Review of Thompson River Partnership Monitoring Report

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1.0 Introduction

Public complaints about foam, an increase in periphyton growth, a perceived decrease in sensitive benthic invertebrates, fish tainting and issues concerning water colour in the Thompson River were voiced in the early 1970's. Initial monitoring in the system related to these complaints was initiated in 1973. Some monitoring had been conducted in the mid-1960's shortly after the construction of a pulp mill in Kamloops. Impact assessment monitoring was expanded in the mid 1970's and 1980's and continued through varying degrees in the succeeding decades.

A formal Thompson River monitoring program partnership committee was formed in 2003 in an effort to coordinate required and voluntary monitoring programs conducted by dischargers and stakeholders along the lower Thompson River and Kamloops Lake. Current partnership members include:

- City of Kamloops
- Village of Ashcroft
- Ministry of Environment
- Environment Canada
- Fisheries and Oceans Canada
- Skeetchestn Indian Band
- Tk'emlups Indian Band
- Domtar
- Tobiano Resort

The monitoring program currently includes water quality samples collected from upstream of Kamloops to Spences Bridge near the confluence with the Fraser River, BC. This monitoring is a shared effort with the Domtar pulp mill monitoring four stations and the Ministry of Environment monitoring one main stem station and tributaries. Periphyton sampling (chl-*a,* taxonomy) is conducted concurrently with water quality sampling with the mill responsible for sampling the Savona and Walachin stations and the Ministry sampling the Ashcroft and Spences Bridge stations. Benthos sampling is also conducted as a shared effort between the mill and the City of Kamloops. Water sampling is the most frequent monitoring covering low flow periods from October to March with biological collections in February and March of each year.

The integrated monitoring program focuses on impact assessment of loadings and loading changes on downstream water quality, periphyton growth, benthic invertebrate communities, intra-gravel oxygen concentrations in the lower Thompson River and trophic and limnological status of Kamloops Lake. The integrated multi-tropic nature of the monitoring program was truly visionary for its

time and the fact that it has maintained a consistent approach over temporal and spatial scales for over 30 years is unique and highly commendable.

2.0 Current Situation and Program Review

Review of the monitoring data by the multi-stakeholder monitoring partnership revealed that, over the past six years, no significant changes were measured in the receiving water resulting from changes made to the City of Kamloops sewage treatment plant. However, the Committee desired continued integrated monitoring to address the following issues:

- Identification of significant short term trends and impacts due to known contaminant and nutrient loading changes;
- Observation of long term trends;
- Filling of assessment gaps regarding significant effects of loading on designated water uses such as aquatic life, irrigation, human consumption and recreation; and
- Effective and practical integration of existing legislated monitoring requirements into an objectives oriented program.

In order to address these issues, the integrated monitoring project required consideration of recent and historic studies, existing contributions by each partnership member, cost effectiveness and suitability of the existing program in meeting the above objectives, appropriateness of the current water quality objectives in the lower Thompson River and potential changes in loadings changes.

In order to meet the conditions listed above, the Committee decided to have independent reviewers assess the results of the previous six years of monitoring.

3.0 Objectives for Independent Review

The reviewers were instructed to review all 'relevant reports and information' concerning the Thompson River. 'Relevant reports and information' included, but were not necessarily limited to, all data reports and so far unreported data by members of the Partnership between 2003 and mid 2010, as well as relevant summaries of previous results. Based on the results of this review, this analysis was to identify only those information and knowledge gaps that may result in the ignorance of significant risks to the designated uses and ecosystem health (including through enrichment and toxicity).

Thompson River and Kamloops Lake data reports from 2003 to 2010 were reviewed, with summaries of previous study results also reviewed as required to assess the following objectives:

1. Does the information collected so far result in sufficient knowledge to identify whether current water quality of the lower Thompson River and Kamloops Lake directly or indirectly impairs these water bodies for designated uses, particularly aquatic life, recreation, irrigation, and human consumption?
2. Is the current harmonized monitoring design (of the last six years) suitable to pick up environmental changes that may cause impacts to the above designated uses?
3. Is the knowledge gained so far sufficient to determine critical factors that influence existing water quality and its effect on designated users of the Thompson River and Kamloops Lake?
4. Identify data gaps based on the above data sufficiency review.
5. Based on the above data review, is the current water quality objective for periphyton in the Thompson River adequate, overprotective or not sufficie nt in protecting the designated uses.
6. Propose a cost effective and practical monitoring program for future integrated water quality monitoring by the Thompson River Partnership that meets the objectives as indicated under *'Current Situation and Rationale for Consultant Project Review'* of this document.

