Water Quality Restoration Plan
Rogue River Basin
Lower Rogue River Sub Basin
Grave Creek

Bureau of Land Management (BLM), Medford District Office

2001

Grave Creek at a Glance

Hydrologic Unit Code (identification #)	1710031003
Watershed area/ownership	Total: 104,371 acres BLM Ownership: 50,273 acres (48%) Non-federal Ownership: 54,098 acres (52%)
Stream Miles assessed	Total: 194.6 miles BLM Ownership: 65.4 miles (34%) Non-Federal Ownership: 129.2 miles (66%)
303(d) listed parameter	Temperature
Key Resources and uses	Salmonid, domestic, agricultural, aesthetic
Known Impacts (human)	Timber harvest, roads, agriculture, mining, water withdrawals, residential, urban and transportation infrastructures
Natural Factors	Varied geology, shallow soils, low water holding capacity resulting in low summer flows, East to West orientation

Statement of Purpose

This water quality restoration plan (WQRP) has been prepared to meet the requirements of Section 303d of the 1972 Federal Clean Water Act.

This plan covers land managed by the Bureau of Land Management (BLM) within the Grave Creek Watershed, from the headwaters to the mouth at the confluence of Grave Creek and the Rogue River.

The Oregon Department of Environmental Quality (DEQ) has lead responsibility for creating Total Maximum Daily Loads (TMDLs) and Water Quality Management Plans (WQMP) to address water quality impaired streams for Oregon. This WQRP will be provided to the DEQ for incorporation into an overall WQMP for the Grave Creek watershed. DEQ has a comprehensive public involvement strategy, which includes informational sessions, mailings, and public hearings. The BLM will provide support and participate in this public outreach.

Grave Creek Water Quality Restoration Plan 2001

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Grave Creek Watershed Overview

Morphology

Elevation Range	690 ft.-5,265 ft. (mouth of Grave Creek to King Mountain)
Drainage pattern	dendritic
Orientation	east to west
Total stream miles	1,096; BLM- 477 (43%)
Watershed size	104,371 acres; BLM 50,273 (48%)
Transient Snow Zone	38,731 acres (Land above 2,500 ft.)
Geographic Province	Klamath Mountains

Meteorology

Annual precipitation	45 to 60 inches (highest amounts near King Mountain)
Type	Rain and snow
Timing	80% occurring October thru May
Temperature	0-100 degrees F

Surface Water

Minimum flow	1.0 cfs during several summers (USGS gaging station near Placer (discontinued))
Maximum peak daily flow (Grave Creek near Placer)	8000 cfs Oct. 29, 1950
Reservoirs	numerous small private ponds (2 BLM ponds (Burma Pond, Dutch Herman)) numerous pump chances
Water quality limited stream miles	81.3 (303d listed for temperature above 64 degrees F.) BLM 27.5 (34%)

Groundwater

Aquifers	No regional aquifers, local subsurface, mainly unconfined, aquifers
Springs	numerous springs (not mapped). No data available at this time.

Geology

Formation	Galice (formed of metamorphic sedimentary and ultramafic rock)
Soils	Shallow depth, many different series and complexes. Basin wide, very low water holding capacity, relatively infertile.
Vegetation	Primarily mixed confer and hardwoods. Vegetative communities differ by slope, aspect, elevation and soil.

Human Influence

Roads	808 miles
Roads within one tree length of streams (166 ft)	314 miles BLM 121 (38%)
*Roads within one tree length of fish streams (166ft)	57 miles BLM 16 (28%)

Road density	5.0 mi/mi²
Timber production	Timber harvest on federal and non federal lands
Agriculture	gardens, livestock grazing and crops
Mining	Placer claims on most tributaries and Grave Creek. Several hard rock mines. (Grave Creek WA. Appendix I)
Utility corridors	natural gas line, fiber optics line, electric power line, railroad
Communications sites	King Mtn., Sexton Mtn., Northwest of I-5 on Stage Hill
Communities	Wolf Creek/Sunny Valley Approximately 1250 residents in Grave Creek (Josephine Cty Planning dept.)

Biological

Candidate(c), threatened (t), species Listed under the Endangered Species Act	Spotted owl (t) 18 active sites marbled murrelet (t)(none found) steelhead (c) coho salmon (t)

*

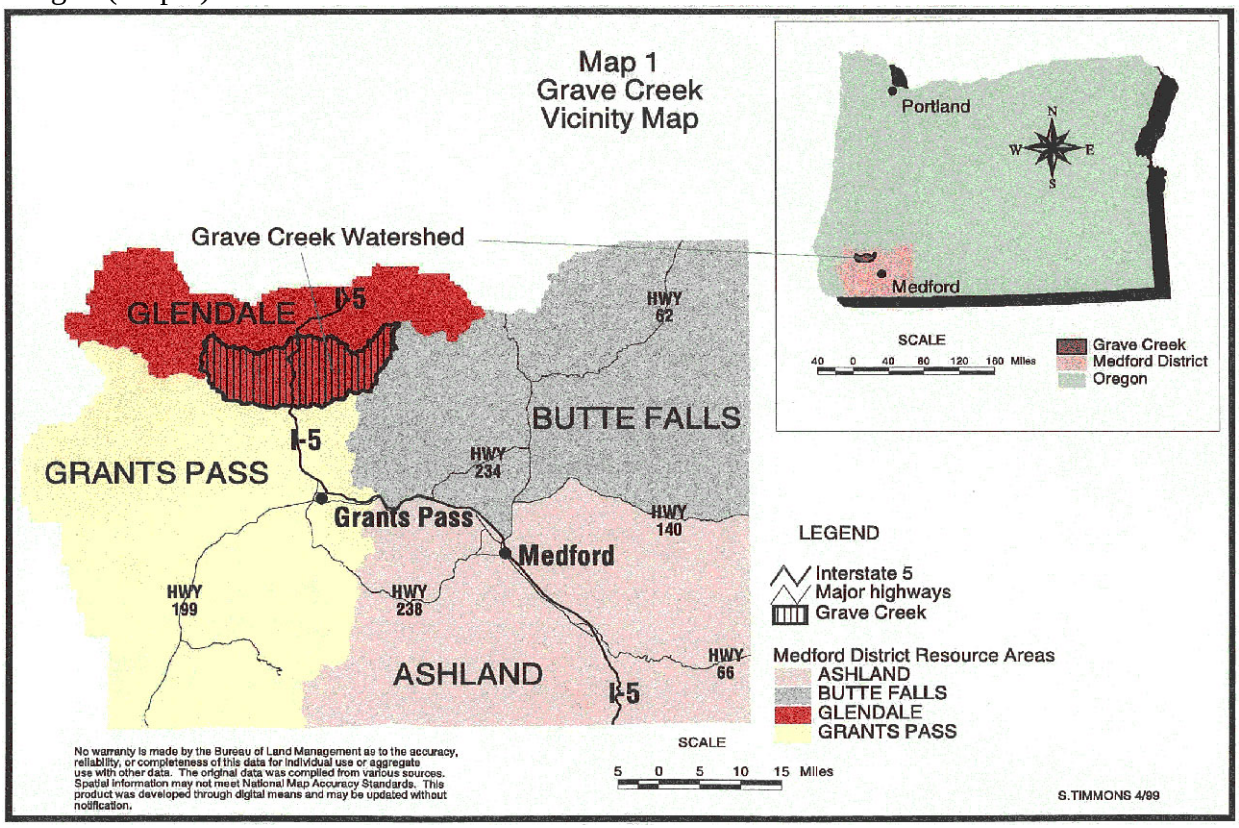
Footnote: Fish streams were identified from records of surveys from ODFW and BLM. Distribution information for Cutthroat trout was use since it has the largest distribution within the watershed.

Introduction

This document is prepared to comply with the Environmental Protection Agency requirements. This requires a management plan to be written for watersheds that have streams listed for not meeting water quality standards for beneficial uses of the waters.

There is a question regarding whether lands under federal management activities are providing the coolest water possible to downstream uses. This document will detail what extent water is being warmed and what factors are contributing to that warming as well as outline efforts to protect and enhance water quality on federal lands in this watershed.

Grave Creek is a 104,371 acre watershed that is a tributary to the Rogue River in Southwest Oregon (Map 1).



