Table 4-1: Summary of EFN setting approach, uncertainties and data needs by stream

Stream	EFN setting approach	Uncertainties	Considerations for EFN implementation	Recommendations
Coldstream	• Kokanee spawning and Rainbow rearing: used WUW data to adjust EFNs upwards from Okanagan Tennant EFNs because naturalized flows are much greater than flow standards and WUW declines rapidly; critical flows based on %LTMAD and reflecting naturally high baseflows • Rainbow spawning: set EFN just below Okanagan Tennant EFN; critical flows based on riffle analysis	• Lack of low flow WUW data. Greater uncertainty in low end of WUW curve for Kokanee spawning and Rainbow rearing. EFNs were set conservatively just below the lowest WUW measurement but well below naturalized flows and residual flows	• Significant groundwater contributions produce higher baseflows than most other streams; however, the water balance completed for this EFN did not consider withdrawals from hydraulically connected aquifers. The demands from this and other wells could be considered in future water balance work • EFNs and critical flows are relatively attainable due to comparatively high naturalized and residual flows • Large amount of high quality fish habitat remains due to low degree of channel modifications • Highly important Kokanee stream	• Collect low flow WUW data from riffle transects to confirm critical flow recommendations • Obtain residual and maximum licensed flow data estimates • Continue operating the hydrometric station near McClounie Road and upgrade to real-time to provide flow information in high quality fish habitats • Consider protecting available water resources and fish habitat
Equesis	• Kokanee spawning and Rainbow rearing: used WUW data to adjust EFNs upwards from Okanagan Tennant EFNs because of long-term flow augmentation from Pinaus Lake; critical flows set based on %LTMAD • Rainbow spawning: set EFN at Okanagan Tennant EFN; critical flows based on riffle analysis	• Naturalized LTMAD and summer low flow estimates were considered low • Lack of low flow WUW data. Greater uncertainty in low end of WUW curve for Kokanee spawning and Rainbow rearing. EFNs were set conservatively just below the lowest WUW measurement, greater than naturalized flows but no greater than residual flows	• EFNs and critical flows are relatively attainable due to flow augmentation from Pinaus Lake • Relatively large amount of high quality fish habitat remains • Highly important Kokanee stream • Stream would be dry from late July to mid-September if licensed withdrawal and storage volumes were maximized	• Collect low flow WUW data from riffle transects to confirm critical flow recommendations • Continue operating the hydrometric station near Westside Road • Confirm OKIB reservoir management to ensure it is consistent with previous management and/or assumptions included in Associated (2019) • Develop an operating plan for Pinaus Lake to meet EFN and water use needs • Monitor ditch diversions upstream and downstream of Westbank Road
Naswhito	• Kokanee spawning and Rainbow rearing: used WUW data to adjust EFNs upwards from Okanagan Tennant EFNs because: (1) naturalized flow estimates that confined the Okanagan Tennant EFN were low compared to measured flows (2) WUW at	• Lack of historical hydrometric records • Naturalized flow estimates for the summer and fall period were considered uncertain because they are lower than those recorded by the hydrometric station from 2016-2018.	• High quality fish habitat remains • August flows fall below the Rainbow rearing EFN sometimes • September flows fall below Kokanee spawning EFNs in some years • Actual water use is uncertain and individual points of diversion may have a large cumulative impact on streamflows	• Continue operating the hydrometric station near the mouth to reduce uncertainty regarding residual and naturalized flows at the mouth • Identify large points of diversion and determine their cumulative impact on flows

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	naturalized flows was extremely low; • Kokanee critical flows based on median naturalized flows and riffle analysis • Rainbow rearing critical flows based on riffle analysis • Rainbow spawning: set EFN at Okanagan Tennant EFN; critical flows based on riffle analysis	• Residual flow estimates may underestimate the magnitude of large diversions observed during field visits	• Stream would be dry from early August to mid-September if licensed withdrawals were maximized • Migratory access for Kokanee spawners is susceptible to riffle passage constraints. Maintenance of critical flows during the spawning period is crucial to spawning success. Fall rain events likely play an important role in providing spawner access.	• Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) rapidly increasing WUW for Kokanee spawning and Rainbow rearing with small increases in flow, (2) large diversions observed, (3) frequent failure to meet EFNs in August and September
