2012 Fish Passage Assessments in BCTS Kootenay Business Area (PD13TFE006)

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1.0 EXECUTIVE SUMMARY

Between September and November 2012, VAST Resource Solutions (VAST) conducted a stream crossing assessment study in the Rocky Mountain Resource District in the East Kootenay Region. The study area included four watershed groups: the Kootenay River, the Bull River, the Elk River, and the St Mary River. The objective of the study was to identify barriers on high quality fish habitat streams and provide recommendations for future restoration work. Assessments were completed following the 2011 field assessment protocol for determining fish passage status of closed bottom structure (MOE, 2011).

A total of 926 stream crossings were assessed in 41 watersheds throughout the study area along 1,474 km of forestry roads. Following analysis of the data collected at each site, 71 crossings were identified as impassable barriers on high quality fish habitat streams and 29 were recommended for priority restoration works. Among the selected sites, 10 were located in the Elk River watershed group, 8 on the Bull River, 6 on the St Mary River, and 5 on the Kootenay River.

Funding for this study was provided by the BC Land Based Investment Program (Project # PD13TFE006).

2.0 STUDY AREA

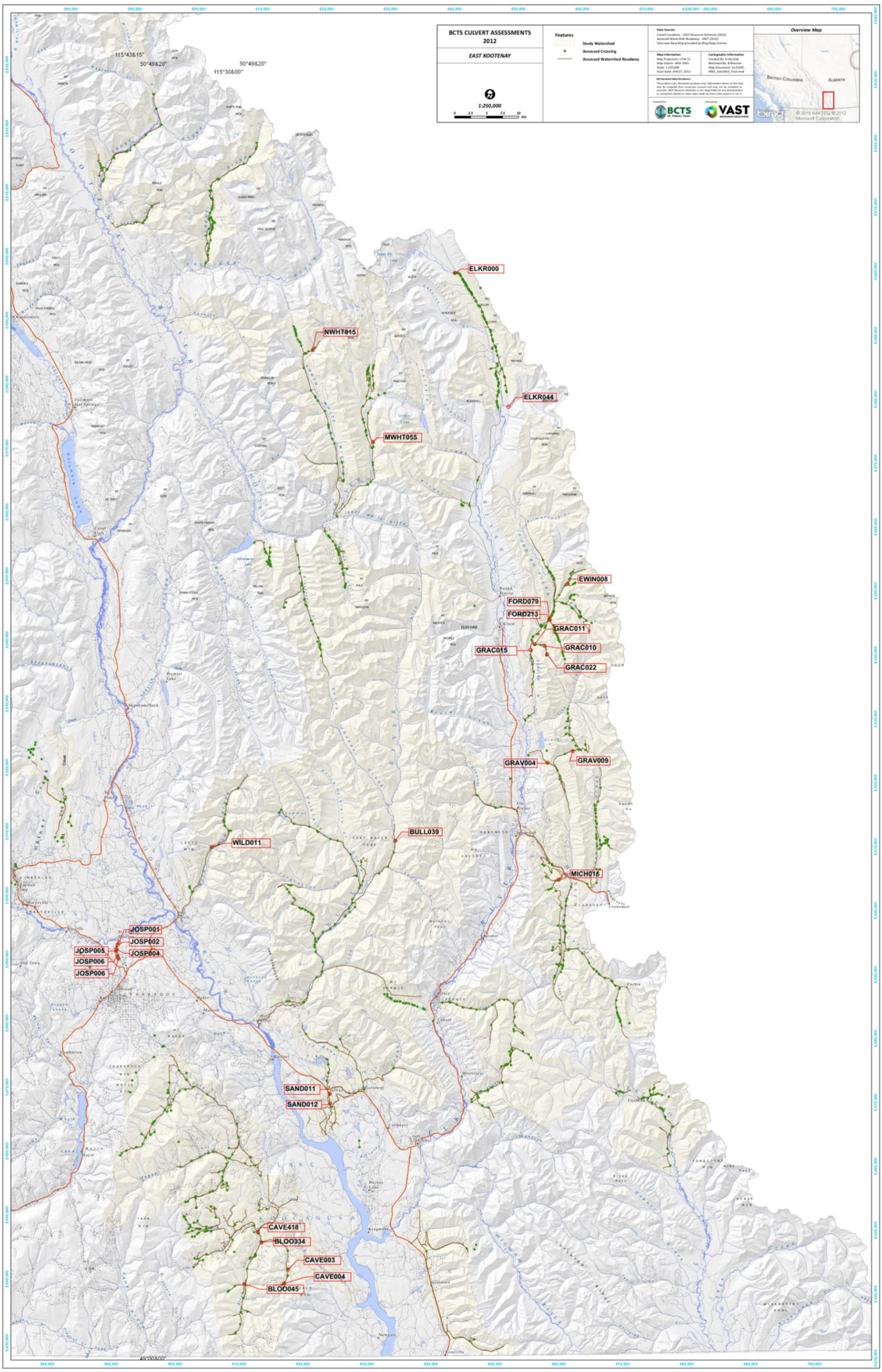
Stream crossing assessments were conducted throughout the Rocky Mountain Resource District of the East Kootenay Region. The study area included 41 watersheds encompassed in four main watershed groups: the Elk River, the Kootenay River, The Bull River, and the St Mary River. A general map of the study area is presented in Figure 1. A list of all the surveyed watersheds is presented in Table 1.

Major towns within the study area include Cranbrook, Kimberley, Fernie, Sparwood, Invermere, Fairmont Hot Spring, and Radium Hot Springs. Forestry and Mining are the two main historical industries in the area. Biogeoclimatic conditions encountered at most assessed stream crossings typically consisted of Montane Spruce and Engelmann Spruce - Subalpine Fir. Bull Trout (BT) and Westslope Cutthroat Trout (WCT), two blue-listed fish species in BC, occur throughout the area.

