WALLOWA-WHITMAN NATIONAL FOREST

FISHERIES HABITAT IMPROVEMENT

ANNUAL REPORT FY 1990

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GRANDE RONDE RIVER SUBBASIN

UPPER NORTH FORK JOHN DAY RIVER SUBBASIN

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INTRODUCTION

This report describes fisheries habitat improvement accomplishments on the Wallowa-Whitman National Forest (NF) during FY 1990 (April 1, 1990 - March 31, 1991). This multi-year, multi-phase fish habitat improvement effort which began in 1984, is funded under the amended (1987) Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, Measure 703(c)(l), Action Item 4.2. Principal program funding is being provided by the Bonneville Power Administration (BPA).

The overall Forest fisheries program goal is to optimize anadromous spawning and rearing habitat conditions for juvenile and adult chinook salmon and steelhead trout, thereby maximizing smolt production as a mitigation measure for fishery losses due to the mainstem Columbia River hydroelectric system. Specific goals and objectives of this fisheries habitat improvement program are detailed in the Wallowa-Whitman National Forest Habitat Improvement Plan (Uberuaga 1988).

Project activities are located on four Ranger Districts (RD) within the Wallowa-Whitman National Forest. The Baker and Unity RD administer the upper headwater portions of the North Fork of the John Day River. The Umatilla National Forest (NF) administers the remaining downstream sections on NF lands. The LaGrande, Wallowa Valley, and Eagle Cap RD's and Hells Canyon NRA administer streams on NF lands within the Grande Ronde River subbasin; the LaGrande RD being responsible for the Upper Grande Ronde and the other units the Lower Grande Ronde and tributaries.

Project Subbasin Descriptions

The Grande Ronde River subbasin is comprised of a drainage area of approximately 4,070 square miles which includes such major streams as Joseph Creek, Catherine Creek, the Upper Grande Ronde, Wenaha, Wallowa, Lostine, and Minam Rivers, as well as a few smaller tributaries (Oregon Department of Fish and Wildlife 1986). The Upper Grande Ronde Drainage, approximately 1,622 square miles, is located above the confluence of the Grande Ronde and Wallowa Rivers. There are currently four ongoing improvement projects on NF lands within this basin (Figure 1). The Joseph Creek drainage, a major drainage within the Lower Grande Ronde River, drains approximately 556 square miles and contains four major ongoing projects (Figure 2). While these upstream areas are all on NF lands, those lands below the headwaters lie primarily in private ownership. Streamflow patterns in the Grande Ronde exhibit typical spring floods common to northeast Oregon streams with minimum flows usually occurring in August or September.

The North Fork of the John Day River originates on the northeast slopes of Columbia Hill, a peak of the Elkhorn Mountain Range within the North Fork John Day Wilderness. After three miles, the stream leaves wilderness at Peavy Cabin, a local landmark, and re-enters the wilderness near the North Fork John Day Campground, approximately seven miles of non-wilderness stream. The North Fork of the John Day River is under part of the National Wild and Scenic Rivers System and is an anadromous fish emphasis

area under the Forest Plan. The river and its tributaries provide over 40 stream miles of salmon and steelhead habitat.
Anadromous fish contend with the lower three Columbia River dams with regard to upstream and downstream passage. Figure 3 identifies several John Day subbasin fisheries improvement project areas on NF lands. Additional projects may be implemented following study in FY 91.

Fisheries Resources

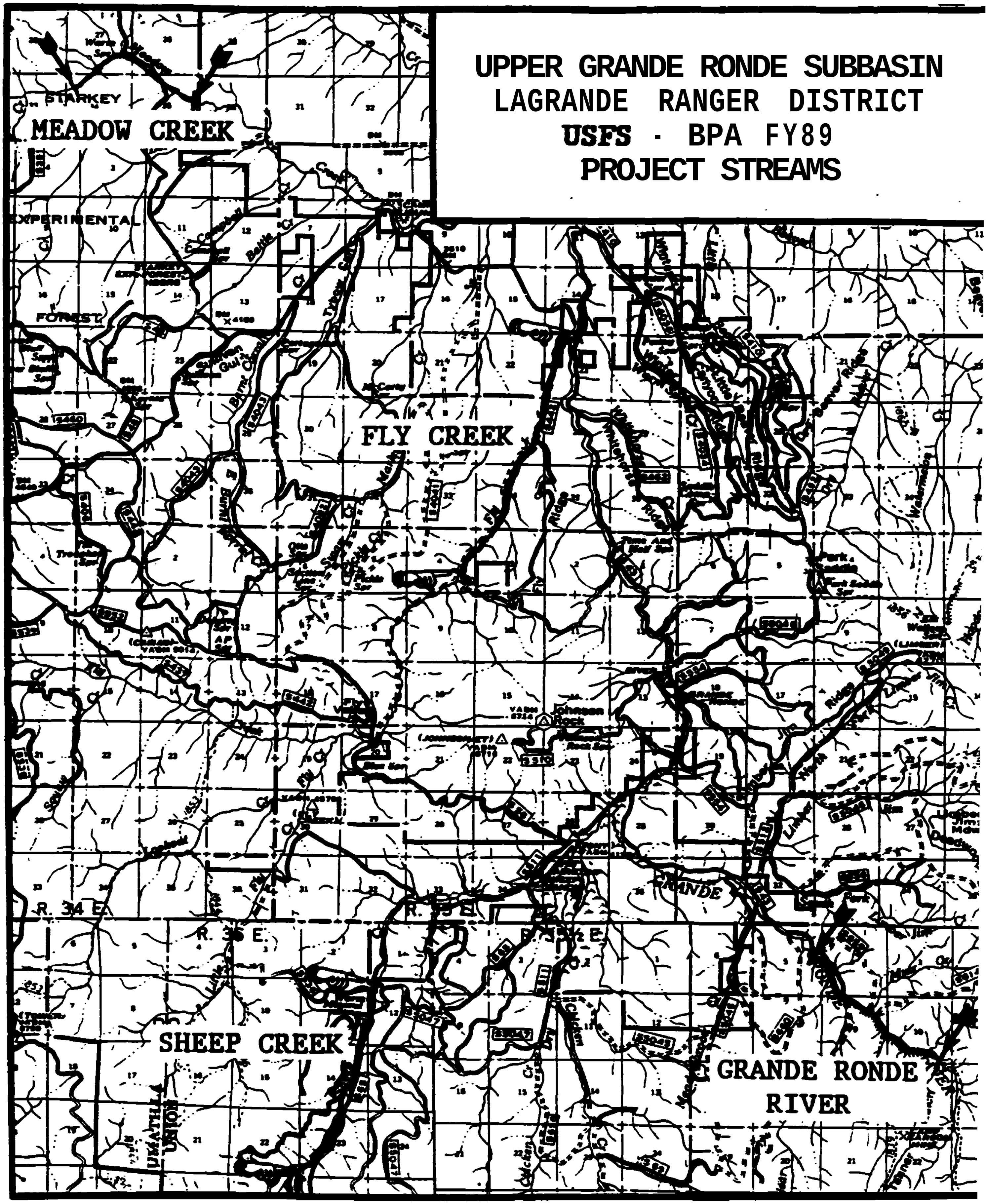
The Grande Ronde River subbasin supports both natural and hatchery runs of spring chinook salmon and steelhead trout. Natural rainbow trout and bull trout are also produced. Sockeye salmon and coho salmon runs are now extinct in the basin. Chinook salmon juveniles which are used for supplementation of natural stocks are currently being produced at Looking Glass Hatchery. A new chinook and steelhead adult trapping and juvenile outplanting facility was recently constructed (1987) at the confluence of Deer Creek (Big Canyon) and the Wallowa River. The Joseph Creek subbasin is strictly managed for wild steelhead production. Current steelhead production potential for the Grande Ronde Basin is estimated at 16,566 adults and 432,844 smolts (Oregon Department of Fish and Wildlife 1986). However, actual production is estimated to be near l0-20 percent of potential due to mainstem passage problems for juveniles and adults.

The John Day River subbasin supports the largest remaining, exclusively wild runs of spring chinook and summer steelhead in Northeast Oregon, the North Fork of the John Day River being the most important anadromous producer in the subbasin.

FIGURE 1

.4 S.

5 S.



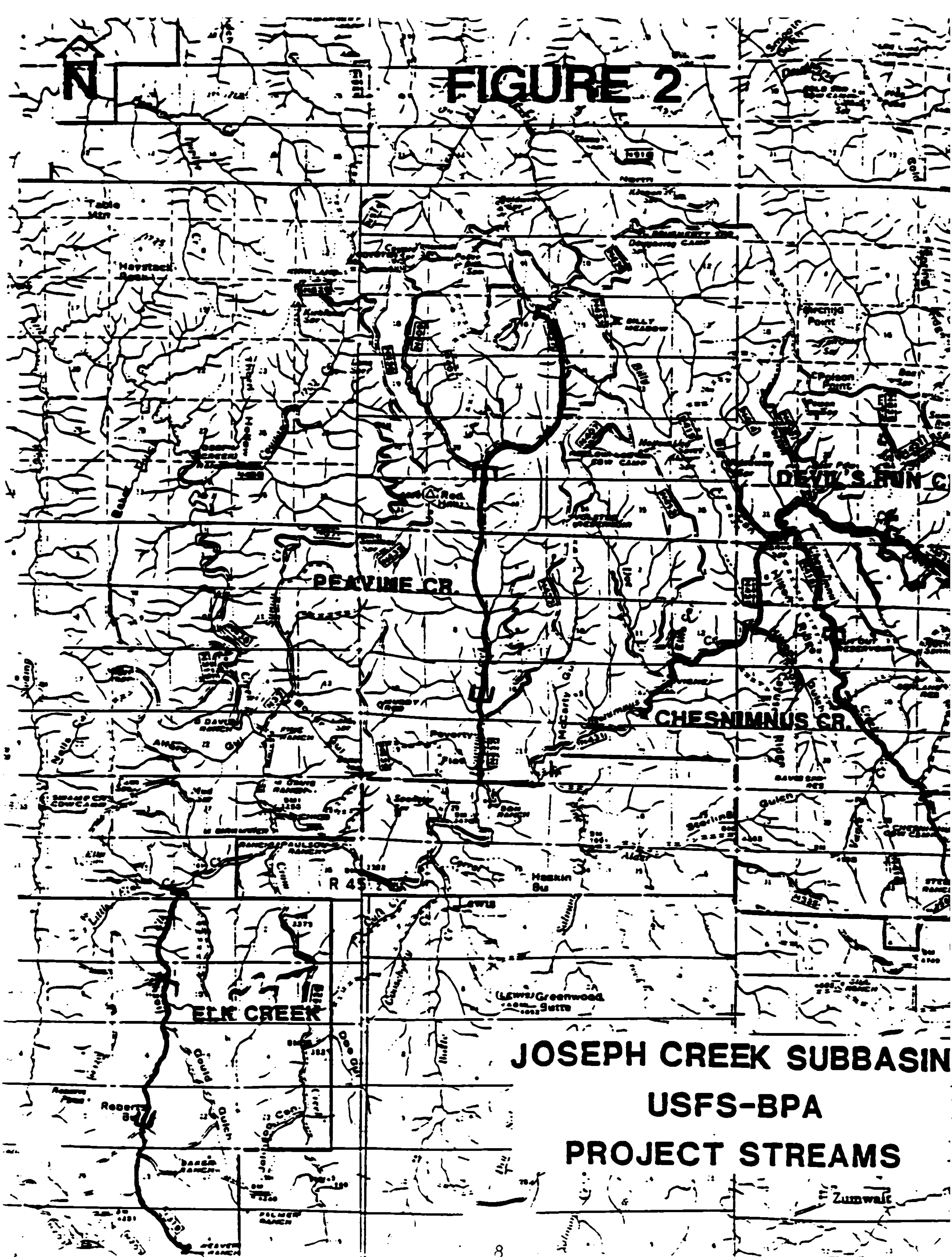


FIGURE 2

JOSEPH CREEK SUBBASIN
USFS-BPA
PROJECT STREAMS

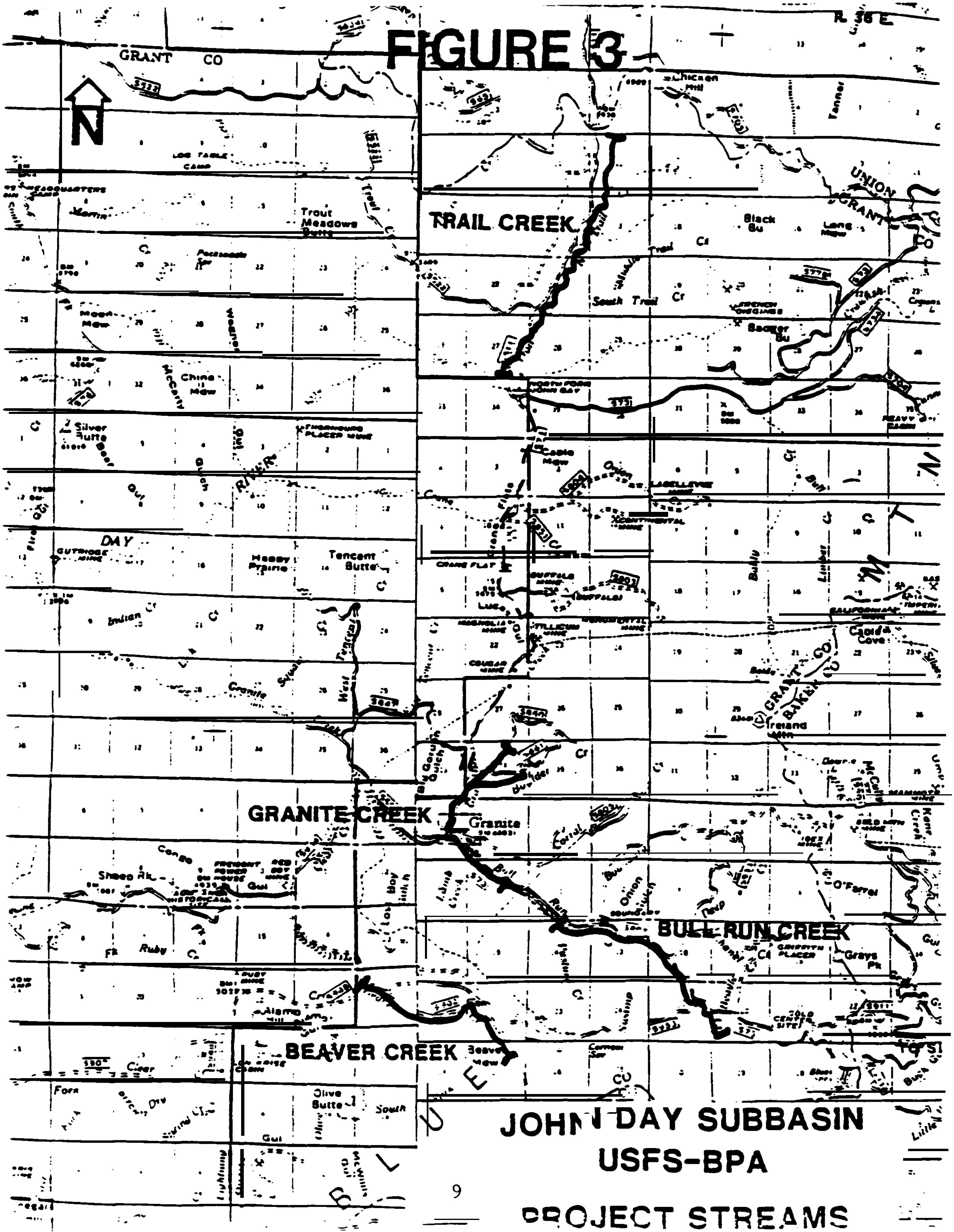


FIGURE 3

JOHN DAY SUBBASIN
USFS-BPA
PROJECT STREAMS

Limiting Factors

Historic patterns of land use in northeast Oregon have left most riparian areas in a far less productive state than their natural potential. Placer mining in the late 1800's left many streams with little or no shade, large sediment loads, and radically disturbed channels. Inadequate control of past activities such as logging, roading, and grazing left managers with degraded habitats in most cases. Farming and irrigation of cropland in the lower portions of the basins has also significantly added to habitat loss. Symptomatic of these conditions are wide, shallow streams with low summer flows and high water temperatures, channels with low diversity, and typically without adequate amounts of instream debris.