The Grave Creek Watershed is a fifth-field watershed in the Klamath Mountains province, located in southwest Oregon, approximately 20 miles north of Grants Pass (Map 1). BLM administers about 50,273 acres (48 percent) of the watershed. The towns of Wolf Creek and Sunny Valley are the major communities in the watershed. There are residential areas located along Grave Creek, Coyote Creek and Wolf Creek.

Major tributaries include Rueben Creek, Poorman Creek, Wolf Creek, and Rock Creek. The unit has been divided into seven sixth-field watersheds (table 1) and 90 seventh-field watersheds ranging from about 450 acres to about 6,000 acres. These include a series of small unnamed creeks which drain directly into Grave Creek. Annual precipitation in the watershed averages about 45 inches. Extended summer drought is common.

Table 1. Acres of BLM Ownership by Sixth-field watersheds.

Drainage	**Total**	**BLM**	**Percent**
GV01 Upper Grave	19,890	10,553	53
GV02 Placer	12,786	6,183	48
GV03 Sunny Valley	19,563	6,038	31
GV04 Upper Wolf	11,163	5,588	50
GV05 Coyote	9,843	5,097	52
GV06 Lower Wolf	7,325	2,806	38
GV07 Lower Grave	23,802	14,005	59

Soils in the unit are derived from metasedimentary and metavolcanic rock types. Soils associated with metasedimentary rocks tend to be deeper and have more nutrients available. Soils developed from metavolcanic rock types tend to be shallow and have less soil nutrients and soil development than the sedimentary. Organic matter plays an increasing role in the productivity of the metavolcanic sites. Some of the unit is dominated by serpentine-derived soils which are low in calcium and high in magnesium and other minerals which produce unique vegetative communities, and preclude many plant species which are adapted to calcium-based soils (including Douglas-fir).

The entire watershed has federal lands intermingled with non-federal lands in a “checkerboard” pattern characteristic of much of the Oregon and California (O & C) railroad lands of Western Oregon (Table 2, Map 2).

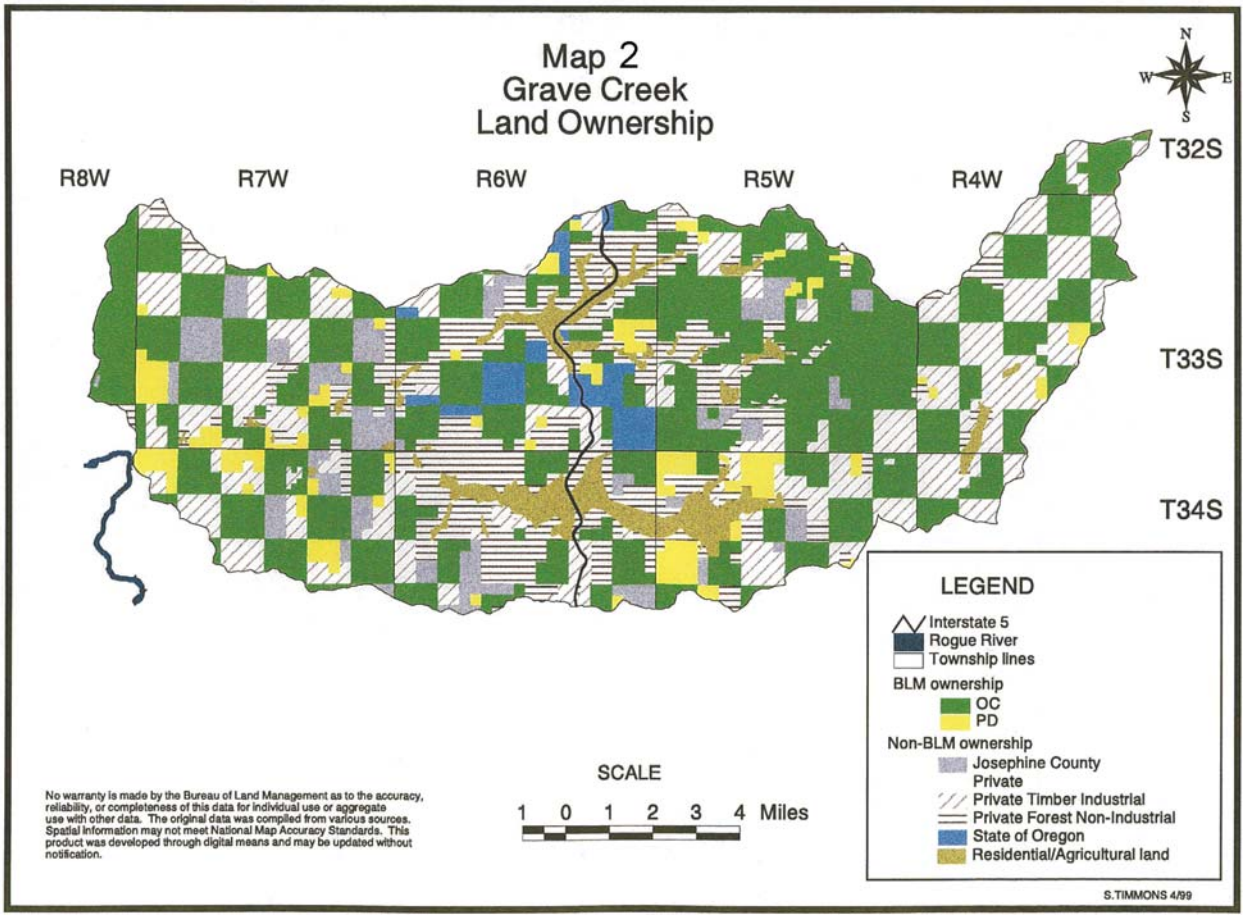


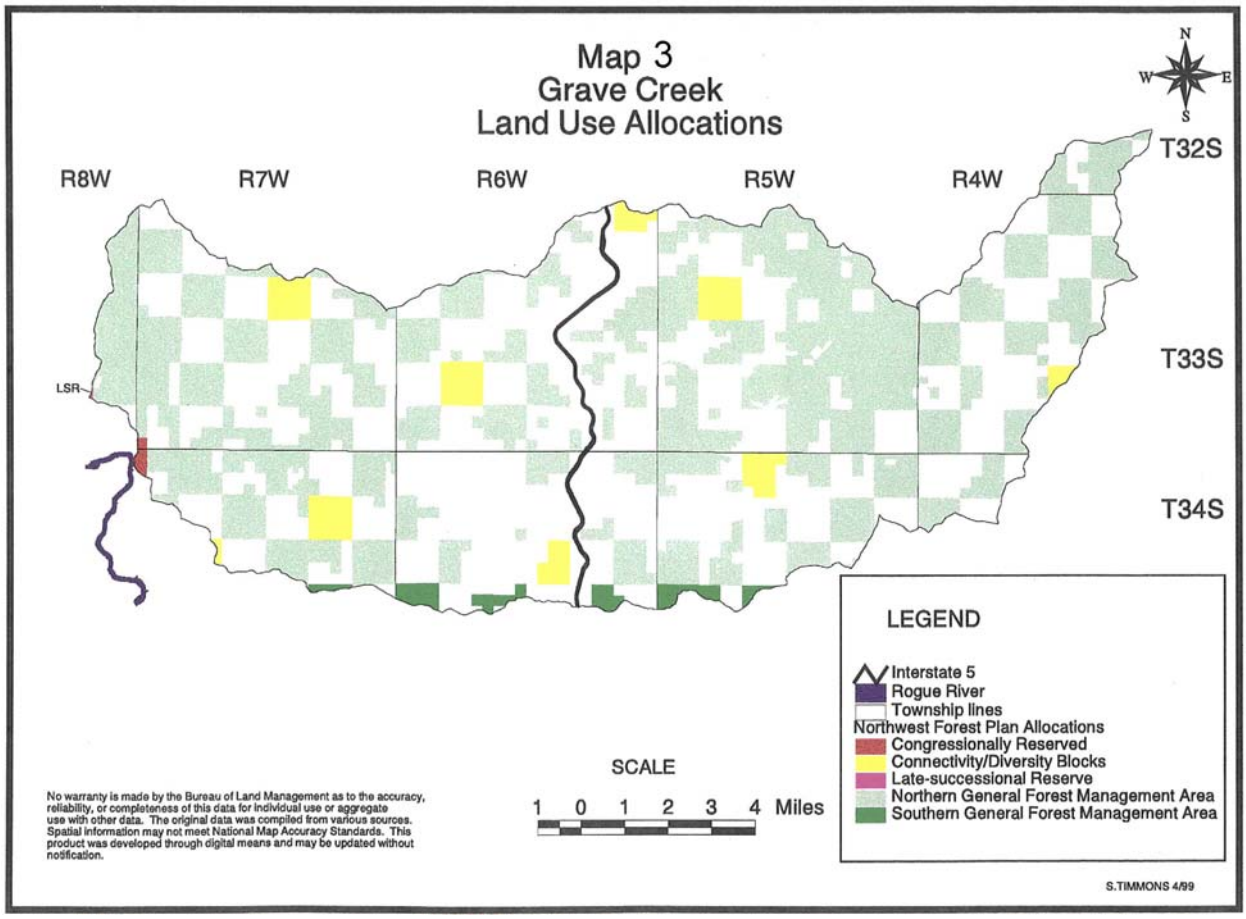
Table 2. Land Ownership – Grave Creek Watershed

