UMATILLA RIVER BASIN, ANADROMOUS FISH HABITAT ENHANCEMENT PROJECT

Annual Report 1989

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ABSTRACT

The Umatilla habitat improvement program is funded under the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program measure 704 (d) (1) 34.02, and targets the improvement of water quality and the restoration of riparian areas, spawning and rearing habitat of steelhead, spring and fall chinook and **coho** salmon.

The Confederated Tribes of the Umatilla Indian Reservation is responsible for enhancing reaches of stream within the Reservation boundaries as guided by an implementation plan developed cooperatively with the Oregon Department of Fish and Wildlife and the U.S.D.A. Forest Service, Umatilla National Forest.

The channelization of Meacham Creek by the Union Pacific Railroad combined with poor riparian livestock management created extreme channel instability and **bedload** movement within the project area. The resulting loss of riparian vegetation caused an increase in water temperatures, evaporative losses and sediment loading from upland sites.

Four leases and nine right-of-way agreements were procured for the restoration of 2 miles of stream channel on Meacham Creek and lower Boston Canyon Creek. Treatment designs and concepts were developed under subcontract with **Albrook** Hydraulics Lab which focused on improving channel stability and increasing fish habitat complexity. Treatments included: sloping of gravel deposits to reduce channel braiding and develop a more stable channel configuration, placement of rock and wood structures to reduce erosion of stream banks and encourage the deposition of fines for the establishment of riparian vegetation, placement of **instream** boulders, weirs and large organic debris to increase holding and hiding cover and to encourage the development of a stable thalweg, and the enhancement of riparian vegetation through planting of hardwood cuttings and grass and forb seeds.

Riparian corridor fencing was postponed until the 1990 project year to allow for the safe location of the fence line following evaluation of the stability of new channel configurations in high flows.

Baseline data on stream flows, water temperature and suspended sediments, and channel morphology was collected.

ACKNOWLEDGEMENTS

We would like to thank the land owners Rosemary S. Gladow, Robert Hoskins, Sam B. Merryman, Frank C. Tubbs, Glen D. Williams, Merna Tovey , Francis E. Williams, Fawn M. Williams, Royal L. Robie, Normal J. Rainville, Claudette M. Tripp, Dorcas Courville and the late Kenneth Bill for their cooperation and support, and the Union Pacific Railroad for providing material, services and access to the project area.

Thanks to Ed Calame and John Sanchez of the Umatilla National Forest and Randal Reeve and Tim Baily of the Oregon Department of Fish and Wildlife for their support, review and assistance.

We would like to thank the CTUIR staff who cooperated in the production of this report, Gary James for providing technical oversight and critical review of this report, Joe Richards for providing administration of the agreement, and Julie Burke and Celest Reves for providing secretarial services.

Special thanks to Ken Hall for the long hours and dedication required to complete this ambitious undertaking.

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INTRODUCTION

This report covers work accomplished by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) during-April 1989 through March 1990 as part of the Umatilla Drainage Habitat Improvement Program. This Program is funded under the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, Measure 704 (d) (1) 34.02, as partial mitigation for construction of hydroelectric dams and the subsequent losses of anadromous fish throughout the Columbia River system. The CTUIR as co-managers of the fisheries resources, was identified as the agency responsible for implementation of habitat improvements within the Umatilla Indian Reservation boundaries.

The Umatilla River Drainage Anadromous Fish Habitat Improvement Implementation Plan (Implementation Plan), was developed by the Oregon Department of Fish and Wildlife (ODFW), U.S.D.A. Forest Service, Umatilla National Forest (USFS), and the CTUIR to guide enhancement activities in the basin from 1988 through 1992 (Reeve et al. 1988). Enhancement activities target improvement of water quality, and restoration of riparian areas and spawning and rearing habitat of steelhead (Oncorhynchus mykis), spring and fall chinook salmon (Oncorhynchus tschawytscha), and coho salmon (Oncorhynchus kisutch). These species represent an important cultural and religious resource to the Indian Tribes and their protection is mandated by Treaty with the United States Government.

Enhancement strategies include riparianvegetation restoration and protection, habitat diversity improvement and channel development. Improvements are being implemented in conjunction with other anadromous fish restoration efforts in the Umatilla River Basin including passage improvements (ladders, screens,and flow enhancement) and hatchery supplementation. These other efforts will help to boost spawning escapement and natural production in the enhanced habitat throughout the Umatilla Basin.

DESCRIPTION OF PROJECT AREA

Meacham Creek is a major tributary to the Umatilla River, entering at rivermile (RM) 79 (Figure 1). It drains approximately 165 square miles and produces 145,000 acre-feet annually at RM 5 near the head of the project area. The principle aquifer is guaternary alluvium composed of unconsolidated sand and gravel, gravel, and some silt. Alluvium may reach a depth of up to 12 feet (Gonthier and Harris, 1975).

Boston Canyon Creek, entering Meacham Creek at RM 2.1, is the largest tributary to Meacham Creek within the reservation. It contributes over 4,000 acre-feet annually to Meacham Creek from a drainage basin of approximately 5.5 square miles. It runs over and through large alluvial deposits as it enters the Meacham Creek floodplain.

Elevations in the project area range from 1,800 to 2,000 feet above sea level, giving the area an unusually long growing season. Stream gradients average less than 2 percent. Flooding in the project area usually occurs in late winter and spring as a result of rain on snow event. The flood peaks tend to be high and the volumes large, but the duration of damaging stages seldom last more than a day or two (U.S. Army, Corps of Engineers, 1975).

The project lies in a big game winter grazing zone as outlined by the CTUIR Land Development Code (1983). The primary land use is livestock grazing, May to November. Timber harvest is permissible under a conditional use permit.

The riparian corridor has been greatly reduced by encroachment from the east bank by the railroad right-of-way built in the late 1880's. The riparian area was further reduced and- the river channelized following the 1964/65 flood when the Union Pacific Railroad (UPRR) built training dikes which forced the river against the west bank to prevent erosion of the railroad right-of-way.

Heavy grazing pressure year round from domestic livestock and big game species has effectively prevented riparian recovery. Unhealthy riparian conditions and channelization have resulted in extreme channel instability and bedload movement throughout the project area. Low flow channels braid through and flow under barren gravel bars during summer months where water temperatures may exceed 80 F. Evaporative losses are extreme.

The severe habitat problems in Meacham Creek coupled with multiple species use (summer steelhead and spring chinook) resulted in a high ranking for Meacham Creek in terms of enhancement need and potential benefit (Reeve et al. 1988).

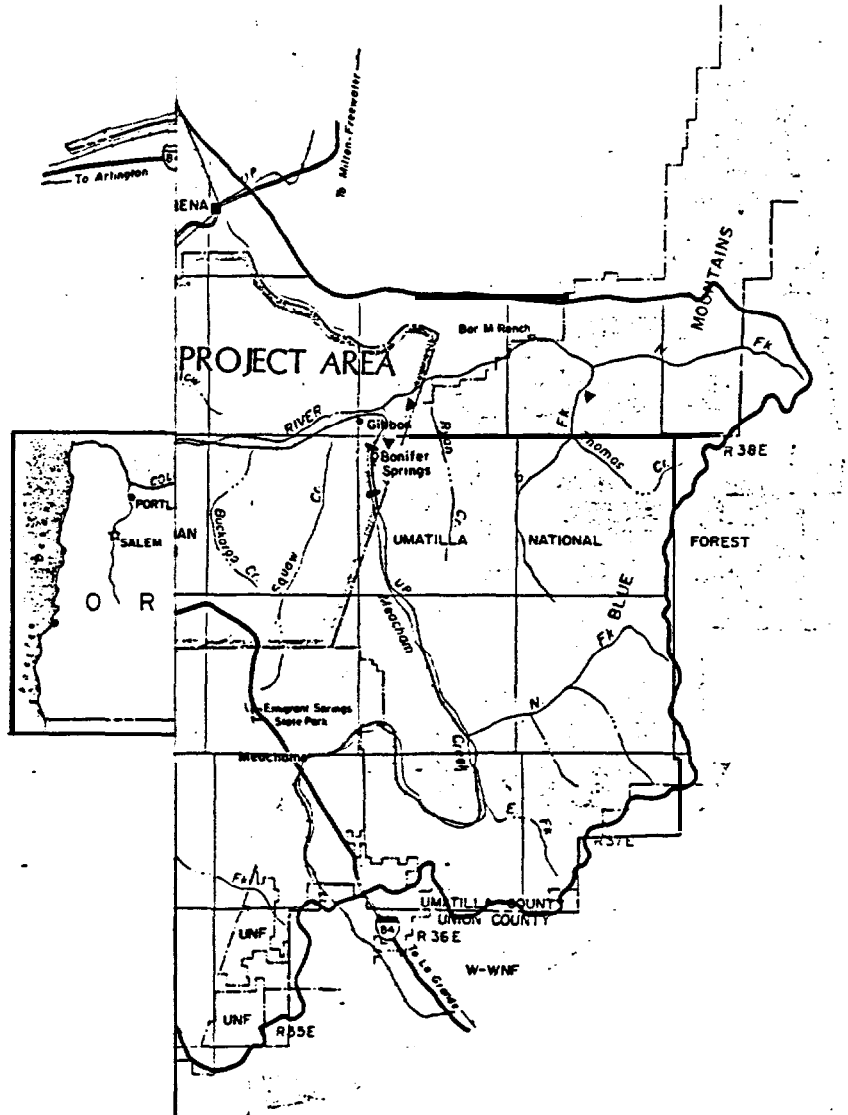


Figure 1. MEACHAM CREEK FISH HABITAT ENHANCEMENT PROJECT VICINITY MAP

METHODS AND MATERIALS

The efforts of the CTUIR fish habitat enhancement staff during FY '89 are divided into categories based roughly on chronology as follows:

1) Pre-construction:

The pre-construction phase of the project included all project planning and preparatory activities including: landowner coordination and the development and acquisition of lease and Right-of Way (ROW) agreements; acquisition of all required federal, state and local permits: the survey of properties for accurate property line locations and for project design; the development and award of construction and delivery contracts: the collection of pre-construction biological and physical data and the establishment of recovery transects and photopoints; and the development of implementation schedules and plans.

The completion of this phase of operations required considerable time on the part of tribal staff to coordinate with landowners and state and federal agencies. Lease and ROW acquisition, project design and much of the initial planning occurred during the 1988 project year following a rescheduling of construction related activities to the 1989 project year.

Project Design and Property Line Survey

The CTUIR contracted with the Albrook Hydraulics Lab for the development of designs and blueprints of the upper two miles of Meacham Creek Section C and Lower Boston Canyon Creek. Designs included design rational and cross sections of stream channel and flood plain, for use in physical monitoring and permit acquisition. These designs were completed during the 1988 project year.

Property line survey was conducted under sub-contract with a BIA approved land surveyor to meet the requirements of the Code of Federal Regulations Section 169. All other activities were conducted by CTUIR staff.

Landowner Agreements

Lease and ROW procurement for a 2 mile reach of Meacham Creek programmed for construction in 1988 was ongoing throughout the FY 88 and concluded in FY 89. This reach consisted of three BIA Trust Allotments with approximately 20 shareholders and five tracts of fee land ranging from 80 to 520 acres with a total of 4 owners. Each landowner or shareholder was either contacted by phone or letter initially and then sent an information packet with draft agreements for their review. Field tours of the project area and slide presentations were given to all interested landowners on request.

Project reviews and slide presentations were given to the Umatilla Tribal General Council at their regularly scheduled meetings and to the general public during evening meetings.

Monitoring and Data Collection

Data on water temperature and turbidity were collected at sites selected during the pre-construction phase of implementation. These sites included three ISCO waste water sampler stations, each with an associated Temp-mentor hydrothermograph. Stations were placed to create a control reach above the project area, to measure water quality entering the project area, and to record the out-flowing water quality. Samples were taken at 6 hour intervals to create a composite daily sediment sample. Water samples were processed at the USFS water lab in Pendleton by CTUIR habitat staff. All laboratory supplies and the use of the lab equipment was donated by the Umatilla National Forest.

Ryan Tempmentor thermographs were also deployed at the lower reaches of Squaw and Buckaroo Creeks. Water temperatures were recorded every half hour.

Stream channel development and riparian recovery were documented using cross channel transects to measure changes in channel morphology and using standardized photo points to record riparian recovery and changes in channel morphology. Permanent photo point andtransectmarkers were placed through out the project area. Channel measurements and standardized

photos were taken initially prior to construction activities and immediately following construction to document construction related changes in channel cross section and initial riparian condition. This recovery documentation will be repeated following the first years high flow events and there after every other year.

2) Construction:

The construction phase of the project consisted of all on-the-ground activities including: initial project staking, development of machine accesses, delivery of materials to structure sites, construction of instream and riparian area structures, riparian vegetation enhancement; construction of riparian exclosure fence, project construction monitoring and data collection, and photodocumentation.

Instream Activities

Instream activities were scheduled to correspond to periods of low stream flow and to avoid spawning periods for salmonids. The location and type of instream and riparian structures were determined by the hydrologists and engineers under subcontract in coordination with tribal habitat' biologist.

Petroleum absorbent booms were deployed downstream from all heavy equipment working in the stream zone to protect against spills of petroleum products from engine and hydraulic

systems.

Meacham Creek - Deflectors, spur dikes, and turning rocks were placed to reduce erosion of stream banks and the influx of sediments from adjacent riparian areas and to encourage the deposition of fines for the establishment of riparian vegetation.

Weirs, large organic debris, and instream boulder placements were used to increase holding and hiding cover and to encourage the development of a stable, narrow thalweg.

In areas of extensive bed-load deposition and high channel instability, river gravels were sloped and shaped to form a stable channel configuration and to facilitate the recovery of riparianvegetation. This stable channel configuration will be maintained by the placement of boulder structures and through the recovery of a stable riparian community.

Boston Canyon Creek - The alluvial fan of Boston Canyon Creek is dissected by the UPRR track and access road at Bonifer Pond fish acclimation facility. Built up bed-load at the UPRR bridges has been dredged out and piled upstream of the bridges for many years, burying the riparian area and creating a barrier to late season migration of fish. Local recruitment of gravel from the dredge tailings caused a continual problem for the operation of the Bonifer acclimation facility by filling in the raceways and blocking passage to and from the

facility.

A prescription was developed which included the removal of built up gravel from the riparian zone to eliminate the local recruitment problem and the construction of a series of drop structures to stabilize the channel bottom and provide jump pools for passage and holding. Gravel recruitment from above the project area needed to be controlled to prevent bedload from building up beneath the UPRR bridges where removal would be expensive and difficult. Large catchment pools were prescribed in areas where access for removal of bedload would be convenient and inexpensive.

Riparian Corridor Fencing

Livestock grazing will be eliminated from the project area using a high tensile smooth wire fence to enclose the riparian corridor. Fence designs and specifications were provided by the Oregon Department of Fish and Wildlife. Tribal habitat staff was trained in construction and inspection techniques during a joint fence construction project on the Hemphill property on Birch Creek.

Riparian Vegetation Enhancement

High summer water temperature and the loss of habitat diversity resulting from excessive bedload movement and stream bank instability are major limiting factors to salmonid production in the basin. The reestablishment of riparian

vegetation in the project area is critical to the long term stabilization of the bedload and the subsequent development of a narrow shaded channel. Vegetative recovery and enhancement will be achieved through livestock exclusion and the planting of riparian hardwood cuttings from local stock and seeding of all gravel bars and exposed banks with a mix of grasses and forbs recommended by the Soil Conservation Service.

Monitoring and Data Collection

Water quality data including suspended sediments and water temperature were collected through out the construction period. Construction activities were photographed and videotaped.

3) Post-construction:

This phase of project implementation included the post-construction project monitoring and water quality data collection as follows:

Monitoring and Data Collection

Riparian recovery and changes in channel morphology were monitored at preselected photo points and cross channel transects which were established during the pre-construction phase of the project. Channel cross sections were resurveyed before and after the spring high flow event to assess the effectiveness of the prescribed structures at meeting desired

goals of riparian stabilization and enhanced fish habitat. Post-construction standardized photographs were taken at all transects and at other preselected photo points to document riparian recovery and structure success.

RESULTS AND DISCUSSION

1) Pre-construction:

Landowner Agreements

Response to the program was good with all owners of tax lots and the share holders of all but 1 allotment consenting to a riparian lease. The majority holder of the nonconsenting allotment did sign a ROW. However, the highly vocal minority holders made continued pursuit of an easement impractical. This tract of land included the west bank to the center of the channel over approximately 1/4 mile of the project. Omission of this tract of land from the project did not effect the implementation and is not expected to have a significant effect on the long term success of the project.

Sub-contracts

All subcontract documents and specifications were developed by the Department of Natural Resources, Fisheries staff during the 1988 and 1989 project years.

Property Line Survey - Property line surveys were completed under subcontract in order to meet the requirements of the Bureau of Indian Affairs and the Code of Federal Regulations Part 169.

Equipment Rental - Sub-contract for equipment rental was awarded to Harney County Gypsum for the rental of a D-8 crawler dozer, a track mounted excavator, a crawler loader and two 10 cu yd dump trucks.

Sub-contract was awarded to Pioneer Construction for the rental of a D-8 crawler dozer to complete gravel bar sloping and channel development.

Cultural Archaeological Survey - Sub-contract for cultural and Archaeological survey was awarded to Ronald Pond for the survey of all properties scheduled for enhancement through 1992. The final report was developed by the Tribal fish habitat biologist for the Oregon State Historic Preservation Office.

Project Design - Design of the lower 2 miles of Meacham Creek was sub-contracted to River Masters Engineering. Project design was developed in coordination with Tribal habitat biologist.

Fence Construction - Fence construction was rescheduled for the 1990 project year to allow for the evaluation of flow characteristics and channel migration following construction to ensure the safe location of the fence line. Therefore no sub-contract was advertised.

2) Construction and Post-construction:

Materials Supply and Delivery

Rock supply and delivery was coordinated with the Union Pacific Railroad (UPRR) and the Umatilla National Forest (USFS). The UPRR donated the delivery and purchase of 2500 cu yds of boulders from a stock pile at Wyeth. This rock was sorted and loaded as part donation from the UPRR and partially under sub-contract with Rick Franklin Corporation. The UPRR also donated the load and haul of 2000 cu yds of boulders from the Barnhart pit near Pendleton which were purchased using BPA funds.

All rock was hauled to a stockpile site at Gibbon where it was off loaded and stock piled by the USFS and trucked to sites on the South Fork Umatilla River and lower Meacham Creek and Boston Canyon Creek. Approximately 180 cu yds of boulders stockpiled and purchased from the Barnhart Pit, but not hauled by the UPRR to Gibbon, was given to ODFW for projects on Birch Creek.

Approximately 2500 of the 4500 cubic yards of boulders hauled to the Gibbon Y railroad siding by the Union Pacific Railroad were trucked to structure sites on Meacham Creek and Boston Canyon Creek.

The Umatilla National Forest donated 12 pine logs and hauled them to site on Boston Canyon Creek for log weirs and bank protection.

Instream Activities

All **instream** activities were directed and inspected by Tribal habitat staff. Rock and log structures throughout the project were secured using over 1000 **Hilti** Fastening system placements and a total of 1000 **ft** of **1/2** inch steel cable.

Meacham Creek - Initial **instream** activities included the development of a stable channel configuration through unstable gravel deposits. Large organic debris was removed from the flood plain and solid root wads and logs were stock piled for bank protection and fish cover structures. A total of 42,500 cu yds of gravels were bulldozed to improve flow characteristics and capacities throughout the project area. Project area roads were developed for machine and truck access.

Instream fish cover was improved with the placement of 220 fish cover boulders, 30 sets of turning rocks (90 Boulders), and 34 revetment trees which were cabled along over 2000 ft of stream banks to reduce erosion and improve hiding cover for adults. Additional bank protection was achieved through the placement of 16 rock deflectors, 2000 feet of boulder toes, 4 toe rock deflector wings (190 ft), 10 point bar armors including 1500 ft of boulder toe rocks, and a 100 ft long boulder faced spur dike.

Sediment inputs from adjacent floodplains were reduced through the reconstruction of 1000 feet of cobble dikes to

replace washed out sections of the UPRR dike system.

Adult holding water was increased through the construction of 2 rock weirs with adult holding pools.

Boston Canyon Creek - Built up bed load deposits were removed from the channel and riparian area of Boston Canyon Creek by Readymix Sand and Gravel Co. and stock piled for removal in rail airdump cars. Gravels under the UPRR bridges were removed by ODFW fish habitat staff using their small crawler loader.

A Log weir and boulder deflector was built to create an area of high velocity under the UPRR bridges and in front of the Bonifer acclimation race ways in hopes of passing bedload through to the main channel of Meacham Creek.

Four log weirs and a log sill were built with two holding pools and 2 large gravel catch basins with approximately 550 cubic yards of bed load capacity. Stream bank protection included 275 feet of boulder toe and 55 feet of revetment trees.

Riparian Vegetation Enhancement

Riparian vegetation was enhanced through the planting of 500 willow cuttings in Meacham Creek and 50 cuttings in Boston Canyon Creek. A crew of 4 YCC workers under the supervision and training of tribal habitat personnel, completed most of the willow planting.

Areas disturbed during implementation were seeded with a mix of grasses and forbs to reduce erosion and the growth of undesirable species. A total of 100 lbs of seed mix was spread during the fall and additional seed will be spread in the spring following high flows.

Monitoring and Data Collection

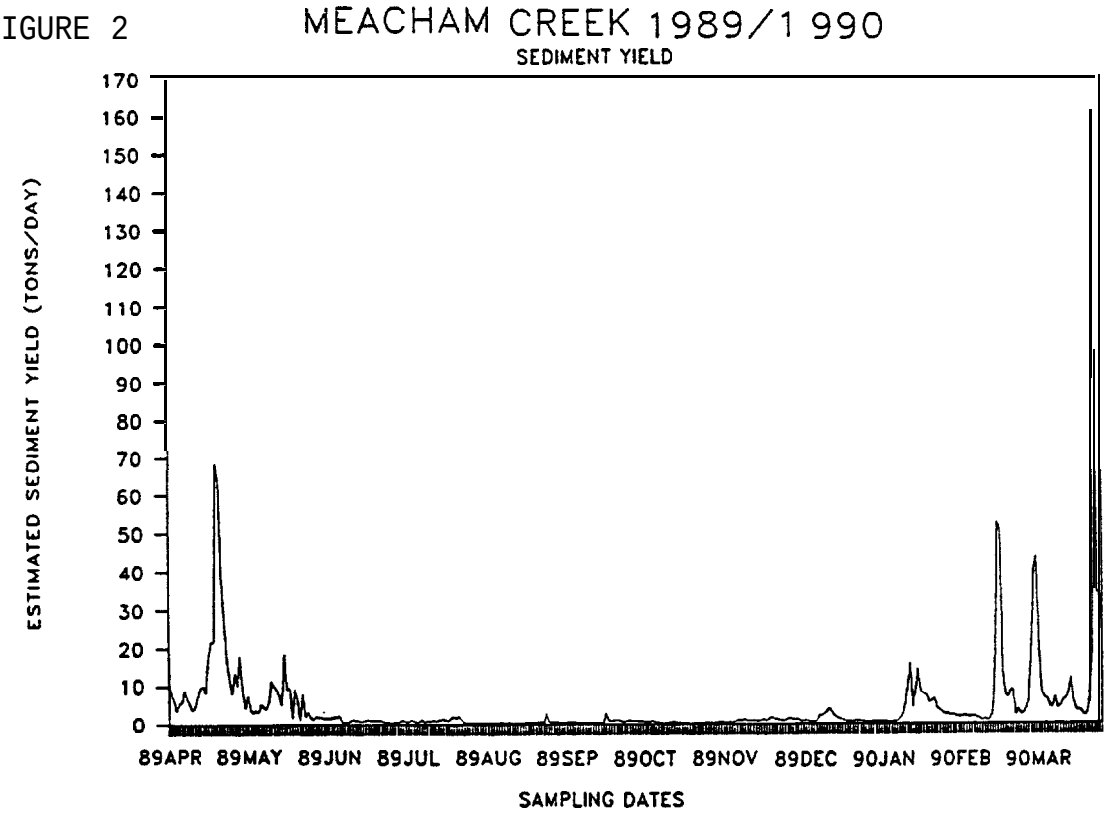
Cross sectional transects and photo points were established at 17 locations along the project area to monitor changes in channel morphology and document riparian recovery. Stream channel cross sections were measured prior to and immediately following construction activities. Project documentation and recovery photos weretaken prior to, during, and following construction.

