MAXAN WATERSHED STREAM HABITAT RESTORATION WORKS

1998/99

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1. Introduction:

1.1. Background:

In April 1995, the Yin Waghunlee Habitat Enhancement Corporation (YINCO), with the support of the Broman Lake Band, Decker Lake Forest Products, Guide Outfitters, B.C. Trappers Association and the Ministry of Forests Lakes District, submitted a proposal to Forest Renewal British Columbia (FRBC) to conduct a watershed assessment on the Maxan watershed. The purpose of the assessment was to identify areas in the watershed with potential impacts from forest harvesting which required further assessment or remedial action.

YINCO retained AGRA Earth and Environmental (AEE) to conduct an Overview Fish and Fish Habitat assessment in the watershed. The overview fish and fish habitat assessment identified Maxan Creek, the Bulkley River and Foxy Creek as the top three priorities for detailed assessment.

In 1996, AEE was again retained by YINCO (now called Dz'ilh K'Az Kwa or DKK) to conduct detailed fish and fish habitat assessments and prescribe remedial actions for;

- reaches of Maxan Creek downstream from Maxan Lake,
- lower reaches of Foxy Creek, and for
- reaches of Bulkley River downstream from Bulkley Lake to the Lakes Forest District Boundary.

Unfortunately due to the late date of contract preparation only preliminary assessment and prescriptions were possible that year. The prescriptions developed were presented in the report titled, "1996 Maxan Watershed Stream Habitat Restoration and Enhancement Design Report" AGRA Earth and Environmental, March 1997. This report included Habitat Restoration Prescriptions for 12 sites on the Bulkley River, 2 sites on Foxy Creek and 1 site on lower Maxan Creek.

In 1997, Babine Forest Products took over as lead proponent for the Maxan Watershed Project. They retained AEE to conduct restoration works on the Foxy Creek and Maxan Creek sites for which there were prescriptions. The results of these projects are presented in the report, "Maxan Watershed Stream Habitat Restoration and enhancement - Level 3" AGRA Earth and Environmental, October 1997.

Also in 1997, AEE completed work on the detailed fish and fish habitat assessment carried over from 1996. The results from this assessment are presented in two reports;

- Fish and Fish Habitat Assessment of Maxan Creek Watershed, British Columbia, AGRA Earth and Environmental Limited, February 1998, and

- Maxan Watershed Stream Habitat Restoration and Enhancement Level 2 Design Report, AGRA Earth and Environmental Limited, January 1998.

The first of these reports provides the results of the fish and fish habitat assessment on Maxan and Foxy Creeks. The second report provides prescriptions for habitat restoration at 11 sites on Maxan Creek.

In August 1998, restoration works were conducted on one reach of Maxan Creek. The report presented here (Maxan Stream Restoration 1998/99), provides a detailed description of those habitat restoration works completed on Maxan Creek during August 1998.

1.2. Study Area:

1.2.1. Geographic Location

The Maxan watershed is approximately 83,000 ha in area. It includes the upstream most portion of the Bulkley River and it's tributaries within the Lakes Forest District. The watershed has been divided into four sub basins. They are; Maxan, Crow, Day Lake and Bulkley. Figure 1 shows the Provincial location of the Maxan Watershed. Figure 2 shows the subunits making up the Maxan Watershed.