Limiting factors associated with instream and riparian habitat degradation were identified by the Oregon Department of Fish and Wildlife, USDA-FS, and Confederated Tribes of the Umatilla Reservation (James 1984). These factors are:

1. High summer water temperature - Loss of riparian vegetation and low summer flows result in water temperatures in excess of 80 degrees fahrenheit. High temperatures limit available summer smolt rearing habitat and make the cooler upstream tributaries relatively more important to salmonid production.

2. Low summer flows - Irrigation withdrawals result in extremely low flows in the Grande Ronde River. Poor watershed management practices further aggravate flow conditions, resulting in many intermittent streams which were once perennial.

3. Lack of riparian vegetation - Riparian vegetation loss, principally from ungulate overgrazing, results in many undesirable conditions. Essential fish habitat is lost along with the riparian area's ability to dampen flood peaks and increase groundwater recharge. Channels become unstable and readily erode, concentrating flows and accelerating downcdtting.

4. Lack of habitat diversity - Low habitat diversity, is caused principally from the absence of large, woody debris in and along stream channels. Wood plays a critical role in maintaining stream structure and fisheries production. Past activities such as instream debris cleaning programs, have left many streams without this critical component.

5. Lack of Channel Stability - Low channel stability results from many causes: overgrazing, improper timber harvest methods, instream timber salvage. mining operations, etc. Streams, once narrow and deep, widen out and become shallower, becoming more prone to creating new channels and down cutting. Research data released in 1991 indicates a major loss of pool habitat in the Upper Grande Ronde River except of those areas rehabilitated by the BPA/USFS habitat projects (Sedell and Everest 1991).

METHODS AND MATERIALS

FY 90 FS fisheries improvement implementation projects were performed by FS fish, wildlife, and range personnel using service type contracts for equipment use and project construction.

Riparian Vegetation Restoration

Fencing - Fencing to control ungulate use along riparian zones is a primary management approach used to protect and rehabilitate habitats. Two commonly used methods are riparian pasture fencing and riparian exclosure fencing. Pasture fencing usually encloses a wide section of riparian zone, allowing for future carefully controlled grazing. Riparian exclosure fencing results in permanent, narrow exclosures along riparian zones with no future grazing. Several streamside management unit fencing techniques are considered, i.e., conventional barbed-wire, smooth-wire New Zealand, and buck and pole.

Streamside Plantings - Streamside vegetation plantings were integrated with other rehabilitation measures to provide riparian shade and cover. This is needed to reduce water temperatures, stabilize streambanks, and supplement the release of existing natural vegetation. To ensure success and provide protection of this investment, supplemental plantings usually occurred within fenced riparian pastures or exclosures. Species most commonly planted were willow, cottonwood, alder, dogwood, and hawthorne. Plantings are made from small scions (12-16"), larger pole cuttings (3-6'). potted nursery stock from seedlings, and rooted stock from cuttings. Planting is done either by hand, auger or backhoe depending on site conditions. Planting procedures usually include scalping, excavation to the water table, mulching and fertilization.

Habitat Diversity Improvement

Adding habitat diversity to a stream channel may occur in many ways and usually results in an improvement of pool area, pool quality, spawning gravel and cover, all parameters characteristic of good habitat. The types of instream structure used include: log weirs/berms in a variety of configurations; whole tree additions with and without rootwads; rock sills/berms; rock clusters and deflectors, riprap. Both "hard" structures such as rock and log sills or weirs and "soft" structures such as whole tree additions or boulder placement were constructed. First, the sources of large woody material were identified and individual trees marked for felling. When abundant and not contributing to stream shading, trees were taken from within or near riparian zones. Soft structure additions were added at various angles, usually parallel to shore in order to maximize edge habitat. When possible, leaning trees next to the stream with attached rootwads were pushed over by the backhoe. Whole trees were cabled to their stumps or nearby debris with 3/8" galvanized cable; cabled and revetted into banks; cabled and deadmanned into banks; anchored by piling large boulders on top of the tree trunk; and left uncabled when approximately two-thirds of the tree length was above high water.

Planning, Inventorying, and Monitoring

Planning, inventory, and monitoring activities were conducted on NF lands in FY 90 in addition to habitat restoration. Each of these activities are ongoing in nature and continue to be refined.

RESULTS

Fisheries habitat improvement accomplishments during Fiscal Year 1990 occurred in four major work activities:

(1) Project monitoring, evaluation and reporting.
(2) Maintenance of previous projects.
(3) Streamside vegetation plantings.
(4) Implementation of habitat rehabilitation projects.

The following discussion presents the current status of each active project along with FY 90 accomplishments.

Wallowa Valley Ranger District

Project I - Peavine Creek

Peavine Creek, a tributary to Chesnimnus Creek, is an important contributor to wild steelhead production in the Grande Ronde River system. Spawning and rearing habitat has been reduced because of man-caused factors in recent decades. High stream temperatures and lack of pools are chronic problems in this stream. Optimum rearing habitat is severely limited. Redd counts have dropped from 22.6 per mile in 1960 to zero in 1979. The 1984 count was 1.6 per mile, and the 1990 count was 8.8 per mile.

Recent surveys of Peavine Creek indicate that existing spawning and rearing habitat is marginal for its entire length. Host historical spawning of steelhead occurred in the 4.5 mile mainstem area. This stream has a history of extremely high spring flows due to a combination of its physiographic setting and to past management activities.

Much of the undesirable situation now seen in Peavine Creek can be attributed to logging practices which took place in the 1950's. Logging access roads, skid trails, and landings constructed within or adjacent to stream channels were a primary cause of watershed deterioration. Removal of shade, increased sediments, degraded stream banks, and logging debris in channels resulted in higher stream temperatures and loss of pools needed as rearing habitat for juvenile salmonids. A subsequent result of this logging activity has been to open up the stream bottom to provide easier access for ungulates. Heavy grazing within the riparian zone and floodplain is perpetuating the problem. Young deciduous and coniferous vegetation are slow to become reestablished in the riparian zone; thus conditions are slow to recover. Optimum rearing habitat for natural runs of summer steelhead is severely limited in Peavine Creek due primarily to the lack of streamside cover and to lack of deeper pools for holding and rearing juvenile fish.

Peavine Creek was identified as the highest priority stream for rehabilitation in the Northwest Power Planning Councils,"Columbia River Basin Fish and Wildlife Program". The primary objective of this project is to initiate activities which will mitigate adverse impacts and result in optimum steelhead spawning and rearing habitat.

Historical project activities on Peavine Creek included construction of 51 instream structures (25 weirs and 26 deflectors) in 1983 to create pools and stop channel braiding. Planting of deciduous vegetation took place in 1984 on 41 acres of Peavine Creek riparian areas. Also in 1984 5.5 miles of riparian protection fence was constructed, exclosing 2.75 miles of mainstem Peavine Creek.

FY 90 project accomplishments include construction of 260 instream habitat improvement structures, consisting of boulders, whole trees, logs, root wads, artificial log jams, or combinations of these. A major emphasis was placed on "soft" structures. The objective of structure design was to imitate naturally occurring large organic matter (LOM) and reproduce these hydraulic processes. (see Appendix I for locator map, and Appendix II for Explanation and Summary sheets).

Equipment Used:

Backhoe - Case 580C	147.5 hrs at $34.50/hr =	$5,088.75
Loader - Cat 931	187.5 hrs at $34.50/hr =	$6,468.75
Truck/Trailer	21.0 hrs at $34.50/hr =	$ 724.50
Dumpbox Trailer	39.5 hrs at $34.50/hr =	$1,362.75
		$13,644.75

Project II - Wallowa Valley Streamside Vegetation Planting

This project consolidates all Wallowa Valley Ranger District streamside vegetation plantings. Vegetation plantings in riparian areas, used in conjunction with other rehabilitation measures, prove effective in providing riparian shade and cover, two essential components of good fish habitat. Portions of Chesnimnus Creek, Elk Creek, Peavine Creek and Devils Run Creek have been identified through habitat inventory as being deficient in stream shade and stabilizing streambank vegetation. This project is designed to correct that situation by continuing with ongoing, effective programs of planting deciduous trees, conifers, and by emphasizing the use of rooted native species in critical riparian areas.

In FY 90 emphasis was placed on the use of larger than seedling size native plants (or non-local stock of the same species). Two size classes were utilized, 2-6 feet tall (medium), and 6-12 feet tall (large), that were acquired, stored and planted under contract in critical fenced riparian areas.

FY 90 project accomplishments include Chesnimnus Creek, Section E, (1.35 miles divided equally into 2 exclosures) and Devils Run Creek (2.0 miles, one exclosure). Of the total number of plants 40% (480) went into Chesnimnus Creek, Section E, and 60% (720) into Devils Run Creek;

Species	Quantity
Quaking Aspen (Populus tremuloides)	100
Common Chokecherry (Prunus virginiana)	75
Dog Wood (Cornus stolonifera)	200
Willow (Salix bebiana, exigua, lasiandra, scouleriana)	200
Black Cottonwood (Populus trichocarpa)	100
Serviceberry (Amelanchier alnifolia)	75
Rose (Rosa gymnocarpa, nutkana, nutkana hispida, woodsii, woodsii ultramontana)	75
Mountain Ash (Sorbus scopulina)	100
Alder (Alnus rhombifolia. tenuifolia, sinuata)	200
Current (Ribes spp.)	75
	1200

Funding of the "Plant and Supply" contract was shared by Bonneville Power Administration (70%) and the USDA Forest Service (30%).

Project III - Administration, Monitoring, & Reporting

This project consolidates all Wallowa Valley Ranger District monitoring, evaluation, planning, and reporting.

Administration

1) Preparation of NEPA documents for project implementation
2) Presentation to FS Biologists (Wallowa Whitman N.F.) on "How to accomplish BPA project implementation"
3) Presentation to Regional Field Review Team (R6) on accomplishments of Elk Creek fisheries habitat improvement project
4) Preparation of BPA FY 91 Work Statement
5) Plan and coordinate out year implementation needs

Monitoring

1) Preparation of monitoring plan.
2) Installation of instrumentation, and data retreival and analyses of streamwater temperatures (both winter 6 summer).
3) Summarized stream morphology survey information for pre- and post-BPA projects. Data was used from 1965-66 and 1990.
4) Installation of permanent stations and measurement of riparian canopy density. Re-measurement of stations also took place.
5) Conducted riparian planting survival survey.
6) Mapping of temperature and riparian canopy stations.

Reporting

1) Preparation of Monthly reports on BPA activities and accomplishments
2) Preparation of BPA Annual Report
3) Mapping of all fisheries habitat improvement measures (e.g., instream structures, fencing)

Monitoring Discussion

Monitoring variables included streamwater temperature, stream morphology (e.g., percent of habitat types, pool depths, woody debris loading), and riparian vegetation (i.e., recovery of shade, and success of plantings). Prior to BPA work these variables were identified to be in poor condition for salmonid populations. The key for a successful stream rehabilitation program will be to improve these characteristics.

I. Streamwater Temperature

Streamwater temperature was recorded every hour during the summer months for Chesnimnus (Sec. F), Devil's Run (Exclosure 3), Elk (Exclosures 7-ll), and Peavine Creeks (Exclosures l-6). Additionally, streamwater was recorded every 2 hours during the winter months of Devil's Run Creek. Monthly maximum and minimum temperatures were determined from this data. Temperature stations were located above and below BPA fence exclosures on these streams. Data was collected with Ryan TempMentors. This data will help determine the current water quality status of these streams and evaluate the effectiveness of BPA project work.

Figure 4 shows the monthly maximum stream water temperatures for Chesnimnus, Devil's Run, Elk, and Peavine Creeks during the summer of 1990. This figure indicates that all streams, except Elk Creek, had streamwater temperature increases through the exclosure(s). The largest temperature increases,in degrees F., were 11.1 (Peavine), 8.6 (Devil's Run), and 3.0 (Chesnimnus). These temperature increases occurred during July or August between 1430 and 1630. Temperatures consistently increased through these three stream sections . Stream shading is still lacking in these streams.

Besides streamwater temperature increases the actual temperatures in these streams often exceeded State water quality standards (68 degrees F.). Peavine and Chesnimnus Creeks had especially high temperatures, 80 and 82 degrees F, respectively. These temperatures are probably lethal to rearing steelhead/rainbow trout.

Figure 5 illustrates the number of days that streams had water temperatures that exceeded State water quality standards. This graph shows the number of days streamwater temperature exceeded 68 degrees F before it entered a BPA project area (i.e., "above"). These temperatures can not be altered by BPA projects (result of upstream management). However, as water flowed through the project area the number of days increased for all streams except for Elk Creek and is associated with BPA project work. For example, in Peavine Creek there were 14 days that water temperatures exceeded 68 degrees F above the fence exclosures. At the downstream end of the exclosures the number of days increased to 48 days. This section of Peavine caused water temperatures to exceed State standards 34 additional days.

Elk Creek, however, indicates a "cooling" effect. Figure 4 shows that during the monthly maximum streamwater temperatures this BPA project area helped reduce temperatures. As much as 5 degrees F in August. Figure 5b shows the net monthly maximum streamwater temperature change through the project area in 1983 and 1990. Temperatures remained relatively constant through this area before project implementation in 1983. During 1990 streamwater temperatures, depending on the month, showed a 3-5 degrees F decrease. Reduction of water temperatures appears to be directly connected to BPA project work rather than a meteorological change (i.e., wetter conditions; more water available in watershed for cooling). Summer flows for rivers in nearby basins were actually lower in 1990 than 1983 (20-40% lower depending on the month).

Streamwater temperatures in Elk Creek, still exceed State water quality standards. There were 51 days where streamwater temperatures exceeded 68 degrees F. above the BPA project area (Figure 5a). However, unlike Devil's run, Peavine and Chesnimnus Creeks, Elk Creek helped reduce these number of days to 38. This suggests that stream shading (riparian plantings) as well as the retention of soil and water (stream structures) are effecting streamwater temperatures.

Elk Creek, after 5-6 years, is beginning to recover. Rate of improvement in the future should be faster on Elk Creek as riparian plantings are at a height where their canopy is beginning to overhang the stream. If Elk Creek is an example of what is to come from other BPA project streams then changes in streamwater temperature would be expected in 1995-1996. But this depends on the initial conditions of the stream (e.g.. amount of soil loss, location of water table) and the survival of riparian plantings.

