APPENDIX C
STEELHEAD HABITAT ASSESSMENT REPORT

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

STEELHEAD HABITAT ASSESSMENT
FOSTER PARK WELL FIELD AREA
VENTURA COUNTY, CALIFORNIA

Prepared for:

Hopkins Groundwater Consultants, Inc.

and

City of Ventura

Prepared by:

Padre Associates, Inc.
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Ventura, CA 93003
(805) 644-2220

December 2012

Project No. 1202-0421

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1.0 INTRODUCTION

1.1 BACKGROUND

The National Marine Fisheries Service (NMFS) listed the southern California Evolutionary Significant Unit of steelhead trout as Endangered on August 11, 1997. This listing affected trout populations in the Ventura River watershed. A group of local public and private agencies (including the City of San Buenaventura) with responsibilities for surface water, groundwater and flood control collaborated to develop a management plan for steelhead trout in the Ventura River watershed. A draft Ventura River Steelhead Restoration and Recovery Plan was developed in December 1997 with the assistance of ENTRIX, Inc. and Woodward-Clyde Consultants. Since that time, the City of San Buenaventura has participated in the development of the Recovery Plan, to ensure the long-term survival of steelhead in the Ventura River, while meeting the potable water needs of City residents.

The City understands harvesting groundwater (wells Nye 7, Nye 8, Nye 11) and subsurface river flows at Foster Park may reduce the volume and duration of surface water in the Ventura River, and possibly adversely affect steelhead and their habitat. Therefore, the City contracted Hopkins Groundwater Consultants (Hopkins) in 2009 to study surface water/groundwater interactions at Foster Park (Casitas Springs to the Casitas Vista Road bridge). The 2009 Hopkins study consisted of collecting data from upstream and downstream of the Foster Park well field, including surface water flow, stream height, groundwater level and groundwater production rates to determine the effects of groundwater production on surface flows. The results of the 2009 Hopkins study indicated that harvesting about 3,000 gallons per minute of groundwater (subsurface river flow) reduced surface flow by about 6 cubic feet per second (cfs). However, the rate of rising groundwater was observed to offset the loss such that the difference in flow upstream and downstream of the study reach was not substantially affected during the study period (April 14 to July 6, 2009).

The City requested Hopkins to conduct an additional study in 2010 that included additional stream flow measurement stations within the Foster Park reach of the Ventura River. The seasonal study period extended from July 17 to September 9, and consisted of 12 monitoring events to document late summer/fall flows. Padre Associates was requested by the City to conduct a steelhead habitat assessment in 2010 in coordination with the surface water/groundwater interaction study. The purpose of the 2010 steelhead habitat assessment was to document habitat conditions as they change through the summer, with declining surface flow rates.

1.2 PURPOSE

The purpose of this study is to conduct a steelhead habitat assessment in coordination with data collection for another surface water/groundwater interaction study. The study is intended to provide further documentation of low flow conditions and the effects that declining surface flows have on steelhead habitat.

1.3 SCOPE OF WORK

Padre Associate's scope of work consisted of conducting a steelhead habitat assessment on a periodic basis (generally weekly) simultaneously with surface flow data collected by Hopkins. A total of 24 sampling events were completed to encompass the dry season decline in surface flow from May 3 to September 19, 2012. Most of the data was collected during periods of normal groundwater pumping by the City (as required to meet seasonal demands). However, groundwater pumping was manipulated prior to several sampling events to observe the effect of groundwater pumping at Foster Park on surface water flow rates and steelhead habitat.

2.0 METHODOLOGY

The steelhead habitat assessment methodology utilized for this study is the rainbow trout Habitat Suitability Index (HSI) model developed by the U.S. Fish and Wildlife Service (Raleigh et al., 1984), as modified by Thomas R. Payne & Associates (2007). The HSI method was selected because it has been repeatedly used to assess the habitat quality of the Ventura River, and was used to assess potential effects of the City's proposed Foster Park Embankment Protection project. Therefore, the results of this study can be compared to existing studies to detect both seasonal changes and year-to-year changes associated with variable rainfall and river channel conditions. Past studies using the rainbow trout HSI model in the vicinity of Foster Park include:

- Assessment of Steelhead Habitat in the Ventura River/Matilija Creek Basin; Stage Two: Quantitative Stream Survey (Thomas R. Payne & Associates, 2004);
- Steelhead Population and Habitat Assessment in the Ventura River/Matilija Creek Basin; 2006 Final Report (Thomas R. Payne & Associates, 2007);
- Steelhead Population and Habitat Assessment in the Ventura River/Matilija Creek Basin; Final Report 2007 (Thomas R. Payne & Associates, 2008); and
- Assessment of Habitat Quality and Potential Enhancement for Steelhead in the Ventura River in Association with the Foster Park Embankment Protection and Restoration Project (Thomas R. Payne & Associates, 2009).

2.1 STUDY SITE

The boundaries of the study site were consistent with the 2009, 2010 and 2012 Hopkins studies, and consisted of the reach of the Ventura River from the Casitas Vista Road bridge upstream to Casitas Springs (just upstream of Mobil Lane). Based on measurements from a 2011 high resolution geo-rectified aerial photograph, the study site included approximately 8,850 linear feet of the low flow channel. The location map of the study site is provided as Figure 1.

2.2 SAMPLE UNIT SELECTION

The study site was classified according to the California Department of Fish and Game Level II stream habitat classification system, provided in the California Salmonid Stream Habitat Restoration Manual developed by Flosi et al. (1998). The results of the habitat typing identified 11 percent pools, 43 percent runs and 46 percent riffles within the 8,850 foot-long study reach. Six sample units were randomly selected from each of three habitat types, yielding 18 sample units (6 pools, 6 runs, and 6 riffles). The location of each sample unit is provided on a 2011 aerial photograph (Figures 2 and 3), and the latitude and longitude of each sample unit (WGS 84 datum) is provided in Table 1.

Table 1. Coordinates of the Sample Units

Unit no.	Pools	Riffles	Runs
1	34° 21.155'/119° 18.476'	34° 21.152'/119° 18.498'	34° 21.285'/119° 18.584'
2	34° 21.373'/119° 18.598'	34° 21.275'/119° 18.582'	34° 21.402'/119° 18.667'
3	34° 21.506'/119° 18.691'	34° 21.563'/119° 18.707'	34° 21.915'/119° 18.665'
4	34° 21.590'/119° 18.721'	34° 21.853'/119° 18.664'	34° 21.962'/119° 18.668'
5	34° 22.065'/119° 18.699'	34° 21.941'/119° 18.666'	34° 22.116'/119° 18.693'
6	34° 22.315'/119° 18.581'	34° 22.325'/119° 18.582'	34° 22.349'/119° 18.572'

2.3 HSI MODEL MODIFICATIONS

Modifications to HSI variable curves recommended by Thomas R. Payne & Associates (2007) were used, including:

- Maximum water temperature during rearing and adult migration (V1): the original variable curve yielded a zero suitability value due to relatively high temperatures found in the Ventura River in summer; therefore, the curve was adjusted to be consistent with observed conditions in California streams.
- Maximum water temperature during embryo development and smoltification (V2): the original variable curve yielded a zero suitability value due to relatively high temperatures found in the Ventura River in summer; therefore, the curve was adjusted to be consistent with observed conditions in California streams.
- Spawning water velocity (V5): the variable curve was modified to increase habitat suitability at higher velocities suitable for steelhead;
- Percent substrate size class (V8): winter rearing substrate was re-defined from 10 to 40 cm in diameter to greater than 10 cm.
- Stream shading (V17): the variable curve was modified by extending the area of maximum habitat suitability to include areas with greater canopy closure.

2.4 HSI MODEL DESCRIPTION

The HSI model uses 18 variables to calculate five different suitability indices for steelhead; adult, juvenile, fry, embryo and other (affects all life stages). These five HSI values are combined using equal weighting (equal component value method) to produce an overall HSI value. Data is collected for each of the 18 variables, and a variable curve is used to estimate an index score (ranging from 0 to 1.0) for each of the variables. Formulas presented in Raleigh et al. (1984) were used to calculate HSI values from the index scores. Table 2 lists the variables used in the HSI model, how they are used to calculate habitat suitability and methods used to collect data.

2.5 DATA COLLECTION

Water temperature, dissolved oxygen and pH were measured in-situ at each sample unit using a YSI model 556 meter. The thalweg water depth (deepest part of the active channel) was measured using a survey rod (to the nearest 0.05 feet) at 3 to 4 locations within each sample unit. The channel width was measured to the nearest inch at each sample unit using a fiberglass tape measure. Data concerning vegetation, instream cover, shading and substrate listed in Table 2 (field estimates) were collected at each sample unit on May 3, 2012. Surface water flow rate (variable V5) was measured on July 26, 2012 at each sample unit using a Global Water FP101 flow probe. Table 3 lists the date of each sampling event, and identifies which of the City's three Foster Park wells were operating during the sampling event. As indicated in Table 3, well pumps were turned off for several days and groundwater elevations allowed to equilibrate to represent an experimental condition (on August 2, 8, 23) to determine the effect of well pumping on surface flows and steelhead habitat.

The focus of the assessment was to document habitat changes as surface flow rates decline over the dry season, which should be reflected in changes in thalweg depth. Due to the composition of the streambed (primarily cobble and boulders), thalweg depth varied substantially within each sample unit. A data collection location at each sample unit was marked in the field with flagging, and data was collected at precisely the same location within each sample unit during the sampling events. This method allows for a more accurate comparison of thalweg depths (and flow width) between sampling events.

Water temperatures present during adult migration, smolt migration and incubation were taken from Thomas R. Payne & Associates (TRPA, 2009) because the present assessment did not include time periods when these events occur (winter, spring). Water velocity (variable V5) measured at each sample unit on July 26, 2012 was used to calculate HSI values. However, these values may not represent flows present during steelhead egg incubation (typically January to March). Therefore, an expansion factor of 2.0 was taken from Thomas R. Payne & Associates (2007) and used to convert measured summer water velocity to that expected to be present during egg incubation.

Data collection included measuring pH (variable V13) at each sample unit during each assessment, with the average of the 18 sample units used in the HSI calculation. However, these values may not fully represent annual values. Flow regime data (variables V14 and V18) were taken from TRPA (2009) to be consistent with past HSI model steelhead habitat assessments.

Table 2. HSI Model Variable Descriptions

Variable Code	Variable Description	Model Component	Life Stage/Process	Data Source
V1A V1B	Maximum summer water temperature Maximum water temperature during adult migration	Other Adult	Rearing Adult migration	Measured in-situ TRPA (2009)
V2A V2B	Maximum smoltification water temperature Maximum water temperature during embryo development	Juvenile Embryo	Smolt migration Incubation	TRPA (2009) TRPA (2009)
V3	Minimum dissolved oxygen during low water period	Other	Rearing	Measured in-situ
V4	Thalweg depth during low water period	Adult	Rearing	Measured
V5	Velocity over spawning gravel	Embryo	Incubation	Measured, converted to incubation flows using a 2.0 expansion factor
V6a V6j	Instream cover (adults) during low water period Instream cover (juveniles) during low water period	Adult Juvenile	Rearing Rearing	Field estimate Field estimate
V7	Substrate size in spawning areas	Embryo	Incubation	Field estimate
V8	Percent substrate over 10 cm	Fry	Rearing	Field estimate
V9	Dominant substrate type in riffles & runs	Other	Food production	Field estimate
V10	Percent pools during low water period	Adult, fry, juvenile	Rearing	Field estimate
V11	Vegetation cover on stream bank during summer	Other	All	Field estimate
V12	Rooted woody vegetation & stable rock along stream bank	Other	All	Field estimate
V13	Annual maximum/minimum pH	Other	All	Measured in-situ
V14	Annual base flow during the low flow season as a percentage of average annual daily flow	Other	Rearing	TRPA (2009)
V15	Pool class (quality) rating	Adult, juvenile	Rearing	Field estimate
V16	Percent fines in riffle-run areas during low flows	Fry, embryo, other	Incubation, food production	Field estimate
V17	Stream shading during midday	Other	Rearing, food production	Field estimate
V18	Mean flow during upstream migration as a percentage of annual mean flow	Other	Adult migration	TRPA (2009)

Table 3. Sampling Dates

Date	Foster Park Wells in Operation	Variable Data Collected
May 3, 2012	Nye 7*, 8*, 11	V1, V3, V4, V5, V6, V7, V8, V9, V11, V12, V13, V16, V17, stream width
May 10, 2012	Nye 7, 8, 11	V1, V3, V4, V5, V13, stream width, photographs
May 17, 2012	Nye 7, 11	V1, V3, V4, V5, V13, stream width
May 24, 2012	Nye 7, 8, 11	V1, V3, V4, V13, stream width
May 31, 2012	Nye 7, 8, 11	V1, V3, V4, V13, stream width
June 7, 2012	Nye 7, 8, 11	V1, V3, V4, V13, stream width
June 14, 2012	Nye 7, 8, 11	V1, V3, V4, V13, stream width
June 21, 2012	Nye 7, 8, 11	V1, V3, V4, V13, stream width
June 28, 2012	Nye 7, 8, 11	V1, V3, V4, V13, stream width
July 5, 2012	Nye 7, 8, 11	V1, V3, V4, V13, stream width
July 12, 2012	Nye 7, 8, 11	V1, V3, V4, V13, stream width
July 19, 2012	Nye 7, 8	V1, V3, V4, V13, stream width, photographs
July 26, 2012	Nye 7, 8, 11	V1, V3, V4, V5, V13, stream width
August 2, 2012		V1, V3, V4, V13, stream width
August 8, 2012		V1, V3, V4, V13, stream width
August 13, 2012	Nye 8	V1, V3, V4, V13, stream width
August 16, 2012	Nye 7, 8	V1, V3, V4, V13, stream width
August 20, 2012	Nye 7, 8	V1, V3, V4, V13, stream width
August 23, 2012		V1, V3, V4, V13, stream width
August 28, 2012	Nye 7, 8	V1, V3, V4, V13, stream width, photographs
August 31, 2012	Nye 7, 8	V1, V3, V4, V13, stream width
September 5, 2012	Nye 7, 8	V1, V3, V4, V13, stream width
September 12, 2012	Nye 7, 8	V1, V3, V4, V13, stream width
September 19, 2012	Nye 7, 8	V1, V3, V4, V13, stream width

*Wells Nye 7 and 8 turned on at 1200, near end of sampling event

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STUDY SITE LOCATION MAP
FIGURE 1

