Exxon Valdez **Oil Spill**
Restoration Project Final Report

In Stream Habitat and Stock Restoration for Salmon
Otter Creek Barrier Bypass Subproject

Restoration Project 94139-B1
Final Report

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Study History: Restoration Project 94139-B1 was initiated from Restoration Project 93063, Survey and Evaluation of Instream Habitat and Stock Restoration Techniques for Anadromous Fish, draft report 1993 by K.L. Wedemeyer. This report identified the Otter Creek barrier and opportunity to initiate a restoration project focused on pink salmon.

Abstract: In 1994, two barrier falls on Otter Creek, Bay of Isles, Knight Island, Prince William Sound were modified to provide upstream passage to adult pink salmon (*Onchorhynchus gorbuscha*). The falls were modified by using wire basket gabions, rock drills and wooden weir structures. In addition, an existing set of Alaska steeppasses were maintained and slightly modified for efficient passage of salmon.

Key Words: , *Onchorhynchus gorbuscha*, fishway, steeppass, *Exxon Valdez*, pink salmon, Prince William Sound.

Citation: Wedemeyer,K., and D.Gillikin. 1995. In stream habitat and stock restoration for salmon, Otter Creek barrier bypass subproject, *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 94139-B1), U.S.D.A. Forest Service, Anchorage, Alaska.

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Executive Summary

During the summer of 1994, the Forest Service made significant improvements to an existing fishway at Otter Creek, Bay of Isles, Prince William Sound. The purpose of the fishway modifications was to allow pink salmon access to previously inaccessible spawning habitat. Modifications focused on improving existing jump-pools to overcome two small five foot high barrier falls.

Otter Creek, located within the Chugach National Forest, flows into a cove on the northeast side of Bay of Isles, Knight Island in Prince William Sound. The Bay of Isles received heavy amounts of oil from the 1989 *Exxon Valdez* oil spill. Otter Creek supports small runs of pink (2,000 fish) and coho salmon (*Onchorhynchus kisutch*, 400 fish), and a few errant sockeye salmon have been recorded in the stream. Cutthroat trout and Dolly Varden also reside within the stream.

The Forest Service installed two Alaska steeppasses and associated jump pools in 1982. The steeppasses allow salmon access past a series of barrier falls near the mouth of Otter Creek. The purpose of the 1982 project was to create a small coho salmon run which spawned and reared young in the Otter stream and lake system. Annual Forest Service monitoring indicated that both pink and coho salmon successfully negotiated both steeppasses. Coho were then successfully proceeding upstream by jumping two small falls above the steeppasses. Pink salmon were blocked from further upstream movement by the first small falls located about 100 feet above the upper steeppass. The other small falls, located about 150 feet above the upper steeppass, was also determined to be a likely barrier to pink salmon. As a result of these findings, the Forest Service proposed to construct instream modifications to the falls that would allow pink salmon access to approximately 26,800 square feet of additional spawning gravels. The proposal was accepted and funded by the *Exxon Valdez* Oil Spill Trustees in 1994. The fishway improvements were completed in 1994 through construction of three pools using rock filled wire basket gabions and/or wooden weirs, modifying falls and jump-pools using a rock drill, and improving existing pools at the entrances and exits of the steeppass.

Introduction

Otter Creek (Alaska Department of Fish and Game Anadromous Stream Catalog #226-30-1680), located within the Chugach National Forest, flows into a cove on the northeast side of Bay of Isles, Knight Island in Prince William Sound (Figure #1). The Bay of Isles received heavy amounts of oil from the 1989 *Exxon Valdez* oil spill, Middleton, et al. (1992). Otter Creek supports small runs of pink (2,000 fish) and coho salmon (400 fish), and a few errant sockeye salmon have been recorded in the stream. Cutthroat trout and Dolly Varden also reside within the stream system. Population size of these species is generally unknown and considered small yet potentially significant.

The Forest Service installed two Alaska steeppasses and associated jump-pools within Otter Creek in 1982. The steeppasses successfully allowed salmon access past a series of barrier falls near the mouth of the stream. The purpose of the 1982 project was to create a small coho salmon run which spawned and reared young in Otter Creek and lake. Immediately after the fishway was constructed, the Alaska Department of Fish and Game stocked coho salmon in the system.

