East Fork Williams Creek
Sediment Analysis

East Fork Private Road Inventory and Sediment Analysis

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Abstract

This study is a result of information gathered during the Williams Creek Watershed Assessment and Action Plan process and addresses the observations of high sediment loads in the East Fork Williams Creek, a subwatershed of the Williams Creek Watershed. This study specifically collects information about the conditions of private roads and their impact on the sediment delivered to local streams in the East Fork branch of Williams Creek and its tributaries. This information is useful in determining the non-point sediment sources that contribute sand and finer material to the East Fork Williams Creek and gravel substrate used for spawning of salmon and aquatic invertebrates in these streams. Used in conjunction with the Bureau of Land Management's database of road conditions on public lands, this publication identifies the sediment problems that need remediation and recommends possible tracks to take to complete them. Additionally, studies addressing the geology, spawning suitability, rainfall totals, and potential sediment sources are included within.

The East Fork Williams Creek has been recognized as a source for high sediment loads, especially during heavy rain events, contributing to the listing by the Oregon Department of Environmental Quality listing on a 303 (d) as streams exceeding water quality standards. Non-point sources of sediment input are difficult to pinpoint as they can be spread out over miles of stream or a result of sudden change in erosion pattern during large and moderate flood events. To accomplish this task we have collected data on private roads, ditch and culvert conditions, turbidity levels during high water in 12 locations, sampled bedload material in several tributaries, developed cross sections in select locations, completed Wolman pebble counts, and observed erosion sites and unstable stream banks. We have also combined this study with geologic mapping of the Williams Creek Watershed to better understand the role of rock types that greatly influence the sedimentation rate. Over 75% of the East Fork subwatershed is underlain by intrusive igneous rock types that weathers rapidly in the high humidity and abundant rainfall and much of the fine sediment load is derived from these areas.

The properties involved in this study are in reaches of the East Fork subwatershed and are predominately made up of small farms and rural lots and in the upland forested areas. Many of these roads are access routes to homes whose owners have a vested interest in the upkeep of the roads and lands. Problem areas revolve around sediment reaching the creeks from erosion along roadside ditches and runoff from cattle ranches when surface water reaches saturation limits that soils are unable to absorb and filter. Answers to these problems are complicated and involve designing systems that work with the landowners' usage of the land and the feasibility of constructing such a project. This report is designed to compile information, report on the situation, as it exists, propose specific remedies, and resolve sediment delivery to creeks where possible.

Our observations have found several types of erosion sources that influence the high sediment loads in the creeks and the effects on the stream gravels important to the life cycles of anadromous fish and aquatic life. Private roads, culvert diversions along roads, ditches along roadbeds, and over-steepened road cuts contribute to fine sediment in the creeks. Other sources include runoff from grazing lands directly into creeks, degraded farm roads along creek channels, excessive livestock in riparian zone, and reduced vegetation along creek banks causing

bank erosion. Channelization and instream wood removal has produced a stream condition that is disconnected from flood plain relief and has resulted in rapid discharge during rain events with subsequent downcutting and occasional bank erosion that can remove acres of land within hours.

Solutions to these problems are varied, with road improvement and decommission being the highest, and re-vegetation and reduction of grazing in highly prone areas such as riparian zones being next. Other improvements could encompass erosion control structures along stream bank instabilities or redesigning stream bank habitat and native vegetation abundance to develop resistance to flooding and erosion.

Acknowledgements

The development and completion of this study was made possible through the combined efforts of local citizens, the Williams Creek Watershed Council, state and federal agencies, and the staff. Funding was provided by the Oregon Watershed Enhancement Board and the Oregon Department of Environmental Quality to study the high sediment loads and private road system in the East Fork subwatershed. Other contributors include the Applegate River Watershed Council, Mike Matthews, Tim Franklin, Chris Vogel, Dave Mauer of the BLM, Jim Roper of BLM, Bob Ettner, and Randy Carey, Karen Rogers, and Evelyn Roether.

The cover picture is a low level oblique aerial photograph of the East Fork subwatershed, looking south and taken from 6000 feet, showing the lower agricultural lands and the upland forested zones.

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Overview
The Williams Creek Watershed

The Williams Creek Watershed is situated in the Siskiyou Mountains of southwestern Oregon, about 15 miles south of Grants Pass. Encompassing approximately 52,841 acres, it is one of six major watersheds draining into the Applegate River, which flows into the Rogue River. The watershed is in the southeastern corner of Josephine County, with a small sliver extending into Jackson County. Rimmed on the south, east, and west by Siskiyou Mountain ridge tops, elevations in the watershed range from 1,160 feet near the Applegate River to 6,680 feet on the top of Sugarloaf Peak. Two-thirds of the watershed is mid-elevation, forested mountains. The remaining one-third contains the floodplain and low terrace lands that make up the valley floor.

Williams Creek and its many tributaries drain 82 square miles of land. The mainstem of Williams Creek is a low gradient stream for approximately seven miles. Above its confluence with the East and West Forks, the gradient gradually increases as the valley width narrows. In the uppermost reaches of the watershed, steep, narrow, and entrenched channels reflect the 45-70% slopes of the mountainous terrain.

Land use in the Williams Creek Watershed is predominantly forestry, with two-thirds of the land zoned *Forest Commercial* or *Woodlot Resource*. Forestlands administered by the Bureau of Land Management (BLM) and the United States Forest Service (USFS) amount to 27,809 acres. Josephine County Forestry and private timber companies manage 1,640 and 5,641 acres respectively. Thus, a total of 35,090 acres (68%) of the watershed is utilized as commercial forestlands. (WCWC, 2000)

Much of the Williams Valley, which extends along the mainstem and East and West Forks of Williams Creek, is zoned *Rural Residential*, *Exclusive Farm*, and *Farm Resource*. Agricultural enterprises such as hay production, plant nurseries, and several organic seed crop and produce farms operate on the fertile floodplain. Small-scale animal husbandry operations in the valley include beef and dairy cows, llamas, horses, and an ostrich/emu farm. Thirty-two percent of the watershed is classified as agricultural and rural residential lands.

The watershed also supports a diversity of wildlife species. There are 67 potential sensitive species in the Williams Creek Watershed including twenty birds, fifteen mammals, eight amphibians, five reptiles, four fish, eight insects, and seven mollusks. Resident and anadromous fish include coho, winter and summer steelhead, fall chinook, sea-run and resident cutthroat, rainbow trout, and Pacific lamprey. (WCWC, 2000)

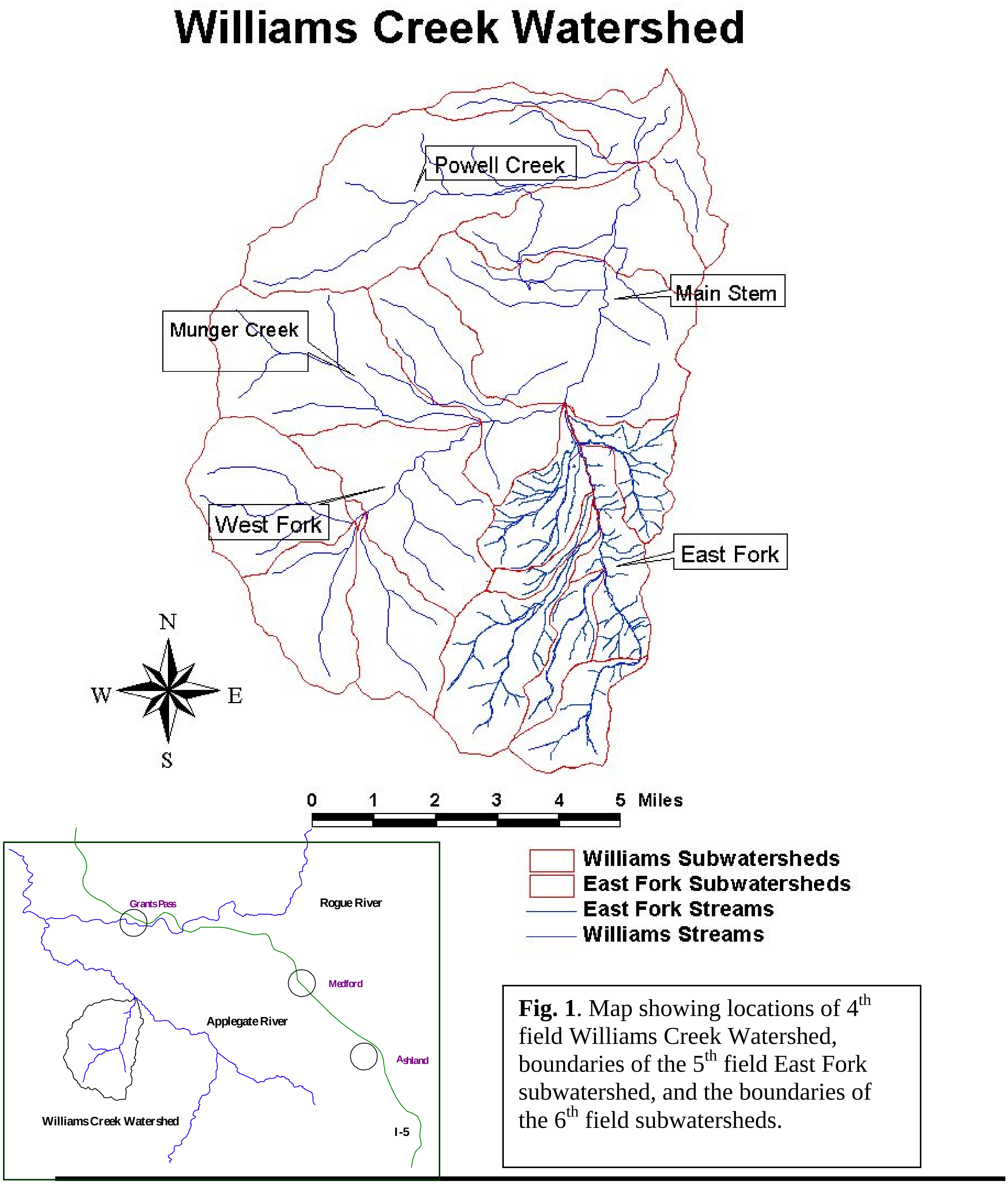


Fig. 1. Map showing locations of 4th field Williams Creek Watershed, boundaries of the 5th field East Fork subwatershed, and the boundaries of the 6th field subwatersheds.

The Private Road Inventory

The purpose of the Private Road Inventory is to collect information about the roads and driveways on private lands within the East Fork subwatershed, and to look for non-point sources of sediment along streams that might affect the quality of water and degrade salmon spawning habitat. Erosion along gravel or native soil roads contributes major amounts of sediment to streams throughout Western Oregon. Water from runoff carries silt and sand down ruts or channels in roadbed to eventually get dumped into the lower areas of streams or channels. Unless this runoff is stopped or diverted to the side of the road, it will continue to erode downward, deepening the ruts and increasing sediment discharge. Waterbars placed across roads are the first defense to this erosion, along with ditches, cross drain culverts, and outsloped roadbeds.

This inventory takes into account the type of culverts, placement, and functionality built into the system along with the grade analysis, roadbed material, geologic soil types, and erosion characteristics.

Goals of the Sediment Study

Goal 1: To collect information on the private roads and culverts in the East Fork subwatershed and record any problems associated with sediment delivery to nearby streams and conditions of roadbed.

Goal 2: To characterize the streambed as to the content of clastic material and determine the percentages of each component. Compare data to known spawning habitat and determine usability by salmon in preparing spawning redds on various contents of sand within creek gravel substrate

Goal 3: Develop workshops on road improvement and design to inform the public about care of their driveways and methods of improvement.

Goal 4: Collect information for turbidity, bedload, and impact of sand on salmon spawning beds.

Goal 5: Develop priorities on restoration projects that would improve water quality in the East Fork subwatershed with goals to improve the erosion potential of target tributaries and road interactions and crossings

All goals presented here are part of larger objectives including restoration and improvement of the local watershed, especially information from which this study shows is lacking. Steps taken to seek information to alleviate these problems should be used in the context of improving water quality and quantity along with improving riparian function.

Chapter 1

Sediment and Impacts on Riparian Health

Implications of Sediment Delivery

The downstream movement of suspended fine particulates and bed loads of cobble, gravel, and sand are critical for the formation of fertile floodplains, stable streambeds, and productive fish spawning grounds. Too *little* sediment can adversely affect aquatic systems, but more often the problem is one of *excessive* sediment. High levels of sedimentation can have detrimental effects on fish habitats and riparian ecosystems. Fine sediment deposited in spawning gravel can reduce survival of eggs and developing alevins. Benthic invertebrate abundance, and thus food availability for fish, may be reduced as sediment levels increase. Increased levels of suspended sediment can disrupt social and feeding behavior. Pools, an important habitat type, may be filled due to increased levels of suspended sediment (USDA 1993).

In the Williams Creek Watershed, sedimentation has been identified by the Oregon Department of Environmental Quality (ODEQ) as a parameter that may be exceeding water quality standards on three segments of Williams Creek. In its 1998 consideration for stream listings on the 303 (d) list, ODEQ named the following as stream segments with possible water quality limitations due to sedimentation: Williams Creek from the mouth to the confluence of East and West forks; East Fork Williams Creek from the mouth to Rock Creek; and West Fork Williams Creek from the mouth to headwaters. Nevertheless, with a lack of supporting data, these segments have not been listed on the 303(d) list.

Chemical and physical weathering gradually breaks down the rock into soil and decomposed rock. This includes the chemical breakdown of abundant minerals present such as feldspar into clay and iron minerals of pyroxenes and amphiboles into oxidation products of rust and clay. Delivery of sediment to streams is primarily from mass wasting (the movement of large soil mass downslope under the influence of gravity) and surface erosion (the physical removal of particles of soil by water with high velocity, ice, and sometimes wind). Mass wasting generally occurs at higher elevations and is of particular concern on mountain slopes at the south end of the watershed where highly erosive granitic soils dominate the landscape. Slope failures, though naturally occurring, can be exacerbated by human activities such as logging and road building. Most surface erosion is a result of water flowing over or through soils that are then transported downslope into stream systems. Soil particles that are exposed from devegetation, road building, or other disturbances are particularly susceptible to erosion (BLM 1996).

Sediment Transport Processes

Channel Sources

In or near channel sources of sediment are associated with debris flows and bank sloughing. A debris flow occurs when a landslide reaches a steep stream channel, incorporating logs, boulders, and additional soil and water, growing in size as it races downstream, and stopping when the slope of the stream lessens. Most streams that have experienced this kind of event will probably have one again in the future. Repeat occurrence intervals vary and can be influenced by human activity and high storm intensity (Parchal N/D). An example of a debris flow in the watershed occurred during the 1997 flood in Wallow Creek (BLM road # 38-5-17), approximately ½ mile off of Powell Creek Road. The apparent cause is related to natural ground contour and slope, associated ground saturation, and soil type. The BLM has determined that the roads above the site (BLM roads #38-5-17 and 38-5-18.2) have had minimal effect on the debris flow, and are not contributing to further erosion at the landslide site (BLM 2000).

Bank sloughing is caused by the lateral movement of stream channels and is often exacerbated by a lack of riparian vegetation. Bank sloughing is more prevalent in unconstrained channels and can be seen along many of the lower reaches of the mainstem of East Fork Williams Creek, and Clapboard Creek. Some of this sloughing is due to the steepness of the terraces and road proximity. Other locations along Clapboard Creek are the result of vegetation removal by livestock grazing along steep banks of granitic soils in and around the riparian zones.

Hillslope Sources

Hillslope sediment is moved downslope primarily by surface erosion and by mass wasting. Landslides, a form of mass wasting, can occur when the cohesiveness of the soil is exceeded by high soil moisture content and when slope steepness causes soils to detach and move downslope rapidly. Generally, slopes greater than 70% have a high risk of future landslides, while slopes of 40% to 70% have a moderate risk of slope failure (ODFa 1998). (According to Tom Wiley, a geologist for the Oregon Department of Geology and Mineral Industries.)

The risk of sediment transport to a stream is primarily a function of soil type, slope, proximity to the stream, and duration and intensity of rainfall. However, the extent of vegetative cover, forest duff, and litter can decrease or increase the likelihood of stream impact. Vegetative canopy buffers the intensity of the rainfall and evaporates some moisture back into the air, while forest duff and litter absorb some of the moisture, and plant and tree roots tend to bind or hold the soil together. Degree of soil compaction, the presence of road drainage systems, and land management activities can also shape the land's response to erosion potential.

Fig 2. Aerial photo of landslide area on upper Rock Creek taken after BLM used hydroseeding techniques on the landslide to slow the erosion process. Photo by C.Rogers

Geologic Implications for Erosion Problems

Geology, including the rock type, structural features, composition, and resistance to surface weathering are some of the main factors in erosion of a particular landscape. Approximately 55% of the land base within the East Fork watershed is composed of granitic soils, especially diorite and gabbros that contain large amounts of ferromagnesium and feldspar which weather rapidly in moist environment to iron oxides and clay minerals. Weathering processes alter minerals within the upper soil horizons to clay products in place and any erosion below the organic forest floor mobilizes the minerals. These rock types are highly susceptible to erosion especially in their weathered condition. Steep slopes and high mountain terrain combine with the rock characteristics to produce a landscape highly susceptible to erosion.

Review of the Josephine County Geologic Map (DOGAMI 1979) indicates older landslides in the East Fork area associated with granitic rock. A physiographic feature was noted on a topographic map that suggests a probable older landslide associated with granitic rocks in the Rock Creek area. Other possible landslide sites were observed in the Glade Fork and Clapboard drainages. Recent geologic mapping has confirmed the presence of large landslide deposits in the Rock Creek drainage.

Surface erosion can occur when the rain intensity exceeds the ability of the soil to absorb water, where the surface of the soil has been exposed by the removal of vegetation or forest duff, or where it has been compacted, reducing the ability of the soil to absorb water (such as road surfaces, heavily grazed areas, or areas compacted by heavy machinery). Within this category, there are many forms of erosion that may take place, including sheet erosion, raindrop splash erosion, rill and gully erosion, and ravelling (see glossary for definitions of these terms).

Land use such as home site development, logging, skid and yarding trails, mine headwalls, rock quarries, etc. can also contribute to slope instability. The use of heavy equipment and the removal of vegetation associated with these uses can result in soil compaction and exposed soils, both of which exacerbate erosion and landslide potential.

Although no research has been conducted locally on the subject, studies in other parts of Oregon and Washington have shown that harvesting trees on steep terrain increases the rate of slope failures by two to four times over that seen in uncut areas (Ice 1985; as cited by ODSL 1995). During the last century, the steeper headwalls of the Williams Creek Watershed (where slope instability and sediment delivery are of most concern) were utilized primarily for timber extraction. A comprehensive inventory of these areas is needed to determine the degree of sediment contribution from these sources. Due to the existence of some landslides, presence of erodable soils, steep slopes, and high precipitation, there is potential for continued sediment delivery from slope instability that is not related to roads.

Upland sections of the East Fork watershed contains many areas that contain granitic soils that are subject to landslides and slumps, especially in the steeper sections. Fortunately, many of these areas are covered by vegetation and are stable. Only when these areas are logged or vegetation removed are they subject to the erosion possibility of landslides, debris flows, or slumps.

Geology of Williams and East Fork Subwatershed

Erosion is controlled by several factors influencing the amount, type, and timing of particulates in streams. The geology of the specific area is primary to the erosion potential. The East Fork subwatershed contains a large portion (>55%) of highly weathered and erodable soils consisting of granitic varieties of diorite, quartz diorite, and gabbro. Other rock types that interface in this area are metamorphic varieties of volcanic deposits and quartzite along with formations of serpentine, schist, slate, ultramafics, and gneiss. Each rock type has its own susceptibility to erosion due to its physical and chemical properties and their reaction to the weathering processes. Erosion may also be influenced in part by the structural configuration that is developed in this area of high mountain exposures from rapid uplift and steep slopes of Grayback and Sugarloaf Mountains. This combined with abundant rainfall from coastal influence with 40-60 inches rain per year, soil development, slope steepness and length, vegetation, channel and stream flow characteristics, all of which influence natural weathering and erosion rates. Land management practices including forestry practices, logging operations, and road building processes adding up to produce dynamic forces that, if influenced, will produce erosion products that can significantly impair riparian habitat throughout the watershed.

Since the rock types are important to the discussion of erosion, we will include a detailed description of the geology in this watershed, the forces that are at work to create different types of erosion, and how erosion is distributed and developed in this terrain. Owing to the fact that this area contains several distinct formations that intersect and contact each other, the geology has been influence greatly by the contacts that are created by faults, fracture zones, and intrusions of granitics into these zones. Some streams and tributaries form along weakness planes in the rocks and continue to erode and cut downward following the pathways of the predominant structural weaknesses. This is the case with the East Fork Creek where it has followed the major contact between the Western Hayfork and the Rattlesnake Terranes, an area that has been intruded with the massive Grayback Pluton. Other secondary fracture patterns have been noted, but have not been mapped, and may be influential in the development of weakness patterns that produce streambed formation crosscurrent to the northward flowing East Fork Creek. Other streams are developed by erosion and these can begin by disturbances in the natural system, concentration of surface flow, and resulting downcutting and removal of soil and erodable particulates in susceptible rock types.

We have recently completed a geologic mapping study that includes the entire Williams Creek watershed in conjunction with the groundwater study of the Williams Valley. This map will be useful in identifying the location of areas of concern with respect to erosion and will be included in this report.

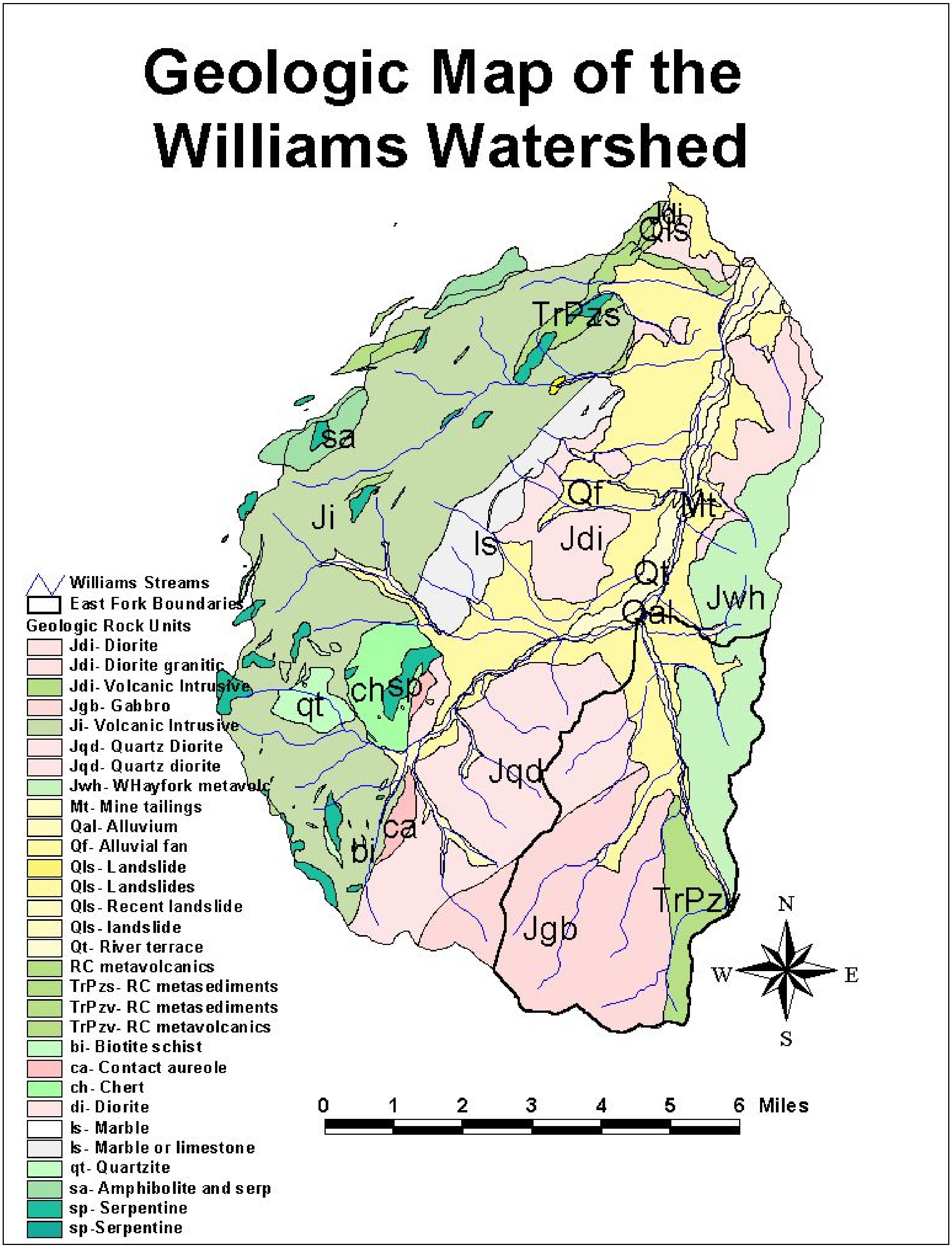


Fig. 3. New unpublished geologic map of Williams Creek watershed.

A large portion of the East Fork area (>75%) is dominated by igneous plutonic rocks of the Grayback Pluton of Jurassic Age 164 million years ago and make up the highest portions of the watershed. These rocks are formed from intrusion of molten magma in the crust at approximately 15 mile depth and subsequently faulted into place during and after the cooling process. Evidence gathered by Martha Godchaux in her dissertation of the geochemistry of the Greyback Pluton indicated that there is a bimodal composition of the plutonic rocks giving way to inclusions of two types of rocks in samples found in this region. Analysis indicates that high iron and magnesium contents of the rocks along with high percentages of feldspars allow the formation of extensive weathering in surface samples. Deeply weathered soils form along the sides of the Grayback Pluton due to the abundant rainfall in this region, steep slopes, and the susceptibility of the minerals to chemical weathering and erosion. Extreme oxidation of abundant iron bearing minerals of pyroxene and hornblende result in the friable characteristics of the rocks. This, combined with the hydrolysis of feldspars, where ion exchange chemically weathers the minerals to clay particles, results in deeply weathered soils with friable quality that reduces the rocks *in situ* to clay soils. Erosion processes pick up fine-grained minerals that encounter flowing water that carries it down to the streams and into the rivers.

Other rock types include the Western Hayfork terrane composed of metavolcanics and quartzites of the Applegate Group occupying the eastern side of the valley. The Rattlesnake Formation composed of ultramafics, serpentines, and sedimentary rock is exposed in the upper portions of the East Fork around Pipe Fork Creek and is similar to the rocks found in the western portions of Williams Valley.

SEDIMENT SOURCES

The following sediment sources are addressed in this assessment, in approximate order of impact:

1. Roads
    a. Commercial Forest Road Erosion and Instability
    b. Private Rural Road Erosion and Sedimentation
    c. Roads built on erosion-susceptible geologic formations
2. Riparian Erosion Associated with Livestock
    a. Steep erodable stream channels
    b. Overgrazed rangeland
3. Slope Instability, Not Related to Roads
    a. Highly weathered soils
    b. Concentrated runoff
4. Erosion from Agricultural Land
5. Sedimentation from Mining
6. Erosion from Burned Land

Roads

Roads and their Effects on the Ecosystem

Much research has been conducted showing that road building, especially on steep slopes, is a major source of sediment. According to congressional testimony given by a University of Washington geomorphologist, numerous studies on forest road failures and road-related landslides have shown that these events have increased erosion rates in roaded watersheds that were many times greater than natural erosion rates in undisturbed watersheds (D. Montgomery, Testimony to the U.S House of Representatives Subcommittee on Interior Appropriations 1994, as cited by Pacific Rivers Council 1996). One study in the Western Olympics in Washington linked erosion and landslides along logging roads with declines in coho salmon populations (Cedarholm and Reid 1987, as cited by Pacific Rivers Council 1996). Over time, as road cuts and fill slopes stabilize, erosion potential generally decreases. However, roads that were poorly placed and constructed to begin with or heavily used haul roads can generate sustained increases in sedimentation of streams (Reid and Dunn 1984; as cited by Pacific Rivers Council 1996).

It should be understood that rarely can roads have *no* impact on streams. Roads modify drainage systems and accelerate erosion. These changes can affect basic stream flow characteristics including sediment transport and storage, channel bank and bed configurations, substrate composition, and the stability of slopes adjacent to the streams. These changes can have important biological effects to stream ecosystems. Salmonids require stream habitats that yield food, shelter, spawning substrate, suitable water quality, and access for movement upstream and downstream during their life cycles. Roads can have an important impact to these functions (Furniss).

