MOLYBDENITE CREEK:
FISH PASSAGE CULVERT INSPECTIONS

Prepared for:

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1.0 INTRODUCTION

With funding provided by Forest Renewal British Columbia (FRBC), Weldwood of Canada Ltd. (Williams Lake Operations) retained Westroad Resource Consultants Ltd. to conduct Fish Passage Culvert Inspections (FPCI) in the Molybdenite Creek drainage. The three objectives of the procedure are as follows:

1. to identify culverts which may act as barriers to fish passage,
2. to establish priorities for replacing culverts, and
3. to provide an estimate of correct culvert diameter for sites identified as potential barriers.

Molybdenite Creek is a fourth order stream situated east of the City of Williams Lake in central British Columbia (see Figure 1). It drains into McKinley Creek, an important sockeye *(Oncorhynchus nerka)*, chinook *(O. tshawytscha)*, and coho *(O. kisutch)* spawning tributary of the Horsefly River (G3 Consulting, 1998; DFO and MoELP, 1996). A large proportion of the Molybdenite drainage is characterized by steep and moderately steep valley sideslopes. In the lower reaches (lowest 4-km of the mainstem) the creek drains a wide valley bottom through an expansive wetland complex. Accordingly, the majority of high value fish habitats seem to be concentrated in the mainstem and tributaries of the lower reaches. The basin (approx. 8,100 ha) is dominated by mature and immature forests except at its headwaters where the land was cleared to operate a mine (now abandoned). Elevations range from a high of 2,158-m to a low of approximately 930-m at the confluence with McKinley Creek.

Fish species information for Molybdenite Creek is sparse. Although there are no records of natural permanent barriers preventing migration into the system, anadromous salmon have not been recorded in the drainage. It is likely that within the lower reaches of the mainstem, where wetlands are abundant, large, stable beaver dams act as barriers limiting or preventing upstream migration. In an FRBC fish and fish habitat inventory conducted in 1997 (Cariboo Envirotech in prep.), rainbow trout *(Oncorhynchus mykiss)* were the most frequently captured species in the drainage. Other less common species were redside shiner *(Richardsonius balteatus)*, northern pikeminnow *(Ptychocheilus oregonensis)*, and unidentified sucker *(Catostomus* spp.*)*.

2.0 METHODS

All potential culvert sites were first identified and marked on Weldwood of Canada Ltd. 1:20,000 Development Plan Maps (93A006, 016, and 026). These sites occurred where any road or trail crossed a TRIM-based waterway. In subsequent meetings with the Weldwood Operations Superintendent (Ernie Schmid) and other foresters familiar with the drainage, sites without culverts (including bridges) were eliminated from the set of sites requiring site visits. Waterways bearing potential culvert sites were assigned watershed codes (if available) or interim locational points. Watershed codes were obtained online from the Ministry of Environment, Lands and Parks website <http://fshux1.env.gov.bc.ca:8088/wsg20k.html>.

Reach break locations depicted on the project map were taken from the McKinley Creek Habitat Assessment Procedure report (G3 Consulting Ltd., 1998). These were used rather than those identified by the reconnaissance fish and fish habitat inventory (Cariboo Envirotech in prep.) as the inventory maps and report had not yet been finalized.

Culvert inspections were conducted between October 24 and 29, 1999 and followed the methodology detailed in the Fish Passage Culvert Inspection Completion Procedures Manual (Draft 3C) (Parker 1999). Specialized equipment used during the inspections included: a Swoffer Instruments 2100 Current Velocity Meter for measuring stream and culvert water velocities, an Abney Level (with 5x magnification) for measuring culvert gradients, and a Smith Root 12B POW Backpack Electroshocker for fish sampling. Using a Trimble Pro XL GPS unit, UTM coordinates were collected at sites where full culvert assessments were conducted. Coordinates reported on Form A are differentially corrected values.

In general, sites were numbered sequentially as they were visited. Full assessments were only conducted at culverted sites if stream characteristics met the following criteria;

- no natural permanent barriers to migration (i.e. falls or gradients >20%) exist at the site or downstream of it within 50-m, or overwintering habitat was apparent upstream of the site;
- the site is situated on a true stream as defined by the Forest Practices Code (i.e. not a non-classifiable drainage).

