Exxon Valdez Oil Spill
Restoration Project Annual Report

Sockeye Salmon Stocking
Solf Lake

Restoration Project 98256B
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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April 1999

Sockeye Salmon Stocking Solf Lake
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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. This project is the continuing investigation and enhancement of lost subsistence opportunities through the stocking of sockeye salmon (*Oncorhynchus nerka*) in Solf Lake, Herring Bay, in Prince William Sound (PWS). Solf Lake has been recognized as an opportunity for establishing a self-sustaining sockeye salmon population since the 1960's. The lake now provides an excellent opportunity to establish a replacement fishery to benefit subsistence users in Western Prince William Sound

Habitat improvements were made in 1978, 1980 and 1981 to provide access to the lake for anadromous fish. The lake was never stocked and subsequent investigations suggest that it was fishless, but had adequate habitat to support a sockeye salmon population. There are two phases to this project: Phase 1, which began in FY96, verified the ability of Solf Lake to support a sustainable population of sockeye salmon. Phase 2 includes stocking the lake with 100,000 sockeye salmon fry, starting in 1998 and ensuring access to Solf Lake for returning adult sockeye salmon.

Abstract: During the 1998 field season Forest Service personnel completed the installation of the diversion weir structure at Solf Lakes' western outlet. With the stop boards in place, the diversion weir successfully stopped all low flows through the western outlet. Personnel from the Main Bay Hatchery successfully collected eggs from Eyak brood stock and reared them at their Main Bay facility. This resulted in the release of 109,872 fry into Solf Lake in the spring of 1998. The Alaska Department of Fish and Game reports that the 1998 stocking levels had little influence on the abundance or total biomass of the macrozooplankton population at Solf Lake

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

Project Data: *Description of data* - There are three primary sets of digital data developed for this project: (1) The feasibility phase of the study included examination of zooplankton and algal biomass, temperature and light profiles, dissolved oxygen and water chemistry. (2) Modified Hankin and Reeves (1988) stream survey information that incorporates the geophysical and hydrological characteristics of the stream into distinct habitat units. (3) An inventory of fish and macro-invertebrate populations. *Format* - Data sets are in Excel spreadsheets and Word Perfect formats. *Custodian* - Contact Dan Gillikin at the Glacier Ranger District Office, USDA Forest Service, POB. 129 Girdwood, Alaska 99587. PH. (907) 783-3242, Fax (907) 783-2094, E-mail dgillikin/r10_chugach_glacier@fs.fed.us. *Availability* - copies of preliminary data sets are available upon written request.

Citation: Gillikin D. 1998. Sockeye salmon stocking Solf Lake, *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 98256B), 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 because of the *Exxon Valdez* Oil Spill. This project continues to improve subsistence opportunities through the stocking of sockeye salmon (*Oncorhynchus nerka*) and stream improvements to allow adult salmon passage in to Solf Lake, Herring Bay, Prince William Sound (PWS). Solf Lake has been recognized as an opportunity for establishing a self-sustaining sockeye salmon population since the 1960's. The lake now provides an excellent opportunity to establish a replacement fishery to benefit subsistence users in Western Prince William Sound.

This 1996 project began as a feasibility assessment. In Fiscal Year 1996 (FY96) the Trustee Council-funded project 96256 which was a combined proposal to assess the feasibility of establishing a stocking program at both Columbia and Solf Lakes. The feasibility phase of the project completed in (FY96) included investigations of zooplankton, algal biomass, temperature, light profiles, dissolved oxygen, water chemistry and an inventory of fish and macro-invertebrate populations and the available fish habitat.

Interim reports and a recommendation on the feasibility of these two lakes for stocking were provided to the Trustee Council in the fall of 1996. It was determined that Solf Lake could support stocking levels of as many as 400,000 fry based on the available zooplankton. However, a more conservative level of stocking of 100,000 sockeye salmon fry is recommended at this time, with close monitoring of the effects on the zooplankton population of the Lake.

Solf Lake has two outlets, the eastern outlet had historically provided anadromous access, and a western outlet, which has an impassable waterfall. Currently both are impassable to anadromous salmon. For many years, Dolly Varden (*Salvelinus malma*) has been the only recorded species of fish in Solf Lake. In 1978, the Forest Service removed the barriers from the east channel and created a dam at the western outlet to provide adequate stream flows in the newly improved eastern channel, allowing access for sockeye salmon. Additional improvements to the new outlet channel and dam were made in 1980 and 1981, but the system was never stocked with salmon.

The existing improvement structures at the two outlets of the lake were also evaluated. It was determined that the old structure, which dams the impassable western outlet, required extensive reconstruction to provide adequate flow for fish passage at the lakes eastern outlet. The eastern outlet, that would provide fish access to the lake also required reconstruction of the "irrigation type" control dam, this work was completed in 1997. An engineered survey of the western outlet and suitable dam design was completed in 1997 and in 1998, installation of the new diversion dam at the western outlet. Additionally the first stocking of 109,827 Eyak sockeye salmon fry was successfully completed in the spring of 1998.

In April of 1995, the original proposal for this project was presented to the Prince William Sound Copper River Regional Fisheries Planning Team (RPT.) for approval. On April 7, 1997 the Forest Service participated in a teleconference with the RPT and discussed brood stock source, mixed stock issues and stocking levels. The RPT approved the project but recommended a lower level of stocking than. The RPT's recommendation was to stock 100,000 fry to achieve the goal of 10,000 adult fish returning to Solf 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). Solf Lake provides an opportunity to establish a large replacement fishery that is easily accessible, approximately 40 miles from Chenega Bay.

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). Based on historical limnological data from the 1980's, stream survey collected in 1996, and analysis of current limnological data it is reasonable to expect that the lake is capable of supporting a sustainable sockeye population with an adult return of approximately 10,000 fish. Establishing this fishery would directly benefit subsistence users in Western Prince William Sound.

Solf Lake has been recognized as opportunities to reestablish a sockeye salmon run in Prince William Sound for many years. 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. For two years in this same period, ADF&G personnel transported adult sockeye salmon from Eshamy River to Solf Lake (Jackson, personal communication). Unfortunately, necessary stream improvements had not been completed when the offspring from the transplanted fish returned. In 1978, 1980 and 1981, the USFS implemented improvements to the lake and outlet stream. The work consisted of improving the eastern outlet and partially damming the western outlet. The dam was designed to raise the level of the lake to provide adequate water flow for fish passage at the eastern outlet. The improved eastern outlet channel is less than 100 meters in length, with an average gradient of 23 percent (Figure 2, Appendix A). Stocking of the lake never occurred after the habitat improvements because of other priority projects for both the USFS and ADF&G.