4.0 Reports Reviewed

4.1. Primary Reports Reviewed

- Domtar EEM Cycles 1 – 5
- Domtar Annual Monitoring Program (for MOE) – 2004/05 to 2009/10
- Thompson R. Intra-Gravel Dissolved Oxygen Monitoring 2004 to 2010 Data Summary (COK)
- Kamloops Lake Information Collation & Assessment (COK)
- Assessment of Changes in Total Phosphorus in Kamloops Lake, BC: A Paleolimnological Assessment (March 2008) (B. Cumming)
- Assessment of Changes in Total Phosphorus in Kamloops Lake, BC: An Updated Paleolimnological Assessment (March 2009) (B. Cumming)

4.2. Examples of Ancillary Reports Reviewed

- Bothwell, Culp, Lowell, Dube publications from early 1980s
- Thompson River Water Quality Assessment and Objectives: Technical Appendix (MOE, 1992)
- The Limnology of Kamloops, Lake, B.C., (St. John et al 1976).
- City of Kamloops Environmental Impact Study – Mass Balance. (Harkness, J. 2002).

- Sources and effects of algal growth, colour, foaming, and fish tainting in the Thompson River system. Federal-provincial Thompson River Task Force. Thompson River Task Force. (1976).
- Limnology of Kamloops Lake. (F. J. Ward, 1964).
- Preliminary Assessment of Water Quality in Thompson River (unpubl./MOE)
- Preliminary Assessment of Water Quality in Kamloops Lake (unpubl./MOE)

5.0 Review of Objectives

A review of documentation was conducted by both consultants independently and preliminary results were then compiled, discussed and integrated relative to the six objectives of the review. A partnership meeting was held in Kamloops, BC on Friday, October 18, 2010 and results of the preliminary review were presented by the consultants to obtain feedback. The powerpoint presentation was subsequently made available to the committee members...

The review of each objective is presented below. Any comments by partnership members relative to the objectives are also provided and responded to if necessary.

5.1. Objective 1: Water Body Impairment

Does the information collected so far result in sufficient knowledge to identify whether current water quality of the lower Thompson River and Kamloops Lake directly or indirectly impairs these water bodies for designated uses, particularly aquatic life, recreation, irrigation, and human consumption?

Significant monitoring data exist on this system covering seasons, years, and trophic levels from primary producers to primary and secondary consumers. The data collection has been well thought out, inclusive, priority driven, and most importantly, consistent in terms of experimental design and method of sample collection. This is commendable and quite unique in Canada for such a length of time. Data show very good to excellent spatial and temporal coverage.

Although the monitoring information collected is sufficient to assess this objective, the objective itself has not been assessed in the data analysis.

The data need to be analyzed and presented in two contexts: 1) to measure change over time and space as a deviation from natural variation; and 2) to determine how and if data exceed criteria related to designated uses. This reporting should be done each year assessment reports are required and in the same consistent format year after year. It should be reported in a manner that

readers can see quickly and easily for each parameter, what is normal for that station and that parameter and when samples are outside of that value in any given year, season, and station. A consistent "hot spot" and "hot moment" assessment and a consistent comparison to guidelines for designated uses are required.

For each parameter and for each station, it is critical to show trends in data and deviations from natural variation. Extensive literature on effects-based monitoring approaches and data presentation exists in Canada as well as methods on how to determine natural variation. It is essential to know the variation in each indicator and when measurements fall outside of this variation. Benchmarking approaches are well documented in the literature. Normal or natural variation can be determined by reference areas in time or space for each site. Clearly, sites and samples impacted by the City and mill downstream in the early years would not be included in the determination of the reference or normal confidence intervals.

Seasonality must be considered in this analysis on a parameter by parameter basis and "natural" not be so inclusive that the ability to detect change outside of normal is impossible because of the scope of natural variation encountered.

Defining what one would expect to observe at a site based on what has been found across the years and seasons is straightforward. Each parameter should be reported in the same format from here on as a trend over time with confidence intervals or standard deviations plotted.

