Appendix G

SSTEMP Temperature Modeling

Framework Water Quality Restoration Plan and Total Maximum Daily Loads (TMDLs) for the Lake Helena Watershed Planning Area:

Volume II – Final Report

August 31, 2006

Prepared for the Montana Department of Environmental Quality

Prepared by the U.S. Environmental Protection Agency,
Montana Operations Office
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1.0 INTRODUCTION

The Lake Helena Volume I report concluded that Prickly Pear Creek from the confluence of Lump Gulch to the mouth is impaired because of thermal modifications (i.e., increased temperature). To better understand the impairment, temperature in Prickly Pear Creek was modeled with the USGS Stream Segment Temperature Model Version 2.0 (SSTEMP) (Bartholow, 2002). SSTEMP is a simplified, steady-state model capable of predicting the change in temperature along a stream reach. The model simulates the various natural heat flux processes found in a stream such as convection, conduction, and long and short wave radiation. Some of the various user inputs to the model are shown below.

- Hydrology: segment inflow, segment outflow, inflow temperature
- Channel Geometry: segment length, upstream and downstream elevation, wetted width and depth, Manning's "n"
- Meteorology: segment latitude, average daily air temperature, relative humidity, wind speed, ground temperature, thermal gradient, possible sun (percentage), percentage of shade, time of the year

The model predicts mean, minimum, and maximum stream temperatures at a specified reach outflow under steady-state conditions. It also assumes that conditions along the reach – such as air temperature, shade, and channel shape – do not change. "The theoretical basis for the model is strongest for the mean daily temperature" (Bartholow, 2002 p.13). Therefore, mean temperature values were given the most consideration.

The goal of the SSTEMP modeling was to create realistic temperature models under current conditions, to evaluate current condition modeling results against naturally occurring temperature, and to ascertain the relative benefits of restoration measures, such as enhancing riparian vegetation along Prickly Pear Creek. The following sections discuss the setup, calibration, and use of the SSTEMP model.

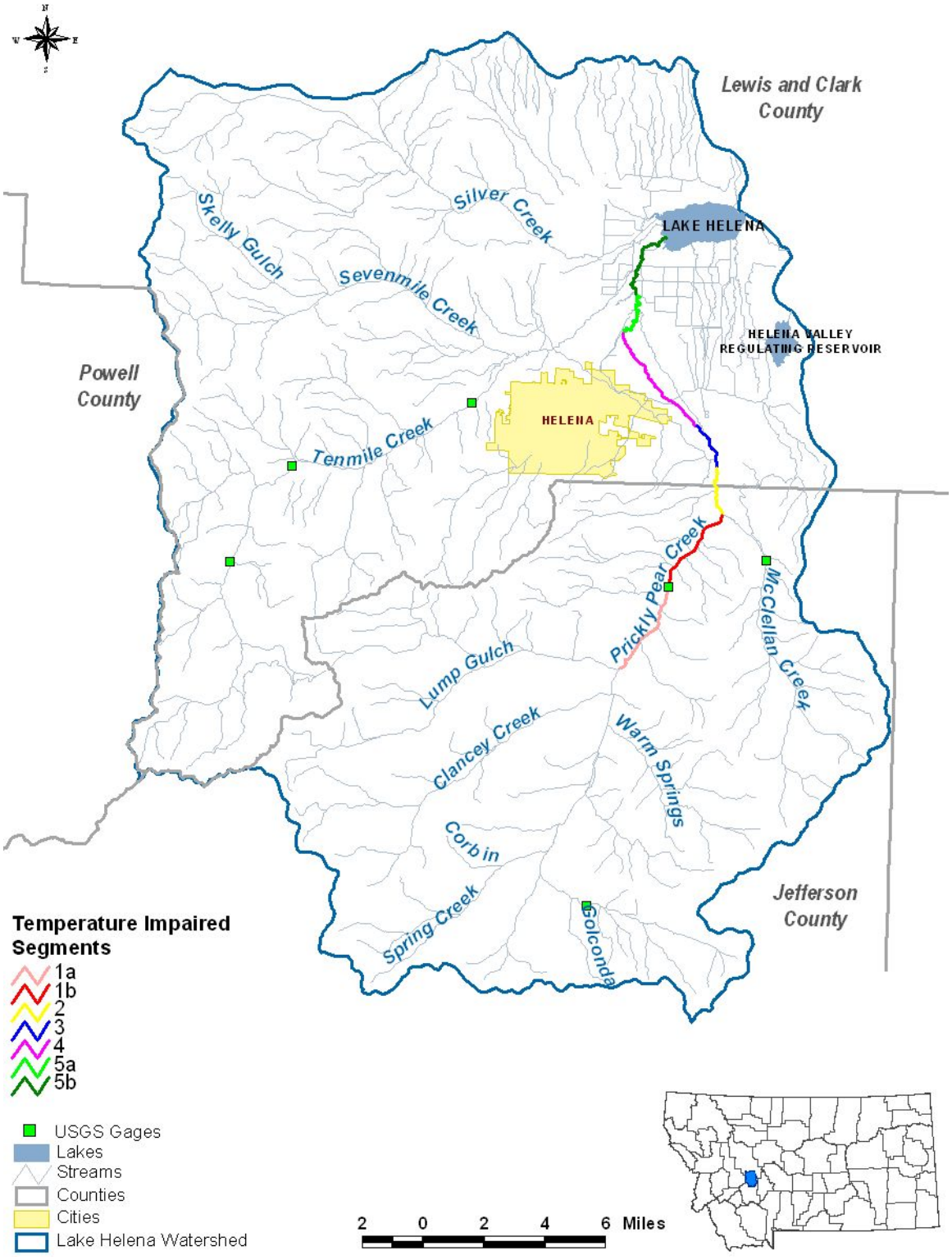

Figure G-1. Segments of Prickly Pear Creek that are temperature impaired.

2.0 MODEL SETUP AND CALIBRATION

SSTEMP is a steady state model, and assumes that stream segments have similar characteristics throughout the modeled reach. However, the impaired portion of Prickly Pear Creek is not homogenous. Characteristics (such as shade, flow, gradient, etc.) vary throughout. Therefore, Prickly Pear Creek was modeled as several smaller segments to account for changes in the reach characteristics. Also, to calibrate the model, segments were delineated to flow and water quality gages. In the end, seven segments were used to calibrate and model temperature in Prickly Pear Creek. (Table G-1; Figure G-1).

Table G-1. Temperature impaired segments of Prickly Pear Creek and the corresponding SSTEMP modeling segments.

303(d) Segment	Modeling Segment	Location
MT41I006_040	Segment 1a	Confluence with Lump Gulch to USGS gage #06061500 (3.5 miles).
	Segment 1b	Confluence with Lump Gulch to confluence with McClellan Creek (6.8 miles).
	Segment 2	Confluence with McClellan Creek to ASARCO Dam (1.7 miles).
	Segment 3	ASARCO Dam to Wylie Drive (1.7 miles).
MT41I006_030	Segment 4	Wylie Drive to Helena Wastewater Treatment Plant discharge (4.3 miles)
MT41I006_020	Segment 5a	Helena Wastewater Treatment Plant to Sierra Road (2.7 miles).
	Segment 5b	Helena Wastewater Treatment Plan to the mouth (5.9 miles).

2.1 Calibration Inputs

After the modeling segments were defined, the model was calibrated to measured conditions in Prickly Pear Creek occurring on August 7, 2003. This date was chosen because there were sufficient calibration data (i.e., segment inflow, segment outflow, air temperature, segment inflow temperature, etc.) collected on or near this date. Also, conditions at that time were representative of critical summer conditions.

SSTEMP input parameters were assigned based on available monitoring data for this date and default parameters suggested in the SSTEMP User's Manual (Bartholow 2002). Input values are shown in Table G-2 and Table G-3. The following sections then describe the rationale for each input value.

Table G-2. SSTEMP input variables for calibration on August 7, 2003.

Input Parameter	Segment 1a	Segment 1b	Segment 2	Segment 3	Segment 4	Segment 5a	Segment 5b
Segment Inflow (cfs)	8.55	8.55	18.9	9.0	3	1.5	1.5
Segment Outflow (cfs)	9.4	9.9	9.0	3.0	1.5	7.5	16.5
Inflow Temperature (ºF)	55	55	64.3	67.2	69.2	59.7	59.7
Accretion Temperature (ºF)	53	53	53	53	53	53	55
Latitude (degrees)	46.51	46.55	46.57	46.59	46.62	46.65	46.66
Dam at Head of Segment	Not checked	Not checked	Not checked	Checked	Not checked	Not checked	Not checked
Segment Length	3.75	7.40	2.28	1.56	5.25	3.03	6.83
Upstream Elevation (ft)	4195	4195	3975	3900	3838	3708	3708
Downstream Elevation (ft)	4067	3975	3900	3838	3708	3677	3650
Width's A Term (s/ft^2)	16.7	16.7	17.0	15.0	14.4	14.8	15.0
B Term	0.098	0.099	0.10	0.11	0.11	0.15	0.19
Manning's n	0.036	0.034	0.032	0.035	0.036	0.035	0.034
Air Temperature (^oF)	77.28	77.28	77.81	78.06	78.40	78.74	78.74
Maximum Air Temperature (^oF)	Not checked	Not checked	Not checked	Not checked	Not checked	Not checked	Not checked
Relative Humidity (%)	34.0	34.0	33.4	33.2	32.8	32.4	32.4
Wind Speed (mph)	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Ground Temperature (^oF)	55	55	55	55	55	55	55
Thermal Gradient ($j/m^2/s/C$)	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Possible Sun (%)	90	90	90	90	90	90	90
Dust Coefficient	5	5	5	5	5	5	5
Ground Reflectivity (%)	25	25	25	25	25	25	25

Table G-3. SSTEMP shading variables for calibration on August 7, 2003.

Parameter	Segment 1a		Segment 1b		Segment 2		Segment 3		Segment 4		Segment 5a		Segment 5b	
Segment Azimuth (degrees)	45		45		0		-22.5		-45		40		30	
	West	East	West	East	West	East	West	East	West	East	West	East	West	East
Topographic Altitude (degrees)	6	15	12	10	12	6	13	6	6	6	6	4	6	4
Vegetation Height (ft)	10	25	15	25	15	15	10	20	15	10	5	10	5	10
Vegetation Crown (ft)	10	15	10	15	10	15	10	15	10	10	15	10	10	10
Vegetation Offset (ft)	1	1	2	1	3	5	2	4	5	10	5	5	10	5
Vegetation Density (%)	50	55	60	65	40	35	30	50	15	30	20	10	15	25

2.1.1 Flow and Temperature Inputs

Values for inflow, inflow temperature, and segment outflow were obtained from data collected in the field. Data for each modeled segment are summarized below.