Table 1 List of assessed streams

Watershed Group	Assessed Stream	Watershed Group	Assessed Stream
ELKR	Alexander creek	BULL	Bloom creek
	Bingay creek		Bull river
	Coal creek		Caven creek
	Corbin creek		Galton
	Cummings creek		Gold creek
	Elk river		Sand creek
	Ewin creek		Tepee creek
	Flathead river	KOTR	Albert river
	Fording river		Blackfoot creek
	Forsyth creek		Cochran creek
	Grace creek		Cross river
	Harmer creek		Dry creek
	Leach creek		Grave creek
	Line creek		Inlet creek
	Lizard creek		Mitchell river
	Michel creek		North white river
	Morrissey creek		Schofield creek
SMAR	Joseph creek		Thunder creek
	Lost dog creek		White river
	Mark creek		
	Wild horse river		

Figure 1 Study area map. Assessed sites are represented by green marks. Red labels indicate sites selected for priority restoration.



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3.0 SCOPE OF WORK COMPLETED

The overall objective of the study was to assess stream crossing structures on known or inferred fish habitat streams and identify those that constitute a barrier to fish. Fish passage failure at stream crossings is responsible for a significant loss of freshwater habitat for migratory and resident fish populations in BC. This assessment is the second step of the BC Fish Passage Program which aims at remediating stream crossings which impede fish passage.

The scope of the work completed was to confirm the location of stream crossings, determine their barrier score based on provincial standards, conduct a preliminary assessment of fish habitat quality and potential upstream habitat gain, and provide recommendations for future restoration works. Both open bottom structures (OBS) (e.g. bridges) and closed bottom structures (CBS) (e.g. round culverts) were assessed. Road conditions within the targeted watersheds and presence of potential hazards were also documented.

4.0 METHODS

Work was completed in accordance with the following provincial standards:

1. General FIA Standards (FS 1001) April 2007
2. Field Assessment for determining Fish Passage Status of CBS (August 2011)
3. "A Day in the Field – Fish Passage"
4. Fish Passage Assessment – Project Deliverables
5. The Strategic Approach: Protocol for Planning and Prioritizing Culverted Sites for Fish Passage Assessment and Remediation (March 2009)
6. Fish Passage Activity (Engineering Activities) (March 2009)

4.1 Pre-field planning

A preliminary sampling plan was developed by BCTS based on known and inferred fish distribution data, stream networks, and road networks. The resulting map showed the location of more than 3,000 "theoretical" stream crossings throughout the study area. Watershed maps were produced by VAST to be used by field crews for navigation. The coordinates of all targeted stream crossings were entered into GPS units.

4.2 Field Assessments

Field crews consisted of two crew members travelling by means of a 4 by 4 vehicle or an ATV. Progress within targeted watersheds were tracked using GPS handheld units to document the extent of the assessed areas. Road conditions and presence of potential hazards were documented (see APPENDIX B). Each crew member was trained to become proficient in conducting stream crossing assessments following the provincial standards. Crews always included at least one experienced fisheries biologist or fisheries technologist.

Stream crossing assessments were conducted using the standard datasheet provided by the Ministry. Parameters recorded at each CBS are summarized in Table 2. A simplified assessment was conducted at OBS sites.

As required under the provincial standards, a minimum of five pictures were taken at each assessed crossing. The location of crossings was recorded in a GPS unit. The habitat value at a given site was assessed based on the availability of rearing, spawning, and overwintering habitat, indicated by

parameters such as pool depth, % cover, substrate composition, instream habitat type, and water temperature. Following assessments, each site was marked with blue flagging tape indicating crossing reference, project number, date of the survey, and initials of the field crew members. At the end of each day, crew leads exchanged datasheets to conduct QA/QC checks and ensure that standard methods had been followed.

Table 2 Parameters recorded during fish passage assessment

Location and Overview	Stream Information	Crossing Assessment	Recommendations
Date of Assessment	Channel Width	Crossing Type	Culvert Fix
Crossing Reference	Stream Slope	Crossing Subtype	Diameter or Span
Crew Members	Beaver Activity	Diameter or Span	
UTM Coordinates	Fish Sighted	Length or Width	
Stream Name	Valley Fill	Embeddedment	
Road Name	Habitat Value	Backwatering	
Road Km Mark		Fill Depth	
Road Tenure		Outlet Drop	
		Outlet Pool Depth	
		Inlet Drop	
		Culvert Slope	

4.3 Data Submission

Following the completion of field work, all collected data were entered into the standard Excel spreadsheet provided by the Ministry. Further QA/QC checks were conducted to ensure the maximum accuracy of the data. All data were submitted electronically to the Provincial Stream Crossing Inventory System (PSCIS).

4.4 Data Analysis

Results of the stream crossing assessment study were analyzed to produce a ranked list of candidate sites for priority restoration work. The objective was to identify restoration opportunities that would achieve greatest benefit.

The following parameters, presented in order of importance, were taken into consideration to prioritize sites for restoration work:

1. Barrier score: Described as Barrier, Potential Barrier, or Passable based on physical parameters measured at crossing sites. For the purpose of the analyses, sites identified as potential barriers were treated as barriers until further field assessments can determine their true barrier status.
2. Habitat value: Described as Low, Medium, and High based on preliminary assessments conducted by field crews at crossing locations following methods described in section 4.2. Only sites with high quality fish habitat were considered for priority restoration work.
3. Known fish bearing status: Described as Known, Inferred, or Unknown based on historical fish distribution data, known fish barrier locations, and stream gradient. Only sites with known and inferred fish bearing status were considered for priority restoration work.
4. Presence of listed fish species in watershed. Watersheds where listed species occur were given higher priority.
5. Observed and inferred Habitat Gain Index: Calculated by GIS as the number of km of fish habitat available upstream of a crossing. Sites with higher observed HGI were given higher priority.

6. Anticipated cost of restoration work: Described as High, Medium, or Low based on the type and size of the replacement structure, ease of access, and amount of excavation required.
7. Final selection made by an experience fisheries biologist based on his/her local knowledge of each watershed.