Discussions with the partners suggested the use of the term 'steady state' instead of 'normal'. The reviewers strongly disagree with this. Steady state suggests a system with constant variation which is clearly not the case in any natural system. Steady state also suggests that the system is stable now and has been throughout history which is also not the case. Resistance to the term "normal" illustrates a lack of familiarity with the intent and usefulness of effects-based monitoring approaches and the 10 years of literature available in Canada. In the same way that human health providers understand normal ranges for healthy people for key indicators, ecosystems health can be assessed and managed in the same manner. This simply show readers and reviewers if results are as expected or not (effects-based assessment) and if they may be affected (designated use assessment).

Assessment of changes in space (hot spots) and time (hot moments) outside of normal for each parameter and at each station is one way to understand the status of the system. Status should be reported on in a consistent manner and on a regular basis. If a parameter is outside of normal, then a specified action is taken which could include increased monitoring or repeat sampling (for example) to confirm. This does not determine if the system meets designated use criteria

but tells you if measurements are within what you would expect for that parameter and that site.

The data analysed show 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, indicate that salmonid fish populations are healthy (Bison, MOE; 2010; Bailey, DFO).

The study completed on intragravel dissolved oxygen concentrations (IGDO) in the lower Thompson River and Kamloops Lake indicated that the IGDO concentrations recorded during the monitoring program are capable of sustaining the earlier stages of freshwater aquatic life. Further, the intra-gravel and ambient dissolved oxygen concentrations do not appear to be negatively impacted by concentrations of algal biomass which were recorded to exceed the BC water quality guideline for the protection of aquatic life.

Total dissolved phosphorus and orthophosphorus concentrations in the water column, as well as in mill effluent, show significantly reducing trends with apparent correlations between mill reduction in phosphorus use and water column reductions. Periphyton biomass sampling (chl 'a') from 2005 - 2010 does not illustrate a relationship with total phosphorus (Hatfield 2010, stakeholder meeting presentation), nor does a strong spatial gradient appear by site for the same years compared. There is however, a clear cyclical pattern that is consistent across all sites over years that is likely more due to differences in temperature or river flow than nutrients. That is also apparent for benthos (density, richness) although less pronounced than for chlorophyll a.

The second context of assessment is evaluation of the same data relative to guidelines for the protection of designated uses. National guidelines and provincial objectives are available for each designated use. Data for each parameter should be evaluated against its criteria for use designation. It is simply another benchmark on the same graph that was generated above. If changes exist as measured above, and they exceed designated use criteria, then this will show up as sampling points exceeding the guideline. Changes in a parameter may exist outside of normal but be within designated use criteria. Changes may exceed designated use criteria but be within natural variation for that station and site. Understanding what these types of results mean getting to the heart of the difference between ecosystem health assessment and designated use assessment; assessments which are both required but differ in approach and intent.

One final comment on this revolves around assessment of the health of the system for the protection of freshwater aquatic life. Use of national or provincial objectives to assess this is not recommended, as often objectives do not account

for site-specific characteristics (such as high levels of mineralization). For example, it does not make sense to have low water quality objectives for the protection of freshwater aquatic life at a site where natural metal levels exceed objectives simply on the basis of high normal mineralization in the surficial geology. For assessment of ecosystem health, use of natural variation to set benchmarks to evaluate change is far more desirable.

The analyses of the data are currently not directed toward designated uses but inferences could be made.

Comments from Tobiano support the interest of stakeholders in better reporting relative to the designated use assessment.

5.2. Objective 2: Suitability of harmonized monitoring design

Is the current harmonized monitoring design (of the last six years) suitable to pick up environmental changes that may cause impacts to designated uses?

The monitoring program is "harmonized" and has been since the early years in terms of integrated or concurrent sampling. The strength of this program has been the concurrent sampling over time and space. Any change to monitoring design in terms of stations, parameters, methodology, is strongly discouraged.

Reporting however is far from harmonized which is limiting the effective and consistent communication of results. With a revision to reporting, the program would be suitable to pick up environmental changes that may be causing impacts to designated uses.

5.3. Objective 3: Critical factors that influence existing water quality

Is the knowledge gained so far sufficient to determine critical factors that influence existing water quality and its effect on designated users of the Thompson River and Kamloops Lake?

This objective can be taken in two different contexts:

i Is there sufficient knowledge to determine the **critical ecological drivers** that influence existing water quality and
ii Is there sufficient knowledge to determine the **critical man-made drivers** (point and non-point sources) that influence existing water quality.

