APPENDIX G

Supporting Documentation for Development Of Temperature Load Allocation

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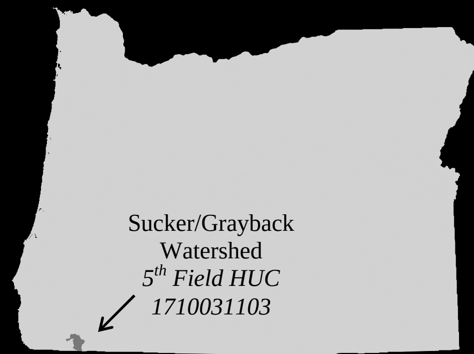
Watershed at a Glance

Basin:	Rogue
Sub-Basin:	Illinois
Watershed:	Sucker/Grayback
Key Resources:	Chinook and Coho Salmon
	Steelhead Trout
Uses Affected:	Salmonid Spawning & Rearing
Impairment:	Water Temperature Increase
Pollutant:	Heat Energy (Solar Radiation)
Sources Considered:	NPS – Forest Practices, Mining



DOCUMENT ORGANIZATION

Preparation of the Sucker/Grayback Watershed TMDL considers a number of issues regarding surface water temperature and the relationship to requirements of 303(d). These issues have been divided into topic areas which include target identification (quantified end-points that will lead to attainment of water quality standards), source identification (a description of hazards areas that contribute to the problem), allocations designed to reduce pollutant inputs to those waters exceeding State water quality standards, and a margin of safety. In order to provide a framework for discussing these issues, this TMDL development document is organized into the following sections:

- ✓ Introduction
- ✓ Source Assessment – Stream Heating Processes
- ✓ Target Identification
- ✓ Deviation from the Target – Current Condition
- ✓ Source Assessment
- ✓ TMDL / Allocations
- ✓ Margin of Safety
- ✓ Seasonal Variation

Highlights of each TMDL development document section are summarzed in **Table 1**.

Table 1. Sucker/Grayback Watershed TMDL Components	
State/Tribe: Oregon Waterbody Name(s): All streams within the 5th field HUC (hydrologic unit code) 1710031103 – Sucker/Grayback watershed, RM 10.4 to headwaters. (See figure 1 page 7 of WQMP) Point Source TMDL:_____ Nonpoint Source TMDL:__X__ (check one or both) Date: March 1999	
Component	***Comments***
Pollutant Identification	Stream temperature is an expression of *Heat Energy per Unit Volume* and is expressed in English Units as Btu per cubic feet. $$\text{Temperature} = \frac{\text{Heat Energy}}{\text{Volume}} = \frac{\text{Btu}}{\text{ft}^3}$$ *Pollutant:* Heat Energy *Anthropogenic Contribution:* Excessive Solar Energy Input
Target Identification *CWA 303(d)(1)* *40 CFR 130.2(f)*	*Applicable Water Quality Standards* **Temperature: OAR 340-41-365(1)(b)(A)** The seven day moving average of the daily maximum shall not exceed the following values unless specifically allowed under a Department-approved basin surface water management plan: **64°F (17.8°C)** or- **55°F (12.8°C).** Where **55°F (12.8°C)** applies during times and in waters that support salmon spawning, egg incubation and fry emergence from the egg and from the gravel. *Loading Capacities* • No more than 488 $\text{Btu}\cdot\text{ft}^{-2}\cdot\text{day}^{-1}$ solar loading as an average measured value over perennial stream length, or site potential (climax) solar radiation loading.
Existing Sources *CWA 303(d)(1)*	*Anthropogenic sources of thermal gain from riparian vegetation removal:* • Forest management within riparian areas *Anthropogenic sources of thermal gain from channel modifications:* • Mining, Timber Harvest, Roads
Seasonal Variation *CWA 303(d)(1)*	*Condition*: Based on USFS data (1992 to 1997) *Flow*: Low flow associated with maximum stream temperatures *Critical Conditions*: Increase desirable riparian vegetation to site potential (climax) conditions. *Inputs*: Solar ration increased by more exposed stream surface area as a result of decreased effective shade and increased channel width.
TMDL/Allocations *40 CFR 130.2(g)* *40 CFR 130.2(h)*	*WLAs*: None (There are no point sources within this watershed.) *LAs:* Effective shade levels of 80% as measured by solar pathfinder for summer months, or site potential (climax) shade conditions.
Margins of Safety *CWA 303(d)(1)*	Margins of Safety demonstrated in critical condition assumptions regarding groundwater inflow, wind speed and air temperature.
WQS Attainment Analysis *CWA 303(d)(1)*	• Statistical demonstration of temperature related to current shade conditions. • Analytical assessment of simulated temperature change related to allocated solar loading.
Public Participation *40 CFR 25*	See page 11 of the WQMP and Section 8 of Appendix G

1. INTRODUCTION

The Sucker/Grayback Watershed, part of the Rogue River basin, is home to productive forested lands and has the distinction of containing streams with historically abundant salmonid populations. Valuable contributions from forestry and fisheries in the Rogue River Basin have prompted extensive data collection and study of the interaction between land use and water quality. The knowledge derived from these data collection efforts and academic study, some of which is presented in this document, will be used to design protective and enhancement strategies that address water quality issues.

Recently several agencies have been mandated to take proactive roles in developing management strategies in the Rogue River Basin. In the near future water quality management plans will be developed for forested, agricultural and urban lands that address both nonpoint and point sources of pollution. It is imperative that these plans consider the relatively robust data that describe water quality, instream physical parameters and landscape features. The impending management efforts (*see* **EXISTING WATER QUALITY PROGRAMS**) demand that stakeholders, land managers, public servants and the general public become knowledgeable with water quality issues in the Rogue River Basin.

A Total Maximum Daily Load (TMDL) has been developed to address fisheries concerns For Sucker Creek and Grayback Creek and all tributaries on BLM and USFS lands. The TMDL builds upon the Northwest Forest Plan and Forest Ecosystem Management Assessment Team (FEMAT) protection/restoration measures.

The data review contained in this document summarizes the varied, yet extensive, data collection and study that has recently occurred in the Sucker/Grayback Watershed. It is hoped that water quality programs will utilize this TMDL to develop and/or alter water quality management efforts. In addition, this TMDL should be used to track water quality, instream physical parameters and landscape conditions that currently exist. In the future it will be important to determine the adequacy of planned water quality improvement efforts. Looking back at this TMDL, written in November 1998, it will be possible to track the changes that have occurred in water quality, instream and landscape parameters that affect fish, as well as people, in the Sucker/Grayback Watershed.

Excessive summer water temperatures in several tributaries and Sucker Creek and Grayback Creek may be reducing the quality of rearing habitat for chinook and coho salmon, as well as steelhead trout. Primary watershed disturbance activities which contribute to surface water temperature increase include past forest management within riparian areas, timber harvest in sensitive areas outside the riparian zone and instream mining practices. As a result of water quality standards (WQS) exceedances for temperature, waters in the Sucker/Grayback watershed are on Oregon’s 1996 303(d) list. This TMDL and Water Quality Management Plan (WQMP) also address habitat and flow modifications. Specific management prescriptions designed to reduce input of pollutants into streams within the Federal lands covered by this TMDL are:

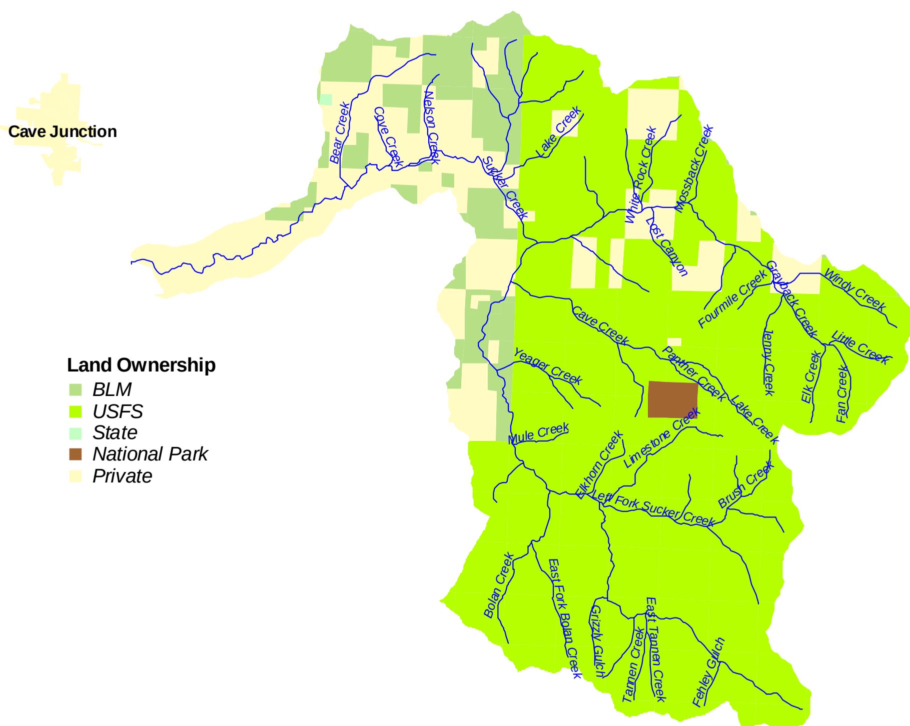
- Riparian conservation reserves that promote targeted shade levels
- Riparian conservation reserves that promote targeted channel morphology
- Riparian conservation reserves that promote targeted instream habitat goals
- Aquatic conservation strategy

Surrogate Measures (*"other appropriate measures"*) are used in conjunction with heat **Load Capacity** targets to address water temperature increases. Namely, *percent effective shade* is an effective measure of anthropogenic heat contributions and a descriptor of riparian condition. In essence, the **Surrogate Measure** (percent effective shade) is **Allocated** as a translation of the developed solar radiation **Loading Capacities**.

SCOPE

This TMDL builds upon the protection/restoration measures prescribed by the Northwest Forest Plan. The area covered by the TMDL and WQMP includes land managed primarily by the U.S. Forest Service (USFS) and Bureau of Land Management (BLM) (headwaters to the confluence of Sucker and Grayback Creeks). This portion of the Sucker/Grayback Creek is a key watershed as defined by the President's Northwest Forest Plan (1995, USDA, USDI). Private forested lands are managed under the Oregon Forest Practices Act (FPA). A subsequent TMDL and WQMP will be written by the Oregon Department of Environmental Quality (DEQ) to include non-Federal lands within the Sucker/Grayback Watershed. Land ownership is displayed in **Image 1**. Of the 62,100 acres within Sucker/Grayback Watershed, 42,500 are managed by USFS, 5,800 by BLM and the remaining 13,800 acres are private or State lands.

Image 1. Land Ownership in the Sucker/Grayback Watershed



As a result of water quality standards (WQS) exceedances for temperature, Sucker Creek is included on Oregon's 1998 303(d) list. In addition, this TMDL addresses potential temperature water quality impairment conditions for streams within the USFS and BLM managed lands that are not currently on Oregon's 303(d) list.