Whiteman	• Kokanee spawning and Rainbow rearing set to Okanagan Tennant EFNs • Kokanee critical flows based on %LTMAD • Rainbow rearing critical flows based on riffle analysis • Rainbow spawning: set EFN slightly below Okanagan Tennant EFN; critical flows based on riffle analysis	• lack of recent hydrometric records from the mouth • Residual flow estimates indicate near zero water withdrawal but this needs confirming through field surveys	• High quality fish habitat remains • Low fall flows are a known problem during the Kokanee spawning season and EFNs may not be met during some years. • Migratory access for Kokanee spawners is susceptible to riffle passage constraints. Maintenance of critical flows during the spawning period is crucial to spawning success. Fall rain events likely play an important role in providing spawner access. • High quality Rainbow rearing habitat is susceptible to naturally low flows during summer and fall. • Flows would be below the EFN throughout the summer and below critical flows during the Kokanee spawning period if licensed withdrawals were maximized.	• Continue operating the hydrometric station near the mouth to obtain more recent flow data in key Kokanee spawning habitats • Identify points of diversion and determine their impact on flows • Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) rapidly increasing WUW for Rainbow rearing with small increases in flow, (2) diversions observed, (3) frequent failure to meet EFNs in August and September
Mission	• Kokanee spawning and Rainbow rearing: used WUW data to adjust EFNs upwards from Okanagan Tennant EFNs because of long-term flow augmentation stipulated by Water Use Plan. Residual flows used for EFN setting. Critical flows based on riffle analysis. Passage conditions highly variable due to the wide range of channel modifications	• Channel conditions highly variable due to channelization • Moderate scatter in some WUW curves because of varying transect characteristics (i.e., lower gradient near the mouth to higher gradient near the canyon) • Some transects unsuitable for critical riffle analysis due to lack of measurements over the required range of flows	• Highly important Kokanee and adfluvial Rainbow stream • Habitat availability in the lower reaches impacted by channel modifications • EFNs and critical flows are relatively attainable due to extensive headwater storage • Water Use Plan implementation is lacking during some years • High water temperatures likely impair Rainbow rearing in the lower reaches	• Work with water managers to implement flow releases to meet EFNs • Continue operating the real-time hydrometric station near the mouth to monitor flows in key Kokanee spawning habitats • Re-establish real-time hydrometric station on Pearson Creek • Estimate maximum licensed flows

Stream	EFN setting approach	Uncertainties	Considerations for EFN implementation	Recommendations
	• Rainbow spawning: set EFN at Okanagan Tennant EFN; critical flows based on riffle analysis			• Develop safe ramping rates to provide protection to fish during adjustments in reservoir releases
McDougall	• Kokanee spawning and Rainbow rearing EFNs set to Okanagan Tennant EFNs • Kokanee critical flows based on %LTMAD • Rainbow rearing critical flows based on riffle analysis • Rainbow spawning EFNs set to Okanagan Tennant EFN; critical flows based on riffle analysis	• Lack of historical hydrometric records and lack of water management information • Complicated surface water-groundwater interactions including dry sections and extensive wetland areas • Naturalized flow estimates for the summer and fall period were considered uncertain because they were extremely low for the stream size • Residual flow estimates indicate flow augmentation which is highly unlikely given observed flow records. They likely underestimate the true magnitude of diversions	• No Kokanee population observed in recent history • Stream dewatering and Rainbow stranding was observed during field visits • Habitat quality impacted by channel modifications • High water temperatures likely impair Rainbow rearing in the lower reaches • Severely impacted by flow diversions and critically low flows are common • Low fall flows are a known problem and EFNs are not met during August and September in most years • Stream would be dry from late July to mid-September if licensed withdrawal and storage volumes were maximized	• Continue operating the hydrometric station near the mouth to obtain more recent flow data • Obtain information on the operation of Hayman Lake in the headwaters to meet downstream water use needs • Identify points of diversion and determine their impact on flows • Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) rapidly increasing WUW for Kokanee spawning and Rainbow rearing with small increases in flow, (2) numerous diversions observed, (3) frequent failure to meet EFNs in August and September
