EDI ENVIRONMENTAL DYNAMICS INC.
Natural Resource Consultants

Weir Feasibility Study for the Stewart River Watershed

CRE 26N-03

Prepared for:

YUKON RIVER PANEL

PO Box 20973
Whitehorse, YT
Y1A 6P4

and

THE FIRST NATION OF THE NACHO NYAK DUN
P.O. Box 280
Mayo, Yukon
Y0B 1M0

Prepared by:

Nathan Ferguson, B.Sc., Dipl. Tech
and
Tim Antill, B.NRSc., B.I.T, A.Ag.

EDI ENVIRONMENTAL DYNAMICS INC.
Suite 206 – 4133 4th avenue,
Whitehorse, Yukon
Y1A 1H8

EDI Project No.: 604-04

January 2004

ABSTRACT

There is currently no chinook salmon indexing system located within the Stewart River watershed. During the summer and fall of 2003 *Environmental Dynamics Inc.* conducted assessments of potential weir locations for monitoring chinook salmon within the Stewart River watershed. Twelve streams were initially selected based on findings from literature review. Ultimately four of the twelve streams were chosen and investigated in the field, with the McQuesten River, Janet Creek, Mayo River and Crooked Creek being selected as potential candidates. Selections were reviewed based on several factors including the number of returning chinook salmon, stream and channel characteristics, access to high quality weir sites and the potential for community involvement. Although all four streams selected were found to be suitable for a weir, the Mayo River was chosen as the best overall site due to its proximity to the Village of Mayo, large numbers of returning chinook and its ability to provide a consistent annual index.

ACKNOWLEDGEMENTS

The Yukon River Salmon Restoration and Enhancement Fund, a salmon restoration partnership between the State of Alaska and Yukon Territory administered by the Yukon River Panel, provided funding for this project (Project Number CRE26M-03). Hugh Monaghan is the Executive Secretary for the Yukon River Panel and administers and oversees the Yukon Based Projects. Patrick Milligan, Stock Assessment Biologist, Fisheries and Oceans Canada, Whitehorse, provided technical expertise and guidance. Brian Mercer and Brad Wilson (weir specialists) provided insight and valuable information during field visits.

Several members of the Nacho Nyak Dun, Lands and Resources Department contributed to this project. Anne Leckie, Dick Mahoney and Roman Krska provided background information and input into the direction and focus of the project. Dick Mahoney, Roman Krska, Crystal Stevenson and William Patterson helped complete the fieldwork and Millie Olson (NND GIS/Mapping) completed a portion of the mapping for the project.

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1.0 INTRODUCTION

The Stewart River watershed is the third largest sub-basin (51, 000 km^2) within the Canadian portion of the Yukon River Watershed and is a major producer of chinook salmon with an estimated 17 % of the total upper Yukon River (upstream of the Alaska boarder) escapements (Triton. 1992). Presently, there is little in the way of quantitative information available for the Stewart River and there is no escapement index within the entire system. In the spring of 2003 *Environmental Dynamics Inc* (EDI) was contracted by the Nacho Nyak Dun First Nation (NND) to investigate the feasibility of installing and operating a weir within the Mayo area on salmon bearing rivers within the Stewart River Watershed. It is envisioned that the results of this project will lead to the development of a chinook enumeration program, which will provide an in-season management tool through which conservation concerns specific to the Stewart River system can be addressed. A permanent index site in the Stewart River sub-basin will also provide the opportunity to collect annual stock specific information such as age-sex-length data, genetic material and other information critical to the future restoration and conservation of Stewart River chinook stocks.

1.1 Objectives

The objectives of this study are as follows:

- Identify potential chinook salmon indexing streams within the Stewart River drainage, with emphasis on locations within the NND Traditional Territory.
- Evaluate the suitability of chosen streams as weir sites based on physical characteristics, logistics and status as spawning streams.
- Select sites that are most suited for a weir operation.
- To provide training, employment, technical capacity and foster stewardship within the NND Traditional Territory.

1.0 STUDY AREA

The study area for this project during the initial investigations included the entire Stewart River watershed, but was subsequently narrowed to include only those systems within the Stewart River watershed that were found to be easily accessible (Figure 1).

Figure 1. Study area map.

3.0 METHODS

The study was conducted in two parts, the collection of background information from within the study area and the on site assessments which focused on the identification of potential weir locations within each system.

Pre-field investigations involved the collection of information about individual streams, which was obtained from stream files held at Fisheries and Oceans Canada (DFO) in Whitehorse, through the use of the DFO's online Fisheries Information Summary Systems (FISS) database and literature found in local libraries and the NND Lands and Resources Office. Streams were primarily evaluated based on ease of access. The number of chinook returning to each stream was also an important consideration, although this information was quite limited. In order for a weir program to be feasible, salmon in large enough numbers must migrate up the selected streams. A minimum benchmark number of 100 chinook salmon documented within a stream was required for a stream to pass the initial review stage (based on recommendations made by Patrick Milligan of DFO). Although this study was conducted within the Stewart River watershed, due to the involvement of the NND First Nation, it was important to the scope of this project to examine streams located primarily within the NND Traditional Territory. Streams located lower in the Stewart River basin (downstream of McQuesten River), where there is an overlap between the NND's Traditional Territory and that of the Tron Dek Hwechin (Dawson) First Nation, were generally not considered within this study. Tributaries to the Stewart River within the NND's Traditional Territory were examined based on existing, albeit limited, hydrological and biological information, along with logistical considerations.

Once a list of potentially weirable stream was compiled, field visits were conducted to determine if any adequate weir sites existed. On June 17th and 18th of 2003, EDI staff, Brad Wilson (weir specialist) and Dick Mahoney (NND Habitat Steward) conducted a field assessment of the Mayo River, Crooked Creek, McQuesten River and Janet Creek. Crystal Stevenson (NND Resource Technician) was present on the second day when assessments on the McQuesten River and Crooked Creek were undertaken. On July 30, 2003, additional field visits were conducted on the Mayo River and Crooked Creek by EDI staff with the help of Dick Mahoney, Crystal Stevenson and William Patterson (NND Technician). During theses investigations, an attempt was made to access the proposed Janet Creek weir site, but poor weather conditions resulted in cancellation of the trip. On November 6 2003, the McQuesten River was visited by EDI staff accompanied by Brian Mercer (weir specialist), Dick Mahoney and Roman Krska in order to reassess the weirability of this system during more favorable water levels.