Table 2. USFS and BLM Managed Lands 303(d) listed Segments and Applicable Water Quality Standards	
• Sucker Creek Temperature, mouth to Grayback Creek (RM 10.4 to Confluence with Grayback is within the USFS and BLM managed Lands)	*OAR 340-41-365(2)(b)(A)*

EXISTING WATER QUALITY PROGRAMS

Oregon's Total Maximum Daily Load Program

The quality of Oregon's streams, lakes, estuaries and groundwaters is monitored by the Department of Environmental Quality (DEQ). This information is used to determine whether water quality standards are being violated and, consequently, whether the *beneficial uses* of the waters are being threatened. *Beneficial uses* include fisheries, aquatic life, drinking water, recreation and irrigation. Specific State and Federal plans and regulations are used to determine if violations have occurred: these regulations include the *Federal Clean Water Act* of *1972* and its amendments 40 *Codified Federal Regulations* 131, and *Oregon's Administrative Rules* (**OAR Chapter 340**) and *Oregon's Revised Statutes* (**ORS Chapter 468**).

The term *water quality limited* is applied to streams and lakes where required treatment processes are being used, but violations of State water quality standards occur. With a few exceptions, such as in cases where violations are due to natural causes, the State must establish *a Total Maximum Daily Load* or *TMDL* for any waterbody designated as *water quality limited*. A *TMDL* is the total amount of a pollutant (from all sources) that can enter a specific waterbody without violating the water quality standards.

The total permissible pollutant load is allocated to point, nonpoint, background, and future sources of pollution. *Wasteload Allocations* are portions of the total load that are allotted to point sources of pollution, such as sewage treatment plants or industries. The *Wasteload Allocations* are used to establish effluent limits in discharge permits. *Load Allocations* are portions of the *Total Maximum Daily Load* that are attributed to either natural background sources, such as soils, or from nonpoint sources, such as agriculture or forestry activities. *Allocations* can also be set aside in reserve for future uses. Simply stated, *allocations* are quantified measures that assure water quality standard compliance. The *TMDL* is the integration of all developed *allocations*.

Northwest Forest Plan

In response to environmental concerns and litigation related to timber harvest and other operations on Federal Lands, the United States Forest Service (USFS) and the Bureau of

Land Management (BLM) commissioned the Forest Ecosystem Management Assessment Team (FEMAT) to formulate and assess the consequences of management options. The assessment emphasizes producing management alternatives that comply with existing laws and maintaining the highest contribution of economic and social well being. The "backbone" of ecosystem management is recognized as constructing a network of late-successional forests and an interim and long-term scheme that protects aquatic and associated riparian habitats adequate to provide for *threatened species* and *at risk species*. Biological objectives of the Northwest Forest Plan include assuring adequate habitat on Federal lands to aid the "recovery" of late-successional forest habitat-associated species listed as threatened under the Endangered Species Act and preventing species from being listed under the Endangered Species Act.

Oregon Plan

The State of Oregon has formed a partnership between Federal and State agencies, local groups and grassroots organizations, that recognizes the attributes of aquatic health and their connection to the health of salmon populations. The Oregon Plan considers the condition of salmon as a critical indicator of ecosystems (CSRI, 1997). The decline of salmon populations has been linked to impoverished ecosystem form and function. Clearly stated, the Oregon Plan has committed the State of Oregon to the following obligations: an ecosystem approach that requires consideration of the full range of attributes of aquatic health, focuses on reversing factors for decline by meeting objectives that address these factors, develops adaptive management and a comprehensive monitoring strategy, and relies on citizens and constituent groups in all parts of the restoration process.

The intent of the Oregon Plan is to conserve and restore functional elements of the ecosystem that supports fish, wildlife and people. In essence, the Oregon Plan is distinctly different from the traditional agency approach, and instead, depends on sustaining a local-state-federal partnership. Specifically, the Oregon Plan is designed to build on existing State and Federal water quality programs, namely: Coastal Zone Nonpoint Pollution Control Programs, the Northwest Forest Plan, Oregon's Forest Practices Act, Oregon's Senate Bill 1010 and Oregon's Total Maximum Daily Load Program.

WATER QUALITY IMPAIRMENTS

Monitoring has shown that water quality in the Sucker/Grayback Watershed often does not meet State water quality standards. The narrative and numeric standards for *temperature, flow modification* and *habitat modification* are not achieved in the mainstem reaches of the Sucker/Grayback Watershed.

Section 303(d) of the Federal Clean Water Act (1972) requires that water bodies that violate water quality standards, thereby failing to fully protect *beneficial uses*, be identified and placed on a 303(d) list. Following further assessment, *Total Maximum Daily Load* (TMDL), will be implemented to restore water quality. In addition to watershed condition assessment and problem statements, a water quality management plan (WQMP) requires identification of water quality goals and objectives, designation of responsible parties, implementation of the management plan (TMDL), some measure of assurance that the plan (TMDL) will actually be implemented, and a monitoring of feedback loop (DEQ WQMP guidance 1997).

Temperature +

Location:
- Sucker Creek (mouth to Grayback Creek)

Time Period:
- Rearing: June 1 through September 30
- Spawning Through Fry Emergence: October 1 through May 31 or waterbody specified as identified by ODFW biologist.

Supporting Data:
- USFS (1992 – 1997)

Flow Modification +

Location:
- Sucker Creek (mouth to Bolan Creek)

Time Period:
- All time periods

Supporting Data:
- USGS, OR DWR

Habitat Modification +

Location:
- Sucker Creek (mouth to Bolan Creek)
- Grayback Creek (mouth to headwaters)

Time Period:
- All time periods

Supporting Data:
- USFS
- ODFW

Oregon Administrative Rules (**OAR Chapter 1, Division 41, Table 19**) lists the designated beneficial uses for which water is to be protected. The beneficial uses occurring in the Sucker/Grayback Watershed are presented in **Table 3**.

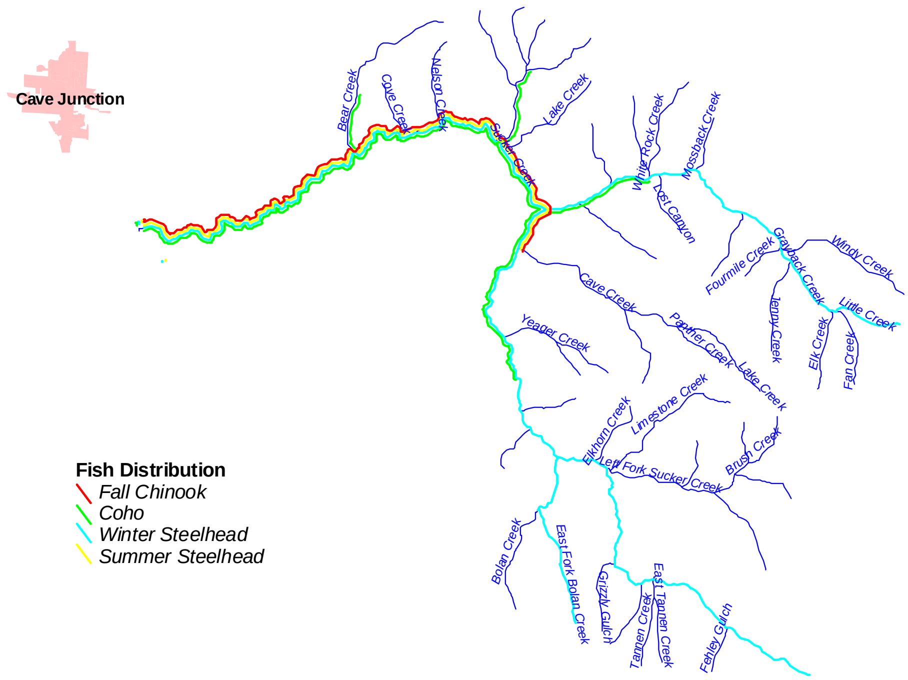
Table 3. Beneficial uses occurring in the Sucker/Grayback Watershed

Beneficial Use	***Occurring***	***Beneficial Use***	***Occurring***
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	

Numeric and narrative water quality standards are designed to protect the most sensitive *beneficial uses*. In the Sucker/Grayback Watershed, resident fish and aquatic life and

+ 1996 303(d) listed water quality parameter salmonid spawning and rearing are designated the most sensitive *beneficial uses*. Sensitive *beneficial uses* (salmonid migration, spawning and migration) are presented in **Image 2**.

Image 2. Sensitive Beneficial Uses – Salmonid Migration, Spawning and Rearing



POLLUTANTS

Water temperature is an expression of heat energy per unit volume:

$$\text{Temperature} = \frac{\text{Heat Energy}}{\text{Volume}} = \frac{\text{Btu}}{\text{ft}^3}.$$

Anthropogenic increase in heat energy is derived from solar radiation as increased levels of sunlight reach the stream surface and raises water temperature. The pollutant (solar heat energy) is a source of stream temperature increase that is within management measures and is targeted in this TMDL.

SURROGATE MEASURES - DEFINED

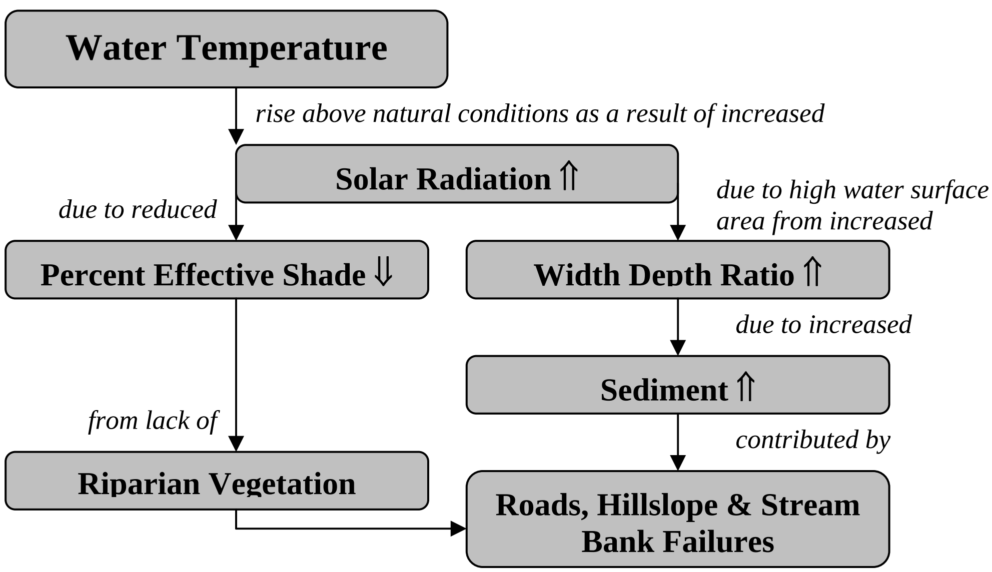
The Sucker/Grayback TMDL incorporates measures other than "*daily loads*" to fulfill requirements of 303(d). Although a loading capacity for heat is derived [e.g. 488 British Thermal Units (Btu) per square foot per day], it is of limited value in guiding management activities needed to solve identified water quality problems. In addition to heat loads, the Sucker/Grayback TMDL allocates "*other appropriate measures*" (or surrogates) as provided under EPA regulations [40 CFR 130.2(i)]. The specific surrogate used is *percent effective shade* (as defined in **SOURCE ASSESSMENT**).