Sites on streams not meeting these criteria, were not assessed.

The fish-bearing status of most streams within the drainage is unknown. Data from the above-mentioned fish and fish habitat inventory (Cariboo Envirotech, in preparation) provided definitive fish presence for four streams - Molybdenite Creek, and the unnamed streams bearing sites 4, 6 and 26. This information and any fish captures made during the culvert inspections were incorporated into the fish -bearing status coding of relevant stream reaches. The project map accompanying this report (Appendix IV) depicts reaches as:

1. KNOWN FISH-BEARING based on fish captures from the above-mentioned fish inventory or from this culvert assessment;
2. PRESUMED FISH-BEARING based on a map-interpreted gradients of less than 20%, and likely presence of fish habitat;
3. UNDETERMINED FISH BEARING status based on the likelihood that fish habitat is lacking; or
4. NON FISH-BEARING based on field observations confirming:
    i. the presence of natural permanent gradient barriers downstream and the apparent lack of overwintering habitat upstream (stream class S5 or S6), or
    ii. lack of fish habitat due to the absence of a stream channel (ie. watercourse classified as an non-classifiable drainage - NCD)

The two types of non-fish-bearing watercourses are further distinguished on the accompanying project map; non-fish-bearing reaches are drawn as solid yellow lines while non-classifiable drainages are drawn as dashed yellow lines. Although depicting these on the maps is a departure from the Standards we felt that it adds valuable and easily-interpreted information to the final product.

At each site where a full assessment was conducted, data were recorded onto standard forms (Form A). A series of four or more photos was taken at each site showing the inlet and outlet ends of the culverts and the upstream and downstream views of the stream. The potential of each culvert to be a fish passage barrier was assessed by analyzing the various components of the data and comparing them with known jumping and swimming capabilities of fish, as provided in the FPCI Manual (Parker 1999). The dynamic nature of a number of variables (ie. water velocities, plunge pool depths, culvert water depths, stream and culvert gradients, etc.) was considered in the determination of barrier types. In developing suggested prescriptions, the primary factors considered were; stream widths, gradients, Forest Practices Code culvert diameter estimates, as well as road alignments and fill requirements.

Once culverts had been characterized in terms of their barrier status (i.e. Full, Partial, or Undetermined), they were ranked in order of their importance for replacement to improve fish passage (see Form B – Appendix II). Ranking was based on the scoring system detailed in the FPCI Manual (Parker, 1999). This system takes into account six factors:

- the number and type of fish species utilizing the stream
- fish habitat values in the stream
- the type/degree of barrier the culvert presents (i.e. Full, Partial or Undetermined)
- the length of stream being opened for fish use above the site in question,
- the length of habitat upstream of the site expressed as a proportion of the length of the mainstem on which the culvert is situated, and
- whether there are culverts upstream which are considered to be either Full, Partial or Undetermined barriers

All stream crossings identified at the outset of the project were included on the accompanying map. Each site falls into one of four categories:

- culvert assessed as a Full, Partial or Undetermined Barrier,
- site visited but not assessed,
- site not visited (excluding bridges), or
- bridge.

The Manual (Parker 1999) requires that reports include three sections. Section 1 is to contain all barrier culvert information including the FPCI Summary Table (Form B), Section 2 is to contain information related to all non-barrier culvert sites including non-prioritized culverts, and Section 3 is to contain all remaining sites not falling into one of the first two sections.

In the Molybdenite drainage, all assessed culverts were deemed to be barriers. Other culverts were not assessed because of the presence of a natural gradient barrier at, or downstream of the site. While all the information required by the Manual is provided herein, the report's organization has been modified for easier readability. The report follows a standard scientific format, with a results section (Section 3) detailing the findings of each culvert inspection. The results are also tabulated and presented in three appendices, roughly corresponding to the first two sections required by the Manual. The Molybdenite drainage does not contain any culverts that fit into the Manual's designated Section 3. Appendix I presents the data from each culvert site (Form A) along with photographs. The sites are organized in order of decreasing replacement priority. Appendix II presents Form B - Priority Rankings of

Assessed Culverts. Appendix III presents Form C, a table identifying maintenance issues and/or sediment sources.