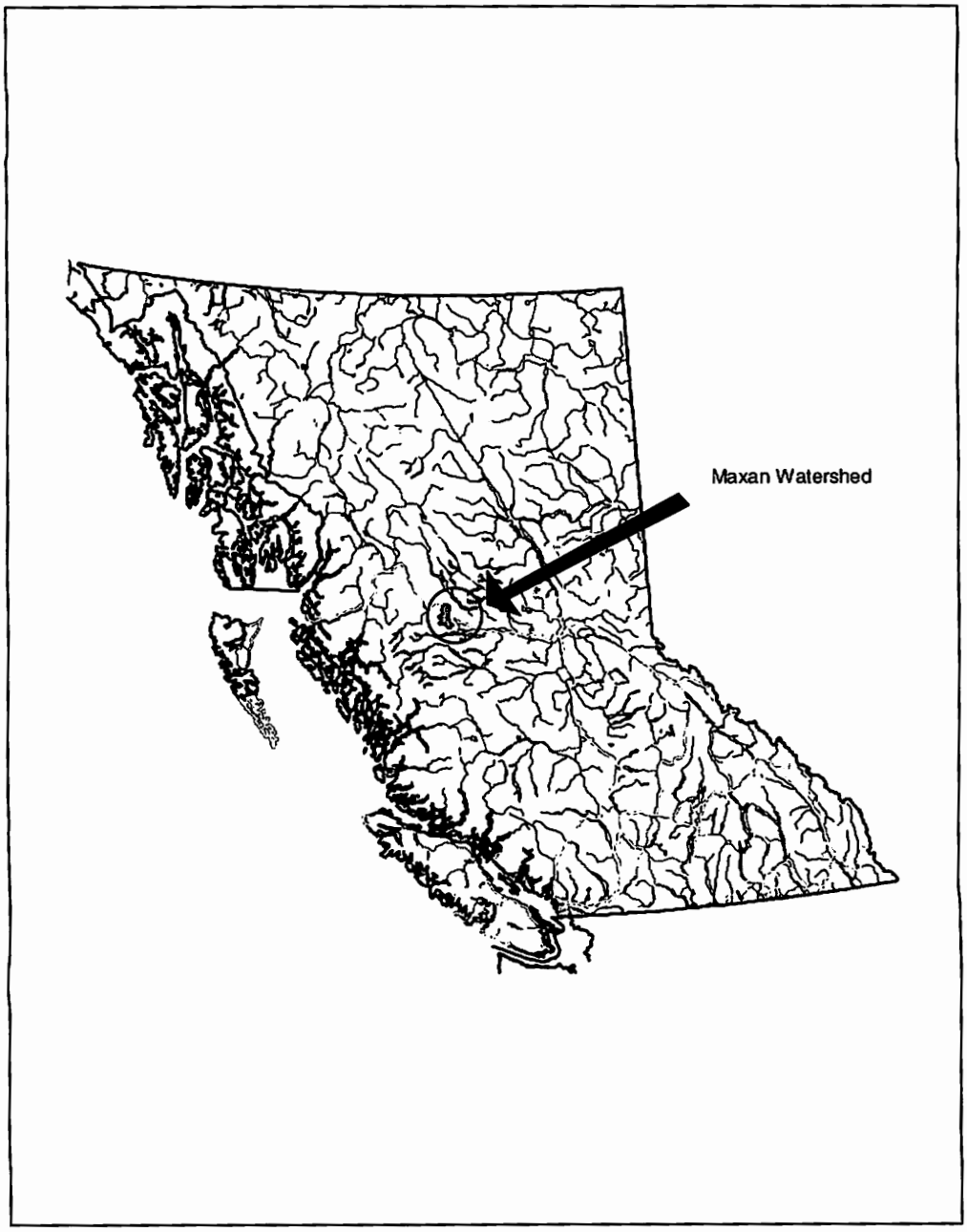

Figure 1: Maxan Watershed Provincial Location

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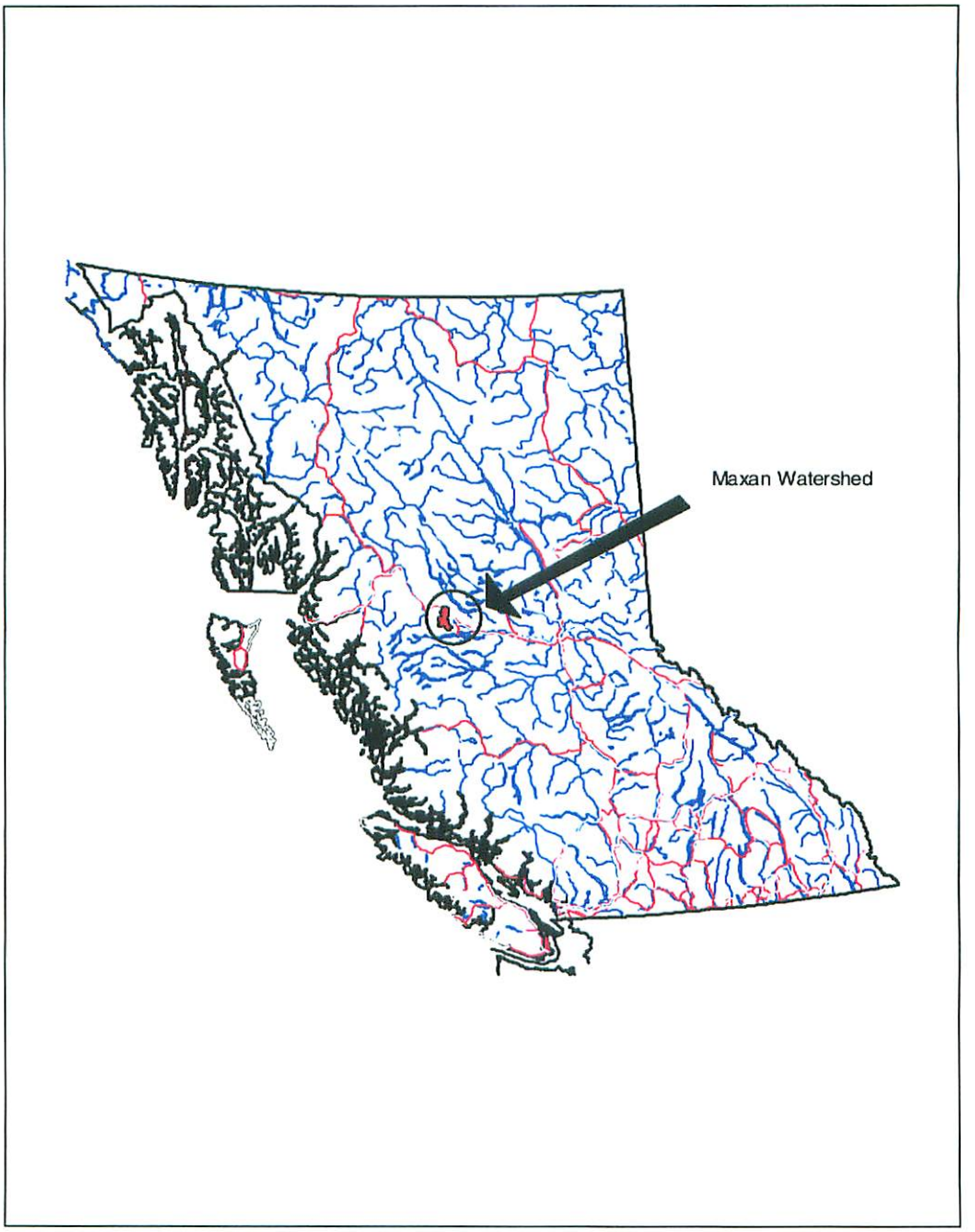