2. SOURCE ASSESSMENT

STREAM HEATING PROCESSES

Decreased effective shade levels result from lack of adequate riparian vegetation available to reduce sunlight (e.g. heat from incoming solar radiation). Human activities that contribute to degraded water quality conditions in the Sucker/Grayback Watershed include improper timber harvest, roads and instream mining. Wider channels also increase the stream surface area exposed to heat transfer from solar radiation. The relationship between the percent effective shade (surrogate) and factors that impact stream temperature are described in **Figure 1**.

Figure 1. Factors that Impact Water Temperature



Note: Boxes depict measured or calculated key indicators

Riparian area and channel morphology disturbances have resulted from past timber management and mining land uses. These nonpoint sources of pollution primarily affect the water quality parameter (temperature) through increased solar loading by: (1) increasing stream surface solar radiation loading and (2) increasing stream surface area exposed to solar radiation loading. Although timber harvest and mining continue in the Sucker/Grayback Watershed, altered management practices that comply with surrogate measures (allocations) presented in this document are intended to ameliorate pollutant delivery.

Riparian vegetation, stream morphology, hydrology, climate, and geographic location influence stream temperature. While climate and geographic location are outside of human control, the condition of the riparian area, channel morphology and hydrology can be affected by land use activities. Specifically, the elevated summertime stream temperatures attributed to anthropogenic causes in the Sucker/Grayback Watershed result from the following listed conditions:

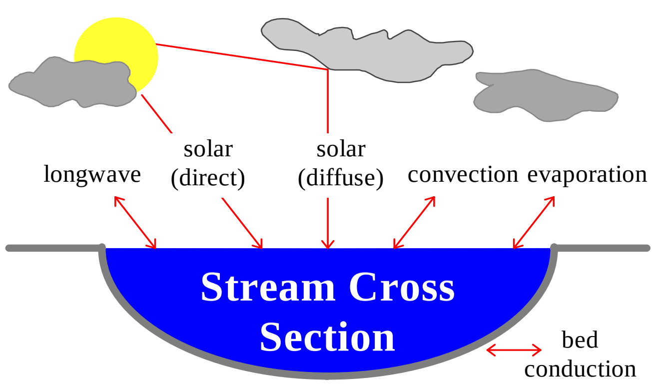
1. *Channel widening (increased width to depth ratios) that increases the stream surface area exposed to energy processes, namely solar radiation,*
2. *Riparian vegetation disturbance that compromises stream surface shading, riparian vegetation height and density (shade is commonly measured as percent effective shade),*
3. *Reduced summertime base flows that result from instream withdrawals per instream water rights.*

Analysis presented in this TMDL will demonstrate that developed loading capacities will ensure attainment of State water quality standards. Specifically, the link between shade surrogate measures (allocations) for solar radiation loading capacities and water quality attainment will occur via two processes:

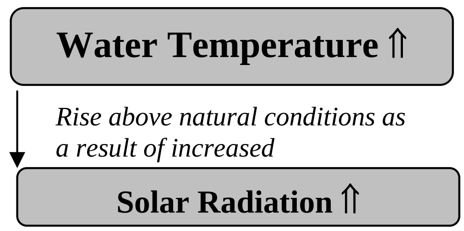
1. *Remove human (anthropogenic) solar radiation contributions from temperature dynamics in the Sucker/Grayback Watershed, and*
2. *Restore riparian reserves that function to protect stream morphology and encourage bank building processes in severe hydrologic events.*

Stream temperature is an expression of heat energy per unit volume, which in turn is an indication of the rate of heat exchange between a stream and its environment. The heat transfer processes that control stream temperature include solar radiation, longwave radiation, convection, evaporation and bed conduction (Wunderlich, 1972; Jobson and Keefer, 1979; Beschta and Weatherred, 1984; Sinokrot and Stefan, 1993; Boyd, 1996). With the exception of solar radiation, which only delivers heat energy, these processes are capable of both introducing and removing heat from a stream. **Figure 2** displays heat energy processes that solely control heat energy transfer to/from a stream.

Figure 2. Thermodynamic (heat transfer) processes that heat or cool water.



When a stream surface is exposed to midday solar radiation, large quantities of heat will be delivered to the stream system (Brown 1969, Beschta et al. 1987). Some of the incoming solar radiation will reflect off the stream surface, depending on the elevation of the sun. All solar radiation outside the visible spectrum (0.36μ to 0.76μ) is absorbed in the first meter below the stream surface and only visible light penetrates to greater depths (Wunderlich, 1972). Sellers (1965) reported that 50% of solar energy passing through the stream surface is absorbed in the first 10 cm of the water column. Removal of riparian vegetation, and the shade it provides, contributes to elevated stream temperatures (Rishel et al., 1982; Brown, 1983; Beschta et al., 1987). The principal source of heat energy delivered to the water column is solar energy striking the stream surface directly (Brown 1970). While exposed to summertime midday solar radiation, large quantities of heat energy will be imparted to the stream. Exposure to direct solar radiation will often cause a dramatic increase in stream temperatures. When shaded throughout the entire duration of the daily solar cycle, far less heat energy will be transferred to the stream. The ability of riparian vegetation to shade the stream throughout the day depends on vegetation height, density and position relative to the stream.



Both the atmosphere and vegetation along stream banks emit longwave radiation that when received by the stream surface has a warming influence. Water is nearly opaque to longwave radiation and complete absorption of all wavelengths greater than 1.2μ occurs in the first 5 cm below the surface (Wunderlich, 1972). Longwave radiation has a cooling influence when emitted from the stream surface. The net transfer of heat via longwave radiation usually balances so that the amount of heat entering is similar to the rate of heat leaving the stream (Beschta and Weatherred, 1984; Boyd, 1996).

Evaporation occurs in response to internal energy of the stream (molecular motion) that randomly expels water molecules into the overlying air mass. Evaporation is the most effective method of dissipating heat from water (Parker and Krenkel, 1969). As stream temperatures increase, so does the rate of evaporation. Air movement (wind) and low vapor pressures increase the rate of evaporation and accelerate stream cooling (Harbeck and Meyers, 1970).

Convection transfers heat between the stream and the air via molecular and turbulent conduction (Beschta and Weatherred, 1984). Heat is transferred in the direction of warmer to cooler. Air can have a warming influence on the stream when the stream is cooler. The opposite is also true. The amount of convective heat transfer between the stream and air is low (Parker and Krenkel, 1969; Brown, 1983).

Depending on streambed composition, shallow streams (less than 20 cm) may allow solar radiation to warm the streambed (Brown, 1969). Large cobble (> 25 cm diameter) dominated streambeds in shallow streams may store and conduct heat as long as the bed is warmer than the stream. Bed conduction may cause maximum stream temperatures to occur later in the day, possibly into the evening hours. The instantaneous heat transfer rate experienced by the stream is the summation of the individual processes:

$$\Phi_{Total} = \Phi_{Solar} + \Phi_{Longwave} + \Phi_{Evaporation} + \Phi_{Convection} + \Phi_{Conduction} \,.$$

Solar Radiation (Φ_{Solar}) is a function of the solar angle, solar azimuth, atmosphere, topography, location and riparian vegetation. Simulation is based on methodologies developed by Ibqal (1983) and Beschta and Weatherred (1984). *Longwave Radiation* ($\Phi_{Longwave}$) is derived by the Stefan-Boltzmann Law and is a function of the emissivity of the body, the Stefan-Boltzmann constant and the temperature of the body (Wunderlich, 1972). *Evaporation* ($\Phi_{Evaporation}$) relies on a Dalton-type equation that utilizes an exchange coefficient, the latent heat of vaporization, wind speed, saturation vapor pressure and vapor pressure (Wunderlich, 1972). *Convection* ($\Phi_{Convection}$) is a function of Bowen's Ratio (1926) and terms include atmospheric pressure, and water and air temperatures. *Bed Conduction* ($\Phi_{Conduction}$) simulates the theoretical relationship ($\Phi_{Conduction} = K \cdot dT_b / dz$), where calculations are a function of thermal conductivity of the bed (K) and the temperature gradient of the bed (dT_b/dz) (Sinokrot and Stefan, 1993). Bed conduction is solved with empirical equations developed by Beschta and Weatherred (1984).

MECHANICS OF SHADE

Stream surface shade is a function of several landscape and stream geometric relationships. Some of the factors that influence shade are listed in **Table 4**. Geometric relationships important for understanding the mechanics of shade are displayed in **Figure 3**. In the Northern Hemisphere, the earth tilts on its axis toward the sun during summertime months allowing longer day length and higher solar altitude, both of which are functions of solar declination (i.e. a measure of the earth's tilt toward the sun). Geographic position (i.e. latitude and longitude) fixes the stream to a position on the globe, while aspect provides the stream/riparian orientation. Riparian height, width and density describe the physical barriers between the stream and sun that can attenuate incoming solar radiation (i.e. produce shade). The solar position has a vertical component (i.e. altitude) and a horizontal component (i.e. azimuth) that are both functions of time/date (i.e. solar declination) and the earth's rotation (i.e. hour angle). While the interaction of these shade variables may seem complex, the math that describes them is relatively straightforward geometry, much of which was developed decades ago by the solar energy industry.

