Annual Compendium Of Aquatic Rehabilitation Projects For The Watershed Restoration Program 1998 - 1999

LWD Boulder Complexes

Off-channel Habitats

Culvert Replacements

Bank Stabilization

Pool-riffle Reconstructions

Watershed Restoration Project Report No. 13
1999

British Columbia

Funded by:
Forest Renewal BC

Watershed Restoration Program
Ministry of Environment, Lands and Parks
and Ministry of Forests

Annual Compendium Of Aquatic Rehabilitation Projects For The Watershed Restoration Program 1998 - 1999

Editor
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Watershed Restoration Project Report No. 13

Watershed Restoration Program
Ministry of Environment, Lands and Parks
2204 Main Mall, UBC
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1999

Executive Summary Highlights

B.C's Watershed Restoration Program (WRP) was implemented under the Province's Forest Renewal Plan in mid-1994 in response to a historical lack of mechanisms for ensuring rehabilitation of logging-impacted hillslopes, riparian areas and streams. In combination with the Forest Practices Code, WRP provides an important opportunity to improve water quality and reverse fish habitat impairment. A strategic target, established by Forest Renewal BC, is to complete restoration of 20 % of the high priority or key watersheds over the next five years. WRP is a watershed level program in recognition of "top-down" linkages of roads, gullies and streams. Seventy five percent of expenditures are initially directed at hillslopes (reported on elsewhere by the Ministry of Forests). Twenty five percent of expenditures have been directed at streams (reported on here by the Ministry of Environment, Lands and Parks).

Aquatic restoration **facts and figures**:

- Watershed sub-basin level **projects** in 1998/99;
  - **460** aquatic condition assessments
  - **177** aquatic restoration projects
  - **41** effectiveness monitoring projects
- Approximately **$9 million** expended in 1998/99 on restoration works; **$67,000** average cost for **126** works projects (summaries attached);
- Lead **proponents** in 1998/99;
  - forest licensees (**45 %**)
  - government agencies **(20 %**)
  - First Nations (**12 %**)
  - forest worker/fisher groups (**7 %**)
  - community and environmental stewardship groups (**16 %**)
- As a key indicator, an estimated total of **222 km** treated in 1998/99 (about 3-fold that of 1997/98);
  - fish access restored (**48 %,** largely culvert blockages)
  - in-stream habitat rehabilitated and channels stabilized (**38 %)**
  - off-channel habitat restored or replaced (**14 %)**

BC Environment Region	Off-channel km	In-stream/Channel km	Fish Access km
Vancouver Island	9.4	17.2	9.1
Lower Mainland	19.4	14.5	0
Thompson-Okanagan	1.5	22.8	3.0
Kootenays	0.1	8.1	9.6
Cariboo-Mid-coast	0.4	4.8	72.5
Skeena – QCI	0.3	4.5	0.9
Omineca-Peace	0	11.7	12.0
Total by Type	**31.1**	**83.6**	**107.1**

- In comparison, US Forest Service averaged about **250 km per year** of restoration on federal lands (50 % of Washington plus Oregon) over the past decade;
- Benefits are much broader than restored aquatic resources, and include:
  - community employment operating machines, securing structures, and planting;
  - training/mentoring of 1500 people via courses, workshops and conferences since1995;
  - a sharp increase from a few to 30 experienced stream restoration consulting firms;
  - greater than 90 % functionality of stream restoration projects;
  - positive responses of fish stocks based on initial intensive effectiveness monitoring;
  - positive perceptions within the forest products marketplace.

Preface

The Annual Compendium of Aquatic Rehabilitation Projects for the Watershed Restoration Program is a valuable technical reference to those planning, implementing and monitoring restoration of water quality and fish habitat affected by historical logging practices. This compendium of descriptions by practitioners also provides a useful technical reference for communications information and public education. Program planners and reviewers are provided with an equally important snapshot of aquatic restoration projects facilitated or managed by the Ministry of Environment, Lands and Parks. Close to 100 % of all aquatic restoration projects (excluding condition assessments) undertaken in 1998/99 by the Watershed Restoration Program are summarized in this compendium. Hillslope restoration projects are summarized separately by the Ministry of Forests. A diversity of proponents and their contractors, including forest licensees, government agencies, community and environmental stewardship groups and First Nations were involved in both assessment of aquatic-riparian conditions and restoration throughout the Provincial Forest in 1998/99.

