SUSITNA
HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114

AQUATIC MONITORING MANUAL

DRAFT REPORT

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SUSITNA HYDROELECTRIC PROJECT

AQUATIC MONITORING MANUAL

Report by
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Prepared for
Alaska Power Authority

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NOTICE

ANY QUESTIONS OR COMMENTS CONCERNING
THIS REPORT SHOULD BE DIRECTED TO
THE ALASKA POWER AUTHORITY
SUSITNA PROJECT OFFICE

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PREFACE

This manual was prepared by the Alaska Power Authority for use during the development and operation of the Susitna Hydroelectric Project. Several sources provided material for inclusion in this manual. Major portions were derived directly from procedure manuals developed by the Alaska Department of Fish and Game for previous studies on the Susitna Project.

The Power Authority is the project proponent for the Susitna Hydroelectric Project. The Director of the Power Authority, working in concert with the Board of Directors, is ultimately responsible for the overall monitoring program. However, the key contact concerning the implementation and progress of the monitoring plan will be the Director of Environment and Licensing. This individual, or a designee, will manage the program and will be responsible in assuring that it is carried out as planned. At present, the Alaska Department of Fish and Game's SuHydro Aquatic Study Team carries out many aspects of the program, particularly the fisheries-related studies. It is anticipated that they will continue in that role. Other aspects of the program not performed by the SuHydro Study Team will be carried out directly by the Power Authority or its designee. It is anticipated that the resource agencies will continue to be actively involved in the monitoring activities through continued interagency consultation with the Power Authority, on-site visits, and the annual review process.

Mention of specific product names does not constitute an endorsement by the Power Authority. Certain instruments have been used in previous and on-going monitoring work; therefore, it is recommended that either the current models or their equivalent be used for future studies.

1.0 Introduction

Monitoring is an essential part of the Susitna Hydroelectric Project. The purpose of this long-term aquatic monitoring plan is to determine if objectives for maintaining fish and aquatic habitat are met. It will focus on areas downstream of the project in order to:

- Determine baseline (natural) and with-project conditions
- Evaluate the effectiveness of mitigation measures
- Provide input to refine operation procedures and mitigation measures
- The Susitna Hydroelectric Project will impact aquatic resources

The basic approach to aquatic monitoring is to compare selected pre-project conditions with with-project conditions to determine if unpredicted significant impacts have occurred, and to determine the effectiveness of mitigation measures. The data requirements will depend upon the parameter or situation to be monitored. Monitoring will begin with the 1985 field season and continue through project completion (Table 1). It is believed that as the project matures, significant impacts will be mitigated fully and the need for monitoring will decrease. Should monitoring reveal that conditions other than those anticipated exist, the resource agencies will be consulted and agreement will be reached on specific modifications to correct them.

This manual only presents procedures for monitoring. The overall rationale for development of the monitoring plan and selection of parameters are presented in other documents (Harza-Ebasco 1985, APA 1986).

TABLE 1

SUSITNA HYDROELECTRIC PROJECT
SCHEDULE FOR LONG-TERM AQUATIC MONITORING PLAN

Study Element	Prior Data Avail.	1985 W S S F	1986 W S S F	1988 W S S F	1989 W S S F	1990 W S S F	Stage I Watana Complete	Stage II Devil Canyon Complete	Stage III Watana Complete	Complete Project + 5 years
A. Water Quality										
1. Dissolved Gas Supersaturation	yes	-----					-----	-----	-----------	------->
2. Temperature	yes	--------	-			--------	-----------	-----------	-----------	--------
3. Ice	yes	--------	-			--------	-----------	-----------	-----------	--------
4. Turbidity/Sediment	yes									
5. Heavy Metals	no					-----	-----	-----		-----
6. Miscellaneous Water Quality Parameters	yes	--------	-				-----	-----		-----
B. Water Quantity	yes	--------	--------	--------	--------	--------	-----------	-----------	-----------	------->
C. Fish Resources	yes	---	---	---	---	---	-----	-----	----------	------->
D. Structural										
1. Fluvial Geomorphology	yes						-----	-----	----------	------->
2. Slough Modification	no	(If incorporated as part of mitigation) (Performed on an as-needed basis)					-----	-----	----------	------->

W S S F - Winter, Spring, Summer, Fall

431007/TBL

2.0 PROCEDURES

2.1 Water Quality

2.1.1 Total Dissolved Gas Saturation

2.1.1.1 Program Description

i. Objectives:

The main objectives of the total dissolved gas monitoring will be to:

- Document the relationship between river discharge and natural, total dissolved gas concentrations
- Monitor total dissolved gas concentrations resulting from fixed cone valve, spillway, and powerhouse discharges
- Assure that concentrations meet any regulatory requirements

ii. Rationale

Dissolved gas supersaturation from dams primarily occurs when water is released over a spillway and plunges into a pool. This entrains air and carries it to depth where the hydrostatic head forces it into solution. If the hydrostatic head at depth is sufficient, the air will stay in solution. At shallower depths, however, supersaturated gas comes out of solution as the gases equilibrate with the atmosphere, thus causing bubbles to form. If the gas comes out of solution within a fish, it may cause mortality, or sublethal stress.

To avoid potential impacts from supersaturation, operational procedures for the project have been designed to minimize the need for spillway discharges. One way this will be accomplished is to store and release all floods with recurrence of 50 years or less. Another means will be to provide fixed cone valves for both dams. Releases from these valves would be dispersed as a spray and therefore would not plunge to depth nor be expected to cause dissolved gas saturation in excess of 110% downstream.

To assure that these operational procedures and structural features work as designed, total dissolved gas concentrations resulting from discharges through spillways, fixed cone valves, and the powerhouses of each dam will be monitored.

Turbulence in Devil Canyon naturally causes supersaturation downstream of the canyon, with higher discharges resulting in higher dissolved gas concentrations (Figure 1). These concentrations can exceed the State of Alaska maximum allowable standard of 110% total dissolved gas saturation when flows in the river are greater than about 15,000 to 20,000 cfs. Naturally occurring supersaturation levels decrease by approximately 50% in the first 20 miles downstream of Devil Canyon. Fish collected in the area of highest gas concentrations have not exhibited any of the signs associated with bubble disease (ADF&G 1983). The data collected thus far is sufficient to provide a general understanding of the relationships concerning dissolved gas concentrations in the Devil Canyon reach. Additional pre-project data will be needed, however, to fill some information gaps.

iii. Program Design

This task will focus on comparing total dissolved gas concentrations resulting from various combinations of project discharge from fixed-cone valves, spillways, and powerhouses for both dams. These

INSERT FIGURE 1

DISSOLVED GASES RELATIONSHIP

both dams. These concentrations will be compared to baseline pre-project conditions and to State water quality standards in order to ascertain whether or not a significant impact exists.