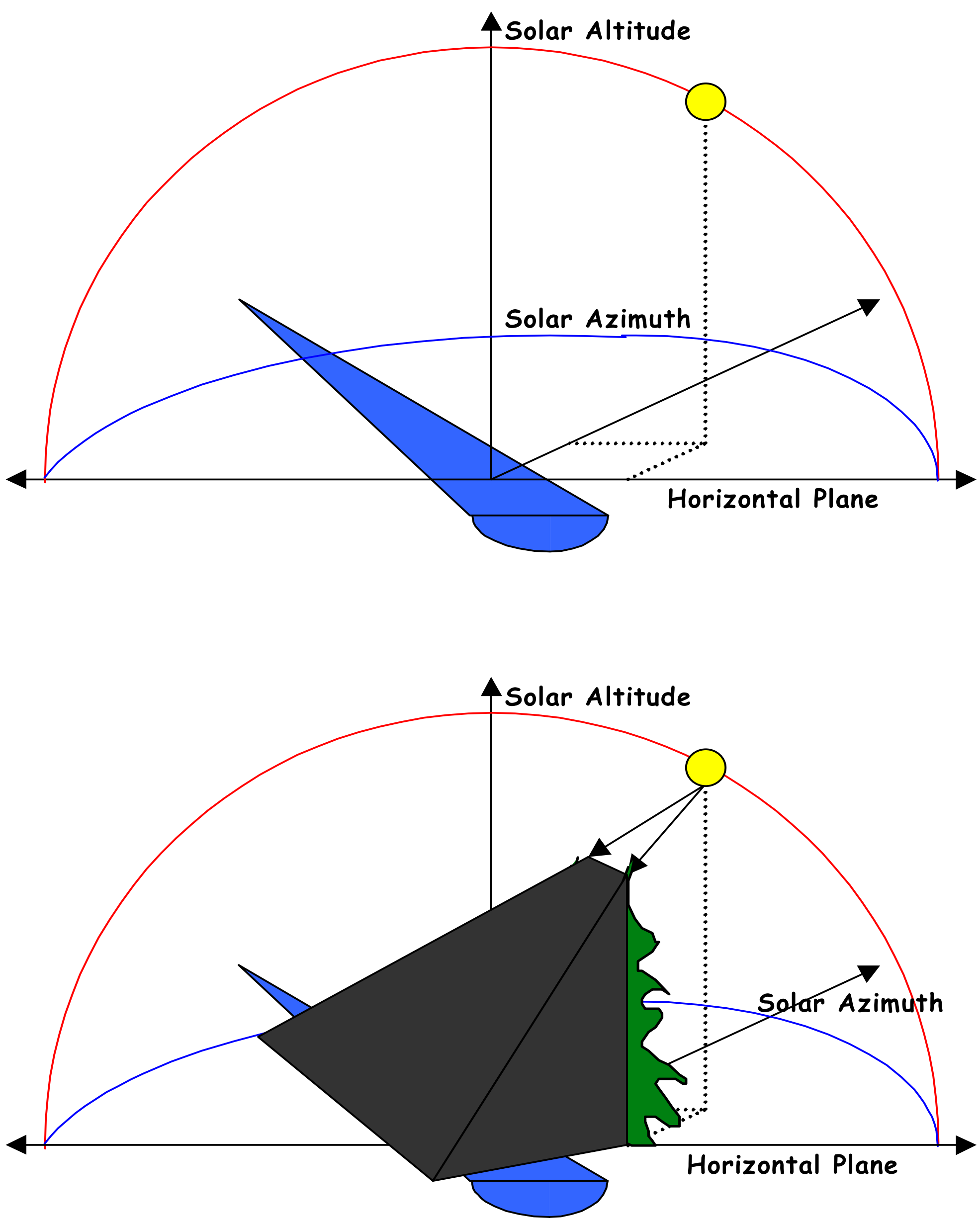
Table 4. Factors that Influence Stream Surface Shade

Description	Measure
Season	Date
Stream Characteristics	Aspect, Bankfull Width
Geographic Position	Latitude, Longitude
Vegetative Characteristics	Buffer Height, Buffer Width, Buffer Density
Solar Position	Solar Altitude, Solar Azimuth

Figure 3. Geometric Relationships that Affect Stream Surface Shade

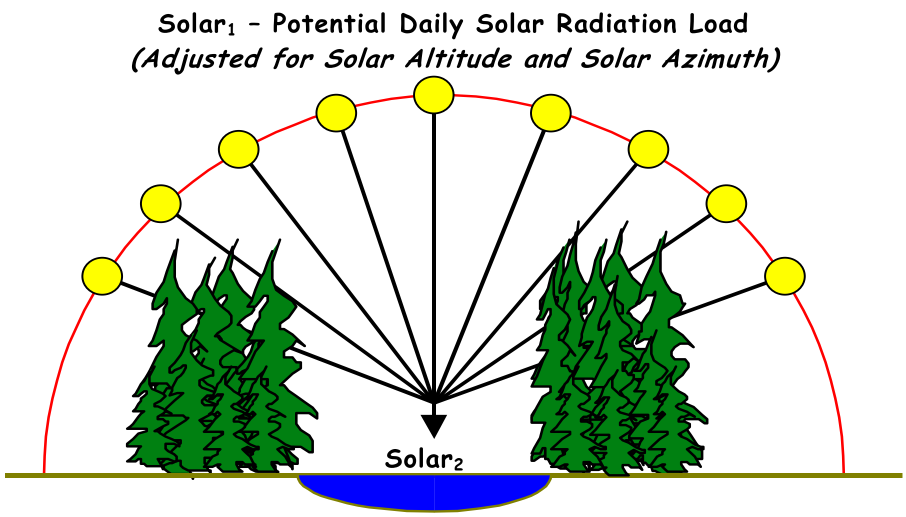
Solar Altitude and **Solar Azimuth** are two basic measurements of the sun's position. When a stream's orientation, geographic position, riparian condition and solar position are known, shadeing characteristic can be simulated.

Solar Altitude measures the vertical component of the sun's position
Solar Azimuth measures the horizontal component of the sun's position



The percent effective shade is perhaps one of the easiest and straightforward stream parameters to monitor/calculate and is most helpful in directing water quality management and recovery efforts. **Figure 4** demonstrates how effective shade is monitored/calculated. Using solar tables or mathematical simulations, the *potential daily solar load* can be quantified. The *measured solar load at the streams surface* can easily be measured with a Solar Pathfinder© or estimated using mathematical shade simulation computer programs (Boyd, 1996 and Park, 1993).

Figure 4. Effective Shade Defined



Effective Shade Defined:

$$\text{Effective Shade} = \frac{(Solar_1 - Solar_2)}{Solar_1}$$

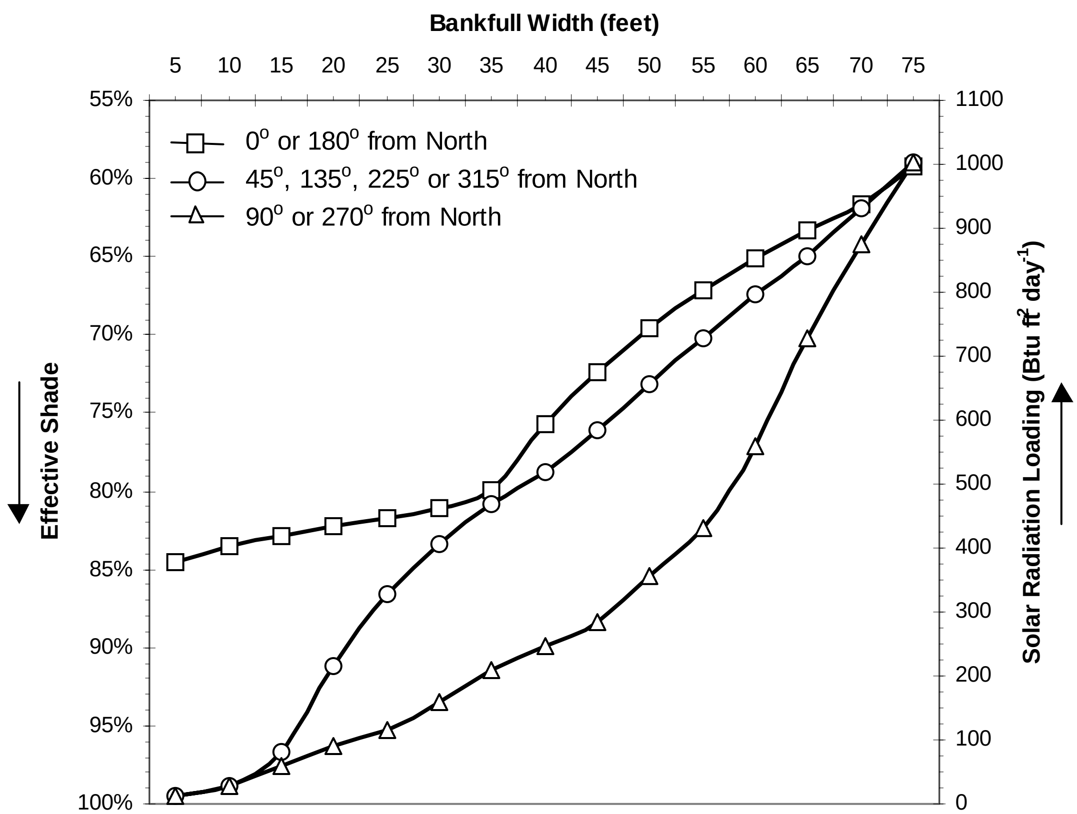
Where,

$Solar_1$: Potential Daily Solar Radiation Load
$Solar_2$: Measured Daily Solar Radiation Load at Stream Surface

Site potential effective shade and solar radiation loading were simulated for various channel widths (bankfull). Site potential vegetation is assumed to be late seral Douglas fir. In the Sucker/Grayback Watershed, undisturbed riparian areas generally progress towards late seral woody vegetation communities (mixed hardwood, but conifer dominated). Few, if any, riparian areas in the Sucker/Grayback are unable to support either late seral woody vegetation or tall growing herbaceous vegetation. Further, the climate and topography are well suited for growth and maintenance of large woody vegetative species in the riparian areas. **Figure 5** shows the simulated percent effective shade (as defined in **Figure 4**) and solar radiation load that result when site potential riparian conditions are achieved.

Figure 5. Site Potential Effective Shade and Solar Radiation Loading Based on Bankfull Channel Width and Stream Orientation (Aspect) for Late July and Early August

Site Potential Riparian Vegetation
Buffer Height: 120 feet
Buffer Width: 200 feet
Buffer Density: 65%



3. TARGET IDENTIFICATION - APPLICABLE WATER QUALITY STANDARDS

The Oregon Environmental Quality Commission has adopted numeric and narrative water quality standards to protect designated *beneficial uses*. In practice water quality standards have been set at a level to protect the most sensitive uses and seasonal standards may be applied for uses that do not occur year round. Cold-water aquatic life such as salmon and trout are often the most sensitive *beneficial uses* in Sucker/Grayback Watershed. In this forested watershed, concerns related to the effects of excessive water temperatures on rearing of salmonid fish been well documented.

Temperature: OAR 340-41-365(1)(b)(A)
The seven day moving average of the daily maximum shall not exceed the following values unless specifically allowed under a Department-approved basin surface water management plan:

64°F (17.8°C) June 1 – Sept. 30
-or-
55°F (12.8°C). October 1 – May 31

Where **55°F (12.8°C)** applies during times and in waters that support salmon spawning, egg incubation and fry emergence from the egg and from the gravel.

Habitat and Flow Modification: OAR 340-41-365(2)(i)
The creation of tastes of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish shall not be allowed.

4. DEVIATION FROM TARGETS – EXISTING CONDITIONS

OBSERVED LONGITUDINAL STREAM HEATING

Generally, stream temperatures follow a longitudinal (downstream) heating pattern, where smaller tributaries are cooler than the mainstem reaches of Sucker Creek and Grayback Creek. **Figure 6** displays stream heating as a function of measured perennial stream distance from headwaters. Headwater temperatures are near groundwater temperatures (51°F to 53°F) and warm roughly 20°F over the 25 miles of perennial stream length to the Sucker Creek/Illinois River confluence.