Construction of a road network can lead to accelerated erosion and sediment loading by altering slope morphology and altering the runoff characteristics. The sediment contribution from roads is usually more that all other management activities combined, including logging operations. Road construction can increase the frequency of slope failure with road location being the most influential. In a study on the Clearwater River in Washington, Cedarholm et al. (1981) found that the percentage of fine sediment in spawning gravels increased above natural levels when more than 2.5% of the basin area was covered by roads.

Roads can change the stream hydrograph and affect sediment deposition in streams. Harr et al. (1975) reported an increase in peak flows following road construction. King and Tennyson (1984) found that the hydrologic behaviors of small forested watersheds are altered when as little as 3.9% of the watershed was occupied by roads. These alterations reroute the drainage patterns and lead to changes in the erosion and hydrologic behavior of streams.

Most forest roads in the watershed run perpendicular to hillsides, which can intercept shallow groundwater at the cut-slope, leading to cut-slope degradation and increased surface water flow. In past road construction, the most common method for dealing with road drainage was to cut a ditch at the uphill edge of the road (Fig. 2). Cut-slope degradation or outright cut-slope failure can fill the in-board ditch, causing the drainage to be diverted to the roadbed. Once on the road surface, the water drainage can erode the roadbed before diverting back to the ditch or spilling over and eroding fill on the outer edge of the road (Fig. 3)

Roads and Their Effects on Salmon Habitat

Salmon habitats are particularly susceptible to road construction with sedimentation from loosened soil and temporary stream crossings. All salmon require access to spawning areas, appropriate substrates for reproduction (egg incubation, alevin development, and fry emergence), and suitable water quality. Some species such as coho salmon rear in streams for up to a year and need food organisms and protection from predators and overheating. Any alterations in sediment loading can adversely affect all freshwater stages of these fish.

Adult salmon have specific requirements for spawning, including substrate sizes, water depth, and stream velocity. The amount and kind of spawning gravel can be severely affected by high sediment loads. Fine sediment can be deposited in the interstices, even in fast moving streams. If the fine sediment in the gravel is too great, the gravel may become too cemented or impacted that fish are not able to dig redds. An excess of fine sediment can cover spawning gravels and cause shallow channel braiding leading to warm water, reduced pool volume and frequency, and increased subsurface flow essentially reducing spawning habitat.

Incubation of salmonids depends heavily on water flow through gravels to provide oxygen, remove carbon dioxide, and other waste products. If gravels are filled with fine sediments, water flow and gas exchange are reduced and egg survival is jeopardized. Increased peak flows can destroy young embryos by sedimentation or gravel scour. Increased sedimentation can have adverse effects on juvenile salmonids by effecting the survival of macroinvertibrates living in the stream on which the juvenile fish feed.

Vegetation along the banks of streams is vital to rearing habitat, including shade, food supply, and channel stability. Road construction often removes this component by limiting riparian habitat. The importance of large woody debris in and near the stream is well documented.

The effects of fine sediment on spawning habitat are complex and depend on many interacting factors. These include the species and race of fish, duration of freshwater rearing, spawning system, presence of other fish, availability of spawning and rearing habitats, stream gradient, channel morphology, sequence of flow events, basin lithology, and history of land use (Everest et al. 1987a).

Roads and Their Construction

Road fill that is placed on the outer portion of the road can be unstable and subject to sliding, particularly if the road drainage system is not functioning and diverts water over the fill. An example of road damage resulting from in-board ditch filling is on Rock Creek Road (BLM Road # 39-5-14), approximately ¼ mile past the locked gate. There, massive land sliding and debris flows resulted from inboard ditch saturation on eroded granitic soils.

During heavier than normal stream flows, undersized or plugged culverts can also blow out in a slurry of soil, water, and debris. In the past, culvert size was estimated and designed to withstand less than the 50-year recurrence interval (50-year flood). New drainage construction by BLM is now sized for the 100-year recurrence interval. Private timberland owners are required by the Oregon Forest Practice Administrative Rules to size their culverts for 50-year recurrence intervals (OAR 629-625-320). Even when adequately sized, forest litter and sediment can accumulate and block the culvert entrance, thereby causing culvert failure. Current examples within the watershed of plugged or undersized culverts causing blowouts or overflow of water onto roads are on BLM road # 39-5-2 (off Panther Gulch Road) and approximately 1¼ mile up BLM road #39-5-22 in the Glade Fork drainage near the end of East Fork Road at the Glade Fork Creek under crossing.

Public land management agencies and some private landowners are employing a number of new road construction methods to try to alleviate the problems noted above. Roads, in some cases, can be located along or near ridge tops so that they intercept less shallow ground and surface water and are farther from the larger streams. The Rogue River National Forest, for example, does a landform analysis to detect areas with past slope stability problems so that road placement can be tailored accordingly or perhaps avoided altogether (Jones, P. RRNF. Personal communication, March 1999).

For culverts that channel ditch water beneath the road before it reaches the stream (cross-drains), an angled culvert and a structure to dissipate the water's energy can be installed to prevent erosion of the road fill and the hillside. To help alleviate road damage in the event that debris obstructs the culvert entrance, an armored (rocked) or paved roadbed can be installed at the stream crossing so that the overflow does not erode the roadbed. It should be recognized, however, that there is no "one size fits all" approach for every situation. For example, an in-board ditch may sometimes be the best approach in some locations to route the water away from an unstable area.

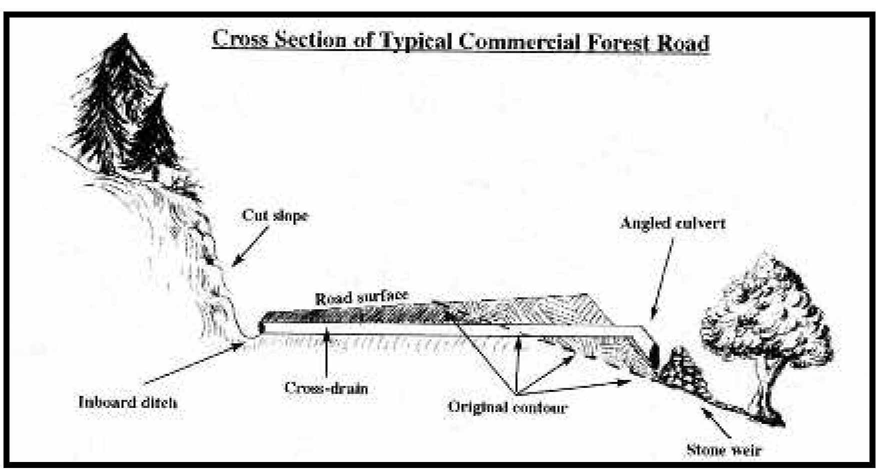


Fig. 4. Cross Section of Typical Commercial Forest Road

An alternative road construction technique involves building roads that are sloped to divert water off the road surface into adjacent vegetated swales. There, any sediment can be filtered out by vegetation, rather than directed into stream drainages via in-board ditches. This technique also helps alleviate the problem of sediment or debris filling in-board ditches and culverts – a phenomenon that can trigger road failure.

Outsloped Roads

Outsloped road design removes the inboard ditch and outslopes the road bed sideward, using the slope of the natural hillside contours to help transfer the surface runoff from the upslope side of the road to the downslope side. This allows the water to quickly run off the roadbed, reducing the erosion and movement of fine particulates from the gravel surface. It also reduces the continual downcutting and erosion of the roadbed as water flows lengthwise down the ruts and side channels of a road.

Cross drain culverts are not normally used in this design unless they are needed to transfer water from a small stream or rill across the roadbed. Culverts are a source of plugging and failure and rolling dips or hardened swales are used to transfer water across the road. Another advantage to this system is the ability to transfer water across the road where sediment can be filtered out in vegetation or organic soils before reaching the streams.

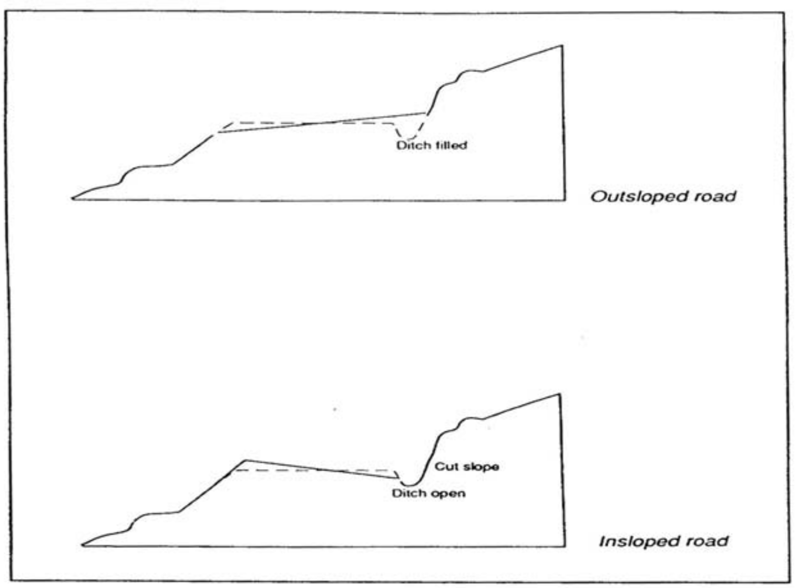


Fig.5. Outsloped Road Design

Roads In the Watershed

There are over 25 miles of roads in the East Fork subwatershed composed of paved access roads, gravel driveways, forest roads of various types, and logging roads that traverse moderate to steep terrain. Many of these roads are maintained by BLM, as mandated by federal guidelines. Private roads constitute the numerous roads that are built and used on private land and are in a variety of conditions of repair and use. These private roads are the focus of this project. We have developed protocol to record and evaluate the conditions and impacts that they are having, or will have, on stream systems in the East Fork.

Erosion from roads is a major source of sediment in this and many other heavily roaded watersheds. The Grants Pass Resource Area BLM estimated that, as of 1996, there were approximately 417.27 miles of road in the Williams Creek Watershed, about half of which are on BLM lands. Road density in the Williams watershed is approximately 5.14 miles of road per square mile. The average road density on BLM land is approximately 4.54 miles per square mile, and on private land there is an average of 5.80 miles of road per square mile. Because of guidelines issued in the Northwest Forest Plan and the Medford District RMP, the BLM is mandated to decrease road densities on land under its jurisdiction. In this watershed, the target goal is an average of 1.5 miles of road per square mile (WCWC, 2000).

Table 1: Road Densities for the East Fork subwatershed

Drainage Basin	Miles of Road	Square Miles in drainage	Estimated Road Density
Clapboard/ Sugarloaf Creeks	4.0	2.65	1.51
East Fork Williams Creek	16.2	4.99	4.03
Glade Fork Creek	12.5	1.67	7.48
Pipe Fork Creek	2.5	2.28	1.09
Rock Creek	29.5	5.11	5.77
Total Miles	**64.7**	**16.7**	**3.87 average**

Road Surface

Road surface types also shape the intensity and duration of the erosion process. Natural surface roads contribute to sedimentation at a higher rate than equivalent rock surfaced roads. Some timber companies place armored (rocked) dips every few hundred feet on their natural surface roads in order to divert water from the road surface. This reduces the energy of the water and directs it to the slope, where any sediment can be filtered out by grass and the forest duff. The condition of unsurfaced roads is especially susceptible to damage during winter use. Peter Jones, an engineering geologist for the Rogue River National Forest, estimated that “about 90% of damage to [unsurfaced] roads and associated erosion occurs in the wet season” (1995; 20). The Medford District BLM estimates that there are 44.01 miles of unsurfaced BLM roads in the Williams Creek Watershed, mostly in upslope areas that are open to year-round vehicular traffic. The amount of unsurfaced roads on private lands in the watershed is unknown (BLM 1996). Rock surfaced roads (which account for the majority of commercial forest roads in this watershed) contribute to sedimentation through desiccation of surface material and crushing of surface material by traffic (Robichaud et al. 1999).

> *Roads may have unavoidable effects on streams, no matter how well they are located, designed, or maintained. Road closure (decommissioning) is considered*

the most significant and beneficial method of mitigating road related sediment impacts to aquatic habitats (USDC/NMFS 1997).

Private Roads

Fortunately, many of the private roads have a good history of repair and maintenance due to the fact that the landowners live and work on the land and take pride in their property. This is not always the case, either for lack of funds or from inheriting the problems from land purchase and previous owners' neglect. Nevertheless, these problem areas have a variety of extent of damage and solutions to them are varied and site specific. Some areas have concerns about culverts while others have constructed ditches that need constant repair or are inadequately designed.

Gullies formed along Lower East Fork Road by cross-drained culvert outflow

Drainage on roadbed that empties into creek system – Spring Creek driveway

Fig. 6. Photos of two erosion problems on the East Fork

There are over eight miles of signed private and public right-of-way roads in the East Fork subwatershed that are not maintained by the Josephine County or the BLM (not including driveways and other unsigned roads). An examination of these roads indicates road condition and potential for sedimentation is related to the road's ability to drain surface water off the road surface. Crowned or sloped roads are consistently in better condition, even on slopes. Most of these roads have some surface degradation. However, of the roads surveyed, only the Spring Creek Driveway, two sections of the Upper East Fork Road, and Cherry Gulch Road appear to have erosion that has the potential to reach watershed streams, primarily via the county road drainage system.

These roads have erosion problems that present challenges for conservation and repair crews and have significant erosion occurring during winter flows. The Spring Creek Driveway, which accesses Patrick's property, has had enormous erosion problems, but these problems have been addressed by this study. This road has had engineering and improvements that out slope the road and divert water and sediment into the forest floor where it can be filtered. The upper East Fork Road has enormous sediment potential from rills and channels in the road carrying sediment to the creeks. We are in the process of seeking ways through Title II grants to reduce the erosion of these sites and may be able to help resolve issues that continue to produce sediment in the East Fork subwatershed.

Table 2. Private Right of Way Roads not Maintained by the County

Road	Length (miles)	Condition	Surface	R.O.W.	Subwatershed
Cherokee Rd.	0.50	Fair	Rock	Private	Clapboard – Sugarloaf Gulch
Spring Creek Driveway	0.50	Good/Poor (Improved)	Rock	Private/BLM	Spring Creek
Turley	0.45	Fair	Rock	Private/BLM	East Fork
Granny Lane	0.25	Good	Rock	Private	Clapboard – Sugarloaf Gulch
Freeborne	0.2	Good	Rock	Private	East Fork
Pipe Fork Road	4.1	Good	Rock	BLM	East Fork
Upper E F Rd	1.2	Poor	Dirt	BLM	East Fork
Farver	0.25	Good	Rock	Private	East Fork
Baugh	0.25	Good	Rock	Private	East Fork
Jamie	1.2	Good	Rock	Private	Clapboard – Sugarloaf Gulch
Saint-Parris Dr.	0.25	Good	Rock	Public	Rock Creek
Percy Lane	0.2	Fair	Rock	Private	Rock Creek and E F Williams Creek
Homestead Rd.	0.4	Good	Rock	Public	East Fork Williams Creek
Cherry Gulch Rd.	0.25	Poor	Rock	Private/BLM	E F Williams Creek & Williams Mainstem
Total	**8.8 miles**				

Good = Road appeared to be well maintained, have little or no sediment run-off, and drainage system appeared to be functioning well
Fair = Road appeared to be somewhat maintained, have some sediment problems, and/or drainage impairment
Poor = Road appeared to be poorly maintained, have serious sediment problems, and/or inadequate drainage

Note: Many of these roads turn into logging roads or driveways, and exact length is difficult to ascertain. Mileage determined by odometer. Road distances measured and condition noted during June 2001.

Roads with Proximity to Streams

Roads in close proximity to streams often impact the delivery of sediment to flowing stream systems. These are roads that typically span streams with culverts or bridges, run adjacent to streams, and have drainage ditches that deliver turbid runoff into the stream system.

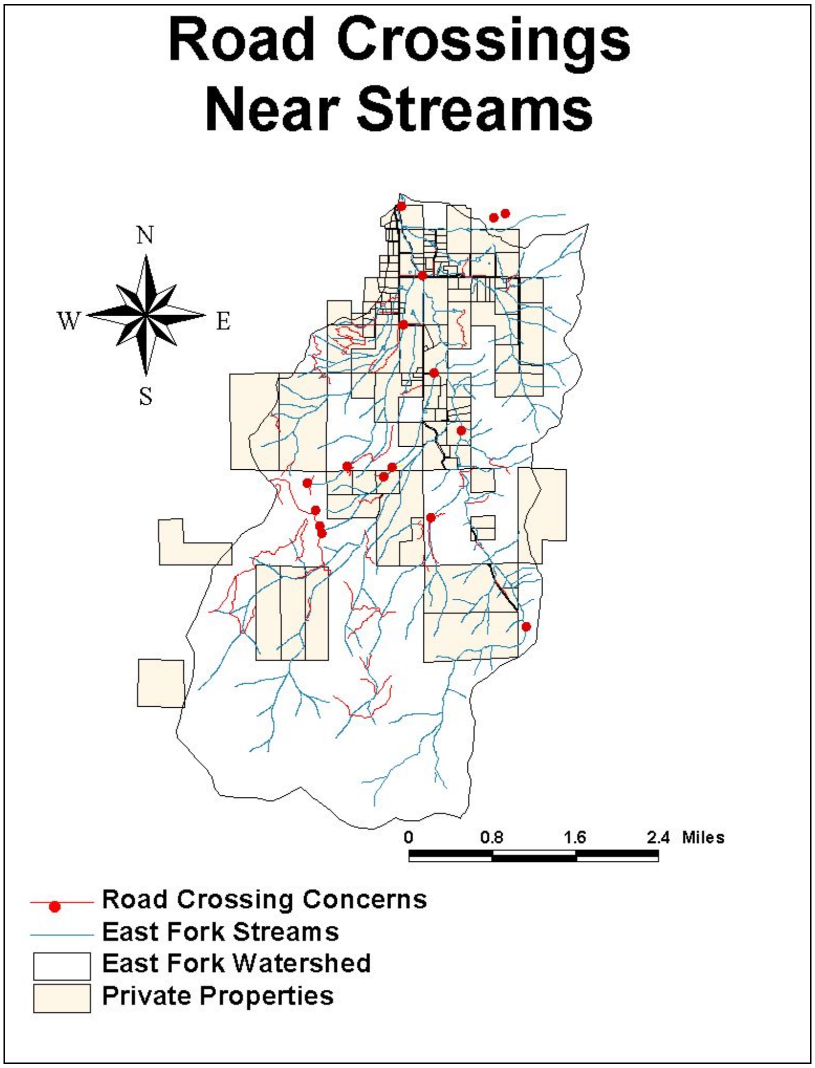


Fig 7. East Fork Subwatershed showing streams and road segments that cross streams systems. These represent areas that are possible sediment delivery sites. Some of these sites are on private property or may cross over into public lands.

Public Roads

The number and length of public roads by far outweigh the private roads in the East Fork subwatershed. Some of them are logging roads that have not been used for approximately 50 years when the majority of logging was done in this area, but others include presently used access roads that are open or gated. Gates are installed by BLM on public lands to reduce the traffic, especially in wet seasons when damage is done by vehicles, to stop illegal trash dumping, and to stop the spread of soil borne diseases such as Port Orford Cedar root disease, which kills Port Orford Cedar trees.

Fig. 8. Upper East Fork Road erosion damage from one year

Forest roads that are open in the watershed do not generally have serious degradation problems and are in good condition because of repeated maintenance, but others *do* have problems such as: filled in-board ditches; plugged or partially plugged culverts; minor roadbed erosion to gullied roadbeds (often a result of an impaired drainage system); roadbed cracking (a precursor to roadbed failure); cross-drain washout of side cast (due either to the failure of a no-angled culvert to carry water off of fill and/or no structure to dissipate the water's energy at the end of the angled culvert); and culvert blow-outs due to plugging. Even roads that are in good condition have the potential to deliver sediment through the road drainage system. Basic road maintenance (i.e. grading, ditch, and culvert cleaning) does not appear to be adequate.

Maintenance schedules for road crews can add to the sediment delivered to streams by removing vegetation from ditches during fall schedules. Publicly employed road crews often maintain road ditches and clean culverts in the late fall to remove dirt and vegetation from the drainage system before the heavy rains come during December and January. This schedule can increase the possibility of sediment washing into the streams. The removal of vegetation and debris by machinery scrapes the ground alongside the ditches, exposing the soil and loosening the surface allowing for greater erosion during high rainfall events. Alternatively, if this maintenance were performed in summer, leaf fall and other remnant vegetation would prevent erosion during the first few rain events. On this schedule, vegetation would have a chance to grow during the fall and help hold the soils that are exposed in roadside ditches.

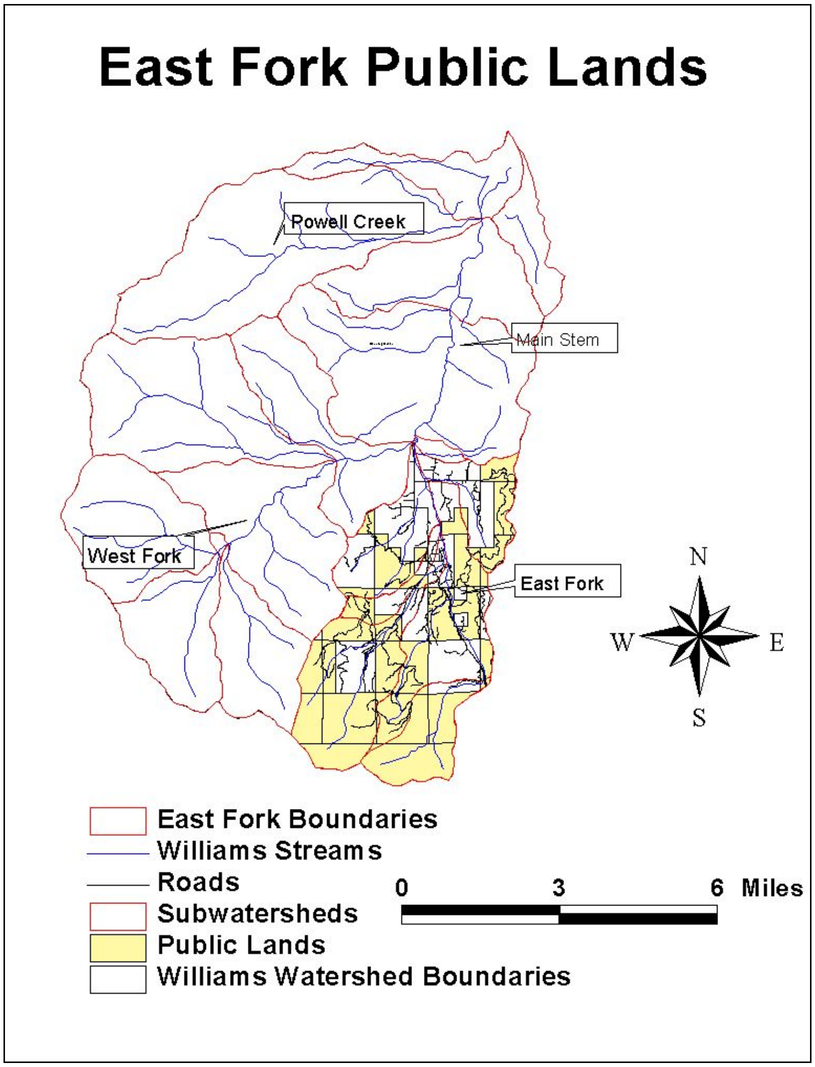


Fig 9. Public Lands found within the East Fork Subwatershed with roads.

Josephine County Forestry has not done a road inventory and is not aware of any serious erosion problems on its roads (WCWC Assessment, 2000). Josephine County Forestry, in partnership with the BLM, WCWC, and affected landowners, has arranged for locked gates to be installed at the end of East Fork Road where erosion problems on a county access road were first noted in 1973 and are a significant sediment source in East Fork Williams Creek (BLM 2000).

Commercial Forest Roads

The category of commercial forest roads includes roads on BLM, Josephine County Department of Forestry, and private timber company land. These roads were developed primarily for timber extraction; however, other uses may prevail locally, such as fire protection, mining and recreation access.

In 1998, the Medford District BLM completed an inventory of its roads in the Williams Creek Watershed. The road inventory consists of a comprehensive mapping of all BLM road locations and a record of road surface condition and the size and condition of drainage structures. With this information in hand, the BLM is prioritizing replacement of drainage structures that impede anadromous fish passage and replacing culverts to be sized for a 100-year recurrence interval (BLM 1996). The BLM has recently replaced two undersized, fish-blocking culverts with adequately sized, fish-friendly open bottom concrete arches on East Fork Williams Creek near the confluence with Glade Fork. The BLM has analyzed road drainages by calculating the potential sediment load of the road prism (which includes cut-slope, ditch, roadbed, and sidecast). The agency will then prioritize the placement of additional cross-drains (culverts across the road to channel the in-board ditch water to the slope) so that sediment can be diverted prior to reaching the stream by way of the in-board ditch. Road closures, gating, and decommissioning are also being implemented on a limited basis due to funding constraints and the existence of Reciprocal Right-Of-Way Agreements that are attached to many BLM roads. This has process has been done and is called the Transportation Management Objectives.

Josephine County Forestry has not done a road inventory and is not aware of any serious erosion problems on its roads (WCWC, 2000). Josephine County Forestry, in partnership with the BLM, WCWC, and affected landowners, has arranged for locked gates to be installed at the end of East Fork Road where erosion problems on a county access road were first noted in 1973 and are a significant sediment source in East Fork Williams Creek.

Private timber companies who have holdings in the watershed have either inventoried their roads within this watershed or are in the process of inventorying roads on their property. In general, the private timber companies who responded to queries stated that they winterize their roads by water barring and gating during the wet season (approximately November to May) to prevent private vehicles from rutting or otherwise damaging them.

Table 3. Estimated Miles of Commercial Forest Roads in East Fork Drainage.

Drainage	Miles of	Estimated Road
Clapboard / Sugarloaf Gulch	4.0	1.51
East Fork Williams Creek	16.2	4.03
Glade Fork	12.5	7.48
Pipe Fork	2.5	1.09
Rock Creek	29.5	5.77
Total Miles (does not include county or non-commercial forest roads)	**35.2**	**3.98 average**

Source: Road miles were estimated using a map wheel, BLM Ashland & Grants Pass Resource Area Transportation Maps, and BLM Williams Watershed Project Planning Map. This method of measurement does not have a high degree of accuracy. Therefore, this information should not be used for planning purposes.

County Maintained Roads

The Williams Creek Watershed has 34.42 miles of county roads that are maintained by Josephine County Public Works (JCPW 1998). All of these county roads are paved and have a low gradient, both of which significantly inhibit erosion from occurring. The erosion impacts noted were roadside ditch-bed and ditch-bank erosion. The practice of winter cleaning and maintenance of the roadside ditches removes any grass, which holds soil in place, and reduces water velocity. Josephine County Public Works practices winter ditch maintenance according to seasonal road crew availability. The county targets ditches for cleaning which show an accumulation of sediment that is sufficient enough to cause an elevation of the water flow line, which could expose the road base material to water damage or cause culvert plugging. The county applies winter sanding for traction on an as-needed basis. Sand is removed from the road surface when no longer needed by a mechanized sweeper (not vacuum assisted). Except at bridges, where it is manually collected, the sand is incorporated into the shoulder of the road and the roadside ditch(WCWC Assessment, 2000). The drainage ditch system along county roads has been identified as a conduit for the transport of sediment into streams.

Table 4. Josephine County Public Works Road Maintenance in the East Fork Subwatershed.

Road	Length
Browns Road	0.75 Miles
East Fork Road	6.60 Miles
Latigo Ranch Road	0.50 Miles
Total	**6.35 Miles**

Riparian Erosion due to Grazing and Cattle

Livestock in riparian zones have the potential to denude the soil of vegetation through overgrazing. Animal hooves can cut the sod, exposing bare soil to erosion, and can cause compaction that leads to surface erosion. Factors that affect the severity include: the number of animals in the riparian zone, duration of animal access, season of access, and whether the stream flows seasonally or perennially. Fencing livestock out of riparian areas, developing off-stream stock water options, implementing seasonal grazing schedules, and multiple pasture grazing systems can minimize potential impacts (WCWC Assessment 2000).