The ADF&G surveyed Solf Lake in 1985/1986 as part of a lake investigation study. The results of this survey, which included attempts to capture fish, suggest that the lake may be fishless (Pellissier and Somerville, 1987). However 1996 minnow trapping by USFS crews indicated a larger population of Dolly Varden than has been previously observed, but still not significant. These results are also supported by the composition and biomass of the zooplankton populations, which were sampled in 1986 (P. Shields, personal communication 1996). The Pellissier and Somerville (1987) survey also documented that water was flowing through the western outlet due to an incomplete seal by the dam structure. Three minor barriers to fish passage were identified in the eastern channel. The report also suggested that if all the water passing under the dam at the western outlet was stopped these barriers might disappear.

The eastern outlet, to the lake also required reconstruction of the "irrigation type" control dam; this work was completed in 1997. An engineered survey of the western outlet and suitable dam design were also completed in 1997, and in 1998, installation of the new diversion dam at the western outlet was completed. The new diversion dam after construction was monitored for

effectiveness it appeared to completely divert all low flows to the eastern outlet with a complete seal to the native bedrock. Additionally the first stocking of 109,827 sockeye salmon fry into Solf Lake was completed 1998 along with the collection of eggs and fry rearing at Main Bay Hatchery for 1999 stocking.

The ADF&G recommends stocking based on their zooplankton studies and added that the instability of the macrozooplankton community in barren lakes when faced with predation necessitates stocking programs based on a conservative approach. Close evaluation and experimenting with stocking strategies will ameliorate significant impacts to the macrozooplankton community. Major reasons for the disparity of response to stocking barren lakes include. 1) The inherent low productivity of these lakes; 2) macro zooplankton abundance, composition, and ability to adapt to predation; 3) stocking density; 4) morphometric factors and 5) variability in the indirect effects of predation in individual lakes. Consequently, based on limnological information for the first three years, the stocking level at Solf Lake could be 400,000 fry, with monitoring of the zooplankton once per month during June-October required. After three years of stocking at this level, if the zooplankton community did not show a significant impact, the level could be increased to perhaps 500,000 fry. This level of stocking could be done for another three years with continued evaluation of the zooplankton community. While Solf Lake is most likely capable of supporting stocking at this level, it has been decided to take a more conservative approach to stocking.

Based on the available spawning area, it is estimated that Solf Lake could sustain a run of approximately 10,000 sockeye salmon. An escapement goal of approximately 4,500 fish would be required to fully seed the system without depleting the zooplankton populations, leaving 5,500 sockeye available for harvest. Consequently, we are recommending stocking at the 100,000 fry level to meet the objective of the stated desired return and the assumption that there will be a high fry to adult survival.

Solf Lake is located off Herring Bay on Knight Island. The lake is approximately 40 miles by boat from Chenega Bay and 46 miles from Whittier. The lake is unnamed on USGS maps; however, Nickerson (1978), PWSRPT (1983 and 1986), Barto and Nelson (1982) all refer to the lake as Solf Lake (ADF&G Stream 690). The lake is described in the Anadromous Waters Catalog as number 226-10-16900-0010 (ADF&G, 1992; Figure 1, Appendix A).

OBJECTIVES

Phase 1. The overall objective of this phase of the project was to determine the feasibility of stocking Solf Lake with sockeye salmon. The four components to this objective are:

1. Determine if Solf Lake can sustain a population of sockeye salmon; (completed).
2. Determine appropriate stocking levels; (completed).
3. Coordinate with PWSAC and Main Bay Hatchery to establish an appropriate brood stock and the necessary logistics to begin a stocking program; (completed).
4. Evaluate the existing habitat improvement structures to ensure adequate conditions for adult migration; (completed in FY98).

Phase 2. Implementation phase of the project. There are three objectives to this phase.

1. Design and construct necessary improvements to the outlet channel and dam to ensure adequate passage for adult salmon migration; (50% completed)
2. Stock Solf Lake with sockeye salmon to produce a self-sustaining population that can provide an adequate subsistence harvest; (ongoing)
3. Monitor zooplankton and smolt out-migration to ensure appropriate stocking levels; (ongoing)

METHODS

Project 98256B included one season of improvement structure construction spanning the western outlet; the implementation of the sockeye salmon stocking program; and the continuation of limnological sampling. The following section is divided into three parts. Part 1 describes the methods needed to establish a self-sustaining sockeye salmon population. Part 2 describes the possible types of habitat improvements that may be needed to provide access for returning adult salmon. Part 3 describes the sampling methods used to collect biological, physical and morphological information at Solf Lake.

Part 1. This section outlines the methods to implement a stocking program at Solf Lake.

Interagency Coordination (1997): Close coordination between the USFS, ADF&G, PWSAC and the PWS/CR RPT are mandatory for the success of this project. Prince William Sound is a complex ecosystem and the potential stocking of Solf Lake needs to be considered in perspective with the overall management of the Sound. Interagency coordination has occurred in 1996 through 1998 to identify appropriate brood stocks, determine appropriate stocking levels, meet hatchery-related requirements, and to address mixed-stock fisheries issues.

Stocking Program (1998 to 2002): Appropriate stocking levels and strategies will be determined in coordination with ADF&G and PWSAC using all available data. Sockeye fry will be short-term reared at the Main Bay Hatchery and transported to the lake for release. The Eyak and Coghill stocks are identified in the PWS/CR Phase 3 Comprehensive Salmon Plan (PWS/CR RPT, 1994) as potential stocks for Solf Lake. Stocking began in 1998 and is planned to continue until the year 2002. On May 25th, Main Bay Hatchery (MBH) personnel released 109,827 Eyak fry via floatplane at the southern end of Solf Lake, approximately 300 meters offshore. Additionally MBH collected eggs from Coghill fish and are currently rearing them at their facility for release in the spring of 1999.

The success of the stocking program is being monitored through sampling of the fish population during the smolt out-migration and during adult returns. Smolt will be collected by weir to estimate the total out migration, starting in 1999. Fish will be sampled to determine age, length, and weight to evaluate the health of the population. Fry stocked in 1998 were marked with half length coded wire tags, code number 13-01-02-08-10. Returning adults will be enumerated at a weir on the eastern outlet stream and, if possible, with aerial surveys. Scales and tags will be collected and the age structure of the returning fish will be analyzed.

Part 2. Describes the types of improvements needed to provide access for returning salmon.

Solf Lake was visited by ADF&G personnel as part of a PWS lake investigation project in 1985 (Pellissier and Somerville, 1987). Three minor barriers to fish migration were identified in the outlet channel. These barriers were velocity barriers that ranged in size from 1.5 to 2.5 meters. The barriers may potentially be removed through the creation of plunge pools or by installing steeppasses. The report also suggested that the barriers might not exist if more water were in the outlet channel, which could be achieved by repairing or rebuilding the dam at the waterfall of the original outlet channel. Until the fishway design is completed this season, it is unknown what specific type of improvements will be needed in the eastern outlet to ensure salmon passage.

The logistics for construction of the diversion weir began in mid May with the transport of the construction materials and equipment from Anchorage to Portage on a 40-foot flat trailer. Once in Whittier all materials and equipment were loaded onto a landing craft and transported to Herring Bay. The morning of May 14th; work crews, the landing craft and a Bell 212 helicopter proceeded to sling-load construction materials and equipment from the landing craft to the job site, without incident.

