3.6 McDougall Creek

McDougall Creek is a tributary to Okanagan Lake, flowing from the west side of the Okanagan Basin through West Kelowna, B.C. The watershed has an area of approximately 53 km^2 (Associated 2016) with a total stream length of approximately 16 km (Summit 1996). From the forested uplands, the creek flows through an incised valley onto a gently sloped terrace before flowing over an alluvial fan and into Okanagan Lake (Associated 2017). A summary of creek characteristics is found in Table 3-16 and additional stream-specific data is provided in Appendix B6.

The lower reaches of McDougall Creek flow through urban areas in West Kelowna with related impacts such as bank stabilization, stormwater outfalls, road crossings, and extensive channel straightening and armouring for flood control purposes in the lowermost 1 km from the mouth. Riparian vegetation cover is relatively good considering the location of the creek in an urban center, except for the lowermost 500 m, which are almost completely devoid of riparian vegetation due to recent flood control modifications.

No permanent barriers to fish migration have been reported for McDougall Creek (Associated 2016). The stream is known to support populations of Rainbow (Associated 2016; Summit 1996) and Rainbow fry and parr were observed in the reaches above Westside Road during field visits for this project. McDougall Creek may have historically supported a small Kokanee spawning population that was naturally constrained by low summer and fall flows. With increasing irrigation water demand on the creek, the amount of residual flow to accommodate Kokanee spawning had become almost negligible, which likely resulted in the elimination of the population (Wightman & Taylor 1978). No Kokanee were observed during the (very limited) enumeration visits over the past 20 years (Webster 2008-2016). However, it is possible that Kokanee spawners may use McDougall Creek in the future, particularly if sufficient flows during the spawning period and during the winter incubation period were maintained.

A total of three riffle and four glide transects were established in McDougall Creek in August of 2016 (Figure B6-3, Appendix B6). Transects were distributed between the mouth and the top of the alluvial fan above the city of West Kelowna.

At present there are 63 points of diversion within the watershed and 5 pending water licence applications; however, the actual volume extracted annually is unknown (Associated 2019). The City of West Kelowna and Westbank First Nation are the two main water users in the watershed, with developed storage at the headwaters at Hidden and Hayman lakes (Associated 2016). McDougall Creek is subject to numerous points of diversion through West Kelowna, as documented during field surveys in 2017. The stream is currently fully recorded for irrigation unless supported by storage (FLNRORD 2016). During the summer low flow season, the creek goes completely dry from just upstream of Shannon Lake Road downstream to a large groundwater discharge area below Daimler Drive where the creek regains a substantial amount of flow. Stranded Rainbow parr were observed in the dry section below Shannon Lake Road. Water losses and gains across the alluvial fan are unknown and could not be clearly characterized during this study due to the number and complexity of water diversions in the system. Inter-basin water transfers out of the basin occur when water is diverted from the headwater lakes to Shannon Lake. There is relatively little historic hydrometric information available for McDougall Creek. Two hydrometric stations were installed for this project: one at the top of the alluvial fan upstream of West Kelowna and most points of diversion; and one at the mouth which continues to operate (Figure B6-3, Appendix B6). McDougall Creek is 'flow sensitive' during summer and winter as naturalized flows are below 20% LTMAD (Table 3-17).

Table 3-16: McDougall Creek description

Drainage Area	53.5 km^2
Median Elevation	1071 m
WSC station	08NM014 (Historic) – McDougall Creek near Westbank (1920-1926)
ONA station	08NM590 – McDougall Creek at Jennens Road Bridge – Hydromet 1 (2016-present) 08NM591 – McDougall Creek at mouth of Canyon – Hydromet 2 (2016-2018)
LTMAD	0.132 m^3/s (Associated 2019)
Fish species expected	Rainbow (ESSA & Solander 2009)
Land use	The lower watershed contains irrigated agricultural land and commercial and residential developments (Associated 2016). The lowest reaches of McDougall Creek flows through Westbank First Nation reserve.

Naturalized, residual and maximum licensed flow data were provided by Associated (2019) with an estimated data quality rating of C (data error between 25% and 50%). Naturalized flow estimation in McDougall Creek is complicated because of numerous points-of-diversion, scant information on flow regulation, and complicated groundwater-surface water interactions on the fan (water disappears and then re-emerges in a large wetland area). Naturalized flow estimates by Associated (2019) for the summer and fall period were considered uncertain because they appeared extremely low. Residual flow estimates by Associated (2019) indicate flow augmentation, which is highly unlikely in this creek, and likely underestimate the true magnitude of diversions. They are not shown in the EFN plots below for that reason. Estimated maximum licensed flows indicate that the creek would be dry from late July to mid-September if licensed withdrawal and storage volumes were maximized.