Much grazing land has been developed on marginal agricultural lands with moderate slopes (2-5%), shallow soils, along rocky stream terraces, and bordering and including historically forested lands. These properties are subject to increased erosion during periods of high rainfall or runoff, especially with long time grazing by cattle.

Table 5. Livestock Impact to Streams by Subwatershed

Subwatershed	Estimated Length of Impact	Stream Type
Clapboard Creek	1000 ft	Seasonal
East Fork Williams Creek 2 Sites	500 ft.	Year Round
	2200 ft.	Seasonal


Fig 10. Fine sediment runoff during rainstorms is common from grazing land where cattle have disturbed and loosened the soil. Some of the runoff reaches the stream system along the East Fork Creek

Erosion from Agricultural Land

Erosion from agricultural land is the leading cause of soil loss in the United States, comprising some 70% of the total (Wright 1999). Soil loss is aggravated by steep slopes and agricultural methods or crops that leave the soil exposed.

Approximately 1,793 acres or 3.4% of the watershed is zoned exclusive farm (EF), of which only a small percentage is tilled annually. Most farming within the watershed is on the valley floor, where the slope is slight. The prevalence of perennial hay crops and pasture help to minimize soil erosion. Because these considerations are employed, the degree of erosion from agricultural land in the Williams Creek Watershed is limited. Some occurrence of surface erosion and gullying in compacted or fallow fields has been noted. Without some system to filter the runoff through vegetation and settling ponds, the runoff continues to the creeks and impacts the water with increased pollution. A complete inventory of this potential sediment source should be conducted.

Sedimentation from Mining

There are two types of mineral deposits, lode and placer. Lode deposits are mineral deposits that occur in consolidated rock (solid rock), while placer deposits are occurrences of minerals associated with unconsolidated stream or bench gravels. Due to their in-stream and streamside location, placer deposits have the highest potential for stream impact. Minerals, most notably but not limited to gold, are removed from placer deposits by 'washing' or agitating in water, using processes that take advantage of the minerals' high specific gravity, e.g. panning, sluicing, or dredging. The damage from in-stream mining results from the disturbance of somewhat stable stream deposits, which when disturbed suspends finer sediments. These finer sediments are then deposited further downstream, where they may inhibit successful spawning or otherwise degrade aquatic habitat.

There is no evidence of mining being done in the East Fork subwatershed. Gold has not been discovered in this area of the Williams Valley nor are there other types of mineral deposits that might be economical to extract. The only rocks that are periodically mined are quarry rock from the two known borrow pits, one at the end of East Fork Road, managed by BLM, and the other on private property owned by Gregg Hyde on Panther Gulch Road. Neither produces sedimentation at this time nor poses a risk to salmon habitat.

Erosion from Burned Land

Forest and grass fires have the potential to remove tree and brush canopy, forest duff, and grasses that protect the soil from surface erosion. Burned land is at risk for approximately one to two seasons after burning, by which time vegetative re-growth will protect the soil from erosion (GWEB 1999).

The BLM estimates that 28% of the watershed has a high fire hazard rating (BLMa 1998; BLM 1996). Due to the extent of the forested area within the Williams Creek Watershed (greater than 65%), the extent of roads which allow access for accidental ignition, the prevalence of homes in the forest/rural interface (an ignition source), and past wildfire suppression efforts which have allowed a build-up of fuel, the potential for fire and associated soil erosion is high.

Fortunately wildfires have not been common in the East Fork area for many years. This potential still exists with the numerous forest homes in this area, extensive road network, and extreme danger during summer months. Open fields of grass also poses a risk to wildfires and with the large open fields along the road, the potential for fire is good.

Incised Drainages

Channelization and incision is common in the creeks and tributaries of the East Fork, especially in areas of high relief and steep gradient (>5%). This implies that downcutting is occurring at a rate that overcomes the ability of the streams to deposit and hold sand and gravel in the streambed and on the banks. Incision can also be a result of increased erosion on stream banks from various reasons. This can include a high amount of existing roads, road building, cattle grazing, or riparian vegetation removal. The effects of channelization are important in that the high velocity and discharge amounts remove gravel beds used for spawning salmon and reduce complexity in the stream system. Rapid moving water straightens channels allowing for removal of excessive rapid runoff. This also changes the components of the stream gravel system. With higher runoff, pebble and cobble size classes are removed and the remainder is larger cobbles and boulders, which, in themselves, are unfit for salmon habitat. It also reduces the connectivity of the channel to the flood plain, the major source of relief for swollen channels during winter runoff and depository of excess sand and sediment.

Continued incision will remove gravels and reduce useable salmon habitat, increase erosion, continue to remove wood from the creeks, and reverse the effects of side channels that increase channel complexity needed for viable salmon habitat. Large wood is often termed the backbone so the streams because they hold in the gravels and slow the velocity of the runoff. This allows meandering and complexity to develop with deep pools and riffle habitat important of the spawning and rearing of salmon.

Instream Ponds and Dams

Instream ponds are constructed on many private properties to collect surface runoff or subsurface flow for irrigation, recreation, and landscaping purposes. These ponds restrict the flood runoff during times of high precipitation and can cause problems if overflow systems are not constructed properly or are not maintained regularly. Ponds in the East Fork are generally small but can receive enormous amounts of runoff in a short period of time.

One such pond on Panther Gulch Road that collects the entire flow of Panther Creek overflowed its walls and eroded the dam during high rainfall in December of 2002. This produced an enormous release of water and carried tons of sediment across Homestead Road and through neighbors' property and emptied into East Fork Williams Creek. (See section: Results of Analysis of Tributaries, Page 71) This problem has wide implications toward the development of ponds to collect instream waters. These ponds collect the sediment from the runoff over many years time and deposit it in the bottom and with the breach of the dam; they can release more sediment in a few hours than what is produced by the stream system over tens of year's time. This sediment impacts gravels of the main stem and effects salmon habitat throughout the system for years with very few ways to track the source.

Miscellaneous Sediment Sources

During January and February 2002 and 2003 some sediment sources were noted that did not fall into any of the discreet categories, such as: private driveway and parking lot erosion; wet season landscaping projects; human alteration of water courses; the tracking of mud onto the roadway by trucks that are used off-road or by farm tractors; wet season building site and road construction; off-highway vehicles used on natural surfaced roads or off the road completely, in a manner or location that caused ruts. Individually these sources are minor, but collectively across the watershed the impact may be significant and should be studied further.

Discussion

The high percentage of fine sediment found in the substrate material of Williams Creek and many of its tributaries such as the East Fork (as detailed in the "Fish and Fish Habitat" chapter of the Williams Creek Watershed Assessment) indicates that sediment loading is a problem in the watershed. The causes of its occurrence are less obvious and less provable. The sources of sediment that are most commonly identified are those associated with human management activities, and become most apparent when large-scale changes are triggered by storm and flood events. One such storm, locally known as the New Year's Day Flood (1997), unleashed untold cubic yards of sediment into the Williams Creek system. Much of this material was released as a result of numerous slope failures, associated with upslope roads and adjacent land use. Sediment generated from land-use-related or naturally occurring erosion and mass wasting in higher elevation drainages can be quickly transported through steep and confined tributary channels and deposited in low gradient reaches of the mainstem of Williams Creek. Once sediment is deposited, it can persist for decades or centuries in the lower gradient gravel bedded reaches of rivers and creeks that historically served important spawning and rearing habitat for many fish stocks (Frissell et al. N/D). To what extent the decline in anadromous fish in Williams Creek is attributable to excessive fine sediment is unknown, although benchmarks for excessive fine sediment amounts range in the 20 –25% range (ODFW guidelines for salmon habitat).

Within the East Fork watershed, there are numerous potential causes for high sediment loading in the creeks. Sediment deposition resulting from road construction and road erosion is one of the most pervasive non-point source water quality pollutants. The high road density in this watershed and ill-placed and/or poorly maintained roads are contributing to this problem. The BLM's *Williams Creek Watershed Analysis* (1996) suggests that " [t]he high road density, combined with the large amount of area in clear-cut equivalent condition [29.4%] located in transient snow zones (TSZs), appears to be the primary contributor of fine sediment in the Lone/Goodwin area"(33). Although not specifically analyzed in this assessment, the increasing amount of cleared land (due to development, timber harvest, farming, etc.) is probably reducing the land's ability to capture and filter sediment in its downslope movement.

ODFW stream surveys for 1994-1995 indicated that there is a high incidence of actively eroding stream banks along the East Fork of Williams Creek. For example, in Reach 2 of East Fork (between Clapboard and just below Percy Lane) 52% of the stream banks were actively eroding. This is associated grazing practice along this reach that allows cattle into the riparian zones all along the property. Restricting cattle to small sections of this area would reduce erosion considerably.

These stream surveys also showed that many reaches in the entire watershed had a high percentage of fine sediment in riffles, the highest sedimentation being found in the East Fork of Williams Creek. Reach 5, which extends from the confluence with Spring Creek and Glade Fork to just past the end of East Fork Road, had 50% sediment present in riffles. In Spring Creek, a tributary to the East Fork subwatershed, sand and silt was the dominant substrate ranging from 50 to 80%.

Recent efforts by ARWC to measure winter turbidity and suspended sediment loads in Williams Creek and its tributaries help determine sediment yields and sources. (See Water Quality chapter of WCWC Assessment.) This study follows these examples and expands the research further. Many of the stream segments were sampled during high water events to quantitatively measure the turbidity and contrast and compare each tributary to each other and develop an understanding of the areas where much of the sediment originates. Although sediment is a naturally occurring and important component to healthy aquatic ecosystems, humans have drastically altered the disturbance regimes that dictate its distribution, duration, frequency, and amount. Episodic delivery of sediment and woody debris has been replaced with chronic, frequent delivery over shorter time spans (WCWC 2000).

The high incidence of bank erosion, sediment in substrate, and presence of granitic soils in the East Fork subwatershed indicates that a combination of natural and human induced factors are causing sedimentation problems that may be limiting fish productivity. High road density in the upper reaches and heavy grazing pressures in riparian areas in the lower reaches are probably exacerbating naturally heavy sediment loads in this subwatershed. As this sediment is moved into lower gradient reaches it can cause embeddedness of substrate materials, that in turn can inhibit fish ability to successfully spawn and can diminish overall water quality.

In order to fully understand sediment source potential in the watershed, an in-depth characterization of sediment sources and types is included in this report, involving a comprehensive analysis of geology and soils in the watershed. A particular focus on steep granitic slopes that have been logged and/or heavily roaded and on agricultural/grazing lands that are adjacent to streams help to identify areas that are most likely to be contributing sediment into important fish habitat.

Table 6. Erosion, Fine Sediment, and Benchmark Comparison from 1994-1995 ODFW Stream Reports.

Basin	Stream	Reach	Land Use	Bank Erosion %	Riffles %Fines	ODFW Benchmark
East Fork Williams	East Fork Williams	1	RR	26	26	U
	East Fork Williams	2	HG/RR	52	28	U
	East Fork Williams	3	TH/RR	13	25	U
	East Fork Williams	4	TH/RR	8	49	U
	East Fork Williams	5	ST/RR	23	50	U
	East Fork Williams	6	PT/LT	12	41	U
	Glade Fork Williams	1	ST/PT	0	48	U
	Glade Fork Williams	2	LT	0	35	U

Land Use Codes: **TH**=timber harvest, **LT**=large timber, **AG**=agricultural, **PT**=partial cut timber; **ST**=second growth timber, **MT**=mature growth timber, **YT**=young forest trees; **RR**=rural residential, **LG**=light grazing, **HG**=heavy grazing

Benchmarks: **D**=Desirable, **U**=Undesirable; **B**=Between Desirable and Undesirable, **NA**=Data not available

Chapter 2:
Techniques and Field Work

Private Road Inventory

The Private Road Inventory was accomplished during the period of October 2001 through June 2002. This inventory was established following methodology developed from the *Forest Road Hazard Inventory Protocol* from the Oregon Coastal Salmon Recovery Initiative. A specific form was developed to inventory aspects in the Williams watershed. This form is included in the Appendix B. All inventories were completed and recorded on this form. Eight roads were inventoried which did not include many of the private roads that access areas that are not used often or are access roads for farm machinery.

These inventories were conducted to have base information on the roads of the East Fork subwatershed in respect to the conditions of the roads and the culverts that transfer water beneath them. We found that these roads are in a variety of conditions depending on the usage and ownership of the roads. Inboard ditches and undersized culverts were common on many roads with the downslope fall from some culverts high to moderate and causing erosion on the downslope side of the fill of the road. Some of the problem areas were observed on public lands and are not a part of the Private Road Inventories.

Inventories were accomplished by walking each road noting all the culverts, slope breaks, or sediment sources. The purpose of this inventory was to identify sediment delivery problems noting conditions of the roadbed. Roads that follow the streams or cross tributaries were the main focus of the study and attention was given to theses situations. Surface material used for the covering of the road was noted as an important aspect, whether it was paved, graveled, or dirt, and the condition of the surface drainage. Particular attention was given to the construction design, such as whether it was an inboard ditch or outsloped, culvert designs or hardened swales, condition of the culverts, or if it was built on a side hill or ridge top placement.

Public Road Review

BLM has completed their road inventory of their roads in the Williams Creek Watershed and has listed all their roads and conditions that are in. They are now working to update and improve public roads throughout the watershed for the purpose of reducing erosion and to maintain their road system. There are many such logging roads that contribute sediment to the streams. Some are on completed logging sites and others are part of a road network that is maintained by BLM for future logging and public access. Several roads have gates installed at the entrance to reduce the amount of traffic and erosion along the roads and the spread of Port Orford Root Disease, *Phytopthora linealis* that is responsible for reducing the number of Port Orford cedar throughout Oregon.

Turbidity Sampling

Turbidity sampling was performed at established sites along the East Fork Creek and its tributaries where access was convenient during high water without creating dangerous situations. These sites included bridges that cross the creeks, culverts, and streamside areas that are easily reached from the road. In all, 12 monitoring sites were located on the main stem and tributaries of the East Fork subwatershed. These include the East Fork Williams Creek in 4 places, Jones Creek, Glade Fork Creek, Spring Creek, Clapboard Creek, West Fork Williams Creek, and several smaller unnamed creeks that drain cattle grazing fields. Turbidity sampling is a way to ascertain the relative amount of erosion being done in a particular reach or tributary basin during rain events compared to others in the same area. Some of these sites were found to be inadequate or unneeded after the first winter season while others were added later to complete the analysis. Not all sites were easily accessible and this left some tributaries not sampled, such as Pipe Fork Creek, which is at the headwaters of the East Fork Creek. Other tributaries such as Yewwood Creek and Panther Creek were diverted into instream ponds and did not have an open passage for suspended sediment to the East Fork Williams Creek.

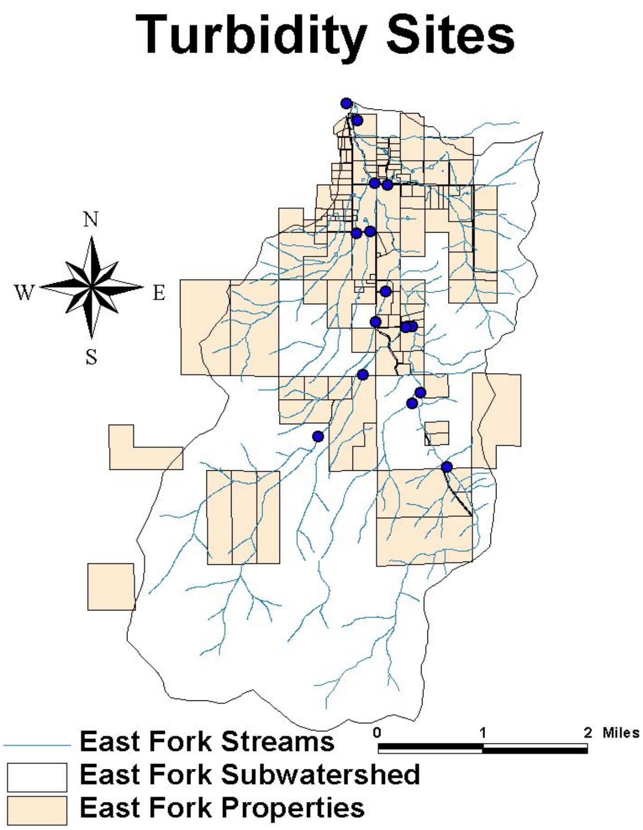


Fig 11: Dots show the turbidity collection sites

Of these sites, the East Fork Williams Creek was the one that was sampled the most, from four different sites along the main system. These samples yielded data that allows us to compare the different reaches and the amount of fine sediment that is added or lost during flow down the basin to the mouth of the East Fork Williams Creek. Additions of suspended sediment indicate that a source of sediment such as bank erosion, surface erosion, or channel instability exists between the collection sites. Alternatively, losses of suspended sediment indicate a depositional site exists such as a filtering mechanism of vegetation, ponded and slack water, or a floodplain connection in the region between the collection sites. Changes in the amount of turbidity warranted a further study, if possible.

Turbidity was sampled from the upper levels of the flow system, 3-6 inches below the surface of the water. The middle or bottom flow systems where particulates of sand or gravel would be moving were not sampled. Therefore, only suspended particulates of fine silt and clay or dissolved minerals were being sampled. The implications of this are that the sampling was of the finest particles of weathering and erosion that are loosened first or prior to movement of coarser sand or silt. This can also represent material that is important in understanding the hardening and compaction of gravels whereas a large amount of finer material will precede coarser gravels.

Samples were visually analyzed during collection to determine if they were composed of fine particulates or organic matter, including forest leaf litter and upper soil organic material. Many of the samples early in the rainy season were composed of organic matter, especially those collected after the first large rain events that flush out and transport detritus that has accumulated during the previous year.

Suspended sediment and particulates do not show a significant increase in turbidity readings until there is a sufficient amount of rainfall to stir up and loosen fine sediment and carry it into the creeks. This usually happens during the heaviest rainfall periods of late November and early December. The amount of sediment varies depending on the type of rainfall, duration, intensity, and time of year. Other effects include the geology and rock types, weathering amounts, soil types, slope, road density, pastureland and the density of grazing animals, recent or historical logging, landslide potentials, building abundance, and even solar exposure on soil layers.

Observations on the correlation of rainfall amounts and measurable increases in turbidity in streams relates to rainfall totals of over 1.5 inches in a 24-hour period (See Tables and Charts, Page 35 & 36). Any rainfall events less than 1.5 inches did not loosen and deliver turbidity to creeks. In these instances water in streams remained clear. Larger rainfall events (>2.5 inches) carried the most turbidity from surface, bank, and streambed erosion processes. (See charts Page 35, 36, 39). Turbidity increases were minimal during the first rainfall as the ground was dry and porous and infiltration was great, soaking up water quickly. Increases in suspended sediment were observed as saturation of soil layers increased and rainfall was unable to infiltrate soil layers and instead developed into surface flow and erosive action.

Base levels of turbidity in clear water measured in NTU in the East Fork Williams Creek and its tributaries are fairly low (1-2 NTU) and stay consistent between high flow, with the base levels being attained between rain events within one to two days and staying clear and steady for weeks between rain events. Turbidity analysis was completed for the water cycle from September to June of 2001-2002 and 2002-2003 as shown on the charts in the following pages.

The data collected during this study affords insight as to the location and source of sediment in a general pattern with comparisons to each tributary of the East Fork drainage. These comparisons can be use to track sediment load to non-point sources and sometimes to specific reaches that are supplying clastic material to the stream system. For instance, five sites along East Fork Williams Creek were sampled within different reaches to give a comparison to the area where source sediments might be originating. By looking at the data it might be able to reveal the reach that has the most bank erosion or input of sediment from another tributary that flows into it. Much of this data tracks a gradual increase of turbidity as the East Fork Williams Creek flows down the valley. It is picking up sediment and turbidity along the way from bank instability or other inputs.

Information on the 2001-2002 Table 5 are much higher than the 2002-2003 associated chart because the NTU scale is set to compare values for both years, the latter being much lower at peak flows. Nevertheless, the values do show that the turbidity values change as the stream picks up velocity, discharge, suspended sediment, and the density of the water increases. This will increase the erosive action of the water downstream and continue to build turbidity values.

Table 7: Turbidity Samples for East Fork Subwatershed

		11/21/01	11/25/01	11/29/01	12/5/01	12/18/01	1/21/02	1/21/02	2/7/02	2/20/02
1	UpperEFRd drainpipe		1.8	260.0	25.9	15.6		83.8		2.4
2	JnsCrk @EFReach 4		1.8		7.6	10.9		28.5		2.4
3	East Fork Rd @Reach 4		1.8	319.0	7.6	5.3		5.4		1.5
4	EastForkCrk @Reach 3		1.8	258.0	12.0	5.2	3.1	4.8	83.6	1.5
5	EFRd @ Road Mi 2		1.8		6.7	5.9		50.3	179.0	1.6
6	EFCrk @PantherGLRd		1.8	358.0	8.7	5.2		2.4	288.0	1.6
7	EFCrk @Brown'sRdBr		1.8	407.0	9.9	6.1		3.3		1.6
8	Glade Fork @EFRd		1.8	653.0	11.6	7.5		5.5		1.8
9	ClapbCrk @PantherGRd		1.4	184.0	21.2	18.6		11.7	59.6	1.6
10	ClapbCrk @EFRd		1.4		20.4	16.4	13.3	17.7	112.0	1.6
11	End of RockCrkRd		1.4		17.6	22.9		64.5		1.5
12	RockCrk @Reach 1	124.0	1.4	26.6	12.0	4.0	4.5	2.8	43.6	1.2
13	RockCrk @ Reach 3		1.4	221.0	9.1	4.9		2.9		1.2
14	SprCrk @ Reach 1		1.4		12.0	13.3		3.3	45.9	1.6
15	SprCrk @EFRd-Reach 3		1.4	790.0	16.4	16.6		19.6	169.0	1.6
16	SprCrk @SprCrkDr-Reach 3		1.4	92.0	14.3	14.9	9.4	17.4		1.6
17	WForkCrk @EFRdBr		1.4	228.0	22.5	9.3		14.5		1.5

The highest values were recorded during the 11/29/01 as seen by the high columns across the board on all reaches during that period. Columns with the highest values on specific dates indicate stream reaches that need special attention and carry the most amount of sediment. The chart also indicates that some streams only react at certain times of the year pertaining to the particular type of erosion that is occurring. For instance the area that is draining East Fork Road crossing or East Fork Williams Creek at Panther Road only increases turbidity during high rainfall after the ground has reached saturation and the surface runoff from grazing fields is mobilized and enters the creek system. Therefore, the values jump up quickly when surface runoff is important and active.

The following chart attempts to compile the data into a visual display that shows the various turbidity values in comparisons. This chart is formatted in a way to show the differences between the streams that were sampled and look at the overall values. Each collection site is separated on the horizontal axis with the different collection values charted next to each other to show any changes over the water year.

Areas that show low values are places where the sediment is being filtered out of the stream system by large wood or ponded log jams that help to deposit sand and particulates. These are areas that contain the complexity and vegetation to filter the sediment and decrease the turbidity values.

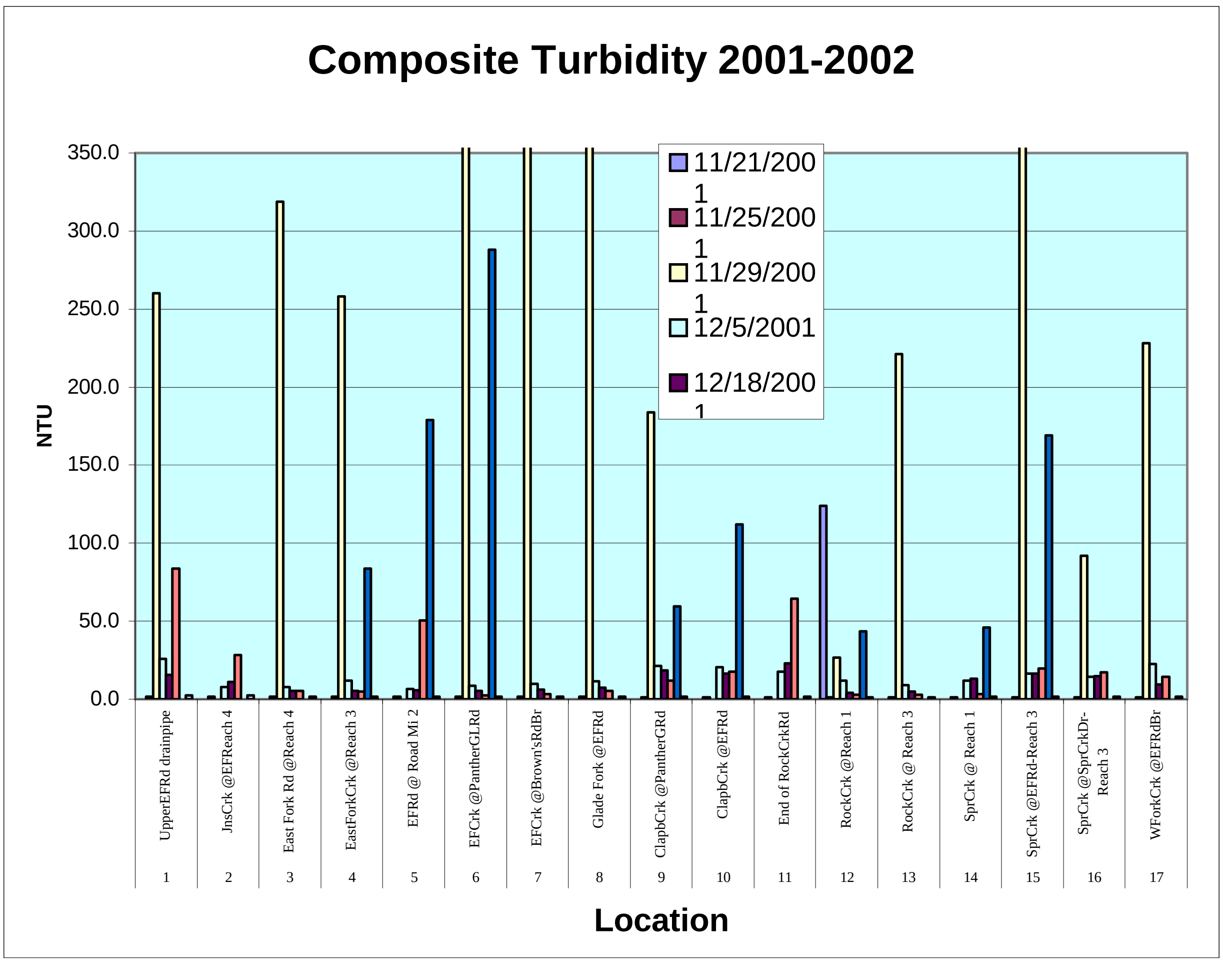


Fig 12. Composite Chart

Table 8. Turbidity Samples for 2002-2003

NTU's

1	UpperEFRd drainpipe				67			37.5
2	SmCrkat EFCrk @ Reach 4		33.1		30.6	52.3		12.1
3	EFRd @ Reach 4	5.08	7.5	53.7	113	42.2		19.6
4	EFCrk @Reach 3 RkCr	4.96	8.1	39.8	55.4	33		15
5	EFCrk @ PantherGRd-Rch 2		28.7	15.3	261	41.5	0.89	15.9
6	EFCrk @Brown'sRd Rch1		9.1		113	139		19.5
7	GladeForkCrk @EFRd		10.8		122			18.5
8	EFRdculvert @RoadMile 2			253	90.8			12.1
9	ClapbCrk @EFRd							36.1
10	ClapbCr @PantherGRd		31	16.3	87	329	2.15	19.5
11	End of RockCrkRd							
12	RockCrk @Reach 1	4.19	8.8	30.9	49.4	52.3		10.2
13	SprCrk @Reach 1							
14	SprCrk @ EFRd-Re 2		23.5	38.1	81	48		23.5
15	SprCrk @ SprCrkDr-Re 3		23	36	79	44.5		22.3
16	WFCrk @EFRd Bridge		14.9	16	84.6	109		18.5
	Staff Plate-East Fork/Rock	1	1.15	1.7	2.5	1.2		1.5
	Rainfall-48 hours	4.9	2.5	3.1	7.5	2.3		1.75
1	UpperEFRd drainpipe				67			37.5

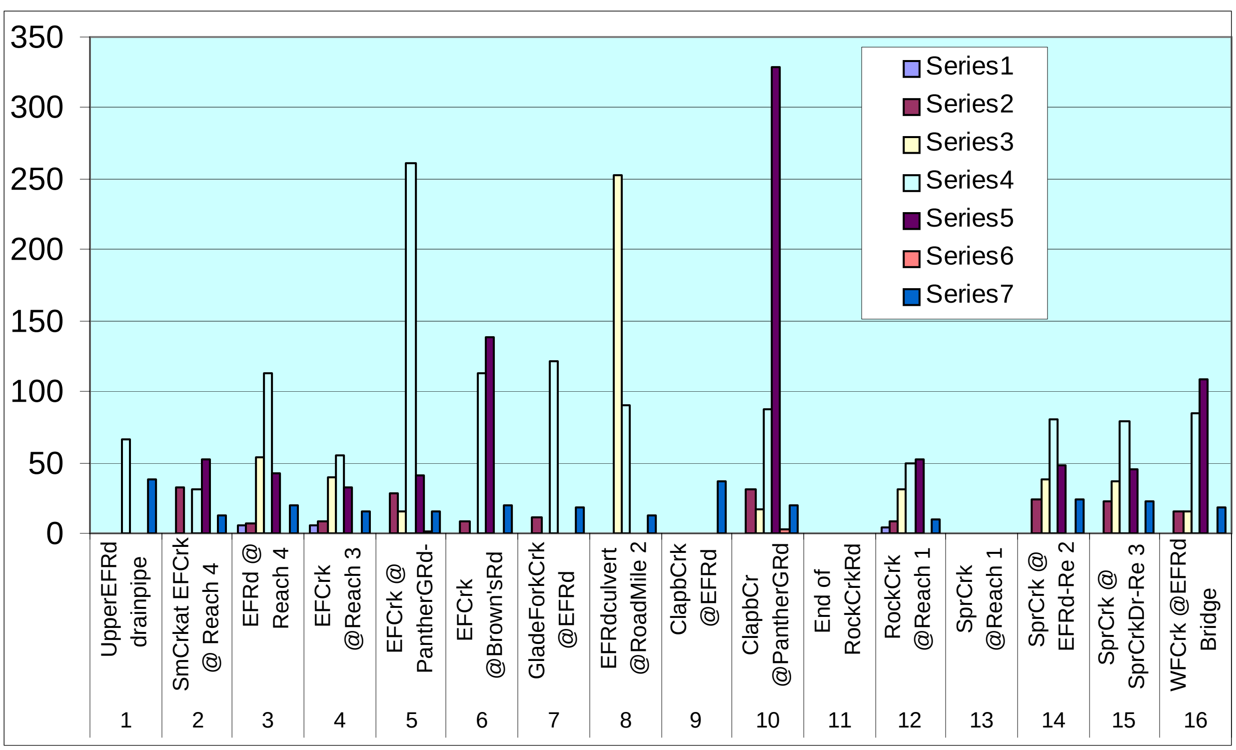


Fig 13. Composite Turbidity Chart 2002-2003

Rainfall Collection

Daily rainfall and rainfall totals were collected to compare the turbidity values to recent rainfall amounts. This information was collected in the East Fork Williams Creek near the confluence with Rock Creek at the 1960' Mean Sea Level elevation. This data is included within the charts on the following pages and is graphed displaying the selected turbidity measurements taken at the nearby collection site on Rock Creek. Rainfall totals show a marked difference from the official station in the Williams Valley because the official NOAA Rainfall Collection Station is collected at a lower elevation and in the middle of the Valley where rainfall is not a great as the East Fork subwatershed. Generally rainfall amounts were 30% higher at the Rock Creek collection site.

