to whether the commencement of the SPEA should be at 348.3 metres elevation or 348.7 metres elevation which translates into an 80 cm difference at the "top of the bank" commencement of the setback. The assessment methods permit the QEP to use the 348.3 metre elevation which is an agreed elevation provided that he is satisfied of certain conditions. I cannot resolve the factual dispute about compliance with the certification but on the face of the report it complies, as required, and that point is not material to the issue before me.
>
> [74] I agree with the conclusions of the chambers judge on this issue. The requirement of s. 4(2)(b)(ii) of the *Riparian Areas Regulation* is that the qualified environmental professional certify that the assessment methods have been followed. The City of Salmon Arm was not required to go behind the certification. Accordingly, the courts cannot go behind the certification in reviewing the exercise of powers by the City.
>
> [75] The regulation appears to entrust the issue of compliance with assessment methods to the professional judgment of the qualified environmental professional. We need not decide, on this appeal, whether there is any way for an interested party to challenge an allegedly faulty report or to prevent a local government from accepting such a report on a development application. If there are methods of challenging the report, however, those methods do not include doing so by way of judicial review of the local government's decision.
>
> As to the requirement to follow the assessment methods, the court said:

> [80] Section 1.2.7 is in Part 1 of the schedule, and does not set out an assessment method. Rather, it purports to provide instructions for the qualified environmental professional to follow once the assessment is complete. As such, it does not form part of the regulatory framework of the *Riparian Areas Regulation*. To the extent that it provides instructions that appear to conflict with the body of the regulation, it has no legal force.

The Province is considering whether to amend the RAR to deal with certain issues raised by this decision.

The RAR relies on the *Fisheries Act* as an enforcement tool. Improvements to the *Fisheries Act* will improve the enforceability of the RAR. Enforceability could be improved by revisions/improvements to the *Fisheries Act*, ie. ability to ticket, to order stop work, and order remediation in the case of HADD. Also, the *Fisheries Act* does not recognize ecological principles of succession in provisions of habitat ie. the potential vegetation argument.

PULP AND PAPER AND MINING EFFLUENTS

Panel 43

Douglas Hill (Ministry of Environment – BC); Robert Grace (Ministry of Environment – BC); Michael Hagen (Environment Canada); Janice Boyd (Environment Canada)

June 13, 2011

Overview

The Policy and Practice Report #15 – Municipal Wastewater, Pulp and Paper and Mining Effluents – 24 May 2011 sets out the basic framework of regulation with respect to municipal wastewater, pulp and paper and mining effluent disposal practices pursuant to section 36 of the *Fisheries Act*, and various pieces of federal and provincial legislation.

The *Fisheries Act*, section 36 and regulations thereunder, including the *Pulp and Paper Effluent Regulations* (PPER) and the *Metal Mining Effluent Regulations* (MMER) , and the *Canadian Environmental Protection Act*, together with certain regulations made under it including the Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulation and the Pulp and Paper Mill Defoamer and Woodchip Regulations are the primary federal legislation in this area. Provincially the *Environment Management Act*, together with the Pulp Mill and Pulp and Paper Mill Liquid Effluent Control Regulations, as well as the *Water Act*, the *Fish Protection Act* and parts of the *Mining Act* and associated regulations and thereunder are the primary sources of provincial legislation in regard to this area.

There are 7 operating pulp mills and 7 active metal mines in the Fraser River watershed.

The federal government requires Environmental Effects Monitoring (EEM) programs for pulp mills under the PPER (since 1992) and for metal mines under the MMER (since 2002). The Province requires the monitoring of pulp mills and metal mines on a more site specific basis.

While there was some evidence that those pulp mills and some of the mines has some effects on resident fish, there was little or no evidence that either pulp and paper effluents or metal mine effluents have been a primary cause of the long term decline in the productivity of Fraser River sockeye or of the collapse of the 2009 run. The evidence shows that there has been a 99% reduction in dioxins and furans since 1992, a 94% reduction in Biological Oxygen Demand (BOD) as of 2000, and a 70% decrease in Total Suspended Solids (TSS) from pulp and paper mills.

Technical Report 6 indicates that it is unlikely that various factors including forestry, mining and contaminants were primary drivers behind the long-term decline in the productivity of Fraser River sockeye. Technical Report 3 concluded that changes in the fresh water environment, including logging and mining were unlikely to have caused the recent decline in Fraser River sockeye.

Technical Report Context

Technical Report 6 – Fraser River Sockeye Salmon: Data Synthesis and Cumulative Impacts - states that it is unlikely that various factors including mining and contaminants were the primary drivers behind the long term decline in Fraser River sockeye productivity (Executive Summary re: Stage 1, Stage 2, Stage 3 and Stage 5).

Technical Report 3 – Evaluating the Status of Fraser River Sockeye and the Role of Freshwater Ecology in their Decline - states that ". . . We believe that recent declines in Fraser River sockeye salmon are unlikely the result of changes to the freshwater environment" – (Executive Summary, page vi).

Further in reviewing changes to the freshwater environment the Report considered various human activities including logging, hydroelectricity, urbanization, agriculture and mining. (Executive Summary, page i).

Specifically the analysis of mining looked at various types of mining including placer mining, gravel (construction aggregate) mining, industrial minerals mining, metal mining, coal mining, oil and gas production, and exploration activities. The Report stated that ". . . The data suggests that the impacts of mining on sockeye salmon are likely small and difficult to detect because of contrasts amongst stocks and strength and effect relative to the other factors is low." (Executive Summary, page iv)

In addition, the Report notes that with the exception of the Endako Mine, which is located near Francoise Lake, none of the other 5 active metal mines are in close proximity to habitat occupied by juvenile sockeye salmon (page 31).

Technical Report 12 – Fraser River Sockeye Habitat Use in the Lower Fraser and Strait of Georgia - at page 48, found that distribution of contaminants associated with areas of long term effluent discharge associated with pulp and paper mills and waste water treatment plants had a low or nil risk summary of loss or degradation of sockeye habitats. Further, the Report found:

- No or low ranking related to effects on sockeye production
- Contaminants can potentially exacerbate stress related to warmer environmental conditions experienced by migrating salmon particularly migrating adult returning to spawn.

- In areas of sockeye production, dominant levels are low and exposure duration is brief.

PPR Context

While the PPR generally sets out an accurate summary of the specific regulations that apply, there were a number of factual corrections to the PPR that were dealt with in oral testimony including:

- Paragraph 82 – 7 mills (not 10) are currently operating in the Fraser River basin *(Boyd, June 13, 2011, p. 5, ll. 14-16)*
- Paragraph 201 – there are current 7 (not 6) active metal mines in the Fraser River watershed *(Hagen, June 13, 2011, p. 34, ll. 39-44)*
- Paragraph 265 – 4 metal mines (not 3) are subject to the MMER (*Hagen, June 13, 2011, p. 35, ll. 2-7)*
- Paragraph 29 – the reference should be to 10 coastal BC pulp and paper mills (not 139) (*Boyd, June 13, 2011, p. 67, ll. 9-14)*
- Paragraph 196 – Boyd added that there is also sub lethal toxicity testing twice a year, three times (*Boyd, June 13, 2011, p. 67, ll. 18-31*)
- Paragraph 203 – there is some doubt about whether the Huckleberry Mine discharges into the Fraser River Basin (*Hagen, June 13, 2011, p. 67, ll. 33-47*)
- Paragraph 65 – There is other Provincial legislation governing environmental management and protection including the *Water Act*, the *Fish Protection Act* and parts of the *Mines Act* (*Hill, June 13, 2011, p. 75, l. 23-40*)
- Paragraph 70 – a business or activity listed under Schedule 2 of EMA may not discharge without a permit unless there is a code of practice that they would register and discharge under *(Hill, June 13, 2011, p. 76, ll. 18-33)*
- Paragraph 288 – contrary to the Environment Canada observation referred to therein, the Province has maintained a fairly constant frequency of inspections since the 1990s (*Hill, June 13, 2011, p. 77, ll. 5-20)*

The Key Exhibits

Exhibit 1026 - Lowell et al, National Assessment of Pulp and Paper Environmental Effects Monitoring Data-Findings from Cycles 1 through 3, 2005
Exhibit 1027 - Improving the Effectiveness and Efficiency of Pulp and Paper Environmental Effects Monitoring-A Smart Regulation Opportunity, Dec 2005
Exhibit 1029 - Tessier et al, National Assessment of Cycle 4 Data from the Pulp and Paper Environmental Effects Monitoring Program, Jan 30 2009
Exhibit 1031 - Hagen et al, Environmental Response to Decreased Dioxin and Furan Loadings from BC Coastal Pulp Mills
Exhibit 1032 - Summary Review of Performance of Metal Mines, Subject to the Metal Mining Effluent Regulations in 2009, Sep 2010

Exhibit 1033 - Metal Mining Environmental Effects Monitoring Review Team Report, Aug 2007
Exhibit 1034 (?) - Lowell et al, National Assessment of Phase 1 Data from the Metal Mining Environmental Effects Monitoring Program
Exhibit 1035 - Mill Effluent Discharge Permit PE-01152 for Cariboo Pulp and Paper, Jul 12 2005
Exhibit 1036 - Mine and Mill Effluent Discharge Permit PE-00416 for Gibraltar Mine, Jul 12 2009
Exhibit 1038 - Clean, Safe Water-Implementing Sustainable Practices in the Pulp and Paper Industry, A 10-year Path to Success, undated [GOC]
Exhibit 1040 - Holmes, Review of Thompson River Partnership Monitoring

Key Testimony

As a result of the PPER and two regulations under the *Canadian Environmental Protection Act,* the Pulp and Paper Mill Effluent Chlorinated Dioxin and Furans Regulation and the Pulp and Paper Mill Defoamer and Woodchip Regulation, there has essentially been a 99% elimination of dioxins and furans from pulp and paper mill effluent *(Boyd, June 13, 2011, p.31, ll. 21-35).*

A study concerning dioxins and furans coming from 10 coastal pulp mills found that between 1989 and 1994 there was a 97% decrease in dioxins and furans and effluents . It also found significant declines in dioxin and furans toxicity equivalents of between 61% for sediment, to 85% for Dungeness crab, to 93% for oysters (*Hagen, p. 31, ll. 46-47; p. 32, ll. 1-4; Exhibit 1031, Environmental Response to Decreased Dioxin and Furan Loadings from BC Coastal Pulp Mills, (Abstract))*

Exhibit 1038, Clean Safe Water – Implementing Sustainable Practices in the Pulp and Paper Industry – *A 10-year Path to Success* sets out the following information at page 2 concerning the improvement in the quality of effluent since various regulations (referred to in the first paragraph under Key Testimony) came into effect in 1992:

- Discharges of chlorinated dioxins and furans have been virtually eliminated (from 288 g/yr in 1989 to 3 g/yr in 1997);
- BOD materials are down by 94% (from 26 kg/tonnes of products in 1987 to 2 kg/tonnes in 2000); and
- TSS releases have decreased by 70% (from 11kg/tonnes of products in 1987 to 3 kg/tonnes in 2000).

Environment Canada appears not to be concerned with enrichment in fish and in benthic communities in British Columbia because of the process it has in place which is one where they are working towards solutions. EC is still seeing some effects in the receiving environment from pulp mill effluent but they are working towards solutions. *(Boyd, June 13, 2011, p. 21, ll. 2-26).*

EEM requires fish tissue analysis if certain thresholds are met. There has not been any fish tissue analysis for mills in the Fraser Basin because those thresholds have not been triggered. (*Hagen and Boyd, June 13, 2011, p. 30, ll. 10-30*)

The environmental effects monitoring (EEM) program under the PPER and the MMER focuses on the receiving environment (*Boyd, June 13, 2011,p. 8, ll. 37-47*) and is designed to evaluate resident species not sockeye (*Boyd, June 13, 2011, p. 32, ll. 39-47 and p. 33, ll. 1-2*). Environment Canada has not done any effects monitoring on sockeye because it is not a resident fish; further, Environment Canada does not know whether pulp and paper effluent today has an impact on sockeye because its studies are not specifically designed for sockeye. The assumption is the migratory and transit species would be less likely to be affected than resident fish (*Boyd, June 13, 2011, p. 73, ll. 15-35*).

Environment Canada and the Province do not assess effluent discharges on migratory salmonids, rather they target resident fish given the assumption that resident fish would be more highly affected by effluent than migratory fish such as sockeye (*Boyd, June 13, 2011, p. 62, ll. 2-11; Grace, June 13, 2011, p. 62, ll. 17-29; Hill, June 13, 2011, p. 63, ll. 3-13).*

Exhibit 1030, Upper Fraser River Environmental Effects Monitoring (EEM) Cycle Five interpretive Report, March 2010, with respect to pulp mills in Prince George and Quesnel, indicates that there may have been a mild enrichment response in both the Quesnel and Price George regions in previous cycles and further that in cycle five there were no signs of enrichment observed in the Quesnel region, but results were mixed in the Prince George region with exposure fish being smaller but having larger livers. Also the toxicity results suggested that potential zones of sublethal toxicity were small during cycle five (Executive Summary – Conclusions, p. xii)

In response to a question from Mr. Leadem concerning Exhibit 833, Late-Run Sockeye at Risk-An Overview of Environmental Contaminants in Fraser River Salmon Habitat, where he read out the following quote:

> "Research has demonstrated the decline in the concentrations of a large compound of endocrine disrupter compounds after secondary treatment of the pulp mill effluent."

Boyd testified that all pulp mills in British Columbia have secondary treatment (*Exhibit 833,* Late-Run Sockeye at Risk-An Overview of Environmental Contaminants in Fraser River Salmon Habitat*, p. 84, ll. 21-37*).

There has been testing for sublethal toxicity in pulp mill effluent since EEM was introduced in 1992 (twice a year – three tests) (Boyd, *June 13, 201,* p. 83, ll. 13-18).