Water turbidity monitoring was ongoing throughout the reporting period at 3 ISCO water samplers installed on Meacham Creek on **2/1/88** at the upstream and downstream ends of the project area and 2 miles upstream of the project area to create a control reach. However, variations in samples resulting from placement of sample intake tube were greater than variations resulting from the location of the sampler stations along the creek. Therefore the system of samplers,' as applied, was not sensitive enough to detect any change in sediment yield resulting from the project activities.

Sediment samples from the three stations were averaged and combined with stream flow data collected from the USGS gage

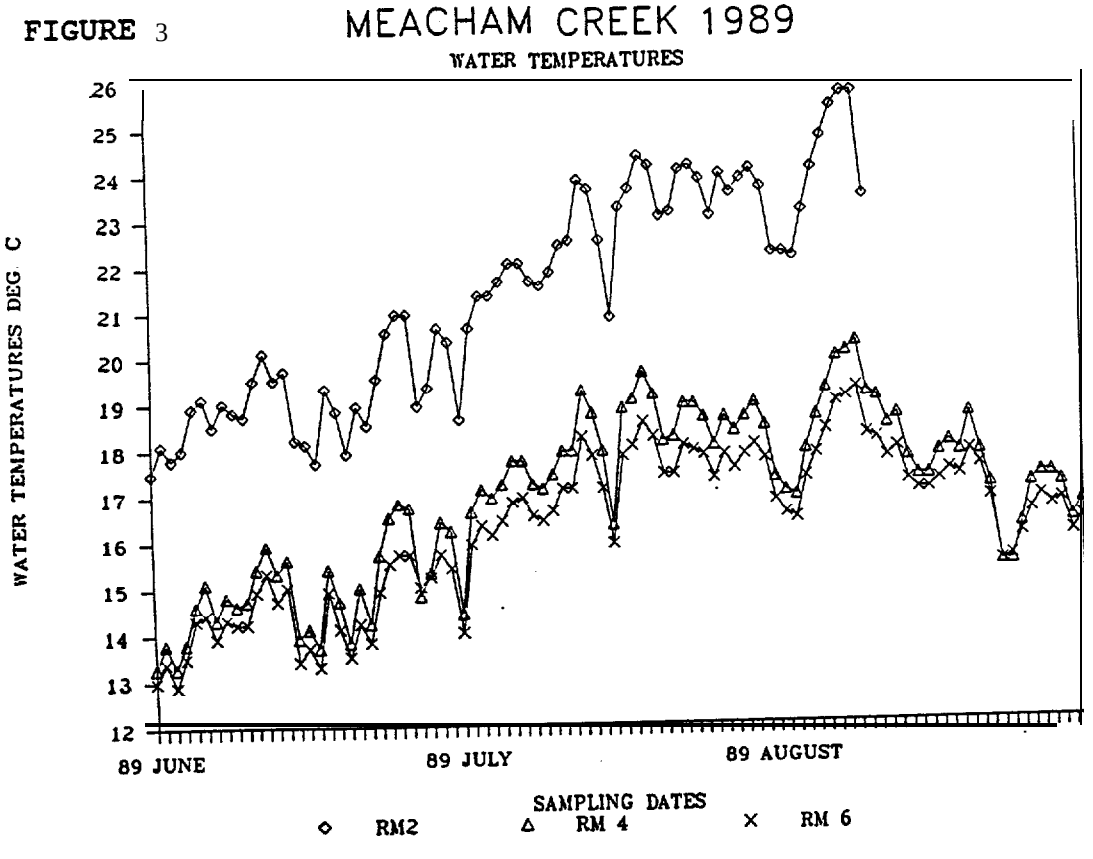
station at RM 2 to develop daily estimates of total sediment yield from Meacham Creek. Flows during the project period ranged from 10 cfs in late summer to peaks of 1480 and 885 cfs in April1989 and March 1990 respectively. Sediment yield data is summarized in graphic form (Figure 2). The peaks in sediment yield correspond closely to normal high flow periods in late winter and spring. The maximum recorded daily sediment yield of over 160 tons per day occurred on March 20 1990 as a result of peak 1990 flows.

FIGURE 2



Stream temperatures were monitored throughout the reporting period at river miles 2,4, and 6. The thermograph probe at the RM 2 ISCO was damaged by beavers and became inoperable on August 11, 1989. This data has been summarized into tabular form showing minimum, maximum and mean daily temperatures in Appendix A. Water temperature increases between RM 4 and RM 2 stations was far greater than increases from RM 6 to RM 4 at the head of the treatment area (Figure 3). This disparity is expected to decrease as the adjacent riparian vegetation within the treatment area recovers and solar inputs are reduced.

FIGURE 3



RECOMMENDATIONS

Enhancement activities in the 1989 project area should be followed up with continued enhancement of instream cover and adult holding water for spring chinook as the increase in channel stability permits overtime. The effectiveness of some in-channel structure placements could be maximized and the possibility of flows modifying structures minimized by implementing a project in stages over several years.

This staged approach may be most appropriate in situations such as Meacham Creek where access is good and the level of channel and flood plain modification is extreme. The movement of gravels disturbed during initial enhancement efforts may have a significant effect on the hydraulics of the modified channel during the first high flow periods. Allowing time for the substrate to stabilize and the channel's thalweg to equilibrate to the initial structure placements will allow for the more effective placement of the next stage of structures. This should minimize the amount of expensive maintenance and readjusting of structures.

In order to best meet the immediate habitat needs of the fish, enhancement efforts in 1990 should emphasize increased adult holding water in the more stable lower reaches of Meacham Creek. In-pool cover could be particularly important to protect against harassment of adults during the summer holding period.

Riparian plantings should be followed up to replace previous plantings that did not "take" and to take advantage of the modified sediment deposition patterns resuiting from enhancement activities

The investment in riparian fencing in some of the most unstable areas should be put off until the stability of channel modifications has been proved by high flows. In the case of Meacham Creek the majority of this years project qualified for this approach. The entire project should be fenced during the 1990 project year following evaluations of stream bank stability and structure effectiveness.

The overall success of the project can be improved by increasing the length of contiguous stream reach treated. To this end, the pursuit of landowner cooperation above and below the project area should be continued and funding of future efforts secured.

SUMMARY OF **EXPEDITURES - HABITAT** ENHANCEMENT

April 1, 1989 - March 31, 1990

1) Personnel (Salaries and fringe benefits)	$ **77,068.52**
2) Travel	$ **1,828.33**
3) Services and Supplies	$ **41,724.36**
4) Contractual Services	$ **144,139.60**
5) Capital Outlay	$ **5,957.11**
6) Overhead	S 34.436.58
7) Total	$ **305,154.50**

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APPENDIX A

WATER TEMPERATURE DATA

RTM Data Summary

MEACHAM CREEK ISCO STATION (RM 2)

Date	Minimum	Maximum	Mean
1Apr89	7.2	9.7	8.5
2Apr89	7.6	9.8	8.6
3Apr89	7.8	10.8	8.9
4Apr89	7.8	10.8	9.0
5Apr89	8.9	11.6	10.2
6Apr89	8.9	12.0	10.4
7Apr89	8.4	12.2	9.8
8Apr89	7.4	11.2	9.0
9Apr89	7.4	11.8	9.4
10Apr89	8.4	10.8	9.4
llApr89	7.8	12.9	10.0
12Apr89	8.2	13.2	10.4
13Apr89	8.6	13.8	10.9
14Apr89	9.1	12.8	10.8
15Apr89	9.5	11.3	10.4
16Apr89	9.1	12.6	10.6
17Apr89	9.6	13.4	11.1
18Apr89	9.5	14.4	11.6
19Apr89	9.8	13.9	11.4
20Apr89	9.9	14.4	11.8
21Apr89	10.4	12.8	11.3
22Apr89	9.8	12.5	10.9
23Apr89	9.5	14.1	11.5
24Apr89	9.6	12.7	11.0
25Apr89	9.9	12.0	10.6
26Apr89	9.5	**11.9**	10.5
27Apr89	9.9	13.4	11.3
28Apr89	10.0	12.3	11.1
29Apr89	9.0	15.5	11.9
30Apr89	9.9	16.2	12.8
lMay89	11.0	12.6	11.8
2May89	10.5	13.9	12.1
3May89	10.1	16.0	12.8
4May89	10.8	16.8	13.4
5May89	11.2	17.1	13.9
6May89	12.1	16.5	14.1
7May89	12.1	17.4	14.4
8May89	11.5	18.2	14.4
9May89	12.1	16.7	13.9
10May89	11.5	13.5	12.2
llMay89	10.6	14.1	12.0
12May89	9.7	15.3	12.3
13May89	10.3	16.5	13.1
14May89	11.5	17.1	13.7
15May89	**11.1**	18.2	14.2
16May89	**11.6**	15.8	13.7
17May89	**12.1**	17.7	14.3

Date	Minimum	Maximum	Mean
18May89	11.5	14.5	12.9
19May89	10.8	16.7	13.1
20May89	10.8	18.3	14.2
21May89	11.8	16.8	14.1
22May89	12.1	17.2	14.5
23May89	12.6	15.6	13.8
24May89	11.6	15.3	13.1
25May89	11.6	17.1	13.7
26May89	11.4	16.3	13.8
27May89	12.5	14.1	13.3
28May89	11.0	15.9	13.1
29May89	12.2	14.4	13.1
30May89	11.8	19.0	15.0
31May89	12.6	21.0	16.4
1Jun89	13.6	22.3	17.5
2Jun89	14.6	22.5	18.1
3Jun89	15.0	21.5	17.8
4Jun89	14.3	22.9	18.0
5Jun89	15.0	23.7	18.9
6Jun89	15.6	23.6	19.1
7Jun89	14.7	23.2	18.5
8Jun89	15.2	23.8	19.0
9Jun89	15.5	23.2	18.8
10Jun89	15.1	23.5	18.7
11Jun89	15.6	24.6	19.5
12Jun89	16.3	24.6	20.1
13Jun89	17.7	21.8	19.5
14Jun89	17.5	22.9	19.7
15Jun89	16.8	19.3	18.2
16Jun89	14.9	22.6	18.1
17Jun89	15.0	20.8	17.7
18Jun89	15.3	24.4	19.3
19Jun89	16.5	22.0	18.8
20Jun89	15.5	21.7	17.9
21Jun89	14.9	24.1	18.9
22Jun89	17.0	20.9	18.5
23Jun89	15.4	24.7	19.5
24Jun89	16.5	25.4	20.5
25Jun89	16.8	25.6	20.9
26Jun89	17.9	24.6	20.9
27Jun89	16.5	21.8	18.9
28Jun89	16.7	22.0	19.3
29Jun89	17.6	25.0	20.6
30Jun89	18.0	23.8	20.3
1Jul89	17.2	20.2	18.6
2Jul89	17.1	25.5	20.6
3Jul89	17.4	26.2	21.3
4Jul89	17.7	25.8	21.3
5Jul89	18.1	26.2	21.6
6Jul89	18.0	26.9	22.0
7Jul89	18.7	26.4	22.0
8Jul89	18.2	26.2	21.6
9Jul89	17.7	26.2	21.5

Date	Minimum	Maximum	Mean
10Jul89	18.2	26.2	21.8
llJu189	18.4	27.2	22.4
12Jul89	20.0	25.7	22.5
13Jul89	20.2	28.4	23.8
14Jul89	20.9	27.7	23.6
15Jul89	20.3	25.5	22.5
16Jul89	18.8	22.6	20.8
17Jul89	20.0	27.7	23.2
18Jul89	20.2	28.8	23.6
19Jul89	20.9	28.7	24.3
20Jul89	21.5	27.9	24.1
21Jul89	19.7	27.3	23.0
22Jul89	19.0	28.1	23.1
23Jul89	20.1	28.9	24.0
24Jul89	20.8	28.7	24.1
25Jul89	19.7	28.7	23.8
26Jul89	20.5	26.8	23.0
27Jul89	20.3	28.7	23.9
28Jul89	19.5	28.4	23.5
29Jul89	19.9	28.7	23.8
30Jul89	20.3	28.7	24.0
31Jul89	20.1	27.9	23.6
1Aug89	20.0	26.2	22.2
2Aug89	20.1	25.7	22.2
3Aug89	20.2	25.2	22.1
4Aug89	19.2	28.2	23.1
5Aug89	20.0	29.0	24.0
6Aug89	20.7	29.8	24.7
7Aug89	21.8	29.7	25.4
8Aug89	22.7	29.8	25.7
9Aug89	23.2	29.7	25.7
10Aug89	21.6	27.7	23.4

RTM Data **Summary**

MEACHAM CREEK ISCO STATION (RM 6)

Date	Minimum	Maximum	Mean
1Apr89	3.3	5.7	4.6
2Apr89	3.7	6.0	4.7
3Apr89	3.8	6.4	5.0
4Apr89	3.7	6.4	5.0
5Apr89	4.6	7.6	6.0
6Apr89	4.9	8.0	6.3
7Apr89	4.2	8.1	5.7
8Apr89	3.6	7.4	5.1
9Apr89	3.5	7.8	5.4
10Apr89	4.3	6.7	5.1
llApr89	3.6	8.9	5.8
12Apr89	3.8	8.9	6.2
13Apr89	4.5	9.6	6.6
14Apr89	4.9	8.6	6.5
15Apr89	5.2	7.1	6.1
16Apr89	4.9	8.3	6.3
17Apr89	5.1	8.9	6.6
18Apr89	4.9	10.2	7.1
19Apr89	5.2	9.7	6.9
20Apr89	5.2	10.1	7.3
21Apr89	5.8	8.2	6.7
22Apr89	5.2	7.8	6.1
23Apr89	4.6	9.6	6.9
24Apr89	4.9	8.2	6.5
25Apr89	5.5	7.1	6.1
26Apr89	5.3	7.9	6.3
27Apr89	5.6	9.6	7.2
28Apr89	5.8	8.5	6.8
29Apr89	4.7	11.4	7.7
30Apr89	5.6	11.9	8.5
1May89	6.7	8.7	7.5
2May89	6.3	9.8	7.8
3May89	5.6	11.7	8.4
4May89	6.3	12.2	8.8
5May89	6.7	12.6	9.4
6May89	7.8	12.2	9.7
7May89	7.7	12.7	9.8
8May89	7.0	13.6	9.9
9May89	7.7	12.5	9.6
10May89	7.1	8.6	7.8
llMay89	6.3	9.8	7.7
12May89	5.3	10.9	8.0
13May89	6.0	11.8	8.8
14May89	7.1	12.4	9.4
15May89	6.6	13.9	10.0
16May89	7.4	11.7	9.5
17May89	7.9	13.1	10.1

Date	Minimum	Maximum	Mean
18May89	7.1	10.5	8.5
19May89	6.5	12.6	9.0
20May89	6.5	14.0	10.0
21May89	7.5	12.3	9.7
22May89	7.7	12.6	10.2
23May89	8.1	11.4	9.5
24May89	7.4	10.8	8.8
25May89	7.2	12.3	9.4
26May89	7.2	11.2	9.5
27May89	7.8	9.8	9.1
28May89	6.8	12.1	9.2
29May89	8.0	11.0	9.2
30May89	7.7	14.7	11.0
31May89	8.3	16.7	12.1
1Jun89	9.2	17.8	13.0
2Jun89	10.1	18.0	13.4
3Jun89	10.4	16.3	12.9
4Jun89	9.8	18.3	13.5
5Jun89	10.5	19.0	14.3
6Jun89	10.9	19.0	14.4
7Jun89	10.0	18.7	13.9
8Jun89	10.5	19.2	14.3
9Jun89	10.9	18.8	14.2
10Jun89	10.7	18.9	14.2
11Jun89	11.0	19.9	14.9
12Jun89	11.7	19.9	15.3
13Jun89	13.1	17.3	14.7
14Jun89	13.0	18.1	15.0
15Jun89	11.9	14.0	13.4
16Jun89	10.7	18.3	13.7
17Jun89	10.8	16.5	13.3
18Jun89	11.0	20.1	14.9
19Jun89	12.1	17.5	14.1
20Jun89	11.6	17.1	13.5
21Jun89	10.9	18.8	14.2
22Jun89	12.4	15.7	13.8
23Jun89	11.6	19.6	14.9
24Jun89	12.3	20.3	15.5
25Jun89	12.6	20.1	15.7
26Jun89	13.9	18.8	15.7
27Jun89	14.1	16.1	15.0
28Jun89	13.6	17.3	15.2
29Jun89	13.0	20.0	15.7
30Jun89	13.4	18.8	15.4
1Jul89	12.7	15.6	14.0
2Jul89	12.7	20.8	15.9
3Jul89	12.8	21.2	16.3
4Jul89	12.9	21.1	16.1
5Jul89	13.1	21.3	16.4
6Jul89	13.3	21.8	16.8
7Jul89	13.7	21.8	16.9
8Jul89	13.4	21.2	16.5

Date	Minimum	Maximum	Mean
9Jul89	13.0	21.1	16.4
10Jul89	13.3	21.2	16.6
11Jul89	13.6	22.0	17.1
12Jul89	14.9	19.9	17.1
13Jul89	14.9	22.9	18.2
14Jul89	15.6	21.8	17.8
15Jul89	15.2	20.2	17.1
16Jul89	14.1	17.4	15.9
17Jul89	15.2	22.3	17.8
18Jul89	15.0	22.5	18.0
19Jul89	15.6	23.0	18.5
20Jul89	15.9	22.6	18.2
21Jul89	14.6	22.0	17.4
22Jul89	14.1	22.3	17.4
23Jul89	14.8	22.6	18.0
24Jul89	15.3	22.4	17.9
25Jul89	14.5	22.5	17.8
26Jul89	15.2	20.9	17.3
27Jul89	15.1	22.3	17.8
28Jul89	14.4	22.3	17.5
29Jul89	14.7	22.3	17.8
30Jul89	15.2	22.5	18.0
31Jul89	15.0	21.8	17.7
1Aug89	14.8	20.3	16.8
2Aug89	14.9	19.0	16.5
3Aug89	15.0	19.6	16.4
4Aug89	14.2	22.3	17.3
5Aug89	14.7	22.9	17.8
6Aug89	15.3	23.3	18.3
7Aug89	16.0	23.2	18.9
8Aug89	16.7	23.2	19.0
9Aug89	17.0	23.5	19.2
10Aug89	15.8	22.6	18.2
11Aug89	15.6	22.7	18.1
12Aug89	15.5	21.7	17.7
13Aug89	15.2	22.6	17.9
14Aug89	15.0	20.5	17.2
15Aug89	15.2	20.3	17.0
16Aug89	14.2	21.7	17.0
17Aug89	14.5	21.6	17.2
18Aug89	14.7	22.1	17.4
19Aug89	15.0	21.1	**17.3**
20Aug89	16.2	21.7	17.8
21Aug89	15.9	20.8	17.5
22Aug89	15.7	18.9	16.8
23Aug89	15.0	15.7	15.4
24Aug89	14.8	16.7	15.5
25Aug89	14.7	18.7	16.0
26Aug89	13.8	20.9	16.5
27Aug89	14.5	21.5	16.8
28Aug89	14.2	20.5	16.6
29Aug89	14.4	19.6	16.7
30Aug89	14.7	18.6	16.0

Date	Minimum	Maximum	Mean
23Oct89	10.4	13.9	11.8
24Oct89	8.9	10.1	9.5

RTM Data **Summary**

MEACHAM CREEK ISCO STATION (RM 6)

Date	Minimum	Maximum	Mean
15Nov89	7.7	9.2	8.4
16Nov89	7.1	9.5	8.3
17Nov89	7.7	9.2	8.6
18Nov89	7.1	10.1	8.4
19Nov89	7.3	10.5	8.6
20Nov89	7.5	10.5	8.7
21Nov89	7.4	10.0	8.7
22Nov89	6.7	9.2	7.6
23Nov89	7.1	8.3	7.7
24Nov89	**6.6**	8.1	7.5
25Nov89	6.7	7.6	7.0
26Nov89	6.4	8.2	7.2
27Nov89	6.1	8.5	7.0
28Nov89	5.3	7.6	6.0
29Nov89	5.0	7.2	5.8
30Nov89	5.1	6.7	5.7
1Dec89	4.9	6.7	5.6
2Dec89	4.9	6.3	5.4
3Dec89	5.3	7.4	6.6
4Dec89	7.0	7.8	7.4
5Dec89	6.9	8.5	7.5
6Dec89	6.9	8.5	7.6
7Dec89	6.4	8.1	7.1
8Dec89	7.1	8.8	7.7
9Dec89	6.6	8.0	7.2
10Dec89	6.0	7.4	6.7
llDec89	4.7	6.4	5.5
12Dec89	3.9	6.0	4.8
13Dec89	4.2	6.3	5.1
14Dec89	4.6	7.1	5.5
15Dec89	4.6	6.2	5.2
16Dec89	4.1	5.9	4.7
17Dec89	4.1	4.9	4.4
18Dec89	3.7	5.6	4.7
19Dec89	4.6	6.3	5.2
20Dec89	4.2	6.3	5.2
21Dec89	4.5	6.8	5.3
22Dec89	4.1	6.0	4.7
23Dec89	4.2	6.8	5.5
24Dec89	4.4	6.0	5.0
25Dec89	4.1	5.8	**4.8**
26Dec89	3.6	5.3	4.2
27Dec89	3.3	5.2	4.0
28Dec89	3.8	4.7	4.3
29Dec89	3.0	5.3	3.9
30Dec89	3.8	6.3	4.6

