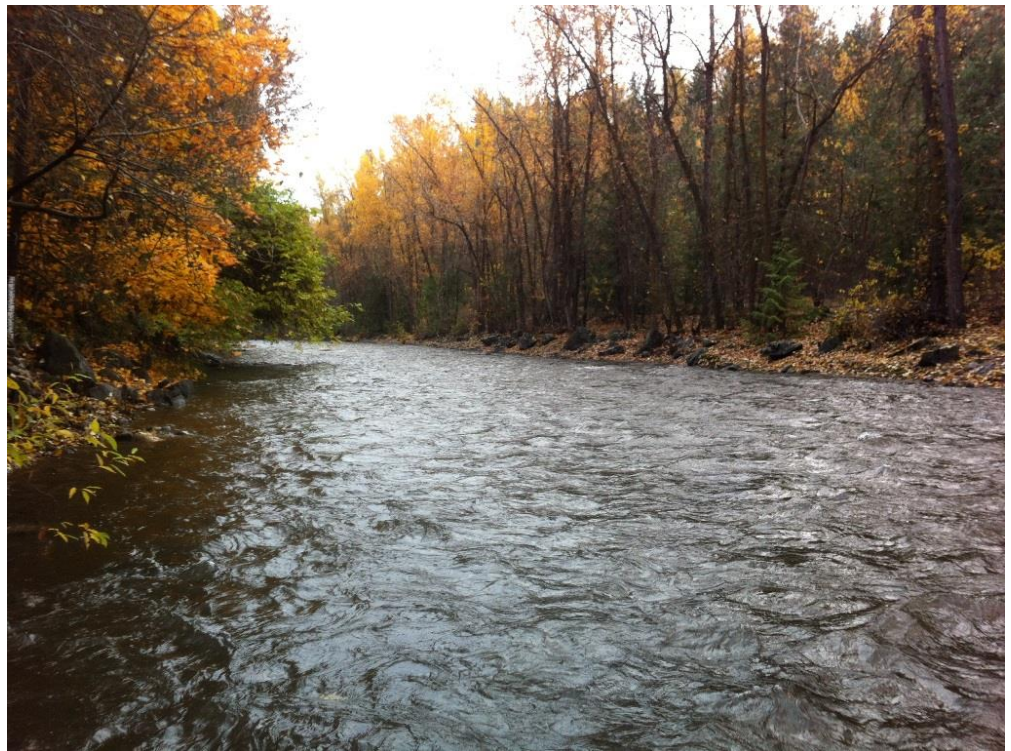


Appendix L - Mission Creek

APPENDIX L

Okanagan Basin Water Board Okanagan Nation Alliance B.C. Ministry of Forests, Lands and Natural Resource Operations

Mission Creek



May 2016

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APPENDIX L

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1 Introduction

The purpose of this appendix is to provide information to support the application of recommended environmental flow needs (EFN)-setting methods for Mission Creek following the methods outlined in the accompanying report¹. This document contains information obtained and collated by Associated Environmental Consultants Inc. (Associated) and will be revised following additional input from Okanagan Nation Alliance. A summary of current available information for Mission Creek is provided in Table 6-1 in the accompanying report and Table L-1 at the end of this appendix.

Section 5 in the accompanying report provides an overview of two recommended EFN-setting methods for tributaries within the Okanagan Basin, while Section 6 lists the key steps to implement each of the two methods, in both flowchart and text form.

Environmental flows have been previously recommended for Mission Creek by Koshinsky (1972), Shepherd and Ptolemy (1999), nhc (2001), ESSA and Solander (2009), Epp (2008-2010), and Water Management Consultants (2010) (Table 6-1 in the accompanying report).

Water Management Consultants (2010) developed a Water Use Plan for Mission Creek. The plan established minimum flows for fish in the Mission Creek watershed and recommended that the plan be reviewed every five years.

2 Relevant Information for Setting Environmental Flow Needs

This section summarizes the information available to support EFN-setting in Mission Creek. Available information sources for Mission Creek are included within Table L-1 at the end of this appendix.

2.1 OVERVIEW OF THE WATERSHED

Mission Creek is the largest watershed in the Okanagan Basin, with a watershed area of approximately 845 km². Mission Creek drains an eastern portion of the Okanagan Basin and discharges to Okanagan Lake within Kelowna. Mission Creek is the largest tributary to Okanagan Lake. The forested, gently sloping plateau headwaters are used predominantly for agriculture, forestry, and grazing. The lower watershed includes portions of Kelowna and East Kelowna and is dominated by urban development.