Construction began May 16th with the placement of a temporary sandbag cofferdam on top of the existing dam. Visqueen was laid down on the lakeside of the cofferdam to preventing water from leaking through and underneath the coffer (Figure 3, 4; Appendix B). Crews removed portions of the existing dam, cleared rocks and debris and prepared the bedrock surface by removing all organic material within the footprint of the new dam. The dam was laid out and outlined with paint on the bedrock. Two rows of holes were drilled into the bedrock 18-inches deep on 12-inch centers the full length of the dam. Reinforcing rebar (#7) was used for vertical reinforcement and adhered into the holes with Hilti C-100 adhesive. For horizontal reinforcement, four rows of #5 rebar were wired to the vertical rebar (Figure 7, Appendix B).

The concrete forms were constructed with sheets of ½" plywood, 2 by 4 braces, 2 by 4 mud sills and pencil rod metal ties. It was decided to maximize control of the water and ensures a good seal along the base of the new wall the construction process would occur in three separate pours. The first part of the structure to be formed and poured was the 8-foot long base of the spillway notch. Before pouring, a piece of 6" by 6" expanded wire fabric was centered in the slab to provide greater structural integrity (Figure 5, Appendix B).

The next portion of the structure formed and poured was the 22-foot section on the right side. The form was constructed with the back wall vertical and the front varying in slope from about 10 degrees to about 35 degrees, depending on the height of the wall. The dam has a 2.5-ft base and a 0.8-ft apex. A steel stop board channel is 6-inches by 15.3-ft and was placed adjoining the spillway notch (Figure 6, Appendix B).

The last portion of the dam, a 35-foot section, was formed and poured in exactly the same manner as the right side. The last item to be completed was the stop boards for the spillway notch. Six pieces of treated lumber measuring eight feet long and 4" by 6" were cut to fit the steel channels imbedded into the dam, completing the seal.

After the completion of the structure, all equipment and excess materials were yarded from the work site to the Forest Service landing craft the *Williwaw*. This allowed for the safe and expeditious removal of heavy equipment and tools.

Part 3. Collection methods of biological, physical and morphological information at Solf Lake:

Limnological Sampling (1998): Data collection and analysis included: Algal biomass (chlorophyll a), zooplankton populations (biomass, body-sizes, species composition etc.), temperature and light profiles, dissolved oxygen, and water quality (nutrients) to estimate the potential productivity of the lake. Procedures for the collection of these samples are detailed in Koenings et. al. (1987). Samples were collected from a minimum of two permanent collection sites every three to four weeks May - September to assess seasonal variation.

Sustainable Sockeye Returns: Are based on the available spawning area times a redd density of 6.7 m^2 and a fecundity of 2,000 eggs / gravid female, and a 1:1 sex ratio. Survival rates assume a 10% egg to fry survival, a 15% fry to smolt survival and a 15% smolt to adult return.

Smolt out-migration: will be conducted by the Alaska Department of Fish and Game in early spring of 1999. ADF&G will be operating a total capture weir at the control structure in the eastern outlet to enumerate smolt numbers.

RESULTS

The results from the limnology work and water chemistry testing in FY96 were analyzed by personnel from the ADF&G Limnology Lab in Soldotna along with data collected in 1982, 1984, and 1986. The following are the stocking recommendations made by ADF&G. Based on limnological information, for the first three years, the stocking level in Solf Lake could be 400,000 fry. Monitoring of the zooplankton occurring once per month between June and October would be required. After three years of stocking at this level, if the zooplankton community did not show a significant impact, the level could be increased to perhaps 500,000 fry. This level of stocking could be done for another three years with continued evaluation of the zooplankton community. However, the RPT's recommendation was to stock 100,000 fry to achieve the goal of 10,000 adult fish returning to Solf Lake. The RPT's recommendation were adopted for this project. The reduction was based on meeting the stated objective of the project, the desired escapement goal of 4,500 adult sockeye, and on the probability of very high fry to smolt to adult survival rates.

The species composition of the macrozooplankton community in Solf Lake in 1998 was found to be comprised of three major taxa and one relatively rare species. The copepod component consists of the calanoid form Diaptomus *kenai* and the cyclopoid, tentatively described, as Cyclops *scutifer*. Bosmina *coregoni* dominates the cladoceran forms with Daphnia *longiremis* present in very small numbers (Figure 8, Appendix C). With the exception of 1986, Diaptomus has accounted for more than 50% of the total biomass followed by Cyclops, which generally comprises about 30 % of the total. The remainder of the total macrozooplankton (TMZ) consists primarily of the cladoceran form Bosmina and very small numbers of Daphnia.

Areal density (number/m^2) and biomass (mg/m^2) of the macrozooplankton were estimated to compare seasonal and annual abundance, the preference is to use biomass as a comparison, which incorporates the additional information of body size and weight. The TMZ annual mean biomass ranged from 192 to 589 mg/m^2, while estimates for Diaptomus, Cyclops, and Bosmina ranged from 62 to 336, 33 to 351, and 23 to 188 mg/m^2, (Figure 9, Appendix C). Weighted seasonal mean body size measurements of Diaptomus, Cylops, and Bosmina have varied from 1.38 to 1.72, .61 to .72, and .55 to .60 mm., (Figure 10, Appendix C).

Stream information was collected by Forest Service personnel in 1996, the results indicated that Solf Lake and it's tributaries are capable of providing a shoal spawning area within the lake of 10,710 m^2 and 4,258 m^2 in the inlet streams. However spawning success in the inlet stream may be limited by winter low flows. Peak flows in the inlet stream are approximately 333 cfs. with winter low flows estimated to be as low as 0.366 cfs. Based on the available spawning area it is estimated that Solf Lake could sustain a run of approximately 10,000 sockeye salmon. An escapement goal of approximately 4,500 fish would be required to fully seed the system without depleting the zooplankton populations, leaving 5,500 sockeye available for harvest.

During the 1998 field season Forest Service personnel completed the installation of the diversion weir structure at the lakes western outlet. This structure is approximately 65-feet long and 4-feet high at its highest point and 2.5-feet thick of reinforced concrete, properly anchored to the existing bedrock. With the stop boards in place, the diversion weir successfully stops all low flows through the western outlet. All that is required at the western outlet is the removal of the existing gabion dam.

Personnel from the Main Bay Hatchery successfully collected 139,00 green eggs from Eyak brood stock and reared them at their Main Bay facility. Overall, survival of green eggs to released fry was 92.9%. This resulted in the release of 109,872, 0.51 gram fry into Solf Lake in the spring of 1998. Of the total number of fry released, 3,193 were marked with half-length coded wire tags # 13-01-02-08-10. Discussions with PWSAC and the RPT have indicated that PWSAC intends to change their Area Management Plan and that Coghill brood stock will be the only brood stock available at Main Bay for future stocking activities at Solf Lake.