2.1.1.1 Segment 1a and 1b

Flow measurements during the summer of 2003 showed that an average of 0.85 cfs was gained between Lump Gulch and the USGS gage station near Clancy, Montana (Segment 1a). Because temperature data were not available for the selected model date at the USGS gage, statistical summaries of the synoptic sampling data from the USGS gage were used to generate a realistic mean temperature for comparison to model results (USGS NWIS 2004). Consideration was given to the effects of drought on the stream's temperature, which resulted in using a higher average output temperature value for model calibration. The value for inflow water temperature was back calculated to achieve the expected average output temperature at the USGS gage. A 53 ^{o}F accretion value was used in the model. The accretion value represents one standard deviation above the mean of all USGS synoptic well data for the Lake Helena Watershed from 1980 to 1995 (USGS NWIS 2004). The value was raised by one standard deviation to reflect the effects of drought.

A second model was then run from Lump Gulch to McCellan Creek (Segment 1b) using input from the first model. A total gain of 1.35 cfs of flow was modeled as occurring to account for observed gains at the USGS gage station and an additional 0.5 cfs. Once again a 53 ^{o}F accretion value was used in the model.

No significant diversions were identified in the field or from the DNRC water rights database, and streamflow did not appear to be problematic during the summer water quality monitoring or during the field source assessment.

2.1.1.2 Segment 2

Prickly Pear Creek from McClellan Creek to the ASARCO dam (Segment 2) was broken into a separate model due to the large inflow received from McClellan Creek. A flow input of 9 cfs from McClellan Creek to Prickly Pear Creek was modeled. Flow was then withdrawn from the segment because of visible irrigation diversions and records of DNRC identified water rights along the creek. Nine cubic feet per second of flow was withdrawn. Significant irrigation diversions were identified along the lower portion of this segment of Prickly Pear Creek, and were visible on the aerial photographs above the ASARCO holding ponds. Investigation into the DNRC water rights database and communication with the ASARCO environmental manager revealed that the upper holding pond on the creek serves as a reservoir for diverting flow. Segment flow losses were deduced from average summer synoptic streamflow values measured on the creek just downstream of this segment in the summer of 2003. Streamflow was always present in this segment of the creek during the 2003 water quality monitoring and the field source assessment.

The temperature mixing equation was used to arrive at the model inflow temperature by using the mean model output temperature from the upstream segment and a drought elevated temperature value for McClellan Creek (Bartholow 2002). The drought elevated temperature value for McClellan Creek was taken by proportionally raising the mean synoptic July and August temperature observed at the USGS McClellan Creek gage station by 3.95 ^{o}F. 3.95 ^{o}F represents the increase in temperature observed in the upper-most modeled segment of Prickly Pear Creek for August 7, 2003 over the non-drought mean temperature observed at the USGS gage station. Once again a 53 ^{o} F accretion value was used in the model.

2.1.1.3 Segment 3

Flow input and temperature values were taken from the output model for the upstream segment (outflow from Segment 2) to input into Segment 3 (ASARCO Dam to Wylie Drive). The segment was modeled as loosing 6 cfs. A loss of 6 cfs would equate to an output flow of 3 cfs, which is the flow value observed during the August 7, 2003 diel oxygen and temperature survey. The 6 cfs flow loss also comparable to the flow loss observed during a mid-August 2003 summer water quality monitoring event between the site below the ASARCO dam and the site at Wylie Drive. Once again a 53 ^{o} F accretion value was used in the model. Streamflow was always present in the creek during the 2003 summer water quality monitoring and the field source assessment; however elevated temperatures were noticeable and flows were limited at the end of this segment. A significant irrigation diversion above Wylie Drive was identified during the field source assessment and was also visible on the aerial photographs along this segment of Prickly Pear Creek.

2.1.1.4 Segment 4

For Segment 4 (Wylie Drive to the Helena WWTP outfall), flow and temperature input values were taken from the output model for the upstream segment (outflow from Segment 3). Generally the stream is dry in about one half mile of this 5 mile segment during the summer irrigation season. A significant irrigation diversion was visible on the aerial photographs just downstream of Wylie Drive. Much of the flow gained in the lower portion of this reach is assumed to be groundwater discharge, as water temperatures were noticeably cooler in the lower portion of this segment versus the upper portion of the segment. Flow data measured at the end of segment 4 showed that an average of 1.5 cubic feet per second of inflow was gained near the end of the reach due to groundwater recharge and irrigation returns.

2.1.1.5 Segment 5a and 5b

During the summer, this segment of Prickly Pear Creek is not hydrologically connected by surface water to the upper portion of the creek, due to the dewatering that occurs in the upstream segment. Recent summer flow gains for this segment were calculated from the 2003 synoptic streamflow measurements, and from observations made during the 2003 diel dissolved oxygen and temperature survey. No significant diversions were identified in the field or from the DNRC water rights database, but return flow ditches and a few spring creeks were visible on the aerial photographs. Synoptic sampling data indicate that this segment of Prickly Pear Creek is a flow gaining reach. Streamflow was always present in the creek during the water quality monitoring

and the field source assessment; however elevated summer temperatures were noticeable at Sierra Road.

The SSTEMP model was first run on a 3 mile sub-reach of the segment extending from the Helena wastewater treatment plant discharge (WWTP) to Sierra Road (Segment 5a) in order to check model output values against field measured values. A second model was then run for the entire 6.8-mile length of the segment (Segment 5b). Multiple sources of inflow are present within this segment including the City of Helena WWTP, tile drainage and surplus irrigation water discharges associated with the Helena Valley Irrigation District operations, and ground water discharge. Discharges from the WWTP and irrigation drains tend to be highly variable due to seasonal land application of the wastewater and sporadic irrigation water demands. Flow measurements during the summers of 2003 and 2004 showed that an average of 15 cfs was gained between the site above Stansfield Lake (near the beginning of segment MT41I006_020 and just below York Road) and the sampling site at Sierra Road. However, observations on August 7th, 2003 indicated that less than half of this gain was occurring. Therefore model input values for inflows and inflow water temperature were taken from observed flows and measured average temperature at the August 7th, 2003 diel monitoring site above Stansfield Lake. For the second model, a gain of 15 cfs was estimated to occur along the entire segment. To account for warmer inflows from irrigation influenced waters an accretion value of 55^{o} F was used in the model for the entire segment.

2.1.2 Meteorology Inputs

Detailed weather data for August 7th, 2003 were acquired for the Helena Regional Airport from the Weather Underground website (2004). Air temperature and relative humidity values were corrected for elevation differences between the weather station and average values for the stream segments (Bartholow, 2002). The default values were used for ground temperature, thermal gradient, possible sun, dust coefficient, and ground reflectivity values.

2.1.3 Channel Geometry Inputs

Topographic maps and GIS layers were used to calculate elevation, aspect, and stream length for segments MT41I006_040, MT41I006_030 and MT41I006_020. Photo coverage for almost all of the modeled segments was available from 2004 High Resolution Color Orthophotos of the Helena area (1 foot resolution). The level of detail provided by the 2004 Orthophotos lead to an increase in stream segment lengths over the 2004 SSTEMP modeling inputs.

The Width's A and B term represent the wetted width to discharge relationship, where $W = A*Q^B$ (W = known width, A= untransformed y-intercept of the relationship between the natural log of width versus the natural log of discharge, Q = known discharge, and B = power relationship) (Bartholow, 2002). The Width's A and B term were calculated from USGS gage station measurements and from 2003 and 2004 channel cross-sectional measurements taken during the summer sampling events (Figure G-2 to Figure G-4); Wayne Berkas, personal communication). Because the relationship tends to break down at low flow levels, only two of three flow measurement runs were used for Prickly Pear Creek at Wylie Drive (one high and one low flow). Manning's n was selected based on the stream segments' geomorphic characteristics (Barnes 1967, Rosgen 1994).

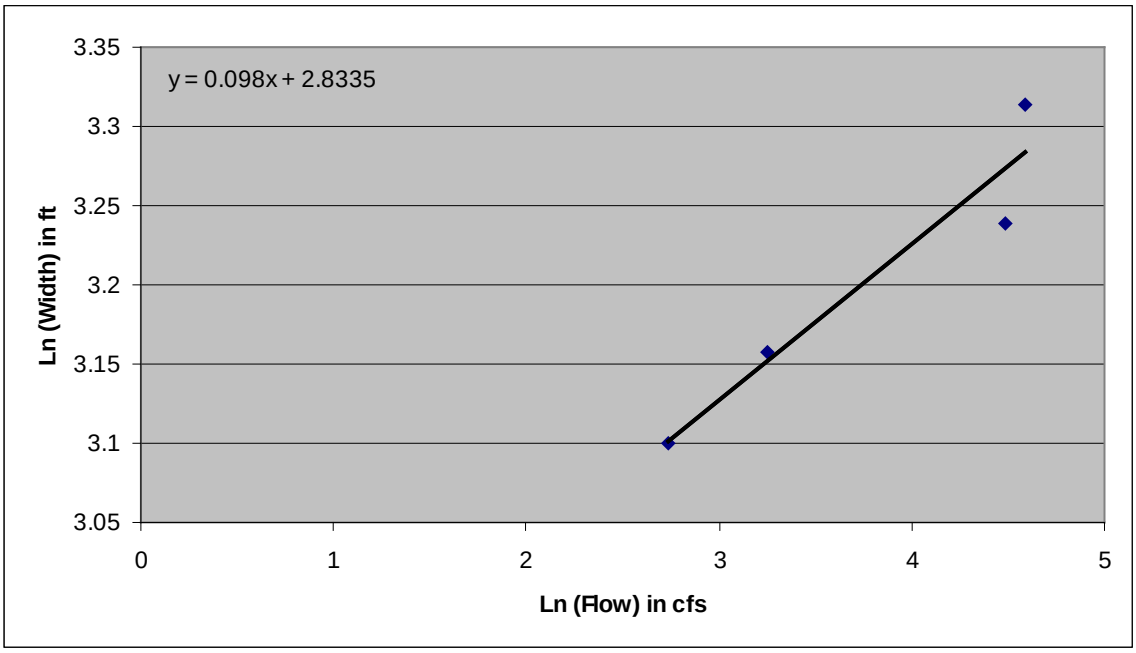

Figure G-2. Width to flow relationship for MT41I006_040 based on data from the USGS gage station below Clancy (06061500).