The main tributaries to Mission Creek include Pearson, Joe Rich, Belgo, Hydraulic, and KLO Creeks. Summit (2009) estimated that Mission Creek contributes 28% of the total streamflow within the Okanagan Basin.

¹ Associated Environmental Consultants Inc. (Associated). 2016. Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams. Working Document, Current Version. Prepared for the Okanagan Basin Water Board, Okanagan Nation Alliance, and B.C. Ministry of Forests, Lands and Natural Resource Operations. May 2016

The Mission Creek watershed is shown in Figure 1-1 in the accompanying report.

2.2 STREAMFLOWS

2.2.1 Hydrometric Data

There are currently two active Water Survey of Canada (WSC) hydrometric stations within the Mission Creek watershed:

- **Mission Creek near East Kelowna** (WSC 08NM116; Drainage area: 795 km²; Regulated; Period of record: 1949-2010)
- **Belgo Creek Below Hilda Creek** (WSC 08NM232; Drainage area: 70.7 km²; Regulated; Period of record: 1976-2010)

In addition, historic records are available for the following hydrometric stations within the watershed:

- **Mission Creek Rutland Diversion** (WSC 08NM057; Regulated; Period of record: 1922-1930)
- **Mission Creek near Rutland** (WSC 08NM016; Drainage area: 622 km²; Regulated; Period of record: 1919-1946)
- **Hydraulic Creek near the Mouth** (WSC 08NM010; Drainage area: 89.6 km²; Regulated; Period of record: 1919-1982)
- **Hydraulic Creek Diversion near Kelowna** (WSC 08NM039; Regulated; Period of record: 1919-1968)
- **KLO Creek Diversion near Kelowna** (WSC 08NM060; Regulated; Period of record: 1923-1968)
- **Hydraulic Creek Southeast Kelowna Diversion** (WSC 08NM040; Regulated; Period of record: 1920-1930)
- **KLO Creek at McCulloch Road** (WSC 08N226; Regulated; Period of record: 1976-1982)
- **KLO Creek near Kelowna** (WSC 08NM004; Drainage area: 77.7 km²; Natural; Period of record: 1919-1922)
- **Mission Creek Below B.M.I.D. Intake** (WSC 08NM239; Regulated; Period of record: 1980-1980)
- **Daves Creek near Rutland** (WSC 08NM137; Drainage area: 31.1 km²; Natural; Period of record: 1965-1986)
- **Myra Ditch Below KLO Creek** (WSC 08NM207; Regulated; Period of record: 1973-1985)
- **Pooley Creek Above Pooley Ditch** (WSC 08NM210; Drainage area: 18.1 km²; Natural; Period of record: 1973-1979)
- **McCulloch Reservoir at McCulloch Dam** (WSC 08NM213; Regulated; Period of record: 1973-1986)
- **Hydraulic Creek at Outlet of McCulloch Reservoir** (WSC 08NM011; Regulated; Period of record: 1919-1986)
- **Fish Lake at the Outlet** (WSC 08NM215; Regulated; Period of record: 1973-1977)
- **Long Meadow Lake Reservoir Above the Dam** (WSC 08NM217; Regulated; Period of record: 1973-1977)
- **Browne Lake Reservoir Above the Dam** (WSC 08NM216; Regulated; Period of record: 1973-1977)

- **Joe Rich Creek near Rutland** (WSC 08NM129; Drainage area: 44.8 km²; Regulated; Period of record: 1964-1987)
- **Belgo Creek near the Mouth** (WSC 08NM225; Drainage area: 190 km²; Regulated; Period of record: 1976-1982)
- **Pearson Creek near the Mouth** (WSC 08NM172; Drainage area: 73.6 km²; Natural; Period of record: 1970-1987)
- **Mission Creek Above Pearson Creek** (WSC 08NM233; Drainage area: 233 km²; Regulated; Period of record: 1977-1982)
- **Hilda Creek near Rutland** (WSC 08NM018; Drainage area: 18.1 km²; Natural; Period of record: 1920-1920)
- **Belgo near Rutland** (WSC 08NM017; Drainage area: 38.9 km²; Regulated; Period of record: 1920-1920)
- **Ideal Lake near the Outlet** (WSC 08NM231; Regulated; Period of record: 1963-1980)
- **Loch Katrine Creek at Outlet of Graystone Lake** (WSC 08NM229; Drainage area: 16.1 km²; Regulated; Period of record: 1977-1998)
- **Graystone Lake at the Outlet** (WSC 08NM230; Regulated; Period of record: 1977-1998)