DISCUSSION and CONCLUSIONS

Fishless lakes are susceptible to overgrazing by large numbers of obligate planktivores, i.e. sockeye fry, resulting in steep declines in macrozooplankton numbers and biomass. Diet selectivity studies for rearing sockeye fry have shown that fry presented with a wide choice of food items tend to select for cladoceran and large calanoid forms. Although sockeye fry do graze on Cyclops, it is not actively selected. Thus, in Solf Lake, we would expect the large, red pigmented, and therefore, highly visible Diaptomus, to be an indicator species of excessive grazing pressure and a guide to gauge stocking levels.

It appears that the 1998 stocking level of 109,827, 0.51 gram, sockeye fry has had little influence on (TMZ) or the abundance of preferred prey species Diaptomus and Bosmina. The 1998 annual mean (TMZ) biomass estimate of 382 mg/m^2 is approximately the midpoint of the range of yearly estimates. The mean 1998 species biomass estimates, with the exception of Cyclops, also fall within the range of annual fluctuations.

The decline in Cyclops is probably not due to grazing, as we would expect the preferred prey species to exhibit a population declines first. Decreases in species body size can also signify concentrated grazing pressure. Body sizes were measured to the nearest 0.02 mm and it appears that measurements taken in 1998, although slightly less, fall within the margin of error, again indicating little pressure from grazing fry.

The construction project was initiated in mid May and lasted into mid August. Fisheries crews, throughout most of the construction period, encountered adverse weather conditions that slowed, or ultimately halted construction. Twice, high volumes of rain flooded Solf Lake causing vast amounts of water to overflow the cofferdam. This, in turn, created unsafe working conditions for crews and construction was halted until water conditions returned to normal. Returning crews, on several occasions, found previous work damaged due to sever weather conditions and had to do repair work to previous construction, resulting in additional labor cost.

Both the recently finished diversion weir at the western outlet and the control structure on the eastern outlet have been successfully completed and are working properly. During the1998 field season, the control structure at the eastern outlet was inspected for serviceability. After a full year exposed to the rigorous weather of Prince William Sound the structure remains operational showing little sign of wear.

With control structures at both outlets, we can now control the discharge at Solf Lake, to facilitate future surveys and construction activities, a critical factor given the systems flash nature. A survey and preliminary design for the fishway improvement in the eastern outlet are scheduled to be completed by August 1, 1999 and will be submitted to the Trustees for approval.

In response to the 1998, reviewers concerns regarding over escapements into Solf Lake we will soon be initiating discussions with the Village of Chenega and the ADF&G to develop a harvest strategy for Solf Lake. We intend to conduct rigorous monitoring of adult returns starting in the year 2000 looking for three-year-old jack salmon as an indication of the overall returns.

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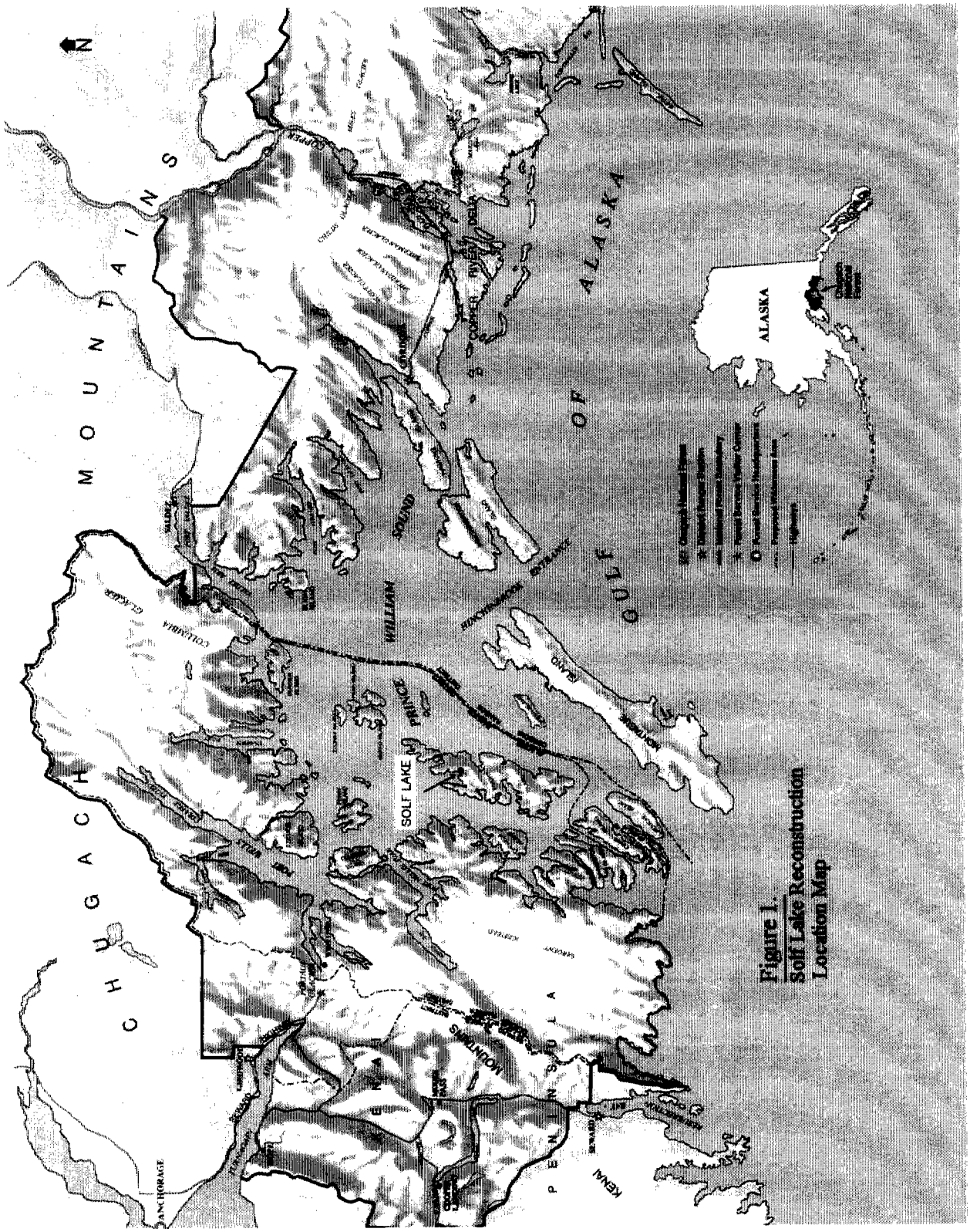
APPENDICES

Appendix A. Figure 1. Location Map.