Figure 1: Maxan Watershed Provincial Location

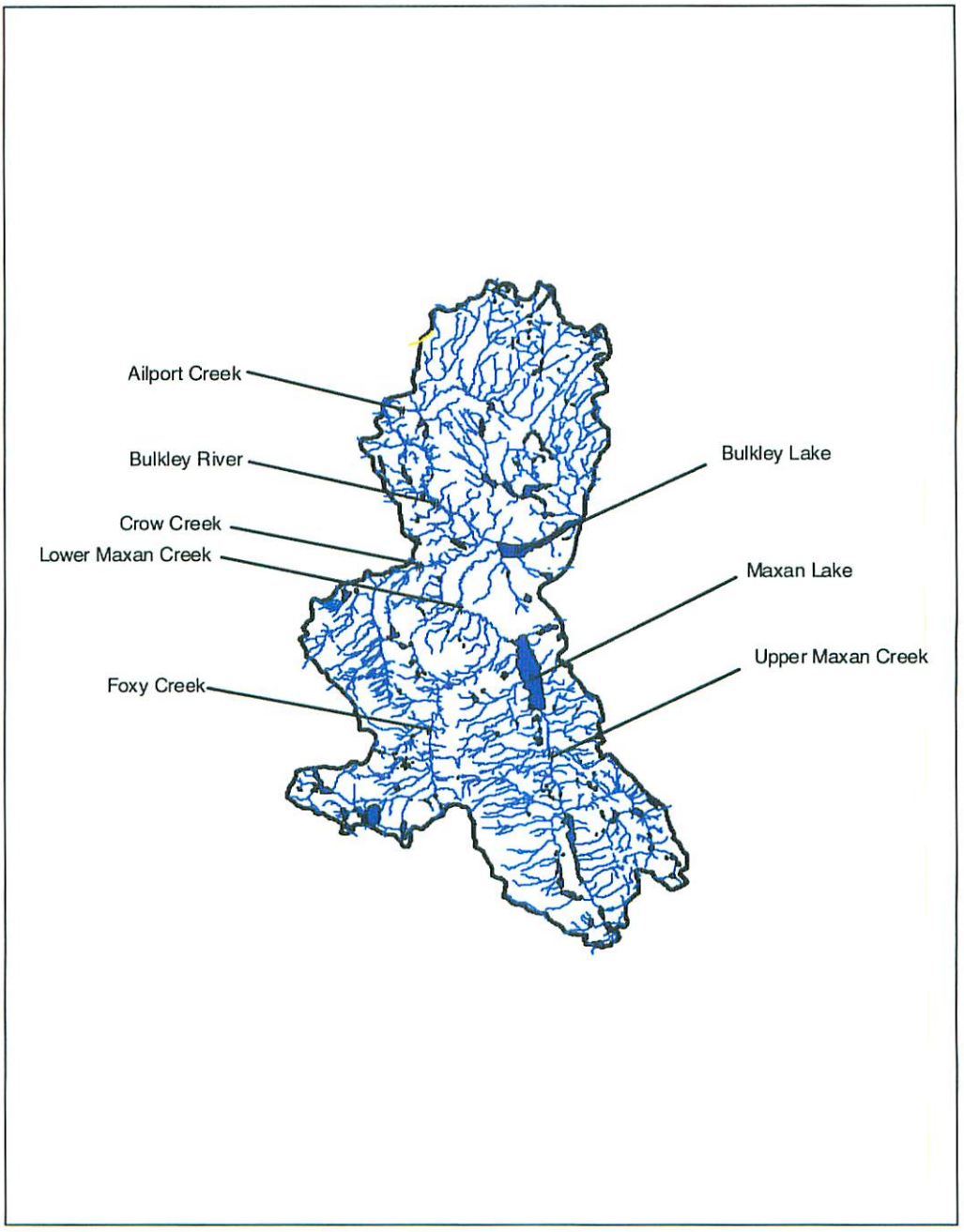

Figure 2: Maxan Watershed Subunits

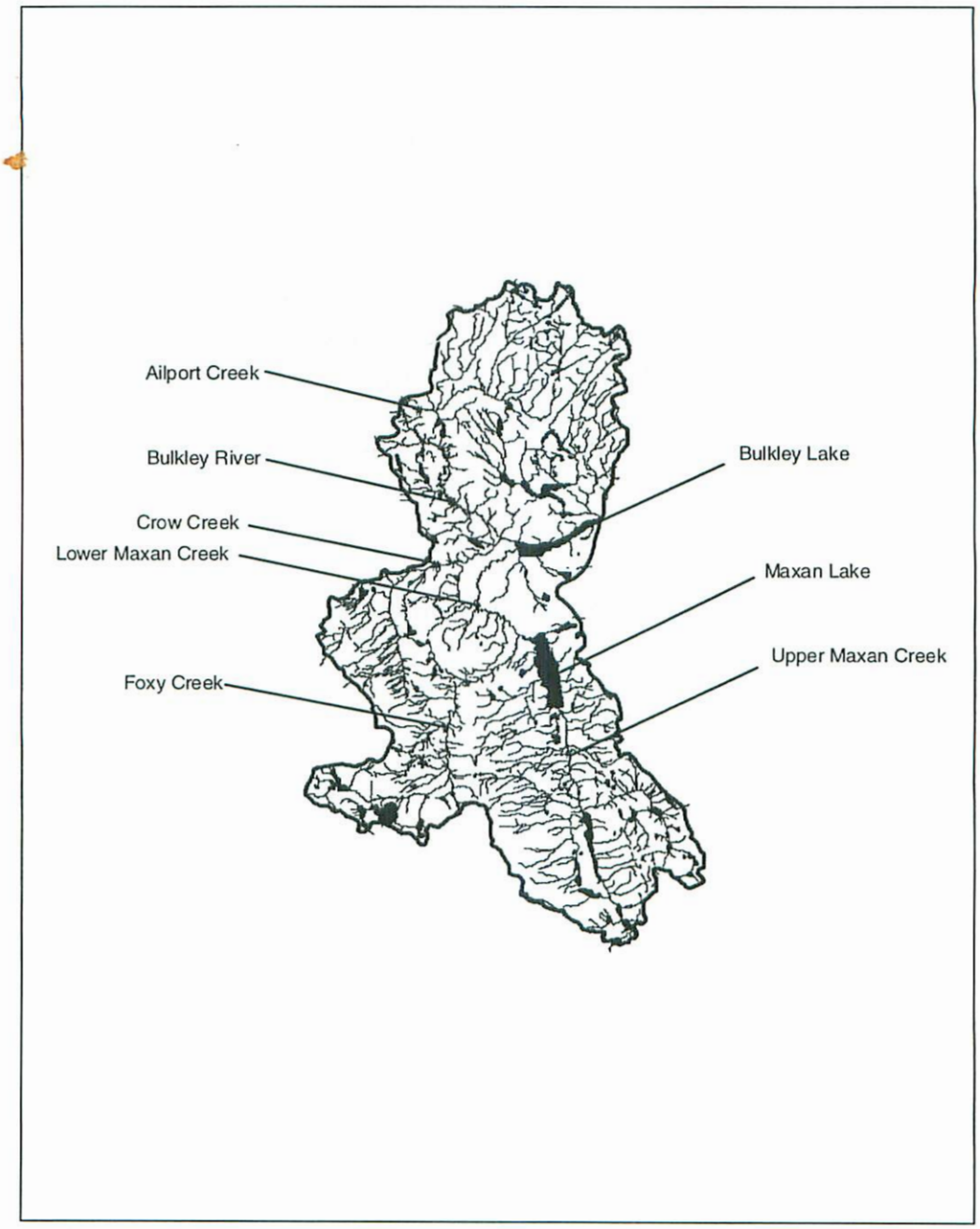

Figure 2: Maxan Watershed Subunits

The Maxan sub unit is comprised of Maxan Creek, Foxy Creek and several tributaries. It is a fourth order watershed comprised of the confluence of three third order watersheds and several first and second order watersheds (Watershed Atlas).

The works described in this report are located on Lower Maxan Creek. Lower Maxan Creek flows north from Maxan Lake for about 16 km into Bulkley Lake. The stream is joined by Foxy Creek about 1 km downstream from Maxan Lake. This section of Maxan Creek has been divided into two reaches; reach 1 being the lower or downstream most reach.

1.2.2. Fish Species

Five species fish had previously been reported from Maxan Creek They include; Rainbow trout, Dolly Varden, Chinook salmon, Coho salmon, and Pacific lamprey (AEE, 1996). Additional sampling in 1997 also found mountain whitefish, longnose dace and longnose suckers (AEE, 1998). Sockeye salmon have been reported as far upstream as Bulkley lake (AEE, 1996) and quite possibly have utilized lower reaches of Maxan Creek in the past (anecdotal information).

1.2.3. Habitat

Reach 1 of Maxan Creek meanders through flat bottom land into Bulkley Lake. The reach is 7.3 km in length. AEE (1998) reported the average bankfull width for this reach as 20.2 m and the mean wetted width at 8.1 m (August 8 - 13, 1997). Discharge at the time was 0.22 cms. Pools, riffles and glides comprised 13%, 18% and 20% of the reach respectively. Average gradient is 2%. Stream temperatures measured on July 30, 1998 (during a period of very warm weather) reached 22 $^{\circ}$ C (personal observation).

Approximately 30% of the forest east of the reach has been harvested (AEE, 1996). About half of the reach is located on private lands (lower half). There are two landowners; E.A Strimbold and Rolf Johnston. Livestock range freely throughout the reach on both Crown and private lands. On private lands, large clearings have removed riparian vegetation. Actively eroding, vertical streambanks are common in these areas. A network of trails provides access to both sides of the creek. Beaver are common. AEE (1998), described this reach of Maxan Creek as follows:

> Reach 1 of Maxan Creek had a low gradient (< 3%), irregular meandering channel occasionally confined between unarmored banks. Riparian vegetation included grasses, willow, alder, cottonwood and spruce. The canopy was open. Habitat consisted of large riffle/pool/glide sequences. The substrate was frequently embedded with fines. Fines (including sand and silt) were abundant along channel margins, back eddies, pools and downstream ends of channel bars and were common in glides and riffles. In addition, fines were dominant in the lower part of the reach. Distribution of LWD was clumped and few (less than 1 piece per Wb)

pieces of functional LWD are present over the reach. Filamentous algae was observed frequently in the reach. Disturbance indicators found included eroding banks, LWD parallel to banks, log jams, and extensive sediment wedges.

AEE (1998), concluded that:

> The dominant fish use within Maxan and Foxy Creeks is rearing. Limiting rearing habitat conditions included pool area and frequency, lack of functional LWD, minimal off-channel habitat, some infilling of gravels and cobbles and limited holding pools. Channel aggradation and channel widening from bank erosion has occurred, especially in reach 1 of Maxan Creek. Habitat condition within Maxan Creek, reach 1 was rated poor for functional LWD, off channel habitat, and pool area. It was rated as poor to fair for gravel quality (moderate amounts; fines abundant). Reach 1 had abundant fines and infilling of cobble and gravel was occurring.
>
> These limiting or poor habitat conditions are caused by loss of riparian vegetation and LWD, erosion, and resulting sedimentation.

1.3. Objectives:

The main objective of 1998 works was to restore salmonid spawning and rearing habitat by:

- reducing the delivery of sediments to the stream channel from eroding stream banks, and
- increasing cover from pools and LWD.

A secondary objective was to reduce maximum stream temperatures by:

- narrowing the stream channel, and
- establishing riparian vegetation.

2. 1998 Maxan Creek Restoration Works:

1998 works were based mainly on drawings and descriptions presented in Watershed Restoration Technical Circular No. 9 and on discussions with regional WRP specialist Jeff Lough. Works were conducted by the Ministry of Environment, in cooperation with local landowners, at eight sites on reach 1 of lower Maxan Creek. All of the sites were located on private lands owned by Mr. E. A. Strimbold. For the most part, discussions and agreements regarding the project were with Mr. Marvin Strimbold who

manages the property for his father. Funding for the works was provided through the Forest Renewal British Columbia (FRBC) Watershed Restoration Program (WRP). As their contribution to the project, the landowner provided materials (trees, willows) and equipment (skidder and caterpillar).

Works consisted of bank and bar stabilization. Target species were Rainbow trout, Chinook salmon and Dolly Varden. Work was completed during the period from August 1 to August 15, 1998. All works were completed by local contractors under the supervision of the Ministry of Environment, Lands and Parks (MELP). Day to day project supervision and coordination was provided by Waterside Ventures Ltd. under contract to MELP.

2.1. Bank Stabilization

The basic method used to stabilize banks was the large woody debris revetment for moderate energy sites (page 6-20, WRP Technical Circular No. 9). Typical installation is shown in Figure 3 and involved the following steps:

1. The revetment began and ended at locations where there was opportunity to key the structure into a naturally protected section of streambank.

2. beginning at one end, an excavator was used to place a footer log along the base of the streambank, parallel to the bank. The footer log was debranched and had the root wad removed.

3. the excavator was then used to excavate a trench to the depth of the top of the footer log at an angle near to perpendicular to the streambank. The trench was typically about five meters in length to accommodate the length of tree stem and one to two meters deep depending on the bank height.

4. a tree stem with root wad was cut to length using a chainsaw and then placed in the excavated trench by the excavator such that the root wad projected over the footer log to a distance of about one to two meters from the bank. The tree stem angled slightly in an upstream direction. Tree stem / root wads were placed about seven meters apart.