Forest Service monitoring of this fishway indicated that both pink and coho salmon successfully negotiated both steeppasses. Coho were successfully proceeding upstream by jumping two small falls (Figure #2) above the steeppasses. Pink salmon were blocked from further upstream movement by the first small falls located about 100 feet above the upper steeppass. The other small falls, located about 150 feet above the upper steeppass, was determined to be a likely barrier to pink salmon. Each of these falls is approximately five feet high. It was also likely, though not observed, that these two small falls would be a partial barrier to anadromous cutthroat trout and Dolly Varden, limiting some upstream migrations of these species. The Forest Service conducted temporary experimental modifications to these barriers by creating pools during the 1993 field season. This work established that adequate jump pools at the base of these barriers would allow pink salmon access over the falls. Also during 1993, approximately 500 pink salmon were dip netted over the barriers to monitor upstream migration. The stream reaches above the barriers, the lake and the inlet streams to the lake were surveyed to determine if these pink salmon were dispersing upstream of the barriers. Thirty pink salmon were counted in the stream leading to the lake and 20 at the inlet streams to the lake, some fish were noted to be engaged in redd building activity. This provided enough information to suggest that pink salmon would utilize spawning habitat above the barriers if they could access that habitat.

The existing fishway was functioning as designed for coho salmon. With some minor modifications, pink salmon could pass over the two small barrier falls allowing access to approximately 26,800 square feet of spawning gravels.

Objectives

Pink salmon were identified as an injured species resulting from the *T/V Exxon Valdez* oil spill. The project is located in an area of Prince William Sound which was most heavily oiled. The project objective was to increase the available spawning habitat for pink salmon by modifying stream barriers to allow this species increased spawning habitat in Otter Creek. To achieve this, the Forest Service designed and constructed jump-pools allowing pink salmon the ability to overcome the two small falls above the upper steeppass and conducted general repair and maintenance of all the original structures.

Methods

The fishway improvements were made between May 31 and June 6, 1994 by a field crew of 7 individuals. A field camp was set up along the shore of the cove and the crew was shuttled daily by a 17 foot skiff to the mouth of Otter Creek.

Upper Falls. A jump pool was constructed at the base of the upper falls (Figure #2) by installing a 9 foot(')long by 3' wide by 11/2' high (9'x3'x1.5') gabion parallel to and 5' downstream of the falls. The old gabion that was previously in this location had to be removed to allow the new one to be repositioned to accommodate the addition of a wooden weir. The gabion was anchored in the stream channel by 17/8 inch (") galvanized pipes drilled and mortared into the bedrock. To enclose the pool, a wooden weir (Figure #3) constructed of two pressure treated 8 inch x 8 inch (8"x8") boards capped with pressure treated 2"x6" boards was installed. A "V" shaped notch was cut in the center to allow fish a direct passageway into the pool. The notch was cut approximately 12" wide and 7" deep. The 8'x8's were pinned together with 3/8" rebar and the base of the weir was grouted with an underwater epoxy mortar. A rock drill was used to chip away an area of bedrock, 16"x24" from the face of the upper falls to improve the jump pool.

Lower Falls. Two 9'x3'x3' gabions were removed and then reinstalled at the lower falls in a slightly different configuration. The gabions were anchored in the same manner as the gabion at the Upper Falls, (Figure #2 & #3). Approximately 12" of loose rock was removed from the bottom of the pool. A new 6'x3'x3' gabion anchored by a 17/8" galvanized pipe drilled and mortared into bedrock was installed immediately downstream of the primary jump pool at these falls. Approximately 12" of loose rock was removed from the bottom of this intermediate step pool and 10" of bedrock was drilled out.

Upper Steeppass. A diversion into a pool at the upstream inlet of the steeppass was repaired by replacing the deteriorating 9'x3'x3' gabion with a 9'x3'x1.5' gabion. Wire repairs and repacking with rock were made to the backfill gabions along the sides of the steeppass. The remnants of a single low water diversion gabion below the steeppass (on the right bank looking upstream) were removed. The steeppass was inspected and found to be in good condition. Debris was cleaned from inside the baffles and the plywood covers were removed in order to facilitate future maintenance. The covers showed signs of deterioration and were not replaced.

