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

Sockeye Salmon Stocking
Solf Lake

Restoration Project 97256B
Annual Report

This annual report has been prepared for peer review as part of the *Exxon Valdez* Oil Spill Trustee Council restoration program for the purpose of assessing project progress. Peer review comments have not been addressed in the annual report.

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Study History: Subsistence resources and services were injured throughout Prince William Sound as a result of the *Exxon Valdez* Oil Spill. Solf Lake has been recognized as an opportunity for establishing a self-sustaining sockeye salmon (*Oncorhynchus nerka*) population since the 1960's. This is the second year of a seven year project designed to improve subsistence opportunities through the stocking of sockeye salmon in Solf Lake, Herring Bay, in Prince William Sound (PWS). It was created specifically to benefit subsistence users of Prince William Sound, focusing primarily on residents of Chenega Bay.

There are two phases to this project. Phase one examined the ability of Solf Lake to support a sustainable population of sockeye salmon. Phase two involves implementation of stocking and creating access to Solf Lake for returning adult sockeye salmon. Most of phase one was completed in 1996. Results indicated the lake was capable of supporting a self-sustaining run of sockeye with a recommended stocking level of 100,000 fry to minimize adverse affects to the phytoplankton community and to account for spawning habitat availability. This was estimated to provide an approximate escapement of 10,000 adults, of which 5,500 would be available for harvest by subsistence users. In 1996 the RPT approved use of the early run Eyak fish as the brood stock. Surveys also indicated that channel modifications were necessary to facilitate fish passage to the lake.

Abstract : In 1997 the initial flow control structure was installed to provide adequate flows for fish passage in the stream channel and a detailed design of the diversion weir was completed. Additionally, a survey of the passage channel was conducted while flows were diverted for a more detailed inspection. Some minor in-stream alterations (rock removal/placement) were made to this channel to insure adequate fish passage below the proposed weir.

Key Words: *Exxon Valdez,* sockeye salmon *(Onchorynchus, nerka*), stocking, fishway, Limnology, Solf Lake, Prince William Sound.

Project Data: *Description of data* - There are three primary sets of data associated with this project: (1) zooplankton and algal biomass, temperature and light profiles, dissolved oxygen and water chemistry data, (2) modified Hankin and Reeves (1988) stream survey information, and (3) an inventory of fish and macroinvertebrate populations. *Format* - Data sets are in Excel spreadsheets and Word Perfect formats. *Custodian* - Contact Dan Gillikin at the Glacier Ranger District, USDA Forest Service, POB 129 Girdwood, Alaska 99587, (907) 783-3242. *Availability* - copies of preliminary data sets are available upon written request.

Citation: Gillikin, D. 1997. Sockeye salmon stocking at Solf Lake, *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 97256B). U.S. Forest Service, Glacier Ranger District, Girdwood, Alaska.

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EXECUTIVE SUMMARY

Subsistence resources and services were injured throughout Prince William Sound as a result of the *Exxon Valdez* Oil Spill. Solf Lake has been recognized as an opportunity to establish a self-sustaining sockeye salmon *Onchorynchus nerka*) population since the 1960's. This is the second year of a seven year project designed to improve subsistence opportunities through the stocking of sockeye salmon in Solf Lake, Herring Bay, in Prince William Sound (PWS). It was created to benefit subsistence users of Prince William Sound, focusing primarily on residents of Chenega Bay.

In 1996 we determined that Solf Lake was capable of supporting a self-sustaining run of sockeye with a recommended stocking level of 100,000 fry to minimize adverse affects to the ecosystem and to account for spawning habitat availability. This was estimated to provide an escapement of 10,000 adults, of which 5,500 would be available for harvest by subsistence users. In 1996 the RPT approved use of the early run Eyak fish as the brood stock. Surveys also indicated that channel modifications were necessary to facilitate fish passage to the lake.

In 1997 the initial flow control structure was installed to provide adequate flows for fish passage in the stream channel and a detailed design of the diversion weir was completed. Additionally, a survey of the passage channel was conducted while flows were diverted for a more detailed inspection. Some minor in-stream alterations (rock removal/placement) were made to this channel to insure adequate fish passage below the proposed weir.