The suitability of potential weir sites was evaluated based on the relative ease of access to the site, proximity of the site to the Stewart River, site characteristics and channel morphology. Sites were chosen that would facilitate the easy establishment and operation of the proposed weir. Table 1 lists the characteristics that were used as a basis when evaluating potential weir locations.

Table 1. Ideal stream attributes at a potential weir location.

Attribute	Desirerable characteristics
Access	Easily accessible by vehicle or boat and located close to a local community.
Downstream spawning potential	Should be located as close as possible to the mouth of the river to limit the number of fish spawning downstream of the weir.
Stream banks	Gradually sloping banks that allow changes in water level to dissipate outward rather than upward. This ensures that increases in flow result in minimal increases in water depth.
Channel width	The channel should be as narrow as possible to reduce the cost of materials but wide enough to maintain low water velocities.
Channel	A flat homogeneous stream bottom combined with a shallow channel.
Gradient and water velocity	A low stream gradient and a low water velocity.
Channel substrates	Pebbles to fist sized cobbles with few sands and fines, to provide high substrate stability.

At each selected weir location, numerous site conditions were recorded. A surveyors level and rod were used to determine the stream channel profile. Gradient, channel measurements, and average water velocities were also taken. Site conditions were recorded and numerous photographs were taken of each location.

Using all of the information collected for this report, each stream was ranked based on its overall value based on potential for success, ease of access, number of chinook returning to spawn and the potential for stewardship opportunities.

4.0 RESULTS

The results of the investigations conducted for this report include information derived from pre-field and field examinations. The outcome of each is presented below.

4.1 Pre-field Investigation

Table 2 outlines the streams identified in pre-field investigations and summarizes the rational used in identifying the ones that were selected as possible weir candidates.

Table 2. Initial stream review.

Stream Name	Comments	Meets Initial Review Criteria (Yes/No)
Hess River	Chinook have been documented in this system (FISS 2003); however, access is poor.	No
Pleasant Creek	Chinook are reported to spawn below Pleasant Lake (FISS 2003), however, access is poor.	No
Lasing River	Chinook are reported to utilize the Lasing River (FISS 2003). The area is too remote to effectively operate a fish weir.	No
Beaver River	Chinook are reported to extend up the river to the Rackla River rapids (FISS 2003). The access to Beaver River was considered inadequate for this project.	No
Keno Ladue River	No chinook were documented in this system (FISS 2003).	No
Nadaleen River	Chinook have been observed approximately 25 km upstream of the mouth (FISS 2003). The area is too remote to effectively operate a fish weir.	No
Nogold Creek	No chinook have been documented in this stream (FISS 2003).	No
Janet Creek	Janet Creek is known to be a significant spawning stream. In a report prepared by Smith (1997), 137 returning salmon including 91 spawning females in 1997 were documented. Although, access is not ideal, this steam has potential for a weir project.	Yes
Mayo River	Chinook are well documented in Mayo River up to Wareham Dam. A rough estimate produced by Triton (1992) suggests an escapement of 588 to 1940 chinook salmon in this river. In 1994 a weir was established on the river which documented 642 adult chinook passing through between July 31 and August 28th however, the project was discontinued (Herron 1994). Due to the unnatural flow conditions caused by the dams upstream, the Mayo River may not be the ideal index stream. Access to the Mayo River is excellent.	Yes
Crooked Creek	Chinook salmon are well documented in this system. In a report prepared by Smith (1997) estimates between 40 and 130 chinook were present within the River in 1997. There is good access to the mouth of Crooked Creek near the community of Stewart Crossing.	Yes
Moose Creek	Chinook have been identified in the stream; however, the numbers of fish are unknown. There is highway access near the mouth. Due to the small size of the stream, limited chinook spawning potential and the lack of chinook run information this stream was excluded as a potential weir candidate.	No
McQuesten River	The McQuesten River is known to have relatively significant numbers of chinook salmon returning each year (as many as 833 documented during one count in 1990, Tobler 2003; and a weighted index of 1,245 in 2002, Mercer 2002), and known hydrological data is available for this system. There is highway access near the mouth of the river.	Yes

4.2 Field Investigations

Based on the initial investigations, systems that showed high relative numbers of returning chinook as well as a high likelihood of being successfully weirable included the Mayo River, the Crooked Creek, the McQuesten River and Janet Creek (Figure 1). Surveys were conducted on each of these streams in order to determine the highest quality weir locations.

4.2.1 Mayo River

The Mayo River is located approximately 200 km upstream of the confluence of the Stewart and Yukon Rivers and flows into the Steward River in close proximity to the Village of Mayo (Figure 2). During the initial site visit in June of 2003, two potential weir locations were identified. When EDI and NND staff visited the river a second time in July of 2003, two additional potential weir sites were located.

Figure 2. Mayo River weir locations.

Flows on the Mayo River have been monitored since 1958 (Figure 3).

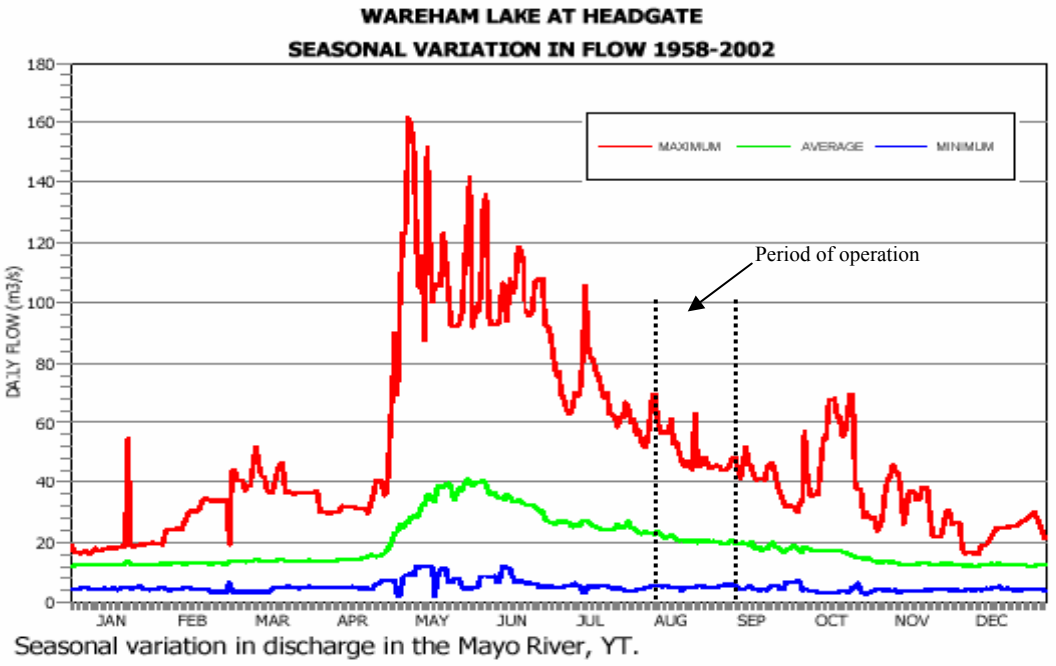

Figure 3. Graph showing flow information for the Mayo River from 1958 to 2002, as well as the probable timing of weir operation.