Lower Steeppass and Turning Pools. Two gabions, 6'x3'x3' and 3'x3'x1.5', in the resting-pool above the steeppass were replaced. Removal of several large boulders and loose rock further improved the resting pool. The steeppass was found to be in good condition. The plywood covers were removed and not replaced to facilitate future maintenance as was done with the covers to the upper steeppass. The baffles of the steeppass were cleaned of debris. The backfill gabions were in fair condition, minor wire repairs and repacking with rock were made to the backfill gabions along the sides of the steeppass. The turning pools at the entrance to the steeppass were in good condition. The elevation of the walls on the down-stream sides of the turning pools were raised 8" by adding pressure treated 8"x8" boards (Figure #4). Rock debris from the entire fishway was removed to improve holding water and jump-pools.

Rock Work. General rock work was performed throughout the entire fishway. The majority of this

work was performed with the use of hand tools, the rest using a gas powered rock drill.

Results

Upper Falls. A jump-pool that is 5' by 6.5' averaging 2.5' in depth during moderate stream flows was created. There is a vertical jump height of 12" from the pool over the falls during moderate stream flows. The "V" shaped notch that was cut in the wooden weir will allow fish direct passageway into the pool with a vertical jump of 14" from a downstream pool into the notched passageway. This pool allows pink salmon improved passage over the falls at all but extreme low and high flows.

Lower Falls. A larger 9'x10' jump pool was created at the base of this five foot falls to reduce the vertical jump to 12" during moderate stream flows. The new gabion placement reduces the outlet to a 10" wide slot with a higher control point. This has the effect of raising the elevation of the pool and reduces the jump height. This provides an average pool depth of 3 feet. At moderate flows, water will slightly overtop the gabions. The 6'x3'x3' gabion forms a second jump pool immediately downstream of the primary (double gabion) jump-pool. This step-pool was required since the control point of the primary pool was raised. This provides pink salmon easier access into the primary jump pool's outlet by shortening the vertical jump height to 12" and reducing water velocity at the outlet. The step pool is 5'x7' with an average depth of 2 feet.

Upper Steeppass. It was determined that the steeppass covers were not serving a useful purpose and increased the risk of debris becoming lodged within the steeppass and not being detected during monitoring and maintenance activities. The gabion below this section of steeppass was removed because it was severely eroded and seemed to have little or no effect on the pool depth and steeppass efficiency when removed. This gabion was also blocking salmon passage up a side channel into the pool below the steeppass.

Lower Steeppass. The work in the pool above the steeppass resulted in an average pool depth of 3 feet. It is expected that these repairs will last approximately three years after which complete replacement may be needed. The higher walls added to the turning pools will act to restain fish within the pool from injuring themselves by jumping over the former lower walls of the pools and bouncing on the bedrock outcrops below the pool. The upstream side of the turning pool was left low to allow fish to re-enter the pool if they came back out of the steeppass, or were washed down at high flows.

Discussion and Conclusions

The modifications to the Otter Creek fishway allow the passage of both coho and pink salmon. The effects of the modification are not significant to coho salmon as they passed the former fishway with little trouble. The benefits focused toward pink salmon . This species now has the opportunity to utilize an additional 26,800 square feet of spawning habitat previously unavailable to them.

There is the possibility of indirect effects to coho salmon, cutthroat trout and Dolly Varden from the movement of pink salmon further upstream. These three species all can take advantage of spawning pink salmon through preying on eggs and fry as they emerge from the gravels and move to the estuary. This

predation should not be considered detrimental to the pink stocks as a surplus of young pink salmon should be produced to provide a net increase to the surviving pink salmon utilizing the Otter Creek and the marine environment. The fishway will be monitored and maintained annually by the Forest Service. Specific monitoring items can be found in the Forest Service project file related to function of this fishway. Considering the availability of funding, adult escapement surveys should occur annually. Further investigations of the cutthroat trout and Dolly Varden population and the relationship to the increase in pink salmon could also be undertaken.