Aquatic restoration, as described in the 1998/99 Compendium, is scientifically founded on several decades of research on watershed processes, limitations to salmonid production in streams, and fish habitat rehabilitation techniques, the latter described in 15 chapters in Slaney and Zaldokas (1997). These techniques provide the basis for a suite of integrated restorative measures to accelerate natural recovery processes in forested watersheds impacted by past practices. Natural recovery would otherwise require several decades (landslides) to 1-2 centuries (stream channels). Success is closely associated with a watershed-scale focus, effectiveness monitoring, and training and education initiatives, including an ongoing BC-US technical exchange with the US Forest Service.

Today there is much greater knowledge of the effects of past forest harvest practices on water quality, fish stock productivity and habitat losses of anadromous and resident fish (summarized in Slaney and Martin 1997). Briefly, most watersheds in the province that have supported intensive forest harvesting activities in the past have altered flow and drainage patterns, resulting in greater sediment delivery to fish-bearing streams and community water supplies. Over the past decade, hillslope failures from roads and gullies have become much more evident as logging has shifted to steeper slopes. Old roads have failed more frequently at drainage crossings or saturated side-casts which incorporated decaying woody debris. Further, most coastal and many interior streams were historically logged to the streambanks, augmenting bank erosion and creating a major deficit in the future supply of large mature wood to stream channels. Large wood is the primary structuring element in forested streams, providing pool habitat and cover for fish rearing in summer as well as critical refuges from extreme winter-spring conditions. Although the role of large wood in streams in providing fish habitat was established earlier, the linkage to the natural riparian-channel process of large wood loss and recruitment was not understood or recognized until the 1980's (Slaney and Martin 1997). Past fisheries legislation tended to promote large wood removal, and past practices by fisheries and water management agencies that resulted in removal of wood, especially of log jams, has compounded the problem further. Moreover, channelized or uniform sections of streams are also common where streams have been aligned or diverted to protect logging roads, crossings, log sorting and milling sites. Fish passage at road culverts has been a long-standing and universal concern, but it was not appreciated in the past that juveniles frequently require off-channel refuges to successfully over-winter. A lack of stream nutrients, resulting from the combination of watershed impacts and overfishing which reduces salmon carcasses as a source of nutrients and carbon, is a more subtle and unrecognized impact that is only now receiving greater attention as declining trends in escapements of salmon become more evident. Recent tracer studies in the USA and Canada demonstrate the key role of marine-derived nutrients, even in the smaller salmon streams. Finally, early forestry practices favoured natural restocking of trees, which resulted in a dominance of deciduous trees, and promoted damming activity by beavers on small streams utilized by migrant fish species.

Case studies that examine biological benefits of watershed restoration at a watershed or reach level are sparse, but there is compelling evidence that selected aquatic techniques are successful. Off-channel fish habitat projects have a high incidence of success because of a lengthy history in British Columbia; typical egg-to-fry and juvenile survivals are much higher than in mainstems. Evidence supporting stabilization of logged hillslopes and channels, or restoration of large wood in streams, is largely from a few US case studies. For example, hillslope and channel stabilization at Deer Creek, Washington, have reduced sediment transport and in-filling of boulder substrates and pools. There, adult coho salmon and summer steelhead have been documented to have recovered to 60-80 % of historical abundance, from a low of 10-20 % a decade ago. Also, the effects of restoration of large wood in three debris-poor streams were monitored at Porter Creek (Washington) and at tributaries of the Alsea and Nestucca Rivers (Oregon). Smolt outputs increased 3-5-fold from the treated streams compared to controls. Results have been less conclusive from monitoring of 14 km of large wood restoration at a higher gradient stream at Fish Creek, Oregon, where the boulder substrate provided some of the habitat structure. More recent effectiveness monitoring of restoration projects in British Columbia are providing additional support, as documented at the Keogh River for anadromous fish and at the West Kettle River for resident fish, and preliminary results are summarized in the 1998/99 Annual Compendium. For example, watershed level treatments of the Keogh system, including road-gully stabilization, annual nutrient replacement, off-channel habitat restoration or replacement, and ongoing instream fish habitat rehabilitation have been recently associated with strong upward trends in the abundance and average sizes of both coho salmon and winter steelhead trout.