Graphs depicting rainfall are shown in two separate frames which cover the rainfall period starting in November 1st and ending in May 30, the time period when Williams receives much of its rainfall. Both graphs are set up with the same scale and intervals on the two vertical axes. The left scale marks the accumulation of total rainfall over the time period and corresponds with the dark continuous line on the graph. The right scale marks the rainfall event that lasts from 24 to 36 hours and is depicted on the graph as a small box with drop lines and marks the range of 0 to 10.0 inches of rainfall. Turbidity is charted using triangles that float within the graph and are labeled as to their NTU value. These turbidity values were collected at the Rock Creek site.

The graph shows a marked difference in rainfall amounts between the two years. The 2001-2002 period reached 32 inches of rain while the 2002-2003 year accumulated close to 50 inches of rainfall. The major rainfall events occurred in the November, December, and January period and tapered off from there into smaller events that slowly accumulated totals over the following four months, until the rainfall reaches none or little during the summer months. The early larger rain events produced the most amount of turbidity although suspended loads did not increase immediately as seen by the triangles, but sediment was carried in immediately following events. The chart for 2002-2003 shows very large rain events occurring at the beginning of the season amounting to 10 inches followed within a week of 12 inches. This produced significant flooding and erosion in the East Fork subwatershed, including the break of dams and emptying of a pond on Panther Creek.

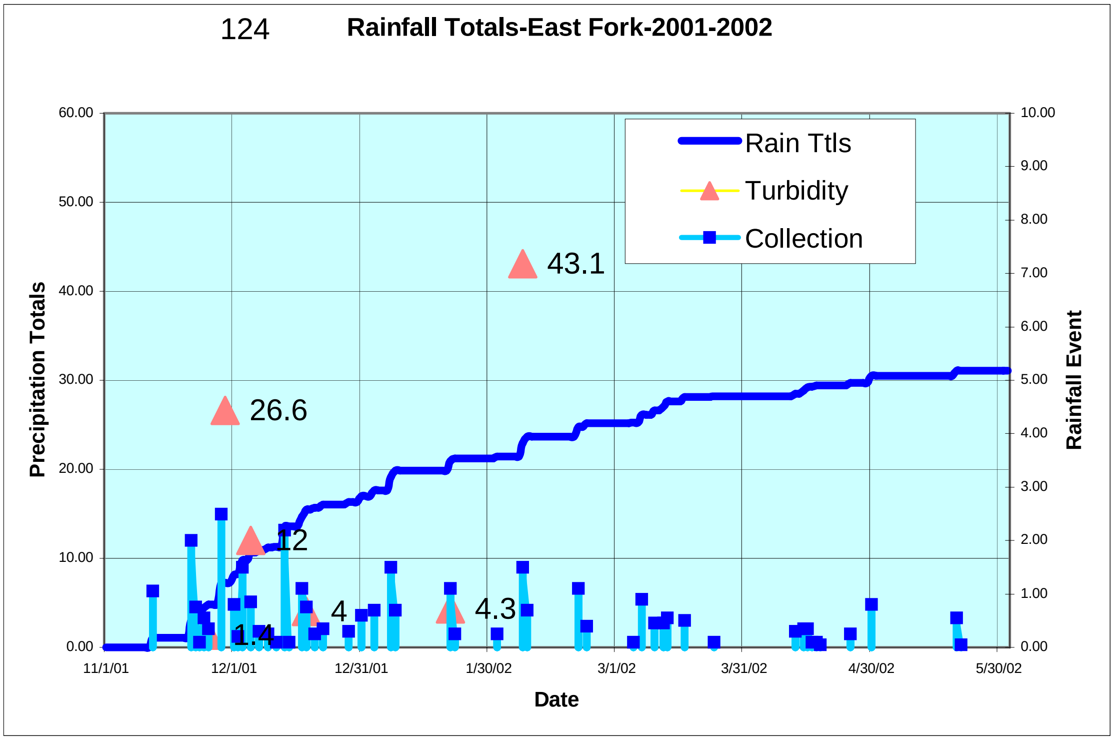


Fig. 14. Rainfall for 2001-2002

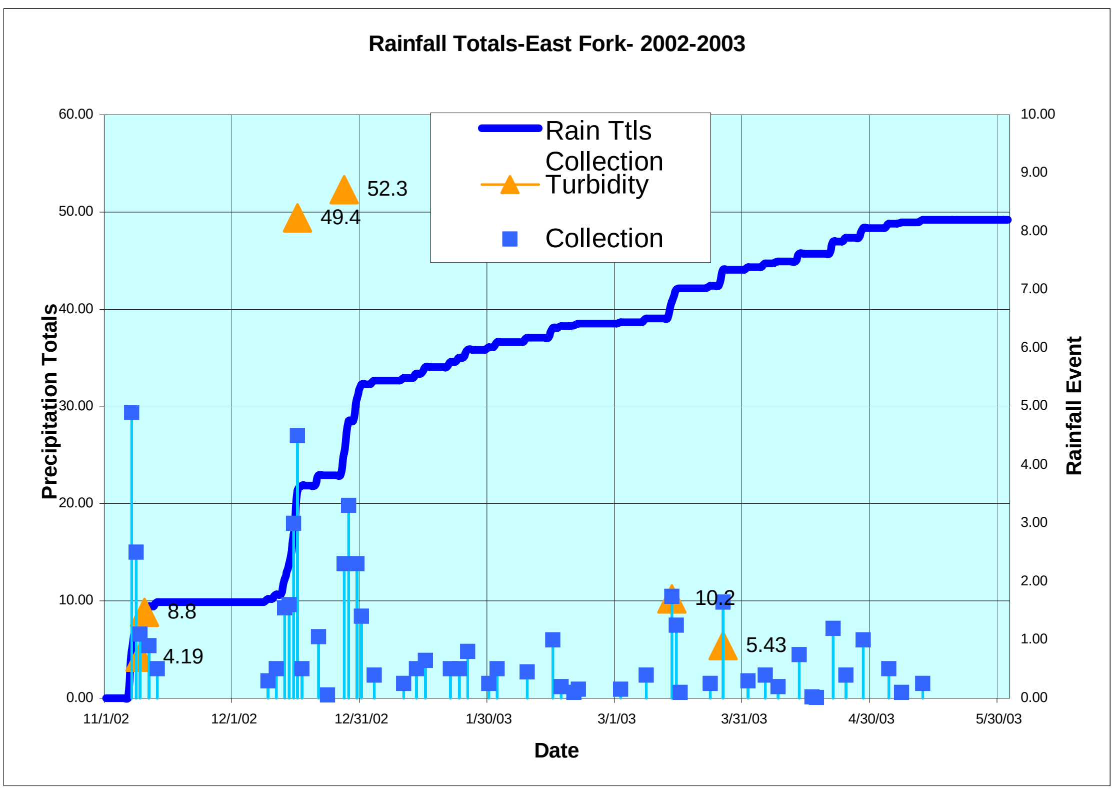


Fig. 15. Rainfall for 2002-2003

Barrel Sampling

Barrel sampling was utilized as a method of sampling the bedload of the creek to quantify the types of gravel traveling through the stream and available for spawning habitat for indigenous salmon. This method was published in an article by Milhous et al. in October 1995 and used by several researches to understand the bedload of rivers and creeks in New Mexico and Colorado. Our methods were modified to apply to streams in the Southern Oregon area.

Understanding and quantifying the bed material is a critical component for assessing sediment transport, stream stability, and aquatic habitat. Size classes range between four orders of magnitude of particle size with a vertical column structure of relatively large particles at top underlain by a finer substrate with a more graded size distribution (Thomas 1992). Problems related to sampling revolve around the choice of sites, inability to sample large cobble and boulders with finer material, or difficulty in sampling representative sites that are typically under water.

Features of streambed gravels typically exhibit a coarse surface layer with a finer substrate mixture beneath. The coarse surface layer is a function of gravel deposition and subsequent removal of finer particulates of sand and silt as the stream dynamics and energy level dissipates as water volume declines.

Barrel sampling in the East Fork was done during low water on the gravel bars or point bars of creeks in areas that would be good spawning habitat or useable for salmon redds if it was covered by water. After sampling, the gravel was sent through a series of sieves to separate different types of bedding material for analysis. These sieves are classed to separate the gravel into the following class sets:

Table 9. Size classes for clastic sediment

Standard Size Classes		**Size Class for Sediment Study**	
Boulders	>64mm		
Cobbles-	5mm-64mm	Cobbles	>5mm
Pebbles-	2mm -5mm	Pebbles	2mm-5mm
Coarse Sand-	0.5mm-2mm	Coarse Sand	0.5mm-2mm
Fine Sand-	0.125mm-0.5mm	Fine Sand	<0.5mm
Silt-	0.0256mm-0.125mm		
Clay-	<0.0256mm		

The various class sizes are reflective of the conditions of the stream bedload during each bankfull episode at the point where the sample was collected. Although some variation in sampling is expected, care was taken to collect gravels that constitute similarities to spawning areas or redd development. Consequently, several gravel samples were taken from each area to support the data.

Techniques to measure gravels in the field were developed to make it possible to analyze the samples without removing gravels or transporting large volumes of bedload material. This was accomplished using a volumetric measurement rather than a mass measurement mostly because of the presence of water in the gravels and the difficulties of drying gravels to weigh them. Gravels were separated and sieved using a water bath method, drained, and measured by placing the sieved material in a bucket of water with an overflow spigot. The amount of overflow water was collected in liter measuring containers and recorded in the field notebook. These samples are compiled and graphed in the following pages and were the basic measurements for gravel analysis.

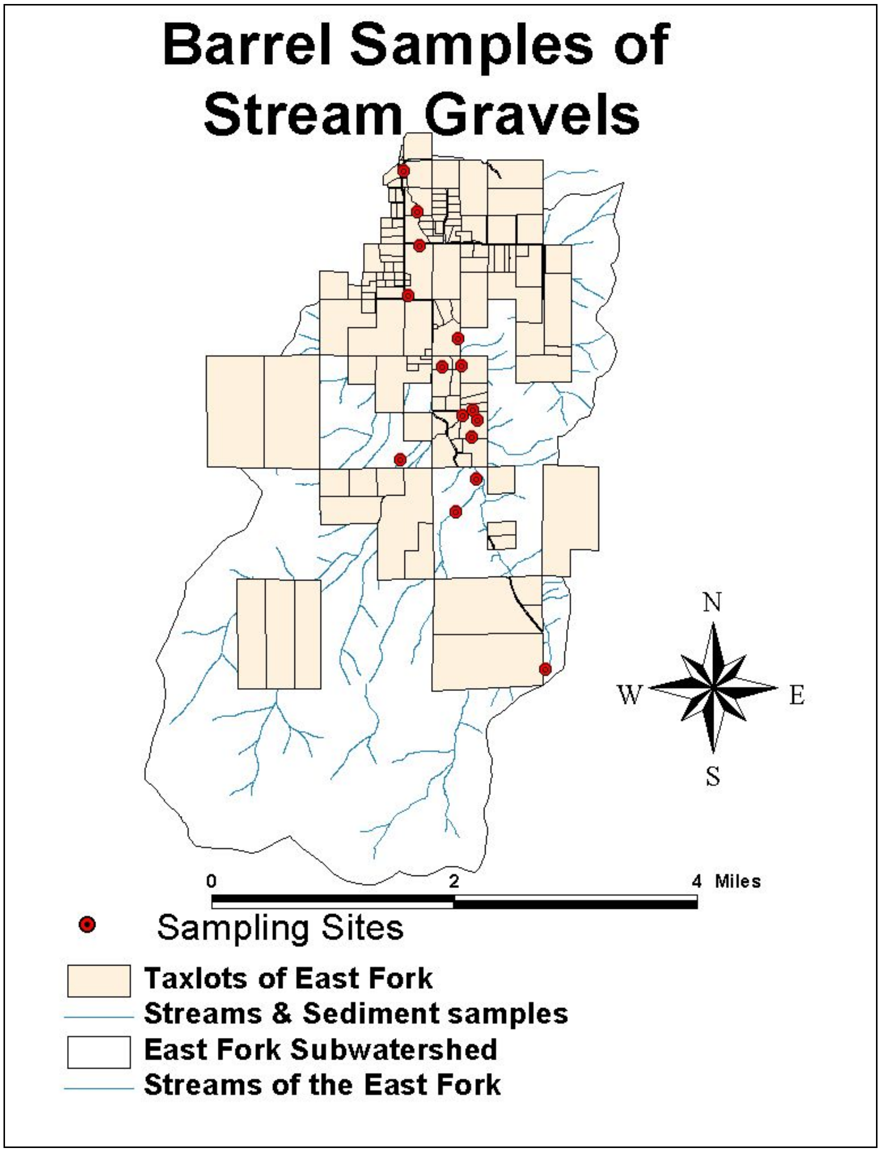


Fig 16. Barrel sample sites on the East Fork

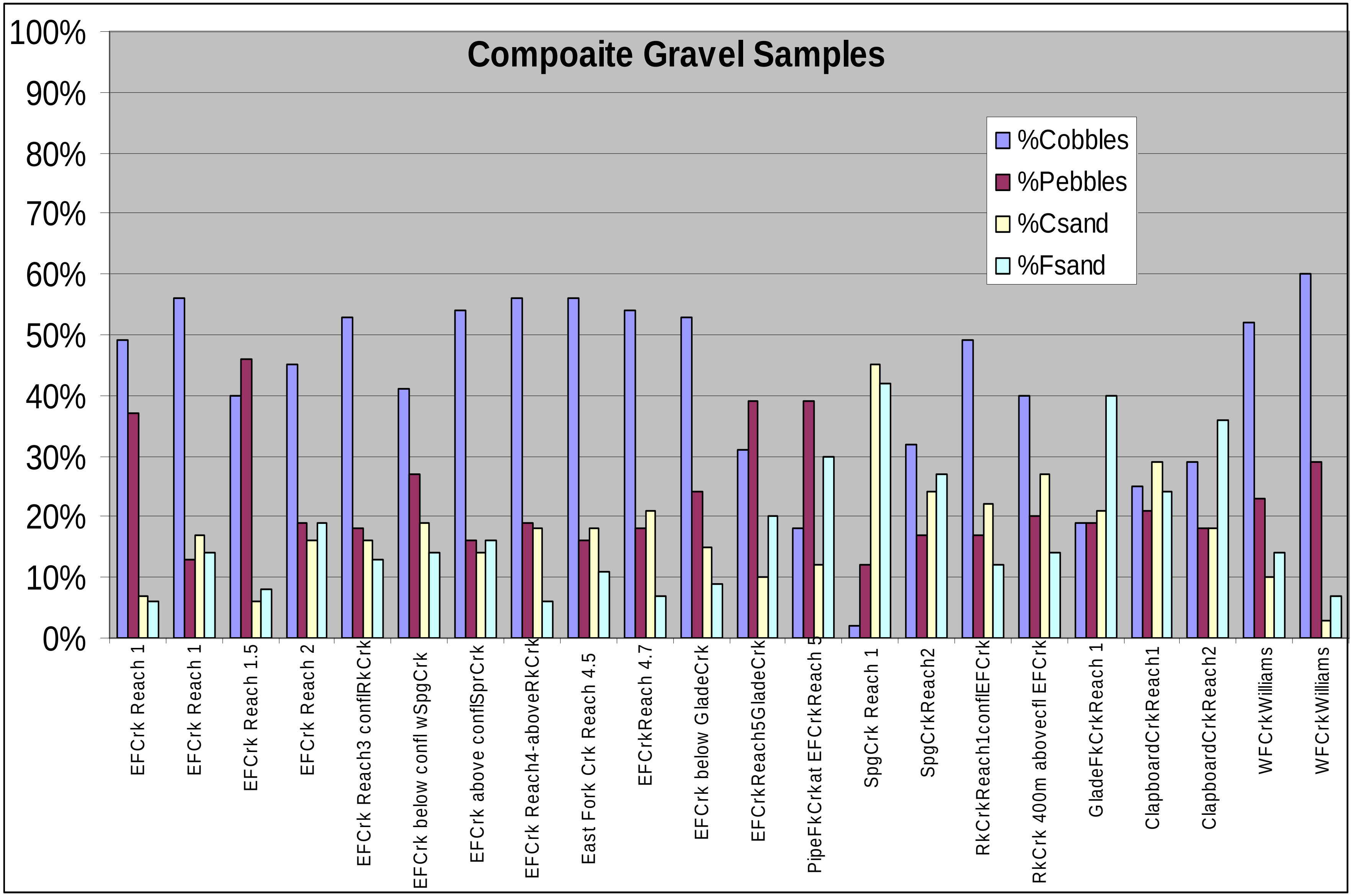
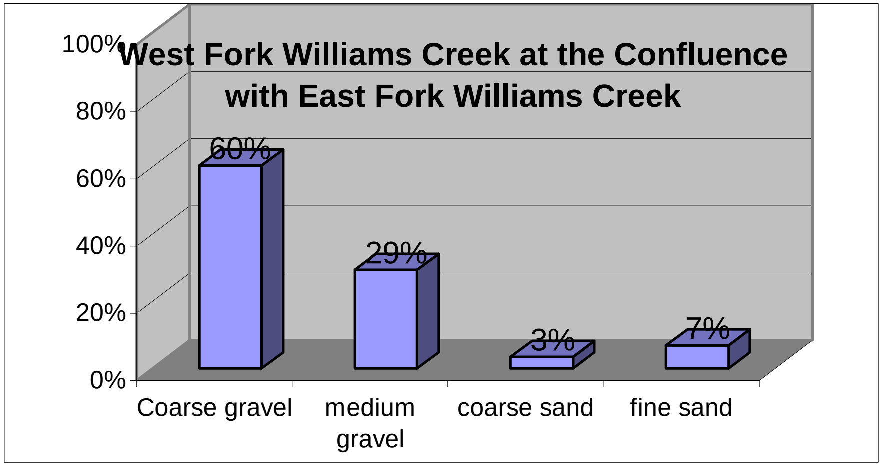


Fig 17. Graphs of Barrel Samples of Stream Gravels

Table 10 :Composite Chart of Barrel Sampling Data for East Fork

Location	Cobbles	Pebbles	CoarseSand	FineSand	%Cobbles	%Pebbles	%Csand	%Fsand
East Fork Crk Reach 1	16.83	12.65	2.5	2.2	49%	37%	7%	6%
East Fork Crk Reach 1	2.2	0.5	0.65	0.55	56%	13%	17%	14%
East Fork Crk at Reach 1.5	11.62	13.09	1.85	2.2	40%	46%	6%	8%
East Fork Crk Reach 2	1.4	0.6	0.5	0.6	45%	19%	16%	19%
East Fork Crk Reach 3 confl Rock Crk	1.2	0.41	0.37	0.3	53%	18%	16%	13%
East Fork Crk below confl with Spring Creek	0.89	0.58	0.41	0.3	41%	27%	19%	14%
East Fork Crk above confl with Spring Creek	1.2	0.35	0.3	0.36	54%	16%	14%	16%
East Fork Crk Reach 4 -above Rock Crk	17.5	6	5.7	2	56%	19%	18%	6%
East Fork Crk Reach 4.5	12.3	3.5	4	2.4	56%	16%	18%	11%
East Fork Crk Reach 4.7above erosion bank	11.2	3.7	4.3	1.5	54%	18%	21%	7%
East Fork Crk below Glade Fork Crk	1.8	0.8	0.5	0.3	53%	24%	15%	9%
East Fork Crk Reach 5 near Glade Fork Crk	0.95	1.2	0.3	0.6	31%	39%	10%	20%
Pipe Fork Crk at East Fork Crk Reach 5	0.22	0.48	0.15	0.37	18%	39%	12%	30%
Spring Crk Reach 1	0.5	2.8	10.75	10	2%	12%	45%	42%
Spring Crk Reach 2	1.3	0.7	1	1.1	32%	17%	24%	27%
Rock Creek Reach 1at confl w East Fork Crk	1.8	0.62	0.82	0.45	49%	17%	22%	12%
Rock Creek 400m above conflu w East Fork Crk	11.75	5.8	8	4	40%	20%	27%	14%
Glade Fork Crk Reach 1	0.5	0.5	0.56	1.05	19%	19%	21%	40%
Clapboard Crk Reach 1	0.95	0.79	1.1	0.9	25%	21%	29%	24%
Clapboard Crk Reach 2	0.8	0.5	0.5	1.0	29%	18%	18%	36%
West Fork Creek Williams	1.3	0.57	0.26	0.35	52%	23%	10%	14%
West Fork Creek Williams	1.75	0.85	0.1	0.2	60%	29%	3%	7%

Individual Charts for the Samples Taken from the Tributaries of East Fork Williams Creek



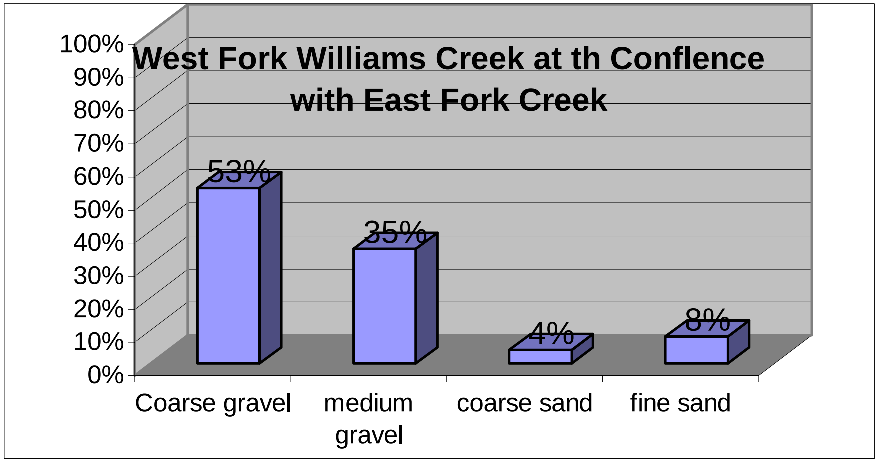


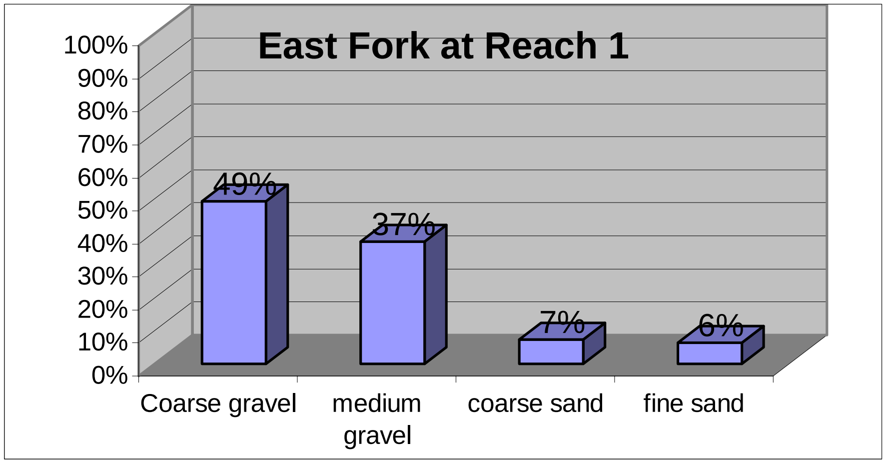
Fig 18: West Fork Williams Creek at the Confluence of East and West Fork Williams Creeks

The Confluence of the East Fork and West Fork WilliamsCreeks are just downstream of the Brown's Road Bridge. This area has experienced considerable lateral erosion of pastureland and floodplain on the landowner's property.

Nevertheless, gravel quantity and quality is excellent for spawning habitat. Sand content is low, with fine and coarse combined totals of 10 – 12 % in the sites sampled. Variability of gravels is high with pockets of coarse gravel intermixed with medium and fines. Riffle-pool habitat is good, but quantity of woody debris is low owing to the high velocity of flood waters experienced during the last three years. Bank erosion and scour has removed riparian trees and shrubs leaving land open to solar heating and drying. The original channel has been abandoned and a new channel developed that impacts property and has restructured the boundaries.

This area is subject to the constrictions developed by the East Fork Road and Brown's Road bridges just upstream of the confluence. This constriction produces higher than normal velocities contributing to scour and removal of vegetation. A large pond is located between the two creeks that is in the pathway of the eroding banks and may be impacted by the flow of the creeks if erosion continues.

Sampling was done in this area as a comparison to the East Fork Williams Creek to see how the sediment deposition relates to the other major tributary of Williams Valley. This area is also subject to enormous amounts of erosion and will need a major restoration and erosion control project that can address the associated problems.