5. The trench was backfilled and compacted by the excavator burying most of the tree stem. Some of the stems were anchored with driveable anchors before backfilling. The protruding length of the tree stem was secured with ¼ inch or 3/16 inch galvanized aircraft cable to the footer log.

6. a header log was placed over top of the protruding tree stems and was secured to them with ¼ inch or 3/16 inch aircraft cable.

7. boulders were placed inside the header and footer logs adjacent to the streambank and at upstream and downstream ends of the revetment.

8. Finally, willow cuttings were staked inside the header and footer logs, and grass seed was spread over all disturbed areas at the top of the bank.

Variations of this method were used depending on site conditions and materials available. Variations included; placing an additional row of root wads over top of the header log, placing root wads with no footer log, placing root wads with no header or footer log, using branched spruce trees as the header logs, incorporating live willow clumps into the structure, and anchoring root wads with driveable anchors.

It is anticipated that these structures will limit streambank erosion by reducing water velocities adjacent to erodible banks. It is also anticipated that the structures will catch and accumulate floating debris thereby further armoring the banks. Fines will settle out in the low water velocity areas creating lateral bars. Vegetation should colonize these bars. The net effect will be to promote the formation of a narrower and somewhat deeper stream channel and improve substrate quality for spawning and rearing by reducing cobble and gravel infilling with fines.

Fish cover will also be improved by;

- the addition of LWD along the stream margin,
- formation of pools adjacent to rootwad ends, and
- from the growth of overhanging riparian vegetation.

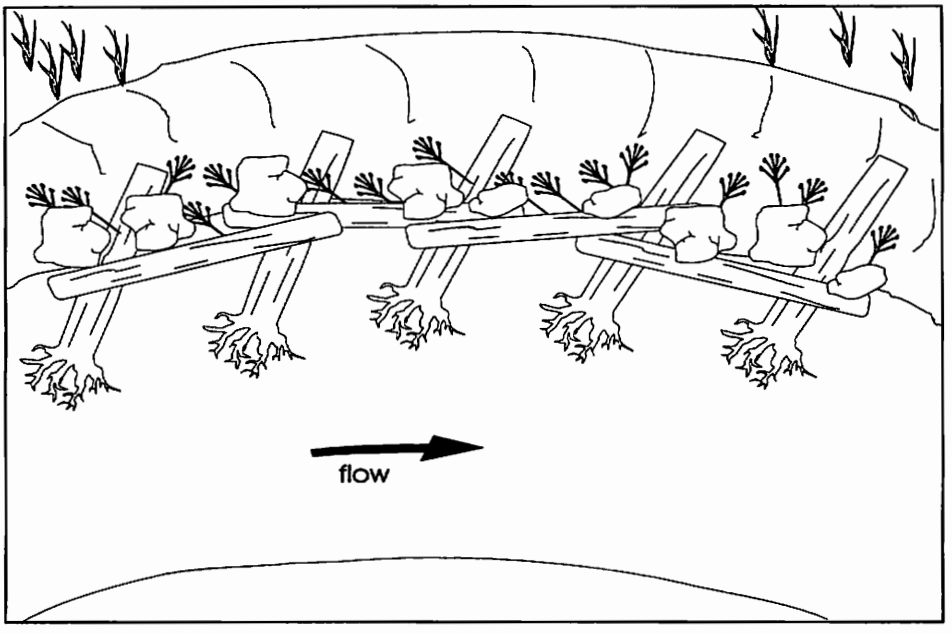

Figure 3: Typical LWD Revetment

2.2. Bar Stabilization

The method used to stabilize gravel bars is described, "StreamLine", Watershed Restoration Technical Bulletin (Volume 2, Number 3). An attempt was made to mimic the natural patterns of LWD deposition and bar stabilization observed in the project area. Triangular or V - shaped arrangements of LWD were placed in strategic locations on lateral bars. LWD consisted of tree stems with root wads. Various patterns were used including V shapes with the base facing downstream, triangles with the apex facing upstream and triangles with the apex facing downstream. Structures were anchored in place using driveable duck bill anchors.

It is anticipated that water velocity will be reduced within and downstream from the structures, allowing fines to settle out and vegetation to become established.

2.3. Equipment, Materials and Labor

Equipment used for the project included a Hitachi EX 200LC-3 excavator, a D-6 caterpillar, skidders, self loading logging trucks, and gravel dump trucks. The D-6 cat and one skidder were provided by the landowner, Mr. Strimbold. Trees were knocked over using the D6 cat or excavator and were hauled to the sites using either self loading logging trucks or skidders depending on where they were obtained. Trees used were mainly pine with some spruce and aspen. Rock was loaded into dump trucks using the excavator and was hauled to the site. Access was such that materials could be hauled and stockpiled adjacent to most sites..

Trees, rock and willow cuttings were obtained free of charge except for hauling costs. Rock was obtained from local MoF rock pits. Trees were obtained from crown and private lands. About half of the trees used for the project were obtained from crown land and half were from land owned by Mr. Strimbold. Willow cuttings were obtained from the Kalum Forest district. These cuttings were surplus to project needs for that District and were slated to be disposed of.

Labour was provided by Waterside Ventures (Burns Lake) and consisted of a crew of from two to four people as required. The location of 1998 Maxan Creek Restoration Sites - 1 to 8 are shown in Figure 4.

Figure 4: Maxan 1998 Works, Sites 1 - 8

2.4. Individual Sites

A description of the sites and restoration works are provided in the following section. Photographs are in Appendix 1.

2.5. Site 1

Maxan Creek Site 1 corresponds to site 11A of AEE (1997). It is approximately 130 m in length and is located adjacent to a large cleared pasture area. The streambank was about 2.0 meters in height, vertically reposed and actively eroding. The stream at this point is a straight, relatively shallow riffle / run complex. Instream cover is limited by an absence of pools, pocket water, overhanging vegetation and LWD.

The eroding streambank at this site was stabilized using a large woody debris revetment (Figure 5). Approximately 40 tree/root wads were used along with 5 loads of rock, 800 willow cuttings, 1.5 bags of grass seed, 300 feet of aircraft cable and 10 driveable anchors.