Ownership	**Acres**	% of Grave Creek Watershed
Medford BLM	50,273	48
State of Oregon	2,828	3
Josephine County	7,001	7
Private Timber Industry	22,227	21
Private Forest: Non-industry	16,628	16
Agricultural/Residential	5,414	5
Total	**104,371**	**100**

Most streams have a history of placer mining, which is ongoing. Riparian vegetation has been destroyed as a result of mining and past logging practices. The channels are unstable at this point and will probably continue to be unstable until riparian vegetation is reestablished and the uplands become revegetated.

Land Use Allocations

The Medford District Resource Management Plan (RMP) designated several land use allocations for federal lands within the watershed. These allocations provide overall management direction and varying levels of resource protection. (Map 3)



Late-successional reserves (LSRs) are areas designated in the RMP where the major management objective is to maintain or promote late-successional and old growth habitat. In this watershed there is only a small part of a large LSR which is located to the west, and 15 spotted owl core areas of about 100-acres each.

Connectivity/Diversity blocks are generally square mile sections in which at least 25-30 percent of each block will be maintained in late-successional conditions. They are designed to promote movement of species associated with late-successional habitat across the landscape and add richness and diversity to the land outside LSRs. There are portions of nine of these Connectivity/Diversity blocks in the watershed.

The General Forest Management Area (GFMA) is the allocation where timber harvest is a primary objective. Most of the Grave Creek Watershed falls into the northern GFMA, where the RMP calls for retaining at least 6-8 large trees per acre in regeneration harvests. There is a small part of the watershed which has been designated as southern GFMA. There is a higher level of retention called for under this regime.

Table 3 shows the approximate acreages of the above mentioned allocations.

Table 3. Federal Land Use Allocations within the Grave Creek Watershed.

Land Use Allocation	**Acres**	**% of federal land**
Late-successional Reserves/1	1,798	4
Area of Critical Environmental Concern/Recreation Areas	227	Less than 1
Connectivity/Diversity Blocks	3,850	8
Northern General Forest Management Area/2	43,131	86
Southern General Forest Management Area/2	1.208	2
Total	**50,214**	**100**

/1 Late-successional reserves include portions of large LSR and 100 acre spotted owl core areas.
/2 General forest management area includes acres of riparian zones that are withdrawn from entry.

Within the General Forest Management Area lands there are 8,700 acres which have been withdrawn from intensive timber harvest. The majority of these acres were withdrawn due to rocky soils which preclude successful replanting. In addition to these land allocations, there are also several other important designations that occur within the watershed. A portion of the headwaters of Grave Creek was designated as 'Deferrred Watersheds' in the RMP. This means that programmed timber harvest is not allowed for the first decade of the plan, i.e., until 2004. This resulted from cumulative effects analysis indicated one or more factors were contributing to increasing hydrologic risk in those watersheds.

BLM manages approximately 48 percent of the watershed, only 34 percent of the current water quality limited stream miles within this watershed occur on BLM. Most of the streams are listed from the mouth to the headwaters, but in many cases the monitoring site was at the mouth. Temperature is listed as being the limiting factor for the beneficial use of waters of Grave Creek. There are several conditions within the watershed that would explain the higher percentage of water quality limited miles on non-federal lands. BLM lands are higher in elevation, and contain many of the 1st through 3rd order streams. These streams are steep and narrow and are fed by ground water sources which are naturally cool. Due to the small width of these channels, overhanging brush and smaller trees have been observed to provide adequate shading. Lower elevation 4th through 6th order streams have lower gradients and are wider. These streams are primarily on non-federal land. Larger trees are required to adequately shade these streams, but due to logging practices and other agricultural pursuits, such as grazing, most of the riparian vegetation and width of riparian zones do not provide the shading. The east/west orientation of the streams also expose the waters to greater solar heating during the day.

Geology and soils of this watershed do not allow for a great degree of water storage. Uplands are steep and soils profiles are relatively shallow. Recharge of streams by ground water is very limited during summer months.

Element 1: Condition Assessment and Problem Description

APPLICABLE WATER QUALITY STANDARDS

Beneficial Uses

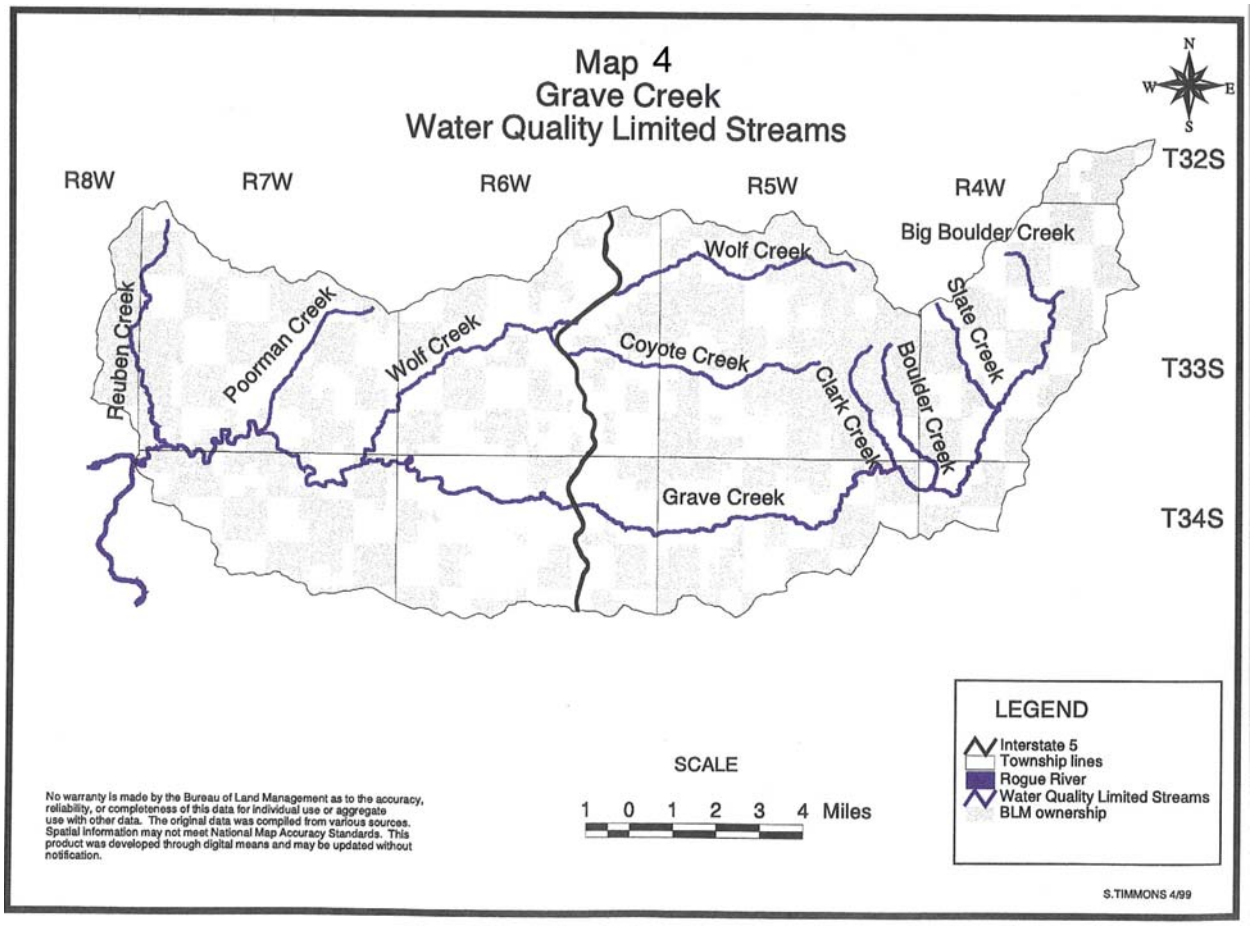
Oregon Administration Rules (OAR 340–41–322) lists the designated beneficial uses for Middle Rogue waters. The specific beneficial uses occurring in the Grave Creek watershed are presented in below (Table 4).

