MOSS CREEK REHABILITATION PROJECT

GOVENER'S WATERSHED ENHANCEMENT BOARD
(GWEB)
PROJECT #88-041B

1996 MONITORING REPORT

SUBMITTED BY
TILLAMOOK COUNTY SOIL & WATER CONSERVATION DISTRICT

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SECTION I

EXECUTIVE SUMMARY

I. EXECUTIVE SUMMARY

Project Area

Moss Creek, a tributary of the Miami River, is located 1 1/2 miles northeast of Garibaldi, Oregon. It is approximately
3 1/2 miles long and encompasses 3,138 watershed acres. Forest land makes up 98 percent of the acres, agriculture 1 percent and residential 1 percent. Major forest land owners are Oregon Department of Forestry and Boise Cascade. Ninety- three percent of the watershed has been recently harvested and reforested.

Annual precipitation averages from 90 inches in the valley to 150 inches in the upper watershed. The watershed is characterized by steep slopes, unstable and highly erosive soils.

Moss Creek, a fourth order coastal stream, supports chum, coho, chinook salmon, winter steelhead and cutthroat trout. Unstable woody debris quantities in and along Moss creek have been reduced. Available pool habitat has been reduced approximately thirty percent. Intermittent streams flows in lower Moss Creek preclude summer rearing of coho, chinook salmon and steelhead and cutthroat trout. Fluctuating flows strand juvenile fish and dewater developing eggs.

A 135 cow dairy operation located in the watershed did not have adequate manure storage capacity to allow the flexibility needed to apply manure when soil and climatic conditions were favorable. manure runoff, as well as livestock access to the stream, was contributing to the water pollution problem.

Project's Purpose

The Moss Creek project's purpose was to implement a cost-effective streambank erosion control project. Once project is implemented, the following benefits would be achieved:

- Improved water quality
- Reduced streambank erosion
- Increased fish habitat diversity
- Improved anadromous fish passage, spawning and rearing
- habitats
- Restore riparian vegetative zones
- Reduce downstream salmon embryo losses
- Provide future sources of organic debris recruitment

Project Highlights

The Tillamook County Soil and Water Conservation District applied for Senate Bill 617, Extended Streambank Erosion Planning, grant funds in February 1986. In April 1986 the Oregon Department of Agriculture, Soil and Water
Conservation Division, approved the $12,000 grant for the Moss Creek Extended Streambank Erosion Control Planning Project.

A Coordinated Resource Management Planning process was used to develop a restoration plan. This plan was the basis for the Governor's Watershed Enhancement Board's grant application.

The District formed a Technical Advisory Committee to assist in the plan development. The Moss Creek Technical Advisory Committee members were representatives from the following agencies and/or organizations:

- Tillamook County Soil and Water Conservation District
- Moss Creek dairyman
- Moss Creek Resident
- Longview Fibre
- Tillamook County Community Development
- Tillamook County Public Works
- Oregon Department of Fish and Wildlife
- Oregon Department of Forestry
- USDA Natural Resources Conservation Service

The Tillamook County Soil and Water Conservation District contracted with Clearwater BioStudies to develop the Moss Creek Rehabilitation Plan. This Plan was completed in August 1987. The District also contracted with an Oregon State University graduate student to gather data and analysis needed to assess the relative slope stability of the drainage basins within the Moss Creek Watershed. The graduate student was under the direction and supervision of the Northwest Oregon Area's Department of Forestry geotechnical specialist. This report was completed in July 1987.

The USDA Natural Resources Conservation Service conducted the soil survey. The soil survey for Moss Creek Watershed was completed in September 1986.

In December 1987, the Tillamook County Soil and Water Conservation District and the Moss Creek Technical Advisory Committee completed the Moss Creek Extended Streambank Erosion Control Planning Project Summary Report.

On January 14, 1988, the Tillamook County Soil and Water Conservation District submitted the Moss Creek Rehabilitation Project to the Governor's Watershed Enhancement Board for a $51,480 grant to implement the project. This project was approved March 29, 1988.

Ten stream sections were initially identified where measures could be installed that would achieve the project's purpose. One section, site 5 located on Widenoja Creek, was canceled. This site was considered as a potential rearing pond area. However, an investigation by the Natural Resources Conservation Service’s geologist indicated that constructing the rearing ponds were not feasible. The substratum at the site was not suitable for storing water during the summer. The cost to construct the ponds and seal them sufficiently so water would be available during the summer months, outweighed the expected benefits. Also, excessive bedload movement could create costly maintenance.

As a result of the G-WEB project, the following treatment measures were installed with the grant:

- 1 livestock crossing
- 486 feet of streambank stabilized
- 4,243 feet of fence installed
- 9 jetties
- 6 existing instream fish habitat logs stabilized
- 1 water control structure
- 1 rock diversion structure
- 4 boulder dam structures
- 3 boulder deflectors
- 2 instream log structures
- 280 conifers planted along stream's upper corridor
- 1360 Willows planted in stream's lower corridor
- 3.5 acres of construction sites and/or access road seeded.

In November 1986, the Moss Creek dairy operator requested an animal manure pollution abatement Long Term Agreement under the USDA Agricultural Stabilization and Conservation Service (ASCS)program. The dairy farm was rated a high priority for receiving federal dollars to install animal waste management practices which prevent manure runoff into Moss Creek.

The animal manure pollution abatement plan was completed by the Soil Conservation Service in October 1987. On March 18. 1988, the ASCS committed $35,000 over a ten year period to install the animal manure pollution abatement measures included in the plan developed by the USDA Natural Resources Conservation Service.

Volunteers were used on the project. The volunteers included:

- Miami Anglers
- Boy Scouts of America

The Oregon Conservation Youth Corps(OYCC) was also used. They installed most of the fencing. They also stabilized the instream fish habitat logs in one stream section.

The Miami Anglers installed the fencing in the lower stream section. The Boy Scouts planted willows within existing riprap and planted conifers in the upper section to increase future debris recruitment to the stream.

The Moss Creek Rehabilitation Project required the following permits:

- Tillamook County Development Permit
- Division of State Lands Fill/Removal Permit
- US Army Corps of Engineers Fill/Removal Permit
- Oregon Department of Forestry Equipment Operators Permit

The project met the requirements of the Oregon Coastal Zone Management Program.

SECTION II

PROJECT SITE NARRATIVE

II. SITE NARRATIVE

SITE 1 Between mile 0.0 and 0.2

This stream section was void of riparian vegetation. Pastures were not fenced adjacent to the stream corridor. Livestock had severely degraded the riparian zone and water quality. Inadequate manure storage on the dairy forced pasture application during storm events. Subsequent manure runoff degraded the water quality.

Treatment measures recommended were: installing a manure management system on the Moss Creek dairy, fencing both sides of the stream, installing a livestock crossing and planting and/or allowing riparian vegetation to reestablish.

