Appendices

Appendix A: Study Plan for 2009 surveys

Study Plan for Population Size Estimates of *O. mykiss* in the lower Tuolumne River

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Table of Contents

List of Tables

Appendices

1 BACKGROUND AND PURPOSE

Fisheries monitoring for the Don Pedro Project (FERC Project No. 2299) by the Turlock Irrigation District (TID) and Modesto Irrigation District (MID) has long documented the presence of *Oncorhynchus mykiss (O. mykiss)* in the lower Tuolumne River (TID/MID 2005). On March 19, 1998 the National Marine Fisheries Service (NMFS) first listed the Central Valley steelhead as threatened under the Endangered Species Act (ESA). After several court challenges, NMFS issued a new final rule relisting the Central Valley steelhead on January 5, 2006 (71 FR 834). In a separate process regarding terms of the 1996 FERC license amendments for the Project, NMFS staff provided input to a draft limiting factors analysis for Tuolumne River salmonids (Mesick et al 2007) and included recommendations for developing abundance estimates, habitat use surveys and anadromy determination of resident *O. mykiss*. These recommendations were conceptually used to develop the Districts FERC Study Plan (TID/MID 2007) which was the subject of an April 3, 2008 FERC Order. As part of the Order, the Districts are required to conduct population estimate surveys in summer (June/July) and winter (February/March), starting in summer 2008 to determine *O. mykiss* population abundance by habitat type.

The purpose of the proposed *O. mykiss* population surveys is to provide population size estimates over several sampling seasons of differing environmental conditions to determine habitat use and needs within the lower Tuolumne River. The surveys will be used to examine the following hypotheses:

> Hypothesis 1: Summertime distribution of suitable habitat by observed life stages of *O. mykiss* is related to ambient river water temperature.
>
> Hypothesis 2: Habitat use by *O. mykiss* juveniles and adults observed in the Tuolumne River occurs at the same density in both restored and nearby reference sites.

As recommended by Stillwater Sciences (Stillwater), the surveys will employ a two-phase sampling approach of potential *O. mykiss* habitat using snorkel surveys for the development of a "bounded count" population estimate (Hankin and Mohr 2001). Although the methodology presented below discusses both repeated dive counts and calibration by depletion electrofishing, current ESA permit restrictions for both NMFS Section 10(a)(1)(A) permit No's 1280 (TID) and 1282 (Stillwater) do not allow sufficient incidental take to conduct the second phase surveys at this time using electrofishing. Discussions with NMFS permitting staff and Stillwater have occurred since submittal of the 2007 FERC Study Plan, resulting in a pending formal request to NMFS by Stillwater for modification of Permit 1282 (see Section 6 below). The Section 10 Permit 1280 issued to TID in 2005 authorized only up to 5 juvenile *O. mykiss* annually by electrofishing that was further restricted to River Mile 25–30 during September to November. Thus that permit is not applicable or adequate to the season, location, and fish numbers needed to conduct the electrofishing for this population estimate study. Consequently, the July 2008 survey was conducted using snorkel surveys only as provided for in the 2007 study plan. It is not anticipated that the pending permit amendment request will be resolved prior to the winter 2009 survey, as such this will be conducted using snorkel surveys. If the pending amendment request is resolved prior to July 2008, then summer 2009 surveys will be conducted using the combined method presented below.

2 FIELD SAMPLING AND DATA COLLECTION

The two-phase stratified sampling design involves snorkeling pre-selected habitat units (e.g., riffle, run, pool, etc.) multiple times in order to quantify the variance associated with density and

subsequent population estimates. Habitat units are selected using stratified random sampling where the habitat types possess a pre-determined probability of occurrence within areas where *O. mykiss* have been frequently observed during the summer in the lower Tuolumne River, extending from approximately river mile (RM) 52–40 during summers and potentially extending to near the city of Waterford (RM 30) during colder winter conditions.

In a typical Phase 1 sampling approach, primary snorkel surveys (Edmundson et al. 1968, Hankin and Reeves 1998, McCain 1992, Dolloff et al. 1996) will be conducted across a subset of all habitat units. In Phase 2, approximately 20–70% of each habitat type sampled will be randomly selected for replicated surveys by either repeated dive counts or depletion electrofishing (Reynolds 1996). Although the bounded counts methodology was developed for use in smaller stream systems (Hankin and Mohr 2001), applying the methodology to a larger system such as the Tuolumne River is feasible provided key assumptions are satisfied. A critical assumption of the bounded counts approach is that all individuals have a chance of being observed. This may not be practically attainable due to the depths of some of the in-channel mining pits and also potentially due to low visibility conditions occurring at downstream locations or due to winter-time sediment inputs during rain events. Hankin and Mohr (2001) found that their survey designs were suitable for coho salmon (*O. kisutch*), but they were less confident about applying the methodology to *O. mykiss* juveniles because the fish's furtive nature may violate the assumption that all fish have an observation probability >0. Sampling sites and methods may be modified following initial surveys because local conditions cannot be anticipated and may dictate the use of other schedules, locations, or techniques. Stillwater Sciences will notify TID, FERC, and permitting authorities if substantive changes in the study design, methods or schedule are anticipated.

2.1 Habitat Typing

On-the-ground mapping of potential habitat for *O. mykiss* will be delineated on digital ortho-rectified aerial photographs and information from previous habitat mapping efforts. Appendices A and B shows preliminary habitat units from RM 52–30 based upon habitat mapping conducted by Stillwater Sciences (2008) between La Grange Dam (RM 52) and Roberts Ferry Bridge (RM 40) (Appendix A) as well as preliminary habitat units from RM 40 to Waterford (RM 30) based upon mapping conducted by McBain & Trush (2004) and EA Engineering (1997) shown in Appendix B. The Appendix B habitat maps will be updated for flow and morphological characteristics in the field in late February and late June in each year. The final habitat maps will delineate all potential *O. mykiss* habitats according to the major types listed in Table 1, as well as transitional habitats that may be preferentially used by various size classes (i.e., pool heads, pool bodies, pool tails, run heads, run bodies, run tails, and riffles).

Table 1. Coarse scale habitat types to be used during snorkel surveys

Habitat Type	Description[a]	Approximate Depth
Riffle	Shallow with swift flowing, turbulent water. Partially exposed substrate dominated by cobble or boulder. Gradient moderate (less than 4%).	0–4 ft
Run	Fairly smooth water surface, low gradient, and few flow obstructions. Mean column velocity generally greater than one foot per second (fts^{-1}).	4–10 ft
Pool	Slow flowing, tranquil water with mean column water velocity less than 1 fts^{-1}.	>10 ft

[a]Major habitat types determined based upon observed hydraulic conditions (McCain 1992, Thomas and Bovee 1993, Cannon and Kennedy 2003)

A Geographic Information System (GIS) will be used to update and refine habitat maps prior to thorough field verification of flow, depth, and habitat conditions in the river. Within each reach, individual habitat units will be digitized as two-dimensional features of varying shapes, or polygons, where each unit is a discrete functional habitat, as defined above. This approach is consistent with the general techniques of McCain (1992), Thomas and Bovee (1993), and Cannon and Kennedy (2003) and allows a flexible approach to evaluating habitat and habitat use patterns at a scale that can be easily delineated given available data, readily depicted, and is ecologically meaningful for aquatic species.

Habitat units will be assigned a natural sequence order (NSO), starting at one which is the first unit at the upstream end of the site, and a habitat type unit number (1…N pools, runs and riffles). The maximum depth, length and width (usually at 1/3 and 2/3 of the units length) will be recorded and flagging tied at both upstream and downstream ends of units to be surveyed. Pertinent information such as date, unit number, and type is included on the flag. Lastly, the upper and lower end of each unit will be located by GPS and mapping from previous efforts will be verified or updated.

2.2 Sample Site Selection

After all potential habitat units are typed and all pertinent information recorded, a subset of each habitat unit type will be selected for single-pass snorkel surveys. Although additional units may be selected at gravel augmentation and other in-channel restoration sites (See Hypothesis 2), selection for sampling proceeds by random selection of the starting sampling unit in the upper survey section, followed by a systematic uniform sampling of the remaining units in the survey reach. For example, every 3rd, 4th or larger selection interval will be used to distribute the selected units uniformly across the survey reach.

Because the total length of river sampled affects the confidence bounds of the resulting *O. mykiss* population estimates, at least 10% of the total length of a given habitat type and a minimum of 5 units of each type will be sampled. Based upon preliminary habitat mapping and median unit lengths of various habitat types, Table 2 shows that 63 sampling units for the winter surveys will be selected from representative locations between RM 52–30 to meet the minimums above. This estimate further assumes that, since detailed habitat type mapping has not been conducted from RM 40–30, habitat type distribution and median length from RM 40–30 are similar to RM 52–40, as determined by summer 2008 habitat type mapping (Stillwater Sciences 2008). The exact number sampled will be determined after random selection of the habitat units prior to study implementation.

During summer, an estimated 35 units will be selected for single-pass snorkel survey from representative locations between RM 52–40 (Table 2). For both winter and summer surveys, the number and location of habitat units may be adjusted if initial systematic sampling does not allow the study to adequately to test Hypothesis 2.

Table 2. Estimated number of sampling units that will meet study design assumption of sampling at least 10% of the total length of a given habitat type.

Habitat Type	Total length (ft) RM 52-40[a]	Estimated total length (ft) RM 40-30[b]	Estimated total length (ft) RM 52-30	Median length (ft)[c]	# of units to be sampled Winter 2009 RM 52-30[d]	Estimated sampled Length Winter 2009	# of units to be sampled Summer 2009 RM 52-40[d]	Estimated sampled Length Summer 2009
Riffle	14,320	13,590	27,910	322	9	10%	5	11%
Pool head	619	618	1,237	106	9	77%	5	86%
Pool body	6,741	6,795	13,536	393	9	26%	5	29%
Pool tail	781	618	1,399	124	9	80%	5	79%
Run head	2,067	1,853	3,920	51	9	12%	5	12%
Run body	37,350	35,829	73,179	843	9	10%	5	11%
Run tail	2,393	2,471	4,864	54	9	10%	5	11%
Total	**64,271**	**61,775[e]**	**126,046**		**63**		**35**	

[a]From Stillwater Sciences (2008)
[b]Assumes same proportion of habitat types as from RM 52-40
[c]Assumes median habitat unit lengths from RM52-40 are proportional to median lengths along RM 40-30.
[d]Assumes at least 10% of the total length of each habitat type will be sampled; Estimates based upon 10% of the total length of a habitat type by median habitat unit length to determine a minimum number of units
[e]Actual river length from RM 40-30

2.3 Sampling Period

Winter sampling will begin in late February with systematic random selection of habitat units from RM 52-30, based upon summer 2008 maps (Appendix A) and previous habitat typing between RM 40–30 (Appendix B). Following habitat selection, Stillwater will use single-pass snorkel surveys and second phase calibration surveys within units of each type to develop uncertainty and bias estimates. Second phase sampling will be conducted using multi-pass snorkel surveys and/or depletion electrofishing methods as allowed under applicable permits (See Section 6).