Work over the next few years will focus on completion of the flow control and fish passage structures as well as stocking sockeye salmon and monitoring fish and limnological characteristics of the lake.

INTRODUCTION

Subsistence use of resources in the oil spill area declined following the spill. Although restoration studies have shown that harvest levels have since returned to pre-spill levels in most oil spill communities, Chenega Bay and Tatitlek are exceptions (Seitz and Fall, 1995; Seitz and Miraglia, 1995). These communities showed reduced harvest levels in 1993-94 and an increased reliance on salmon harvests (Seitz and Fall, 1995; Seitz and Miraglia, 1995). Projects available for the restoration or replacement of lost subsistence services are limited. Solf Lake (Appendix 1) provides an opportunity to establish a large replacement fishery that is easily accessible to Chenega residents (40 miles by boat).

Solf Lake has been recognized for many years as an opportunity to reestablish a sockeye salmon run in Prince William Sound. According to Nickerson (1978), "This system had historic runs of sockeye salmon. An earthquake in the 1930's caused blockages of the natural outlet resulting in water flowing over an impassable fall." Starting in the early 1970's various attempts have been made to reestablish sockeye salmon in Solf Lake. During two years in the early 1970's, Alaska Department of Fish and Game (ADF&G) personnel transported adult sockeye salmon from Eshamy River to Solf Lake (Jackson, pers. comm.). Stream improvements had not been completed when the adults of the transplanted fish returned. In 1978, 1980, and 1981 the U.S. Forest Service (USFS) made improvements to the lake and outlet stream. The work consisted of creating a new outlet channel and a partial dam at the existing outlet. The dam was designed to raise the level of the lake to provide adequate water flow through the newly created outlet. The new outlet channel is less than 100 meters in length with an average gradient of 23 percent. Stocking of the lake never occurred after the habitat improvements because of other priority projects for both USFS and ADF&G.

Solf Lake is a clear water lake with a mean depth of 42.5 m and a surface area of approximately 0.61 km^2 (Barto and Nelson 1982). ADF&G surveyed Solf Lake in 1985 and 1986 as part of a lake investigation study. The results of this survey, which included attempts to capture fish, suggested that the lake may have been devoid of fish (Pellissier and Somerville 1987). However, 1996 minnow trapping by USFS crews indicated a larger population of Dolly Varden than had been previously recorded. The Pellissier and Somerville (1987) survey also documented that water was flowing through the original outlet where an incomplete seal in the dam structure occurred. Three minor barriers to fish passage were identified in the created outlet channel. The report suggests that if all the outlet flow was directed down the created channel these barriers may disappear.

OBJECTIVES

This is a multi-year project comprised of two phases. In 1996 the first three objectives in the Feasibility/Planning Phase were completed. This past year we completed portions of objective 4 of the Feasibility/Planning Phase and objective 1 of the Implementation Phase. All other objectives are scheduled for following years.

Feasibility/Planning Phase

1. Determine if a self-sustaining population of sockeye salmon could be established in Solf Lake (completed).
2. Determine appropriate salmon stocking levels (completed).
3. Determine an appropriate brood stock and the necessary logistics to begin a stocking program (completed).
4. Evaluate and determine fish passage needs to ensure adequate conditions for adult migration (to be completed in FY99).

Implementation Phase

1. Design and construct necessary improvements to the outlet channel and flow control structures to ensure adequate passage for adult salmon migration (initiate in FY97 and ongoing through FY00).
2. Stock Solf Lake with sockeye salmon to produce a self-sustaining population that can provide an adequate subsistence harvest (stocking begins in 1998 and ends in 2002).
3. Monitor zooplankton and smolt out-migration to ensure appropriate stocking levels (monitoring begins in 1998 and continues through 2003).