Appendix A. Figure 2. Site Plan

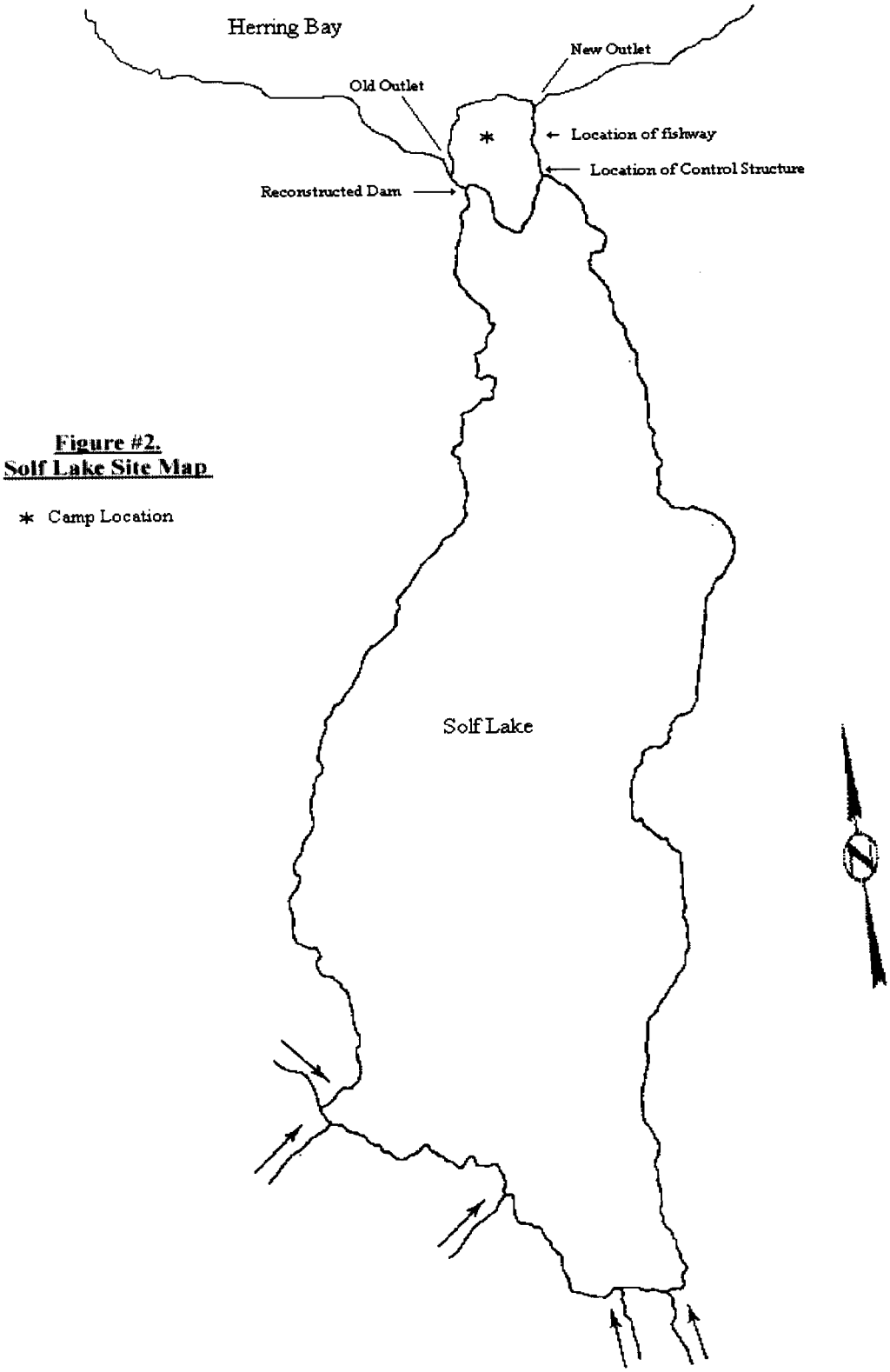
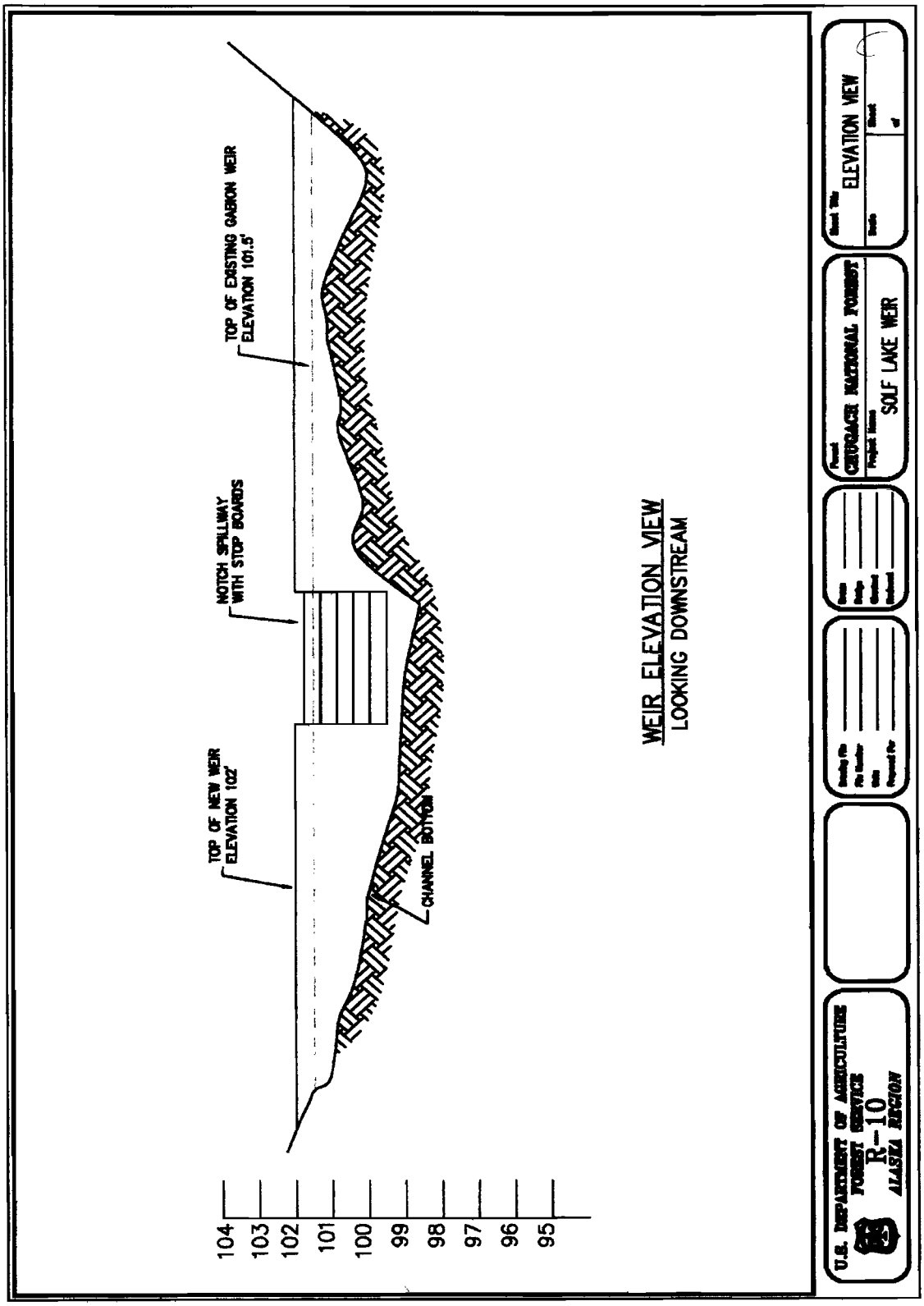