Date	Minimum	Maximum	Mean
31Aug89	13.6	20.8	16.3
1Sep89	14.1	20.0	16.2
2Sep89	13.9	17.9	15.5
3Sep89	13.1	20.3	15.7
4Sep89	13.3	20.8	16.1
5Sep89	13.8	19.8	15.8
6Sep89	12.8	19.6	15.3
7Sep89	12.8	19.9	15.4
8Sep89	13.1	20.0	15.7
9Sep89	13.1	19.6	15.3
10Sep89	12.3	19.0	14.8
llSep89	12.4	18.8	14.6
12Sep89	11.9	19.0	14.6
13Sep89	12.2	19.7	14.9
14Sep89	12.5	20.0	15.3
15Sep89	12.7	20.0	15.4
16Sep89	13.1	17.9	15.0
17Sep89	13.6	15.0	14.2
18Sep89	12.8	18.7	14.6
19Sep89	12.1	18.8	14.3
20Sep89	11.9	18.6	14.3
21Sep89	12.1	18.8	14.6
22Sep89	12.5	19.2	14.9
23Sep89	12.9	19.5	15.3
24Sep89	13.1	19.6	15.5
25Sep89	13.5	17.7	15.3
26Sep89	13.3	17.1	14.8
27Sep89	12.6	18.7	14.8
28Sep89	13.1	18.9	15.2
29Sep89	13.4	19.1	15.6
30Sep89	13.6	14.7	14.4
1Oct89	13.1	15.0	13.9
2Oct89	11.9	15.6	13.3
3Oct89	10.8	16.0	12.5
4Oct89	10.2	16.3	12.4
5Oct89	11.5	15.6	13.2
6Oct89	11.2	16.8	13.1
7Oct89	11.3	16.5	13.2
8Oct89	11.5	17.1	13.5
9Oct89	11.3	17.3	13.4
10Oct89	11.6	17.2	13.6
11Oct89	12.0	14.3	12.9
12Oct89	11.8	14.7	12.9
13Oct89	11.6	13.9	12.5
14Oct89	10.5	14.9	12.5
15Oct89	9.2	14.1	11.0
16Oct89	9.0	14.1	10.8
17Oct89	9.1	14.2	10.9
18Oct89	10.0	14.2	11.7
19Oct89	10.5	13.5	11.9
20Oct89	11.4	12.4	12.0
21Oct89	11.3	12.3	11.9
22Oct89	11.0	11.8	11.4

Date	Minimum	Maximum	Mean
31Dec89	3.5	5.4	4.4
1Jan90	4.3	5.6	4.9
2Jan90	3.3	4.9	4.0
3Jan90	3.6	5.2	4.4
4Jan90	4.2	5.0	4.6
5Jan90	4.2	5.9	5.1
6Jan90	5.2	6.9	5.7
7Jan90	5.4	6.9	6.2
8Jan90	5.3	6.7	5.9
9Jan90	5.2	6.8	5.9
10Jan90	5.2	6.4	5.6
11Jan90	4.9	5.4	5.1
12Jan90	4.6	5.0	4.7
13Jan90	4.6	5.9	5.2
14Jan90	5.0	5.6	5.3
15Jan90	5.1	6.0	5.5
16Jan90	4.7	5.3	5.1
17Jan90	4.2	5.3	4.9
18Jan90	3.1	5.3	4.0
19Jan90	3.0	4.2	3.6
20Jan90	2.4	4.6	3.5
21Jan90	2.6	4.6	3.7
22Jan90	3.9	5.4	4.6
23Jan90	3.9	5.1	4.4
24Jan90	2.9	4.9	3.9
25Jan90	3.7	4.9	4.3
26Jan90	3.4	5.3	4.2
27Jan90	3.0	3.8	3.4
28Jan90	3.7	4.6	4.1
29Jan90	3.3	5.7	4.3
30Jan90	3.2	4.5	3.9
31Jan90	3.5	5.6	4.3
1Feb90	3.3	5.7	4.4
2Feb90	3.8	6.4	4.8
3Feb90	3.7	4.3	4.1
4Feb90	3.3	7.1	4.6
5Feb90	2.5	4.2	3.3
6Feb90	2.7	6.3	4.1
7Feb90	2.4	4.6	3.4
8Feb90	3.3	4.6	4.0
9Feb90	4.4	5.2	4.8
10Feb90	4.3	6.3	5.3
11Feb90	3.4	6.2	4.4
12Feb90	2.8	4.3	3.3
13Feb90	1.7	2.7	2.0
14Feb90	1.0	3.4	2.1
15Feb90	1.4	2.1	1.8
16Feb90	1.7	4.6	2.7
17Feb90	1.4	4.2	2.5
18Feb90	1.1	4.3	2.4
19Feb90	0.1	4.3	1.7
20Feb90	1.4	3.2	2.4
21Feb90	3.1	6.3	4.3

Date	Minimum	Maximum	Mean
22Feb90	2.8	7.2	4.4
23Feb90	2.8	6.8	4.4
24Feb90	3.3	6.5	4.5
25Feb90	3.1	6.7	4.4
26Feb90	3.2	6.4	4.3
27Feb90	2.4	6.0	3.8
28Feb90	2.3	6.4	3.9
1Mar90	2.4	6.7	4.1
2Mar90	2.4	7.1	4.4
3Mar90	3.2	5.5	4.2
4Mar90	3.4	6.9	4.8
5Mar90	4.2	5.3	4.6
6Mar90	3.3	7.1	4.9
7Mar90	3.6	6.1	4.8
8Mar90	2.8	6.0	4.4
9Mar90	2.8	6.6	4.5
10Mar90	3.8	4.8	4.4
11Mar90	3.3	5.6	4.1
12Mar90	2.7	5.6	3.8
13Mar90	2.2	6.8	4.1
14Mar90	3.3	6.0	4.6
15Mar90	3.2	8.2	5.3
16Mar90	3.1	7.7	5.3
17Mar90	4.6	8.9	6.4
18Mar90	4.9	9.0	6.4
19Mar90	4.4	8.5	6.2
20Mar90	4.6	7.4	5.8
21Mar90	4.6	8.2	6.0
22Mar90	4.1	8.5	5.9
23Mar90	3.7	5.6	4.6
24Mar90	3.7	7.5	4.9
25Mar90	2.6	7.9	5.0
26Mar90	3.5	8.6	5.7
27Mar90	3.2	8.9	5.6
28Mar90	3.0	8.9	5.7
29Mar90	3.3	9.5	6.1
30Mar90	3.7	9.8	6.5
31Mar90	4.5	10.6	7.2

RTM Data Summary

MEACHAM CREEK ISCO STATION (RM 4)

Date	Minimum	Maximum	Mean
1Apr89	3.4	5.9	4.6
2Apr89	3.7	6.0	4.7
3Apr89	3.9	6.7	5.0
4Apr89	3.7	6.6	5.0
5Apr89	4.6	7.5	6.0
6Apr89	4.9	8.2	6.5
7Apr89	4.2	8.2	5.8
8Apr89	3.6	7.2	5.2
9Apr89	3.4	7.9	5.4
10Apr89	4.2	6.6	5.1
llApr89	3.6	8.9	5.9
12Apr89	3.9	9.1	6.3
13Apr89	4.4	9.7	6.7
14Apr89	4.9	8.8	6.5
15Apr89	5.2	7.1	6.1
16Apr89	4.9	8.4	6.3
17Apr89	5.2	9.1	6.6
18Apr89	5.0	10.2	7.2
19Apr89	5.2	9.7	7.0
20Apr89	5.0	10.2	7.4
21Apr89	5.9	8.3	6.7
22Apr89	5.3	8.1	6.3
23Apr89	4.8	9.9	7.0
24Apr89	5.1	8.3	6.6
25Apr89	5.6	7.5	6.3
26Apr89	5.5	7.8	6.4
27Apr89	5.8	9.5	7.3
28Apr89	5.9	8.5	7.0
29Apr89	4.8	11.4	7.8
30Apr89	5.6	12.0	8.6
1May89	6.9	8.7	7.6
2May89	6.4	9.8	7.9
3May89	5.7	11.8	8.5
4May89	6.3	12.4	9.1
5May89	6.9	12.6	9.6
6May89	7.8	12.3	9.9
7May89	7.8	13.0	10.1
8May89	7.2	13.8	10.1
9May89	7.8	12.6	9.7
10May89	7.1	9.0	8.0
11May89	6.5	10.0	7.9
12May89	5.3	11.2	8.1
13May89	6.0	11.9	9.0
14May89	7.2	12.9	9.6
15May89	6.7	14.3	10.2
16May89	7.4	11.8	9.7
17May89	8.1	13.5	10.3

Date	Minimum	Maximum	Mean
18May89	7.3	10.5	8.7
19May89	6.7	12.8	9.1
20May89	6.6	14.1	10.2
21May89	7.7	12.6	10.0
22May89	8.0	12.9	10.4
23May89	8.4	11.6	9.7
24May89	7.7	11.2	9.1
25May89	7.4	12.6	9.6
26May89	7.4	11.8	9.8
27May89	8.0	10.0	9.4
28May89	7.1	12.0	9.3
29May89	8.4	11.1	9.4
30May89	7.9	15.0	11.2
31May89	8.7	16.8	12.3
1Jun89	9.5	18.0	13.3
2Jun89	10.5	18.1	13.8
3Jun89	10.6	16.8	13.3
4Jun89	10.1	18.5	13.8
5Jun89	10.8	19.1	14.6
6Jun89	11.3	19.5	15.1
7Jun89	10.4	19.0	14.3
8Jun89	10.9	19.8	14.8
9Jun89	11.2	19.3	14.6
10Jun89	11.0	19.6	14.7
llJun89	11.3	20.7	15.4
12Jun89	11.8	20.6	15.9
13Jun89	13.5	18.0	15.3
14Jun89	13.3	18.7	15.6
15Jun89	12.3	14.5	13.9
16Jun89	10.8	18.8	14.1
17Jun89	11.1	17.0	13.7
18Jun89	11.1	20.8	15.4
19Jun89	12.3	18.6	14.7
20Jun89	11.6	17.5	13.8
21Jun89	10.8	20.5	15.0
22Jun89	12.6	17.0	14.2
23Jun89	11.3	21.3	15.7
24Jun89	12.3	22.0	16.5
25Jun89	12.4	22.1	16.8
26Jun89	13.6	21.3	16.7
27Jun89	12.1	18.1	14.8
28Jun89	12.6	18.3	15.3
29Jun89	13.4	21.4	16.4
30Jun89	13.7	19.9	16.2
1Jul89	12.9	16.2	14.4
2Jul89	13.0	22.0	16.6
3Jul89	12.9	22.6	17.1
4Jul89	13.1	22.3	16.9
5Jul89	13.4	22.5	17.2
6Jul89	13.5	23.3	17.7
7Jul89	14.0	23.0	17.7
8Jul89	13.4	22.5	17.2

Date	Minimum	Maximum	Mean
9Jul89	13.0	22.4	17.1
10Jul89	13.6	22.7	17.4
llJu189	13.6	23.6	17.9
12Jul89	15.3	21.4	17.9
13Jul89	15.3	24.6	19.2
14Jul89	16.0	23.7	18.7
15Jul89	15.4	21.5	17.9
16Jul89	14.1	18.1	16.3
17Jul89	15.5	24.2	18.8
18Jul89	15.5	24.4	19.0
19Jul89	16.0	24.6	19.6
20Jul89	16.5	24.0	19.1
21Jul89	14.6	23.2	18.1
22Jul89	14.0	23.5	18.2
23Jul89	15.0	24.2	18.9
24Jul89	15.5	23.9	18.9
25Jul89	14.6	23.8	18.6
26Jul89	15.4	22.4	18.0
27Jul89	15.2	24.1	18.6
28Jul89	14.3	23.6	18.3
29Jul89	14.7	23.8	18.6
30Jul89	15.4	23.9	18.9
31Jul89	15.0	23.3	18.4
1Aug89	15.1	21.6	17.3
2Aug89	15.1	20.2	17.0
3Aug89	15.2	20.6	16.9
4Aug89	14.1	23.4	17.9
5Aug89	14.7	24.2	18.6
6Aug89	15.4	24.9	19.2
7Aug89	16.4	24.9	19.9
8Aug89	17.2	24.9	20.0
9Aug89	17.7	25.1	20.2
10Aug89	16.0	24.2	19.1
11Aug89	15.6	24.1	19.0
12Aug89	15.8	22.7	18.4
13Aug89	15.3	23.8	18.6
14Aug89	15.1	21.1	17.7
15Aug89	15.2	20.8	17.3
16Aug89	14.0	22.3	17.3
17Aug89	14.4	23.0	17.8
18Aug89	14.6	23.3	18.0
19Aug89	15.2	22.0	17.8
20Aug89	16.5	23.3	18.6
21Aug89	16.2	20.5	17.8
22Aug89	15.9	19.3	17.1
23Aug89	15.0	15.8	15.4
24Aug89	14.7	16.9	15.4
25Aug89	14.7	18.8	16.2
26Aug89	13.7	21.9	17.1
27Aug89	14.6	21.7	17.3
28Aug89	14.3	21.9	17.3
29Aug89	14.5	20.3	17.1

Date	Minimum	Maximum	Mean
30Aug89	14.9	19.3	16.3
31Aug89	13.6	21.4	16.7
1Sep89	14.0	20.3	16.5
2Sep89	13.9	17.8	15.5
3Sep89	12.6	20.9	16.0
4Sep89	13.1	21.6	16.5
5Sep89	13.9	20.2	16.2
6Sep89	12.6	20.2	15.5
7Sep89	12.5	20.6	15.6
8Sep89	13.0	20.8	16.0
9Sep89	12.7	20.2	15.5
10Sep89	11.9	19.9	15.0
llSep89	12.0	19.4	14.7
12Sep89	11.3	19.5	14.7
13Sep89	12.0	20.4	15.2
14Sep89	12.5	20.8	15.6
15Sep89	12.6	20.8	15.7
16Sep89	12.8	18.7	15.3
17Sep89	13.6	15.2	14.2
18Sep89	12.6	18.8	14.8
19Sep89	11.6	19.0	14.4
20Sep89	11.6	19.0	14.4
21Sep89	11.7	19.4	14.7
22Sep89	12.3	19.8	15.2
23Sep89	12.6	20.2	15.6
24Sep89	13.1	20.4	15.9
25Sep89	13.6	18.1	15.6
26Sep89	13.1	17.7	15.0
27Sep89	12.3	19.1	15.0
28Sep89	12.8	19.6	15.4
29Sep89	13.1	20.0	15.9
30Sep89	13.7	15.0	14.5
1Oct89	12.9	15.3	13.8
2Oct89	11.3	15.3	13.1
3Oct89	10.0	16.2	12.2
4Oct89	9.4	16.5	12.2
5Oct89	11.3	16.2	13.2
6Oct89	10.8	17.2	13.1
7Oct89	10.8	17.1	13.2
8Oct89	11.1	17.7	13.5
9Oct89	10.8	17.8	13.5
10Oct89	11.2	17.7	13.8
11Oct89	11.7	14.6	13.0
12Oct89	11.5	14.9	12.8
13Oct89	11.3	14.1	12.4
14Oct89	10.2	15.9	12.6
15Oct89	8.6	14.1	10.6
16Oct89	8.1	13.9	10.3
17Oct89	8.1	**14.2**	10.5
18Oct89	9.3	14.1	11.3
19Oct89	9.8	13.7	11.7
20Oct89	11.3	12.6	11.9

Date	Minimum	Maximum	Mean
21Oct89	11.3	12.3	11.9
22Oct89	10.6	11.8	11.2
23Oct89	10.3	13.9	11.8
24Oct89	8.8	9.8	9.2

RTM Data Summary

MEACHAM CREEK ISCO STATION (RM 4)

Date	Minimum	Maximum	Mean
15Nov89	7.4	8.9	8.2
16Nov89	6.4	9.2	7.9
17Nov89	7.6	9.2	8.4
18Nov89	6.7	10.0	8.2
19Nov89	6.9	10.3	8.5
20Nov89	7.1	10.5	8.6
21Nov89	7.1	9.5	8.5
22Nov89	6.0	8.5	7.3
23Nov89	6.6	8.2	7.4
24Nov89	6.4	8.0	7.2
25Nov89	6.4	7.3	6.7
26Nov89	6.4	7.9	6.9
27Nov89	5.6	8.4	6.8
28Nov89	4.8	7.1	5.5
29Nov89	4.4	6.7	5.2
30Nov89	4.6	6.2	5.2
1Dec89	4.2	6.4	5.2
2Dec89	4.4	5.8	5.0
3Dec89	4.6	7.4	6.3
4Dec89	7.1	8.2	7.5
5Dec89	6.9	8.5	7.6
6Dec89	6.7	8.3	7.4
7Dec89	6.1	8.0	6.9
8Dec89	6.9	8.5	7.6
9Dec89	6.4	7.8	7.0
10Dec89	5.6	7.2	6.4
11Dec89	4.3	5.9	5.0
12Dec89	3.4	5.5	4.3
13Dec89	3.4	5.7	4.5
14Dec89	3.9	6.5	5.0
15Dec89	4.0	5.6	4.7
16Dec89	3.3	5.3	4.1
17Dec89	3.5	4.4	3.9
18Dec89	3.3	5.0	4.2
19Dec89	4.2	6.1	4.8
20Dec89	3.7	6.0	4.8
21Dec89	4.0	6.6	5.0
22Dec89	3.4	5.3	4.3
23Dec89	3.7	6.7	5.1
24Dec89	3.7	5.5	4.6
25Dec89	3.9	5.6	4.5
26Dec89	2.9	4.6	3.7
27Dec89	2.7	4.6	3.5
28Dec89	3.3	4.5	3.8
29Dec89	2.3	4.8	3.4
30Dec89	3.3	5.6	4.1

Date	Minimum	Maximum	Mean
31Dec89	2.4	4.7	3.8
1Jan90	3.9	5.5	4.6
2Jan90	2.9	4.5	3.7
3Jan90	2.9	4.9	3.9
4Jan90	4.1	5.0	4.4
5Jan90	3.9	5.6	4.9
6Jan90	4.9	6.7	5.6
7Jan90	5.3	6.8	6.1
8Jan90	5.3	6.6	6.0
9Jan90	5.3	6.9	6.0
10Jan90	5.2	6.3	5.6
11Jan90	4.9	5.4	5.1
12Jan90	4.5	5.1	4.7
13Jan90	4.4	5.8	5.1
14Jan90	5.0	5.5	5.3
15Jan90	5.2	6.0	5.4
16Jan90	4.7	5.3	5.0
17Jan90	4.2	5.2	4.9
18Jan90	2.9	5.4	4.0
19Jan90	3.0	4.0	3.5
20Jan90	2.3	4.5	3.4
21Jan90	2.4	4.6	3.5
22Jan90	3.7	5.6	4.5
23Jan90	3.9	5.2	4.5
24Jan90	2.9	4.7	3.8
25Jan90	3.7	4.9	4.2
26Jan90	3.3	5.2	4.1
27Jan90	2.7	3.7	3.2
28Jan90	3.7	4.8	4.0
29Jan90	3.3	5.6	4.3
30Jan90	3.1	4.5	3.8
31Jan90	3.3	5.4	4.2
1Feb90	3.3	5.6	4.3
2Feb90	3.8	6.3	4.7
3Feb90	3.7	4.3	4.0
4Feb90	3.1	7.0	4.5
5Feb90	2.6	4.2	3.1
6Feb90	2.4	6.1	3.9
7Feb90	2.6	4.2	3.3
8Feb90	3.3	4.6	3.9
9Feb90	4.4	5.1	4.7
10Feb90	4.6	6.4	5.4
11Feb90	**3.4**	6.3	4.5
12Feb90	2.8	**4.3**	3.3
13Feb90	1.6	2.8	1.9
14Feb90	0.9	3.3	2.0
15Feb90	1.4	2.0	1.7
16Feb90	1.6	4.6	2.6
17Feb90	1.3	4.5'	2.5
18Feb90	1.2	4.3	2.4
19Feb90	-0.5	4.5	1.6
20Feb90	1.1	3.1	2.3
21Feb90	2.8	6.4	4.3

Date	Minimum	Maximum	Mean
22Feb90	2.8	7.6	4.5
23Feb90	2.8	6.9	4.5
24Feb90	3.2	6.7	4.5
25Feb90	3.0	6.7	4.4
26Feb90	3.3	6.4	4.4
27Feb90	2.4	6.0	3.8
28Feb90	2.3	6.3	3.9
1Mar90	2.4	6.7	4.1
2Mar90	2.4	7.1	4.4
3Mar90	3.1	5.5	4.3
4Mar90	3.4	6.9	4.8
5Mar90	4.2	5.3	4.6
6Mar90	3.2	7.1	4.9
7Mar90	3.6	6.1	4.8
8Mar90	2.9	6.3	4.5
9Mar90	2.8	6.7	4.5
10Mar90	3.9	4.8	4.5
11Mar90	3.3	5.5	4.1
12Mar90	2.7	5.6	3.8
13Mar90	2.1	6.8	4.1
14Mar90	3.4	6.2	4.7
15Mar90	3.3	8.4	5.4
16Mar90	3.2	7.8	5.4
17Mar90	4.6	8.9	6.4
18Mar90	5.0	9.1	6.5
19Mar90	4.3	8.6	6.2
20Mar90	4.6	7.4	5.8
21Mar90	4.6	8.2	6.0
22Mar90	4.0	8.4	5.9
23Mar90	3.7	5.6	4.6
24Mar90	3.7	7.6	5.0
25Mar90	2.6	7.9	5.0
26Mar90	3.5	8.7	5.7
27Mar90	3.1	9.2	5.6
28Mar90	3.1	9.0	5.7
29Mar90	3.3	9.5	6.1
30Mar90	3.7	10.0	6.6
31Mar90	4.4	10.7	7.3

UMATILLA RIVER BASIN ANADROMOUS FISH HABITAT ENHANCEMENT PROJECT 1990 ANNUAL REPORT

Prepared by

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ABSTRACT

The Umatilla habitat improvement program is funded under the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program measure 704 (d) (1) 34.02, and targets the improvement of water quality and the restoration of riparian areas, spawning and rearing habitat of steelhead, spring and fall chinook and coho salmon.

The Confederated Tribes of the Umatilla Indian Reservation are responsible for enhancing stream reaches within the Reservation boundaries as guided by an implementation plan developed cooperatively with the Oregon Department of Fish and Wildlife and the U.S.D.A. Forest Service, Umatilla National Forest.

Treatment areas included the lower 4 miles of Meacham Creek, the lower 1/4 mile of Boston Canyon Creek, and the Umatilla River between RM 78.5 and 80. The upper 1/2 of the Meacham Creek project area including Boston Canyon Creek, which were initially enhanced during 1989, were reentered for maintenance and continued enhancements.