Weir Site 1

This site is located approximately 50 m downstream of the village of Mayo main sewer pipe that runs beneath the river (Figure 4). Stream measurements show a very wide channel at this location (Table 3), however the channel profile indicates that much of the flow is concentrated on one side of the stream at lower flows (Figure 5).

Table 3. Channel characteristics of Mayo River weir site 1.

Access	Very accessible. It is possible to drive right to the weir location.				
Downstream spawning potential	There is approximately 700 m of channel downstream of the weir location.				
Stream banks	The left bank is a gradual sloping gravel bar, while the right bank on the outside of the bend is vertical.				
Channel width (m)	80.0				
Gradient (%)	0.5				
Water velocity (m/sec)	June 17 - 1.02	July 30 – 1.3	August 13 – 0.5	August 22 – 0.6	September 5 – 0.7
[1]Substrates	Cobbles (5 cm diameter)/ gravels and fines				

[1] Cobbles (> 64mm to 256 mm diameter), Gravels (> 2.0 to 64.0 mm diameter), Fines (clay, silt or sand < 2.0 mm diameter) (BCE 1995)

Figure 4. Downstream view, looking at the right bank of weir site 1 on the Mayo River.

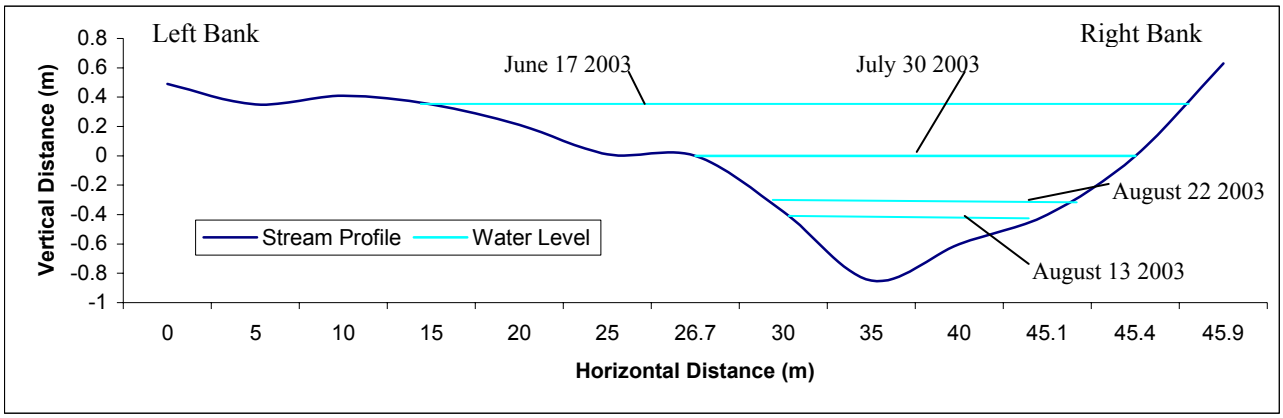

Figure 5. Stream profile of potential weir site 1 on the Mayo River looking downstream.

Weir Site 2

The second site on the Mayo River is located approximately 200 m downstream of the highway bridge (Figure 6). The stream channel in this location is much narrower than at site 1 (Table 4), but the channel profile indicates a highly variable stream bottom (Figure 7).

Table 4. Channel attributes at Mayo River potential weir site 2.

Access	Access to this site can be gained through the community picnic grounds located on the west side of the highway bridge. It is possible to drive right to the weir location.			
Downstream spawning potential	There is approximately 3 km of stream downstream of this location.			
Stream banks	The right bank is vertical while the left bank is gradually sloping.			
Channel width (m)	60.8			
Gradient (%)	0.5			
Water velocity (m/sec)	July 30 – 1.3	August 14 – 0.6	August 22 – 0.6	September 5 – 0.7
[2]Substrates	Cobbles/gravels			

[2] Cobbles (> 64mm to 256 mm diameter), Gravels (> 2.0 to 64.0 mm diameter), Fines (clay, silt or sand < 2.0 mm diameter) (BCE 1995)

Figure 6. Cross-stream and downstream view of weir site 2 on the Mayo River (June 18, 2003).

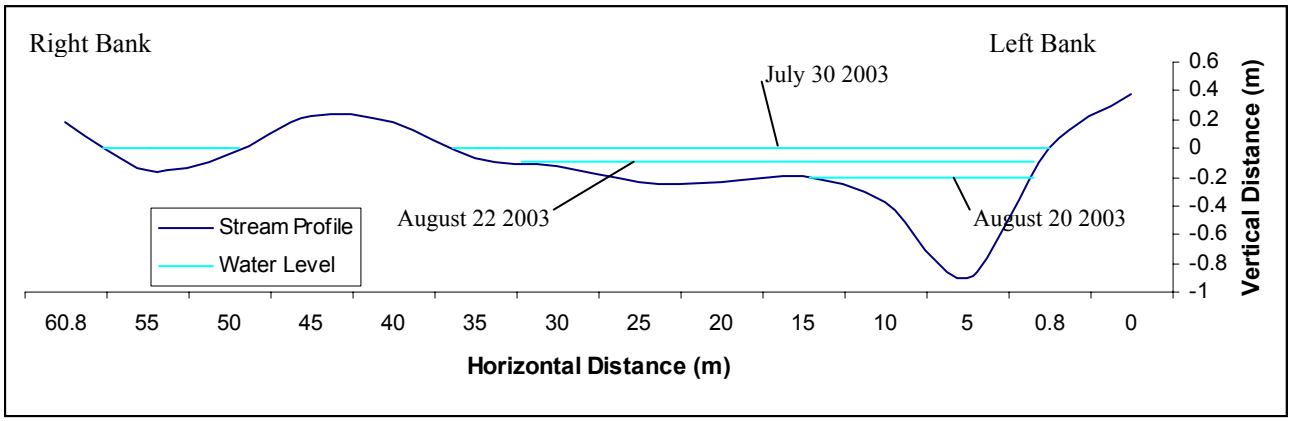

Figure 7. Stream profile of potential weir site 2 on the Mayo River looking upstream.