Winter streamwater temperatures were measured in Devil's Run. Temperatures changed slightly between above and below BPA fence exclosures. Minimum streamwater temperatures were below 32 degrees F. for December through Febuary. March and April had temperatures of 33 and 35 degrees F, respectively. Very little is known about winter conditions and salmonid populations. A frozen stream, however, provides poor habitat diversity especially in shallow stream systems. Also, frozen streams cause soil erosion to banks during ice break up. Hence, the goal of BPA project work is too reduce the amount of time the stream remains frozen. Theories suggest that as riparian vegetation returns this vegetation will help "hold" the heat within the stream and subsequently reduce freezing the stream. By continuing to monitor winter streamwater temperatures this data will help determine if such a hypothesis is correct.

1990 SUMMER STREAMWATER TEMPERATURES

[above & below exclosures]

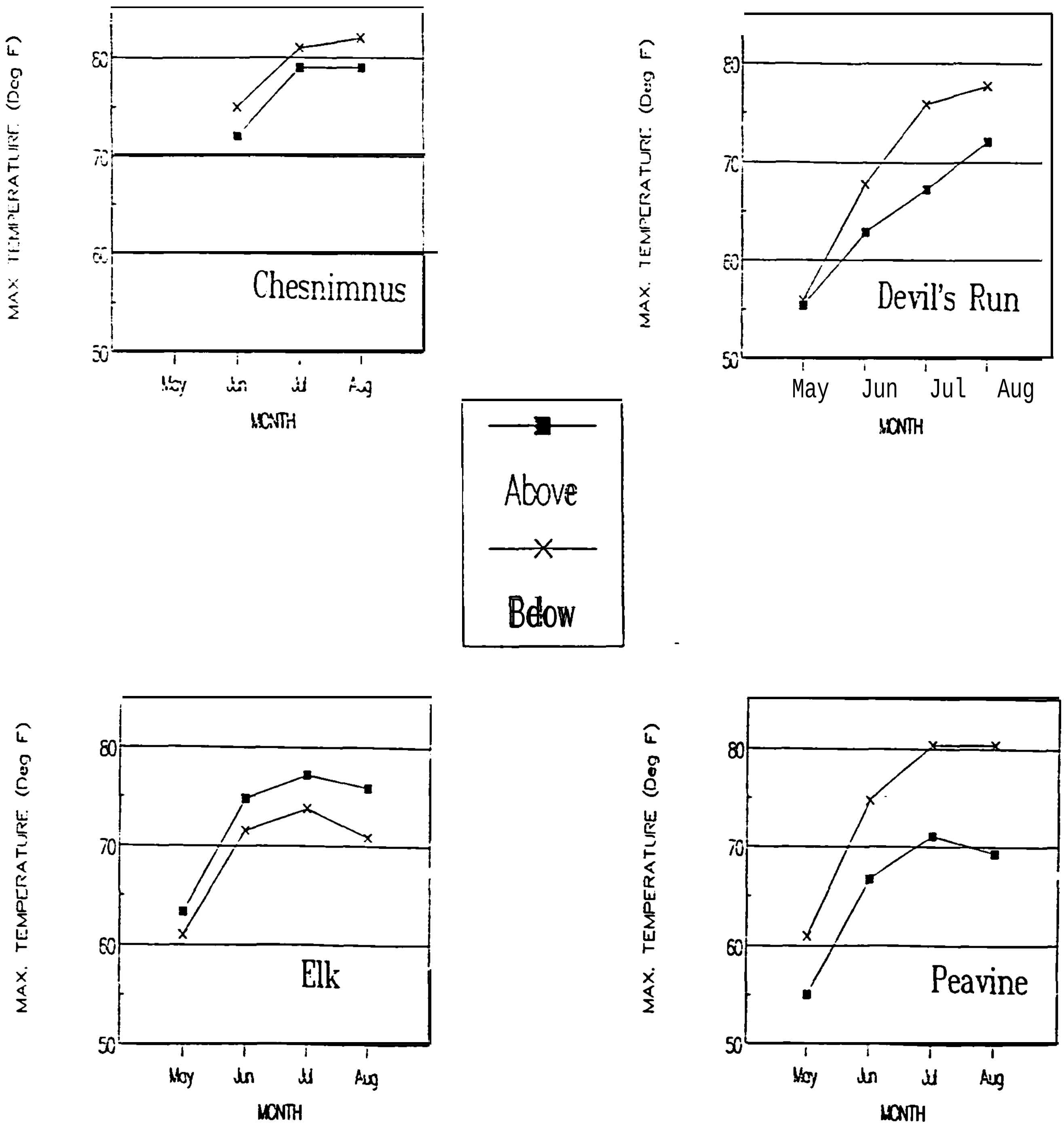


Figure 4 Monthly maximum streamwater temperatures above and below BPA fence exclosures for Chesnimnus, Devil's Run, Elk, and Peavine Creeks during 1990.

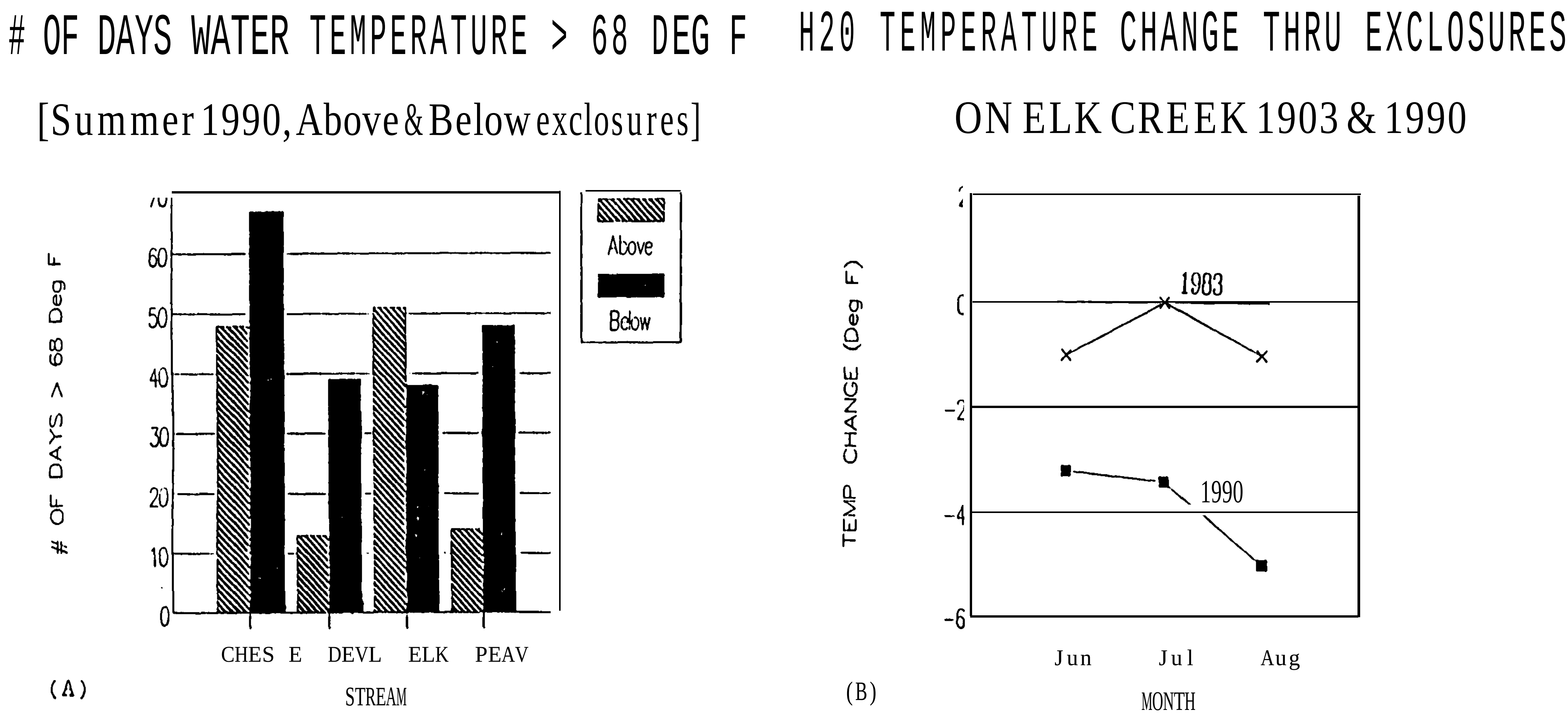


Figure 5 (a) The number of days streamwater temperature exceeded 68 degrees F. above and below BPA fence exclosures for Chesnimnus, Devils Run, Elk, and Peavine Creeks, and (b) The net change in summer streamwater temperatures after passing through BPA fence exclosures for Elk Creek during 1983 and 1990.

II. Stream Morphology

Five streams were surveyed during the summer of 1990 (funding for these surveys were from USDA Forest Service). Surveys were conducted on Chesnimnus. Devil's Run, Elk, and Peavine Creeks. The Hankin and Reeves stream survey method (1988) was used to collect stream information. The information collected included: percentage of habitat types, average residual pool depth, total woody debris pieces/mile, and bankfull channel width/depth ratio. Such information indicates the morphology of the stream and therefore the suitability for salmonid populations. Moreover, these stream characteristics can be measured in subsequent years to help determine the effectiveness of BPA projects. Described below and listed in Table 1 are the results of these stream surveys.

Chesnimnus Creek (Sec. G) had no BPA rehabilitation work. This survey was conducted to examine the current condition of this section of stream. Compared to other streams in this area the percentage of pools were relatively high (36% of the available habitat and 43.7 pools/mile). However, these pools were generally small, shallow, and wide [residual pool depth of 1.0 ft. and a high bankfull channel width to depth ratio (16.7)]. Additionally, woody debris loading was low to moderate (89 pieces/mile). Some stream rehabilitation may improve these characteristics. Installation of "soft" structures would help increase the number of pools, increase their depth, and trap sediment to reduce the channel width.

Chesnimnus Creek (Sec. E) had "soft" structures installed and two fence exclosures constructed this summer. A stream survey was conducted after this work was completed. Glides were the dominant habitat type (56%) while pools only made up 12% of the habitat area. Pools were shallow (residual pool depth of 1.5 ft) and wide (bankfull width to depth ratio was 21.8). Total woody debris loading was high (219 pieces/mile) and was probably attributed to the installation of "soft" structures.

Devil's Run (Exclosures 1-3) had "soft" structures installed and three exclosure constructed during the summer of 1989. Riffles made up the dominant habitat type (76%) while pools had only 6% of the avaiable stream area. Pools were shallow (residual pool depth was 1.2 ft). Total woody debris loading was moderate when compared to other streams in this area (125 pieces/mile). Based on other streams in this area and past logging activities this level of woody debris is probably a result of the installation of "soft" structures.

Elk Creek (Exclosures 7-11) has had fence exclosures built (1985), "hard" structures installed (1984). and riparian trees planted (1985,1989). The log weirs seemed to help create deep pools (residual depth of 2.1 ft) but the percentage of pools still remains fair (17%). Woody debris loading was fair (105 pieces/mile). For this size stream the bankfull channel width to depth ratio is still relatively high (13.3).

Peavine Creek (Exclosures l-6) had the stream survey conducted prior to the installation of "soft" structures during the summer of 1990. Before this time Peavine Creek had 5 log weirs installed (1983) and six riparian fence exclosures constructed (1984). Riffles made up 88% of the stream habitat types while pools had 6% of the available stream area. The pools were generally shallow (residual pool depth of 1.1 ft). Total woody debris loading was very low (31 pieces/mile).

In summary, the initial results of the installation of "soft" structures is not surprising; the amount of woody debris loading increases [e.g., compare Devil's Run and Chesnimnus (E) to Peavine and Chesnimnus (G)]. The primary goals of this wood are to help increase the number of pools by scouring the channel bottom and reducing the channel width by trapping sediment. Number of pools and bankfull channel width to depth ratio are still in poor to fair condition in these streams. This result is as expected as pool formation and channel width changes take time. How much time is still elusive. If Figure 6 is any indication then we still have a long way to go to achieve the percentage of pools measured in 1965-66. For example, Chesnimnus Creek (Sec E) had 62% pools in 1965 but today is only at 12%. Additionally, examining Elk Creek, where "hard" structures were installed in 1984, it is still only at approximately 30% of its pool habitat potential after 6 years. Other functions of streams (e.g., riparian root mass helps stabilize banks) work in conjuction with woody debris inputs to help create pools; pool formation depends on other functions besides woody debris inputs; processes associated with these functions (e.g., channel sinuosity) will recover at different rates. Hence, even though woody debris is present pool formation may take more time to occur. Future surveys will help to determine these rates of recovery.

Table 1: Stream morphology characteristics for Chesnimnus, Devil's Run, Elk, and Peavine Creeks. (1990 Stream survey)

STREAM MORPHOLOGY CHARACTERISTICS

STREAM NAME	LENGTH OF SURVEY (MILES)	% OF HABITAT UNITS POOL	RIFFLE	GLIDE	# POOLS PER MILE	RESIDUAL POOL DEP. (FT)	WOODY DEBRIS (#/MILE)	BANKFULL WIDTH/DEP RATIO	COMMENTS
CHESNIM (SEC G)	1.2	36	15	49	43.7	1.0	89	16.7	PRE-PROJECT.
CHESNIM (SEC E)	1.3	12	32	56	22.2	2.1	219	21.8	ONE MONTH AFTER WOODY DEBRIS INSTALLED.
DEVIL'S RUN	2.3	6	76	18	13.2	1.2	125	11.7	ONE YEAR AFTER WOODY DEBRIS INSTALLED.
ELK	2.8	17	35	48	26.8	2.1	105	13.3	POST PROJECT. (APPROX. 6 YEARS)
PEAVINE	4.4	6	88	6	20.7	1.1	31	10.7	PRE-PROJECT.

PERCENTAGE OF POOLS

[1965-66 ODF&W, 1990 USFS]

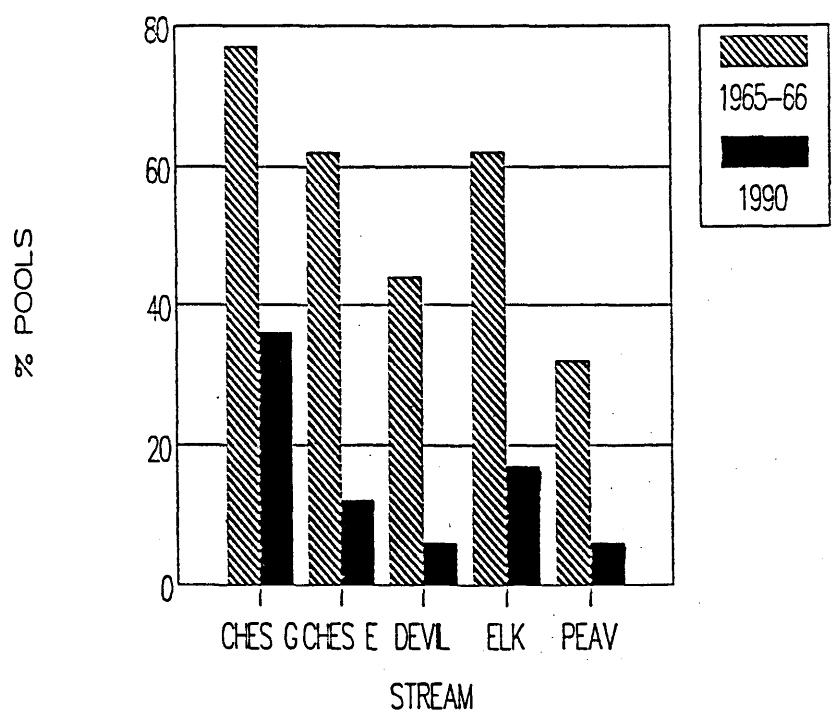


Figure 6: Percentage of pools in Chesnimnus, Devil's Run, Elk, and Peavine Creeks during 1965-66 and 1990.