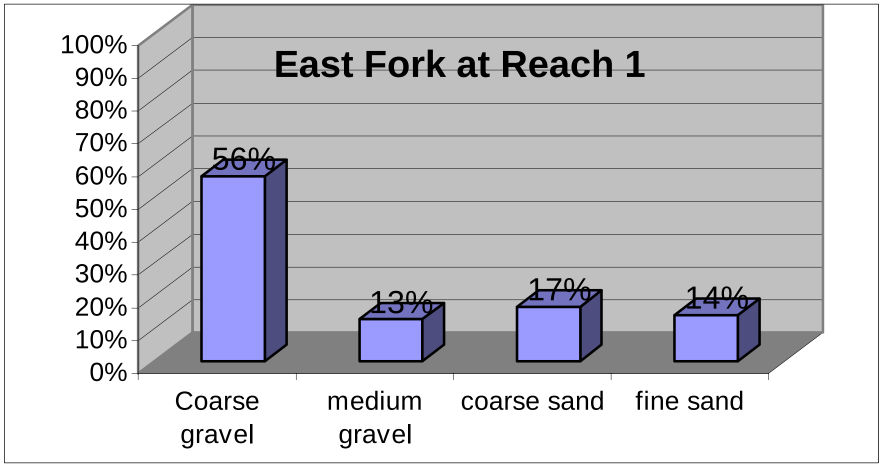


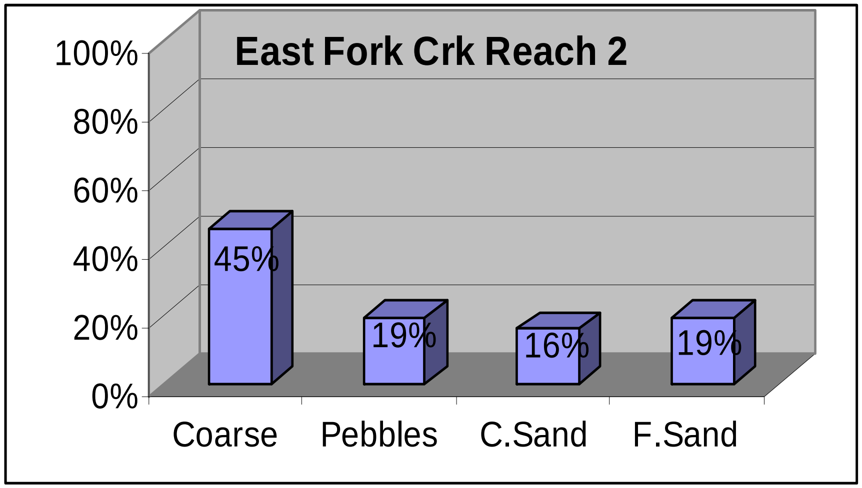
Fig 19: East Fork Williams Creek at Reach 1

This is the lowest stream reach on the East Fork and has excellent spawning habitat. Sand content is in the 13 – 30% range, varying by location. Several sitings of spawning salmon have been observed in this reach. Complexity of channel structure is good with some large woody debris present to check the rapid flow, although the past three years have experienced higher than normal peak flows that have removed wood and reduced complexity.

The Brown's Road Bridge is just below this sampling site. The restriction that it creates results in a slack water area where gravel and sediment accumulate. This sediment threatens to raise the creek bed level and force floodwaters over the road and into the bridge. Restoration practices in this reach are needed within the next few years to reduce the erosion and property loss.

Landowners are motivated to increase the habitat while improving erosion control measures. Large wood and boulder anchors are needed to redirect flow and increase the pool riffle configuration of this reach.

Dumping of trash has occurred on the west banks of the old homestead at the corner of Brown's Road property and much of the trash has been covered or buried. Several old cars are used to stabilize the banks with the rusty hulks sometimes migrating out into the stream and moving downstream a short distance.



This sampling site is in Reach 2 at River Mile 1 and contains excellent spawning habitat. Sand content is in the 30% level with moderate amounts of wood debris. Large trees shade the reach and provide organic material for quality spawning habitat. Channel complexity is low with straight channel development, although restoration design could be very effective in this reach. Landowners have a pump station established at this site and want to incorporate restoration designs with their irrigation needs.

Fig 20. East Fork Williams Creek at the upper end of Reach 2

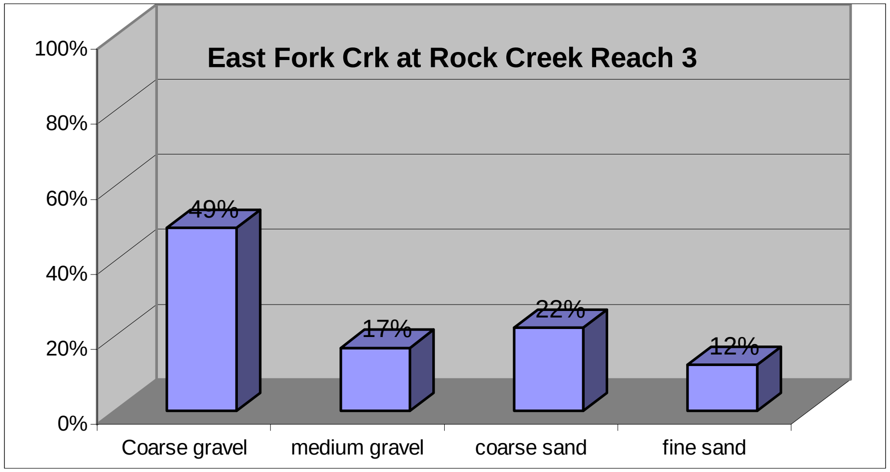
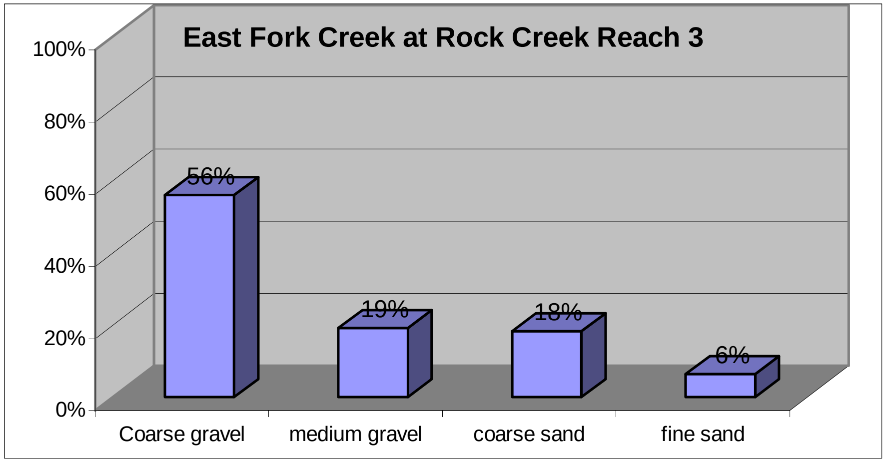


Fig 21. East Fork Williams Creek at Reach 3 near Rock Creek



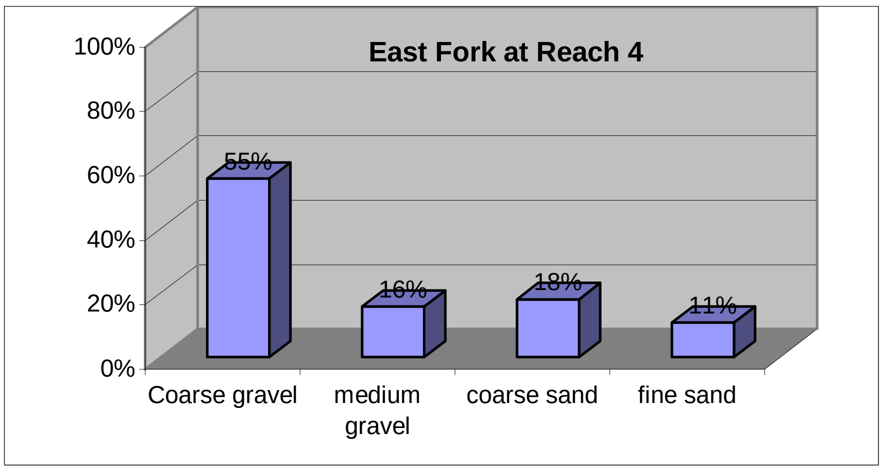


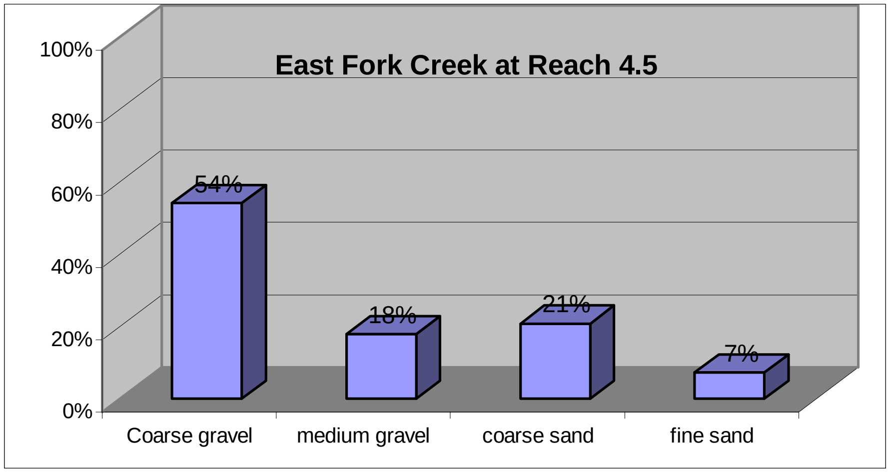
Fig 22. East Fork Williams Creek at Reach 3 near boundary of Linebaugh and Farver

Reach 3 of East Fork Williams Creek extends up to the confluence with Rock Creek, which supplies 40-50% of the water flow. Coarse gravel dominates this reach with sand content in the 24% range. Coarse sand outweighs the fine sand due to the proximity to the granitic source rock and the high energy system as these two creeks converge. Numerous boulders with little woody debris are found in this reach, but fish counts indicate juvenile survival is present but low.

East Fork Creek at Reach 4, River mile 3 is higher in sand content reaching from 24-34% in a highly variable structure. The gradient is steeper than lower systems, and the boulder content is higher. Coarse sand outnumbers the fine sand component in this area because of the source material of igneous rock just upstream. Coarse gravels may not impact the gravels in the same way as fines and the separation of the two types can be useful in these types of areas.

Woody debris content is low and large boulders and cobbles are abundant. Pool riffle structure is impaired. However, spawning and rearing habitat is good due to the existence of large trees that line the banks and cool, clear waters that flow year around.

Restoration practices could improve the habitat structure in this area, allowing the deposition of gravel beds, wood structures, and floodplain connectivity. Deposition of sand onto floodplains would possibly reduce the sand content within the streams in this area. Future programs could be effective in the improvement of the ability of juvenile survival for the entire East Fork subwatershed.



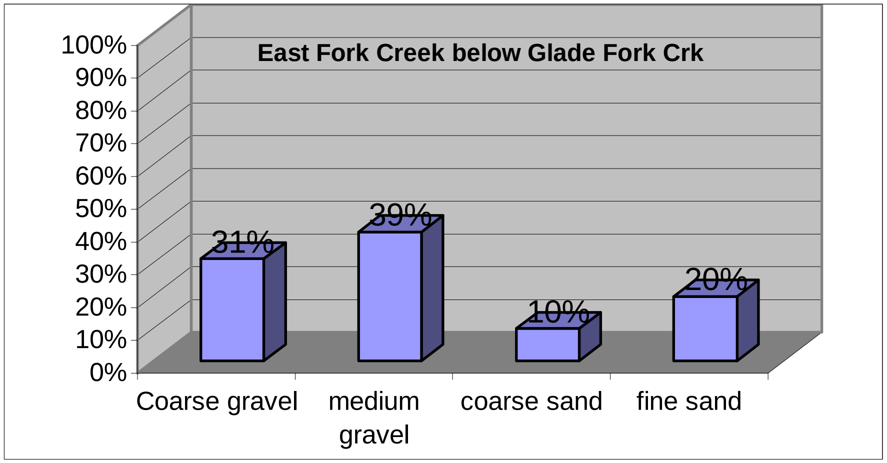
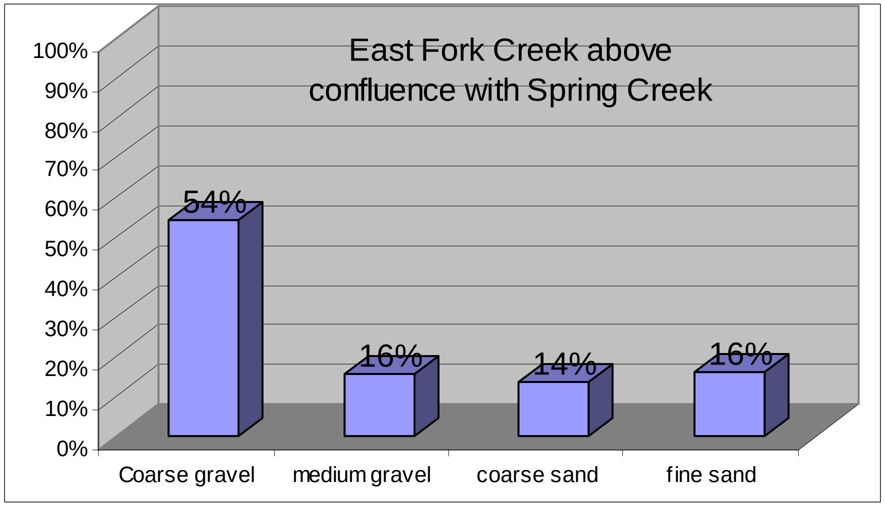


Fig 23. East Fork Creek at the confluence of Glade Fork Creek Reach 4

Reach 4.5 is ideal for coho, steelhead and macroinvertibrates with low gradient stream systems, abundant gravels, and good quality water clarity and low water temperatures. Temperatures are moderate during summer months but channel complexity is low. Large wood content is low due to removal of wood over time without replacement. This is a stream system that would do well with restoration including installation of wood structures, boulder clusters, and increased stream shade systems.

Spawning coho have been seen and photographed in this reach and the landowner has reported that he remembers seeing many more salmon spawning in this area 30- 40 years ago when he first moved here. This area could also benefit with tree planting and improvement of the riparian zone. Several houses are very near the creek with clearings and roads that impact the habitat. Blackberries have invaded much of the open areas and the addition of trees would go a long way in improving the native habitat. Erosion has been observed along the banks in the upper reaches and can be contributing to the high amounts of sand being transported throughout the system.

Glade Fork Creek transports high amounts of sand as it drains and erodes granitic rocks and picks up coarse and fine particles. The fine particles outnumber the coarse ones in this tributary, probably because of the highly weathered and erosive soils that are found in this area. Extensive road building and logging have been completed it this area 20–30 years ago and the roads have contributed much to the sediment deposition in Glade Fork as well as the East Fork Creek.



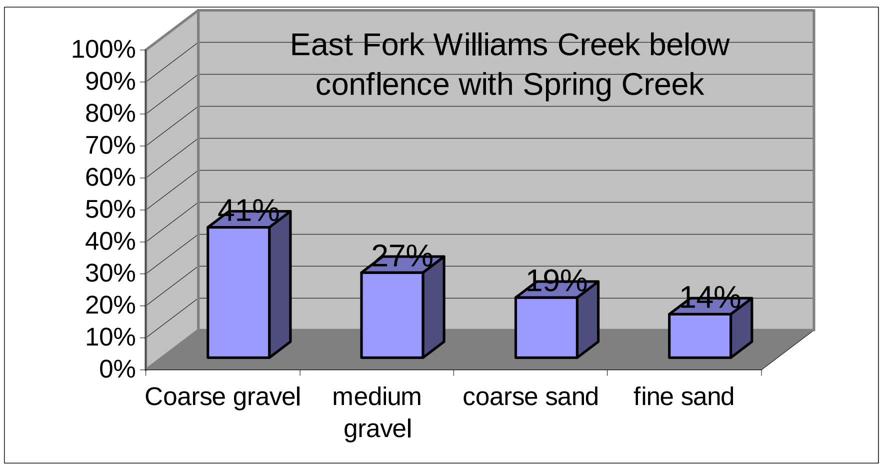
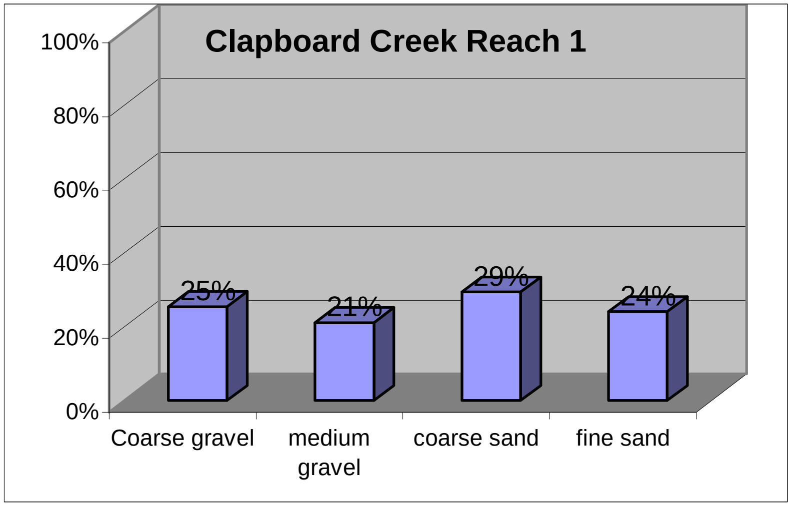


Fig 24. : East Fork Williams Creek above and below the confluence with Spring Creek

Spring Creek is identified as one of the tributaries that carries the highest content of sand in the East Fork subwatershed. Sampling was done at the confluence of Spring Creek to see if the impact on East Fork could be recognized by the gravel and sand content in the creek. Samples were taken above the confluence and below the confluence with the results shown o the graphs.

Results were mixed but did show that the coarse sand content increased to the lower side of the Spring Creek confluence with the fine sand content decreasing. This may be due the fact of the input of Spring Creek is directly eroded off the granitic rocks and has not been physically broken down into its finer components. Pebble content increases in the downstream graph also supporting the coarsening of the gravels from Spring Creek. Other possibility for the coarsening is that the finer sand may be depositing in the low gradient fields above the confluence area as sand bars and flood deposits.



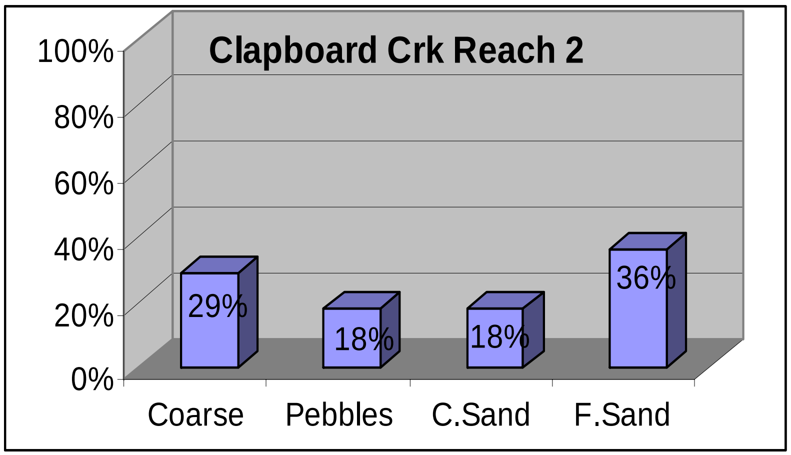
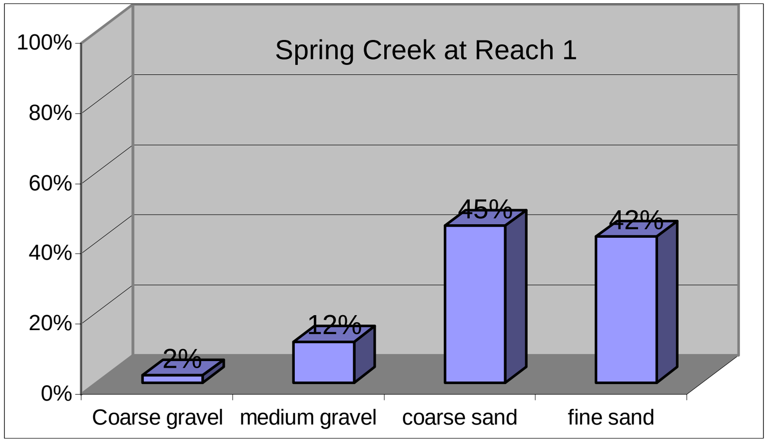


Fig 25. Clapboard Creek near the confluence with East Fork Williams Creek and in upper Reach 2

Clapboard Creek shows a marked increase in coarse and fine content of sand with the total sand content increased to 54% in the lower reaches and up to 54% in the upper reaches. Coarse-grained sand content is higher than fines in the lower reaches but fine sands increase considerably in reach 2 where sandy terraces are actively slumping and eroding into the creek. Much of this is the result of cattle in the riparian zones and dirt roads along the stream banks that are slumping.

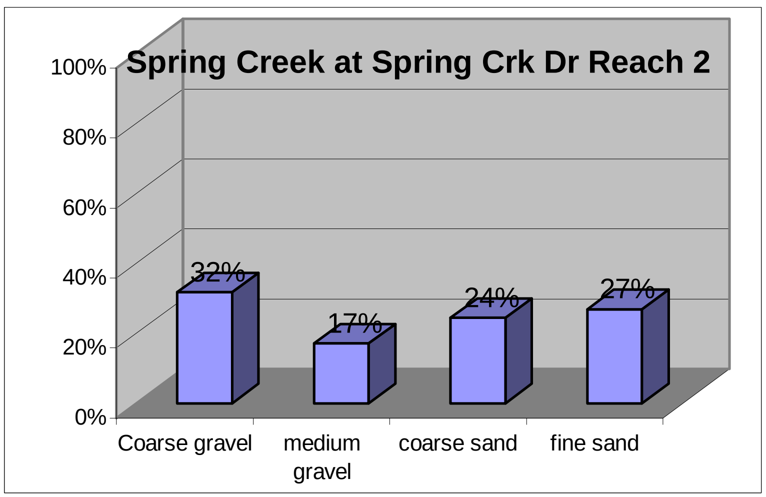
Sand content in the gravels indicates nearness to the source gravels and although with fine sand this high it would be difficult to attest to good spawning habitat. Sand particles are angular or sub rounded, suggesting short duration in the stream gravels for rounding. Coarse gravel and medium gravel content are low.

Clapboard Creek contributes an enormous amount of sand to the East Fork Creek system due to the source area being entirely granitic with large sandy terrace deposits and deeply incised drainages. This area has two landowners with very different management practices, one with no cattle and abundant vegetation along creeks and another with cattle in riparian zone and little understory vegetation. Needless to say the latter has the most erosion and incision of the creek.



Spring Creek shows high contents of sand in both the fine and coarse size class. The chart showing Spring Creek gravels in River Mile 1 or Reach 1 were collected in an area that contains a lot of sand deposition. Sand has been depositing here in the drainage where clusters of willow, alder, and other trees have been able to slow the water velocity and filter the sand. The high sand content here probably reflects the lower gradient and broad floodplains that receive deposits and have good soil accumulations.

Spring Creek Drive is located in River Mile 2 or Reach 2 and shows a balance of coarse, medium gravels along with a near equal amount of fine and coarse sands. This is very near the source of erosion of granitic rock in the Spring Creek drainage and is a good representation of the type of clastic material washing down off the granitic rocks. A large landslide has been eroding material near the headwaters of this drainage on BLM land from the 1997 winter flood.



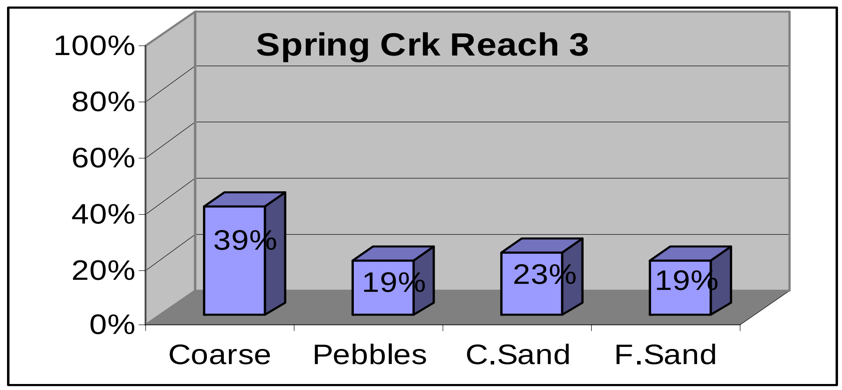


Fig 26. Spring Creek at Reach 1 and 2

Sediment Traps

Sediment traps were devised to collect sediment movement for the period between September 2001- June 2002 to ascertain the quantity and types of sand movement in nine months time during the rainy season and peak flows. These traps were made of 5 quart buckets embedded in the creek substrate with the lip of the buckets being flush with the streambed. At each location a surveyed cross section was established and 3 to 4 buckets were placed along the creek cross-section, perpendicular to flow and at 2-foot intervals to collect gravel in several hydraulic regimes. Each series of sediment traps were established in late summer and removed early in the following summer. The samples were collected, separated, and sieved using the water bath method and an average value was computed within each series of locations. The coarse cobbles were then disregarded during analysis. These samples were charted and graphed on the following pages.

The sediment traps were only established during one season as this type of sediment transport is expected to be similar within several year cycles (unless a major slide or erosion event occurred). The traps were especially useful in establishing the type or class of sand that is moving through the system presently and to try and determine which area had to greatest movement of fine clastic material. Specific concern is the fine sand component that fills the pore space between larger granular materials and reduces viable salmon habitat. With high fine sand content, spawning salmon have difficulties moving gravel or digging redds to lay eggs and spawn.

The Composite Chart for Sediment Traps includes all the samples collected during the winter rainy season of 2001-2002 and were collected during the summer of 2002. For comparison purposes this chart has been presented first to illustrate how the different sites compare, especially in relationship to the accumulation of pebbles, coarse sand, and fine sand. This chart shows the amount of fine sand (<0.5mm), which directly impacts the gravels used by spawning salmon, varies within the East Fork Creek from the lower reaches to the upper reaches. Also important is the amount of coarse sand moving through the system. This component indicates close proximity to the granitic source material and soil and erosion products are not completely degraded to fine material. Finally the fine sand component varies considerably in the samples, but the fact of movement of large amounts of sand I the system indicates that recent erosion of stream banks during lateral movement or gravel bars during vertical scour is moving this material downstream.

The sediment traps generally reveal that we have a large amount of sand presently moving through the stream system. This graph identifies the tributary or Reach of East Fork Creek that is identified in this part of the sediment study. Since only six site locations were chosen to collect mobilized sediment, the information gathered is limited and more detailed collections would be needed to support this process. Nevertheless, the data so far suggests that fine sediments are moving through all tributaries and reaches of the East Fork Creek at this time. Although this method cannot determine how much, it can give a relative amount that yields a comparison as to which tributary carries the most sediment.