Weir Site 3

This site is located approximately 250 m upstream of the Mayo sewer line crossing that runs beneath the river (Figure 8). Stream attributes were found to be similar to site 2 (located downstream), with the exception of dominant channel substrates and channel width (Table 5). The profile of the Mayo River at this location was found to be the most uniform of the four potential weir locations surveyed (Figure 9).

Table 5. Channel attributes at Mayo River potential weir site 3.

Access	More difficult than other Mayo River sites. Trails would be needed to access the site on foot.
Downstream spawning potential	There is approximately 900 m of stream downstream of this location.
Stream banks	The left bank was a gradual sloping gravel bar, while the right bank was vertical with overhanging vegetation
Channel width (m)	35.0
Gradient (%)	1.0
Water velocity (m/sec)	July 30 – 0.9
[3]Substrates	Gravels/cobbles

[3] Cobbles (> 64mm to 256 mm diameter), Gravels (> 2.0 to 64.0 mm diameter), Fines (clay, silt or sand < 2.0 mm diameter) (BCE 1995)

Figure 8. Upstream and cross-stream view of weir site # 3 on the Mayo River (July 30, 2003)

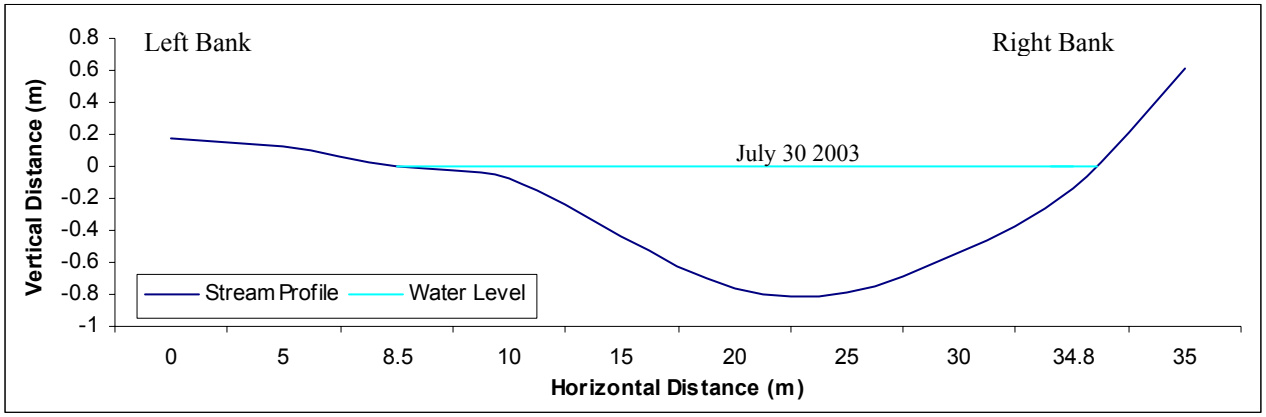

Figure 9. Stream profile of potential weir site 3 on the Mayo River looking downstream.

Weir Site 4

This site is located approximately 1 km downstream of the highway bridge (Figure 10). The stream characteristics combined with the highly variable channel profile at this location make this site the least ideal as a potential weir site on the Mayo River (Table 6, Figure 11)

Table 6. Channel attributes at Mayo River potential weir site 4.

Access	Difficult with a relatively long trail needed to access the site on foot.
Downstream spawning potential	There is approximately 2.2 km of channel downstream of this location.
Stream banks	Both stream banks are relatively steep with overhanging vegetation with a gravel bar located on the downstream right side of the river
Channel width (m)	48.8
Gradient (%)	1.5
Water velocity (m/sec)	July 30 - 1.5
[4]Substrates	Cobbles (>10cm)/gravels

[4] Cobbles (> 64mm to 256 mm diameter), Gravels (> 2.0 to 64.0 mm diameter), Fines (clay, silt or sand < 2.0 mm diameter) (BCE 1995)

Figure 10. Cross-stream and downstream view of weir site 4 on the Mayo River (July 30, 2003).

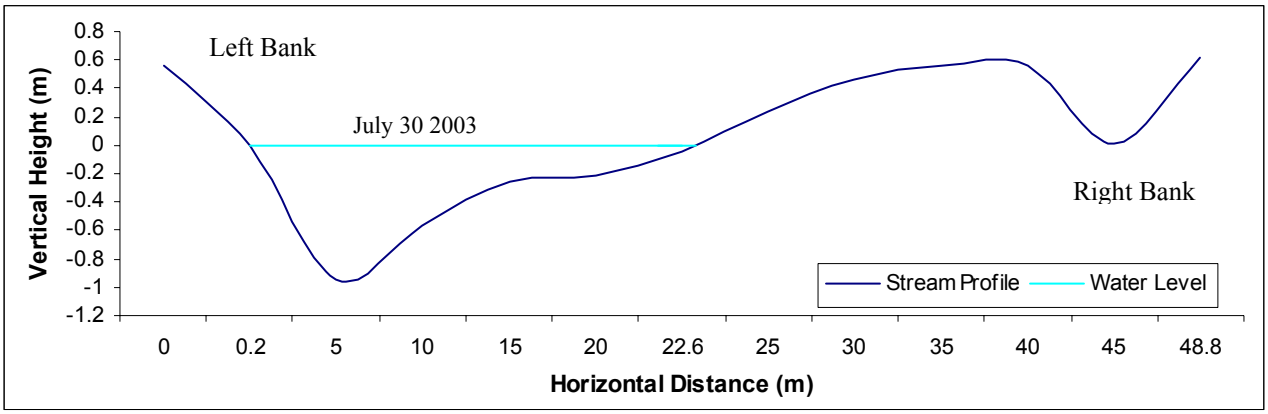

Figure 11. Stream profile of potential weir site 4 on the Mayo River looking downstream.