Approximately 2,400 cu. yds. of boulders and 1,000 cu. yds. of riprap was used in the construction of in-stream, stream bank and flood plain structures and in the anchoring of large organic debris (LOD) placements. In-stream structures were designed to increase instream cover and channel stability and develop of a defined thalweg to focus low summer flows. Flood plain structures were designed to reduce sediment inputs and facilitate deposition on flood plains.

Riparian recovery was enhanced through the planting of over 1,000 willow cuttings and 400 lbs. of grass seed mix and through the exclusion of livestock from the riparian corridor with 4.5 miles of high tensile smooth wire fence.

Photo documentation and elevational transects were used to monitor changes in channel morphology and riparian recovery at permanent standardized points throughout the projects. Water quality (temperature and turbidity) data was collected at locations within the project area and in tributaries programmed for future enhancements..

ACKNOWLEDGEMENTS

This program was funded by the Bonneville Power Administration (BPA). The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) thank Jerry Bauer and other BPA personnel for their assistance. Thanks are extended to Tim Baily, Jim Phelps and Steve Williams of the Oregon Department of Fish and Wildlife (ODFW) and John Sanchez and Ed Calame of the Umatilla National Forest for field and technical assistance.

We would like to acknowledge the many landowners who supported our efforts through the signing of conservation easements and by providing invaluable background on the properties within the project areas. Thanks go to the Union Pacific Railroad for their assistance in the transport of boulders for instream structures.

Thanks to CTUIR staff, whose cooperation and contributions are evident in this report. Special thanks to Ken Hall, Melvin Farrow, and Mike McCloud for their long hours of on-the-ground efforts. Gary James provided critical technical review of the project and Joe Richards provided administration of this agreement. Julie Burke and Celeste Reves provided secretarial services.

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INTRODUCTION

This report covers work accomplished by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) during April 1990 through May 1991 as part of the Umatilla Drainage Habitat Improvement Program. This Program is funded under the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, Measure 704 (d) (1) 34.02, as partial mitigation for construction of hydroelectric darns and the subsequent losses of anadromous fish throughout the Columbia River system. The CTUIR as co-managers of the fisheries resources, was identified as the agency responsible for implementation of habitat improvements within the Umatilla Indian Reservation boundaries.

The Umatilla River Drainage Anadromous Fish Habitat Improvement Implementation Plan (Implementation Plan), was developed by the Oregon Department of Fish and Wildlife (ODFW), U.S.D.A. Forest Service, Umatilla National Forest (USFS), and the CTUIR to guide enhancement activities in the basin from 1988 through 1992 (Reeve et al. 1988). Enhancement activities target improvement of water quality, and restoration of riparian areas and spawning and rearing habitat of steelhead (Oncorhynchus mykiss), spring and fall chinook salmon (Oncorhynchus tshawytscha), and coho salmon (Oncorhynchus kisutch). These species represent an important cultural and religious resource to the Indian Tribes and their protection is mandated by Treaty with the United States Government.

Enhancement strategies include riparian vegetation restoration and protection, habitat diversity improvement and channel development. Improvements are being implemented in conjunction with other anadromous fish restoration efforts in the Umatilla River Basin including passage improvements (ladders, screens, and flow enhancement) and hatchery supplementation. These other efforts will help to boost spawning escapement and natural production in the enhanced habitat throughout the Umatilla Basin.

DESCRIPTION OF PROJECT AREA

Meacham Creek is a major tributary to the Umatilla River, entering at rivermile (RM) 79 (Figure 1). It drains approximately 165 square miles and produces 145,000 acre-feet annually at RM 5 near the head of the project area. The Umatilla River is a tributary to the Columbia River at RM 289. It has a drainage basin of 308 square miles below the confluence of Meacham Creek. The principle aquifer is quatemary alluvium composed of unconsolidated sand and gravel, gravel, and some silt. Alluvium may reach a depth of up to 12 feet (Gonthier and Harris 1975).

Boston Canyon Creek, entering Meacham Creek at RM 2.1, is the largest tributary to Meacham Creek within the reservation. It contributes over 4,000 acre-feet annually to Meacham Creek from a drainage basin of approximately 5.5 square miles. It runs over and through large alluvial deposits as it enters the Meacham Creek floodplain.

The project area includes the lower 4 miles of Meacham Creek, the lower 1/4 mile of Boston Canyon Creek, and the Umatilla River between RM 78.5 and 80. The upper 2 miles of Meacham Creek and the lower section of Boston Canyon Creek , initially treated during the 1989 project year, were reentered for maintenance and continued enhancements. The lower two miles of Meacham Creek and the work on the mainstem Umatilla represent initial entries.

Elevations in the project area range from 1,760 to 2,000 feet above sea level, giving the area an unusually long growing season. Stream gradients average less than two percent. Flooding in the project area usually occurs in late winter and spring as a result of a rain on snow event. The flood peaks tend to be high and the volumes large, but the duration of damaging stages seldom last more than a day or two (U.S. Army, Corps of Engineers 1975).

The project lies in a big game winter grazing zone as outlined by the CTUIR Land Development Code (1983). The primary land use is livestock grazing from May to November. Timber harvest is permissible under a conditional use permit.

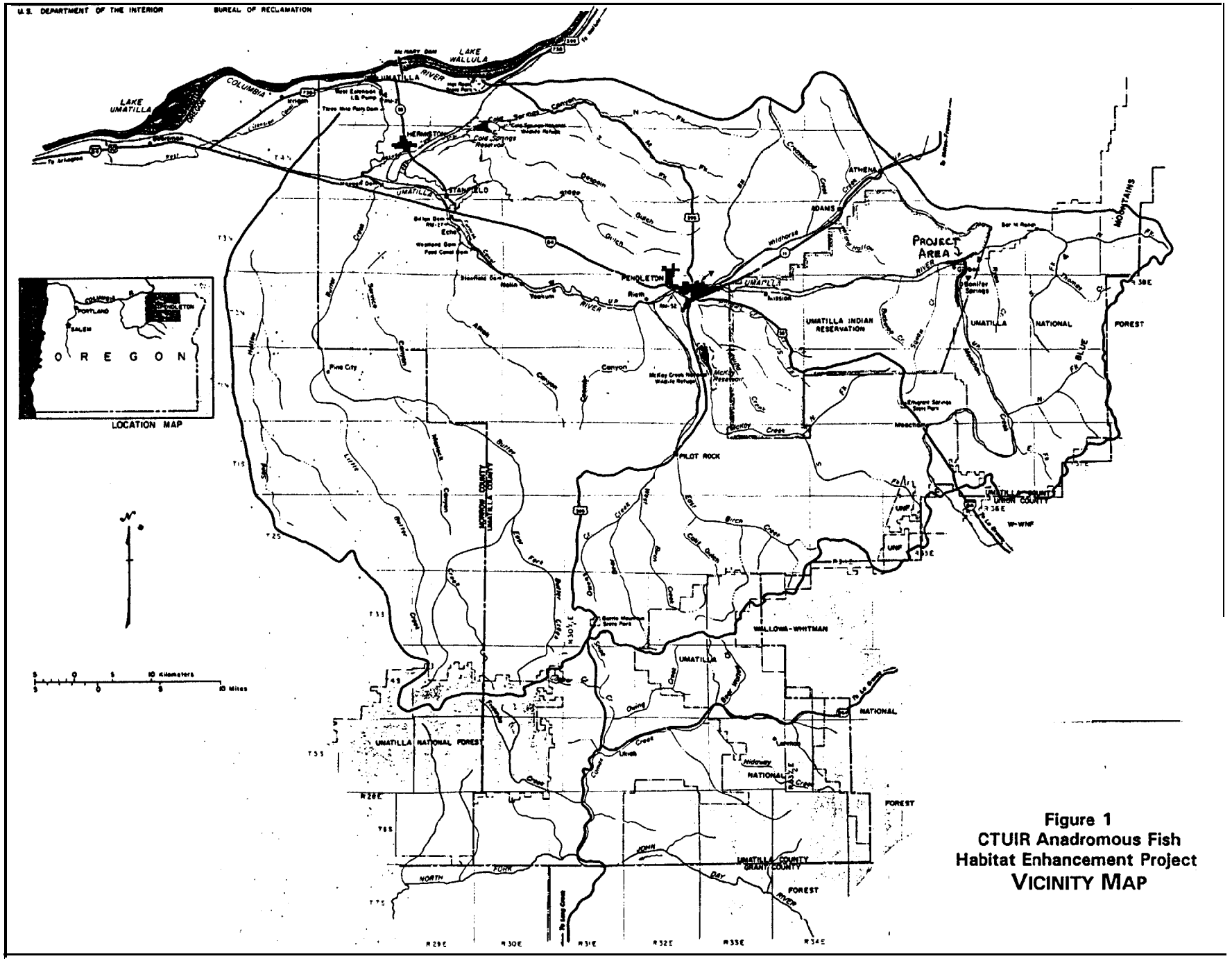


Figure 1
CTUIR Anadromous Fish Habitat Enhancement Project
VICINITY MAP

METHODS AND MATERIALS

The efforts of the CTUIR fish habitat enhancement staff during the 1990/91 project year are divided into categories based roughly on chronology as follows:

1) Pre-construction:

The preconstruction phase of the project included all project planning and preparatory activities including:- landowner coordination and the development and acquisition of lease and Right-of Way (ROW) agreements; acquisition of all required federal, state and local permits; the survey of properties for accurate property line locations and for project design; the development and award of construction and delivery contracts; the collection of pre-construction biological and physical data and the establishment of recovery transects and photopoints; and the development. of . implementation schedules and plans.

Project Design and Property Line Survey

The CTUIR contracted with River Masters Engineering, Inc. for the development of designs and blueprints of the lower two miles of Meacham Creek, Section C and selected sites on the Umatilla River. Designs included design rational and cross sections of stream channel and flood plain, for use in physical monitoring and permit acquisition. These designs were completed during the 1989\90 project year.

Property line survey was conducted under subcontract with a BIA approved land surveyor to meet the requirements of the Code of Federal Regulations, Section 169. All other activities were conducted by CTUIR staff.

Landowner Agreements

Lease and ROW' procurement for the lower 2 miles of Meacham Creek. and the Umatilla River, Sec. B and C, was' ongoing throughout the 1988\89 project year. Each landowner or shareholder was contacted initially by either phone or letter, and then sent an information packet with draft agreements for their review: Field tours of the project area and slide presentations were given to all interested landowners on request.

Monitoring and Data Collection

Data on water temperature and turbidity were collected at sites selected during the pm-construction phase of implementation. These sites included three ISCO waste water sampler stations, each with an associated Tempmentor hydrothermograph. Stations were placed during the 1988\89 project year at RM 2, 4, and 6. The station at RM 6

was moved to the Umatilla River approximately 100 yds. downstream from the confluence with Meacham Creek prior to commencement of instream activities in the Umatilla River and lower two miles of Meacham Creek.

Samples were taken at six hour intervals to create a composite daily sediment sample. Water samples were processed at the USFS water lab in Pendleton by CTUIR habitat staff and USFS personnel. All laboratory personnel time and the use of the lab equipment was donated by the Umatilla National Forest.

Ryan Tempmentor thermographs were also deployed at the lower reaches of Squaw and Buckaroo Creeks. Water temperatures were recorded every half hour.

Stream channel development and riparian recovery were documented using cross channel transects to measure changes in channel morphology and using standardized photo points to record riparian recovery and changes in channel morphology. Permanent photo point and transect markers were placed throughout the project area. Channel measurements and standardized photos were taken prior to construction activities and immediately following construction to document construction related changes in channel cross section and initial riparian condition. This recovery documentation will be repeated following the first years high flow events and thereafter every other year.

2) Construction:

The construction phase of the project consisted of all on-the-ground activities including: initial project staking, development of machine accesses, delivery of materials to structure sites, construction of instream and riparian area structures, maintenance of existing structures, riparian vegetation enhancement, construction of riparian exclosure fence, project construction monitoring and data collection, and photo documentation.

In-stream Activities

In-stream activities were scheduled to correspond. to periods of low stream. flow and to avoid spawning periods for salmonids. The' location. and type of in-stream and riparian structures were determined by the hydrologists and engineers under subcontract in coordination with the tribal habitat biologist.

Petroleum absorbent booms were deployed downstream from all heavy equipment working in the stream zone to protect against spills of petroleum products from engine and hydraulic systems.

Meacham Creek and the Umatilla River - Deflectors, spur dikes, and turning rocks were placed to reduce erosion of stream banks and the influx of sediments from adjacent riparian areas and to encourage the deposition of fines for the establishment of riparian vegetation.

Weirs, large organic debris, and instream boulder placements were used to increase holding and hiding cover and to encourage the development of a stable, narrow thalweg .

The Hilti rock hammer drill was used to drill 9\16" diameter holes approximately 6" into boulders. Half inch diameter aircraft cable was epoxied into the holes to anchor LCD and to increase stability and long term durability of the structures.

In areas of extensive bed-load deposition and high channel instability, river gravels were sloped and shaped to form a stable channel configuration and to facilitate the recovery of riparian vegetation. This stable channel configuration will be maintained by the placement of boulder structures and through the recovery of a stable riparian community.

Boston Canyon Creek - Additional log sills were placed to set grade in the lower sections where the channel had become incised during high spring runoff.

Riparian Corridor Fencing

Livestock grazing will be eliminated from the project area using a high tensile smooth wire fence to enclose the riparian corridor. Fence designs and specifications were provided by the Oregon Department of Fish and Wildlife.

Riparian Vegetation Enhancement

High summer water temperature and the loss of habitat diversity resulting from excessive bedload movement and stream bank instability are major limiting factors to salmonid production in the basin. The reestablishment of riparian vegetation in the project area is critical to the long term stabilization of the bed-load and the subsequent development of a narrow shaded channel. Vegetative recovery and enhancement will be achieved through livestockexclusion and the planting of riparian hardwood cuttings from local stock and seeding of all'gravel bars and exposed banks with a mix of grasses and forbs recommended by the Soil Conservation Service.

Monitoring and Data Collection

Water quality data including suspended sediments and water temperature were collected throughout the construction period. Construction activities were photographed and video-taped.

3) Post-construction:

This phase of project implementation included the post-construction project monitoring and water quality data collection as follows:

Monitoring and Data Collection

Riparian recovery and changes in channel morphology were monitored at preselected photo points and cross channel transects which were established during the preconstruction phase of the project. Channel cross sections were resurveyed before and after the spring high flow event to assess the effectiveness of the prescribed structures at meeting desired goals of riparian stabilization and enhanced fish habitat. Post-construction standardized photographs were taken at all transects and at other preselected photo points to document riparian recovery and structure success.

RESULTS AND DISCUSSION

1) Pm-construction:

Landowner Agreements

Agreements were signed with 15 landowners for nine tax lots and two trust allotments on approximately 3.4 miles of stream channel. This included 1.9 miles of the Umatilla River in Sections B and C, and approximately 1.5 miles of Meacham Creek. A total of approximately 140 acres of stream channel and riparian area were included in these agreements.

Right of Way agreements were signed by an additional 18 share holders in two trust allotments for which 100 percent consent was not obtained. These allotments were left untreated pending agreements with three more share holders.

Sub-contracts

All subcontract documents and specifications were developed by the CTUIR, Department of Natural Resources staff during the 1990\91 project year.

Property Line Survey - Property line surveys were completed under sub-contract with William R. Wells Land Surveying and Planning, in order to meet the requirements of the Bureau of Indian Affairs and the Code of Federal Regulations Part 169.

Equipment Rental - Sub-contract for equipment rental was awarded to Hamey County Gypsum for the rental of a D-8 crawler dozer, a track mounted excavator, and a crawler loader.

Rock Haul - Sub-contract for the loading and haul of boulders and riprap was awarded to Humbert Excavating.

Project Design - Design of the lower two miles of Meacham Creek was sub-contracted to River. Masters Engineering; Project design was developed in coordination with the tribal habitat biologist.

Fence Construction - Fence construction sub-contract was awarded to Raymond Doherty. for 4.5 miles of fence in the 1989\90 project area on Meacham Creek.

2) Construction and Post-construction:

Materials Supply and Delivery

Rock supply and delivery was coordinated with the Union Pacific Railroad (UPRR). The UPRR donated the delivery of 2,400 cu. yds. of boulders from a stock pile at Bamhart Pit to the Gibbon Siding at Gibbon, OR. This rock was purchased from Meridian Aggregate Co.

Offloading of rail cars and trucking of rock to structure sites on Meacham Creek and the Umatilla River was completed under sub-contract with Humbert Excavating.

An additional 1,000 cu. yds. of riprap was excavated from a local pit and hauled to site by Hamey County Gypsum Company. This riprap was used primarily for bank revetment.

Instream Activities

All instream activities were directed and inspected by Tribal habitat staff. Rock and log structures throughout the project were secured using over 1,000 Hilti Fastening system placements and a total of 1,000 ft of 1/2 inch steel cable.

Meacham Creek - Initial instream activities included the development of a stable channel configuration through approximately 1/2 mile of unstable gravel deposits. Adult holding water was improved in the lower two miles of channel through the construction of eight rock weirs with holding pools. Stream bank stability was improved by the placement of 34 boulder deflectors, over 1,000 lineal feet of boulder wing walls and toe rocks, 120 feet of rock bank revetment and 60 feet of log bank revetment. Instream cover was increased through the placement of 30 in-pool boulders, 33 boulder clusters, and 24 large organic debris placements with anchor boulders. Channel thalweg and instream cover was enhanced by the placement of 60 thalweg boulders and 23' sets of turning boulders. Stream bed stability was increased with the construction of three bed level boulder sills to control-vertical channel erosion.

Boston Canyon Creek - Continued enhancements and repairs included the repair of one log sill which had been lost to a channel head wall cut. Channel grade was stabilized with two additional log weirs and 50 cu. yds. of riprap channel bottom armor. Additional boulders were placed to neck down the chute on one log weir.

Umatilla River - Adult holding water was improved through the construction of an adult holding pool and boulder weir. Large organic debris was cabled in place to bedrock within the pool to improve cover.

The channel was stabilized through the construction of two vertical control sills, eight boulder deflectors, 70 feet of log revetment, 950 feet of boulder revetment, and 220 feet of boulder wing wall.

Rearing habitat and instream cover was improved with 15 LOD placements including 18 anchor boulders, 12 boulder clusters, 13 sets of turning boulders, and two slough developments.

Fence Construction

The lease areas were enclosed with 4.5 miles of high tensile smooth wire fence to exclude livestock. Three stream crossing structures and six gates were also constructed. The fencing of lease areas in the 1990 project areas on the lower two mile of Meacham Creek and the Umatilla River was deferred to the following year in order that the effectiveness and integrity of the instream and flood plain structures could be evaluated through a high flow event. This strategy should reduce the risk of high flows damaging fences due to improper location within the flood plain.

Riparian Vegetation Enhancement

Riparian vegetation was enhanced through the planting of over 1,000 willow cuttings in Meacham Creek, the Umatilla River and Boston Canyon Creek. A D-8 crawler dozer with four foot long ripper was used successfully to plant large numbers of cuttings deeply in the extensive gravel bar areas in the project. Large clumps of alder were planted using a track mounted excavator.

Areas disturbed during implementation were seeded with a mix of grasses and forbs to reduce erosion and the growth of undesirable species. A wet site seed mix was used along stream margins and in sloughs. A total of. 300 lbs. of dry site seed and 100 lbs. of wet site seed were spread during the fall and spring following high flows. All seed used was certified weed free.

Monitoring and Data Collection

Water temperatures were recorded at the mouth of Meacham' Creek, lower Squaw Creek and in the Umatilla River below the mouth of Meacham Creek to monitor the output temperatures from the primary spring chinook and steelhead spawning and rearing areas on the Reservation (Figs 2 - 4, and appendix a). The critical period for anadromous fish was during July and August when the mean daily water temperatures frequently exceeded 65 F. Temperatures in excess of 65 F have been shown to result in impairment of anadromous fish production (Theurer et al, 1984; Theurer et al 1985; Bell 1984).