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SAMPLE UNIT LOCATION MAP - DOWNSTREAM
FIGURE 2

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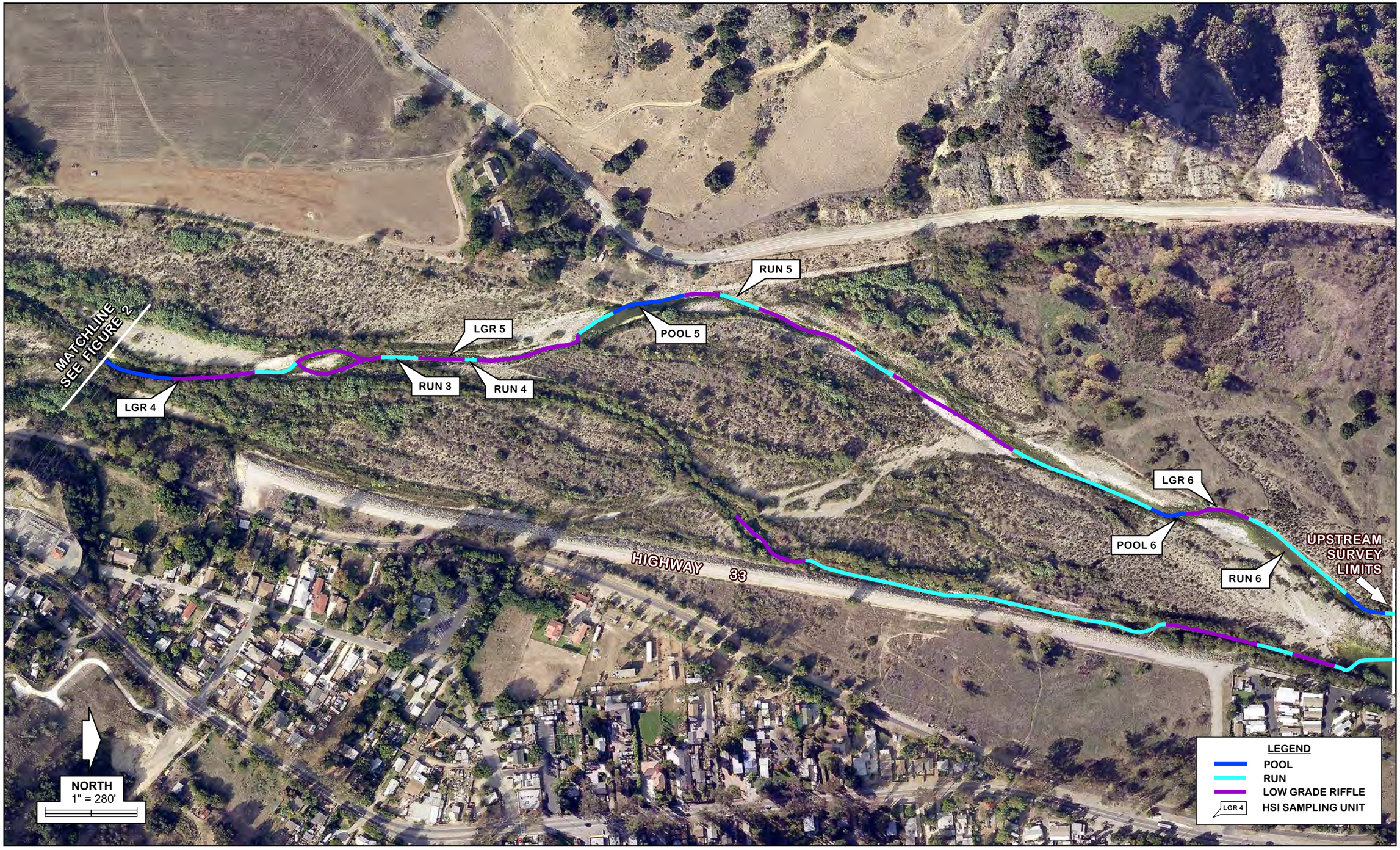

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SAMPLE UNIT LOCATION MAP - UPSTREAM

FIGURE 3

3.0 STUDY RESULTS

Data collected during this steelhead habitat assessment are summarized in Appendices A (raw HSI variable data and index scores) and B (HSI calculation forms). Photographs of the sample units are provided as Appendix C. The following is a discussion of the data collected.

3.1 WATER DEPTH

The focus of the assessment was to document habitat changes as surface flow rates decline over the dry season, which should be reflected in changes in thalweg depth. The HSI variable curve for thalweg depth indicates habitat suitability declines as thalweg depth falls below 45 cm (1.4 feet). As indicated in Table 2 (variable V4), the HSI methodology uses thalweg depth only for adult habitat suitability. The HSI calculations (see Table 6) used the average thalweg depth of all 18 sample units (6 pools, 6 runs, 6 riffles). Therefore, sample units that became dry (zero depth) later in the season are averaged in, and reduced HSI values for the study reach as a whole. Table 4 and Figure 4 provide a summary of water depth data collected over the study period. Bold values in Table 4 represent sampling events when the City's Foster Park wells were not in operation, which appeared to reduce the seasonal decline in water depth. Photographs of each sample unit provided in Appendix C also illustrate changes in water depth and habitat quality over the study period.

Water depths in the upper portion of the study reach (Run-5, Pool-6, Riffle-6, Run-6; see Figure 3) did not decline as much as the lower portion over the study period, and did not appear to be affected by changes in City water production (see Table 4 and Figure 4: Upper Reach). Figure 5 illustrates the observed average thalweg depth for each sampling event as compared to the surface flow rate measured by Hopkins at the Casitas Vista Road bridge.

3.2 WATER TEMPERATURE

Water temperature typically increases over the summer as ambient temperature increases, and may increase as water depth decreases as shallow water is more easily heated by the sun. Maximum daily water temperature during the low flow season (summer) is also an HSI Model variable (V1A) that addresses habitat suitability for juvenile and adult steelhead during the summer rearing season. Surface flow in the Ventura River was composed of rising groundwater originating about one mile upstream of the study site, and surface flows contributed from San Antonio Creek. Water temperature was measured at each of the 18 sample units and generally increased as ambient temperature increased during the sampling period.

The maximum temperature was used with the modified V1A HSI variable curve to obtain an index score. Overall, data collected in 2010 and in 2012 indicates water temperature peaks around 2 p.m. Data was typically collected from 9 a.m. to 1:30 p.m., such that the sampled maximum temperature (generally at the end of the data collection period) is likely within one degree Fahrenheit of the actual daily maximum water temperature within the study site on the sampling date.

Based on data collected during 24 sampling events, a water temperature pattern was observed, with higher temperatures between Riffle-4 and Run-5, and lower temperatures between Pool-6 and Run-6 (see Figures 2 and 3). An average difference of 2.8 ^{o}C (range of 0.9 to 7.5 ^{o}C) in water temperature was observed each sampling day between sample units Pool-4 and Riffle-4. The reason for this temperature pattern is unclear.

As the dry season progressed and water depths declined, water temperatures increased in those sample units with very low water depths. Nearly total fish mortality was observed prior to complete drying of the sample unit, likely due to high water temperatures (exceeding 25 ^{o}C) and low nighttime dissolved oxygen (due to algal respiration).

Table 4. Changes in Water Depth over the Study Period

Sampling Date	Study Reach Average Depth (cm)	Pool Average Depth (cm)	Run Average Depth (cm)	Riffle Average Depth (cm)	Upper Reach Average Depth (cm)
May 3, 2012	53	90	42	28	36
May 10, 2012	51	88	37	27	35
May 17, 2012	50	87	36	26	35
May 24, 2012	43	75	37	18	29
May 31, 2012	43	75	37	17	32
June 7, 2012	41	75	32	15	30
June 14, 2012	41	75	32	15	29
June 21, 2012	41	76	33	15	29
June 28, 2012	39	71	32	15	30
July 5, 2012	37	69	28	13	29
July 12, 2012	38	71	30	13	28
July 19, 2012	38	72	29	13	27
July 26, 2012	36	69	29	12	27
August 2, 2012	**38**	**71**	**30**	**15**	**25**
August 8, 2012	**37**	**71**	**28**	**13**	**25**
August 13, 2012	36	68	29	11	26
August 16, 2012	33	65	25	9	25
August 20, 2012	29	56	25	7	24
August 23, 2012	**33**	**67**	**23**	**9**	**23**
August 28, 2012	28	54	22	7	25
August 31, 2012	25	52	17	5	25
September 5, 2012	22	45	16	5	23
September 12, 2012	18	36	13	5	23
September 19, 2012	16	31	12	4	22

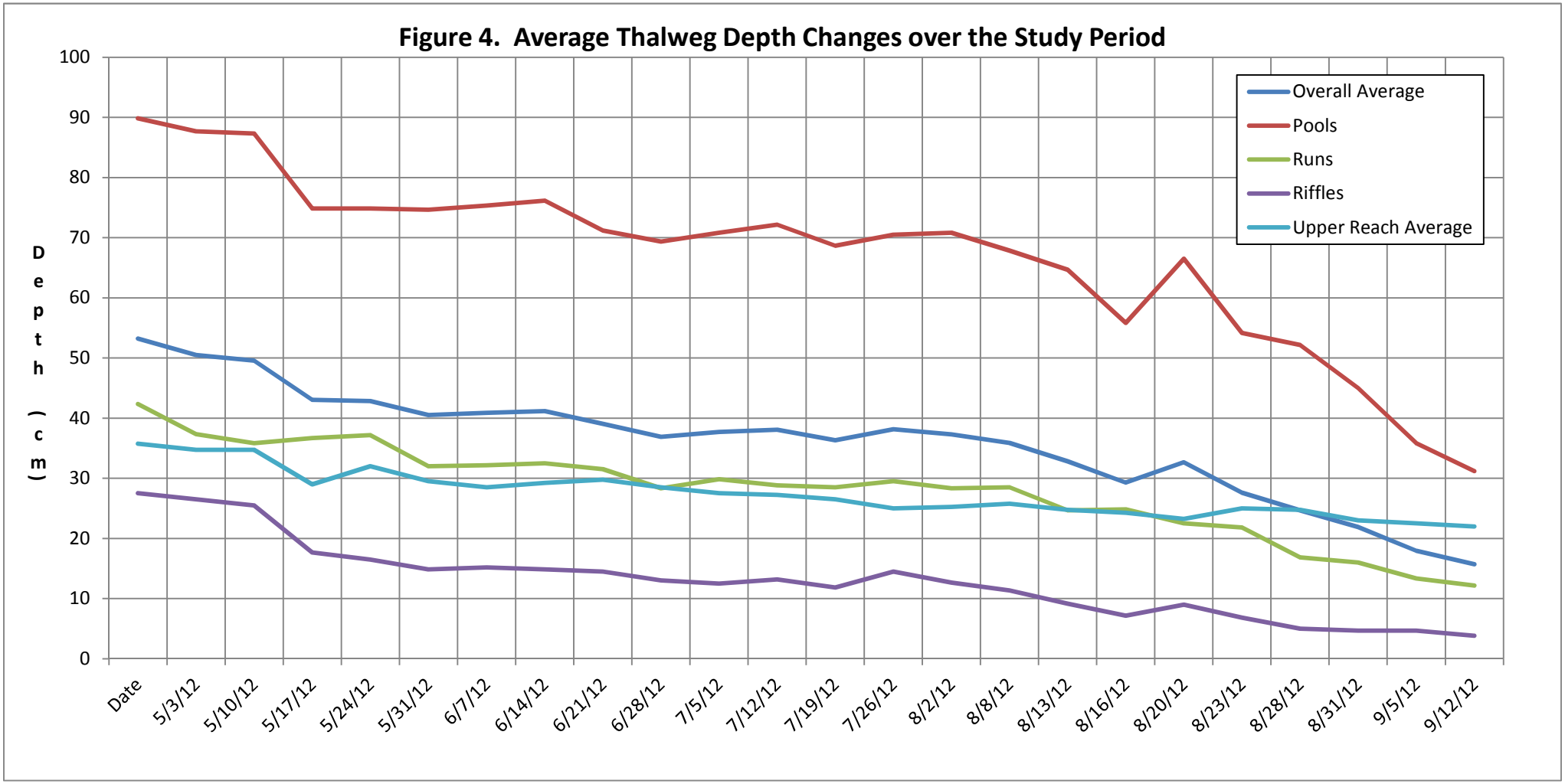
Figure 4. Average Thalweg Depth Changes over the Study Period
Depth (cm)
100
90
80
70
60
50
40
30
20
10
0
Date
5/3/12
5/10/12
5/17/12
5/24/12
5/31/12
6/7/12
6/14/12
6/21/12
6/28/12
7/5/12
7/12/12
7/19/12
7/26/12
8/2/12
8/8/12
8/13/12
8/16/12
8/20/12
8/23/12
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9/12/12
Overall Average
Pools
Runs
Riffles
Upper Reach Average

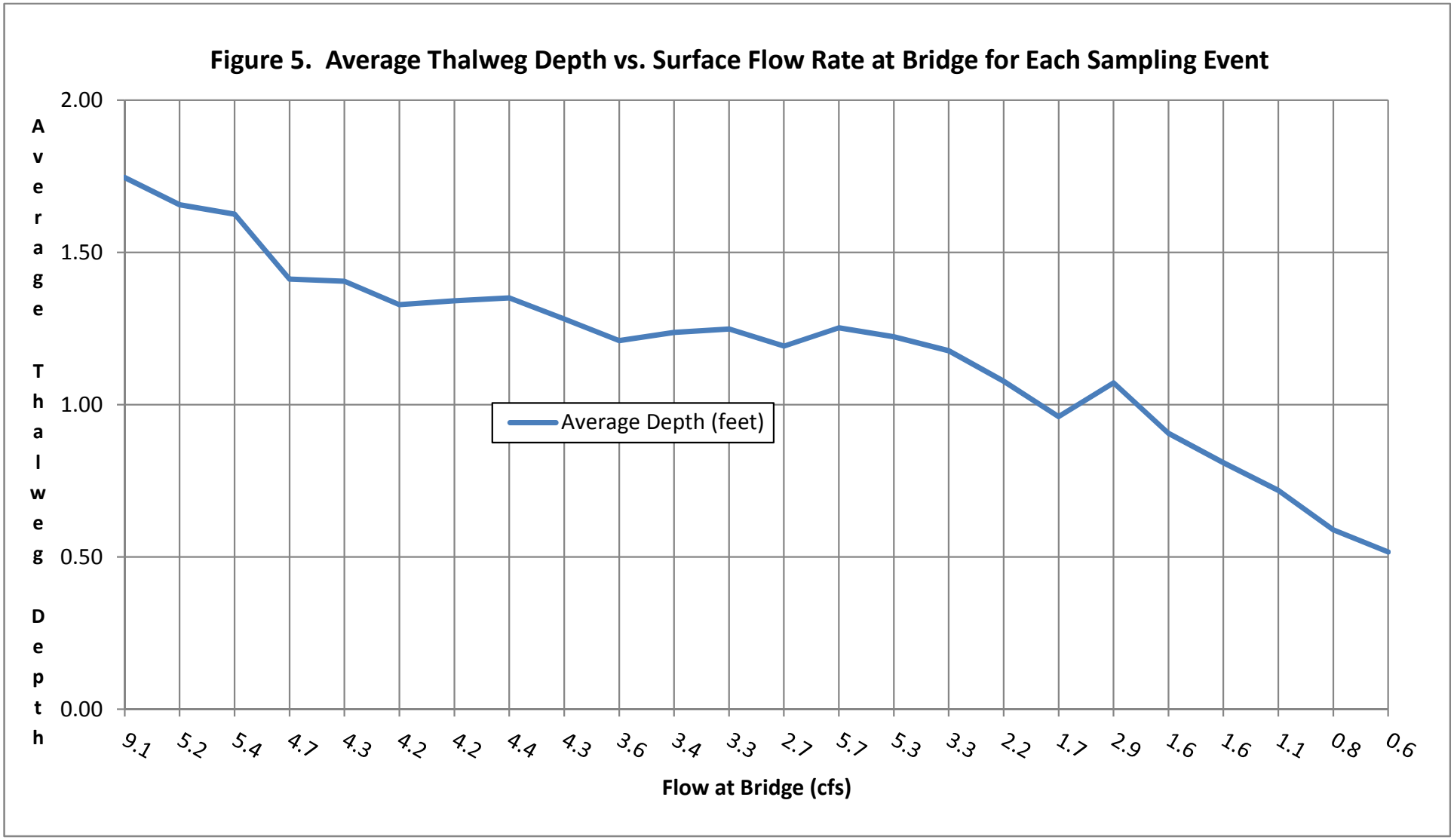
Figure 5. Average Thalweg Depth vs. Surface Flow Rate at Bridge for Each Sampling Event
Average Thalweg Depth
2.00
1.50
1.00
0.50
0.00
Average Depth (feet)
9.1
5.2
5.4
4.7
4.3
4.2
4.2
4.4
4.3
3.6
3.4
3.3
2.7
5.7
5.3
3.3
2.2
1.7
2.9
1.6
1.6
1.1
0.8
0.6
Flow at Bridge (cfs)