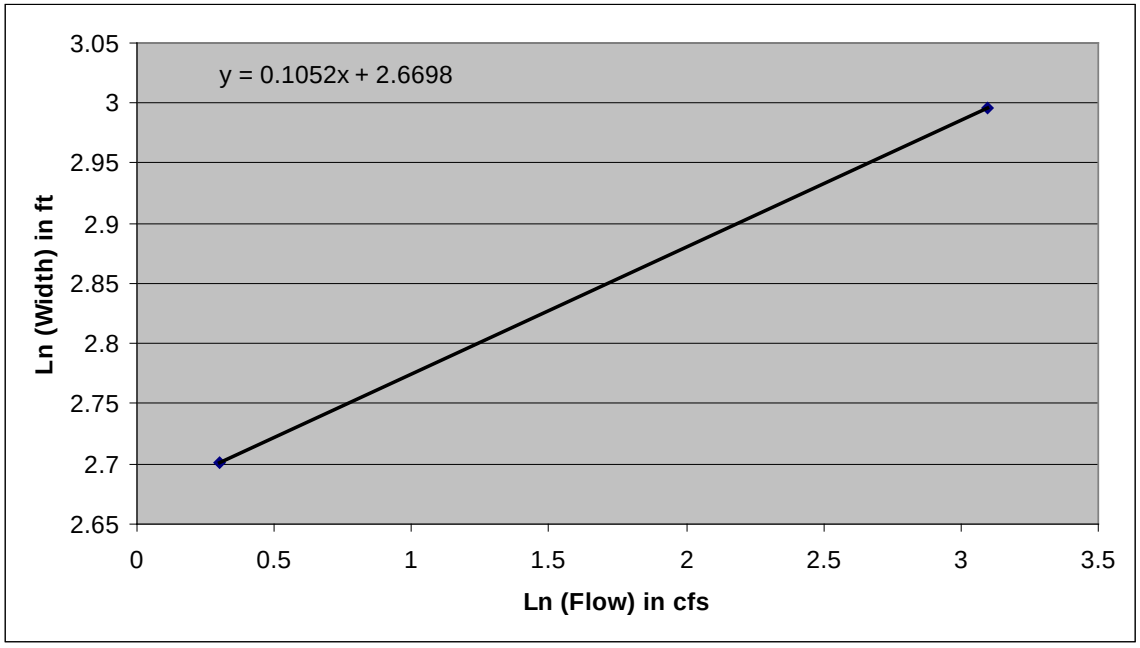

Figure G-3. Width to flow relationship for MT41I006_030 based on data from the sample site at Wylie Drive.

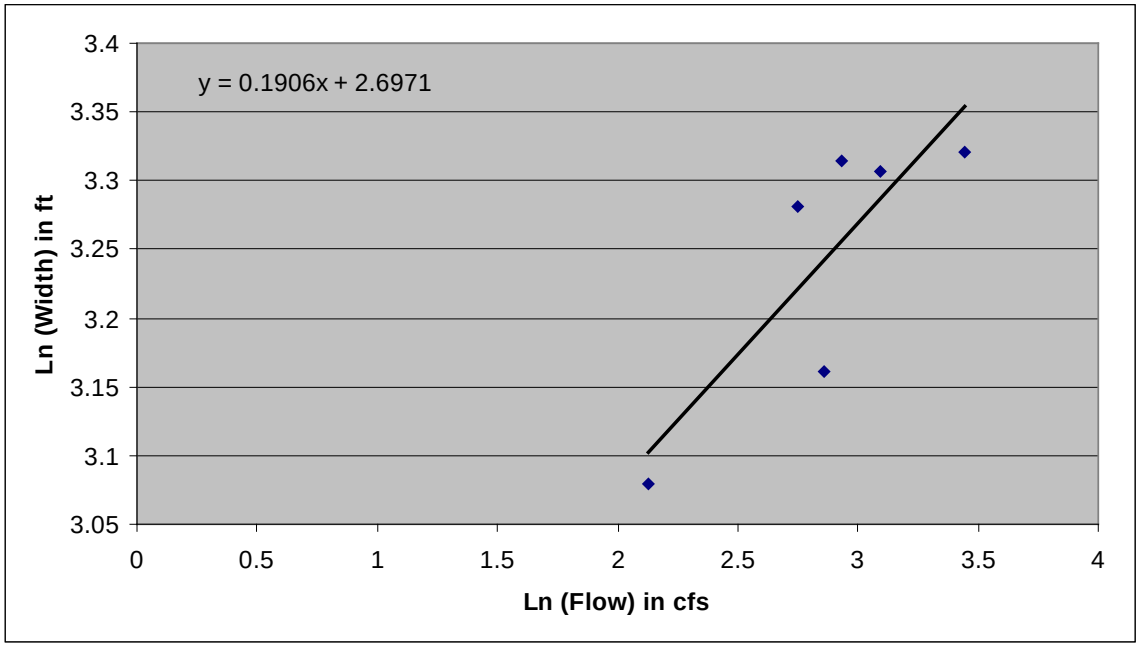

Figure G-4. Width to flow relationship for MT41I006_020 based data from the sample site at Sierra Road.

2.1.4 Optional Shading Variable Inputs

Shading variables were calculated based on site-specific field data collected during the 2005 field source assessment. Point specific field data were adjusted to account for the average, modeled segment reach characteristics. Adjustments were made based on field observations and evaluation of the 2004 High Resolution Color Orthophotos. The following sections describe the riparian condition present along each modeled reach of Prickly Pear Creek.

2.1.4.1 Segment 1

Along this segment of Prickly Pear Creek, riparian vegetation density is variable, but overall fairly dense and in good condition. The dominant riparian vegetation consists primarily of willows with areas of cottonwood overstory. The width of the riparian buffer generally corresponds with the distance from roads, as much of this segment is channelized. However, enough time has passed since road building that the riparian community has recovered to what is generally full potential along the banks of this reach.

2.1.4.2 Segment 2

Along this segment of Prickly Pear Creek, riparian vegetation density is variable, with conditions progressing from good to poor. The dominant riparian vegetation consists primarily of willows with areas of cottonwood overstory. In the upper portion of the segment the width of the riparian buffer is limited by confining valley conditions as well as railway and highway encroachment. A Proper Functioning Condition (PFC) Assessment was conducted near the beginning of this segment in 2003. The field crew rated this site as "Functional – at risk" (FAR). A key reason for the FAR rating was the presence of vigorous riparian vegetation. A significant loss of riparian vegetation occurs from the confluence with Holmes Gulch to the end of this segment and is attributed to extensive channel alterations associated with historic placer mining, current agricultural operations (irrigation diversions, cropping and possibly grazing), and the ASARCO facility.

2.1.4.3 Segment 3

Along this segment of Prickly Pear Creek, riparian vegetation density is variable, but overall fairly dense and in good condition. The dominant riparian vegetation consists primarily of willows with cottonwoods becoming more prominent near the town of East Helena. For most of the segment, the width of the riparian buffer is limited by development adjacent to the stream for the ASARCO facility and the town of East Helena. However, enough time has passed since development that the riparian community has recovered to what is almost full potential along the banks of this reach, save for a section along the ASARCO slag pile.

2.1.4.4 Segment 4

Along this segment of Prickly Pear Creek riparian vegetation density is sparse, and is overall in poor condition. Where present, the dominant riparian vegetation consists of decadent cottonwoods with willow understory. Grasses are more prevalent than woody vegetation species. Loss of riparian vegetation occurs from channel alterations associated with current agricultural practices (irrigation diversions, cropping, and grazing), housing development, and the Helena Sand and Gravel Pit operation. Two Proper Functioning Condition (PFC) assessments were conducted along this segment in 2003. At both sites, the field team gave the stream a rating of "non-functional" (NF). A limited riparian zone and lack of diverse riparian vegetation were some of the reasons for the NF ratings. At the time of the survey, succulent vegetation was growing in the dewatered portion of this segment. There are upstream portions of this segment that have experienced a near total removal of riparian vegetation, but riparian conditions improve slightly near the end of the segment.

2.1.4.5 Segment 5

Along this segment of Prickly Pear Creek riparian vegetation density is sparse, and is overall in poor condition. Where present, the dominant riparian vegetation consists of decadent cottonwoods with willow understory. In many areas, grasses are more prevalent than woody vegetation species. Loss of riparian vegetation occurs from channel alterations associated with housing development and current agricultural practices: cropping and grazing. A Proper Functioning Condition (PFC) assessment was conducted along this segment in 2003, near Sierra Road. The field crew rated this site as "non-functional" (NF), noting a lack of diverse or stabilizing riparian vegetation as some of the reasons for the NF rating. Riparian conditions tend to improve somewhat near the end of the segment.

2.2 Calibration Results

Summary results of the SSTEMP calibration for August 7, 2003 (critical low flow condition) are presented in Table G-4. The difference between measured and calibrated values varied for each segment, and ranged from –6.1 to 6.7 ^{o} F (0 to 10 percent difference). Results of the individual segment calibrations are further discussed below.

Table G-4. Results of the SSTEMP Calibration.

Segment	Parameter	Calibrated Water Temperature	Difference from Measured Water Temperature	Percent Difference
1a – Confluence with Lump Gulch to USGS gage #06061500	Mean	64.0 ^{o} F	+0.4 ^{o} F	1
	Maximum	72.6^{o} F	-4.4 ^{o} F	6
	Minimum	55.3 ^{o} F	+1.7 ^{o} F	3
1b – Confluence with Lump Gulch to confluence with McClellan Creek	Mean	65.7 ^{o} F	+2.1 ^{o} F	3
	Maximum	72.6 ^{o} F	-4.4 ^{o} F	6
	Minimum	58.8 ^{o} F	+5.2 ^{o} F	9
2 – Confluence with McClellan Creek to ASARCO Dam	Mean	67.2 ^{o} F	+0.7 ^{o} F	1
	Maximum	77.4 ^{o} F	+6.7 ^{o} F	9
	Minimum	57.0 ^{o} F	-5.8 ^{o} F	10
3 – ASARCO Dam to Wylie Drive	Mean	69.2 ^{o} F	+0.4 ^{o} F	1
	Maximum	74.3 ^{o} F	-0.7 ^{o} F	1
	Minimum	64.1 ^{o} F	+0.7^{o} F	1
4 – Wylie Drive to Helena Wastewater Treatment Plant discharge[1]	Mean	NA	NA	NA
	Maximum	NA	NA	NA
	Minimum	NA	NA	NA
5a – Helena Wastewater Treatment Plant to Sierra Road	Mean	65.0 ^{o} F	0.0 ^{o} F	0
	Maximum	78.4 ^{o} F	+3.4 ^{o} F	5
	Minimum	55.4 ^{o} F	-6.1 ^{o} F	10
5b – Helena Wastewater Treatment Plan to the mouth	Mean	66.3 ^{o} F	+1.3^{o} F	2
	Maximum	76.0 ^{o} F	+2.3 ^{o} F	3
	Minimum	56.6 ^{o} F	-2.4 ^{o} F	4

[1] Input and output flows in Segment 4 are not hydrologically connected due to dewatering. The segment could not be properly calibrated.

2.2.1 Segment 1 Calibration Summary

The calibration model output for Segment 1a (confluence with Lump Gulch to USGS gage 06061500) was compared to July and August synoptic data collected at the USGS gage on Prickly Pear Creek near Clancy Creek (Table G-5). The calibration model produced mean temperature results within 1 percent of the average synoptic value measured during the drought years of 2000 to 2002 in July and August. The modeled mean value of 64.0^{o} F is 0.4 ^{o} F more than the average synoptic value. This is a reasonable outcome given that the measured temperatures were recorded synoptically, and that the effect of a prolonged drought appears to have naturally elevated water temperatures.

The calibration model for Segment 1b (Lump Gulch to McClellan Creek) produced mean temperature results within 3 percent of the average synoptic value measured during the drought years of 2000 to 2002 in July and August. The modeled mean value of 65.7^{o} F is 2.1 ^{o} F more than the average synoptic value. This is a reasonable outcome given that the measured temperatures were recorded near the middle of the segment, and that little flow is gained in this reach between the USGS gage station and McClellan Creek.