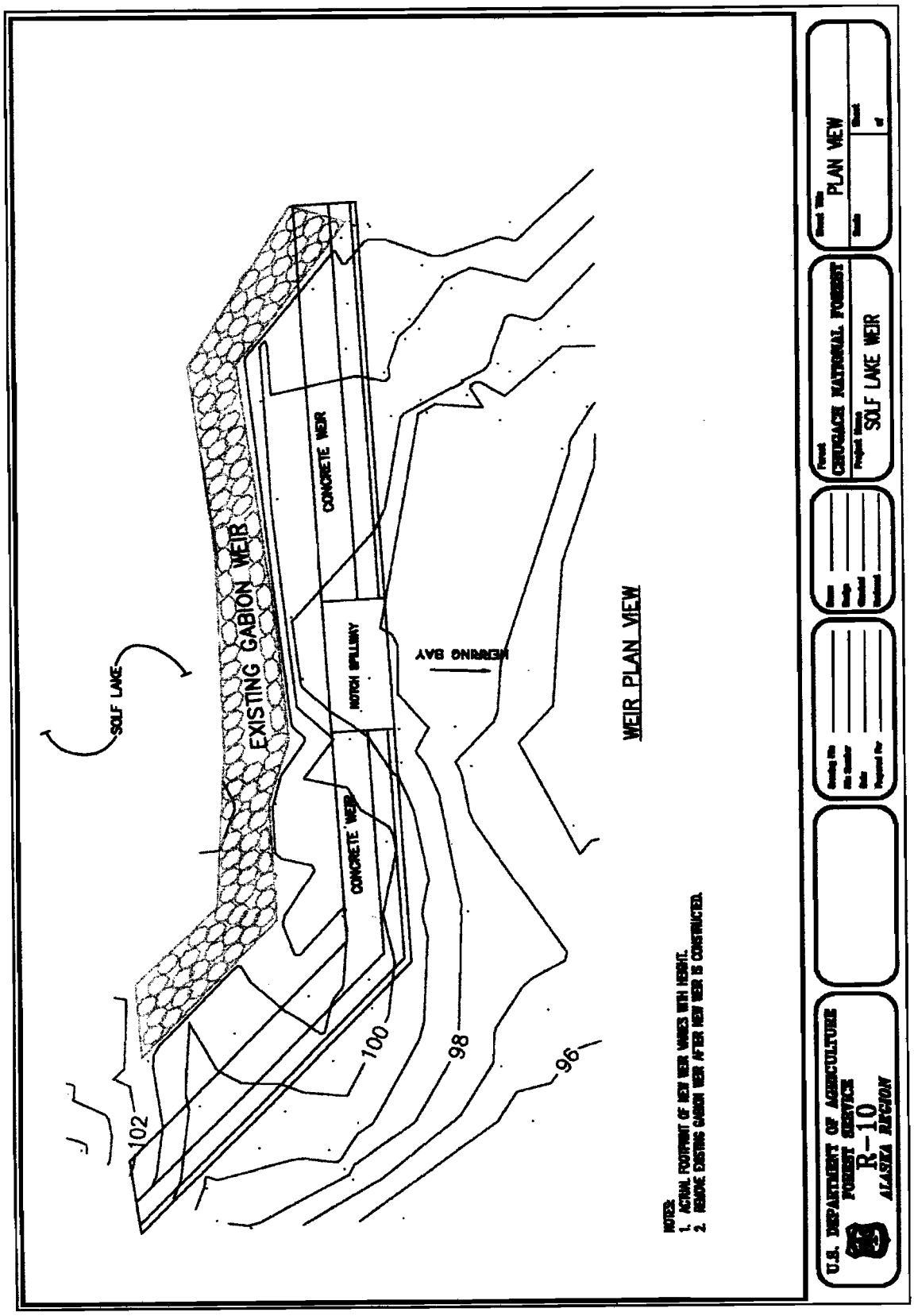
Figure #2.
Solf Lake Site Map

* Camp Location

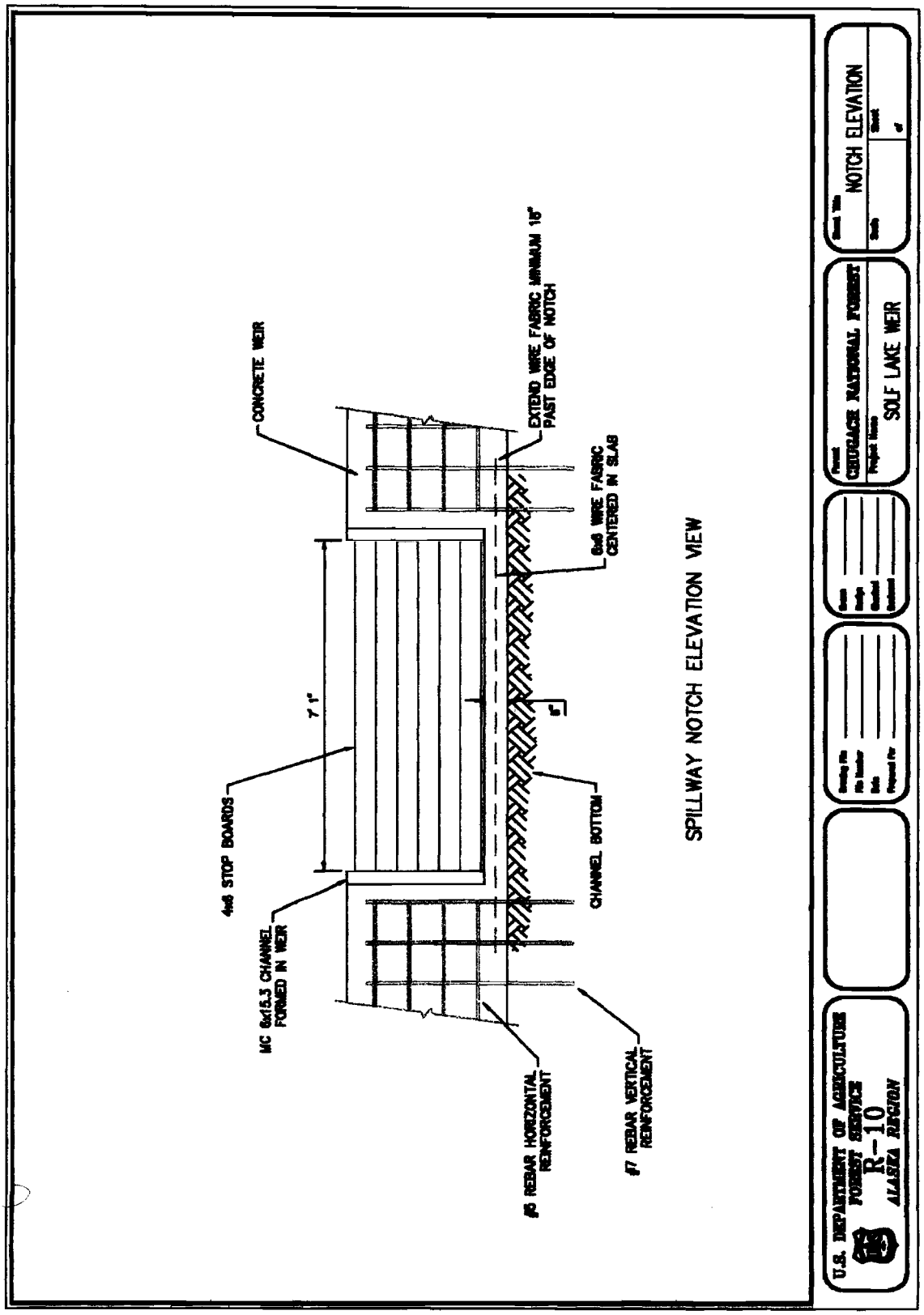
Appendix B. Figure 3. Weir Elevation View.