5.0 RESULTS

A total of 926 stream crossings were assessed throughout the study area, including 701 closed bottom structures and 225 open bottom structures (Table 4). Overall, 68% (n = 633) of all assessed crossings were identified as barriers or potential barriers to fish passage while only 30% were passable (Table 4). The large majority of barriers (89%; n = 562) occurred on low or medium fish habitat quality streams (Table 3). However, a total of 71 impassable barriers and potential barriers were found on high quality fish habitat streams. After a detailed review of instream habitat features, occurrence of listed fish species, and habitat gained index data, 29 candidate sites were selected for priority restoration work. Detailed information on selected priority sites is presented in Table 5.

Table 3 Summary of barrier status and fish habitat value for each watershed group

Watershed Group	Barrier Status	Habitat Value			Total
		High	Low	Medium	
BULL	Impassable Barrier	23	76	39	138
	Potential Barrier	1	7	1	9
ELKR	Impassable Barrier	25	163	49	237
	Potential Barrier	2	23	6	31
KOTR	Impassable Barrier	9	136	27	172
	Potential Barrier		8	5	13
SMAR	Impassable Barrier	10	14	4	28
	Potential Barrier	1	1	3	5
	Total	**71**	**428**	**134**	**633**
	Percentage	**11%**	**68%**	**21%**	**100%**

Table 4 Summary of stream crossing assessments for each crossing type and barrier score

		Crossing Types						Barrier Score				
Watershed Group	Watershed Name	Bridge	Ford	Oval Culvert	Pipe Arch	Round Culvert	Wood Box	Barrier	Potential	Passable	Unkown	**Total**
BULL	Bloom Creek	4				15		13		6		**19**
	Bull River	17				41		38	2	18		**58**
	Caven Creek	4				44	1	39	2	8		**49**
	Galton	3				4		4		3		**7**
	Gold Creek	6	1			3		2	1	6	1	**10**
	Sand Creek	4				11		3	4	8		**15**
	Tepee Creek	4				26		26		4		**30**
	Upper Gold Creek	6	1		1	13	3	13		10	1	**24**
ELKR	Alexander Creek	7	3			27		20	3	11	3	**37**
	Bingay Creek	1				3		3		1		**4**
	Coal Creek	10			1	8	1	8		12		**20**
	Corbin Creek	1								1		**1**
	Cummings Creek	3								3		**3**
	Elk River	2				85	1	53	12	23		**88**
	Ewin Creek	9	1			25	1	23	2	10	1	**36**
	Flathead River	4	9			18	1	16	2	5	9	**32**
	Fording River	4	1			26		19	7	4	1	**31**
	Forsyth Creek	1								1		**1**
	Grace Creek					10	1	8	1	2		**11**
	Harmer Creek	1				2	1	2		2		**4**
	Leach Creek	1				12		10		3		**13**
	Line Creek	2				8		7		3		**10**
	Lizard Creek	2				19		16	1	4		**21**
	Michel Creek	17				46		30	3	30		**63**
	Morrissey Creek	6		1		23		22		8		**30**
KOTR	Albert River	9				35		31	2	11		**44**
	Blackfoot Creek	8	1			14	1	13	1	9	1	**24**
	Cochran Creek	4				1		1		4		**5**
	Cross River	4				13		13		4		**17**
	Dry Creek	4				15		11	3	5		**19**
	Grave Creek	3				10		9	1	3		**13**
	Inlet Creek	3				15	2	14	1	5		**20**
	Middle White River	7				39		35	4	7		**46**
	Mitchell River	1				2		2		1		**3**
	North White River	6				14		13	1	6		**20**
	Schofield Creek	1				14		14		1		**15**
	Thunder Creek	5				16	1	16		6		**22**
SMAR	Joseph Creek	4				12		11	1	4		**16**
	Lost Dog Creek	9				15		5	2	17		**24**
	Mark Creek					6		4	2			**6**
	Wild Horse River	7				8		8		7		**15**
	Total	194	17	1	2	698	14	575	58	276	17	**926**
	Percentage	21%	2%	0%	0%	75%	2%	62%	6%	30%	2%	**100%**

Table 5 Summary of sites selected for priority restoration work.