Table 4. Beneficial uses in the Grave Creek Watershed

Beneficial Use		***Beneficial Use***	
Public Domestic Water Supply	✓	Anadromous Fish Passage	✓
Private Domestic Water Supply	✓	Salmonid Fish Spawning	✓
Industrial Water Supply	✓	Salmonid Fish Rearing	✓
Irrigation	✓	Resident Fish and Aquatic Life	✓
Livestock Watering	✓	Wildlife and Hunting	✓
Boating	✓	Fishing	✓
Aesthetic Quality	✓	Water Contact Recreation	✓
Commercial Navigation & Trans.		Hydro Power	✓

The Oregon Environmental Quality Commission has adopted numeric and narrative water quality standards to protect designated *beneficial use*s. In practice water quality standards have been set at a level to protect the most sensitive uses. Seasonal standards may be applied for uses that do not occur year round. Cold-water aquatic life such as salmon and trout are the most sensitive *beneficial uses* in the Grave Creek watershed.

The Clean Water Act of 1972, as amended by the Water Quality Act of 1987, provides direction for designation of beneficial uses and limits pollutants (section 303d). DEQ is responsible for designating streams that fail to meet established water quality criteria for one or more beneficial uses. These designated streams are often referred to as the 303d list. Water quality monitoring by several agencies throughout Grave Creek has resulted in 303d listings for 81.3 miles of streams that have failed to meet established criteria for one or more beneficial uses. See Table 5 (map 4).



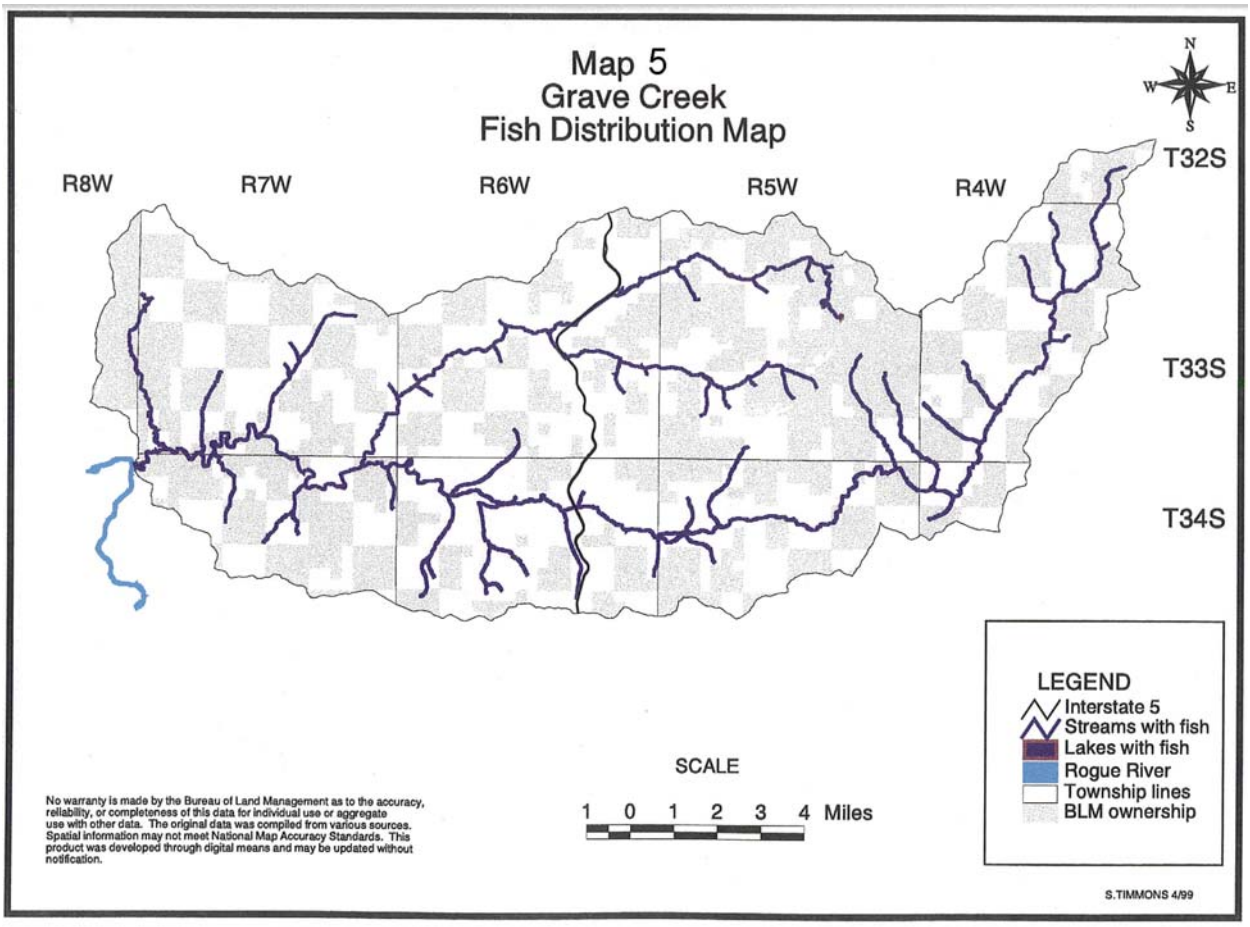
Grave Creek is of moderate importance as a fisheries stream as determined by the Glendale Resource Area fisheries biologist. Chinook and coho salmon and summer and winter steelhead are known to spawn in the creek during higher flow periods. Cutthroat trout are also present in most of the tributaries and the mainstem. Mining, timber harvest, agriculture and rural residential development all contribute to less than optimal conditions for fish habitat within this watershed.

Table 5. Water quality limited streams in the Grave Creek watershed.

Stream	Water Quality Parameter	Approximate Miles
Boulder Creek	Temperature	1.9
Big Boulder Creek	Temperature	4.0
Slate Creek	Temperature	3.5
Clark Creek	Temperature	3.5
Coyote Creek	Temperature	7.3
Wolf Creek	Temperature	15.3
Grave Creek	Temperature	34.4
Poorman Creek	Temperature	4.5
Reuben Creek	Temperature	6.9

Note: The above streams were listed from mouth to headwaters, except for Grave Creek above Last Chance Creek.

Streams listed for temperature do not meet the criteria (the rolling 7 day average of the daily maximum temperature) for anadromous fish rearing (temperature exceeds 64 degrees). This also applies to the resident fish and other aquatic life, particularly resident cutthroat, which are present in these streams. (Map 5 *shows fish distribution.)*



Stream temperatures exceed the standard in the Grave Creek Watershed during some periods between June and September for five years of record (1995-2000). Stream temperature data is presented in Table 6. Data from 1994 were not used for calculating the 7-day high for the period of record since that period was during a drought.
Section 303(d)(1) of the Clean Water Act requires that Total Maximum Daily Load (TMDL) "be established at a level necessary to implement the applicable water quality standard with seasonal variations." Both stream temperature and flow vary seasonally and from year to year. Water temperatures are cool during the winter months, and only exceed the State standard between the summer months of June and September when stream flows are lowest and solar radiation is the highest. Table 6 lists the site locations where BLM monitoring has occurred.