3.0 RESULTS

Initially, a total of 34 potential sites were identified. Based on meetings and telephone conversations with Weldwood foresters, eight of these sites were eliminated from the sample set. Two of these were bridge crossings (sites 32 and 33) and four others were located on a recently deactivated historic mining trail (Sites 23-26) on which culverts had been removed. Two sites (30 and 31) could not be located. Development plan maps indicate that the crossings were situated on a trail rather than a road. Based on ground observations, it is probable that this trail was overgrown and no longer visible. The status of the cutblock into which the trail provided historical access was not determined.

Of the 26 sites visited, only nine met the criteria for full assessment. The rationales for not conducting assessments at the other fifteen sites are provided in Table 1. The data from each culvert assessment are presented in Appendix I along with site photographs. All culverts were examined for maintenance or repair requirements whether they underwent full assessment or not (see Form C – Appendix III). The locations of all 34 sites are shown on the accompanying map.

Where water levels allowed, fish sampling was conducted at each assessed site. Rainbow trout were the only species captured during the inspections. In light of the lack of historical captures of anadromous species in the drainage, the target species in preparing prescriptions was rainbow trout.

3.1 Assessed Culverts

Of the nine sites assessed for fish passage, three (3, 10, 19) were classified as Full Barriers, four (1, 4, 5 11) as Partial Barriers, and two (6, 8) as Undetermined Barriers. the culvert at Site 28, which could not be fully assessed because of snow and ice cover, may also be a barrier. Culverts were considered Full Barriers if all life stages of all fish species were prevented from passing through the culvert to upstream points. Culverts assessed as Partial Barriers prevented certain fish species or certain life stages from passing upstream under all, or specific, flow regimes. Sites 6 and 8 were classified as Undetermined Barriers. Under the flow regimes encountered during the assessment, Site 6 did not appear to be a barrier; however, as indicated by the high water mark, higher flows in the spring may be

significant enough to limit fish passage. Further assessment of this culvert at high flows could be conducted but is not recommended due to the barrier presented by the beaver dams 20-m upstream.

Site 8 has been classified as an Undetermined Barrier due to the stream's uncertain fish-bearing status at this point in the drainage. Based on steep road grades approaching the site, as well as steep stream gradients at Site 9, it is likely that a natural barrier to fish migration exists downstream of the site. If a barrier exists, Site 8 could be considered non-fish bearing. Due to low water temperatures at the time of the assessment, the lack of fish captures could not be used to support non-fish-bearing status. A follow-up stream assessment (including fish sampling) above Site 10 (where rainbow trout have been verified) is recommended before a prescription for site 8 is prepared.

The status of Site 28 as a barrier remains undetermined. Due to the presence of snow and ice at the time of survey, only a cursory assessment could be conducted. If a full assessment were to be completed, the culvert would likely be classified as a Full or Partial Barrier because of an outfall drop; however, the presence of fish this high up in the drainage (near the headwaters of a first order tributary) is questionable. Furthermore, as the amount of habitat upstream of the culvert is relatively low (approximately 400-m upstream is an abandoned settling pond utilized when the mine was in operation), replacement of the culvert to improve fish access would serve limited value. Further assessment at this time is not recommended.

Table 1: List of Road and Trail Crossing Sites of Watercourses within the Molybdenite Creek Drainage

Site #	Was Site Visited		Culvert Present?		Assessed?		Comments
	Y	N	Y	N	Y	N	
1	✓		✓		✓		Probable partial barrier; fish presence not confirmed
2	✓		✓			✓	No streambed upstream of culvert – assumed non fish-bearing (NCD)
3	✓		✓		✓		Full barrier but suspected to be non fish-bearing; low value habitat
4	✓		✓		✓		Partial barrier; RB captured upstream and downstream of CV
5	✓		✓		✓		Partial barrier; RB captured upstream and downstream of CV
6	✓		✓		✓		Barrier type is UNDETERMINED but likely NONE; beaver dams, which likely act as barriers, are present beginning 20-m upstream
7	✓		✓			✓	31% gradient barrier (cascade with no pools) for first 25-m upstream of CV (location: 557 on 550 Rd.)
8	✓		✓		✓		UNDETERMINED barrier status but likely FULL. Presumed fish-bearing although natural gradient barrier downstream may make this a non-fish-bearing reach
9	✓		✓			✓	600-mm CV on ILP 00009. Average stream gradient = 23%. Max gradient is 27% over 15-m. Non-fish-bearing based on gradient, limited upstream catchment area and apparent lack of upstream overwintering habitat.
10	✓		✓		✓		Full barrier; additional stream survey upstream of culvert should be conducted prior to installing a replacement structure.
11	✓		✓		✓		Partial Barrier; Fish-bearing based on fish capture upstream at site 10
12	✓		✓			✓	Non-fish-bearing; NCD
13	✓			✓		✓	Site visit established that watercourse is an NCD; crossing is corduroyed logs
14	✓		✓			✓	Non-fish-bearing watercourse (NCD); not shown as part of TRIM network; drains into cutblock downstream where stream channel disappears
15	✓		✓		✓		Non fish-bearing; 28-30% gradient barrier directly upstream of culvert

