3.17 Penticton Creek

Penticton Creek flows from the east side of the Okanagan Basin into Okanagan Lake just upstream and east of the Okanagan Lake outlet dam at Penticton, B.C. The Penticton Creek watershed is approximately 180 km^2 and has a number of main tributaries including James, Reed, Municipal, Harris, and Steward Creeks (Associated 2016). From its headwaters, Penticton Creek flows through a deeply incised canyon and onto an alluvial fan at the City of Penticton (Associated 2017). A summary of creek characteristics is found in Table 3-51 and additional stream-specific data is provided in Appendix B17.

Historically, Penticton Creek supported a large run of Kokanee; however, channelization for flood control purposes in the 1950s essentially eliminated the run (Pearson 1977). The lower reaches within the city of Penticton were partially lined in concrete and 39 drop structures were installed to reduce the gradient. As a result, Penticton Creek is highly impaired in terms of fish habitat (Lukey & Louie 2015; Mould 2017). The channelization of Penticton Creek combined with the concrete substrate installed in the 1950s has led to considerable increases in water velocities that also prove to be migration barriers for fish. The largest barrier to fish migration is located 4.46 km from the mouth at "Penticton Dam #2" with a number of partial barriers existing downstream along with a series of fish ladders for mitigation. A recent effort to restore Penticton Creek has resulted in a detailed restoration plan for the lower reaches (Mould 2017) and restoration of a short demonstration section in 2015.

The creek has had support for populations of Kokanee in the form of several constructed spawning beds but there are no longer annual Kokanee fry releases (Askey pers. comm. 2019). Juvenile Rainbow have also been observed in the lower reaches and the stream is available to adfluvial Rainbow spawning, though the habitat is drastically impaired. Stream temperature data is not available for the lower reaches of Penticton Creek; however, water temperature was taken during field discharge surveys by ONA on August 30, 2016, which showed an average water temperature of 17.3°C.

Penticton Creek has a long history of supplying water for the City of Penticton. At present, there are 35 points of diversion within the watershed (Associated 2019); however, the actual volume extracted is unknown. The stream is currently fully recorded (FLNRORD 2016). The City of Penticton is the main water supplier, and has developed water storage at Greyback Reservoir (Associated 2016). They release a minimum of 0.230 m^3/s at the water treatment plant throughout the year to limit sedimentation at their intake (Lejbak 2019). Penticton Creek is not 'flow sensitive' during summer or winter under residual flows but would be under naturalized flows (Table 3-52). No field measurements were available to estimate groundwater gains or losses on the alluvial fan and they are therefore unknown.

Due to the highly modified nature of the lower reaches of Penticton Creek, it is not suitable for conventional flow estimation procedures (Shepherd & Ptolemy 1999). Nonetheless, Okanagan Tennant EFNs for Penticton Creek are provided with the exception that residual flows were used in place of naturalized flows as the altered channel requires much higher flows to maintain fish habitat. Naturalized and residual flows were provided by Associated (2019) with an estimated data quality rating of B (data error between 10% and 25%); maximum licensed flows were not available at the time of reporting. Naturalized summer low flow estimates for Penticton Creek were lower than expected for the stream size. No WUW data were collected. Fish periodicity and flow standards described in Table 2-2 to Table 2-6 were used. A summary of EFNs for Penticton Creek is provided in Table 3-53 including the median EFN and the range of weekly EFNs, with weekly details in Figure 3-36, Figure 3-37 and Appendix B17 and flow sensitivities in Table 3-52. Further information on EFN setting in Penticton Creek is provided at the end of this section.