3.3 CHANNEL WIDTH

One goal of the assessment was to document steelhead habitat changes as surface flow rates decline over the dry season, which should be reflected in changes in channel width. The rainbow trout HSI model assesses only habitat suitability and not habitat area (or volume). The width of the active channel was measured at each sampling unit at a consistent location to document the change in steelhead habitat area. The results of this effort are provided in Table 5. Bold values in Table 5 represent sampling events when the City's Foster Park wells were not in operation, which appeared to reduce the decline in channel width over the dry season.

Table 5. Changes in Channel Width over the Study Period

Date	Study Reach Average Channel Width (feet)	Average Pool Width (feet)	Average Run Width (feet)	Average Riffle Width (feet)
May 3, 2012	32.7	31.1	36.1	30.8
May 10, 2012	32.3	30.8	35.8	30.4
May 17, 2012	32.1	30.7	35.6	30.1
May 24, 2012	30.6	29.7	33.9	28.4
May 31, 2012	30.7	30.2	33.9	28.0
June 7, 2012	30.8	30.3	33.8	28.2
June 14, 2012	31.1	30.4	34.1	28.7
June 21, 2012	30.7	30.4	33.4	28.3
June 28, 2012	30.6	29.9	33.3	28.7
July 5, 2012	30.2	29.6	33.3	27.5
July 12, 2012	30.0	29.7	33.1	27.0
July 19, 2012	29.3	29.3	32.2	26.4
July 26, 2012	28.9	28.5	31.9	26.3
August 2, 2012	**30.3**	**29.9**	**33.1**	**27.8**
August 8, 2012	**29.5**	**29.8**	**32.2**	**26.6**
August 13, 2012	28.7	29.2	31.8	25.2
August 16, 2012	27.3	28.3	30.7	22.8
August 20, 2012	24.6	24.8	29.0	20.1
August 23, 2012	**26.4**	**28.6**	**28.9**	**20.7**
August 28, 2012	23.7	24.1	27.4	19.8
August 31, 2012	21.0	23.7	22.0	17.5
September 5, 2012	19.7	21.0	20.9	17.3
September 12, 2012	15.8	17.2	15.8	14.5
September 19, 2012	13.6	14.7	12.0	14.2

3.4 HABITAT SUITABILITY RESULTS

The rainbow trout HSI model uses 18 variables to calculate five different suitability indices for steelhead; adult, juvenile, fry, embryo and other (affects all life stages). These five HSI values are combined to produce an overall HSI value. As indicated in Section 2.5 and Table 3, physical data not directly related to surface flow was collected at each sampling unit. These parameters included substrate, vegetation, bank stability, shading and instream cover which were assumed to remain constant over the study period. Data collected during each sampling period was generally limited to water temperature, pH, dissolved oxygen, thalweg depth and channel width. The only parameters that substantially affected HSI values were maximum daily water temperature (during the low flow period) and thalweg depth. Maximum daily water temperature values appeared to be related to the ambient temperature, amount of cloud cover, and surface water depth. Note that maximum water temperature only affects the "Other" and "Overall" HSI values (when combined with the HSI values for adult, juvenile, fry, embryo). Thalweg depth only affects "Adult" HSI and "Overall" HSI values (when combined with the HSI values for adult, juvenile, fry, embryo). Thalweg depths less than or equal to 25 cm substantially reduce "Adult" HSI values (see Table 6, August 31 to September 19).

As indicated in Table 6, the "Adult" HSI value ranged from 0.465 to 0.918, primarily based on thalweg depth. Bold values in Table 6 represent sampling events when the City's Foster Park wells were not in operation, which slightly reduced the decline in "Adult" HSI values over the dry season. The "Adult" HSI value addresses habitat variables that affect adult rainbow trout survival, and is calculated using index scores of the following variables (see Table 2 for an explanation of the variables):

- Average thalweg depth (V4);
- Instream cover (V6);
- Percent pools (V10); and
- Pool quality class rating (V15);

As indicated in Table 6, the "Other" HSI value ranged from 0.627 to 0.776, primarily based on maximum daily water temperature. The "Other" HSI value addresses habitat variables that affect all rainbow trout life stages, and is calculated using index scores of the following variables (see Table 2 for an explanation of the variables):

- Maximum temperature (V1);
- Average minimum dissolved oxygen (V3);
- pH (V13);
- Average base flow (V14);
- Substrate type (V9);
- Percent streamside vegetation (V11);
- Percent fines in riffles & runs (V16);
- Bank stability (V12);
- Midday shade (V17); and

- Average daily flow (V18).

"Adult" HSI values began to decrease on May 24, as the average thalweg depth declined below 45 cm, and continued to decrease with declining water depth over the dry season. Figure 6 provides a correlation of "Adult" HSI values with measured surface flow rate at the Casitas Vista Road bridge for each of the 24 sampling events. As surface flow rate does not directly affect thalweg depth and "Adult" HSI values are not substantially affected until the thalweg depth declines below 25 cm, there is little correlation with "Adult" HSI values when surface flow rates (and generally thalweg depth) are relatively high. However, Figure 6 illustrates the drastic reduction in "Adult" HSI values associated with declining thalweg depth as the measured flow rate at the Casitas Vista Road bridge decreased below 2 cfs.

Table 6. Steelhead Habitat Suitability Summary

Date	Adult HSI Value	Juvenile HSI Value	Fry HSI Value	Embryo HSI Value	Other HSI Value	Overall HSI Value
May 3, 2012	0.918	0.608	0.765	0.56	0.776	0.714
May 10, 2012	0.918	0.608	0.765	0.56	0.688	0.697
May 17, 2012	0.918	0.608	0.765	0.56	0.689	0.697
May 24, 2012	0.915	0.608	0.765	0.56	0.739	0.707
May 31, 2012	0.914	0.608	0.765	0.56	0.738	0.706
June 7, 2012	0.906	0.608	0.765	0.56	0.708	0.699
June 14, 2012	0.906	0.608	0.765	0.56	0.760	0.709
June 21, 2012	0.907	0.608	0.765	0.56	0.758	0.709
June 28, 2012	0.902	0.608	0.765	0.56	0.735	0.704
July 5, 2012	0.885	0.608	0.765	0.56	0.727	0.700
July 12, 2012	0.890	0.608	0.765	0.56	0.766	0.708
July 19, 2012	0.894	0.608	0.765	0.56	0.683	0.692
July 26, 2012	0.881	0.608	0.765	0.56	0.690	0.692
August 2, 2012	**0.896**	**0.608**	**0.765**	**0.56**	**0.699**	**0.696**
August 8, 2012	**0.887**	**0.608**	**0.765**	**0.56**	**0.690**	**0.693**
August 13, 2012	0.881	0.608	0.765	0.56	0.675	0.689
August 16, 2012	0.866	0.608	0.765	0.56	0.677	0.687
August 20, 2012	0.841	0.608	0.765	0.56	0.666	0.680
August 23, 2012	**0.861**	**0.608**	**0.765**	**0.56**	**0.627**	**0.676**
August 28, 2012	0.816	0.608	0.765	0.56	0.657	0.675
August 31, 2012	0.737	0.608	0.765	0.56	0.666	0.663
September 5, 2012	0.670	0.608	0.765	0.56	0.745	0.665
September 12, 2012	0.585	0.608	0.765	0.56	0.675	0.635
September 19, 2012	0.465	0.608	0.765	0.56	0.639	0.609

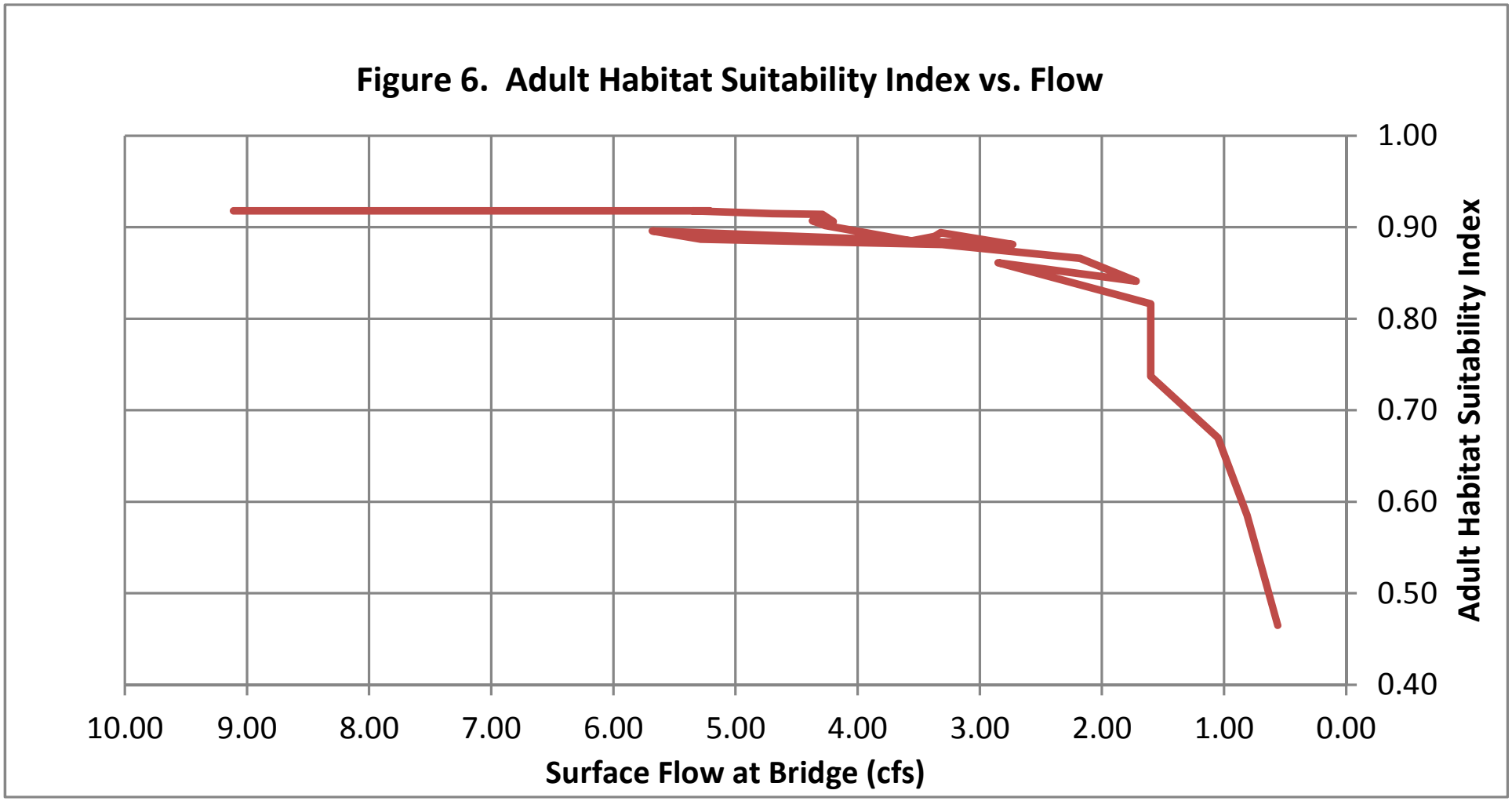
Figure 6. Adult Habitat Suitability Index vs. Flow
1.00
0.90
0.80
0.70
0.60
0.50
0.40
Adult Habitat Suitability Index
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Surface Flow at Bridge (cfs)

Note that these "Adult" HSI values represent an average for the entire study reach, while individual pools were present within the study reach that were suitable for steelhead throughout the study period. "Other" HSI values varied inversely with the maximum daily water temperature, but generally declined as ambient temperature increased over the summer. The "Overall" HSI values incorporate all five HSI values (adult, juvenile, fry, embryo, other), and generally declined over the dry season as water depth decreased and water temperature increased.

3.5 CHANGES IN HABITAT QUANTITY

The HSI model provides an estimate of habitat suitability, but not quantity. Fish habitat is expected to decline in quantity as surface flows decline over the dry season. A crude method to estimate fish habitat quantity is to multiply the average channel width, by the average thalweg depth, by the live stream length. Table 7 provides an estimate of habitat quantity changes over the study period. Note that the study reach began to dry on August 16, and the length of the live stream generally decreased through the remainder of the study period. It is important to note that Table 7 is merely a crude estimate of water volume, and does not imply that remaining waters are suitable for steelhead, especially as thalweg depth declined over the dry season.