Table G-5. August stream temperatures in Prickly Pear Creek downstream of Clancy Creek (USGS Gage #06061500).

Statistics	August Values (1983-1999)	August Drought Values (2000-2002)
Mean	60.0 ^{o} F	63.6 ^{o} F
Median	58.1 ^{o} F	63.1 ^{o} F
Standard Deviation	6.0 ^{o} F	8.3 ^{o} F
Minimum	50.0 ^{o} F	53.6 ^{o} F
Maximum	69.8 ^{o} F	77.0^{o} F
Samples	15	10

2.2.2 Segment 2 Calibration Summary

The calibration model output for Segment 2 (McClellan Creek to the ASARCO Dam) was compared to August synoptic data collected for the EPA Superfund program upstream of the ASARCO dam (Table G-6). The calibration model produced mean temperature results within 1 percent of the average August synoptic value measured for the EPA Superfund program above the ASARCO dam. The modeled mean value of 67.2^{o} F is 0.7 ^{o} F more than the average synoptic value. This is a reasonable outcome given that the measured temperatures were recorded synoptically, and that the effect of a prolonged drought appears to have naturally elevated water temperatures.

Table G-6. August stream temperatures in Prickly Pear Creek upstream of the ASARCO Dam.

Statistics	August 1994 and 1995
Mean	66.5 ^{o} F
Median	66.2 ^{o} F
Standard Deviation	2.7 ^{o} F
Minimum	62.8 ^{o} F
Maximum	70.7 ^{o} F
Samples	9

2.2.3 Segment 3 Calibration Summary

The calibration model output for Segment 3 (ASARCO Dam to Wylie Drive) was compared to thermograph data collected on August 7th, 2003 below the ASARCO dam (Table G-7). The calibration model produced mean temperature results within 1 percent of the average value collected by a thermograph on August 7th, 2003 below the ASARCO dam. The modeled mean value of 69.2^{o} F is 0.4^{o} F more than the average thermograph value. This is a reasonable outcome given that the measured temperatures were recorded near the beginning of the segment, before any major flow losses occur.

Table G-7. August 7, 2003 diel stream temperatures in Prickly Pear Creek downstream of the ASARCO Dam.

Statistics	August 7, 2003 Values
Mean	68.8 ^{o} F
Median	68.1 ^{o} F
Standard Deviation	3.9 ^{o} F
Minimum	63.4 ^{o} F
Maximum	75.0^{o} F
Samples	51

2.2.4 Segment 4 Calibration Summary

Segment 4 of Prickly Pear Creek could not be calibrated because of flow alterations near the Wylie Drive Bridge. Flows and temperatures measured at the end of Segment 4 (near the Helena WWTP outfall) represented groundwater recharge and irrigation returns, and not upstream flow.

2.2.5 Segment 5 Calibration Summary

The calibration model output for Segment 5a (treatment plant outfall to Sierra Road) was compared to diel temperature data collected at Sierra Road (Table G-8). The calibration model produced mean temperature results equivalent to the average value measured during the August 7th diel survey. The modeled mean value of 65.0^{o} F is equal to the average survey value.

The calibration model for Segment 5b (treatment plant outfall to Lake Helena) produced mean temperature results within 2 percent of the average value measured during the August 7th diel survey. The modeled value of 66.3^{o} F is 1.3 ^{o} F more than the average survey value. This is a reasonable outcome given that the measured temperature was recorded midway along the segment before more than half of the inflow from groundwater or irrigation returns was gained.

Table G-8. August 7, 2003 diel stream temperatures in Prickly Pear Creek near Sierra Road.

Statistics	August 7, 2003 Stream Temperatures
Mean	65.0 ^{o} F
Median	63.9 ^{o} F
Standard Deviation	5.5 ^{o} F
Minimum	59.0 ^{o} F
Maximum	73.8 ^{o} F
Samples	13

3.0 MODEL SCENARIOS

Once calibrated, the SSTEMP model was used to model natural conditions in Prickly Pear Creek (i.e., no anthropogenic sources), and compare the modeled natural conditions to the modeled existing conditions. Also, SSTEMP was used to assess various restoration strategies (i.e., increased shading, increased flows) to determine how to best remediate the temperature impairments. The following sections summarize the results of the two modeling scenarios – natural conditions and restoration strategies. Complete model output, including a sensitivity analysis, is included in Section 5.0.

3.1 Comparison to Natural Conditions

Current conditions were modeled in Prickly Pear Creek using the input data discussed in Section 2.1. This represents a critical summer, low flow period that is likely to have the most impact from anthropogenic sources. Natural conditions were approximated based on field surveys of flow and habitat alterations, point source data, and best professional judgment. The natural model flow input values, which assumed no flow loss from the major diversions, are within the aquatic life survival flows suggested by MFWP for Prickly Pear Creek (MFWP 1989). In all likelihood, these "natural" flow values represent a conservative estimate of in-stream flows, as the available flow data are not adequate to determine exact flow losses attributed to irrigation diversions or flow gains attributed to groundwater discharge. A water budget study for Prickly Pear Creek is proposed for the TMDL effectiveness monitoring which could be used to identify if in-stream flows could be increased by irrigation water management without affecting water rights (see Appendix H). In order to estimate natural riparian vegetation conditions along lower Prickly Pear Creek, the riparian vegetation was augmented using best professional judgment for most of lower Prickly Pear Creek with consideration given to the full potential of the predominant types of woody vegetation observed in the field. A summary of the natural conditions in each segment is provided below. The naturally occurring values used for each segment are shown in Table G-9 and G-10.

- *Segment 1 (Lump Gulch to McClellan Creek)* – The field survey suggested that Prickly Pear Creek from Lump Gulch to McClellan Creek (Segment 1) was already in a natural condition, and did not require any adjustments to the model input parameters.
- *Segment 2 (McClellan Creek to the ASARCO Dam)* – To achieve natural conditions in Segment 2, flow losses were restored, and riparian density was enhanced along the entire reach.
- *Segment 3 (ASARCO Dam to Wylie Drive)* – Natural conditions in Segment 3 were approximated by using the "natural" flow and temperature outputs from Segment 2, and by augmenting riparian vegetation along the entire reach.
- *Segment 4 (Wylie Drive to the Helena WWTP Outfall)* – Natural conditions in Segment 4 were approximated by using the "natural" flow and temperature outputs from Segment 3, and by augmenting riparian vegetation along the entire reach.
- *Segment 5 (Helena WWTP Outfall to the Mouth)* – Natural conditions in Segment 5 were approximated by using the "natural" flow and temperature outputs from Segment 4, and by augmenting riparian vegetation along the entire reach.

Table G-9. SSTEMP input variables for modeled natural conditions.

Input Parameter	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
Segment Inflow (cfs)	8.55	18.9	19.8	19.8	21.3
Segment Outflow (cfs)	9.9	19.8	19.8	21.3	36.3
Inflow Temperature (ºF)	55.0	64.3	65.62	66.52	67.65
Accretion Temperature (ºF)	53.0	53.0	53.0	53.0	55
Latitude (degrees)	46.55	46.57	46.59	46.62	46.66
Dam at Head of Segment	Not checked	Not checked	Checked	Not checked	Not checked
Segment Length	7.40	2.28	1.56	5.25	6.83
Upstream Elevation (ft)	4195	3975	3900	3838	3708
Downstream Elevation (ft)	3975	3900	3838	3708	3650
Width's A Term (s/ft^2)	16.7	17.0	15	14.4	15
B Term	0.099	0.10	0.11	0.11	0.19
Manning's n	0.034	0.032	0.035	0.035	0.034
Air Temperature (^{o} F)	77.28	77.81	78.06	78.40	78.74
Maximum Air Temperature (^{o} F)	Not checked	Not checked	Not checked	Not checked	Not checked
Relative Humidity (%)	34.0	33.4	33.2	32.8	32.4
Wind Speed (mph)	7.1	7.1	7.1	7.1	7.1
Ground Temperature (^{o} F)	55	55	55	55	55
Thermal Gradient ($j/m^2/s/C$)	1.65	1.65	1.65	1.65	1.65
Possible Sun (%)	90	90	90	90	90
Dust Coefficient	5	5	5	5	5
Ground Reflectivity (%)	25	25	25	25	25

Table G-10. SSTEMP shading variables for modeled natural conditions.

Parameter	Segment 1		Segment 2		Segment 3		Segment 4		Segment 5	
Segment Azimuth (degrees)	45		0		-22.5		-45		30	
	West	East	West	East	West	East	West	East	West	East
Topographic Altitude (degrees)	12	10	12	10	13	10	15	10	10	10
Vegetation Height (ft)	15	25	15	15	10	20	15	10	25	15
Vegetation Crown (ft)	10	15	10	15	10	15	10	10	10	10
Vegetation Offset (ft)	2	1	2	3	2	2	2	2	5	2
Vegetation Density (%)	60	65	55	50	50	60	55	65	50	55

Modeled natural conditions in Prickly Pear Creek were then compared to the modeled existing conditions (Table G-11). Anthropogenic sources present from McClellan Creek to the Wylie Drive Bridge increase the daily average stream temperatures anywhere from 0.5 ^{o}F to 2.7 ^{o}F. When model uncertainties are accounted for, worst-case scenarios reveal that temperatures may be as much as 3.2 degrees Fahrenheit greater than natural conditions. Natural stream temperatures from the Wylie Drive Bridge to the mouth could not be compared to existing temperatures because the stream is currently dewatered, and segments are not hydrologically connected during summer low flow months.

Table G-11. Modeled current versus natural daily average stream temperatures in Prickly Pear Creek for a critical summer low flow event.

303(d) Segment	Modeling Segment	Avg Modeled Temperature – Natural	Avg Modeled Temperature – Existing	Difference (Natural-Existing)	Percent Difference	Changes Needed To Achieve Natural Conditions
MT41I006_040	Segment 1 – Lump Gulch to McClellan Creek	65.7 ^{o} F	65.7 ^{o} F	0.0 ^{o} F	0.0%	None.
	Segment 2 – McClellan Creek to ASARCO Dam	65.6 ^{o} F	67.2 ^{o} F	-1.6 ^{o} F	2.2%	Increase vegetation density with no loss of flow and gain 0.9 cfs.
	Segment 3 – ASARCO Dam to Wylie Drive	66.5 ^{o} F	69.2 ^{o} F	-2.7 ^{o} F	3.8%	Increase vegetation density with inflow from restoration in upstream segment.
MT41I006_030	Segment 4 – Wylie Drive to Helena WWTP Outfall	67.7 ^{o} F	Dewatered – Could Not Be Calibrated/ Evaluated	NA	NA	Increase vegetation density with inflow from restoration in upstream segment. No loss of flow and gain 1.5 cfs.
MT41I006_020	Segment 5 – Helena WWTP Outfall to Mouth	65.8 ^{o} F[1]	Dewatered – Could Not Be Calibrated/ Evaluated	NA	NA	Increase vegetation density with inflow from restoration in upstream segment. Gain 15 cfs.

[1] Natural stream temperature decreases from Segment 4 to 5 because of cold-water groundwater inputs.