16	✓		✓		✓		Non fish-bearing; 28-30% gradient barrier downstream of culvert
17	✓		✓			✓	Non fish-bearing; 25% gradient downstream of culvert

Table 1 cont'd: Road and Trail Crossings of Watercourses within the Molybdenite Creek Drainage

Site #	Was Site Visited		Culvert Present?		Assessed?		Comments
	Y	N	Y	N	Y	N	
18	✓		✓			✓	NCD; no stream channel downstream of culvert
19	✓		✓		✓		FULL barrier; presumed fish-bearing based on gradient
20	✓			✓		✓	Site visited; no evidence of crossing found
21	✓			✓		✓	Site visited; no evidence of crossing found
22	✓			✓		✓	Site visited; no evidence of crossing found
23		✓		✓		✓	Historic mining trail deactivated by Weldwood (no CV present)
24		✓		✓		✓	Historic mining trail deactivated by Weldwood (no CV present)
25		✓		✓		✓	Historic mining trail deactivated by Weldwood (no CV present)
26		✓		✓		✓	Historic mining trail deactivated by Weldwood (no CV present)
27	✓			✓		✓	Deactivated Road; no CV present
28	✓		✓			✓	Site was not assessed due to snow and ice cover;
29	✓			✓		✓	Deactivated mine site; crossing structure has been removed and the channel appears to have been diverted from its original alignment.
30	*			*		✓	Access to this site could not be located; old trail likely brushed in.
31	*			*		✓	Access to this site could not be located; old trail likely brushed in.
32		✓		✓		✓	Bridge
33	✓			✓		✓	Bridge
34	✓		✓			✓	(NCD); Non-fish-bearing

* Sites 30 and 31 were not located.

3.2 Priority Ranking of Culverts for Improving Fish Passage

Fully assessed culverts were prioritized with respect to improving fish passage. Standard criteria for ranking are provided in the FPCI manual (Parker, 1999). The matrix of ranking criteria, with the associated scoring values, has been included at the end of each Form A (Appendix I) to clearly show how the scores were derived. Within the matrix, the applicable score for each criterion appears as bold text. Although scores reflect the outcome of the standard scoring system, the ranking of sites may incorporate a subjective evaluation of site specific factors. These factors, as discussed below, resulted in the change in rank of Site 11 (See Form B – Appendix II).

Scores ranged from a high of 40 to a low of 25. Scores between 55 and 39 are considered high priority and those between 38 and 26 are considered moderate. Sites with a score of less than 26 are considered low priority.

The culvert at **Site 5** is the only one having high priority. The score of 40 reflects the high amount of habitat to be gained (2,640-m), the high habitat values (spawning and rearing), and the importance of replacing this culvert before benefits to fish passage can be realized by culverts upstream.

All but one of the other eight assessed culverts are of medium priority. Scores ranged from 38 to 32.

Site 4 is the next-highest ranked site. Replacing the culvert would open up more than 3-km of high value rearing habitat. Some rainbow spawning is likely to occur in the lower portions of the stream system.

Site 11 has been ranked ahead of four sites having higher scores. This ranking is based on a subjective assessment which considered the considerably higher value of the fish habitats present (overwintering and potentially spawning), the capture of an overwintering sub-adult upstream (Site 10), and the considerably larger average channel width of the stream relative to the other streams. Rationales for the priority rankings of the remaining culverts are as follows.