Okanagan Tennant EFNs for McDougall Creek were developed in accordance with the methods outlined in Section 2.2. Fish periodicity and flow standards described in Table 2-2 to Table 2-6 were used. Weekly Okanagan Tennant EFNs were set to the lower of the naturalized flow or flow standard. WUW information from the study transects was then reviewed to determine whether final EFN recommendations needed adjustment from the Okanagan Tennant EFN. A summary of EFNs for McDougall Creek is provided in Table 3-18 including the median EFN and the range of weekly EFNs, with weekly details in Figure 3-11, Figure 3-12 and Appendix B6, and flow sensitives in Table 3-17. Critical flows were calculated as described in Section 2.4. Further information regarding EFN and critical flow setting in McDougall Creek is provided at the end of this section.

Table 3-17: Flow sensitivities in McDougall Creek

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	0.024	18%		
Insect production				
Kokanee spawning				
Rainbow overwintering			0.023	17%
Kokanee egg incubation				

Source: Associated (2019)

Table 3-18: EFN summary table for McDougall Creek

Species & life stage	Time period	Okanagan Tennant EFN		WUW EFN (m^3/s)	Recommended EFN (m^3/s)				Critical flow	
		Median (m^3/s)	% LTMAD		Median	% LTMAD	Min	Max	Flow (m^3/s)	% LTMAD
Rainbow rearing & insect production [a]	April 1 – Oct 31	0.026	20%	0.026	0.026	20%	0.026	0.659	0.010	8%
Rainbow spawning	May 20 – Jul 10	0.373	281%	0.373	0.363	274%	0.128	0.659	0.161	122%
Kokanee spawning	Sep 1 – Oct 20	0.026	20%	0.028	0.028	21%	0.028	0.028	0.013	10%
Rainbow overwintering	Nov 1 – March 31	0.026	20%	n/a	0.026	20%	0.025	0.032	0.010	8%