Table: 6 Temperature Monitoring Locations and years monitored

Grave Creek Stream Temperature Monitoring Locations
BLM – Glendale Resource Area
And years monitored

Site ID	Site Location Description	High 7 day temp for period of record	1994	1995	1996	1997	1998	1999	2000
BBLD	Big Boulder Creek @ confluence with Grave Creek	70.6		X	X	X	X		
BBD2	Big Boulder Creek (#2)	67.2					X	X	X
BBD3	Big Boulder Creek @ top of road 33-4-15.1 (#3)	62.4					X	X	X
BBD4	Big Boulder Creek on tributary below road 33-4-15.1 & 33-4-9.1 junction	57.5						X	X
BBD5	Big Boulder Creek below road 33-4-15.1 & 33-4-9.1 junction	58.3						X	X
BOLD	Boulder Creek @ confluence with Grave Creek	67.8			X	X	X	X	
BDR2	Boulder Creek (#2) @ 2860 ft	57.3					X	X	
BDR3	Boulder Creek (#3) @ 3320 ft, above road 34-4-5 crossing	60.3					X	X	
BDR4	Boulder Creek (#4) road 34-4-5 in SW SW SW corner of 33S sec 31	73.6						X	

Site ID	Site Location Description	High 7 day temp for period of record	1994	1995	1996	1997	1998	1999	2000
BUTG	Butte Creek near confluence with Grave Creek	63.4				X			
CLKG	Clark Creek @ confluence with Grave Creek	64.8		X	X	X			
	Coyote Creek @ Interstate 5	NA	X						
COYT	Coyote Creek @ road 33-5-21.1 near 33S 5W 22/27 border	63.4						X	X
GRVP	Grave Creek @ Pease Ranch below Baker Creek above Ditch Creek Road	80.9			X	X	X	X	
GRV2	Grave Creek at Pleasant Creek road (#2)	69.9					X	X	X
GRV3	Grave Creek @ Last Chance Creek above Confluence	65.0					X	X	X
GRV4	Grave Creek @ road 33-4-11 (to West Evans Creek)	64.6					X	X	X
GRVU	Grave Creek above Last Chance Creek, rd 33-4-33	64.1		X	X	X	X	X	X
GRAV	Grave Creek @ confluence with Rogue River	79.2		X	X	X			
GRVW	Grave Creek above Wolf Creek confluence	78.5	X	X	X				
GVSV	Grave Creek below confluence with Salmon Creek @ Interstate 5	80.5			X	X			
GRVA	Grave Creek ambient air temp @ road 34-5-2.1 in 34S 4W sec 2	NA						X	X
LAST	Last Chance Creek @ confluence with Grave Creek	64.4		X	X	X			
POOR	Poorman Creek @ confluence with Grave Creek	68.7	X	X	X	X	X		

Site ID	Site Location Description	High 7 day temp for period of record	1994	1995	1996	1997	1998	1999	2000
PRM2	Poorman Creek (#2) @ 1200 ft	63.8					X	X	X
PRM3	Poorman Creek @ sec 14/23 line	63.2							X
	Reuben Creek sec 30	NA	X						
RUBL	Reuben Creek @ confluence with Grave Creek	70.5		X	X	X	X		
REU2	Reuben Creek (#2) near section 30/31 line	70.5					X		
REU3	Reuben Creek (#3) @ 1610 ft	70.6					X		
REU4	Reuben Creek (#4) @ 1780 ft at sec 13/18 line	62.4					X		
ROKG	Rock Creek above confluence with Grave Creek	63.3	X	X	X	X			
SLTG	Slate Creek @ confluence with Grave Creek	65.6		X	X	X			
SLT1	Slate Creek @ 2690 ft	64.3					X	X	X
SLT2	Slate Creek @ 3260 ft	61.8					X	X	X
SLT3	Slate Creek @ 33S 4W 20/29 section border	61.8						X	X
WOLF	Wolf Creek @ confluence with Grave Creek	81.4	X	X	X	X			
SPEK	Wolf Creek above Hole in the Ground Creek, @ lower BLM line sec 9	66.2	X	X	X	X	X	X	
SECG	Secesh Gulch (Wolf Creek) @ road 33-5-10 above culvert	63.6					X	X	X
DTH1	Dutch Herman Pond outlet	75.5							X
DTH2	Dutch Herman Pond inlet	54.8							X
BRMA	Burma Pond outlet above 33-5-10 rd	60.3							X

Temperature

Maximum summer water temperatures in Grave Creek downstream of Salmon Creek have probably always exceeded the current DEQ standard because its width, low gradient, and east/west orientation create a condition that allows for maximum absorptions of solar radiation throughout the day. In addition, bedrock, which is a major component of the substrate, absorbs heat during the day and radiates it to the stream at night. But natural factors by themselves do not appear to be significantly limiting stream productivity. Rather, habitat problems are the direct result of human activities.

There are many factors that may contribute to listing these streams as water quality limited for temperature. In many cases there is more than one factor operating on an individual stream. The important factors are:

- Several of the tributary streams have segments that have no surface flow during summer periods;
- Low summer discharge (less than 1.0 cfs, from USGS gage records at Placer, discontinued 1955) gage was located about 3 miles upstream of I-5
- Riparian cover is absent or reduced due to
    - Agricultural practices are adjacent to streams;
    - Past salvage logging has occurred within riparian zones;
    - Logging has removed shade over streams;
- Wide streams and stream orientation allow for direct solar heating;
- Wide, shallow gravel/bedrock channel;
- Relatively low gradient channels result in slower velocities therefore longer water retention time; and
- High percentage of roads in or adjacent to riparian zones.
- Many of the larger tributaries to Grave Creek are on non-federal land
- (State regulations regarding management activities in riparian areas are less restrictive than those of the Northwest Forest Plan and BLM's RMP);
- Instream diversions for irrigation, pushup dams and pumping;
- Gravel operations;
- Placer mining.

Stream channel widths on order 1–order 4 tributary headwater streams are narrow enough for stream-side vegetation to provide adequate shade to meet TMDL target. The stream side vegetation consists of brush, hardwood and conifer species. However, canopy closure over many fish-bearing streams order 5 and above is inadequate to maintain water temperatures when riparian zones are subjected to timber harvest, land clearing and water diversion. Water diversions in Grave Creek and nearly all its tributaries limits the amount of water available for fish and other aquatic species.

Stream Flow

The lowest 7-day low flows for the historic gage at Grave Creek near Placer (located about 3 miles upstream of I-5) for the period of record from 1913 to 1955 were recorded at 0.08 cfs. (see map 5). Low flows generally reflect annual precipitation levels with higher low flows in wetter years and lower summer flows in drier years. Variation in low flow from year to year is typical for this stream system. Historic data for the gaging station is available at web site address: http://www.wrd.state.or.us/cgi-bin/choose-gage.pl Tablized data is not included in this document due to volume of data on that web site.

Disturbance of the riparian area and stream channel from wildfires and floods can also lead to increases in summer stream temperatures. These disturbances are considered part of the natural processes, and are expected change agents considered in the Aquatic Conservation Strategy (FEMAT, 1993). Grave Creek Watershed has a frequent fire history with return intervals averaging 15 to 30 years on ponderosa pine dominated areas to over fifty years in more moist aspects and higher elevations (Grave Creek Watershed Analysis). Recovery of riparian vegetation in areas disturbed by fire and flood will most likely be offset by future events. The gain and loss of riparian vegetation by natural processes will fluctuate within the range of natural variability for this watershed and is outside the scope of this assessment. This Water Quality Restoration Plan (WQRP) focuses on areas where BLM management activities may have exacerbated natural disturbance and may have affected water quality and quantity.

Factors Affecting Stream Temperature

There are many interrelationships between riparian /floodplain vegetation, summer stream temperatures, sediment storage and routing, etc., and the complexity of habitats in the Grave Creek Watershed. It should be mentioned here that large mature conifers or hardwoods would likely continue to be rare on private lands, particularly agricultural lands, within the watershed unless major changes in land uses or land use regulations occur. This translates to a continuance of unrecovered conditions on private lands, largely due to agricultural activities. These low gradient areas have high biological potential for salmon as “grubstake habitat” (Frissell 1993). In addition, recovery of large tree components on upstream public lands will not greatly benefit these habitats on private lands if these large tree lengths are not allowed to remain in the stream channel on private lands. An exception will be the anticipated decrease in sediment, fine and coarse. Less sediment production upslope and upstream may benefit these downstream aquatic and riparian habitats on private lands. Given these conditions, most high-quality salmonid habitat will be located on public lands in federal reaches or headwater streams. These upstream areas will benefit certain species of salmonids, e.g., trout and steelhead, more than others, e.g., coho and chinook.

The Grave Creek Water Quality Restoration Plan addresses stream shade, changes in channel form, and flow as the three management factors contributing to water temperature problems.