Field data will be obtained from continuous recording total dissolved gas meters located at fixed sampling locations. Intensive sampling will be performed during early phases of each project stage. Once it is demonstrated that mitigation measures (fixed cone valves, flood flow retention, etc.) have achieved their goals over a range of project conditions, the monitoring of dissolved gas concentrations will be reduced or phased out.

2.1.1.2 Data Collection

i. Methods

Continuous recording dissolved gas meters will be used. The baseline data has been collected with two models of recorders - both built by Common Sensing (   ).

It is recommended that either these models or their equivalent be used for future data collection. If models are changed, tests must be made to determine the comparability of data collected between the new models and those previously used. The methods for operation and calibration of these meters are attached in Appendix A. Interfaced with these meters are datapod recorders (Appendix B). Also coupled with the meters are continuous recording temperature probes (see Figure 2). Although internal gel cell batteries are provided with the model _____, the meters must be connected to a 12 volt car battery (or its equivalent) for long term reliability. Probes will be attached to the meters using 30 ft. cable (available from the manufacturer). This will allow sufficient length for placement of the meter and battery above the high water mark.

INSERT FIGURE 2

CONTINUOUS RECORDING TEMPERATURE PROBE

high water mark. Each meter and attached battery must be appropriately guarded from weather, theft, and vandalism.

Prior to field operation, the meters must be calibrated and checked to ensure that they are functioning properly. This must be done according to instructions described in Appendix A. Information that must be maintained in the permanent data files includes:

- o Data on calibration or servicing
- o Person or group that performs servicing
- o Repairs or calibrating that has been performed
- o Any notes on the general condition of the units

During the field season, the meters should be checked once each month and calibrated to assure that they are functioning properly. This should be done in conformance with instructions in Appendix A. Particular attention must be paid to the general condition of the probe and semi-permeable membrane, battery output, and readings for temperature and dissolved gas recordings. If a meter is not functioning properly, and the problem cannot be corrected, then the meter must be removed from the field and repaired.

When a meter is placed at a particular location, the following must be recorded either in a permanent log book or on data forms:

- o Date/time of placement and person(s) and group responsible

- o Location of unit (to nearest 0.1 river mile)- include a map with notes on general current flow, depth of probe, and location of meter

- o Notes on initial performance and any additional calibration required

During the sampling season, meters must be checked at least once each month. Data is recorded on an erasable miniature electronic memory chip or data storage module (DSM). Total dissolved gas is measured every 5 minutes and the average, minimum, and maximum are recorded ever 6 hours on the DSM. A DSM has a storage capacity of 2,047 readings and thus, replacement is necessary every 84 days. Prior to installation each probe must be calibrated and assigned a correction value. The following must recorded:

- o Date and time of servicing and the person(s) or group responsible

- o Notes on any recalibration or servicing needed, including:

    1. Condition of probe with particular attention to semipermeable membrane - replace if damaged or not working correctly. Replace according to instructions in Appendix A.

    2. Check temperature against glass thermometer (accurate to ± 0.1 °C). Adjust if necessary.

    3. Check total gas pressure against a mercury barometer to determine if recalibration is necessary. If the total gas meter is recalibrated, this must be noted in a log book or on a data form.

    4. The data storage module (DSM) should be removed, its serial number recorded, and a new DSM chip (with serial number recorded) replaced in the datapod.

At the end of each sampling season, the meters must be cleaned, serviced, and checked. They are then to be checked through the Power Authority's equipment control and placed in dry storage for use during the next season.

Field installation procedures for the total dissolved gas meters are as follows (refer to Figure 3):

1. Install a fence post on the stream bank out of the range of flood flows and attach a waterproof storage box to the post.

2. Install the meter and a datapod recorder in the waterproof storage box.

3. To obtain water temperatures at the streambed, attach the probe to either a weight or a spike so that the probe can monitor the total dissolved gas (and temperature) of the lower portion of the water column. Then run the probe cable along the streambed/steambank to the recorder, concealing the cable so it cannot be damaged by debris, vandalism, or wildlife.

4. Attach the probe cable(s) to the recorder.

5. Check the operation of the datapod and probes. To ensure the datapod and probes are operating normally, a short data display sequence must be activated. This is done by pressing the grey exterior button. The following information is then displayed: errors made in storage, number of storage points used, minutes until the next recording, and current total dissolved gas and temperature readings. Surface water temperature will be

INSERT FIGURE 3

DISSOLVED GAS DATAPOD FIELD INSTALLATION measured at the surface water probe with a calibrated thermometer with an accuracy of ±0.1 °C and compared to the datapod temperature.

6. Close the waterproof storage box, making sure it is properly sealed and secured.

Units must be monitored twice monthly after installation for low battery charge or disturbance. Probes and cables must be checked for physical damage, siltation, or dewatering. The short data display sequence is activated and recorded, and the total dissolved gas (and water temperature at the streambed) is calibrated according to precedures in Appendix A. Data concerning calibration and servicing are recorded. Data storage modules are changed if necessary. They are replaced when nearly full or sooner, if the data are required prior to scheduled replacement.

ii. Locations

During the pre-project baseline monitoring, sampling locations will be in the mainstem river at Curry Station (RM 120), Gold Creek (RM 136.9), just upstream of Portage Creek (148.9), and at the Watana Dam site (RM 184.4). With-project monitoring will begin with initial testing of the fixed cone valves and the spillway for Watana. Sampling locations during this initial period will be the same as for natural conditions (Table 2). An additional station will be located immediately upstream of either the cone valve intakes or the spillway. This station will serve as a control for comparison to measurements downstream. Similar positioning of stations will occur at the Devil Canyon damsite when it becomes operational. One station, will be upstream of either the spillway or cone valve intake. The other downstream stations will include those for pre-project sampling.

TABLE 2

SUSITNA HYDROELECTRIC PROJECT
TOTAL DISSOLVED GAS SAMPLING LOCATIONS AND FREQUENCY OF SAMPLING FOR
SUSITNA HYDROELECTRIC PROJECT AQUATIC MONITORING PROGRAM

Project Phase	Pre-project	Watana Operation (Stage I)	Devil Canyon Operation (Stage II)	Watana Operation (Stage III)	Long-term Permanent
Curry Station (Mainstem Susitna)	X	X	X	X	
Gold Creek (Mainstem Susitna)	X	X	X	X	
Above Portage Creek (Mainstem Susitna)	X	X	X	X	X
Watana Damsite (Mainstem Susitna)	X	X Downstream of Project	X Downstream of Project	X Downstream of Project	
Spillway, Powerhouse, or Cone Valve Intake-Devil Canyon Dam		X			
Spillway, Powerhouse, or Cone Valve Intake-Devil Canyon Dam			X		
Spillway, Powerhouse, Cone Valve Intake-Watana III				X	

X - Meter will be at this location until testing of various combinations of spillway, cone valve, and powerhouse discharges are complete.