4.2.2 Janet Creek

Janet Creek is located approximately 32 km upstream of the village of Mayo along the Stewart River via an approximately 1.5 hour boat trip (Figure 1). A suitable weir site was found 100 m upstream from the mouth located midway within an extended riffle section (Figure 12). Table 7 shows a narrow channel with high water velocities, while Figure 13 indicates a fairly uniform channel bottom at this location.

Table 7. Channel attributes at the Janet Creek potential weir site.

Access	A long boat trip is required to access this location.
Downstream spawning potential	There is approximately 100 m of channel downstream of the weir location
Stream banks	The left bank is vertical and the right bank is gradually sloped.
Channel width (m)	11.8
Gradient (%)	0.5
Water velocity (m/sec)	June 17 - 1.7 August 21 – 1.4
[5]Substrates	Cobbles /gravels (average 4 cm diameter)

Figure 12. Cross-stream and downstream stream view of weir site on Janet Creek (June 17, 2003).

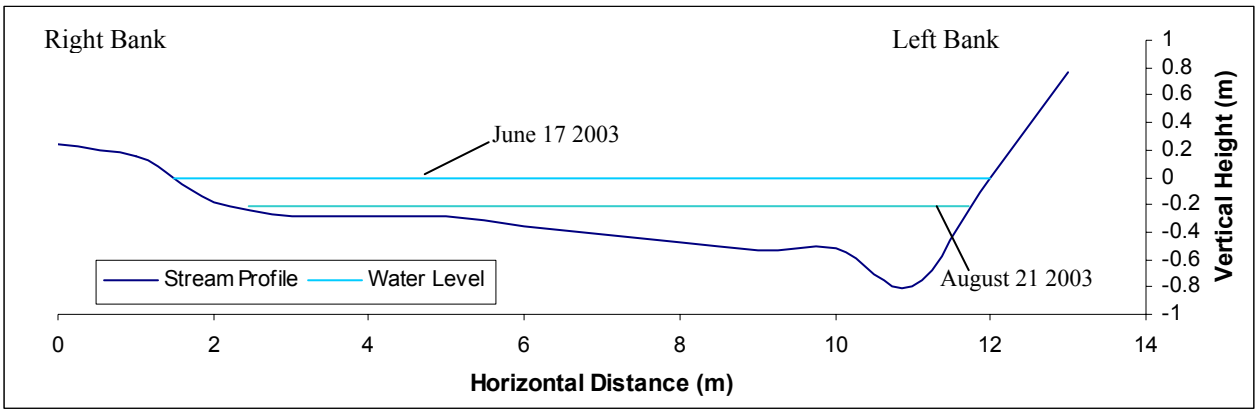

Figure 13. Stream profile of potential weir site on Janet Creek looking upstream.

[5] Cobbles (> 64mm to 256 mm diameter), Gravels (> 2.0 to 64.0 mm diameter), Fines (clay, silt or sand < 2.0 mm diameter) (BCE 1995)

4.2.3 McQuesten River

The McQuesten River is located approximately 53 km west of Stewart Crossing along the Klondike Highway (Figure 1). During the November 6 2003 visit one potentially weirable site was identified at approximately 950 meters upstream of the Klondike Highway bridge (Figure 14). Channel characteristics are outlined in Table 8 while Figure 15 shows the highly uniform nature of the channel bottom at this location.

Table 8. Channel attributes at the McQuesten River potential weir site.

Access	Access is good via a road leading directly to the weir site.
Downstream spawning potential	There is approximately 2.9 km of channel downstream of the weir site.
Stream banks	The left bank is gradually sloped while the right bank is near vertical.
Channel width (m)	45.0
Gradient (%)	0.5
Water velocity (m/sec)	June 18 – 0.9 November 6 - 1.35
[6]Substrates	Cobble/gravels

Figure 14. Cross-stream and downstream view of weir site on the McQuesten River (November 6, 2003).

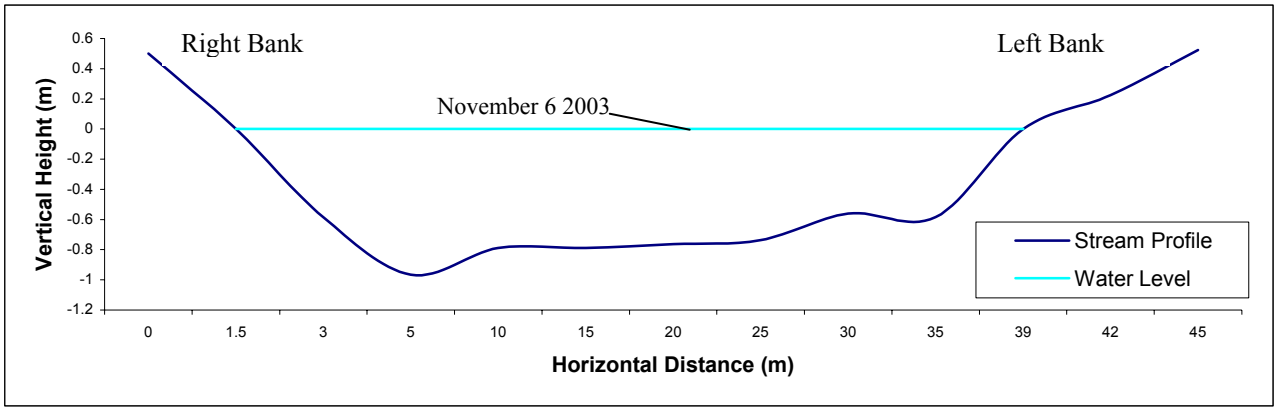

Figure 15. Stream profile of the potential weir site on the McQuesten River looking upstream.

[6] Cobbles (> 64mm to 256 mm diameter), Gravels (> 2.0 to 64.0 mm diameter), Fines (clay, silt or sand < 2.0 mm diameter) (BCE 1995)

Flows data for the McQuesten River is available from as far back as 1979 (Figure 16).