Table 7 lists some historic and present condition information about elements that may affect temperature on Grave Creek.

Table 7. Historic and current conditions of selected elements.

Riparian Vegetation	
Historical Condition Present Condition	• Late seral vegetation dominant prior to 1850's when mining initiated riparian clearing. • Early to mid seral vegetation dominant in low lands mainly resulting from mining and agriculture
Forest Health & Productivity	
Historical Condition Present Condition	• Frequent, low intensity fires maintained low fuel levels and open under-story • Fire exclusion resulting in high fuels • Much of harvested lands are densely planted and overstocked (increased competition) • Soil compaction due to tractor harvest
Roads	
Historic Condition Present Condition	• Few roads before industrial timber harvesting began in the early 1950's • High road density (5.0 mi/mi^2) • Road placement often occurs in riparian areas • High number of stream crossings • Stream network extension (due to ditch lines) increases frequency of 5 and 10 year flood regimes
Flow Regime	
Historic Condition Present Condition	Low flows of less than 1 cfs have been recorded by USGS gaging station near Placer (station discontinued) Little other information exists on flows for this basin Portions of Wolf Creek and Coyote Creek are dry in summer time, mainly resulting from consumptive use. Portions of Grave Creek have been channelized (I-5)

Temperature Factor 1. - Stream Shade

Without riparian shade trees, most incoming solar energy would be available to heat the stream. Riparian vegetation can effectively reduce the total daily solar heat load. The stream shade assessment determined where the stream shade has been reduced by management activities and placer mining and calculated the resulting increase in total daily solar heat loading. To determine where shade problems exist and the magnitude of the problem, the stream network of Grave Creek was broken down into sections consisting of the main stem and its tributaries.

For the listed parameter ,i.e., stream temperature, the beneficial uses affected are: Resident Fish and Aquatic Life and Salmonid Fish Spawning and Rearing. The state standard for Grave Creek Watershed requires that the seven (7) day moving average of the daily maximum shall not exceed 64 degrees Fahrenheit. A stream is listed as Water Quality Limited when the rolling

seven (7) day maximum average exceeds the standard.

Stream temperature is driven by the interaction of many variables. Energy exchange may involve radiation, longwave radiation, evaporative heat transfer, conduction and advection (e.g., Lee 1980, Beschta 1984). While interaction of these variables is complex, certain of them are much more important than others (Beschta 1987). For a stream with a given surface area and stream flow, any increase in the amount of heat entering a stream from solar radiation will have a proportional increase in stream temperature. Solar radiation is the singularly most important radiant energy source for the heating of streams during daytime conditions (Beschta 1997).

Management activities can increase the amount of solar radiation entering a stream by harvesting riparian shade trees and through the introduction of bedload sediment resulting in increases in the stream's surface area. In addition to increases in solar radiation, water withdrawals during summertime may exacerbate maximum temperatures as demonstrated by Brown's equation. The BLM monitored several listed streams in summers of 1998 and 1999 to determine which portion of the streams are water quality limited. Definitive information on where stream temperatures meet the standard on stream reaches have not been analyzed. It will take several years of monitoring to determine the reaches that have temperature limiting problems. BLM recognizes that until target shade values exist, will still be listed.

Temperature Factor 2. - Channel Form

Changes in sediment input and discharge can lead to a change in channel form. When sediment input increases over the transport capability of the stream, sediment deposition can result in channel filling, thereby increasing the width-depth ratio. An increase in channel width will increase the amount of solar radiation entering a stream. A wide, shallow stream will heat up faster than a narrow, deeper stream with the same discharge. During storm events, management-related sources can increase sediment inputs over natural sources, and contribute to channel widening and subsequent stream temperature increases.

Temperature Factor 3. Flow

The temperature change produced by a given amount of heat is inversely proportional to the volume of water heated or, in other words, the discharge of the stream. A stream with less flow will heat up faster than a stream with more flow given all other channel and riparian characteristics are the same.

BLM has two non-consumptive water rights on flow-through ponds in upper Wolf Creek. Water withdrawal for domestic and agricultural uses throughout the basin is consumptive and reduces potential flow.

Routing of surface and subsurface waters via interception by road cuts has resulting in more rapid runoff during storm events and has precluded infiltration and subsequent slower release of stored water.

The flood plain in Grave Creek Watershed has developed upstream of constricted rocky canyons. The flat areas of deposition are currently the places where small communities exist (Wolf Creek

and Sunny Valley). Most of the residences and lands surrounding these communities are situated on or adjacent to the flood plain. Most activities on these lands are agricultural including largely grazing. Much of the flood plains have been altered from their original state by hydraulic mining and dredging. The road network and mining have changed the channel configuration from meander to straight with little or no channel complexity. The absence of beaver and continued disturbance by mining, cattle grazing and other human activities will restrict the input of large wood and natural channel migration. Ground water storage will likely remain below potential as a result, since flood waters would seldom spread out and store within the flood plain.

Temperature Findings

TMDL targets for temperature are based on a two-pronged approach to the temperature issue: shade and channel form. Temperature goals with this plan are to produce the coolest water possible in the shortest amount of time. Shade effects from historic harvest will largely recover in the next 30 years on the smaller tributaries on BLM controlled lands. This is based on age classes on harvest units adjacent to streams on BLM lands taken from operations inventories. (Grave Creek WA pg17), but riparian zones on larger tributaries and mainstem Grave Creek may take considerably longer (100 years) (see Table 8). An assumption was made that small order streams would be shaded by brush, hardwood and conifer species at an earlier age than the larger order streams ie. 30 years. Most of the small order streams are hillslope constrained and narrow. When the data in table 8 is compared to the data presented in the TMDL Allocation for Federally-Administered Lands (Appendix 1) there was found to be very strong correlation between modeled existing shade percentage and percentage of seral stages over 30 years of age. The recovery period in the TMDL table is based on site potential and time required to reach maturity for conifer species and disregards hardwoods and brush species. National Marine Fisheries Service bases consultation on 30 years of age as being hydrologically mature. The sites that have a 100-year target for shade recovery are also affected by changes in channel form (see TMDL ASSESSMENT REPORT: Riparian Shade, Appendix A, Table A1). It is difficult to set an exact recovery time for channel form when the recovery process is storm dependent. There is still active placer mining taking place within the basin so channel condition and storage of ground water surrounding these sites will likely slow recovery of the system.

Table. 8 Acres of Riparian Reserves by seral stage on BLM administered portions of Grave Creek drainages. 3/99 GIS Data

Seral Stage	Grave Creek Total	Sixth-field watersheds						
		Upper Grave GV01	Placer GV02	Sunny Valley GV03	Upper Wolf GV04	Coyote GV05	Lower Wolf GV06	Lower Grave GV07
Non Forest	382	75	27	46	98	43	75	17
0-10 years	1,483	294	105	264	4	156	54	607
11-20 "	1,358	481	81	162	252	144	8	229
21-30 "	796	264	62	99	112	101	44	114
31-40 "	1,449	710	179	134	127	122	6	171
41-50 "	1,015	441	60	4	234	60	69	147
51-60 "	203	35	13	6	26	46	1	76
61-70 "	306	61	13	28	50	6	113	35
71-80 "	350	63	16	8	89	40	66	67
81-200 yrs.	7,946	952	1,028	1,044	655	912	285	3,070
201+ "	3,200	894	179	30	359	258	324	1,157
81+ Modified	1,405	243	153	210	194	96	44	464
Total Acres:	19,893	4,513	1,916	2,035	2,200	1,984	1,089	6,154

Flow augmentation in this watershed is not considered an option. The only thing that is believed to possibly benefit flows in this basin, in terms of timing and release would be decommissioning of roads and ripping of the surfaces to allow for increased percolation and subsequent release. Dams are not feasible. No part of the basin is above the transient snow zone so augmentation by increasing snow depth is not an option.

Element 2: Goals and Objectives

All recovery goals and plans are strongly linked to the philosophy of maintaining those components of the ecosystem that are believed to be currently functioning, and to improving those sites that show the greatest potential in the shortest time frame. This philosophy

maximizes recovery while minimizing expensive, extensive and risky treatments.

The objective of this plan is to eventually meet water quality standards through appropriate management practices. Anthropogenic causes of water quality degradation within this watershed will receive the majority of effort through time for restoration activities. Those standards when met will protect the beneficial uses identified for the Rogue Basin under the Oregon Administrative Rules (OAR) 340-41-362.