Once the various combinations of spillway, cone valve, and powerhouse discharge are tested, and if no significant problems due to dissolved gas supersaturation are found, the sampling locations will be reduced to the one permanent station just upstream of Portage Creek.

The test conditions that should be monitored are maximum powerhouse, spillway, and cone valve discharge. Each one of these should be tested separately (e.g., monitor for total dissolved gas) in areas downstream of the respective dams during the largest operational powerhouse discharge. Repeat the test during a maximum cone valve release.

For any of the above test conditions, an intermediate discharge should also be tested (e.g., one-half the operational cone valve discharge). The spillway will be tested during initial project startup. Although the actual discharge over either the Watana or Devil Canyon spillways is not known at present, monitoring gear must be in place before maximum flows are reached.

iii. Schedule

Extensive amounts of data have already been collected concerning total dissolved gas concentrations in the Susitna River (ADF&G ___, APA 1986). These serve as sufficient information for baseline purposes. One additional data collection during the open-water season will be required prior to commencement of project construction. This will be necessary to assure that earlier data collections represent baseline conditions (i.e. no physical changes have occurred in the Susitna River which may have altered baseline conditions).

During project construction and operation, sampling will be initiated at the beginning of each new project phase and will continue until combinations of discharge from spillways, cone valves, and powerhouses are sufficiently examined to assure that no significant problems exist.

One meter will be maintained upstream of Portage Creek for an indeterminant amount of time. Once the relationships between total dissolved gas resulting from the various project discharge structures are defined, operation of this meter will be discontinued.

2.1.1.3 Data Handling

i. Field Data

Field records will be in the form of:

a. Records on meter and datapod performance (e.g., calibration dates, repairs, etc.)

b. Data storage modules (DSM's) from the datapods and records about placement and retrieval of the data storage modules

ii. Date Transfer

A copy of the records for (a) above will be kept at the field office (location undetermined at this time). A duplicate copy will be kept at the SuHydro office in Anchorage. At the end of each calendar year, a copy of the records for the entire year will be sent to the Power Authority.

The DSM's will be sent directly to SuHydro in Anchorage for translation. The data is retrieved from the DSM via an Omnidata model 217 Datapod/Cassette Reader (in Anchorage) and printed as 6-hour maximum, minimum and mean dissolved gas levels.

The following general procedures are followed when transmitting field data to Anchorage.

1. After the data has been reduced and checked as stated above, the data is transmitted to the QC auditor in Anchorage.

2. The QC auditor checks for obvious errors and proper format and corrects problems (after consultation with field crews). The QC auditor transfers a photocopy of the data to the project computer for processing. The original copies of the data are categorized and filed by site and activity (i.e., form number) in chronological order.

3. The data is processed into the project computer.

4. A printout of the processed data is returned to the QC auditor for checking and editing. It is then transferred to the project leaders, and field personnel for additional checking and editing.

5. The checked and edited printout is returned to the QC auditor for transmittal back to the computer.

iii. Data Analysis

As part of their annual report to the Power Authority, SuHydro will provide an analysis of the data. This analysis will include:

- A time series graph (for the entire year) for each station that shows discharge (mainstem at Gold Creek - USGS gaging station no.), and total dissolved gas saturation

- A hard copy, tabular computer output which has the total dissolved gas saturation (percent saturation), temperature, discharge (mainstem at Gold Creek) and date shown by six hour increments for each sampling date

- A comparison to long-term natural baseline conditions and water quality standards

- A discussion of difficulties or problems encountered during sampling which may affect results

- A detailed description of any calculations or adjustments used in arriving at the final data (e.g., any adjustments made to percentage saturation as a result of temperature or barometric pressure)

2.1.2 Water Temperature

2.1.2.1 Program Description

i. Objective

The main objective of the water temperature monitoring task will be to document pre-project and with-project water temperatures downstream of the project. This documentation will be used to determine if with-project water temperatures agree with pre-project projections and to refine, if necessary, multi-level intake and cone valve operation.

ii. Rationale

Water temperature is a key parameter that directly affects every aspect of the life history of aquatic organisms in the Susitna River. It also affects aquatic habitat, primarily through the effects of ice processes. These effects can be either positive or negative; therefore, documentation of pre-project and with-project water temperature regimes is a necessary component of aquatic monitoring.

The Power Authority has included multi-level intakes in the designs for both the Watana (Project Phases I and III) and Devil Canyon developments in order to mitigate for potential temperature impacts on ice formation and aquatic organisms. These intakes will be operated to provide as near natural temperatures as possible. There is some flexibility in selecting temperatures of the water discharged from these structures. Within the range of selection, some optimization of the temperature regime for downstream areas may be possible. To perform this optimization, water temperatures must be recorded and used in the overall analysis of with-project impacts.

iii. Program Design

Pre-project and with-project temperature data will be collected at fixed stations on the Susitna River. This will be done on a continuous basis except when conditions during the ice-covered period are at or near 0°C. Spot checks will be made to confirm this.

With-project water temperatures will be compared to pre-project data and model predictions (APA 1986). They will also be used as a key factor in the analysis of project impacts on aquatic organisms.

2.1.2.2 Data Collection

i. Methods

Water temperature data will be collected in conjunction with sampling for total dissolved gases. The meters used for total dissolved gases (see Appendix ____) incorporate a temperature recording system that can store data in the attached datapods. All data collection and processing, calibration, and field procedures will be the same as those for total dissolved gases monitoring (see Section 2.1.1), except at Sunshine Station were only a datapod recorder will be used.

Two-channel Datapod recorders (or their equivalents) using TP10V temperature probes (see Appendix B) will be used to monitor and record surface water temperatures at Sunshine Station. Instrument accuracy, as stated by the manufacturer (Omnidata International), is ± 0.1 °C. Data is recorded on an erasable memory chip or data storage module (DSM). Temperatures are measured every 5 minutes and the average, minimum, and maximum are recorded every 6 hours on the DSM. A DSM has a storage capacity of 2,047 readings and thus, replacement is necessary every 84 days. Prior to installation each probe must be calibrated and assigned a correction value.

ii. Locations

Sampling sites will be the same as those for total dissolved gases with the addition of a site at the Sunshine Station (RM 80). The same scheme for placement of the meters will be used for both pre-project and with-project monitoring.

iii. Schedule

Pre-project studies will occur during the open water season (May through October). With-project studies will be conducted throughout the year at stations where meters can be maintained. During the open water season, this will be at all stations. During the ice-covered season, only those stations upstream of the ice front will be maintained.

Extensive amounts of water temperature data on the Susitna River are already available; therefore, only one additional year of data will be needed prior to the initiation of project construction. Extensive data collection efforts will continue at all stations throughout construction and at least 5 years into operation. Thereafter, the monitoring program for temperature will be reduced in scope with only one permanent station tentatively located just upstream of Portage Creek. If temperature measurements at this station are not found to be representative of the river (in other words, the flows from the powerhouse, cone valves, and spillway are not well mixed by the time they reach this station), then another permanent station may be needed downstream.