Watershed Name	Crossing Reference	Easting	Northing	Barrier Result	Fish Status	Listed Species	Observed HGI	Potential HGI	Replacement Cost
Joseph Creek	JOSP001	589921	5492889	Barrier	Confirmed	BT, WCT	48.8	252.3	Moderate
Joseph Creek	JOSP002	589892	5492776	Barrier	Confirmed	BT, WCT	48.6	252.1	High
Joseph Creek	JOSP004	589721	5491961	Barrier	Confirmed	BT, WCT	47.7	250.5	High
Joseph Creek	JOSP005	589678	5491624	Barrier	Confirmed	BT, WCT	47.3	249.6	High
Joseph Creek	JOSP006	589864	5490955	Barrier	Confirmed	BT, WCT	46.3	239.4	High
Joseph Creek	JOSP007	590060	5490523	Barrier	Confirmed	BT, WCT	45.6	235.3	High
Caven Creek	CAVE418	612562	5448057	Barrier	Confirmed	BT, WCT	47.3	184.9	High
Sand Creek	SAND012	623539	5468378	Barrier	Confirmed	BT, WCT	40.5	134.5	High
Sand Creek	SAND011	623461	5469841	Potential	Confirmed	BT, WCT	38.3	131.3	High
Bloom Creek	BLOO334	613177	5446502	Barrier	Inferred	BT, WCT	14.7	67.0	High
Elk River	ELKR044	648350	5583889	Barrier	Confirmed	BT, WCT	5.8	32.5	High
Bloom Creek	BLOO045	610161	5435537	Barrier	Confirmed	BT, WCT	6.3	27.1	High
Caven Creek	CAVE003	617344	5441277	Barrier	Confirmed	BT, WCT	4.7	26.8	Low
Caven Creek	CAVE004	616843	5440132	Barrier	Confirmed	BT, WCT	0.0	1.8	Moderate
Grave Creek	GRAV004	656631	5522266	Barrier	Confirmed	BT, WCT	11.2	26.2	High
Ewin Creek	EWIN008	659250	5550343	Barrier	Confirmed	WCT	0.0	23.6	Moderate
Grave Creek	GRAV009	659277	5523718	Barrier	Confirmed	BT, WCT	7.9	22.7	High
Elk River	ELKR000	640770	5598669	Barrier	Confirmed	BT, WCT	0.0	17.3	High
Middle White River	MWHT055	628439	5571939	Barrier	Confirmed	BT, WCT	0.0	16.8	Moderate
Michell Creek	MICH016	658686	5503994	Barrier	Confirmed	BT, WCT	0.0	14.9	High
Grace Creek	GRAC015	653796	5539818	Barrier	Confirmed	BT, WCT	0.0	13.2	Moderate
Grace Creek	GRAC011	654302	5540768	Barrier	Confirmed	BT, WCT	0.0	11.9	High
Grace Creek	GRAC010	655808	5540581	Barrier	Confirmed	BT, WCT	0.0	8.3	Moderate
Bull River	BULL039	633036	5509670	Barrier	Inferred	WCT	0.0	5.1	High
Wildhorse River	WILD011	604377	5508165	Barrier	Confirmed	BT, WCT	0.0	5.0	High
Grace Creek	GRAC022	656177	5539092	Barrier	Confirmed	BT, WCT	0.0	1.9	Moderate
North White River	NWHT015	618724	5586217	Barrier	Inferred	BT, WCT	0.0	1.9	Moderate
Fording River	FORD079	656391	5544771	Potential	Confirmed	WCT	4.6	26.2	High
Fording River	FORD213	656363	5544727	Barrier	Confirmed	WCT	0.0	0.3	High

6.0 RECOMMENDATIONS

6.1 High Priority Sites

A total of 29 sites were identified as high priority candidate sites for restoration. These crossings were selected because they are located on high quality fish habitat streams where migratory listed fish species have been recorded and/or because their replacement would result in a significant gain of upstream fish habitat. However, further field investigations should be conducted by experienced fisheries biologists to confirm these initial results.
An overview map showing the location of selected sites for high priority restoration work can be found in Figure 1. All photo documentation for the priority sites are located in APPENDIX A.

- JOSP001, JOSP002, JOSP004, JOSP005, JOSP006, JOSP007
  These 6 crossings are located on the lower reaches of Joseph Creek near the confluence with the St Mary River. The structures are not properly embedded, creating velocity barriers to juvenile fish. These crossing were selected due to the recorded presence of two listed fish species in the stream (BT and WCT) and the large potential upstream habitat gain. However, it should be noted that Joseph Creek flows through the town of Cranbrook, likely resulting in a deterioration of instream habitat. Some barriers may exist within the city limits that have not been assessed during this study. Further study is needed. Nevertheless, restoration of fish passage within the Joseph Creek watershed is highly beneficial to the stream's fish community. Replacement of existing closed bottom structures by open bottom structures, such as low profile arches, is recommended.

- CAVE 418
  The round culvert is located on Caven Creek and is not properly embedded, creating a velocity barrier. Two blue-listed fish species, WCT and BT, have been recorded in the watershed. Approximately 47.3 km of fish habitat is available upstream of this crossing. Replacement of the current structure by a bridge crossing with a span at least 8 m long is recommended.

- SAND011 and SAND012
  These crossings are located on Little Sand Creek along Baynes Lake Road. Both crossings consist of large round culverts, which are not properly embedded, creating velocity barriers. Sand Creek and Little Sand Creek are known spawning streams for Kookanusa Bull Trout and Kokanee populations. Westslope Cutthroat Trout also occur throughout the watershed. Approximately 40Km of fish habitat is available upstream of these crossings. The replacement of the current culverts by a bridge or an arch structure is recommended. The minimum recommended span of the replacement structures for SAND011 and SAND012 is 10 m and 12 m respectively.

- BLOO334
  The crossing is located on Bloom Creek, a major tributary to Caven Creek. It consists of a round culvert with a perched outlet resulting in an impassable barrier. Spawning BT have been recorded in the stream and WCT occur throughout the watershed. Approximately 14.7 km of fish habitat is available upstream of the crossing. Replacement by a 7 m bridge is recommended.

- ELKR044
  The crossing is located on Weary Creek, a tributary to the Elk River. It consists of two round culverts that are not properly embedded, resulting in a velocity barrier. Both BT and WCT have been recorded in the watershed. The creek has deep pools and suitable spawning substrate. Approximately 5.8 km of fish habitat is available upstream of the crossing. Replacement by an open bottom arch structure is recommended at this site. Based on the measure stream width, the replacement structure should be at least 7 m in diameter.

- BLOO045
  The Crossing is located on an unnamed tributary to Bloom Creek. It consists of an arch culvert and a round culvert, which are perched at the outlets and not properly embedded. There are records of mature BT captured throughout the Bloom Creek watershed, including in the tributary where the crossing is located. The creek has deep pools, good spawning substrate, and likely provide spawning habitat to Koocanusa BT population. WCT also occur throughout the watershed. The confirmed habitat gained upstream of the crossing is 6.3 km. The replacement of the current structure with a bridge crossing 7 m long is recommended.

- CAVE003, CAVE004
  The two crossings are located on Whickman Creek, a tributary to Caven Creek. They consist of single round culverts that are not properly embedded and perched at the outlet. Both BT and WCT have been recorded in the watershed. Approximately 4.7 km of confirmed fish habitat is available upstream and potentially up to 26.8 km. The crossings could be restored using 2 m diameter open bottom arch structures. A simulated substrate culvert may be an option at CAVE 003.