Significant work has been conducted relative to the **critical ecological drivers,** including paleolimnological cores of the lake, bathometric lake surveys, significant data collection to understand lake stratification and mixing dynamics

and its influence on river hydrology and ecology. Equally significant is the intensity of monitoring relative to the **critical man-made drivers** to assist in understanding the influence of phosphorus discharged from point sources (sewage and pulp mill effluents).

Linking stressors (whether ecological or man-made) to water quality or more broadly, aquatic ecosystem responses, results in the development of predictive relationships. Certainly this exists for the point sources, specifically for phosphorus and its relationship to periphyton and somewhat for benthos. The basis of understanding this relationship has lead to the mill proceeding through *Investigation of Cause* and *Investigation of Solutions* through the federal *Environmental Effects Monitoring Program*.

The numerous studies conducted on the system indicate phosphorus concentrations in river water were not predictive of periphyton or benthic community matrices suggesting periphyton growth in current conditions of the Lower Thompson River are relatively insensitive to total dissolved phosphorus concentrations.

Results of the past six years of monitoring through the Joint Thompson River Monitoring Program have confirmed the conclusions of previous studies, namely that the lower Thompson River supports relatively high periphyton biomass, as well as diverse and relatively stable communities of benthic invertebrates.

Predictive relationships between other water quality variables and point sources have been less developed, but are possible with the existing data sets. Development of predictive relationships between water quality and non-point sources is less developed and would require additional data collection. Development of predictive relationships between water quality and ecological drivers (flows, climate normals) are less developed. The influence of flow on periphyton biomass has also not been investigated.

The relationship between the dominant point sources (city, mill), phosphorus and periphyton are well established and have served well to assist with management of the system. The question then becomes, "*How important are the other predictive relationships beyond the ones already investigated*"? It seems that, with a more directed effects-based analysis with the existing data and a commitment to surveillance monitoring on a less frequent basis then the present monitoring, the ability to assess any changes relative to normal and user objectives in the future can be detected, assessed and adaptively managed. This will require a commitment from either the existing Committee or some other source.

Identification of potential natural drivers and anthropogenic stressors that may affect the Thompson River, as well as the designated uses of the system, is the primary goal of any watershed assessment and management program. Gaining

this understanding in a full and predictive manner is very, very difficult due to simply normal fluctuations in system dynamics as well as cumulative effects including stressors such as climate change. To expect a full understanding of how different natural and man-made factors will affect the system is an unrealistic goal. To understand what is normal in the system and to establish a reporting format that allows any changes outside of normal to be detected provides the first defence to detect change. Assessing these same data in both an effects-based context and a designated use context will provide the due diligence associated with surveillance monitoring and reporting. Identification of causal sources to that change should be considered in a tiered, strategic approach. For example, if monitoring upstream begins to show increasing nutrient loadings, then the possibility of non-point sources contributing to this should be investigated. If temperature changes in Kamloops Lake continue, then gaining a better understanding on how that may affect downstream uses should be investigated. No less than annual management meetings are critical to evaluate and review the effects-based and designated use assessments and to make tiered, strategic decisions on next steps if unexpected results are detected. This is essentially, solid adaptive management in practice.

5.4 Objective 4: Identify data gaps based on the data sufficiency review.

There does not appear to be any real significant gaps in data, however, the reporting of existing data should be taken further. This includes a better integrated assessment with emphasis on normal and identification of change outside of normal variability and outside of objectives. In addition, development of a trigger-based management platform to feed the analysis into decisions is important to manage the watershed for the future. What will be done if exceedances occur? How many exceedances and of what magnitude will result in different tiers of actions to be undertaken.

Certainly there are gaps in the other parameters that could be measured such as some emerging contaminants. However, it is questionable whether there is a need as the biological endpoints would indicate if something was occurring outside of normal with surveillance monitoring as any well set-up effects-based monitoring program does.

The changes in lake stratification are interesting and worthy of surveillance to ensure lake productivity is not altered significantly with changes in stratification and hence mixing. This would then also apply to the downstream river environment.

A better understanding of the contribution of non-point sources especially in the North Thompson River watershed is important considering the significant contribution of this system to phosphorus loadings. There were no available data

sources that indicated what landscape and land use changes have occurred in the upper Thompson system over time. If this information is available, it would be important to include it in future impact assessments.