2.1.2.3 Data Handling

i. Field Data

Immediately after installation of the recorder and prior to removal of a full DSM, a streambed water temperature is obtained with a calibrated mercury thermometer. In addition, streambed water temperature is obtained from a "short data dump" which the recorder is programmed to yield. The "short data dump" is a listing of data which also includes errors accumulated, numbers of data points stored, and minutes to next recording. The two streambed water temperatures are compared, taking into consideration probe calibration factors, to ensure accuracy of the instrument.

ii. Data Transfer

Data on temperature will be transfered simultaneously with total dissolved gas measurements (See Section 2.1.1.3ii).

All data/information requests or transmittals must go through the Power Authority. In addition, all data/information requests or transmittals to persons/agencies outside the Alaska Power Authority must go through the Power Authority's Aquatic Studies Coordinator.

A complete copy of all data transmitted and a copy of the transmittal letter/memo will be kept in the QC files. In addition, a log is maintained which provides a record of all transmittals.

iii. Data Analysis

As part of their annual report to the Power Authority, SuHydro will provide an analysis of the temperature data. This analysis will include:

- A time series graph (for the open-water season and ice free areas in the winter) for each station that shows water temperature (in degrees centigrade) and discharge (as measured in the mainstem at Gold Creek)

- A hard copy, tabular computer output which has water temperature, discharge at Gold Creek, and date. This should be shown by six hour increments for each sampling date

- A comparison to long term natural baseline conditions

- A discussion of difficulties or problems encountered during sampling which may affect results

- A detailed description of any calculations or adjustments used in arriving at the final data

2.1.3 Ice

2.1.3.1 Program Description

i. Objective

The main objectives of ice monitoring will be to document ice conditions to determine if they follow pre-project predictions and to adjust dam operational procedures, if needed, to optimize ice formation and breakup for the benefit of human and non-human resources.

ii. Rationale

The Watana (Stages I and III) and Devil Canyon Reservoirs will cause water temperatures and ice processes in downstream areas to differ from natural conditions. In winter, due to reservoir releases of water ranging from 0 to 4°C, a large portion of the river downstream of the dam will remain free of ice. In the Middle River, ice cover formation will be delayed from natural conditions (ice front progression up the Middle River will be delayed 2 to 6 weeks). Breakup will be earlier and less severe because the ice, at least in the Middle River, is expected to melt in place. When Stage III is completed, the ice front is estimated to be located 15 to 30 miles downstream from Devil Canyon. In the ice-free area, temperatures may remain above natural (0°C) by up to 3°C throughout the winter. The variation from natural will be greatest near the dam, and will decrease with distance downstream. Under the ice cover, temperatures will be 0°C, the same as for natural conditions (AEIDC, 1984).

Higher-than-natural winter discharges will result in elevated water levels downstream of the ice front. Upstream of the with-project ice front, water levels will be lower than natural because ice-cover staging will be eliminated.

Changes from natural conditions will result in more frequent overtoppings of slough berms wherever an ice cover forms. This overtopping will introduce cold (0°C) water and ice into the sloughs. Plans to prevent this overtopping include increasing the height of the berms at the upper ends of sloughs (WCC 1984a). The Power Authority has included multi-level intakes in the designs for both the Watana (both stages) and Devil Canyon developments to provide as near natural temperatures as possible.

The ice processes in the Susitna River can cause extensive changes in habitat and potentially can affect human resources (e.g., ice can impact structures such as bridges, railroad beds, etc.). Although the with-project ice processes are expected to have less potential for causing change, it is necessary that ice formation and breakup be carefully monitored, especially during the early years of project operation, to assure that pre-project predictions are realized. This monitoring will also be needed to determine if any changes in dam operation could provide more optimum ice processes (e.g., release warmer winter discharges to further delay ice formation).

iii. Program Design

Pre-project overflights and field studies of the Susitna River have been completed. The observations made during the overflights have concentrated on ice formation and ice front progression up the river, ice thickness at selected locations, overtopping of sloughs due to staging, location and effects of ice jams, forms of ice development (anchor ice, frazil ice, etc.) and breakup processes (R&M Consultants, in press). In addition to these overflights, extensive modelling of with-project ice conditions has been made (APA 1986). Monitoring of with-project ice conditions will be continued throughout the operation of the project. This monitoring will be intensive during initial project operation and will then generally decrease as project operation becomes routine.

In addition to ice observations, weather stations were maintained at Denali, Watana damsite, Devil Canyon damsite, Sherman and Talkeetna. The purpose of these stations was to provide weather data for correlation to ice formation. All stations except the Talkeetna weather station were maintained by R&M Consultants (1984). The Talkeetna weather station (located at the Talkeetna airport) was maintained by the National Oceanographic and Atmospheric Administration (NOAA). Two stations (Devil Canyon and Talkeetna) will be maintained to support the ice monitoring studies, as needed.

2.1.3.2 Data Collection

i. Methods

Pre-project overflights were made by helicopter from Cook Inlet to the upper Susitna River (AEIDC, in press). They were generally conducted on a weekly basis from September through January to describe the freeze-up process. Breakup was periodically observed from April 12 to May 15. Once the process began, observations were made on a daily basis until breakup was complete.

With-project overflights will be the same as pre-project.

ii. Locations

Overflight observations will be made from Cook Inlet to the Watana damsite (for Stage I only and then Devil Canyon thereafter). They will concentrate on the mainstem Susitna River.

Weather stations will be maintained at Talkeetna and Devil Canyon to continue supplemental information collection that may be needed for correlation to ice observations. It is expected that these stations will be maintained primarily for other reasons (it is assumed thac NOAA will maintain the station at Talkeetna as part of its normal weather observations and the Power Authority will maintain the Devil Canyon station as part of normal project data collections).

2.1.3.3 Data Handling

i. Field Data

Field data will be separated into two different types:

- Observations made during overflights and data from the weather stations

A trip report will be required for each overflight. This report will be a narrative description that will include, but not be limited to:

- Date of overflight
- Observer
- General weather conditions
- Time of trip (begin/end)
- Location of ice bridges
- Locations and effects of ice jams
- Channel morphology changes
- Aquatic habitat modifications (e.g., overtopping of sloughs)
- Ice in side channels and sloughs
- Flooding of islands

- Measurements at selected locations to determine staging due to the ice cover (this will be done at existing staff gauges at:

    1.
    2.
    3.
    4.
    5.
    6.
    7.