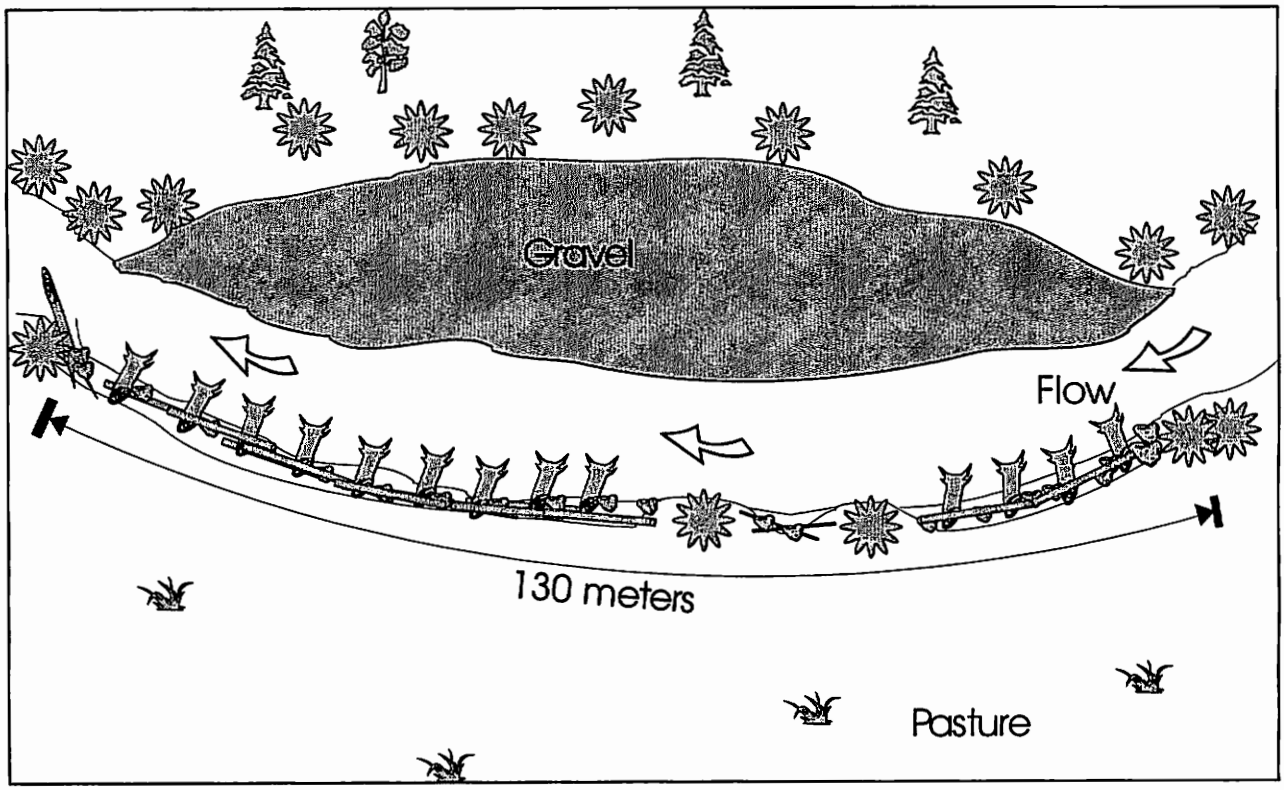

Figure 5: Site 1

2.6. Site 2

Maxan Creek Site 2 was not prescribed for in AEE (1997). It is approximately 16 m in length and located adjacent to a large cleared pasture area. The streambank was about 2.0 meters in height, vertically reposed and actively eroding. The stream at this point is a straight, relatively shallow riffle / run complex. Instream cover is limited by an absence of pools, pocket water, overhanging vegetation and LWD.

The eroding streambank at this site was stabilized using a large woody debris revetment (Figure 6). Approximately 3 tree/root wads were used along with 4 clumps of livc willow, 1/2 bag of grass seed and 100 feet of aircraft cable. Live willow clumps were scooped up by the excavator from a nearby area, and placed between root wads, near the wetted perimeter.

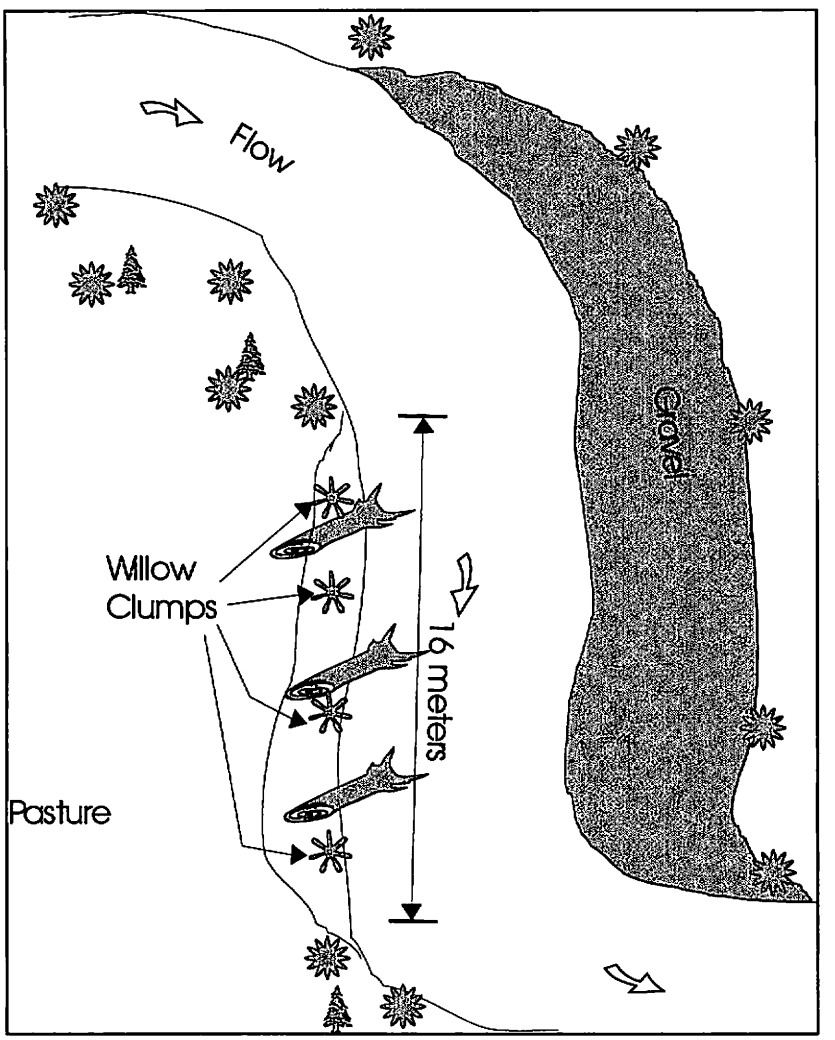

Figure 6: Site 2

2.7. Site 3

Maxan Creek Site 3 was not prescribed for in AEE (1997). It is approximately 60 m in length and is also located adjacent to a cleared pasture area and trail. The streambank was about 1.5 meters in height, vertically reposed and actively eroding. The stream here is a gently curving, relatively shallow riffle / run complex. Instream cover is limited by an absence of pools, pocket water, overhanging vegetation and LWD.

The eroding streambank at this site was stabilized using a large woody debris revetment (Figure 7). Approximately 17 tree/root wads were used along with 8 branched spruce trees, 5 clumps of livc willow, 4 loads of rock, one bag of grass seed and 250 feet of aircraft cable. Live willow clumps were scooped up by the excavator from a nearby area, and placed between rootwads, near the wetted perimeter. Branched spruce trees were used as header logs for about half the revetment. They were placed with the butt on top of the upstream root wad and the top underneath the downstream root wad. Their branches should further reduce water velocities along the bank.

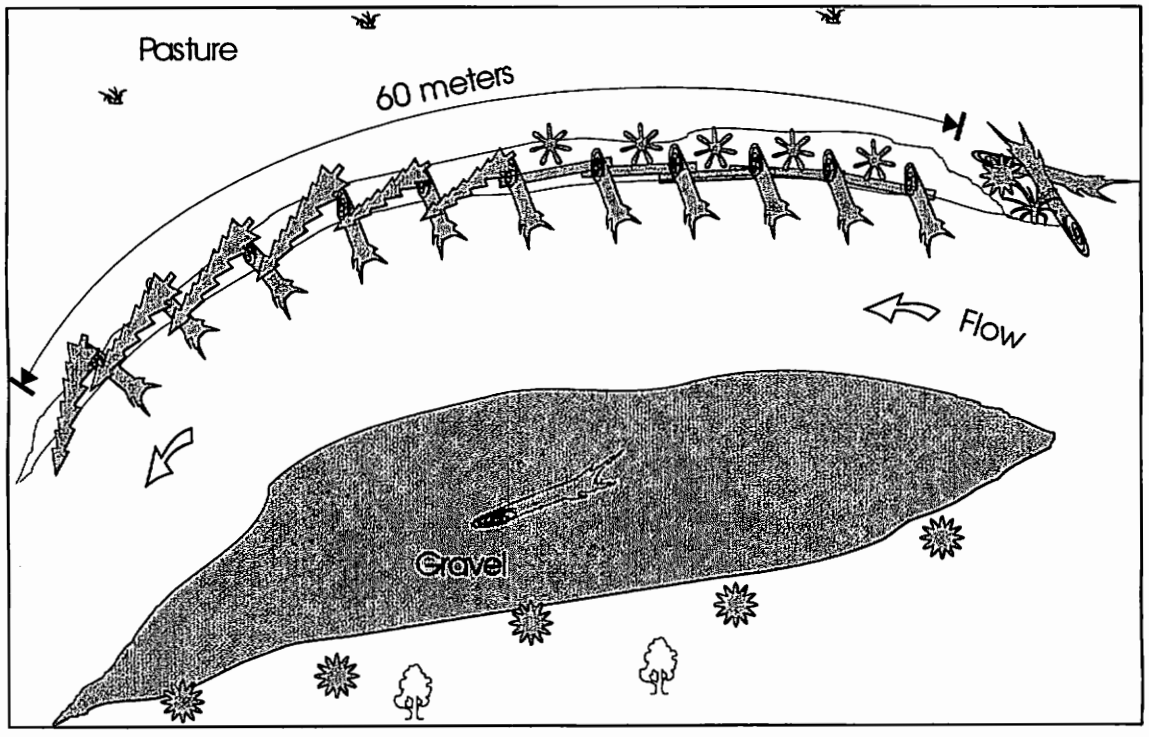

Figure 7: Site 3

2.8. Site 4

Maxan Creek Site 4 was not prescribed for in AEE (1997). It is approximately 115 m in length and is located adjacent to a cleared pasture area and trail. The streambank was about 1.5 meters in height, vertically reposed and actively eroding. The stream here is a curving, relatively shallow riffle / run complex. The channel is divided. At the beginning of the project the majority of flow was along the outside of the meander bend. A beaver dam was constructed shortly afterwards, redirecting the majority of flow through the shallow cut off channel. Instream cover is limited by an absence of pools, pocket water, overhanging vegetation and LWD.