In regard to Exhibit 1032, Summary Review of Performance of Metal Mines Subject to the *Metal Mining Effluent Regulations* in 2009 and in answer to the question of whether

interpretive reports from mines in the province show significant impacts on fish health from metal mines in the Fraser River Basin, Hagen (at p. 42, ll. 42-47 and p. 43, ll. 1–32) responded that:

- Huckleberry results could not confirm that there were effects on fish or benthos in the area that they were sampling;
- Gibraltar had not yet issued its first interpretive report (it was due in July 2011); and
- Endako had conducted two surveys and in general found an enrichment effect on benthos and both inhibitory and enrichment effects on rainbow trout and there seems to be some uncertainty about the results.

Hagen testified that his impression was the BC mines generally were in compliance with most of the parameters of MMER and if they were not it was usually a relatively minor issue (*Hagen, June 13, 2011, p. 48, ll. 22-30).*

The amount of effluent discharged from a mine varies from time to time and the amount discharged may often be less than then amount permitted. Also, the Gibraltar Mine is not allowed to discharge effluent between November and April, during winter low flow (*Hagen, June 13, 2011, p. 64, ll. 38-47; p. 65, ll. 9-13*).

Provincial monitoring for mills and mines are determined on a site specific basis (*Hill, June 13, 2011, p. 52, ll. 34-41*).

The entire suite of metals is tested at the lab (*Hill, June 13, 2011, p. 53, ll. 1-4*).

Applications for provincial permits are referred to Environment Canada and if Environment Canada wants additional parameters included in the permit, the Province would do so (*Hill, June 13, 2011, p. 53, ll. 9-18*).

The Provincial database, MINFILE, contains data on mines going back over 100 years. Environment Canada is aware of 15 larger closed mines and 12 smaller closed mines. (*Hagen, June 13, 2011, p. 69, ll. 7-25*). Environment Canada is also aware of a small acid rock drainage problem at one closed open pit mine near Kamloops and that situation is under active management (*Hagan, June 13, 2011, p. 69, ll. 36-47*).

The Provincial Spill Reporting Regulation requires that all unauthorized releases that exceed certain thresholds must be reported and any significant unauthorized releases have to be reported immediately. Failure to do so would constitute an offense (*Hill, June 13, 2011, p. 77, ll. 46-47; p. 78, ll. 1-20*).

Exhibit 1040 –Review of Thompson River Partnership Monitoring Report, November 30, 2010 – describes a voluntary partnership committee, formed in 2003, that coordinates required and voluntary monitoring programs conducted by dischargers and stakeholders along the lower Thompson River and Kamloops Lake. Those involved include: the City of Kamloops, Village of Ashcroft, BC Ministry of Environment, Environment Canada, DFO, Skeetchstn Indian Band, Tk'emlups Indian Band, Domtar, and Tobiano Resort

(page 2). It is interesting to note that this is a voluntary arrangement that includes Domtar, owner of a pulp mill in the monitored area. The monitoring program data indicated that "…current water quality in the Lower Thompson River does not appear to have negative impacts on primary and secondary trophic levels of aquatic life based on the length of this study and previous studies conducted in the last three decades. Fisheries work done outside the scope of this partnership indicates that salmonid populations are healthy. (Bison, MOE 2010; Bailey, DFO)." (page 7)

Issues

Are pulp and paper effluents and mining effluents a primary factor in the long term decline of productivity of Fraser River sockeye or in the collapse of the 2009 run?

Submissions/Discussion

1. Pulp and paper and mining effluents were not a primary factor in the long term decline and productivity of Fraser River sockeye or the collapse of the 2009 run.

    - Technical Reports do not identify pulp and paper and mining effluents as a likely primary driver for long term decline in productivity of Fraser River sockeye.
    - Specifically, Technical Report 6 states that it is unlikely that other factors including mining and contaminants, were the primary drivers than long term decline in productivity of Fraser River sockeye. (Executive Summary, Stage 1, Stage 2, Stage 3 and Stage 5).
    - Technical Report 3 states that the impacts of mining on sockeye salmon are likely small and difficult to detect because of contrasts amongst stocks and the strength of effect relative to other factors is low (Executive Summary, page iv).
    - Technical Report 3 further states that it is unlikely that the recent declines in Fraser River sockeye salmon productivity are the result of changes to the freshwater environment and that freshwater environment includes human activities such as mining (Executive Summary, pages iii and vi).
    - The evidence in the hearing does not link pulp and paper effluent or mining effluent to either the long term decline in productivity of Fraser River sockeye or to the collapse of the 2009 run.

2. The quality of effluent has improved significantly since 1992 as follows:
    - Discharges of chlorinated dioxins and furans have been virtually eliminated (from 288 g/yr in 1989 to 3 g/yr in 1997);
    - BOD materials are down by 94% (from 26 kg/tonnes of products in 1987 to 2 kg/tonnes in 2000); and
    - TSS releases have decreased by 70% (from 11kg/tonnes of products in 1987 to 3 kg/tonnes in 2000). (*Exhibit 1038, Clean, Safe Water-*

Implementing Sustainable Practices in the Pulp and Paper Industry, A 10-year Path to Success, p. 2)

3. The interpretive reports from the metal mines in the Fraser River watershed indicate that:
    - Huckleberry results could not confirm that there were effects on fish or benthos in the area that they were sampling;
    - Gibraltar had not yet issued its first interpretive report (it was due in July 2011) ; and
    - Endako had conducted two surveys and in general found an enrichment effect on benthos and both inhibitory and enrichment effects on rainbow trout and there seems to be some uncertainty about the results. (*Hagen, June 13, 2011, p. 42, ll. 42-47 and p. 43, ll. 1-32*).

4. Exhibit 1040 – Review of Thompson River Partnership Monitoring Report, Nov 30, 2010 – page 7, states that " .. current water quality in the Lower Thompson River does not appear to have negative impacts on primary and secondary trophic levels of aquatic life based on the length of this study and previous studies conducted in the last three decades. Fisheries work done outside the scope of this partnership indicates that salmonid populations are healthy. (Bison, MOE 2010; Bailey, DFO)."

MUNICIPAL WASTEWATER

Panel 44
Ken Ashley (Northwest Hydraulic), Peter Ross (DFO), and Graham van Aggelen (EC)

June 14, 2011

PANEL 45
James Arnott (EC), and Albert van Roodselaar (Metro Vancouver)

June 15, 2011

OVERVIEW

The Policy and Practice Report #15 – Municipal Wastewater, Pulp and Paper and Mining Effluents – 24 May 2011 sets out the basic framework of regulation with respect to municipal wastewater, pulp and paper and mining effluent disposal practices pursuant to section 36 of the *Fisheries Act*, and various pieces of provincial legislation.

The *Fisheries Act*, section 36 and Regulations there under, and the *Canadian Environmental Protection Act*, together with certain regulations made there under are some of the main Federal Regulations. Provincially the *Environment Management Act*, as well as the *Water Act*, the *Fish Protection Act*, as well as Regulation there under are the primary sources of Provincial legislation in regard to this area.

TECHNICAL REPORT CONTEXT

Technical Report 6 – Fraser River Sockeye Salmon: Data Synthesis and Cumulative Impacts states that it is unlikely that various freshwater factors were the primary drivers behind the long term decline in Fraser River sockeye productivity (Executive Summary re: Stage 1, Stage 2, Stage 3 and Stage 5).

Technical Report 3 – Evaluating the Status of Fraser River Sockeye and the Role of Freshwater Ecology in their Decline states that ". . . We believe that recent declines in Fraser River sockeye salmon are unlikely the result of changes to the freshwater environment" – (Executive Summary, page vi).

Further in reviewing changes to the freshwater environment the Report considered various human activities including logging, hydroelectricity, urbanization, agriculture and mining. (Executive Summary, page i).

Technical Report 2 – Effects of contaminants on Fraser River sockeye salmon is referenced in PPR 15, Municipal Wastewater, Pulp and Paper and Mining Effluents (See e.g. paras 5-11*).* See also Peter Ross and *Exhibit 833, Johannessen and Ross,*

Late-Run Sockeye at Risk-An Overview of Environmental Contaminants in Fraser River Salmon Habitat, 2002

Technical Report 12 – Fraser River Sockeye Habitat Use in the Lower Fraser and Strait of Georgia at page 48 found that distribution of contaminants associated with areas of long term effluent discharge associated with pulp and paper mills and wastewater treatment plants had a low or nil risk summary of loss or degradation of sockeye habitats. Further, the Report found:

- No or low ranking related to effects on sockeye production
- Contaminants can potentially exacerbate stress related to warmer environmental conditioning experienced by migrating salmon particularly from migrating adult returning to spawn.
- In areas of sockeye production, dominant levels are low and exposure duration is brief.

PPR Context

PPR 15, Municipal Wastewater, Pulp and Paper and Mining Effluents is generally accurate. Two corrections to the PPR were dealt with in oral testimony on June 13:

- Paragraph 65 – There is other Provincial legislation governing environmental management and protection including the *Water Act*, the *Fish Protection Act* and parts of the *Mines Act (Hill, June 13, 2011, p. 75, ll. 23-40)*
- Paragraph 70 – a business or activity listed under Schedule 2 of EMA may not discharge without a permit unless there is a code of practice that they would register and discharge under (*Hill, June 13, 2011, p. 76, ll. 18-33)*

The Key Exhibits

Exhibit 1049: Proposed Integrated Liquid Waste and Resource Management

Exhibit 1050: Letter from Lake (BC MOE) to Jackson (MetroVan) re Liquid Waste Management Plan, with revisions

Exhibit 1051: Greater Vancouver Regional District, Liquid Waste Management Plan

Exhibit 1058: Canada-wide Strategy for the Management of Municipal Wastewater Effluent

Key Testimony

Ross, the author of Late-Run Sockeye at Risk: An Overview of Environmental Contaminants in the Fraser River Salmon Habitat (*Exhibit 833, Johannessen and Ross, Late-Run Sockeye at Risk-An Overview of Environmental Contaminants in Fraser River Salmon Habitat, 2002*), was qualified as an expert in aquatic toxicology (Ross, June 14,

2011, p. 1; *Exhibit 1043, Curriculum Vitae of Peter Ross*). Van Aggelen was qualified in toxicology and toxicogenomics *(Aggelen, June 14, 2011, pp. 2-3; Exhibit 1044, Curriculum Vitae of Graham van Aggelen).* Ashley was qualified in environmental engineering, aquatic ecology and limnology ("the scientific study of inland waters, freshwater oceanography, for lack of a better term") *(Dr. Ashley, June 14, 2011, p. 3, ll. 27-29).*

The Metro Van LWMP was discussed by the "science" panel. (*Exhibit 1049, Proposed Integrated Liquid Waste and Resource Mgmt, May 2010*; *Exhibit 1050, Letter from Lake (BC MOE) to Jackson (MetroVan) re Liquid Waste Mgmt Plan, with revisions, May 30 2011.*). In addition, there were limited Metro Van comments on the LWMP: *Dr. van Roodselaar, June 15, 2011, pp. 23-25*: EC encourages upgrade of Iona and Lions Gate wastewater treatment plants "without delay" (*Exhibit 1063, Letter from M Wilson (EC) to A van Roodselaar (MV) re EC's Comments on Metro Vancouver's LWM Plan Five-Year Review).*

Ashley discussed types of treatment (*Dr. Ashley, June 14, 2011, p. 27*) and cost (*Dr. Ashley, June 14, 2011, p. 28*)
Ashley said that Iona going beyond secondary wasn't as urgent because it is in the Gulf of Georgia, not the Fraser River (*Dr. Ashley, June 14, 2011, p. 29, l. 33).*

Marmorek said: "I don't think it should be that hard" - or, presumably, expensive -

> 17 ...to collect some smolts at the
> 18 outlet of the Fraser and examine them for
> 19 contaminant burdens and get better estimates of
> 20 exposure, and then do a kind of screening
> 21 assessment on how large or small the problem is.
>
> *(Marmorek, September 19, 2011, p. 61, ll. 14 – 21)*

Liquid Waste Management Plans are approved by the Province. These approvals sometimes carry a condition, such as:

> 21 The Ministry supports [the] upgrading to
> 22 secondary level treatment the Lions Gate
> 23 wastewater treatment plant by 2020 and Iona
> 24 Island wastewater treatment plant as soon as
> 25 possible, but no later than 2030.
>
> *(Dr. Ashley, June 14, 2011, p. 33, ll. 19–25)*

Dr. Ashley suggested that the suggested upgrades be done simultaneously to the best available technology which was considerably beyond secondary treatment. Dr. Ross commented that this was "outside his expertise", and upgrades to both these plants

should be done sooner rather than later as they may reduce risk associated with discharge of deleterious substances, which would be of net benefit to salmon habitat

(Dr. Ashley and Dr. Ross, June 14, 2011, p. 33, ll. 30–41).

Dr. Ashley and Dr. Ross believe that it is important for environmental monitoring to include the examination of salmon. Dr. Ross suggests that laboratory tests under strict conditions do not necessarily do anything more than document risks associated with acute immediate effects. When one looks at the cumulative effects in the real world such as the long-term endocrine-disrupting effects on salmon, he called for a better understanding of the nature of many pollutants that end up in Fraser River sockeye habitat, and stated there is a need to expand beyond the laboratory testing procedures.

(Dr. Ashley and Dr. Ross, June 14, 2011, p. 34, l. 40 – p. 35, l. 20)

Hearing of June 15, 2011 - Panel No. 45:

The legislative structure is complex:

> 44 Q Okay. Now, regulation of wastewater from a
> 45 federal perspective is primarily handled at this
> 46 point through s. 36(3); is that fair?
> 47 MR. ARNOTT: Under the authority of the ***Fisheries Act***,
>
> 1 yes.
> 2 Q Yes. And these new proposed regulations under the
> 3 ***Fisheries Act*** would set out in much more detail a
> 4 federal approach to regulation of wastewater?
> 5 MR. ARNOTT: Correct.
> 6 Q Each of the provinces also have the capability of
> 7 enacting legislation which relates to the
> 8 environment in which wastewater is discharged?
> 9 MR. ARNOTT: Correct.
> 10 Q And British Columbia does have legislation dealing
> 11 with that?
> 12 MR. ARNOTT: Legislation, and to be specific, a
> 13 regulation.