Any additional notes or observations that appear meaningful should be incorporated into the report. An example of additional notes would include comments on any damage to modified sloughs, particularly the berms that protect them. All locations mentioned in the report must be referenced to the nearest 0.1 river mile.

ii. Data Transfer

When an overflight is completed, the narrative description will be formalized. The original of this report will be maintained by the group performing the overflight. A copy will be sent to the Power Authority for their files. At the end of the ice-covered season, an annual summary report will be submitted to the Power Authority within two months after the final overflight.

The weather data from the Talkeetna station will be obtained from NOAA through a formal request by the Power Authority or its designee. Data from the Devil Canyon site will be processed on a monthly basis.

iii. Data Analysis

Unless further analysis for ice processes is warranted, the ice observation data and the weather station data will archived by the Power Authority for future reference. If, however, some unforeseenproblems do arise or there is a need to change operational procedures for the dam (e.g., change the release temperature), then further analyses will be performed as appropriate. It is anticipated that both the ice observation data and the weather data will be used for other purposes, such as terrestrial monitoring studies, or to address any potential concerns of the Alaska Railroad or people that inhabit sites near the river downstream of the dams. It is, therefore, important that these files be well-maintained.

2.1.4 Turbidity/Sediment

2.1.4.1 Program Description

i. Objective

Turbidity monitoring will be performed to document changes to selected optical characteristics of waters downstream of the project. Sediment monitoring will be performed to document changes to both bedload and suspended sediment discharges from the impoundment zone. Both programs will provide basic input for evaluating potential biological changes at all trophic levels in waters downstream of the project.

ii. Rationale

Most sediments that presently depend on the river's tractive force for downstream transport are expected to be trapped upstream of the dams. Particles passing downstream through the dams will be fewer and smaller, and the average mineral composition and three-dimensional shapes will be altered. The present suspended sediment and turbidity regimes should become more seasonally continuous and less variable. Enhancement of biological productivity is possible if sufficiently clearer water can be combined with river temperatures and a flow regime which protects critical aquatic habitats during appropriate seasons.

Biological changes are expected to occur at all trophic levels in aquatic habitats directly affected by project-induced changes in suspended sediment and turbidity regimes. Because changes in these parameters can either positively or negatively affect fishery resources, it is important to understand how much change will occur.

iii. Program Design

Turbidity monitoring will include the determination of nephelometric turbidity units (NTU's) of waters sampled, plus a complete, detailed description of sample collection and sample analysis procedures, and all notations (including field notes) made.

Sediment monitoring will include the determination of the following:

- Total sediment discharge (tons/day)
- Bedload sediment discharge (tons/day)
- Suspended sediment discharge (tons/day)
- Suspended sediment concentration (mg/liter)
- Settleable solids (mg/liter)
- Suspended sediment particle size classification

2.1.4.2 Data Collection

i. Methods

Turbidity samples will consist of replicate subsamples of each sample collected for suspended particulate analysis (see below). Each subsample will be taken according to the best available technology utilized by the USGS. Nephelometric analysis of all samples will be performed within 24 hours of collection. Samples will be stored at less than 4°C in darkness until they are prepared for analysis by warming them to a standardized laboratory temperature (18 to 24°C). The temperature and subjective appearance of each sample shall be recorded at the time of analysis.

Total sediment, bedload sediment, and suspended sediment discharges will be collected using the technology recommended by the USGS (1969). Samples to be analyzed for suspended and settleable sediment concentrations, sediment particle size classification, and for turbidity will be subsampled from composited, verticallyintregrated water/sediment samples taken with an appropriate device (e.g. USGS P61 sampler). Such samples will be collected from at least three substations along a horizontal transect at each sampling station (see Section ii. Location, below). Each substation will represent at least one-third of the river's discharge (i.e., nearshore, middle, and farshore). One liter water samples taken vertically at each substation will be combined to form a "composite" station sample. Each station sample will be analyzed as follows:

Total Suspended Sediment (mg/l) - Prewash and weigh a 0.45 - 0.50 micron nominal pore size filter until a constant weight is attained. Attach to vacuum bottle containing water sample and apply vacuum pressure. Dry filter at 105°C until a constant weight is attained. Repeat for at least two 100-500 ml replicates and record all replicate weights.

Settleable Solids (mg/l) - Use the most recent methodology, according to the "Standard Methods for Water and Wastewater" of the American Public Health Association (1980).

Suspended Sediment Particle Size Classification - Use the most recent USGS methodology (USGS 1969).

ii. Location

Samples for turbidity and sediment analysis will be collected at the following stations:

- o Vee Canyon (RM 223.1)
- o Gold Creek (RM 136.4)
- o Sunshine (RM 83.9)
- o Susitna (RM 25.8)

iii. Schedule

Samples for turbidity and sediment analyses will be collected twice monthly.

2.1.4.3 Data Handling

i. Laboratory Data

All data generated by water sample analyses will be tabulated according to sampling location and time, and stored both on paper and electronically. Each month a hard copy of all analyses and results will be sent to the Power Authority. A summary hard copy will be sent at the end of the sampling year (See Section 4.0).

ii. Data Analysis

Tabulated data will be compared to ascertain if with-project conditions differ significantly from pre-project conditions. Appropriate statistical procedures involving either parametric (e.g., t-tests) or non-parametric (e.g., sign tests) testing will be used, depending on the hypothesis being tested and the characteristics of the data produced from the sampling regime.

2.1.5 Mercury

2.1.5.1 Program Description

i. Objective

The objective of this program is to collect baseline and with-project data on the total tissue concentration of mercury in middle Susitna River fish and fish predators, to evaluate this data, and to make recommendations related to public health.

ii. Rationale

Literature published during the last two decades indicates that mercury has a tendency to concentrate in a toxic form in the tissues of higher trophic level organisms as a result of impoundment construction. The trophic position of vertebrates, particularly fish and fish predators, is ideal for the bioaccumulation of mercury at levels that may be of concern to human health.

The Susitna Hydroelectric Project has the potential to induce bioaccumulation of mercury in animal tissues. It is anticipated that this will not be a significant problem. There are no known methods to mitigate for this phenomena other than awareness of the danger and avoidance of contaminated food organisms. A program is needed, therefore, to collect and evaluate the data needed to determine if mercury bioaccumulation is occurring.

iii. Program Design

The program is designed to determine the mercury concentrations in the tissues of four species of sport fish found in the proposed Watana and Devil Canyon impoundment zones, including:

- o Rainbow trout
- o Burbot
- o Lake trout
- o Arctic grayling

Tissue levels of mercury will also be determined in river otter, a fish predator. Samples of muscle tissue will be collected in the fall, when fat reserves are highest. With-project samples will be compared to baseline samples collected prior to construction to determine the degree of impact, if any, the project has had on tissue concentration of mercury.