The recovery of water temperature conditions in Grave Creek will be dependent upon implementation of the BLM Medford District Resource Management Plan (RMP). Paramount to recovery is adherence to the Standard and Guidelines of the NFP to meet the Aquatic Conservation Strategy (ACS). This includes protection of riparian areas as reserves and may include some silvicultural work to reach vegetative potential as rapidly as possible. See Table 9.

Table 9. Goals for Federal Lands

Element	**Goal**	**Passive restoration**	**Active Restoration**
Temperature Shade Component	Achieve coolest water temperatures possible through achievement of shaded riparian reserves.	Allow vegetation to grow naturally in riparian reserves as described in the NFP Aquatic Conservation Strategy	Silvicultural projects designed to promote achievement of site potential hardwood and conifers in a more rapid manner.
Temperature Channel Form Component	Maintain channel configuration of 1st through 4 order streams on BLM lands which are currently hydrologically properly functioning at this point.	Allow natural hydrologic processes to occur within the riparian reserves. Follow standards and guidelines of NFP Aquatic Conservation Strategy	Maintain roads to reduce sediment delivery to streams. Install drainage structures capable of passing 100 year flood events. Decommission roads to minimize potential sediment sources.
Temperature Stream Flow Component	Maintain natural flow conditions. Maintain flow needed for aquatic life.	Minimize consumptive use in management of BLM lands	Work with state Watermaster to identify unauthorized diversions. Reduce road densities by decommissioning roads which are no longer needed for management.

Element 3: Identification of Responsible Participants

Responsible Parties:

Federal Lands - Participants in this plan for federal lands include DEQ and BLM. The BLM is the only federal land manager in this watershed and is responsible for completion and implementation of the WQRP for federal lands.

Nonfederal Lands - A subsequent WQMP for the remainder of the watershed is expected to be developed by DEQ and other Oregon Departments responsible for lands within this watershed. That WQMP will deal with state and local government lands as well as private lands, including private forest lands within the Grave Creek Watershed.

The Oregon Department of Forestry (ODF) is the Designated Management Agency (DMA) for regulation of water quality on nonfederal forest lands. The Oregon Board of Forestry in consultation and with the participation and support of DEQ has adopted water protection rules in the form of BMP's for forest operation. These rules are implemented and enforced by ODF and monitored to assure their effectiveness. ODF and DEQ will jointly demonstrate how the Oregon Forest Practices Act, forest protection rules (including the rule amendment process) and Best Management Practices (BMPs) are adequate protection for water quality.

Oregon Water Resources Division (WRD) is a participant within the implementation and monitoring components of this plan. WRD will be doing flow measurements, and will also assist in identifying opportunities for converting consumptive uses to instream rights.

The Oregon Department of Geology and Mineral Industries (DOGAMI) is also a participant with respect to mining impact assessment and permit modifications. DOGAMI covers mining operations that exceed one (1) acre of disturbance or 5000 cubic yards of production within a 12-month period. Operators are required to obtain an operating permit if they are located above the 2-year floodplain of creeks and rivers.

Element 4. - Proposed Management Measures

The following standards and guidelines from the NFP will be used to attain the goals of the Grave Creek Water Quality Restoration Plan:

<u>Stream Temperature – Shade</u>

Aquatic Conservation Strategy: B-9 to B-11, C-30 (denotes section and page # of NFP)
Standard and Guidelines for Key Watersheds: C-7
Riparian Vegetation: B-31
Riparian Reserves: B-12 to B-17 and ROD 9
Watershed Restoration: B-30

Stream Temperature - Channel Form

Aquatic Conservation Strategy: B-9 to B-11, C-30
Standard and Guidelines for Key Watersheds: C-7
Riparian Vegetation: B-31
Riparian Reserves: B-12 to B-17 and ROD 9
Watershed Restoration: B
Roads: B-19, B-31 to B-33

Stream Temperature - Flow

BLM is currently upgrading its transportation objectives within each watershed. This endeavor is expected to be completed within two years. Part of the plan is to identify roads that need surfacing, pipe replacement or could be decommissioned.

All the sub-watersheds have high road densities and all are above the two miles per square mile target established by the National Marine Fisheries Service for proper functioning condition. Above 3 miles per square mile is considered not functioning properly by NMFS. Road densities would be decreased where possible.

Aside from elements covered under this heading, there is a general idea that restrictions within the Forest Plan have greatly contributed to reducing impacts on the aquatic system. These include, but are not limited to, wide riparian buffers on all streams, including intermittent channels; green-tree retention on harvest units; restrictions on new road construction and requirements for 100 year flood capacity for road crossing structures. Best management practices that were designed for implementation under the NFP would help reduce impacts and in some cases, actually restore conditions to “Properly Functioning”.

Assessing Potential for Recovery - Properly Functioning Condition Methodology

Recovery of riparian areas, stream channels, and aquatic habitat requires a base condition with adequate vegetation, channel form, and large woody debris to dissipate stream energy associated with high water flows. The BLM/USFS methodology known as Properly Functioning Condition (PFC) assesses the capability of streams to withstand 30-year interval storm events. This quick, interdisciplinary method is the first step in determining the feasibility of restoration and recovery.

The entire system meets the minimum requirements of the PFC methodology for restoration and recovery. Until there is adequate vegetation, channel form, and large woody debris to dissipate stream energy associated with high flows, the middle reach of Grave Creek below Placer and above Leland will likely continue to be less effective at water storage since it is not connected to the flood plain.

Assessing Potential for recovery – ODFW Methodology

Restoration in Grave Creek will be both active and passive. Growth of vegetation on floodplains

is integral to recovery. The overall goal is to move the attributes considered in this assessment; pool/riffle ratio, pool frequency, large wood, and riparian forest conditions from the present "poor" and "fair" ratings to "good" and "fair", per ODFW benchmarks. These attributes are used to measure if and when the stream is nearing its biological potential for supporting dependent aquatic and riparian species, including anadromous fish. Natural variation will cause changes in stream and floodplain conditions and make allowance for some attributes as being rated "fair". These attributes and benchmarks should be validated with subsequent inventory and monitoring work in the watershed, refining them to suit the range of conditions expected in the Grave Creek Watershed as we learn more about the watershed.

Element 5: Time line for Implementation and Attainment

Stream shade recovery will be realized more quickly than habitat recovery with the growth of hardwoods, e.g., alder, maple, ash and cottonwood. Habitat recovery and associated sediment storage/routing in the channel will only recover to an optimum range of conditions with the recovery of riparian conifers to mature size. This will afford some added shade as these trees reach more height. Lower summer water temperatures and creation of quality habitat conditions for trout and salmon are anticipated with maturation of riparian forests in these watersheds, addressing road-related problems in the watershed, and reduced timber harvest under the NFP. Harvest related slope failure issues will be addressed through the adaptive management measures within the NFP.

BLM proposes to accomplish reduction or maintenance of stream temperature through the following during the immediate and near future:

Use timber sales to fund a portion for road renovation
Use Jobs-in-the-Woods funding to accomplish some projects related to roads
Make emergency repairs as problems are discovered.
Periodically maintain the BLM road network
Utilize passive restoration
Renovate roads (outslope, gravel surface, water dip)

Element 6: Reasonable Assurance of Implementation

BLM has followed the standards and guidelines of the NFP aquatic conservation strategy and will continue to do so. Until the Plan is revised or replaced BLM is responsible for implementation of the Plan.

Element 7: Monitoring and Evaluation

Monitoring will provide information as to whether standards and guidelines are being followed, and if actions prescribed in the WQMP are achieving the desired results. In addition to the monitoring identified in the WQMP, RMP/Forest Plan monitoring occurs annually to assess implementation of standards and guidelines. Information obtained from both sources of monitoring will ascertain whether management actions need to be changed. Continued monitoring would be prioritized upon review of findings.

The monitoring plan itself will not remain static and will be periodically adjusted, as appropriate;

to assure the monitoring remains relevant. See Table 10.