METHODS

Methods for objectives completed last year are included in the 1996 annual report (Gillikin 1996). Methods listed below apply only to work completed this past year. The flow control structure was built where the excavated access channel leaves Solf Lake (Appendix 2). It was approximately 4 feet high and 16 feet wide with an adjustable gate to control flow (Appendix 3). All flow was directed down the original lake outlet to conduct the survey of the excavated channel. The site survey for the dam on the original lake outlet was conducted using standard engineering construction survey protocols.

RESULTS

The flow control structure was built and was functioning properly. Surveys of the existing excavated channel indicated large amounts of fractured rock where some flow was being lost through the substrate. Some rock was moved in the channel to facilitate upstream migration. The site survey and design for the dam at the lake outlet was completed (Appendices 4-6).

DISCUSSION and CONCLUSIONS

Most work was completed as planned. However, existing conditions in the excavated channel found during the survey will require additional alterations to ensure fish passage. Specifically, a more detailed survey is necessary following construction of the diversion weir in order to determine what level of work is necessary in the excavated channel. Once the dam is operational we will be able to determine more easily what changes are needed for passage based on flow availability in the excavated channel.

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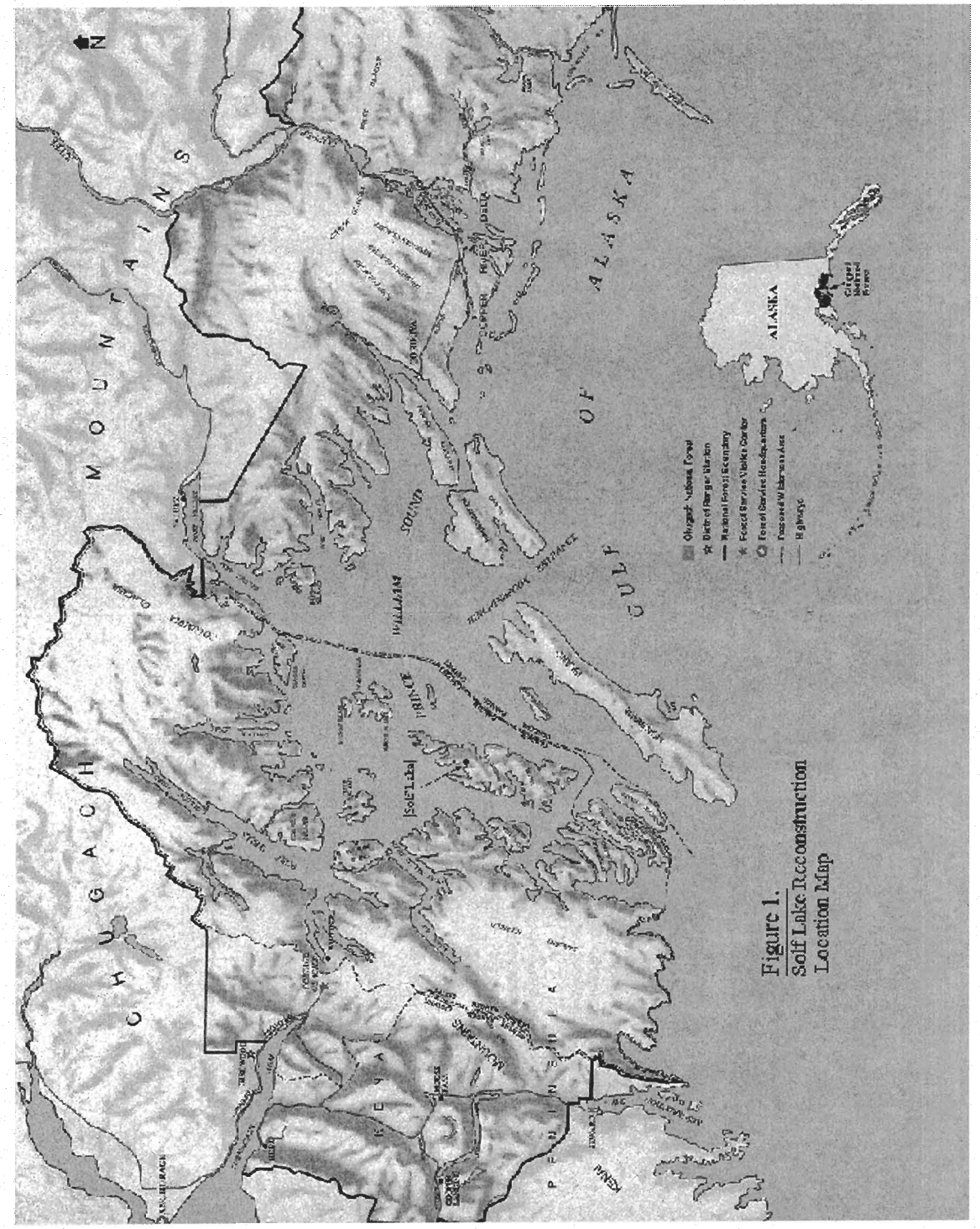
Seitz, J. and R.Miraglia. 1995. Chenega Bay. In: Fall, J.A and C.J. Utermohle, (eds). *An investigation of the sociocultural consequences of outer Continental Shelf development in Alaska; II. Prince William Sound.* MMS 95-011; Technical Report No. 160.