Table 7. Habitat Quantity Estimates

Date	Average Channel Width (feet)	Average Thalweg Depth (feet)	Live Stream Length (feet)	Habitat Volume (cubic feet)
May 3, 2012	32.7	1.75	8850	505,000
May 10, 2012	32.3	1.66	8850	474,000
May 17, 2012	32.1	1.63	8850	462,000
May 24, 2012	30.6	1.41	8850	383,000
May 31, 2012	30.7	1.41	8850	382,000
June 7, 2012	30.8	1.33	8850	362,000
June 14, 2012	31.1	1.34	8850	369,000
June 21, 2012	30.7	1.35	8850	367,000
June 28, 2012	30.6	1.28	8850	347,000
July 5, 2012	30.2	1.21	8850	323,000
July 12, 2012	30.0	1.24	8850	328,000
July 19, 2012	29.3	1.25	8850	324,000
July 26, 2012	28.9	1.19	8850	305,000
August 2, 2012	30.3	1.25	8850	335,000
August 8, 2012	29.5	1.22	8850	319,000
August 13, 2012	28.7	1.18	8850	299,000
August 16, 2012	27.3	1.08	8750	257,000
August 20, 2012	24.6	0.96	6950	164,000

Table 7. Continued

Date	Average Channel Width (feet)	Average Thalweg Depth (feet)	Live Stream Length (feet)	Habitat Volume (cubic feet)
August 23, 2012	26.4	1.07	8400	235,000
August 28, 2012	23.7	0.91	6700	144,000
August 31, 2012	21.0	0.81	5650	96,000
September 5, 2012	19.7	0.72	5450	77,000
September 12, 2012	15.8	0.59	4900	46,000
September 19, 2012	13.6	0.52	4550	32,000

3.6 STEELHEAD OBSERVATIONS

Juvenile and/or adult rainbow trout/steelhead (at least 25 cm fork length) were observed within the sample units, including Pool-1, Pool-3, Pool-4 and Pool 5 (see location on Figures 2 and 3). Since evidence of attempted steelhead reproduction (redds) was reported in the study reach by the National Marine Fisheries Service, it was assumed that trout observed were steelhead.

Dissolved oxygen decreased below 2 mg/l at Pool-3 and Pool-4 on August 20, as flow from the upstream reaches terminated, and steelhead if present were unlikely to have survived. By September 12, the volume of Pool-5 had declined drastically, and an adult steelhead (42 cm fork length) was found dead adjacent to this sample unit. It is possible that this fish had spawned during winter high flows, and appeared in good condition when found. Therefore, the cause of mortality of this adult steelhead is unknown.

Pools supporting steelhead at the end of the study period (September 19, 2012) are likely to be limited to Pool-1 and the large pool located just downstream of the City's subsurface dam/collector.

4.0 COMPARISON TO OTHER STUDIES IN THE AREA

4.1 2010 STEELHEAD HABITAT ASSESSMENT

The 2010 Steelhead Habitat Assessment was conducted following a more normal rainy season, with 36.54 inches recorded at Matilija Dam (10/1/2009-9/30/2010). The current 2012 Assessment was conducted following a rainy season with only 14.17 inches recorded at Matilija Dam (10/1/2011-9/23/2012). Due to higher rainfall, surface flows in the Ventura River within the study reach were much higher during the 2010 Assessment. In addition, the average measured thalweg depth was 56 cm on June 24, 2010, but only 41 cm on June 21, 2012. The average thalweg depth declined to 53 cm by September 9, 2010, while in 2012 it declined to 18 cm by September 12.

In 2010, the average thalweg depth was adequate throughout the study period, such that it did not influence HSI values. Steelhead HSI values in 2010 were primarily determined by daily maximum water temperature, which appeared to be determined by ambient temperature. Overall, the primary difference in the 2012 Assessment is that low average thalweg depth substantially reduced “Adult” HSI values by the end of the study period.

4.2 FOSTER PARK EMBANKMENT PROTECTION AND RESTORATION PROJECT

Thomas R. Payne & Associates (TRPA) completed a steelhead habitat assessment for the Foster Park Embankment Protection and Restoration Project in November 2009. The TRPA study area was included within the current study area; however, the current study area extended further upstream and downstream than the TRPA study. The methodology used in both studies was the same, including the selection of 6 sample units from each basic habitat type (pool, run, riffle). Data was collected for the TRPA study on September 15 and 16, 2009. The HSI values provided by the 2009 TRPA study are:

- Adult HSI: 0.969
- Juvenile HSI: 0.696
- Fry HSI: 0.910
- Embryo HSI: 0.514
- Other HSI: 0.691
- Overall HSI: 0.737

The above HSI values are similar to that calculated for the present study at the beginning of the study period (see Table 6). However, the 2009 TRPA study was conducted for a shorter reach supporting a larger number and deeper pools than the current study. In addition, the 2009 TRPA study was limited to a single sampling event conducted in September 2009. HSI values estimated for the September 19, 2012 sampling event are much lower than the 2009 TRPA study, primarily due to average thalweg depth, which was 16 cm as compared to 60 cm for the 2009 TRPA study.

Other differences between the HSI values is due to the percent pools variable (V10) and pool class variable (V15). The TRPA study found 80 percent pools within their study area, with an average pool class (quality) of A. The current study found only 11 percent pools within the larger study area, with an average pool class of B.

5.0 REFERENCES

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APPENDIX A

HSI VARIABLE DATA AND INDEX SCORES

May 3, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	15.1	15.4	15.6	15.7	15.9	16.4	16.6	16.6	16.6	17.8	17.9	17.9	17.8	17.8	17.7	17.4	17.5	17.4	17.9	1.00
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	9.58	10.16	9.98	9.53	10.11	10.27	10.62	11.65	12.23	11.24	11.20	11.73	11.25	11.25	11.76	11.56	11.82	11.39	11.0	1.00
V4	Thalweg Depth (cm)	102	27	38	47	56	70	111	30	113	23	29	24	41	104	41	53	23	26	53.2	1.00
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	9.84	10.01	9.66	9.72	9.86	9.55	9.66	9.65	9.54	9.97	10.48	10.13	9.39	9.08	9.91	9.99	10.32	10.09	9.8	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	21.1	50.1	22.8	43.8	27	50.5	31.5	16.2	36.1	20.4	32.5	26.4	24.4	43	32.9	27.8	48.9	32.7	32.7	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

May 10, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	21.2	21.3	21.4	21.6	20.2	21.6	22.1	22.4	22.4	24.2	23.6	23.5	24.0	22.4	22.2	21.3	21.7	21.3	24.2	0.26
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	11.64	12.24	11.77	11.61	8.89	12.12	11.08	11.57	12.72	11.13	11.38	11.20	11.24	10.69	11.59	10.02	9.93	9.96	11.2	1.00
V4	Thalweg Depth (cm)	101	32	29	47	49	46	120	20	98	26	30	29	38	105	37	53	23	26	50.5	1.00
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	8.36	8.39	8.26	8.26	7.8	8.21	8.38	8.42	8.44	8.4	8.44	8.41	8.4	8.44	8.42	8.29	8.34	8.31	8.3	0.91
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	21	49.8	22.6	43.7	26.8	50	31.3	15.9	35.9	20.1	32.8	25.9	23.2	42.8	32.5	27.1	48.1	32.3	32.3	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

May 17, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	18.7	19.2	18.8	18.8	18.5	19.5	20.3	20.9	20.4	24.0	23.8	23.8	23.7	23.0	23.0	20.9	20.9	21.0	24.0	0.27
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	11.58	13.25	11.37	11.24	8.80	14.40	12.00	12.28	13.02	12.34	11.65	11.79	11.74	10.99	11.20	12.05	11.94	12.01	11.9	1.00
V4	Thalweg Depth (cm)	102	30	30	44	47	40	117	18	96	23	30	29	40	107	37	55	23	24	49.6	1.00
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	8.31	8.27	8.17	8.16	8.21	8.4	8.48	8.52	8.4	8.5	8.46	8.5	8.47	8.47	8.43	8.39	8.47	8.4	8.4	0.89
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.9	49.4	22.5	43.5	26.8	49.9	31.3	15.7	35.6	19.8	32.5	25.7	23	42.5	32.3	26.8	47.7	32.1	32.1	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

May 24, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.7	17.7	17.7	17.8	17.5	17.5	17.7	18.3	18.8	20.1	20.8	20.9	21.1	21.3	21.7	20.9	21.0	20.9	21.7	0.56
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.60	9.80	9.80	9.60	8.40	9.19	9.92	11.30	12.30	10.90	11.90	9.50	11.74	9.10	10.70	11.44	11.24	12.44	10.4	1.00
V4	Thalweg Depth (cm)	85	24	16	55	44	34	107	15	79	18	27	24	37	94	40	40	9	27	43.1	0.98
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.69	7.73	7.73	7.74	7.54	7.77	7.93	8.02	8.08	8.13	8.24	8.22	8.2	8.18	8.12	8.07	8.07	8.03	8.0	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	21	48.5	21.2	40.5	25.3	49	26.5	15.5	38	20.5	31.6	23	22	39.6	30.3	27.8	41.5	29.7	30.6	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

May 31, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	16.0	16.4	16.6	16.6	16.8	16.6	17.3	18.0	18.0	20.2	20.8	21.0	21.1	21.1	21.3	20.1	20.5	20.6	21.3	0.57
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.86	9.25	9.20	9.17	8.40	9.19	9.92	11.30	12.30	10.90	11.90	11.86	11.74	12.54	10.70	11.44	11.24	12.44	10.6	1.00
V4	Thalweg Depth (cm)	91	18	20	46	43	44	101	11	72	14	29	21	34	99	43	43	15	27	42.8	0.97
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.79	7.82	7.81	7.75	7.74	7.8	8.1	8.21	8.26	8.35	8.4	8.42	8.38	8.36	8.32	8.17	8.19	8.11	8.1	0.97
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	21.1	47	20.2	42.3	29.3	48.3	26.7	15.2	37.5	20.1	33.2	23.3	21.7	38.5	28.6	27.8	42.4	29.2	30.7	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

June 7, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.5	17.9	17.7	17.7	17.9	18.1	18.9	19.7	19.8	22.8	22.8	22.8	22.7	22.4	22.4	21.0	20.9	21.2	22.8	0.35
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	9.65	10.90	10.60	10.83	8.22	11.65	10.60	11.94	12.83	10.92	11.68	11.52	11.63	12.32	11.08	11.80	11.62	12.59	11.2	1.00
V4	Thalweg Depth (cm)	93	18	15	41	46	24	91	15	85	12	27	17	34	93	43	40	12	23	40.5	0.92
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.95	8	7.95	7.83	7.66	7.96	8.2	8.27	8.33	8.37	8.44	8.41	8.43	8.38	8.35	8.23	8.21	8.23	8.2	0.96
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.7	48.8	19.9	41	28.8	48.3	29.7	15.1	36.8	19.8	33.3	23.1	21.3	37.8	29	27.8	42.6	29.8	30.8	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

June 14, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.2	17.3	17.2	17.3	17.2	17.4	17.2	17.3	17.3	18.3	18.4	18.5	18.6	18.9	19.7	19.5	19.5	19.7	19.7	0.78
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.85	8.42	9.03	9.18	6.93	9.06	9.22	9.77	10.96	11.41	11.62	11.66	11.60	13.60	10.78	11.31	11.56	11.77	10.3	1.00
V4	Thalweg Depth (cm)	94	14	15	43	47	34	102	12	78	15	29	20	29	90	38	41	15	20	40.9	0.92
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.78	7.76	7.76	7.78	7.78	7.8	7.34	8.03	7.74	8.25	8.35	8.33	8.32	8.45	8.28	8.11	8	8.13	8.0	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.8	49.8	19.9	41.4	29	48.3	29.7	14.8	36.6	22.1	33.2	24.1	22	38.5	29.6	27.8	41.5	29.8	31.1	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

June 21, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.4	17.4	17.4	17.4	17.3	17.4	17.3	17.3	17.4	18.2	18.5	18.6	18.8	18.9	19.7	19.6	19.5	19.8	19.8	0.76
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.03	8.49	9.05	9.22	7.23	8.93	9.31	10.38	10.78	11.39	11.77	11.80	11.90	12.85	11.13	11.59	11.90	11.97	10.4	1.00
V4	Thalweg Depth (cm)	91	17	18	37	49	37	96	11	87	14	24	18	34	91	40	43	11	23	41.2	0.93
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.39	7.66	7.68	7.7	7.29	7.73	7.75	8.06	7.82	8.32	8.36	8.36	8.36	8.4	8.3	8.17	8.13	8.13	8.0	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.6	49	20.5	40.5	29.8	46.8	28.3	15.3	36.4	19.2	32.5	23.5	22.1	38.3	29.3	28.8	42.5	29	30.7	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

June 28, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	16.6	16.9	17.2	17.3	17.2	17.2	18.0	18.8	18.6	21.3	21.4	21.6	21.7	21.7	21.9	20.5	20.4	20.7	21.9	0.52
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.93	8.77	10.55	10.96	7.43	10.00	9.85	11.64	12.40	10.54	11.70	11.41	11.50	12.33	10.88	12.20	12.50	12.95	10.9	1.00
V4	Thalweg Depth (cm)	85	14	14	37	35	35	91	15	79	14	29	18	30	88	35	49	12	23	39.1	0.90
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	0	5	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.03	7.42	7.73	7.7	7.58	7.79	7.76	8.24	8.18	8.34	8.4	8.4	8.4	8.39	8.31	8.25	8.13	8.25	8.0	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.5	48.9	20.2	41.1	26.8	46.9	29	15.3	36	22.3	32.4	23.5	20.9	38	28.4	29.1	42.1	29.8	30.6	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

July 5, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.9	18.0	17.9	17.9	17.7	18.1	18.0	18.3	18.1	20.4	20.7	21.1	21.5	21.9	22.3	20.8	20.7	20.6	22.3	0.46
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.96	8.22	9.05	9.17	6.38	9.18	9.61	10.84	11.20	12.12	12.47	12.20	12.00	12.96	10.88	12.58	12.25	13.20	10.7	1.00
V4	Thalweg Depth (cm)	87	14	14	30	38	30	87	11	73	12	23	15	29	87	38	44	12	20	36.9	0.80
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	0	5	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.3	7.5	7.72	7.65	7.36	7.81	7.62	8.19	7.83	8.42	8.48	8.48	8.47	8.44	8.35	8.27	8.23	8.23	8.0	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.3	48	19.9	39.7	28	47.8	28.1	14.5	36	19	33	22.8	21.1	37.6	28.3	27.8	41	30.1	30.2	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

July 12, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.6	17.7	17.6	17.6	17.8	17.9	17.7	17.7	17.9	18.8	18.9	18.9	18.8	18.9	19.0	18.5	18.5	18.6	19.0	0.86
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.73	8.02	8.52	8.55	6.78	8.01	8.53	10.01	11.06	11.62	11.88	11.62	11.57	12.30	10.64	11.09	11.33	11.68	10.1	1.00
V4	Thalweg Depth (cm)	90	12	15	35	38	38	88	11	81	11	20	15	30	85	35	43	11	21	37.7	0.83
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	6.93	7.44	7.6	7.52	7.32	7.6	7.88	8	8	8.37	8.43	8.39	8.38	8.35	8.38	8.11	8.08	8.08	7.9	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.5	47.9	20	41.5	28.1	46.8	29	14.7	35.8	16.2	32.7	22.9	20	37.3	28.7	27.7	40.5	29	30.0	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