III. Riparian Vegetation

Permanent transect stations were installed within BPA project areas in Devil's Run (20 stations) and Peavine (15 stations) Creeks. These stations will measure the success in re-establishing riparian vegetation and ultimately streamside shade. Canopy density is used as an index for determining the amount of shade; it is the percentage of vegetation covering the stream. Canopy density measurements were taken with a spherical densiometer according to the methodology described in Platts et al. (1987).

Canopy density was measured on all stations of Devil's Run and Peavine Creek. Both these sections of streams are capable of achieving at least 75% canopy density. Streams are still far from their riparian growth potential (Figure 7). For example, fence exclosures 1 and 2 on Peavine Creek had canopy densities of 23%. Exclosures 1, 2, and 4 on Peavine Creek and exclosures 1 and 3 on Devil's Run Creek are scheduled for riparian plantings in 1991. Exclosures 3, 5 and 6 on Peavine Creek were planted in 1988. From streamwater temperature data on Elk Creek canopy densities appear to begin significantly changing in 5-6 years as the plant's crown develops.

Survival of 1989 plantings were conducted on fence exclosures 7-11. Overall the percentage of survival of all planted species was approximately 70% (Figure 7). Individual plant species varied and their associated survival percentage is list below: Aspen (92%), Choke Cherry (63%), Dogwood (80%), and Willow (68%). Future survival surveys are planned for FY91. Such surveys will help determine (1) how well species survive in various environments (i.e., aspect, elevation) and (2) future selection of riparian planting projects.

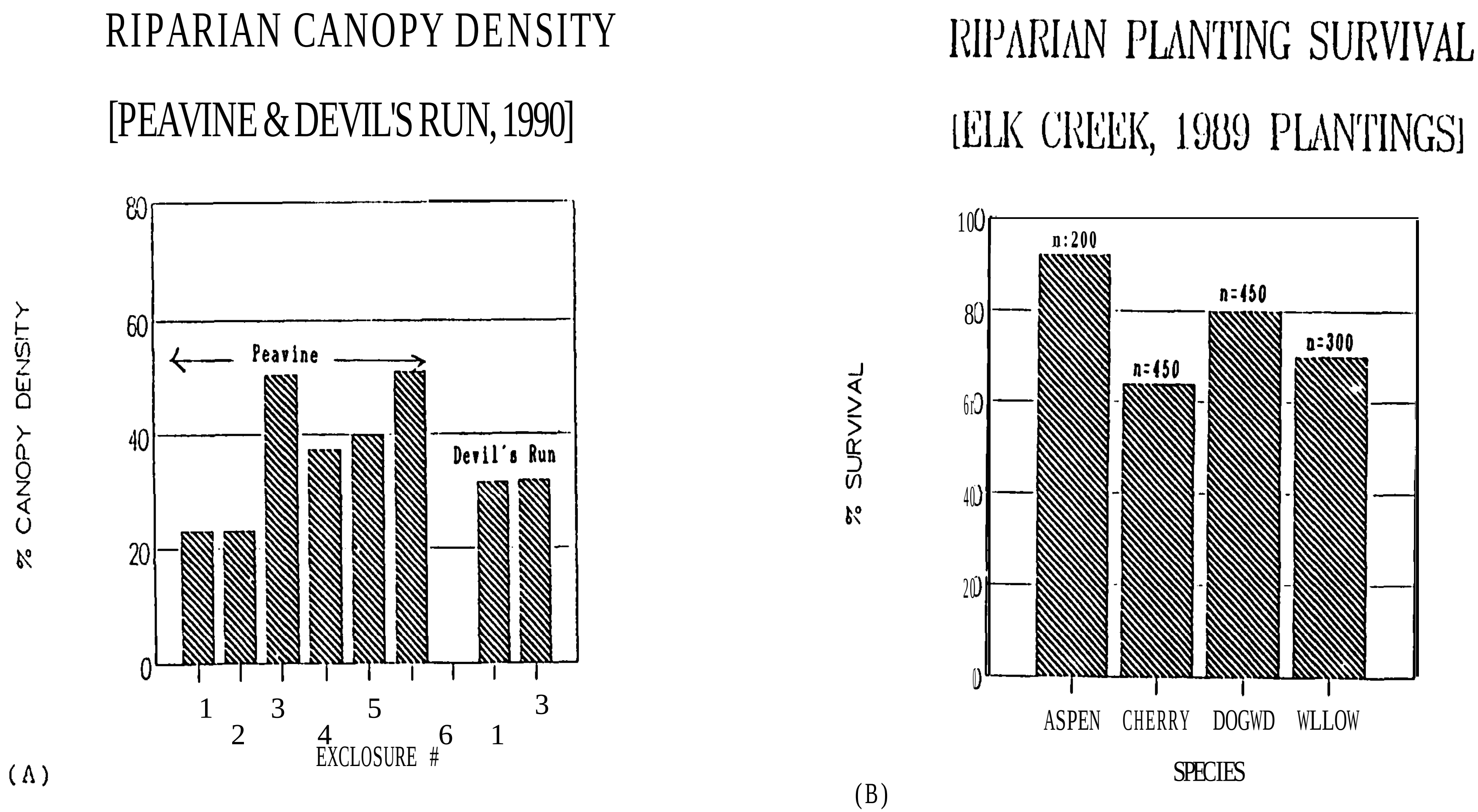


Figure 7: (a) Average riparian canopy density in BPA fence exclosures for Peavine and Devil's Run Creeks during summer 1990, and (b) percent survival rate of 1989 riparian plantings in Elk Creek .

Project IV - Wallowa Valley Maintenance

This project consolidates all Wallowa Valley Ranger District maintenance of exclosure fences and instream habitat improvement structures.

Fencing

Maintenance of a total of 31.3 miles of exclosure fencing (15.65 miles of stream) was accomplished. Maintenance was initiated prior to the start of the grazing season to repair damage occurring during the winter months (e.g., deadfall, blowdown). Maintenance continued through the grazing season at monthly intervals and as damage was reported during the physical monitoring phase or as reports of damage were received (e.g., tighten wire, mend broken wires).

Table 2.

STREAM NAME	FENCING		
	MILES OF	TYPE OF	STREAM EXCL.
CHESNIMNUS	15.0	4-STRAND BARBED	7.50
DEVILS RUN	4.00	4-STRAND BARBED	2.00
ELK	5.80	4-STRAND BARBED	2.90
PEAVINE	5.50	ELECTRIC	2.75
	1.00	5-STRAND BARBED	0.50

Instream Structure

Structural maintenance of instream structures was identified during the physical monitoring phase of the maintenance activity. If desired results were not being achieved maintenance was performed. A total of 3 log weirs required maintenance, two required the re-laying of the apron, and one required stabilization of the log ends with additional rip-rap. All maintenance required the use of a backhoe.

Table 3.

STREAM NAME	INSTREAM STRUCTURES MAINTENANCE PERFORMED
CHESNIMNUS	
SEG. C	1 LOG WEIR
SEG. F	1 LOG WEIR
ELK	1 LOG WEIR

Baker Ranger District

Project V - Trail Creek Instream Structures

Trail Creek, a tributary to the Upper North Fork John Day River, is an important resident trout and summer steelhead stream. North Trail and South Trail tributaries are ODFW steelhead spawning index streams. The 5 year average redd/mile count on the Trail Creek system is among the lowest of 30 steelhead index streams in the John Day Basin (Claire and Smith, 1989 John Day District Annual Report). A 1989 habitat inventory indicated a pool/riffle/glide ratio of 13/78/9 on Main Trail Creek, which includes the 1990 BPA project area. Cover was also identified as a limiting factor in 1987 and 1989 surveys. Previous impacts include sheep grazing, mining, and timber harvests. Sheep grazing was discontinued prior to the mid-1980's.

During FY 1990 instream structure additions consisted of 65 log/whole tree structures (includes single log deflectors, 2-3 log deflectors, bank erosion stabilizers, and cover additions), 10 boulder clusters, 6 boulder deflectors, 3 boulder weirs, and 1 boulder upstream V-structure. The project length was approximately 1.5 miles, ending at downstream and upstream boundaries where the present woody debris levels and stream complexity increased naturally. The bottom l/4 mile of South Trail Creek, which occurs within the project area was excavated of a cobble debris deposit which had filled the channel and blocked steelhead travel since spring of 1989.

Logs, selected on-site trees, and boulders were delivered to structure sites with a rubber-tired backhoe. Structures and excavation were completed by a tracked hydraulic excavator. The two pieces of heavy equipment and their operators were procured with a personal services rental contract. Logs were delivered by a purchase order agreement with a local operator. Both access routes to the project meadow site were barricaded in the fall of 1990 to allow for meadow recovery and to discourage woodcutters from taking the remaining snags. Remaining FY 90 accomplishments include structure tagging and location mapping.

Project VI - Administration, Monitoring, & Reporting - Baker and Unity RD

Administration

Preparation of NEPA documentation and acquiring required permits.

Update and preparation of 1991-1995 implementation plan needs.

Contract preparation.

Monitoring

Establishment of photo points on Trail Creek and Beaver Creek.
Trail Creek: Four riparian monitoring photo points and 88 structure photos.
Beaver Creek: Six riparian/stream monitoring photo points.

USFS funded Hankin & Reeves survey of Beaver Creek, Boundary Creek, and portions of Corral, Granite, and Boulder Creeks.
Beaver Creek: 2.5 miles
Boundary Creek: 3.7 miles
Corral Creek: 2.0 miles
Granite Creek: 1.24 miles
Boulder Creek: 1.25 miles

Spot temperature monitoring of Bull Run and Granite Creeks.
Bull Run: Five temp readings 6/15-8/21, high temperature of 69 F.
Granite Creek: Ten temp readings 6/15-8/21, high of 67 F.

Reporting

Preparation of monthly reports on BPA activities and accomplishments.

Preparation of PBA Annual Report.

LaGrande Ranger District

Project VII - Meadow Creek

Meadow Creek, a major subbasin of the Upper Grande Ronde River, lies within the Starkey Experimental Forest boundary. Meadow Creek and its riparian zone have a long history of impacts dating back to early logging activities. Grazing has further impacted the riparian community. Salmonid populations in Meadow Creek are composed of anadromous summer steelhead trout and resident rainbow trout. Historic Umatilla Indian tribal records document chinook salmon production in this stream. An extensive biological data base exists from aquatic research conducted since 1977.

The Meadow Creek project is a jointly funded BPA-FS improvement and evaluation project. The FS is responsible for funding all pre and post project improvement evaluations while BPA funds the planned implementation activities. The Pacific Northwest Research Station conducted both spring and fall out-migrant smolt sampling during FY 87. Their personnel also conducted an analysis of large woody debris, comparing current conditions to those of a historical U.S. Fish and Wildlife Service inventory. During FY 87, the FS also contracted with Washington State University to conduct a complete hydrological analysis of the Meadow Creek drainage, including design and location of proposal improvement structures. A research design was prepared by PNW in 1988 which identifies evaluation objectives for 22,400 feet of stream.

Further analysis of pre-enhancement data (Everest and Boehne M.S.) revealed that the primary limiting factor was the lack of large pools with high quality cover. This indicated a need to revise the original work plan. Fred Everest and Jim Sedell from PNW research lab along with John Anderson (forest fish biologist) and district fisheries personnel developed a revised work plan which utilizes woody debris as the primary structure material. The detailed work plan is available on request and contains information on specific habitat improvement measures at different locations including structure objectives and construction design evaluations. This work plan was interfaced with the long term research design.

FY 90 project accomplishments include the improvement of the access road, acquisition of New Zealand fencing wire for installation in FY91, and the installation of 405 instream habitat improvement structures. These consisted of whole tree additions, "vee" structures, diagonal sill deflectors, root wads, artificial log jams, or a combination of these.

Project VIII - Upper Grande Ronde River

The Upper Grande Ronde River (RM 194-212) drains an area of approximately 69 square miles. A FY 85 habitat inventory of the upper reaches identified approximately three miles of poor quality salmon and steelhead spawning/rearing habitat, due primarily to past mining activities. A hydrological engineering evaluation in June 1987 provided the final design for structure placement. Specific project objectives were: (1) adult holding pool construction, (2) spawning gravel retention, and (3) increase juvenile habitat diversity. Implementation work commenced in FY 87 on one mile of stream. Approximately one mile of additional mainstem stream was improved during FY 88 with a total addition of over 230 soft structures, and construction of 90 large pools. Specific details describing type and location of structures can be found in the FY 87 and FY 88 annual reports. Construction work has been confined to a narrow time frame between July 1 and August 15 due to the timing of spring chinook spawning activity. Construction has been accomplished with a personal services rental contract for a Model 201-C Hydra excavator with operator, a 580-C Case tractor and dump truck. Additional boulders and logs were stockpiled in FY 88 for initiating construction on the last mile of stream. Instream structure work and bend repairs scheduled for FY 89 was deferred to FY91. Preparatory supplies and materials needed for the next mile of construction are stockpiled at the district.

FY 90 accomplishments include the purchase of two interpretive signs, and the acquisition of 50 structure logs to be used in the instream habitat rehabilitation project planned for FY91.

Project IX - Fly Creek

Fly Creek, a significant tributary to the Upper Grande Ronde at river mile 184, has a drainage area of 52 square miles and a stream length of about 16 miles. The stream is characterized by two general reaches. The upper B-mile reach of stream (Fly and Little Fly) lies on private land and is a low gradient, meandering meadow-dominated reach that has been impacted by livestock grazing.

The lower 7-mile reach lies on NF lands and is a low-moderate gradient stream coursing the first mile through a meadow bottom into a narrow valley. A 1985 habitat inventory identified a pool/riffle ratio of .2/.8 with low quality pools and little instream structure. Previous impacts include livestock grazing, roading and logging. Habitat objectives included increasing pool quality and quantity, diversifying instream habitat for rearing steelhead trout and increasing streambank stability. Approximately 250 instream structure additions occurred in FY 87, consisting of 56 hard structures (log weirs) and 194 soft structures (whole tree additions). Instream structure additions continued during FY 88 resulting in a total of 354 whole tree additions, 80 weirs, 5 boulder groups and 3 side channel excavations over the 7 mile reach. All structures were placed with a personal services rental contract for a backhoe and operator during June through September.

Considerable effort was also spent during FY 88 to close the Fly Creek road and its five stream crossings. Physical barriers were excavated at the top of the project above the first stream crossing and downstream at the Forest boundary. The closure was subsequently reinforced in FY 89 by district road maintenance crews to include ripping, seeding and cross drains.