Expected Benefits:

- Improved water quality
- Reduced streambank erosion
- Stream shading and streambank protection
- Increased habitat diversity

Materials Used

A. Liquid Manure Tank System

- 5,245'- 7/8 inch rebar
- 3,375'- 3/4 inch rebar
- 2,758'- 5/8 inch rebar
- 1,671'- 1/2 inch rebar
- 32'- 3/8 inch rebar
- 186.1 cubic yards of concrete
- 40 cubic yards of drain rock
- 1 agitator/pump
- 48' 12 inch PVC pipe

B. Livestock Crossing Abutments

- 2,9301 -1/2 inch rebar
- 32.25 cubic yards of concrete
- 12.00 cubic yards of drain rock
- 30.00 cubic yards of rock riprap

C. Livestock Crossing Decking and Railing

- 80’ - 2x4
- 80’ - 2x6
- 90’ -6x8
- 84’ - 2x12
- 480’ - 4x12
- 70’ - 6x6
- 120’ - 6x21 pressure treated laminated beams
- 18 3/4”x14” galvanized hex machine bolts/washers/nuts
- 36 - 5/8”x14” galvanized hex machine bolts/washers/nuts
- 41 - 1/2”x8”' galvanized hex machine bolts/washers/nuts
- 240 - 8” galvanized spikes
- 160 - 20 penny galvanized nails

D. Seeding

- 15 pounds of seed

E. Fencing

- 18 - 8’x6.5”x9” railroad ties
- 62 - 6’ steel posts
- 3,710’ - 4 point barbed wire; clips & staples

Methods Used

The animal manure pollution abatement Plan of Operation was finalized on October 13, 1987. Best management practices scheduled in the plan were as follows:

- Gutters and downspouts
- Gutter outlets
- Below ground liquid manure tank
- Agitator
- Two waste transfer lines
- One roof
- Waste utilization

Estimated cost for installing the pollution abatement practices was $48,384. ASCS cost-share dollars approved for these practices was $35,000. The producers cost is approximately $13,384.

During May 1988, the dairyman hired a private contractor to construct the 48'x 10' (133,900 gallons) below ground reinforced concrete tank. Excavation required for tank construction was 1,661 cubic yards. Clean drain rock was placed in bottom of the excavation.

The tank was constructed in three phases. The tank floor was poured first followed by the tank walls. The cover was poured last. Concrete strength was 3,500 pounds per square inch. **A** concrete pumper was used to pour the tank. **As** concrete was poured, it was vibrated. **All** honeycombs and form tie holes created during tank construction were mortared. A DeLaval PTO Agitator, Model TP270 III was installed in the tank. An agitator is required to keep solid manure suspended in liquid phase when emptying tank for pasture transport. Failure to agitate will cause solid build-up in bottom of tank. Excessive build-up will decrease the storage retention time.

A 12 inch PVC Class Code 125 pipe was installed between existing liquid manure tank, new milk parlor and the constructed liquid manure tank. Cost-share dollars earned to date for installing the manure management practices have been $27,822. The producer's costs have been $9,843.

The additional storage capacity will allow 90 days manure storage. Increased storage capacity will allow the flexibility needed to apply manure to pastures when soil and climatic conditions are favorable. Manure runoff will be prevented, thus improving Moss Creek's water quality.

During August, September and October 1989, two private contractors constructed the 40.6 foot long by 12 foot wide livestock crossing over Moss Creek. The crossing support beams are 8.3 feet above the bottom of the channel. The livestock crossing was constructed of reinforced concrete abutments, pressure treated support beams and pressure treated wood decking and railing. It

Rainfall in August was 2.65 inches. This created unexpected stream flow at the livestock crossing construction site. Normally, there is no flow in lower Moss Creek during August. As a result, there were additional construction costs.

Five water pumps were needed to keep water away from abutment construction site. Three 2 inch, one 3 inch and one 4 inch gasoline trash pumps were used to keep the stream flow diverted. Drain rock was needed to properly construct the abutment footings. Additional man hours and equipment time were also expended. This unforeseen Moss Creek flow increased the livestock crossing costs by $1,326.54.

In the abutment walls, two mats of 1/2 inch reinforcement steel bars (rebar) were used. The bank side vertical rebar was placed 24 inches on center while the stream side rebar was spaced 8 inches on center. The horizontal 1/2 inch rebar was tied 16 inches on center to both sets of vertical rebar and extended into the footing. In the footing, horizontal rebar was placed 12 inches on center.

Wing wall horizontal rebar was placed 9 inches on center on the bank side. on the stream side one 1/2 inch rebar was installed at the top of wing wall face. The 1/2 inch vertical rebar was placed 12 inches on center.

Wing wall design modifications made by the SCS engineer required additional concrete. This increased the cost of the abutments by $215.84.

Clean gravel was placed behind the abutment for proper drainage. improper drainage could result in excessive water pressure causing the abutment to collapse.

Abutments' backfill and livestock crossing approach material was obtained from the gravel bar at the mouth of Moss Creek. The dairyman supplied the gravel. An additional 110 cubic yards of backfill was required for the crossing approach than was originally estimated. This increased the cost by $189.20.

Rock riprap was placed on the stream side of the abutments to prevent erosion. This erosion control measure increased the costs at this site $375.00.

Three quarters by 14 inch galvanized machine bolts were placed in the concrete abutments' 10 inch beam seats during the concrete pour. These bolts were used for attaching the pressure treated laminated beams. Two by twelve wood sills were attached to the 3/4 inch bolts. Steel plates were used to attach the beams to the wooden sills and abutments. Steel plates were fastened to the beams and sills by the 3/4 inch bolts, washers and nuts.

Decking was constructed with pressure treated 4 x 12's. Eight inch galvanized nail spikes were used to secure the 4 x 12's to the three support beams. Equipment runners were constructed from 2 x 12's secured to the decking with galvanized 20 penny nails.

Curbing was constructed with pressure treated 6 x 8's attached to the decking and rail supports with 5/8” x 14” galvanized hex machine bolts, nuts and washers.

Rail supports were constructed with pressure treated 6 x 6's and 6 x 8's. The supports were attached to the curbing with 5/8” x 14” galvanized hex machine bolts, nuts and washers.

Livestock railing was constructed with 2 x 4 and 2 x 6 lumber. They are attached to the 6 x 6 and 6 x 8 timber supports with 1/2” x 8” galvanized hex machine bolts, nuts and washers.

Riparian fencing began in July 1989 with the installation of pressure treated rail road ties as corner and pull posts. A four strand barbed wire fence has been planned for both sides of the creek. Steel posts and barbed wire have been purchased for the fencing at this

site. Volunteers **will** install the fence, as weather and time permit, in accordance with the USDA Natural Resources Conservation Service Specifications.

Construction site areas and south side access road were seeded during October 1989. There are blackberries already growing on the north side of the stream. They should regenerate if left undisturbed. The 1990 project evaluation will determine if willow cuttings are needed at this site.

SITE 2 **Near stream mile 0.2**

At this site the north streambank was severely eroding. A cut bank approximately eight feet high existed. Pastureland bordering the stream was being lost.

Spawning chum, chinook, coho and steelhead utilize this stream section. This stretch has subsurface base flow during summer months. Consequently, no successful salmonoid rearing occurred. Treatment measures would primarily benefit adult salmonoids before and during spawning.

Treatment measure recommended was a rock jetty to deflect streamflow away from eroding streambank.

Expected Benefits

- Reduced streambank erosion and stream sedimentation
- High quality salmon holding habitat developed at jetty's toe
- Spawning chum, chinook, coho and steelhead would use the sorted gravels below the scoured jetty toe.

Materials Used

- 184 cubic yards of rock 250 willows
- 2 lb. grass/legume mix
- 10 61 steel posts
- 2 rail road ties
- 350' 12-1/2 gauge 4 point barbed wire

Methods Used

During July, August and September 1988, a private contractor installed the two jetties. These protect 60 feet of streambank and reduced stream sedimentation. The jetties were spaced forty feet apart. They were installed at a 45 degree angle with bank. They were extended into the channel 5 feet to deflect stream flows away from the eroding streambank. Jetties were keyed into the streambank four feet.