Although the loadings balance for the system has been conducted previously on several occasions, it may be necessary to update the numbers. This would be important if a better sense of "normal loadings" is required to set a benchmark for evaluating the future landscape and land use change. Updating the loadings balance could then be considered a possible data gap.

If possible, integration of the information into a common database would be valuable considering the volumes of hard copy reports that exist. Once the system is set up, then consistent reporting can be managed more efficiently and in a more integrated manner. At the very minimum, a bibliography of research on the river would be helpful to communicate the legacy of work that has been done and the basis for decisions that have been made. Consideration should be given to a central home or hub for the information; perhaps on the Ministry of Environment website.

5.5 Objective 5: Periphyton water quality objective

Based on the above data review, is the current water quality objective for periphyton in the Thompson River adequate, overprotective or not sufficient in protecting the designated uses.

The objective was based on BC criteria set by Nordin (1985). In actuality, the BC objectives were partially based on Thompson River work of the day. It was concluded that the periphyton biomass that existed in the mid-70's exceeded that which was generally acceptable to the public, and that 50 mg/m2 chl. 'a' was a reasonable threshold for acceptance by the public for recreational use. The criterion for aquatic life (100 mg/m2 chl. 'a') [in the '85 document] was also partially based on the Thompson River data and the perception that a change had occurred in the benthic invertebrate community (Nordin & Holmes, 1992).

The objective appears to be too low to be representative of the normal river condition. All sites across years (with the exception of October in one year) have been exceeded. It would be useful to see the periphyton data presented and summarized as described by site and over years with measures of central tendency and variance displayed. Variation by decade would also be useful to see whether the spread of the data has changed over time. If normal has been relatively consistent at each site and over time, (i.e., the data are representative of the ecology for this endpoint) and both the averages and variance have responded with decreases in phosphorus loadings to the river, then comparison of the normal to the objective can be made with confidence

Participants of the joint monitoring program should continue to work together to harmonize monitoring as appropriate, share information, and manage nutrient inputs to their shared receiving environment .

Any future programs targeting benthos or periphyton should continue to monitor the five lower Thompson River stations along its length, given results are much more interpretable than those derived from sampling only at Savona and Walhachin, and provide better information regarding magnitude, extent and temporal variability of effects observed

Inclusion of periphyton sampling at North and South Thompson River water quality sampling stations should be considered in any future monitoring programs, to provide additional interpretive information.

5.6 Objective 6: Cost effective and practical monitoring program

Propose a cost effective and practical monitoring program for future integrated water quality monitoring by the Thompson River Partnership that meets the objectives as indicated under 'Current Situation and Rationale for Consultant Project Review' of this document.

Recommendations for a future monitoring program include the following:

- Consideration should be given to a reduced monitoring design, towards a surveillance program, with the understanding that biological monitoring and changes outside of normal would trigger back into more frequent monitoring. A frequency of once every two years would seem appropriate.

- Any future programs targeting benthos or periphyton should continue to monitor the five lower Thompson River stations along its length, given results are much more interpretable than those derived from sampling only at Savona and Walhachin, and provide better information regarding magnitude, extent and temporal variability of effects observed.

- Better characterization of non-point sources might also be considered, at least for the major upstream influences, namely the North Thompson River. How have loadings changed? Has the landscape and land use changed? Do we expect it to change in the future with resulting changes in nutrient loadings?

- Inclusion of periphyton sampling at North and South Thompson River water quality sampling stations should be considered in any future monitoring programs, to provide additional interpretive information.

- The program should consider more frequent monitoring of water temperatures from October to April, ideally using continuously recording thermographs in Kamloops Lake, upstream tributaries and at Savona, to better determine how the river plume mixes and/or moves through the lake in winter.

- Participants of the joint monitoring program should continue to work together to harmonize the monitoring as appropriate. The question that should be asked is if this relationship is sustainable into the future for more watershed-based monitoring and assessment?

- A better integrated analysis and reporting of the existing data into a "management useful" effects-based assessment is required. What is normal, what is the variance, has it changed over time, how does this variance compare to objectives, in the future, what will we do if changes outside of this variance occur?

The following is a prioritized list of recommended future monitoring to be considered by the Thompson River Monitoring Partnership. It is understood that other factors may be present which may affect the ability to carry out the proposed program and/or modify it.