Table 3-51: Penticton Creek description

Drainage Area	180 km^2
Median Elevation	1282 m
WSC station	08NM240 (active) Two Forty Creek near Penticton (1983-present) 08NM241 (active) Two Forty-One Creek near Penticton (1983-Present) 08NM242 (active) Dennis Creek near 1780 Meter Contour (1985-present) 08NM169 (historic) Greyback Lake at the Outlet (1970-1987) 08NM168 (historic) Penticton Creek Above Dennis Creek (1970-1999) 08NM068 (historic) Howard Creek near Penticton (1930-1930) 08NM069 (historic) Reed Creek near Penticton (1930-1930) 08NM170 Penticton Creek Below Harris Creek (1970-1981) 08NM063 (historic) Penticton Creek Lot 19 Diversion (1926-1954) 08NM076 (historic) Penticton Creek Above Diversion (1936-1941) 08NM032 (historic) Penticton Creek main Diversion (1919-1966) 08NM031 (historic) Penticton Creek Below Diversion (1919-1921) 08NM118 (historic) Penticton Creek at the Mouth (1950-1972)
Other hydrometric stations	Penticton Creek at Nanaimo Ave (2001-2016)
LTMAD	1.159 m^3/s (Associated 2019)
Fish species expected	Rainbow, Kokanee, Eastern Brook Trout, Longnose Dace (ESSA & Solander 2009)
Land use	Forestry in upper watershed, agriculture and urban development in lower watershed (Associated 2016)

Table 3-52: Flow sensitivities in Penticton Creek based on naturalized flow

Species & life stage	**1-in-2 yr 30-day summer low flow**		**1-in-2 yr 30-day winter low flow**	
	Flow (m^3/s)	% LTMAD	Flow (m^3/s)	% LTMAD
Rainbow rearing	0.104	9%		
Insect production				
Kokanee spawning				
Rainbow overwintering			0.086	7%
Kokanee egg incubation				

Source: Associated (2019)

Table 3-53: EFN summary table for Penticton Creek based on residual flows

Species & life stage	**Time period**	**Okanagan Tennant Recommended EFN**				**Critical flow**	
		Median (m^3/s)	% LTMAD	Min (m^3/s)	Max (m^3/s)	Flow (m^3/s)	% LTMAD
Rainbow rearing & insect production [a]	April 1 – Oct 31	0.497	43%	0.369	0.733	0.058	5%
Rainbow spawning	May 20 – Jul 10	1.63	142%	0.864	5.20	0.576	50%
Kokanee spawning	Sep 6 – Oct 7	0.417	36%	0.369	0.486	0.115	10%
Rainbow overwintering	Nov 1 – Mar 31	0.373	32%	0.331	0.526	0.058	5%

a while EFNs apply to the entire period, median values are presented for the summer low flow period from Jul 15-Sept 30.