The eroding streambank at this site was stabilized using a large woody debris revetment (Figure 8). Approximately 32 tree/root wads were used along with; 20 branched spruce trees, 850 willow cuttings, one bag of grass seed and 300 feet of aircraft cable. Branched spruce trees were used as header logs. These were placed such that the butt rested on top of the upstream root wad and underneath the downstream root wad.

An attempt was made to stabilize the large gravel bar at this site using 4 LWD structures. Each of these structures consisted of 2 tree/root wads, cabled together and anchored in place using driveable anchors.

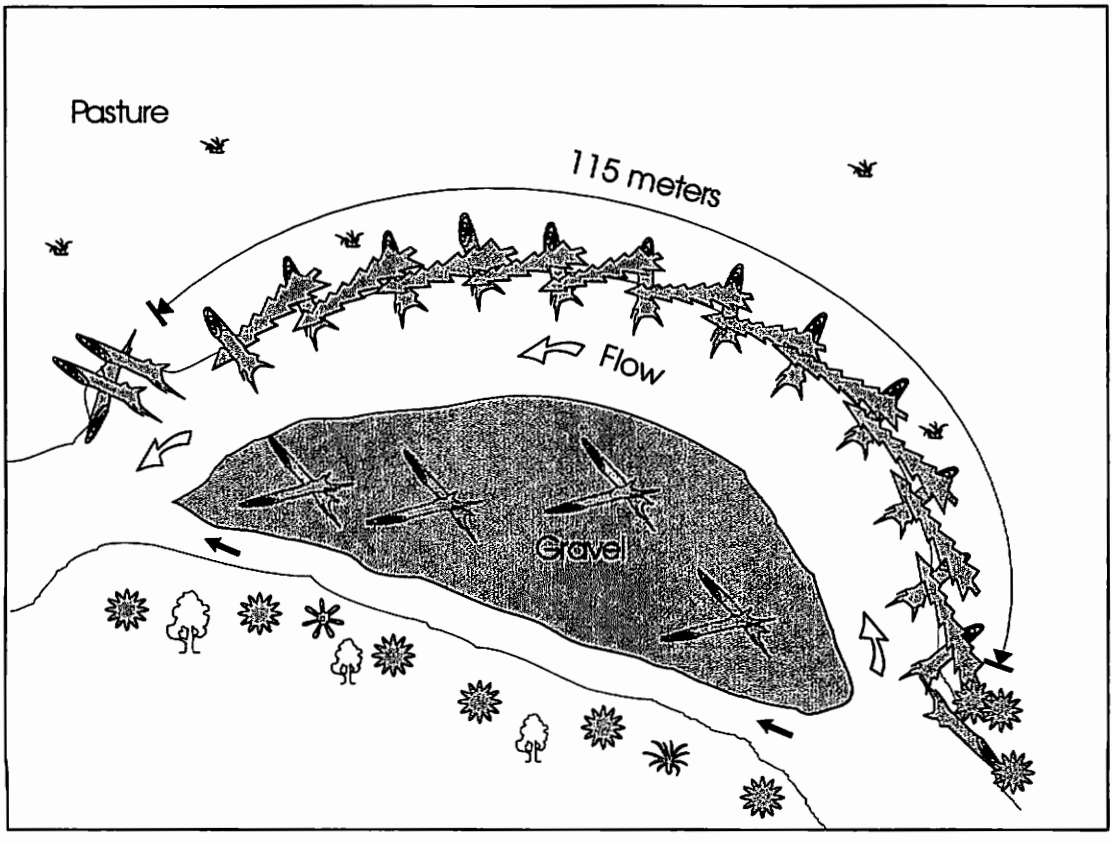

Figure 8: Site 4

2.9. Site 5

Maxan Creek Site 5 corresponds to Site 10 in AEE (1997). It is approximately 100 m in length and is located adjacent to a cleared pasture area. The stream channel is divided. All flow in 1998 was through the shallow, straight, cut off channel. At higher flows water would flow along the outside of the meander bend as well. This bank was about 0.5 to 1.0 meters in height, vertically reposed and actively eroding.

The bank was stabilized using a large woody debris revetment (Figure 9). Approximately 19 tree/root wads were used along with; 6 loads of rock, 1000 willow cuttings, 1.5 bags of grass seed and 300 feet of aircraft cable.

The large gravel bar at this site was stabilized using 3 LWD structures. Each of these structures consisted of 2 - 3 tree/root wads cabled together and anchored in place using driveable anchors.

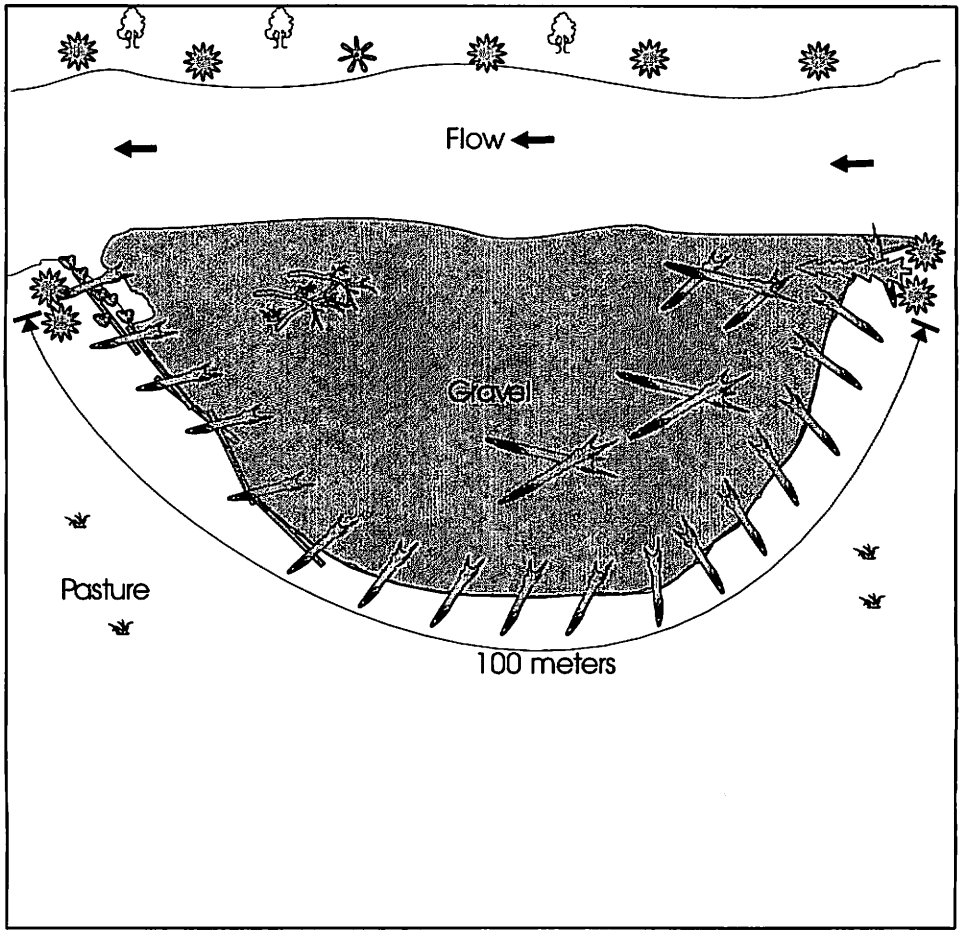

Figure 9: Site 5

2.10. Site 6

Maxan Creek Site 6 is not prescribed for in AEE (1997). It is approximately 125 m in length and is located adjacent to a cleared pasture area. The stream channel is divided. All flow in 1998 was through the shallow, straight, cut off channel. At higher flows water would flow along the outside of the meander bend as well. This bank was about 0.5 to 1.0 meters in height, vertically reposed and actively eroding.