Temperature

The BLM, with cooperators, will continue to monitor stream temperatures throughout Grave Creek. We monitor to meet a variety of objectives, so site locations will vary over time. Monitoring activities for BLM will try to determine the source area of temperature increase within reaches of streams that are listed for temperature. Through monitoring, BLM's goal is to determine the upper extent of the problem area and delist the reaches or streams that through time meet the water quality standard for temperature. Our objectives are to monitor long-term temperature recovery, better understand the natural temperature variability, and to track potential project effects. There are several locations that are monitored annually during the summer months to establish temperature ranges within the basin.

Temperature - Shade Component

It is unlikely that over the next few years that the Glendale Resource Area will prescribe riparian stand treatments in stands located adjacent to perennially flowing water (active restoration). Precommercial thinning (PCT) may occur in conjunction with normal stand maintenance in unit having a stream flowing though it or adjacent to it. BLM will continue to adhere to the Aquatic Conservation Strategy of the NFP by providing riparian reserves along streams.

Temperature - Channel Form Component

Through management activities such as timber sales, Jobs-in-the-Woods projects and routine maintenance, BLM will endeavor to reduce road generated sediment. Monitoring of actions will take place periodically to ensure desired reduction of sediment is achieved.

Temperature – Flow

BLM will continue to maintain or improve flow conditions on federal lands. Passive management will be stressed as there are no current identified opportunities for flow augmentation within the federal managed lands of this basin.

Table 10. Interim Benchmarks and monitoring strategy for Grave Creek

Element	**Management measure**	**Interim benchmark**	**Monitoring parameter**	**Monitoring frequency**
Temperature Shade component	Passive treatment of riparian vegetation. Implement standards and guides of NWFP. Some PCT may occur in conjunction with units that have streams flowing through or adjacent to them.	Allow stands to grow toward shade target.	Shade, canopy closure over stream focusing first on hardwood species.	Review of selected reaches every 5 to 10 years using aerial photos, field check condition of riparian vegetation. Within one year complete PFC surveys for selected streams within basin.
Temperature Channel form component	Maintain integrity of streams channels on land under BLM control.	Assess roads and culvert conditions within the watershed within the next 2 years.	Sedimentation resulting from roads by miles of road surfaced or decommissioned.	Review yearly miles of road decommissioned, renovated or maintained.
Temperature Flow component	Road management objectives	Yearly evaluation	Proper drainage and routing	Miles of road decommissioned, out sloped, rocked, number of culverts replaced.

The shade model ran by DEQ utilized 1996 aerial photos. It is believed that some canopy closure has occurred since 1996 and therefore more shade is already on streams than is indicated in the TMDL portion of DEQ Water Quality Management Plan.

Element 8: Public Involvement

This WQRP is a procedural step that focuses on water quality using elements of the Northwest Forest Plan (NFP). It tiers to and appends the Grave Creek Watershed Analysis. Watershed analyses are a recommended component of the Aquatic Conservation Strategy under the NFP and RMP. The Record of Decision (ROD) for the RMP was signed in June of 1995, following extensive public review.

Public involvement was integrated into the development of the Grave Creek Watershed Analysis. Public meetings were held in the Sunny Valley Grange hall several times during the analysis process. Public involvement for the WQMP will be coordinated by DEQ in conjunction with the effort addressing state, county and private lands within this watershed.

Element 9: Discussion of Cost and Funding

Restoration Prioritization and Funding

Funding for instream restoration will likely be very limited for BLM. Activity plans include decommissioning of roads, road renovation projects and possible density management projects.

Much of the restoration activity that may occur will likely be funded indirectly through projects (timber sales and silvicultural projects).

As part of the Clean Water Action Plan, Oregon has begun an interagency effort that identifies high priority watersheds in need of restoration and protection as part of the Unified Watershed Assessment. It is possible that funding associated with the Clean Water Action Plan could be accessed to carry out protection and restoration actions in the Grave Creek Watershed.

Element 10: Legal Authorities to be used

Clean Water Act Section 303(d)

Section 303(d) of the federal Clean Water Act (CWA) as amended, requires states to develop a list of rivers, streams, and lakes that cannot meet water quality standards without application of additional pollution controls
beyond the existing requirements on industrial sources and sewage treatment plants. Waters that need this additional help are referred to as "water quality limited" (WQL). Water quality limited waterbodies must be identified by the Environmental Protection Agency (EPA) or by a delegated state agency. In Oregon, this responsibility rests with the Department of Environmental Quality. The DEQ updates the list of water quality limited waters every two years. The list is referred to as the 303(d) list. The CWA section 303 further requires that Total Daily Maximum Loads (TMDLs) be developed for all waters on the 303(d) list. A TMDL defines the amount of pollution that can be present in the waterbody without causing water quality standards to be violated. A TMDL Water Quality Management Plan is developed to describe a strategy for reducing water pollution to the level of the TMDL, which will restore the water quality and result in compliance with the water quality standards.

Northwest Forest Plan

Federal land management is guided by the Northwest Forest Plan. The NFP creates a system of reserves to protect a full range of species. Biological objectives of the plan also include assuring adequate habitat on Federal lands to aid in the “recovery” of late-successional forest habitat-associated species and prevention of species from being listed under the Endangered Species Act. The Aquatic Conservation Strategy is an essential component of the Plan which ensures streams, lakes, and Riparian protection on Federal lands. The intent is to maintain or enhance water quality and aquatic ecosystem function.

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Appendix 1

TMDL Allocation for Federally-Administered Lands

Solar Loading[1] / TMDL Lower Grave 6th field HUC			
Target Shade	**86%**	Target Solar Load	**364 BTU/ft^2/day**
Existing Shade	**72%**	Existing Solar Load / TMDL	**728 BTU/ft^2/day**
Change in Shade	**14%**	Change in Solar Load	**-364 BTU/ft^2/day**

Solar Loading[1] / TMDL Lower Wolf 6th field HUC			
Target Shade	**92%**	Target Solar Load	**208 BTU/ft^2/day**
Existing Shade	**85%**	Existing Solar Load / TMDL	**390 BTU/ft^2/day**
Change in Shade	**7%**	Change in Solar Load	**-182 BTU/ft^2/day**

Solar Loading[1] / TMDL Coyote 6th field HUC			
Target Shade	**93%**	Target Solar Load	**182 BTU/ft^2/day**
Existing Shade	**74%**	Existing Solar Load / TMDL	**676 BTU/ft^2/day**
Change in Shade	**19%**	Change in Solar Load	**-494 BTU/ft^2/day**

Solar Loading[1] / TMDL Upper Wolf 6th field HUC			
Target Shade	**94%**	Target Solar Load	**156 BTU/ft^2/day**
Existing Shade	**80%**	Existing Solar Load / TMDL	**520 BTU/ft^2/day**
Change in Shade	**14%**	Change in Solar Load	**-364 BTU/ft^2/day**

Solar Loading[1] / TMDL Sunny Valley 6th field HUC			
Target Shade	**95%**	Target Solar Load	**130 BTU/ft^2/day**
Existing Shade	**74%**	Existing Solar Load / TMDL	**676 BTU/ft^2/day**
Change in Shade	**21%**	Change in Solar Load	**-546 BTU/ft^2/day**

Solar Loading[1] / TMDL Placer 6th field HUC			
Target Shade	**91%**	Target Solar Load	**234 BTU/ft^2/day**
Existing Shade	**85%**	Existing Solar Load / TMDL	**390 BTU/ft^2/day**
Change in Shade	**6%**	Change in Solar Load	**-156 BTU/ft^2/day**

Solar Loading[1] / TMDL Upper Grave 6th field HUC			
Target Shade	**94%**	Target Solar Load	**156 BTU/ft^2/day**
Existing Shade	**71%**	Existing Solar Load / TMDL	**754 BTU/ft^2/day**
Change in Shade	**23%**	Change in Solar Load	**-598 BTU/ft^2/day**

Solar Loading[1] / TMDL Grave Ck 5th field HUC			
Target Shade	**92%**	Target Solar Load	**208 BTU/ft^2/day**
Existing Shade	**75%**	Existing Solar Load / TMDL	**650 BTU/ft^2/day**
Change in Shade	**17%**	Change in Solar Load	**-442 BTU/ft^2/day**

1 – based on 2,601 BTU/ft^2/day (maximum July insolation at Medford, OR; collector: flat-plat, facing south at a fixed tilt; +/- 9% uncertainty). **Calculation: [(1.0 - decimal percent shade) * 2,601 BTU/ft^2/day]**

NOTE: All values are reach-weighted averages for 6th field watershed indicated.