Summer sampling will use habitat maps from RM 52–40 developed in summer 2008 (Appendix A). Although no additional habitat mapping is anticipated following winter 2009 surveys, habitat unit flagging will be established in advance of each snorkel survey effort and seasonal changes in habitat distribution may force revision of habitat type maps, specifically the upper and lower boundaries of habitat units and/or channel margins, prior to summer 2009 surveys.

2.4 Measurement Parameters and Sampling Methods

Multiple parameters will be measured in order to meet the objectives for this study (Table 3). Photos and GPS locations will be taken at each site, and site locations identified on GIS maps corresponding to mapped aquatic habitat units. General site information recorded at fish sampling locations will include site name, GPS coordinates, time, date, and crew member names. *In situ* water quality parameters (Temperature, dissolved oxygen, and conductivity) will be collected using a pre-calibrated multi-probe (YSI 85, Yellow Springs Instruments, Yellow Springs, OH). Underwater visibility will also be estimated into the sun and away from the sun using a Secchi disk to monitor any changes in visibility. Dissolved oxygen probes will be recalibrated at each site and checked for accuracy against concentrations measured in Winkler titrations (Grasshoff et al 1983) at the beginning and end of the sampling effort using a dissolved oxygen test kit.

Table 3. Measurement parameters and methods for snorkel surveys

Parameter	Method	Metric/Descriptor	Method Reporting Limit
Habitat Typing Attributes			
Natural sequence order (Reach ID – Habitat unit #)	N/A	A-1, A-2, A-3, …	N/A
Latitude/Longitude	Handheld GPS receiver	UTM	N/A
Habitat type	Visual estimation	See Table 1	N/A
Average unit width	Horizontal distance	meters (feet) (measured at multiple transects)	3 ft (1 m)
Average unit length	Horizontal distance	meters (feet)	3 ft (1 m)
Maximum/minimum depth	Vertical distance	meters (feet)	1 ft (0.3 m)
Bed substrate composition	Visual estimation	bedrock, boulder, cobble, gravel, organic, sand, silt	10%
Cover type	Visual estimation	none, boulder, cobble, IWM, bedrock ledges, overhead vegetation, aquatic vegetation	10%
Field Data During Snorkel Surveys			
Temperature	EPA 170.1	°C	0.1 °C
Dissolved Oxygen	SM 4500-O	mg/L	0.0 mg/L
Conductivity	SM 2510A	umhos/cm	1.0 umhos/cm
Visibility	Secchi depth	meters (feet)	0.01 m (0.1 ft)
Date/Start time/End time	N/A	Day/month/year	N/A
Number of Individuals	Visual estimation	Number	1
Fish length – snorkeling	Visual estimation	millimeter	50 mm
Fish length – electrofishing	Fork length	millimeter	1 mm
Weight - electrofishing	Electronic balance	gram	0.1 g

2.4.1 Snorkel Surveys

Snorkel surveys will be conducted during daylight hours (7:00am–5:00pm winter; 6:00am–8:00pm summer). A two phase survey design will be used to survey the seven different strata (Table 4). At the first phase, single-pass dive surveys will be conducted by a four to five person crew depending upon river flows and underwater visibility. Sampling units will generally be sampled from downstream to upstream in dive lanes using a zigzag pattern, passing fish and allowing them to escape downstream of the diver. If fish are observed to escape upstream, the diver will take care to avoid counting these fish twice. Divers will record their observations of pertinent attributes (Table 3) and numbers of *O. mykiss* and Chinook salmon (*O. tshawtscha*) observed; with fish lengths to be estimated in 50 mm size ranges using a scale model or markings on the slates to correct for underwater size distortion. After the first dive pass is completed a tab is then pulled to determine if the unit is included in the second phase of sampling.

Table 4. Preliminary sample unit selection and survey count.

	Winter 2009				Summer 2009			
	Phase I Dives		Phase II Survey		Phase I Dives		Phase II Survey	
Habitat	Initial Units	Passes	Repeat Units	Passes	Initial Units	Passes	Repeat Units	Passes
Riffle	9	1	2	2	5	1	2	2
Pool head	9	1	2	2	5	1	2	2
Pool body	9	1	2	2	5	1	2	2
Pool tail	9	1	2	2	5	1	2	2
Run head	9	1	2	2	5	1	2	2
Run body	9	1	2	2	5	1	2	2
Run tail	9	1	2	2	5	1	2	2
	Total	63	Total	28	Total	35	Total	28

The second phase of sampling collects data that will later be used to extrapolate dive counts to total population estimates by three passes of either repeated dive counts or depletion electrofishing. Ideally, if the count of *O. mykiss* from the Phase 1 snorkel survey is less than or equal to 20 individuals then three additional dive passes are made. If electrofishing is permitted, all units with a count of juvenile *O. mykiss* counts greater than 20 individuals will be surveyed by electrofishing. Lastly, occurrence of other native and non-native fish species will be recorded as presence/absence.

2.4.2 Electrofishing at Riverine Sites

If employed during the summer 2009 survey, electrofishing will be conducted by a 4 person crew during the daylight hours (6:00am-8pm) following the dive surveys. Ideally, 3-pass electrofishing will be used on all second phase dive units where the first dive pass exceeded 20 *O. mykiss*. Dive units that require electrofishing for dive calibration will be completed as soon as possible after the dive survey.

Shallow water habitat may be sampled using back pack electrofishing units while deep water habitat may be sampled using a boat electrofishing unit. Back pack electrofishing in shallow waters less than 3–4 ft depth will be conducted using two or more Smith-Root back pack electrofishers (Model LR-24 or Model 12 with 11-inch anode rings and standard "rat-tail" cathodes). Boat electrofishing may be used in deeper riverine habitats using a boat mounted Smith Root 1.5 KVA electrofishing unit. To ensure the health of all fish captured during electrofishing, all electrofishing will be conducted in accordance with NMFS (2000) electrofishing guidelines and an electrofishing logbook will be maintained and updated at each sampling site.

Depending upon river flows and depth, electrofishing will use block nets placed at the upstream and downstream ends of the unit to be fished, taking care to avoid disturbance of the unit during net set-up. Block nets will be set up where possible to prevent fish from moving out of the unit. If block nets are not feasible, then a snorkeler may be stationed at the upstream end of a unit to observe any fish moving out of the unit.

First pass electrofishing will proceed slowly and deliberately upstream from the downstream end of the unit; members of an electrofishing crew will move to the top and back down to the bottom working closely together. To maintain equal effort on subsequent passes, electrofishing time (seconds) will be recorded to allow for any adjustments in sampling effort. A fourth pass will be conducted if one of the following applies:

1. The number of *O. mykiss* caught on the 2nd pass exceeds the number of *O. mykiss* caught on the 1st pass.
2. The number of *O. mykiss* caught on the 3rd pass is greater than or equal to 25 percent of number caught on the 2nd pass.

The procedure may be modified in riffle habitats to facilitate capture of shocked fish in fast water. In the riffle strata, a pass consists of a sweep from the top to the bottom of the unit. Depending on the water velocity, block nets may or may not be set at the upstream end of riffle units.

2.4.3 Fish Handling Protocols

Any fish captured during electrofishing surveys will be processed, and information collected regarding species identification, fork length (FL, mm), weight (g), and, if applicable, notes on general condition. All fish will be rapidly retrieved using dip nets and placed immediately into aerated live wells or buckets with water. Large fish will be kept separate from juvenile fish to avoid confinement predation. Fish will be identified to species and origin (hatchery or wild stock) where possible. Fish that are weighed and measured will be anesthetized using clove oil to minimize handling stress. After all fish are identified, counted, and measured, fish will be held for approximately 10 minutes, until they show signs of "normal" swimming patterns and behavior.

2.5 Hypothesis Testing

The purpose of the proposed *O. mykiss* population surveys is to provide population size estimates over several sampling seasons of differing environmental conditions to determine habitat use and needs within the lower Tuolumne River. The surveys will be used to examine the following hypotheses:

> Hypothesis 1: Summertime distribution of suitable habitat by observed life stages of *O. mykiss* is related to ambient river water temperature.
>
> Hypothesis 2: Habitat use by *O. mykiss* juveniles and adults observed in the Tuolumne River occurs at the same density in both restored and nearby reference sites.

While the selection for sampling proceeds by random selection of the starting sampling unit in the upper survey section, followed by a systematic uniform sampling of the remaining units in the survey reach, additional units adjacent to or near restoration sites may be non-randomly selected to provide treatment and control locations to test Hypothesis 2, especially during winter 2009 surveys when low ambient river water temperatures obviate the need to test Hypothesis 1.

2.6 Field Work Notification

To ensure field staff safety and to satisfy scientific collecting permit requirements, the parties listed in Table 5 will be notified in advance of the proposed sampling in as required to confirm sampling dates.

Table 5. Field Work Notification

Contact	Affiliation	Address	Phone and Email
Tim Ford	TID	333 East Canal Dr. Turlock, CA 95380	209.883.8275 tjford@tid.org
Tim Heyne	CDFG	P.O. Box 10 La Grange, CA 95329	209.853.2533 x1# theyne@dfg.ca.gov
Jeffery Jahn	NMFS	777 Sonoma Ave. Rm 325 Santa Rosa, CA 95404	707.575.6097 Jeffrey.Jahn@noaa.gov

Prior to mobilization, planned river operations by the Districts will be checked to determine if fish sampling would be safe under the anticipated flow and all parties will be notified of any delay or modification to the sampling schedule.

3 QUALITY ASSURANCE

The objective of data collection for this Project is to produce data that represent as closely as possible, *in situ* conditions of the Tuolumne River with respect to river flow conditions, water quality, abundance and habitat use by *O. mykiss*. To meet this objective, field sampling, sample preparation, and analysis will follow general guidelines outlined in USEPA (2002) by ensuring that:

- the project's objectives, hypotheses and data quality objectives are identified and agreed upon,
- the intended measurements and methods are consistent with project objectives,
- the assessment procedures are sufficient for determining if data of the type and quality needed and expected are obtained, and
- any potential limitations on the use of the data can be identified and documented.

Aquatic environments are inherently variable, but management decisions must be based on a data from a limited number of locations and often collected in short time periods. How well the information collected represent the reach or river-wide fish population depends upon a systematic approach to quality assurance.

3.1 Data Quality Objectives for Measurement Data

The data quality parameters used to assess the acceptability of the data are precision, accuracy, representativeness, comparability, and completeness. Precision measures the reproducibility of measurements under a given set of conditions. Analytical precision is limited to water quality and physical habitat characteristics (Table 6). Accuracy is an expression of the degree to which a measured or computed value represents the true value. Field accuracy is controlled by adherence to sample collection procedures.

Table 6. Data quality objectives for field parameters

Parameter	Units	Accuracy	Precision	Completeness
Dissolved Oxygen	mg/L	± 0.5	10%	90%
Temperature	^{o}C	± 0.5	5%	90%
Conductivity	umhos/cm	± 5%	± 5%	90%
Depth	meters	± 0.2	N/A	N/A
Visibility (Secchi)	meters	± 0.05	N/A	N/A

- Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. For this study, monitoring site selection will be conducted based on physical habitat attributes. Additionally, specific measurement parameters have been identified as relevant based on numerous studies indicating factors associated with species distribution.

- Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. For this biological assessment, comparability of data will be established through the use of standard analytical methodologies and reporting formats.

- The project goal for completeness, a measure of the amount of data that is determined to be valid in proportion to the amount of data collected, will be 90% for analytical water quality parameters. The data quality objective for completeness for all components of this study is 90%.

3.2 Training Requirements/Certification

Specialized training is required for the proposed sampling activities, however none of the sampling activities require outside certification from an agency or another entity. Required permits for biological sampling are discussed in Section 5. Field crews will be staffed by a variety of qualified personnel, which due to the nature of extended field activities, will necessarily be rotated in and out of the field.

3.3 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

To ensure proper equipment performance in the field, maintenance and operational procedures, including preventative maintenance, will be performed on all YSI multiprobes (temperature, dissolved oxygen, and conductivity). YSI maintenance will be recorded in a logbook with the date the maintenance was performed and the initials of the technician. When the instruments are not deployed, the calibration or storage cup will be used to protect sensors from damage and desiccation.

3.4 Instrument Calibration and Frequency

Field probes used for field sampling will be calibrated prior to use, midway through each sampling event, and at the end of each sampling event. Measurement devices for conductivity will be checked against a standard whose source is different than that selected for calibration. Dissolved oxygen will be checked against aerated water whose oxygen content is established by the Winkler method (Grashoff et al 1983). Temperature does not require calibration because of the unvarying nature of the temperature sensor and its conditioning circuitry.

3.5 Reconciliation with Data Quality Objectives

If data do not meet the project's specifications, the following actions will be taken. First, the task leaders working with the field crew leaders (in some cases they will be the same person) will review the errors and determine if the problem is equipment failure, calibration/maintenance techniques, or monitoring/sampling techniques. They will suggest corrective action. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the task leaders will review the data quality objectives (DQOs) and determine if the DQOs are feasible. If the

specific DQOs are not achievable, they will determine whether the specific DQO can be relaxed, or if the parameter should be eliminated from the monitoring program.

3.6 Data Management

All field data will be amassed in a quality-checked database and summarized. QA checks will be applied to all data before data entry and data will be stored on Stillwater Sciences servers. Full backup of data from all offices is done on a weekly basis, while differential backup (files that have changed since the last full backup) is done on a nightly basis. The backup process is accomplished with a Fast Tape Library and backup processes are completed during off-peak hours. Two sets of tapes are taken offsite by two Information Technology (IT) staff members on a weekly basis to ensure recovery in case of failure or catastrophe.

4 DATA ANALYSIS

Data analysis will be conducted to summarize *in situ* water quality and fish counts in each sampling strata. Bounded counts or depletion estimators will be used to determine populations and linear density for each sampled unit, together with estimates of uncertainty. In addition to comparisons of fish density between sampling strata, the density estimates and uncertainties will be propagated across the unsampled areas for an overall population estimate. Exploratory multiple regression analysis will also be used to determine relationships between fish density and recorded habitat variables.

5 REPORTING

A data report will be prepared for use with permitting authorities that includes: date, time, and location of sampling activities; species and number of species collected; and a copy of field data sheets. Results of the winter 2009 surveys will be transmitted to TID electronically within three weeks of the survey completion (April/May 2009). A client review draft of the technical report covering the results of both winter and summer 2009 surveys will be submitted to TID by August 24, 2009. Assuming an internal and Agency review comments are received within one and three weeks of issuance of the client review and Agency review drafts, respectively, the Agency review draft will be available by September 8, 2009 and final report will be complete by October 16, 2009.

6 PERMITTING REQUIREMENTS

Stillwater Sciences will maintain the following permits to sample fish populations that may be present:

- NMFS Section 10(a)(1)(A) permit 1282
- California Department of Fish and Game individual Scientific Collection Permits.

A NMFS Section 10(a)(1)(A) permit 1282 has been obtained and all NMFS guidelines (e.g., notification, data gathering, preservation) will be followed if any Central Valley steelhead are captured. Under that existing NMFS permit, electrofishing is limited to an authorized incidental take of 40 juvenile *O. mykiss* and the <5% unintentional mortality limit, and no adults. An amendment to the sampling description was submitted to NMFS on June 2, 2008 with increased take limits for handling electrofishing of 100 adults and 200 juveniles at an unintentional mortality rate of <10%. Mr. Jeffrey Jahn of NMFS will be notified at least two weeks prior to applicable sampling to confirm

sampling dates and locations. Electrofishing under an amended permit will be suspended in the event that the authorized incidental take limits were exceeded and all subsequent calibration surveys would be made by repeat dive surveys. Annual reporting will be provided to Mr. Jeffrey Jahn of NMFS by March 1, of each year.

CDFG Scientific Collecting Permits (SCPs) will be maintained for species potentially present in the project area. CDFG guidelines (e.g., notification, data gathering, and preservation) will be followed if special-status species are captured and the CDFG 24-hr dispatch (916.446.0045) will be notified should unrelated events result in fish kills.

No intentional mortality or removal of special-status species from the wild is included in this study plan. In the event unintentional mortality occurs beyond the take permit limits, NMFS staff will be contacted within 24 hrs and a fin-clip will be provided to the Salmonid Genetic Repository. CDFG will also be contacted to determine the disposition of the individual specimen and whether the individual may be retained for otolith analysis.

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Appendix B: 2008 Habitat Maps


Run Body
NSO 009
NSO 008
Run Head
NSO 007
Riffle
NSO 006
Pool Tail
NSO 005
Pool Body
NSO 004
Pool Head
Pool Tail
NSO 003
NSO 002 Pool Body
NSO 001
Pool Head
Riffle
RM 52
Pool Tail
Pool Body
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 01
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet

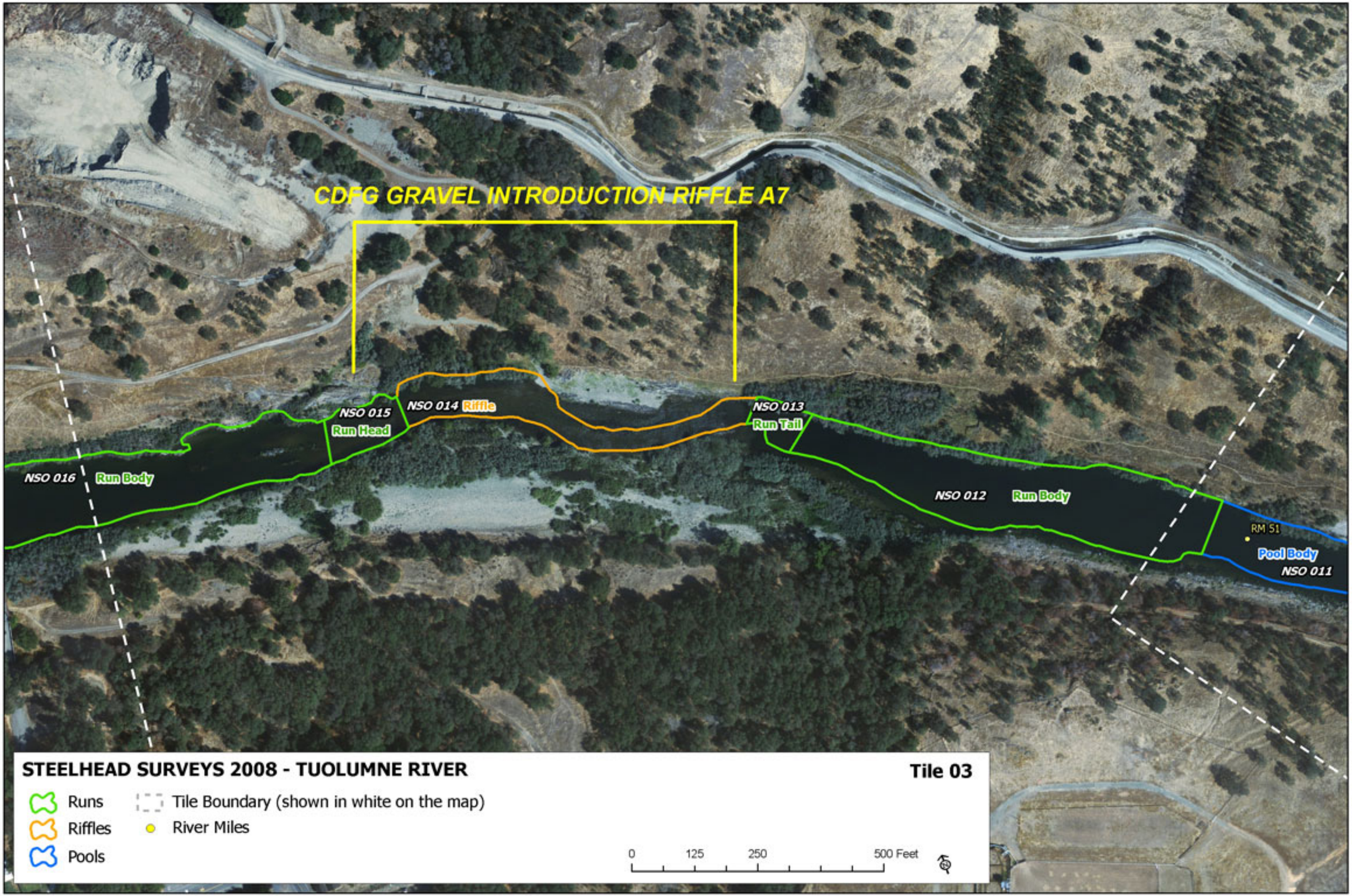
Run Body
NSO 012
RM 51
NSO 011
Pool Body
NSO 010
Run Tail
NSO 009
Run Body
NSO 008
Run Head
NSO 007
Riffle

STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile 02

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

0 125 250 500 Feet


CDFG GRAVEL INTRODUCTION RIFFLE A7
NSO 015
Run Head
NSO 014 Riffle
NSO 013
Run Tail
NSO 016
Run Body
NSO 012
Run Body
RM 51
Pool Body
NSO 011
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 03
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet

CDFG GRAVEL INTRODUCTION RIFFLE 1A/1B

NSO 021
Run Tail
NSO 020
Run Body
NSO 019
Run Head
NSO 018
Riffle
NSO 017
Run Tail
Run Body
NSO 016
NSO 023
Riffle
Run Head
NSO 022
NSO 024
Run Body
RM 50

STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile 04

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

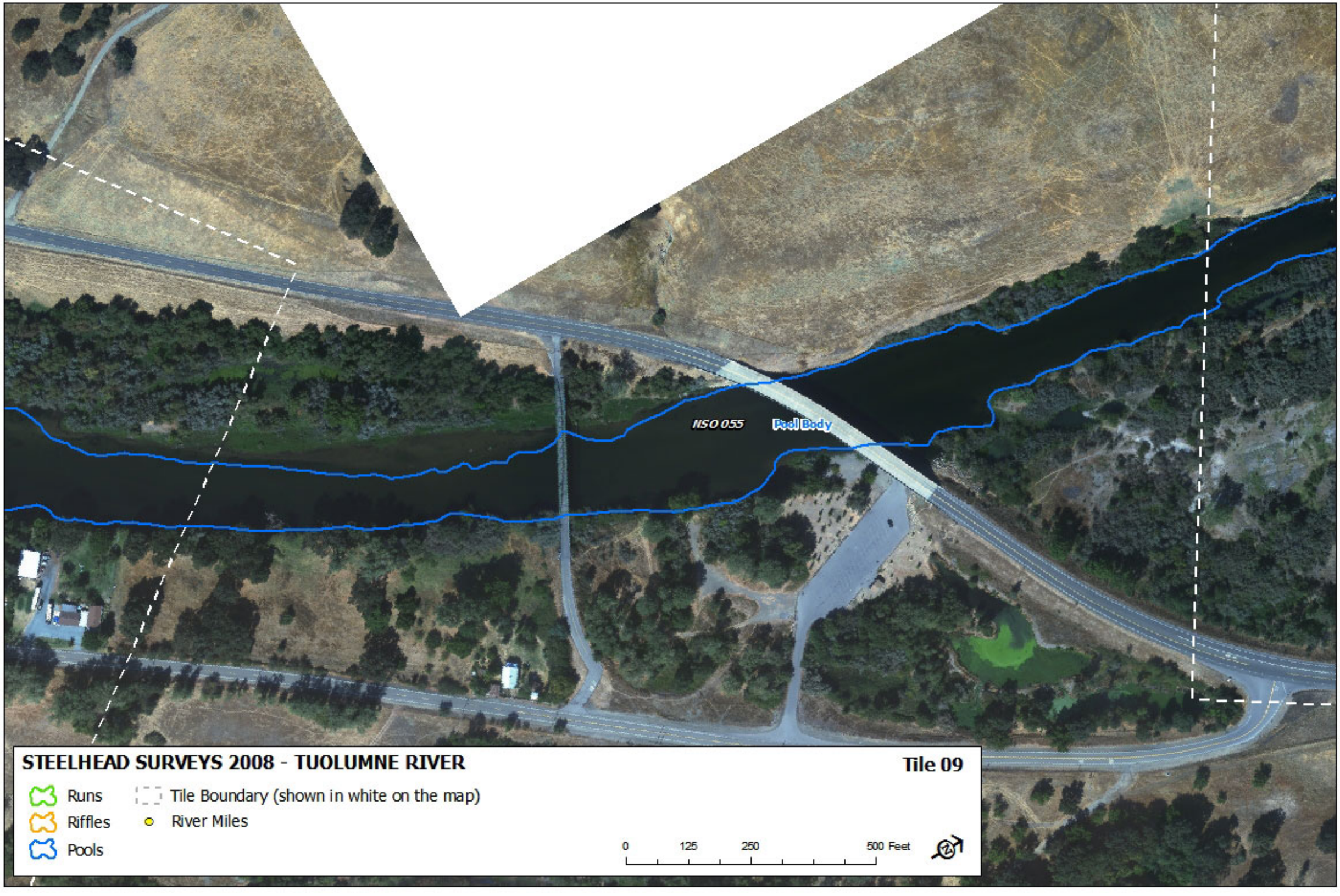
0 125 250 500 Feet

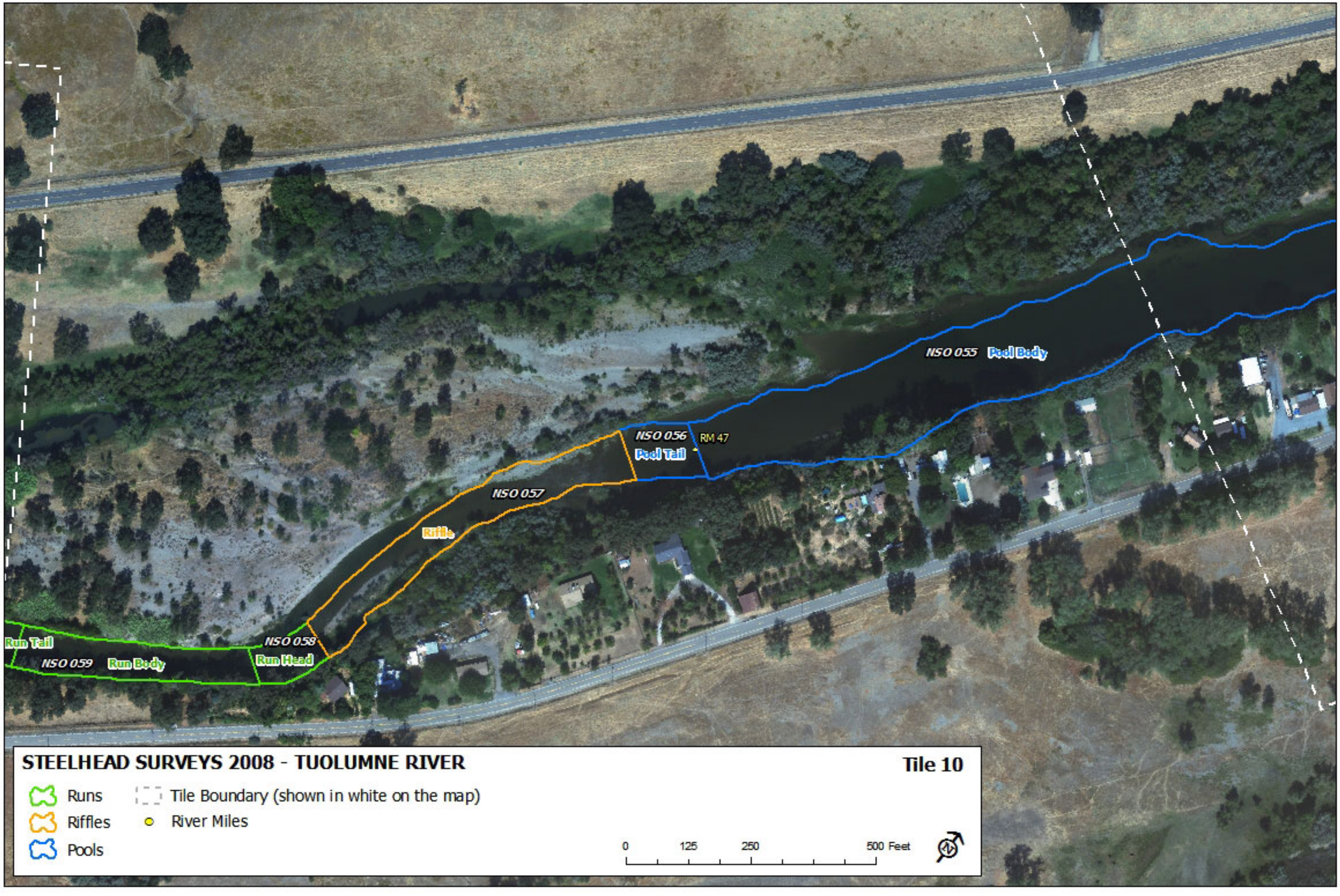

NSO 028
Pool Body
NSO 027
Pool Head
Pool Tail
Run Head
NSO 029
NSO 030
NSO 026
Riffle
Run Tail
NSO 025
NSO 031
Run Body
NSO 024
Run Body
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 05
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet
N


NSO 032
Run Tail
NSO 031
Run Body
NSO 033
Riffle
Riffle
NSO 041
Run Tail
NSO 039
NSO 040
Run Body
NSO 037
Run Head
Run Tail
NSO 035
RM 49
Run Body
NSO 034
Run Head
Riffle
NSO 038
NSO 036
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 06
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet


NSO 042
Run Head
NSO 043
Run Body
NSO 041
Riffle
NSO 044
Run Tail
Run Head
NSO 045
Riffle
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 07
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet


NSO 055
Pool Body
Pool Head
NSO 054
Riffle NSO 053
NSO 052
Run Tail
NSO 051
Run Body
NSO 050
Run Head
NSO 049
Riffle
RM 48
NSO 048
Run Tail
NSO 047
Run Body
NSO 046
Run Head
NSO 045 Riffle
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 08
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet


NSO 055
Pool Body
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 09
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet


NSO 055
Pool Body
NSO 056
Pool Tail
RM 47
NSO 057
Riffle
NSO 058
Run Head
Run Tail
NSO 059
Run Body
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 10
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet

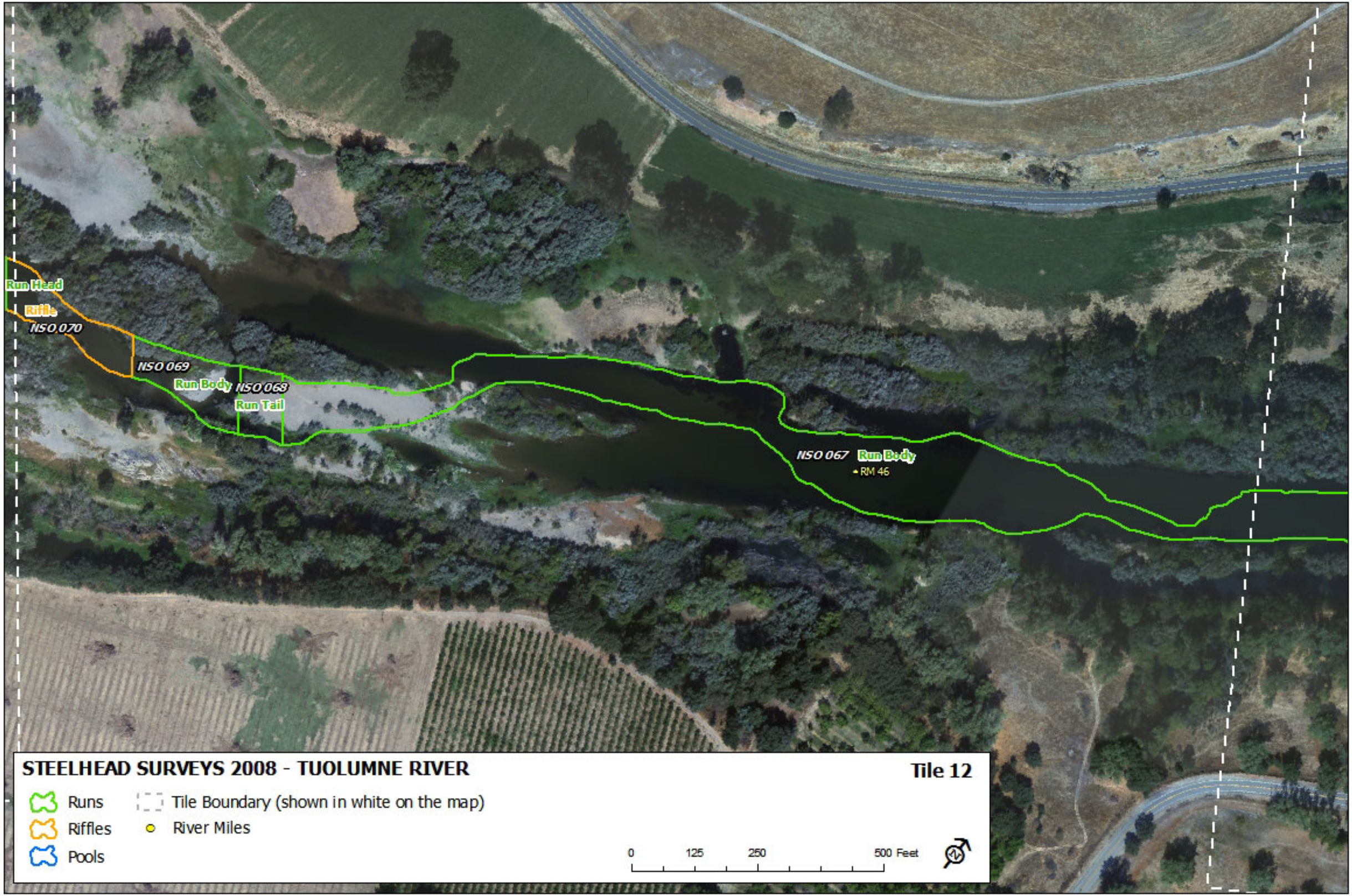
NSO 067
Run Body
NSO 066
Run Head
NSO 065
Riffle
Run Tail
NSO 064
NSO 063
Run Body
NSO 062
Run Head
NSO 061
Riffle
Run Tail

STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile 11

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

0 125 250 500 Feet


Run Head
Riffle
NSO 070
NSO 069
Run Body
NSO 068
Run Tail
NSO 067
Run Body
RM 46
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 12
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet

NSO 083
Run Body

Run Head
NSO 082

NSO 081
Pool Body

NSO 080
Run Body

NSO 079
Run Head

NSO 078
Riffle

Run Tail

NSO 077
Run Body

NSO 076

NSO 075
Run Head

NSO 074
Riffle

NSO 073
Run Tail

NSO 072
Run Body

STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile 13

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

0 125 250 500 Feet

NSO 089
Riffle
NSO 088
Pool Tail
NSO 087
Pool Body
NSO 086
Pool Head
Riffle
NSO 085
NSO 084
Run Tail
RM 45
NSO 083
Run Body
Run Head
NSO 082
Pool Body
NSO 081
NSO 080
Run Body

STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile 14

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

0 125 250 500 Feet

N

NSO 101
Riffle
NSO 100
Run Tail
NSO 099
Run Body
NSO 098
Run Head
NSO 097
Riffle
Run Tail
NSO 096
Run Body
NSO 095
NSO 094
Run Head
NSO 093
Riffle
Run Tail
NSO 091
Run Body
NSO 090
Run Head
NSO 089
Riffle
Run Head
NSO 103
Run Body

STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile 15

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

0 125 250 500 Feet

N


NSO 104
Pool Body
Run Body
NSO 103
RM 44
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 16
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet
N


NSO 106
Run Tail
Riffle
NSO 107
NSO 105
Run Body
Pool Body
NSO 104
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 17
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet


FOT BOBCAT FLAT RESTORATION SITE
NSO 120
Run Body
Riffle
NSO 118
Run Head
Run Tail
NSO 119
NSO 117
Run Body
NSO 116
NSO 115
Pool Tail
NSO 114
Run Head
NSO 113
Pool Body
NSO 112
Pool Head
NSO 111
Riffle
NSO 110
Run Tail
RM 43
NSO 109
Run Body
NSO 108
Run Head
NSO 107
Riffle
NSO 106
Run Tail
NSO 105
Run Body
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 18
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet


NSO 125
Run Body
NSO 126
Riffle
NSO 124 Run Body
NSO 123
Run Head
Riffle
NSO 122
Run Body
NSO 120
Run Tail
NSO 121
Run Head
Riffle
NSO 128
Run Body
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 19
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet
N

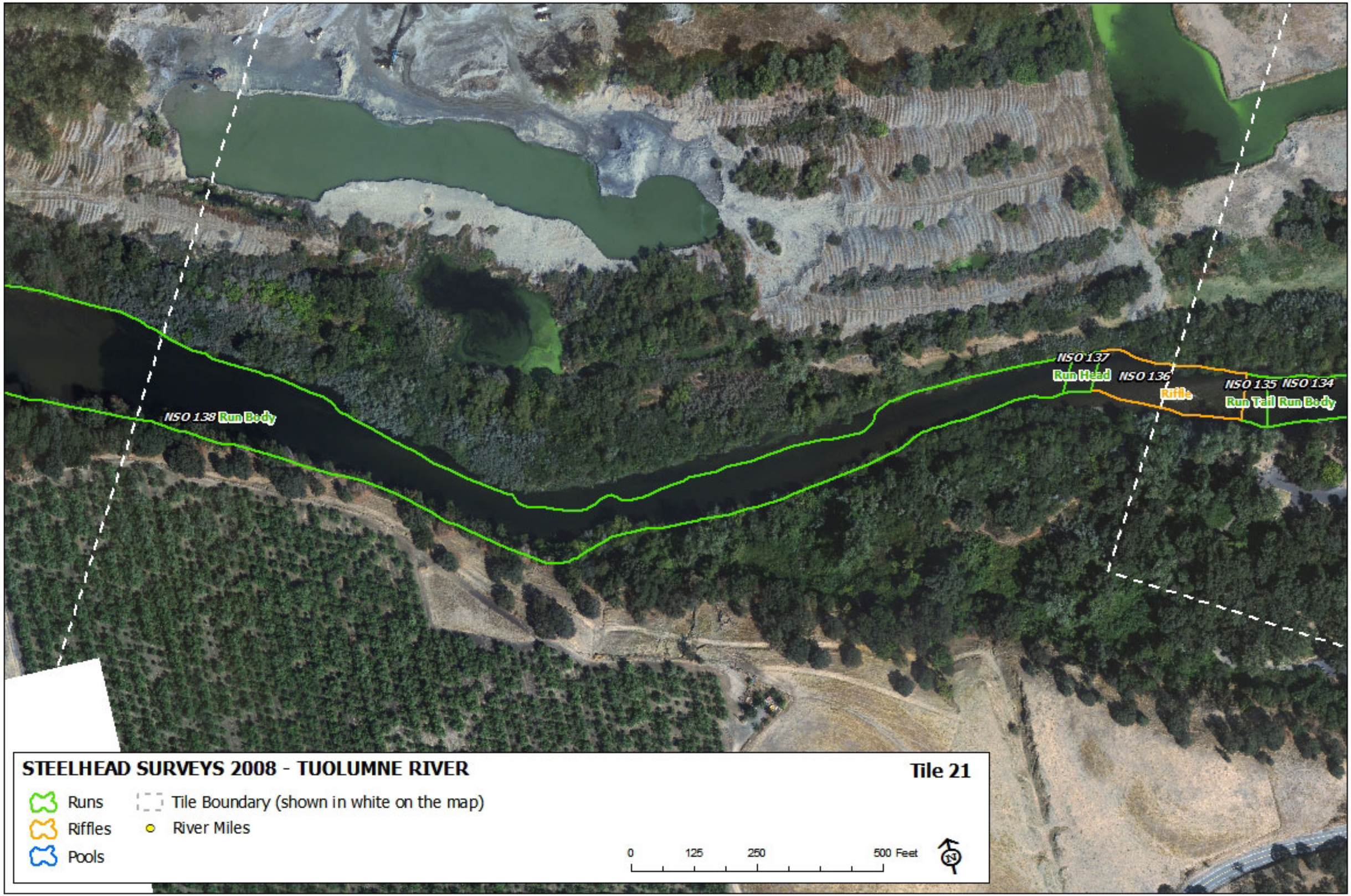
NSO 128
NSO 129 Riffle
Run Head
Riffle
NSO 131
NSO 132
Run Tail
NSO 130 Run Body
NSO 133
Run Head
NSO 134
Run Body
NSO 135
Run Tail

STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile 20

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

0 125 250 500 Feet


NSO 138 Run Body
NSO 137
Run Head
NSO 136
Riffle
NSO 135
NSO 134
Run Tail Run Body
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 21
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet
N


NSO 146
Run Body
NSO 145
Run Head
NSO 144
Riffle
NSO 143
Run Tail
NSO 142
RM 41
Run Body
NSO 141
Run Head
NSO 140
Riffle
NSO 139
Run Tail
NSO 138
Run Body
NSO 139
Run Tail
NSO 140
Riffle
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 22
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet

Riffle
Run Tail
NSO 150
Run Body
NSO 149
Run Head
NSO 148
Riffle
NSO 147
Run Tail
Run Body
NSO 146

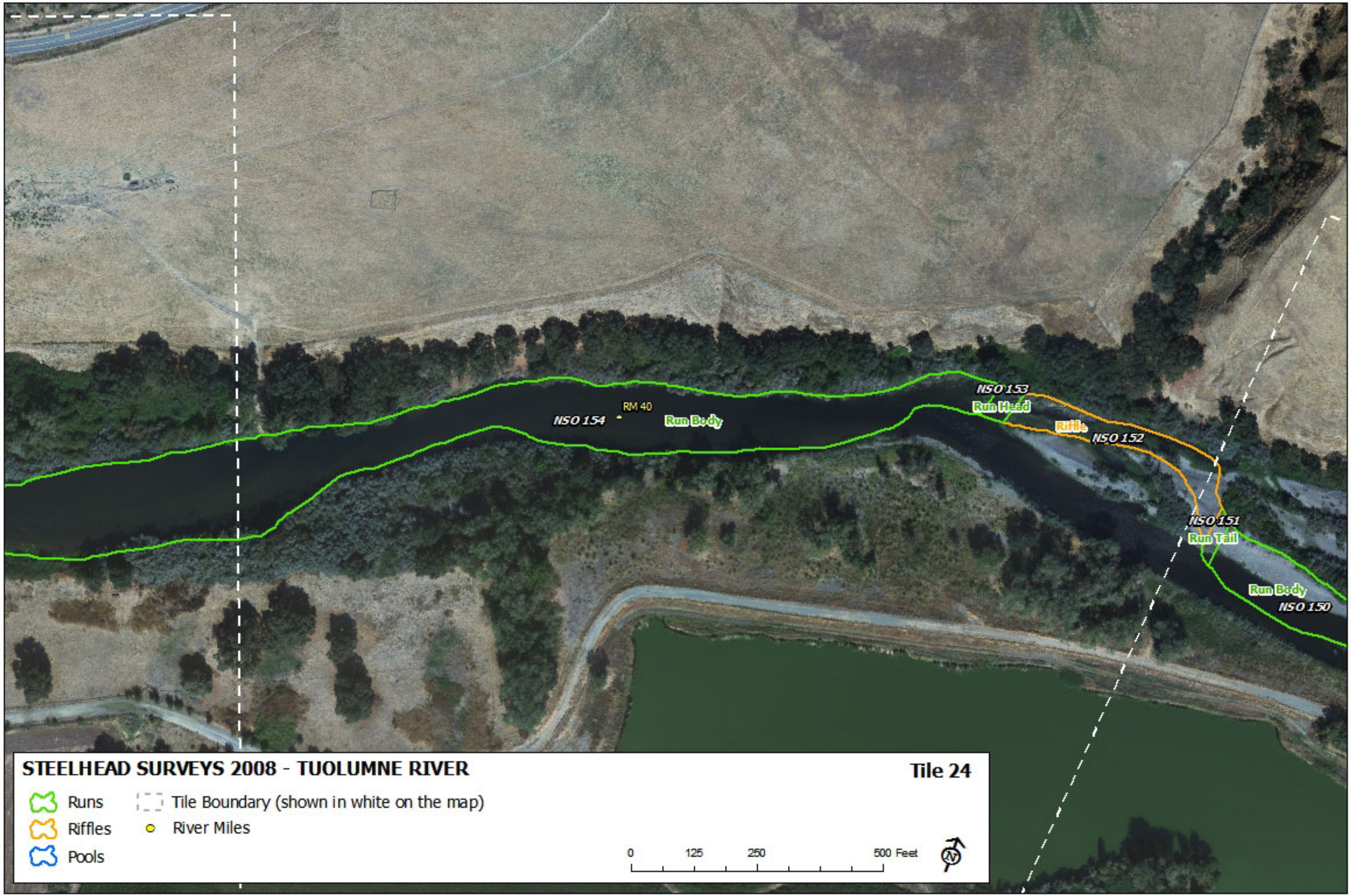
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile 23