July 19, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	18.1	18.5	18.7	18.9	19.0	19.0	18.8	21.5	21.2	25.4	25.2	25.5	25.5	25.1	25.4	22.6	22.4	22.5	25.5	0.23
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.61	9.98	10.74	11.00	7.01	9.46	10.01	12.30	13.80	12.10	12.40	12.53	12.07	12.60	10.82	12.37	12.80	12.90	11.3	1.00
V4	Thalweg Depth (cm)	88	14	18	35	38	34	93	11	84	11	20	14	29	87	35	43	11	20	38.1	0.85
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.59	7.83	7.87	7.88	7.5	7.76	8.16	8.38	8.44	8.51	8.57	8.56	8.54	8.42	8.34	8.3	8.27	8.3	8.2	0.95
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.3	47.9	19.4	41	27.6	46	29	14.1	35.4	14.5	32.5	21.8	17	37.5	28.3	25.9	40.7	28.2	29.3	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

July 26, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.5	17.7	17.8	18.0	18.1	18.5	18.0	19.6	20.0	22.9	22.8	23.1	23.0	23.2	23.6	21.4	21.2	21.2	23.6	0.25
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.82	9.46	10.07	10.38	7.22	9.31	9.19	11.85	12.63	11.94	12.60	12.07	12.02	13.10	10.64	12.05	12.74	12.82	11.0	1.00
V4	Thalweg Depth (cm)	82	12	15	34	35	35	87	9	79	11	23	15	26	85	32	44	9	21	36.3	0.78
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.5	7.76	7.76	7.76	7.56	7.73	8.03	8.31	8.37	8.48	8.54	8.43	8.53	8.49	8.35	8.29	8.27	8.29	8.1	0.98
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.3	47.2	19.8	39.2	25.7	45	26.8	13.7	34.8	15	32.5	19.8	17.3	37.2	28.5	26.3	42.3	28.8	28.9	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

August 2, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.6	17.9	18.1	18.2	17.9	18.5	19.2	20.0	20.0	22.6	22.8	23.0	23.0	23.0	23.3	21.2	21.1	21.2	23.3	0.29
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.62	9.64	9.70	9.90	6.15	8.27	8.82	12.36	13.50	12.85	12.56	12.36	12.34	12.85	10.61	12.20	12.70	13.26	11.0	1.00
V4	Thalweg Depth (cm)	85	20	21	40	46	41	87	12	79	11	23	14	23	85	30	41	9	20	38.2	0.86
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.38	7.63	7.75	7.75	7.43	7.66	7.84	8.29	8.27	8.5	8.86	8.56	8.56	8.39	8.37	8.3	8.27	8.3	8.1	0.98
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.8	49.8	21.3	42.3	29.6	49.1	28.3	15.3	36.4	15.3	32.6	22.7	16.4	37.5	29.1	26.8	42.6	28.8	30.3	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

August 8, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.9	18.3	18.3	18.5	18.0	18.9	19.2	20.8	21.0	25.0	24.7	24.7	24.6	24.3	25.1	22.3	22.0	22.3	25.1	0.25
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.04	9.13	9.47	9.68	7.20	7.68	8.48	12.30	13.82	11.91	12.55	12.55	12.12	12.90	10.33	11.80	12.30	13.21	10.9	1.00
V4	Thalweg Depth (cm)	81	20	15	35	47	35	94	12	78	8	21	12	27	85	32	40	9	20	37.3	0.81
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.46	7.86	7.83	7.81	7.56	7.68	7.88	8.31	8.39	8.54	8.6	8.47	8.58	8.48	8.37	8.28	8.24	8.3	8.1	0.98
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.6	49.8	20.6	41.8	29.8	47.5	28.4	14.3	36.2	14.3	31.4	18.6	15.9	37.2	28.2	26.8	41.8	28.1	29.5	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

August 13, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	18.3	18.6	18.5	18.1	18.5	18.7	19.8	21.1	20.9	26.1	25.3	25.4	25.0	24.7	25.4	22.7	22.3	22.2	26.1	0.20
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.68	8.77	9.21	9.50	6.62	8.63	8.54	12.16	13.60	10.66	13.60	12.62	12.77	12.10	10.20	11.64	11.65	12.93	10.7	1.00
V4	Thalweg Depth (cm)	82	15	17	32	44	40	82	8	78	8	20	12	24	81	32	40	8	23	35.9	0.78
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.56	7.87	7.79	7.77	7.72	7.78	8.06	8.31	8.27	8.56	8.65	8.62	8.56	8.42	8.36	8.25	8.23	8.23	8.2	0.95
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.5	49.8	20.4	39.2	29.4	48.1	28	14	35.4	7.8	31.8	17.5	15.3	36.9	27.9	25.1	41.5	28.5	28.7	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

August 16, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	18.0	18.7	18.6	18.8	18.3	19.6	18.8	19.8	17.5	25.0	26.0	26.2	26.1	25.0	25.7	22.6	22.3	22.2	26.2	0.20
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.10	9.56	10.32	10.32	5.82	8.63	4.93	9.13	10.38	9.10	14.06	13.39	13.30	12.71	10.18	11.72	12.38	13.32	10.4	1.00
V4	Thalweg Depth (cm)	78	14	11	26	34	32	81	6	73	5	17	11	23	81	32	41	8	18	32.8	0.70
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.77	7.71	7.78	7.75	7.42	7.6	7.56	8.3	7.5	8.6	8.76	8.67	8.65	8.51	8.37	8.29	8.24	8.26	8.1	0.98
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.3	46.8	20.0	38.3	26.4	46.0	26.5	5.4	33.3	6.0	30.6	17.0	15.0	36.8	28.0	26.2	41.8	26.1	27.3	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

August 20, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	18.9	19.0	19.5	19.5	18.1	20.5	19.5	Dry	25.8	Dry	27.4	27.6	26.8	25.2	26.0	23.3	22.8	22.7	27.6	0.16
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.01	9.94	11.40	11.91	5.82	12.10	1.58	Dry	1.20	Dry	13.37	14.45	13.32	13.10	10.10	11.52	12.16	13.19	10.2	1.00
V4	Thalweg Depth (cm)	75	12	11	23	34	38	76	0	27	0	15	11	26	82	26	41	9	21	29.3	0.59
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.73	7.75	7.87	7.77	7.4	7.65	7.36	Dry	7.25	Dry	8.81	8.76	8.71	8.54	8.39	8.3	8.22	8.26	8.0	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	19.8	45.0	19.2	37.4	26.3	43.2	25.8	0.0	15.4	0.0	25.1	16.2	15.7	36.7	28.0	24.8	40.4	24.5	24.6	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

August 23, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	18.8	18.9	18.9	19.0	19.1	19.8	19.8	22.0	19.2	Dry	27.8	29.4	27.8	25.0	26.1	23.2	22.8	22.6	29.4	0.08
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.84	10.16	9.95	10.43	7.61	9.32	6.02	6.64	5.53	Dry	17.40	16.15	21.20	13.22	10.33	11.37	12.13	13.06	11.1	1.00
V4	Thalweg Depth (cm)	81	15	15	27	44	37	84	6	69	0	12	9	15	81	24	40	9	20	32.7	0.68
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.62	7.85	7.75	7.73	7.48	7.57	7.52	7.79	7.61	Dry	8.95	9.08	9.1	8.57	8.23	8.33	8.22	8.25	8.1	0.98
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.3	45.7	20.1	39.5	28.9	46.8	27.5	6.0	33.4	0.0	22.0	12.2	13.0	36.5	27.8	25.1	40.0	24.4	26.1	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

August 28, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	18.0	18.7	18.7	19.0	18.3	19.1	18.1	Dry	23.9	Dry	28.2	27.9	26.8	25.3	26.3	22.8	22.4	22.4	28.2	0.14
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.23	11.30	11.70	12.95	5.93	11.30	2.12	Dry	0.80	Dry	12.19	13.53	13.74	12.85	10.08	11.80	12.31	13.47	10.3	1.00
V4	Thalweg Depth (cm)	75	11	9	26	27	30	76	0	24	0	8	9	20	82	27	41	12	20	27.6	0.49
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.49	8.01	7.93	7.93	7.43	7.63	7.19	Dry	7.6	Dry	8.99	8.93	8.81	8.58	8.44	8.34	8.31	8.31	8.1	0.98
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	20.0	44.9	19.3	36.8	25.6	42.9	24.8	0.0	12.5	0.0	17.0	12.6	15.3	36.3	27.8	25.4	41.9	24.3	23.7	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

August 31, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	19.1	19.9	19.2	19.4	18.7	19.3	19.9	Dry	27.5	Dry	Dry	Dry	Dry	25.1	25.7	23.4	23.0	22.9	27.5	0.16
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	8.26	10.72	11.08	12.15	7.21	9.16	2.35	Dry	3.64	Dry	Dry	Dry	Dry	12.80	10.02	11.24	12.25	13.07	9.5	1.00
V4	Thalweg Depth (cm)	73	11	8	24	29	29	75	0	20	0	0	0	0	76	27	40	11	21	24.7	0.40
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.81	8	7.88	7.85	7.46	7.56	7.46	Dry	7.82	Dry	Dry	Dry	Dry	8.62	8.45	8.54	8.3	8.32	8.0	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	19.9	44.9	19.2	37.1	25.6	43.5	25.1	0.0	10.5	0.0	0.0	0.0	0.0	35.5	27.2	25.3	41.0	23.9	21.0	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

September 5, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	18.8	19.2	18.6	18.5	18.2	18.7	18.8	Dry	21.0	Dry	Dry	Dry	Dry	19.6	19.7	18.9	18.8	18.7	21.0	0.61
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	7.07	9.10	9.82	10.27	6.17	9.90	2.10	Dry	1.70	Dry	Dry	Dry	Dry	12.60	10.20	10.30	10.60	10.46	8.5	0.98
V4	Thalweg Depth (cm)	72	11	8	23	30	27	64	0	11	0	0	0	0	56	26	37	9	20	21.9	0.30
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.81	7.8	7.88	7.64	7.32	7.59	7.5	Dry	6.95	Dry	Dry	Dry	Dry	8.5	8.39	8.17	8.03	8.03	7.8	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	19.7	44.1	19.0	35.0	24.8	39.0	23.3	0.0	4.5	0.0	0.0	0.0	0.0	28.0	27.1	25.5	40.5	24.4	19.7	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

September 12, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	19.7	20.5	20.2	20.2	18.8	21.1	20.5	Dry	Dry	Dry	Dry	Dry	Dry	22.8	26.6	24.3	24.0	23.7	26.6	0.19
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	5.24	5.55	8.30	8.69	7.50	5.29	1.69	Dry	Dry	Dry	Dry	Dry	Dry	12.10	12.13	11.43	12.13	13.13	8.6	0.98
V4	Thalweg Depth (cm)	78	9	8	18	29	21	47	0	0	0	0	0	0	23	23	38	11	18	17.9	0.20
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.54	7.64	7.8	7.7	7.39	7.73	7.52	Dry	Dry	Dry	Dry	Dry	Dry	8.22	8.66	8.4	8.32	8.34	7.9	1.00
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	19.6	28.0	18.4	24.2	24.3	21.8	19.5	0.0	0.0	0.0	0.0	0.0	0.0	14.9	25.8	24.8	40.7	23.0	15.8	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

September 19, 2012 HSI Data

		Pool-1	Riffle-1	Riffle-2	Run-1	Pool-2	Run-2	Pool-3	Riffle-3	Pool-4	Riffle-4	Run-3	Riffle-5	Run-4	Pool-5	Run-5	Pool-6	Riffle-6	Run-6	Mean	Index
V1a	Adult migration (Jan-Mar) Water Temp (oC)																			15.4	1.00
V1r	Rearing Water Temp (measured)	17.7	18.8	18.3	18.9	17.7	21.5	17.1	Dry	Dry	Dry	Dry	Dry	Dry	22.3	24.0	22.7	22.4	22.0	24.0	0.27
V2s	Smolt Migr Temp (Mar-Jun)																			16.8	0.60
V2e	Emb Incub. Temp (Jan-Mar)																			16.8	0.56
V3	DO (mg/l)	5.33	6.49	9.60	10.20	6.84	5.30	2.10	Dry	Dry	Dry	Dry	Dry	Dry	13.01	10.95	11.26	11.92	12.80	8.8	0.98
V4	Thalweg Depth (cm)	73	9	5	17	27	15	32	0	0	0	0	0	0	17	23	38	9	18	15.7	0.10
V5	Velocity, embryo development (cm/sec)	24	152	226	91	55	24	12	134	12	171	49	79	43	12	43	43	195	79	80	0.95
V6j	Instream Cover, juveniles (%)	5	10	5	5	0	10	20	0	10	0	5	0	0	5	0	5	0	0	4.4	0.65
V6a	Instream Cover, adults (%)	0	0	0	0	0	0	10	0	5	0	0	0	0	5	0	0	0	0	1.1	0.35
V7	Substrate Size (cm)	9	10	7	16	3	3	24	14	5	12	15	10	11	6	6	7	3	8	9.4	1.00
V8	Substrate >4" (%)	75	40	75	75	5	0	90	80	5	70	75	50	35	0	55	60	25	80	49.7	1.00
V9	Predominate Substrate (riffle-run)		1	1	1		2		1		1	1	1	2		2		1	1	1.3	1.00
V10	Percent Pools																			11	0.60
V11	Streambank Cover (Veg. Index)	175	180	185	165	115	178	155	155	165	190	190	160	170	110	190	175	180	153	166.2	1.00
V12	Streambank Stability (%)	90	30	80	80	20	90	20	40	40	80	80	100	80	100	90	50	70	40	65.6	0.94
V13	pH	7.66	7.76	7.98	7.88	7.5	7.7	7.64	Dry	Dry	Dry	Dry	Dry	Dry	8.82	8.71	8.4	8.37	8.35	8.1	0.98
V14	Low flow/average daily flow (%)																			5	0.10
V15	Pool Quality (Class: 1,2,3)	2				2		2		2					2		2			2.0	0.60
V16b	Percent fines (riffle-run)		5	15	10		45		5		15	15	10	30		20		10	10	15.8	0.95
V17	Midday Shading	50	30	60	10	10	25	60	30	10	20	10	5	5	5	0	10	0	0	18.9	0.55
V18	Migration flow/average annual flow (%)																			246	1.00
NA	Width (feet)	19.5	27.7	18.4	14.9	23.4	9.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	3.5	24.7	24.5	39.2	23.4	13.6	

Note: water temperature (V1r) used to calculate the habitat suitability index is the maximum, not mean