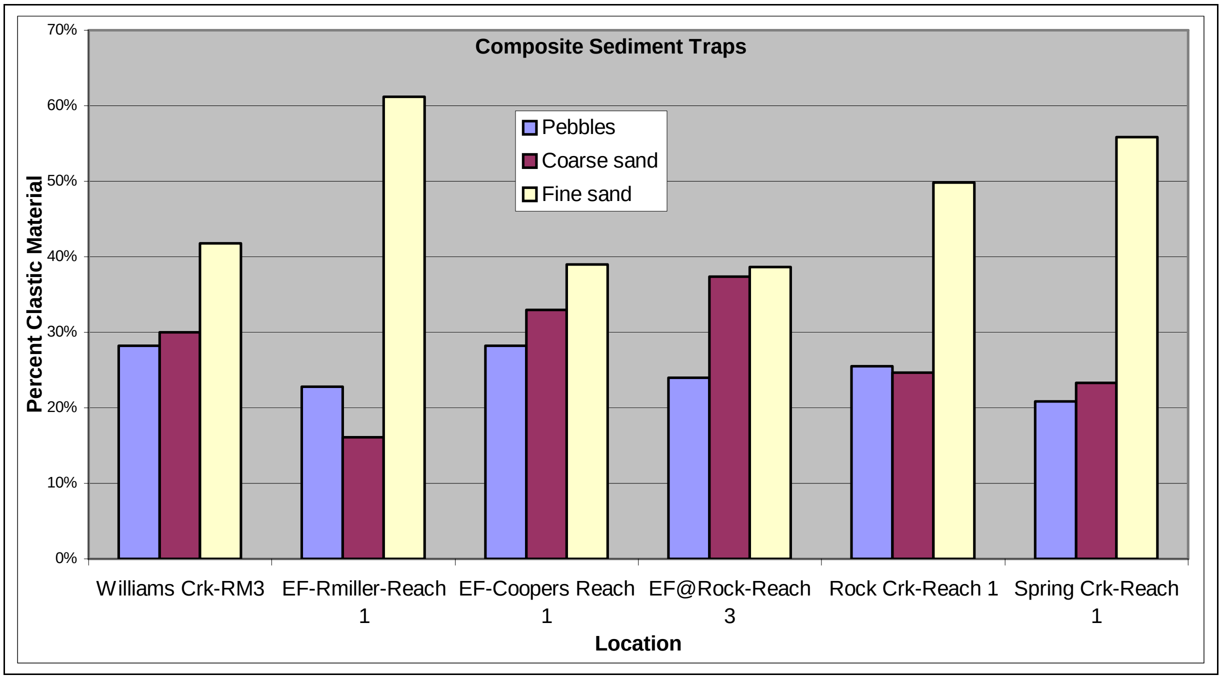


Fig 27. Sediment Traps - 6 compared in one chart

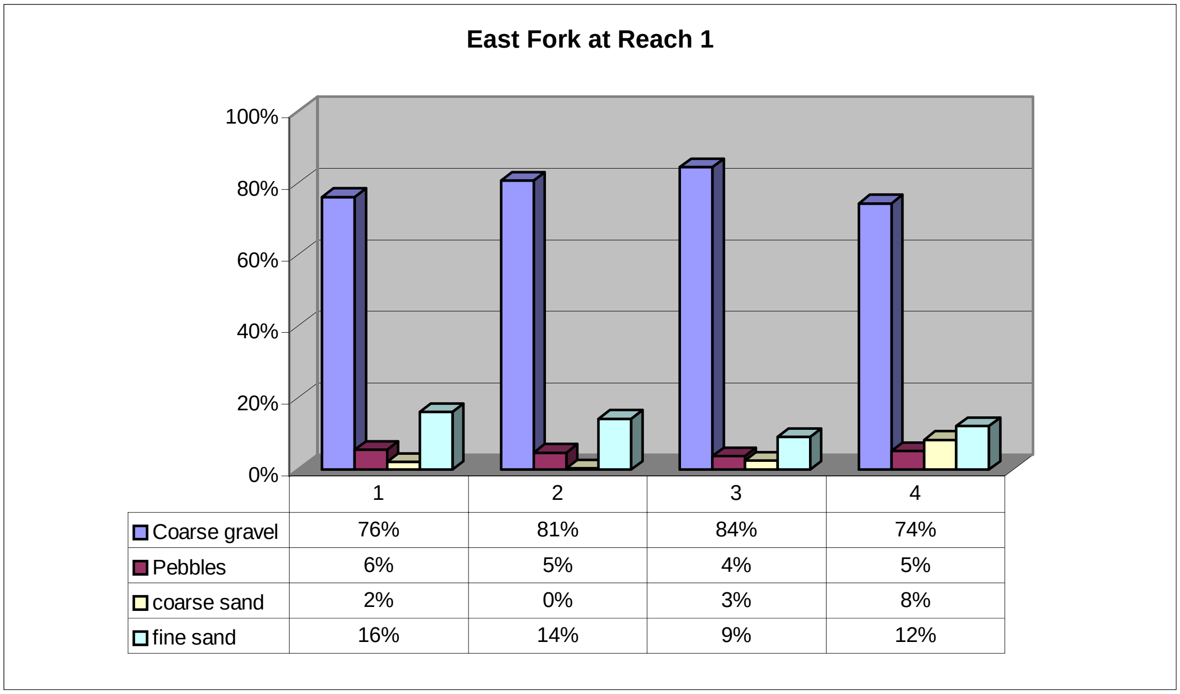
The data suggests that both Spring Creek and Rock Creek transport fine sediment and coarse sediment in high amounts to the East Fork Creek where fine sediment is reduced, probably from higher velocities of the main system carrying it to a lower reach or lower energy system where deposition is predominant. Areas that slow the water and create pools during peak flows allow sand and fine sediments to deposit within the main channel. The flow patterns that create sand in the substrate have historically been the floodplains that receive the overflow and slack water as seen by the accumulations of large terraces of sand and fine particulates along many of the creeks that carry the most amount of sand. Of course sand content is related to the rock type that is the source area for these tributaries, and Rock Creek and Spring Creek issue from the tall granitic mountains.

Essentially the sediment traps can be useful to determine which streams systems carry a large measure of sand component and will need erosion control measures developed in the drainage to reduce the content and increase the amount of pebble and gravel component. This is part of the erosion control measures applied to reduce road erosion, ditch erosion, and landslide occurrence. For example, Spring Creek contains up to 85% sand and has been identified as a major contributor. Consequently, we have identified and improved erosion control measures on the Spring Creek Driveway that was one of the major sources of fine material in this stream system.

How the trapped sediment compares with historical sedimentation can be deduced from a comparison with the barrel samples (Pages 43-52) collected on stream bank deposits that represent sediment from previous years. This may only be possible in a limited way, but a general trend can be discerned from the graphs. For instance by looking at the samples collected from Rock Creek traps and comparing them to the barrel samples of Rock Creek we can see that there is a difference of 4% fewer coarse sand deposits and 38% greater fine sand in the traps or presently being transported. This indicates that fine sediment is moving through but not necessarily being deposited in this area.

Of course, the hydraulic energy of the stream segment is an important aspect to consider in the movement of different sand sizes. High-energy segments will loosen and move larger particles than a quieter low energy segment. These segments are indicative of the structural aspects of the streambeds such as natural check dams that slow the water down during flooding and deposit sand and gravel or to the channelized sections that allow the water to rush downward and carry larger and denser components of the erosion products. Boulders and large woody debris slow the water and force gravel to deposit upstream along with pooling the water and creating spawning habitat.

These features can also create a rise in the streambed level, flooding along banks, and deposition of sand and fine material on stream terraces, effectively reducing the percentage of sand component in the stream system. Vegetation and intact boulder systems are an important function to holding the erosive material in place and producing increased opportunities for spawning habitat for indigenous fish populations.



	1	2	3	4
Coarse gravel	76%	81%	84%	74%
Pebbles	6%	5%	4%	5%
coarse sand	2%	0%	3%	8%
fine sand	16%	14%	9%	12%

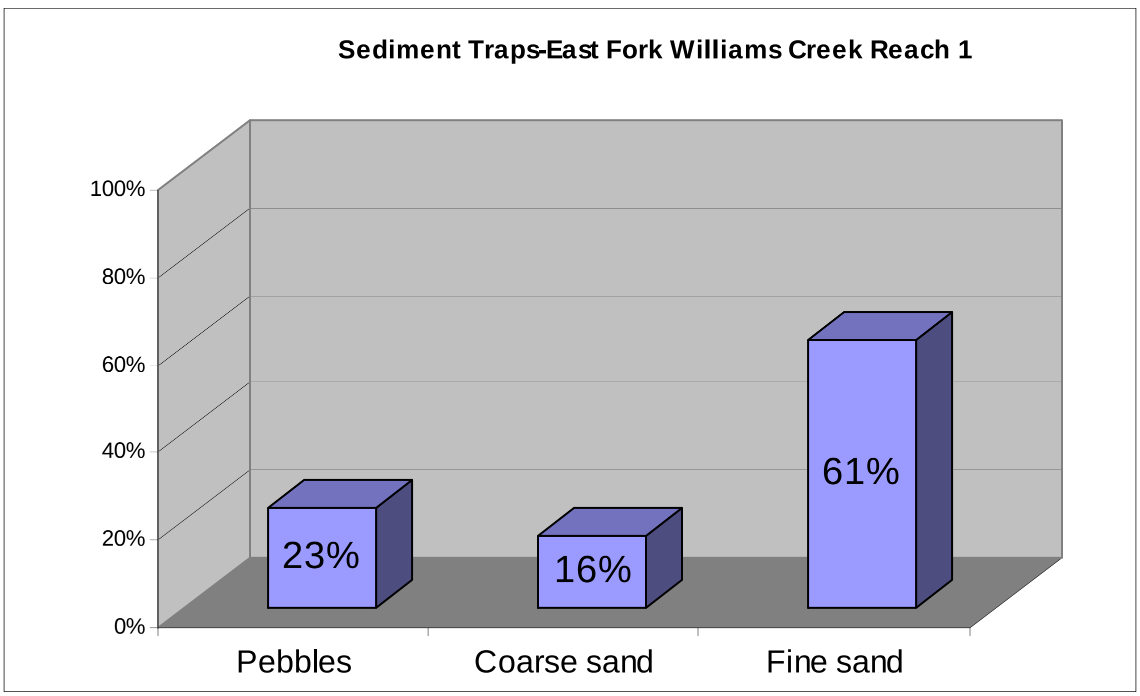
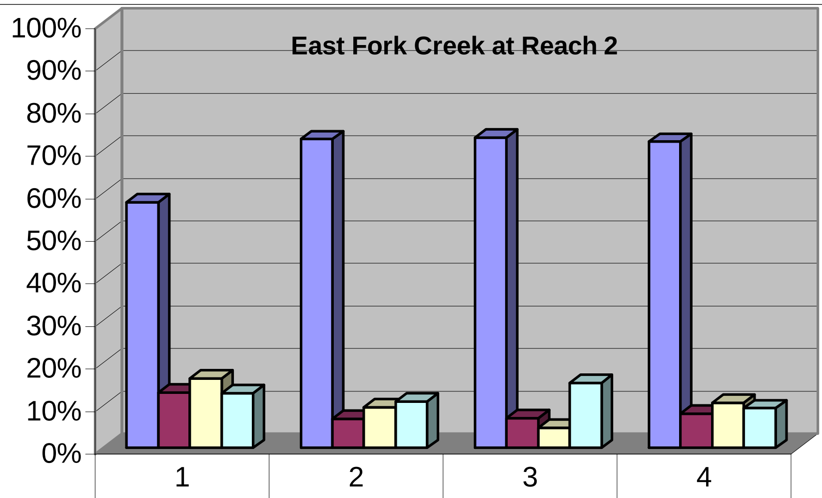


Fig 28. The upper chart shows the complete analysis of each trap. The Coarse gravel is the largest component but was added to the bucket to stabilize it during winter flows. The lower chart shows only the pebbles, coarse and fine sand component for easier comparisons.



	1	2	3	4
Coarse gravel	58%	73%	73%	72%
Pebbles	13%	7%	7%	8%
coarse sand	16%	10%	5%	11%
fine sand	13%	11%	15%	9%

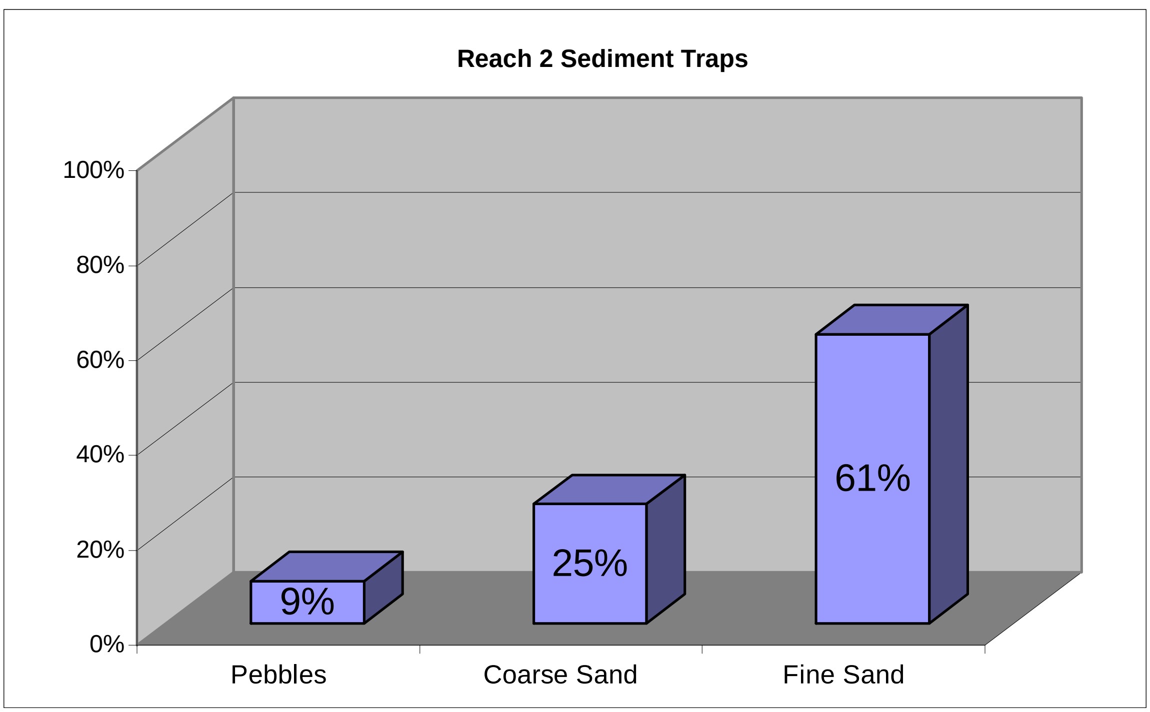
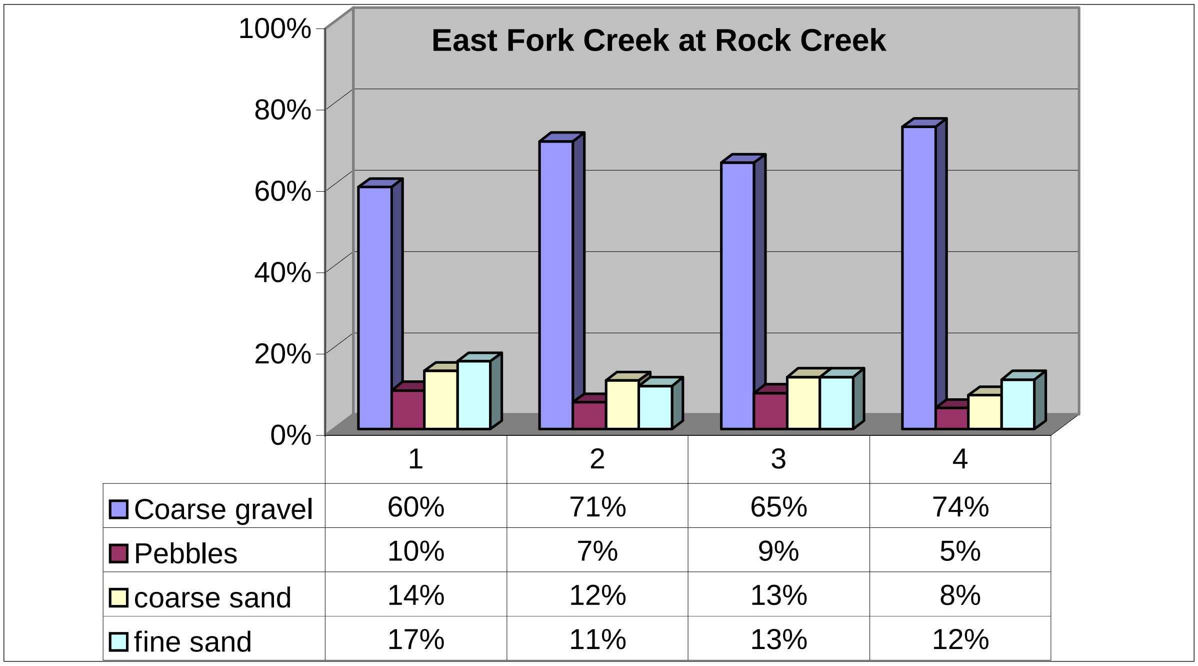


Fig 29: Upper chart is the total deposits with the lower chart only showing the pebbles, coarse and fine sand.



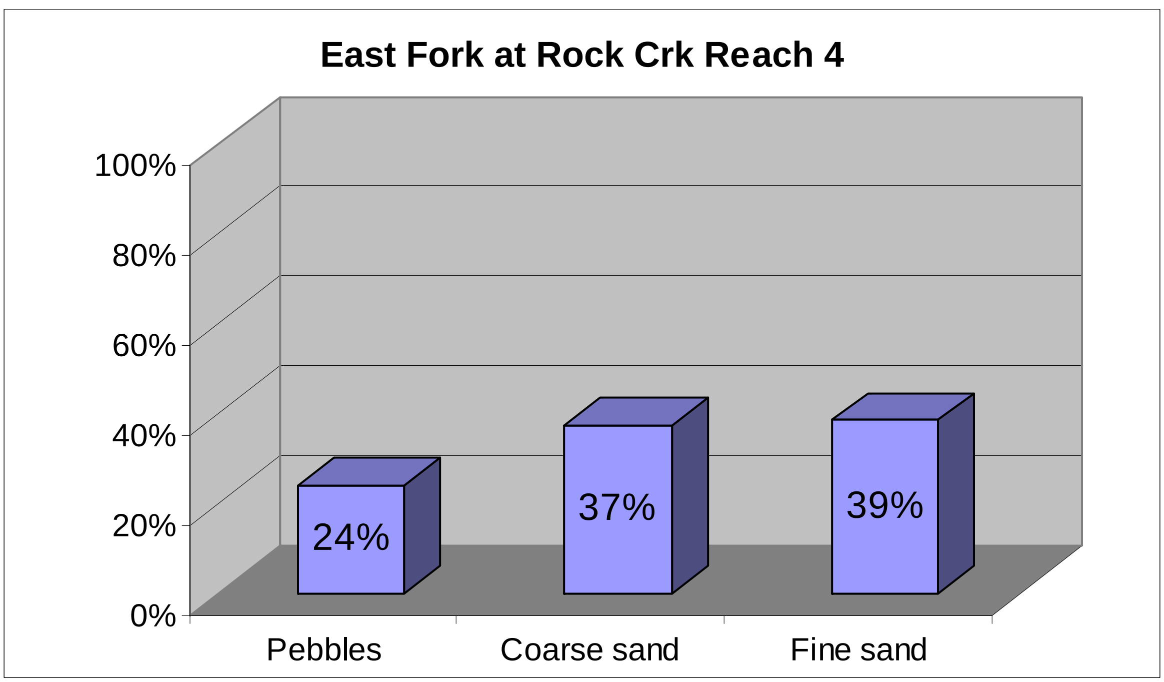
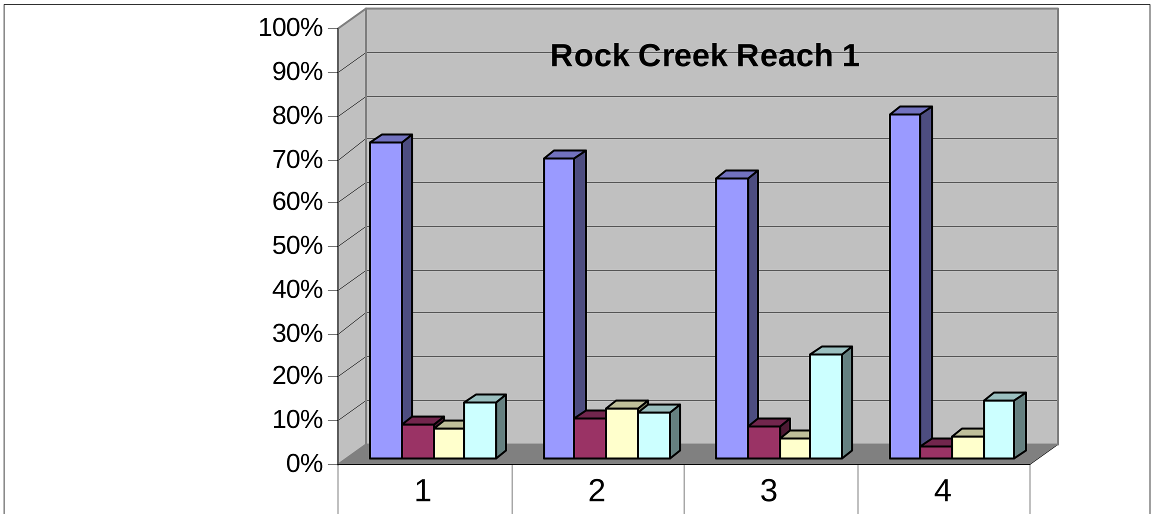


Fig 30: East Fork at Rock Creek



	1	2	3	4
Coarse gravel	73%	69%	64%	79%
Pebbles	8%	9%	7%	3%
Coarse sand	7%	11%	5%	5%
Fine sand	13%	10%	24%	13%

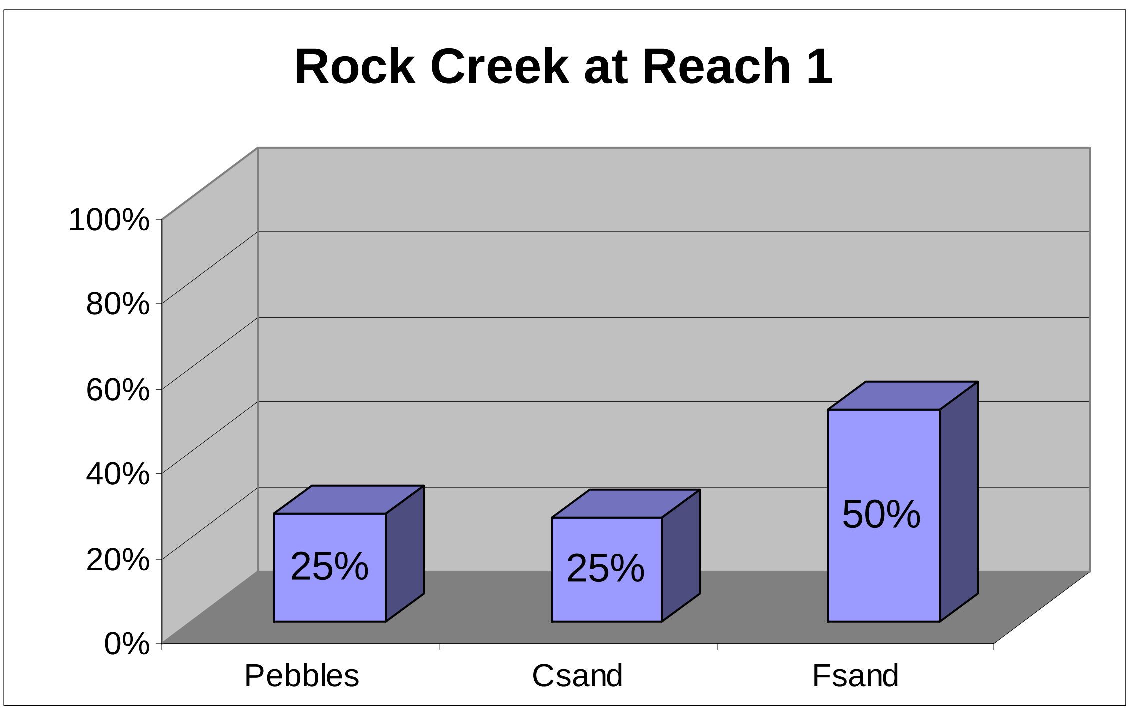
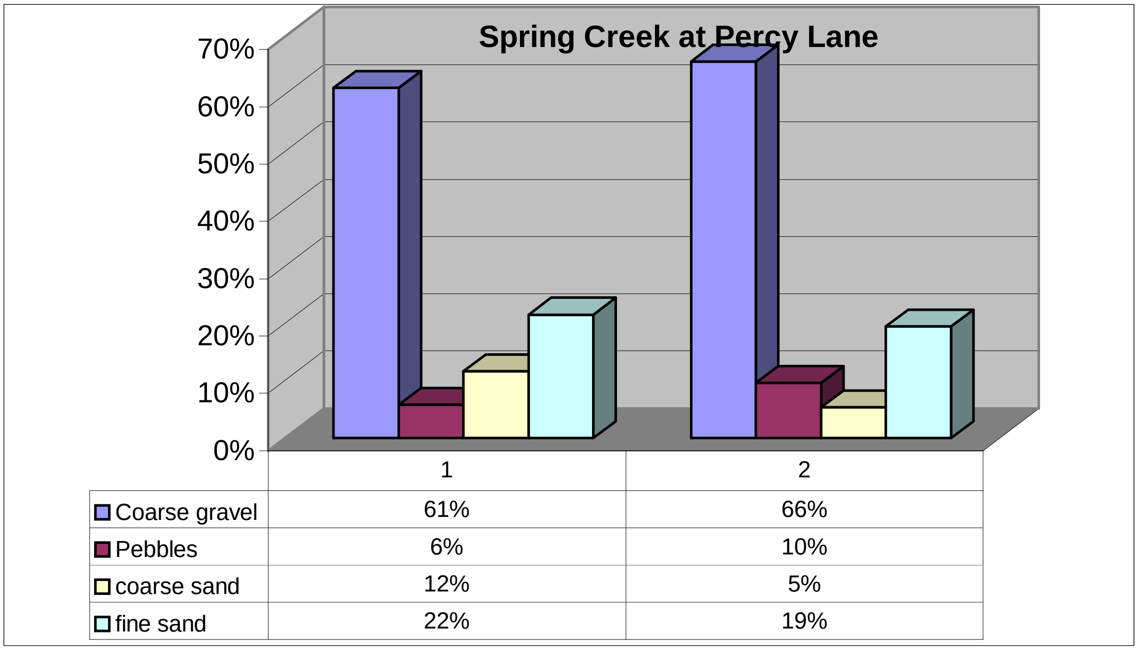


Fig 31: Rock Creek at Reach 1



	1	2
Coarse gravel	61%	66%
Pebbles	6%	10%
coarse sand	12%	5%
fine sand	22%	19%

Fig 32: Spring Creek at the Percy Lane Crossing Reach 1

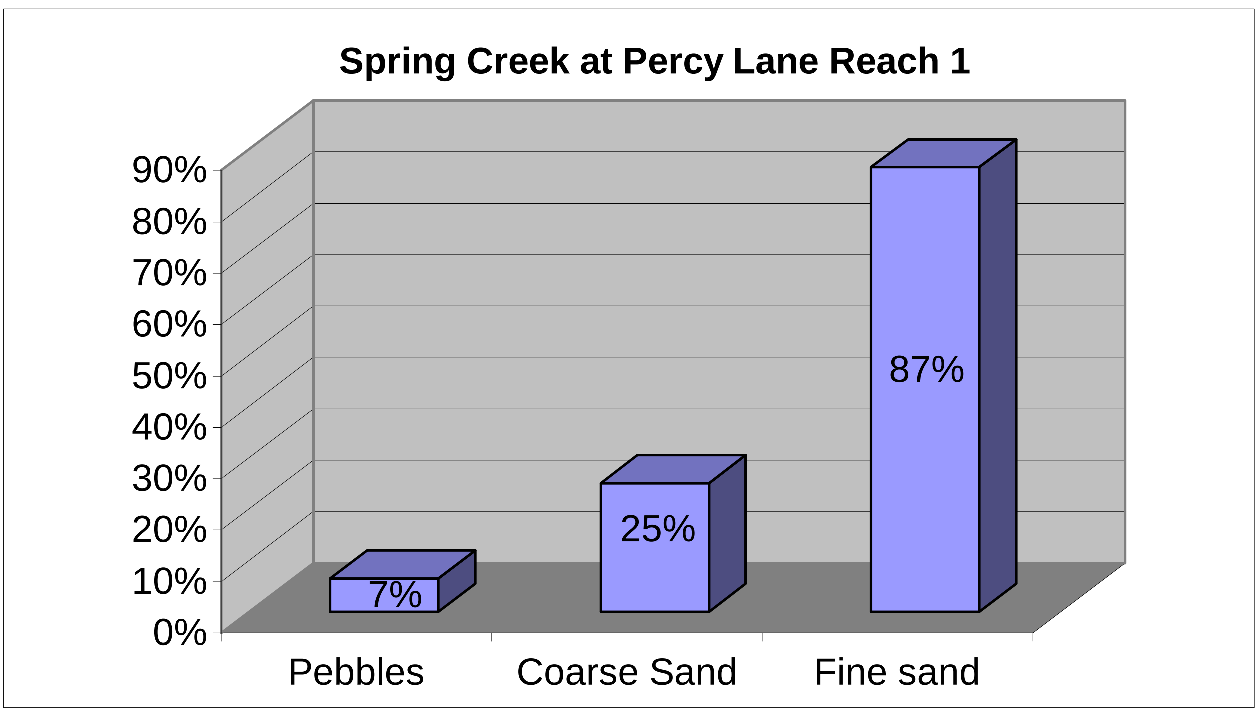
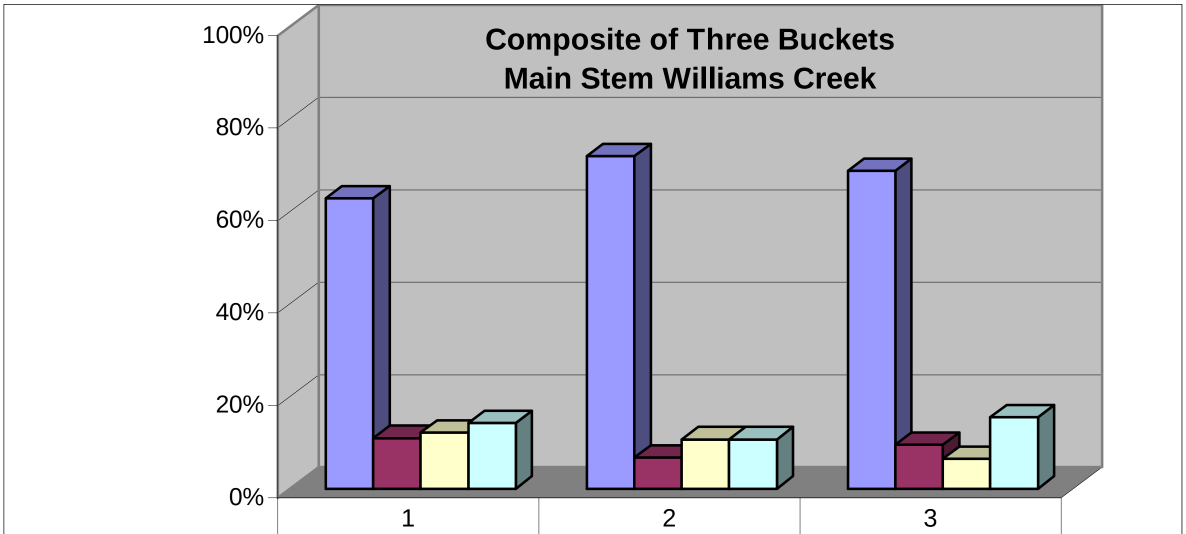