Site 10 is ranked lower than Site 11 due to its relative position in the drainage. It is situated considerably further upstream and replacement for the purpose of improving fish access should be based on the results of a habitat assessment and fish sampling to define the limits of fish distribution. It should be noted that site 10 has some important maintenance and potential sediment delivery concerns and as such, replacement may be

required in the near future regardless of upstream use by fish. One sub-adult rainbow trout was captured just downstream of the culvert in a large pool. It had already begun its overwintering period under a boulder.

The culvert at **Site 19** is a Full Barrier. Habitat values are moderate, however more than 1-km of habitat is to be gained by culvert replacement.

Site 1 is situated on a tributary of the lower Molybdenite Creek. The maps indicate that approximately 200-m upstream of the site is a lake. Based on ground observations during the culvert inspection, habitat values appear low. Before the culvert is replaced, the waterbody should be examined to determine whether it is a lake or wetland and whether it allows fish access to points upstream.

The habitat values upstream of **Site 3** appear to be low such that the benefits of replacing the existing culvert to improve access are limited, particularly if fish do not utilize the stream.

The fish-bearing status of the stream at **Site 8** is uncertain. Fish were not captured during the culvert assessment and with an average stream gradient of 11.5%, it is possible that barriers to migration occur downstream. It is recommended that a stream assessment be conducted to confirm the presence/absence of natural barriers. If barriers are not located the assessment should include fish sampling.

Site 6 has the lowest priority of all sites assessed. The low ranking is due to two factors; the presence of a known barrier just 20-m upstream of the culvert (old, stable and vegetated beaver dams which act as Partial or Full Barriers), and the undetermined status of the culvert as a barrier. If replacement is considered, the barrier status during a period of high flows should first be assessed.

3.3 Culverts Requiring Maintenance or Repair (Form C)

Three of the nine fully assessed culverts were also found to have maintenance and/or sediment delivery concerns. Site 10, of moderate priority in this regard, is characterized by a small debris jam at the inlet of the culvert and tension cracks in the road. The crack occurs adjacent to the creek directly downstream of the culvert.

Sites 1 and 5 have low priority for maintenance or sediment delivery. Site 1 is characterized by a minor debris jam, which may require attention should it continue to trap sediment and debris. Spring run-off flushing may eliminate this concern. Due to the significantly undersized culvert at Site 5, as indicated by the FPCI culvert diameter estimate, this site has the potential to create sedimentation and erosion problems. Although eroding banks were not observed, the degree of sedimentation and/or erosion should be further assessed at high flows to determine whether culvert replacement should be considered.

Culverts that were not assessed for fish passage posed minor or no sediment delivery or maintenance concerns. Site 12 appeared to be transporting sediment from the ditch line; however there was little or no probability of sediment entering the stream system because the culvert was situated on a non-classifiable drainage.

Maintenance or sediment sources were not of concern at any of the other culvert sites

4.0 CONCLUSIONS AND RECOMMENDATIONS

Ten sites out of a total of 34 original sites met the criteria for full assessment. One of these (Site 28) could not be assessed because of snow and ice cover.

Site 5 is at the top of the priority list to replace the existing culvert with one that allows unimpeded fish passage. A prescription should be prepared by a qualified engineer to determine whether a round pipe or open-bottomed structure is most suitable for the site. The structure should not encroach on the banks of the natural stream channel and should be placed in such a manner as to promote the establishment of a natural streambed through its length. **Site 4** is next on the priority list obtaining a ranking score at the upper end of the moderate priority scale. The existing perched culvert (1200-mm) is a partial barrier limiting access to more than 3.7-km of valuable habitat. It should be replaced by a larger (approx. 1800-mm) closed- or open-bottom culvert.

Sites 11, 10, 19, 1, 3 and 8 are of moderate priority with ranking scores decreasing respectively. Due to the relatively steep stream gradient (avg. 9.5%) at **Site 11**, an open-bottomed culvert or bridge should replace the existing culvert. The culvert at **Site 10** should be replaced to improve fish passage only if a stream survey determines that a natural gradient barrier does not exist in proximity to the Site (e.g. within 500-m of the site). The culvert at **Site 19** is a Full Barrier and should be replaced with a closed-bottom pipe culvert. **Site 1** has been classified as a Partial Barrier. Prior to culvert replacement, the waterbody located approximately 200-m upstream should be assessed to confirm that fish access to points further upstream can occur through this wetland/lake. **Site 3** is a Full Barrier. As much as 820-m of fish habitat are to be gained by replacement of the existing culvert. Replacement should occur only after a stream assessment determines the stream to be fish-bearing. A suitable replacement culvert is a closed-bottom 800 or 900-mm culvert. The culvert at **Site 8** should only be replaced after a stream assessment determines that no natural barriers are present downstream of the site to Site 10. If a barrier is not located, an open-bottom culvert or bridge should replace the existing culvert. A closed-bottom culvert (round pipe) is not recommended for steep sites such as at site 8.