In May 1989 87.5 feet of fencing was constructed by owner. Rail road ties were installed as corner and pull posts. Average spacing for steel posts was 9 feet. Corner and pull posts were spaced 44 feet apart.

Disturbed construction site area was seeded in September 1988. Seed was broadcast into Jetty rock voids.

During April 1989 local willow cuttings were planted between the two jetties and upstream of the second jetty. A 2'x 2' spacing was used. A four foot long crow bar was used to make holes for the willow cuttings. Soil was compacted around the cuttings.

SITE 3 **Also near stream mile 0.2**

The south streambank was severely eroding. A cut bank approximately eight feet high and 240 feet long existed. Continued streambank erosion would undermine the county road.

Treatment measures recommended were the construction of three rock jetties to deflect streamflow away from eroding streambank.

Expected Benefits

- Reduced streambank erosion
- Adult salmon holding habitat development at jetty toes
- Well sorted spawning gravels created immediately down stream.

Materials Used

- 220 cubic yards of rock riprap
- 10 6' steel posts
- 2 railroad ties
- 350' 12-1/2 gauge 4 point barbed wire

Methods Used

In the summer of 1988 a private contractor installed the four jetties. This protected 179 feet of streambank and reduced stream sedimentation. The jetties were spaced forty feet apart. They were installed at a 45 degree angle with streambank and extended into the stream channel five feet. Since the jetties could not be keyed into the streambank, a toe trench three feet deep and five feet wide was excavated for the rock placement.

In May 1989 87.5 feet of fencing was installed by the dairyman. Railroad ties were installed. They were spaced 44 feet apart. Steel posts were spaced an average of 9 feet apart.

Stream flows during early 1989 washed away some of the lover downstream jetty. In July 1989, twenty cubic yards of rock were added to this jetty.

SITE 4 **Near stream mile 0.3 on Moss Creek's south side**

Riparian zone was not fenced. Livestock had severely degraded stream corridor.

Treatment measures recommended were fencing and planting appropriate herbaceous species. Treatment should improve stream's riparian zone condition.

Expected Benefits

- Reduced streambank erosion and associated streambed sedimentation
- Stream shading and protected streambanks
- Increased habitat diversity
- Increased nutrient input from riparian vegetation.

Materials Used

- 125 Placer Erect (SALIX rogida) willows
- 125 Clatsop Hooker (SALIX hookeriana) willows
- 3968 12-1/2 gauge, 4 point barbed wire
- 60 6 ft. heavy duty steel fence posts
- 10 rail road ties 6-1/2 x 9 x 8
- 2 lb. fence staples
- 100 cubic yards of rock riprap
- 20 cubic yards of gravel
- 4 2" x 4" x 8' boards
- 2 2" x 4" x 16' boards
- 10 lb.grass/legume seed mix

Methods Used

In April 1988, Tillamook Boy Scout Troop 629 planted 250 willow cuttings in 380 feet of existing rock riprap. Willow cuttings were obtained from the USDA Natural Resources Conservation Service's Plant Material Center at Oregon State University's Hyslop Agronomy Farm, Corvallis, Oregon.

During August 1988, under the supervision of ODFW personnel, Oregon Youth Conservation Corps (OYCC) installed 955 feet of fencing according to ODFW fencing guidelines. Railroad ties were installed as pull posts. They were placed three feet in the

ground. Spacing varied with stream curvature. Posts were generally placed 205 feet apart. Steel posts were installed at approximately 14 foot intervals. Four strand barbed wire was installed at 16", 25",33" and 41" above the ground. The reason for the greater spacing on the lowest wire is to allow fawns to go under the fence without harm. The highest wire allows adult deer to jump over easily.

Two livestock crossings were in the original plan: one at Site 1, and the other at Site 4. Delays in obtaining abutment designs in 1988 forced postponement of livestock crossing construction until summer 1989. By that time, construction costs had increased to a level which would not allow constructing both crossings as originally budgeted. The crossing at Site I had a higher priority, so the following alternative treatment was applied at this site.

A private contractor installed streambank protection in August 1989. Rock riprap was installed to protect 130 feet of streambank and reduce streambank sedimentation loading. The streambank was sloped 1-1/2:1. A three foot wide by three foot deep core trench was excavated at the toe of the slope for riprap placement. A one half inch gravel filter blanket was placed on the sloped bank. Gravel was obtained from the stream channel.

In October 1989 construction area was seeded.

SITE 5 on Widenoja Creek

Widenoja Creek is a perennial Moss Creek tributary 1.8 stream miles below West Fork's mouth. Coho salmon currently utilize the lower 1.8 miles below mouth. Juvenile coho rearing is limited by degraded habitat and low summer stream flows. During the summer, juvenile coho were very densely crowded in this small tributary. As flows receded, large numbers died from stranding.

Widenoja Creek was considered a potential rearing pond (resting pool) site because of its perennial flow and relatively stable channel. Little was known about bedload movement or maintenance of constructed ponds at this site. The lower reach seemed to have suitable pond construction gradient (1-2%).

Treatment measures recommended were three rearing ponds (resting pools) to be constructed in lower Widenoja Creek. This recommendation was contingent on bedload movement riot creating costly maintenance.

Expected Benefits

- Increased juvenile coho salmon rearing habitat

Methods Used

In June of 1988, an Oregon Department of Fish & Wildlife representative and NRCS Geologist investigated the proposed rearing pond (resting pool) site. SWCD contracted for

backhoe work. The investigation indicated that constructing the resting pools was not feasible. The substratum in the area was not suitable for storing water during the summer. The cost to construct the ponds and seal them sufficiently so water would be available during the summer months outweighed the expected benefits. Investigation also determined that excessive bedload movement could create costly maintenance. GWEB was notified that this portion of the project would not be pursued. The budgeted amount for these ponds was $2355. This amount was removed from the total grant by GWEB and redistributed to another project.

SITE 6 **Near stream mile 0.8**

It is along Moss Creek's south bank immediately upstream of Widenoja Creek confluence. Moss Creek's south bank was severely eroding upstream of existing rock riprap. Cut bank was approximately 6 feet high and 150 feet long. Spawning chum and chinook salmon utilize this area. No summer juvenile salmon rearing occurs. During the dry season, this stream section has only subsurface flow. Habitat improvement by protecting the eroding bank would benefit adult fish.

Treatment measures recommended were constructing three rock jetties to deflect streamflow from eroding streambank.

Expected Benefits

- Reduced streambank erosion and associated stream sedimentation
- Jetty toe scouring will create adult fish holding area
- Well-sorted gravels deposited downstream of project would provide good chum, chinook, coho and steelhead habitat

Materials Used

- 322 cubic yards of rock riprap
- 50 cubic yards of gravel
- 460 willows
- 5 lb. grass-legume seed

Methods Used

The Widenoja family, an absentee landowner at this site, was not willing to accept the operation and maintenance responsibility for the life of the project. Design modifications were made. Tillamook County Public Works Department and Tillamook County SWCD would jointly accepted the operation and maintenance responsibility based on the design modifications.

A private contractor installed the streambank protection during July 1989. Riprap and three jetties were installed to protect 117 feet of streambank and reduce stream

sedimentation loading. Tillamook County Public Works donated 150 cubic yards of rock.

Streambank was sloped to 1-1/2:1. A 3 foot wide by 3 foot deep core trench was excavated at toe of slope for riprap placement. A 1/2 inch gravel filter blanket was placed on the slope. Gravel was obtained from the stream channel.