Fig 33. Spring Creek at Percy Lane, Reach 1



	1	2	3
Coarse gravel	63%	72%	69%
Pebbles	11%	7%	9%
coarse sand	12%	11%	6%
fine sand	14%	11%	15%

Fig 34. Sediment Traps at the Mainstem of Williams Creek

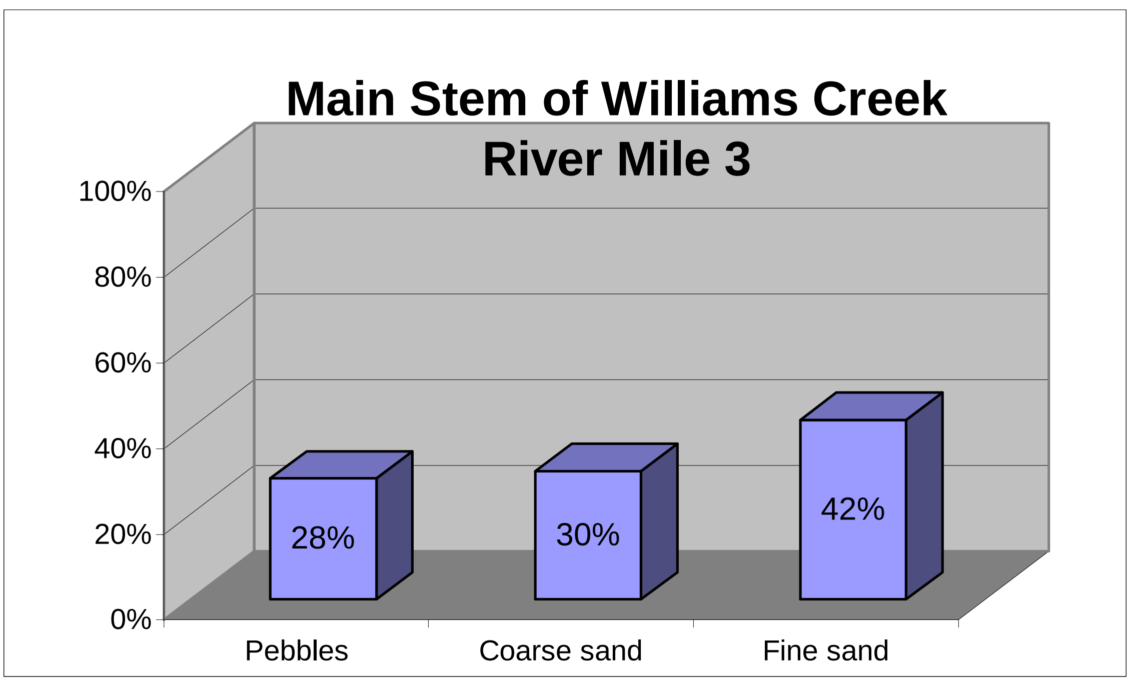


Fig 35. Main Stem of Williams Creek, River mile 3.

Wolman Pebble Counts

These samples are useful in understanding the type of flow regime that is active during peak flow. Only the high flow carries these larger cobble and boulder clasts. As the peak flow wanes, the fine sediment is removed as the high energy reduces but still carries the coarse and fine sand component, but will not transport the more coarse cobbles and they are deposited. This leaves a surface layer of coarse cobbles and boulders on the surface without many of the fine material that is present during transport. This is the material that is being sampled and is in these following charts

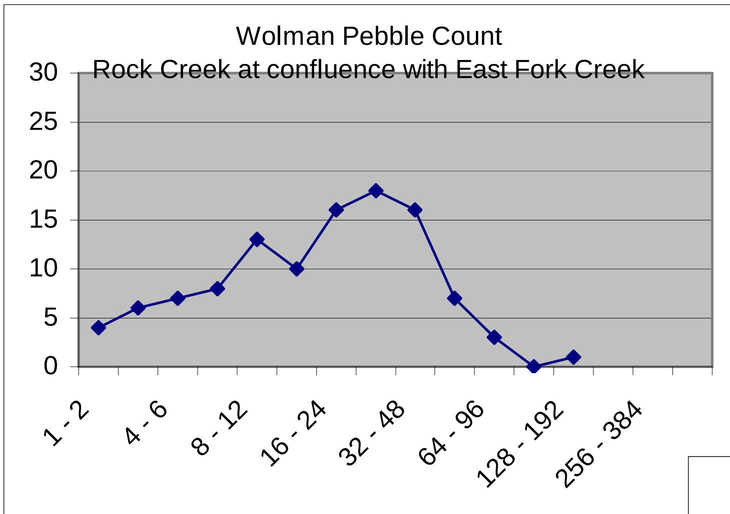


Fig 36. Wolman pebble, Count 2002- Rock Creek

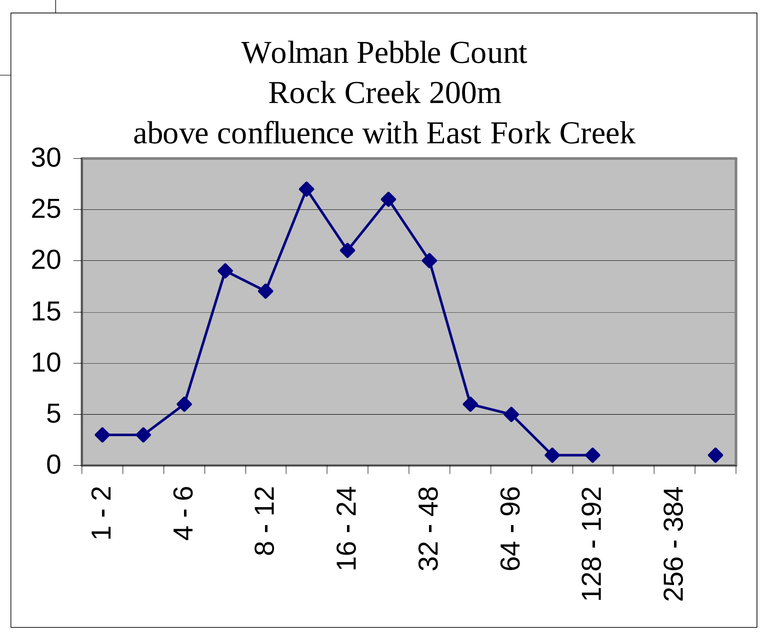


Fig 37. Wolman Pebble Count 2002, 200 meters upstream on Rock Creek

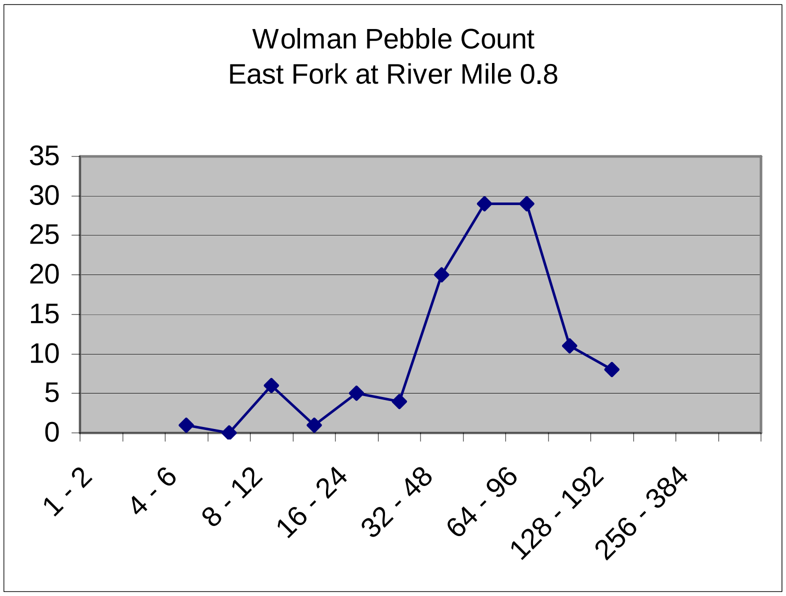


Fig. 38 East Fork Williams Creek at Coopers, Reach 1

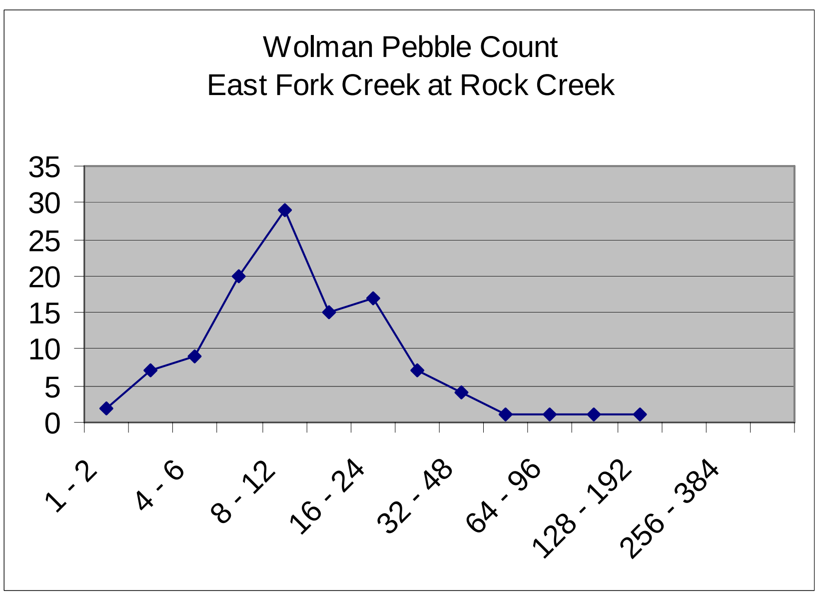
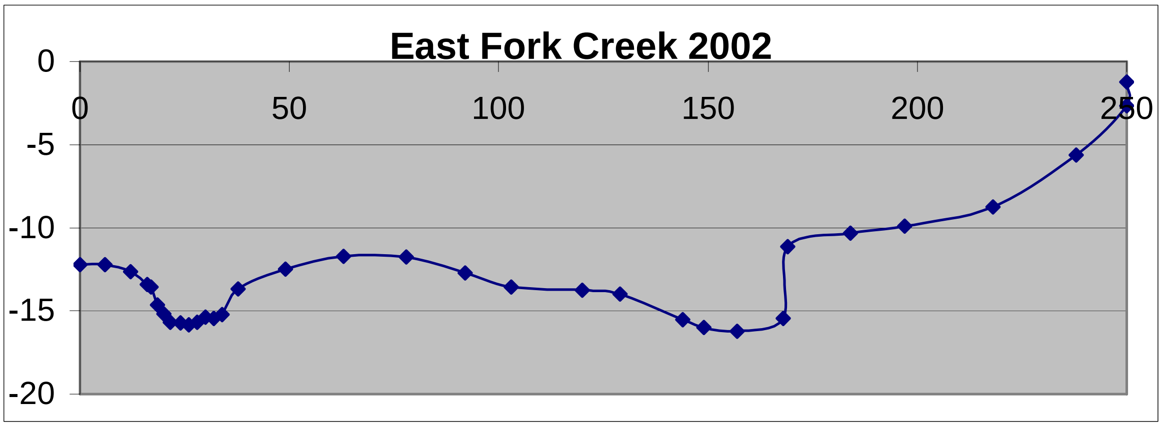


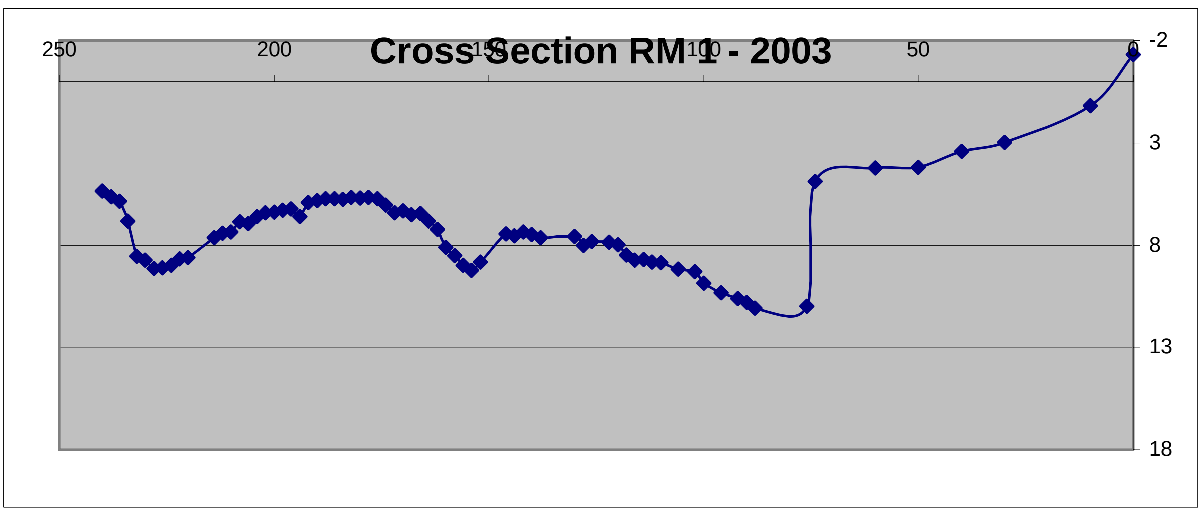
Fig. 39: East Fork Williams Creek at Reach 3

Stream Cross Sections

Several cross sections were established to help define the configuration of the streambed in several locations and compare measurements from the successive year. This would help understand the change of the thalwag, deposition of gravel, scouring of gravel, and general configuration of the creeks in this area. This also gives us a base understanding of the creek configuration at this spot.

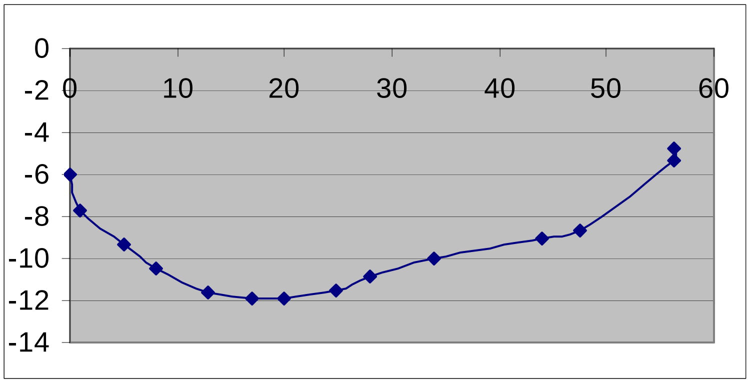
Cross Sections on Several Sites in the East Fork Subwatershed





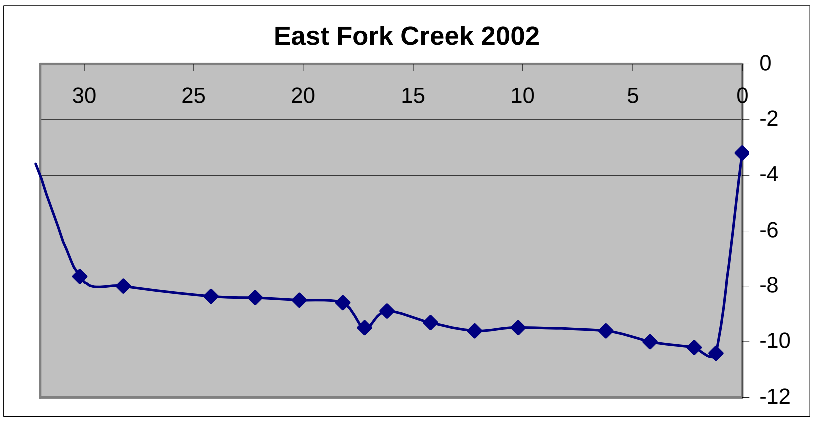
Comparisons of cross sections from successive years indicate erosion is active laterally and vertically. The right bank has been eroded close to 2.7 feet vertically and 6 feet laterally. Scour has been rapid where logs have been embedded producing pools. Deposition of large gravel continues here where the channel is restricted by the Brown's Road Bridge 200 feet downstream.

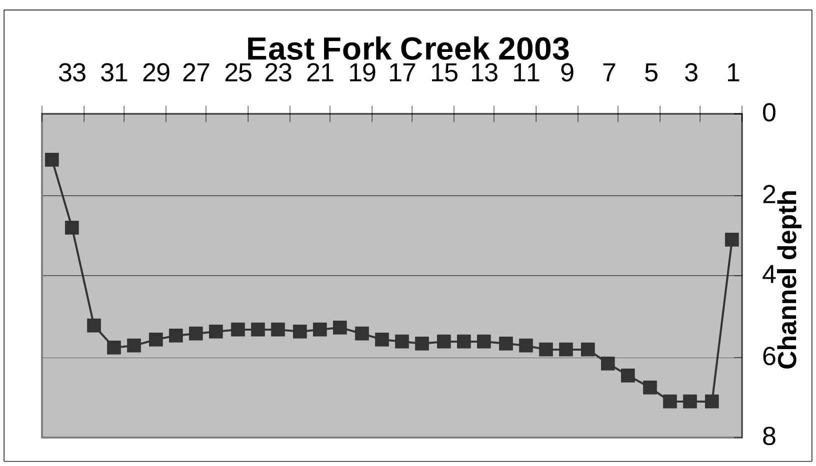
Fig 40. East Fork Creek Reach 1 - 2002



Little change occurred in this reach and cross sections were not continued during this study. Further longitudinal profiles would be useful in this reach.

Fig 41. East Fork Reach 1





East Fork Creek experienced a debris dam 60 feet downstream of this point during the winter of 2003 which backed up the water and deposited gravel in this area. Accumulation of gravel built up the substrate with a broad riffle, several scour pools, and other channel features. Longitudinal profiles would be useful in this area.

Fig 42: East Fork Williams Creek above Rock Creek, Reach 4

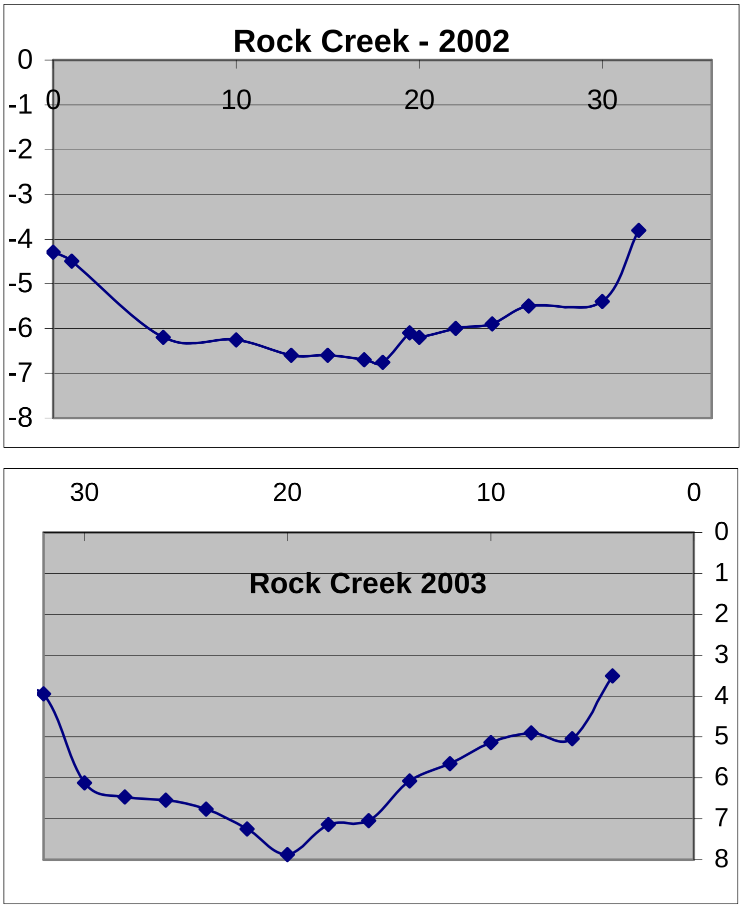


Fig 43. Rock Creek Reach One – 2002 - 2003

Rock Creek was subject to increased scour and erosion in this reach that increased the depth of the bed down 1 foot in the center in one year's time. Removal of large wood and rapid discharge will continue this process as water rapidly runs off the steep hillsides. Lateral erosion continues as bank height increases and undercutting promotes bank instability.

Chapter 3

Private Road Repairs

Introduction

Roads in the East Fork that have been inventoried (Page 20) are in a variety of conditions with only a few in need of immediate repair to reduce the sediment that enters the tributaries of the East Fork Williams Creek. We have reviewed these roads with a road engineer and technician and developed solutions to the immediate problems of sediment erosion and delivery to nearby stream systems. The following pages examine these erosion problems with more detail and chronicle the work done to improve the roads and reduce erosion. Much of the work done was in cooperation with the landowner seeking to alleviate damage to salmon habitat and spawning grounds adjacent to the road or driveway.

Spring Creek Driveway

This road is deemed one of the most erosive in the East Fork subwatershed and could become a model for road repair and redesign. Enormous amounts of runoff occur during the winter rainy season, cutting deep ditches and ruts into the roadbed and causing soil and fine particulates to dump into the nearby Spring Creek. Spring Creek is one of the creeks that carry the highest amounts of fine sediment to the East Fork Williams Creek.

The first 300 feet of this roadway are owned by BLM and the road traverses through thick old growth forestlands crossing Spring Creek in a low area that is underlain by two culverts, one 32” wide and the other is 48” wide. These culverts commonly fill halfway up with sediment and debris. Erosion and undercutting of soil layers are evident along with mobile woody debris and periodic clogging of the culverts during peak winter flows.

Immediately after crossing Spring Creek is a short (120’) uphill section with a 8% changing into a 18% grade that cut gullies into the side of the roadbed and delivered sediment along the road. This area was highly channelized and funneled material directly down the road into Spring Creek. A side road at the top of this grade carried some of the runoff into the forest from the next steep grade of 14% (160’) and other efforts by the road users have been made to keep the runoff to a minimum.

The road then leaves BLM property and enters private land. The first part of the road has a shallow grade of 6% and 3% for 425 feet and then descends a 4% grade to a low area where water during winter rains ran across the road due to a plugged undersized culvert. The granitic soils and concentrated runoff had cut a deeply incised channel (6-7’ deep) into the soil on the north side of the road. This channel receives sediment from several old logging roads that drain the hillside and overloads the holding capacity of the soils therefore resulting in the downcutting of the land. This caused excessive surface water that eroded the roadbed and formed a gully that carried excessive water and sediment into the Spring Creek drainage.

In the process of studying this road, we retained the help of several road technicians who gave suggestions on how to repair the problems and relieve the erosion along the lower portion of the road. In an effort to reduce the sediment loading into Spring Creek the Watershed Council hired a road technician to work on the road and develop an outsloped condition that sheds water off into the forest immediately adjacent to the road. Soil and rock were collected to fill the low areas and the road was outsloped to deposit water and sediment into the forest floor rather than into the roadside ditch. Large pit run rock was laid and compacted onto the roadbed. This process has created an outsloped road surface that will shed water to the side and reduce the deposition into Spring Creek.

Above this point the road has received considerable repair by the landowner. Here, the road is outsloped and drains off into the adjacent forest where sediment and water are filtered before running downhill into the Spring Creek.

Future Restoration

BLM is also planning to complete the construction of another open-bottom culvert at the crossing of Spring Creek where considerable erosion and sediment delivery has been recorded for several years. This road is used by residences above BLM property for access to their homes and has been degraded by erosion for many years. The original construction of this road was for timber extraction without consideration for the erosion that would occur in later years. Therefore the road system that was constructed was built by bulldozing the pathway into the forest floor by moving the material to the side and creating a channelized roadbed that carries and distributes water and sediment down the road and eventually into the Spring Creek. Little concern was given to the location of the road except to form a pathway to the big old trees that existed at the time. The overall pathway was formed along the ridges but not necessarily at the top to the ridges. Side cutting and incising of the hillside were a part of the construction along with the nature of climbing directly up the hill into steeper terrain. Without the construction of contouring or gradual slope, the road climbs up the mountain at a steep slope that results in the removal of sediment that empties into Spring Creek at the bottom.

Photos of Road Repair and Erosion Control

The landowner that uses this road has envisioned the road as being a model for minimum repair needs that includes ideas that use side-cast design incorporated with no culverts and minimum runoff down the roadbed. Previous work completed by the landowner on the upper section of this road has shown that this process can be very successful in reducing the erosion along the road. These improvements will produce a road that needs very little maintenance and reworking except for spreading of gravel that has been displaced from vehicle travel.

The following pages show photos of the work done on the Spring Creek Driveway to reduce erosion and divert it from entering Spring Creek.

Photos of Erosion Problems on Spring Creek Driveway

Fig. 44. Erosion down steep forest road carries fine material downslope

Fig 47 Erosion on side of road continues to down into Spring Creek mixing with clear water

Fig. 45 Erosion on Spring Creek Driveway collecting at crossing of Spring Creek

Fig 48. Gully erosion along Spring Creek Drive where erosion has cut 7 feet deep

Fig 46. Sediment flowing directly into Spring Creek, tributary of East Fork Williams Creek

Fig 49. Runoff travels down road and enters gully during rainstorm continuing erosion

Road Improvement and Erosion Control on Spring Creek Driveway

Fig 50. Erosion along side of road continues to cut ditches and removes gravel to Spring Creek

Fig 51 Road repair began with knocking down the berm and filling in the ditches

Fig 52. Dozer used to spread rock to outslope the road

Fig 53. Backhoe fills in the road ditches

Fig 54. Smoothing and sculpting the road for erosion control

Fig 55. Completed section of road with outsloping and packed rock

Turley Driveway Improvements

This road segment has steep slope from the gate to the house ranging from 10% to 14% grade. Much of it is in fair condition, but the runoff from this driveway entered the BLM road section and caused erosion of the roadbed material. This produced gullies and ditches that formed all the way down the gravel road to the bridge over East Fork Williams Creek. Here it deposited along the banks or emptied into the creek.

We contracted a road technician to help design and improve the conditions of the driveway. We were able to outslope the section below the gate and encourage the runoff to deposit into the forest adjacent to the road. What water and sediment did reach the road was diverted into the side ditch where it would run down and filter out through the vegetation alongside the road.

Future Work Planned

BLM has been alerted to the erosion problems along this road segment and has offered to repair and improve the road for future erosion control. They have also agreed that more cross drain culverts need to be installed to divert the water out of the main roadside ditch, underneath the road, and out into the forest adjacent to the road on the downslope side. This will keep the water and sediment from reaching the East Fork Williams Creek and be filtered through the forest vegetation.