The bank was stabilized using a large woody debris revetment (Figure 10). Approximately 30 tree/root wads were used along with; 5 loads of rock, 1000 willow cuttings, 1.5 bags of grass seed and 350 feet of aircraft cable.

The large gravel bar at this site was stabilized using 7 LWD structures. Each of these structures consisted of 2 - 3 tree/root wads cabled together and anchored in place using driveable anchors.

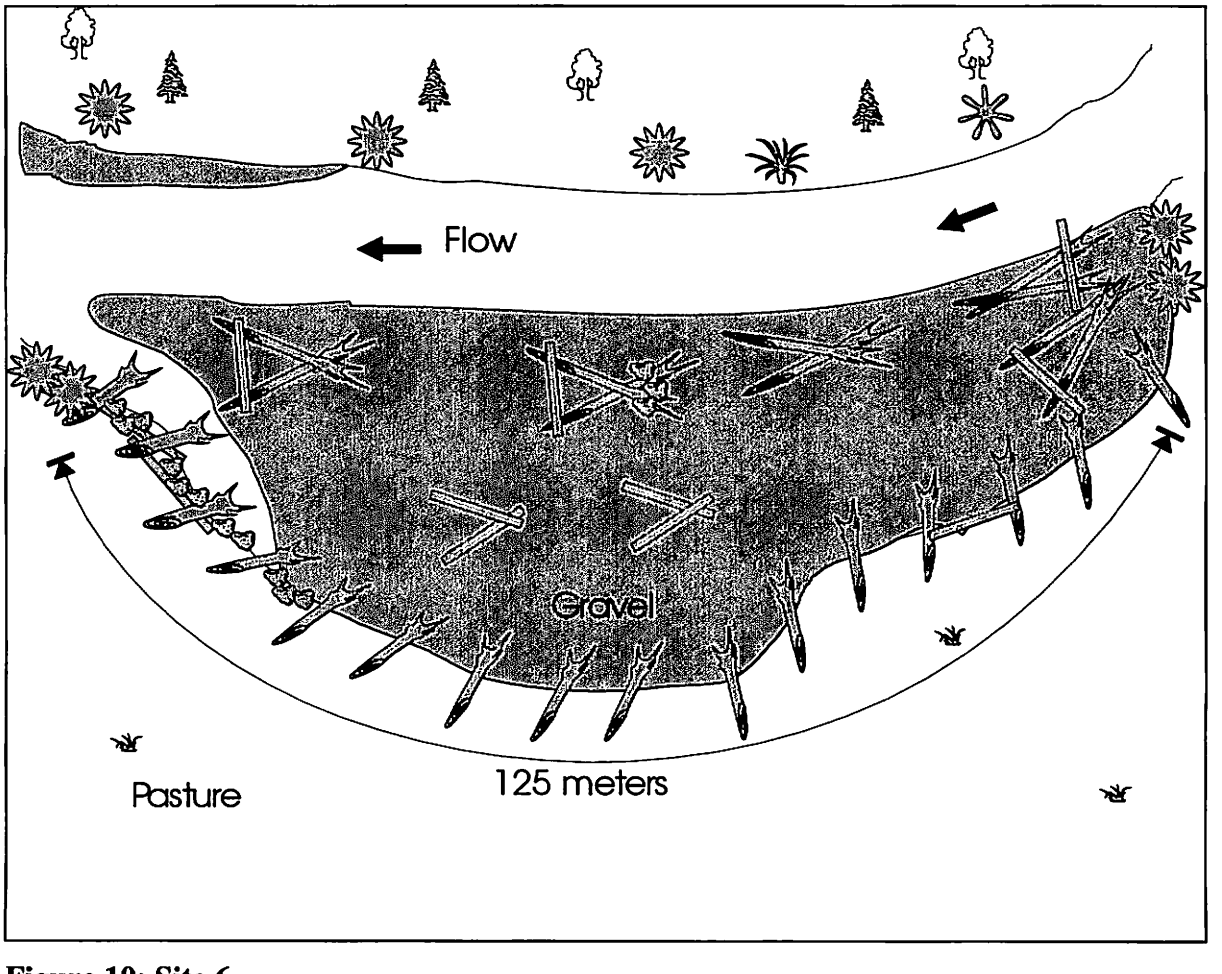

Figure 10: Site 6

2.11. Site 7

Maxan Creek Site 7 corresponds to Site 9 in AEE (1997). It is approximately 10 m in length. The banks are destabilized by heavy livestock use.

The stream channel at this site is straight or gently curving. At higher flows water would also flow along the outside of the meander bend opposite from the site.

The bank was stabilized using a large woody debris revetment (Figure 11). Approximately 3 tree/root wads were used along with; 50 willow cuttings, and 50 feet of aircraft cable.

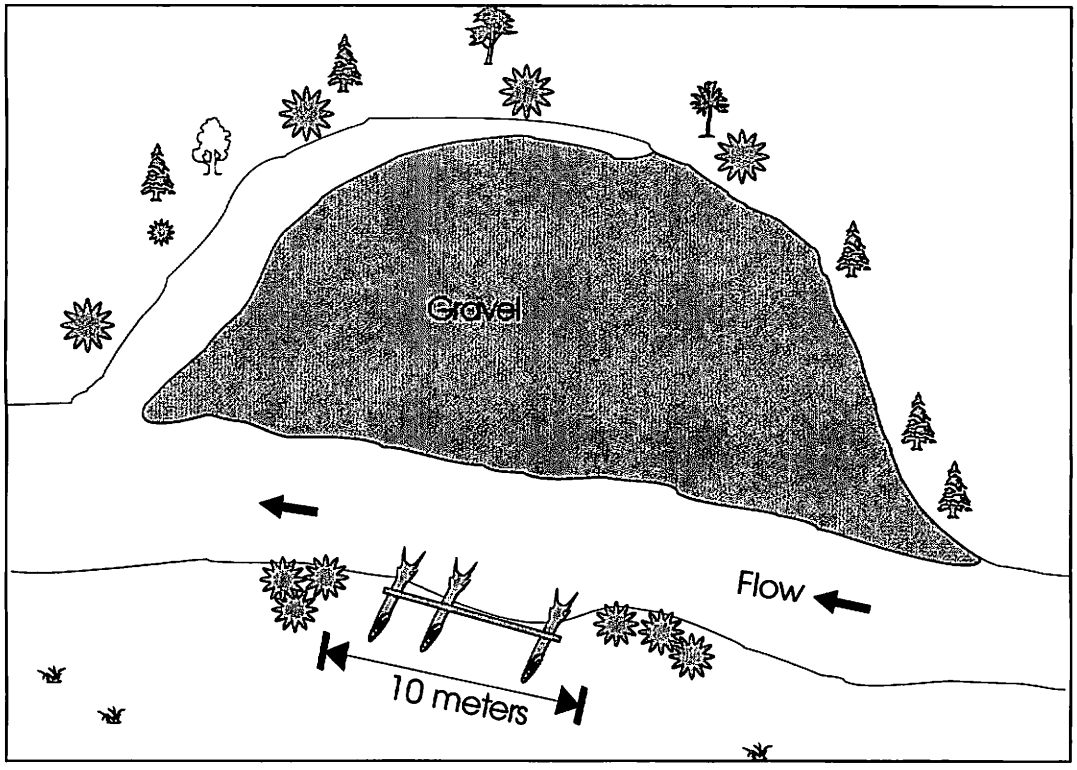

Figure 11: Site 7

2.12. Site 8

Maxan Creek Site 6 is not prescribed for in AEE (1997). It is approximately 50 m in length and is located adjacent to a cleared pasture area. There is no deep rooted riparian vegetation remaining on this side of the creek. The streambank was about 1.5 - 2.0 meters in height, vertically reposed and actively eroding. The stream is a gently curving, relatively shallow riffle / run complex. Instream cover is limited by an absence of pools, pocket water, overhanging vegetation and LWD.