Image 3. Sucker/Grayback Stream Temperature *(1992 to 1997)*

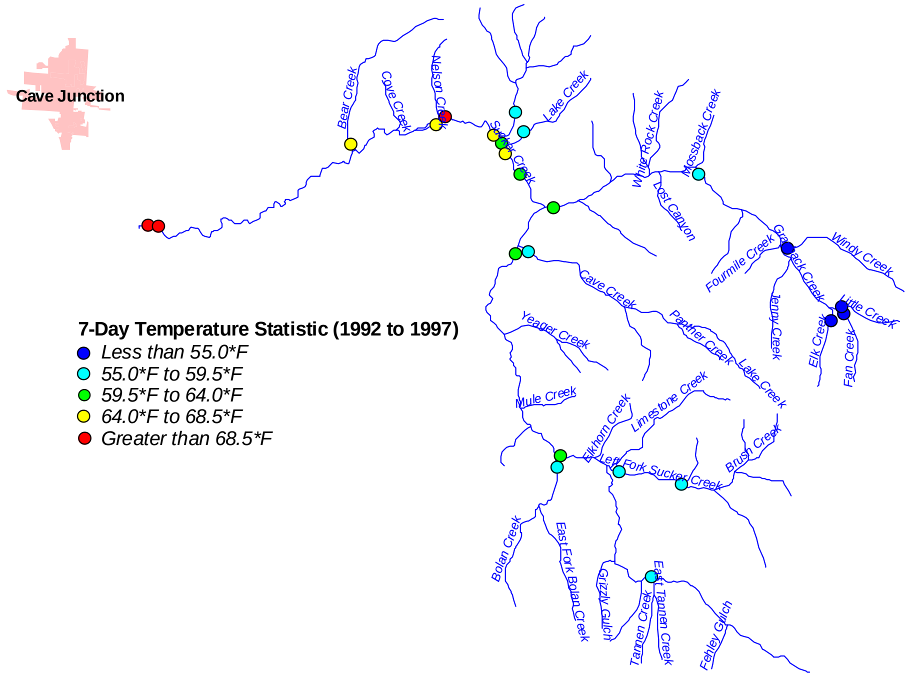
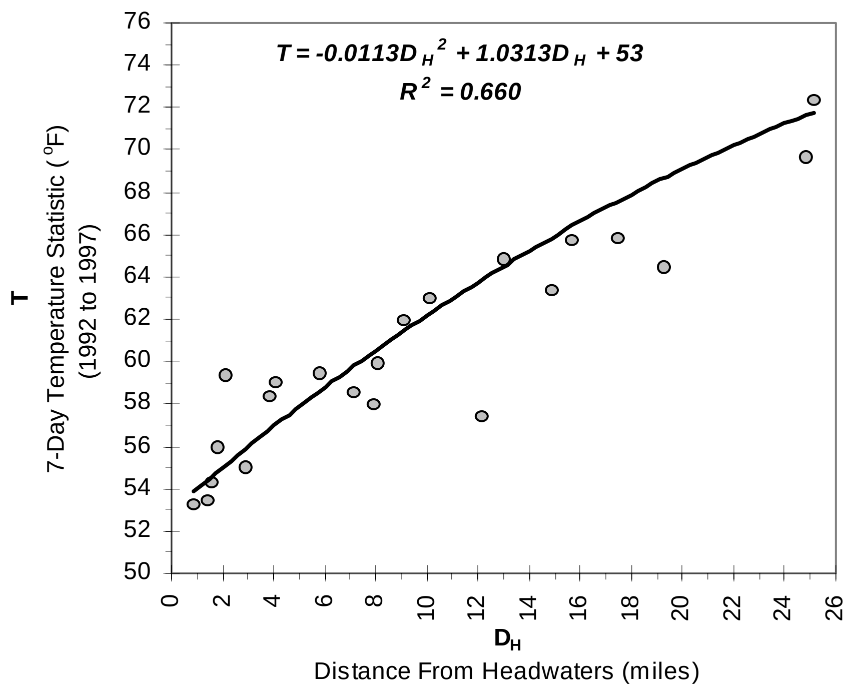


Figure 6. Longitudinal Stream Heating Curve – Seven Day Statistic Values Related to Distance from Headwaters
(1992 to 1997)

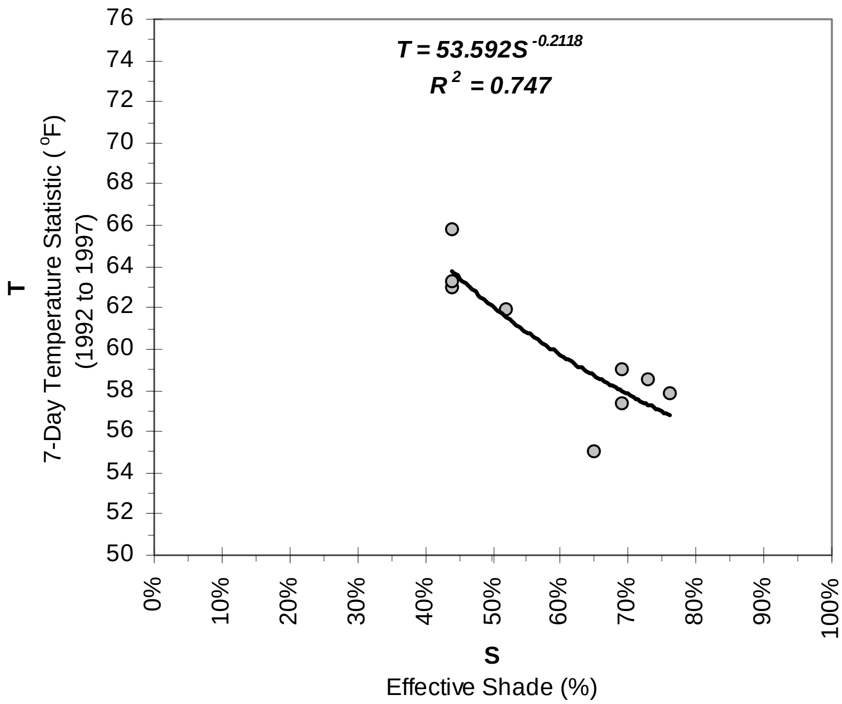


SHADE RELATED TO OBSERVED LONGITUDINAL STREAM HEATING

Longitudinal heating is a natural process. However, rates of heating are dramatically reduced when high levels of shade exist and solar radiation loading is minimal. The overriding justification for the solar loading reduction (loading capacity) is to minimize longitudinal heating. A limiting factor in reducing longitudinal stream heating is the site potential effective shade level (see **Figure 5**).

Statistical analysis of the temperature data that fall within stream reaches that have known effective shade levels (n=10) demonstrates an inverse relationship is apparent. High effective shade levels correspond to cooler 7-day stream temperature values (**Figure 7**). Stream temperature may also exhibit a threshold condition in which slight reductions in effective shade allow considerable stream heating. Dramatic stream temperature increase is possible when the stream surface moves from a highly shaded condition to partial shade.

Figure 7. Effective Shade and Observed Stream Heating (1992 to 1997)



5. TMDL – Loading Capacities and Surrogate Measures (Allocations)

Loading Capacities

Regulatory Framework

Under the current regulatory framework for development of TMDLs, identification of the loading capacity is an important first step. The loading capacity provides a reference for calculating the amount of pollutant reduction needed to bring water into compliance with standards. By definition, TMDLs are the sum of the allocations [40 CFR 130.2(i)]. Allocations are defined as the portion of a receiving water loading capacity that is allocated to point or nonpoint sources and natural background. EPA's current regulation defines loading capacity as "*the greatest amount of loading that a water can receive without violating water quality standards*."

Solar Radiation Loading Capacities

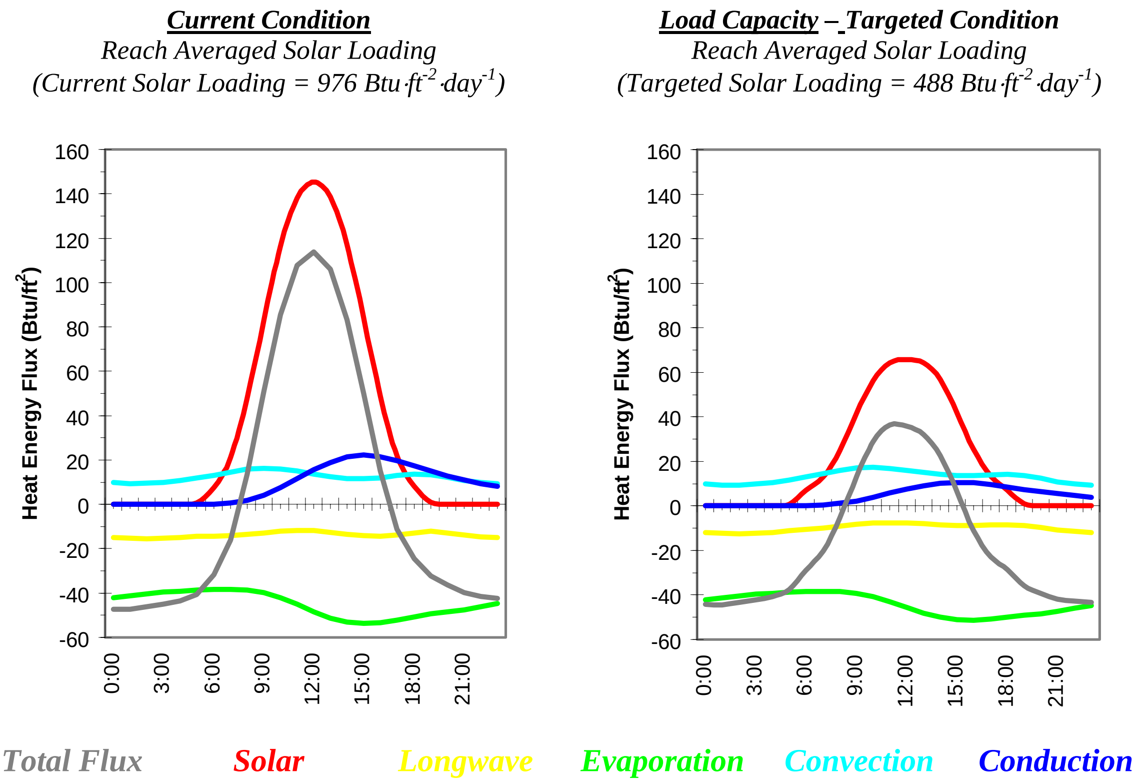
Loading capacities in the Sucker/Grayback Watershed are heat from incoming solar radiation expressed as Btu/ft^2 per day. Analysis of heat transfer processes indicate that water temperatures increase above natural daily fluctuations when the heat load from solar radiation is above 488 Btu/ft^2 per day. Recognition of site potential has been given. Streams in which climax solar loading has been determined are allocated site potential solar loading capacities. **Table 5** lists the site potential loading capacities for the Sucker/Grayback Watershed. Streams that are not listed in **Table 5** do not have a site potential analysis completed, and therefore, are assigned the 488 Btu/ft^2 per day solar radiation loading capacity. **Figure 5** (site potential effective shade and solar radiation loading based on bankfull channel width and stream orientation for late July and early August) can be used to determine site potential loading capacity and effective shade conditions for those streams in the Sucker/Grayback Watershed lacking a site potential analysis.