3.2 Restoration Strategy

An overall decrease of 2.2 ^{o}F in water temperature is needed in Prickly Pear Creek from McClellan Creek to Wylie Drive. A TMDL restoration strategy was modeled for Prickly Pear Creek from Lump Gulch to Wylie Drive (303(d) listed segment MT41I006_040). The restoration strategy involves a combination of maintaining some in-stream flows and enhancing the riparian vegetation along this section of Prickly Pear Creek. No more than 10 percent of the in-stream flow was diverted within a reach and shading provided by enhancements to riparian vegetation was increased by an average of 40 percent. The final result is an average overall 2.2 ^{o}F decrease in stream temperature (Table G-12). A summary of this restoration strategy for each segment is provided below. The restoration values used for each segment are shown in Tables G-12 and G-13, and are summarized below.

- *Segment 1 (Lump Gulch to McClellan Creek)* – The field survey suggested that Prickly Pear Creek from Lump Gulch to McClellan Creek (Segment 1) was already in a natural condition, and did not require any adjustments to the model input parameters.
- *Segment 2 (McClellan Creek to the ASARCO Dam)* – Only 2.3 cfs of flow was diverted, and riparian density was enhanced along the entire reach.
- *Segment 3 (ASARCO Dam to Wylie Drive)* – Flow and temperature outputs from Segment 2 were used as model inputs, only 1.5 cfs of flow was diverted, and riparian density was enhanced along the entire reach.

Table G-12. Modeled current average daily stream temperatures in Prickly Pear Creek versus potential TMDL restoration for a critical summer low flow event.

303(d) Segment	Modeling Segment	Average Modeled Temperature – Restoration	Average Modeled Temperature – Existing	Difference (Restoration-Existing)	Percent Difference	Changes Needed To Achieve Natural Conditions
MT41I006_040	Segment 1 – Lump Gulch to McClellan Creek	65.7 ^{o} F	65.7 ^{o} F	0.0 ^{o} F	0.0%	None.
MT41I006_040	Segment 2 – McClellan Creek to ASARCO Dam	66.1 ^{o} F	67.2 ^{o} F	-1.1 ^{o} F	1.5%	Increase vegetation density with a loss of only 2.3 cfs.
MT41I006_040	Segment 3 – ASARCO Dam to Wylie Drive	67.0 ^{o} F	69.2 ^{o} F	-2.2 ^{o} F	3.1%	Increase vegetation density with a loss of only 1.5 cfs. Inflow from restoration in upstream segment.
MT41I006_030						
MT41I006_020						

Table G-13. SSTEMP input variables for the TMDL restoration strategy for Prickly Pear Creek from Lump Gulch to Wylie Drive.

Input Parameter	Segment 1	Segment 2	Segment 3
Segment Inflow (cfs)	8.55	18.9	17.5
Segment Outflow (cfs)	9.9	17.5	16.0
Inflow Temperature (ºF)	55.0	64.3	66.1
Accretion Temperature (ºF)	53.0	53.0	53.0
Latitude (degrees)	46.55	46.57	46.59
Dam at Head of Segment	Not checked	Not checked	Checked
Segment Length	7.40	2.28	1.56
Upstream Elevation (ft)	4195	3975	3900
Downstream Elevation (ft)	3975	3900	3838
Width's A Term (s/ft^2)	16.7	17.0	15
B Term	0.099	0.10	0.11
Manning's n	0.034	0.032	0.035
Air Temperature (^oF)	77.28	77.81	78.06
Maximum Air Temperature (^oF)	Not checked	Not checked	Not checked
Relative Humidity (%)	34.0	33.4	33.2
Wind Speed (mph)	7.1	7.1	7.1
Ground Temperature (^oF)	55	55	55
Thermal Gradient ($j/m^2/s/C$)	1.65	1.65	1.65
Possible Sun (%)	90	90	90
Dust Coefficient	5	5	5
Ground Reflectivity (%)	25	25	25

Table G-14. SSTEMP shading variables for the TMDL restoration strategy for Prickly Pear Creek from Lump Gulch to Wylie Drive.

Parameter	Segment 1		Segment 2		Segment 3	
Segment Azimuth (degrees)	45		0		-22.5	
	West	East	West	East	West	East
Topographic Altitude (degrees)	12	10	12	10	13	10
Vegetation Height (ft)	15	25	15	15	10	20
Vegetation Crown (ft)	10	15	10	15	10	15
Vegetation Offset (ft)	2	1	2	3	2	2
Vegetation Density (%)	60	65	55	50	50	60

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5.0 SSTEMP MODELING OUTPUT

Segment 1a, Prickly Pear Segment MT41I006_040, from Lump Gulch to the USGS Gage

Current conditions (Calibration/Natural)

"English", "Segment Inflow (cfs)", "8.550"
"English", "Inflow Temperature (°F)", "55.000"
"English", "Segment Outflow (cfs)", "9.400"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.510"
"English", "Segment Length (mi)", "3.750"
"English", "Upstream Elevation (ft)", "4195.00"
"English", "Downstream Elevation (ft)", "4067.00"
"English", "Width's A Term (s/ft²)", "16.700"
"English", " B Term where W = A*Q**B", "0.098"
"English", "Manning's n", "0.036"
"English", "Air Temperature (°F)", "77.280"
"English", "Relative Humidity (%)", "34.000"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "632.105"
"English", "Total Shade (%)", "42.265"
"English", "Segment Azimuth (degrees)", "45.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "6.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "1.000"
"English", "Vegetation Density (%)", "50.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "15.000"
"English", "Topographic Altitude (degrees)", "25.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "1.000"
"English", "Vegetation Offset (ft)", "55.000"
"English", " Maximum Air Temp (°F)", "82.226"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 63.95"
"Estimated Maximum (°F) = 72.61"

"Approximate Minimum (°F) = 55.29"
"Mean Equilibrium (°F) = 68.88"
"Maximum Equilibrium (°F) = 76.44"
"Minimum Equilibrium (°F) = 61.32"

Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)
Original mean temperature = 63.95°F

Variable	Temperature change (°F) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cfs)	-0.17	+0.20	**
Inflow Temperature (°F)	-1.71	+1.81	**********
Segment Outflow (cfs)	+0.59	-0.62	*****
Accretion Temp. (°F)	-0.26	+0.26	**
Width's A Term (s/ft²)	-0.63	+0.67	*****
B Term where W = A*Q**B	-0.15	+0.14	*
Manning's n	+0.00	+0.00	
Air Temperature (°F)	-3.86	+3.46	**********
Relative Humidity (%)	-0.60	+0.60	*****
Wind Speed (mph)	+0.07	-0.08	*
Ground Temperature (°F)	-0.20	+0.20	**
Thermal gradient (j/m²/s/C)	+0.02	-0.02	
Possible Sun (%)	-0.22	+0.30	**
Dust Coefficient	+0.02	-0.02	
Ground Reflectivity (%)	-0.02	+0.02	
Segment Azimuth (degrees)	+0.03	-0.02	
West Side:			
Topographic Altitude (degrees)	+0.00	0.00	
Vegetation Height (ft)	+0.03	-0.03	
Vegetation Crown (ft)	+0.03	-0.03	
Vegetation Offset (ft)	-0.01	+0.01	
Vegetation Density (%)	+0.08	-0.08	*
East Side:			
Topographic Altitude (degrees)	+0.01	0.00	
Vegetation Height (ft)	+0.04	-0.06	
Vegetation Crown (ft)	+0.05	-0.06	
Vegetation Offset (ft)	-0.01	+0.01	
Vegetation Density (%)	+0.30	-0.30	**

Segment 1b, Prickly Pear Segment MT41I006_040, from Lump Gulch to McClellan Creek

Current conditions (Calibration/Natural)

"English", "Segment Inflow (cfs)", "8.550"
"English", "Inflow Temperature (°F)", "55.000"
"English", "Segment Outflow (cfs)", "9.900"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.550"
"English", "Segment Length (mi)", "7.400"
"English", "Upstream Elevation (ft)", "4195.00"

"English", "Downstream Elevation (ft)", "3975.00"
"English", "Width's A Term (s/ft²)", "16.700"
"English", " B Term where W = A*Q**B", "0.099"
"English", "Manning's n", "0.034"
"English", "Air Temperature (°F)", "77.280"
"English", "Relative Humidity (%)", "34.000"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.836"
"English", "Total Shade (%)", "51.103"
"English", "Segment Azimuth (degrees)", "45.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "12.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "60.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "25.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "1.000"
"English", "Vegetation Offset (ft)", "65.000"
"English", " Maximum Air Temp (°F)", "82.227"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 65.70"
"Estimated Maximum (°F) = 72.59"
"Approximate Minimum (°F) = 58.81"
"Mean Equilibrium (°F) = 67.75"
"Maximum Equilibrium (°F) = 74.64"
"Minimum Equilibrium (°F) = 60.87"

Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)
Original mean temperature = 65.70°F

Variable	Temperature change (°F) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cfs)	-0.26	+0.27	**
Inflow Temperature (°F)	-0.57	+0.61	****
Segment Outflow (cfs)	+0.51	-0.57	****
Accretion Temp. (°F)	-0.29	+0.29	**
Width's A Term (s/ft²)	-0.53	+0.55	***

B Term where W = A*Q**B -0.13 +0.11 *
Manning's n +0.00 +0.00
Air Temperature (°F) -4.78 +4.45 **********
Relative Humidity (%) -0.74 +0.75 *****
Wind Speed (mph) +0.18 -0.19 *
Ground Temperature (°F) -0.25 +0.25 **
Thermal gradient (j/m²/s/C) +0.04 -0.04
Possible Sun (%) -0.23 +0.32 **
Dust Coefficient +0.02 -0.02
Ground Reflectivity (%) -0.02 +0.02
Segment Azimuth (degrees) +0.03 -0.03
West Side:
Topographic Altitude (degrees) +0.01 -0.01
Vegetation Height (ft) +0.04 -0.06
Vegetation Crown (ft) +0.04 -0.04
Vegetation Offset (ft) -0.02 +0.01
Vegetation Density (%) +0.12 -0.12 *
East Side:
Topographic Altitude (degrees) +0.00 0.00
Vegetation Height (ft) +0.06 -0.10 *
Vegetation Crown (ft) +0.06 -0.09 *
Vegetation Offset (ft) -0.01 +0.01
Vegetation Density (%) +0.45 -0.45 ***

Segment 2, Prickly Pear Segment MT41I006_040, from McClellan Creek to the ASARCO Dam

Current conditions

"English", "Segment Inflow (cfs)", "18.900"
"English", "Inflow Temperature (°F)", "64.300"
"English", "Segment Outflow (cfs)", "9.000"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.570"
"English", "Segment Length (mi)", "2.280"
"English", "Upstream Elevation (ft)", "3975.00"
"English", "Downstream Elevation (ft)", "3900.00"
"English", "Width's A Term (s/ft²)", "17.000"
"English", " B Term where W = A*Q**B", "0.100"
"English", "Manning's n", "0.032"
"English", "Air Temperature (°F)", "77.810"
"English", "Relative Humidity (%)", "33.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.479"
"English", "Total Shade (%)", "24.452"
"English", "Segment Azimuth (degrees)", "0.000"