Figure 2

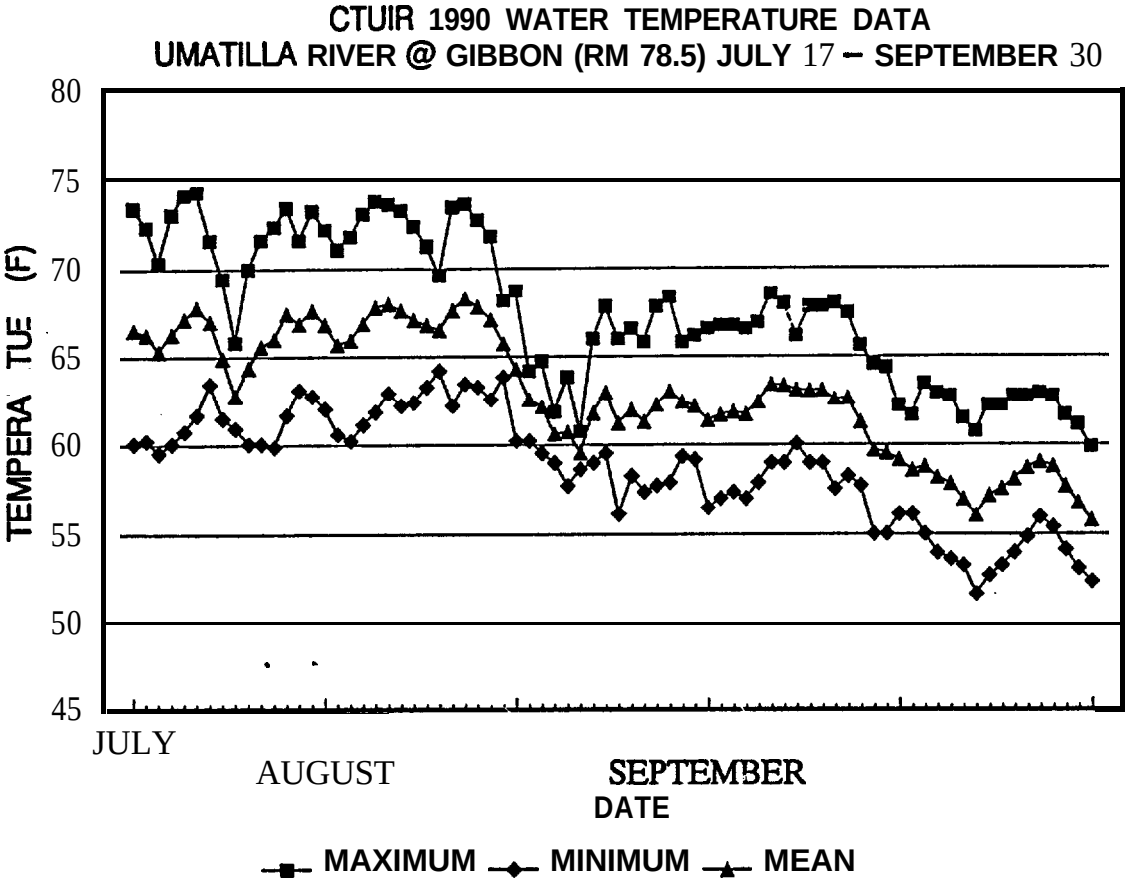


Figure 3

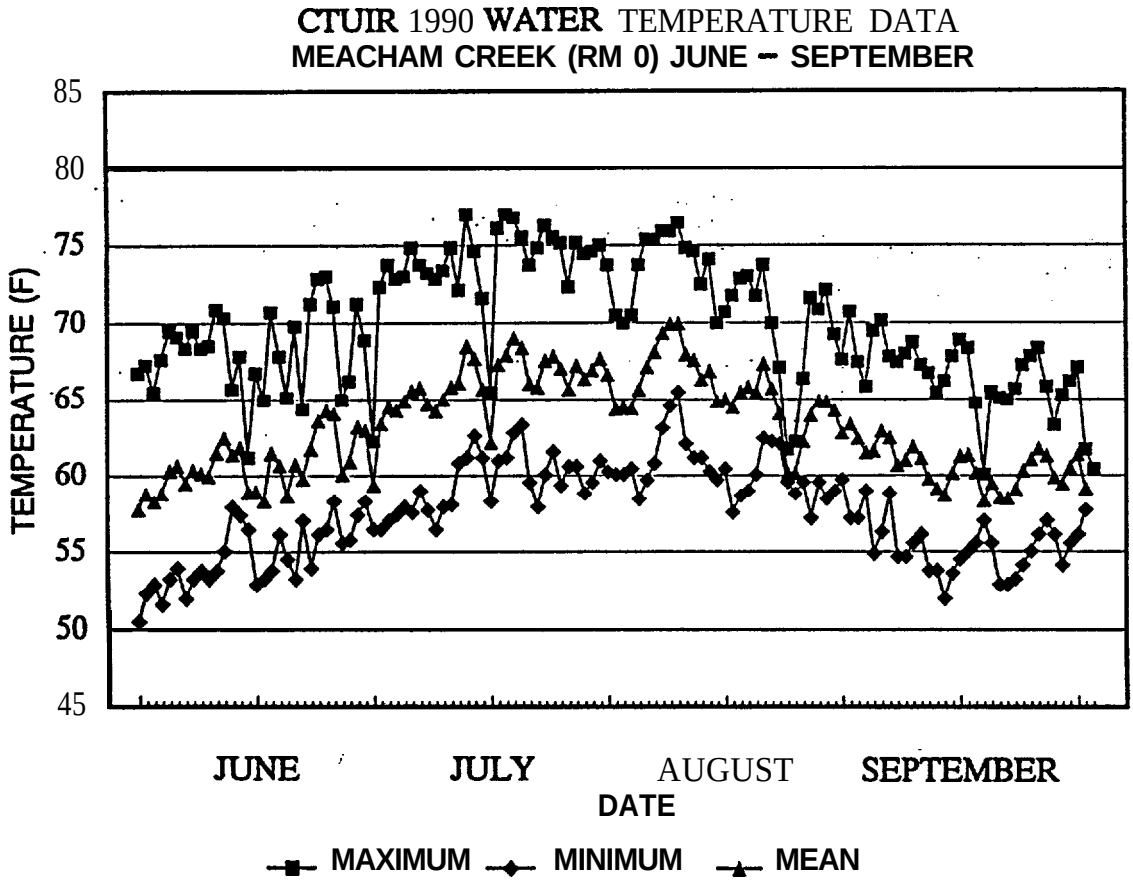
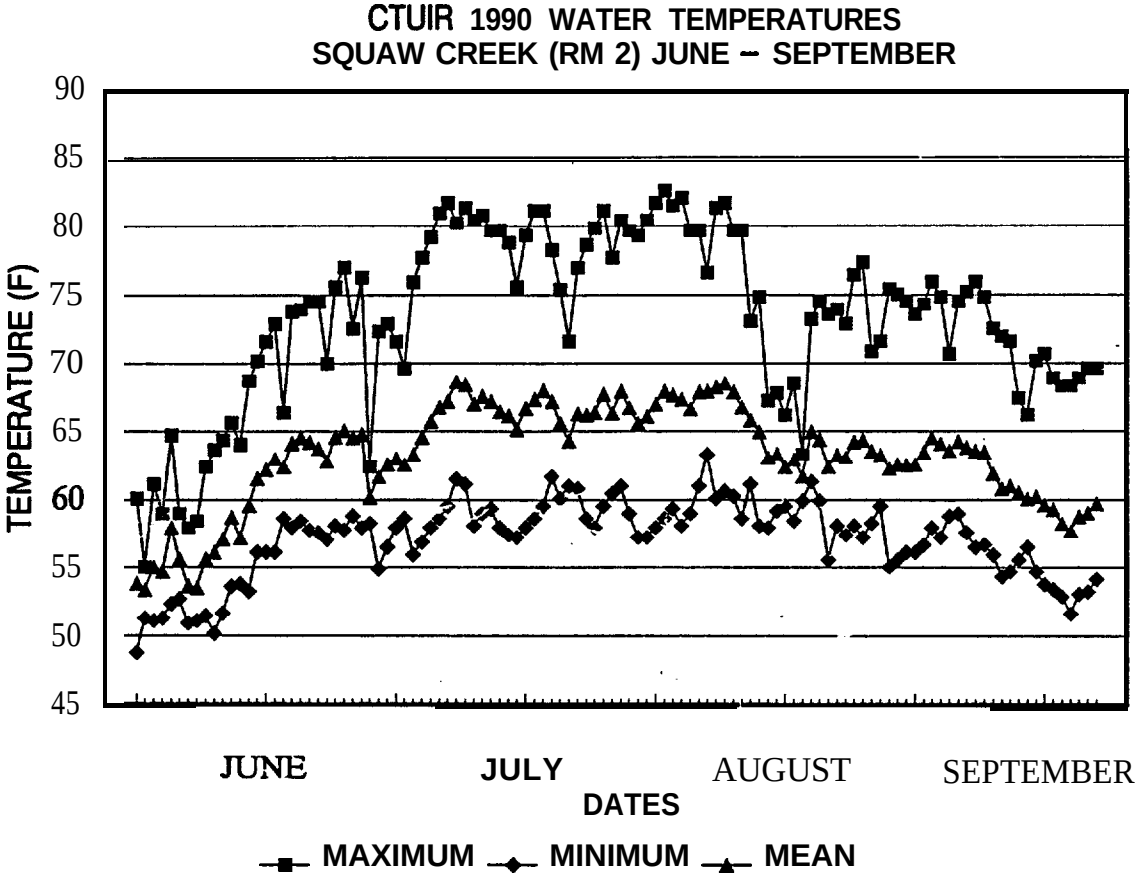


Figure 4


CTUIR 1990 WATER TEMPERATURES
SQUAW CREEK (RM 2) JUNE -- SEPTEMBER
TEMPERATURE (F)
90
85
80
75
70
65
60
55
50
45
JUNE
JULY
AUGUST
SEPTEMBER
DATES
MAXIMUM
MINIMUM
MEAN

Maximum water temperatures during the critical period occurred between 4pm and 5pm reaching the mid 70s F in Meacham Creek and the Umatilla River and often exceeding 80 F in Squaw Creek. The upper lethal limit due to indirect effects such as reduced growth, reduced capacity to compete for food and avoid predators and increased disease virulence is 68 F (Theurer et al. 1984). Temperatures of between 73 and 77 F have been shown to cause direct mortality in chinook and steelhead (Bell 1984; Theurer et al., 1984). Successful holding, spawning, and rearing of steelhead was documented in Meacham Creek, Squaw Creek and the Umatilla River and successful holding and spawning of spring chinook was documented in Meacham Creek and the Umatilla River even with these extremes in temperature.

Daily minimum temperatures during the critical period ranged from a low of 54.9 F in Squaw Creek to a high of 65.5 F in Meacham Creek. Minimum daily temperatures were generally recorded between 6 and 8 am. The average diurnal fluxes during the critical period were 9.3 F in Meacham Creek, 12.9 F in the Umatilla River and 18 F in Squaw Creek. These daily variations in temperature combined with the use of cool water refuges from springs and subsurface flow interception may permit successful production in what appears to be unsuitable conditions.

Estimates of suspended sediments were made from samples taken at the three ISCO stations and analyzed with stream flow data collected from the USGS gage stations at Meacham Creek RM 2 and the Umatilla River RM 80.5, to develop daily estimates of total sediment yieid from Meacham Creek and the Umatilla River (Fig. 5 & 6).

The total estimated sediment yield from Meacham Creek for the 13 month project period (April 1, 1990 - April 30, 1991) exceeded 2800 tons. Samples from the Umatilla River were incomplete for the project period and no estimate of total project period yield was made.

The largest recorded peak in Meacham Creek of over 320 tons/day occurred on May 31, 1990 as a result of heavy spring rains. Normal high spring and winter flows of twice the magnitude Would not tend to cause such extreme peaks. The August peaks on the Umatilla River were the result of instream 'enhancement activities.

Figure 5

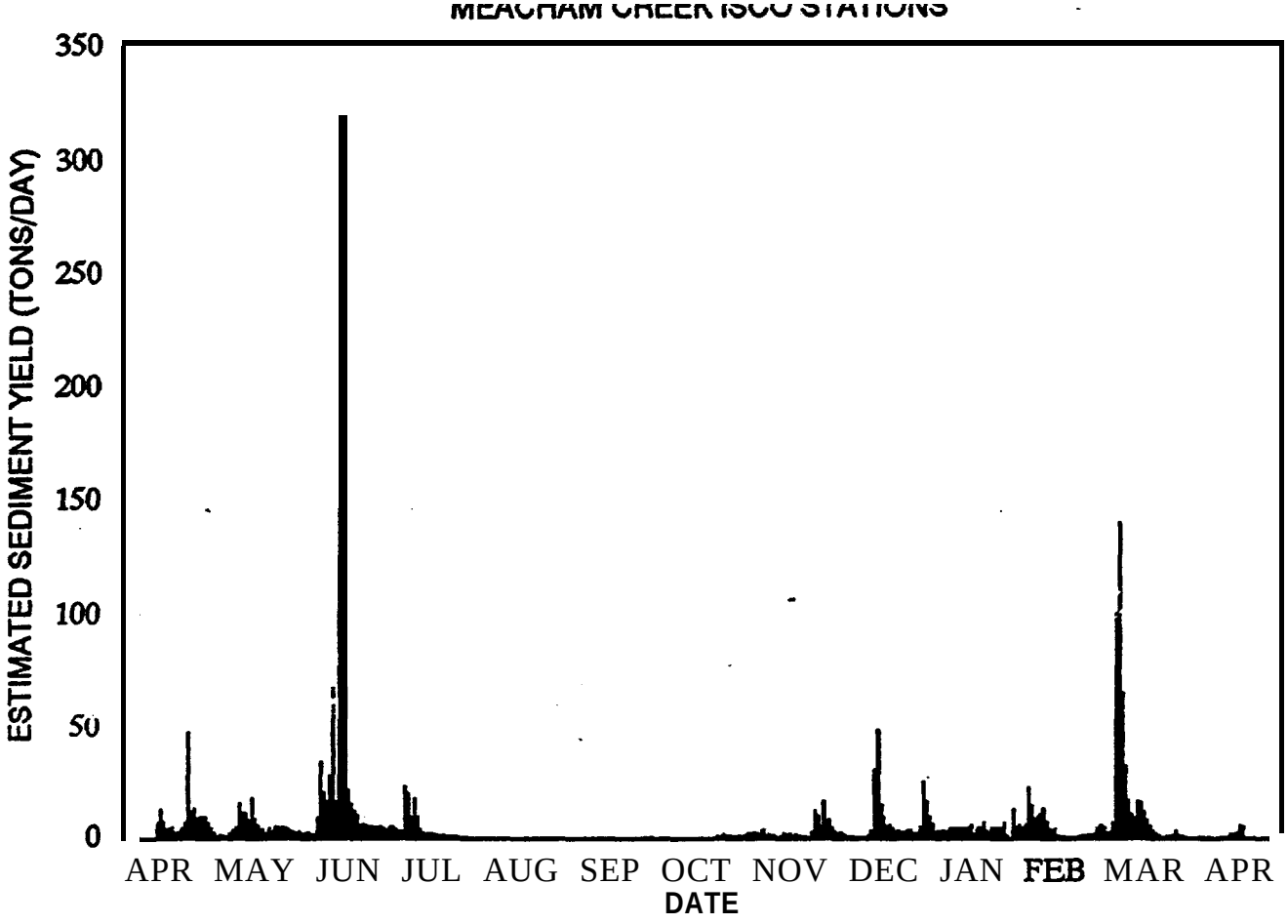
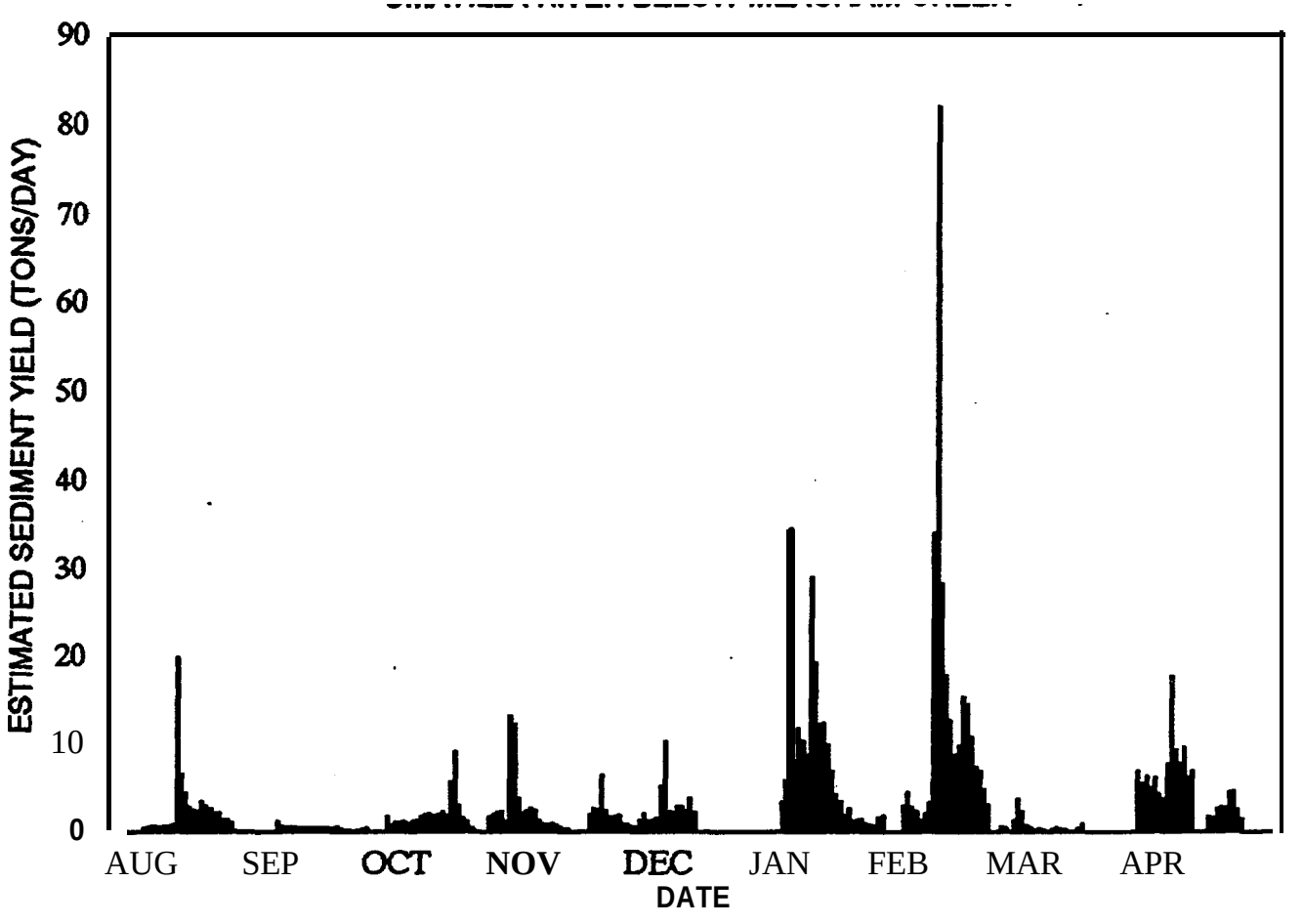

MEACHAM CREEK ISCO STATIONS
ESTIMATED SEDIMENT YIELD (TONS/DAY)
350
300
250
200
150
100
50
0
APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR
DATE

Figure 6


ESTIMATED SEDIMENT YIELD (TONS/DAY)
90
80
70
60
50
40
30
20
10
0
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
DATE

Summary of Expenditures - Habitat Enhancement April 1, 1990 - April 30, 1991	
1. Personnel (Saiaries & Fringe Benefits)	$ 85,830.74
2. Travel	$ 2,160.86
3. Services and Supplies	$ 21,278.37
4. Contractual Supplies	$ 145,547.89
5. Capital Outlay	$ 973.97
6. Overhead	$ 32,601.65
7. Total	$ 288,393.49

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Reeve, R., S. Williams, J. Neal and J. Sanchez. 1988. Umatilla River Drainage Anadromous Fish Habitat Improvement Implementation Plan. March 1988, **Available** from: Bonneville Power Administration, Portland, Oregon 53 pages.

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APPENDIX A
WATER QUALITY DATA

YOU ARE IN TL901387.001. 1.0
1 hours / sample 1.0
max. = 25.0 degrees C. 25.0
min. = -32.2 degrees C. -32.2
05/31/89 07:30:00 SN901387 #001 5.0 31.0 89.0 7.0 50.0 0.0 1.0

MEACHAM CREEK RM 0 1 HR INTERVAL 0.0 1.0

DEPLOYED 5/31/89 0600 CAS 5.0 31.0 89.0 800.0

DIRTO c:\hdb\arrvm2\
For auto permanent entries
DIRFROM + DIRTO (- - - > change)