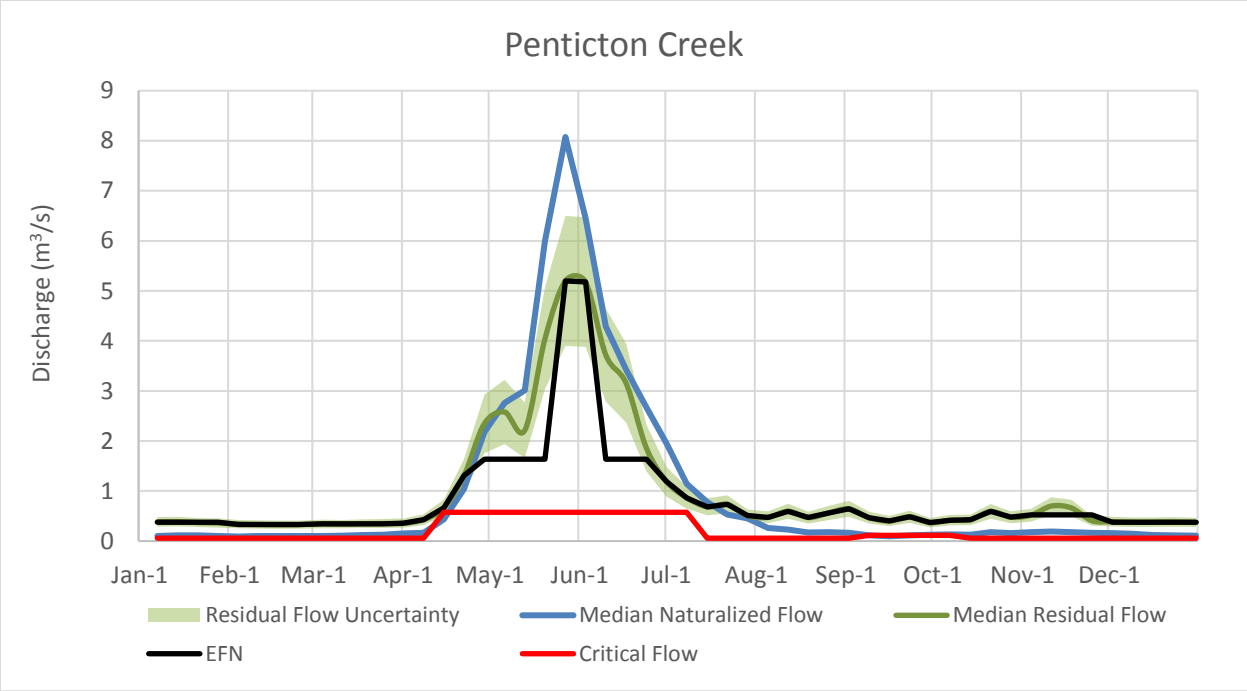

Figure 3-36: Weekly EFNs, critical flow and streamflows in Penticton Creek

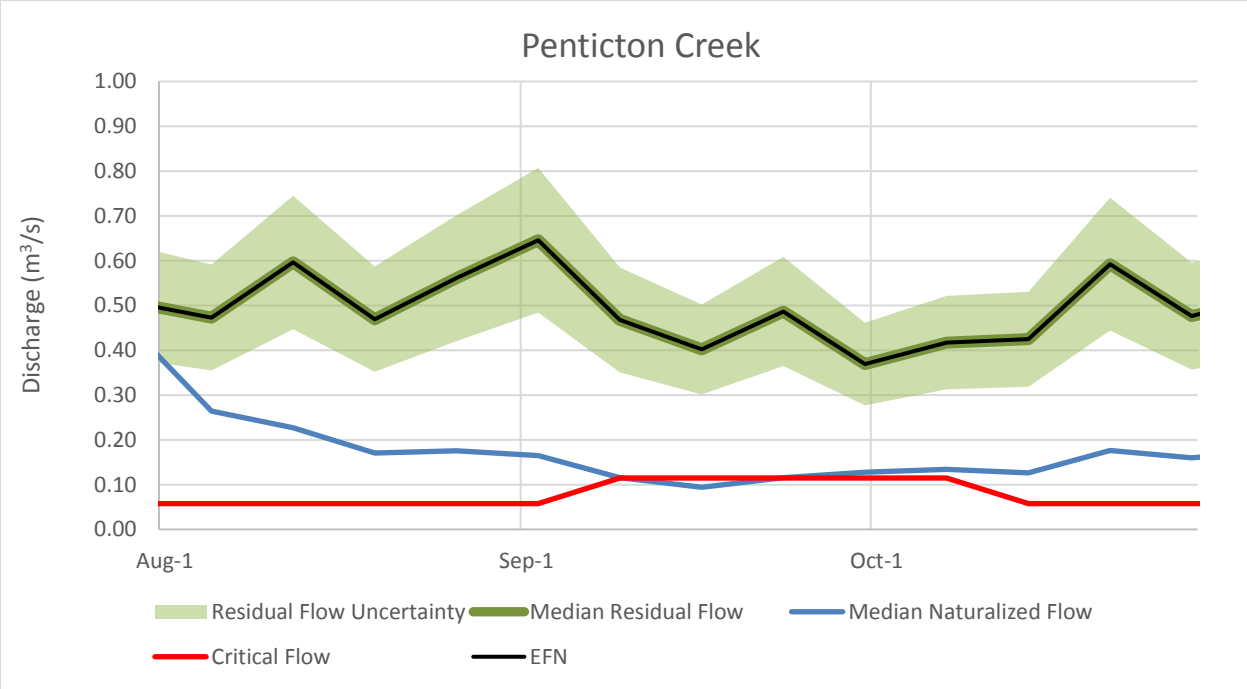

Figure 3-37: Weekly EFNs, critical flow and streamflows during the summer and fall period in Penticton Creek