"West Side Variables"
"English", "Topographic Altitude (degrees)", "12.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "3.000"
"English", "Vegetation Density (%)", "40.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "6.000"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "5.000"
"English", "Vegetation Offset (ft)", "35.000"
"English", " Maximum Air Temp (°F)", "82.774"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 67.18"
"Estimated Maximum (°F) = 77.40"
"Approximate Minimum (°F) = 56.95"
"Mean Equilibrium (°F) = 71.34"
"Maximum Equilibrium (°F) = 80.05"
"Minimum Equilibrium (°F) = 62.62"

Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)
Original mean temperature = 67.18°F

Variable	Temperature change (°F) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cfs)	+0.09	-0.10	*
Inflow Temperature (°F)	-3.81	+4.00	**********
Segment Outflow (cfs)	+0.08	-0.09	*
Accretion Temp. (°F)	+0.00	+0.00	
Width's A Term (s/ft²)	-0.27	+0.28	**
B Term where W = A*Q**B	-0.07	+0.07	*
Manning's n	+0.00	+0.00	
Air Temperature (°F)	-2.23	+1.97	**********
Relative Humidity (%)	-0.35	+0.35	***
Wind Speed (mph)	+0.11	-0.11	*
Ground Temperature (°F)	-0.11	+0.11	*
Thermal gradient (j/m²/s/C)	+0.02	-0.02	
Possible Sun (%)	-0.16	+0.22	**
Dust Coefficient	+0.01	-0.01	
Ground Reflectivity (%)	-0.01	+0.01	
Segment Azimuth (degrees)	+0.00	+0.00	
West Side:			
Topographic Altitude (degrees)	+0.01	-0.01	
Vegetation Height (ft)	+0.02	-0.03	
Vegetation Crown (ft)	+0.02	-0.02	

Vegetation Offset (ft) -0.01 +0.01
Vegetation Density (%) +0.06 -0.06
East Side:
Topographic Altitude (degrees) +0.00 0.00
Vegetation Height (ft) +0.02 -0.02
Vegetation Crown (ft) +0.02 -0.02
Vegetation Offset (ft) -0.01 +0.01
Vegetation Density (%) +0.06 -0.06

Natural conditions

"English", "Segment Inflow (cfs)", "18.900"
"English", "Inflow Temperature (°F)", "64.300"
"English", "Segment Outflow (cfs)", "19.800"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.570"
"English", "Segment Length (mi)", "2.280"
"English", "Upstream Elevation (ft)", "3975.00"
"English", "Downstream Elevation (ft)", "3900.00"
"English", "Width's A Term (s/ft²)", "17.000"
"English", " B Term where W = A*Q**B", "0.100"
"English", "Manning's n", "0.032"
"English", "Air Temperature (°F)", "77.810"
"English", "Relative Humidity (%)", "33.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.479"
"English", "Total Shade (%)", "35.681"
"English", "Segment Azimuth (degrees)", "0.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "12.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "55.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "3.000"
"English", "Vegetation Offset (ft)", "50.000"
"English", " Maximum Air Temp (°F)", "82.774"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"

"Predicted Mean (°F) = 65.62"
"Estimated Maximum (°F) = 73.70"
"Approximate Minimum (°F) = 57.55"
"Mean Equilibrium (°F) = 70.00"
"Maximum Equilibrium (°F) = 77.97"
"Minimum Equilibrium (°F) = 62.03"

Restoration 1. Increase vegetation density

"English", "Segment Inflow (cfs)", "18.900"
"English", "Inflow Temperature (°F)", "64.300"
"English", "Segment Outflow (cfs)", "9.000"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.570"
"English", "Segment Length (mi)", "2.280"
"English", "Upstream Elevation (ft)", "3975.00"
"English", "Downstream Elevation (ft)", "3900.00"
"English", "Width's A Term (s/ft²)", "17.000"
"English", " B Term where W = A*Q**B", "0.100"
"English", "Manning's n", "0.032"
"English", "Air Temperature (°F)", "77.810"
"English", "Relative Humidity (%)", "33.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.479"
"English", "Total Shade (%)", "36.283"
"English", "Segment Azimuth (degrees)", "0.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "12.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "55.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "3.000"
"English", "Vegetation Offset (ft)", "50.000"
"English", " Maximum Air Temp (°F)", "82.774"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 66.57"
"Estimated Maximum (°F) = 75.47"

"Approximate Minimum (°F) = 57.67"
"Mean Equilibrium (°F) = 69.93"
"Maximum Equilibrium (°F) = 77.86"
"Minimum Equilibrium (°F) = 62.00"

Restoration 2. No loss of outflow and gain 0.9cfs

"English", "Segment Inflow (cfs)", "18.900"
"English", "Inflow Temperature (°F)", "64.300"
"English", "Segment Outflow (cfs)", "19.800"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.570"
"English", "Segment Length (mi)", "2.280"
"English", "Upstream Elevation (ft)", "3975.00"
"English", "Downstream Elevation (ft)", "3900.00"
"English", "Width's A Term (s/ft²)", "17.000"
"English", " B Term where W = A*Q**B", "0.100"
"English", "Manning's n", "0.032"
"English", "Air Temperature (°F)", "77.810"
"English", "Relative Humidity (%)", "33.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.479"
"English", "Total Shade (%)", "24.013"
"English", "Segment Azimuth (degrees)", "0.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "12.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "3.000"
"English", "Vegetation Density (%)", "40.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "6.000"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "5.000"
"English", "Vegetation Offset (ft)", "35.000"
"English", " Maximum Air Temp (°F)", "82.774"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 66.08"
"Estimated Maximum (°F) = 75.39"
"Approximate Minimum (°F) = 56.78"
"Mean Equilibrium (°F) = 71.39"

"Maximum Equilibrium (°F) = 80.13"
"Minimum Equilibrium (°F) = 62.65"

Restoration 3. TMDL Restoration Strategy

"English", "Segment Inflow (cfs)", "18.900"
"English", "Inflow Temperature (°F)", "64.300"
"English", "Segment Outflow (cfs)", "17.500"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.570"
"English", "Segment Length (mi)", "2.280"
"English", "Upstream Elevation (ft)", "3975.00"
"English", "Downstream Elevation (ft)", "3900.00"
"English", "Width's A Term (s/ft²)", "17.000"
"English", " B Term where W = A*Q**B", "0.100"
"English", "Manning's n", "0.032"
"English", "Air Temperature (°F)", "77.810"
"English", "Relative Humidity (%)", "33.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.479"
"English", "Total Shade (%)", "35.804"
"English", "Segment Azimuth (degrees)", "0.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "12.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "55.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "3.000"
"English", "Vegetation Offset (ft)", "50.000"
"English", " Maximum Air Temp (°F)", "82.774"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 66.13"
"Estimated Maximum (°F) = 74.26"
"Approximate Minimum (°F) = 58.00"
"Mean Equilibrium (°F) = 69.99"
"Maximum Equilibrium (°F) = 77.95"
"Minimum Equilibrium (°F) = 62.02"

Segment 3, Prickly Pear Segment MT41I006_040, from the ASARCO Dam to Wyle Drive

Current conditions

"English", "Segment Inflow (cfs)", "9.000"
"English", "Inflow Temperature (°F)", "67.180"
"English", "Segment Outflow (cfs)", "3.000"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.590"
"English", "Segment Length (mi)", "1.560"
"English", "Upstream Elevation (ft)", "3900.00"
"English", "Downstream Elevation (ft)", "3838.00"
"English", "Width's A Term (s/ft²)", "15.000"
"English", " B Term where W = A*Q**B", "0.110"
"English", "Manning's n", "0.035"
"English", "Air Temperature (°F)", "78.060"
"English", "Relative Humidity (%)", "33.200"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.181"
"English", "Total Shade (%)", "27.525"
"English", "Segment Azimuth (degrees)", "-22.500"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "13.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "30.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "6.000"
"English", "Topographic Altitude (degrees)", "20.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "4.000"
"English", "Vegetation Offset (ft)", "50.000"
"English", " Maximum Air Temp (°F)", "83.031"
"Dam at Head of Segment","Checked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 69.18"
"Estimated Maximum (°F) = 74.26"
"Approximate Minimum (°F) = 64.11"
"Mean Equilibrium (°F) = 71.01"
"Maximum Equilibrium (°F) = 79.52"
"Minimum Equilibrium (°F) = 62.50"

Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)
Original mean temperature = 69.18°F

Variable	Temperature change (°F) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cfs)	+0.05	-0.06 *	
Inflow Temperature (°F)	-3.15	+3.38	**********
Segment Outflow (cfs)	+0.05	-0.05	
Accretion Temp. (°F)	+0.00	+0.00	
Width's A Term (s/ft²)	-0.21	+0.21 **	
B Term where W = A*Q**B	-0.04	+0.04	
Manning's n	+0.00	+0.00	
Air Temperature (°F)	-2.79	+2.48	**********
Relative Humidity (%)	-0.43	+0.43 ****	
Wind Speed (mph)	+0.19	-0.19 **	
Ground Temperature (°F)	-0.14	+0.14 *	
Thermal gradient (j/m²/s/C)	+0.03	-0.03	
Possible Sun (%)	-0.19	+0.27 **	
Dust Coefficient	+0.02	-0.02	
Ground Reflectivity (%)	-0.02	+0.02	
Segment Azimuth (degrees)	-0.02	+0.02	
West Side:			
Topographic Altitude (degrees)	+0.01	-0.01	
Vegetation Height (ft)	+0.03	-0.03	
Vegetation Crown (ft)	+0.02	-0.02	
Vegetation Offset (ft)	-0.01	+0.01	
Vegetation Density (%)	+0.07	-0.07 *	
East Side:			
Topographic Altitude (degrees)	+0.00	0.00	
Vegetation Height (ft)	+0.02	-0.02	
Vegetation Crown (ft)	+0.03	-0.03	
Vegetation Offset (ft)	-0.01	+0.01	
Vegetation Density (%)	+0.10	-0.10 *	

Natural conditions

"English",	"Segment Inflow (cfs)",	"19.800"
"English",	"Inflow Temperature (°F)",	"65.620"
"English",	"Segment Outflow (cfs)",	"19.800"
"English",	"Accretion Temp. (°F)",	"53.000"
"English",	"Latitude (degrees)",	"46.590"
"English",	"Segment Length (mi)",	"1.560"
"English",	"Upstream Elevation (ft)",	"3900.00"
"English",	"Downstream Elevation (ft)",	"3838.00"
"English",	"Width's A Term (s/ft²)",	"15.000"
"English",	" B Term where W = A*Q**B",	"0.110"
"English",	"Manning's n",	"0.035"
"English",	"Air Temperature (°F)",	"78.060"
"English",	"Relative Humidity (%)",	"33.200"
"English",	"Wind Speed (mph)",	"7.100"

