

**Appendix H - Inkaneep Creek**

## APPENDIX H

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

#### Inkaneep Creek



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# APPENDIX H

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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 Inkaneep Creek following the methods outlined in the accompanying report<sup>1</sup>. 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 Inkaneep Creek is provided in Table 6-1 in the accompanying report and Table Q-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 Inkaneep Creek by ESSA and Solander (2009). In addition, Associated (2016a) reported a critical flow threshold for fish rearing in Inkaneep Creek near the mouth, as recommended by the B.C. Ministry of Forests, Lands, and Natural Resource Operations (FLNRO).

## 2 Relevant Information for Setting Environmental Flow Needs

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

### 2.1 OVERVIEW OF THE WATERSHED

Inkaneep Creek has a watershed area of approximately 179 km<sup>2</sup> and discharges into Osoyoos Lake. The Inkaneep Creek watershed is within the traditional territory of the Sy'ilx (Okanagan) Nation. The main tributaries to Inkaneep Creek include McCuddy, Baldy, Gregoire, and Coteay Creeks. Land use in the watershed includes agriculture along the lower approximately 6 km of Inkaneep Creek, as well as further upstream on McCuddy Creek. In addition, logging occurs within the headwaters of the watershed.

The Inkaneep Creek watershed is shown in Figure 1-1 in the main report.

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<sup>1</sup> 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

## 2.2 STREAMFLOWS

### 2.2.1 Hydrometric Data

There is currently one active Water Survey of Canada (WSC) hydrometric station within the Inkaneep Creek watershed:

- **Inkaneep Creek near the Mouth** (WSC 08NM200, Drainage area: 227 km<sup>2</sup>; Regulated; Period of record: 1973-2010)

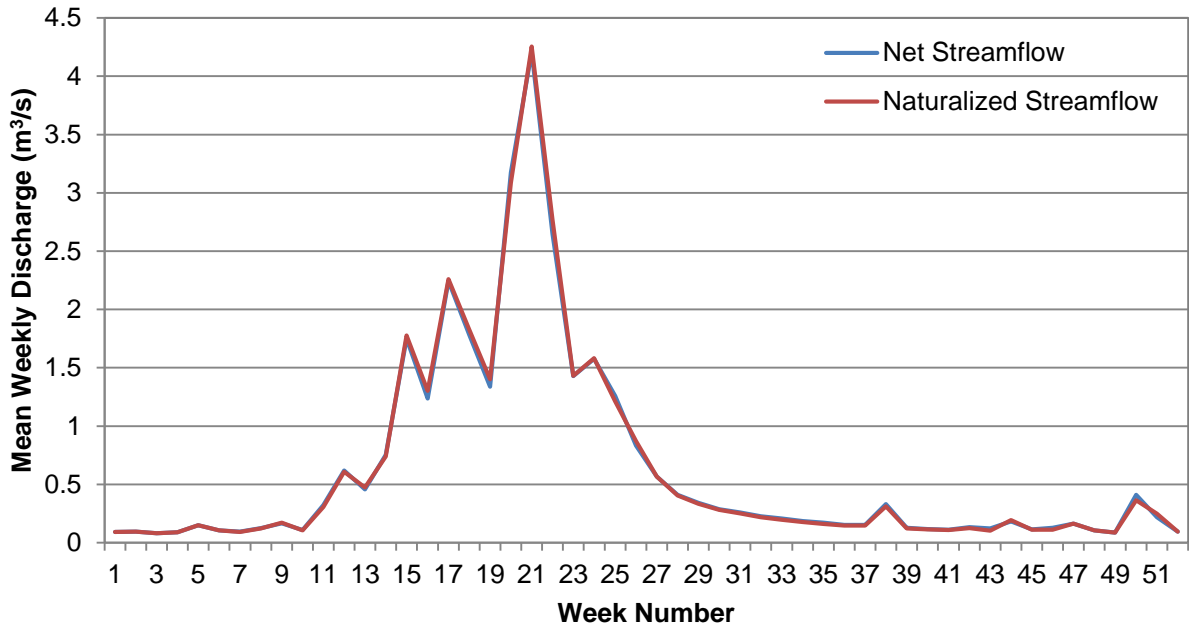
In addition, historic records are available for the following hydrometric stations in the watershed:

- **Inkaneep Creek near Oliver (Lower Station)** (WSC 08NM012; Drainage area: 164 km<sup>2</sup>, Natural; Period of record: 1919-1950)
- **Inkaneep Creek near Oliver (Upper Station)** (WSC 08NM082; Drainage area: 70.4 km<sup>2</sup>; Natural; Period of record: 1941-1950)

### 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 Inkaneep 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 Inkaneep Creek (Summit 2010). Figure 2-1 provides a summary of the modelled mean weekly net and naturalized streamflows for Inkaneep Creek at the mouth for 1996-2006 (i.e., the model calibration period).

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, change to irrigation efficiencies, and other factors. Net and naturalized streamflow outputs for Inkaneep Creek at the mouth are available for each future scenario.



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

### 2.3 FISH AND AQUATIC HABITAT

Matthews and Bull (2003) rated Inkaneep Creek as “very high” for significance for fish protection and habitat restoration and “high” for habitat impact. Dobson (2001) reported that the entire lower reaches of Inkaneep Creek (approximately 3 km) provide ideal spawning and rearing habitat for sockeye salmon and rainbow trout.

