Executive Summary

This report presents the results of a study to develop robust methods for determining the Environmental Flow Needs (EFN) of Okanagan streams, and provide information needed to customize the methods for 19 specific tributaries within the Okanagan Basin. The work represents Phase 1 of an Okanagan EFN-setting project. EFNs for specific streams will be established in future phases. The Phase 1 study is titled: "Collaborative Development of Operational Environmental Flow Designations for Okanagan Streams". The study proponents were the Okanagan Basin Water Board (OBWB), the Okanagan Nation Alliance (ONA), and the B.C. Ministry of Forests, Lands, and Natural Resource Operations (FLNRO). The work was completed by a consulting team led by Associated Environmental Consultants Inc.

This report acknowledges that EFN-setting can be a complex decision-making process involving information from multiple sources. The work described herein is purely technical. The outcomes of an EFN-setting exercise conducted using the methods described in this report would provide credible science-based information to a decision-making body.

Section 1 of this document introduces the project and provides the background and approach used to complete the study. Collaboration was a core element of the approach. The consulting team was purposefully large, to bring a significant diversity of ideas to bear on the issue. In addition, consultation occurred with a wide range of individuals and agencies, in an effort to promote a broad consensus on the suitability of the approaches ultimately recommended herein. Section 2 summarizes the individuals and agencies consulted during the project. Notably, the Okanagan Nation Alliance (ONA) has agreed to provide additional technical information in the future, and the advice and review of one or more Knowledge Keepers, to add value to a future revision of this report.

Approaches to EFN-setting used elsewhere in North America are listed in Section 3. In Section 4, the report describes previous EFN investigations completed in the Okanagan, including the B.C.-Modified Tennant method, the B.C. Instream Flow Methodology, and the Weighted Useable Width method.

Section 5 describes a context for EFN-setting that includes both technical recommendations and subsequent consideration of other factors before an EFN regime is adopted by a decision-making body. It also lists several Okanagan-specific considerations relevant to EFN-setting, including the concept of meta-populations, which implies that fish populations in some streams may be connected rather than isolated from each other, and the concept that habitat degradation may have rendered aquatic populations less resilient than they were under historic natural conditions.

Section 5 describes a recommended approach to EFN-setting that combine a desktop method and a field-based method. The desktop method is recommended for establishing EFNs in low-risk situations; and the desktop method should be followed by the field-based method for EFN-setting in higher risk situations. The recommended approach is characterized as a "moderately prescriptive guideline" to highlight the concepts

that while the methods can be described as a sequence of steps in a flowchart, there is flexibility on the level of effort to apply at each step, and that experience and good judgment are required to execute the approach.

The desktop method is termed the "Okanagan Tennant method", and is a variation of the B.C.-Modified Tennant method successfully used in the Okanagan in the past. The field-based method is a variation of a Weighted Useable Width (WUW) method previously used successfully in the Okanagan, termed the "Okanagan Weighted Useable Width method". The Okanagan WUW method does not prescribe a particular level of field effort, but instead allows flexibility as a function of the risk tolerance of a decision-maker, key aquatic resources dependent upon the stream, the available data, and other factors.

The Okanagan Tennant method is focussed on setting an EFN flow regime that meets the *Water Sustainability Act* definition of a properly functioning ecosystem. It recommends adopting a monthly time step for August through March, and a weekly time step for April through July. EFNs should be set at the lower of the median flow for the time period of interest and the "instream presumptive flow standard". The method includes an approach to understanding the implications of flows lower than the recommended EFNs. It also acknowledges that flows in dry years will drop below EFN values, and recommends, for real-time operational management purposes (not for water licensing purposes), allowing the EFN to drop to match the natural low flow. The Okanagan Tennant method will be useful for developing an initial understanding of the risks to aquatic habitat and ecological processes from existing and proposed water allocations relative to natural or naturalized flows, and will act as a useful starting step for setting EFNs in the Okanagan.

The Okanagan WUW method extends the Okanagan Tennant method to consider site-specific fish and fish habitat conditions in the streams and reaches of interest and refine the EFNs recommended using the Okanagan Tennant method. WUW analysis is a standard technique that has been used throughout B.C., including several watersheds in and near the Okanagan. WUW is calculated using depth and velocity measurements at intervals along transects located in the appropriate habitat units for the species and life stage of interest, in conjunction with Habitat Suitability Index (HSI) curves. Section 5 discusses the relevance of existing HSI curves, and provides advice on choosing the level of field intensity needed for a given application. The Okanagan WUW method addresses the tendency to recommend optimal flows by scaling streamflows between zero and one, where "zero" is defined as the critical environmental flow threshold (a flow below which severe consequences to aquatic populations are expected), and "one" is defined as the median (or suitable alternative based on stream-specific considerations) flow for the particular time period. Section 5 also provides guidance on using the information collected to judge the risks associated with flows less than EFNs; and for collecting additional data needed to inform "expert judgment", which is intended to be considered before an EFN recommendation is made. Finally, the Okanagan WUW method includes provision for specifying ecological function flows, and riffle passage flows.

Section 6 outlines the steps required to implement the method(s) in a specific application. It includes advice on how to choose the approach (i.e. the Okanagan Tennant method alone or the Okanagan Tennant method followed by the Okanagan WUW method); and, using a flowchart and accompanying text, it

describes the steps needed to implement each of the methods in a specific case. Section 6 also outlines the steps needed to "naturalize" a streamflow record that has been affected by water storage and diversions (i.e. to convert that record into an estimated "natural" record by removing the effects of human flow management).

Section 7 recommends several studies to improve the EFN-setting methods proposed in the report. The first recommendation is to complete a test of the recommended methods by applying them to two or three selected tributaries. On the basis of this test, the methods would be refined and a new version of this report would be issued. Other recommendations of Section 7 will improve the EFN-setting methods, but none are needed before implementation can begin. Conclusions and Recommendations are presented in Section 8.

Appendix A contains an agenda and summary of a technical workshop held March 23, 2016 amongst the project team consultants, key members of the proponent team (OBWB, ONA, and FLNRO), and representatives of many other agencies. Appendix B contains a tabular listing of EFN-setting methods used elsewhere. Appendices C and D contain supplemental information on the Okanagan Tennant method and the Okanagan WUW method, respectively, that is not provided in the main body of the report. Appendix E contains fish periodicity information and HSI curves relevant to the Okanagan. Appendices F through X contain information and data specific to each of 19 selected Okanagan tributaries identified for this first Phase of the Okanagan EFN project.

This report is referred to as a Working Document, Version One. It is primarily a technical document. The title conveys the intent that the document is a living document, and is likely to be revised as new information becomes available, and experience is gained using the methods recommended herein. In the relatively short term, it is anticipated that additional technical information will be contributed by the Okanagan Nation Alliance Fisheries Department, and that the report will be reviewed and refined by Okanagan Nation Knowledge Keepers.