"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.181"
"English", "Total Shade (%)", "36.587"
"English", "Segment Azimuth (degrees)", "-22.500"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "13.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "50.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "20.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "2.000"
"English", "Vegetation Offset (ft)", "60.000"
"English", " Maximum Air Temp (°F)", "83.031"
"Dam at Head of Segment","Checked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 66.52"
"Estimated Maximum (°F) = 68.60"
"Approximate Minimum (°F) = 64.45"
"Mean Equilibrium (°F) = 70.10"
"Maximum Equilibrium (°F) = 77.97"
"Minimum Equilibrium (°F) = 62.22"

Restoration 4. Increase vegetation density, with inflow from restoration 1 in upstream segment

"English", "Segment Inflow (cfs)", "9.000"
"English", "Inflow Temperature (°F)", "66.570"
"English", "Segment Outflow (cfs)", "3.000"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.590"
"English", "Segment Length (mi)", "1.560"
"English", "Upstream Elevation (ft)", "3900.00"
"English", "Downstream Elevation (ft)", "3838.00"
"English", "Width's A Term (s/ft²)", "15.000"
"English", " B Term where W = A*Q**B", "0.110"
"English", "Manning's n", "0.035"
"English", "Air Temperature (°F)", "78.060"
"English", "Relative Humidity (%)", "33.200"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"

"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.181"
"English", "Total Shade (%)", "39.130"
"English", "Segment Azimuth (degrees)", "-22.500"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "13.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "50.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "20.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "2.000"
"English", "Vegetation Offset (ft)", "60.000"
"English", " Maximum Air Temp (°F)", "83.031"
"Dam at Head of Segment","Checked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 68.14"
"Estimated Maximum (°F) = 72.56"
"Approximate Minimum (°F) = 63.72"
"Mean Equilibrium (°F) = 69.62"
"Maximum Equilibrium (°F) = 77.34"
"Minimum Equilibrium (°F) = 61.90"

Restoration 5. Inflow from restoration 2 in upstream segment

"English", "Segment Inflow (cfs)", "19.800"
"English", "Inflow Temperature (°F)", "66.080"
"English", "Segment Outflow (cfs)", "19.800"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.590"
"English", "Segment Length (mi)", "1.560"
"English", "Upstream Elevation (ft)", "3900.00"
"English", "Downstream Elevation (ft)", "3838.00"
"English", "Width's A Term (s/ft²)", "15.000"
"English", " B Term where W = A*Q**B", "0.110"
"English", "Manning's n", "0.035"
"English", "Air Temperature (°F)", "78.060"
"English", "Relative Humidity (%)", "33.200"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"

"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.181"
"English", "Total Shade (%)", "25.777"
"English", "Segment Azimuth (degrees)", "-22.500"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "13.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "30.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "6.000"
"English", "Topographic Altitude (degrees)", "20.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "4.000"
"English", "Vegetation Offset (ft)", "50.000"
"English", " Maximum Air Temp (°F)", "83.031"
"Dam at Head of Segment","Checked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 67.17"
"Estimated Maximum (°F) = 69.56"
"Approximate Minimum (°F) = 64.78"
"Mean Equilibrium (°F) = 71.38"
"Maximum Equilibrium (°F) = 79.97"
"Minimum Equilibrium (°F) = 62.79"

Restoration 6. TMDL Restoration Strategy with inflow from restoration 3 in upstream segment

"English", "Segment Inflow (cfs)", "17.500"
"English", "Inflow Temperature (°F)", "66.130"
"English", "Segment Outflow (cfs)", "16.000"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.590"
"English", "Segment Length (mi)", "1.560"
"English", "Upstream Elevation (ft)", "3900.00"
"English", "Downstream Elevation (ft)", "3838.00"
"English", "Width's A Term (s/ft²)", "15.000"
"English", " B Term where W = A*Q**B", "0.110"
"English", "Manning's n", "0.035"
"English", "Air Temperature (°F)", "78.060"
"English", "Relative Humidity (%)", "33.200"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "631.181"

"English", "Total Shade (%)", "36.972"
"English", "Segment Azimuth (degrees)", "-22.500"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "13.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "50.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "20.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "2.000"
"English", "Vegetation Offset (ft)", "60.000"
"English", " Maximum Air Temp (°F)", "83.031"
"Dam at Head of Segment","Checked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 67.03"
"Estimated Maximum (°F) = 69.35"
"Approximate Minimum (°F) = 64.71"
"Mean Equilibrium (°F) = 70.02"
"Maximum Equilibrium (°F) = 77.87"
"Minimum Equilibrium (°F) = 62.16"

Segment 4, Prickly Pear Segment MT41I006_030

Current conditions

"English", "Segment Inflow (cfs)", "3.000"
"English", "Inflow Temperature (°F)", "69.180"
"English", "Segment Outflow (cfs)", "1.500"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.620"
"English", "Segment Length (mi)", "5.250"
"English", "Upstream Elevation (ft)", "3838.00"
"English", "Downstream Elevation (ft)", "3708.00"
"English", "Width's A Term (s/ft²)", "14.400"
"English", " B Term where W = A*Q**B", "0.110"
"English", "Manning's n", "0.036"
"English", "Air Temperature (°F)", "78.400"
"English", "Relative Humidity (%)", "32.800"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.897"

"English", "Total Shade (%)", "9.481"
"English", "Segment Azimuth (degrees)", "-45.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "6.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "5.000"
"English", "Vegetation Density (%)", "15.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "6.000"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "30.000"
"English", " Maximum Air Temp (°F)", "83.382"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 73.06"
"Estimated Maximum (°F) = 82.67"
"Approximate Minimum (°F) = 63.46"
"Mean Equilibrium (°F) = 73.08"
"Maximum Equilibrium (°F) = 82.68"
"Minimum Equilibrium (°F) = 63.47"

Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)
Original mean temperature = 73.06°F

Variable	Temperature change (°F) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cfs)	0.00	+0.01	
Inflow Temperature (°F)	-0.02	+0.02	
Segment Outflow (cfs)	+0.00	+0.00	
Accretion Temp. (°F)	+0.00	+0.00	
Width's A Term (s/ft²)	-0.05	+0.07	
B Term where W = A*Q**B	-0.01	+0.01	
Manning's n	+0.00	+0.00	
Air Temperature (°F)	-4.72	+4.57	**********
Relative Humidity (%)	-0.77	+0.79	*****
Wind Speed (mph)	+0.50	-0.54	***
Ground Temperature (°F)	-0.24	+0.25	**
Thermal gradient (j/m²/s/C)	+0.08	-0.08	*
Possible Sun (%)	-0.42	+0.59	****
Dust Coefficient	+0.03	-0.03	
Ground Reflectivity (%)	-0.04	+0.04	
Segment Azimuth (degrees)	-0.02	+0.02	
West Side:			
Topographic Altitude (degrees)	+0.00	0.00	

Vegetation Height (ft) +0.04 -0.04
Vegetation Crown (ft) +0.03 -0.03
Vegetation Offset (ft) -0.03 +0.03
Vegetation Density (%) +0.07 -0.07
East Side:
Topographic Altitude (degrees) +0.00 0.00
Vegetation Height (ft) +0.03 -0.03
Vegetation Crown (ft) +0.02 -0.01
Vegetation Offset (ft) -0.02 +0.03
Vegetation Density (%) +0.03 -0.03

Natural conditions

"English", "Segment Inflow (cfs)", "19.800"
"English", "Inflow Temperature (°F)", "66.520"
"English", "Segment Outflow (cfs)", "21.300"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.620"
"English", "Segment Length (mi)", "5.250"
"English", "Upstream Elevation (ft)", "3838.00"
"English", "Downstream Elevation (ft)", "3708.00"
"English", "Width's A Term (s/ft²)", "14.400"
"English", " B Term where W = A*Q**B", "0.110"
"English", "Manning's n", "0.035"
"English", "Air Temperature (°F)", "78.400"
"English", "Relative Humidity (%)", "32.800"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.897"
"English", "Total Shade (%)", "36.419"
"English", "Segment Azimuth (degrees)", "-45.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "55.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "2.000"
"English", "Vegetation Offset (ft)", "65.000"
"English", " Maximum Air Temp (°F)", "83.382"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"

"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 67.65"
"Estimated Maximum (°F) = 74.36"
"Approximate Minimum (°F) = 60.93"
"Mean Equilibrium (°F) = 70.12"
"Maximum Equilibrium (°F) = 78.00"
"Minimum Equilibrium (°F) = 62.23"

Restoration 7. Increase vegetation density with inflow from restoration 4 in segment MT41I006_040

"English", "Segment Inflow (cfs)", "3.000"
"English", "Inflow Temperature (°F)", "68.140"
"English", "Segment Outflow (cfs)", "1.500"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.620"
"English", "Segment Length (mi)", "5.250"
"English", "Upstream Elevation (ft)", "3838.00"
"English", "Downstream Elevation (ft)", "3708.00"
"English", "Width's A Term (s/ft²)", "14.400"
"English", " B Term where W = A*Q**B", "0.110"
"English", "Manning's n", "0.036"
"English", "Air Temperature (°F)", "78.400"
"English", "Relative Humidity (%)", "32.800"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.897"
"English", "Total Shade (%)", "41.961"
"English", "Segment Azimuth (degrees)", "-45.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "2.000"
"English", "Vegetation Density (%)", "55.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "2.000"
"English", "Vegetation Offset (ft)", "65.000"
"English", " Maximum Air Temp (°F)", "83.382"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"

"Predicted Mean (°F) = 69.26"
"Estimated Maximum (°F) = 76.77"
"Approximate Minimum (°F) = 61.75"
"Mean Equilibrium (°F) = 69.27"
"Maximum Equilibrium (°F) = 76.79"
"Minimum Equilibrium (°F) = 61.75"

Restoration 8. Inflow from restoration 5 in segment MT41I006_040

"English", "Segment Inflow (cfs)", "19.800"
"English", "Inflow Temperature (°F)", "67.170"
"English", "Segment Outflow (cfs)", "21.300"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.620"
"English", "Segment Length (mi)", "5.250"
"English", "Upstream Elevation (ft)", "3838.00"
"English", "Downstream Elevation (ft)", "3708.00"
"English", "Width's A Term (s/ft²)", "14.400"
"English", " B Term where W = A*Q**B", "0.110"
"English", "Manning's n", "0.036"
"English", "Air Temperature (°F)", "78.400"
"English", "Relative Humidity (%)", "32.800"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.897"
"English", "Total Shade (%)", "8.194"
"English", "Segment Azimuth (degrees)", "-45.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "6.000"
"English", "Vegetation Height (ft)", "15.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "5.000"
"English", "Vegetation Density (%)", "15.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "6.000"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "30.000"
"English", " Maximum Air Temp (°F)", "83.382"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 69.71"
"Estimated Maximum (°F) = 78.64"

"Approximate Minimum (°F) = 60.79"
"Mean Equilibrium (°F) = 73.39"
"Maximum Equilibrium (°F) = 83.03"
"Minimum Equilibrium (°F) = 63.75"