Lower Shingle	• Juvenile fish rearing, Rainbow spawning and Steelhead spawning EFNs set to Okanagan Tennant EFNs; critical flows based on riffle analysis • Chinook spawning EFNs set to naturalized flows (well below the Okanagan Tennant flow standard); critical flows also set to naturalized flows due to riffle passage concerns • Kokanee and Sockeye spawning EFNs set to Okanagan Tennant EFN; critical flows for Kokanee and Sockeye spawning set based on %LTMAD	• Limited recent and historical hydrometric records from the mouth • Naturalized flow estimates for the summer and fall period were low for stream size • Moderate scatter in the WUW curves for Kokanee spawning and juvenile fish rearing • Impact of water use on instream flows is not well known due to limited recent hydrometric data	• Juvenile fish rearing EFNs and critical flows were mostly met in years with recent hydrometric data near the mouth; historical records show flows much below EFNs • EFNs for Chinook spawning and particularly migration were not always met in recent years • Kokanee and Sockeye spawning EFNs were generally met in recent years • Habitat quality impacted by channel modifications • Water temperatures approach tolerance limits of juvenile fish and Chinook spawners • One of few Okanagan streams with documented use of spring Chinook	• Obtain residual and maximum licensed flow estimates • Continue operating the hydrometric station near the mouth to obtain more recent flow data • Determine the impact of water use on flows • Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) high flow needs for spring Chinook, (2) numerous diversions observed, (3) frequent failure to meet EFNs in July and August

Stream	EFN setting approach	Uncertainties	Considerations for EFN implementation	Recommendations
			• Flows above the EFN from July-October would greatly benefit all fish species in the creek in particular Chinook spawners	
Upper Shingle	• Juvenile fish rearing EFNs: used WUW data to adjust Okanagan Tennant EFN upward to naturalized flows because of very low WUW; critical flows based on riffle analysis • Rainbow spawning and Steelhead spawning EFNs: used WUW data to adjust Okanagan Tennant EFN upward to near naturalized flows providing near maximum WUW; critical flows based on riffle analysis • Chinook spawning EFNs set to naturalized flows which were well below the Okanagan Tennant flow standard; critical flows based on %LTMAD which is near naturalized flows	• Limited recent and historical hydrometric records • Moderate scatter in WUW curves for Chinook fry rearing • Extent of Chinook distribution in the system is unknown	• High quality fish habitat remains • Spring Chinook spawning is constrained by naturally low fall flows • Extensive water diversion results in dry streambed during some years and EFNs for juvenile fish rearing, Chinook migration and spawning are frequently not met • Water temperatures approach tolerance limits of juvenile fish and Chinook spawners • Flows greater than the EFN from July-October would greatly benefit all fish species in the creek through rapidly increasing WUW	• Obtain residual and maximum licensed flow estimates • Continue operating the hydrometric station in the Gabriel field to obtain more recent flow data • Determine the impact of water use on flows • Conduct surveys to determine the extent of Chinook distribution in Upper and Lower Shingle Creek • Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) high quality fish habitat, (2) observed incidents of dewatering from water diversion, (3) high flow needs for spring Chinook (4) frequent failure to meet EFNs from July-September
Shuttleworth	• Juvenile fish rearing EFNs set to Okanagan Tennant EFN; critical flows based on %LTMAD • Rainbow and Steelhead spawning EFNs set to Okanagan Tennant EFN; critical flows based on riffle analysis • Chinook spawning EFNs set to Okanagan Tennant EFN which is well below the Tennant flow standard; critical flows based on %LTMAD which is near naturalized flows • Sockeye spawning EFNs set to Okanagan Tennant EFN which is well below the Tennant flow	• Limited recent and historical hydrometric records • Moderate scatter in WUW curves for Chinook fry rearing • Summer naturalized low flow estimates were very low • Due to very limited information, residual flow estimates likely do not reflect the amount of observed water use at large-scale diversions in the lower reaches	• Medium quality fish habitat remains • Spring Chinook and Sockeye spawning is constrained by naturally low fall flows • Extensive water diversion results in dry streambed during many years and EFNs for juvenile fish rearing and fall spawning species are frequently not met. Juvenile Rainbow stranding observed during field visits. • Water temperatures exceed tolerance limits of juvenile fish and Chinook spawners • Flows greater than the EFN from July-October would greatly benefit all fish species in the creek through rapidly increasing WUW	• Continue operating the hydrometric station at Maple Street and install a station upstream of water diversion to obtain more recent flow data • Confirm groundwater- surface water interactions across the alluvial fan • Determine the impact of water use on flows and monitor withdrawals at large diversion • Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) quality fish habitat, (2) observed incidents of dewatering from water diversion, (3) high flow needs for spring

Stream	EFN setting approach	Uncertainties	Considerations for EFN implementation	Recommendations
	standard; critical flows based on %LTMAD which is near naturalized flows			Chinook (4) frequent failure to meet EFNs from July-September