The fence location has been coordinated with the grazing permitee and a one mile meadow dominated reach was laid out in FY 89 to include watering and crossing sites for sheep. Contract specifications for New Zealand smooth wire fence was adjusted for a sheep type exclosure.

FY 90 accomplishments include the construction of 2.1 miles of New Zealand smooth wire fencing.

Project X - Administration, Monitoring and Reporting

Monitoring

1) Reading permanent photopoints on Sheep Creek.
2) Structure effectiveness evaluation with random photo monitoring on Fly Creek and Upper Grande Ronde River.
3) Sediment embeddedness sampling on the Upper Grande Ronde River.
4) Establishment of 60 photo points on Meadow Creek.
5) Photo albums, structure evaluation documents and embeddedness data are available at the district upon request.

Administrative

1) Review and comment on subbasin planning activity.
2) Update and preparation of 1990 - 1995 implementation plan needs with projected budgets for active and new projects.
3) Coordinating NEPA document changes and acquiring required permits.
4) Coordination and evaluation of objectives for the Meadow Creek project design with PNW scientists.
5) Field coordination of fence design and layout with permittees.
6) Coordination with engineers for access road development.
7) Contract preparation.

Reporting

1) Preparation of monthly reports on BPA project activities and accomplishments.
2) Preparation of BPA annual report.
3) Map preparation for all fisheries habitat improvement projects.

Project XI Maintenance

All previously placed instream structures and riparian fencing areas were checked for maintenance needs and all necessary maintenance was completed. Maintenance consisted primarily of rip-rap reinforcement of weir key ends and adjustment of soft structure configuration and was completed using hand equipment.

Due to the low levels of spring runoff, there were no major structure failures.

The table 1. displays the projects monitored for maintenance needs in FY90.

Table 4.

STREAM NAME	FENCING		INSTREAM STRUCTURES		
	TYPE	LENGTH	TYPE	MILES	NUMBER
SHEEP CREEK	BARBED	1.6 MI.	HARD SOFT	3.0	101 0
FLY CREEK	SMOOTH	2.1 MI.	HARD SOFT	6.0	112 388
UPPER GRAND RONDE RIVER			HARD SOFT	2.0	95 330

Sheep Creek

Sheep Creek is tributary to the Grande Ronde River at RM 197. The drainage area comprises approximately 58 square miles. Eleven miles of stream contain spawning and rearing habitat for chinook salmon. The upper two miles of stream lie on NF land and is characterized by a moderate gradient, narrow valley floor, which is heavily timbered. The middle three miles are characterized by a low gradient, meadow/timber complex with a high degree of meander. The remaining six miles of stream are low gradient, meadow dominant, and lie on private land. Watershed uses and impacts include roading, logging, livestock grazing, and loss of lodgepole pine stands from insect epidemics.

Sheep Creek has received aquatic habitat improvements over a number of years. In 1980, a riparian pasture fence was constructed along one mile of stream, followed by the addition of 101 structures in 1985, creating 10,489 and 3,228 square feet of pool and cover areas, respectively.

In FY 86, riparian pasture fencing was constructed along an additional 1.6 miles of stream.

A June 1987 habitat improvement project evaluation contract with hydrologist John Osborne, Washington State University, recommended digger log modifications and additional large woody debris placements along Sheep Creek. Twenty-seven structures were modified during FY 87.

Task accomplishment for 1988 included normal fence maintenance, photo point evaluation of structure effectiveness and planting of 3,000 3 year old Engelmann spruce trees, 2,000 deciduous cuttings and 3,000 deciduous nursery stock. Deciduous stock was comprised of native alder, hawthorne, willow, red-osier dogwood and black cottonwood. First year estimates of survival appear to be 80% for the spruce and 50% for the deciduous stock.

During FY 89 additional modification was done on the remaining digger logs. An additional 300 rooted deciduous stock (hawthorne and alder) were spot planted along 1500 ft. of stream. Second year estimates of survival appear to be leveling at 60% for spruce and 40% for the deciduous stock.

FY 90 accomplishments include maintenance surveys of the project area including photo point monitoring.

SUMMARY AND CONCLUSIONS

Significant progress in stream habitat restoration continues to occur within the two project subbasins. The work accomplished in 1990 marks the end of the five year contract period for the Grande Ronde and John Day Projects. Work proposed in the FY90 project was accomplished in a timely manner and to professional standards.

A number of events occurred during the contract period that set a direction for the future of BPA-USFS cooperate project development. The concept of holistic watershed management, although always considered, has moved to the forefront of managerial thinking. Field reviews and managerial meetings between Forest Service and BPA administrators has resulted in agreements to use watershed wide management concepts in all future projects. Emphasis on watershed-wide plans by BPA. The Columbia Basin Anadromous Fish Policy of the Forest Service and the Forest Plan are promoting a new and progressive environment for stream rehabilitation projects.

The projects created through BPA funding have allowed the development of new stream technology and research. Research work partially funded by BPA at Meadow Creek is expected to be instrumental in furthering adaptive management course changes in stream rehabilitation on the Forest and in the Columbia Basin.

System and subbasin planning efforts are proving instrumental in reaching short term improvement goals and providing long-term direction. The Wallowa-Whitman has acknowledged the abundant opportunities for habitat improvement and in less than two years has added expert fisheries staff to both the Forest and District levels. It is anticipated that project plans for FY92 and into the future will be steadily expanding and improving.

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APPENDICES

APPENDIX I

BPA-USFS PROJECT LOCATOR MAPS

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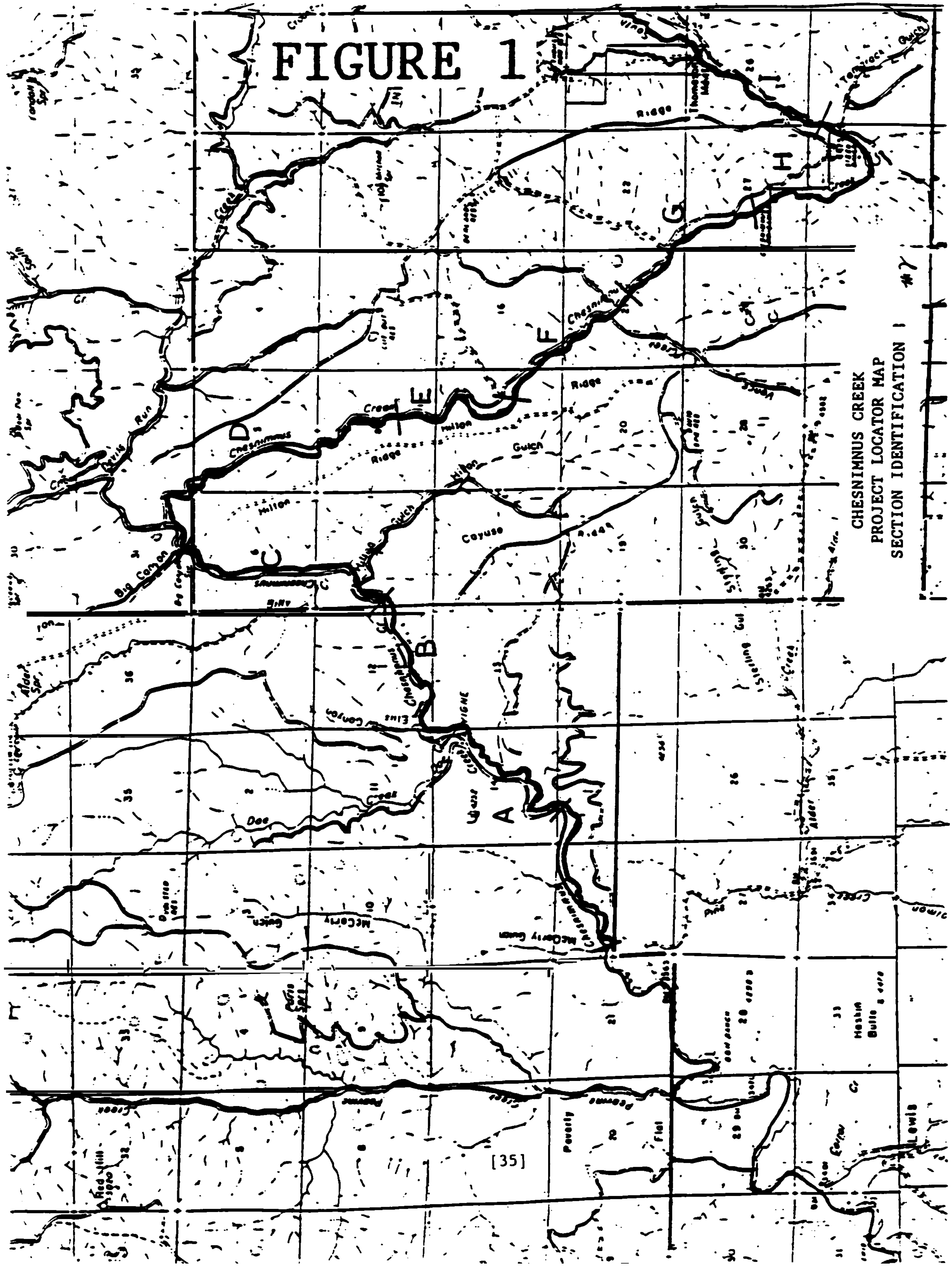
FIGURE 1



CHESNIMNUS CREEK
PROJECT LOCATOR MAP
SECTION IDENTIFICATION

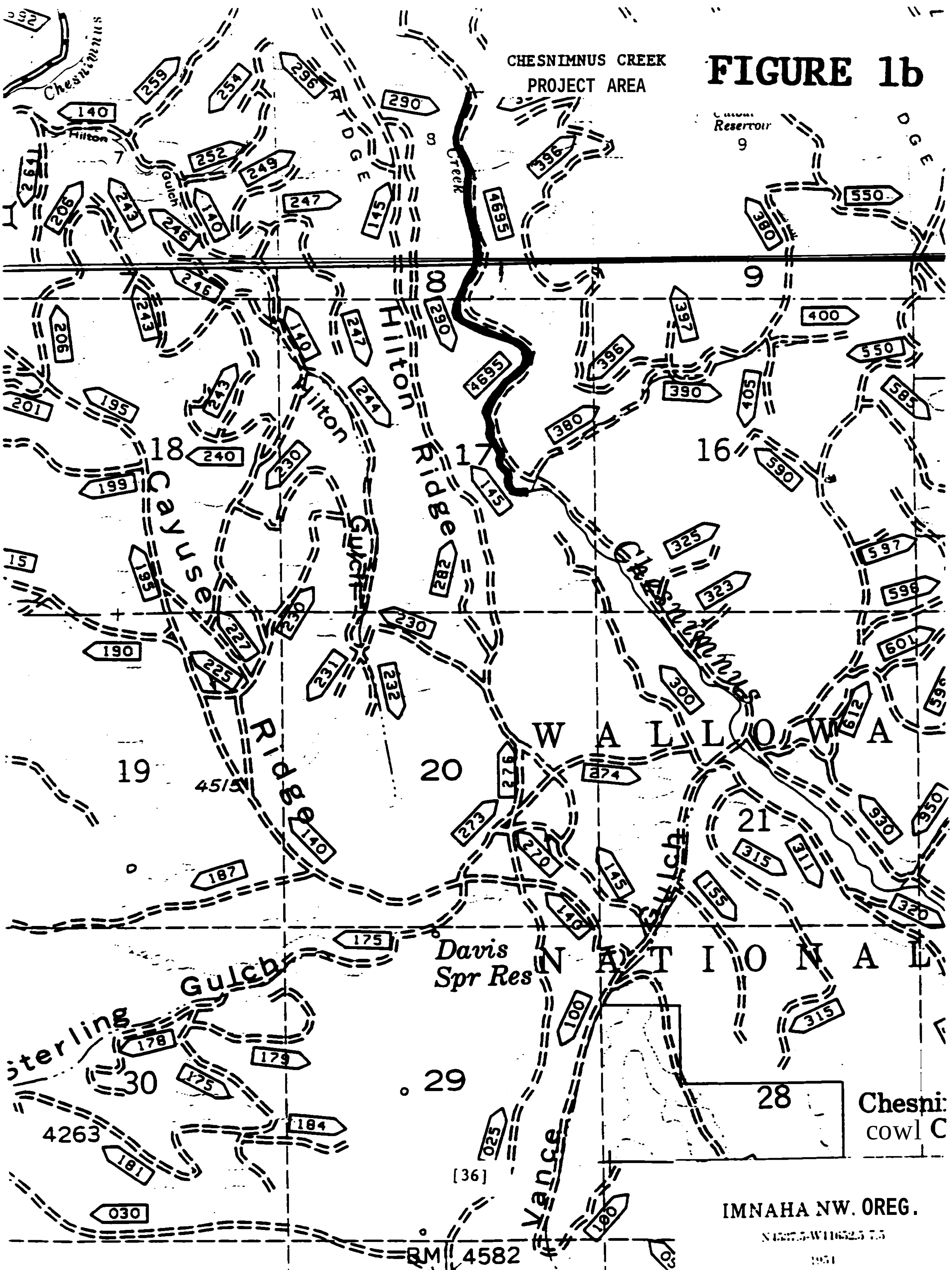
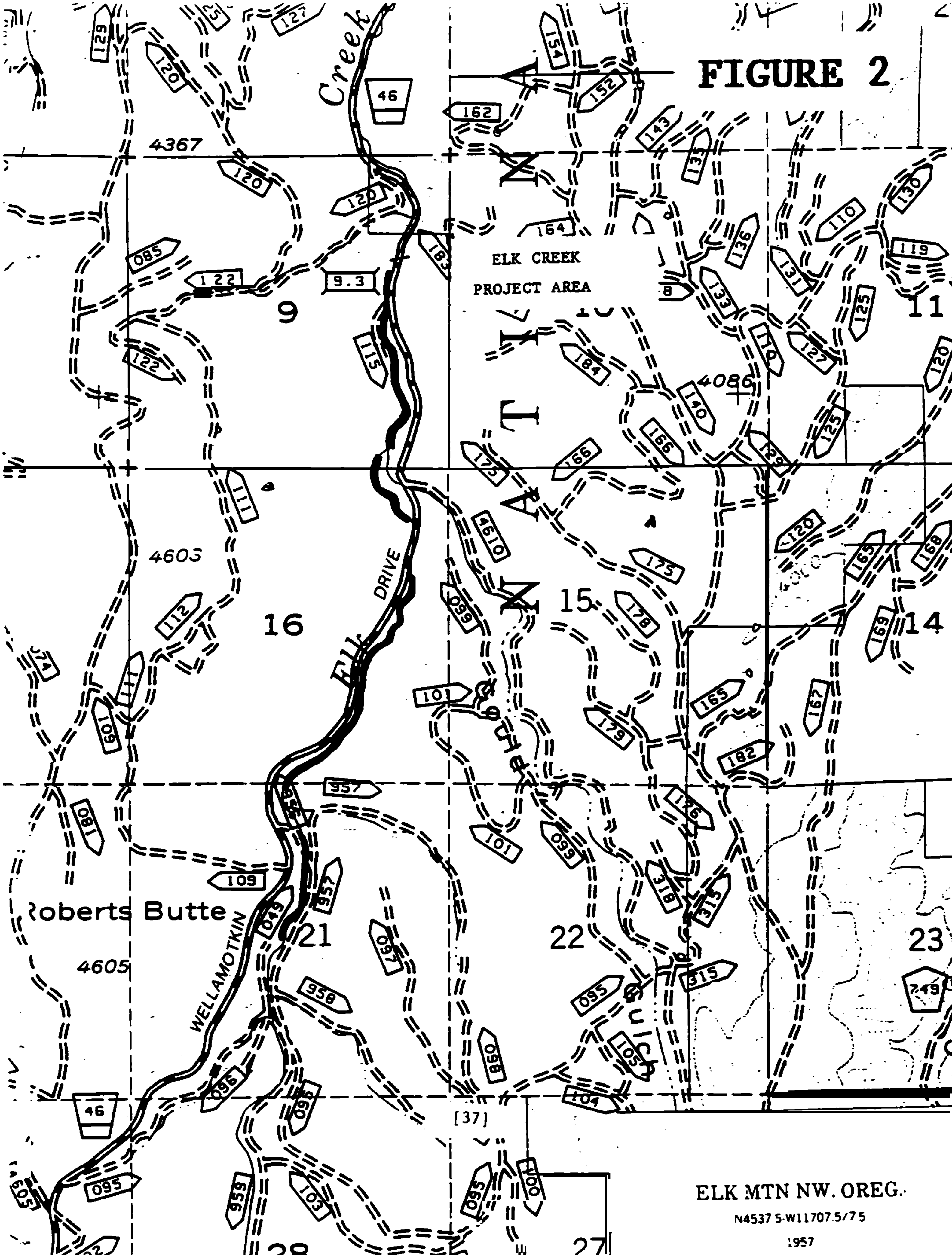
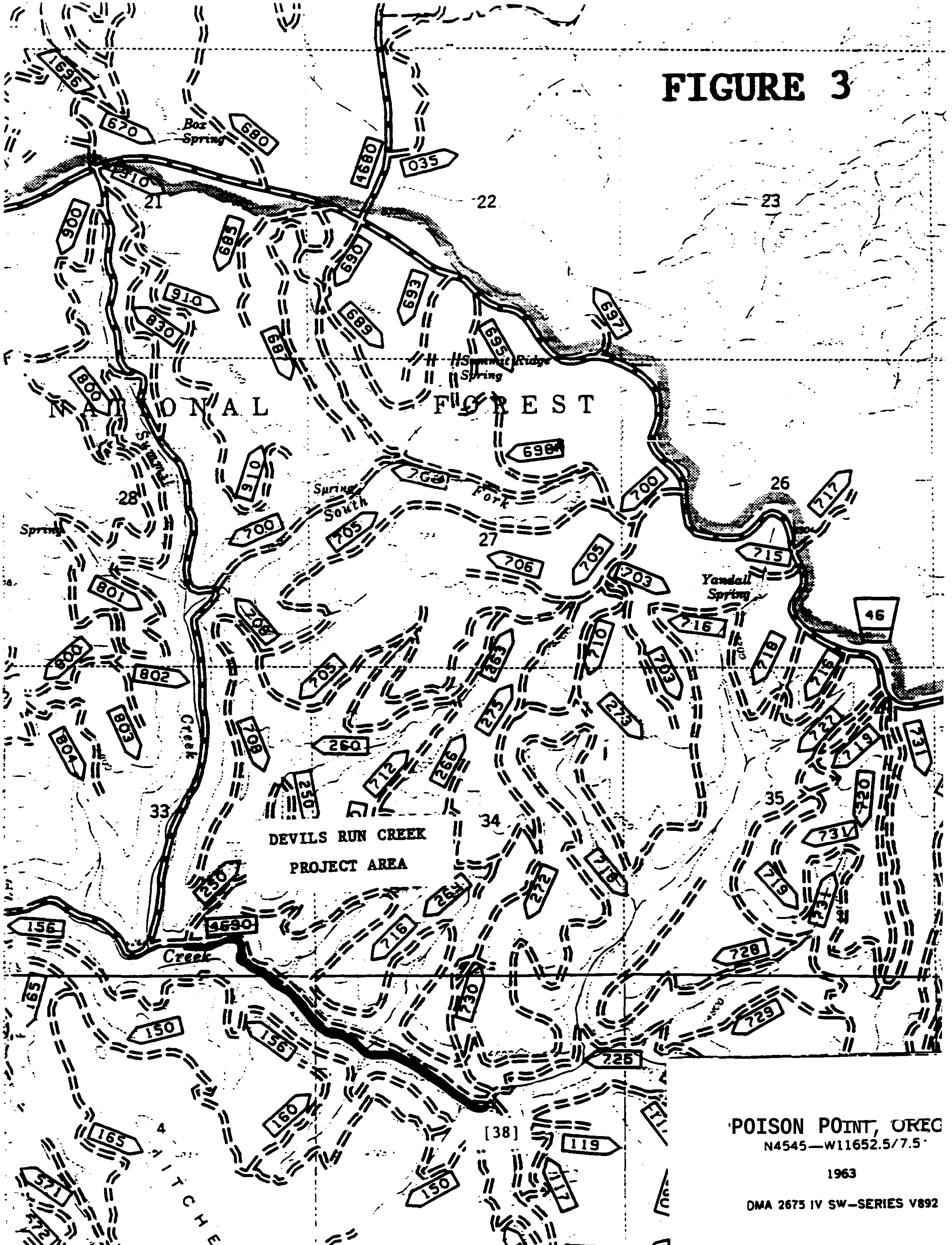