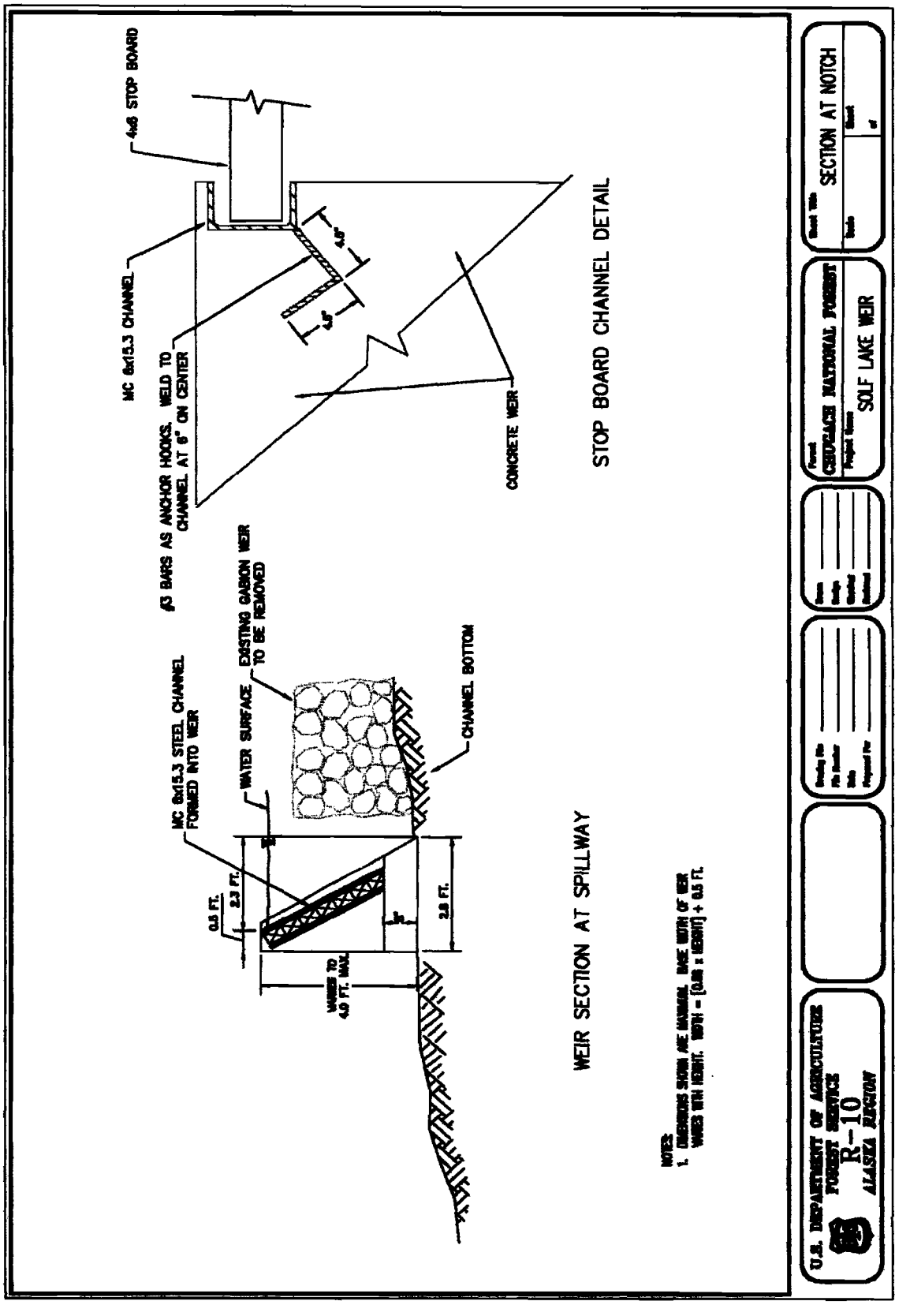
Appendix B. Figure 4. Weir Plan View.