It is assumed that restoration of structural diversity and nutrient sources (often salmon carcasses) will accelerate recovery of aquatic communities and biodiversity of disturbed aquatic ecosystems. Large, old growth trees in stream channels with their massive rootwads as anchors are the type of structure that cannot be easily duplicated or replaced. This is the rationale for cable-anchoring of woody complexes to streamside trees and instream boulders, at least on the first pass. Salmon spawners and kokanee, in particular, are keystone species as the vital link between aquatic and terrestrial communities, especially within the riparian zone. For the long term, riparian restoration needs to be implemented and maintained to accelerate recovery of riparian functions, providing future desired conditions for fish and wildlife resources; shrubs and deciduous trees for leaf litter mixed with mature coniferous trees for large wood recruitment and fluvial-resistive root systems. Most of the projects outlined in the Compendium are focused on the short term (20-50 years), but riparian projects are increasingly focused on the long term.

Practitioners of restoration have little control over fish harvest rates, or climatic conditions that cause shifts in migrant survivals. However, recent measures in British Columbia to preserve stocks-at-risk, improve management of weak stocks and rebuild other stocks should ensure more rapid positive responses to watershed restoration.

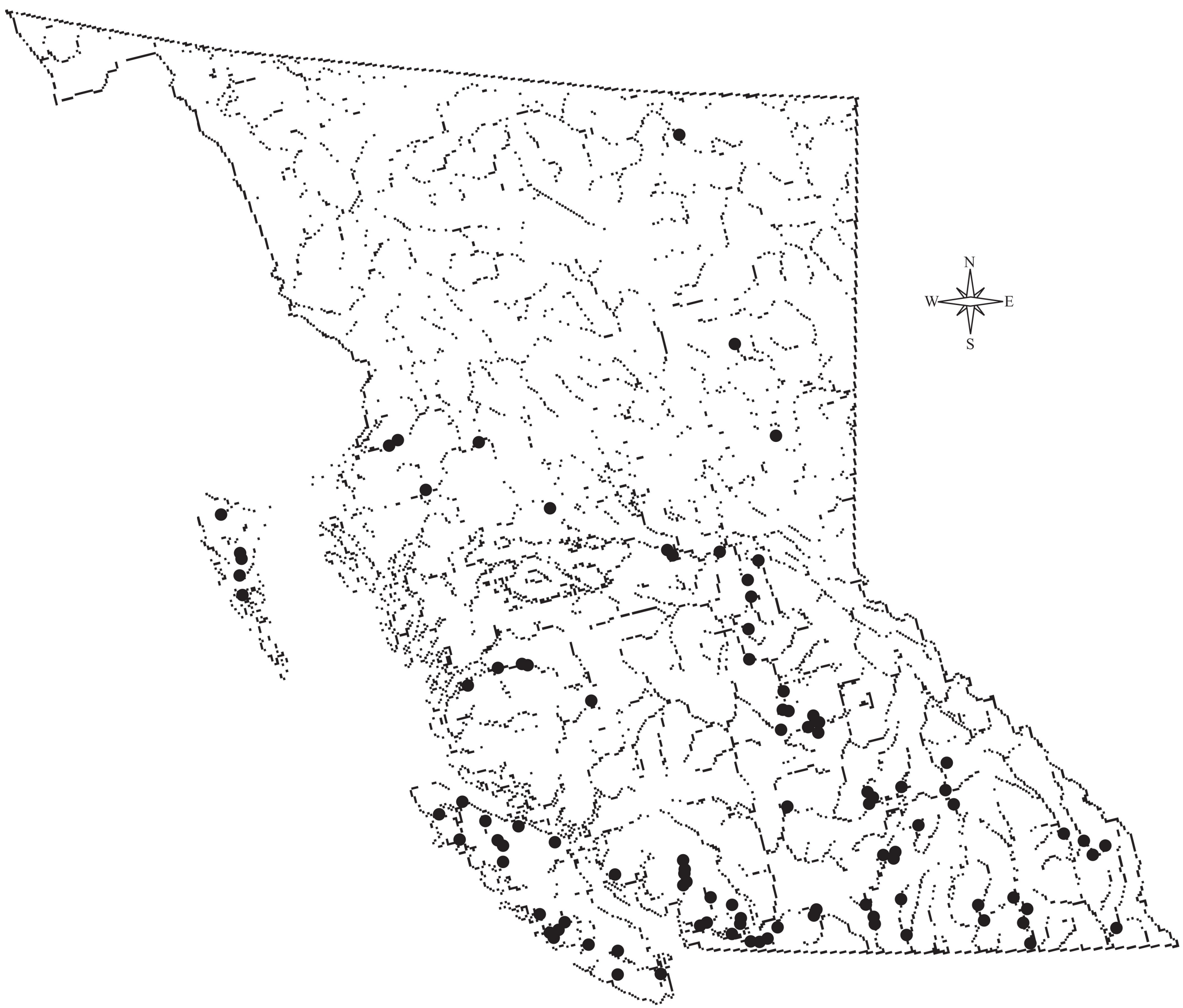
Pat A. Slaney, Technical Coordination Manager
Watershed Restoration Program
Ministry of Environment, Lands and Parks