In addition, the B.C. Ministry of Environment operated two seasonal hydrometric stations on Mission Creek between 2006 and 2007:

- **Mission Creek upstream of Gordon Drive** (Period of record: 2006-2007)
- **Mission Creek upstream of East Kelowna Drive** (Period of record: 2006-2007)

Black Mountain Irrigation District (BMID) also operated a seasonal hydrometric station on Mission Creek between 2004 and 2007:

- **Mission Creek below BMID intake** (Period of record: 2004-2007)

Additional hydrometric (and aquatic habitat) monitoring was completed on Mission Creek in 2007 – 2009 by Epp (2008, 2009, 2010).

2.2.2 Naturalized Streamflows

Figure 6-1 in the accompanying report highlights the necessity of producing hydrographs under natural conditions and under actual, licensed, and future proposed water use conditions. nhc (2001) and Summit (2009) provided naturalized streamflow estimates for Mission Creek at the mouth. In addition, as part of the Okanagan Water Supply and Demand Project, net and naturalized flows were modelled for the majority of Okanagan tributaries, including Mission Creek (Summit 2010). Figure 2-1 provides a summary of the modelled mean weekly net and naturalized streamflows for Mission Creek at the mouth for 1996-2006 (i.e., the model calibration period).

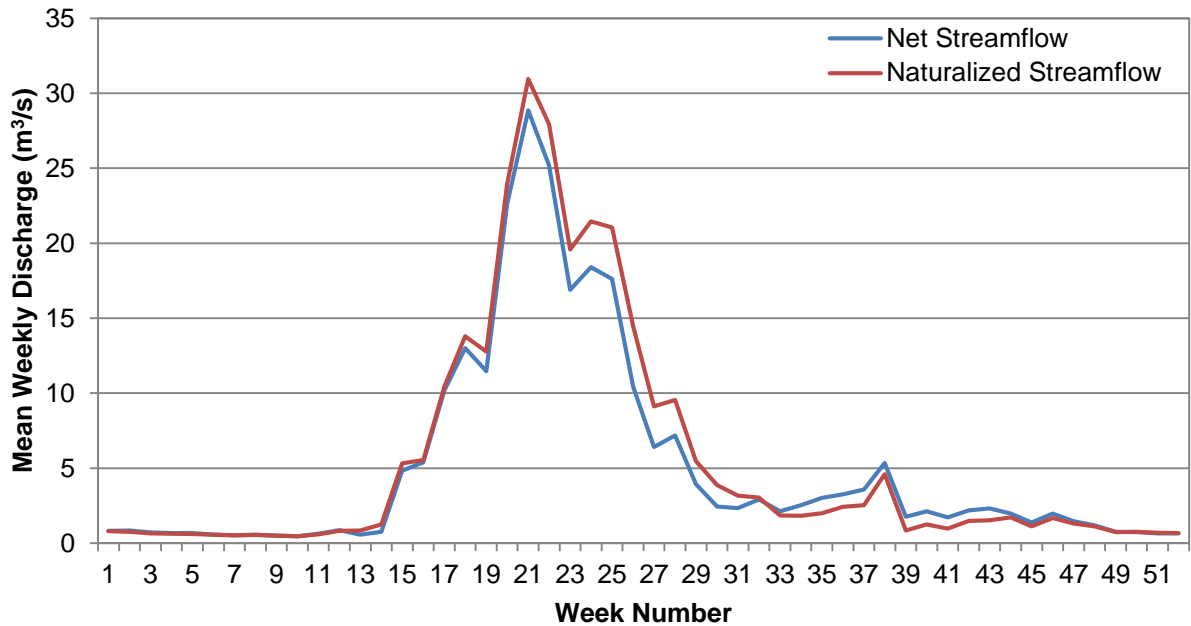


Figure 2-1
Mean weekly net and naturalized flows for Mission Creek at the mouth, 1996-2006 (Summit 2010)

Phases 2 and 3 of the Okanagan Water Supply and Demand Project included modeling of multiple future scenarios for the Okanagan Basin, which considered projected climate change, population growth, changes to irrigation efficiencies, and other factors. Net and naturalized streamflow outputs for Mission Creek at the mouth are available for each future scenario.

2.3 FISH AND AQUATIC HABITAT

Mission Creek provides valuable habitat for a number of fish species. Rae (2005) provides a comprehensive overview of aquatic habitat within Mission Creek. Additional information on channel characteristics and aquatic habitat is provided by Grainger and Associates Consulting Ltd. (2010). Extensive channel characteristic information is also provided by Burge (2010), as part of a channel and streamway width assessment.