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

0 125 250 500 Feet

N


NSO 154
RM 40
Run Body
NSO 153
Run Head
Riffle
NSO 152
NSO 151
Run Tail
Run Body
NSO 150
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER
Tile 24
Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles
0
125
250
500 Feet

RM 39
Run Body
Run Head
Riffle
Run Tail
Run Body
Run Head
Riffle
Run Tail
Run Tail
Run Body
NSO 155
Run Body
NSO 154

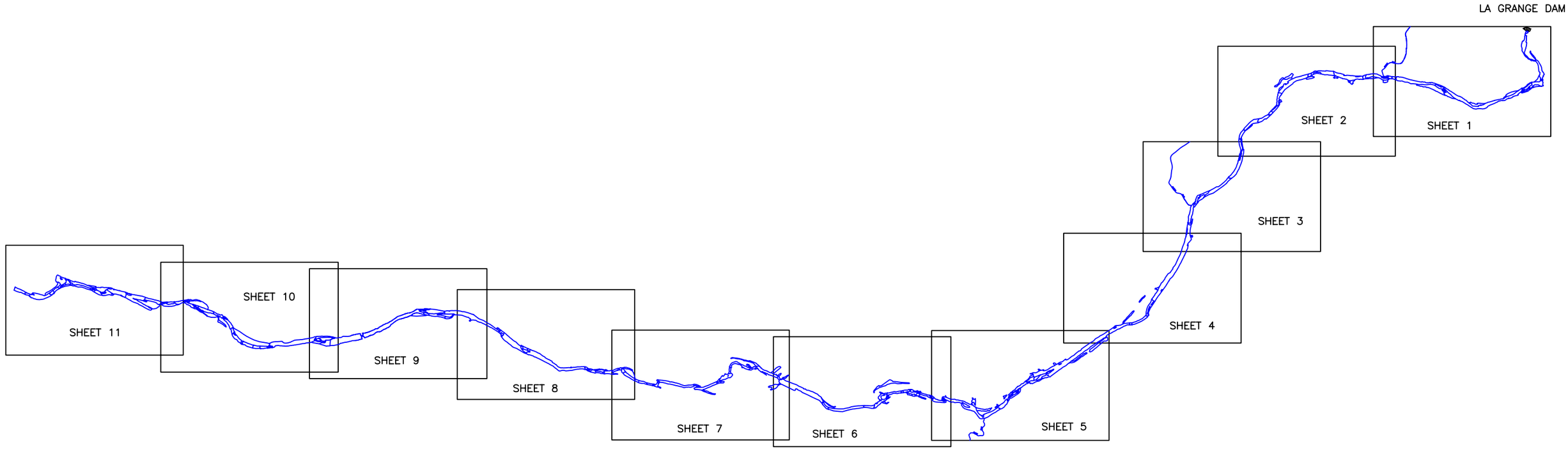
STEELHEAD SURVEYS 2008 - TUOLUMNE RIVER

Tile25

Runs
Riffles
Pools
Tile Boundary (shown in white on the map)
River Miles

0 125 250 500 Feet

Appendix C: 2004 Habitat Maps



NORTH

4500 2250 0 4500

SCALE: 1 IN = 4500 FT

TUOLUMNE RIVER HABITAT MAP SHEET INDEX

McBain & Trush 2004

6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT

Gasburg Creek

CDFG La Grange Field Office

Phase I Access Road

Phase I CDFG Gravel Introduction Completed 2001

R1A

OLD LA GRANGE BRIDGE

Existing Road

Access Road

Completed by CDFG 2003

RA7

Completed by CDFG 2001

XS 2802+00

XS 2780+00

Completed by CDFG 2002

XS 2799+00

XS 2804+00

Road Access (with minor improvements)

River Mile 51

USGS Cableway

La Grange Dam

Not sampled

FLOW

R2

RA3/4

XS 2846+00

27 ft Maximum Depth

XS 2841+00

XS 2847+00

XS 2844+00

Stockpile Area

Access Road

XS 2833+00

XS 2836+00

Legend

- Proposed coarse sediment introduction site
- Area with sensitive O. mykiss habitat
- Spawning area (@ 300 cfs)
- Riffle
- Run
- Special run pool
- Pool
- Glide
- Medial or lateral bar
- Submerged lateral bar
- Deep backwater
- Shallow backwater
- Island complex
- Off-channel pond
- Bedrock
- Access road
- Cross section
- Station alignment