The jetties were spaced 40 feet apart. They were installed at a 45 degree angle to the streambank. They extend into the channel seven feet to deflect stream flows away from the eroding stream bank. Jetties were keyed into the streambank four feet.

Disturbed construction site areas were seeded in September 1988. Seed was also broadcast on the riprap area.

During April 1989, local willow cuttings were planted at base of riprap toe between jetties, top of jetties and in one row at bank top. A 2'x 2' spacing was used. A four foot long crow bar was used to make holes for the willow cuttings. Soil was compacted around the willow plantings.

SITE 7 **Near stream mile 1.1.**

Large logs had been anchored by cable to increase channel complexity, pool depth and habitat diversity. There was a high potential for debris jams to form because these logs, linked by loose cable, restrict debris flows through stream corridor. Spawning chum, coho and chinook salmon utilized this area. Properly placed and anchored, logs provide valuable holding and cover habitat for adult salmon and steelhead. No juvenile salmon or trout rearing area existed in this section because subsurface flows occurred during the dry season. If a log jam formed and subsequently dislodged during flooding, streambank erosion, salmon embryo losses and bridge damages could occur.

Treatment measures recommended were log placement and stabilization modification for increased stability and a lower potential for bridge failure

Expected Benefit

- Reduced downstream bridge failure potential
- Reduced downstream bank erosion potential
- Reduced potential downstream salmon embryo losses

Materials Used

- 6 gabions 6' x 3' x 3'
- 2 gabions 6' x 3' x 18"
- 1 gabion 9' x 3' x 18"
- 1/2 inch cable and fasteners

Methods Used

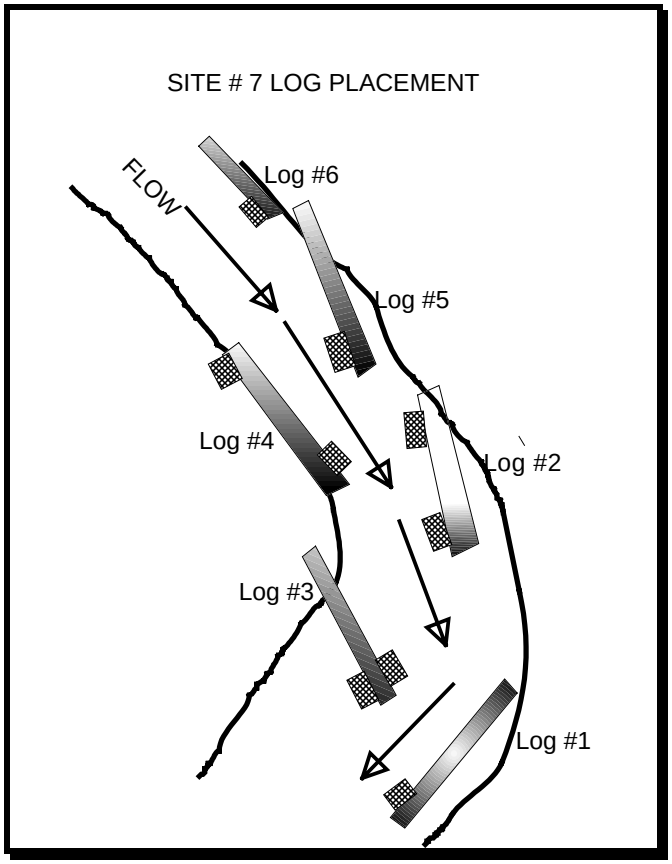
During the summer of 1988, the OYCC crew, under the supervision of ODFW biologists, attached rock filled gabion baskets to existing instream logs to increase stability of the logs.

Six to eight inch rock from the stream was used to fill the gabion baskets. Cable was used to attach the gabion to the existing logs. Cable fasteners were used to secure the cable.

Log Number 1 is located furthest downstream on the south side. The log is 24 feet long and 2-1/2 feet in diameter. It was parallel with streamflow. This log had previously been cabled to an existing tree. A 12 foot long, one inch diameter cable placed through a steel eye had secured the upstream end to a tree. A 61 x 31 x 31 gabion was placed on the water side, downstream end of the log. Two holes were drilled through the log. Cable was put through the log and gabion 2 feet from the gabion basket ends. During fall, winter and spring flows, water is around the log. (see figure)

Log Number 2 is located just upstream of Log Number 1 on the south side. The log is at a 30 degree angle with stream flow. It is 40 feet long and 4 feet in diameter. This log had not been previously secured. OYCC crew installed a 6'x3'x3' gabion baskets filled with rock at the log's downstream and upstream ends. Cable was used to secure gabions to the log. Holes were drilled through the log. Cable was put through the logs and gabions 2 feet from the gabion ends. (see figure)

Log Number 3 is located across creek on north side. Log is at a 45 degree angle with stream flow. This log extended across the creek. Approximately 3 feet of the log extending onto the south side was sawed off. This left approximately two thirds of the log extending across the creek channel. The log is 33 feet long and 3 feet in diameter. The end that is out of the channel is wedged against the upstream side of a tree. Gravel bar has built up on this side. Two gabion baskets, 6'x3'x3' filled with rock, were placed on the downstream end of the log that extends into the channel. One gabion was placed on the upstream side of the log and one placed on the downstream side. Cable was wrapped around the log three times and through the gabion on the log's downstream end. Cable was wrapped around the log and through the gabion twice on the log's upstream side. (see figure)



Log Number 4 is located on same side of channel and upstream from log number 3. It is 42 feet long and 2 1/2 feet in diameter and parallels the stream flow. Two rock filled gabions, 6'x3'xl8", were placed at both ends. Gabions were placed on opposite sides. Log was drilled twice at both ends. Cable was run through the log and gabions at both ends. (see figure)

Log Number 5 is located on south side and upstream of log number 4. This log is 33 feet long and 2.5 feet in diameter and is at a 35 degree angle with stream flow. The log's upstream end had previously been secured by 1 inch cable attached to a tree. A 6'x3'x3' rock filled gabion basket was attached to the down stream end. Cable was wrapped twice around the log and through the gabion basket. Cables were approximately 10 inches apart and secured nine feet from the log's downstream end.

Log Number 6 is located upstream and on the same side of the stream as log number 5. It is 26 feet long and 2 1/2 feet in diameter. The upstream end had previously been secured by a 1 inch cable attached to a tree. Log parallels the stream flow. A 9'x3'xl8" rock-filled gabion was installed on the waterside, downstream end of the log. Log was drilled at two places. Cable was run through these two holes, and around the log and through the gabion approximately in the center of the gabion. (see figure)

SITE 8 Near stream mile 1.2

A minor tributary was eroding a logging roadbed. Moss Creek was overtopping its banks and flowing down the logging road. Two head cuts had developed. Chum, coho and chinook utilize this section.

Treatment measures recommended were: Stabilize the two head cuts along the tributary channel and divert Moss Creek flows to minimize future erosion problems.

Expected Benefits:

- Head cuts would be stabilized
- Moss Creek flows would be diverted and erosion problems minimized
- Improved fish habitat conditions

Materials Used

- 70 cubic yards of rock
- 12 boulders, 2-1/2 to 3-1/2 feet in diameter
- 5 lb. of grass/legume seed

Methods Used

During June 1988, a private contractor installed a rock water control structure in this minor tributary. The structure's purpose was to reduce headcutting. The tributary's high velocities and Moss Creek backing up the tributary during high flows caused the headcutting.