Segment 5a, Prickly Pear Segment MT41I006_020 to Sierra Road

Current conditions

"English", "Segment Inflow (cfs)", "1.500"
"English", "Inflow Temperature (°F)", "59.700"
"English", "Segment Outflow (cfs)", "7.500"
"English", "Accretion Temp. (°F)", "53.000"
"English", "Latitude (degrees)", "46.650"
"English", "Segment Length (mi)", "3.030"
"English", "Upstream Elevation (ft)", "3708.00"
"English", "Downstream Elevation (ft)", "3677.00"
"English", "Width's A Term (s/ft²)", "14.800"
"English", " B Term where W = A*Q**B", "0.150"
"English", "Manning's n", "0.035"
"English", "Air Temperature (°F)", "78.740"
"English", "Relative Humidity (%)", "32.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.649"
"English", "Total Shade (%)", "5.819"
"English", "Segment Azimuth (degrees)", "40.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "6.000"
"English", "Vegetation Height (ft)", "5.000"
"English", "Vegetation Crown (ft)", "15.000"
"English", "Vegetation Offset (ft)", "5.000"
"English", "Vegetation Density (%)", "20.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "4.000"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "5.000"
"English", "Vegetation Offset (ft)", "10.000"
"English", " Maximum Air Temp (°F)", "83.734"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 65.04"
"Estimated Maximum (°F) = 77.18"

"Approximate Minimum (°F) = 52.91"
"Mean Equilibrium (°F) = 73.56"
"Maximum Equilibrium (°F) = 83.35"
"Minimum Equilibrium (°F) = 63.77"

Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)
Original mean temperature = 65.04°F

Variable	Temperature change (°F) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cfs)	-0.11	+0.11	*
Inflow Temperature (°F)	-0.12	+0.14	*
Segment Outflow (cfs)	+0.52	-0.58	*****
Accretion Temp. (°F)	-2.12	+2.12	**********
Width's A Term (s/ft²)	-0.52	+0.58	*****
B Term where W = A*Q**B	-0.12	+0.12	*
Manning's n	+0.00	+0.00	
Air Temperature (°F)	-3.39	+3.02	**********
Relative Humidity (%)	-0.53	+0.54	*****
Wind Speed (mph)	+0.14	-0.15	*
Ground Temperature (°F)	-0.17	+0.17	*
Thermal gradient (j/m²/s/C)	+0.03	-0.03	
Possible Sun (%)	-0.30	+0.42	****
Dust Coefficient	+0.02	-0.02	
Ground Reflectivity (%)	-0.03	+0.03	
Segment Azimuth (degrees)	-0.01	+0.01	
West Side:			
Topographic Altitude (degrees)	+0.00	0.00	
Vegetation Height (ft)	+0.01	-0.01	
Vegetation Crown (ft)	+0.02	-0.02	
Vegetation Offset (ft)	-0.01	+0.01	
Vegetation Density (%)	+0.02	-0.02	
East Side:			
Topographic Altitude (degrees)	+0.00	0.00	
Vegetation Height (ft)	+0.02	-0.02	
Vegetation Crown (ft)	+0.01	-0.01	
Vegetation Offset (ft)	-0.01	+0.01	
Vegetation Density (%)	+0.02	-0.02	

Segment 5b, Prickly Pear Segment MT41I006_020

Current conditions

"English", "Segment Inflow (cfs)", "1.500"
"English", "Inflow Temperature (°F)", "59.700"
"English", "Segment Outflow (cfs)", "16.500"
"English", "Accretion Temp. (°F)", "55.000"
"English", "Latitude (degrees)", "46.660"
"English", "Segment Length (mi)", "6.830"
"English", "Upstream Elevation (ft)", "3708.00"

"English", "Downstream Elevation (ft)", "3650.00"
"English", "Width's A Term (s/ft²)", "15.000"
"English", " B Term where W = A*Q**B", "0.190"
"English", "Manning's n", "0.034"
"English", "Air Temperature (°F)", "78.740"
"English", "Relative Humidity (%)", "32.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.578"
"English", "Total Shade (%)", "7.040"
"English", "Segment Azimuth (degrees)", "30.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "6.000"
"English", "Vegetation Height (ft)", "5.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "10.000"
"English", "Vegetation Density (%)", "15.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "4.000"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "5.000"
"English", "Vegetation Offset (ft)", "25.000"
"English", " Maximum Air Temp (°F)", "83.734"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 66.31"
"Estimated Maximum (°F) = 76.03"
"Approximate Minimum (°F) = 56.59"
"Mean Equilibrium (°F) = 73.42"
"Maximum Equilibrium (°F) = 83.14"
"Minimum Equilibrium (°F) = 63.70"

Sensitivity for mean temperature values (10% variation) SSTEMP (2.0.8)
Original mean temperature = 66.31°F

Variable	Temperature change (°F) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cfs)	-0.05	+0.05	
Inflow Temperature (°F)	-0.02	+0.02	
Segment Outflow (cfs)	+0.38	-0.41	****
Accretion Temp. (°F)	-2.11	+2.11	**********
Width's A Term (s/ft²)	-0.45	+0.51	****

B Term where W = A*Q**B -0.20 +0.20 **
Manning's n +0.00 +0.00
Air Temperature (°F) -3.47 +3.13 **********
Relative Humidity (%) -0.54 +0.55 *****
Wind Speed (mph) +0.18 -0.19 **
Ground Temperature (°F) -0.17 +0.17 *
Thermal gradient (j/m²/s/C) +0.04 -0.04
Possible Sun (%) -0.30 +0.42 ****
Dust Coefficient +0.02 -0.02
Ground Reflectivity (%) -0.03 +0.03
Segment Azimuth (degrees) 0.00 0.00
West Side:
Topographic Altitude (degrees) +0.01 0.00
Vegetation Height (ft) +0.01 -0.01
Vegetation Crown (ft) +0.00 0.00
Vegetation Offset (ft) -0.01 +0.01
Vegetation Density (%) +0.00 0.00
East Side:
Topographic Altitude (degrees) +0.00 0.00
Vegetation Height (ft) +0.04 -0.04
Vegetation Crown (ft) +0.02 -0.02
Vegetation Offset (ft) -0.02 +0.02
Vegetation Density (%) +0.05 -0.05

Natural conditions

"English", "Segment Inflow (cfs)", "21.300"
"English", "Inflow Temperature (°F)", "67.670"
"English", "Segment Outflow (cfs)", "36.300"
"English", "Accretion Temp. (°F)", "55.000"
"English", "Latitude (degrees)", "46.660"
"English", "Segment Length (mi)", "6.830"
"English", "Upstream Elevation (ft)", "3708.00"
"English", "Downstream Elevation (ft)", "3650.00"
"English", "Width's A Term (s/ft²)", "15.000"
"English", " B Term where W = A*Q**B", "0.190"
"English", "Manning's n", "0.034"
"English", "Air Temperature (°F)", "78.740"
"English", "Relative Humidity (%)", "32.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.578"
"English", "Total Shade (%)", "30.302"
"English", "Segment Azimuth (degrees)", "30.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "25.000"

"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "5.000"
"English", "Vegetation Density (%)", "50.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "2.000"
"English", "Vegetation Offset (ft)", "55.000"
"English", " Maximum Air Temp (°F)", "83.734"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 65.82"
"Estimated Maximum (°F) = 71.98"
"Approximate Minimum (°F) = 59.66"
"Mean Equilibrium (°F) = 70.80"
"Maximum Equilibrium (°F) = 79.10"
"Minimum Equilibrium (°F) = 62.50"

Restoration 9. Increase vegetation density under current flow

"English", "Segment Inflow (cfs)", "1.500"
"English", "Inflow Temperature (°F)", "59.700"
"English", "Segment Outflow (cfs)", "16.500"
"English", "Accretion Temp. (°F)", "55.000"
"English", "Latitude (degrees)", "46.660"
"English", "Segment Length (mi)", "6.830"
"English", "Upstream Elevation (ft)", "3708.00"
"English", "Downstream Elevation (ft)", "3650.00"
"English", "Width's A Term (s/ft²)", "15.000"
"English", " B Term where W = A*Q**B", "0.190"
"English", "Manning's n", "0.034"
"English", "Air Temperature (°F)", "78.740"
"English", "Relative Humidity (%)", "32.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.578"
"English", "Total Shade (%)", "34.466"
"English", "Segment Azimuth (degrees)", "30.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "25.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "5.000"

"English", "Vegetation Density (%)", "50.000"
"East Side Variables"
"English", "Segment Azimuth (degrees)", "10.000"
"English", "Topographic Altitude (degrees)", "15.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "2.000"
"English", "Vegetation Offset (ft)", "55.000"
"English", " Maximum Air Temp (°F)", "83.734"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 64.12"
"Estimated Maximum (°F) = 71.50"
"Approximate Minimum (°F) = 56.74"
"Mean Equilibrium (°F) = 70.25"
"Maximum Equilibrium (°F) = 78.28"
"Minimum Equilibrium (°F) = 62.22"

Restoration 10. Inflow from restoration 8 in segment MT41I006_030

"English", "Segment Inflow (cfs)", "21.300"
"English", "Inflow Temperature (°F)", "69.710"
"English", "Segment Outflow (cfs)", "36.300"
"English", "Accretion Temp. (°F)", "55.000"
"English", "Latitude (degrees)", "46.660"
"English", "Segment Length (mi)", "6.830"
"English", "Upstream Elevation (ft)", "3708.00"
"English", "Downstream Elevation (ft)", "3650.00"
"English", "Width's A Term (s/ft²)", "15.000"
"English", " B Term where W = A*Q**B", "0.190"
"English", "Manning's n", "0.034"
"English", "Air Temperature (°F)", "78.740"
"English", "Relative Humidity (%)", "32.400"
"English", "Wind Speed (mph)", "7.100"
"English", "Ground Temperature (°F)", "55.000"
"English", "Thermal gradient (j/m²/s/C)", "1.650"
"English", "Possible Sun (%)", "90.000"
"English", "Dust Coefficient", "5.000"
"English", "Ground Reflectivity (%)", "25.000"
"English", "Solar Radiation (Langleys/d)", "630.578"
"English", "Total Shade (%)", "5.910"
"English", "Segment Azimuth (degrees)", "30.000"
"West Side Variables"
"English", "Topographic Altitude (degrees)", "6.000"
"English", "Vegetation Height (ft)", "5.000"
"English", "Vegetation Crown (ft)", "10.000"
"English", "Vegetation Offset (ft)", "10.000"
"English", "Vegetation Density (%)", "15.000"
"East Side Variables"

"English", "Segment Azimuth (degrees)", "4.000"
"English", "Topographic Altitude (degrees)", "10.000"
"English", "Vegetation Height (ft)", "10.000"
"English", "Vegetation Crown (ft)", "5.000"
"English", "Vegetation Offset (ft)", "25.000"
"English", " Maximum Air Temp (°F)", "83.734"
"Dam at Head of Segment","Unchecked"
" Maximum Air Temp (°F)","Unchecked"
"Solar Radiation","Disabled"
"Total Shade","Disabled"
"Month/day","08/07"
"Predicted Mean (°F) = 67.86"
"Estimated Maximum (°F) = 75.72"
"Approximate Minimum (°F) = 59.99"
"Mean Equilibrium (°F) = 73.59"
"Maximum Equilibrium (°F) = 83.37"
"Minimum Equilibrium (°F) = 63.82"