The bank was stabilized using a large woody debris revetment (Figure 12). Two layers of rootwads were used. The top layer was placed over top of the header logs. A brush/debris barrier was placed about 3 meters back from the revetment to limit livestock access.

Approximately 26 tree/root wads were used along with; 500 willow cuttings, one bag of grass seed and 350 feet of aircraft cable.

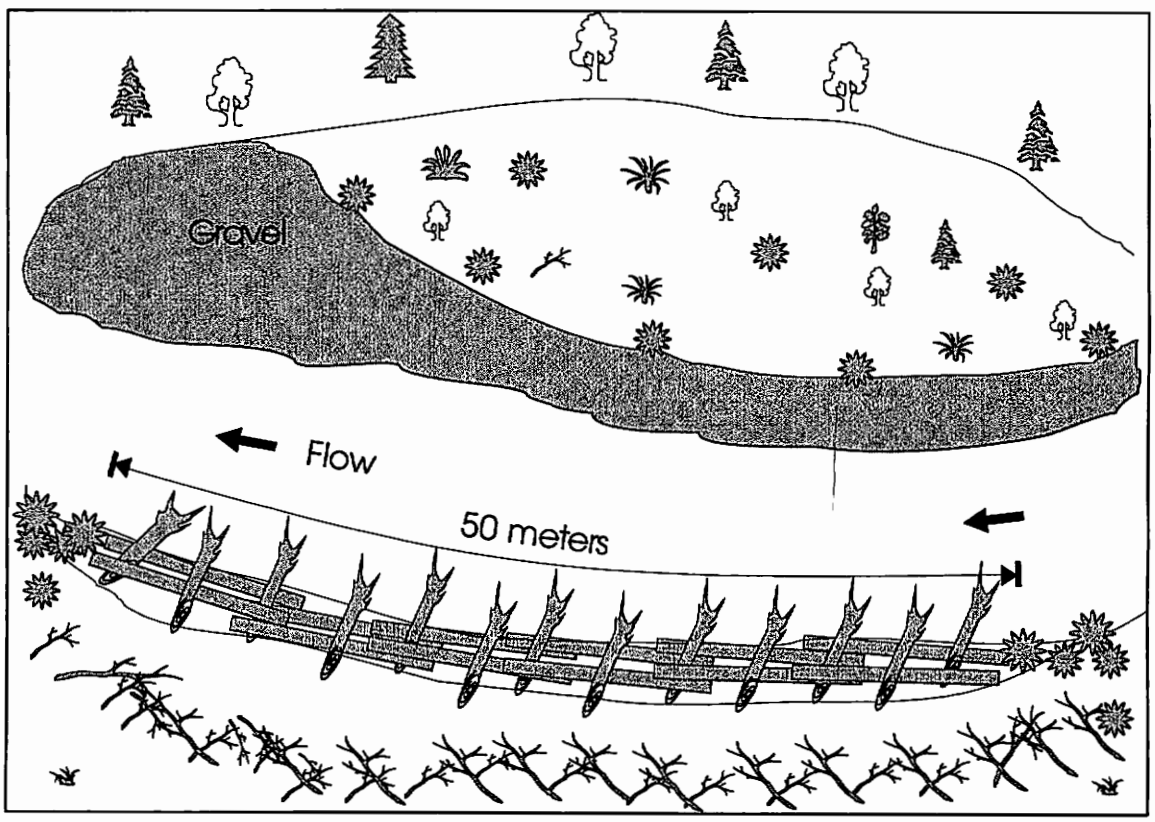

Figure 12: Site 8

3. Conclusions

Restoration works were completed at all eight sites by August 15, 1998. Total cost for the project was $42,899.42. A cost breakdown is provided below.

Expenditure Type	Amount
Manpower	$17,825.00
Equipment Cost	$20,901.27
Materials and Supplies	$4,173.15
Totals	$42,173.42

Manpower was split as follows:

	Days	**Cost/Day**	**Cost**
Sr. Biologist	14 days	$500/ day	$7,000
Crew supervisor	14 days	$400/ day	$5,600
2 Person Crew	9.5 days	$550/ day	$5,225
Total			$17,825

Materials used for the works included;

- tree stems with root wads 170,
- willow cuttings 4200,
- driveable duck bill anchors 100,

- galvanized aircraft cable (feet) 2000,
- grass seed (50 lb bags)..... 8, and
- boulders (truck loads)..... 20

4. Monitoring

This report will provide the basis for future assessment of project effectiveness. Monitoring of structure stability, riparian vegetation condition and fish habitat condition will be conducted on an annual basis. Monitoring will occur following spring freshet. Structure repairs will be conducted as required.

It is anticipated that survival of willow cuttings will be fairly low because of warm dry conditions during the mid summer planting. Additional willow planting will be conducted in the spring as required.

5. Future works

Future work at these sites will include measures to reduce livestock impacts to the stream and riparian areas, and additional planting of spruce and cottonwood in riparian areas.

A tentative agreement has been reached with the landowner (Mr. Strimbold) and the Department of Fisheries and Oceans (DFO), to fence and manage the area as a riparian pasture / hay field. Fencing materials will be provided by DFO, manpower and equipment to construct the fences will be provided by the Landowner, and additional manpower and materials as required would be provided by MELP with funding from FRBC. In return for the fencing materials and manpower funding, the landowner will agree to utilize the pasture areas for hay production, leaving a riparian buffer area, and only allow livestock into the area for a short period in the fall.

6. Appendix I: Photos

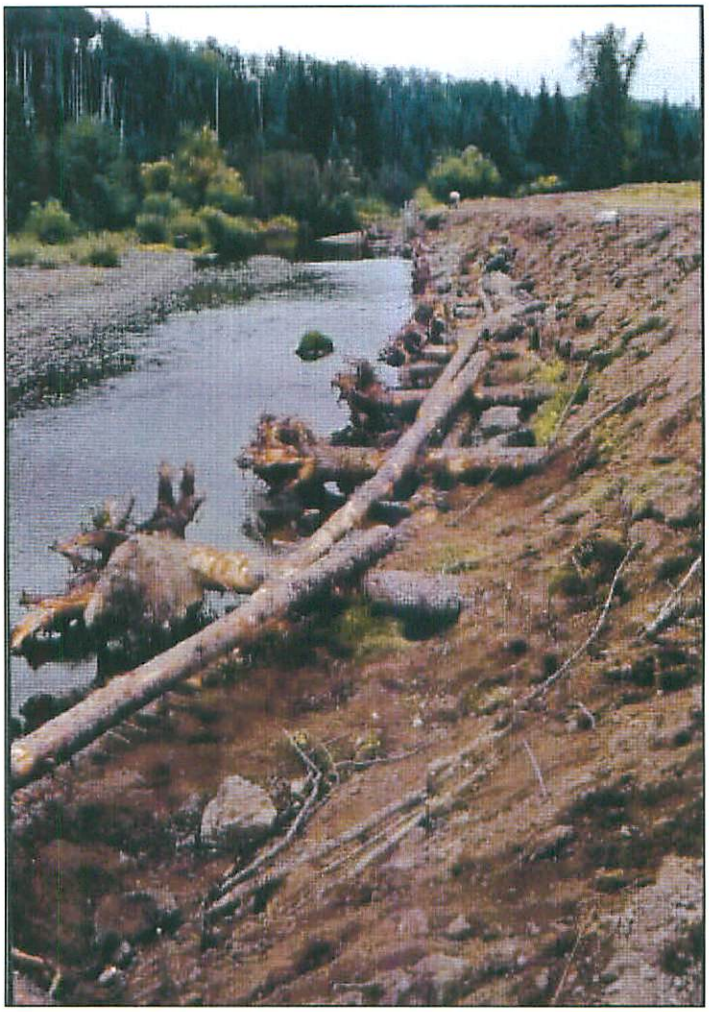

Figure 3: Site 1 - LWD Revetment

1. Appendix I: Photos

Figure 1: Site 1 - Placing LWD

Figure 2: Site 1 - LWD Revetment

Figure 4: Site 6 - Bar Stabilizaton Structure

Figure 5: Site 6 - Anchoring for Bar Stabilization Structures