The water control structure is 24 feet long, 21 feet wide at the base and 4 feet high at the weir opening. Weir opening is 9 feet wide by 1.25 feet deep. Structure was keyed 4 feet into the streambank and 3 feet into the channel. A nine foot long rock apron was installed on the downstream side. The OYCC crew seeded the construction site area and structure during July 1988.

The original rehabilitation plan also recommended log placement at the point where Moss Creek entered the minor tributary. With Oregon Department of Fish and Wildlife biologist's approval, less expensive boulders were placed across the logging road to prevent excessive flow in the tributary. Disturbed area was seeded in September 1988.

SITE 9 Near stream mile 1.4

Major habitat factors limiting fishery resources were poor pool quality, unstable streambanks and streambed. This section was heavily utilized for spawning and rearing by salmon and steelhead. Site 9 was the lowest Moss Creek site suitable for improving juvenile salmon summer rearing habitat. Because of subsurface flows in Moss Creek's

lower section, and few accessible stream reaches in upper sections, there were few opportunities for this type of habitat improvement. Recommended land treatment measures at this site emphasized juvenile fish rearing habitat improvement.

Treatment measure recommended was placing 8 -10 logs in Moss Creek to deflect stream flow and scour rearing pools.

Expected Benefit:

- Additional summer rearing habitat created.
- Decreased stream velocity.

Materials Used

- 48 boulders 2-1/2 to 3-1/2 feet diameter
- 45 lb. seed
- 75 feet of 1/2 inch cable
- 2 hemlock trees

Methods Used

The grant application specified that 8 to 10 logs would be placed in stream to deflect stream flow and scour rearing pools. After an on-site field investigation by ODFW fish biologist an alternative treatment measure was recommended. These changes are outlined in an August 8, 1989 letter (attached). Based on these recommendations, four boulder structures, two boulder jetty deflectors and 1 instream habitat rock was installed at Site 9. Two hemlock trees were felled into the stream channel.

All boulder structures are built to form a U-shaped structure with the bottom of the U facing upstream.

Rock structure number 1 is located furthest downstream. Ten large round rocks were used. An existing log wedged between three trees was utilized as abutment for the rock structure.

Rock structure number 2 is located 75 feet upstream from the first structure. Twelve round rocks were wedged together with the south end rock wedged against an existing large log.

Rock jetty deflector number 1 is located 60 feet upstream of the second structure, on the stream's south side. Four 3 to 3-1/2 foot diameter rocks were used. This jetty is constructed at a 35 degree angle with the streambank.

Rock jetty deflector number 2 is located 45 feet upstream of jetty 1, on the north side. Five 3 to 3-1/2 foot diameter boulders were used . Jetty is constructed at a 30 degree angle with the streambank.

Rock structure number 3 is located 40 feet upstream of jetty number 2. Nine 2-1/2 to 3-1/2 foot diameter rocks were used.

Rock structure number 4 is located 130 feet upstream of structure 3. Seven 2-1/2 to 3-1/2 foot diameter boulders were used. The south side of the structure was wedged against an existing log.

A 2-1/2 foot diameter boulder was placed in the channel 110 feet upstream of the 4th structure.

Approximately 170 feet upstream of the 4th structure, the first of the hemlock trees (22" diameter) was felled. The other tree (12" diameter) was felled two to four feet upstream. These trees extend the width of the stream channel. ODFW fish biologist used 1/2" cable to secure the north end of the trees to the larger stump for stability. The south side did not need stabilization because the trees were dropped upstream of a clump of trees between 8 and 16 inches in diameter.

These instream structures at Site 9 improved 620 feet of stream habitat. Access road to Site 9 was seeded following construction.

SITE 10 **between stream mile 1.84, and 2.42.**

This stream segment had lost the capacity to store debris torrents and flood related sediment. There was a lack of conifers within the riparian corridor along this stream reach. Consequently, natural large organic debris recruitment to the stream channel was limited. Insufficient large organic debris recruitment limited quality pool and overwintering habitat development.

Treatment measure recommended was planting conifers in this section for future large organic debris recruitment.-

Expected Benefits :

- Future summer rearing and overwintering habitat improvement
- Future sediment storage improvement that will buffer downstream section from damages caused by rapid upper watershed sediment releases.

Materials Used

Two hundred and eighty 2-0 Douglas fir seedlings, donated by the Oregon Department of Forestry, were planted at this site.

Methods Used

Tillamook Boy Scout Troop 629 planted trees March 11, 1989. Scout leaders and NRCS personnel provided supervision. Shovels were used to plant trees according to an acceptable planting method. Tree spacing varied according to the following criteria: no trees planted where there were existing conifer seedlings; soil had suitable depth.

SECTION III

PROJECT EVALUATION

III. 1996-MONITORING AND EVALUATION REPORT

In July, 1996 Bob Pedersen of the USDA Natural Resources Conservation Service Tillamook Field Office and Randy Stinson of the Tillamook County Soil and Water Conservation District performed the 1996 Moss Creek Project Operation and Maintenance inspection.

During 1996 no maintenance was performed. There were no expenses associated with Project's Operation and Maintenance.

SITE #1

This stream section was void of riparian vegetation. Pastures were not fenced adjacent to the stream corridor. Livestock had severely degraded the riparian zone and water quality. Inadequate manure management system on the dairy resulted in pastureland manure applications during inclement weather conditions. Manure runoff and livestock access to the stream degraded Moss Creek's water quality.

Treatment Measures Recommended:

- Manure management system installation
- Stream fencing
- Livestock crossing installation
- Plant and/or allow riparian vegetation to establish

Expected Benefits:

- Improved water quality
- Reduced streambank erosion
- Stream shading and streambank protection
- Increased habitat diversity

Practices Installed:

1. A 48'x 10' below ground liquid manure tank installed 05/02/88 under the ASCS Long Term Agreement cost-sharing program

2. A waste transfer pipe 48 foot long installed between the existing liquid manure tank and the newly constructed liquid manure tank 12/09/88 under the ASCS Long Term Agreement cost-sharing program.

3. Two roofs were installed over the manure accumulation areas 12/17/91 under the ASCS Long Term Agreement cost-sharing program. Under this program, gutters, downspouts and outlet on the animal confinement buildings were to be installed. As of 10/28/96 this portion of the plan has yet to be implemented as scheduled in the Conservation Plan of Operations.

4. A livestock crossing installed across Moss Creek in March 1989

5. 876 feet of fencing installed on both sides of Moss Creek by the Miami Anglers during February 1990

6. In March 1990, two varieties of willows were planted on the south side of Moss Creek

7. During 1993, the dairy producer participated in the Tillamook County Creamery Association's Stream Side Control Program. The following practices were installed in the pastures adjacent to Moss Creek:

    i) 1,110 feet of fencing installed on both sides of an open ditch that outlets into the lower end of Moss Creek.

    ii) Two livestock watering facilities installed in the pastures

    iii) 2,100 feet of water pipe line installed to provide a source of water for the livestock watering facilities

    iv) Two culverts placed in the open ditch to provide livestock crossings for cattle access to the pastures adjacent to the open ditch

8. During 1996 native Willows were planted on the south streambank of the Miami River above the confluence of Moss Creek by the Hire The Fishers Program workers.

1996 Evaluation:

Water quality samples were not taken prior to or after the project's implementation. However, livestock do not have access to Moss Creek or the open water course, that outlets into Moss Creek. Most of the animal waste management system components have been installed.

The livestock crossing and fencing are performing as planned. Livestock do not have access to the creek or the riparian zone.