In terms of water temperature increases, the principle source of heat energy is solar radiation directly striking the stream surface. **Figure 8** illustrates the total energy budget for Sucker/Grayback streams in the *reach averaged* current condition (Current Solar Loading = 976 Btu·ft^{-2}·day^{-1}) and the targeted loading capacity condition (Solar Loading Capacity = 488 Btu·ft^{-2}·day^{-1}). Note that the targeted solar loading capacity condition results in significant diurnal heat energy reductions. **Figure 8** clearly shows solar radiation is the predominant heat energy process in the current condition simulation. The simulated loading capacity (targeted condition) is also displayed in **Figure 8**, where a significant reduction in the diurnal (daily) solar radiation load is apparent.

Table 5. Loading Capacity – Summertime Solar Radiation Loading						
			Loading Capacity			
Perennial Stream Reach	*Contributing Flow (%)*	***Current Condition*** *Solar Load (Btuft⁻²day⁻¹)*	***Site Potential*** *Solar Load (Btuft⁻²day⁻¹)*	*Required Solar Load Decrease (%)*	*Nonpoint Source of Pollutant*	*Time for Load Capacity Attainment (years)*
Sucker Creek	N/A	1171	1147	2%	Harvest	60
Sucker Creek (Grayback to Yeager)	N/A	1171	854	34%	Mining	100
Tannen Creek	30	342	268	27%	Harvest	10
Deadhorse Creek	15	561	342	64%	Harvest	45
Grizzly Creek	17	439	268	64%	Harvest	35
LF Sucker Creek	30	756	366	107%	Harvest	50
Limestone Creek	6	781	268	191%	Harvest	50
Bolan Creek	20	586	464	26%	Harvest	35
Cohen Creek	5	1464	293	400%	Harvest	50
Yeager Creek	7	659	268	145%	Harvest	35
Cave Creek	20	659	366	80%	Harvest	50
Grayback Creek	N/A	1366	1049	30%	Harvest	45
Fan Creek	20	1440	342	321%	Harvest	45
Little Creek	30	1708	342	400%	Harvest	45
Jenny Creek	30	1147	512	124%	Harvest	50
Windy Creek	25	854	537	59%	Harvest	50
Four Mile Creek	27	1781	1025	74%	Harvest	45
White Rock Creek	15	903	342	164%	Harvest	50
Lost Canyon Cr.	5	1122	756	48%	Harvest	50
All other tributaries*	N/A	N/A	488	N/A	N/A	N/A

* Streams without site potential analysis.

Figure 8. Simulated Daily Heat Energy Balance



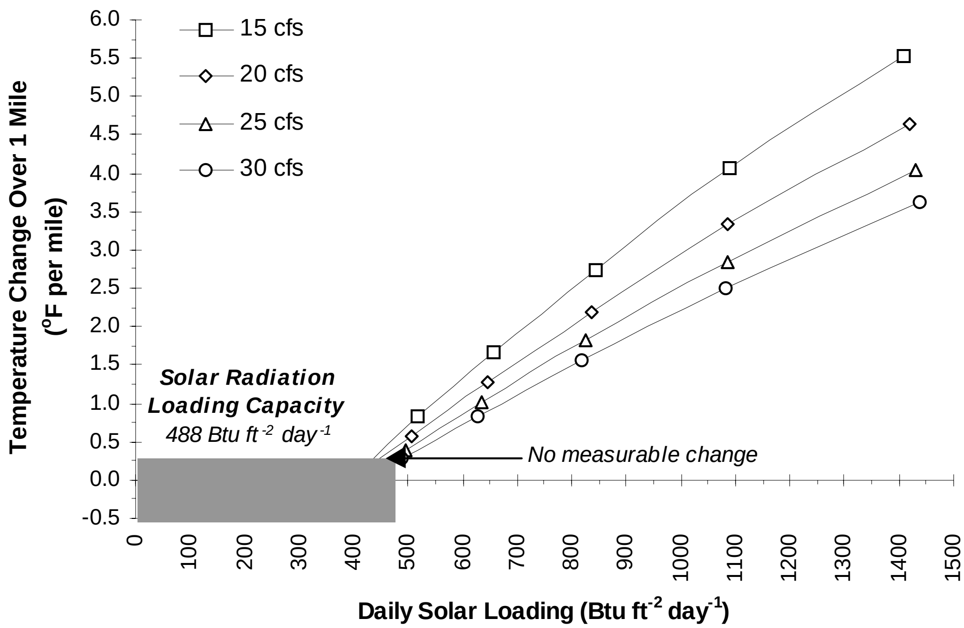
Water Quality Attainment - Temperature Change Related to Solar Loading Capacities

Using mathematical relationships, the rate of change in water temperature over one mile of stream length can be estimated (Boyd 1996). Relationships include both the total energy transfer rates to the stream (i.e. the sum of heat energy transfer processes) and the response of water temperature to heat energy absorbed. Heat transfer processes considered in the analysis include solar radiation, longwave (thermal) radiation, convection, evaporation and streambed conduction. This analysis has been developed using typical streamflows and channel characteristics commonly found in the Sucker/Grayback Watershed as well as conservative assumptions described in the margin of safety discussion.

Figure 9 displays simulated stream temperature change results. No measurable increase in stream temperature occurs when solar radiation loads are less than the loading capacity (Targeted Solar Loading = 488 Btu·ft^{-2}·day^{-1}). As demonstrated by simulation results, stream heating is a function of streamflow. Lower flows correspond to increased stream heating. Solar radiation loading of 488 Btu·ft^{-2}·day^{-1} represents a reasonable starting point for defining loading capacity (i.e. the greatest amount of loading that surface waters can receive without violating water quality standards). Average flat plane solar radiation loads above the riparian canopy in late July to early August are on the order of 2440

Btu·ft^{-2}·day^{-1}. This 80% reduction in potential solar radiation load delivered to the water surface defines another target (*or "appropriate measure*") which can be used for TMDL development.

Figure 9. Effect of Solar Radiation Loads on Water Temperature



SURROGATE MEASURES (ALLOCATIONS)

Regulatory Framework

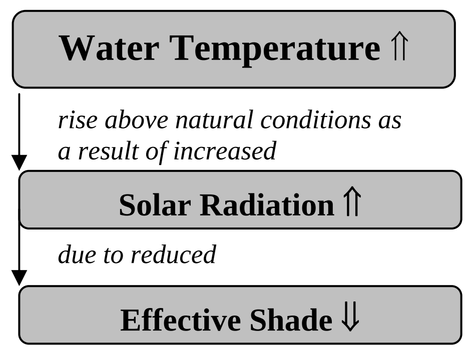
The Sucker/Grayback TMDL uses measures other than *"daily loads"* to fulfill requirements of 303(d). Although a loading capacity for heat energy is derived (488 Btu·ft^{-2}·day^{-1}), it is of limited value in guiding management activities needed to solve identified water quality problems. In addition to heat energy loads, the Sucker/Grayback TMDL uses *"other appropriate measures"* (or surrogates) as provided under EPA regulations [40 CFR 130.2(i)].

The *Report of Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program"* (FACA Report, July 1998) offers a discussion on the use of surrogate measures for TMDL development. The FACA Report (Appendix G) indicates:

> *"When the impairment is tied to a pollutant for which a numeric criterion is not possible, or where the impairment is identified but cannot be attributed to a single traditional "pollutant," the state should try to identify another (surrogate) environmental indicator that can be used to develop a quantified TMDL, using numeric analytical techniques where they are available, and best professional judgment (BPJ) where they are not. The criterion must be designed to meet water quality standards,*

> *including the waterbody's designated uses. The use of BPJ does not imply lack of rigor; it should make use of the "best" scientific information available, and should be conducted by "professionals." When BPJ is used, care should be taken to document all assumptions, and BPJ-based decisions should be clearly explained to the public at the earliest possible stage.*
>
> *If they are used, surrogate environmental indicators should be clearly related to the water quality standard that the TMDL is designed to achieve. Use of a surrogate environmental parameter should require additional post-implementation verification that attainment of the surrogate parameter results in elimination of the impairment. If not, a procedure should be in place to modify the surrogate parameter or to select a different or additional surrogate parameter and to impose additional remedial measures to eliminate the impairment."*

As discussed, water temperature warms as a result of increased solar radiation loads. A loading capacity for heat (i.e. incoming solar radiation) can be used to define a reduction target. This reduction target forms the basis for identifying surrogates. The specific surrogate used is percent effective shade (expressed as the percent reduction in potential solar radiation load delivered to the water surface). The decreased effective shade is the result of a lack of adequate riparian vegetation available to reduce sunlight (i.e. incoming solar radiation).



Because factors that affect water temperature are interrelated, the surrogate measure (percent effective shade) relies on restoring/protecting riparian vegetation to increase stream surface shade levels, reduce stream bank erosion and stabilize channels. Likewise, narrower channels still require riparian vegetation to provide channel stability and shade, thus reducing heat loads (unless confined by canyon walls or shaded by topography).

Effective shade screens the water's surface from direct rays of the sun. Highly shaded streams often experience cooler stream temperatures due to reduced input of solar energy (Brown 1969, Beschta et al 1987, Holaday 1992, Li et al 1994). Stream surface shade is dependent on topography as well as riparian vegetation type, condition, and shade quality. Over the years, the term shade has been used in several contexts, including its components such as shade angle or shade density. For purposes of this TMDL, shade is defined as the percent reduction of potential solar radiation load delivered to the water surface. Thus, the role of effective shade in this TMDL is to prevent or reduce heating by solar radiation.

Effective Shade Surrogate Measures (Allocations)

Allocations in the Sucker/Grayback Watershed TMDL are derived using heat loads. Percent effective shade (surrogate measure) can be linked to specific areas and, thus, to management action needs to solve problems that cause water temperature increases (Park 1993). Sucker/Grayback Watershed allocations are listed in **Table 6**.