(*Arnott, June 15, 2011, p. 5, l. 44 – p. 6, l. 13)*

Exhibit 1058: Canada-wide Strategy for the Management of Municipal Wastewater Effluent:

Canada-wide Strategy for the Management of Municipal Wastewater Effluent, a Canada-wide approach to the regulation and treatment of wastewater, was developed

under the Canadian Council of Ministers of the Environment (CCME) by Canada and the provinces.

> 22 Q Are you able to briefly set out for the
> 23 Commissioner, explain the structure, explain what
> 24 the CCME is, and the division of legislative
> 25 responsibility, and I'll ask you perhaps to do
> 26 that, Mr. Arnott.
> 27 MR. ARNOTT: Sure. So CCME in general exists as a body
> 28 that jurisdictions, in this case federal,
> 29 provincial and territorial governments, can talk
> 30 and collaborate and discuss issues related to
> 31 environmental protection. Generally environmental
> 32 protection is a shared jurisdiction, depending on
> 33 the issue. In the case of effluents released from
> 34 wastewater systems, that is the case. There's
> 35 provincial and federal jurisdiction, and the
> 36 territorial jurisdictional issues are a bit
> 37 different, but they're at play.
> 38 So in this case, CCME was the forum that was
> 39 chosen to take on this matter. CCME is a
> 40 structure, develops agreements that aren't legally
> 41 binding. They're agreements that the
> 42 jurisdictions agree to do certain things. That's
> 43 the case for the CCME Canada-wide Strategy.
>
> (*Arnott, June 15, 2011, p. 5, ll. 22-43)*

<u>Federal regulation of wastewater: EC and 36(3) of Fisheries Act.</u>

The regulation of wastewater, from a federal perspective, is primarily handled through s. 36(3) under the *Fisheries Act*. The new proposed regulations under the *Fisheries Act* would set out a more detailed federal approach to regulation of wastewater, and each of the provinces also have the capacity of enacting legislation which relates to the environment in which wastewater is discharged. For example, British Columbia has a regulation to deal with this issue.

(*Arnott, June 15, 2011, p. 5, l. 44 – p. 6, l. 13)*

The regulations do not require the testing of or impose limits with respect to emerging contaminants of concern; however, there may be some additional requirements that are proposed in the regulations under environmental effects monitoring. These proposed regulations went through a consultation process and the comments collected, from various groups (such as the Province) on different issues, are still being reviewed. These regulations require environmental effects monitoring, but they do not apply to all

wastewater systems. They would apply to a certain subset of the sector, and those that are already complying or already meeting the effluent quality limits for the deleterious substances.

Q Things like pharmaceuticals, surfactants, some of the persisting organic pollutants, PBDEs, matters such as those.
MR. ARNOTT: In general, no. And we could maybe touch on some of the additional requirements that are proposed in the regulations under the environmental effects monitoring, and we could talk about those features as proposed, because there are some issues there that relate to your question.
Q Okay. Throughout the process of -- or once the draft regulations were developed, they were gazetted and put out for comment through a consultative process; is that fair?
MR. ARNOTT: That's right. So last March published, the proposed regulations were published in *Canada Gazette Part I*, as we always do, and for a 60-day open comment period. And then we go into the phase of reflecting on those comments. In this case we've done quite a bit of follow-up with organizations that did provide comments, and basically spent quite a bit of time on clarifying some technical issues, as well as further clarify what some of the comments were.
Q And were you involved in reviewing those comments?
MR. ARNOTT: Yes, I was.
Q And were you involved in considering, or have you been, in considering possible amendments to the draft regulations, based on the comments received?
MR. ARNOTT: Yes.
Q And that process is ongoing, is it?
MR. ARNOTT: Yes, it is.
Q Okay. And the comments that were received would be those such as the ones forwarded by Metro Vancouver?
MR. ARNOTT: That's correct.
Q And there was a submission, I understand, made by the Province of British Columbia, as well?
MR. ARNOTT: That's correct.
Q Did you receive comments with respect to the degree to which the regulations deal with some of the emerging contaminants of concern, such as

45 endocrine-disrupting compounds?
46 MR. ARNOTT: To a certain extent we characterized the
47 comments we received on the regulations in general

1 in a couple of categories, both in very specific
2 technical detail in terms of what was proposed as
3 well as some additional issues, and that was one
4 of them, certainly.
5 Q Okay. And did some of those comments propose
6 increased regulatory requirements relating to
7 matters such as endocrine-disrupting compounds?
8 MR. ARNOTT: I don't recollect that specifically. We
9 certainly heard about that issue in terms of what
10 might be emerging as concerns related to some of
11 those additional substances. But I don't
12 recollect the direct correlation that you're
13 making, no.
14 Q Do the regulations require environmental effects
15 monitoring?
16 MR. ARNOTT: Yes, they do.
17 Q And who do they require it of?
18 MR. ARNOTT: As proposed, there's a mechanism that
19 would determine that within the regulations, so
20 the key message there is as proposed, the
21 environmental effects monitoring provisions would
22 not apply to all wastewater systems. It would
23 apply to a certain subset of the sector, and those
24 that are already complying or already meeting the
25 effluent quality limits for the deleterious
26 substances that we spoke of already.

(Arnott, June 15, 2011, p. 8, l. 3 – p. 9, l. 26)

Arnott contemplated the proposed provisions for environmental effects monitoring would last about 13 years. Within that 13-year phase, there would be four cycles of monitoring, both water quality monitoring, benthic invertebrate monitoring and it may also include fish population monitoring. If there are no effects identified in the first two cycles within that period, those provisions would not continue. They are considering carefully the timing issue of environmental monitoring in the proposal. Further, they are trying to reflect on the fact that there have been lessons learned from the other existing regulations in the ***Fisheries Act*** for environmental effects monitoring and that led them to propose the scheme that they did.

(Arnott, June 15, 2011, p. 10, ll. 14–46)

Bio-solids:

The regulations presently do not deal with biosolids. However, in terms of the sludges and biosolids that are a by-product of the wastewater treatment process, it is contemplated that the issues will be dealt with. Currently, the Canadian Council of Ministers of the Environment has been working on Canada-wide approach for the management of wastewater biosolids:

(Arnott, June 15, 2011, p. 14, ll. 7-24)

Metro Vancouver sends its biosolids for mine reclamation:

> 30 reclamation. There's two principal locations in
> 31 the province where most of our biosolids go for
> 32 mine application.
> 33 Q Okay. And is that reclamation of strip mines?
> 34 DR. van ROODSELAAR: That's correct.
> 35 Q Okay. And are any of the sites where the
> 36 biosolids are deposited located within the Fraser
> 37 River watershed?
> 38 DR. van ROODSELAAR: No. Looked at locations and do
> 39 not appear to be relevant to Fraser River.

(Dr. Van Roodsellar, June 15, 2011, p. 14, ll. 30-39)

Metro Vancouver has implemented a Liquid Waste Management Plan since 2002. Under British Columbia requirements, a jurisdiction has the option of either operating under the regulations or developing a management plan acceptable to the province. The provincial Minister of Environment recently accepted and specified conditions for a new LWMP for Metro Vancouver and in so doing, made the plan and those conditions a requirement for Metro Vancouver.

(*Dr. Van Roodsellar, June 15, 2011, p. 16, l. 41 – p. 17, l. 15)*

> 8 Q Okay. With respect to Iona, has the monitoring
> 9 that's been conducted disclosed matters that are
> 10 cause for concern or any negative effects on the
> 11 receiving environment or the surrounding environs?
> 12 DR. van ROODSELAAR: No. At the present time the
> 13 monitoring programs which we've been carrying on,
> 14 you know, at the time that the plan was approved
> 15 to the present, any effects that we're seeing with
> 16 respect to the Iona receiving environment are

17 negligible, and those small effects that can be
18 seen are primarily attributed to some nutrient
19 differences in different parts.

(*Dr. Van Roodsellar, June 15, 2011, p. 21, ll. 8-19)*

The Liquid Waste Management Plan, approved in 2002, set a deadline for the upgrade of Iona at 2020, and Lions Gate at 2030. The new Liquid Waste Management Plan mandates that Iona to be upgraded as soon as possible, but no later than 2030. This is a reference to the CCME Strategy, looking to the strategy for guidance, and accepting the strategy as approved by Environment Canada and the Province

The Canada-wide Strategy mandated Iona to be upgraded by 2030. This is consistent with the provincial Minister's approval letter for the new Liquid Waste Management Plan

26 Q And just sort of skipping to the second half of
27 that sentence, or maybe I'll just read the whole
28 sentence:
29
30 The Minster supports upgrading to secondary
31 level treatment the Lions Gate wastewater
32 treatment plant by 2020 and Iona Island
33 wastewater treatment plant as soon as
34 possible, but no later than 2030.
35
36 My question to you, in your position reading that
37 letter, do you interpret that as consistent or
38 inconsistent or somehow different from what's
39 mandated under the Canada-wide Strategy?
40 DR. van ROODSELAAR: I think that's consistent with the
41 Canada-wide Strategy.
42 Q Okay.

(Dr. van Roodselaar, June 15, 2011, p. 24, ll. 26-42)

Dr. van Roodselaar considers that comprehensive monitoring shows that any effects from the outfall of Iona are negligible:

8 MR. McGOWAN:
9 Q Has the consistent message that's coming from
10 Environment Canada and the Department of Fisheries
11 and Oceans, encouraging the timely upgrade of
12 these facilities, as they put it, in the interest
13 of protecting the environment, caused you to
14 question your concern that any effects from the
15 outfall of Iona are negligible?

DR. van ROODSELAAR: You're saying whether their encouragement puts question to the Environmental Monitoring Program that we have in place, and the conclusions that come from those Environmental Monitoring Programs?
Q Your review, you told the Commissioner, of those Environmental Monitoring Programs has caused you to conclude that any effects from Iona are negligible.
DR. van ROODSELAAR: That's correct. Those programs we've had in place are very comprehensive. I would suggest that our Environmental Monitoring Programs are the most comprehensive of any done by a practitioner, a wastewater treatment plant system operator in the country, possibly on the continent. The other aspect of Metro Vancouver's process is that we review those monitoring programs with our Environmental Monitoring Committee on a monthly basis, on a regular basis. We meet with them and we provide all documentation in terms of the results of those monitoring programs.
At the table of that Environmental Monitoring Committee we have the province, and until quite recently we had the federal government. We have representatives from University of British Columbia, as well as Simon Fraser University. We have a public member. We have a representative from Health. So these various individuals that have responsibility for those regulated areas are at the table, are fully open to the results of those monitoring programs. We hire expert

consultants to carry out those various monitoring programs on our behalf. They present those results to the Environmental Monitoring Committee. Those results are discussed, and I think if there were particular concerns with those results, that opportunity to bring that forward and for Metro Vancouver to become aware of that, from other than simply Metro Vancouver's assertion, is there.
So, yes, I think it's reasonable and very responsible on Metro Vancouver's point of view in terms of how we carry out those monitoring programs, and the manner in which they are vetted in terms of determining whether the conclusions

14 are reasonable.
15 Q We had some scientists here yesterday, including
16 Dr. Ken Ashley and Dr. Peter Ross, both of whom
17 expressed some level of concern about potential
18 negative impacts on the receiving environment of
19 Iona. Have you had concerns, any concerns of that
20 nature expressed to you or expressed to Metro
21 Vancouver?
22 DR. van ROODSELAAR: Well, I mean, in terms of the way
23 you put it, you say "potential" for concerns with
24 respect to the environment, and I think I wouldn't
25 -- certainly wouldn't quibble with that. I think
26 there are constituents in municipal wastewater,
27 depending on their concentration, the nature of
28 the receiving environment, the manner in which
29 they would interact with that receiving
30 environment, that potentially could be of concern.
31 And I think that is the whole point of our
32 monitoring program and of our Cautions, Warnings
33 and Triggers Process, and of our review with other
34 authorities, is to ensure to the best of our
35 capability that that is not the case. That to the
36 ability we can affirm it, that we are not causing
37 a significant environmental concern.

(Dr. van Roodselaar, June 15, 2011, p. 26, l. 9 – p. 27, l. 37)

Issues

Are effluents a primary factor in the long term decline of productivity of Fraser River sockeye or in the collapse of the 2009 run?

Submissions/Discussion

1. Effluents were not a primary factor in the long term decline and productivity of Fraser River sockeye or the collapse of the 2009 run.

    - The various Technical Reports do not identify effluents as a possible or likely primary driver for long term decline in productivity of Fraser River sockeye.
    - Specifically, Technical Report 6 states that it is unlikely that other freshwater factors were the primary drivers than long term decline in productivity of Fraser River sockeye. (Executive Summary, Stage 1, Stage 2, Stage 3 and Stage 5)

- Technical Report 3 further states that the recent declines in Fraser River sockeye salmon productivity are unlikely the result of changes to the freshwater environment including human activities (Executive Summary, pages iii and vi).

2. Approval of Metro Vancouver's LWMP in May 2011 is a major milestone.

3. Another major milestone will be the new federal wastewater regulation

TOPIC: CAUSES FOR THE DECLINE OF FRASER RIVER SOCKEYE SALMON

Effects on the Fraser River Watershed: Gravel Removal

Science Panel No. 46 – Dr. Laura Rempel (DFO) / Dr. Marvin Rosenau
Management Panel No. 47 – Jason Hwang (DFO)/ Julia Berardinucci (FLNRO)

June 15-16, 2011

OVERVIEW:

The Fraser River Sediment Management Program (gravel removal program) is one part of the Provincial Flood Protection Program and is specifically developed to maintain the existing flood profile in the Fraser Gravel Reach (Hope to Chilliwack). The program is administered by Emergency Management BC (EMBC). The Province makes decisions with respect to public safety and the need to undertake specific sediment removal projects as one component of a comprehensive approach to manage flood risk.

EMBC applies for the necessary permits from FLNRO (*Water Act* approvals) and DFO, as well as DOT where necessary. In the past four years EMBC has been the proponent for all activities. DFO defers to the Province with respect to matters of public safety and deals with any applications in such a way as to cooperate with the Province while trying to minimize any adverse habitat impact from proposed gravel removal projects.