Willows are starting to establish on the north side riparian zone, though blackberry vines still dominate. The willows planted on the south side are very well established. The Scouler willows are rated excellent for providing stream riparian vegetation. Seventy percent of the willows have survived. The plants have good vigor. The Hooker willow has excellent vigor. It is rated as an excellent willow for providing riparian vegetation. Eighty-five percent of the willows have survived.

No woody vegetation was planted downstream of the livestock crossing. However, several native willows have established on the north and south side. Blackberry vines remain the dominate riparian vegetation downstream of the livestock crossing.

The vegetation is now protecting the streambanks from erosion and substantial stream shading is occurring. As the vegetation's growth increases, more stream shading is expected. An increase in habitat diversity still is not apparent at this time.

No repairs recommended at Site #1.

SITE #2

At this site the north streambank was severely eroding. A cut bank approximately eight feet high existed. Pastureland bordering the stream was being eroded.

Spawning Chum, Chinook, Coho and steelhead utilize this stream section. This stretch has subsurface base flow during the summer months. Consequently, no successful salmonoid rearing occurs. Treatment measures would primarily benefit adult salmonoids before and during spawning.

Treatment Measures Recommended:

- Two Jetties

Expected Benefits:

- Reduce streambank erosion and stream sedimentation
- High quality salmon holding habitat developed at the jetty toes
- Spawning Chum, Chinook, Coho and steelhead would use the sorted gravels below the scoured jetty toes.

Practices Installed:

- Two rock jetties installed during August 1988
- Construction site seeded to a grass-legume mixture during September 1988
- Scouler willows planted during April 1989
- Eighty-seven feet of fencing installed during May 1989

1996 Evaluation:

The upstream jetty is no longer visible from the south side of Moss Creek. The willows and the blackberries have obscured the view. The Scouler willows have excellent vigor. Survival rate is 80 percent. The willows are competing with the blackberry vines. Fencing has prevented livestock access to the stream section.

The jetties are functioning as designed. They have successfully controlled the streambank and created a gravel bar on the north side of the channel. The effect of the gravel bar formation has resulted in the thalweg shifting away from the area of erosion thus moving the higher velocities to the center of the stream.

The streambank at the lower end of this section has experienced severe erosion. The eroded streambank has no riparian vegetation above it and will continue to erode if measures are not taken. A plan to repair the area of streambank erosion at the lower end of this section has been completed. The plan consists of a combination of low bank riprap and biotechnology.

SITE #3

The south streambank was severely eroding. A cut bank approximately eight feet high and 240 feet long existed. Continued streambank erosion would undermine the county road.

Treatment Measures Recommended:

- Three rock jetties

Expected Benefits:

- Reduced streambank erosion
- Adult salmon holding habitat development at jetty toes
- Well sorted spawning gravels created immediately downstream

Practices Installed:

- Four jetties installed during August 1988
- Eighty-seven feet of fencing installed on stream's north side during May 1989

1996 Evaluation:

Fencing the north side has prevented cattle access to this stream section. Natural vegetation has established. Although, blackberries dominate, natural willows are present.

The jetties have deteriorated and broken apart. Immediately upstream from the lower jetty the streambank is exposed susceptible to increased erosion. The other jetties appear to be maintaining their ability to control the streambank erosion. Small pools have formed in the area of the jetties adding to the diversity of the stream.

Streambank erosion has been reduced at the site. Adult salmon holding habit has developed upstream and downstream of the upper jetties. It may be likely that chum spawning occurs at this site.

Repairs are recommended on the lower jetty. This jetty should be altered to form a stream barb. This barb would be oriented at a 45 degree angle upstream. This structure would serve to protect the streambank and create a scour channel by increasing the velocity through this portion of the stream.

SITE #4

This stream section's riparian zone was not fenced. Livestock had severely degraded the stream corridor. A 130 foot section of the stream had severe streambank erosion. A 380 foot section of existing rock riprap was void of riparian vegetation.

Treatment Recommendations:

- Vegetate the existing rock riprap
- Fence this stream section
- Rock riprap the severely eroding streambank

Expected Benefits:

- Reduced streambank erosion and associated streambed
- sedimentation
- Stream shading and protected streambanks
- Increased habitat diversity
- Increased nutrient input from riparian vegetation

Practices Installed:

- In April 1988, the Boy Scouts planted two varieties of willows in the existing rock riprap
- In August 1988, the OYCC installed 955 feet of fencing
- In August 1989, 130 feet of rock riprap installed to protect the severely eroding streambank section.
- In October 1989, the rock riprap construction site was seeded with a grass-legume pasture mix
- In August 1990, the OYCC installed an additional 2,238 feet of fencing

1996 Evaluation:

The willows planted by the Boy Scouts in April 1988 look good. The willows are rated excellent for providing stream riparian vegetation. The willows have excellent vigor. They are competing well with the blackberries. Forty-five percent of the willows originally planted have

survived. Some livestock browsing has occurred. The dairy operator has allowed limited grazing between the fence and the stream to manage the grass and control the weeds. Only those willows at the top of the riprap show sign of browsing. The grazing has caused these willows to stool out and cover more of the existing riprap. The willow plantings have grown and are starting to provide shading and nutrient input at this time. As the willows grow and stool out further, shading and nutrient input should increase.

The rock riprap installed within this section has not been damaged. No woody vegetation was planted at the site. Some blackberries have established. A small Western Hemlock and one red alder have established in the rock riprap. Annual grasses and weeds are still the dominate plants at the site.

The channel is not well defined in this section. Due to the large amount of gravels recruited by the 2/96 flood event the channel has filled with gravels. Streambank erosion occurred at three locations in this section.

A plan to repair the areas of streambank erosion throughout this section has been completed. The plan consists of a combination of low bank riprap and biotechnology.

The fencing in this section that was damaged by the 2/96 flood event and needs to be repaired or replaced.

SITE #5

No measures were installed at this site. Geological investigation indicated that the proposed rearing ponds were not feasible.

SITE #6

At this site the south streambank was severely eroding upstream of existing rock riprap. The cut bank was approximately 6 feet high and 150 feet long. Spawning Chum and Chinook salmon utilize this stream section. No summer juvenile salmon rearing occurred. During the dry season, this stream section has only subsurface flows. Habitat improvement by protecting the eroding bank would benefit adult fish.

Treatment Measures Recommended:

- Three rock jetties

Expected Benefits:

- Reduced streambank erosion and associated stream sedimentation
- Jetty toe scouring would create adult fish holding area
- Well-sorted gravels deposited downstream of project would provide good Chum, Chinook, Coho and steelhead habitat

Practices Installed:

- Three jetties installed during July 1989
- During July 1989, 117 feet of rock riprap installed
- During September 1988, the construction site seeded to a grass -legume mixture
- Willows planted at the base of the riprap, between the jetties, top of the jetties and on top of the bank during April 1989

1996 Evaluation:

No structural damage has occurred. Scouring has occurred between the jetties. This souring has resulted in the loss of most Hooker willows planted between the jetty toes to be lost. The willows planted on top of the bank and jetties have started to spread and are doing well.

Streambank erosion has been reduced. However, excessive gravel is accumulating and the channel is filling in this section. Channel scouring has occurred at the jetty points. Main channel flow is adjacent to the riprap and the base of the jetties. Pool development downstream of the jetties has not occurred.

No repairs recommended.

BETWEEN SITE #6 & #7

In 1990 extensive streambank erosion was occurring on the north bank just below the third county bridge. The erosion was threatening to undermine a large cedar tree and left unchecked could move downstream.