2.1.5.2 Data Collection

i. Methods

Organisms for study will be collected by traps, nets, or snares, which will utilize baits native to the adjacent habitat or no baits at all. A total of three fish of each species and three otters will be collected at each sampling location. All organisms collected will be sexually mature. They will be killed and sealed in polyethylene or polypropylene bags as soon as possible after capture. Contamination or dessication of tissues must be avoided since both actions can affect sample analysis. Each sample bag must be labelled and, then frozen until all samples are collected, at which time they are to be transported to an analytical laboratory.

The laboratory analysis will consist of EPA technique number 245.1 (see Appendix ____), as follows:

1. Remove a 1 to 5 gram sample of muscle tissue and digest in a mixture of sulfuric and nitric acids.

2. Use the cold vapor modification followed by absorption spectrophotometery to determine total mercury content.

ii. Locations

Grayling and lake trout will be sampled in any two upper basin tundra lakes, plus at least one lake in the Watana impoundment zone.

Grayling, rainbow trout, burbot, and river otters will be sampled in the mainstem Susitna River within the upper, middle, and lower river zones.

iii. Schedule

All organisms will be collected in late summer or early fall. Baseline samples will be collected 1 year prior to impoundment; with-project samples will be collected 5 years after impoundment. Samples will be analyzed within three months of collection.

2.1.5.3 Data Handling

i. Field Data

This data will consist of the sampling location, the organism collected, the date, and the collector. The data will be recorded in pencil on waterproof paper and will be affixed to the appropriate sample bag.

ii. Laboratory Data

Data from tissue analyses will be recorded in notebooks and on computer diskettes. A copy of the results will be sent to the Power Authority within one month after the samples are analyzed.

iii. Data Analysis

A threshold level of danger is 0.5 to 1.0 ppm. Appropriate statistical tests (Student's t-test) will be used to determine if with-project tissue levels are significantly higher than pre-project levels. All tissue concentrations will be reviewed for potential public health hazards.

2.1.6 Miscellaneous Water Quality Parameters

2.1.6.1 Program Description

i. Objective

The sampling of dissolved oxygen, pH, conductivity, and temperature is standard in the monitoring of aquatic conditions. The measurement of these parameters will be used to determine if water quality conditions are within the ranges of tolerance of the Susitna River's biologic resources.

ii. Rationale

Construction and operation of the Susitna Hydroelectric Project will cause changes in the physical and chemical characteristics of the Susitna River which, in turn, may have an impact on the river's biological resources. Knowledge of the ranges of tolerance of these parameters for the more prevalent biological entities found in the Susitna River exists. Measurement of these parameters will yield data useful in the evaluation of the project's effects on these organisms.

iii. Study Design

Monitoring of these parameters will occur coincidentally with the monitoring of turbidity and sediment levels (Section 2.1.4). Data collected under natural conditions will be compared to those collected under with-project conditions. Comparison of with-project measurements to known tolerance levels of aquatic organisms found in the Susitna River will be made to determine if detrimental environmental conditions have occurred due to project operation.

2.1.6.2 Data Collection

i. Methods

Field measurements of dissolved oxygen (DO), pH, conductivity, and temperature are taken with a Hydrolab model 4041 portable multi-parameter meter (see Appendix ____). The parameters are measured simultaneously at the sonde unit (underwater probe) and the readings are displayed in an indicator unit. The meters must be calibrated prior to entering the field (temperature is factory-calibrated). Meter calibration, operation, and maintenance procedures are listed in Appendix ____.

To take measurements, place the sonde unit in slow-moving, well-mixed water, such as ehind a boulder, for at least 5 minutes before taking readings. The instrument should have the DO function "ON" during this equilibration process. Following field use, perform a calibration check to adjust the instrument drift.

ii. Locations

Monitoring locations for these parameters are the same as those described for turbidity and sediments (Section 2.1.4).

iii. Schedule

The schedule for monitoring of these parameters is the same as that listed for turbidity and sediments (Section 2.1.4).

2.1.6.3 Data Handling

i. Field Data

Readings taken from the Hydrolab meter are recorded on the "Miscellaneous Water Quality Parameter Form" (Figure Q). All readings are recorded as they are taken.

FIGURE Q

SUSITNA HYDROELECTRIC PROJECT
FIELD DATA FORM
MISCELLANEOUS WATER QUALITY PARAMETERS

Sampling Site (Name/RM)	Sampling Date	Collected by	River Stage (Gold Creek)	Water Temperature (°C)	Dissolved Oxygen (ppm)	PH	Conductivity (umhos/cm)

ii. Data Transfer

Data collected on the field data form is transfered in tabular form to a computer floppy disc, according to the program steps listed in Appendix ___. Transfer into computer storage occurs within three (3) days of sampling completion. All field forms are stored in a three-ringed binder on file with the Director of Environment and Licensing.

iii. Data Analysis

Data from the monitoring of miscellaneous water quality parameters is tabulated upon the completion of each year's field season. Time-series plots are prepared and compared to known tolerance levels of Susitna River biota to determine if cheshold values have been reached or exceeded at anytime throughout the sampling period.

2.2 Water Quantity

2.2.1 Program Description

i. Objective

The objective of this task is to provide the information needed to evaluate performance in meeting the Case E-VI flow criteria and the effectiveness of the criteria in providing for the fishery management program.

ii. Rationale

The habitat available for fish in the Middle Susitna River is related to flows and flow stability. The estimation of habitat available with-project is based on an assessment of the expected effects of with-project flows on fishery habitat (APA 1985). Flow constraints have been developed using this assessment. It will be necessary to monitor with-project flows to determine how the fish resources are responding to the altered conditions, so that needed modifications of the flow constraints can be made to improve conditions.

Additionally, as the flow requirements are expected to be incorporated in to the Project's License, regulatory agencies will need to monitor project performance in meeting the constraints.

iii. Program Design

The program is designed to make all the information necessary for the evaluation of the project's performance in meeting flow requirements readily available for regulatory agencies review. Additionally, a method is incorporated for notifying the appropriate agencies when the flow requirements are not met. A third part of the program is the compilation of flow data on an annual basis for use in other river-related studies.

The evaluation of project performance in meeting flow requirements requires that information on flows in the Susitna River be available for:

- o Gold Creek, where minimum and maximum weekly average flows will be evaluated, and

- o The most downstream operating project (i.e., Watana in Stage I and Devil Canyon in Stages II and III) where flow stability criteria will be evaluated.

Additionally, information will be required on inflows to the project and reservoir water levels to evaluate:

- o Whether natural streamflows for the year comprise a 1:10 year low-flow condition, and

- o Whether fixed cone value and spillway operations were carried out in accordance with flow constraints on rates of change of release from these facilities.