Summary of WRP stream and riparian assessment and restoration projects, by Ministry of Environment, Lands and Parks region/subregion, which were undertaken in the 1998/99 fiscal year, whereby numbers are derived on a watershed sub-basin or tributary level.

	Channel Assessments	Habitat Assessments	Riparian Assessments	Culvert Assessments	Habitat Channel Restoration	Riparian Restoration	Fish Passage Restoration	Project Effectiveness Monitoring[1]
Vancouver Island	4	35	11	6	20	4	1	8
Lower Mainland	10	24	16	4	23	11	0	15
Southern Interior	12	8	3	0	16	16	0	1
Kootenay	3	7	4	1	19	1	1	2
Cariboo	0	24	1	12	8	1	10	2
Skeena	3	30	16	1	13	4	3	8
Omineca	3	15	7	6	6	4	0	4
Peace	4	4	4	182	6	1	9	1
Totals	**39**	**147**	**62**	**212**	**111**	**42**	**24**	**41**

[1] These projects are not routine monitoring.

WRP Project Locations in British Columbia (1998-99)



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Deep Creek Side Channel and Bank Stabilization

Objectives
The Deep Creek side channel and bank stabilization project is intended as a demonstration project to create off-channel rearing and overwintering habitats for salmonids (cutthroat, coho, steelhead /rainbow) as well as additional spawning habitat for coho, pink salmon and cutthroat trout in the Kitsumkalum watershed.

FRBC Region / MELP Region / MOF Region
Skeena-Bulkley / Skeena / Prince Rupert

Authors
Jim Culp, Project Manager and Kezia Sinkewicz, Junior Biologist.

Proponent
Kitsumkalum Band Council

Watershed
Kitsumkalum River

Location
Deep Creek is a tributary to the Kitsumkalum River approximately 6 km north of Terrace, B.C. along the Nisga'a Highway.

Introduction
Logging took place adjacent to the creek likely sometime during the 1960's. Since that time, channel scouring has become more prevalent, turbidity is more common and log jams appear to be more numerous. This change in the fish habitat has caused the habitat to be less productive and inclined to have a negative impact upon eggs incubating in the gravel as a result of siltation and scouring.

Assessments and Prescriptions
The decline in fish habitat productivity in Deep Creek moved the Terrace Salmonid Enhancement Society to submit a plan and apply for funding through the Watershed Restoration Program to stabilize the eroding banks of Deep Creek adjacent to the Deep Creek Fish Hatchery and downstream for about 200 m. As well, the plan includes a scheme to alter the configuration of a log jam at the end of the lower eroded bank to reduce or eliminate future erosion caused by the jam and create a controlled flow surface water side channel just downstream from the hatchery.