DATE	MILITARY TIME 0100	0200	0300	0400	0500	0600	0700	0800	0900	1000.0	1100.0	1200.0	1300.0	1400.0	1500.0	1600.0	1700.0	1800.0	1900.0	2000.0	2100.0	2200.0	2300.0	2400.0	MAX	MIN	MEAN	MAX	MIN	MEAN
05/01/89	12.5	11.9	11.5	11.1	10.8	10.5	10.3	10.4	10.8	11.8	13.0	14.4	15.8	17.3	18.4	19.2	19.5	19.6	18.3	17.1	16.2	15.3	14.4	13.8	19.5	10.3	14.3	66.7	50.5	57.7
05/02/89	13.4	12.9	12.4	12.1	11.8	11.4	11.3	11.4	11.7	12.5	13.6	15.0	16.4	17.7	18.6	19.3	19.6*	19.2	18.5	17.4	16.5	15.6	14.7	14.1	19.6	11.3	14.9	67.3	52.5	58.6
05/03/89	13.9	13.1	12.5	12.4	12.1	11.8	11.8	11.8	12.1	12.9	14.0	15.4	16.5	17.4	18.0	18.4	18.6	18.0	17.4	16.2	15.3	14.4	13.7	13.0	18.6	11.8	14.8	65.5	52.9	58.3
05/04/89	12.7	12.4	12.0	11.6	11.3	11.1	10.9	11.1	11.6	12.6	13.8	15.3	16.7	17.9	19.0	19.7	19.6	19.4	18.6	17.7	16.8	15.9	15.0	14.4	19.6	10.9	14.9	67.8	51.9	58.5
05/05/89	13.9	13.4	13.0	12.6	12.2	11.9	11.8	11.8	12.3	13.2	14.6	16.1	17.6	18.8	19.9	20.6	20.8	20.5	19.5	18.5	17.5	16.6	15.7	15.1	20.8	11.8	15.7	69.4	53.2	60.5
05/06/89	14.4	13.8	13.5	13.1	12.7	12.4	12.2	12.3	12.8	14.0	14.8	16.5	17.7	18.9	19.8	20.5	20.8	20.2	19.5	18.5	17.4	16.5	15.5	14.7	20.8	12.2	15.8	68.1	54.0	60.8
05/07/89	14.1	13.4	12.9	12.4	11.9	11.5	11.4	11.3	11.7	12.7	13.9	15.4	17.0	18.2	19.3	19.9	20.2	19.8	19.1	18.1	17.1	16.2	15.3	14.5	20.2	11.1	15.3	66.4	52.0	58.5
05/08/89	13.9	13.4	12.9	12.5	12.2	11.8	11.8	11.8	12.5	13.3	14.8	16.1	17.8	18.9	19.8	20.5	20.8*	20.5	19.8	18.7	17.7	16.8	15.9	15.1	20.8	11.8	15.6	68.4	53.8	60.4
05/09/89	14.5	14.0	13.4	13.1	12.8	12.5	12.2	12.2	12.6	13.5	14.7	16.1	17.4	18.6	19.5	20.1	20.2	19.6	18.8	17.9	16.9	15.9	15.1	14.4	20.2	12.1	15.6	66.5	53.2	59.6
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05/11/89	14.2	13.7	13.3	12.8	12.5	12.2	12.1*	12.1	12.5	13.2	13.7	15.2	16.8	18.3	19.4	20.1	20.4	21.2	20.5	19.7	18.9	18.0	17.2	16.5	21.2	12.1	16.4	70.5	55.0	62.4
05/12/89	15.2	14.8	14.1	13.8	13.3	12.8	12.8	12.8	13.2	14.0	14.8	16.0	17.5	18.8	19.8	20.8	21.0	21.2	20.5	19.7	19.0	18.0	17.2	16.5	21.2	12.8	16.9	65.7	57.9	61.4
05/13/89	15.9	15.4	15.1	14.8	14.8	14.4	14.4	14.7	15.0	15.5	16.4	17.2	17.7	18.3	18.7	19.2	19.5	19.2	18.7	18.1	17.7	17.1	16.7	16.2	19.5	14.4	16.5	67.8	57.4	61.8
05/14/89	15.8	15.2	14.8	14.7	14.4	14.3	14.3	14.2	14.4	14.5	15.3	16.0	16.8	16.3	16.4	16.7	16.8	16.8	16.1	16.5	17.9	17.4	16.9	16.5	16.8	14.2	15.8	69.2	56.5	59.9
05/15/89	16.2	15.7	15.5	15.2	15.0	14.7	14.7	14.8	14.8	14.9	15.0	15.2	15.2	15.5*	15.3	15.2	15.0	15.2	15.0	14.7	14.4	14.1	13.9	13.6	16.2	13.6	14.9	81.2	56.5	64.9
05/16/89	13.2	12.8	12.4	12.2	11.9	11.8*	11.8	11.8	12.4	12.8	13.9	14.7	16.2	17.3	18.3	19.0**	19.3	18.1	18.8	17.7	16.8	15.9	15.1	14.4	19.3	11.8	15.0	66.7	52.9	59.9
05/17/89	13.8	13.4	12.8	12.6	12.1	11.8	11.8	11.8	12.4	12.9	13.4	14.0	15.2	16.9	17.1	18.0	18.3	18.1	17.8	16.9	16.2	15.8	15.0	14.4	18.3	11.8	14.8	64.9	53.2	58.3
05/18/89	13.8	13.4	12.8	12.7	12.5	12.1**	12.7	12.3	12.9	13.5	16.8	16.5	16.5	20.8	21.9**	21.5	21.5	21.3	20.3	19.4	18.4	17.7	16.8	16.1	21.9	12.3	16.8	70.5	55.0	62.4
05/19/89	15.4	14.9	14.5	13.8	13.6	13.6	13.4	13.7	14.0	14.8	15.6	16.2	16.9	17.1	16.8	16.3	16.1	16.8	16.3	17.5	16.9	16.1	15.5	14.7	17.5	13.4	15.8	67.8	56.1	62.2
05/20/89	14.3	13.8	13.6	13.3	12.8	12.7	12.8	12.6	12.6	13.1	13.2	13.7	14.7	15.8	17.3	18.3	18.4	18.2	17.8	16.8	15.9	15.4	14.7	14.0	18.4	12.5	14.8	66.1	54.5	58.9
05/21/89	13.8	13.0	12.6	12.4	12.1	11.8	11.8	12.0	12.6	13.5	15.0	16.4	17.8	19.0	20.2	21.0*	21.0	20.7	19.8	18.9	17.9	17.0	16.3	15.7	21.0	11.8	16.0	69.8	53.2	60.7
05/22/89	15.3	14.9	14.6	14.3	14.1	13.9**	13.9	14.1	14.4	14.8	15.2	15.8	17.0	18.0	18.8	19.4	19.6	19.2	18.5	17.8	17.2	16.5	15.9	15.4	19.6	13.9	15.4	68.8	55.4	60.8
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05/24/89	15.6	15.1	14.5	14.1	13.8	13.6**	13.6*	13.7	14.3	15.3	16.0	16.8	16.5	16.2	16.0	16.2	16.3	16.2	15.8	15.4	15.1	14.8	14.5	14.2	16.3	13.6	15.1	72.8	56.1	63.6*
05/25/89	16.1	15.4	14.8	14.4	13.9	13.9**	13.9	13.9	14.4	15.8	16.8	16.3	16.2	16.2	16.2	16.3	16.2	16.1	15.8	15.4	15.1	14.8	14.5	14.2	16.3	13.9	15.1	73.0	56.5	64.3
05/26/89	15.8	15.4	14.9	14.6	15.0	14.7	14.8	14.8	15.5	16.5	17.8	18.9	20.2	21.6	22.8	23.6	23.8	23.4	22.5	21.5	20.6	19.8	19.0	18.1	23.8	14.6	17.9	71.1	58.3	64.1
05/27/89	15.3	14.8	14.5	13.8	13.8	13.3	13.1*	13.4	13.7	14.1	14.7	15.5	16.5	17.5	18.1	18.3	18.2	17.9	17.8	17.1	16.7	16.2	15.6	15.1	18.3	13.1	15.6	64.9	55.6	60.1
05/28/89	14.7	14.4	14.1	13.9	13.6	13.4	13.2	13.7	14.5	14.9	15.7	17.1	18.5	19.6	20.6*	20.8*	20.8	20.5	19.8	18.9	17.9	17.1	16.5	16.1	20.8	13.2	16.1	68.2	55.5	60.9
05/29/89	15.3	15.0	14.7	14.5	14.3	14.2	14.1	14.4	14.7	15.5	16.3	17.2	18.5	19.9	21.0	21.7	21.8	21.6	20.8	19.8	18.8	17.9	17.3	16.8	21.8	14.1	17.3	71.2	57.4	63.2
05/30/89	16.2	15.7	15.4	15.0	14.8	14.7	14.8	14.7	15.2	15.9	17.1	18.5	19.4	20.5*	20.3	19.8	19.1	20.8	19.8	18.8	18.0	17.4	16.8	16.2	20.5	14.5	17.2	68.9	56.5	63.0
05/31/89	15.5	15.1	14.7	14.5	13.8	13.9	13.8	14.1	14.4	14.7	15.1	15.4	15.8	16.4	16.7	16.8	16.8	16.5	16.4	16.1	15.7	15.3	15.0	14.8	16.8	13.8	15.2	62.2	56.5	58.4
06/01/89	14.7	14.4	14.1	13.8	13.8	13.7	13.8	13.9	14.4	14.8	15.2	15.8	16.7	17.8	18.8	19.4	20.0	21.1	20.1	19.3	18.4	17.6	16.8	16.2	21.1	13.8	15.9	72.5	56.5	63.4
06/02/89	15.8	15.4	15.0	14.8	14.3	14.1	14.0	14.1	14.4	14.8	15.2	15.8	17.0	18.0	18.7	19.2	19.4*	19.2	18.5	17.8	17.2	16.5	15.8	15.4	19.4	13.8	15.4	73.0	57.0	64.5
06/03/89	15.1	14.8	14.5	14.2	14.0	13.8	13.8	14.1	14.5	14.8	15.2	15.8	16.8	17.8	18.8	19.4	19.8	19.4	18.8	18.1	17.4	16.8	16.2	15.8	19.8	13.8	15.4	73.0	57.0	64.5
06/04/89	15.4	15.0	14.8	14.5	14.1	13.8	13.5*	14.0	14.0	14.2	14.8	15.2	15.8	16.4	16.8	17.2	17.4	17.2	16.8	16.4	16.1	15.8	15.5	15.2	17.4	13.5	15.2	70.2	56.5	62.9
06/05/89	14.8	14.5	14.2	13.9	13.8	13.8	13.8	13.8	14.2	14.5	15.2	15.8	16.5	17.2	17.8	18.2	18.5	18.2	17.8	17.4	16.9	16.5	16.1	15.8	18.5	13.8	15.6	67.8	56.5	62.5
06/06/89	15.4	15.0	14.8	14.5	14.3	14.2	14.1	14.4	14.7	15.1	15.5	16.2	16.8	17.5	18.2	18.8	19.2	19.0	18.5	17.8	17.2	16.6	16.1	15.8	19.2	14.1	15.8	67.8	54.7	60.7
06/07/89	15.1	14.5	13.9	13.6	13.2	12.8	12.6*	12.8	13.1	14.0	15.0	15.8	17.1	18.3	19.3	19.8	20.0	19.8	19.1	18.5	18.0	17.4	16.8	16.2	20.0	12.6	16.1	66.8	54.7	61.0
06/08/89	15.8	15.2	14.5	14.1	13.8	13.4	13.1	13.2	13.5	14.2	15.0	16.4	17.8	18.8	19.8	20.2	20.4	20.1	19.5	18.8	18.4	17.8	17.3	16.8	20.4	13.1	16.2	66.7	54.6	61.0
06/09/89	16.1	15.4	15.0	14.5	14.1	13.7	13.4	13.7	14.5	15.0	15.8	16.5	17.3	18.1	18.8	19.3	19.6	19.2	18.4	17.7	17.1	16.5	15.9	15.5	19.6	13.4	15.8	67.5	54.1	61.1
06/10/89	14.8	14.0	13.8	13.1	12.8	12.3	12.1	12.1	12.5	13.2	14.1	15.3	16.5	17.7	18.6	19.2	19.5	18.9	18.3	17.7	17.1	16.5	15.9	15.5	19.5	12.1	15.4	66.7	53.6	59.8
06/11/89	14.8	14.1	13.5	13.1	12.7	12.3	12.1	12.2	12.5	13.4	14.1	15.2	16.2	17.3	18.0	18.6	18.8	18.2	17.4	16.8	16.2	15.8	15.0	14.4	18.8	12.1	15.1	65.5	53.6	58.2
06/12/89	13.8	13.3	12.7	12.2	11.8	11.5	11.1	11.2	11.6	12.6	13.3	14.6	15.8	17.0	18.0	18.6	19.0	18.5	18.1	17.3	16.6	16.1	15.6	15.0	19.0	11.1	14.8	66.2	52.9	58.7
06/13/89	14.5	13.8	13.4	13.0	12.8	12.2	12.1	12.0	12.3	13.2	14.0	15.3	16.6	17.8	18.8	19.5	19.9	19.6	18.8	18.3	17.7	17.1	16.5	15.8	19.9	12.0	15.5	67.8	53.7	60.1
06/14/89	15.1	14.8	14.8	13.5	13.1	12.8	12.5	12.5	13.0	13.8	14.7	16.0	17.4	18.5	19.8	20.2	20.5	20.3	19.6	18.8	18.2	17.6	16.9	16.3	20.5	12.5	16.2	66.6	54.5	61.2
06/15/89	15.5	15.0	14.4	13.8	13.5	13.2	12.8	13.2	13.8	14.8	15.8	16.8	17.8	18.8	19.8	20.2	20.5	20.2	19.6	18.8	18.0	17.4	16.8	16.3	20.2	12.8	16.3	66.4	54.6	61.3
06/16/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	16.0	66.7	54.1	61.0
06/17/89	15.8	15.2	14.6	14.1	13.8	13.4	13.4	13.7	14.5	15.0	15.8	16.8	17.8	18.8	19.5	19.8	19.8	19.5	18.8	18.1	17.5	16.8	16.2	15.8	19.8	13.4	15.8	67.3	54.1	61.1
06/18/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/19/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/20/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/21/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/22/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/23/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/24/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/25/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/26/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/27/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/28/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/29/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0
06/30/89	15.8	15.2	14.6	14.1	13.8	13.4	13.1	13.2	13.8	14.4	15.2	16.2	17.2	18.2	19.2	19.8	20.2	19.8	19.2	18.4	17.8	17.2	16.8	16.2	19.8	13.1	15.8	66.7	54.1	61.0

YOU ARE IN TL801368.003.
1 hours / sample
max. = 28.1 degrees C.
min. = −32.2 degrees C.
08/04/80 14:33:00 BN801368 #003

SQUAW CREEK RM 2.0 KEN HALL

08/04/80

1.0
1.0
28.1
−32.2
6.0 4.0 90.0 14.0 33.0 0.0——— 3.0
2.0
6.0 4.0 90.0

DIRTO c:\habitat\rm2\
For auto permanent entries
DIRFROM + DIRTO (---> change)