The evidence shows that major fish habitat concerns do not relate to Fraser River sockeye but rather are related to pink salmon, juvenile chinook and sturgeon. DFO witnesses made it very clear that there is little evidence that gravel removal affects sockeye fish habitat.

In recent years there have been discussions between DFO and the Province about a long term plan for gravel removal. A report by Dr. Michael Church in March 2010 and a March 30, 2010 covering letter were the source of some testimony during the hearing and these matters are being followed up by DFO and the Province. Specifically, there was a meeting set for July 2011 to which Dr. Church has been invited to attend.

The Province submits that the provincial Flood Protection Program, which includes the Sediment Removal Program, is a matter solely under provincial jurisdiction and therefore not within the purview of the Commissioner's mandate. Further, the evidence shows there is no link between the decline of Fraser River sockeye and, arguably, the Sediment Management Program; and there is little relationship between Fraser River sockeye and the gravel reach where Sediment Management Program operates. In addition, DFO and the Province are involved in discussions with respect to a long term plan to deal with gravel removal and the related environmental issues.

TECHNICAL REPORT CONTEXT:

There is no mention of gravel removal in Technical Report 12 as being linked to a decline in Fraser River sockeye productivity. Accordingly, the Province submits there is no basis for finding that the Fraser River Sediment Management Program has contributed to or caused that decline.

PPR CONTEXT:

The Province submits that PPR 16, Gravel Removal in the Lower Fraser River, overemphasizes the river type sockeye ecotype in the context of sediment removal. (Dr. Rempel - June 16, pages 25 – 27) and further PPR 16 does not, it is submitted, present a complete picture of the situation with respect to gravel removal and its relationship to Fraser River sockeye. (See Submissions/Discussion section for detailed references.) Therefore the Commissioner should not place much reliance on PPR 16 in so far as it relates to Fraser River sockeye or the purported impacts of gravel removal on Fraser River sockeye.

Examples of the incomplete picture include:

- PPR paragraphs 15 – 20 – These paragraphs do not include any information on the mitigation efforts that are used with respect to any sediment removal. (See Exhibits 1080 and 1081 – DFO CEAA screening reports for Tranmer Bar 2009 and 2011 respectively and associated mitigation requirements. Also see Exhibit 1098 – Reason for Decision A2005590 re: Tranmer Bar 2009). *(Dr. Rempel, June 16, 2011, p. 13, ll. 7-33)*
- PPR paragraph 19 – The information there is incomplete given Exhibit 1090, Environmental Monitor's 30 Day Post-Construction Report for the Dec 2010 Outlet Channel Construction at Little Big Bar which is the Environmental Monitor's 30 Day Post Construction Report for the December 2010 outlet channel construction at Little Big Bar on the Fraser River. The information in that Exhibit shows that over 2000 fish were salvaged as this matter was within the attention of DFO and provincial authorities, and in addition only six of the salvaged fish were sockeye*. (Dr. Rempel, June 16, 2011, p. 34, ll. 31-47 and p. 35, ll. 1,2)*
- PPR paragraph 20 – Contrary to the assertion in paragraph 20, Dr. Rempel testified that DFO had adequate information in hand to appreciate the relative use by sockeye of habitats within the gravel reach (*Dr. Rempel, June 16, 2011, p. 4, ll. 40-47 and p. 5, ll. 1-16*)
- PPR paragraphs 35 to 38 – There are errors in referring to the Provincial representatives on the Technical Committee and the Management Committee and these were rectified in direct examination. (*Berardinucci*, *June 16, 2011 p. 84, ll. 14-47*)

- PPR paragraph 36 – There was testimony from Rempel that these terms of reference were not finalized and therefore the reference to a purpose of the Management Committee being to ensure that gravel removal meets the annual target in keeping with the letter of agreement is not correct. (*Dr. Rempel, June 16, 2011, p. 9, ll. 12 -21*)
- PPR – paragraph 38 refers to a decision of the Regional Water Manager which overrules a recommendation of MoE staff. However, unlike the description of the MoE staff decision, there is no description of the Regional Water Manager's decision, nor is there any mention of the DFO CEAA screening report which supports the decision to allow the project to proceed. (Berardinucci, June 16, 2011, pp. 96-98; Exhibit 1098, Reason for Decision, A2005590 Application for Approval of Gravel Removal from Tranmer Bar; and Exhibit 1079**,** Canadian Environmental Assessment Act (CEAA) Screening Report [sample])
- PPR paragraph 38 – The information is not correct. There is a representative from the Ministry of Forests, Lands and Natural Resource Operations who was formally at MOE on the Technical Committee. The Province is also providing habitat staff to attend at Technical Committee meetings as required. (*Exhibit 1100, Konkin letter to Sue Farlinger, July 30, 2010;* See also *Hwang June 16, 2011, p. 76, ll. 34-39*).

PPR paragraph 54 –The Province has a comprehensive approach to consultation with First Nations. (*Berardinucci, July 8, 2011, pp. 6-8*)

PPR paragraph 69 – 73 –Rempel, Berardinucci and Hwang testified that DFO and the Province have had and are continuing discussions with respect to a long term plan for sediment removal in the Fraser River. Another meeting was scheduled for July, 2011.

KEY DOCUMENTS:

Exhibit 1076: Letter of Agreement, Lower Fraser Gravel Removal Plan
Exhibit 1077: Letter of Agreement, Lower Fraser River Gravel Removal Plan (16 February 1009)
Exhibit 1080: DFO CEAA Screening Report – Tranmer Bar 2009
Exhibit 1081: CEAA Screening Report – Tranmer Bar 2011
Exhibit 1090: Environmental Monitors 30 Day Post Construction Report for December 2010 Outlet Channel Construction at Little Big Bar
Exhibit 1092: CV of Julia Berardinucci
Exhibit 1098: Reason for Decision A2005590, Application for Approval of Gravel Removal from Tranmer Bar (2009)
Exhibit 1099: Ministry of Public Safety and Solicitor General, British Columbia Flood Protection Program – Presentation to BCWF
Exhibit 1100: Konkin letter to Sue Farlinger, July 30, 2010
Exhibit 1101: Financial Chart for the Flood Protection Infrastructure and Sediment Management Program (2005 to 2010)

Exhibit 1102: Flood Protection Infrastructure (Mission to Hope) 2005 – 2011 Budget Sheet

KEY TESTIMONY:

Rempel indicated on a number of occasions that river type sockeye are over emphasized in the context of gravel mining and in the context of PPR 16. (*Dr. Rempel, June 16, 2011, p. 47, ll. 20-34, pp. 25 & 26*) and further stated in this regard

- adult sockeye migrating upstream are not associated with any particular type of habitat. (*June 15, 2011, p. 91, ll. 6–19*).
- not aware of any sockeye spawning in the main reach of the river although DFO is aware of populations spawning the top end of the gravel reach (Mariah Slough – four times in the last three decades with sporadic numbers). (*June 15, 2011, p. 91, ll. 22-35*)
- for her PhD thesis she carried out almost 1000 catch samples over three years and there were a total of 221 juvenile sockeye caught out of approximately 41,000 fish. (*June 15, 2011, p. 92, ll. 7-28 - referring to her thesis, Exhibit 1071, Thesis: Physical and Ecological Organization in a Large, Gravel-Bed River and Response to Disturbance, tables 3-4 and 6.1 respectively)*

Rempel stated that DFO has adequate information in hand to appreciate the relative use by sockeye of habitats in the gravel reach. Although from an academic perspective she would like to know more information. *(Dr. Rempel, June 16, 2011, p. 4, l. 45; p. 8, l. 15*). In addition, she testified that DFO adequately understands the habitats with respect to adult migrating sockeye in the context of the sediment management in the gravel reach. (*Dr. Rempel, June 16, 2011, p. 5, ll. 11–15*).

The 2011 CEAA authorization for Tranmer Bar reflects current monitoring standards. *(Dr. Rempel, June 16, 2011, p. 15, ll. 3–10).*

In referring to Exhibit 1095, Hwang acknowledged that there are some gaps in monitoring *(Hwang, June 16, 2011, p. 82, ll. 32-47).* However Hwang further testified that notwithstanding the new information on sockeye provided by Dr. Rosenau and others, DFO would not be looking to focus new or additional monitoring efforts on sockeye at this time. (*Hwang, June 16, 2011, p. 83, ll. 2-24*)

Rempel testified with respect to the Dr. Church letter (*Exhibit 1085, Letter from M Church to A Griffin (Strategic Mitigation Programs EMBC), 30 Mar 2010)* and the Dr. Church report (*Exhibit 1086, Sediment Management in Lower Fraser River- Criteria for a Sustainable Long-Term Plan for the Gravel-Bed Reach*). She indicated that a long term approach to gravel removal would be a good thing and further that as a scientist the most urgent need is to improve knowledge of the aquatic ecosystem beyond the immediate removal site. (*June 16, 2011, p. 18-22*)

Contrary to the decline of Fraser River sockeye in general, Harrison sockeye productivity has been increasing over the last period of time (*Exhibit 12, Speaking for the Salmon, p. 12 and Dr. Rempel June 16, 2011, p. 33, ll. 21-30*)

There is "no empirical evidence to show negative impact of gravel mining on sockeye salmon populations". (*Dr. Rempel, June 16, 2011, p. 69, ll. 4–8*)

Gravel mining does not necessarily have an adverse effect on sockeye due to the removal of some "high bar habitat". Rempel challenged Rosenau's evidence on this point in re-direct (June 16, 2011, pp. 70–72)

Hwang acknowledged that there is more direct engagement by provincial habitat staff on the Technical Committee although they are not official members of that committee. (*Hwang, June 16, 2011, p. 76, ll. 34–39,* in answer to paragraph 38 of the PPR, Fraser Gravel Memo (*Exhibit 1094*)). Hwang states that the gravel removal file is an example of federal/provincial collaboration on a planning scale (*Hwang, June 16, 11, p. 90, ll. 27–31*).

Sockeye is not high on the radar of either the Technical Committee or the Management Committee (*Hwang, June 16, 2011, p. 82, ll. 33–39, and p. 83, ll. 14–20*).
Hwang also indicates in response to questions of the Church March 30, 2010 letter (*Exhibit 1085, Letter from M Church to A Griffin (Strategic Mitigation Programs EMBC)*) that there are benefits to a long term plan especially with regard to flood risk management and the potential environmental impacts. (*Hwang - June 16, 2011, p. 83, ll. 35- 40*)

DFO defers to British Columbia with respect to the issue of public safety and the use of sediment removal as part of the flood control management issue (*Hwang, June 16, 2011, p. 90, ll. 37–43*).

Hwang testified that while gravel removal is an important fish habitat issue, it is not significant in terms of habitat issues as they relate to sockeye. Sediment removal is an important fish habitat issue for sturgeon, juvenile chinook and pink salmon and notwithstanding the new information from Dr. Rosenau is something that does not strike Hwang "as alarming in terms of the well-being of Fraser River sockeye" (*Hwang, June 16, 2011, p. 92, ll. 12–16, 22–30 and 38–40*).

Sediment removal is just one component of a larger provincial flood management strategy (*Berardinucci, June 16, 2011, p. 93, ll. 40–45; and the power point presentation (Exhibit 1099, BC Flood Protection Program Presentation to BCWF)).*

The Province spent approximately $2.5 million on sediment removal, in comparison to the total provincial amounts of over $13 million spent on infrastructure (e.g. improving dikes) from 2005 to 2009, and over $25 million spent overall by all three levels of government on infrastructure, in regard to flood control management in the Fraser

Gravel Reach from 2005 -2009. *(Berardinucci, June 16, 2011, p. 94, Exhibits 1101, Financial Chart for the Flood Protection Infrastructure and Sediment Management Program (2005 to 2010) and 1102, Flood Protection Infrastructure (Mission to Hope) 2005 – 2011 Budget Sheet respectively).*

Berardinucci also testified that Dr. Church's letter (*Exhibit 1085, Letter from M Church to A Griffin (Strategic Mitigation Programs EMBC)*) and report (*Exhibit 1086, Sediment Management in Lower Fraser River- Criteria for a Sustainable Long-Term Plan for the Gravel-Bed Reach*) are reasonable comments but notes that BC is to work within existing budgets and programs (*Berardinucci, June 16, 2011, p. 103, ll. 22 – 28*).

Berardinucci further states, when questioned whether the Province would be guided by Dr. Church's advice, that the Province is prepared to take advice from a number of qualified professionals (*Berardinucci, June 16, 2011, p. 106, ll. 1–6*).

Berardinucci provided good testimony with respect to the provincial consultation process with First Nations in cross-examination by Ms. Gaertner. (*Berardinucci, July7, 2011, p. 5-8*). She also testified that there are few, if any, applications that are refused but, in large part, that is due to the committee structure and the fact that issues are discussed early on in the process (*Berardinucci, July 7, 2011, p. 4, ll. 6–18*).

Hwang referred to a super type of CEAA or "super screening" as a possible way to deal with the longer term aspects of applications from the proponent EMBC as well as having other matters dealt with, including specific applications, on a year by year basis. There has been no decision on this yet. (*Hwang, July 7, 2011, pp. 11–12*).

Both Hwang and Berardinucci indicated that there is certainly a need for consulting with First Nations and First Nations input but there are some questions about what form that would take, especially as they were not sure how the future would look under any long term plan. Berardinucci also pointed out there is the issue of how best to get the information given that there are so many First Nations who are consulted (*Berardinucci, Hwang, July 7, 2011, pp. 12–14*).