Since the information will be used by the Alaska Power Authority in operation of the project, it will generally be available to interested parties within a short period of its becoming available to the Power Authority. The Power Authority expects that the Project License will require it to notify appropriate regulatory agencies when it becomes apparent that a flow constraint has not been or will not be met. The following specific information will be available from the Power Authority:

- o Discharges at Gold Creek (in cubic feet per second cfs)
- o Project discharges (cfs)
- o Reservoir water levels (in feet of elevation)
- o Reservoir inflows (cfs)

The Power Authority will notify the appropriate agencies when the following conditions occur:

1. The average weekly flow for the previous week was below the minimum flow requirement.

2. The scheduled average weekly flow for the upcoming week will be below the 9,000 cfs minimum by reason of low inflow for the year or low reservoir water level, or for any other reason.

3. The flow stability criteria are not maintained.

4. The reservoir water level reaches the normal maximum level and outlet works operation begins.

5. Outlet works operation ends.

6. The reservoir water level reaches the maximum environmental surcharge level and spillway operation must begin.

7. Spillway operation ends.

8. Susitna River flows at Gold Creek exceed the maximum constraint whether as a result of dam safety

requirements in passing flows or when flow from the area intervening between the project and Gold Creek is large. This notification will be made as soon as the hourly discharge exceeds the maximum constraint, or earlier if it becomes apparent this will happen even if the weekly average flow remains below the constraint.

9. An emergency arises, requiring the project to release either significantly more or less flow than planned. Such an emergency may be:

   - loss of energy generation from some other portion of the generating system requiring additional generation from Susitna.

   - loss of energy generation from Susitna for any reason.

Additionally, the Power Authority will make available, at a central location where flows are recorded, the expected average weekly discharge for the next week and will estimate whether outlet works or spillway discharges are expected.

2.2.2 Data Collection

2.2.2.1 River Flow Data - Gaged Sites. River flows on the Susitna River at the Gold Creek gaging station, Sunshine gaging station, upstream of the reservoir(s) and on the Oshetna River will be determined by standard methods of the U.S. Geological Survey. Water levels at the sites will be monitored, recorded at the site and telemetered to the project operations center and the USGS at hourly intervals. At the project operations center, the water levels will be converted to estimated discharges using the latest available gage rating curves from the USGS. The USGS in cooperation with the Alaska Power Authority will maintain the gages in good order. Periodic measurements of flow at the sites will be made to check the gage rating curve as deemed appropriate by the USGS and using standard methods of the USGS. Gage ratings will be adjusted as deemed appropriate by the USGS.

2.2.2.2 Flow Data - Ungaged Sites. The Power Authority anticipates that it will develop a system for forecasting streamflow into the project as a result of snowmelt and precipitation. This system will be developed after a License is granted. This system will be used to estimate flows from ungaged as well as gaged areas. These estimates will be [illegible] relatively long periods except during floods when project operation requires more frequent data. The system will include a large number of meteorological and hydrological data gathering stations and a mathematical model of basin hydrology. The output of this model will provide the estimates of discharge from ungaged portions of the watershed.

2.2.3.3 Flow data - Project Facilities. Powerhouse flow data will be determined by summing discharges from operating turbines.

Outlet works and spillway discharges will be determined from rating curves established for these features. These rating curves will probably be established by physical hydraulic model studies and will give discharge as a function of water surface level in the reservoir and gate opening.

All powerhouse, outlet works, and spillway flow data will be collected hourly and whenever conditions change significantly such as a change in gate opening or when a turbine begins or ends operation.

2.2.2.4 Reservoir Water Level Data. This data will be determined from gages placed in the reservoir. Data will be transmitted to the central operations center, by wire or by radio.

2.2.3 Data Transfer

2.2.3.1 River Flow Data - Gaged Sites. River water levels at gaging sites will be telemetered to the central project operating center and the water levels and estimated discharges will be displayed, recorded and stored electronically. A summary table will be prepared on a monthly basis.

2.2.3.2 River Flow Data - Ungaged Sites. This will be estimated data and will be generated by a mathematical model most likely located at the project operations center. This data will also be displayed, recorded and stored electronically. Data will be summarized and sent to the Power Authority on a monthly basis.

2.2.3.3 Project Facilities. This data will be transmitted to the project's central operations center by wire or by radio and will be displayed, recorded, and stored electronically. A summary table will be prepared on a monthly basis.

2.2.3.4 Reservoir Water Levels. This data will be transmitted to the central operations center by wire or radio and will be displayed, recorded, and stored electronically. A summary table will be prepared on a monthly basis.

2.2.4 Data Analysis

Flow data will be reviewed weekly to determine if project operation remained within the Case E-VI flow constraints.

At the end of each water year (September 30) all flow data from that year will be compiled. Data will be based on the final rating curves for the appropriate gaging stations as adopted by the USGS. This data may vary slightly from that posted during the year. Data of significant interest include:

- Daily minimum, maximum, and mean flows for the Susitna River at Gold Creek, for the site upstream of the project on the Susitna River, for the Oshetna River site, Sunshine Station and as estimated for the ungaged portion of the basin

- Daily minimum, maximum, and mean powerhouse, outlet works, and spillway releases

- Daily minimum, maximum, and mean reservoir water levels

- Hourly outlet works and spillway discharges for all periods when these features operate

- A summary of all periods when environmental flow requirements were not maintained and the reasons for these occurrences

2.4 Structural

2.4.1 Fluvial Geomorphology

2.4.1.1 Program Description

i. Objective

This program is designed to monitor changes in the general morphology of the Susitna River (downstream of Devil Canyon) that result from operation of the Susitna Hydroelectric Project and to assess the impacts of these changes in geomorphic regime on aquatic resources.

ii. Rationale

The Susitna River is a dynamic system undergoing a natural process of geomorphic evolution due to physical processes such as ice breakup and flooding. River channels often aggrade or degrade to adjust to changes in local climate, runoff, sediment supply, or slope. Changes in these physical processes may be wrought by with-project flow regulations, with a subsequent alteration in aquatic macrohabitat. It is expected that the rate of change will be signficantly reduced with-project; therefore, it is important to document changes in the river's geomorphologic pattern and to periodically compare the effects of these changes on productivity of the aquatic system.

iii. Program Design

The primary means for documenting macrohabitat changes will be through detailed aerial photography of the river from Devil Canyon to Cook Inlet. From these photographs, the macrohabitat types (e.g., mainstem, side-channel, side slough, tributary mouth, etc.) will be examined qualitatively and compared to pre-project photos. Key items of interest will be changes (or lack thereof) due to ice processes and stabilized flows. If other monitoring studies demonstrate that further analyses are required, these photos will be available for more detailed quantitative analysis. The photos will also be used in conjunction with monitoring of terrestrial resources.

2.4.1.2 Data Collection

i. Methods/Locations

The primary method for obtaining photos will be through aerial photography of the entire mainstem river from Cook Inlet to Devil Canyon. Black and white and color aerial photographs will be obtained at an approximate scale of 1 inch = 1,000 feet, for the Middle River (Talkeetna to Devil Canyon) and 1 inch = 2,000 feet for the Lower River (Cook Inlet to Devil Canyon) with a 60 percent overlap between adjacent photos. Baseline photographs of the Middle River for river discharge (as measured at the USGS Gold Creek gaging station) ranging from 5,100 through 23,000 have already been taken (Table 4).