Vaseux	• Juvenile fish rearing EFNs: used WUW data to adjust Okanagan Tennant EFN slightly downward from median naturalized flows; critical flows based on %LTMAD • Rainbow spawning and Steelhead spawning EFNs set to Okanagan Tennant EFNs; critical flows based on riffle analysis • Chinook spawning EFNs: used WUW data to adjust Okanagan Tennant EFN upward from median naturalized flows; critical flows based on %LTMAD • Sockeye spawning EFNs: used WUW data to adjust Okanagan Tennant EFN upward from median naturalized flows; critical flows based on %LTMAD	• Limited recent and historical hydrometric records near the mouth • Naturalized flow estimates for the summer and fall period were considered uncertain because they were extremely low • Residual flow estimates likely underestimate the magnitude of diversions	• EFNs for juvenile fish rearing, and Chinook and Sockeye spawning are rarely met due to stream dewatering most summers • One of few Okanagan streams with documented use of spring Chinook • Water temperatures exceed tolerance limits of juvenile fish and Chinook spawners • Re-establishment of summer and fall flows in the lower reaches is critical to recovery of fish populations • Flows greater than the EFN from July-October would greatly benefit all fish species in the creek and particularly Chinook spawners	• Continue operating the hydrometric station near the mouth and at the outlet of the canyon • Confirm groundwater - surface water interactions across the alluvial fan • Determine the impact of water use on flows and monitor withdrawals at the large diversions on the fan • Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) high quality fish habitat (2) observed major water diversions, (3) high flow needs for spring Chinook (4) frequent dry streambed and failure to meet EFNs from July-September • Explore potential for development of a Water Sustainability Plan (as defined under the WSA) • Conduct spawning ground surveys to confirm Sockeye and Chinook spawning activity
Inkaneep	• Juvenile fish rearing EFNs: used WUW data to adjust Okanagan Tennant EFN upward to naturalized flows because of very low WUWs; critical flows based on riffle analysis • Rainbow spawning and Steelhead spawning EFNs set to Okanagan Tennant EFN; critical flows based on riffle analysis • Chinook spawning EFNs set to naturalized flows which were greater than the Tennant flow	• LTMAD estimated is low due to the low freshet values compared to other watersheds of similar size, leading to very low Okanagan Tennant EFNs • Limited number of WUW measurements required modelling of WUW at intermediate flows	• EFNs for juvenile fish rearing and Chinook spawning are frequently not met • TEK indicates a historical use by spring Chinook • Water temperatures exceed tolerance limits of juvenile fish and Chinook spawners • Flows greater than the EFN from July-October would greatly benefit all fish species in the creek and particularly Chinook spawners	• Determine the impact of water use on flows • Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) high quality fish habitat, (2) high flow needs for spring Chinook (3) frequent very low flows and failure to meet EFNs from July-September

Stream	EFN setting approach	Uncertainties	Considerations for EFN implementation	Recommendations
	standard; critical flows also set to naturalized flows		• Stream would be dry from mid-July to mid-September if licensed withdrawal and storage volumes were maximized	
Shorts	• Rainbow rearing and Kokanee spawning EFNs: used WUW data from nearby Whiteman Creek and the literature to adjust Okanagan Tennant EFN upward from naturalized flows; critical flows based on %LTMAD • Rainbow spawning EFN set to Okanagan Tennant EFN; critical flows based on %LTMAD	• Naturalized flow estimates for the summer and fall period were quite low and residual flows estimated very little water use, which needs verification • Changing sediment deposition conditions on the alluvial fan near the mouth lead to extremely low flows during some years	• EFNs for Rainbow rearing and Kokanee spawning are frequently not met • Significant potential for Kokanee spawning if sufficient flows are maintained • Stream would be nearly dry from mid-August to mid-September if licensed withdrawals were maximized	• Continue operating the hydrometric station above Westside Road • Complete a thorough investigation of water diversion locations and use to verify estimates used for flow naturalization • Confirm groundwater - surface water interactions across the alluvial fan • Ground-truth the recommended EFNs by collecting field measurements at or near the recommended EFN • Explore streamflow restoration opportunities. This creek is a prime candidate because of: (1) high quality fish habitat, (2) frequent very low flows and failure to meet EFNs from July-September, (3) unknown impact of water diversion on the alluvial fan
Mill	• Rainbow rearing and Kokanee spawning EFNs: adjusted Okanagan Tennant EFNs upward to reflect naturally high baseflows; critical flows based on %LTMAD • Rainbow spawning EFN set to Okanagan Tennant EFN; critical flows based on %LTMAD	• Lack of recent hydrometric data	• Significant groundwater contributions support higher baseflows than most other streams • EFNs and critical flows are relatively attainable due to comparatively high naturalized and residual flows • High degree of flow regulation • Rainbow spawning EFN is not met during some years due to flow regulation during freshet • Stipulated conservation flows	• Obtain residual and maximum licensed flow estimates • Continue operating and/or install hydrometric stations along the Mill Creek valley floor to provide information on residual flows and groundwater contributions during low flows