CHESNIMNUS CREEK
PROJECT AREA
FIGURE 1b
Chesnimnus
Hilton
Gulch
Reservoir
RIDGE
Creek
Hilton Ridge
Cayuse Ridge
Hilton Gulch
Gulch
Chesnimnus
WALLOWA
NATIONAL
Davis Spr Res
Sterling Gulch
Gulch
Vance
Chesni
cowl C
4515
4263
BM 4582
7
8
9
16
17
18
19
20
21
28
29
30
140
259
254
296
290
264
252
249
247
145
4695
396
550
380
205
243
246
206
201
195
240
199
230
244
282
397
400
390
405
585
590
325
323
597
598
601
612
930
350
15
193
190
227
225
231
232
276
274
273
270
187
311
315
155
320
175
100
178
179
184
181
025
030
IMNAHA NW. OREG.

FIGURE 2


ELK CREEK
PROJECT AREA
Creek
Elk
DRIVE
WELLAMOTKIN
Roberts Butte
4367
4603
4605
4086
4610
9
16
15
14
11
21
22
23
46
9.3
[37]
ELK MTN NW. OREG.
N4537.5-W11707.5/7.5
1957



NATIONAL FOREST
Box Spring
Summit Ridge Spring
South Fork
Yandall Spring
Creek
DEVILS RUN CREEK
PROJECT AREA
21
22
23
26
27
28
33
34
35
4
[38]
46
POISON POINT, OREG
N4545—W11652.5/7.5
1963
DMA 2675 IV SW—SERIES V892

FIGURE 3

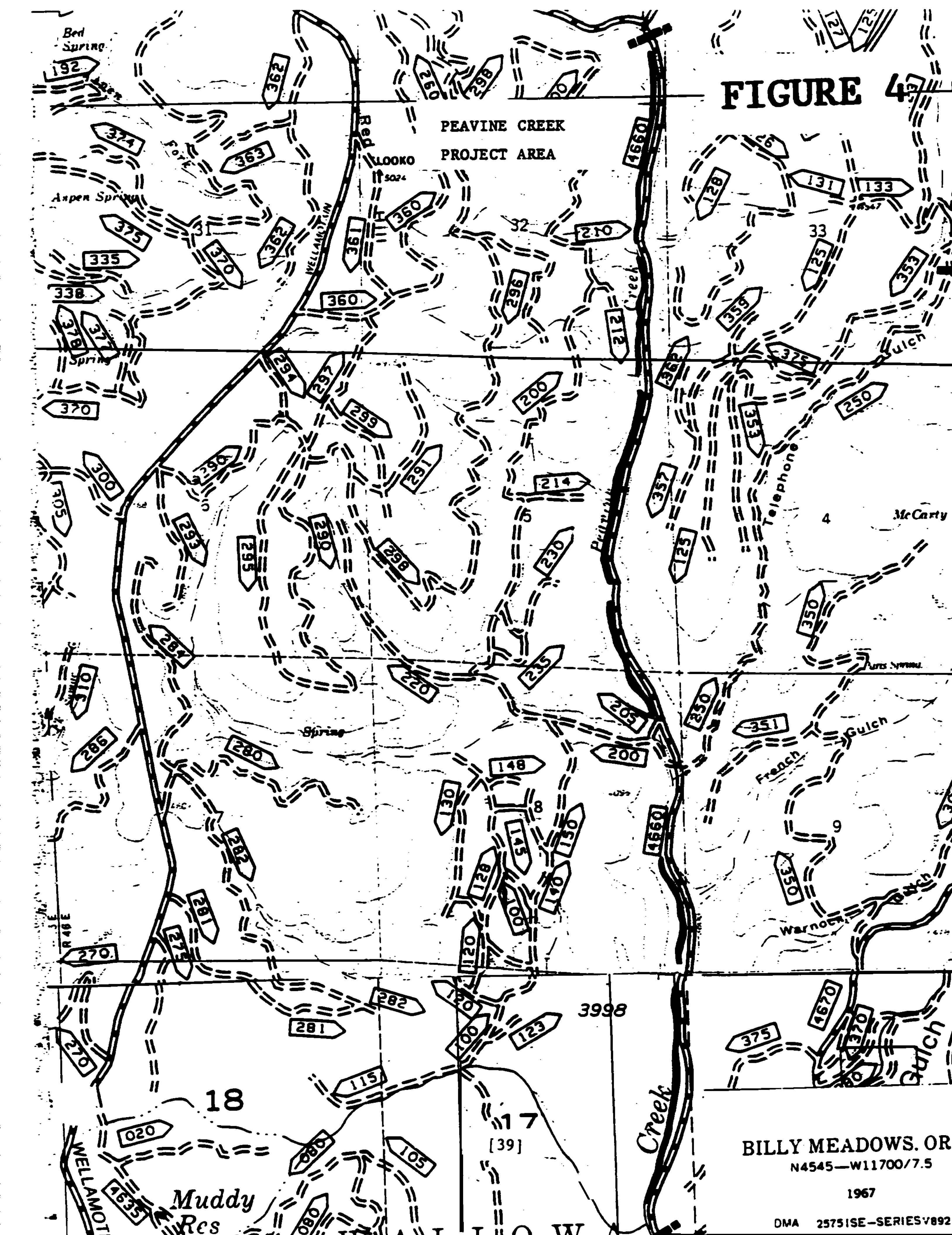
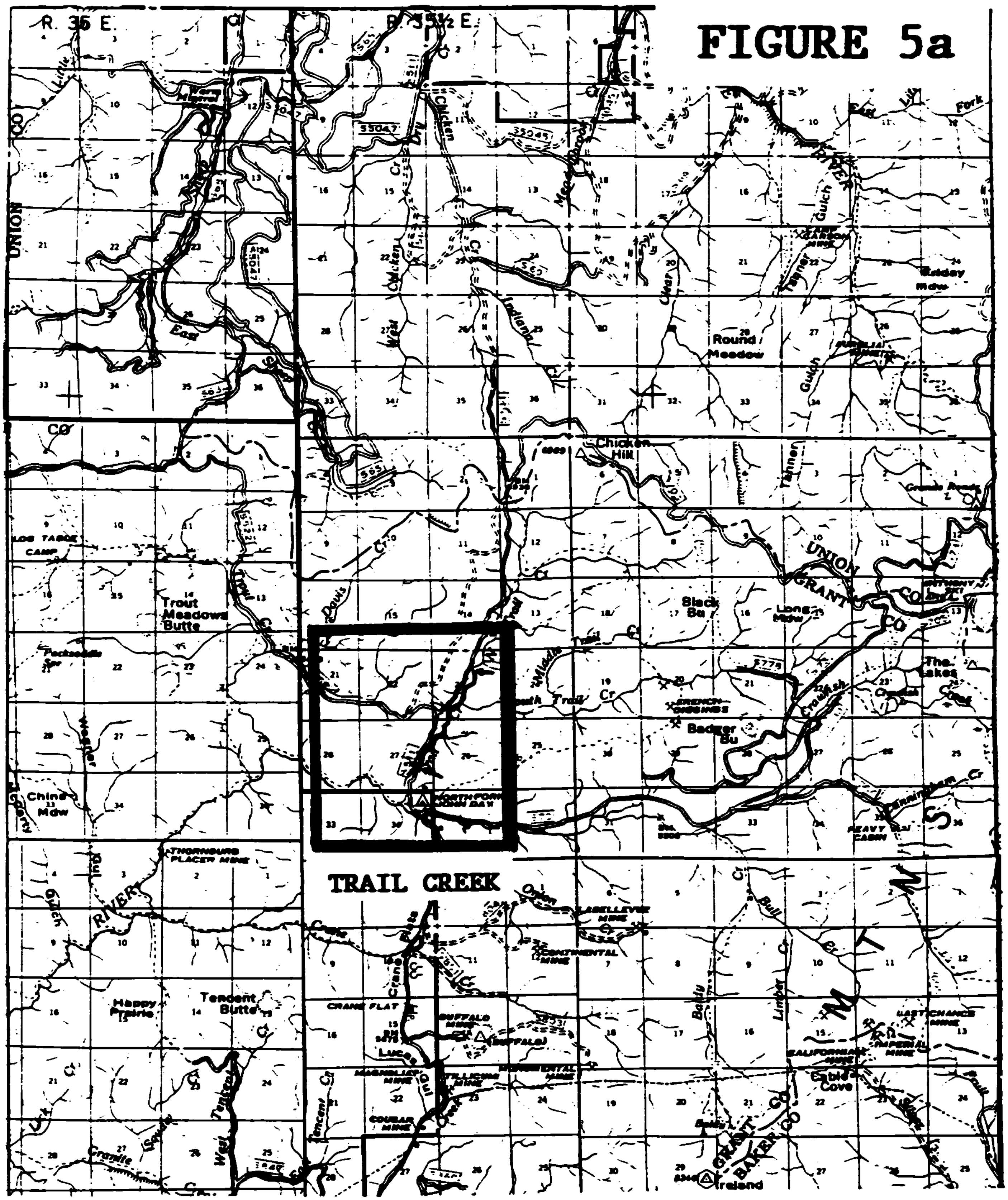


FIGURE 4
PEAVINE CREEK
PROJECT AREA
BILLY MEADOWS. OR
N4545—W11700/7.5
1967
DMA 2575ISE-SERIESV892
Bed Spring
Aspen Spring
Red Fork
WELLAMOTKIN
LOOKO
Creek
Telephone
Gulch
McCarty
French Gulch
Warnock Gulch
Spring
Muddy Res
18
17
[39]
3998
R48E