APPENDIX B

HSI CALCULATION FORMS

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 5/3/2012

Index Data

V1a	1
V1r	1
V2s	0.6
V2e	0.56
V3	1
V4	1
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.775	
CA	0.775	
CAS	0.918	

Juvenile Steelhead

Test 1	OK
Test 2	OK
Test 3	OK
Cj	0.617
Cjs	0.608

Fry

Test 1	OK
Test 2	OK
Cf	0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.610
Co	0.776

Overall HSI: 0.714

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 5/10/2012

Index Data

V1a	1
V1r	0.26
V2s	0.6
V2e	0.56
V3	1
V4	1
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.91
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.775	
CA	0.775	
CAS	0.918	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	

Fry

Test 1	OK	
Test 2	OK	
Cf	0.765	

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.479
Co	0.688

Overall HSI: 0.697

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 5/17/2012

Index Data	
V1a	1
V1r	0.27
V2s	0.6
V2e	0.56
V3	1
V4	1
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.89
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead		
Case 1	0.600	NO
Case 2	0.775	
CA	0.775	
CAS	0.918	
Juvenile Steelhead		
Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	
Fry		
Test 1	OK	
Test 2	OK	
Cf	0.765	
Embryo		
Vs	0.966	
Ce	0.56	
Other		
Part 1	0.987	
Part 2	0.481	
Co	0.689	

Overall HSI: 0.697

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 5/24/2012

Index Data

V1a	1
V1r	0.56
V2s	0.6
V2e	0.56
V3	1
V4	0.98
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.767	
CA	0.767	
CAS	0.915	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	

Fry

Test 1	OK	
Test 2	OK	
Cf	0.765	

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.553
Co	0.739

Overall HSI: 0.707

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 5/31/2012

Index Data

V1a	1
V1r	0.57
V2s	0.6
V2e	0.56
V3	1
V4	0.97
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.97
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.763	
CA	0.763	
CAS	0.914	

Juvenile Steelhead

Test 1	OK
Test 2	OK
Test 3	OK
Cj	0.617
Cjs	0.608

Fry

Test 1	OK
Test 2	OK
Cf	0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.552
Co	0.738

Overall HSI: 0.706

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 6/7/2012

Index Data	
V1a	1
V1r	0.35
V2s	0.6
V2e	0.56
V3	1
V4	0.92
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.96
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead		
Case 1	0.600	NO
Case 2	0.743	
CA	0.743	
CAS	0.906	
Juvenile Steelhead		
Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	
Fry		
Test 1	OK	
Test 2	OK	
Cf	0.765	
Embryo		
Vs	0.966	
Ce	0.56	
Other		
Part 1	0.987	
Part 2	0.508	
Co	0.708	

Overall HSI: 0.699

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 6/14/2012

Index Data

V1a	1
V1r	0.78
V2s	0.6
V2e	0.56
V3	1
V4	0.92
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.743	
CA	0.743	
CAS	0.906	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj		0.617
Cjs		0.608

Fry

Test 1	OK	
Test 2	OK	
Cf		0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.585
Co	0.760

Overall HSI: 0.709

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 6/21/2012

Index Data	
V1a	1
V1r	0.76
V2s	0.6
V2e	0.56
V3	1
V4	0.93
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead		
Case 1	0.600	NO
Case 2	0.747	
CA	0.747	
CAS	0.907	

Juvenile Steelhead	
Test 1	OK
Test 2	OK
Test 3	OK
Cj	0.617
Cjs	0.608

Fry	
Test 1	OK
Test 2	OK
Cf	0.765

Embryo	
Vs	0.966
Ce	0.56

Other	
Part 1	0.987
Part 2	0.582
Co	0.758

Overall HSI: 0.709

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 6/28/2012

Index Data	
V1a	1
V1r	0.52
V2s	0.6
V2e	0.56
V3	1
V4	0.9
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead		
Case 1	0.600	NO
Case 2	0.735	
CA	0.735	
CAS	0.902	
Juvenile Steelhead		
Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	
Fry		
Test 1	OK	
Test 2	OK	
Cf	0.765	
Embryo		
Vs	0.966	
Ce	0.56	
Other		
Part 1	0.987	
Part 2	0.547	
Co	0.735	

Overall HSI: 0.704

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 7/5/2012

Index Data

V1a	1
V1r	0.46
V2s	0.6
V2e	0.56
V3	1
V4	0.8
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.693	
CA	0.693	
CAS	0.885	

Juvenile Steelhead

Test 1	OK
Test 2	OK
Test 3	OK
Cj	0.617
Cjs	0.608

Fry

Test 1	OK
Test 2	OK
Cf	0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.536
Co	0.727

Overall HSI: 0.700

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 7/12/2012

Index Data

V1a	1
V1r	0.86
V2s	0.6
V2e	0.56
V3	1
V4	0.83
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.706	
CA	0.706	
CAS	0.890	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj		0.617
Cjs		0.608

Fry

Test 1	OK	
Test 2	OK	
Cf		0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.595
Co	0.766

Overall HSI: 0.708

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 7/19/2012

Index Data

V1a	1
V1r	0.23
V2s	0.6
V2e	0.56
V3	1
V4	0.85
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.95
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.714	
CA	0.714	
CAS	0.894	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	

Fry

Test 1	OK	
Test 2	OK	
Cf	0.765	

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.473
Co	0.683

Overall HSI: 0.692

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 7/26/2012

Index Data

V1a	1
V1r	0.25
V2s	0.6
V2e	0.56
V3	1
V4	0.78
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.98
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.684	
CA	0.684	
CAS	0.881	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	

Fry

Test 1	OK	
Test 2	OK	
Cf	0.765	

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.482
Co	0.690

Overall HSI: 0.692

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 8/2/2012

Index Data

V1a	1
V1r	0.29
V2s	0.6
V2e	0.56
V3	1
V4	0.86
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.98
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead		
Case 1	0.600	NO
Case 2	0.718	
CA	0.718	
CAS	0.896	
Juvenile Steelhead		
Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	
Fry		
Test 1	OK	
Test 2	OK	
Cf	0.765	
Embryo		
Vs	0.966	
Ce	0.56	
Other		
Part 1	0.987	
Part 2	0.494	
Co	0.699	

Overall HSI: 0.696

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 8/8/2012

Index Data

V1a	1
V1r	0.25
V2s	0.6
V2e	0.56
V3	1
V4	0.81
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.98
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.697	
CA	0.697	
CAS	0.887	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	

Fry

Test 1	OK	
Test 2	OK	
Cf	0.765	

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.482
Co	0.690

Overall HSI: 0.693

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 8/13/2012

Index Data

V1a	1
V1r	0.2
V2s	0.6
V2e	0.56
V3	1
V4	0.78
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.95
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.684	
CA	0.684	
CAS	0.881	

Juvenile Steelhead

Test 1	OK
Test 2	OK
Test 3	OK
Cj	0.617
Cjs	0.608

Fry

Test 1	OK
Test 2	OK
Cf	0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.462
Co	0.675

Overall HSI: 0.689

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 8/16/2012

Index Data

V1a	1
V1r	0.2
V2s	0.6
V2e	0.56
V3	1
V4	0.7
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.98
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.648	
CA	0.648	
CAS	0.866	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	

Fry

Test 1	OK	
Test 2	OK	
Cf	0.765	

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.464
Co	0.677

Overall HSI: 0.687

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 8/20/2012

Index Data

V1a	1
V1r	0.16
V2s	0.6
V2e	0.56
V3	1
V4	0.59
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.595	
CA	0.595	
CAS	0.841	

Juvenile Steelhead

Test 1	OK
Test 2	OK
Test 3	OK
Cj	0.617
Cjs	0.608

Fry

Test 1	OK
Test 2	OK
Cf	0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.449
Co	0.666

Overall HSI: 0.680

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 8/23/2012

Index Data

V1a	1
V1r	0.08
V2s	0.6
V2e	0.56
V3	1
V4	0.68
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.98
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead		
Case 1	0.600	NO
Case 2	0.639	
CA	0.639	
CAS	0.861	
Juvenile Steelhead		
Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	
Fry		
Test 1	OK	
Test 2	OK	
Cf	0.765	
Embryo		
Vs	0.966	
Ce	0.56	
Other		
Part 1	0.987	
Part 2	0.399	
Co	0.627	

Overall HSI: 0.676

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 8/28/2012

Index Data

V1a	1
V1r	0.14
V2s	0.6
V2e	0.56
V3	1
V4	0.49
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.98
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead		
Case 1	0.600	NO
Case 2	0.542	
CA	0.542	
CAS	0.816	
Juvenile Steelhead		
Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	
Fry		
Test 1	OK	
Test 2	OK	
Cf	0.765	
Embryo		
Vs	0.966	
Ce	0.56	
Other		
Part 1	0.987	
Part 2	0.438	
Co	0.657	

Overall HSI: 0.675

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 8/31/2012

Index Data

V1a	1
V1r	0.16
V2s	0.6
V2e	0.56
V3	1
V4	0.4
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.490	
CA	0.490	
CAS	0.737	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	

Fry

Test 1	OK	
Test 2	OK	
Cf	0.765	

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.449
Co	0.666

Overall HSI: 0.663

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 9/5/2012

Index Data

V1a	1
V1r	0.61
V2s	0.6
V2e	0.56
V3	1
V4	0.3
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.424	
CA	0.424	
CAS	0.670	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj	0.617	
Cjs	0.608	

Fry

Test 1	OK	
Test 2	OK	
Cf	0.765	

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.561
Co	0.745

Overall HSI: 0.665

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 9/12/2012

Index Data

V1a	1
V1r	0.19
V2s	0.6
V2e	0.56
V3	1
V4	0.2
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	1
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.346	
CA	0.346	
CAS	0.585	

Juvenile Steelhead

Test 1	OK	
Test 2	OK	
Test 3	OK	
Cj		0.617
Cjs		0.608

Fry

Test 1	OK	
Test 2	OK	
Cf		0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.462
Co	0.675

Overall HSI: 0.635

STEELHEAD
HABITAT SUITABILITY INDEX CALCULATION

Project: Foster Park Surface Water-Groundwater Interaction
Sampling Date: 9/19/2012

Index Data

V1a	1
V1r	0.27
V2s	0.6
V2e	0.56
V3	0.98
V4	0.1
V5	0.95
V6j	0.65
V6a	0.35
V7	1
V8	1
V9	1
V10	0.6
V11	1
V12	0.94
V13	0.98
V14	0.1
V15	0.6
V16b	0.95
V17	0.55
V18	1

Adult Steelhead

Case 1	0.600	NO
Case 2	0.245	
CA	0.245	
CAS	0.465	

Juvenile Steelhead

Test 1	OK
Test 2	OK
Test 3	OK
Cj	0.617
Cjs	0.608

Fry

Test 1	OK
Test 2	OK
Cf	0.765

Embryo

Vs	0.966
Ce	0.56

Other

Part 1	0.987
Part 2	0.487
Co	0.693

Overall HSI: 0.609

APPENDIX C

PHOTOGRAPHS OF THE SAMPLE UNITS

a. May 10, 2012

b. July 18, 2012

c. August 28, 2102

PHOTOGRAPHS OF SAMPLE UNIT POOL-1
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RIFFLE-1
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RIFFLE-2
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RUN-1
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT POOL-2
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RUN-2
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT POOL-3
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RIFFLE-3
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT POOL-4
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RIFFLE-4
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RUN-3
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RIFFLE-5
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RUN-4
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT POOL-5
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RUN-5
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT POOL-6
APPENDIX C