- GRAV004
  The crossing is located on an unnamed tributary to Grave Creek. The round culvert is perched creating an impassable barrier. Both BT and WCT have been recorded in the watershed. The creek offers good spawning substrate and rearing habitat. Approximately 11.2 km of fish habitat has been confirmed upstream of the crossing. Replacement by an open bottom structure with a 8 m span/diameter is recommended.

- EWIN008
  The crossing is located on Todhunter Creek, a major tributary to Ewin Creek. The culvert outlet is perched, creating an impassable barrier. The creek has deep pools, suitable spawning substrate, and good rearing habitat. WCT occurs throughout the watershed. Up to 23.6 km of fish habitat may be available upstream of the crossing but a fisheries investigation is required to confirm the true extent of upstream habitat. Replacement of the current structure with a 5 m diameter low profile arch is recommended at this site.

- GRAV009
  The crossing is located on Grave Creek, a tributary to the Fording River. The large culvert is perched creating an impassable barrier to all species and life stages. The creek has deep pools, suitable spawning substrate, and good rearing habitat. Both WCT and BT have been recorded in the watershed. Approximately 7.9 km of fish habitat has been confirmed upstream of the crossing. Replacement with an open bottom arch structure with a diameter of 8 m is recommended.

- ELKR000
  The crossing is located on Tobermory Creek, a tributary to the Elk River. The large culvert is perched creating an impassable barrier to all species and life stages. The creek has suitable spawning substrate and good rearing habitat for salmonids. Up to 17.3 km of inferred fish habitat may be available upstream. Both WCT and BT have been recorded in the watershed. The replacement of the current culvert by a bridge structure with a minimum span of 7 m is recommended.

- MWHT055
  The crossing is located on Kotsats Creek, a tributary to the middle branch of the White River. BT records exist for this stream, which likely provide spawning habitat for the species. The crossing consists of a perched round culvert which is not properly embedded, creating a velocity barrier. The site was already identified as a priority crossing for restoration in 2000 (Naito, 2001). The creek provides good to fair spawning substrate and high quality rearing habitat. The potential habitat gain upstream of the culvert is 16.8 km. The replacement of the current crossing by a low profile open bottom arch structure (diameter ~5m) is recommended.

- MICH016
  The crossing is located on Fir Creek, a tributary to Michel Creek, and consists of a round culvert with a perched outlet. The stream has good to fair rearing habitat with deep pools and provides some spawning opportunity. WCT and Eastern Brook Trout (EB) have been recorded in the creek and BT is known to occur throughout the Michell Creek Watershed. The potential habitat gain upstream of the crossing is 14.9 km. Replacement of the current structure with a bridge is recommended. Based on the measured stream width, the span of the replacement structure should be at least 7 m.

- GRAC011, GRAC015, GRAC010, GRAC022
  These four crossings are located on the Grace Creek mainstem, a tributary to the Fording River. All sites consist of single and double round culverts with perched outlets, creating a series of impassable barriers on the creek. The creek has deep pools and good spawning substrate. WCT have been recorded in the lower reaches of the creek. BT also occur on the Fording River below Christina Falls and are likely to use Grace Creek for spawning and/or rearing. The Grace Creek road is in poor condition and seems to receive limited use. Removal of the crossings structure may be an option if the road is to be deactivated. Otherwise, the current culverts should be replaced by open bottom structures. Potential HGI on Grace Creek is 13.2 km.

- BULL039
  The crossing is located on Barrier Creek, a tributary to the Bull River, upstream of the Aberfeldie Dam. It consists of a double culvert with perched outlets. Although its fish bearing status is unknown, the creek may provide good rearing and spawning habitat. The crossing is located approximately 50 m from the confluence with the Bull River, preventing use of the tributary habitat by Bull River fish. The potential habitat gain upstream of the crossing is 5.1 km. The replacement of the current structure by a bridge crossing with a span of at least 10 m long is recommended.

- WILD011
  The crossing is located on Victoria Creek, a tributary of the Wildhorse River. It consists of a single round culvert with a perched outlet. The creek offers good rearing and spawning opportunity for WCT, which have been previously recorded in the stream. BT also use the Wildhorse River for spawning. The use of habitat on Victoria Creek by Wildhorse River fish is completely precluded by

the faulty crossing. The habitat gain potential upstream of the crossing is 5.0 Km. Replacement of the current structure by a 7 m bridge crossing is recommended.

- NWHT015
  The crossing is located on an unnamed tributary to the North White River. The single culvert is perched at the outlet. Although its fish bearing status has not been confirmed, the stream has suitable gradient, good spawning gravel and some deep pool. WCT and BT occur in the North White River and may utilize the tributary habitats. The potential habitat gain upstream is 1.9 km. Replacement of the current crossing by an open bottom arch structure (diameter 4 m) is recommended.

- FORD079, FORD213
  These two consecutive crossings are located at the confluence of Dry Creek and the Fording River under the Fording Highway and the CPR railway. They both consist of large diameter double culverts, which are not properly embedded, creating velocity barriers to juvenile fish. Dry Creek has high habitat value with up to 26.2 km potentially available to fish. Although restoration costs at these locations will be high, the replacement of these culverts by open bottom structures is recommended. Alternatively, additional substrate material could be added to the current structure to improve fish passage.

6.2 Medium and low priority sites

An additional 42 barriers were identified on high quality fish habitat streams. Following the review of all available data, these sites were given medium priority for restoration due their unconfirmed fish bearing status, absence of listed species, and/or low HGI. Medium priority sites should be considered for restoration once high priority sites have been addressed.
A total of 562 crossings occurring on medium and low quality fish habitat streams were given low priority for restoration. Ideally, all these should be repaired or replaced. However, a more detailed cost-benefit analysis should be conducted to determine the best approach for each of these crossings.

7.0 CLOSURE

This report has been prepared in accordance with generally accepted biology practices in British Columbia. Vast trusts that this report satisfies the requirements of BCTS and the FPTWG. Should BCTS or FPTWG have any comments, please contact us at your convenience.