In addition, the Mission Creek Restoration Initiative (MCRI) is an ongoing multi-phase, multi-stakeholder partnership established in 2008 to restore natural functions to the lower reaches of Mission Creek (MCRI 2016). Following the significant reduction in aquatic and riparian habitat due to channelization of Mission Creek, the primary focus of the MCRI is to restore fish and wildlife stocks within the lower reaches of the creek.

Ecoscope (2009) completed sensitive habitat inventory and mapping (SHIM) for Hydraulic Creek and KLO Creek, two tributaries to Mission Creek. Fish habitat and fish barriers were mapped in both. The results of the SHIM mapping are found in Section 4.6 and 4.7 of the 2009 Ecoscope report.

Since current (and potentially historic) aquatic habitat information is important for developing an EFN flow regime, it is recommended that up-to-date aquatic habitat information be obtained from publically available databases at the time of investigation.²

2.3.1 Current and Historical Fish Species Presence

Fish species found in Mission Creek include rainbow trout, kokanee salmon, eastern brook trout, burbot, mountain whitefish, northern pikeminnow, sucker (general), longnose dace, prickly sculpin, sculpin (general), redbelt shiner, peamouth chub, and slimy sculpin (ESSA and Solander 2009). Chinook salmon and coho salmon are not currently present in Mission Creek, but could be supported if species recovery to Okanagan Lake occurs in the future (ESSA and Solander 2009).

Since current (and potentially historic) fish presence information is important for developing an EFN flow regime, it is recommended that up-to-date fish presence information be obtained from publically available databases at the time of investigation.³

2.3.2 Fish Periodicity and Habitat Suitability

nhc (2001; 2003) provide a fish periodicity chart for Mission Creek which defines critical timing periods for adult migration, spawning, incubation, fry rearing, and par rearing for rainbow trout and kokanee salmon (Table 6-1 in the accompanying main report). The fish periodicity chart for Mission Creek is provided in Table B-1 of the accompanying report.

Epp (2008-2010) provides Weighted Useable Width results for Mission Creek and provide essential building blocks for developing Habitat Suitability Index (HSI) curves for Mission Creek.

In addition, Appendix E of the accompanying report provides information on salmonid species-specific life stage periodicities for the Okanagan Basin, as well as habitat suitability index (HSI) curves for select species. The information within nhc (2001; 2003), Epp (2008-2010), and Appendix E should be used at a minimum to support EFN-setting for Mission Creek.

2.4 WATER USE AND STORAGE

There are two major water suppliers in the Mission watershed (Dobson 2008 [included on Summit 2010]):

- Black Mountain Irrigation District (BMID)
- Southeast Kelowna Irrigation District (SEKID)

² Aquatic habitat information, including fish barriers can be obtained from the Government of B.C. Habitat Wizard: <http://www.env.gov.bc.ca/habwiz/>.

³ Fish presence information can be obtained from the Government of B.C. Fish Inventory Summary System Database Query: <http://www.env.gov.bc.ca/fish/fiss/>.

The Regional District of Central Okanagan (Falconridge Water Utility), Benvoulin Water Users Community, Mission Creek Water Users Community, Rutland Water Works, and South Kelowna Water Users Community also use the watershed for water supply purposes (Dobson 2008). A summary of water use from major water purveyors is provided in Section 4.2.20 of Dobson (2008).

Summit (2010) provides an estimate of actual surface water use within the Mission Creek watershed for 1996-2006 in Appendix C of the Okanagan Water Supply and Demand Project – Phase 2. The actual mean annual surface water use over 1996-2006 was estimated to be 13,707 ML. These water use estimates were subsequently included in the Okanagan Hydrologic Connectivity Model that was used to investigate ‘first-in-time, first-in-right’ water licence legislation within the Okanagan Basin (Summit 2013).

2.4.1 Storage Reservoirs

BMID operate five storage reservoirs within the upper Mission Creek watershed:

- Fish Hawk Reservoir
- Greystoke Reservoir
- Ideal Reservoir
- Loch Long
- Mission Lake

BMID operate Loch Long on behalf of the Ministry of Environment, releasing storage for in-stream flow requirements. Other BMID reservoirs are operated to capture snowmelt runoff in the spring.

SEKID also operate four storage reservoirs within Hydraulic Creek, KLO Creek, and Stirling Creek watersheds as follows:

- McCulloch Reservoir
- Fish Reservoir
- Browne Reservoir
- Long Meador Reservoir

The total licensed capacity of all SEKID reservoirs is 20,203 ML.