PERSONAL COMMUNICATIONS

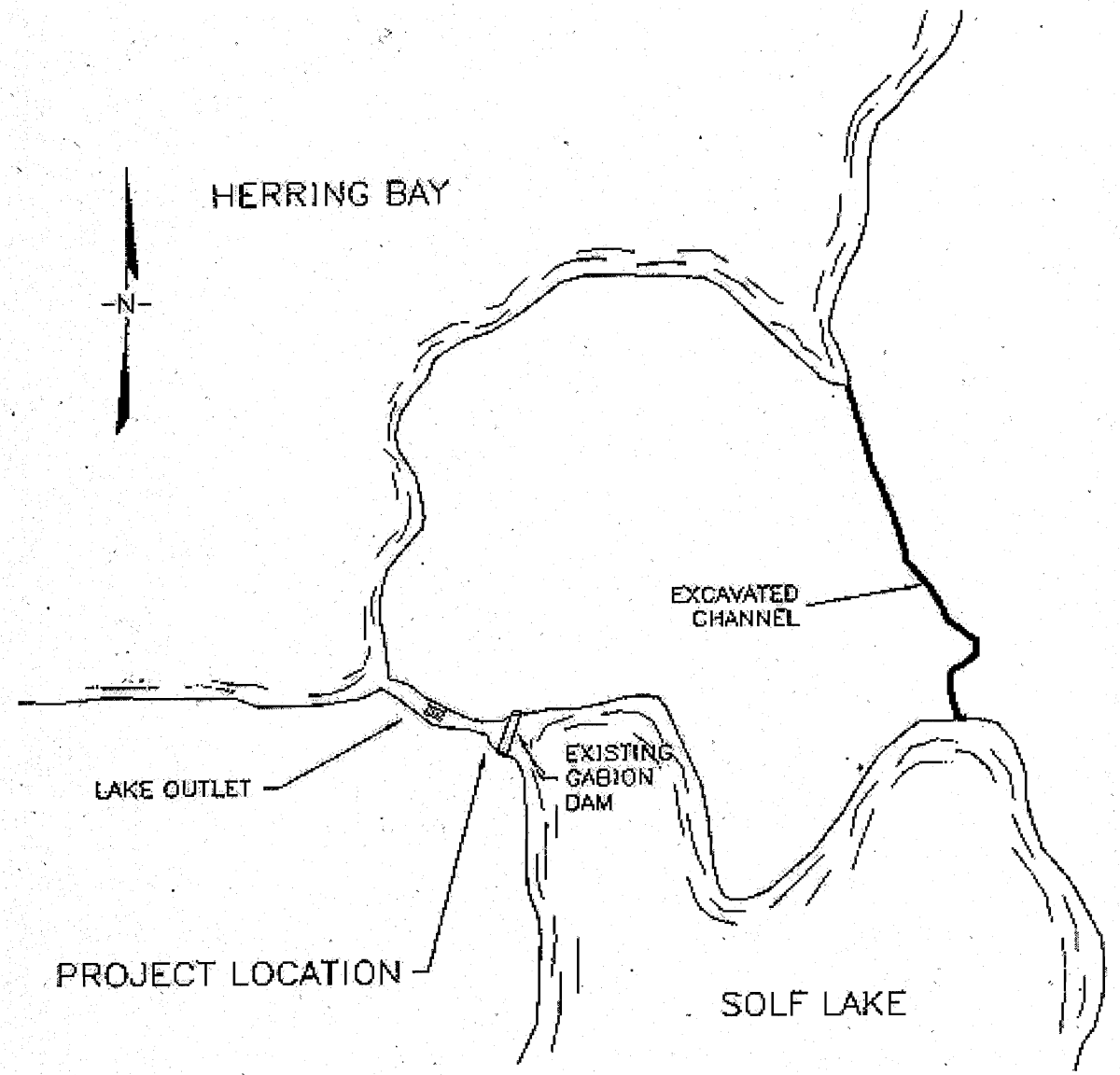
Jackson, M., Fish and Game Tech. (retired). Alaska Dept. of Fish and Game. Cordova. April, 1995.