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

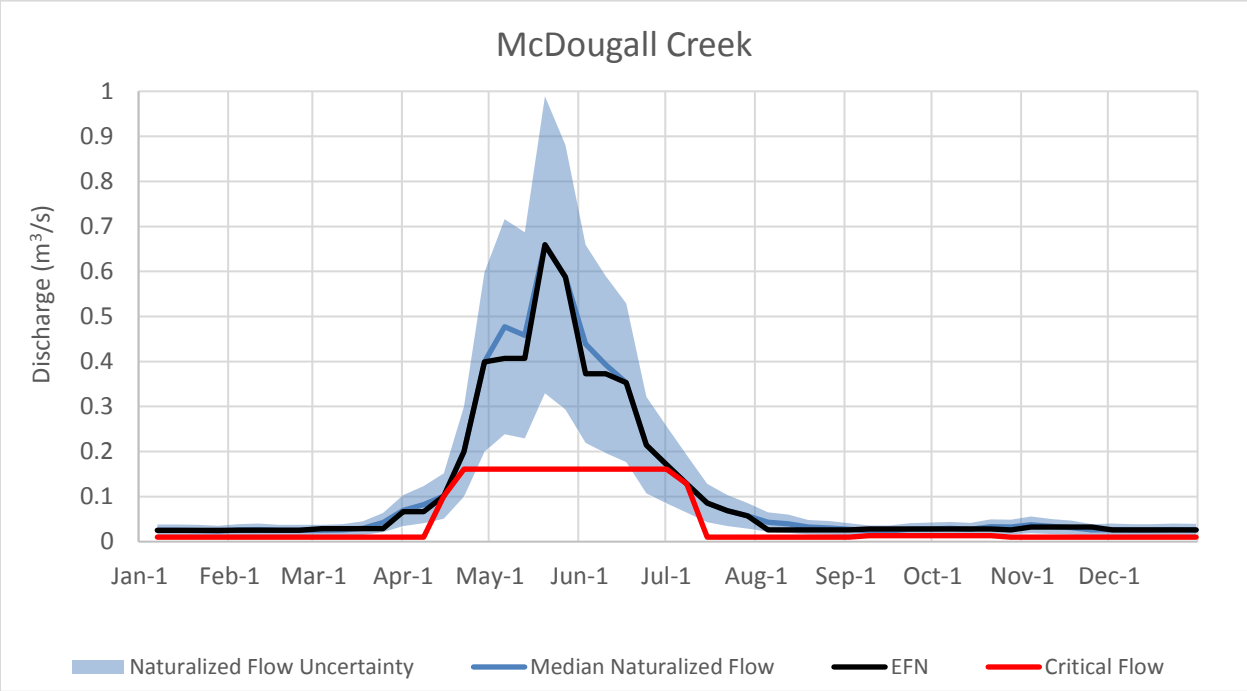

Figure 3-11: Weekly EFNs, critical flow and streamflows in McDougall Creek

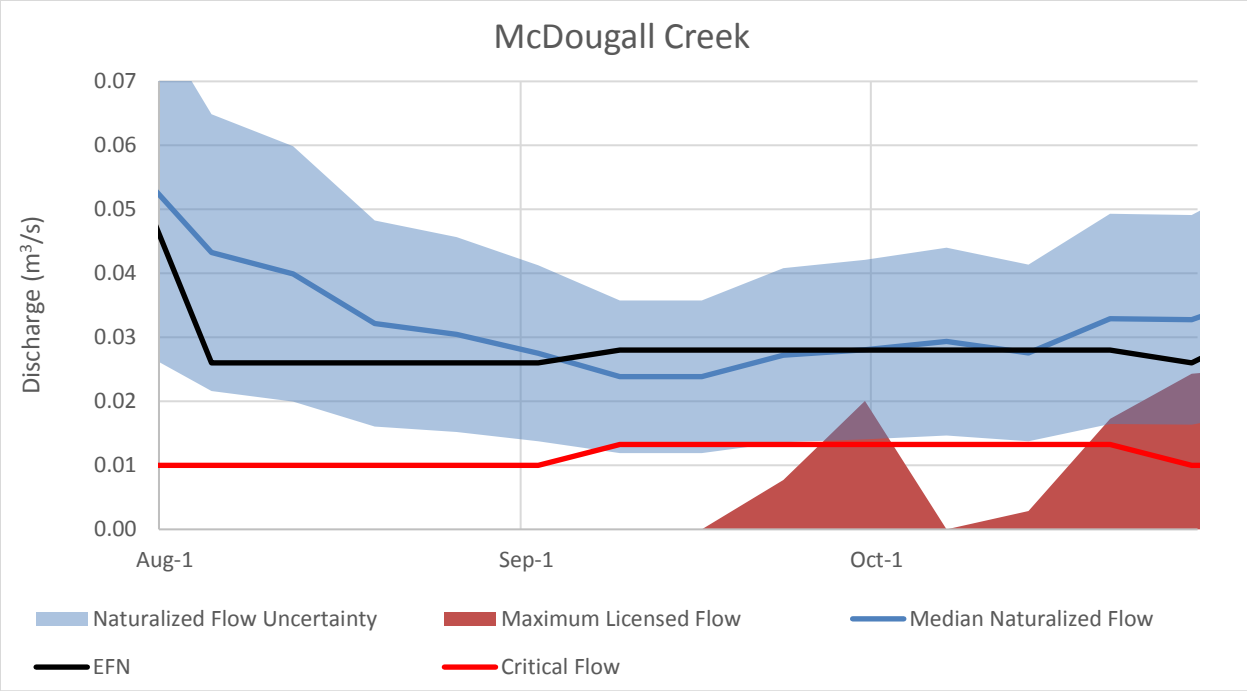

Figure 3-12: Weekly EFNs, critical flow and streamflows during the summer and fall period in McDougall Creek

Note: the peak and subsequent decline in maximum licensed flows in late September is an artifact resulting from assumptions about water use and reservoir release schedules made in the streamflow estimation process.

Rainbow parr rearing

The recommended EFN for Rainbow parr rearing is 0.026 m^3/s (20% LTMAD), which is equal to the median Okanagan Tennant EFN. The EFN maintains approximately 25% of maximum WUW in glides and 20% in riffles (Figure B6-8, Appendix B6) and approximately 10% of maximum insect production WUW from riffles (Figure B6-9, Appendix B6). This EFN value is near the average naturalized summer 30-day low flow (0.027 m^3/s; Associated 2019). Photos of habitat conditions in McDougall Creek at the recommended EFN flows are provided in Plate 3-11. Historical EFN recommendations were substantially higher at 0.085 m^3/s (Robertson 1983) and 0.2 m^3/s (ESSA & Solander 2009) but were not based on field observations in McDougall Creek. Critical flows of 0.01 m^3/s (8% LTMAD) are recommended for Rainbow rearing as riffle widths decline to <60% (Table B6-2, Appendix B6) and insect production from riffles becomes zero (Figure B6-9, Appendix B6).