Rehabilitation Work
The side channel construction began in August 1997 with the excavation of a dry area 383 m^2 by a 490E John Deere excavator (Figs. 6-11, 6-12). A log cribbing berm was built adjacent to Deep Creek and some of the excavated material and large rocks were used as ballast (Fig. 6-13). A deep pool was dug immediately behind the cribbing to create a head pond behind a control structure. Three spawning pads were created in the channel with the existing gravel that was graded by hand using a mesh grader with aluminum pipe grates spaced 3.5 cm apart to regulate the water flow through the channel. A flow control structure was constructed using treated lumber 15 m downstream from the cribbing (Fig. 6-14). The structure is a stop-log design with an opening 120 cm wide by 80 cm deep with slotted sides that 2"x6" planks fit into to control the flow of water. Upon completion of the channel construction, 3 Big 'O' pipes with a diameter of 15 cm and a length of 3 m were placed in the berm to provide, along with the opening through the rocks, an intake for the creek water to flow into the side channel. Following completion of the intake, woody debris and large rocks were installed at key locations in the channel.

Drought conditions during July 1998 caused very low water conditions in Deep Creek resulting in the channel inflow to be dramatically reduced. This threatened the ability of the channel to maintain suitable water conditions for fish to rear in. To alleviate the low flows into the channel during drought periods, a 20'x 12" culvert was placed under the berm at the top of Deep Creek side channel in August 1998 (Fig. 6-15). To accomplish this, a trench was excavated with a mini excavator and covered over by the restoration crew who also completed the bank cleanup and rock placement. The end result of this additional intake was the establishment of suitable flows that will support spawning, incubation and rearing of salmonids during low flows (Fig. 6-16).

Cost Summary

Fees	$ 23,164
Equipment rental	$ 3,616
Disbursements	$ 3,364
Total	$ 30,144

Production Estimates

This project has created overwintering and rearing habitat. Using the biostandards from Marshall and Britton (1990), the coho smolt carrying capacity for the side channel based on its area is 306 per year. This calculation does not factor nutrient level, stream gradient, temperature or flow. A carrying capacity estimate has not been made for other species.

On May 20, 1998, a pair of cutthroat were observed spawning in the lower section of the side channel. On August 31, 1998, one pair of pink salmon was seen spawning in the top gravel pad, 40 m downstream from the control flow structure. Another pair spawned just upstream of the pad. On four occasions, between August 31, 1998 and September 14, 1998, chum salmon were seen swimming through the channel. Two days later, another pair of chum spawned in the channel outlet. In mid-October a lone coho was observed in the channel and on November 25, 1998, a pair of coho were seen spawning at the same location where the chum spawned. In addition, coho, rainbow and cutthroat fry, parr and smolts have been observed throughout the length of channel.

A steady water flow was maintained in the side channel for most of the winter of 1997/98. The bank stabilization under the walking bridge is holding to date.

The culvert installed in August 1998 is working very well, providing a flow of water to the channel that should be sufficient during the lowest Deep Creek water conditions.

For Further Information, Contact:

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Figure 6-11. Abandoned side channel on Deep Creek prior to off-channel habitat rehabilitation.

Figure 6-12. Abandoned side channel after excavation without water intake open.

Figure 6-13. Construction of a berm to protect off-channel development.

Figure 6-14. Box culvert construction; controls flow into side channel.

Figure 6-15. Additional culvert intake installed to increase low flow levels in the side channel.

Figure 6-16. Deep Creek side channel water levels during low flows.