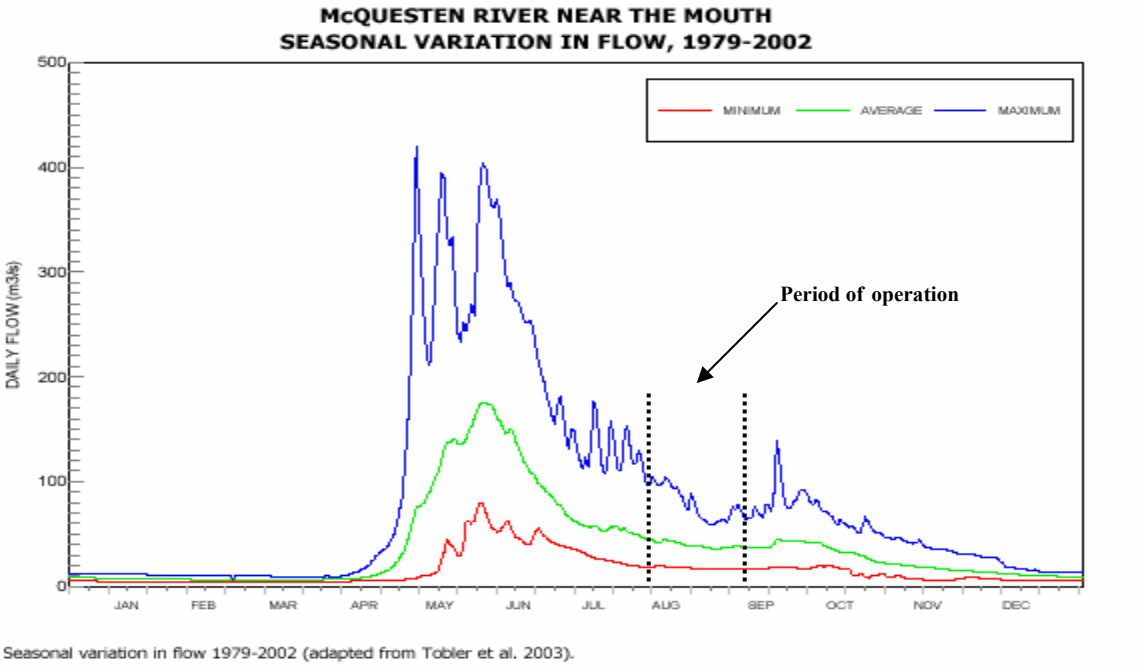

Figure 16. Graph showing flow information for the McQuesten River from 1979 to 2002, as well as the probable timing of weir operation.

4.2.4 Crooked Creek

The confluence of Crooked Creek and Stewart River is located 0.5 km downstream of Stewart Crossing (Figure 1). Two potential weir sites were identified approximately 1.5 km upstream from the mouth of the Crooked Creek.

Weir Site 1

This site is located at the end of a narrow access road, which starts along the Klondike Highway at the top of the hill before descending into the community of Stewart Crossing. Site 1 is located on a bend in the river mid way through an extended riffle section (Figure 17). Stream attributes are listed in Table 9 while Figure 18 shows a somewhat uniform channel bottom.

Table 9. Channel attributes at Crooked Creek potential weir site 1.

Access	Good access via a long gravel road. A vehicle can be driven right to the weir location.
Downstream spawning potential	There is approximately 1.5 km of channel downstream of this location.
Stream banks	Both banks at this location are sloping with the right bank having a steeper incline.
Channel width (m)	17.0
Gradient (%)	1.0
Water velocity (m/sec)	June 17 – 0.9 July 31 – 0.8 August 20 – 0.5
[7]Substrates	Cobbles

Figure 17. Downstream view of potential weir site 1 on the Crooked Creek (July 31, 2003).

[7] Cobbles (> 64mm to 256 mm diameter), Gravels (> 2.0 to 64.0 mm diameter), Fines (clay, silt or sand < 2.0 mm diameter) (BCE 1995)

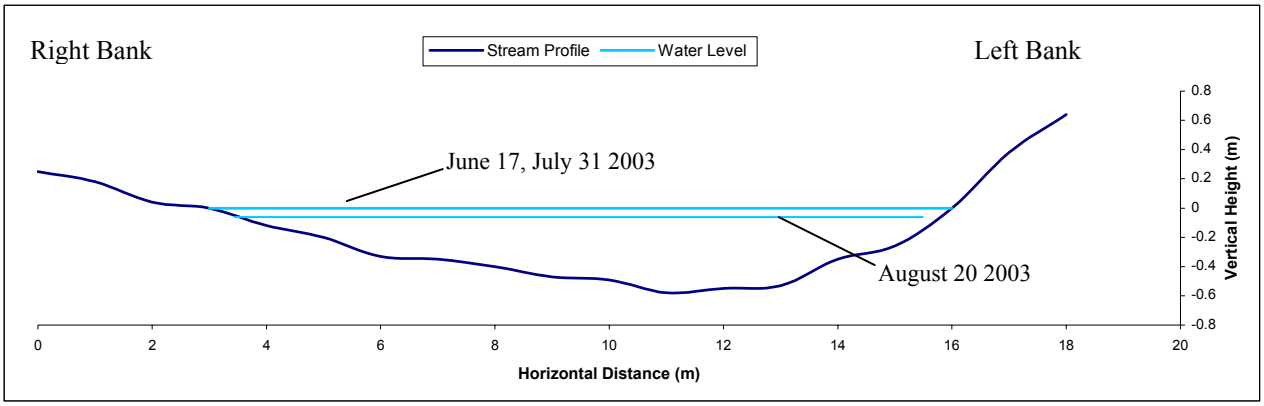

Figure 18. Stream profile of potential weir site 1 on the Crooked Creek looking upstream.

Weir Site 2

This potential weir location is approximately 70 m upstream of site 1 within a slow moving glide (Figure 19). Table 10 lists the stream attributes while Figure 20 illustrates the channel profile at this location.

Table 10. Channel attributes at the Crooked Creek potential weir site 2.

Access	Access via a long gravel road is good. A vehicle can be driven directly to the weir location.
Downstream spawning potential	There is approximately 1.6 km of channel downstream of the weir location.
Stream banks	The right bank is steeply sloped while the left bank is a gradual slope.
Channel width (m)	17.0
Gradient (%)	0.5
Water velocity (m/sec)	June 17 – 1.4 July 31 – 1.6 August 20 – 0.6
[8]Substrates	Gravel/cobbles

Figure 19. Downstream view of potential weir site 2 on the Crooked Creek (July 31, 2003).