The recommended EFN value is approximately equal to the lowest summer residual flows recorded at the ONA hydrometric station on Bartley Road (at the top of the alluvial fan above all water diversions but influenced by flow regulation from Hayman Lake) in 2017, which was a drought year (Figure B6-4, Appendix B6). Flows recorded at the mouth, however, were much lower and nearly dry (minimum 0.007 m^3/s in 2017 and 0.012 m^3/s in 2018). Between the two stations the creek has a section that goes dry but then regains most of its flow in a large groundwater discharge area below Daimler Drive. The limited historical discharge data also indicates very low flows near the mouth (Figure B6-5, Appendix B6). Meeting the Rainbow rearing EFN is likely difficult during most years (Figure B6-4 and B6-5, Appendix B6).

Water temperatures in McDougall Creek recorded at the upper hydrometric station at Bartley Road were generally favorable to Rainbow rearing at the recorded flows (maximum 17°C in early August; Figure B6-

6, Appendix B6) but were unsuitable at the mouth, with daily maximum temperatures above 20°C from late June to early September, and reaching over 25°C in late July (Figure B6-7, Appendix B6).

Rainbow spawning

The recommended EFN for Rainbow spawning is 0.373 m^3/s (283% LTMAD), which is equal to the median naturalized weekly flows during the Rainbow spawning period. This EFN maintains high spawning WUW (~90% of maximum, Figure B6-10, Appendix B6) while also maximizing Rainbow parr rearing WUW in riffles and glides. Residual flows were above the EFN from late April to early June during recent years (Figure B6-4, Appendix B6). Photos of habitat conditions in McDougall Creek at the recommended EFN flows are provided in Plate 3-12. The recommended critical flow for Rainbow spawning is 0.161 m^3/s (122% LTMAD, Table B6-3, Appendix B6) based on the passage depth criterion (Table 2-7). One historical EFN recommendation of 0.6 m^3/s was made by ESSA & Solander (2009).

Kokanee spawning

The recommended EFN for Kokanee spawning is 0.028 m^3/s (21% LTMAD), which is the median naturalized flow during the general Kokanee spawning period observed in other local streams (early September to mid-October). This EFN maintains approximately 30% of maximum Kokanee spawning WUW (Figure B6-11, Appendix B6) and is near the average naturalized summer 30-Day Low Flow (0.027 m^3/s; Associated 2019). Kokanee would benefit substantially from flows greater than the recommended EFN as WUW increases rapidly. Spawning flows near the mouth were substantially greater than the recommended EFN in 2017 (0.06 - 0.10 m^3/s) and ranging from critical flows (0.013 m^3/s) to greater than the EFN (0.069 m^3/s) in 2018 (Figure B6-4, Appendix B6). They were below the EFN during the short period of available historical records (Figure B6-5, Appendix B6). Given the extensive history of low flows and water use in McDougall Creek, Kokanee spawning EFNs are unlikely to be met during most years. Photos of habitat conditions in McDougall Creek at the recommended EFN flows are provided in Plate 3-11.

The recommended critical flow for Kokanee spawning is 0.013 m^3/s (10% LTMAD; Table B6-3) based on the %LTMAD criterion (Table 2-7). Safe riffle passage (0.12 m depth over $\geq$25% of riffle width) would be achieved at 0.046 m^3/s (35% LTMAD; Table B6-2, Appendix B6), which is greater than naturalized flows during the spawning and migration period, indicating that riffle passage may frequently be problematic.

Plate 3-11: McDougall Creek habitat conditions at flows near the recommended Rainbow parr rearing (0.026 m^3/s) and Kokanee spawning EFNs (0.028 m^3/s)

Riffle 2 at 0.024 m^3/s (18% LTMAD)

Riffle 2 at 0.045 m^3/s (34% LTMAD)

Glide 1 at 0.026 m^3/s (20% LTMAD)

Glide 1 at 0.053 m^3/s (40% LTMAD)

Plate 3-12: McDougall Creek habitat conditions at flows near the recommended Rainbow spawning EFN (0.373 m^3/s)

Glide 4 at 0.377 m^3/s (286% LTMAD)

Glide 1 at 0.448 m^3/s (339% LTMAD)