Perennial Stream Reach	*Contributing Flow (%)*	***Current Condition** Effective Shade (%)*	**Allocated**** ***Site Potential*** *Effective Shade (%)*	*Required Increased Effective Shade (%)*	*Nonpoint Source of Pollutant*	*Time for Surrogate Measure Attainment (years)*
Sucker Creek	N/A	52	53	1	Harvest	60
Sucker Creek (Grayback to Yeager)		52	65	13	Mining	100
Tannen Creek	30	86	89	3	Harvest	10
Deadhorse Creek	15	77	86	9	Harvest	45
Grizzly Creek	17	82	89	7	Harvest	35
LF Sucker Creek	30	69	85	16	Harvest	50
Limestone Creek	6	68	89	21	Harvest	50
Bolan Creek	20	76	81	5	Harvest	35
Cohen Creek	5	40	88	48	Harvest	50
Yeager Creek	7	73	89	16	Harvest	35
Cave Creek	20	73	85	12	Harvest	50
Grayback Creek	N/A	44	57	13	Harvest	45
Fan Creek	20	41	86	45	Harvest	45
Little Creek	30	30	86	56	Harvest	45
Jenny Creek	30	53	79	26	Harvest	50
Windy Creek	25	65	78	13	Harvest	50
Four Mile Creek	27	27	58	31	Harvest	45
White Rock Creek	15	63	86	23	Harvest	50
Lost Canyon Cr.	5	54	69	15	Harvest	50
All other tributaries*	N/A	N/A	80%	N/A	N/A	N/A

** Sites < 80% based on optimum management practices to achieve maximum site potential
* Streams without site potential analysis.

Image 4. Effective Shade - Current Conditions

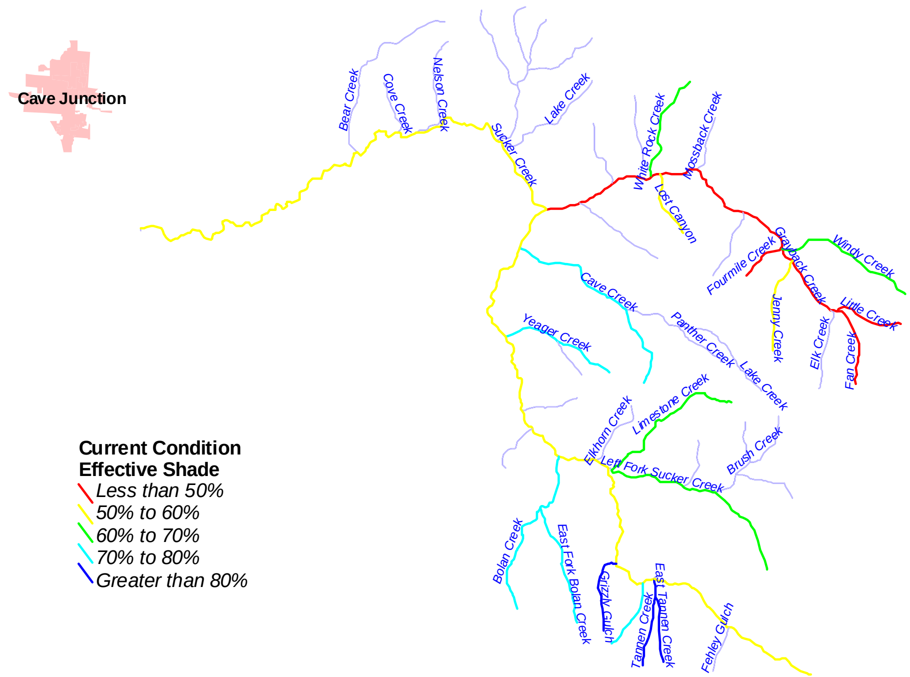
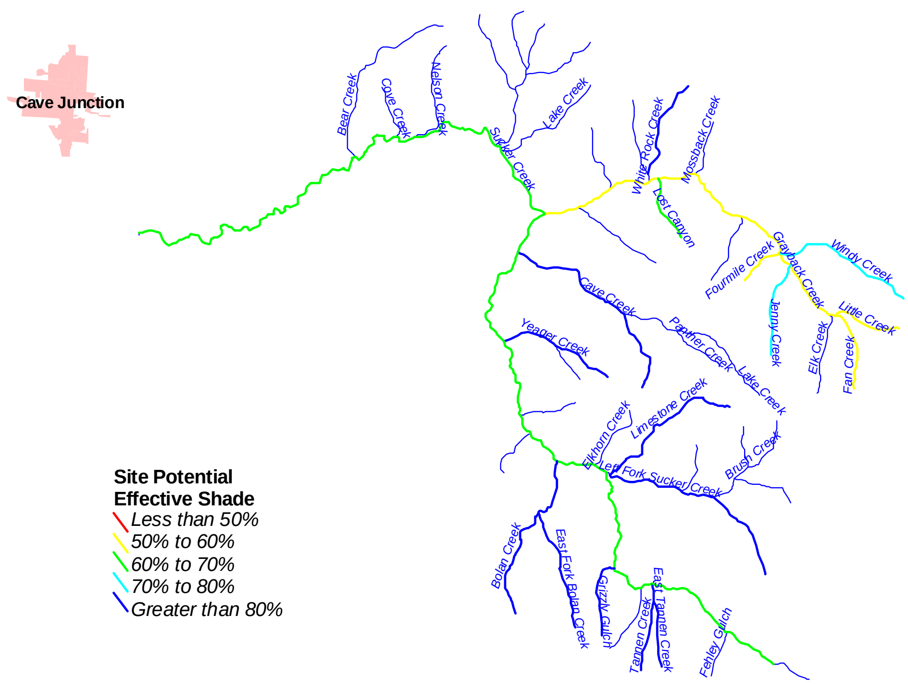


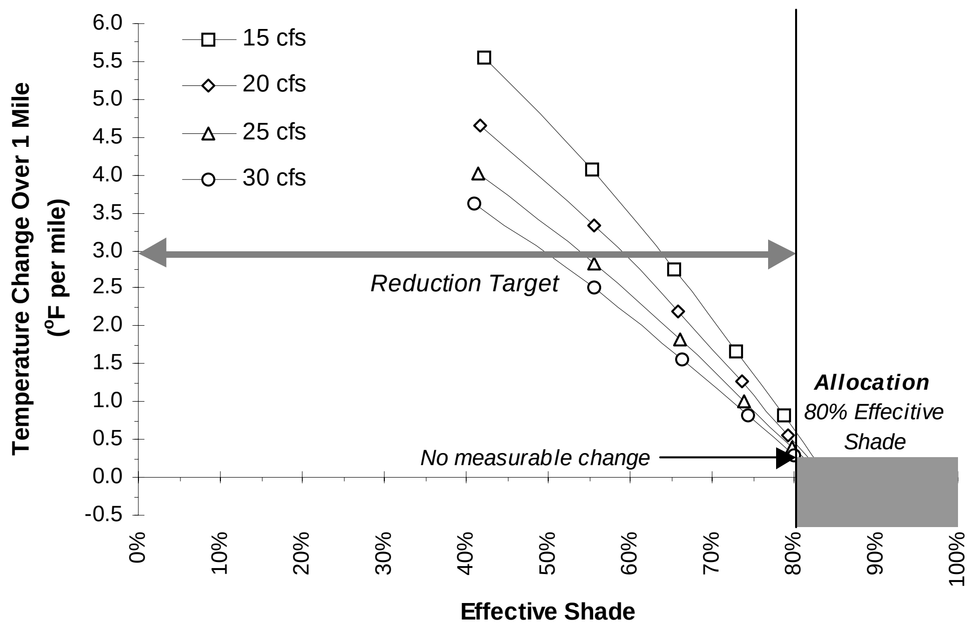
Image 5. Effective Shade - Site Potential



Water Quality Attainment - Temperature Change Related to Shade Surrogate Measures

Figure 10 illustrates the same concept discussed earlier regarding the effect of solar radiation loads on stream temperatures. However, the information is presented in a manner consistent with the definition of effective shade in this TMDL (i.e. the percent reduction of potential solar radiation load delivered to the water surface). This provides an alternative target (or surrogate) which relates to stream temperatures, in this case, an 80% reduction in potential solar radiation delivered to the water surface (i.e. 80% effective shade).

Figure 10. Effective Shade (Allocation - Surrogate Measure) and Water Temperature Change



Stream temperature simulation results, presented in **Figure 10**, clearly demonstrate that decreasing levels of solar radiation can have a drastic stream cooling effect. Language that is more precise would describe the effect of decreased solar loads as preventing stream temperature increases. Simulation results suggest that thermal conditions in the Sucker/Grayback Watershed can have vastly different temperature regimes when adequate riparian protection measures are implemented. This conclusion is consistent with *all* temperature modeling efforts for other waterbodies in the Pacific Northwest (Brown, 1969; Beschta and Weatherred, 1984; Sullivan and Adams, 1990; Boyd, 1996;).

It should be noted that this modeling exercise solely focused on solar radiation as a function of riparian vegetation and the shade it provides the stream. Additional parameters that are related to riparian vegetation that affect stream temperature are wind effects and possible summertime flow augmentation by increasing the volume of water stored in riparian areas (see **MARGIN OF SAFETY**). In essence, excluding wind effects and flow changes as they relate to riparian vegetation condition almost certainly underestimates the cooling attributed to allocated riparian restoration scenarios.

6. MARGIN OF SAFETY

The Clean Water Act requires that each TMDL be established with a margin of safety (MOS). The statutory requirement that TMDLs incorporate a margin of safety is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. A margin of safety is expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions or effectiveness of proposed management actions).

The margin of safety may be implicit, as in conservative assumptions used in calculating the loading capacity, WLAs, and LAs. The margin of safety may also be explicitly stated as an added, separate quantity in the TMDL calculation. In any case, assumptions should be stated and the basis behind the margin of safety documented. The margin of safety is not meant to compensate for a failure to consider known sources. **Table 7** presents six approaches for incorporating a margin of safety into TMDLs.

Table 7. Approaches for Incorporating a Margin of Safety into a TMDL

Type of Margin of Safety	Available Approaches
Explicit	1. Set numeric targets at more conservative levels than analytical results indicate 2. Add a safety factor to pollutant loading estimates 3. Do not allocate a portion of available loading capacity; reserve for MOS
Implicit	4. Conservative assumptions in derivation of numeric targets 5. Conservative assumptions when developing numeric model applications 6. Conservative assumptions when analyzing prospective feasibility of practices and restoration activities.

The following factors may be considered in evaluating and deriving an appropriate margin of safety:

- ✓ The limitations in available data in characterizing the waterbody and the pollutant and addressing the components of the TMDL development process.
- ✓ The analysis and techniques used in evaluating the components of the TMDL process and deriving an allocation scheme.
- ✓ Characterization and estimates of source loading (e.g., confidence regarding data limitation, analysis limitation or assumptions)
- ✓ Analysis of relationships between the source loading and instream impact.
- ✓ Prediction of response of receiving waters under various allocation scenarios. (e.g., the predictive capability of the analysis, simplifications in the selected techniques)
- ✓ Expression of analysis results in terms of confidence intervals or ranges. Confidence may be addressed as a cumulative effect on the load allocation or for each of the individual components of the analysis.
- ✓ The implications of the MOS on the overall load reductions identified in terms of reduction feasibility and implementation time frames.