Two migration barriers have been documented on Inkaneep Creek, as follows (Associated 2016a):

- 11 m long cascade with a gradient of approximately 23% - approximately 3 km upstream from the mouth
- 5.8 m high cascade, approximately 1.5 m in length – approximately 3.5 km upstream from the mouth.

In spring 2006, Long et al. (2006) observed 10 redds in the lower 3.7 km of the creek, providing spawning habitat to migrating steelhead / rainbow trout. In addition, Long (2000) also reported that rainbow and brook trout have been observed throughout Inkaneep Creek (upstream of the two migration barriers), as well as within tributaries Baldy, Gregoire, and Coteay creeks.

A comprehensive summary and map of fish and aquatic habitat within Inkaneep Creek watershed is provided by Associated (2016a).

**2.3.1 Current and Historical Fish Species Presence**

Fish species found in Inkaneep Creek include rainbow trout, steelhead, sockeye salmon and eastern brook trout (ESSA and Solander 2009). Associated (2016a) provides the most up-to-date summary of fish species that have been observed in Inkaneep Creek, as well as Osoyoos Lake (Table F-2). Channel gradients within Inkaneep Creek are relatively low (and therefore provide fish passage opportunities upstream from Osoyoos Lake [Associated 2016a]).

Although sockeye, coho, and chinook salmon have been reported in the lower reaches of Inkaneep Creek historically and Osoyoos Lake, no observations within the creek have been made in recent decades (Associated 2016a).

**Table F-2  
Fish observation in Osoyoos Lake and Inkaneep Creek (Associated 2016a)**

Waterbody / Watercourse	Common Fish Name	Waterbody / Watercourse	Common Fish Name
Osoyoos Lake	Black catfish	Inkaneep Creek	Rainbow trout
	Black crappie		Steelhead
	Brook trout		Brook trout
	Carp		Chinook salmon
	Chinook salmon		Coho salmon
	Coho salmon		Sockeye salmon
	Kokanee		Mountain whitefish
	Lake whitefish		Sculpin spp.
	Largemouth bass		Smallmouth bass
	Longnose sucker		Largemouth bass
	Mottled sculpin		
	Mountain whitefish		
	Northern pikeminnow		
	Pumpkinseed sunfish		
	Rainbow trout		
	Redside shiner		
	Smallmouth bass		
	Sockeye salmon		
	Steelhead trout		
	Yellow perch		

**2.3.2 Fish Periodicity and Habitat Suitability**

Specific life stage timing for rainbow trout within Inkaneep Creek has not been documented; however, Associated (2016a) used critical life stages and timing presented by Associated (2016b) for the Kettle River watershed to represent fish periodicity in Inkaneep Creek. Therefore, a representative fish periodicity chart for rainbow trout (assumed to be a key species) within Inkaneep Creek is provided by Associated (2016a).

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 Associated (2016a) and Appendix E should be used at a minimum to support EFN-setting for Inkaneep Creek.

## 2.4 WATER USE AND STORAGE

Osoyoos Indian Band (OIB) is the major water user within the Inkaneep Creek watershed. OIB use water predominantly for irrigation purposes within the watershed (Dobson 2008 [included in Summit 2010]).

Associated (2016a) provided estimates of normal mean monthly irrigation demand supplied by surface water within the Inkaneep Creek watershed. The irrigation demand estimates were generated by the B.C. Ministry of Agriculture’s Agriculture Water Demand Model (van der Gulik et al. 2010). The mean monthly irrigation demand (supplied by surface water) for 1981-2010 is provided in Table H-1.

**Table H-1 Mean monthly normal irrigation water demand supplied by surface water within Inkaneep Creek watershed (from Associated 2016a)**

Watershed	Mean Monthly Irrigation Water Demand from Surface Water (m <sup>3</sup> /s)					
	April <sup>1</sup>	May	June	July	August	September
Inkaneep Creek	<0.001	0.004	0.006	0.008	0.008	0.004

Note:

1. It was assumed that any blank value within the AWDM dataset (1981-2010) was equivalent to zero water demand for that month.

Summit (2010) also provides an estimate of actual surface water use within the Inkaneep 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 50 ML.

### 2.4.1 Storage Reservoirs

Cassidy Lake (also known as Waterdog Lake) is the only storage reservoir within the Inkaneep Creek watershed (Summit 2009). Water from Inkaneep Creek is diverted into and stored within the Cassidy Lake. Cassidy Lake has no outlet and water from the lake is used by the Osoyoos Indian Band for irrigation purposes within the watershed.

### 2.4.2 Water Licences and Major Points of Diversion

At present, there are 68 current water extractions licences within the Inkaneep Creek watershed. Since knowledge of current water licences is critical in developing EFN flow regimes, it is recommended that up-to-date water licence information be obtained at the time of investigation.<sup>2</sup>

<sup>2</sup> 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](http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input).



### **2.4.3 Interbasin Transfers**

There are no direct diversions of water to or from the Inkaneep Creek watershed.

## **2.5 GROUNDWATER AND SURFACE WATER INTERACTION**


Summit (2009) identified that Inkaneep Creek likely loses water to groundwater and estimated that streamflow is lost to groundwater at a rate of 0.014 m<sup>3</sup>/s per km of channel on the alluvial fan (Section 3.6 of Summit 2009).

## **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.

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