a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RIFFLE-6
APPENDIX C

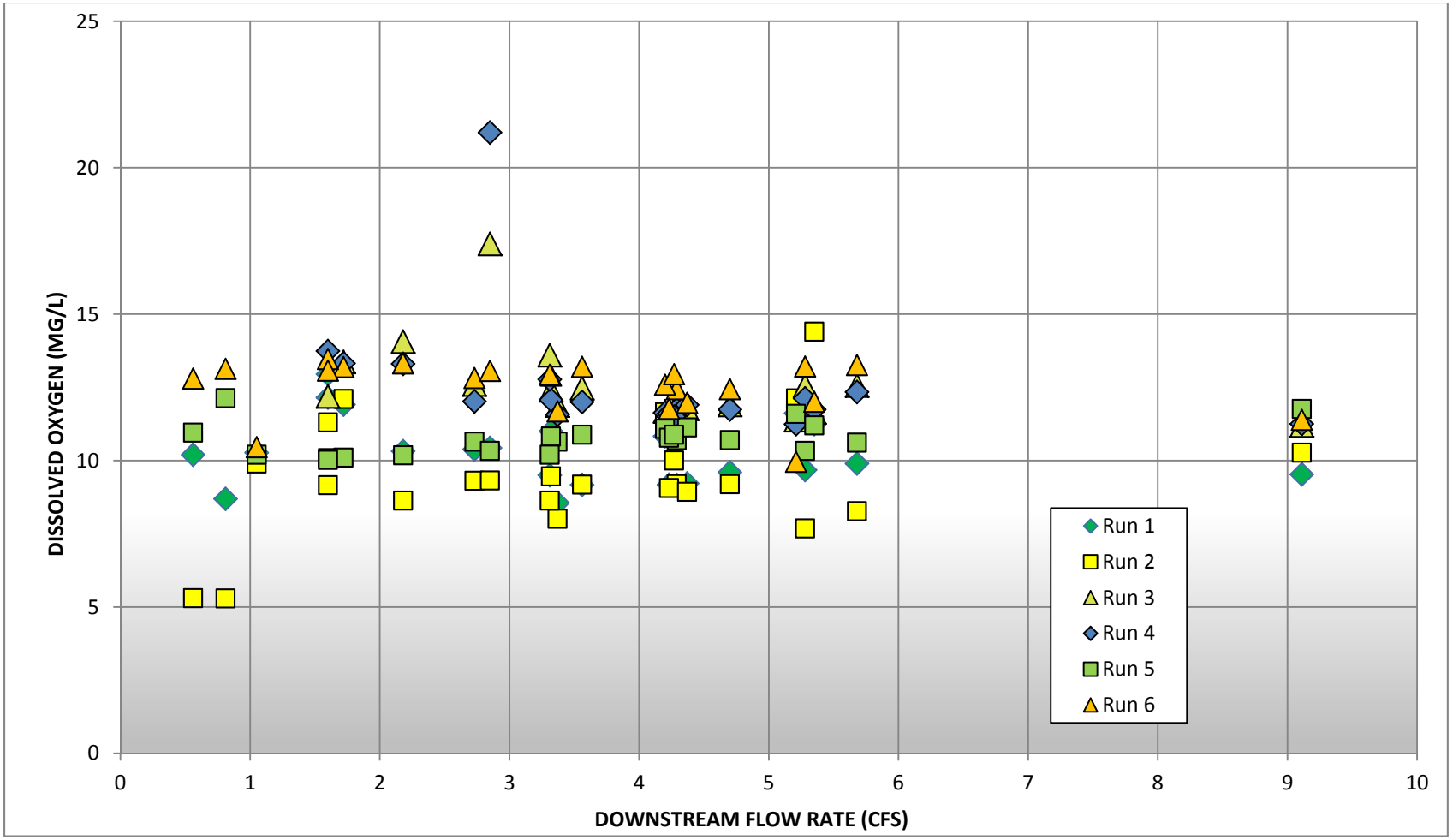
a. May 10, 2012

b. July 19, 2012

c. August 28, 2012

PHOTOGRAPHS OF SAMPLE UNIT RUN-6
APPENDIX C

APPENDIX D
DISSOLVED OXYGEN VERSUS STREAMFLOW DATA

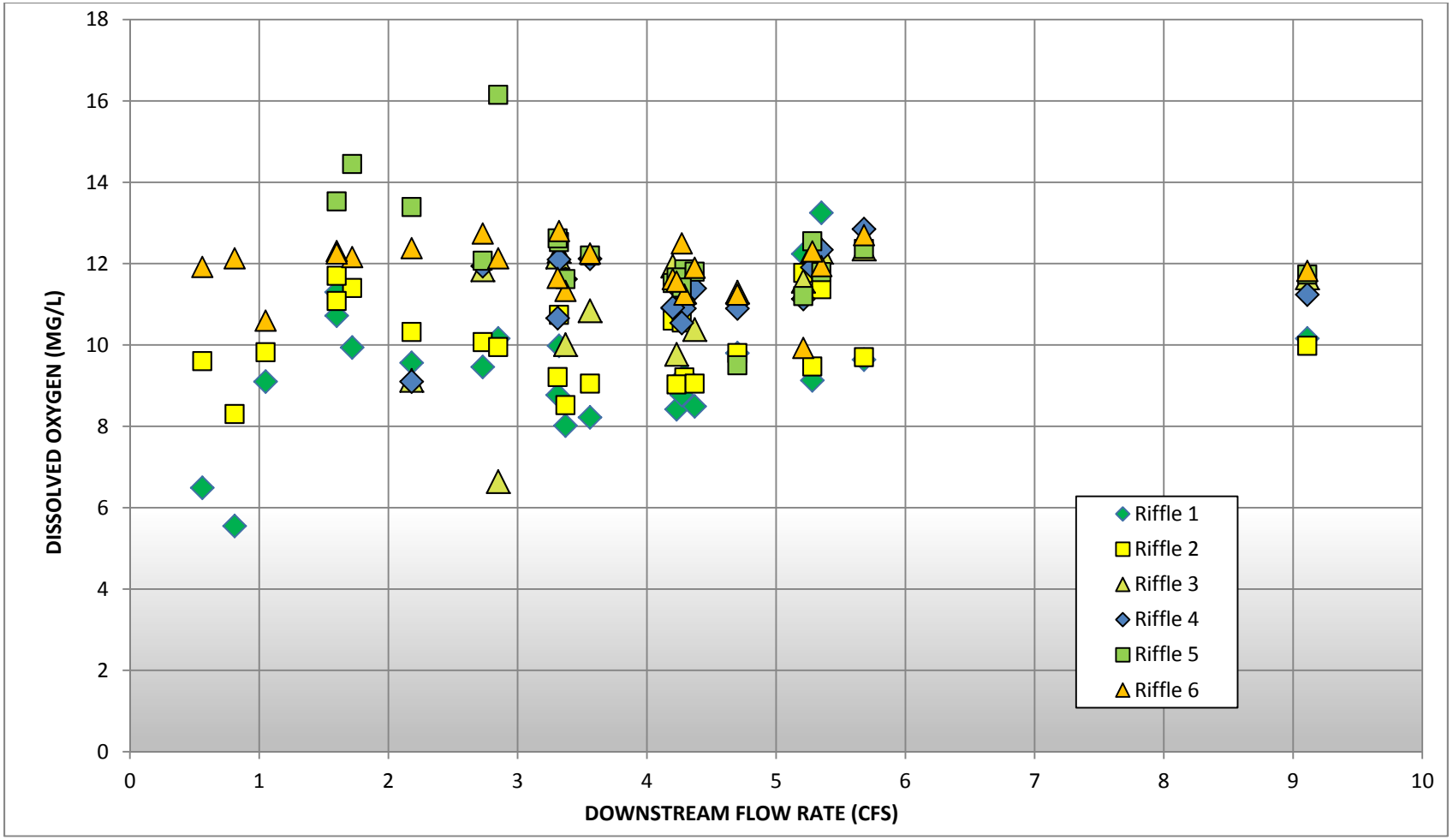


RIVER RUN SAMPLE UNITS
DISSOLVED OXYGEN CONCENTRATION
VERSUS DOWNSTREAM FLOW
Ventura River Surface Water/Groundwater
Interaction Study
City of San Buenaventura
Foster Park, California

PLATE D1

June 2013
Project No. 04-021-09B

HOPKINS
GROUNDWATER
CONSULTANTS

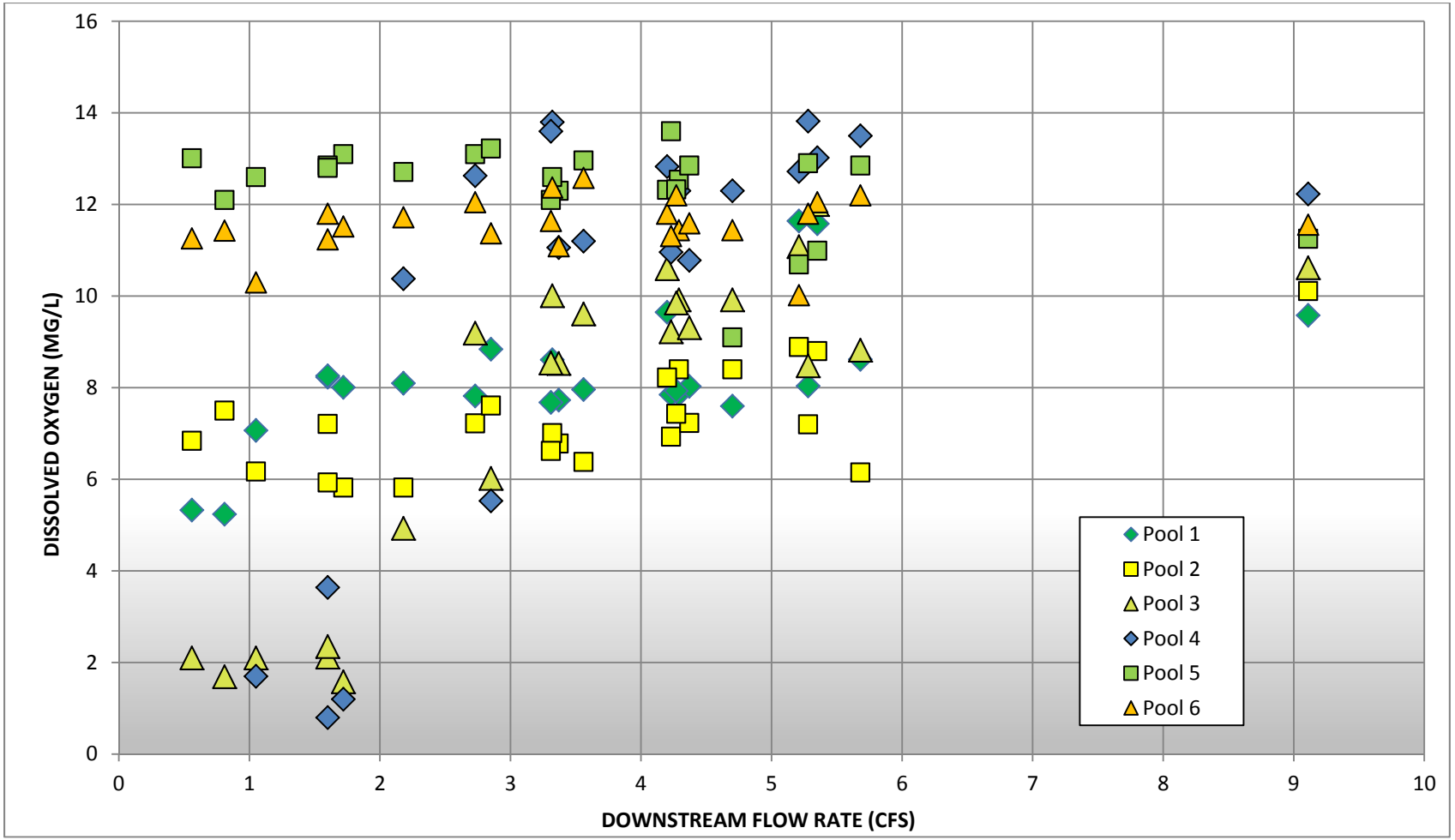


RIVER RIFFLE SAMPLE UNITS
DISSOLVED OXYGEN CONCENTRATION
VERSUS DOWNSTREAM FLOW
Ventura River Surface Water/Groundwater
Interaction Study
City of San Buenaventura
Foster Park, California

PLATE D2

June 2013
Project No. 04-021-09B

HOPKINS
GROUNDWATER
CONSULTANTS

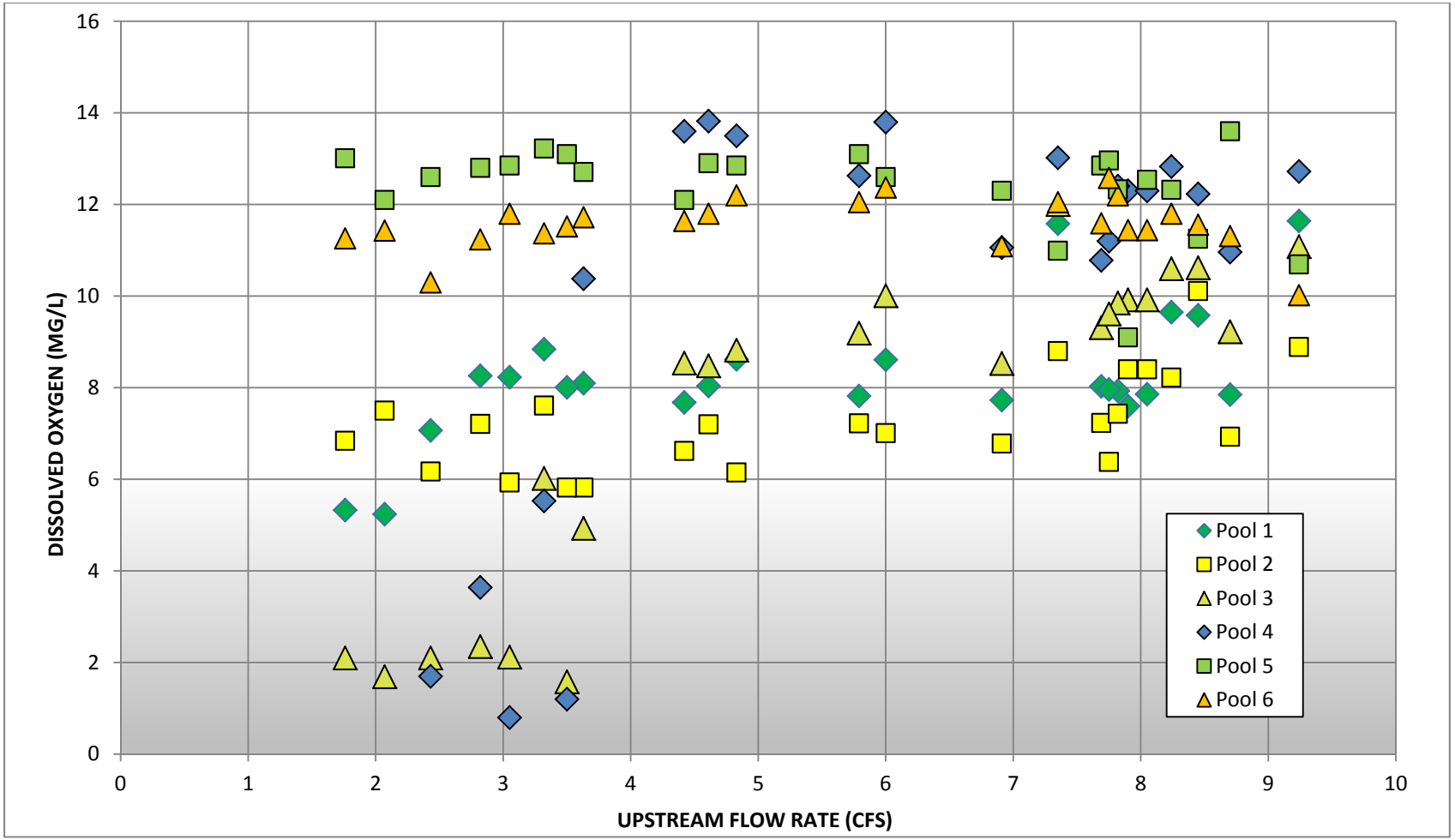


RIVER POOL SAMPLE UNITS
DISSOLVED OXYGEN CONCENTRATION
VERSUS DOWNSTREAM FLOW
Ventura River Surface Water/Groundwater
Interaction Study
City of San Buenaventura
Foster Park, California