1) While significant volumes of data have been collected, integrated analysis has not been done in a manner to serve decision making. If the goal is to really manage and monitor in an integrated manner, then leadership in analysis and reporting to this end is required. We are suggesting analysis and reporting that goes beyond the EEM status quo and typical report-by-report, project-by-project, and regulator-by-regulator focus on content.

2) The recommendation to continue surveillance of Kamloops Lake is encouraged. Upon the completion of the marina at Tobiano, we would like to see the installation of a permanent thermister chain and permanent monitoring location at the end of the break water. The approximate depth at the end of the break water during average water levels is 40m. If the program is going to proceed on a permanent basis, then a permanent sample location would be prudent as it is easily accessible, can easily be monitored by Tobiano staff, and is the current launch point for all existing lake monitoring. We feel there is a strong argument for adjusting the monitoring program to install a permanent, long-term monitoring station at a location where existing monitoring is already occurring by Tobiano Utilities Inc.

3. While not in the recommendations, it was discussed in the meeting that possible adjustments to permits could occur to assist in further aligning the existing group's monitoring and provide additional efficiency of monitoring. This should be encouraged. Additional users should also look at being involved and possibly having their permits adjusted on a voluntary basis to reflect their

involvement. All those who monitor on the system should have their data and information accessible to all through a common portal.

4. Similarly, development and maintenance of a master bibliography of Thompson River watershed aquatic studies and data would be very helpful. So much work has been done over time, most of it in the days before Google, and there is a risk of it all disappearing in the future when folks with the longer history (like us!) stop doing this stuff. Seems to me that this would best be a responsibility of the ministry, and would be best kept on a webpage, so it's easy to update and nobody can lose it on their shelf.

5. If EEM-style fish monitoring is contemplated, non-lethal sampling of sculpin could be considered, given enrichment is a key endpoint of interest. The advantage of a non-lethal program, aside from the minimal mortality, is that many more sites can be surveyed with a given effort relative to a lethal survey, so fish and benthos sampling locations could be paired if desired (for example).

6. Switching benthic methodologies from the Surber sampler for the CABIN kicknet approach is not recommended at this time.

7. Hatfield developed a set of formal Standard Operation Procedures (SOPs) for the mill to use in their field sampling and sample analyses. A set of SOPs that the whole group followed and accepted would be helpful and essential for the legacy to continue.

8. Ways that Pulp &Paper EEM and upcoming Municipal EEM might harmonize (or not) need to be explored – it would be a shame if the City ended up repeating studies that the mill has already done, just because the regulatory process compels them to.

9. A comment was submitted *'suggesting that defining what water quality is considered sustainable should be left to representatives from each section of the Thompson River to decide as each section will have a different idea of what is considered environmentally, socially and economically sustainable in their section of the river'*. We disagree with this suggestion based on our experience that suggests watershed management is more holistic and scientifically defensible. Having independent groups set expectations leads to fragmentation. Certainly, different objectives can be set for different reaches but not at the cost of the integrated watershed approach. Goals and objectives for the watershed and reaches in the watershed should be established together and adaptively managed together.

6.0 Summary Statements

Participants of the joint monitoring program should continue to work together to harmonize monitoring as appropriate, share information, and manage nutrient inputs to their shared receiving environment. The system has been monitored with foresight, and good scientific design harmonization is excellent with good redundancy across biotic and abiotic response variables and strong linkages (and predictive relationships) to the stressors of significance (perhaps of historical significance); namely the dominant point sources (mill and City).

What is required is a step back to do a better integrated analysis of the existing data into a "management useful" effects-based assessment.

Other items to be considered include the following. The Committee should determine whether some better characterization of non-point sources occur, at least for the major upstream influences, namely the North Thompson River? How have loadings changed? Has the landscape and land use changed? Do we expect it to change in the future with resulting changes in nutrient loadings? Would integration (rather harmonization) be furthered by development of a watershed, integrated database that supports integrated analysis? Can the monitoring conducted by DFO and BC Fisheries be better integrated into the existing data base?

The answer to the following important question will obviously determine the future monitoring: *Is the existing functional relationships of the partners sustainable into the future for more watershed-based monitoring and assessment?*

7.0 References Cited

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8.0 Closure

This report has been compiled from information supplied by various individuals and government agencies. The interpretations, conclusions and recommendations are solely the responsibility of Lakeshore Environmental Ltd. and Pugsley/Dube Consulting Inc.

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