ISSUES:

Connection between the gravel removal program and Fraser River sockeye
Dr. Michael Church report and covering letter of March 30, 2010
A long term plan for gravel removal

SUBMISSIONS/DISCUSSION:

3. There is little evidence linking Fraser River sockeye to gravel removal in the Fraser Gravel Reach or otherwise. The DFO witnesses emphasized that the PPR overstates the relationship between sockeye salmon and gravel removal;

and further, the evidence from Dr. Rempel about her PhD research shows that there is very little, if any, spawning of Fraser River sockeye in the channels in the Fraser reach and the only sockeye who are really in the gravel reach are "opportunists". Otherwise sockeye migrate through the gravel reach. The following support this submission:

- PPR paragraphs 9 to 14 – the PPR doesn't mention that river type sockeye form less than 1% of the total Fraser River sockeye population (*Exhibit 735, Technical Report 12, Lower Fraser and Strait of Georgia Habitat Use, p. 3*). Further, the PPR does not mention that Harrison River sockeye, which include river type sockeye, have been increasing in productivity over the last 20 years (*Exhibit 12, Speaking for the Salmon, p. 12 and Dr. Rempel, June 16, 2011, p. 33, ll. 22-30*)
- PPR paragraph 10 "One Stewardship Group Reported to the Department 'substantial numbers' of juvenile stream bearing sockeye in gravel reach and surveys conducted in November 2008." Dr. Rosenau clarified that the survey took place on November 2007 and further acknowledged that "substantial" was not the correct word to be used in respect of the information which he had provided to DFO, given that his 2007 site survey only caught 13 juvenile sockeye in two sets out of a total of 10 (*June 16, p. 29, ll. 22–23*) .Also Rempel indicated that during her PhD thesis she did almost 100 times more sampling than Dr. Rosenau and of approximately 44,000 fish, just over 200 were sockeye. (Dr. Rempel, June 16, 2011, p. 31, ll. 13–18)
- See also Rempel's testimony on June 16, page 47 lines 20 – 34 in regard to " river type sockeye being overemphasized in the context of gravel mining".
- In respect of the December 2010 site visit Rosenau acknowledged that they went out looking for sockeye and caught 5 sockeye that day (*Rosenau, June 16, 2011, p. 30 – referring to Exhibit 1074, Lower Fraser Gravel Reach Assessment of Past and Proposed Gravel Bar Mining Locations, p. 15*.)
- While gravel removal is an important fish habitat issue, it is not significant in terms of habitat issues as they relate to sockeye. Sediment removal is an important fish habitat issue for sturgeon, juvenile chinook and pink salmon. Hwang stated that the new information from Dr. Rosenau is something that does not strike him as alarming in terms of the well-being of Fraser River sockeye (*Hwang, June 16, 2011, p. 92, ll. 12–16, 22–30, and 38–40*).
  (See also *Exhibit 1081, CEAA Screening Report Tranmer Bar 2011, p. 7*)
- In answer to Dr. Rosenau's evidence of the importance of the studies carried out by his students, (*Exhibit 1075, Species Composition, Utilization and Overwintering Survival of Fishes in Off-Channel Habitats of FR, Hope BC*), Dr. Rempel testified that the habitats studied by the students are entirely unaffected by gravel mining; they are located at the most upstream end of the gravel reach where there is no gravel mining activity taking place pursuant to the Province's Sediment Management program. Further these habitats have no connection to the Province's Sediment Management program. She also stated that the observations that Dr. Rosenau made about the habitat at Tranmer Bar is not unique but rather ubiquitous throughout the gravel reach. (*Dr. Rempel, June 16, 2011, p. 4, ll. 1-36.)*

4. Gravel removal has not contributed to nor been the cause in the decline of Fraser River sockeye.
   - River type sockeye make up less than 1% of all Fraser River sockeye (*Exhibit 735, Technical Report 12, Lower Fraser and Strait of Georgia Habitat Use, p. 3 and Dr. Rempel, June 16, 2011, p. 24, ll. 27-40*)
   - Harrison sockeye productivity has been increasing over the last period of time (*Exhibit 12, Speaking for the Salmon, p. 12 and Dr. Rempel, June 16, 2011, p. 33, ll. 21-30)*

5. Gravel removal is a part of the Province's flood protection strategy. It is a public safety issue and is not within the scope of the Commissioner's Terms of Reference.
   - See Commissioner's Terms of Reference
   - Gravel removal is one part of the Province's flood protection strategy *(Berardinucci, June 16, 201, p. 27, ll. 1-45 and Exhibit 1099, BC Flood Protection Program Presentation to BCWF*)
   - The vast majority of funds spent on flood protection matters are spent on dikes and infrastructure (over $25 million in total by the three levels of government) between 2005 and 2009) as opposed to gravel removal (approximately $2.5 million between 2005 and 2009). *(Berardinucci, June 16, 2011, pp. 95-96 and Exhibits 1101 Financial Chart for the Flood Protection Infrastructure and Sediment Management Program (2005 to 2010), and 1102, Flood Protection Infrastructure (Mission to Hope) 2005 – 2011 Budget Sheet respectively*)

6. There are no specific environmental issues with respect to Fraser River sockeye and gravel removal in the Fraser Gravel Reach. DFO carries out environmental assessments of all gravel removal projects, mitigation measures are proposed in most instances; and DFO and the Province collaborate pursuant to the Letter of Agreement *(Exhibits 1076, Letter of Agreement, Lower Fraser Gravel Removal Plan and 1077, Letter of Agreement, Lower Fraser River Gravel Removal Plan (16 February 1009*)
   - There is "no empirical evidence to show negative impact of gravel mining on sockeye salmon populations". (*Dr. Rempel, June 16, 2011, p. 69, ll. 4–8*)
   - Rempel stated that DFO has adequate information in hand to appreciate the relative use by sockeye of habitats in the gravel reach. Although from an academic perspective she would like to know more information. (*June 16, 2011, p. 4, l. 45 and p. 8, l. 15*). In addition, she testified that DFO adequately understands the habitats with respect to adult migrating sockeye in the context of the sediment management in the gravel reach. (*Dr. Rempel, June 16, 2011, p. 5, ll. 11–15*).
   - Gravel mining does not necessarily have an adverse effect on sockeye due to the removal of some "high bar habitat". Rempel challenged Rosenau's evidence that seemed to suggest that gravel mining had obliterated high bar habitat and testified otherwise. She also indicated that gravel mining does not

occur on all bars in the gravel reach, but usually at one or two or three gravel bars in any one year, and in those cases only a fraction (sometimes smaller, sometimes larger) of the entire bar is mined. Further there are at least 15 intact gravel bars along the reach. *(Dr. Rempel, June 16, 2011, p. 72, ll. 1-47)*

- Hwang commented that Technical and Management Committees served as a good example of the collaborative federal/provincial relationship at the planning level. While Hwang had some frustrations about a lack of a provincial biologist on the Technical Committee, he said things were getting better and habitat staff were now attending some of the meetings. (*Hwang June 16, 2011, p. 76, ll. 34-39*) (See also *Exhibit 1100 – July 30, 2010 letter from Doug Konkin, Deputy Minister MoE, to Sue Farlinger RDG DFO Pacific Region* which sets out how MoE technical staff will be involved in the Fraser River Sediment Management Program and how they will interact on technical issues.)
- In the DFO CEAA Screening Report for Tranmer Bar in 2009 (*Exhibit 1079, Canadian Environmental Assessment Act (CEAA) Screening Report [sample])* the mitigation measures include all work being conducted in the winter fisheries window between January 1 and March 15.(*Exhibit 1079, Canadian Environmental Assessment Act (CEAA) Screening Report [sample], p. 8*)

5. DFO and the Province are in the process of discussing a long term plan and in those discussions will look at the Dr. Michael Church report (Exhibit 1086) and letter of March 30,2010 (*Exhibit 1085, Letter from M Church to A Griffin (Strategic Mitigation Programs EMBC), 30 Mar 2010*). The parties should be left to pursue these discussions.
   - Rempel testified with respect to Dr. Church's letter (*Exhibit 1085, Letter from M Church to A Griffin (Strategic Mitigation Programs EMBC), 30 Mar 2010*) and the Church report (Exhibit 1086). She deferred to Dr. Church and indicated that a long term approach to gravel removal would be a good thing and further, as a scientist, she thought the most urgent need is to improve knowledge of the aquatic ecosystem beyond the immediate removal site. (*Dr. Rempel, June 16, 2011, pp. 18-22*)
   - Hwang also indicates in response to questions of the Church March 30, 2010 letter (*Exhibit 1095, Fraser River Gravel Reach Sediment Management - Long Term Planning Meeting Notes*) that there are benefits to a long term plan especially with regard to flood risk management and the potential environmental impacts. (Hwang, June 16, 2011, p. 83, ll. 35-40)
   - Berardinucci also testified that Dr. Church's letter and report are reasonable comments but notes that the Province has to work within existing budgets and programs (Berardinucci, June 16, 2011, p. 103, ll. 22–28).
   - When questioned whether the Province would be guided by Dr. Church's advice, Berardinucci advised that the Province is prepared to take advice from a number of qualified professionals (*Berardinucci, June 16, 2011, p. 106, ll. 1–6*).

- There was a meeting of both the management and Technical Committees on March 14, 2011 where there were wide ranging discussions about a long term plan (Hwang, June 16/11, page 80, lines 40-47 and page 81 lines 1-47. See also Minutes of Fraser River Gravel Reach Sediment Management Long Term Planning Meeting March 14, 2011 (*Exhibit 1095, Fraser River Gravel Reach Sediment Management - Long Term Planning Meeting Notes*)). A follow up meeting, to which Dr. Church has been invited, is scheduled for July, 2011. (*Berardinucci, June 16, 2011, p. 89, ll. 18-46*)

RECOMMENDATIONS:

1. If there should be any recommendation it should be that the DFO and the Province should continue their discussions for a long term plan with respect to gravel removal as it relates to the public safety issue of flood control management.

FORESTRY AND LOGGING PRACTICES AND SOCKEYE HABITAT:
IAN MILLER AND PETER TSCHAPLINSKI

PANEL
Panel No. 48/ Ian Miller/Peter Tschaplinski/Peter Delaney
June 17, 2011 Freshwater Urbanization: Logging

OVERVIEW:

While Technical Report 3 identifies various forestry practices that may impact sockeye salmon, the Commission's evidence occupied one day only. Peter Tschaplinski has conducted research on fish-forestry impacts, watersheds, and stream ecosystems since 1979. Ian Miller is a professional forester who has worked on forest planning and practices legislation and policy under both the *Forest Practices Code of BC Act* and the *Forest and Range Practices Act (FRPA)* in Victoria since the mid-1990s. DFO witness Peter Delaney was involved with the implementation of the Forest Practices Code in the mid-1990s and from 1997 to 2005 held the position of Chief, Habitat Policy, including being DFO's representative on joint committees developed under the *Forest and Range Practices Act*.

Ian Miller gave a brief overview of forestry (p. 16, l. 20 to p.18, l.12).

Peter Tschaplinski's evidence reflected the important research and monitoring work he has done throughout the province including at Carnation Creek on Vancouver Island, Haida Gwaii, the Bowron watershed, and the Stuart-Takla area of the Fraser River basin, as well as the hands on analysis of fish-forestry issues, often in conjunction with distinguished DFO scientist Erland MacIsaac. Ian Miller's evidence reflected his personal zeal on the topic of professional reliance. Peter Delaney testified to the strong relationship exercised with the Forests ministry during his tenure.

FRPA relies on professionals to advise tenure holders and government on how best to ensure that riparian areas are protected. The federal and provincial governments do not always fully agree on the best approach to protect aquatic environments. In the case of the FRPA, the determination of the need and methodology for riparian and watershed assessments is left to the professionals. In a broader historical context, this is an example of the benefits and challenges of relationships between governments, tenure holders, and resource professionals. While there have been challenges, this panel demonstrated a good working relationship between DFO and the province, and improvements since 2007.

The Province submits that the concerns expressed by DFO about forestry and riparian management (like the FRPA's Forest Planning and Practices Regulation, and the

Riparian Area Regulation) are understandable in the context of downsizing and the decline of Fraser River Sockeye Salmon, however the findings of fact and recommendations for future sustainability should assert that FRPA does have robust mechanisms to protect fish and fish habitats, and that the challenges associated with fish habitat management are being addressed by the province, in conjunction with DFO. Thus DFO's own scientist concluded that the vast area impacted by the mountain pine beetle is not impacting fish now.

TECHNICAL REPORT CONTEXT:

The Province is making extensive submissions on Technical Reports 3 and 6. There is no evidence that forestry-related alterations to freshwater ecology has caused or is causing the decline of Fraser River Sockeye salmon. Moreover, the Province's submissions include comprehensive monitoring data collected province wide demonstrating a marked improvement in post-harvest stream conditions and levels of fish habitat protection from 1995 to the present compared with pre-1995 forestry management outcomes. Accordingly, the Province submits that there is no basis for a finding that forestry practices have caused that decline. In these circumstances, the Commissioner should focus any findings of fact and policy or budgetary recommendations on the federal government, and not the Province.

PPR CONTEXT:

The Province accepts PPR 17 as generally accurate, subject to the corrections made on June 17, 2011 at p. 32 |. 12 to p. 38 |. 11.

KEY DOCUMENTS:

Ex 1104: Tschaplinski CV

Ex 1105: Ian Miller CV

Ex 1107: *State of Stream Channel*, December 2010

Ex 1108: *Chief Forester's 2010 Annual Report on the Forest and Range Evaluation Program*, Feb 2011

Ex 1118: *Assessment of Conditions of Small Fish-Bearing Streams*

Ex 1122: *Streamline Watershed Management Bulletin*

EX 1123: *Extension Note – The Bowron River Watershed: A Synoptic Assessment of Stream and Riparian Conditions 20-30 Years After Salvage Logging*

Ex 1124: *Extension Note – Mountain Pine Beetle and Salvage Harvesting* (March 2009)

EX 1125 *MPB Impacts on Channel Morphology*

EX 1126 *Guidance on MPB Salvage Operations*

EX 1119: *Professional Reliance in the Forest Sector* - 2010

EX 1120 *The FRPA and Professional Reliance: Intention versus Reality*, April 5, 2011

EX 1121 *Expectations that Affect the Management of Public Forest and Range Land in British Columbia: Looking Outside of the Legislation*, Reader 2006

KEY TESTIMONY:

1. Peter Tschaplinski explained the main forestry-related impacts on Fraser River Sockeye habitat (p. 6,|.14)
   a. Changes to watershed hydrology and implications for increased precipitation runoff rates, elevated stream flows, hill slope stability, channel erosion and fish habitats
   b. Streamside management practices that may influence aquatic habitat quality
   c. Sedimentation: both natural processes contributing to fish habitat and undisturbed by human activity vs. potential impacts and alterations related to logging practices
   d. Stream bank stability: elevated flows and consequences for streambank and streambed erosion, sediment deposition, and consequences for impacts to fish habitats.