FIGURE 5a



NORTH FORK JOHN DAY SUBBASIN

USFS - BPA

PROJECT STREAM

FY89

FIGURE 5b

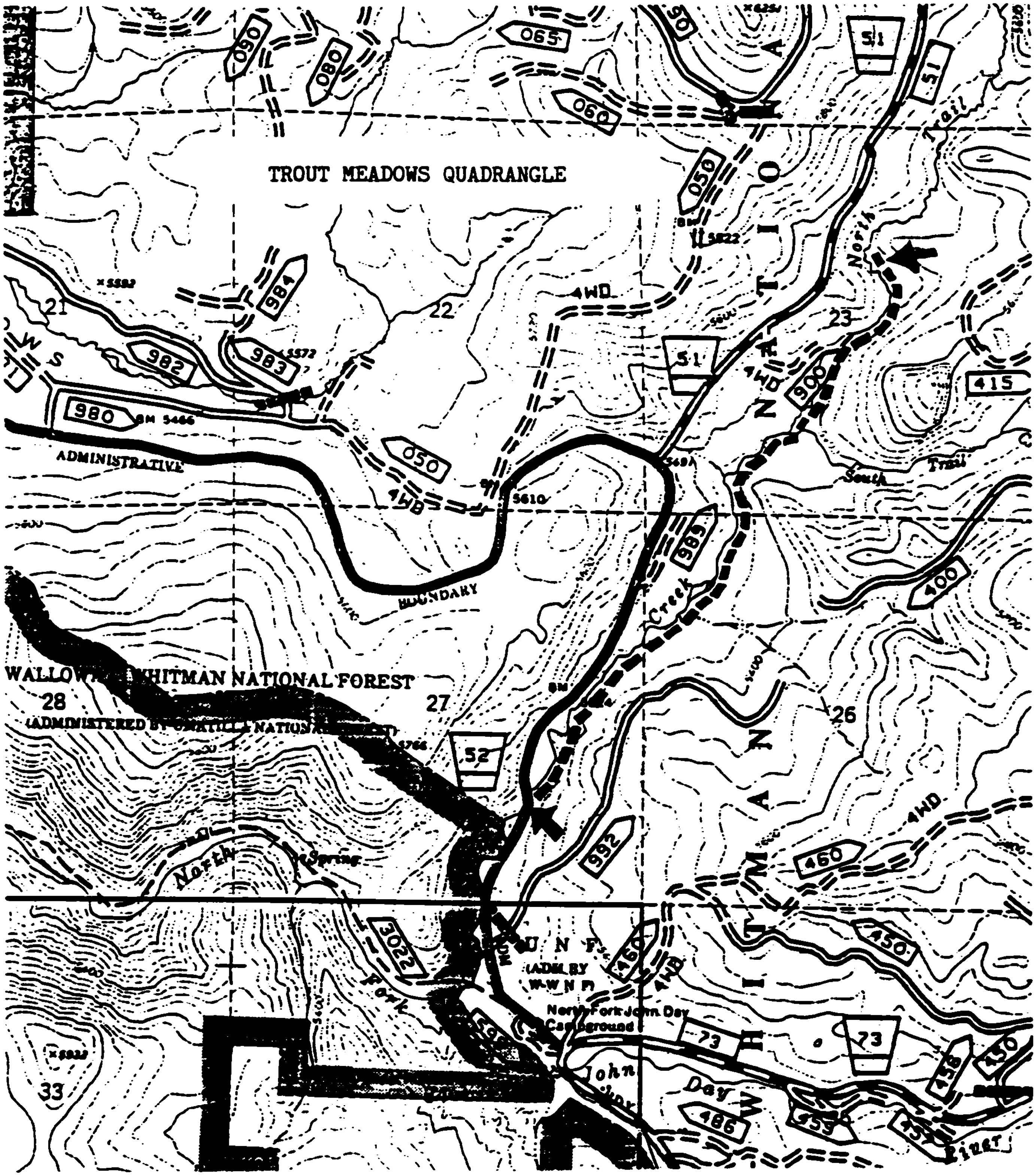
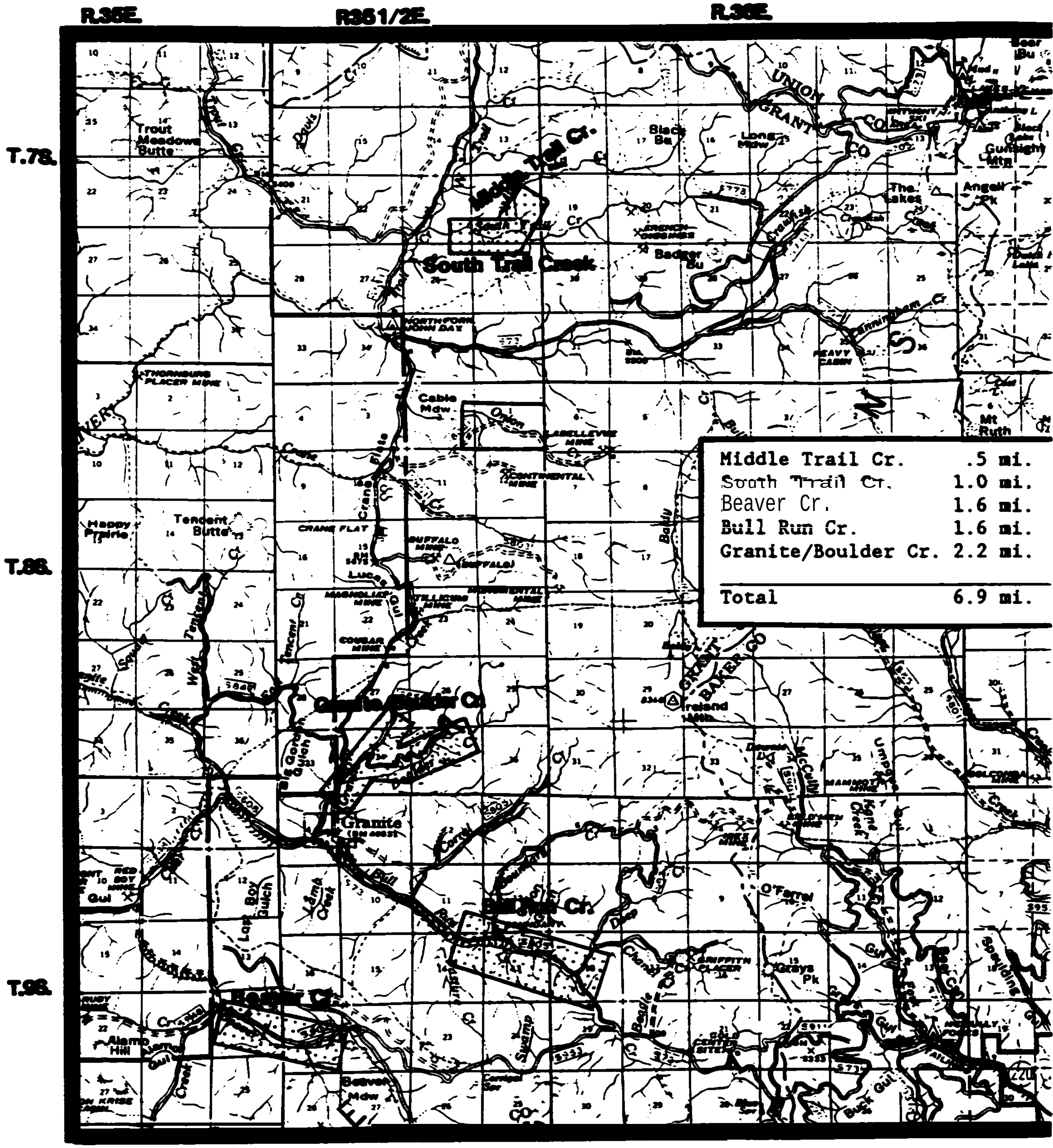
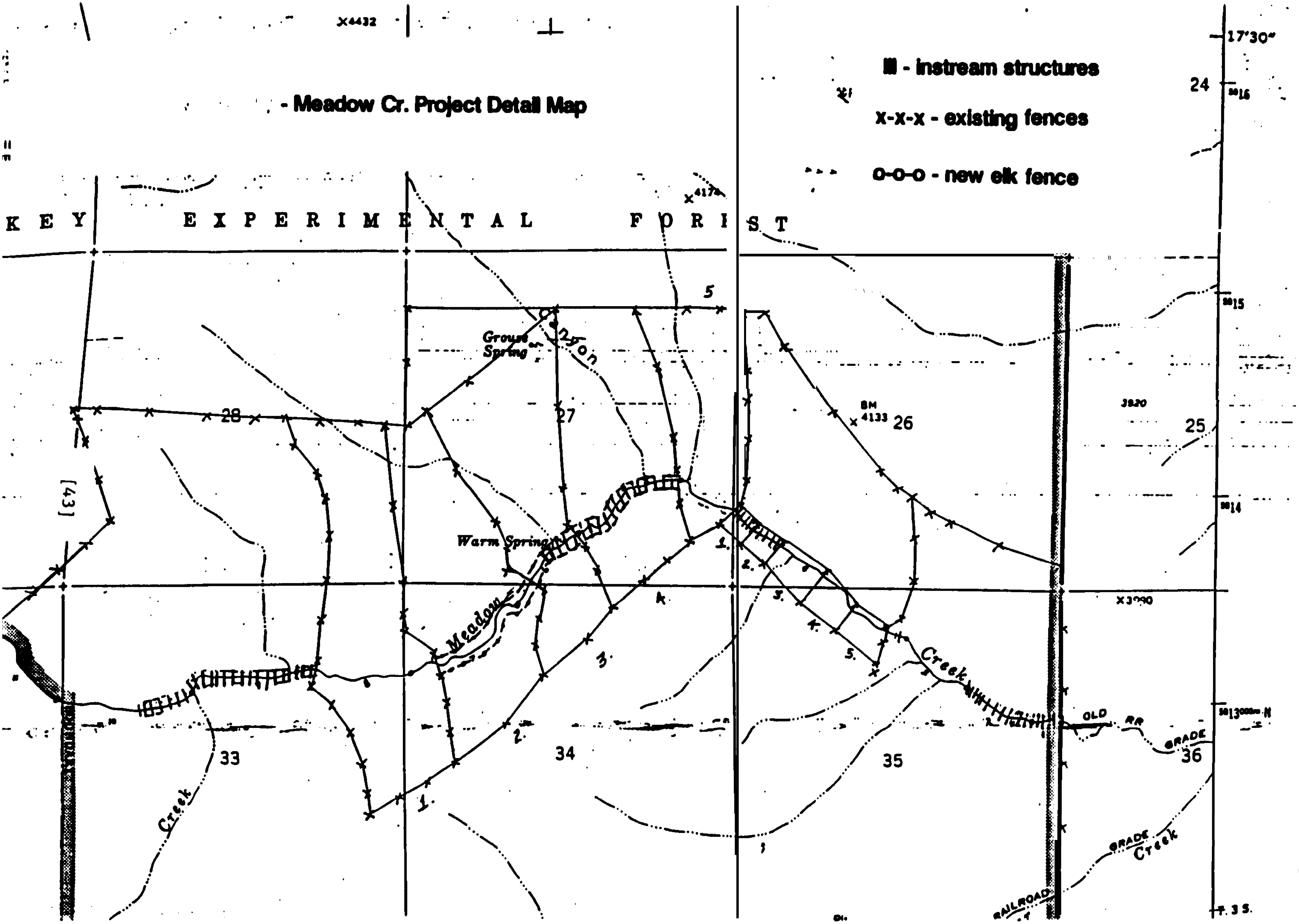


Fig. V. Trail Creek Project Area.

FIGURE 6



TRIBUTARIES TO NORTH FORK JOHN DAY
PROJECT PLANNING AND IMPLEMENTATION
BAKER AND UNITY RANGER DISTRICTS


- Meadow Cr. Project Detail Map
lll - instream structures
x-x-x - existing fences
o-o-o - new elk fence
K E Y   E X P E R I M E N T A L   F O R E S T
X4432
X4170
17'30"
24
25
26
27
28
33
34
35
36
5
Grouse Spring
Canyon
Warm Spring
Meadow
Creek
Creek
BM 4133
3920
X3990
OLD RR GRADE
RAILROAD GRADE
Creek
[43]
T. 3 S.
1.
2.
3.
4.
5.

FIGUR 7

FIGURE 8

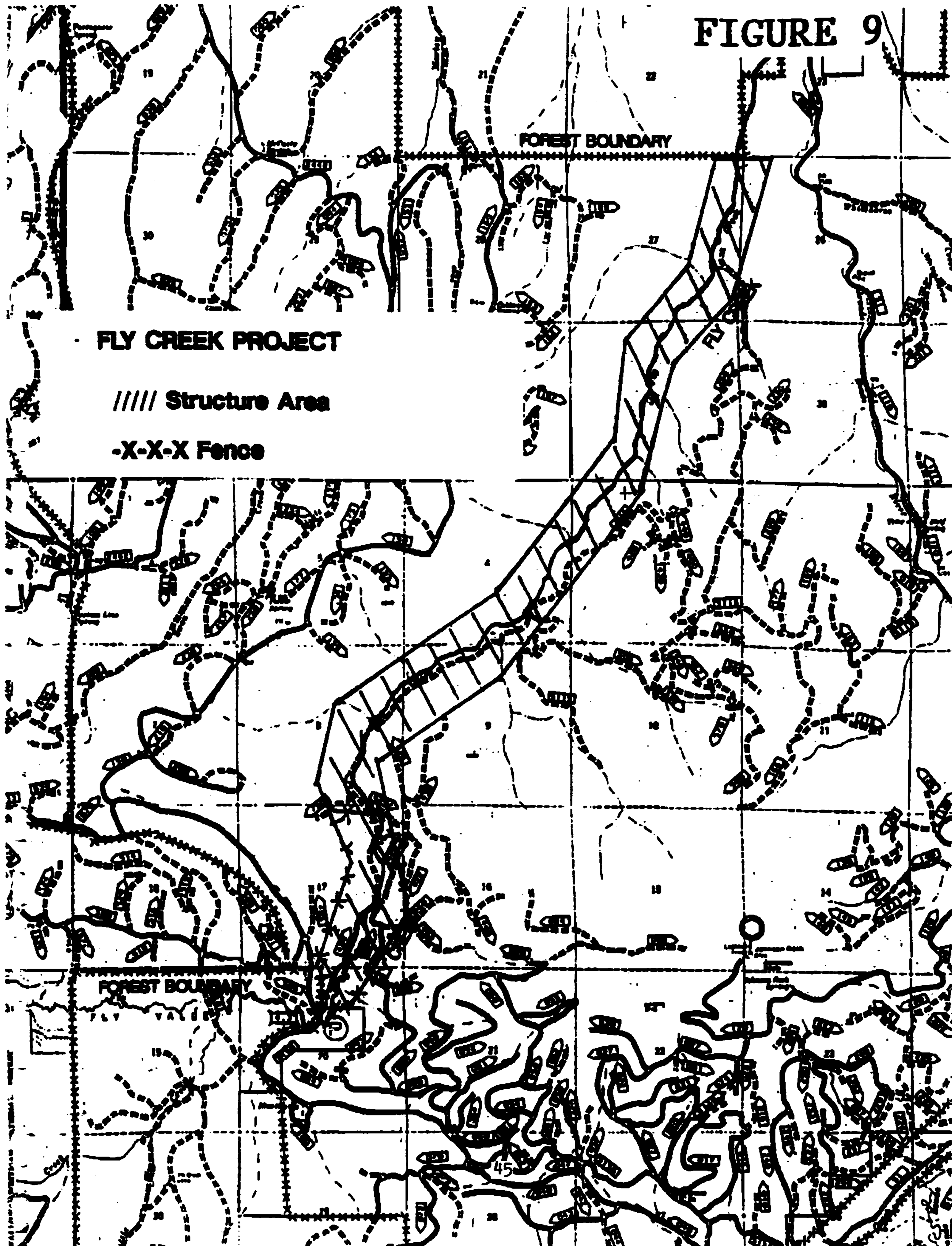
UPPER GRANDE RONDE RIVER PROJECT

FISH HABITAT ENHANCEMENT STRUCTURES

COMPLETED ENHANCEMENT —

PROPOSED ENHANCEMENT - - -

FIGURE 9


FOREST BOUNDARY
FLY CREEK PROJECT
///// Structure Area
-X-X-X Fence
FLY
FOREST BOUNDARY
45