In addition, photos for the Lower River have been taken for various ranges from 13,900 to 75,200 cfs (measured at the USGS Sunshine gaging station) (Table 5).

Prior to project operation, overflights of the Middle River and Lower River will be taken at approximately 12,000 cfs and 35,000 cfs, respectively. The reason for these specific flows is that they are relatively low, allowing definition of many of the macrohabitats. These will be used for comparison to previous

Table 4.

SUSITNA HYDROELECTRIC PROJECT
DATES AND MAINSTEM DISCHARGES AT WHICH AERIAL
PHOTOGRAPHY OF THE MIDDLE SUSITNA RIVER WAS OBTAINED.

Date	Discharge (cfs)
6-1-82	23,000
8-24-80	18,000
9-11-83	16,000
9-6-83	12,500
9-9-84	10,600
10-4-84	7,400
10-14-84	5,100

Source: APA 1985

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TABLE 5.

SUSITNA HYDROELECTRIC PROJECT
DATES AND DISCHARGE AT WHICH AERIAL PHOTOGRAPHY WAS OBTAINED

Date	Discharge at Sunshine
8-27-84	75,200 cfs
8-27-83	59,100 cfs
9-6-83	36,600 cfs
9-16-83	21,100 cfs
10-25-83	13,900 cfs

Source: APA 1985

photos and to document conditions immediately before impoundment. Similar sets of photos will be taken periodically during project operation to continue the documentation and comparison process. If macrohabitat changes are found to be minimal, the period between overflights will be extended or the overflights discontinued.

iii. Schedule

Existing photos have already been taken (Tables 4 and 5). Additional pre-project photos will be taken one year before initial operation. Approximately every five years after impoundment, additional photos will be taken. After each series, the need for further overflights will be reviewed.

2.4.1.3 Data Handling

i. Field Data

Field data will be collected by a commercial aerial photography firm. Their data must include information on date of overflight, time, altitudes, flight lines, participants, and any notes.

Stream discharges will be monitored prior to flights to assure that photos are taken at similar flows.

ii. Data Transfer

Photos will be developed in Anchorage by the commercial firm. The firm will retain original negatives and will send to the Power Authority, a copy of the negatives and two sets of prints each for the Lower River and Middle River overflights. The Power Authority will archive the negatives and one set of prints and will store the other set of prints in an active file.

iii. Data Analysis

The photographs will primarily be used for qualitative assessments of macrohabitat changes. They will be available in the event that more detailed quantitative analyses are needed. Following the examination of each set of photos, a technical memorandum will be written which describes any important features or changes that have occurred from previous photos. Particular attention will be given to any obvious changes in macrohabitat (especially if they may affect mitigation measures such as protective berms for sloughs). If other monitoring shows that the aquatic system has been significantly impacted by the dam, further and more detailed analyses of the macrohabitat may then be warranted.

2.4.2 Slough Modifications

2.4.2.1 Program Description

i. Objective

Various features incorporated into slough habitat modification will be monitored to determine if access for adult salmon is unhindered, and that suitable spawning conditions exist.

ii. Rationale

The Alaska Power Authority has proposed specific structural modifications for several Middle Susitna River sloughs that are utilized by adult salmon for spawning. The purpose of these modifications is to provide fish habitat at existing or higher levels of production under with-project conditions. The modifications must be monitored to ensure that they are meeting their intended function.

iii. Program Design

Protective berms constructed at the heads of sloughs will be inspected to identify and implement needed repairs. Features designed to facilitate adult access into sloughs will also be inspected. Modifications designed to maintain spawning areas will be inspected to ensure the area contains suitable spawning conditions. Water temperature and flow will be monitored to ensure conditions are favorable for egg survival.

2.4.2.2 Data Collection

i. Methods

Berms - A visual inspection of each protective berm is to be performed annually. The structure's integrity, including signs of erosion, scouring, overtopping, or undermining, is of primary concern.

Access Structures - Structures designed to maintain or enhance access of adult salmon into sloughs are to be inspected visually for signs of erosion, undermining, misalignment, or failure. Water depths across the upper, middle, and lower sections of critical passage reaches are to be measured by stretching a meter tape from bank to bank above the water surface at each site and reading the depth every 0.5m with a stadia rod.

Spawning Conditions - During the first 5 years following modification, the distribution and abundance of spawning adult salmon and the number of outmigrating juvenile salmon will be the most useful measure of habitat conditions in modified sloughs (see Section 2.3). Prior to each spawning season a foot-survey and subjective evaluation of habitat conditions in each modified slough is to be completed. The evaluation centers on the quality of spawning gravels (visual estimate of composition), estimated water velocity and depth measurements, and the presence of upwelling groundwater. Structures installed to maintain depths, to control velocities, and to retain gravels are to be inspected for signs of erosion, undermining, defect, and failure.

Sloughs undergoing modifications are to be monitored for changes in flow and temperature. Staff gages are to be installed in each slough and stage-discharge relationships developed following modification. Continuous recording thermographs are to be installed in each slough for use throughout the spawning and incubation periods.

Identification of any deficiency in structural modifications of spawning sloughs may trigger more extensive studies of such parameters as gravel quantity and quality, water quantity and quality, habitat availability, and the incubation environment.

4.0 Reporting

Analyses of all field data will be on an annual basis (January - December) and will be completed by January 15 of the succeeding year so that the data may be incorporated into the Power Authority's annual report to the Federal Energy Regulatory Commission and to the resource agencies. The Power Authority will provide this final report by March 1 of the year following data collection.

Data on water quantity is normally collected on the basis of the "water year" (October 1 to September 30). In order to maintain continuity with other monitoring programs, water quantity data will also be reported on a calendar year basis. This should not create undue hardship, since such data will be summarized on a weekly basis for project operation.

5.0 Contingencies

Although the results of the long-term monitoring program will be reviewed on an annual basis, there may be unforeseen instances when either additional monitoring or a change in on-going monitoring may need to be initiated on short-term notice. In these cases, the Alaska Power Authority's Director of Environment and Licensing (DEL) will notify the appropriate agency or agencies, the situation will be discussed, and action agreed upon will be taken. If such occurrences are first observed by personnel of the resource agencies, such agencies should notify the DEL and request a meeting to address the situation.

The long-term monitoring manual has been designed as a three-ring binder so that when additions or alterations in the long-term monitoring plan occur, they are to be documented and placed in the manual. Copies of such changes are to be distributed to all agencies and individuals possessing copies of the manual. A list of those receiving the manual is to be kept with the master manual copy on file at the office of the DEL.

REFERENCES

6.0 REFERENCES

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