APPENDICES

Appendix 1. Location Map for Solf Lake Project

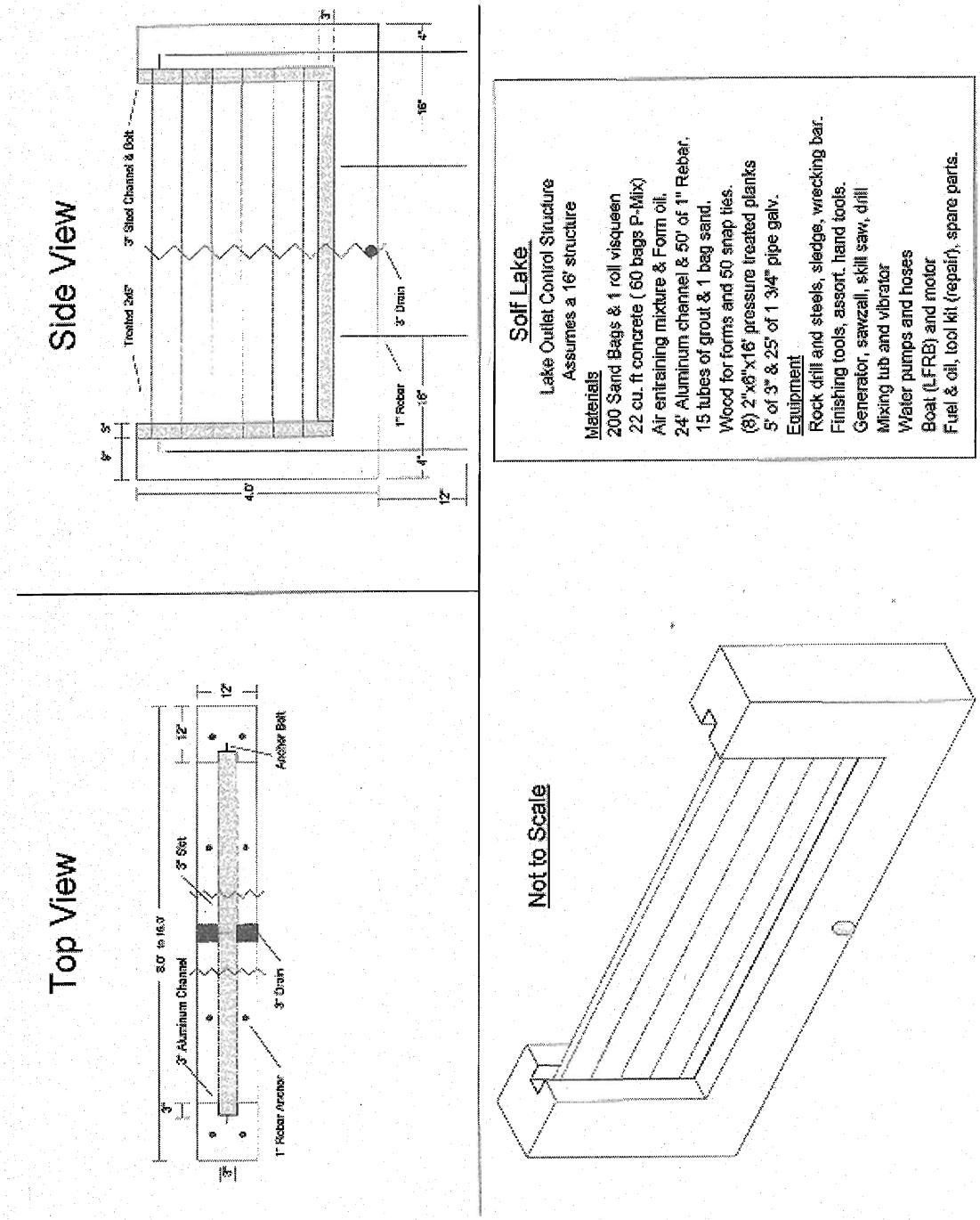


Appendix 2. Site and Construction Plan for Diversion Weir at Solf Lake.