SHEEP CREEK PROJECT
///// Structures and Planting Area
-X-X-X- Fence

FIGURE 10

APPENDIX II

EXPLANATION OF IMPROVEMENT STRUCTURES BY PROJECT CREEK

PEAVINE CREEK

Structure Number	Description of Structure
1	Root Wad (1)
2	Boulder Placed (1)
3	Log Sill placed at 45 degrees in channel
4	Boulders placed (8)
5	Root Wad (1)
6	Digger Log placed at 45 degrees in channel
7	Whole Tree placed at 45 degrees in channel
8	Boulders placed (3)
9	Boulders placed (3)
10	Whole Tree Cover/Pool Created
11	Boulders placed (2)
12	Root Wad placed/Pool cleaned
13	Whole Tree Cover (2)/Root Wad (1)
14	Whole Tree placed at 45 degrees to channel
15	Log at 45 degrees in channel
16	Boulder placed (1)
17	Digger Log at 45 degrees/Pool Created/Whole Tree Cover
la	Digger Log at 45 degrees (2)/Pool Created/Whole Tree Cover
19	Pool Created
20	Log Jam (2 pieces)
21	Digger Log at 45 degrees in channel
22	Log at 45 degrees in channel
23	Log Bank Protection
24	Digger Log at 45 degrees/Pool Created/Whole Tree Cover
25	Whole Tree Cover/Pool Created
26	Pool Created
27	Whole Tree Cover
28	Whole Tree Cover/Pool Cleaned
29	Whole Tree Cover/Pool Cleaned
30	Log Jam (2 pieces)
31	Log Jam (8 pieces)
32	Digger Log at 45 degrees/Whole Tree Cover (2)
33	Whole Tree Bank Protection/Whole Tree at 90 degrees
34	Whole Tree Bank Protection
35	Whole Tree Bank Protection
36	Digger Log at 45 degrees/Boulder placed (1)
37	Whole Tree Bank Protection
38	Log Jam (2 pieces)

39	Pool Created
40	Whole Tree Bank Protection
41	Log Jam (3 pieces)
42	Log Sill placed 45 degrees in channel
43	Whole Tree Bank Protection
44	Log Jam (3 pieces)/Boulders placed (3)
45	Digger Log at 45 degrees/Pool Created/Whole Tree Cover
46	Digger Log at 45 degrees/Pool Created/Whole Tree Cover
47	Whole Tree Bank Protection
48	Log Bank Protection
49	Whole Tree placed at 45 degrees in channel
50	Digger Log at 45 degrees/Whole Tree Cover
51	Whole Tree at 45 degrees in channel (2)
52	Whole Tree Bank Protection/Whole Tree Cover
53	Whole Tree at 45 degrees in channel
54	Log Sill at 45 degrees/Whole Tree Cover
55	Digger Log at 45 degrees/Whole Tree Cover
56	Bank Protection Boulders (5)
57	Log Jam (2 pieces)
58	Log Sill placed at 45 degrees in channel
59	Whole Tree Cover
60	Whole Tree Bank Protection/Whole Tree Cover (2)
61	Whole Tree Bank Protection/Whole Trees at 45 degrees (2)
62	Log Sill/Cover Log/Whole Tree Cover
63	Whole Tree Cover/Pool Created
64	Whole Tree placed at 45 degrees in channel
65	Whole Tree at 45 degrees/Cover Log
66	Whole Tree Cover
67	Whole Tree Cover
68	Whole Tree Cover
69	Whole Tree Cover
70	Whole Tree Cover
71	Whole Tree placed at 90 degrees in channel
72	Whole Tree placed at 45 degrees in channel
73	Whole Tree Cover
74	Whole Tree placed at 45 degrees in channel/Whole Tree Cover
75	Whole Tree Cover
76	Whole Tree Cover
77	Whole Tree placed at 90 degrees in channel/Root Wad (2)
78	Whole Tree Cover
79	Log Sill placed at 45 degrees in channel
80	Root Wad (1)
81	Whole Tree Cover
82	Root Wad (1)
83	Whole Tree Cover
84	Log Jam (2 pieces)
85	Log Jam (4 pieces)
86	Boulder placed (1)
87	Log Jam (4 pieces)
88	Whole Tree Bank Protection (2)
89	Log Jam (3 pieces)
90	Log Jam (2 pieces)
91	Log Sill placed at 45 degrees in channel

92	Log Sill/Whole Tree at 90 degrees/Whole Tree at 45 degrees
93	Whole Tree at 45 degrees/Whole Tree Cover
94	Boulder Bank Protection (5)
95	Log Jam (2 pieces)
96	Log Jam (2 Pieces)/Boulder placed (1)
97	Log Jam (3 pieces)/Boulder placed (l)/Pool created
98	Whole Tree Cover
99	Whole Tree Cover/Log Sill/Pool created
100	Log Sill placed at 45 degrees in channel
101	Digger Log placed at 45 degrees in channel
102	Root Wad
103	Whole Tree Cover
104	Log Bank Protection
105	Boulder placed (1)
106	Log Bank Protection
107	Log Jam (5 pieces)
108	Whole Tree Cover
109	Log Jam (2 pieces)
110	Log Bank Protection
111	Log Bank Protection
112	Log Bank Protection/Whole Tree Cover (2)
113	Log Jam (3 pieces)
114	Whole Tree placed at 45 degrees in channel
115	Whole Tree Bank Protection
116	Log Jam (3 pieces)
117	Boulders placed (25)/Boulder Bank Protection
118	Log Jam (3 pieces)
119	Whole Tree Bank Protection
120	Log Sill 45 degrees/Whole Tree Bank Protection/Whole Tree Cover
121	Digger Log placed at 45 degrees/Cover Log/Whole Tree Cover
122	Boulder placed (1)
123	Log Sill placed at 45 degrees/Boulders placed (5)
124	Log Jam (4 pieces)
125	Whole Tree Bank Protection
126	Whole Tree Cover/Whole Tree placed at 45 degrees
127	Log Bank Protection/Root Wad (1)
128	Whole Tree Bank Protection/Boulders placed (3)
129	Whole Tree Cover/Boulder placed (1)
130	Boulders Placed (7)
131	Whole Tree Cover
132	Log Jam (3 pieces)
133	Whole Tree placed at 45 degrees in channel
134	Log Bank Protection
135	Boulders placed (6)
136	Whole Tree Cover/Whole Tree Bank Protection
137	Log Weir Downstream "Vee"
138	Whole Tree Cover/Whole Tree placed at 45 degrees in channel
139	Digger Log placed at 45 degrees in channel/Pool Created
140	Root Wad (1)
141	Log Sill placed at 45 degrees in channel/Pool Created
142	Whole Tree Cover
143	Whole Tree placed at 45 degrees in channel
144	Whole Tree Cover

145	Whole Tree Bank Protection/Whole Tree at 45 degrees in channel
146	Whole Tree Bank Protection
147	Log Sill at 45 degrees in channel/Whole Tree Cover
148	Whole Tree Bank Protection
149	Log Jam (5 pieces)
150	Whole Tree Cover
151	Log Sill at 45 degrees in channel/Whole Tree Cover
152	Whole Tree Bank Protection
153	Log Jam (3 pieces)
154	Cover Log at 45 degrees in channel/Whole Tree Cover
155	Cover Log at 45 degrees in channel
156	Whole Tree Cover
157	Whole Tree at 45 degrees in channel/Whole Tree Cover
158	Whole Tree at 45 degrees in channel/Whole Tree Cover
159	Whole Tree Cover
160	Whole Tree Cover/Log Sill at 45 degrees/Pool Created
161	Log Jam (3 pieces)
162	Whole Tree Cover
163	Log Sill placed at 45 degrees in channel
164	Log Sill placed at 45 degrees in channel
165	Log Jam (4 pieces)
166	Whole Tree Cover/Pool Created
167	Log Jam (5 pieces)
168	Log Bank Protection
169	Whole Tree at 45 degrees/Whole Tree Cover/Pool Created
170	Log Sill at 45 degrees in channel/Log Jam (3 pieces)
171	Digger Log at 45 degrees in channel/Whole Tree Cover (2)
172	Log Jam (3 pieces)
173	Whole Tree Bank Protection/Whole Tree Cover
174	Whole Tree Cover/Pool Created
175	Log Jam (5 pieces)
176	Whole Tree placed at 45 degrees in channel/Whole Tree Cover
177	Log Sill placed at 45 degrees in channel/Whole Tree Cover
178	Log Jam (3 pieces)/Whole Tree Cover
179	Whole Tree Cover
180	Whole Tree Cover
181	Log Sill at 45 degrees/Whole Tree Cover/Pool Created
182	Cover Log placed at 45 degrees in channel
183	Cover Log placed at 45 degrees in channel
184	Whole Tree Bank Protection
185	Whole Tree Cover/Pool Created

Appendix

KEY TO ABBREVIATIONS OF IMPROVEMENT STRUCTURES

Joseph Creek Subbasin
Peavine Creek

Boulders

BP	Boulders placed
BPB	Bank protection boulders
TB	Turning boulders
BD	Boulder dam

Whole Trees

WT_{45}	Whole tree placed at 45° to channel
WT_{90}	Whole tree placed at 90° to channel
RW	Root wad
WTC	Whole tree cover
WTB	Whole tree bank protection

Logs

LS	Log sill
LS_{45}	Log sill placed at 45° to channel
L_{45}	Log across creek at 45°
CL	Cover log
LWU	Log weir, upstream "vee"
LWD	Log weir, downstream "vee"
LBP	Log bank protection
LJ	Log jam
DL_{45}	Digger log placed at 45° to channel

Appendix

SUMMARY OF IMPROVEMENT STRUCTURES BY PROJECT CREEK

PEAVINE CREEK

	Structure Type																		
Structure Number	BP	BPB	TB	BD	WT_{45}	WT_{90}	WTC	WTB	LS	LS_{45}	L	L_{45}	LWU	LWD	LBP	LJ	DL_{45}	RW	POOL
1																		X	
2	X																		
3										X									
4	X																		
5																		X	
6																	X		
7					X														
8	X																		
9	X																		
10							X												X
11	X																		
12																		X	X
13							X											X	
14					X														
15												X							
16	X																		
17							X										X		X
18							X										X		X
19																			X
20																X			
21																	X		
22												X							
23															X				
24							X										X		X
25							X												X
26																			X
27							X												
28							X												X
29							X												X
30																X			
31																X			
32							X										X		
33						X		X											
34								X											
35								X											
36	X																X		
37								X											

Continued

SUMMARY OF IMPROVEMENT STRUCTURES BY PROJECT CREEK

PEAVINE CREEK (Continued)

Structure Number	Structure Type BP	BPB	TB	BD	WT_{45}	WT_{90}	WTC	WTB	LS	LS_{45}	CL	L_{45}	LWU	LWD	LBP	LJ	DL_{45}	RW	POOL
38																X			
39																			X
40								X											
41																X			
42										X									
43								X											
44	X															X			
45							X										X		X
46							X										X		X
47								X											
48															X				
49					X														
50							X										X		
51					X														
52							X	X											
53					X														
54							X			X									
55							X										X		
56		X																	
57																X			
58												X							
59							X												
60							X	X											
61					X			X											
62							X		X		X								
63							X												X
64					X														
65					X						X								
66							X												
67							X												
68							X												
69							X												
70							X												
71						X													
72					X														
73							X												
74					X		X												

Continued

SUMMARY OF IMPROVEMENT STRUCTURES BY PROJECT CREEK

PEAVINE CREEK (Continued)

Structure Number	Structure Type																		
	BP	BPB	TB	BD	WT_{45}	WT_{90}	WTC	WTB	LS	LS_{45}	CL	L_{45}	LWU	LWD	LBP	LJ	DL_{45}	RW	POOL
75							X												
76							X												
77						X												X	
78							X												
79										X									
80																		X	
81							X												
82																		X	
83							X												
84																X			
85																X			
86	X																		
87																X			
88								X											
89																X			
90																X			
91										X									
92					X	X			X										
93					X		X												
94		X																	
95																X			
96	X															X			
97	X															X			X
98							X												
99							X		X										X
100										X									
101																	X		
102																		X	
103							X												
104															X				
105	X																		
106															X				
107																X			
108							X												
109																X			
110															X				
111															X				

Continued

SUMMARY OF IMPROVEMENT STRUCTURES BY PROJECT CREEK

PEAVINE CREEK (Continued)

	Structure Type																		
Structure Number	BP	BPB	TB	BD	WT_{45}	WT_{90}	WTC	WTB	LS	LS_{45}	CL	L_{45}	LWU	LWD	LBP	LJ	DL_{45}	RW	POOL
112							X								X				
113																X			
114					X														
115								X											
116																X			
117	X	X																	
118																X			
119								X											
120							X	X				X							
121							X				X						X		
122	X																		
123	X											X							
124																X			
125								X											
126					X		X												
127															X			X	
128	X							X											
129	X						X												
130	X																		
131							X												
132																X			
133					X														
134															X				
135	X																		
136							X	X											
137														X					
138					X		X												
139																	X		X
140																		X	
141												X							X
142							X												
143					X														
144							X												
145					X			X											
146								X											
147								X		X									
148								X											

Continued

SUMMARY OF IMPROVEMENT STRUCTURES BY PROJECT CREEK

PEAVINE CREEK (Continued)

Structure Number	Structure Type																			
	BP	BPB	TB	BD	WT_{45}	WT_{90}	WTC	WTB	LS	LS_{45}	L	L_{45}	LWU	LWD	LBP	LJ	DL_{45}	RW	POOL
149																X			
150							X												
151							X			X									
152								X											
153																X			
154							X					X							
155												X							
156							X												
157					X		X												
158					X		X												
159							X												
160							X			X									X
161																X			
162							X												
163										X									
164										X									
165																X			
166							X												X
167																		X	
168															X				
169					X		X												X
170										X						X			
171							X										X		
172																X			
173							X	X											
174							X												X
175																X			
176					X		X												
177							X			X									
178							X									X			
179							X												
180							X												
181							X			X									X
182												X							
183												X							
184								X											
185							X												X

Peavine Creek TOTAL BY TYPE

	Structure Type																			
	BP	BPB	TB	BD	WT_{45}	WT_{90}	WTC	WTB	LS	LS_{45}	L	L_{45}	LWU	LWD	LBP	LJ	DL_{45}	RW	POOL	
TOTALS	19	3	0	0	22	3	68	24	3	14	3	10	0	1	10	30	15	11	24	= 260