The culvert at **Site 6** is not recommended for replacement at this time due to the presence of a natural barrier (large, stable, vegetated beaver dams) 20-m upstream of the site.

Culverts requiring maintenance or sediment delivery mitigation were few (Appendix III). Site 10 was the highest priority in this regard because of a small debris jam at the inlet and tension cracks in the road adjacent to the stream. The two culverts (sites 1 and 5) ranked highest for replacement to improve fish passage were also ranked (low) for their maintenance or sediment delivery concerns. Two additional culverts (not assessed) had low priority concerns for maintenance and sediment delivery (sites 9 and 12).

5.0 CRITIQUE

As the Manual is in a state of revision, comments aimed at improving the procedure have been requested. Three suggestions follow; the first two have been incorporated into this report.

- Table 6 from the Manual could be added to Form A. This provides a convenient means to track how priority ranks were derived and/or whether any errors were made in deriving them.
- An element of subjectivity should be allowed in the priority ranking to account for site-specific factors not incorporated into the scoring matrix. To draw an example from the current report, site 11 was subjectively rated higher than its standard score indicated. This was done because of:
    i. the superior value of the habitats upstream (overwintering and potentially spawning) relative to high value habitats upstream of other sites,
    ii. the capture of an overwintering sub-adult rainbow trout upstream (at Site 10), and
    iii. the larger channel width and, therefore, proportionally greater amount of habitat per unit length being made available.
- The presence of tributaries known to, or suspected of, supporting fish could be recognized in the priority ranking process. This factor is most important when two sites having similar scores differ markedly in their tributary stream length above the site. The culvert site on the stream system having a high amount of potential or known tributary habitat should be weighted more heavily and possibly have its rank increased. An alternative to subjective assessment is to directly incorporate upstream, tributary habitat into the scoring system.

6.0 REFERENCES

Cariboo Envirotech. in prep. Fish and Fish Habitat Inventory of the McKinley Creek Watershed.

Department of Fisheries and Oceans and Ministry of Environment, Lands and Parks. 1996. Fisheries Information Summary System Maps

G3 Consulting Ltd. 1998. McKinley Creek Watershed: Fish Habitat Assessment Procedure. Contract report prepared for Riverside Forest Products Limited (Williams Lake).

Parker, M. 1999. Fish Passage - Culvert Inspection Completion Procedures (Draft 3C). Unpublished manual. Released by Water Management Branch, Min. Env., Lands, Parks (Cariboo Region). 43 pp.

Appendix I: Full Culvert Assessment Data (Form A) and Site Photographs

Appendix II: Priority Rankings for Replacement of Culverts to Improve Fish Passage

Form B - FPCI Summary Table

DRAFT Fish Passage - Culvert Inspection Summary Table

Priority Rank	Score	Site Number	Barrier	Stream Length Gained	% Stream Barred	X - Reference Site Number(s)	Prescription
1 (H)	40	5	P	2,640-m	35.0		Replace with round pipe of suitable size to ensure fish access, embed 20%; install at low gradient; if appropriate size is not possible, then consider open-bottom culvert or bridge.
2 (M)	38	4	P	3,720-m	63.7		Replace with round pipe if gradient <5% can be achieved, else install open-bottom culvert.
3 (M)	33	11	P	420-m	5.6	5	Replace with open-bottomed arch culvert or bridge
4 (M)	38	10	F	1,100-m	14.6	5, 11	Determine whether upstream fish migration is limited by natural gradient barriers between Sites 10 and 8. The accompanying priority rank is based on the assumption that no gradient barrier exists until Site 8. Replace with "fish-friendly" culvert if no barriers are found. Re-prioritize if barriers are found.
5 (M)	38	19	F	1,060-m	63.9		Replace with round pipe; embed and ensure low gradient (<4%)
6 (M)	34	1	P	1,400-m	64.8		Replace with round pipe CV embedded and at low gradient (~0.5%)
7 (M)	34	3	F	820-m	61.1		Confirm fish-bearing status of stream and replace accordingly with open-bottom arch culvert (average stream gradient = 8.75%)
8 (M)	32	8	U	1,650-m	21.9	5, 10, 11	Assess fish habitat values upstream and downstream; conduct further fish sampling; replace culvert with open-bottom culvert or bridge only if stream determined to be fish-bearing
9 (L)	25	6	U	20-m	0.4		No replacement recommended at this time