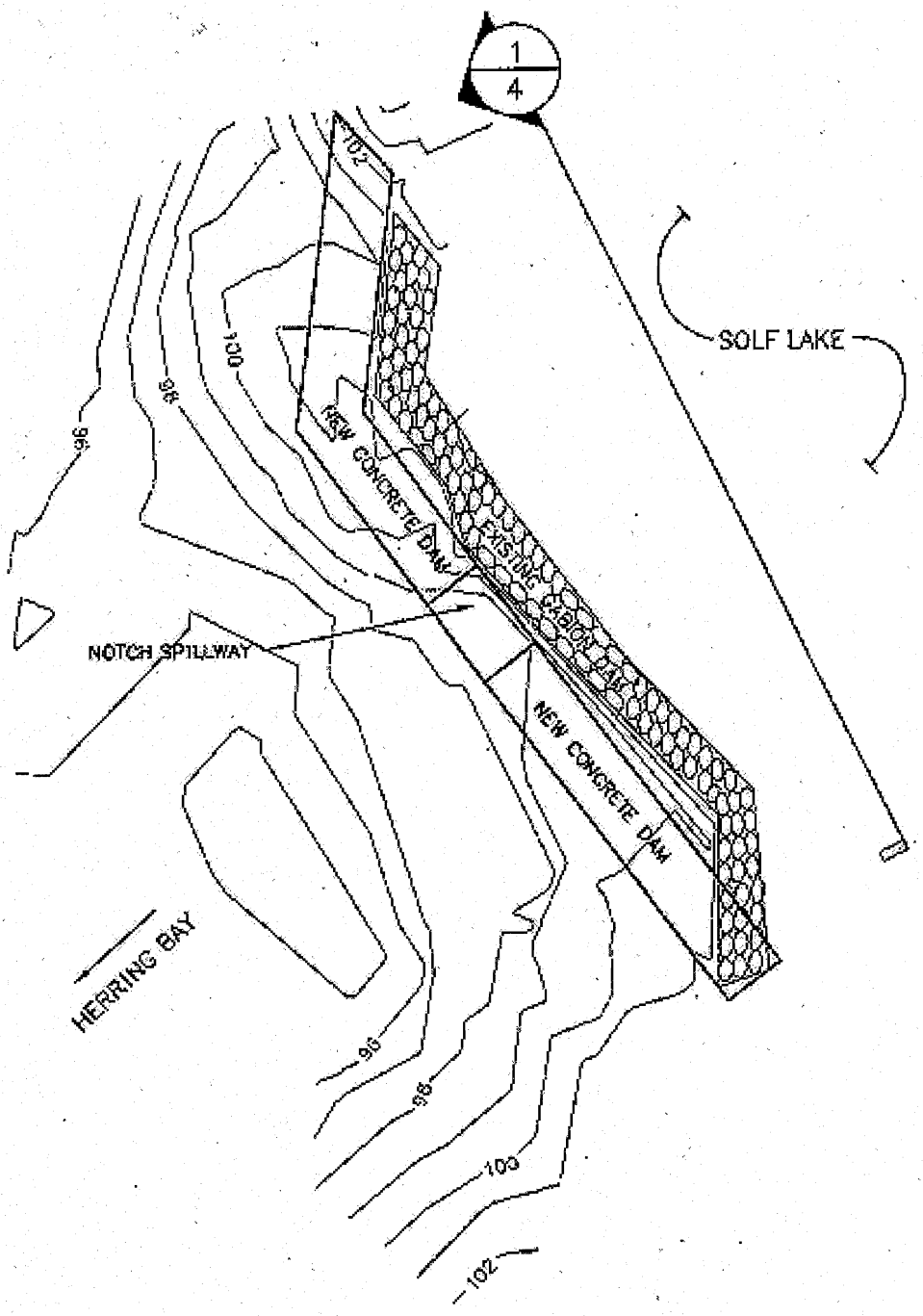


GENERAL SITE PLAN

Appendix 3. Plan View of Installed Control Structure at Solf Lake.

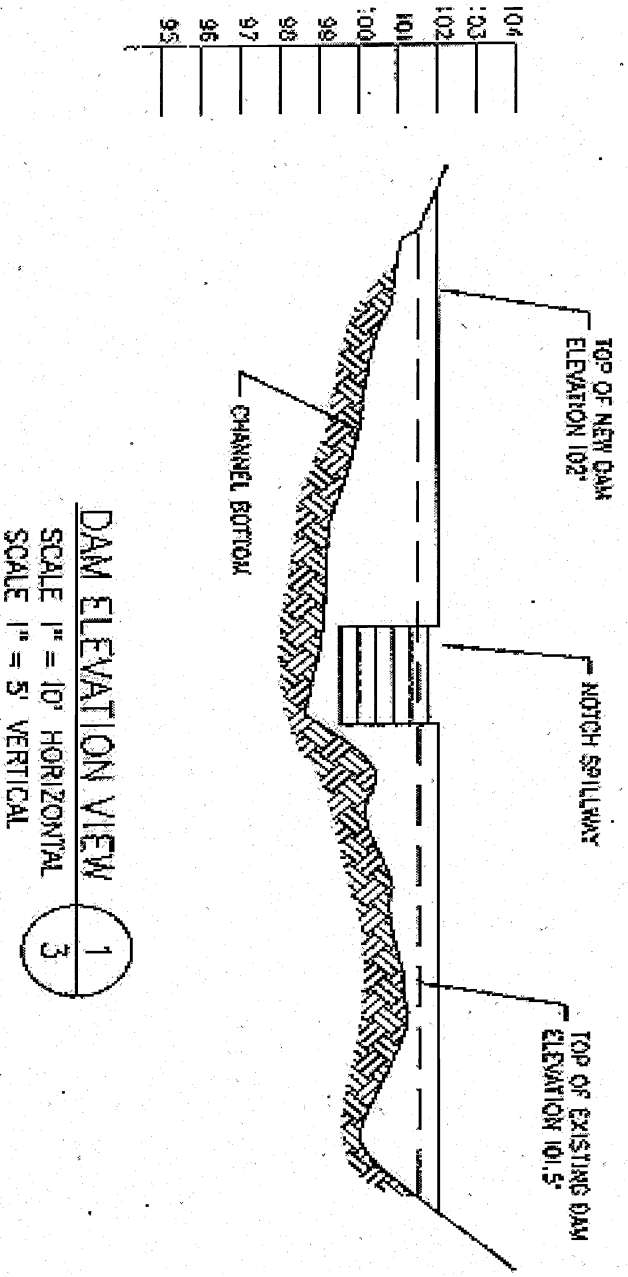


Appendix 4. Dam design at lake outlet.



DAM PLAN VIEW
SCALE 1" = 10'

Appendix 5. Dam design at lake outlet (elevation view)



Appendix 6. Dam design at lake outlet (cross section view).