2. Fish passage obstructions are a serious issue
   a. Natural disturbance
   b. Road crossings: particularly, closed-bottom culverts (p. 9, |.14 – 37)

Mountain Pine Beetle

3. Mountain pine beetle
   a. The great majority of the area affected by MPB is within the Fraser River drainage: impact on sockeye salmon (p. 10,|.8)

b. Studies show that to date salvage harvesting has not affected the riparian area, under FRPA (p. 11, |.5-13)

4. The Mountain Pine Beetle infestation has affected riparian areas but salvage harvesting has not affected these riparian areas differently from routine riparian management, under FRPA (p. 10 and p. 11 |5-13)

5. Exhibit 1124, *Extension Note – Mountain Pine Beetle and Salvage Harvesting: Small Stream and Riparian Zone Response in the Sub-Boreal Spruce Zone* – March 2009) (p. 45, |.23 – p. 46, |.21)
   Peter Tschaplinski discussed the impacts on small fish-bearing streams with different riparian buffers, as well as the recommendation from the report.

6. Exhibit 1125, *Forest Forward – MPB Impacts on Channel Morphology and Woody Debris in Forested Landscapes* (p. 45, |. 41 – p. 46, |.21)
   Peter Tschaplinski explained the focal issues of the report, the consequences found and the conclusion made.

7. In cross by the Conservation Coalition, Peter Tschaplinski noted principles and consequences related to watershed hydrology, terrain stability, streams and fisheries resources with large cut blocks and dead forest, especially those located within the Fraser River basin (p. 73, |.47 – p. 74, |.45)
   He noted that that area and forest wood volumes affected by the Mountain Pine Beetle are of such vast scales that "we couldn't possibly salvage at a rate to make a significant dent in the total amount of forest that's been affected". (p. 74, ||. 24, 25)

8. Salvage harvesting and interactions with fish: the risk is always there. (p. 74, |.46 – p. 75, |.13)

Professional Reliance

9. Ian Miller described the professional reliance approach framework in answer to Commission counsel (p. 25 l 33 to 28 l 12)

10. Professional Reliance is reliance on professionals for sound, credible advice and input to management decisions, policy decisions. (p. 26, |. 9 - 11);

11. The present FRPA moves to a results-based framework, which is a combination of forest practice statutes, professional statutes, guidance to the professionals, scientific research and social expectations, all of which combine to deliver management of forest land in BC. (p. 26, |.39 to p. 27, |.17);

12. EX 1121 *Expectations that Affect the Management of Public Forest and Range Land in British Columbia: Looking Outside the Legislation*, Reader 2006
    a. This paper provides important insight into the changing nature of the roles played by government, forest tenure holders and professionals. The Executive Summary notes that within any statutory regime the most important expectations are those of the Legislature – as set out in the applicable legislation. The next most important expectations are those of the Courts. (p. v).
    b. The paper discusses important ways in which scientific and technical knowledge can be brought to bear on forest and range management decisions: through the effective use of well-qualified , dedicated professionals

> "Professionals who are members of one of the self-regulating profession – including professional foresters, biologists, agrologists, engineers and geoscientists – are subject to their own statutory regimes, which are ***not*** administered by government officials. The regimes that apply to these professionals are administered by their professional associations, which are charged with imposing and enforcing strict standards of conduct and competence. These standards shape the nature and scope of the advice and assistance that professionals can (or cannot) provide. For this reason, professional standards are, in many respects, as important as, if not more important than, the requirements imposed on tenure holders under the FRPA."

As the title suggests, and as Miller testified, expectations in the non-legal realm are also important.

> "Expectations arising in the non-legal realm can also have a profound effect on the management of public forest and range lands.
>
> In our day-to-day lives, societal expectations, which arise in the non-legal realm, are usually the most powerful influences

on our actions and decisions. What our neighbours, clients or customers think of us is generally of greater concern to us than anything the law may require of us in our roles as members of society, public servants, professionals, business-people, landowners, stewards, etc.

With respect to the management of public forest and range lands, the importance of societal expectations easily rivals that of anything found within the legal realm. The pivotal role played by the environmental movement in B.C. illustrates this point, as do environmentally-conscious marketplace initiatives, such as the certification of forest products.

Equally important, insofar as forest and range management decisions are concerned, are the expectations created by scientific/technical knowledge. Not only does this knowledge shape societal expectations, it also has a direct bearing on important concepts arising in the legal realm, such as the due diligence defence that applies under the FRPA and the standard of care that applies in the context of a common law negligence suit."

"The challenge confronting resource management professionals and their professional associations is two-fold:

- To prove to tenure holders that the advice and assistance of these professionals has value; and
- To prove to the government and the public that this advice and assistance has credibility.

Neither of these tasks will necessarily be easy, but, whether they are or not, both tasks will have to be accomplished if the resource management professions are to play anything other than a minor role with respect to the management of public forest and range lands in B.C.

As noted earlier, it is still too soon to say how big their role might be. However, regardless of the form it takes, the role played by any professional inevitably attracts scrutiny."

13. The Professional Reliance Task Force was a group of 4 professional associations, the provincial government, the two largest forest industry associations: COFI (Counsel of Forest Industries) and CFPA (Coast Forest Products Association). (p. 39, |. 46 to p. 40, |. 8) The Task Force developed what remains the working definition of professional reliance in the Province of British

Columbia. Ian Miller was part of that task force, and has worked with the Association of BC Forest Professionals in preparing portions of the annual Forest Legislation and Policy Reference Guide, a compendium produced primarily for students studying for their policy exam, one of the last steps in becoming a registered professional forester. Peter Tschaplinski is the contributing author to the riparian management chapter of this guide which is updated annually with the latest information – this past year, the chapter was revised with the Chief Forester's FREP recommendations for riparian retention for small streams. In turn, those recommendations resulted from the post-harvesting monitoring outcomes from 1441 streams in BC. It is also used as reference material by practising professionals across the province. (p. 40, ||. 11 – 26)

By doing that, Ian Miller, and many other resource professionals are working to provide current and relevant guidance to resource professionals about how to carry out their activities, understanding and applying the concept of professional reliance and fulfilling their legal obligations and professional practice responsibilities. (p. 40, ||. 30 – 35)

14. EX 1119: *Professional Reliance in the Forest Sector* – 2010;

15. EX 1120 *The FRPA and Professional Reliance: Intention versus Reality*, April 5, 2011;

16. Ian Miller used the parenting skills story to explain the theory of societal expectations vs. legislation (p. 42, |. 30 to p. 43, |. 12).
It is interesting to note the term "social licence" referenced by Reader at page 217 was also noted by David Bevan in his testimony on Sept 27, 2011 (p. 6, ||. 31 – 45).

Forest Research and Riparian Areas

17. Peter Tschaplinski has done important research on Carnation Creek over 33 years. The results from the 40-year Carnation Creek research project is an important foundation for the Wild Salmon policy (p.48, l. 29 - p.49, l. 18).

18. Peter Tschaplinski gave a thorough explanation on the importance of the research and monitoring about forest practices under the Code, in conjunction with the decline of sockeye in the last 20 years. (p. 50, |.22 – p. 52, |.11).

Forestry practices and ecological outcomes have improved during the same time that sockeye has declined.

19. Exhibit 1122, *Streamline Watershed Management Bulletin* (p. 44, ||.19 – 42)
Discussed the outcome of the document focused on the importance of small streams in watersheds: the document shows the elevated level of attention by government and academia on small-stream management issues including two international symposia held at UBC and covering the most recent small-stream science and management; and mentioned about working cooperatively with DFO scientist Erland MacIsaac on several research and monitoring initiatives.

20. Exhibit 1123, *Extension Note – The Bowron River Watershed: A Synoptic Assessment of Stream and Riparian Condition 20 – 30 Years after Salvage Logging* – March 2008 (p. 45, ||. 5 – 21)
Peter Tschaplinski briefly gave a background story and their findings of the watershed and riparian clear-cut impacts on riparian areas, channel conditions, and fish habitats.

21. Exhibit 1107, *Report #27, State of Stream Channels, Fish Habitats and their Adjacent Riparian Areas*, Dec. 2010
Peter Tschaplinski made a detailed explanation on the report's background, the scientific foundation of its stream monitoring methodology, the work done, and its conclusions. (p. 11, |.32—p. 12, |.46). This report is not just a routine report, but is also academically peer reviewed and passed with international peer scientific recognition. (p. 38, |.37 – p. 39, |.11)

22. Exhibit 1008, *Chief Forester's 2010 Annual Report on the Forest and Range Evaluation Program*, Feb 2011 (p. 13, |. 17)
Peter Tschaplinski indicated that this report is more a picture under the Code, rather than FRPA, but explained that the stream, lake, and wetland classification system and riparian management system of the Code have been retained by the FRPA. He explained that Code guidance materials including riparian best management practices remain available to forestry practitioners under the FRPA. Preliminary evidence indicates that FRPA practices have incorporated many good practices from the Code. Then he went on to discuss their research findings and the Chief's recommendation for improvement. (p. 13 – 14)

23. Exhibit 1118, *Assessment of the Condition of Small Fish-bearing Streams in the Central Interior Plateau of BC in Response to Riparian Practices Implemented under the Forest Practices Code*. (p. 32 – 34)

Peter Tschaplinski quickly touched all the topics:

a. Wood is an important element for channel structure for many streams. A continued supply of wood from riparian sources is desirable for these streams; however, not all streams require wood for channel morphology (p. 32, |. 37)
b. Carnation Creek Project: 33 years of involvement in this 40-year on-going study (p. 33, |. 7)
   also important for current and future contributions to wild salmon policy (p. 48, |.39 – p. 49, |. 18):
   - Long-term multi-agency watershed scale basic research projects: expensive, but have generated and can continue to generate valuable data and knowledge for natural resource management for years
   - Data was instrumental, and contributed to the Code, the FRPA, and supports DFO's Wild Salmon Policy.
   - Marmorek also agreed on the importance of Carnation Creek in terms of a long time series of data:

28 Q In that context, I noted in your resume that you
29 had had some involvement with Carnation Creek
30 research that has been done by Peter Tschaplinski
31 and others.
32 A Mm-hmm.
33 Q Is that an example of a long-term project that has
34 some messages about importance for understanding
35 problems going forward?
36 A Well, they're looking at effects of forest
37 harvesting on salmon and it's been a very valuable
38 project with a long history. I think that there's
39 always a compromise between a very intensive look
40 at one watershed, like Carnation Creek, versus an
41 extensive look at a bunch of watersheds, and I

42 think you need both of those kinds of studies,

43 because if you just look at one place, it's not

44 going to be representative of all those places.

45 So the 64 stocks that Peterman and Dorner looked

46 at give us a very broad look, but not very deep,

47 and whereas the work that, say, is done on

1 Carnation Creek or on the Kehoe River by Bruce

2 Ward, gives a much deeper look at, you know, a few

3 places. You can't afford to do that everywhere,

4 but I think you need both.

5 Q But, in particular, you need a long time series of

6 data to --

7 A Correct.

8 Q So it's important to keep it going year after

9 year?

10 A Absolutely.

(David Marmorek, Sept 19, 2011, p. 62, |.28 – p. 63, |.10)

c. Watershed assessments were not mandatory for all watersheds, under the FP Code , and are not mandatory under FRPA (p. 33 | 15 – 29)
d. Forest Development Plans (FDP) showing proposed cutblocks and roads at a landscape scale, and Silviculture Prescriptions (SP) showing detailed site-level data and proposed management activities, were mandatory under the Forest Practices Code, and were approved by government. Under FRPA, a less-detailed landscape-level Forest Stewardship Plan is prepared for government approval (p. 33|32 – 47)
e. Wetland and Lake classes for riparian management (p. 34 | 14 – 26)
f. Under both the Code and FRPA, the role of the DFO-BC Joint Steering Committee, and the Joint Management Committee (p. 34 | 43 – 47)

Mr. Miller explained the current status of work on fish stream crossings (p. 69, |. 9 to p.71, |, 4).

ISSUES:

1. Are forest and logging a primary factor in the long term decline of productivity of Fraser River sockeye or in the collapse of the 2009 run?
2. Do the professional reliance mechanisms indeed help to protect fish habitat?
3. Science evidence: mountain pine beetle and riparian areas.

SUBMISSIONS:

1. Forest and logging practices are not a primary factor in the long term decline and productivity of Fraser River sockeye or in the collapse of the 2009 run.
    - The Technical Report does not identify forestry as a likely primary driver for long term decline in productivity of Fraser River sockeye.
    - Specifically, Technical Report 6 states that it is unlikely that other freshwater factors were the primary drivers than long term decline in productivity of Fraser River sockeye. (Executive Summary, Stage 1, Stage 2, Stage 3 and Stage 5)
    - Technical Report 3 further states that the recent declines in Fraser River sockeye salmon productivity are unlikely the result of changes to the freshwater environment including human activities (Executive Summary, pages iii and vi).

2. The professional reliance mechanisms help to protect fish habitat.
3. Science-based monitoring shows forestry and forestry-related environmental outcomes have improved greatly over the past 20 years

DISCUSSION:

This submission focuses on the role of other players in the forest and freshwater environment: the province, and qualified professionals. The DFO witness noted in his evidence, the realities are that the last decade has seen a marked reduction in habitat professionals within both levels of government, and this is not likely to change any time soon.

Whatever concerns and anxieties have existed in the past, the panel served as a demonstration for cooperative federalism in action: good and respectful working relationships with dedicated professionals motivated to make a difference.

Peter Tschaplinski's evidence serves as a model for effective use of science and science-based monitoring for management decision-making.