Upper East Fork Road

This road segment has had erosion problems for over ten years and has had numerous small projects to improve the conditions and alleviate the erosion problems. Erosion continues to run down the dirt road and cut deep gullies and side ditches that transport enormous amounts of granitic soils into the tributaries of the East Fork Williams Creek. Past efforts have included side bars, hay bales, and finally gating the two ends of the road to stop traffic. It is a Josephine County owned easement but no maintenance or repair is accomplished on this road segment. Only horse riders, hikers, and perhaps a trail bike use it now.

This road has the potential to cause enormous amounts of erosion in the winter rainy season. The upper East Fork Williams Creek runs alongside it on one section at the same level as the roadbed and the potential for flooding and scouring is great. The bend in the creek could direct the major part of the flow down the road and carry sediment all the way to the creek.

Future Work Planned

We are in the process of developing plans with the BLM, Josephine County, and Williams Creek Watershed Council to enter this road section and divert the runoff to the side of the road creating an outsloped road prism. This will direct the water and sediment into the forest where it will be filtered before it reaches the East Fork Williams Creek. An old side channel exists that will be able to receive the water and carry it off the road.

Another important aspect is to build and protect the Upper East Fork Creek from jumping it banks and entering the road by placing logs, boulders, or other appropriate materials in the creek and alongside the road to harden to banks and roadsides and direct the water to remain in the existing channel during peak flow. This would improve the erosion potential greatly and reduce the threat of large flooding problems.

Cherokee Road

Cherokee Road is accessed 2 miles up East Fork Road and trends westerly into the foothills of the ridge in the middle of Williams Valley. There are 10 land parcels on this road that use this as sole access to their properties. Numerous cross drain culverts and ditches cross the road, are poorly designed and do not drain the runoff accumulated during storm events. As a result, large potholes have formed from the frequent movement of vehicles that splash and remove fine gravels from the road surface. Accumulation of road gravels along the sides of these potholes has raised the lip and accentuated the hole and retention of water. Drainage and runoff is a result of excessive water accumulating on the roadbed and not drainage from design.

An irrigation ditch crosses beneath the road at the entrance with a good culvert. The road rises to a broad hill and trends downward to the crossing of Yewwood Creek, a shallow drainage system that crosses the road and flows into a wooded wetland. Whether this road is a problem to streams is uncertain. Much of the water that drains off the road enters the wetland and is picked up by an old unused drainage ditch that crosses the valley. From all indications, what water does enter the ditch is blocked by the East Fork Road or never reaches the East Fork Williams Creek.

The road has not been graded for many years and needs to be outsloped to encourage runoff to occur along the contour of the land. A new layer of gravel needs to be applied to cover irregularities and raise the level to where it can be crowned or outsloped. With proper care this road could be converted to one with good condition and easily maintained.

Tributaries of the East Fork Williams Creek

Characteristics and Features

There are seven streams and tributaries of the East Fork subwatershed that are important to the sediment delivery and salmon habitat. Many of these streams have unique characteristics that make them valuable assets to the salmon habitat while others are seasonal or blocked by culverts that stop the passage of fish beyond their points. This section is concerned with the types of sediment material that has accumulated in the streambeds and flows through the creek during peak flow. Various methods were used to characterize these tributaries as outlined below.

1) Turbidity Analysis
   a) Collecting water samples before and during high water marks in streams
   b) Analyzing the water to its NTU content and reading with a turbidity meter
   c) Comparing and contrasting the different tributaries with each other
2) Barrel sampling

a) Collecting gravel from the stream bed in potential spawning regions or areas of lower gradient that accumulates stream material
b) Sampling into the streambed to collect material that is below the surface where sand and finer material collects and concentrates
c) This type of sampling is valuable in determining the bedload characteristics over a two to three year cycle

3) Wolman Pebble Counts
   a) Determines the amount of embeddedness of the stream gravels by measuring the large cobbles and boulders on the surface of the streambed
   b) Gives a numerical count of the large cobbles that accumulate on the surface
   c) Used to determine the flow regime and hydraulic energy capacity for the stream
4) Sediment Traps
   a) Collects sediment on a yearly cycle
   b) Installed in the stream bed during the summer with the top of the bucket, flush with the streambed and is left in place until the next summer
   c) Gravels collected are sieved, separated, and measured into classes of pebbles and coarse sand and fine sand
   d) These measurements are then graphed and compared to each other to determine the relative amount of sand that is moving through the system during one years cycle.
5) Direct Observations and Photo points
   a) Observations during flooding periods
   b) Photos of sites that show turbidity in outflow from erosion points that reaches the creeks
   c) Culverts that clog and back up during flooding cycle

Tributaries of East Fork Williams Creek

Each tributary of the East Fork subwatershed contributes a portion of the waters flowing out of the basin, each with its own discharge amounts and characteristic gravel type. The amount of discharge varies with the land surface that is drained, altitude represented by the drainage basin, and location and climate type found in the area.

Table 11. Tributaries of the East Fork

Drainage	Sq. Miles	Acres	Average Rainfall	Stream Miles
East Fork Williams Creek & Panther Gulch Creek	4.99	3194	38	30.32
Clapboard Creek	2.65	1695	42	12.43
Rock Creek & Spring Creek	5.11	3268	50	16.99
Glade Fork Creek	1.67	1067	50	6.08
Pipe Fork Creek	2.28	1461	53	3.82
Total	**16.7**	**10,685**	**46.6**	**69.64**

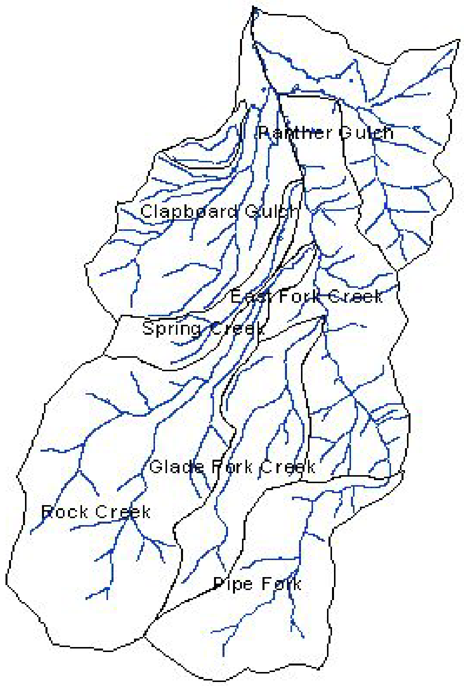


Fig 56: Map of the Tributaries of the East Fork Williams Creek and subwatershed boundaries.

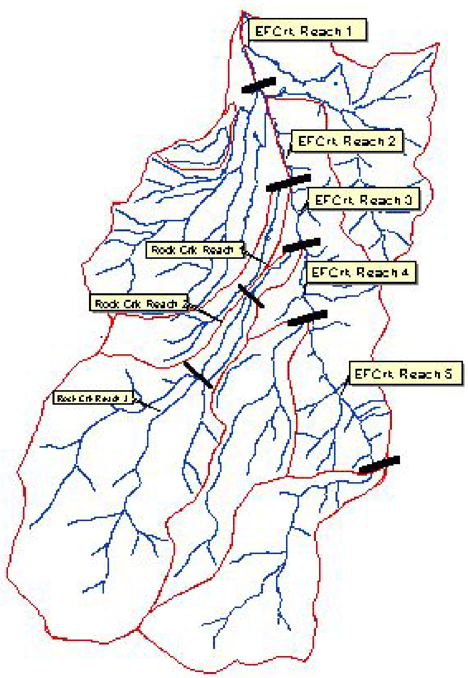


Fig. 57: Map of Selected Reaches

The following is a short analysis of the tributaries of the East Fork subwatershed. Each description looks into the unique aspects of the area and gives an analysis of the impact to the East Fork Williams Creek and its riparian habitat. These tributaries are ones that flow year around and contain habitat suitable for salmonids, native trout, or other macroinvertibrates that inhabit upland wetlands. Other smaller tributaries that either run part of the year or do not contain viable habitat except during winter flows have been omitted in this analysis.

East Fork Williams Creek

East Fork Williams Creek receives surface flow from the six other tributaries in the East Fork subwatershed and is the main drainage channel. Large amounts of water are diverted from the creek for irrigation from several diversions including pumps, head gates and gravity flow pipes. A detailed account of the habitat survey developed by ODFW is included in this section as this is our most important stream system.

Reach 1 extends 0.9 mile from the confluence with the West Fork Williams Creek to the confluence of Clapboard Creek. Riparian vegetation is mixed conifer and young hardwoods. The average gradient is low at 1.6% with riffles and scour pools dominating. Actively eroding stream banks are common (26%) and the fine sediments are high at 26%. Volume of large woody debris is low.

Reach 2 starts at Clapboard Creek and extends 1 mile upstream. The valley is broad but eh channel is constrained by high channels. Land use is residential and heavy grazing. Riparian vegetation is mixed hardwoods and grasses. Average gradient is 3.1% with rapids and riffles the dominant habitat. Active erosion on stream banks is high at 52% with the fine sediments at 25%. Volume of large woody debris is low.

Reach 3 extends 0.7 mile to the confluence of Rock Creek. The channel is constrained by high terraces alternating with hill slopes. Land use is rural residential and timber. Riparian vegetation is mixed hardwoods and conifers. Average gradient is moderate at 4.5% with rapids as the dominant habitat type. Volume of large woody debris is low.

Reach 4 extends to the confluence of Glade Fork Creek, 0.7 miles upstream. The channel is constrained by high terraces and land use is timber and rural residential. Riparian vegetation is a mix of hardwoods and conifers. The average gradient is low at 2.8% and the percentage of fine sediments is high at 32%. Riffles and scour pools are the dominant habitat type. Volume of large woody debris is low.

Reach 5 extends up to Pipe Fork Creek, 1.75 miles upstream. The channel is constrained by high terraces. Riparian vegetation is a mix of hardwoods and conifers. The average gradient is moderate at 4.4% and the percentage of fine sediments is high at 29%. Volume of large woody debris is high.

The potential for spawning on the East Fork Williams Creek is good. Coho, chinook, steelhead, cutthroat trout and Pacific lamprey occupy the reaches of the East Fork Williams Creek. Cattle grazing and high water temperatures in the lower reaches impact the riparian zone. Loss of riparian vegetation and erosion of sediment reduce habitat quality. Fine particulates in gravels are moderate to high and the potential for embedded substrate is a limiting factor. Volume of large woody debris is low.

Panther Gulch Creek

Panther Gulch is located at the 0.8 stream mile of the East Fork Creek and drains an area on the east side of the Williams Valley that includes a subwatershed of the East Fork. Much of the area is utilized for farming or ranching with cattle, horses, and small farms. The main channel of Panther Gulch Creek drains the eastern ridge running north and curves to the west as it crosses farms where many instream ponds intercept the flow and fill from runoff during rain events. The East Side Ditch, which brings water from East Fork Williams Creek near Rock Creek, also crosses Panther Creek at the upper reaches of the valley and is used to fill these ponds during irrigation season, usually during April through July. This ditch intercepts the runoff and diverts it through the ditch system at several points, although no observed erosion was associated with this ditch. The East Side Ditch ends at Cherry Gulch where, presumably, when the water reaches that far the excess runs down this drainage to Williams Creek.

Panther Gulch area is composed largely of granitic soils that are part of the highly erodable plutonic rocks found constituting the valley floor of Williams even though it does drain resistant metamorphic rock formations on the east side of the valley. Alluvium deposits are shallow, as seen by looking at the well logs for private wells drilled in the last 50 years. Groundwater moving from higher elevation to the valley floor is perched above the granitic basement and seeps out in several wetland areas attesting to the high water table in this area. This water table fluctuates seasonally and drops in the summer causing dry surface conditions in this area.

Very little potential for salmon habitat exists on Panther Gulch Creek. With the existence of numerous ponds and diversions, fish passage is impossible. No fish were observed in this drainage nor were spawning gravels sampled or sand content calculated.

Panther Gulch Creek is captured by many ponds on its way to the East Fork Williams Creek with the final pond on lower Panther Gulch Road. This large instream pond fills from runoff and flows out through an overflow gate and into the roadside ditch along Panther Gulch Road and into the East Fork Williams Creek. This pond was the site of enormous erosion during December of 2002 when a large rain event brought 8 inches of rain to the area. The overflow of the water breached the dam, eroded the dam wall, and caused massive failure. This brought enormous amounts of sediment down the valley across Homestead Road and flooding and eroding soil in neighboring property. The overflow eventually entered the East Fork Williams Creek, raising the sediment levels and causing flood damage to nearby property (See photos on following page).

Fig: 58 Aerial photo showing pond on Panther Gulch where dam failure resulted in mudflows and flooding of lower Williams Valley

Drainage ditches were hastily constructed along the outer area of the dam to get the water that exits through the dam breach to flow back into the main ditch for Panther Creek. Although they were successful in this aspect, the ditches are constructed by digging a two-foot wide channel with a backhoe. This leaves steep banks and exposed soil to eroded further and sloughing into the channel, adding to the erosion problem. Further work needs to be done on this pond during the 2003 year to prepare it for winter rains. Reconstruction of the dam and pond will be costly and involved.

Flooding and overflow of pond resulting in collapse of dam and extensive mudflow on the Panther Gulch Creek

Fig 59. Dam failure with overflow of pond

Fig 60 Flooding of neighboring lands

Fig 61. Sediment flowing out of failed pond

Fig 62 Pond emptied of water showing sediment deposited in bottom and failure point

Fig 63. Overflow onto Homestead Road

Fig 64. Flooding of neighboring land

Pipe Fork Creek

Pipe Fork Creek is located in the southernmost area of the East Fork subwatershed and begins at the 4.8 stream mile of East Fork Creek, and reaches into some of the highest riparian zones in the East Fork subwatershed. It has 3.7 stream miles of high quality forestland and riparian habitat. Pipe Fork also transverses several geologic rock types containing granitic, metamorphic, and some ultramafic and serpentine zones. Roads in the Pipe Fork are cut out of the hillside and are covered by a thin layer of rock. Most of the road remains out of the riparian zone with little erosion reaching the creek. Much of the road is designed to be outsloped and the water drains the road prism quickly. Very little maintenance is done on the road and the access to it is limited as the East Fork Road crosses through BLM property and is gated within a mile on each side.

Pipe Fork Creek is a 2nd-order, moderate to high gradient, mid-elevation stream in forested old growth and re-growth. Mixed alder, big leaf maple, Douglas fir, and cedar dominate riparian vegetation. No ponds exist on Pipe Fork or are there any encumbrances to fish passage besides the steepness of the terrain. Large wood content in the streams is moderate to good, although logging completed in the past has aided in the removal of high quality structures that promotes spawning habitat.

Pipe Fork Creek is good habitat for the hardier fish species such as steelhead and cutthroat trout, although other species may range into this area when conditions are right. Samples taken in this area are limited, although indications are that very little turbidity or sedimentation occurs on this branch of East Fork.

Glade Fork Creek

Glade Fork Creek flows into the East Fork at the 3.0 river mile after crossing East Fork Road where there is a culvert that potentially restricts fish passage into the upper reaches of the drainage basin. This culvert is undersized for the stream and drops 3 feet on the outlet side to effectively block fish access under the road and into the upper reaches. Glade Fork contains numerous roads constructed by BLM for logging purposes in various degrees of condition. The main road is in good shape and is graveled and ditched but does not include all the various roads that cross this area. The roads in this area are composed of gravel over granitic soils that scour and form gullies quickly. Many of these roads have not been used for many years and are constructed in granitic soils with high erosion potential. This subwatershed has shown rapid rise in turbidity during rain events showing the mobility of minerals and fine particulates present in the soils. These roads are decommissioned by BLM and no plans are in place to re-enter this area for logging. Port Orford Cedar are abundant in this creek and the *Phytopthora lateralis* root disease is active (personal comm. with Jim Roper, BLM).

The presence of salmon species in this creek is not documented. The potential for steelhead and cutthroat trout are good if fish barriers to passage are improved. High sediment content and particularly high sand content reduces the potential for spawning habitat, but high woody debris and good water flow during winter are positive signs for salmon habitat recovery.

Clapboard Gulch Creek

Clapboard Gulch drains an extensive area but does not extend up into the higher reaches of the Grayback Mountain. Consequently it does not receive the amount of rainfall or runoff that adjacent drainage basins get. There are two branches of this creek system, Clapboard Gulch and Sugarloaf Creek. Flooding in this system is usually in the heaviest rains and it responds quickly and returns back to its former levels soon afterward. This is what is termed a flashy creek. With the potential for runoff being high there may be a high content of groundwater that is supported by the numerous springs that exist on private lands. Clapboard Creek has several tributaries that cross a major forest road, Clapboard Gulch Road which runs along the side slope for about 2 miles.

Yewwood Creek is a small tributary to the Clapboard Creek and is included within the Clapboard Creek drainage. It drains the west side of the valley at the lower ends of the watershed. Many of the tributaries of Yewwood Creek are small and not well developed due to the fact that it has seasonal flow and drains through granitic soils and alluvium that allow for rapid infiltration and subsurface movement. Consequently, stream flow is not connected to the main flow system except during the times of high precipitation and runoff. Then, the water is directed through two ponds where much of the erosion is settled and does not reach the lower parts of the valley. The old drainage system is not apparent today but crosses the road at Granny Lane in two places and then Cherokee Road in one main channel, then filters into the soil through wetlands and ponds. Here, it may enter the ground as subsurface flow before reaching the East Fork Creek.

Considerable logging and road building has occurred on private lands in the area with many logging roads that cross the terrain and creeks. The potential for high volumes of erosion are good, but without the connection of stream flow to the main channel of East Fork Creek much of this sand material does not reach the salmon beds below.

Rock Creek

Rock Creek contains 40% of the stream flow above Reach 3 of East Fork Williams Creek. Water temperatures are low (9.5 C) with good shading on banks. The channel is constrained by high banks of gravel and small terraces. Land use is rural residential and riparian vegetation is mixed hardwood and conifers. The gradient is moderate averaging 6%, with riffles and scour being dominant habitat type. Percentage of fine sediment is moderate at 24% and volume of large woody debris is low at the lower reaches and high in the upper reaches.

Rock Creek drains a large subwatershed that encompasses the east flank of Grayback Mountain. Springs feed the headwaters that issue out of the glades at the 5000’ level and help maintain the year around flow of fresh, cool and clear water. The granitic rocks that underlie enormous landslide and alluvial fan deposits dominate the surface geology of this area. Erosion of granitic rocks produces fine and coarse sand along with cobbles and boulders that deposit in the creek beds.

ODFW habitat survey crews have never surveyed Rock Creek and the information we have on the habitat conditions is included in this report. Rock Creek is one of the highest potential tributaries for habitat and habitat improvement in the East Fork subwatershed. Few fish are sighted in this creek due to various factors including the lack of channel complexity, large wood structures or debris jams, and low amounts of pool structure.

Spring Creek

Spring Creek is a small tributary to East Fork Williams Creek that flows near Rock Creek. It drains a small subwatershed on the east side of Grayback Mountain that traverses through rural residential and forestlands. The vegetation in the lower reaches is grass and mixed young hardwoods, but when it crosses beneath East Fork Road it flows through mixed hardwood and conifer forest. The mouth of the creek enters the East Fork of Williams Creek on a steep bank that cascades into the mainstem with a 3-foot drop.

Reach 1 extends from the confluence to the East Fork Road where it traverses through young forestlands and deeply dissected pastureland where scour and undercutting are actively eroding the sandy soil. Spring Creek flows nine months out of the year in this reach with any upland flow entering the groundwater system.

Reach 2 from East Fork Road to the crossing of Spring Creek Drive is rural residential and farmland where the landowners are actively restoring the habitat by placing wood in the stream, planting trees and vegetation, and protecting the riparian zones with fencing. Sand deposition on the floodplain, wood debris jams, and shady riparian zones improve the habitat where water flows much of the year. The gradients here are moderate (8%) with mix of hardwood and conifers.

Reach 3 continues from Spring Creek Drive to the headwaters and contains pool riffle habitat with a continuous flow of water. The banks are actively eroding and the channel is deep with high terraces. Gradient is moderate (7-10%) with a mix of hardwood and conifers. Large wood debris is high and habitat is good for such a small steam. Active erosion of the granitic soils in this area supply enormous amounts of coarse and fine sand to the gravels, but with active erosion and movement, the substrate is loose and useful for fish habitat.

No ODFW habitat surveys have been conducted on Spring Creek and more information will be needed to develop greater understanding of the potential for fish habitat.

Fish Passage Barriers in the East Fork

A complete inventory of the passage barriers is not included in this report, but several are noted here. Much of this information is derived from the Williams Creek Watershed Assessment, although several of these barriers have been looked at in more detail during the duration of this study and have been included in future projects that address these and other passage concerns. The map below includes an overview of the barriers in the East Fork subwatershed.

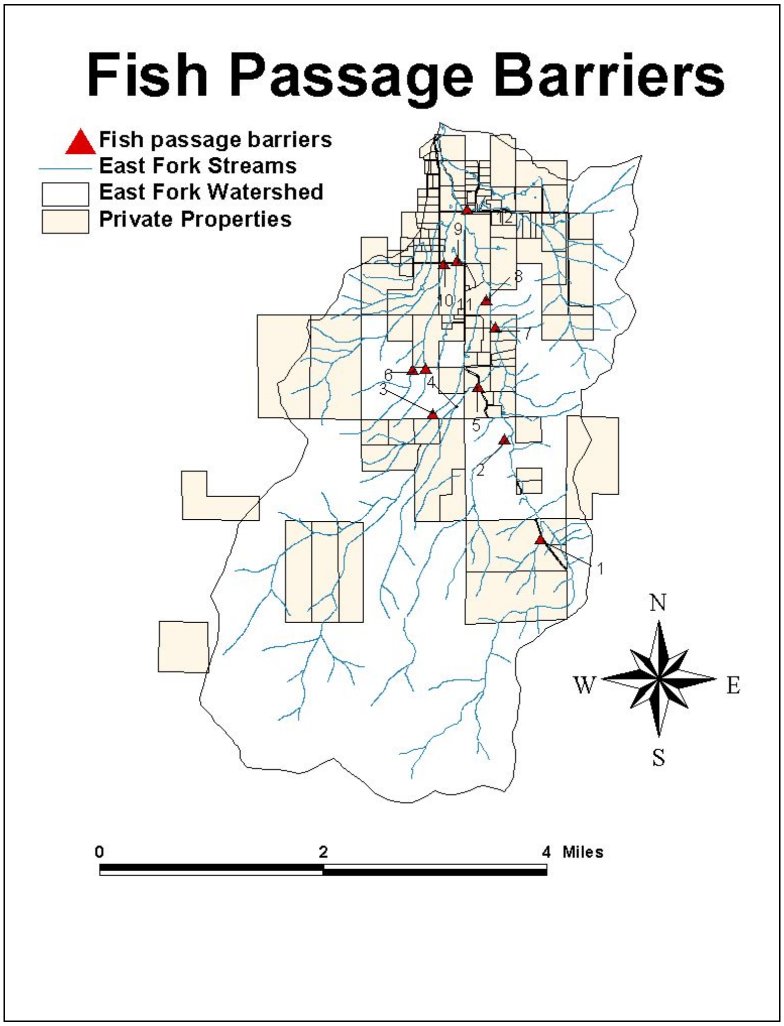


Fig 65 Fish Passage Barriers

1) **Undersized culvert crossing East Fork Road on small tributary, Jones Creek**
   a) Considered for Title II project with BLM to replace
   b) Reduce 3 foot drop and improve fish passage
   c) Targeted species- steelhead, cutthroat trout
2) **Undersized culvert crossing East Fork Road on Clapboard Creek**
   a) Consider for Title II project with BLM, County for replacement
   b) Increase size and improve outflow conditions for fish passage
   c) Targeted species- steelhead, cutthroat trout
3) **Ditch crossing and small pushup dam on Spring Creek to transfer water across streambed**
   a) Rock Creek Ditch carries water form Rock Creek across Spring Creek to lower ponds and irrigation fields
   b) Push up dam on Spring Creek impacts fish passage and restoration
   c) Target species- steelhead, cutthroat

4) **Stream habitat surveys needed for:**
   a) Rock Creek
   b) Clapboard Creek
   c) Spring Creek
   d) Target species steelhead, cutthroat trout
5) **Culvert crossing for Rock Creek beneath East Fork Road**
   a) Gradient higher than creek, needs baffling or restrictors to improve bottom of culvert for fish passage and gravel retention structure
   b) Size of culvert sufficient
   c) Target species- steelhead, cutthroat
6) **Clapboard Gulch Road two cross drain culverts**
   a) Fish barriers, large drop, high gradient
   b) Small flow, unknown fish species usage
7) **Instream dam construction- East Fork Williams Creek River Mile 3**
   a) Fish passage barrier- 6 foot high seasonal dam
   b) Juvenile passage into cooler waters upstream during summer completely stopped from May – October
   c) Target species- coho, chinook, steelhead, cutthroat, Pacific lamprey
8) **Waterfall and three foot drop at mouth of Spring Creek into East Fork Creek**
   a) Old fencing at mouth of creek
   b) Restricted passage to upper Spring Creek
   c) Target species- steelhead, cutthroat trout
9) **Culverts that drain the surface flow of upper cattle grazing field**
   a) Undersized culverts, flooding potential
   b) High turbidity and manure content of surface waters
10) **Clapboard Creek culvert beneath East Fork Road**
   a) Adequate size, but grade to high with one foot drop at end
   b) Needs baffling to simulate streambed and gravel layer
   c) Considered for Title II project with County to be replaced with bottomless arch
   d) Target species- steelhead, cutthroat
11) **Pushup dam-5 feet high Clapboard Creek river mile 0.7**
   a) Eroded and down cut streambed forces landowners to build large pushup dam to restore flow to irrigation ditch
   b) Needs restoration design to deposit gravel and build up streambed to allow irrigator to get water easily
   c) Target species- coho, chinook, steelhead, cutthroat trout, Pacific lamprey
12) **Panther Creek ditched and controlled**
   a) Lower creek is captured by instream pond with control outflow
   b) Pond has overflowed and broken dam structure
   c) Makeshift outflow ditch poorly designed to stop erosion and side cast into ditch
   d) No fish passage or reported presence in Panther Creek

Conclusions

Studies like this one are useful in determining the erosion potential of specific areas with hopes of finding solutions and proposing work plans that address those problems. This study attempted to increase understanding of those processes and to locate non-point sediment sources. Along with looking for sediment sources and recording the amounts of sediment, we were collecting information to help understand the gravels and sediment of the streams in the region. This information will be helpful in developing restoration procedures as we look into improving the habitat of the East Fork.

Priority List of Erosion Concerns in the East Fork subwatershed

1) **Spring Creek Driveway, including BLM, and landowners**
    a. Gullies alongside road where old logging roads concentrate runoff
    b. Culvert restrictions on Spring Creek
2) **Erosion on End of East Fork Road**
    a. Road gully erosion to gravel quarry
    b. Extreme road erosion at end of road beyond the gate where gullies and ditch systems carry sediment to streams
    c. Marlin Turley's driveway
3) **Grazing field contributes surface erosion and high nitrate runoff**
    a. Surface erosion during rainy season
    b. Bank erosion at Clapboard Creek from cattle in riparian zone
4) **Grazing fields on East Fork Williams Creek Reach 3**
    a. Surface erosion off grazing lands during rainy season
    b. Bank erosion along East Fork Williams Creek from cattle in riparian zone
5) **Homestead Road**
    a. Pond erosion from flooding
    b. Outflow channel erosion
6) **Cherry Gulch Road**
    a. Gully erosion
    b. Ditch erosion
    c. Side cast erosion
7) **Cherokee Road- puddles and overflow**
8) **Roadside ditches throughout the watershed maintained by Josephine County**
    a. Fall cleaning loosens soil and removes vegetation causing excessive erosion during winter rains
    b. Undersized culverts plug and overflow roads creating erosion and backup of drains

The possibility of repairing these and other sites lies in the cooperation of landowners and an understanding of the possibility for sediment input. Reducing sediment erosion is important for fish, streams, and water quality. Sediment that erodes into streams can bring with it bacteria, higher temperatures, and chemical runoff from roads. By minimizing the sediment load, we can reduce the associated contamination of water used by anadromous fish and other life forms.

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