[8] Cobbles (> 64mm to 256 mm diameter), Gravels (> 2.0 to 64.0 mm diameter), Fines (clay, silt or sand < 2.0 mm diameter) (BCE 1995)

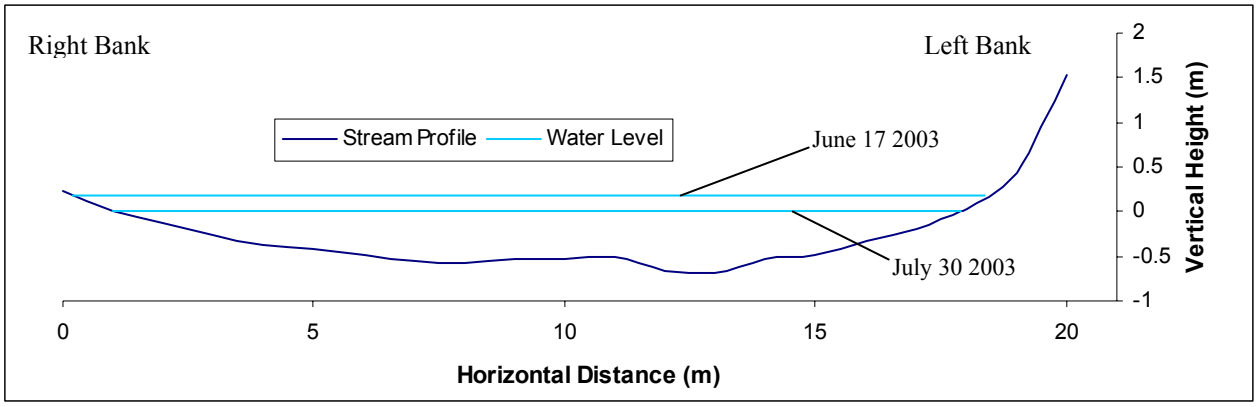

Figure 20. Stream profile of potential weir site 2 on the Crooked Creek looking upstream.

4.3 Rankings

Information from the results of investigations and available literature was used to derive a ranking system based on a scale of 1 to 4. Each stream assessed during this project was then ranked as shown in Table 11.

Table 11. Rankings of the overall relative value of each stream as a weir location. Lower numbers represent a higher overall value.

Stream	*Potential for success	Access	Number of chinook	Stewardship opportunities	Total score/overall value
Mayo River	1	1	2 (642 in 1994) (Herron 1994)	1	1.25
McQuesten	4	2	1 (833 in 1990) (Tobler 2003)	2	2.25
Crooked River	1	3	4 (130 in 1997) (Smith 1997)	3	3
Janet Creek	1	4	3 (137 in 1997) (Smith 1997)	4	3.5

* A weir would be easily designed, constructed and operated during a variety of flow conditions.

Based on the ranking system developed for the four weir streams (Table 4), the Mayo River showed the highest potential for success due to the relative quality and stability of channel characteristics including velocity, substrates and stream profile. Crooked and Janet Creeks also showed suitable channel characteristics, while the McQuesten River was ranked fourth based on its deep wide channel, significant water volumes and high water velocities. The Mayo River ranked best for overall access due to its proximity to the Village of Mayo, Janet Creek ranked last due to a lack of road access, while the other streams fell in order (McQuesten River then Crooked Creek) based on the distance from the Village of Mayo and/or the Klondike Highway. Based on existing literature the McQuesten River showed the highest number of returning chinook with the Mayo second, Janet Creek third and Crooked Creek fourth. Stewardship opportunities were based heavily on the proximity of the potential location to a major center (Mayo) and the probability that community members would access the site if given the opportunity.

5.0 DISCUSSION

A permanent fish weir located within the Stewart River watershed will be an invaluable tool to be used in the assessment of chinook population dynamics and health. In order for a weir to be successful, it must be constructed on a system that stands to provide the best biological data while ensuring that the weir structure remains operational.

5.1 Crooked Creek

This report is not the first to consider Crooked Creek as a potential weir location. Smith (1997) recommended that sites on Crooked Creek be used as potential locations for salmon enumeration. The Crooked Creek weir sites investigated for this report were easily accessible by vehicle and close to the community of Stewart Crossing, which would help with logistics including transporting construction materials to the site. Channel characteristics are favorable for a weir installation due to the sloping nature of the stream banks, suitable substrates and the relatively homogeneous channel bottom. During the investigation some potential spawning areas were noted downstream of the proposed weir sites; however, access to these areas was considered too difficult to set up a weir. If the identified sites were to be considered for use as weir locations, redd and carcass counts downstream may be required in order to accurately determine the number of fish entering the system. Of the two potential weir locations site 2 is preferred over site 1, due mostly to the lower gradient of the site and resultant reduced water velocity. However, at the time of the survey an unoccupied house was located next to the river on the right bank and therefore it is likely that permission from the landowner would be required in order to establish a weir at site 2. Due to the undisturbed nature, stream size and suitable channel characteristics, this system has the potential to be a relatively good weir location. However, the drawbacks are that no potential weir sites where identified closer to the mouth of the river and the number of returning chinook is comparably low (130 in 1997) to other systems examined.

5.2 Janet Creek

The relatively undisturbed nature of the Janet Creek watershed suggests that this stream would be quite desirable for use as an index, although if a weir were to be operational at this location, it would be necessary to establish an extended field camp due to the remoteness of the site (access is approximately 1.5 hours with a suitable riverboat). Channel characteristics and the location of the weir site close to the mouth are conducive to the establishment of a weir; however, water velocities experienced during the field visit were quite high, which could result in problems when trying to keep the weir fish tight. Other drawbacks include the relatively low numbers (137 in 1997) of returning chinook (Smith 1997) and the remoteness of the site.

5.3 McQuesten River

Upon completion of the initial McQuesten River site visit (June 18, 2003) no sites were found that were thought to be suitable for the operation of a standard weir. The site assessment was conducted in June at which time the flow levels of the river were thought to be too great to effectively operate a conventional weir. As shown in Figure 16, average flow levels during the period of operation for a weir are substantially higher than those experienced in the Mayo River (Figure 3). (Note: as no hydrologic information was available for Janet or Crooked creeks, average annual flow levels could not be compared). Another identified issue is that recreational boaters often use the river, and as such it was thought that a weir may present a navigational hazard, therefore a weir would have to be designed and implemented with this in mind.