Priority Rank: A High / Moderate / Low ranking based on Table 6 Scoring Matrix and subjective evaluation of site specific factors (see report text).

Score: Numeric score based on the sum of all Table 6 scoring classes; see individual Form A's in Appendix I.

Site Number: Culvert Assessment site number from Form A "Site Number".

Barrier: Degree of culvert barrier from Form A "Barrier" (F-Full, P-Partial, U-Undetermined)

Stream Length Gained: The number of meters of mainstem stream length to be gained by replacing the barrier culvert as measured with a map wheel.

% Stream Barred: The Stream Length Gained (as above) divided by the total fish bearing mainstem length of system on which culvert exists. From Form A "% Stream Barred".

X-Reference Site Number: The culvert assessment site number from Form A of any site that impacts the same immediate stream system, that must be addressed in conjunction with this site. For example any upstream or downstream culverts that need to be replaced in coordination with this site.

Prescription: Preliminary prescription based on stream size, type of barrier, road usage, flows and fish species.

Appendix III: Priority Rankings for Maintenance or Repair of Culvert Crossings

Form C - Other Priority Culvert Crossings Summary

DRAFT Other Priority Culvert Crossings Summary Table

Priority Rating	Site Number	Maintenance Issues	Sediment Source	Prescription
L	**1**	Y	N	culvert is slightly compressed and some debris has built up within it; replace with suitable structure- see Form A
-	2	N	N	none
-	**3**	N	N	none
-	**4**	N	N	none
L	**5**	N	Y	Because it is significantly undersized for the stream, the culvert likely presents erosion and/or sedimentation concerns at high flows; replace with larger culvert
-	**6**	N	N	none
-	7	N	N	none
-	**8**	N	N	none
L	9	N	N	Slight bend in culvert – not a maintenance issue; no prescription at this time
M	**10**	Y	Y	Tension cracks in road just downstream of culvert are likely to result in sediment delivery to creek if road failure occurs; Replace culvert and repair and armour road to prevent sediment delivery. Also, debris jam is forming at inlet.
-	**11**	N	N	none
L	12	N	Y	some sediment delivery into NCD from road runoff via ditch; low priority
-	13	N	N	none
-	14	N	N	NCD; low priority – no danger of sediment delivery to stream network.
-	15	N	N	none
-	16	N	N	none
-	17	N	N	none
-	18	N	N	none
-	**19**	N	N	none
-	20	N	N	none
-	21	N	N	none
-	22	N	N	none
-	27	N	N	none
not assessed	28	not assessed, but appears to pose no concern	not assessed, but appears to pose no concern	Stream channel and culvert were obscured by ice; culvert appeared to be in good shape. Gradient is nearly level. No apparent sediment source exists. In conjunction with conducting other work in the area one of the Weldwood area foresters should check culvert at a different time of year to confirm this preliminary maintenance assessment. This site can only be accessed from the south via the Hendrix Mine Road.
-	29	N	N	none
-	34	N	N	none

Note: Site numbers in bold type have also been fully assessed for fish passage concerns

Priority Rating: A High / Moderate / Low rating subjectively based on the contractors observations and the fisheries value of the stream.

Site Number: Culvert Assessment site number from Form A.

Maintenance Issue: Indicate Y if there is a structural maintenance issue with the culvert crossing.

Sediment Source: Indicate Y if there is a sediment delivery issue at the culvert crossing.

Prescription: Indicate the structural issue that requires maintenance of the culvert crossing and / or explain the sediment issue of the culvert crossing

Appendix IV: Project Map