Appendix A:

Tools and equipment used at the project site:

- A gasoline powered rotating hammer rock drill (Pounjar) with 4 point 2 inch diameter drill bits and chisel bits for drilling anchor holes and chipping bedrock.
- A smaller gasoline drill (Stihl) for drilling wood and mixing epoxy mortar.
- Wrecking/pry/tamping bars to loosen and move rock.
- Chainsaws to cut lumber, notch weirs, and clear work areas.
- PVC coated galvanized wire basket gabions (various sizes) and wire ties for constructing jump-pools and weirs.
- Geotextile material to line gabions prior to filling with rock.
- 17/8 galvanized pipe used to anchor wood and gabion weirs to the stream bottom.
- Underwater epoxy mortar (Thermo-Chem product #312) to seal weirs, help hold weirs to bedrock, and anchor galvanized pipe in bedrock drilled holes.
- 3/8 inch reinforcing rod (rebar) cut to various lengths.
- 8 inch by 8 inch pressure treated timbers cut to various lengths.
- 2 inch by 6 inch pressure treated lumber cut to various lengths.
- Burlap sandbags (filled) to build temporary water diversions to de-water stream areas allowing the crew to work on permanent structures.
- Miscellaneous hand tools such as claw hammers, sledge hammers, pliers, putty knives and wire cutter. Crews worked instream with hip boots and chest waders.

Acknowledgements

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References

Middleton, M, K. Sundet, M. Kuwada, M. Fink, 1992. Alaska Department of Fish and Game EVOS Operations Report-Habitat Division, 1989-1992.

Figure 1. Map showing approximate location of fish pass barrier bypass on Otter Creek in Prince William Sound. Otter Creek is located on the northeast end of Knight Island, and it flows into the Bay of Isles.