Treatment Measures Recommended:

- Placement of a boulder deflector at the upstream end of the erosion area.

Expected Benefits:

- The boulder deflector will protect the streambank from future erosion thus reducing the amount of fine sediment being transported to the lower reaches.
- Increase fish habitat by creating a scour pool at the toe of the boulder deflector.

Practices Installed:

- A boulder deflector consisting of large boulders on a riprap channel key was installed on the north streambank. The structure was installed on the out side of the channel bend tending downstream.

1996 Evaluation:

The boulder deflector is functioning as designed. The streambank has vegetated and is stable. There is a small scour channel adjacent to the structure thus improving the fish habitat in this reach.

No repairs are recommended.

SITE #7

Large logs had previously been anchored by cable to increase channel complexity, pool depth and habitat diversity. A high potential existed for debris jams because these logs were linked by loose cable. The logs also restricted debris flow through the stream corridor.

Spawning Chum, Coho and Chinook salmon utilize this stream section. Properly placed and anchored, logs provide valuable holding and cover habitat for adult salmon and steelhead. No juvenile salmon or trout rearing area existed in this section because subsurface flows occurs during the dry season. If a log jam formed and subsequently dislodged during flooding, downstream streambank erosion, salmon embryo losses and bridge damages could occur.

Treatment Measures Recommended:

- Log placement and stabilization modifications

Expected Benefits:

- Reduced downstream bridge failure potential
- Reduced downstream bank erosion potential
- Reduced potential for downstream salmon embryo losses

Practices Installed:

- Rock filled gabions secured to 6 fish habitat logs during July 1988
- One log was cut to allow debris passage through this section during July 1988

1996 Evaluation:

Stream channel has narrowed at the site. Pools have formed under and adjacent to the logs. Logs 1 and 3 have the largest and deepest pools. These pools have formed downstream of the rock filled gabions. Pool depth between logs 1 and 3 is 4 feet. Pool depth at the other logs is negligible due to the large amount of gravel recruitment filling in the channel.

Downstream of the log structures, the stream channel has filled in. The gravel deposition has created a plug in the stream.

The log structures are functioning as designed. The area downstream of this site needs to be monitored to determine if the carrying capacity of the stream is great enough to scour the existing deposition. No repairs recommended.

SITE #8

At this site a minor tributary was eroding a logging roadbed. Moss Creek was overtopping its bank and flowing down the logging road. Two head cuts had developed. Chum, Coho and Chinook salmon utilize this section.

Treatment Measures Recommended:

- Two structures to stabilize the head cuts

Expected Benefits:

- Head cuts would be stabilized
- Moss Creek flows would be diverted and erosion problems minimized
- Improved fish habitat conditions

Practices Installed:

- One Water Control Structure installed during June 1988
- One Rock Diversion Structure installed during September 1988

1996 Evaluation

Large gravel buildup in front of structure
Main channel has little flow capacity

The water control structure located at the lower end of the site is working as designed. Water has overflowed structure and some cutting has occurred on spillway. The channel immediately above the structure is 3/4 filled with sediment.

The original rehabilitation plan recommended log placements at the upper end of the site. With Oregon Department of Fish and Wildlife biologist's approval, the less expensive rock boulders were used. The rock diversion structure is working as designed. Gravel deposition is occurring adjacent to this structure. This deposition needs to be monitored to determine if the channel will reform or divert to the logging road.

Headcuts have been stabilized. It appears that few Moss Creek high flows occurs down the logging road. The associated erosion problems have been reduced.

No repairs recommended.

SITE #9

At this site major habitat factors limiting fishery resources were poor pool quality, unstable streambanks and streambed. This section was heavily utilized for spawning and rearing by salmon and steelhead. This site is the lowest Moss Creek site suitable for improving juvenile salmon rearing habitat. Because of subsurface flows in Moss Creek's lower section, and few accessible stream reaches in the upper sections, there were few opportunities for this type of habitat improvement. The recommended land treatment measures at this site emphasized juvenile fish rearing habitat improvement.

Treatment Measures Recommended:

- Placement of 8-10 logs within the stream channel

Expected Benefits:

- Additional summer rearing habitat created
- Decreased stream velocity

Practices Installed:

- Four rock boulder dams installed during September 1988
- Two boulder deflectors installed during September 1988
- Two trees felled into stream channel during September
- During October 1988, the access road seeded to an adapted wildlife forage mixture.
- One boulder placed in stream channel during September

1996 Evaluation

The two hemlock trees that were felled into the channel at this site are performing as planned. A gravel bar has formed upstream on the south side and a pool has form below.

Excellent fish habitat cover has developed under the trees. There is extensive beaver activity in this stream section.

Above the furthest upstream boulder dam structure well sorted gravels have filled in. An small plunge pool exists below this boulder dam structure. The north side of the structure has washed out. The structure is still partly serving the designed purpose.

The second downstream boulder dam is no longer a continuous dam. The rocks have moved, allowing stream flow around the structure. However, there is still a plunge pool below the structure. Well sorted gravels have deposited upstream of the structure.

The next two structures downstream are boulder deflectors. They are performing as designed. However due to the fact that these structures are at a 30-35 degree angle down stream instead of up stream they are not functioning as efficiently as they could be.

The third downstream boulder dam a small plunge pool exists. A well defined S-shaped channel has formed between the second downstream boulder dam and this boulder dam structure.

The fourth downstream boulder dam has a fair plunge pool. A seven foot breach exists on the south side. The stream flows around the south end of the structure. The structure is still considered in fair condition and providing habitat as originally planned. The stream channel has filled in on the south side.

The structures installed in section #9 have improved the instream habitat diversity. There is an increase in the overall stream gradient between the hemlock log structures and the last downstream boulder dam structure. Additional habitat has been created within this stream section.

A large amount of gravel has been recruited into this portion of the stream system. The effectiveness of the boulder dams appear to be limited under these conditions and they are becoming buried in gravel. An increase in the upstream angle and the slope of the boulders (vortex weir) would increase their ability to move the material through this reach. However they are still functioning in a limited capacity. No repairs recommended.

SITE #10

This stream segment had lost the capacity to store debris and flood related sediment. There was a lack of conifers within the riparian corridor. Consequently, natural large organic debris recruitment to the stream channel was limited. Insufficient large organic debris recruitment limited quality pool and overwintering habitat development.

Treatment Measures Recommended:

- Plant conifers within the riparian zone

Expected Benefits:

- Future summer rearing and overwintering habitat improvement
- Future sediment storage improvement that will buffer downstream section from damages caused by rapid upper watershed sediment releases.

Practices Installed:

- 280 Douglas fir planted in the riparian zone during March 1989 by Tillamook Boy Scout Troop 629.