DATE	MILITARY TIME 0100	0200	0300	0400	0500	0600	0700	0800	0900	1000.0	1100.0	1200.0	1300.0	1400.0	1500.0	1600.0	1700.0	1800.0	1900.0	2000.0	2100.0	2200.0	2300.0	2400.0	MAX	MIN	AVE	MAX	MIN	AVE
06/04/80																	14.7	14.5	13.6	12.8	12.3	11.8	11.3	10.8	???	???	???			
06/05/80	10.5	10.3	10.1	9.8	9.8	9.5	9.3	9.5	9.9	10.8	11.2	12.4	13.4	14.2	14.7	15.3	15.8	14.9	14.4	14.1	13.6	13.1	12.6	12.3	15.8	9.3	12.1	60.1	48.7	53.8
06/06/80	12.1	11.8	11.3	11.2	10.8	10.7	10.8	11.0	11.3	11.4	11.9	12.3	12.6	12.8	12.8	12.8	12.6	12.6	12.4	12.4	12.2	12.0	11.8	11.6	12.8	10.7	11.9	56.0	51.3	53.4
06/07/80	11.4	11.2	11.1	11.1	10.8	10.6	10.8	10.7	10.9	11.3	12.0	12.8	13.5	15.0	16.1	15.8	16.2	15.6	14.9	14.1	13.6	13.0	12.5	12.1	16.2	10.6	12.8	61.2	51.1	55.0
06/08/80	11.6	11.2	11.1	11.0	10.8	10.8	10.7	11.0	11.2	11.3	12.1	12.4	12.8	13.7	14.7	15.0	15.0	14.8	14.5	14.2	13.7	13.5	13.1	12.8	15.0	10.7	12.8	59.0	51.3	54.7
06/09/80	12.2	12.0	11.8	11.8	11.4	11.3	11.3	11.5	11.9	12.7	13.8	14.9	16.0	17.1	17.9	18.2	18.2	17.9	17.2	16.6	16.0	15.4	14.8	14.4	18.2	11.3	14.4	64.8	52.3	57.9
06/10/80	13.9	13.6	13.3	12.8	12.7	12.5	12.2	12.0	11.7	11.8	11.8	13.1	14.2	14.9	15.0	14.8	15.0	14.7	13.9	13.2	12.8	12.2	11.8	11.5	15.0	11.5	13.1	59.0	52.7	55.8
06/11/80	11.3	11.0	10.8	10.6	10.6	10.5	10.5	10.6	10.8	11.1	11.8	12.5	12.8	12.8	13.0	13.6	14.4	14.3	13.7	13.2	12.7	12.4	12.0	11.8	14.4	10.5	12.0	57.9	50.9	53.6
06/12/80	11.4	11.2	11.1	10.9	10.8	10.8	10.7	10.7	10.8	10.9	11.0	11.3	12.1	12.9	14.4	14.7	13.7	13.8	13.4	12.7	12.3	12.1	11.8	11.5	14.7	10.8	11.9	58.5	51.1	53.5
06/13/80	11.3	11.2	11.0	10.9	10.8	10.8	10.8	10.9	11.1	11.5	12.5	13.3	15.1	16.1	16.5	16.9	16.8	16.1	15.2	14.2	13.6	13.1	12.8	12.3	16.9	10.8	13.1	62.4	51.4	55.8
06/14/80	11.8	11.4	11.0	10.6	10.5	10.3	10.1	10.2	10.8	11.4	12.5	13.9	15.0	16.2	16.9	17.5	17.8	17.2	16.2	15.4	14.7	13.9	13.8	13.1	17.8	10.1	13.4	63.7	50.2	56.1
06/15/80	12.7	12.3	11.9	11.6	11.3	11.1	10.9	11.0	11.4	12.4	13.5	14.1	15.0	15.9	16.5	17.8	18.0	17.5	16.7	15.7	15.0	14.5	14.0	13.6	18.0	10.9	13.9	64.4	51.8	57.1
06/16/80	13.2	12.9	12.7	12.5	12.3	12.2	12.0	12.1	12.5	13.3	14.4	15.7	17.1	17.7	18.2	18.7	18.8	18.6	17.2	16.2	15.4	14.9	14.4	13.9	18.7	12.0	14.8	65.7	53.6	58.7
06/17/80	13.5	13.1	12.8	12.8	12.3	12.2	12.1	12.2	12.3	12.2	12.2	12.5	12.9	14.7	16.6	17.2	17.8	17.5	16.8	15.6	14.8	14.4	13.9	13.6	17.8	12.1	14.0	64.0	53.8	57.2
06/18/80	13.3	12.9	12.6	12.4	12.1	11.9	11.8	11.8	12.4	13.4	14.5	16.0	17.6	18.7	20.0	20.4	20.2	19.2	18.0	16.9	16.1	15.6	15.2	14.9	20.4	11.8	15.3	68.7	53.2	59.6
06/19/80	14.8	14.4	14.1	13.9	13.6	13.4	13.4	13.6	13.8	14.7	15.8	17.0	18.6	20.1	20.7	21.2	20.9	20.0	18.9	17.8	16.8	16.1	15.8	15.3	21.2	13.4	16.4	70.2	56.1	61.8
06/20/80	15.1	14.7	14.4	14.0	13.9	13.8	13.4	13.4	13.9	14.8	16.1	17.4	18.9	20.5	21.8	22.0	21.5	20.7	19.4	18.0	17.2	16.5	15.9	15.5	22.0	13.4	16.9	71.6	56.1	62.2
06/21/80	15.0	14.7	14.4	14.1	13.7	13.6	13.4	13.4	14.0	15.1	16.4	18.0	19.5	21.1	22.3	22.7	22.3	21.5	20.2	19.1	18.2	17.4	17.0	16.6	22.7	13.4	17.2	72.9	56.1	63.0
06/22/80	16.3	15.8	15.6	15.4	15.1	15.0	14.8	15.0	15.5	16.2	17.0	17.6	18.4	18.7	18.1	18.6	19.1	18.6	18.7	17.9	17.4	17.0	16.6	16.2	19.1	14.8	16.9	66.4	58.6	62.4
06/23/80	15.8	15.5	15.2	15.0	14.7	14.5	14.4	14.5	15.0	15.8	17.1	18.5	20.2	21.7	22.7	23.2	23.0	22.1	20.7	19.3	18.4	17.8	17.0	16.6	23.2	14.4	17.9	73.8	57.9	64.1
06/24/80	16.2	16.0	15.6	15.3	15.1	14.8	14.7	14.8	15.3	16.2	17.4	18.7	20.3	21.8	23.0	23.3	23.0	21.9	20.9	19.6	18.6	17.8	17.2	16.8	23.3	14.7	18.1	73.9	58.5	64.6
06/25/80	16.1	15.7	15.3	15.0	14.7	14.4	14.3	14.3	14.8	15.9	17.1	18.5	20.2	21.8	23.2	23.6	23.5	22.3	20.7	19.3	18.3	17.6	17.0	16.4	23.6	14.3	17.8	74.5	57.7	64.2
06/26/80	16.0	15.6	15.3	15.0	14.7	14.4	14.2	14.2	14.8	15.8	16.9	18.2	19.8	21.8	22.9	23.5	23.6	21.3	19.9	18.5	17.8	17.1	16.7	16.2	23.6	14.2	17.7	74.5	57.6	63.8
06/27/80	15.7	15.3	14.9	14.8	14.3	14.1	13.9	13.9	14.4	15.6	16.8	18.3	19.9	21.0	21.0	21.1	20.7	20.1	19.0	18.4	17.7	17.1	16.8	16.4	21.1	13.9	17.1	70.0	57.0	62.8
06/28/80	16.1	15.7	15.5	15.2	14.9	14.7	14.5	14.7	15.2	16.2	17.4	19.0	20.4	22.3	23.8	24.2	24.0	22.7	21.0	19.0	18.1	17.3	16.8	16.2	24.2	14.5	18.1	75.6	58.1	64.6
06/29/80	15.8	15.4	15.1	14.9	14.7	14.4	14.3	14.4	15.0	16.2	17.4	19.1	20.8	23.1	24.8	25.0	24.8	23.6	21.8	19.7	18.7	18.0	17.4	16.9	25.0	14.3	18.4	77.0	57.7	65.1
06/30/80	16.5	16.2	15.9	15.8	15.3	15.0	14.9	15.0	15.6	16.6	18.0	19.4	21.1	22.5	21.8	20.8	21.8	22.1	20.8	19.3	18.5	17.9	17.4	16.8	22.5	14.9	18.1	72.5	58.8	64.6
07/01/80	16.4	15.9	15.5	15.1	14.8	14.5	14.4	14.4	15.0	16.2	17.5	19.0	20.5	22.6	23.9	24.6	24.2	23.0	21.3	19.3	18.3	17.5	16.8	16.3	24.6	14.4	18.2	76.3	57.9	64.8
07/02/80	15.8	15.5	15.3	15.0	14.9	14.7	14.7	15.0	15.4	16.0	16.8	16.8	16.8	16.5	16.1	15.7	16.2	16.2	16.3	15.8	15.6	15.3	14.8	14.6	16.8	14.6	15.7	62.4	58.3	60.2
07/03/80	14.2	13.8	13.8	13.3	13.1	12.8	12.7	12.8	13.4	14.7	16.1	17.8	19.1	21.2	22.4	22.2	21.4	19.7	19.8	17.8	17.0	16.2	15.7	15.3	22.4	12.7	16.5	72.3	54.8	61.7
07/04/80	15.0	14.5	14.2	14.0	13.7	13.6	13.7	14.2	15.0	16.1	16.7	17.6	19.0	19.7	21.7	22.7	21.3	20.2	19.4	18.6	17.6	17.1	16.4	15.9	22.7	13.6	17.6	72.9	56.5	62.6
07/05/80	15.6	15.1	14.8	14.7	14.5	14.4	14.5	15.0	15.6	16.2	17.4	18.2	18.8	19.1	20.2	21.4	22.0	21.7	20.3	18.5	17.2	16.6	16.2	16.0	22.0	14.4	17.3	71.6	57.9	63.1
07/06/80	15.8	15.6	15.4	15.3	15.3	15.3	15.3	15.5	15.6	15.8	16.8	16.9	17.4	19.7	20.8	20.8	20.9	20.5	19.6	17.4	16.6	15.8	15.3	14.8	20.9	14.8	17.0	69.6	58.6	62.6
07/07/80	14.5	14.3	14.2	13.9	13.6	13.4	13.3	13.3	13.9	15.3	16.8	18.3	19.9	22.3	23.7	24.4	24.1	22.9	21.0	19.6	17.5	16.8	16.1	15.6	24.4	13.3	17.4	75.9	55.9	63.3
07/08/80	15.1	14.9	14.5	14.3	14.0	13.9	13.8	13.8	14.4	15.9	17.4	19.1	20.7	23.2	24.5	25.4	25.3	24.2	22.3	19.4	18.3	17.4	16.8	16.2	25.4	13.8	18.1	77.7	56.8	64.6
07/09/80	15.7	15.4	15.0	14.8	14.5	14.4	14.4	14.4	15.0	16.8	18.1	19.8	21.4	24.0	25.3	26.2	25.8	25.0	23.4	20.4	18.8	17.8	17.1	16.6	26.2	14.4	18.7	78.2	57.9	65.7
07/10/80	16.1	15.8	15.6	15.5	15.0	14.8	14.9	14.9	15.4	16.7	18.5	20.4	22.3	24.9	26.5	27.1	27.2	25.9	23.9	20.9	19.3	18.2	17.4	16.9	27.2	14.8	18.3	81.0	58.6	[illegible]
07/11/80	16.5	16.2	16.0	15.6	15.5	15.3	15.3	15.5	15.9	17.8	19.5	21.1	23.4	26.0	27.3	27.6	24.9	22.9	22.0	20.8	19.8	19.1	18.2	17.8	27.5	15.3	18.8	81.7	59.5	67.2
07/12/80	17.5	17.4	17.3	17.2	17.0	16.8	16.4	16.5	17.1	18.6	19.9	21.5	23.6	26.6	25.8	28.6	24.9	24.4	23.5	21.8	20.8	19.9	19.0	18.2	28.8	16.4	20.4	80.2	61.5	68.7
07/13/80	17.7	17.3	17.0	16.6	16.5	16.2	16.3	16.4	16.6	18.0	19.8	21.4	23.4	26.0	27.4	27.0	27.1	26.2	24.8	21.7	19.9	18.5	17.5	16.6	27.4	16.2	20.2	81.3	61.2	68.4
07/14/80	16.0	15.5	15.2	15.0	14.8	14.7	14.5	14.7	15.3	16.8	18.6	20.7	22.9	25.8	26.8	26.6	26.9	25.8	24.1	21.4	20.1	19.1	18.1	17.2	26.9	14.5	18.5	80.4	58.1	67.0
07/15/80	16.7	16.1	15.6	15.3	15.0	15.0	15.0	15.2	15.8	17.0	19.0	21.8	23.5	25.7	26.7	26.9	27.1	26.2	24.8	21.7	20.2	19.1	18.3	17.6	27.1	15.0	18.8	80.8	59.0	67.8
07/16/80	16.9	16.4	15.9	15.6	15.3	15.2	15.2	15.3	15.6	17.1	18.9	20.8	22.9	24.5	26.3	26.5	26.5	25.7	24.1	21.4	19.6	18.9	17.8	17.2	26.5	15.2	18.8	79.7	59.4	67.2
07/17/80	16.5	15.8	15.3	14.9	14.6	14.4	14.4	14.4	14.9	16.3	18.3	20.3	22.5	24.5	25.6	26.5	26.2	25.3	24.0	21.3	19.8	18.6	17.9	17.2	26.5	14.4	19.2	79.7	57.9	66.5
07/18/80	16.6	16.2	15.4	14.9	14.8	14.4	14.1	14.4	14.9	16.5	18.4	20.4	22.2	24.2	26.0	25.4	24.8	24.4	23.2	21.1	19.8	18.7	17.8	17.1	26.0	14.1	19.0	78.8	57.4	66.1
07/19/80	16.5	16.0	15.4	14.8	14.5	14.0	14.1	14.2	14.9	16.1	18.8	20.2	21.4	24.0	24.2	23.8	23.1	22.9	21.1	20.3	19.5	18.6	17.9	17.3	24.2	14.0	18.4	75.6	57.2	65.2
07/20/80	16.8	16.4	15.9	15.4	15.2	14.8	14.7	14.4	14.7	16.0	17.7	19.4	21.8	23.7	25.7	26.2	26.3	25.8	24.5	22.0	20.5	19.3	18.2	17.5	26.3	14.4	19.3	79.3	57.9	66.7
07/21/80	16.9	16.5	16.1	15.8	15.3	14.9	14.8	14.8	15.1	16.1	18.2	20.3	21.8	23.9	26.3	27.3	27.2	26.8	25.0	22.3	20.7	19.4	18.3	17.5	27.3	14.8	19.8	81.1	58.6	67.4
07/22/80	17.0	16.6	16.2	15.9	15.6	15.3	15.3	15.4	15.7	16.5	18.2	20.0	21.8	24.2	26.8	27.3	27.2	26.9	25.4	23.2	21.4	20.3	19.3	18.5	27.3	15.3	20.0	81.1	59.5	68.0
07/23/80	18.1	17.8	17.6	17.4	17.5	17.1	16.8	16.6	16.5	17.0	17.7	19.3	20.3	21.9	23.9	25.4	25.7	24.8	23.1	21.2	19.8	19.0	18.0	17.4	25.7	16.5	19.8	78.3	61.7	67.2
07/24/80	17.2	16.6	16.7	16.4	16.0	15.8	15.8	15.8	15.9	16.6	17.4	18.2	19.0	21.2	22.9	24.1	24.0	23.4	21.5	20.3	19.4	18.6	18.2	17.6	24.1	15.8	18.7	75.4	60.1	65.8
07/25/80	17.3	17.1	16.8	16.5	16.2	16.2	16.1	16.1	16.2	17.0	17.6	18.0	18.3	19.1	20.2	20.8	22.0	21.2	20.2	19.0	18.0	17.5	17.1	16.8	22.0	16.1	18.0	71.6	61.0	64.3
07/26/80	16.5	16.3	16.2	16.1	16.0	16.0	16.0	16.0	16.4	17.0	17.6	18.6	19.8	22.1	24.2	25.0	25.0	24.8	23.0	21.0	19.7	18.6	18.0	17.4	25.0	16.0	19.1	77.0	60.8	66.3
07/27/80	16.9	16.6	16.1	15.8	15.4	15.0	14.8	14.9	15.0	15.7	17.1	18.8	20.3	22.8	25.3	25.9	25.9	25.5	23.9	21.4	19.9	18.6	17.8	17.1	25.9	14.8	19.0	78.6	58.6	66.2
07/28/80	16.6	16.0	15.5	15.1	14.7	14.4	14.4	14.4	14.8	15.6	16.8	18.6	20.8	23.2	25.7	26.6	26.5	26.1	24.2	22.0	20.6	19.5	18.5	17.9	26.6	14.4	19.1	79.9	57.9	66.4
07/29/80	17.4	16.9	16.6	16.2	15.9	15.6	15.3	15.3	15.6	16.2	17.4	19.3	21.4	24.2	26.2	27.3	27.1	26.6	24.8	22.4	21.1	20.0	19.2	18.4	27.3	15.3	19.8	81.1	59.5	67.7
07/30/80	17.9	17.4	17.1	16.7	16.4	16.1	15.9	15.9	16.1	16.7	17.8	18.7	20.7	23.1	25.4	24.7	23.0	21.8	20.8	20.0	19.4	19.0	18.5	18.2	25.4	15.9	19.1	77.7	60.4	66.4
07/31/80	18.0	17.6	17.4	17.1	16.8	16.5	16.2	16.1	16.2	16.8	18.0	18.7	21.3	23.3	25.8	26.9	26.8	26.0	24.0	22.1	20.6	19.6	18.6	17.8	26.9	16.1	20.0	80.4	61.0	67.9
08/01/80	17.4	16.9	16.4	16.0	15.7	15.3	15.0	15.0	15.3	16.0	17.0	18.5	20.5	23.2	25.8	26.5	26.5	25.7	23.8	21.5	20.1	19.1	18.3	17.6	26.5	15.0	19.3	79.7	59.0	66.7
08/02/80	17.1	16.4	15.9	15.3	14.8	14.4	14.0	14.1	14.5	15.2	16.0	17.5	19.7	22.2	24.9	26.3	26.3	25.6	23.9	21.5	19.8	18.5	17.5	16.8	26.3	14.0	18.7	79.3	57.2	65.8
08/03/80	16.2	15.7	15.3	14.8	14.4	14.2	14.0	14.3	14.7	15.4	16.5	18.3	20.4	22.9	25.7	26.6	26.9	26.5	24.3	21.9	20.5	19.3	18.3	17.4	26.9	14.0	18.8	80.4	57.2	66.1
08/04/80	16.9	16.4	16.0	15.6	15.0	14.7	14.4	14.5	16.0	15.7	16.8	18.7	21.2	23.8	26.5	27.5	27.8	26.4	24.6	22.4	20.8	19.5	18.5	17.8	27.6	14.4	19.4	81.7	57.9	67.0
08/05/80	17.2	16.6	16.2	15.9	15.5	15.0	14.8	14.9	15.4	16.1	17.3	19.3	21.7	24.2	27.0	27.8	28.1	27.4	25.5	23.4	21.7	20.4	19.5	18.4	28.1	14.8	20.0	82.6	58.6	67.9
08/06/80	17.7	17.2	16.6	16.4	16.0	15.6	15.3	15.2	15.4	16.2	17.2	18.7	20.8	23.4	26.2	27.5	27.5	26.9	25.0	22.6	21.1	19.8	18.7	18.0	27.5	15.2	19.9	81.5	59.4	67.7
08/07/80	17.3	16.8	16.3	15.9	15.4	15.6	14.8	14.5	14.8	15.8	16.8	18.5	20.7	23.7	26.7	27.7	27.8	27.2	24.6	22.6	21.4	20.1	19.6	19.1	27.8	14.5	19.6	82.0	58.1	67.3
08/08/80	17.5	17.0	16.6	16.2	15.6	15.3	15.1	15.0	15.4	16.4	17.4	19.0	21.1	24.1	26.5	26.0	24.3	23.2	22.3	21.2	20.4	19.6	18.9	18.2	26.5	15.0	19.3	79.7	59.0	66.7
08/09/80	17.6	17.4	17.0	16.6	16.7	16.4	16.1	16.2	16.6	17.7	18.7	19.6	20.4	22.1	24.6	26.2	26.5	26.0	24.0	22.3	21.0	20.0	19.4	19.0	26.5	16.1	19.9	79.7	61.0	67.8
08/10/80	16.3	16.2	16.0	17.8	17.7	17.5	17.4	17.4	17.8	18.0	18.5	19.6	20.2	22.5	24.3	24.6	24.8	24.0	23.2	21.5	20.5	19.7	19.1	18.4	24.8	17.4	20.0	76.6	63.3	67.8
08/11/80	17.9	17.5	17.1	16.8	16.3	16.1	15.7	15.6	15.9	16.7	17.8	19.6	21.5	24.3	26.5	27.4	27.3	26.7	24.7	22.7	21.3	20.2	19.4	18.6	27.4	15.6	20.2	81.3	60.1	68.3
08/12/80	18.2	17.7	17.4	17.1	16.8	16.4	16.1	15.9	16.1	16.8	18.0	19.7	21.7	24.4	26.5	27.6	27.4	26.5	24.7	22.7	21.4	20.3	19.4	18.6	27.6	15.9	20.3	81.7	60.6	68.6
08/13/80	18.0	17.8	17.1	16.7	16.4	16.1	15.8	15.7	16.1	16.6	18.0	19.4	21.1	23.3	25.8	26.5	26.5	25.8	24.3	22.8	21.2	20.2	19.3	18.4	26.5	15.7	19.9	79.7	60.3	67.9
08/14/80	17.7	17.2	16.7	16.1	15.6	15.2	14.8	14.8	15.1	15.9	16.8	18.2	20.0	22.7	25.6	26.2	26.5	25.8	23.7	22.0	20.6	19.6	19.0	18.4	26.5	14.8	19.3	79.7	58.6	66.8
08/15/80	18.1	18.0	17.7	17.4	17.2	16.8	16.4	16.2	16.4	17.2	17.9	18.5	19.8	21.2	22.0	22.0	22.0	22.3	22.8	21.7	20.2	19.2	18.3	17.5	22.8	16.2	18.8	73.0	61.2	65.8
08/16/80	16.4	15.8	15.6	15.1	14.9	14.7	14.5	14.7	15.3	16.2	17.2	18.2	19.6	21.7	22.8	23.8	23.8	23.4	23.2	22.0	20.6	19.6	18.6	18.0	23.8	14.5	18.3	74.8	58.1	65.0
08/17/80	16.7	16.2	15.7	15.3	14.9	14.7	14.4	14.7	15.0	15.8	17.1	18.0	19.3	19.6	19.6	19.5	18.5	19.3	19.1	18.9	18.4	18.0	17.8	17.5	19.6	14.4	17.3	67.3	57.9	63.1
08/18/80	16.6	16.6	16.4	16.1	15.9	15.5	15.3	15.1	15.3	16.5	17.4	18.1	18.6	19.0	19.7	19.8	19.8	19.6	19.2	18.7	18.1	17.5	16.9	16.4	19.8	15.1	17.4	67.6	59.2	63.4
08/19/80	15.8	15.5	15.3	15.3	15.3	15.8	15.4	15.3	15.7	16.5	17.1	18.3	19.0	19.0	18.9	18.5	17.9	18.0	18.0	17.6	17.4	17.1	16.8	16.2	19.0	15.3	16.8	66.2	59.5	62.4
08/20/80	15.8	15.3	15.0	14.9	15.0	15.8	14.8	14.7	14.9	15.8	17.1	18.0	19.0	18.7	19.9	20.3	20.1	20.1	19.7	19.0	18.1	17.4	17.0	16.7	20.3	14.7	17.2	68.5	58.5	63.0
08/21/80	16.5	16.2	16.0	15.6	15.8	15.6	15.6	15.7	16.1	16.4	16.5	16.9	17.0	17.1	17.1	17.1	17.1	17.4	17.3	17.0	16.8	16.6	16.6	16.6	17.4	15.5	16.5	63.3	59.9	61.7
08/22/80	16.4	16.4	16.4	16.4	16.4	16.3	16.3	16.3	16.4	16.7	17.1	17.7	18.5	20.8	22.4	22.5	22.9	22.0	20.5	19.6	18.6	18.0	17.5	17.3	22.9	16.3	18.3	73.2	61.3	65.0
08/23/80	17.1	17.0	16.8	16.7	16.4	16.1	15.9	15.7	15.7	15.8	16.1	17.1	18.8	20.4	22.7	23.6	23.8	22.7	20.2	18.6	17.6	16.8	16.0	15.5	23.8	15.5	18.0	74.5	59.9	64.4
08/24/80	14.9	14.4	13.9	13.7	13.6	13.3	13.1	13.1	13.3	13.8	15.3	17.0	18.6	20.5	22.3	23.1	23.1	22.0	20.2	19.1	18.0	17.0	16.3	16.0	23.1	13.1	16.9	73.6	56.9	62.4
08/25/80	16.7	16.6	16.4	15.2	14.8	14.8	14.5	14.5	14.8	15.3	15.8	17.0	18.3	20.1	21.9	23.2	23.3	22.3	19.9	18.4	17.4	16.8	16.2	15.8	23.3	14.5	17.4	73.9	58.1	63.3
08/26/80	16.5	16.5	16.3	15.1	14.9	14.5	14.1	14.2	14.8	15.3	16.4	17.4	18.2	19.9	21.9	22.7	22.8	21.5	18.8	18.6	17.8	16.9	16.4	15.9	22.7	14.1	17.3	72.9	57.4	63.1
08/27/80	16.5	16.1	14.7	14.5	14.6	14.6	14.5	14.7	15.2	15.8	16.6	17.6	19.2	20.9	23.3	24.4	24.7	23.5	21.2	19.6	18.5	17.6	17.0	16.4	24.7	14.5	17.9	76.5	58.1	64.2
08/28/80	16.0	15.4	14.9	14.5	14.3	14.0	14.1	14.1	14.1	14.6	16.0	17.5	18.9	21.7	24.0	25.1	25.2	23.8	21.6	20.2	19.2	18.2	17.6	17.1	25.2	14.0	18.0	77.4	57.2	64.4
08/29/80	16.6	16.2	15.7	15.3	15.0	14.7	14.8	14.7	15.3	16.2	17.2	18.4	19.3	20.3	21.6	21.2	20.8	20.5	19.9	19.0	18.1	17.5	16.9	16.5	21.6	14.8	17.9	70.9	58.3	63.6
08/30/80	16.1	15.8	15.4	15.3	15.3	15.5	15.3	15.3	15.5	15.8	16.2	17.0	18.4	20.0	21.7	22.0	21.8	21.2	19.7	18.6	17.6	16.8	16.0	15.8	22.0	15.3	17.4	71.6	59.5	63.3
08/31/80	15.0	14.4	13.6	13.6	13.4	13.2	13.1	12.8	13.1	13.8	14.5	16.0	17.4	20.0	22.2	24.1	23.7	22.7	20.5	19.1	18.0	17.1	16.4	15.8	24.1	12.8	16.8	75.4	56.0	62.3
09/01/80	16.3	14.7	14.3	13.9	13.6	13.4	13.3	13.1	13.3	13.7	14.5	15.6	18.0	20.2	22.5	23.8	23.9	22.8	20.7	19.3	18.0	17.3	16.7	16.0	23.9	13.1	17.0	75.0	55.6	62.6
09/02/80	16.0	16.0	14.5	13.9	13.8	13.8	13.5	13.4	13.6	14.1	14.8	15.9	17.4	19.9	22.8	23.6	23.5	22.5	20.3	19.0	17.8	17.1	16.3	15.7	23.6	13.4	17.0	74.5	56.1	62.6
09/03/80	15.0	14.8	14.3	13.8	13.7	13.5	13.4	13.4	13.4	13.8	14.9	16.3	17.7	20.2	22.1	22.9	23.1	22.2	20.4	19.3	18.4	17.6	17.0	16.5	23.1	13.4	17.0	73.6	56.1	62.6
09/04/80	16.9	16.5	15.8	14.7	14.3	14.0	13.7	13.7	13.9	14.4	15.3	16.6	17.9	20.2	22.9	23.5	23.5	22.4	21.1	20.0	19.2	18.3	17.9	17.1	23.5	13.7	17.5	74.3	56.7	63.5
09/05/80	16.6	16.2	15.7	15.4	15.0	14.7	14.4	14.4	14.5	15.0	15.9	17.1	18.8	21.5	23.3	24.4	24.3	23.3	21.4	20.2	19.2	18.2	17.4	17.0	24.4	14.4	18.1	75.9	57.9	64.5
09/06/80	16.4	15.9	15.6	15.1	14.7	14.4	14.1	14.8	14.2	14.7	15.8	17.2	18.8	20.8	22.9	23.8	23.8	22.9	21.3	20.0	18.9	18.1	17.8	17.4	23.8	14.0	17.8	74.8	57.2	64.1
09/07/80	17.1	16.9	16.7	16.3	16.6	15.8	15.3	15.0	14.9	15.3	16.2	17.6	19.8	21.5	21.2	20.5	19.8	18.5	18.1	18.6	18.0	17.4	17.0	16.8	21.5	14.9	17.6	70.7	58.8	63.6
09/08/80	16.2	16.6	15.5	15.3	15.2	15.0	15.0	15.0	15.0	15.4	16.2	17.5	19.0	20.8	22.6	23.5	23.6	22.6	20.9	18.7	18.7	18.0	17.3	16.8	23.6	15.0	17.9	74.5	59.0	64.3
09/09/80	16.3	15.9	15.4	15.1	14.7	14.6	14.3	14.2	14.4	14.8	15.8	16.9	18.5	20.8	22.9	24.0	23.9	22.7	21.0	19.8	18.6	17.7	16.9	16.2	24.0	14.2	17.7	75.2	57.6	63.9
09/10/80	16.3	15.3	14.9	14.4	13.8	13.7	13.6	13.6	13.7	14.1	15.0	16.5	18.3	21.0	23.0	24.4	24.4	23.2	21.4	20.1	19.0	18.0	17.2	16.8	24.4	13.6	17.6	75.9	56.5	63.6
09/11/80	16.2	15.9	15.4	15.0	14.5	14.2	14.0	13.7	13.9	14.4	15.2	16.6	18.4	20.6	22.6	23.8	23.8	22.8	20.9	19.6	18.4	17.5	16.8	16.3	23.8	13.7	17.5	74.8	56.7	63.5
09/12/80	15.9	15.5	15.0	14.8	14.2	13.8	13.8	13.3	13.5	13.7	14.4	15.5	17.0	19.2	21.3	22.2	22.5	21.3	19.5	18.2	17.2	16.4	15.7	15.2	22.5	13.3	16.6	72.5	55.9	61.9
09/13/80	14.5	13.9	13.4	13.1	12.8	12.7	12.5	12.4	12.5	12.8	13.6	15.3	16.8	18.8	21.3	22.2	22.1	21.1	19.4	18.2	17.3	16.5	15.9	15.3	22.2	12.4	16.0	72.0	54.3	60.8
09/14/80	14.7	14.3	13.7	13.4	13.3	13.0	12.7	12.6	12.9	13.1	13.9	16.3	16.9	18.6	20.5	21.9	22.0	21.1	19.5	18.2	17.3	16.4	15.9	15.3	22.0	12.6	16.1	71.6	54.7	61.0
09/15/80	16.0	14.4	13.9	13.7	13.6	13.4	13.1	13.2	13.4	13.8	14.6	15.6	17.1	18.2	19.7	19.6	19.7	19.4	18.0	17.4	16.6	16.2	15.9	15.3	19.7	13.1	15.9	67.5	55.6	60.6
09/16/80	14.0	14.4	14.1	13.8	13.6	13.6	13.6	13.6	13.9	14.4	15.1	15.8	16.2	16.8	17.8	18.3	18.0	18.6	17.9	17.1	16.3	15.7	15.1	14.8	18.0	13.6	15.6	66.2	56.5	60.1
09/17/80	14.3	13.7	13.6	13.7	13.8	13.8	13.1	12.8	12.8	13.0	13.7	15.1	16.3	17.6	20.0	21.0	21.2	19.6	18.3	17.3	16.4	15.7	15.1	14.5	21.2	12.8	15.7	70.2	54.7	60.2
09/18/80	14.0	13.4	13.2	12.7	12.5	12.2	12.1	12.1	12.2	12.6	13.4	15.2	16.4	17.4	20.3	21.3	21.5	19.9	18.3	17.1	16.2	15.5	14.9	14.4	21.5	12.1	15.4	70.7	53.8	59.7
09/19/80	13.6	13.3	12.8	12.8	12.3	12.1	12.1	11.9	12.0	12.4	13.6	15.4	16.5	17.4	19.6	20.5	20.4	19.4	18.0	17.1	16.2	15.5	14.9	14.4	20.5	11.9	15.2	68.9	53.4	59.3
09/20/80	13.9	13.4	13.0	12.7	12.4	12.1	11.9	11.8	11.8	11.9	12.6	13.8	15.3	16.3	18.6	19.9	20.2	18.9	17.4	16.1	15.2	14.4	13.8	13.2	20.2	11.8	14.6	68.4	52.9	58.3
09/21/80	12.5	12.1	11.7	11.8	11.4	11.3	11.1	10.9	11.1	11.4	12.0	13.4	14.8	16.6	18.5	19.8	20.2	19.1	17.7	16.6	15.8	15.0	14.5	14.0	20.2	10.9	14.3	68.4	51.6	57.7
09/22/80	13.5	13.0	12.6	12.3	12.1	12.0	11.9	11.8	11.7	12.1	12.8	13.8	15.3	16.4	19.0	20.2	20.5	19.4	18.2	17.2	16.3	15.6	15.0	14.4	20.5	11.7	14.9	68.9	53.1	58.8
09/23/80	13.9	13.4	13.1	12.8	12.3	12.1	11.9	11.9	11.8	12.0	12.5	13.9	15.4	16.5	18.1	20.5	20.9	19.8	18.3	17.1	16.2	15.7	15.0	14.7	20.9	11.8	15.0	69.6	53.2	59.0
09/24/80	14.1	13.7	13.4	13.1	12.8	12.8	12.5	12.3	12.3	12.5	13.1	14.4	15.8	16.8	18.3	20.7	20.9	19.8	18.5	17.5	16.8	16.0	15.5	15.1	20.9	12.3	15.4	69.6	54.1	59.7