OTTER CREEK

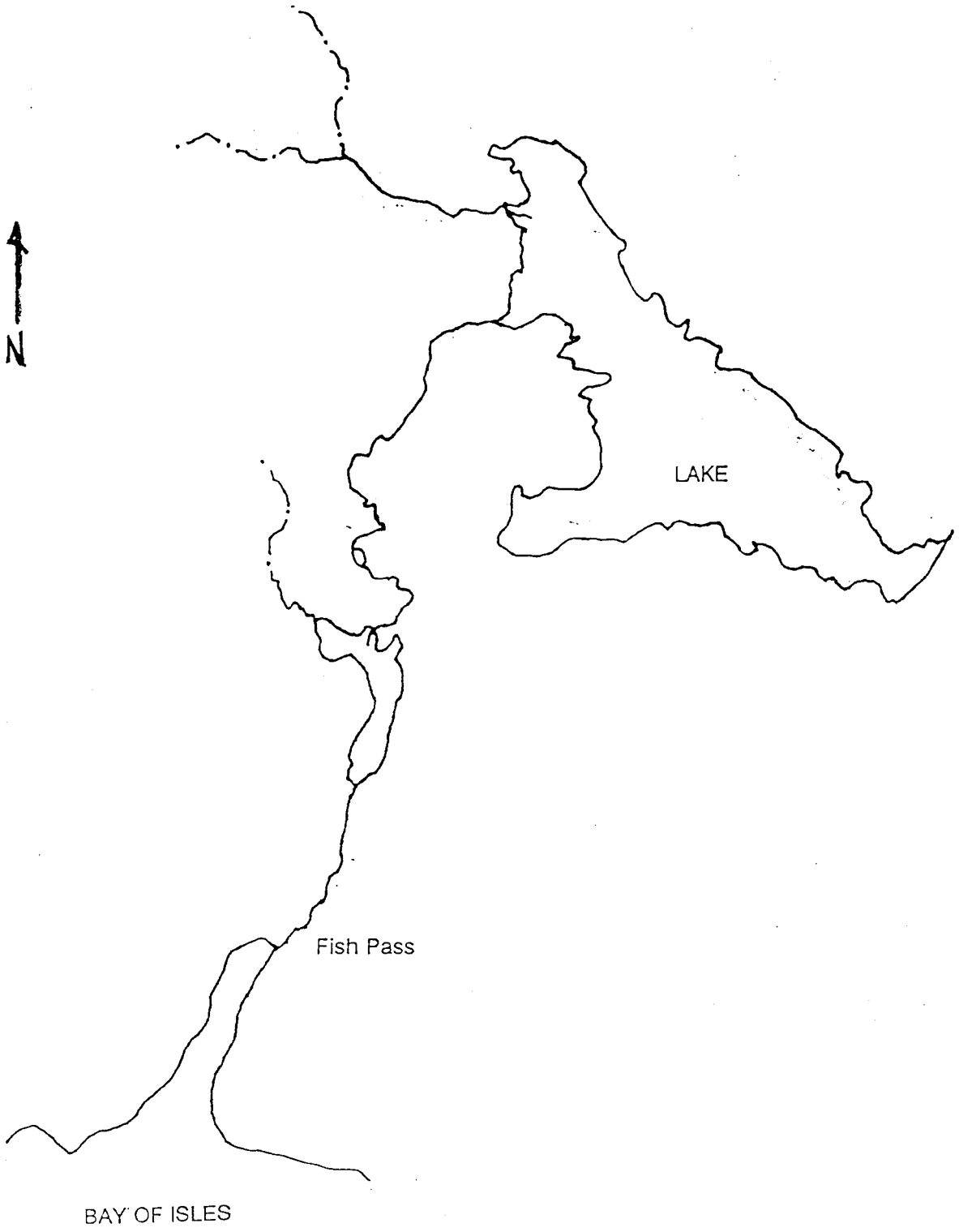

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Figure 2. Locator map showing Otter Creek fish pass modifications. Otter Creek is located on the northeast end of Knight Island, and it flows into the Bay of Isles.