Yours truly,

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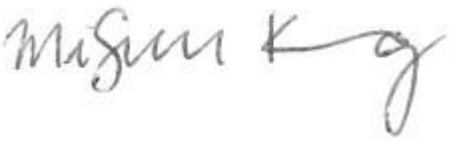

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APPENDIX A PRIORITY SITES PHOTO DOCUMENTATION


Priority Sites_BLOO045_Outlet


Priority Sites_BLOO045_Inlet


Priority Sites_BLOO045_Downstream


Priority Sites_BLOO045_Barrel1

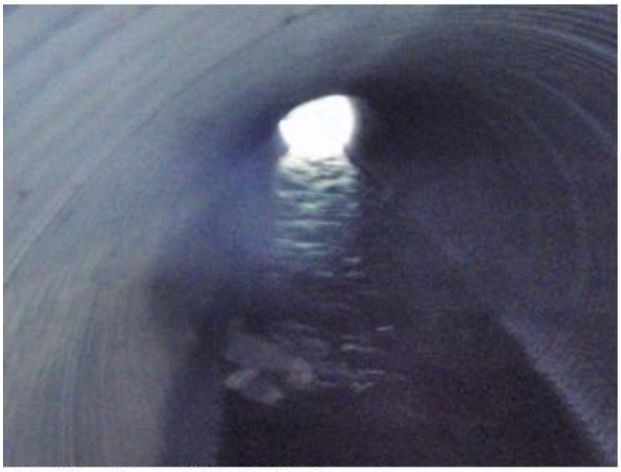

Priority Sites_BLOO045_Barrel


Priority Sites_WILD011_Upstream


Priority Sites_WILD011_Outlet


Priority Sites_WILD011_Inlet


Priority Sites_WILD011_Downstream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Priority Sites_SAND012_Downstream


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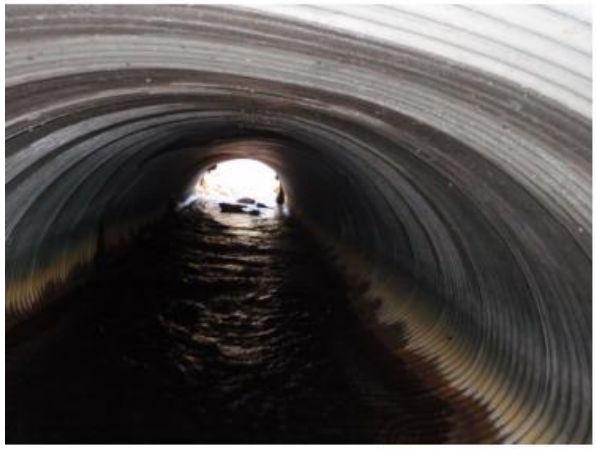
Priority Sites_SAND011_Upstream


Priority Sites_SAND011_Outlet


Priority Sites_SAND011_Inlet


Priority Sites_SAND011_Downstream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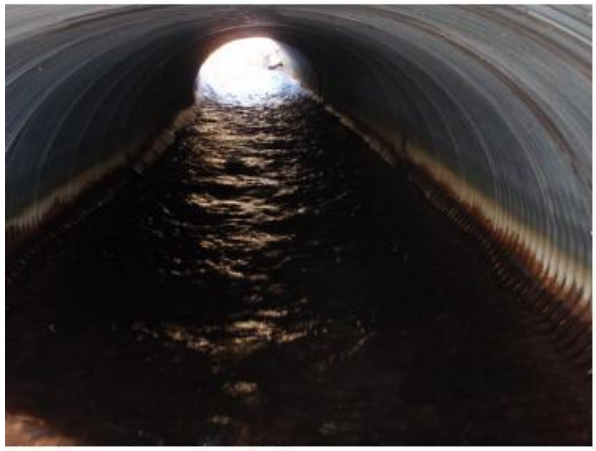
Priority Sites_SAND011_Barrel1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Priority Sites_NWHT015_Outlet


Priority Sites_NWHT015_Inlet


Priority Sites_NWHT015_Downstream


Priority Sites_NWHT015_Barrel


Priority Sites_MWHT055_Upstream


Priority Sites_MWHT055_Outlet


Priority Sites_MWHT055_Inlet


Priority Sites_MWHT055_Downstream


Priority Sites_MWHT055_Barrel


Priority Sites_MICH016_Upstream


Priority Sites_MICH016_Outlet


Priority Sites_MICH016_Inlet


Priority Sites_MICH016_Downstream

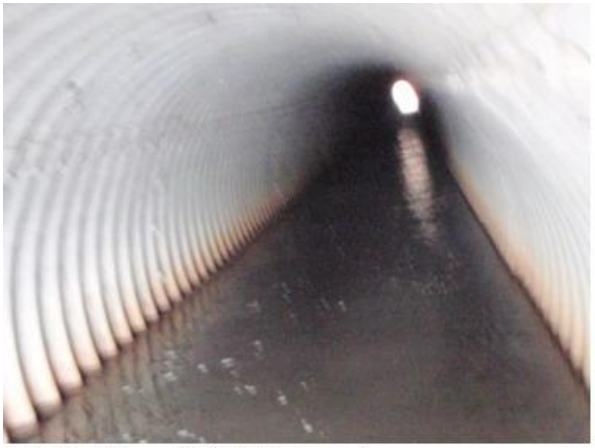

Priority Sites_MICH016_Barrel


Priority Sites_JOSP007_Upstream


Priority Sites_JOSP007_Outlet


Priority Sites_JOSP007_Inlet


Priority Sites_JOSP007_Downstream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Priority Sites_JOSP006_Outlet


Priority Sites_JOSP006_Inlet


Priority Sites_JOSP006_Downstream


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Priority Sites_JOSP005_Inlet


Priority Sites_JOSP005_Downstream


Priority Sites_JOSP005_Barrel


Priority Sites_JOSP004_Upstream


Priority Sites_JOSP004_Outlet


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Priority Sites_JOSP004_Downstream