2.4.2 Water Licences and Major Points of Diversion

The Ministry of Environment hold a licence on Mission Creek for instream (conservation) use for 2,706 ML (Dobson 2008).

Water Management Consultants (2010) provide a map showing the location of the BMID and SEKID intakes within the Mission Creek watershed (Figure 3.2 in Water Management Consultants [2010]), as follows:

- The BMID intake is located on Mission Creek, just upstream of the Daves Creek tributary (Water Management Consultants 2010).

- The SEKID intake is located on Hydraulic Creek, upstream from the confluence with Mission Creek (Water Management Consultants 2010).

At present, there are 365 current water extraction licences and one active application within the Mission Creek watershed. Since knowledge of current water licences is critical in developing EFN-setting methods, it is recommended that up-to-date water licence information be obtained at the time of investigation.⁴

2.4.3 Interbasin Transfers

There are multiple inter-basin water diversions within the Mission Creek watershed. Dobson (2008) provides more information on water use and water transfer to and from the Mission Creek watershed, including diversions from the West Kettle River watershed by SEKID. Water is also distributed throughout the Mission Creek watershed and surrounding areas by BMID and SEKID through their distribution networks (Dobson 2008).

In addition, the City of Kelowna maintains a diversion channel between Mill Creek and Mission Creek. Under flood conditions in Mill Creek, water is transferred to Mission Creek to reduce flood volumes throughout the City of Kelowna (Wildstone Resources, 1992; Dobson 2008).

2.5 GROUNDWATER AND SURFACE WATER INTERACTION

Summit (2009) identified that there is likely no net loss / gain of streamflow to or from groundwater across the entire Mission Creek alluvial fan because losses at the top of the fan are likely offset by gains along the lower reaches (Section 3.6 of Summit 2009).

A detailed groundwater and surface water interaction assessment was completed by Lowen and Letvak (1981) for the section of channel below the BMID intake to the mouth, which found multiple reaches that either gained or lost streamflow. Currently, the Okanagan Basin Water Board is updating the Lowen and Letvak (1981) study.

2.6 TRADITIONAL KNOWLEDGE

The current version of this document does not include presentation of any Okanagan Nation Traditional Knowledge. However it is anticipated that a future revision will include such information, as well as potentially other technical information held by the Okanagan Nation Alliance Fisheries Department.

⁴ Water Licence Information can be obtained from the Government of B.C. Water Licences Query: http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input.

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Information Source	Fish and Aquatic Habitat										Streamflow			Water Management																	
	Current Fish Species Presence	Historic Fish Species Presence	Fish Periodicity Tables	Aquatic Habitat	Channel Characteristics	Channel Cross-Sections	Channel Velocity/Depth Measurements	Habitat Suitability Index	Fish Barriers (Natural/Man-made)	EFN Investigations / Recommended Fish Flows	Other Relevant Information	Streamflow Measurements	Water Quality / Temperature	Streamflow Estimates	Other Relevant Information	History of Water Management	Water License Points-of-Diversion Mapping	Water License Information	Water License – Conservation Storage/Flows	Water Purveyor Intakes	Groundwater Wells Mapping	Groundwater Information	Water Use Information (Actual/Estimated)	Return Flow Information	Land Use and Associated Water Supply Source	Interbasin/Intrabasin Transfers	Flow Regulation	Reservoir Flow Release Patterns	Reservoir Minimum Flow Releases	Other Relevant Information	
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Information Source	Fish and Aquatic Habitat											Streamflow				Water Management																
	Current Fish Species Presence	Historic Fish Species Presence	Fish Periodicity Tables	Aquatic Habitat	Channel Characteristics	Channel Cross-Sections	Channel Velocity/Depth Measurements	Habitat Suitability Index	Fish Barriers (Natural/Man-made)	EFN Investigations / Recommended Fish Flows	Other Relevant Information	Streamflow Measurements	Water Quality / Temperature	Streamflow Estimates	Other Relevant Information	History of Water Management	Water License Points-of-Diversion Mapping	Water License Information	Water License – Conservation Storage/Flows	Water Purveyor Intakes	Groundwater Wells Mapping	Groundwater Information	Water Use Information (Actual/Estimated)	Return Flow Information	Land Use and Associated Water Supply Source	Interbasin/Intrabasin Transfers	Flow Regulation	Reservoir Flow Release Patterns	Reservoir Minimum Flow Releases	Other Relevant Information		
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