SUMMARY:

1. The potential effects of forestry management on watershed function, riparian conditions, and salmon habitats and populations have been long studied and relatively well understood. The development and evolution of forest management regulations and practices has been informed by this research over the past 30 years.

2. The environmental outcomes of forestry practices, including effects on riparian areas and aquatic habitats for salmon have markedly improved over the past 20 years during which time Fraser River sockeye salmon have varied in abundance and have shown long-term general declines. This suggests that there are causal factors other than forestry that are responsible for these declines.

3. The province has made significant investments to monitor the outcomes of forestry practices. Since 2004, FREP monitoring results have shown that streams and riparian areas have been managed effectively and to standards that exceed legal requirements for all classes of stream in BC.

4. The province is active in supporting the continual improvement of forestry related outcomes. FREP riparian and stream monitoring since 2005 has identified areas for incremental improvement, and this information is transferred to forestry practitioners in documents such as the Forest Legislation and Policy Reference Guide.

HYDRO, WATER FLOW AND TEMPERATURE

PANEL 64

Lynn Kriwoken (MoE), Glen Davidson (FLNRO), Jason Hwang (DFO), and Paul Higgins (BC Hydro)

September 16, 2011

PANEL 63

Dr. Craig Orr (Watershed Watch Salmon Society), Dr. Steve MacDonald (DFO), and Dr. Michael Bradford (DFO)

September 15, 2011

Overview

The PPR Regulation of Water Uses in the Fraser Watershed, 18 August 2011, (*PPR 21, Regulation of Water Uses in the Fraser River Watershed)* generally sets out an accurate overview of the existing water licensing scheme (*PPR 21, Regulation of Water Uses in the Fraser River Watershed***,** paras 23–53) as it relates to Fraser River sockeye.

Over 44,000 water licenses have been issued in the Province and over half of those are domestic licenses for small water withdrawals for domestic purposes. Water withdrawals for domestic purposes are not required to be licensed. The underlying premise in the water licensing regime is first in time, first in right which is the prevalent licensing regime in most of western North America.

Some licenses, mainly the newer licenses, and large volume licenses have an instream flow requirements and monitoring requirements. Up to a quarter of the water licenses may have monitoring or reporting requirements.

The Province does not require licenses for groundwater extraction at this point but it does regulate aspects of groundwater extraction with respect to well design and siting. The Province has mapped and classified 960 aquifers and it operates 145 wells to monitor groundwater levels.

There was no evidence that the existing water licensing scheme has caused a long term decrease in productivity of Fraser River sockeye or the collapse in 2009.

The Province has a drought response plan (which involves DFO, and which was used in the 2009 drought). There are some measures which the comptroller of water rights and regional water managers may use with respect to existing water licenses and there are measures available under the *Fish Protection Act* to deal with instream flow issues during drought conditions.

The Province is undertaking a *Water Act* modernization process (WAM) which proposes, amongst other things, to contain instream flow requirements and to require licensing of groundwater extractions of large volumes and all extractions in priority areas. The Province has undertaken considerable province wide consultation with respect to WAM since 2009. The Minister has recently advised that there will be further consultation on draft legislation in 2012.

There are two major hydroelectric projects in the Fraser watershed that have the potential to impact Fraser River sockeye, BC Hydro's Bridge Seton Power Project near Lillooet and Rio Tinto Alcan's Kemano Power Project. There was no evidence presented which indicated that these projects were the cause of the long term decrease in productivity of Fraser River sockeye or that they led to the collapse of the 2009 run.

There are also five small hydro projects or independent power projects (IPP) in the Fraser watershed. There was no evidence that these projects led to the decline in productivity of Fraser River sockeye or that they led to the collapse of the 2009 run.

Technical Report Context

Technical Report 6 - Fraser River Sockeye Salmon: Data Synthesis and Cumulative Impacts – the Report found that various factors including water use, large hydro and small hydro projects were unlikely, taken cumulatively, to be the priority drivers behind the long term declines in sockeye productivity across the Fraser basin (*Exhibit 1896, Technical Report 6, Fraser River Sockeye Salmon: Data Synthesis and Cumulative Impacts – Executive Summary – Stage 1, Stage 2, Stage 3 and Stage 5*).

Technical Report 3 - Evaluating the status of Fraser River Sockeye Salmon and the Role of Freshwater Ecology in their Decline, reviewed the impacts of various human activities on freshwater habitats including hydroelectricity projects. The Report found that the Bridge River Seton Power Project can effect migrations of smolts and adults on Seton River but adverse effects have largely been mitigated by changes in flow diversions and operations at the power house (page iv). The Report went on to say that ". . . the Kemano Project affects water temperatures in the Lower Nechako River but a temperature compliance program has been implemented to ensure that water temperatures remain suitable for adult passage." (*Exhibit 562**,** Technical Report 3, Freshwater Ecology & CU Status, p. iv)*

With respect to IPPs, the Report stated the following:

> "Given the available data and these results, IPPs have not had significant impacts on sockeye salmon populations. This conclusion is based on the small number and proximity to spawning grounds or migration corridors." (*Exhibit 562**,** Technical Report 3, Freshwater Ecology & CU Status, p.* 41)

PPR Context

Generally the PPR sets out a good overall summary of the regulation of water allocation and water use. Further to paragraph 54, the Province notes that the Living Water Smart: British Columbia's Water Plan, Exhibit 1882, should be referenced as that was the document which began the process and set out the Government's commitments with respect to water legislation reform.

With respect to paragraphs 174 and 175 and requirements for Independent Power Projects (IPPs), reference should be made to Exhibits 1891, Province of British Columbia Clean Energy Project Development Plan Information Requirements, July 2011 and Exhibit 1890, Independent Power Production in BC: An Interagency Guidebook for Proponents, British Columbia Integrated Land Management Bureau, 2010.

Key Documents

Exhibit 1882 - Living Water Smart - British Columbia's Water Plan, 2008

Exhibit 1870 - British Columbia's *Water Act* Modernization, Discussion Paper

Exhibit 1872 - British Columbia's *Water Act* Modernization Technical Background Report

Exhibit 1873 - British Columbia's *Water Act* Modernization Report on Engagement

Exhibit 1856 - British Columbia's *Water Act* Modernization, Policy Proposal on British Columbia's new *Water Sustainability Act*, Dec 2010

Exhibit 1874 - DFO Discussion Document, BC *Water Act* Modernization Technical Workshops

Exhibit 1877 - Fisheries and Oceans Canada Preliminary Comments on the Province of BC Draft *Water Act* Modernization Public Discussion Paper

Exhibit 1869 - British Columbia Drought Response Plan, June 2010

Exhibit 1883 - BC Ministry of Environment, Dealing with Drought - A Handbook for Water Suppliers in British Columbia, June 2004 updated July 2009

Exhibit 1890 - Integrated Land Management Bureau, Independent Power Production in BC: An Inter-agency Guidebook for Proponents

Exhibit 1891 - Province of British Columbia, Clean Energy Project Development Plan Information Requirements, July 2011

Exhibit 1876 - DFO, Instream Flow Risk Management Framework, March 2011

Exhibit 1879 - Fisheries & Oceans Canada's Small Hydro Instream Flow Risk Management Framework

Exhibit 1880 - DFO Pacific Region Small Hydro-Instream Flow Working Group Terms of Reference, Nov 2010

Exhibit 1871 - Office of the Auditor General of BC, An Audit of the Management of Groundwater Resources in British Columbia, Dec 2010

Key Testimony

Davidson testified the present water licensing system has over 44,000 licences. Half of those are domestic use licenses; however, there is no requirement to obtain a license for domestic use (*Davidson, September 16, 2011, p. 5, ll. 39–42; p. 56, l. 42–47*).

The fundamental approach to water licensing in British Columbia is first in time/first in right (FIT/FIR) which is used in most of western North America. *(Davidson, September 16, 2011, p. 20, ll. 10–15).*

Some water licenses require reporting on water use either through the terms and conditions of the license and usually larger licenses such as hydroelectric users and big industrial users would have reporting requirements. Around a quarter of the licenses would have some reporting requirements. *(Davidson, September 16, 2011, p. 5, ll. 27–47; p. 6, ll. 16–23)*

The Province does some monitoring of water use especially larger volume users. With respect to smaller users, those matters come to the attention usually based on

complaints by other users. *(Davidson, September 16, 2011, p. 6, ll. 11–2 and ll. 31 – 43)*

Water withdrawals have generally not had any impacts on sockeye but there could be in the future as water demand continues *(Hwang, September 16, 2011, p. 8, ll. 11–20).*

The Province and DFO have worked together to address drought conditions which could pose a threat to sockeye and DFO has an active part in the Province's drought response plan (*Exhibit 1869**,** British Columbia Drought Response Plan, June 2010; Hwang, September 16, 2011, p. 8, ll. 21–33*).

The *Fish Protection Act*, section 9 provides the Minister with the authority to restrict water use during a drought if a fish population is at risk. The *Fish Protection Act* is a relatively new piece of legislation, however, it was used last time when there was a significant drought a couple of years ago. *(Davidson, September 16, 2011, p. 9, ll. 16–34)*

There are various provisions in the *Water Act* and other legislation which allow the Province to deal with instream flow requirements, including:

- Terms and conditions of a new license,
- Some licenses allow the comptroller to change the instream flow requirements in times of scarcity
- conservation licenses (e.g. Ducks Unlimited and DFO in the Nechako River)
- OIC water reserve, e.g. Adams River

(*Davidson, September 16, 2011, p. 58, ll. 18–47 and p. 59, ll. 1–27*)

The Province does consider fisheries impacts in water licensing decisions albeit new water licensing decisions *(Davidson, September 16, 2011, p. 65, ll. 5–16).*

In response to questions concerning guidelines, standards and regulations, Davidson replied that he did not see guidelines or standards as terribly enforceable on their own. It is his view that enforceability came from the *Act* or from the terms of a tenuring document like a water license. Standards and guidelines provide guidance to a decision maker as to actually what to include in the terms and conditions of a license. *(Davidson, September 16, 2011, p. 63, ll. 4-19)*

Dr. Orr expressed concerns about surface water licenses being oversubscribed and because of the principle of "first in time / first in right" (FIT/FIR) and the fact that licenses are granted in perpetuity, there would be conflicts over the amount of water that is available for fish and wildlife *(Dr. Orr, September 15, 2011, p. 6, ll. 22–30; p. 88, ll. 31–44).*

Davidson advised that Provincial officials use "fully recorded" as opposed to "oversubscribed". "Fully recorded" meaning that there is no more available flow for the licensing of that particular stream. In talking about oversubscribed, what Davidson indicated is that "it means that not all licenses can get satisfied at all times of the year. There is more license capacity than there is water. This might be a problem for individual licensees because they can't make full use of their allocation." He also advised that oversubscription may or may not be a problem for instream flows because in some cases instream flows may be protected. *(Davidson, September 16, 2011, p. 57, ll. 35-47 and p. 58, ll. 1 – 17)*

BC does not regulate groundwater extraction but there are regulations (the Groundwater Protection Regulation) that establish a standard for drilling, altering and closing wells and requires well drillers and pump installers to register within the Province. *(PPR 21, Regulations of Water Uses in the Fraser River Watershed, paras 42–45; Davidson, September 16, 2011, p. 12, ll. 5–13; Kriwoken, September 16, 2011, p. 55, ll. 32–47)*

The Province does some mapping and classifying of aquifers. Further, the Province maintains a database of voluntarily submitted groundwater well records (approximately 100,000 are in the system) and in addition the Province has a provincial observation wells network which as of July 29, 2011 had 145 active observation wells covering major developed groundwater areas in the province. (*PPR 21, Regulations of Water*

Uses in the Fraser River Watershed, paras 48-49; Davidson, September 16, 2011, p. 12, ll. 17–24).

Davidson testified in areas where there is heavy groundwater use and heavy surface water use there has been some decline in groundwater levels (*Davidson, September 16, 2011, p.12, ll. 32–46).*

The Auditor General of British Columbia in An Audit of the Management of Groundwater Resources in British Columbia, 2010, voiced concerns about the government not effectively ensuring the sustainability of the Province's groundwater resources. (*Davidson, September 16, 2011, p. 13, ll. 1 – 32; Exhibit 1871, Office of the Auditor General of BC, An Audit of the Management of Groundwater Resources in British Columbia,*). The province acknowledged those concerns and replied in the Report (*Davidson, September 16, 2011, p. 13, ll. 37–44*) and, further, various issues concerning groundwater are being considered as part of the WAM process. (*Davidson, September 16, 2011, p. 13, ll. 1 – 47 and p. 14, ll. 1 – 9*)

The *Water Act* Modernization process was initiated in 2008 with Living Water Smart, British Columbia's Water Plan 2008 (*Exhibit 1882, Living Water Smart - British Columbia's Water Plan, 2008*) which contained government commitments around water and specifically 19 of the 45 commitments were directed towards water law reform (*Kriwoken, September 16, 2011, p. 14, ll. 18–28; p. 48, ll. 16–47).*

Subsequently in 2009 the Province produced two documents, British Columbia's Water Act Modernization, Discussion Paper (*Exhibit 1870, British Columbia's Water Act Modernization, Discussion Paper*) and a companion document, British Columbia's Water Act Modernization, Technical Background Paper (*Exhibit 1872, British Columbia's Water Act Modernization Technical Background Report*) (*Kriwoken, September 16, 2011, p. 15, ll. 5–42*).

The Discussion Paper set out 4 goals:

- protect stream health and aquatic environment

- improve water governance arrangements
- introduce more flexibility and efficiency in the water allocation system
- regulate groundwater extraction and use

DFO was engaged with the Province on the WAM process and has provided feedback/comments to the Province (*Exhibit 1877, Fisheries and Oceans Canada Preliminary Comments on the Province of BC Draft Water Act Modernization Public Discussion Paper; Exhibit 1844, Email chain Thomson, Klaver, and others re "Effluent Processors and Vessels", June 2 2008 to June 3 2008*) and various DFO scientists have been engaged in the process, including Drs. Bradford and Hyatt (*Kriwoken, September 16, 2011, p. 49, ll. 5–23).*

There has been a very good working relationship between British Columbia and DFO on the WAM process. (*Hwang, September 16, 2011, p. 40, ll. 1–8; Kriwoken, September 16, 2011, p. 49, ll. 21-23*).