ADAPTIVE MANAGEMENT

Establishing TMDLs employs a variety of analytical techniques. Some analytical techniques are widely used and applied in evaluation of source loading and determination of the impacts on waterbodies. For certain pollutants, such as heat, the methods used are newer or in development. The selection of analysis techniques is based on scientific rationale coupled with interpretation of observed data. Concerns regarding the appropriateness and scientific integrity of the analysis have been defined and the approach for verifying the analysis through monitoring and implementation addressed. Without the benefit of long term experience and testing of the methods used to derive TMDLs, the potential for the estimate to require refinement is high.

A TMDL and margin of safety, which is reasonable and results in an overall allocation, represents the best estimate of how standards can be achieved. The selection of the MOS should clarify the implications for monitoring and implementation planning in refining the estimate if necessary (adaptive management). The TMDL process accommodates the ability to track and ultimately refine assumptions within the TMDL implementation-planning component.

The Sucker/Grayback TMDL is intended to be adaptive in management implementation. This plan allows for future changes in loading capacities and surrogate measures (allocations) in the event that scientifically valid reasons demand alterations. It is important to recognize the continual study and progression of understanding of water quality parameters addressed in this TMDL/WQMP (stream temperature, habitat and flow). The Sucker/Grayback WQMP addresses future monitoring plans. In the event that data show that changes are warranted in the Sucker/Grayback TMDL or WQMP, these changes will be made by Oregon DEQ, USFS and BLM.

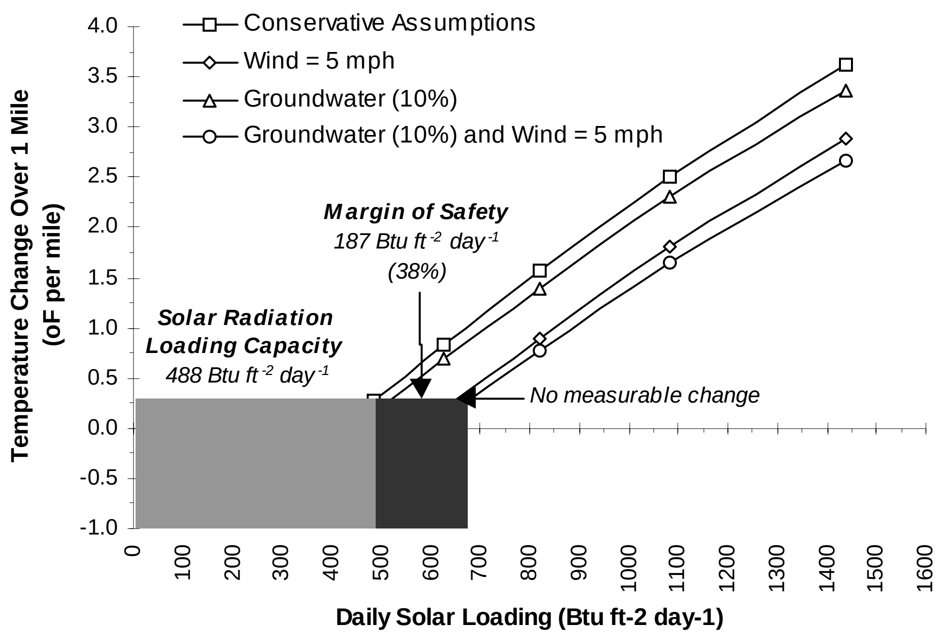
ASSUMPTIONS

Description of the margin of safety for the Sucker/Grayback Watershed TMDL begins with a statement of assumptions. A margin of safety has been incorporated into the temperature assessment methodology. Conservative estimates for groundwater inflow and wind speed were used in the load capacity and surrogate measure (allocation) temperature simulations. Specifically, zero groundwater inflow and zero wind speed (mph). Recall that groundwater directly cools stream temperatures via mass transfer/mixing. Wind speed is a controlling factor for evaporation, a cooling heat energy process. To calculate a numeric margin of safety, additional stream temperature change simulations have been performed and results are presented in **Table 8** and **Figure 11**.

Table 8. Margins of Safety

Potential Source of Cooling	*Allowable Solar Radiation Loading Capacity*	*Margin of Safety*
Conservative Loading Capacity	488 Btu ft^{-2} day^{-1}	0%
Groundwater Inflow (10% of Streamflow)	525 Btu ft^{-2} day^{-1}	8%
Wind Speed (5 mph)	650 Btu ft^{-2} day^{-1}	33%
Groundwater Inflow (10% of Streamflow) *-and-* Wind Speed (5 mph)	675 Btu ft^{-2} day^{-1}	38%

Figure 11. Stream Temperature Change for Margins of Safety



7. SEASONAL VARIATION

Section 303(d)(1) requires this TMDL to be "established at a level necessary to implement the applicable water quality standard with seasonal variations." Both stream temperature and flow vary seasonally from year to year. Water temperatures are coolest in winter and early spring months. Winter water temperature levels decrease dramatically from summer values, as river flows increase and available solar energy is at an annual minimum. Stream temperatures exceed State water quality standards in summer and early fall salmonid rearing months (June, July, August and September). Warmest stream temperatures correspond to prolonged solar radiation exposure, warm air temperature, low flow conditions and decreased groundwater contribution. These conditions occur during late summer and early fall and promote the warmest seasonal instream temperatures. The analysis presented in this TMDL is performed during summertime periods in which controlling factors for stream temperature are most critical.

8. PUBLIC PARTICIPATION

Public participation is covered in the WQMP, see page 11. Below is a copy of the notice of public hearing for the draft plan issued November 24, 1998.

A responsiveness summary document (copy submitted with this document) was prepared by DEQ in reply to comments received at the public hearing and written comments received within the comment period.

Notice Of Public Hearing

Oregon Department Of Environmental Quality

Notice Issued: November 24, 1998
Close Of Comment Period: January 15, 1999

Sucker-Grayback Water Quality Management Plan

PUBLIC PARTICIPATION:

Public Hearing
The public hearing will be held in Cave Junction, Or at 7:00 PM on December 9, 1998 in the County Office Building, 102 S. Redwood Hwy.

Written comments:
Written comments on the proposed water quality management plan (WQMP) must be received at the Oregon Department of Environmental Quality (DEQ) by 5 p.m. on January 15, 1999. Written comments should be mailed to Oregon Department of Environmental Quality, Attn: John Blanchard , 201 West Main, Suite 2-D, Medford, Oregon 97501. ***People wishing to send comments via e-mail should be aware that if there is a delay between servers or if a server is not functioning properly, e-mails may not be received prior to the close of the public comment period.*** People wishing to send comments via e-mail should send them in Microsoft Word (through version 97), WordPerfect (through version 6.x) or plain text format. Otherwise, due to conversion difficulties, DEQ recommends that comments be sent in hard copy. E-mails should be sent to: sucker.tmdl@deq.state.or.us

WHO IS PROPOSING AN ACTION	Oregon Department of Environmental Quality 811 SW 6th Avenue Portland, Oregon 97204-1390
AREA COVERED BY ACTION	The Sucker Creek Watershed, including Sucker Creek, Cave Creek, Grayback Creek and several other tributary creeks, within Siskiyou National Forest and the BLM Medford District in Southwest Oregon.
WHAT IS PROPOSED:	DEQ proposes to submit the Sucker-Grayback WQMP to the U.S. Environmental Protection Agency (EPA) for approval as a total maximum daily load (TMDL) for federal lands within the Sucker Creek Watershed. EPA approval would remove water quality limited streams covered by the WQMP from DEQ's "303d" list of impaired waterbodies. The Sucker-Grayback WQMP is based on the Siskiyou National Forest Land and Resource Management Plan and the BLM Medford Resource Management Plan as amended by the Northwest Forest Plan. *This public hearing addresses only the WQMP that is being submitted to EPA.*
WHO IS AFFECTED:	Local public and private land managers, people interested in water quality and fisheries, and people interested in DEQ's implementation of Section 303(d) of the federal Clean Water Act.
NEED FOR ACTION:	Section 303(d) of the federal Clean Water Act requires development of TMDLs for waterbodies included on a state's "303(d)" list. EPA must approve TMDLs submitted by a state.

WHERE TO FIND DOCUMENTS: The WQMP is available for examination and copying at DEQ's Medford Office at Oregon DEQ, 201 West Main, Suite 2-D, Medford, Oregon 97501 and at DEQ's Headquarters Office at Oregon DEQ, Water Quality Division, 811 S.W. 6th Avenue, Portland, OR 97204. Documents are also available on DEQ's web site at http://www.deq.state.or.us. Click on "water quality" then on "water quality program public notices".

While not required, scheduling an appointment will ensure documents are readily accessible during your visit. To schedule an appointment in Medford contact John Blanchard at 541-776-6010, ext. 240 or TTY at 541-776-6105. For an appointment in Portland call Donna Kelly at 503-229-6962 (toll free at 1-800-452-4011) or DEQ's TTY at 503-229-6993. To request copies of the WQMP call John Blanchard or Donna Kelly at the above numbers.

In addition, copies of the WQMP can be found at the following locations:

Siskiyou National Forest Illinois Valley Ranger District at 26568 Redwood Highway, Cave Junction, Oregon 97523. Judy McHugh (541-592-2166) is the Forest Service contact for this location.

Illinois Valley Soil and Water Conservation and Watershed Council office at 102 S. Redwood Highway, Cave Junction, Oregon 97523. Corky Lockard 592-3731 is the contact at this location.

DEQ Grants Pass Office, 510 NW 4th Street, Grants Pass, Oregon 97526. Sherry Brierty 471-2850 is the contact at this location.

Questions on the proposed WQMP should be addressed to John Blanchard at the above phone number or to Dave Powers at 503-229-5988.

WHAT HAPPENS NEXT: DEQ will review and consider all comments received during the public comment period. Following this review, the WQMP may be sent to U.S. EPA for approval as a TMDL or may be modified prior to submission. You will be notified of DEQ's final decision is you present either oral or written comments during the comment period. If you do not comment but wish to receive notification of DEQ's final decision, please call or write DEQ at the above phone numbers/addresses.

ACCOMODATION OF DISABILITIES: DEQ is committed to accommodating people with disabilities. Please notify DEQ of any special physical or language accommodations you may need as far in advance of the hearing date as possible. To make these arrangements, contact Ed Sale at 503-229-5766 or by calling toll free within Oregon at 1-800-452-4011. People with hearing impairments can call DEQ's TTY at 503-229-6993.

ACCESSIBILITY INFORMATION: This publication is available in alternate format (e.g. large print, Braille) upon request. Please contact DEQ Public Affairs at 503-229-5766 or toll free within Oregon 1-800-452-4011 to request an alternate format. People with a hearing impairment can receive help by calling DEQ's TTY at 503-229-6993.

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