PLATE D3

June 2013
Project No. 04-021-09B

HOPKINS
GROUNDWATER
CONSULTANTS



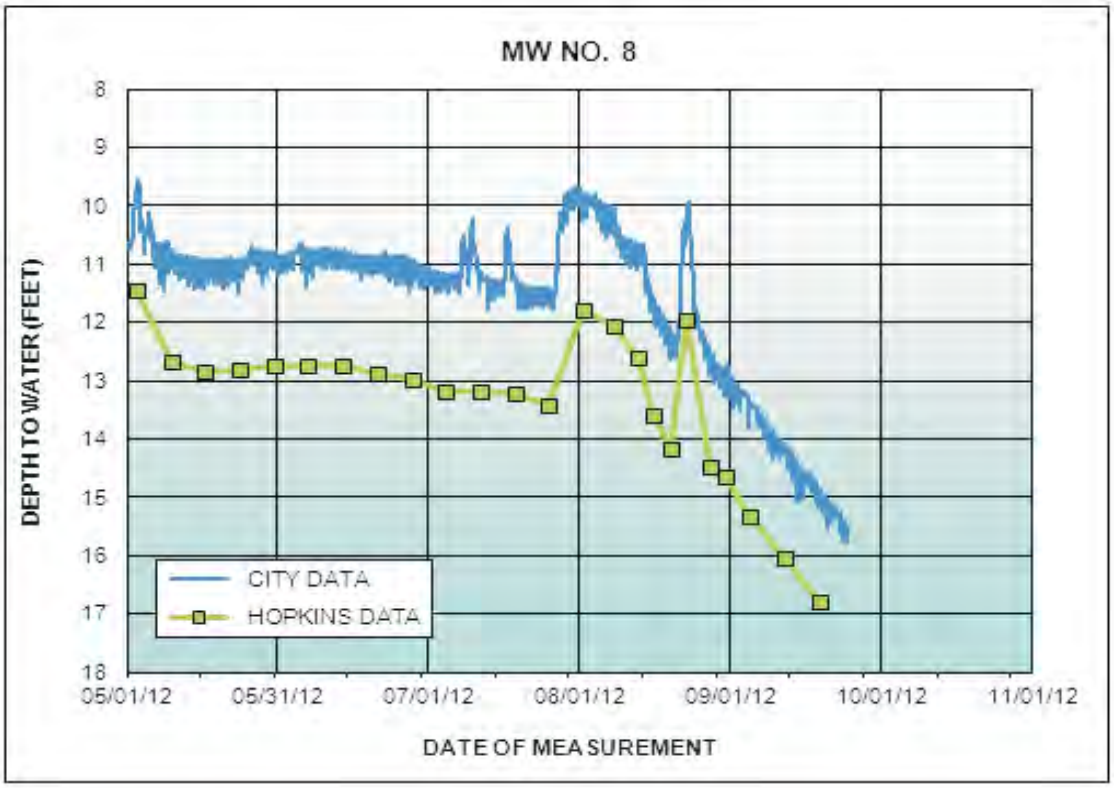
RIVER POOL SAMPLE UNITS
DISSOLVED OXYGEN CONCENTRATION
VERSUS UPSTREAM FLOW
Ventura River Surface Water/Groundwater
Interaction Study
City of San Buenaventura
Foster Park, California

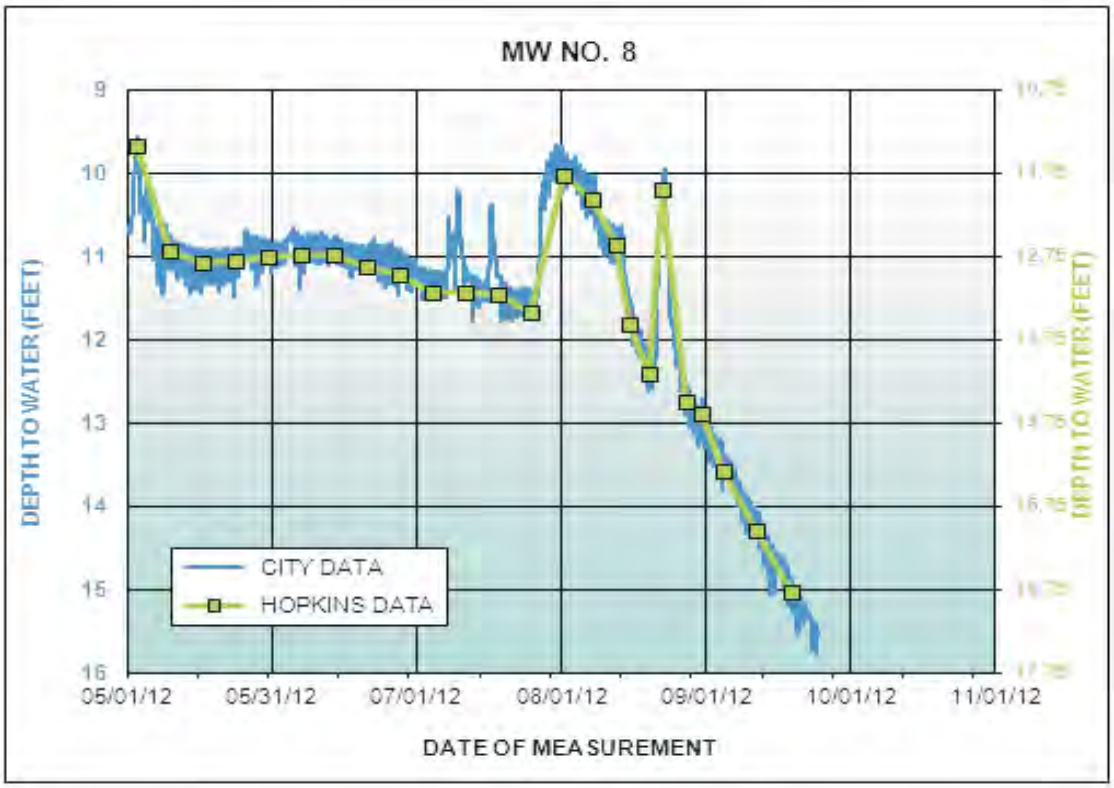
PLATE D4

June 2013
Project No. 04-021-09B

HOPKINS
GROUNDWATER
CONSULTANTS

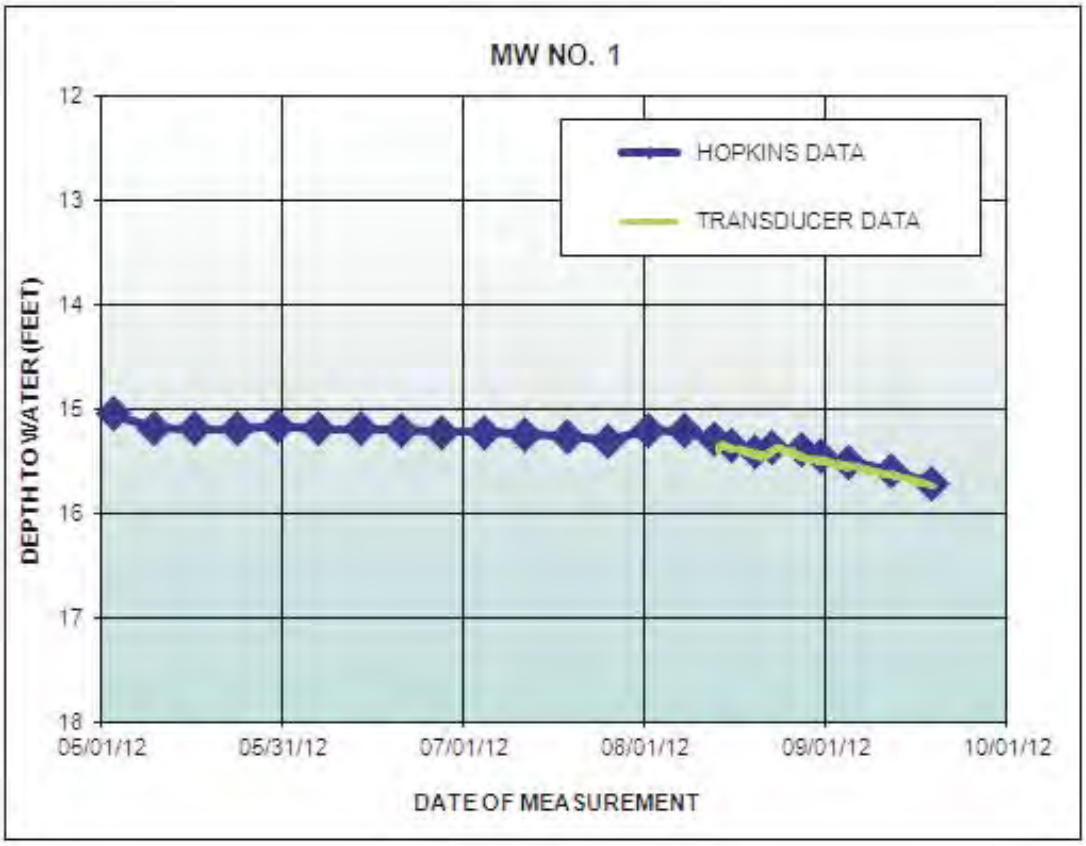
APPENDIX E
GROUNDWATER LEVEL DATA

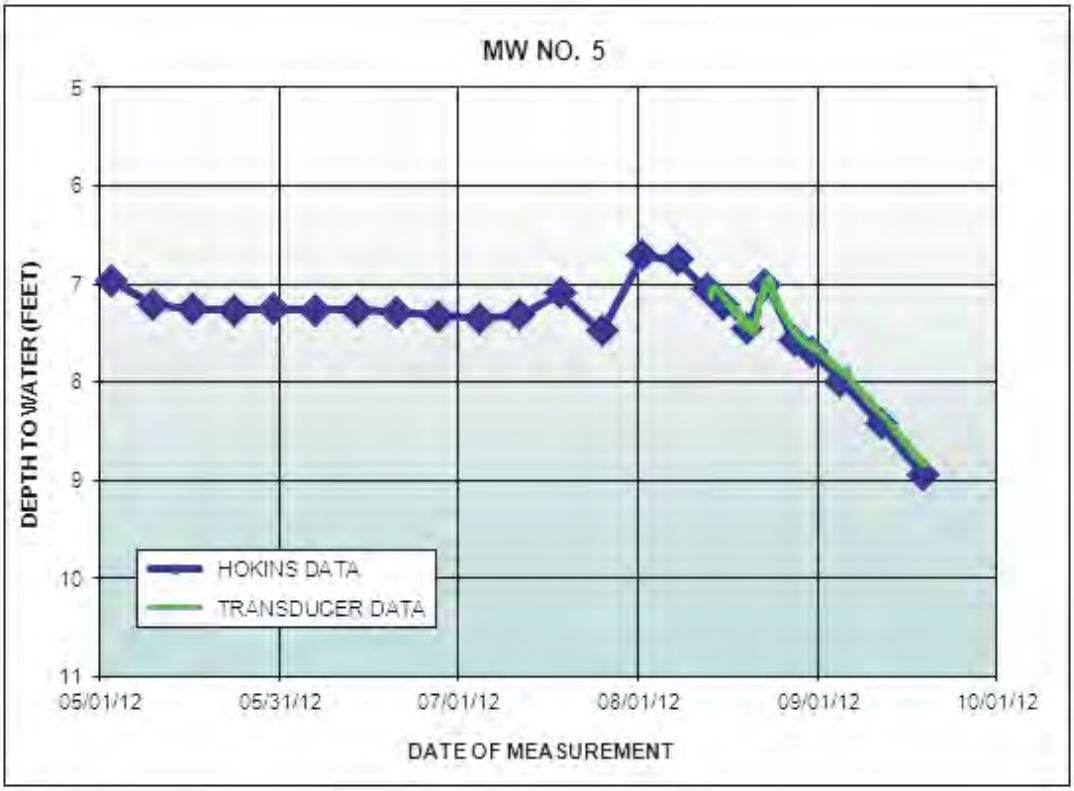

MW NO. 8
DEPTH TO WATER (FEET)
8
9
10
11
12
13
14
15
16
17
18
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
11/01/12
DATE OF MEASUREMENT
CITY DATA
HOPKINS DATA

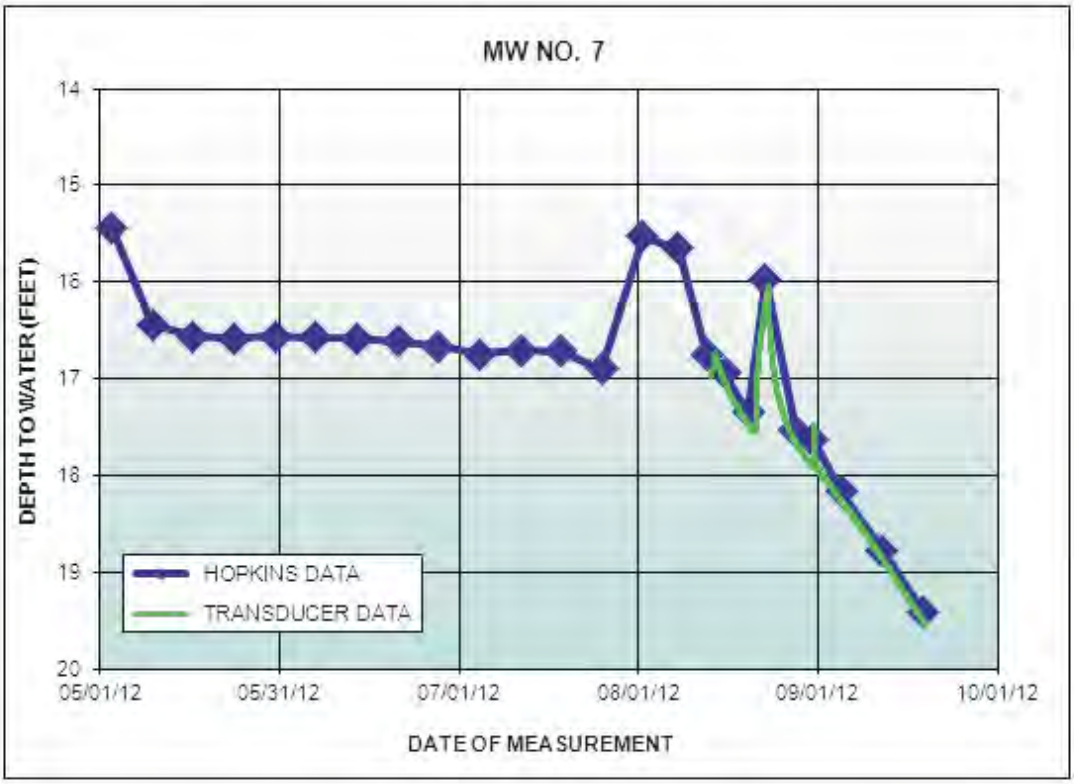

MW NO. 8
DEPTH TO WATER (FEET)
9
10
11
12
13
14
15
16
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
11/01/12
DATE OF MEASUREMENT
CITY DATA
HOPKINS DATA


NYE WELL NO. 2
DEPTH TO WATER (FEET)
15
16
17
18
19
20
21
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
DATE OF MEASUREMENT


DEPTH TO WATER (FEET)
16
17
18
19
20
21
22
23
NYE WELL NO. 2
MW WELL NO. 8
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
DATE OF MEASUREMENT
DEPTH TO WATER (FEET)


MW NO. 1
HOPKINS DATA
TRANSDUCER DATA
DEPTH TO WATER (FEET)
12
13
14
15
16
17
18
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
DATE OF MEASUREMENT


MW NO. 5
DEPTH TO WATER (FEET)
5
6
7
8
9
10
11
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
DATE OF MEASUREMENT
HOKINS DATA
TRANSDUCER DATA


MW NO. 7
DEPTH TO WATER (FEET)
14
15
16
17
18
19
20
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
DATE OF MEASUREMENT
HOPKINS DATA
TRANSDUCER DATA


MW NO. OW2
DEPTH TO WATER (FEET)
10
11
12
13
14
15
16
17
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
DATE OF MEASUREMENT


MW NO. 9
DEPTH TO WATER (FEET)
10
11
12
13
14
15
16
HOPKINS DATA
TRANSDUCER DATA
05/01/12
05/31/12
07/01/12
08/01/12
09/01/12
10/01/12
DATE OF MEASUREMENT