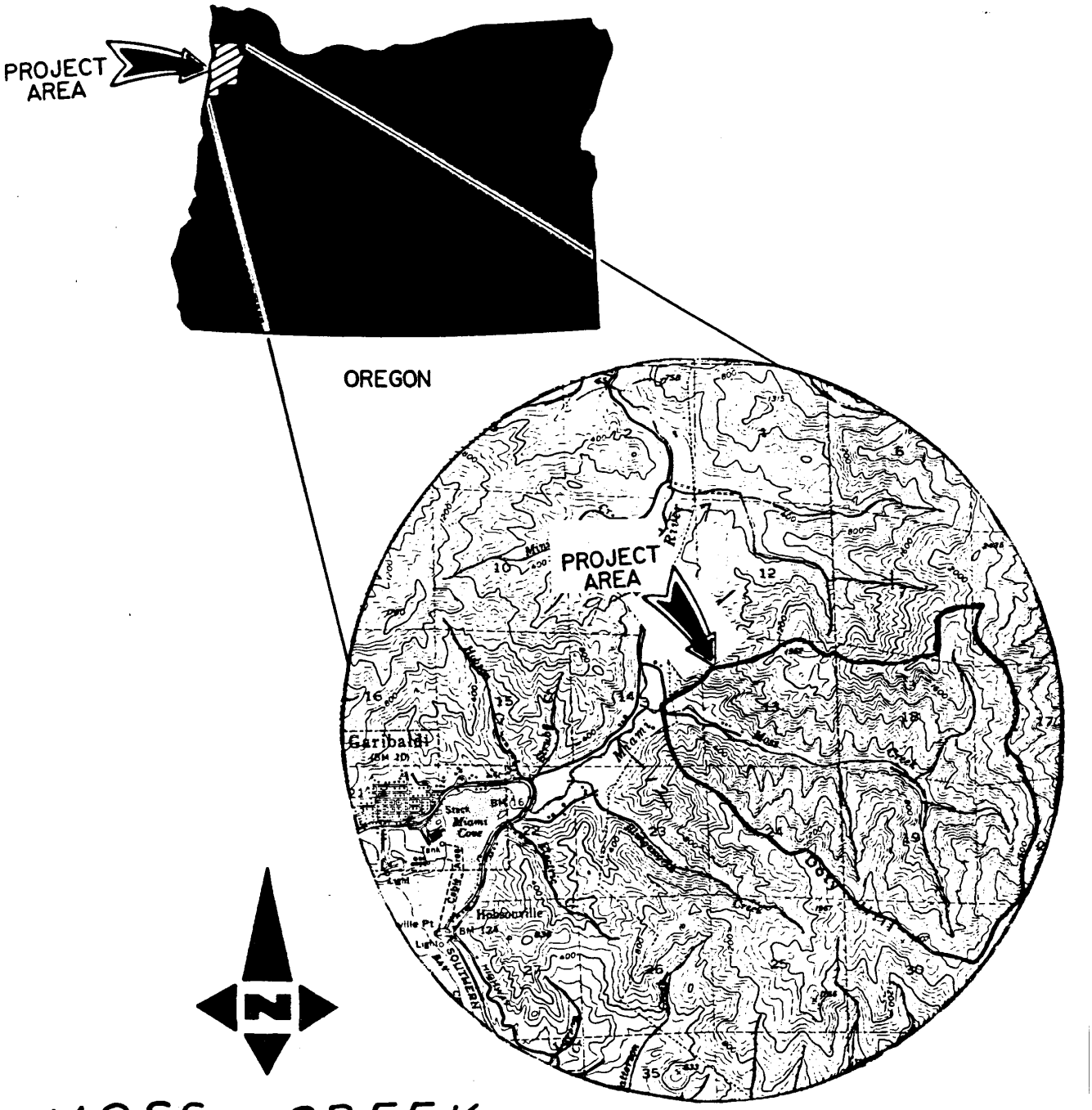
1996 Evaluation

This site was not evaluated this year. However evaluations in the past have indicated that the plantings were doing well and there is no reason to believe that this trend has changed.

No repairs recommended.

SECTION IV

PROJECT DOCUMENTARY PHOTOGRAPHS



MOSS CREEK
PROJECT LOCATION MAP

SCALE 1:62500

1 0 1 2 3 4 MIL

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

1 5 0 1 2 3 4 5 KILOMETERS

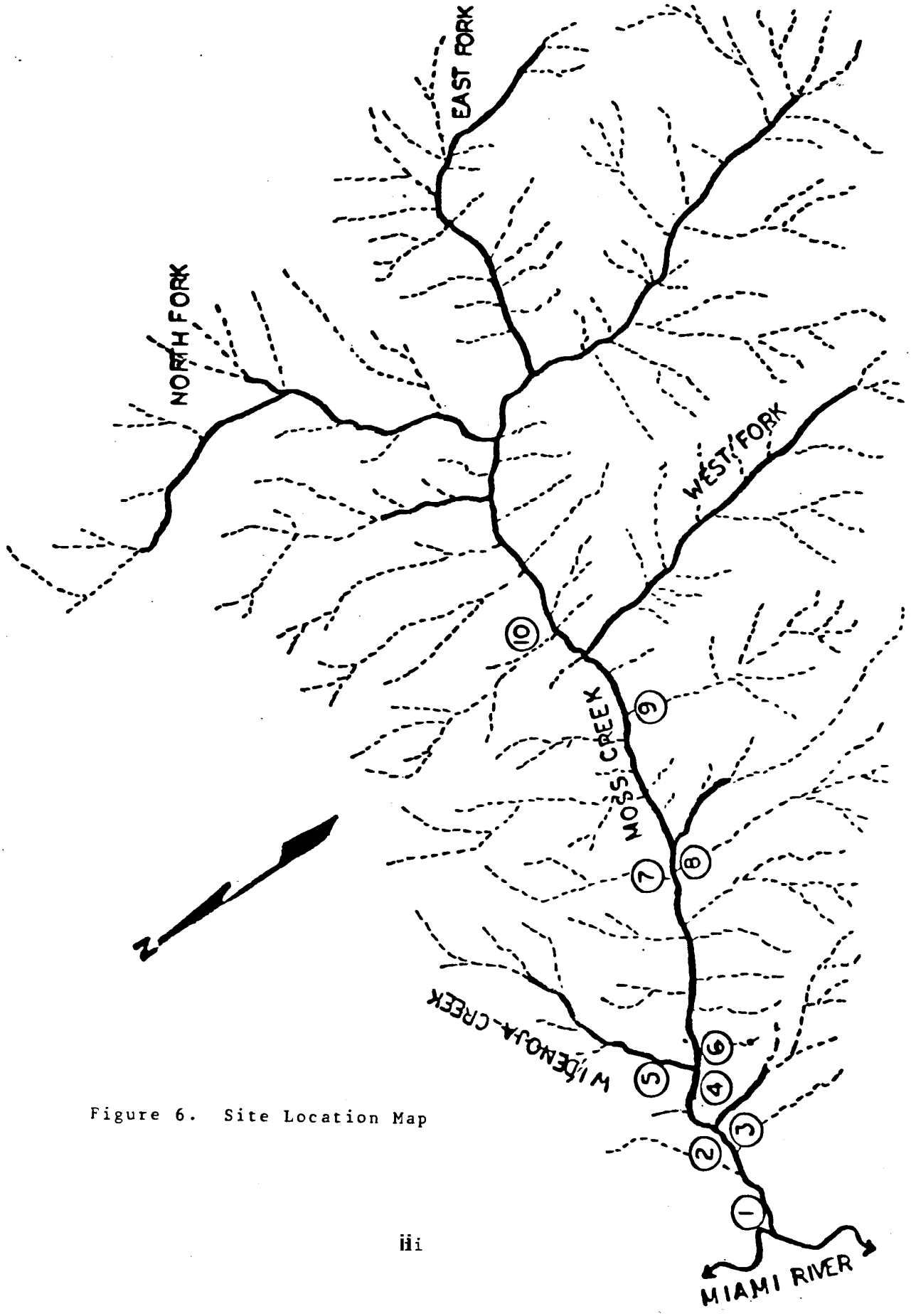


Figure 6. Site Location Map