UMATILLA RIVER BELOW CLARK'S PLACE W/ NEW IRCO PLACEMENTT

7/16/80 BY: KEN HALL NEW LOCATION CAS 7.0 16.0 80.0

DATE	MILITARY TIME 0100	0200	0300	0400	0500	0600	0700	0800	0900	1000.0	1100.0	1200.0	1300.0	1400.0	1500.0	1600.0	1700.0	1800.0	1900.0	2000.0	2100.0	2200.0	2300.0	2400.0	MAX	MIN	MEAN	MAX	MIN	MEAN
07/16/80															22.4	22.0	23.0	22.9	22.3	21.4	20.8	20.2	19.6	19.0	???	???	???			
07/17/80	18.8	18.0	17.4	16.9	16.3	15.9	15.8	15.8	16.2	17.1	18.1	19.0	20.1	21.3	22.2	22.8	23.0	22.7	22.3	21.4	20.8	20.2	19.6	19.0	23.0	15.8	19.2	73.4	60.1	66.5
07/18/80	18.8	18.0	17.5	16.9	16.5	15.9	15.7	15.9	16.5	17.1	18.3	18.9	19.9	21.1	22.0	22.4	22.2	22.3	21.7	21.1	20.5	19.8	19.2	18.8	22.4	15.7	19.0	72.3	60.3	66.3
07/19/80	18.2	17.7	17.1	16.5	16.0	15.6	15.3	15.4	15.9	16.8	18.0	18.7	19.7	21.0	21.1	21.3	21.2	21.0	20.7	20.4	19.8	19.4	18.8	18.8	21.3	15.3	18.5	70.3	59.8	65.3
07/20/80	18.1	17.7	17.1	16.8	16.3	15.8	15.8	15.7	16.2	17.1	18.0	19.0	20.1	21.1	22.0	22.5	22.8	22.8	22.0	21.2	20.7	20.1	19.8	19.0	22.8	15.8	19.0	73.0	60.1	66.5
07/21/80	18.7	18.3	17.7	17.2	16.7	16.2	16.0	16.2	16.7	17.5	18.7	19.5	20.5	21.5	22.4	23.1	23.4	23.2	22.8	21.7	21.1	20.5	19.9	19.3	23.4	16.0	19.5	74.1	60.8	67.1
07/22/80	18.8	18.4	17.9	17.4	17.1	16.5	16.5	16.5	17.1	17.8	18.8	19.9	20.9	22.0	22.9	23.4	23.5	23.5	22.8	22.2	21.5	21.0	20.5	20.1	23.5	16.5	19.9	74.3	61.7	67.8
07/23/80	19.8	19.5	18.9	18.7	18.3	17.9	17.5	17.5	18.0	18.5	19.8	19.8	20.9	20.4	21.1	21.8	22.0	21.3	20.8	20.1	19.7	19.5	19.1	19.7	22.0	17.5	19.4	71.8	63.5	67.0
07/24/80	19.5	19.0	17.7	17.4	16.9	16.5	16.4	16.5	16.8	16.8	17.3	17.7	18.7	19.3	20.4	20.8	20.8	20.3	19.7	19.5	19.0	18.8	18.3	18.0	20.8	16.4	18.2	66.4	61.5	64.0
07/25/80	17.7	17.4	17.1	16.8	16.6	16.4	16.2	16.1	16.2	16.4	16.5	16.8	16.9	17.3	17.8	18.0	18.0	18.3	17.8	17.4	17.1	16.8	16.8	16.8	18.0	16.1	17.1	65.0	61.0	62.8
07/26/80	16.5	16.3	16.2	16.0	15.9	15.7	15.8	15.8	15.9	16.3	16.8	16.8	19.7	20.7	21.4	21.8	22.0	21.7	21.1	20.5	19.8	19.3	18.8	18.5	21.1	15.8	18.0	70.0	60.1	64.4
07/27/80	17.8	17.4	17.1	16.5	16.2	15.9	15.8	15.8	16.3	17.1	18.0	18.8	19.7	20.7	21.4	21.8	22.0	21.7	21.1	20.5	19.8	19.3	18.8	18.5	22.0	15.8	18.7	71.6	60.1	65.8
07/28/80	18.0	17.8	17.1	16.5	16.2	15.7	15.5	15.8	16.2	17.1	18.0	18.9	19.9	20.8	21.7	22.1	22.4	22.2	21.7	21.0	20.4	19.8	19.5	19.1	22.4	15.5	18.9	72.3	59.9	66.0
07/29/80	18.8	18.4	18.3	17.9	17.1	16.3	16.5	16.8	17.1	18.0	18.8	19.8	20.8	21.7	22.4	22.8	23.0	22.8	22.2	21.4	21.0	20.5	20.2	19.9	23.0	16.5	19.7	73.4	61.7	67.4
07/30/80	19.4	19.0	18.7	18.3	17.8	17.4	17.3	17.4	17.9	18.8	19.5	19.3	20.2	21.4	22.0	21.4	20.8	20.5	20.2	19.9	19.5	19.5	19.5	19.0	22.0	17.3	19.4	71.8	63.1	66.8
07/31/80	18.8	18.8	18.5	18.0	17.8	17.2	17.1	17.1	17.5	18.4	19.2	20.1	21.0	21.8	22.5	22.9	22.8	22.8	22.6	21.8	20.7	20.2	19.8	19.3	22.9	17.1	19.8	73.2	62.8	67.8
08/01/80	19.0	18.7	18.4	17.8	17.4	17.0	16.7	16.8	17.2	18.0	18.9	19.8	20.5	21.4	22.0	22.3	22.3	21.8	21.1	20.2	19.9	19.5	19.2	18.8	22.3	16.7	19.4	72.1	62.1	66.8
08/02/80	18.5	18.1	17.7	17.1	16.7	16.2	15.9	16.0	16.5	17.2	18.1	18.9	19.8	20.5	21.1	21.6	21.7	21.4	21.0	20.1	19.5	19.0	18.7	18.2	21.7	15.9	18.7	71.1	60.6	65.7
08/03/80	18.0	17.5	17.1	16.7	16.5	15.9	15.7	15.9	16.3	17.1	18.1	19.0	19.9	20.8	21.7	22.0	22.1	22.0	21.4	20.7	20.1	19.8	19.3	18.9	22.1	15.7	18.8	71.8	60.3	65.9
08/04/80	18.8	18.3	17.8	17.3	16.8	16.5	16.2	16.5	16.8	17.7	18.8	19.8	20.5	21.4	22.2	22.6	22.8	22.5	21.9	21.1	20.5	20.0	19.5	19.2	22.8	16.2	19.4	73.0	61.2	66.9
08/05/80	18.8	18.8	18.1	17.7	17.5	16.8	16.8	16.8	17.4	18.3	19.1	20.2	21.1	22.0	22.8	23.2	23.2	23.1	22.5	21.7	21.1	20.7	20.2	19.8	23.2	16.8	19.9	73.8	61.9	67.8
08/06/80	19.3	19.0	18.7	18.3	17.8	17.4	17.2	17.5	17.8	18.8	19.3	20.2	21.1	22.0	22.8	23.0	23.1	22.8	22.1	21.4	20.8	20.2	19.9	19.4	23.1	17.2	20.0	73.8	63.0	67.9
08/07/80	19.1	18.8	18.4	18.0	17.5	17.0	16.8	16.8	17.4	18.2	19.0	20.1	20.9	21.7	22.5	22.8	22.8	22.5	21.9	21.4	20.8	20.5	20.0	19.8	22.8	16.8	19.8	73.2	62.2	67.8
08/08/80	19.1	18.8	18.5	18.0	17.7	17.1	16.9	16.8	17.4	18.0	18.8	19.8	20.8	21.7	22.4	22.8	21.8	21.2	20.9	20.8	20.3	19.8	19.8	19.2	22.4	16.9	19.5	72.3	62.4	67.1
08/09/80	19.0	18.8	18.5	18.3	18.0	17.7	17.4	17.5	17.8	18.1	18.3	18.7	19.0	20.3	21.3	21.8	21.8	21.1	21.1	20.5	20.1	19.8	19.5	19.3	21.8	17.4	19.3	71.2	63.3	66.8
08/10/80	19.0	18.8	18.8	18.8	18.4	18.1	17.9	17.8	18.1	18.3	18.5	18.9	19.1	20.0	20.8	20.8	20.8	20.8	20.4	19.7	19.3	19.2	18.9	18.8	20.8	17.9	19.2	69.0	64.2	66.5
08/11/80	18.8	18.3	18.0	17.7	17.4	17.1	16.8	17.0	17.5	18.3	19.2	20.2	20.8	21.8	22.5	22.8	23.0	22.7	22.2	21.4	20.8	20.3	20.1	19.7	23.0	16.8	19.8	73.4	62.2	67.8
08/12/80	19.3	19.0	18.8	18.5	18.3	17.9	17.5	17.8	18.0	18.8	19.5	20.5	21.4	22.2	22.5	23.1	23.1	22.8	22.1	21.4	20.8	20.5	20.1	19.8	23.1	17.5	20.2	73.8	63.5	68.5
08/13/80	19.3	19.0	18.7	18.4	18.0	17.7	17.4	17.5	17.8	18.8	19.3	20.2	21.0	21.7	22.2	22.8	22.8	22.3	21.7	21.2	20.7	20.2	19.8	19.5	22.8	17.4	19.8	72.7	63.3	67.8
08/14/80	19.0	18.8	18.5	18.2	17.8	17.4	17.0	17.1	17.4	18.0	18.8	19.5	20.5	21.1	21.7	22.1	22.1	22.0	21.4	20.8	20.2	19.8	19.5	19.2	22.1	17.0	19.5	71.6	62.8	67.1
08/15/80	18.9	18.8	18.7	18.5	18.3	17.8	17.7	17.7	17.8	18.4	18.3	18.8	19.3	19.8	20.0	19.8	20.0	20.1	19.8	19.8	19.7	19.4	18.8	17.7	20.1	17.7	19.8	69.2	64.6	66.8
08/16/80	17.5	17.2	16.9	16.8	16.8	15.7	15.9	16.0	16.8	17.1	18.0	18.9	19.7	19.8	20.1	20.4	20.9	19.8	19.5	19.8	18.8	18.5	18.5	18.0	20.4	15.7	18.0	68.7	60.3	64.3
08/17/80	17.7	17.4	17.1	16.7	16.4	15.8	15.7	15.9	15.8	16.2	16.7	17.1	17.7	17.9	17.8	17.8	17.7	17.7	17.7	17.4	17.2	17.1	16.9	16.8	17.9	15.7	17.0	64.2	60.3	62.6
08/18/80	16.8	16.5	16.3	16.1	15.8	15.5	15.3	15.4	16.1	16.5	17.1	17.2	17.4	17.8	18.2	18.0	18.2	17.7	17.8	17.2	16.8	16.8	16.2	16.2	18.2	15.3	16.8	64.8	59.5	62.2
08/19/80	15.9	15.7	15.8	15.4	15.2	15.1	15.0	15.0	15.5	16.7	16.2	16.5	16.8	16.5	16.8	16.3	16.5	16.5	16.5	16.3	16.2	15.8	15.7	15.5	16.8	15.0	15.9	61.8	59.0	60.6
08/20/80	15.3	15.1	14.9	14.7	14.7	14.5	14.3	14.4	14.8	15.3	15.5	16.1	16.5	16.9	17.3	17.7	17.8	17.4	17.4	17.1	16.8	16.5	16.3	16.2	17.7	14.3	16.0	63.8	57.7	60.7
08/21/80	14.9	14.9	14.8	14.9	15.2	15.0	14.8	14.8	15.0	15.1	15.1	15.2	15.3	15.3	15.3	15.5	15.6	15.6	15.5	15.4	15.3	15.3	15.3	15.3	16.0	14.8	15.3	60.8	58.8	59.8
08/22/80	15.3	15.3	15.2	15.2	15.1	15.0	15.0	15.0	15.3	15.8	16.3	17.3	18.2	18.8	18.8	18.8	18.1	17.8	17.4	17.1	17.0	16.9	16.8	16.8	18.8	15.0	16.8	69.0	59.8	61.8
08/23/80	16.7	16.5	16.4	16.2	15.9	15.8	15.3	15.3	15.8	16.0	16.8	17.7	18.4	19.0	19.5	19.9	19.7	19.3	18.8	17.7	17.4	17.1	16.8	16.2	19.8	15.3	17.2	67.8	59.5	63.0
08/24/80	15.9	15.4	15.0	14.8	14.2	13.9	13.4	13.5	13.8	14.7	15.5	16.5	17.4	18.3	18.7	18.8	18.8	18.8	18.8	17.5	17.1	16.8	16.7	16.5	18.8	13.4	16.2	68.0	56.6	61.2
08/25/80	16.4	16.2	15.8	15.6	15.2	14.7	14.6	14.8	14.8	15.3	16.0	17.0	17.7	18.4	18.8	19.2	19.2	18.8	18.6	17.4	16.8	16.7	16.5	16.3	19.2	14.6	16.7	69.8	58.3	62.8
08/26/80	16.2	15.9	15.8	15.2	14.8	14.4	14.2	14.1	14.4	14.9	15.5	16.0	16.9	17.5	18.5	18.8	18.4	17.9	17.5	16.8	16.5	16.3	16.2	16.0	18.8	14.1	16.3	65.8	57.4	61.3
08/27/80	15.7	15.3	15.0	14.8	14.7	14.4	14.3	14.4	14.7	15.4	16.2	17.1	18.1	18.8	19.5	19.8	19.8	19.5	18.8	18.2	17.7	17.4	17.1	16.8	19.8	14.3	16.8	67.8	57.7	62.5
08/28/80	16.8	16.1	15.8	15.5	15.0	14.7	14.4	14.4	14.8	15.8	16.5	17.7	18.4	19.3	19.8	20.2	20.2	19.7	19.2	18.7	18.3	17.9	17.7	17.4	20.2	14.4	17.2	68.4	57.9	63.1
08/29/80	17.1	16.8	16.5	16.1	15.7	15.5	15.2	15.2	15.5	15.8	16.7	17.1	18.0	18.4	18.8	18.4	18.8	18.4	18.2	17.9	17.4	17.1	16.8	16.8	18.8	15.2	16.8	66.6	59.4	62.5
08/30/80	16.1	15.8	15.6	15.5	15.4	15.3	15.1	15.1	15.5	15.8	16.7	17.3	17.7	18.5	19.0	19.8	19.8	19.8	18.8	18.0	17.5	17.1	16.8	16.5	19.8	15.1	16.8	66.2	59.2	62.2
08/31/80	15.7	15.5	15.4	14.7	14.2	13.8	13.8	14.0	14.8	15.7	16.8	17.7	18.4	19.0	19.2	19.2	19.0	18.2	17.5	17.1	16.7	16.5	16.2	16.2	19.2	13.8	16.3	66.8	56.5	61.4
09/01/80	15.9	15.8	15.3	14.8	14.5	14.1	13.8	13.8	14.1	15.0	15.8	16.8	17.7	18.8	19.0	19.3	19.3	19.0	18.4	17.7	17.2	17.1	16.8	16.5	19.3	13.8	16.5	66.7	57.8	61.7
09/02/80	16.2	15.9	15.8	15.2	14.8	14.5	14.3	14.1	14.4	15.2	16.1	17.0	17.8	18.8	19.0	19.3	19.3	18.9	18.3	17.7	17.1	16.8	16.5	16.2	19.3	14.1	16.8	66.7	57.4	61.9
09/03/80	15.9	15.7	15.3	15.0	14.8	14.2	13.9	13.9	14.4	15.0	15.9	16.8	17.7	18.5	18.8	19.2	19.2	18.8	18.3	17.8	17.4	17.0	16.8	16.5	19.2	13.9	16.5	66.6	57.8	61.7
09/04/80	16.3	16.0	15.8	15.4	15.0	14.7	14.4	14.4	14.7	15.5	16.3	17.2	18.0	18.8	19.2	19.4	19.3	[illegible]	18.7	18.3	17.8	17.5	17.3	17.1	19.4	14.4	16.8	66.8	57.8	62.5
09/05/80	16.8	16.5	16.2	15.9	15.8	15.3	15.0	15.0	15.5	15.9	17.0	18.0	18.8	19.3	19.8	20.3	[illegible]	19.8	19.1	18.8	18.1	18.0	17.8	17.8	20.3	15.0	17.5	69.5	59.0	63.5
09/06/80	17.1	16.7	16.5	16.0	15.8	15.3	15.0	15.0	15.3	15.9	17.0	17.8	18.8	19.1	19.7	19.9	20.4	19.7	19.0	18.4	18.0	17.8	17.7	17.5	20.0	15.0	17.4	68.0	59.0	63.4
09/07/80	17.5	17.4	17.1	16.7	16.5	16.1	15.7	15.6	16.7	17.5	18.8	19.0	19.0	19.4	[illegible]	19.0	18.2	17.8	17.8	17.2	17.1	16.8	16.7	19.0	15.6	17.3	66.2	60.1	63.1
09/08/80	16.5	16.2	15.9	15.7	15.5	15.3	15.0	15.0	15.3	15.9	16.8	17.7	18.5	19.1	19.8	19.9	19.8	19.5	18.8	18.3	18.0	17.7	17.4	17.1	19.9	15.0	17.3	67.8	59.0	63.1
09/09/80	16.8	16.8	16.3	15.9	15.8	15.3	15.0	15.0	15.2	15.9	16.8	17.7	18.5	19.2	19.7	19.9	19.8	19.4	18.8	18.2	17.7	17.4	17.0	16.8	19.9	15.0	17.3	67.8	59.0	63.1
09/10/80	16.5	16.1	15.8	15.3	15.0	14.8	14.5	14.2	14.8	15.3	16.2	17.4	18.3	19.0	19.8	[illegible]	20.0	19.8	18.8	18.3	17.7	17.4	17.1	17.0	20.0	14.2	17.0	69.0	[illegible]	62.8
09/11/80	16.8	16.5	16.1	15.8	15.5	15.0	14.7	14.6	14.8	15.3	16.5	17.4	18.3	19.0	19.3	19.7	19.8	19.1	18.6	17.9	17.4	17.1	16.9	16.9	19.7	14.6	17.0	67.5	58.5	62.7
09/12/80	[illegible]	16.1	15.9	15.5	15.1	14.7	14.4	14.2	14.5	15.0	15.9	16.7	17.4	18.0	18.5	18.7	18.8	18.0	17.4	16.7	16.2	15.8	15.6	15.3	18.7	14.2	16.3	65.7	[illegible]	61.5
09/13/80	[illegible]	14.7	14.3	14.0	13.8	13.5	13.0	12.8	13.2	13.8	14.7	15.8	16.7	17.4	18.0	18.1	18.1	17.7	17.1	16.5	15.8	15.5	15.3	15.2	18.1	12.8	15.4	64.8	55.6	[illegible]
09/14/80	14.8	14.8	14.1	[illegible]	[illegible]	12.5	12.8	12.8	13.2	13.8	14.7	15.8	16.5	17.3	17.7	18.0	18.0	17.8	16.9	16.3	15.8	15.5	15.3	15.2	18.0	12.8	15.2	64.4	54.8	60.5
09/15/80	15.0	14.7	14.5	14.5	14.0	13.8	13.4	13.4	13.8	14.1	15.0	15.8	16.5	16.8	16.8	16.8	16.5	16.8	15.8	15.3	15.1	15.0	14.9	14.9	16.8	13.4	15.1	62.2	58.1	59.2
09/16/80	14.8	14.4	14.1	13.9	13.8	13.6	13.4	13.4	13.5	14.1	14.8	14.9	15.2	15.9	16.2	16.5	16.5	16.1	15.7	15.3	15.0	14.7	14.5	14.3	16.5	13.4	14.8	61.7	56.1	58.6
09/17/80	14.1	13.9	13.8	13.5	13.3	13.1	13.0	12.8	13.1	13.8	14.8	15.4	16.2	16.8	17.4	17.5	17.4	16.8	16.2	15.5	15.1	14.8	14.8	14.4	17.5	12.8	14.8	63.6	56.0	58.8
09/18/80	14.1	13.9	13.8	13.2	13.0	12.8	12.3	12.2	12.5	13.1	14.0	15.0	15.8	16.5	17.0	17.2	17.1	16.7	16.0	15.3	14.9	14.8	14.4	14.1	17.2	12.2	14.5	63.0	54.0	58.2
09/19/80	13.7	13.7	13.4	13.1	12.8	12.4	12.0	12.1	12.3	13.0	13.8	14.9	15.8	16.4	16.7	17.1	16.8	16.3	15.8	15.1	14.7	14.5	14.3	14.0	17.1	12.0	14.4	62.8	53.8	57.8
09/20/80	13.8	13.8	13.2	12.8	12.7	12.3	12.0	11.8	12.1	12.8	13.8	14.3	15.1	15.7	16.2	16.4	16.1	15.8	15.0	14.4	13.9	13.5	13.3	13.1	16.4	11.8	13.8	61.5	53.2	57.0
09/21/80	12.8	12.5	12.2	11.8	11.8	11.3	11.1	10.8	11.2	11.8	12.7	13.7	14.8	15.3	15.8	16.0	15.9	15.5	15.0	14.5	14.1	13.7	13.8	13.4	16.0	10.8	13.4	60.8	[illegible]	56.1
09/22/80	13.3	13.0	12.7	12.4	12.2	11.8	11.7	11.5	11.8	12.4	13.4	14.4	15.1	15.8	16.5	16.8	16.7	16.2	15.8	15.0	14.6	14.4	14.1	13.9	16.8	11.5	14.0	62.2	52.7	57.2
09/23/80	13.8	13.4	13.2	12.8	12.8	12.2	12.0	11.8	12.1	12.8	13.8	14.8	15.4	16.2	16.7	16.8	16.7	16.2	15.8	15.1	14.7	14.4	14.2	14.1	16.8	11.8	14.2	62.2	53.2	57.5
09/24/80	13.9	13.7	13.4	13.1	12.8	12.8	12.5	12.2	12.4	13.1	13.9	15.0	15.8	16.4	16.8	17.1	17.0	16.5	15.9	15.3	15.0	14.7	14.5	14.4	17.1	12.2	14.5	62.8	54.0	58.1
09/25/80	14.2	14.1	13.8	13.6	13.4	13.1	12.9	12.7	12.8	13.5	14.4	15.3	16.1	16.8	17.1	17.0	16.8	16.4	15.8	15.8	15.3	15.2	15.0	14.9	17.1	12.7	14.8	62.8	54.9	58.7
09/26/80	15.0	14.7	14.4	14.1	13.9	13.5	13.4	13.3	13.4	13.9	13.9	14.8	15.8	16.5	17.1	17.1	17.2	17.1	16.2	15.7	15.3	15.0	14.8	14.7	17.2	13.3	15.0	63.0	54.9	58.1
09/27/80	14.5	14.4	14.1	13.9	13.8	13.4	13.1	13.0	13.1	13.7	14.4	15.3	15.9	16.5	17.0	17.1	17.0	16.8	16.0	15.5	15.0	14.8	14.6	14.4	17.1	13.0	14.8	62.8	55.4	58.8
09/28/80	14.1	13.9	13.7	13.5	13.1	12.8	12.6	12.5	12.5	13.0	13.8	14.7	15.5	16.1	16.5	16.5	16.3	15.8	15.2	14.7	14.3	14.0	13.8	13.8	16.5	12.5	14.3	61.7	54.1	57.7
09/29/80	13.4	13.1	12.8	12.8	12.9	12.0	11.8	11.7	11.7	12.4	13.3	14.1	15.0	15.8	16.1	16.2	16.1	15.6	15.0	14.4	14.1	13.8	13.8	13.4	16.2	11.7	13.8	61.2	53.1	56.8
09/30/80	13.3	13.0	12.8	12.4	12.1	11.8	11.5	11.3	11.5	11.8	12.7	13.8	14.3	14.8	15.3	15.5	15.3	14.8	14.2	13.8	13.2	13.2	12.7	12.5	15.5	11.3	13.2	58.9	52.3	55.8