Rainbow parr rearing

The median recommended Okanagan Tennant EFN for summer Rainbow rearing is 0.497 m^3/s (43% LTMAD, Table 3-53) which is equal to the median residual flows during the mid-July to late September period (Figure 3-37). While the minimum flow releases from the City of Penticton of 0.230 m^3/s are equal to the 20% LTMAD flow standard that would typically constitute the Okanagan Tennant EFN, limited information on current habitat conditions in the lower reaches presented in Mould (2017) suggests that water depths (0.06 m) at this flow rate are poorly suited for Rainbow parr rearing. Therefore, the EFN recommended here is equal to the median estimated residual flows (Associated 2019), which are higher than the minimum flow release throughout the year. Field verification of the EFN is recommended. The restoration plan (Mould 2017) is designed to provide suitable habitat conditions at the minimum flow of 0.23 m^3/s; therefore, EFNs should be reviewed periodically and adjusted based on measured habitat conditions as sections of the creek are restored. Previous EFNs set BCIFN thresholds (minimum risk) between ~0.6 m^3/s and ~1.3 m^3/s (ESSA & Solander 2009). The recommended critical flow for Rainbow parr rearing is 0.058 m^3/s (5% LTMAD) based on the LTMAD criterion (Table 2-7).

Median residual flows recorded at the WSC hydrometric station 08NM118 (Penticton Creek at the Mouth, 1950-1972; Figure B17-1, Appendix B17) were well below the recommended EFN from late June for the remainder of the summer and fall, and fell below the critical flow during mid-summer. Flows further upstream were substantially greater, indicating that water management was leading to the low flows recorded near the mouth (Figure B17-1, Appendix B17). More recent data from the City of Penticton station near the mouth (2001-2016) shows median weekly summer flows slightly below the recommended EFN but much higher than historically observed (Figure B17-1, Appendix B17). Meeting EFNs for Rainbow rearing near the mouth is thus considered possible but requires careful management of releases and withdrawals.

Rainbow spawning

The recommended Okanagan Tennant EFN for Rainbow spawning is 1.63 m^3/s, which is equal to the flow standard of 141% LTMAD (Table 3-53). Estimated residual flows (Figure 3-36) are above the recommended EFN for most of the spawning period. Limited information on current habitat conditions in the lower reaches presented in Mould (2017) suggests that flows of at least 2 m^3/s are required to maintain suitable spawning conditions. Future restored sections will be designed to provide suitable habitat conditions for Rainbow spawning at approximately 1 m^3/s (Mould 2017); therefore, EFNs should be reviewed periodically and adjusted based on measured habitat conditions as sections of the creek are restored. A previous EFN recommendation by ESSA & Solander (2009) was approximately 1.4 m^3/s. The recommended critical flow for Rainbow spawning is 0.576 m^3/s (50% LTMAD) based on the LTMAD criterion (Table 2-7).

Historically, median residual flows recorded at the WSC hydrometric stations were above the EFN from mid-April to late July (Figure B17-1, Appendix B17). More recent data from the City of Penticton station near the mouth (2001-2016) shows median weekly flows above the EFN from early May to mid-June (Figure B17-1, Appendix B17).

Kokanee spawning

The recommended Okanagan Tennant EFN for Kokanee spawning is 0.417 m^3/s (36% LTMAD), which is equal to the median residual flows during the Kokanee spawning period (Table 3-53). Limited information on current habitat conditions in the lower reaches presented in Mould (2017) suggests that water depths (0.06 m) at the minimum flow release of 0.230 m^3/s are poorly suited for Kokanee spawning and a

minimum of 0.5 m^3/s is required to provide sufficient depth. Field verification of the EFN is recommended. Future restored sections will be designed to provide suitable habitat conditions for Kokanee spawning at approximately the minimum flow release (Mould 2017); therefore, EFNs should be reviewed periodically and adjusted based on measured habitat conditions as sections of the creek are restored. Historical EFN recommendations for Kokanee are 0.7-1.132 m^3/s (ESSA & Solander 2009; Shepherd & Ptolemy 1999; Shepherd 1993), with minimum flow recommendations between 0.32 m^3/s (Mould 2002) and 0.556 m^3/s (Shepherd & Ptolemy 1999). The recommended critical flow for Kokanee spawning is 0.115 m^3/s (10% LTMAD) based on the LTMAD criterion (Table 2-7).

Median residual flows recorded at the WSC hydrometric station 08NM118 (Penticton Creek at the Mouth, 1950-1972; Figure B17-1, Appendix B17) were well below the recommended EFN during the Kokanee spawning period. More recent data from the City of Penticton station near the mouth (2001-2016) shows median weekly flows at the recommended EFN (Figure B17-1, Appendix B17). Meeting EFNs for Kokanee spawning is thus considered possible but requires careful management of releases and withdrawals.