The Province consulted extensively on the WAM process and as a result of those consultations, the Province published a report on engagement in September, 2010 *(Exhibit 1873, British Columbia's Water Act Modernization Report on Engagement*) which highlighted the major themes that the Province has heard during the engagement process. (*Kriwoken, September 16, 2011, p. 49, 50 and 51)*

The Executive Summary of Exhibit 1873 – British Columbia's Water Act Modernization Report on Engagement Outlines the consultation process during which the Province held 12 one day public workshops, including three specifically for First Nations. In addition, the Ministry received 900 written submissions from individuals, First Nations and stakeholder groups; also 500 participants attended the workshops. The summary indicates that overall there was support for the principles and goals described in the Discussion Paper and that further the key messages from submissions included the following:

- Develop clear standards, processes, responsibilities and expectations for managing BC water
- Regulate groundwater extraction and use
- Improve current water governance arrangements

- Proactively protect drinking water, food production, clean energy and ecological health
- Recognize land/water connection
- Balance ecological protection with economic priorities
- First Nations interests must be respected
- The Province's timelines for modernizing the *Water Act* are too short

Exhibit 1873 sets out more detail on what various stakeholder groups, individuals and First Nations submitted. (pp.33 to 68)

Subsequently, given the overwhelming request for more engagement, the Province published a Policy Proposal – British Columbia's Water Act Modernization – Policy Proposal on British Columbia's New Water Sustainability Act – December, 2010. (*Exhibit 1856, British Columbia's Water Act Modernization, Policy Proposal on British Columbia's new Water Sustainability Act*) (*Kriwoken, September 16, 2011, p. 51, ll. 46-47 and p. 52, ll. 1–8*).

The *Water Sustainability Act* proposal indicates that "the WSA will establish a provincial framework based on risk, competing demands and scarcity and enable an area based approach for water management. The WSA will support the government shift in natural resource sector to an area based model and a more integrated approach for natural resource management." (*Exhibit 1873, British Columbia's Water Act Modernization Report on Engagement, p. 5).*

The framework itself in Table 1 on page 7 sets out policy directions and three levels of action for water stewardship. Those three levels of actions are:

i) In all areas of the Province there will be province wide measures implemented to cover various matters including instream flow assessments, the regulation of ground water use, water reserves for agriculture and many other factors.
ii) In known problem areas additional measures will apply to preempt emerging water supply and quality issues including requirements for water resource assessments, area and sector based conditions for new licenses and additional reporting requirements.
iii) In chronic areas additional measures are to be applied to respond to known water supply issues and risks of water quality including watershed sustainability

> plans, conditions for existing and new licenses, incentives and the collection of additional information through increased monitoring and reporting and periodic reviews. (*Exhibit 1973, Historical Fraser River Abundance, p. 7, table 1*)

The main policy directions in the WSA proposal are:

1. Protect stream health and aquatic environments
2. Consider water in land use decisions
3. Regulate groundwater use
4. Regulate during scarcity
5. Improve security, water use efficiency and conservation
6. Measure and report
7. Enable a range of governance approaches

(*Exhibit 1873, British Columbia's Water Act Modernization Report on Engagement, p. 7, table 1*)

Kriwoken spoke to the three levels of action and the policy proposals in her testimony on pages 52 – 55.

With respect to groundwater, Kriwoken advised that the proposal is to regulate groundwater use in problem areas and all groundwater withdrawals for large users in British Columbia. She advised that there are over 100,000 wells in the Province in the database and the majority are small, single family domestic use wells. The remaining 10% are larger users ranging from municipalities, industry, agriculture, irrigation and hatcheries and it is that 5 – 10% that the focus of regulation would be on. Further, she advised in water stressed areas such as the Gulf Islands and the Okanagan, for example, the proposal will be to regulate individual wells also. (*Kriwoken, September 16, 2011, p. 56, ll. 6–24*)

Kriwoken advised that the Province's existing timetable calls for the introduction of new water legislation in 2012 (*Kriwoken, September 16, 2011, p. 22, ll. 13–16*). However, in response to calls from First Nations and stakeholders, the Minister has recently indicated his intention to engage on draft legislation in 2012 (*Kriwoken, September 16, 2011, p. 22, ll. 7 – 10*).

Kriwoken also advised that the unproclaimed parts of the *Fish Protection Act* are being reviewed as part of the *Water Act* Modernization process. (*Kriwoken, September 16, 2011, p. 70, ll. 1–28*)

Water use plans have been completed for all 23 BC Hydro facilities including all of those in the Fraser Watershed. (*PPR 21, Regulation of Water Uses in the Fraser River Watershed, p. 43 and p. 42, table 6*).

There are significant costs associated with water use planning. BC Hydro paid for much of the planning and there are additional costs associated with ongoing studies, capital works and a loss of revenue from less power generation. The Province has agreed to remit lost revenue resulting from implementing water use plans to BC Hydro. The amount of remittance is capped at $50 million annually, however, to date that figure has not been reached. (*Davidson, September 16, 2011, p. 69, ll. 27-47; p. 61, ll. 1-3*)

The Province has recently revised its approach to drought response in conjunction with DFO and other stakeholders and published a drought response plan (Exhibit 1869 – British Columbia Drought Response Plan, June 2010). In addition, the Province has published a guidebook for water users dealing with such circumstances (*Exhibit 1883, British Columbia Ministry of Environment, Dealing with a Drought – A Handbook for Water Suppliers in British Columbia, June 2004, updated July 2009*).

Hwang testified that DFO was involved in an arrangement in the Okanagan where a "fish water management tool has been used and has been very beneficial to fish as well as other uses of water". (*Hwang, September 16, 2011, p. 29, ll. 46-47 and p. 30, ll. 1-3*). (See also *Exhibits 1968, Canadian Okanagan Basin Technical Working Group Terms of Reference*;

Exhibit 1969, Okanagan Fish/Water Management Tool: Guideline for Apprentice Water Managers v. 2.0.000;

Exhibit 1970, Fish and Water Management Tool – Project Assessment: Okanagan Adult Sockeye Salmon (Oncorhynchus Nerka) Abundance and Biological Traits in 2005

Exhibit 1971, Upper Columbia Aquatic Management Partnership (UCAMP) – A Partnership of Various First Nation Groups)

PPR 21, paragraph 170 states that there are five small Hydro projects – independent power projects (IPPs) operating in the Fraser Watershed, while another 13 are planned but not yet operational. (See also PPR 21, Regulation of Water Uses in the Fraser River Watershed, p. 71, table 9). The Province has guidelines for assessing instream flow requirements for small Hydro projects (PPR 21, Regulation of Water Uses in the Fraser River Watershed, para. 176). Further, DFO has established a framework to review IPP projects in relation to fish and fish habitat issues. (See *Exhibit 1876, DFO, Instream Flow Risk Management Framework and Exhibit 1879, Fisheries & Oceans Canada's Small Hydro Instream Flow Risk Management Framework*) (See also testimony of Hwang, *September 16, 2011,* pp. 35–37).

Hwang testified that he is not aware of DFO authorizing construction or implementation of any IPPs in salmon bearing waters (*Hwang, September 16, 2011, p. 36, ll. 7-17*). Further, DFO is not aware of any existing proposed IPPs that have the potential to impact sockeye migration (*Hwang, 16, 2011, p. 36, ll. 18-21*).

DFO does not see IPPs as "a particular imminent concern" with respect to sockeye salmon because most of the IPPs are situated in places that do not intersect or interact with sockeye (*Hwang, September 16, 2011, p. 45, ll. 27-39*).

Issues

- The extent to which the present provincial water licensing system deals with potential impacts to water flow and temperature in the Fraser River Watershed specifically surface water use and groundwater use for various purposes as those may impact on Fraser River sockeye.
- How the proposed *Water Sustainability Act* will deal with potential impacts to water flow and temperature in the Fraser Watershed and specifically how that will impact Fraser River sockeye.
- The effect that independent power projects and major hydroelectric power projects have in the Fraser Watershed with respect to fish and fish habitat and more specifically Fraser River sockeye.

Submissions

Water Use – Water Regulation

There is little evidence, if any, that water withdrawals have led to the decrease in long term productivity in Fraser River sockeye or the collapse of the 2009 run.

- Jason Hwang testified that generally DFO had no observed impacts of water withdrawals on sockeye *(Hwang, September 16, 2011, p. 8, ll. 11-15).*

- Under the present water licensing regime, various steps can be taken to protect instream flows. Davidson testified that most of the larger power licenses have instream flow terms and modern licenses will often contain instream flow requirements. Further, in times of water scarcity some licenses contain terms that allow the regional water manager or the comptroller to vary instream flow requirements. In addition, action can be taken under section 9 of the *Fish Protection Act* as was done in the drought of 2009. A conservation license can protect water in a system (for example Ducks Unlimited has a number of conservation licenses and DFO holds a conservation license on the Upper Nechako for water for fish). Finally, it is possible to obtain an Order in Council water reserve, for example, there is a water reserve for flow in the Adams River. (*Davidson, Septemeber 16, 2011, p. 58, ll. 21-47; pg. 59, ll. 1-27*).

- The Province's Water Act Modernization process and specifically the *Water Sustainability Act*, a framework for water stewardship in BC, proposes actions that will benefit salmon. The proposal is to have three levels of action for water stewardship in all areas of the province:

    - Province wide measures will be implemented and those will include formula based instream flow assessments for all new groundwater and surface water allocation decisions, use of criteria and thresholds to identify problem areas, regulating of groundwater use, different approaches for managing water during times of scarcity, and allowing for deviation from priority date under exceptional circumstances
    - In known problem areas, additional measures to preempt emerging water supply and quality issues will be implemented including requirements for water resource assessments, area and sector based conditions for new licenses, and additional reporting requirements.
    - In chronic problem areas, additional measures may apply including requirements for watershed sustainability plans, conditions for new and

existing licenses and the collection of additional information through increased monitoring and reporting and periodic reviews.

- In addition, it can be said that all of the 7 policy directions have the potential to help sockeye salmon. (*Kriwoken, September 16, 2011, p. 53, ll. 38-43*)
- Those policy directions include:
    1. Protect stream health and aquatic environments,
    2. Consider water and land use decisions,
    3. Regulate groundwater use,
    4. Regulate during scarcity,
    5. Improve security water use efficiency and conservation,
    6. Measure and report,
    7. Enable a range of governance approaches. (*Exhibit 1873, British Columbia's Water Act Modernization Report on Engagement , p. 7, table 1*)

- The *Water Sustainability Act* policy proposal considers the two major issues that have arisen during the testimony, those being instream flow requirements and the regulation of groundwater.

- There is little or no evidence that BC Hydro facilities in the Fraser Watershed, as listed on page 37, Table 4 of PPR 21, have contributed to a long term decrease in productivity of Fraser River sockeye or the collapse in 2009. (Exhibit 562, Technical Report 3, Freshwater Ecology & CU Status, pp. iv and 43 and Exhibit 1896, Technical Report 6, Fraser River Sockeye Salmon: Data Synthesis and Cumulative Impacts – Executive Summary).

- In addition, as the Kemano Power Project reduces water flows in the Nechako River, there was some concern that this may have an effect on sockeye salmon. The concern being that low water flows in the Nechako may cause higher summer water temperatures which in turn can increase stress on migrating adults and make them more susceptible to disease and pre-spawning mortality. (PPR 21, Regulation of Water Uses in the Fraser River Watershed**,** paras 144–147)

- The Summer Temperature Management Program has been found to be an effective strategy from the perspective of achieving reduced water temperatures at Finmore and thus having a cooling influence on temperatures on the Nechako downstream from Finmore. This part of the Nechako is important for sockeye migration success as it is used by sockeye runs migrating to the Stewart River, and the Nedina and Stelako systems. (PPR 21, Regulation of Water Uses in the Fraser River Watershed**,** para 159) (See also Technical Reports 3 and 6)

IPPs

There is little or no evidence that IPPs contributed to the decline and long term productivity of Fraser River sockeye or the collapse in 2009.

- Technical Report 3, pages iv and 43, Technical report 6 – Executive Summary
- Hwang testified that DFO does not see IPPs as a particular imminent concern with respect to sockeye because most of the IPPs coming in are in places that are not intersecting or interacting with sockeye (*Hwang, September 16, 2011, p. 45, ll. 27-39)*
- Hwang was not aware of DFO authorizing construction or implementation of any IPPs in salmon bearing waters (*Hwang, September, 16, 2011, p. 36, ll. 7-17)*
- Hwang was not aware of any existing or proposed IPPs that have the potential to impact sockeye migration (*Hwang, September, 16, 2011, p. 36, ll. 18-21)*
- DFO has established a framework to deal with proposed IPP projects (See *Exhibit 1876, DFO, Instream Flow Risk Management Framework, March 2011; Exhibit 1879, Fisheries & Oceans Canada's Small Hydro Instream Flow Risk Management Framewor, and Exhibit 1880, DFO Pacific Region Small Hydro-Instream Flow Working Group Terms of Reference, Nov 2010)*
- Instream flow requirements are a condition of a water license for IPPs as necessary. (*Davidson, September 16, p. 60, ll. 4-15*)
- Dr. Bradford was not aware of any IPPs in the Fraser River watershed affecting sockeye salmon or their habitat. *(Dr. Bradford, September 15, page 37, lines 19-28)*

Hydroelectric Facilities

- Dr. MacDonald would not look at hydroelectric facilities as a single or primary cause of the 2009 decline in the Fraser River sockeye. Further, he would "caution against looking at any single event as a cause". (*Dr. MacDonald, September 15, 2011, p. 44, ll. 40-47)*

<u>Recommendations</u>

1. If there should be any recommendation it should be that DFO continue to work with the Province in the Water Act Modernization process and continue to contribute to discussions concerning instream flow requirements, the regulation of groundwater use and related matters.