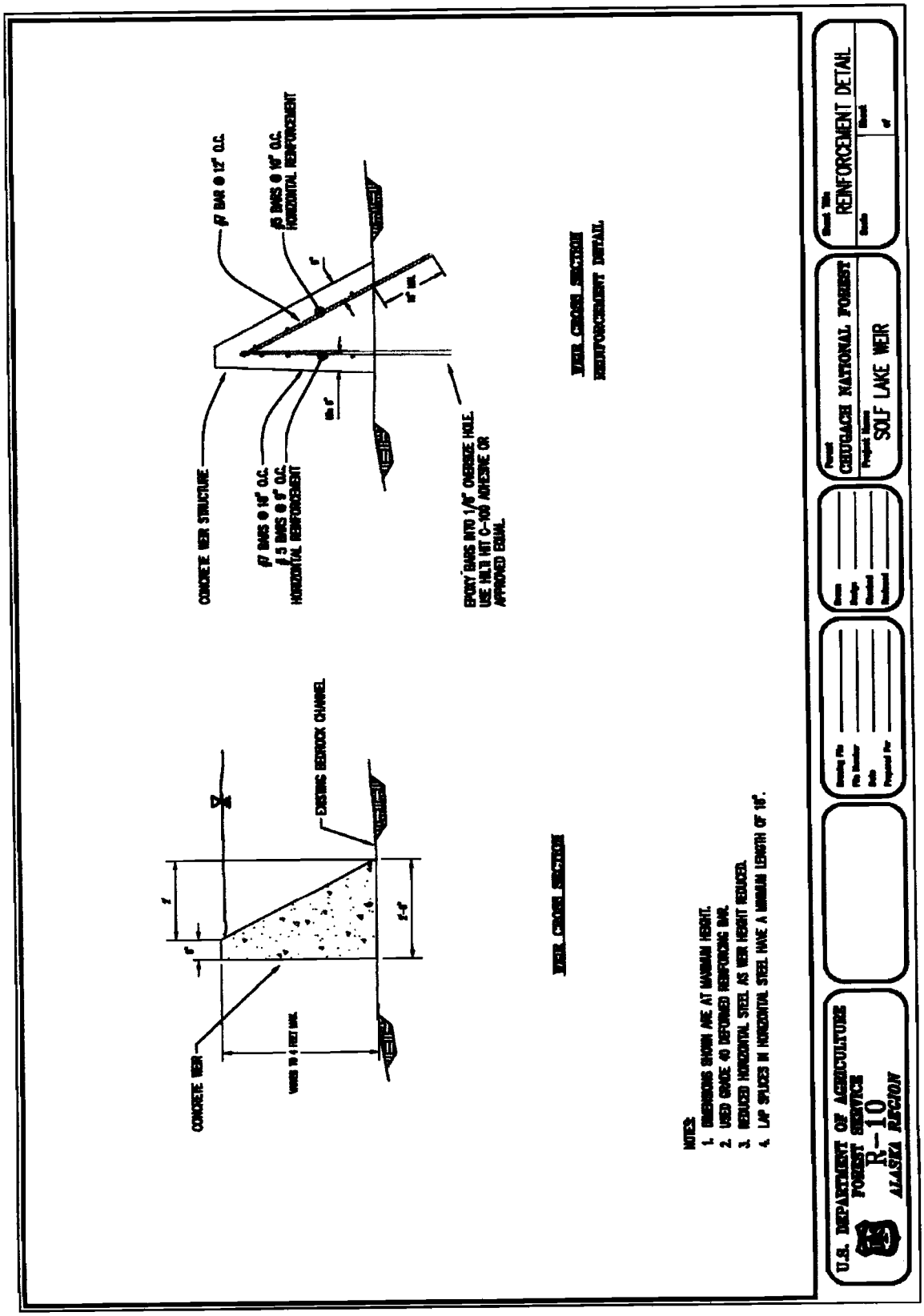
Appendix B. Figure 5. Spillway Notch Elevation View.



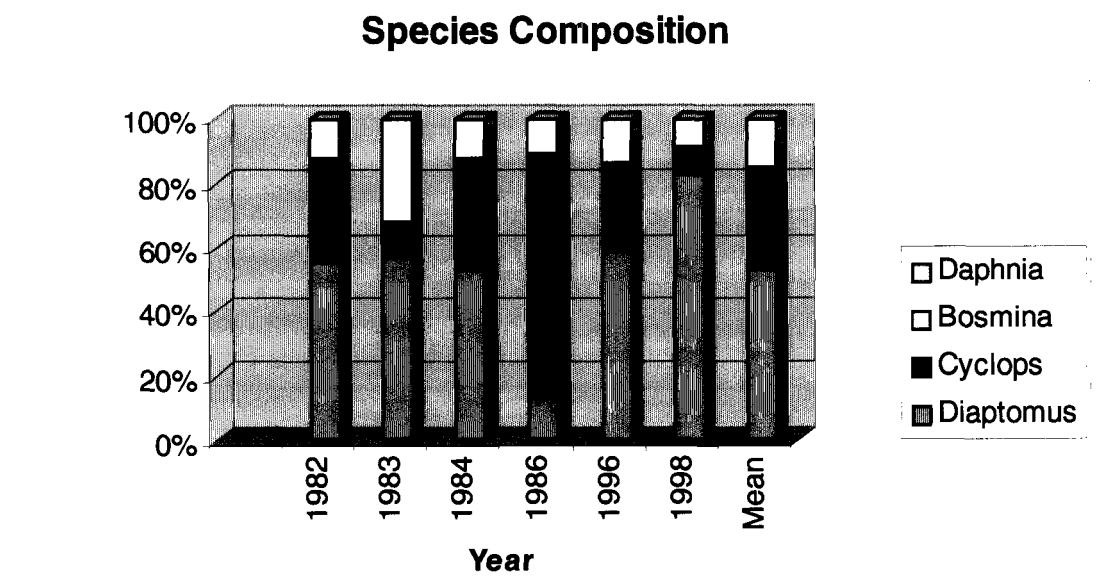
Appendix B. Figure 6. Stop Boards and Channel Details.



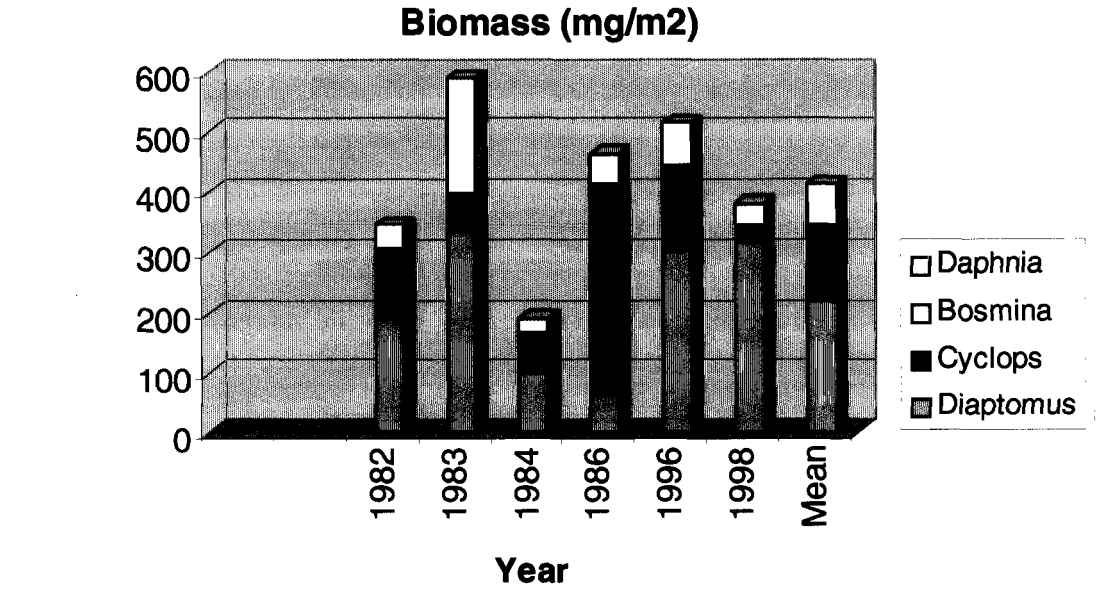
Appendix B. Figure 7. Cross-section and Reinforcement Detail.



Appendix C. Figure 8. Zooplankton Composition.



Appendix C. Figure 9. Zooplankton Biomass.



Appendix C. Figure 10. Zooplankton Body Size.