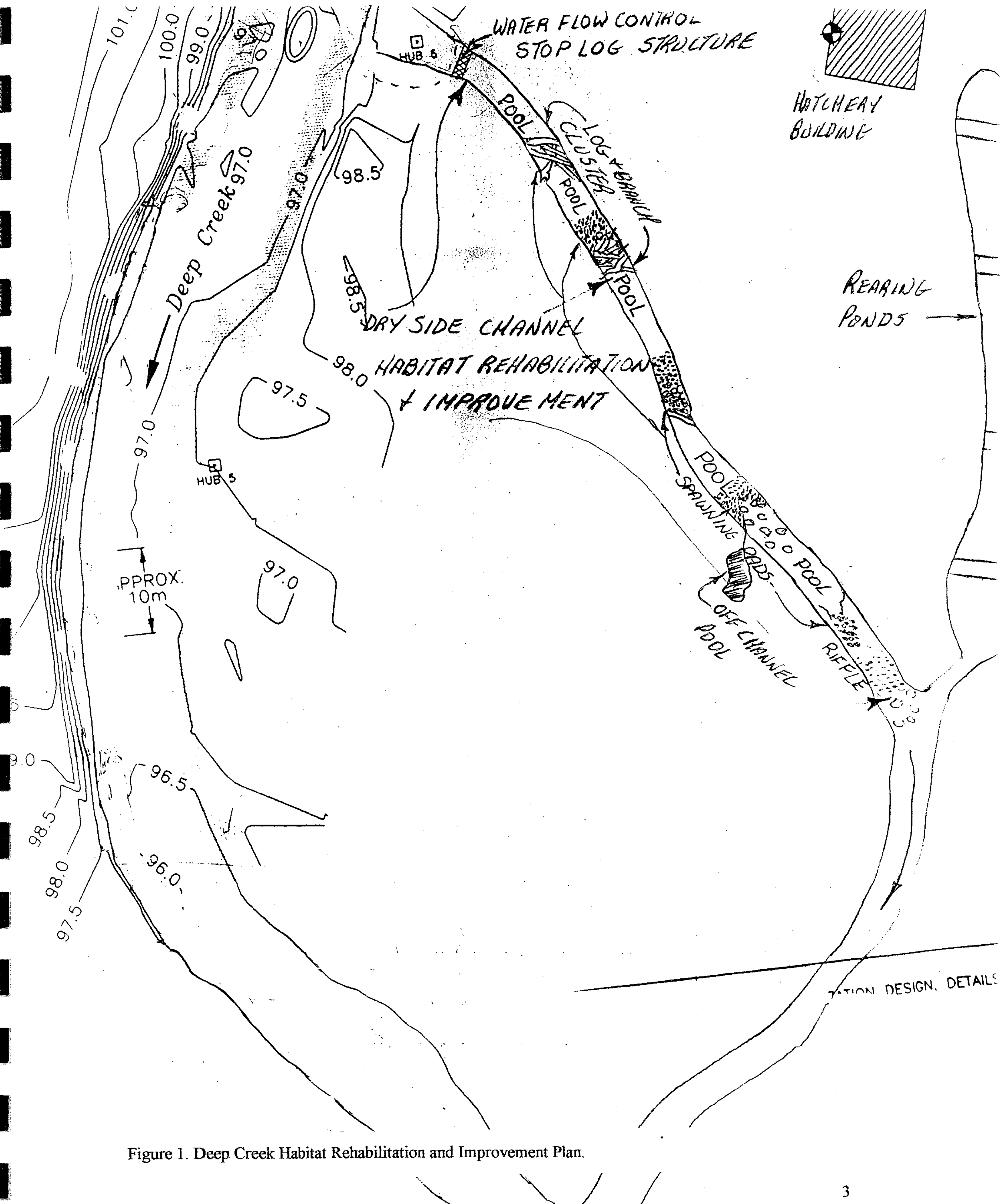

Figure 1. Deep Creek Habitat Rehabilitation and Improvement Plan.

Photo 1. Deep Creek side channel location before construction began.

Photo 2: Side channel after excavation.

Photo 3: Berm construction.

Photo 4: Gravel grader, constructed by TSES.

Photo 5: Box culvert construction; controls flow into side channel.

Photo 6: Deep Creek side channel after complexing.

Photo 7: Bank stabilization below the walking bridge.

Photo 8: Culvert installed August 1998 to allow additional water flow from Deep Creek.