Otter Creek
Fishway Modification
Figure #2

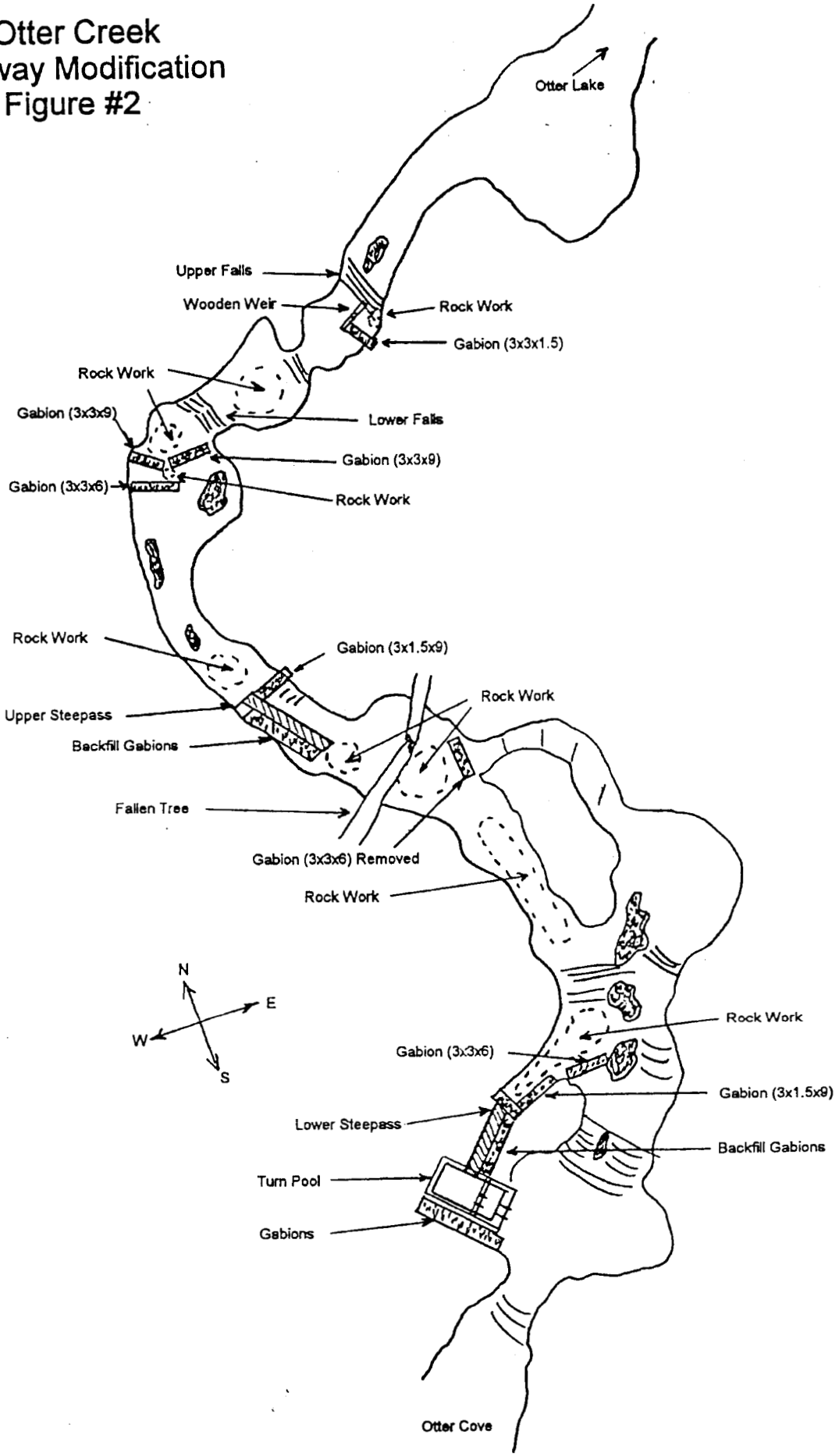
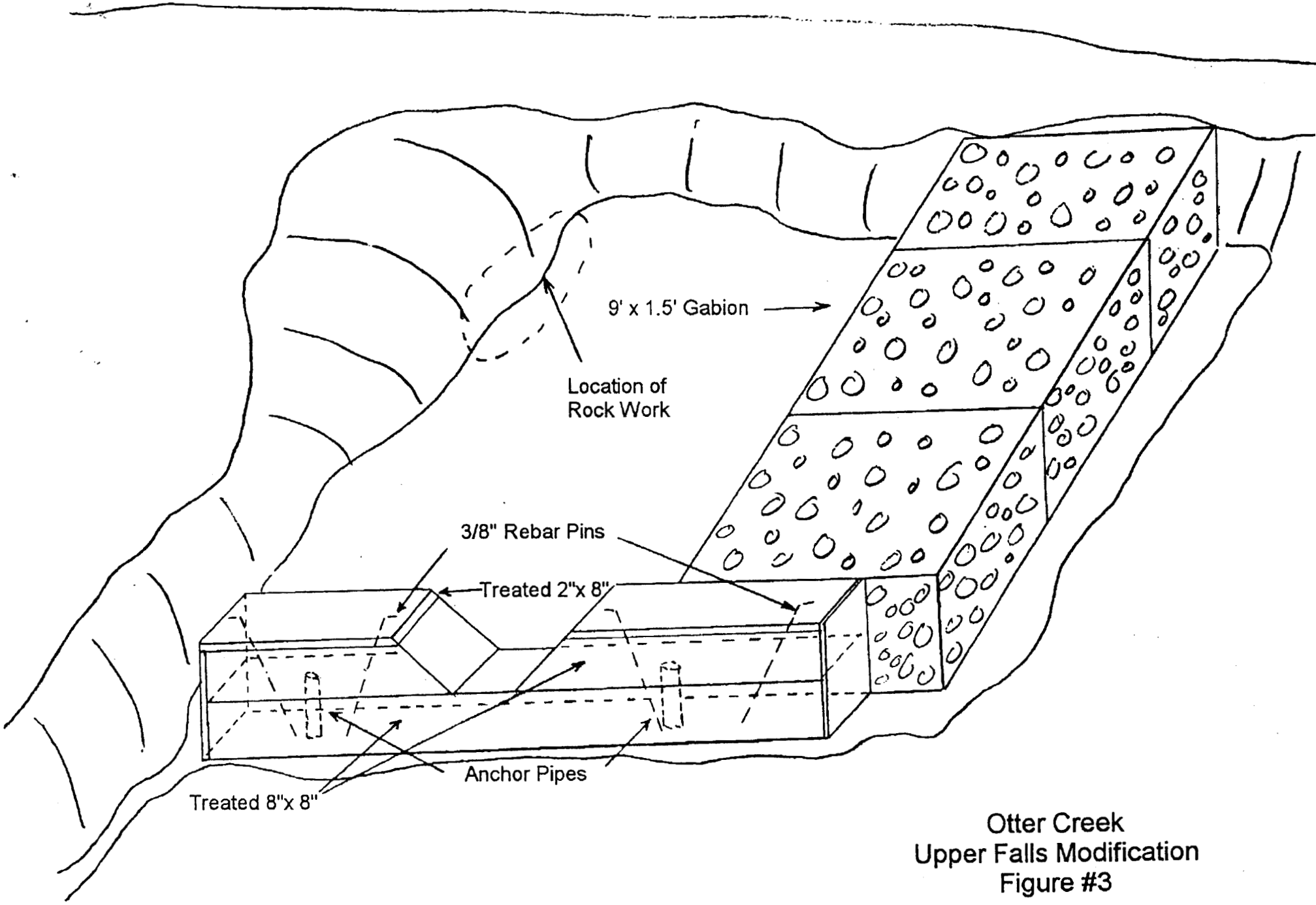
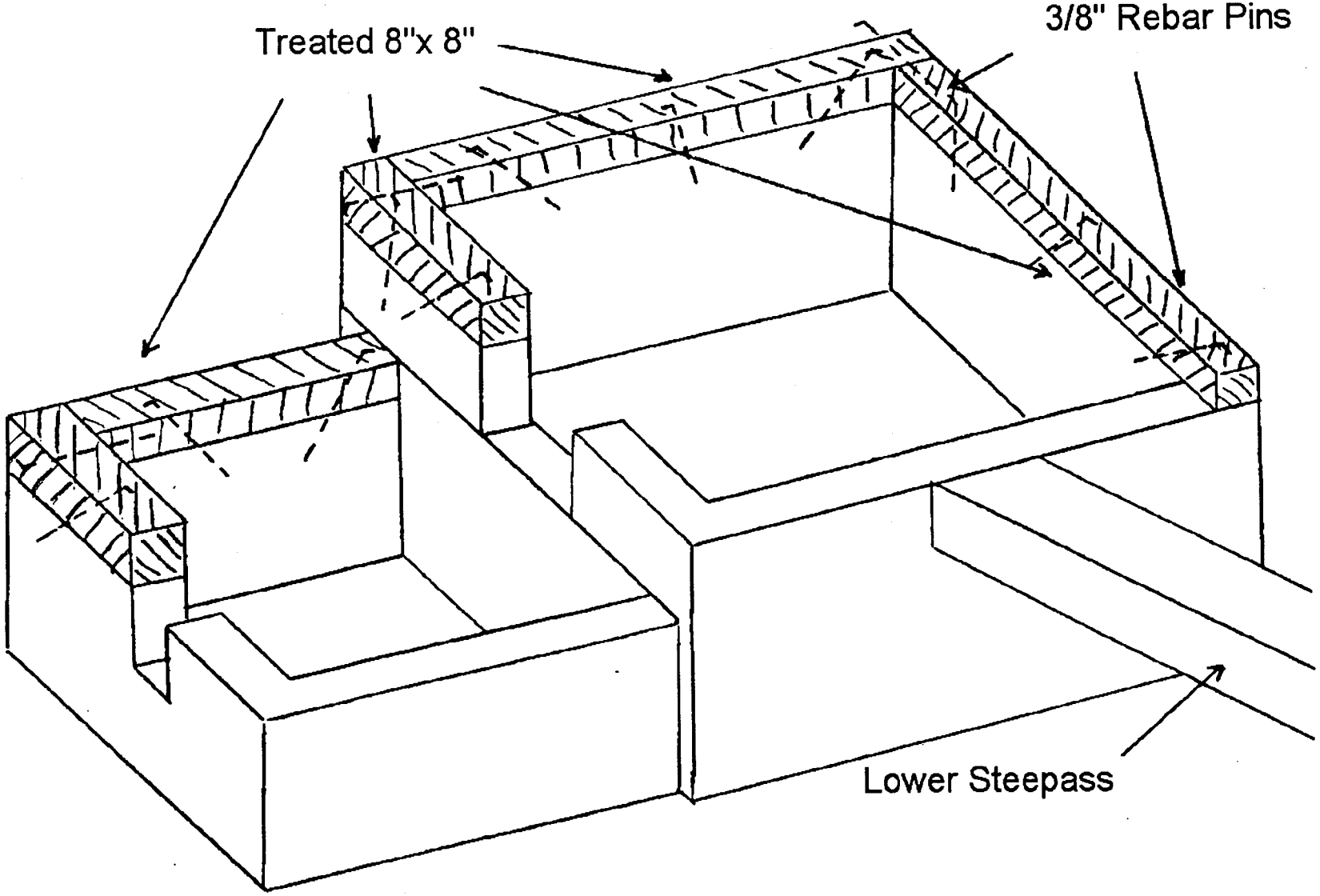


Figure 3. Detail drawing of the modifications made at the upper falls on Otter Creek. Otter Creek is located on the northeast end of Knight Island, and it flows into the Bay of Isles.



Otter Creek
Upper Falls Modification
Figure #3

Figure 4. Details of modifications made on the turning pool in Otter Creek. Otter Creek is located on the northeast end of Knight Island in Prince William Sound, and it flows into the Bay of Isles.



Otter Creek
Turning Pool Modification
Figure #4