Powers	• Rainbow rearing and spawning EFNs set to Okanagan Tennant	• Lack of recent hydrometric data from the mouth	• Significant potential for Kokanee spawning if sufficient flows are maintained	• Obtain residual and maximum licensed flow estimates

Stream	EFN setting approach	Uncertainties	Considerations for EFN implementation	Recommendations
	EFNs; critical flows based on %LTMAD • Kokanee spawning EFN: adjusted Okanagan Tennant EFNs upward to naturalized flows based on historical WUW data; critical flows based on %LTMAD	• Recent channel modification from sediment dredging in key spawning areas at the mouth	• EFNs for juvenile fish rearing and Kokanee spawning were usually met historically but not recently • Stipulated conservation flows • High degree of flow regulation	• Install a hydrometric station near the mouth to monitor residual flows • Conduct field visits to confirm recommended EFNs are appropriate in recently modified channel near the mouth • Improve flow management to meet conservation flows
Trepanier	• Rainbow rearing and spawning, and Kokanee spawning EFNs set to Okanagan Tennant EFNs; critical flows based on %LTMAD	• Lack of recent hydrometric data from the mouth	• History of not meeting EFNs for Rainbow rearing and Kokanee spawning as a result of water withdrawal	• Obtain residual and maximum licensed flow estimates • Install a hydrometric station near the mouth to monitor residual flows • Conduct field visits to confirm recommended EFNs • Explore streamflow restoration opportunities
Naramata	• Rainbow rearing and Kokanee spawning EFNs: adjusted Okanagan Tennant EFNs upward to residual flows; critical flows based on %LTMAD (Rainbow) and 50% of spawning flows (Kokanee) • Rainbow spawning EFN set to Okanagan Tennant EFN; critical flows based on %LTMAD	• Complete lack of historical and recent hydrometric data • Uncertainty over continued flow augmentation by the highline diversion from Robinson and Chute creeks (to be determined by FLNRORD) • Uncertainty over availability of winter flows for Kokanee incubation	• History of flow augmentation from adjacent watersheds • Past widening of channel for flood control • Kokanee population maintained solely through flow augmentation • Fish kills documented during low flow events	• Install a hydrometric station near the mouth • Monitor the highline diversion rates and document the actual diversion operation between Chute, Robinson and Naramata creeks • Collect WUW and flow data to refine Kokanee EFNs and critical flows if continued flow augmentation is to be pursued
Trout	• Rainbow rearing and spawning EFN set to Okanagan Tennant EFN; critical flows based on %LTMAD • Kokanee spawning EFN adjusted upward to median naturalized flows based on historical WUW information; critical flows based on %LTMAD	• Lack of recent hydrometric data from the mouth	• History of extremely low flows and not meeting EFNs for Rainbow rearing and Kokanee spawning as a result of water diversion • History of unnatural daily flow regime with large deviations from natural flow regime • Past channelization for flood control greatly reduced available habitat • Water Use Plan stipulates conservation flows	• Obtain residual and maximum licensed flow estimates • Install a hydrometric station near the mouth • Explore streamflow restoration opportunities

Stream	EFN setting approach	Uncertainties	Considerations for EFN implementation	Recommendations
Penticton	• Rainbow rearing and Kokanee spawning EFNs: adjusted Okanagan Tennant EFNs upward to residual flows; critical flows based on %LTMAD • Rainbow spawning EFN set to Okanagan Tennant EFN; critical flows based on %LTMAD	• Naturalized summer low flow estimates were lower than expected • Critical flows highly uncertain due to lack of WUW measurements and heavy channelization	• Past channelization for flood control greatly reduced available habitat; restoration efforts underway • Higher EFNs required due to low-flow channel widening • High degree of flow regulation • Early and mid-summer EFNs not met in recent years • Minimum flow releases for water utility infrastructure maintenance	• Obtain maximum licensed flow estimates • Collect WUW and flow data to confirm EFNs and determine critical flows • Review EFNs periodically as habitat restoration projects are implemented
McLean	• Juvenile fish rearing, Steelhead, Rainbow and Kokanee spawning EFNs set to Okanagan Tennant EFNs; critical flows based on %LTMAD	• General lack of hydrometric data	• High quality fish habitat remains and high density of rearing *O. mykiss* observed • Cool water temperatures indicate groundwater influence	• Obtain residual and maximum licensed flow estimates • Install hydrometric station to monitor flows near the mouth • Conduct streamflow monitoring to investigate the influence of groundwater on baseflows