Priority Sites_JOSP004_Barrel


Priority Sites_JOSP002_Upstream


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Priority Sites_JOSP002_Downstream


Priority Sites_JOSP002_Barrel


Priority Sites_JOSP001_Upstream


Priority Sites_JOSP001_Outlet


Priority Sites_JOSP001_Inlet


Priority Sites_JOSP001_Downstream


Priority Sites_JOSP001_Barrel


Priority Sites_GRAV009_Upstream


Priority Sites_GRAV009_Outlet


Priority Sites_GRAV009_Inlet


Priority Sites_GRAV009_Downstream


Priority Sites_GRAV009_Barrel


Priority Sites_GRAV004_Upstream


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Priority Sites_GRAV004_Inlet


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Priority Sites_GRAV004_Barrel


Priority Sites_GRAC022_Upstream


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Priority Sites_GRAC022_Inlet


Priority Sites_GRAC022_Downstream


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Priority Sites_GRAC015_Upstream


Priority Sites_GRAC015_Outlet


Priority Sites_GRAC015_Inlet


Priority Sites_GRAC015_Downstream


Priority Sites_GRAC015_Barrel


Priority Sites_GRAC011_Upstream


Priority Sites_GRAC011_Outlet


Priority Sites_GRAC011_Inlet


Priority Sites_GRAC011_Downstream


Priority Sites_GRAC011_Barrel


Priority Sites_GRAC010_Upstream


Priority Sites_GRAC010_Outlet


Priority Sites_GRAC010_Inlet


Priority Sites_GRAC010_Downstream


Priority Sites_GRAC010_Barrel


Priority Sites_FORD213_Outlet


Priority Sites_FORD213_Inlet


Priority Sites_FORD213_Downstream


Priority Sites_FORD213_Upstream


Priority Sites_FORD213_Barrel


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Priority Sites_FORD079_Inlet


Priority Sites_FORD079_Downstream


Priority Sites_FORD079_Barrel


Priority Sites_EWIN008_Upstream


Priority Sites_EWIN008_Outlet


Priority Sites_EWIN008_Inlet


Priority Sites_EWIN008_Downstream


Priority Sites_EWIN008_Barrel


Priority Sites_ELKR044_Upstream


Priority Sites_ELKR044_Outlet


Priority Sites_ELKR044_Inlet


Priority Sites_ELKR044_Downstream


Priority Sites_ELKR044_Barrel


Priority Sites_ELKR044_Barrel 2


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Priority Sites_ELKR000_Inlet


Priority Sites_ELKR000_Downstream


Priority Sites_ELKR000_Barrel


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Priority Sites_CAVE418_Inlet


Priority Sites_CAVE418_Downstream


Priority Sites_CAVE418_Barrel


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Priority Sites_CAVE004_Outlet


Priority Sites_CAVE004_Inlet


Priority Sites_CAVE004_Downstream


Priority Sites_CAVE004_Barrel


Priority Sites_CAVE003_Upstream


Priority Sites_CAVE003_Outlet


Priority Sites_CAVE003_Inlet


Priority Sites_CAVE003_Downstream


Priority Sites_CAVE003_Barrel


Priority Sites_BULL039_Upstream


Priority Sites_BULL039_Outlet


Priority Sites_BULL039_Inlet


Priority Sites_BULL039_Downstream


Priority Sites_BULL039_Barrel


Priority Sites_BLOO334_Upstream


Priority Sites_BLOO334_Outlet


Priority Sites_BLOO334_Inlet


Priority Sites_BLOO334_Downstream


Priority Sites_BLOO334_Barrel


Priority Sites_BLOO045_Upstream

APPENDIX B ROAD ASSESSMENT REPORT

1. INTRODUCTION

In the fall of 2012, Vast Resource Solutions was contracted by BCTS to conduct a culvert assessments study in the Rocky Mountain Resource District of the East Kootenay Region. As part of the study, field crews assessed road conditions for structural, environmental, and safety issues.

A total of 1,474 km were travelled throughout the study area in over 41 different watersheds. All road observations made during the study are summarized in the following report.

2. RESULTS

Albert River

The Albert FSR had a number of culverts that were recently displaced by torrents during the spring freshet. At the 56 km marker, a large failure has made the road impassable by trucks. The other failures occurred beyond this point.

Alexander Creek

The Alexander FSR is in good condition from the highway until the 90 km marker. Branch B forks off the main Alexander at approximately the 91 km marker. Branch B was extremely degraded from current mining exploration. Branch B will need to be re-surfaced. Beyond the 91 km marker, Alexander Creek is closed for motor vehicle use. Deadman's Pass is in very poor condition. It is recommended that Deadman's Pass be closed for motor vehicle use. The Alexander cut-off road is also in very poor condition. The road is very rutted and is very narrow. This road should also be closed for motor vehicle use.

Bingay Creek

There are two roads that access this drainage. The first, Bingay FSR has been de-activated. The second road is Lowe FSR. Lowe is in good condition.

Blackfoot Creek

The Blackfoot FSR was in good condition. The road was re-surfaced one year ago. A car has been pushed over the downhill side of the road near the 27 km marker.

Bloom Creek

The Bloom Creek drainage has a complex road network. Bloom FSR is the mainline road and is in good condition. Larch Road has been de-activated. Ward FSR is in good condition. Middle Bloom FSR is very rutted and needs to be re-surfaced.

Bull River

The Bull River Drainage is accessed by one mainline, the Bull River FSR, and a few secondary roads. The Bull River FSR is heavily utilized for logging traffic. Due to the heavy use, the condition of the road is constantly changing. Iron Creek FSR has been de-activated and is closed to motor vehicle use. Van FSR is becoming quite degraded. Given the high recreational traffic on Van FSR, it is recommended that the road be resurfaced. Tanglefoot FSR has been completely washed out 2 km from its intersection with the Bull River FSR. It is recommended that this road be closed to motor vehicle use. The Galbraith FSR is in poor condition. Due to the recreational activities on the Galbraith FSR, it is recommended that the road be resurfaced. The Goathaven FSR is a very challenging and dangerous road to drive. The road has poor surfacing material. The road should be resurfaced with crushed gravel. The Sulphur- Hartley Pass is in good condition. Brown's Cabin FSR is in good condition. Brown's south FSR is in good condition.