When the river was visited a second time (November 6, 2003), a location was found that possessed channel characteristics that may allow for the installation of a weir, although data collected during that time reviled that the system would still push the limits of a conventional weir. This location is desirerable as the majority of salmon are known to spawn upstream of this location and access to the site is ideal (Mercer pers. comm. 2003). If a weir were to be built in this location one way to improve its chances of

success may be to utilize an alternate weir design such as a floating resistance board or sonar weir, although the costs may be substantial. Please note that the initial evaluation of the McQuesten River (near the highway) for its suitability as a potential location for a Didson Sonar weir reveled stream features (shallow and turbulent flow) thought to be unsuitable (Cronkite pers. Comm. 2003).

The McQuesten River has been noted as having significant runs of chinook salmon (weighted index of 1,245 in 2002) and as such may be of the highest value as an index stream (Mercer 2003); however, the potential problems associated with the high water velocities and deep wide channel of the McQuesten River (Figure 15) resulted in an unclear determination as to whether or not a weir would be successful, especially on an annual basis. If the risk of failure is acceptable, a conventional weir could be constructed and tested on the McQuesten River. If the risk is unacceptable it is expected that further in-depth investigations (i.e. engineered plans) would be necessary in order to ensure that a fish tight weir could be maintained throughout the sampling period.

5.4 Mayo River

In 1994, an enumeration weir was constructed on the Mayo River; however, the operation was cancelled the following year (Herron 1994). This initial indication of the numbers of returning chinook, combined with other data, suggests that this system is a significant chinook producer and that the establishment of a weir would be of significant value. All four of the potential weir sites identified on the Mayo River are considered weirable based on morphology (Figures 5, 7, 9, 11) and flow data (Figure 3), although some sites were better suited in terms of channel characteristics and location (Figure 2).

A potential drawback of using the Mayo River is that it is an unnatural system. Historical records indicate that chinook salmon used the Mayo River as far upstream as Mayo Lake including Duncan and Davidson creeks, with the main spawning grounds located at the outlet of Mayo Lake (Triton 1992). Triton (1992) also indicates that since the construction of the Wareham dam chinook are now only able access the lower 11.2 km of the river, but that most use the lower 10.7 km due to periodic dewatering in the upper section. This historical use is an indication that larger numbers of chinook may have used the Mayo River in the past. Because the NND has expressed interest in conducting works that benefit salmon populations in the Mayo River, an enumeration weir could be used to provide valuable chinook index information based on the current population, as well as to provide valuable insight into the effectiveness of restoration and enhancement works conducted on the lower Mayo River.

5.4.1 Mayo Site 1

This site has a particularly wide channel with an uneven bottom, this combined with a component of fines making up the channel substrates reduce the value of this location as a weir site. The relative easy access and proximity to the community can be viewed both as a positive and a negative at this location. There is great potential for community involvement and education with a weir located so close to town. Unfortunately, there may also be the potential for acts of mischief, vandalism and a distraction to weir staff at a site that is accessible to so many people, and that is known as a common social gathering location. Given the potential for problems this location is not considered ideal.

5.4.2 Mayo Site 2

The highly variable nature of the channel bottom at this location would make for a difficult weir installation. As the proposed site is located near a picnic area it is situated within a highly public spot. This site could be an alternative weir location to Site 1, if the community feels that a weir should be established in a high profile location for the purpose of education and community involvement. Although the potential for mischief still exists, this site is a maintained picnic and camping area and therefore may be less of a concern. Due to the distance upstream from the confluence of the Stewart River, there is the potential to have chinook spawn downstream of this location.

5.4.3 Mayo Site 3

Site 3 has the most uniform channel bottom making it the easiest for weir setup and operation of the four sites. Its gradually sloping banks would allow rising water levels to be dissipated and its narrow channel width and low water velocities are considered valuable characteristics. Access to this location could be gained through the construction of a short trail originating from the sewage treatment plant road or a slightly longer trail on the opposite side of the river. Because of this distance from popular areas, the potential for acts of mischief and vandalism at this location are reduced, but so too are the potential benefits of public and community involvement.

5.4.4 Mayo Site 4

The highly variable channel profile at this location results in high water velocities. These factors combine to reduce the overall value of this location. Of the four potential weir sites selected this location poses the most difficult access. A long trail leading from either side of the river originating at the sewage treatment plant road or the road running along the left side of the Mayo River would need to be constructed (Figure 2).

6.0 CONCLUSIONS AND RECOMMENDATIONS

There is potential to install and run a weir on all four streams; however, the magnitude of chinook runs in the McQuesten and Mayo rivers (being approximately 5 times that of Janet and Crooked Creeks) make them the most desirerable. Although the McQuesten River is considered weirable using conventional techniques, it may only be successful during years with normal flows. It is anticipated that if flows were to exceed average levels during weir operation (Figure 16) a conventional weir may become damaged or fail completely, allowing fish to pass through uncounted. This potential for loss of data is of major concern as the accuracy of any enumeration technique depends heavily on repetition. If there is a desire to weir the McQuesten River it is recommended that it be designed and investigated by a hydraulic engineer.

The overall stability of conditions, high relative numbers of returning chinook and the close proximity to the village of Mayo contributed to the selection of the Mayo River as the best candidate for a weir. Locating a weir on the Mayo River would allow for easy access by weir personnel who could be stationed in the Village of Mayo. As well, based on the past experiences of other weir operators, a location so close to town may be an opportunity to promote stewardship and involve members of the community as well as visitors from outside of the region. The public could become involved in the operation of the weir

through the use of signage and/or educational presentations given on site that explain how a weir works and why it is important.

In order for a weir to be successful in the community of Mayo, steps should be taken to gain public support, promote community involvement and ensure that all possible data is collected. The following recommendations were derived based on information found during the compilation of this report:

1. Of the four potential weir sites on the Mayo River, site 3 is recommended as the most ideal location due the reduced potential for spawning in the lower portion of the river, superior channel characteristics and its relative isolation from popular public areas. This site selection is consistent with Triton (1992) who recommended the same location based on its proximity to two main chinook spawning areas which are located upstream of the site.

2. The weir should be installed by July 20th and run until August 31st to ensure all spawning chinook are recorded.

3. If public participation is desired, signs and/or pamphlets should be created to notify people about the presence of the weir and too ensure that public participation occurs.

4. Spawner and redd counts should be periodically conducted downstream of any potential weir location so that no spawning chinook go uncounted.

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