Caven Creek

The Caven Creek drainage is large with many roads. The mainlines accessing this drainage are Caven Creek FSR and Cherry FSR. Both of these mainlines are in good condition. Many of the Branches and Spurs on the Cherry FSR are no longer in use and should be de-activated. Haller FSR is in good condition.

Cummings Creek.

Cummings Creek FSR is extremely degraded. Many makeshift ATV bridges have been constructed. It is recommended that the road be de-activated.

Dry Creek

Dry Creek FSR is in very good condition. The area was recently logged.

Elk River

There are two mainline roads that access the Upper Elk River drainage. The Elk River FSR is in good condition from Elkford to ~ 130 km Marker. After the 130 km marker, the road is in very poor condition. The road is very rutted and has many large potholes. The Round Prarie FSR is also in very poor condition. It is recommended that both roads be resurfaced. Most of the spur roads that intersect the mainlines, have been de-activated.

Forsyth Creek

The Forsyth Creek FSR is no longer in use and has been de-activated.

Flathead River

There are many roads that are in the Flathead River drainage. The Flathead FSR is the mainline road that accesses the drainage. This road is in very poor condition. There are many ruts, potholes, and small washouts. It recommended that the road be resurfaced. Many of the road kilometer markers are missing on the road. Additionally, the road right-of-way along the Flathead FSR is thick with brush along both sides of the road. It is difficult to see oncoming traffic on the road. The right-of-way should be brushed out to prevent accidents. The Pincher Creek FSR and the Potluck FSR are two roads that intersect

Flathead FSR. Both of these roads have been de-activated. Mclatchie FSR also intersects with Flathead FSR. This road is in poor condition and should be re-surfaced and brushed out.

Grave Creek.

Grave FSR is the mainline road used to access the Grave Creek drainage. The road surface on this road is made up of silt and clay. The road has become rutted and has many large potholes. The road should be resurfaced with crushed gravel. Grave Branch B is no longer in use and should be deactivated. The Grave-Line road is in poor condition and should be re-surfaced. Also, many of the road km markers are missing.

Harmer Creek

Harmer Creek FSR is an old road. It is in good condition but the right-of-way should be brushed out. Also, many of the kilometer markers are missing.

Inlet Creek

The road was in very good condition from where Inlet FSR intersects Blackfoot FSR to the 35km marker on Inlet FSR. A spur road at 34.5 km had been deactivated. Beyond the 35 km marker, Inlet FSR has deep water bars but culverts had been left intact.

Joseph Creek

Most of the roads that are in the Joseph Creek drainage are paved. Gold Creek is the only forest service road in this drainage. All of the roads in this drainage are in good condition.

Leach Creek

The Leach FSR is in very good condition. The road is used to access a cat-skiing operation in the winter.

Line Creek

The Line Creek drainage is accessed by the Grave-Line FSR. This road is in poor condition. The road should be resurfaced. There are also many km marking signs that are missing.

Lizard Creek

The first 5 kms of Mt. Fernie Rd is a public road, which provides access to Mount Fernie Provincial Park. The rest of the road is privately maintained to access Island Lake Lodge. The entire road is in very good condition and has been well maintained.

Lost Dog Creek

The Lost Dog drainage is accessed by 3 main roads; Lost Dog, Cherry, and Mather FSRs. All three main roads are in good condition. There are many spur roads off of these three main lines. Most of the spurs are new and in good condition. However, the Lost Dog Main Spur road has been de-activated after the 13 km marker.

Mark Creek

Most of the roads in the Mark Creek drainage are paved. The roads that are not paved are used as hiking trails. No action is required for these roads.

Michel Creek

The Michel Creek drainage is primarily accessed by the Corbin Highway and Upper Flathead FSR. The Upper Flathead FSR is in very poor condition and should be resurfaced. The Spruce FSR and Wheeler FSR provide access to the lower part of the drainage. The Spruce FSR is in good condition. The Wheeler FSR is utilized by mining traffic for the Martin-Wheeler mine. The condition of this road frequently changes.

Morrissey Creek

The Morrissey Creek FSR is heavily utilized by logging traffic and recreational users. The road conditions change frequently.

Sand Creek

The Sand Creek drainage is very large with many different roads. The Baynes Lake Rd and Tie Lake Rd are both paved and in good condition. The Bull River FSR and Little Sand FSR are both in good condition and are utilized heavily by logging traffic. The Big Sand FSR road is in very poor condition and is quite narrow. For safety reasons, this road should be closed to vehicle use. The Colvalli FSR and Rosicky FSR should both be closed to vehicle use. The roads are in poor condition and provide access to sensitive grasslands. The Suzanne FSR is in good condition.

Thunder Creek

Thunder Creek FSR is in good condition. The material in the road surfacing contains a large amount of gypsum which makes the road very muddy when it rains. It is recommended that more gravel be added to the surface of the road.

3. PHOTO DOCUMENTATION


Cochrane Creek Road Damage 02


Cochrane Creek Road Damage 01


Bull River Road_culvert damage at BULL017


Bull River Road_collapsed culvert damage at BULL017


Blackfoot Creek Road Damage


Albert River Road Damage01


Albert River road damage 02


Thunder Creek road erosion near THUN 020


Thunder Creek Road damage near THUN203


Tepee Creek Road Damage


Teepee Creek Road damage near TEEP612


Schofield Creek Road Damage


Flathead River McLatchie Road Damage


Cummings Creek Road Damage 02


Cummings Creek Road Damage 01


Cochrane Creek Road Damage 05


Cochrane Creek Road Damage 04


Cochrane Creek Road Damage 03

APPENDIX C FIELD DATA

APPENDIX D 1:50,000 STUDY AREA MAPS