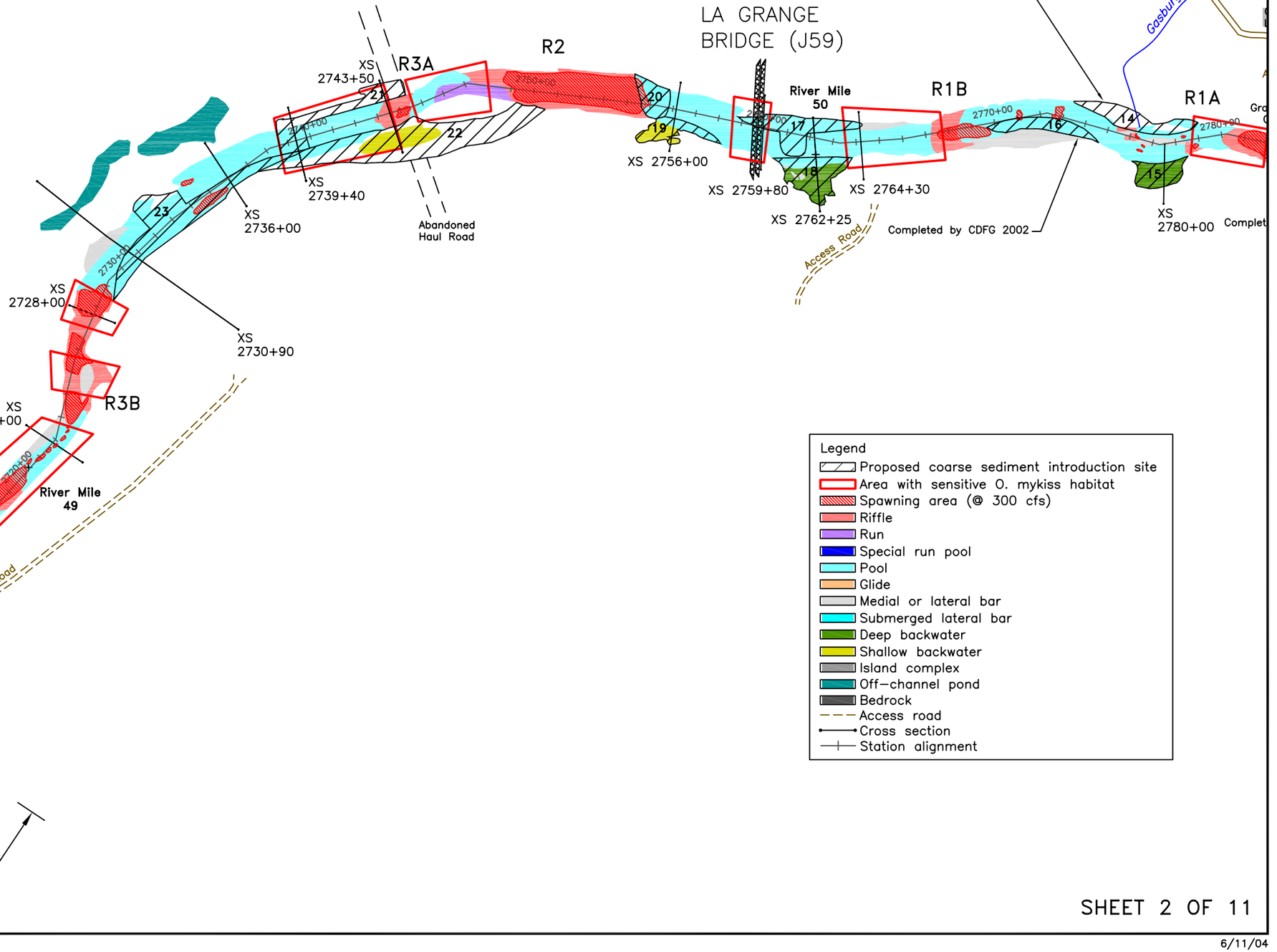
McBain & Trush 2004

6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT

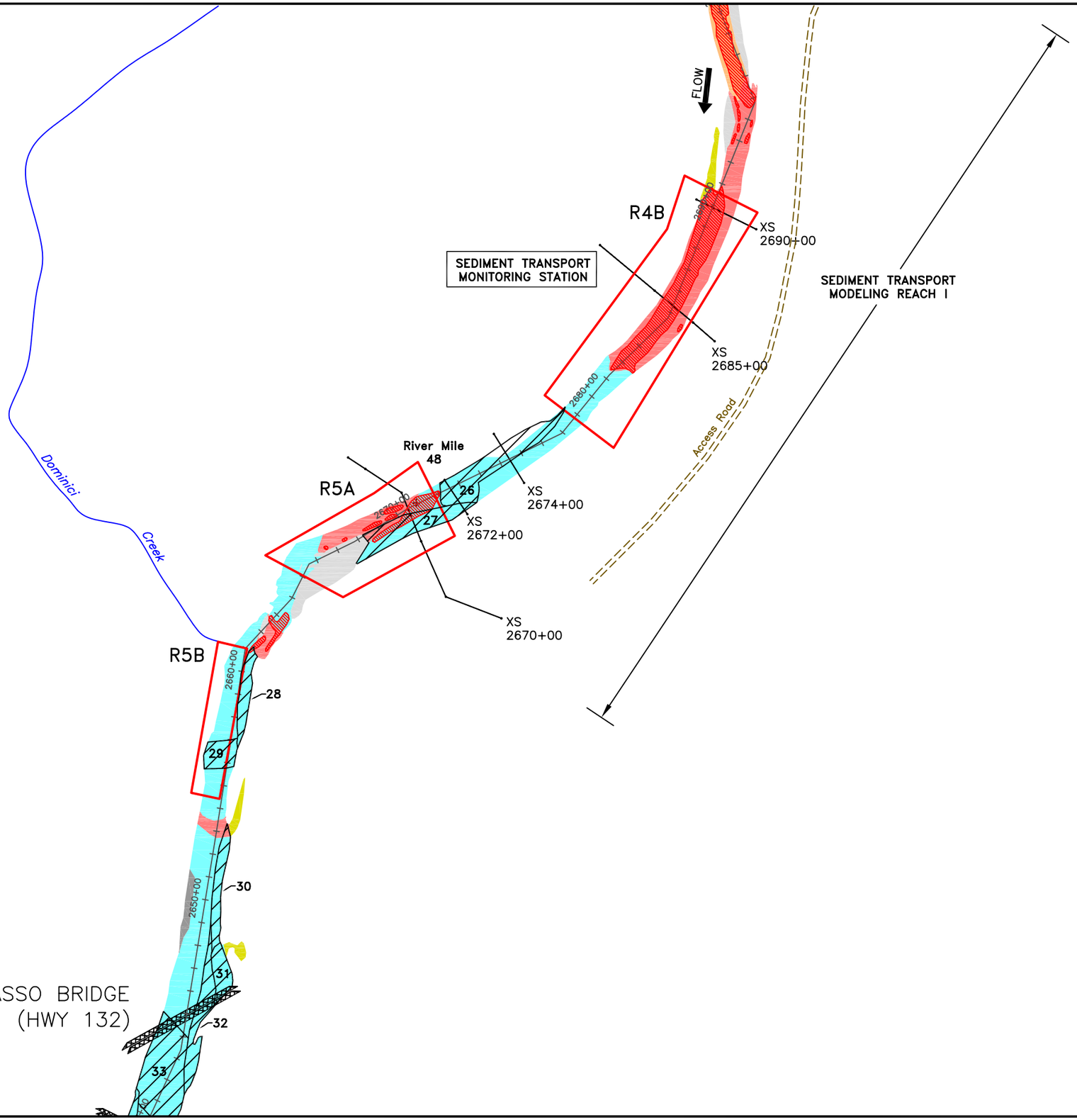


Legend

- Proposed coarse sediment introduction site
- Area with sensitive O. mykiss habitat
- Spawning area (@ 300 cfs)
- Riffle
- Run
- Special run pool
- Pool
- Glide
- Medial or lateral bar
- Submerged lateral bar
- Deep backwater
- Shallow backwater
- Island complex
- Off–channel pond
- Bedrock
- Access road
- Cross section
- Station alignment

McBain & Trush 2004

6/11/04



McBain & Trush 2004

6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT

Legend

- Proposed coarse sediment introduction site
- Area with sensitive O. mykiss habitat
- Spawning area (@ 300 cfs)
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- Run
- Special run pool
- Pool
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- Submerged lateral bar
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- Shallow backwater
- Island complex
- Off-channel pond
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- Access road
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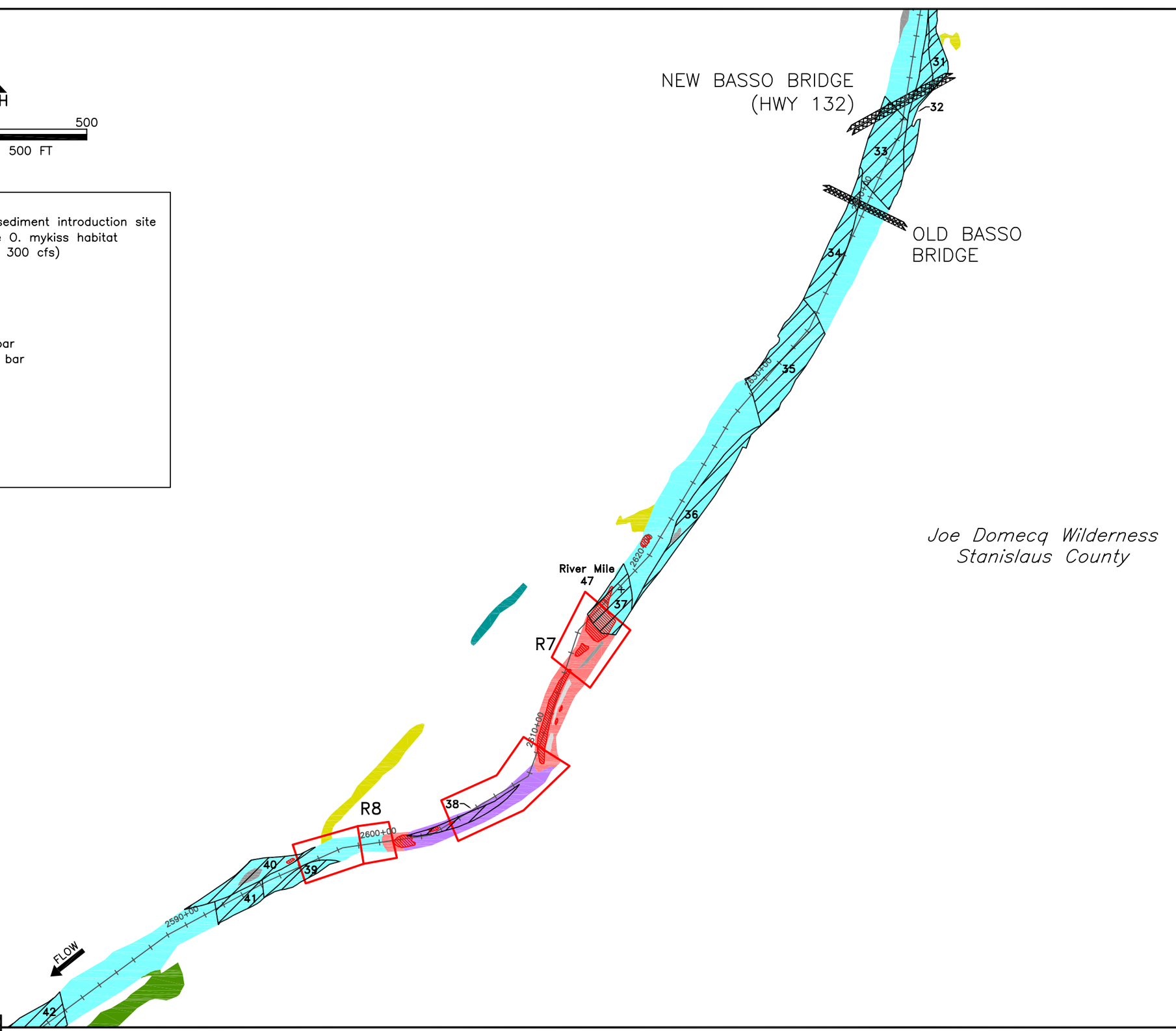
- Station alignment



Joe Domecq Wilderness
Stanislaus County

McBain & Trush 2004

6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT

FLOW

R15

R14

R13A

R13B

R13C

R12

River Mile 45

River Mile 46

16 ft Maximum Depth

2000/01 Salmon Redds

Abandoned Haul Road

Peasley Creek

Legend

- Proposed coarse sediment introduction site
- Area with sensitive O. mykiss habitat
- Spawning area (@ 300 cfs)
- Riffle
- Run
- Special run pool
- Pool
- Glide
- Medial or lateral bar
- Submerged lateral bar
- Deep backwater
- Shallow backwater
- Island complex
- Off-channel pond
- Bedrock
- Access road
- Cross section
- Station alignment

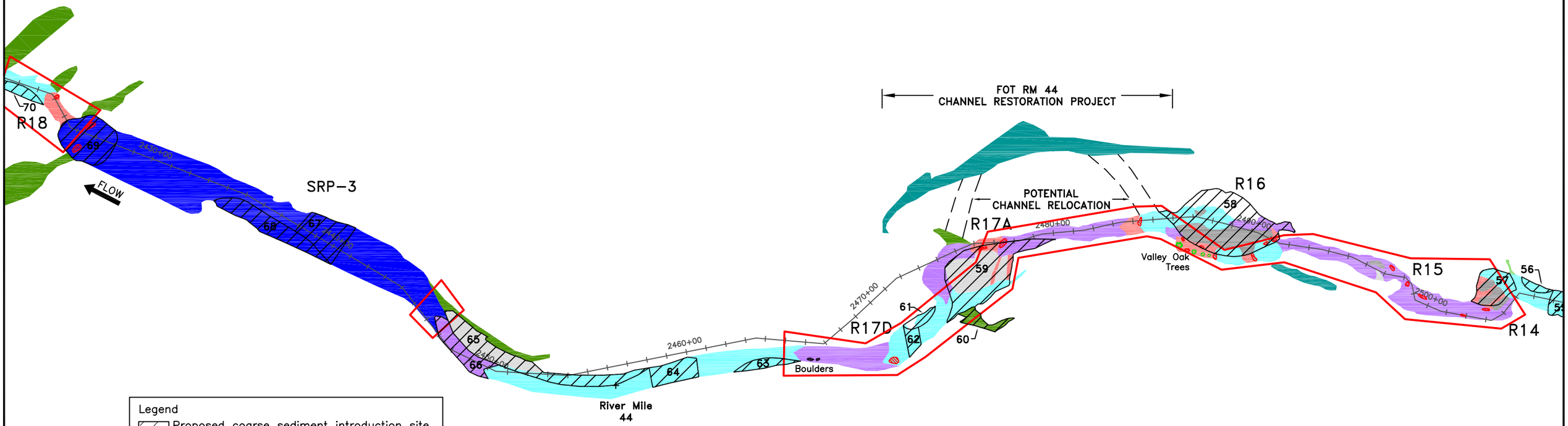
McBain & Trush 2004

6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT



Legend

- Proposed coarse sediment introduction site
- Area with sensitive O. mykiss habitat
- Spawning area (@ 300 cfs)
- Riffle
- Run
- Special run pool
- Pool
- Glide
- Medial or lateral bar
- Submerged lateral bar
- Deep backwater
- Shallow backwater
- Island complex
- Off-channel pond
- Bedrock
- Access road
- Cross section
- Station alignment

McBain & Trush 2004

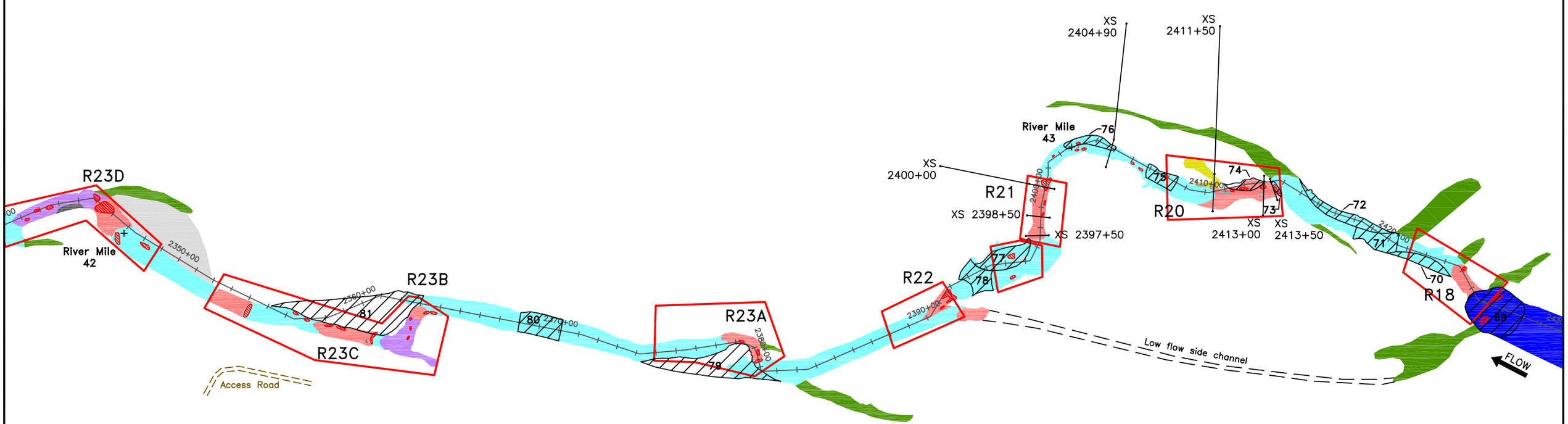
6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT

FOT BOBCAT FLAT
CHANNEL RESTORATION PROJECT



Legend

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- Submerged lateral bar
- Deep backwater
- Shallow backwater
- Island complex
- Off-channel pond
- Bedrock
- Access road
- Cross section
- Station alignment

McBain & Trush 2004

6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT

FLOW

2270+00

87

27

2280+00

R26

River Mile
41

2300+00

SRP–4

86

R25

85

84

83

R24B

2330+00

82

R24

XS 2333+45

XS 2334+45

XS 2335+70

XS 2336+35

XS
2337+10

2340+00

Turlock Lake
State Recreation
Park

R23D

River Mile
42

2350+00

Legend

- Proposed coarse sediment introduction site
- Area with sensitive O. mykiss habitat
- Spawning area (@ 300 cfs)
- Riffle
- Run
- Special run pool
- Pool
- Glide
- Medial or lateral bar
- Submerged lateral bar
- Deep backwater
- Shallow backwater
- Island complex
- Off–channel pond
- Bedrock
- Access road
- Cross section
- Station alignment

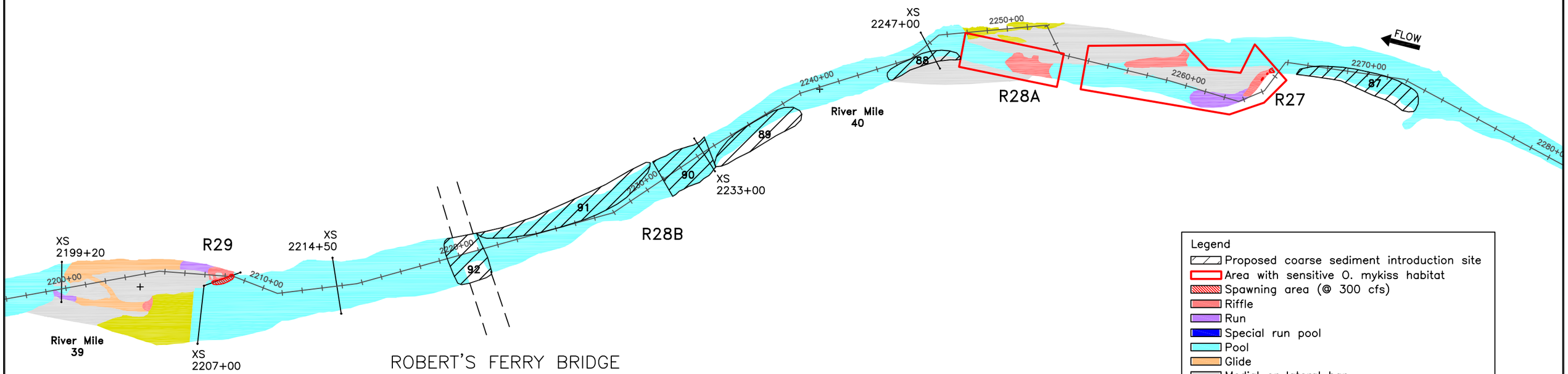
McBain & Trush 2004

6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT



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- Run
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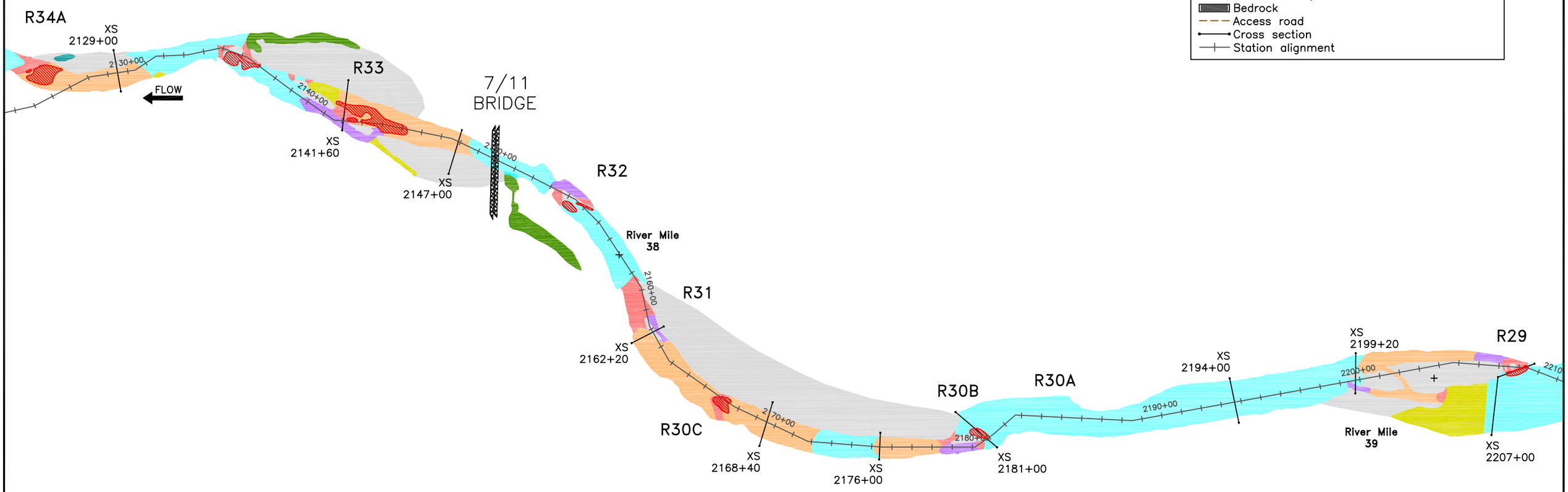
- Submerged lateral bar
- Deep backwater
- Shallow backwater
- Island complex
- Off-channel pond
- Bedrock
- Access road
- Cross section
- Station alignment

McBain & Trush 2004

6/11/04



Legend

- Proposed coarse sediment introduction site
- Spawning area (@ 300 cfs)
- Riffle
- Run
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- Glide
- Medial or lateral bar
- Submerged lateral bar
- Deep backwater
- Shallow backwater
- Island complex
- Off-channel pond
- Bedrock
- Access road
- Cross section
- Station alignment

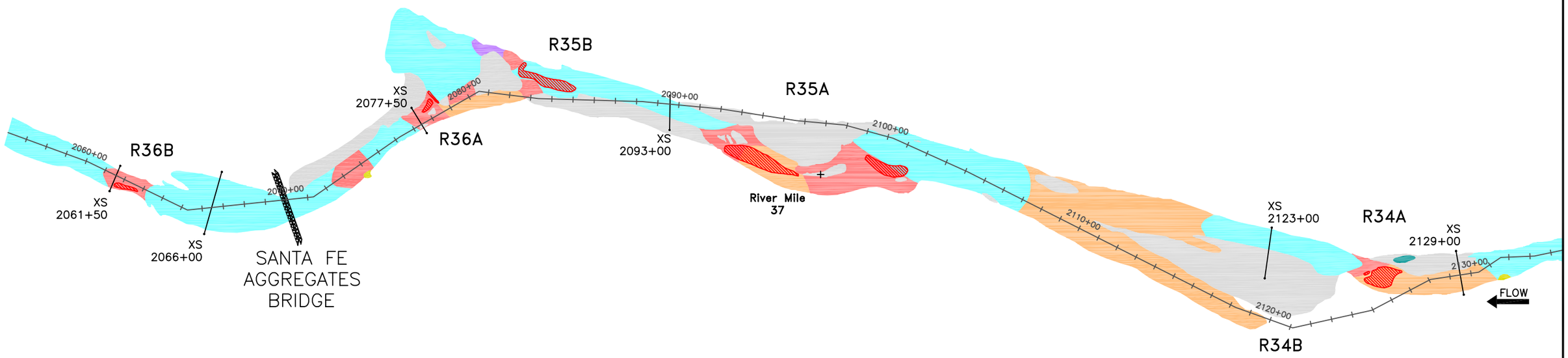
McBain & Trush 2004

6/11/04

NORTH

500 0 500

SCALE: 1 IN = 500 FT



Legend

- Proposed coarse sediment introduction site
- Spawning area (@ 300 cfs)
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- Run
- Special run pool
- Pool
- Glide
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- Submerged lateral bar
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- Access road
- Cross section
- Station alignment

McBain & Trush 2004

6/11/04

Appendix D: Habitat Data

Table D-1. Physical habitat types and dimensions of surveyed areas in the lower Tuolumne River (RM 52–40).

Habitat unit (NSO)	RM	March 2009 survey site	Length (ft)	Average width (ft)	Area (ft^2)	Average depth (ft)	Maximum depth (ft)	July 2008 habitat type
1	51.8		140	75	10,537	5.0	8.0	Pool head
2	51.7		450	143	64,161	18.0	28.0	Pool body
3	51.7		157	61	9,600	1.5	3.0	Pool tail
4	51.6	Yes	85	124	10,506	3.0	5.0	Pool head
5	51.6	Yes	393	129	50,702	18.0	25.0	Pool body
6	51.5	Yes	250	89	22,309	4.0	6.0	Pool tail
7	51.5	Yes	292	68	19,851	3.0	6.0	Riffle
8	51.4		117	82	9,562	5.0	6.0	Run head
9	51.1		2047	97	199,103	6.0	8.0	Run body
10	51.0		182	86	15,733	3.5	4.5	Run tail
11	50.9		457	99	45,397	10.0	16.0	Pool body
12	50.8		843	128	107,699	4.0	7.0	Run body
13	50.8		93	86	7,988	1.5	3.0	Run tail
14	50.6	Yes	708	65	45,670	1.5		Riffle
15	50.6	Yes	161	85	13,760	6.0	7.0	Run head
16	50.5	Yes	704	132	92,609	5.0	8.0	Run body
17	50.4	Yes	59	146	8,600	2.5	3.0	Run tail
18	50.3		941	130	121,948	1.5	2.0	Riffle
19	50.3		59	109	7,193	4.0	8.0	Run head
20	50.1		848	151	107,630	3.0	4.0	Run body
21	50.1		70	119	8,333	1.5	2.0	Run tail
22	50.1	Yes	132	127	16,750	1.0	1.5	Riffle
23	50.0		93	133	12,379	4.0	6.0	Run head
24	49.9		1007	199	200,462	4.0	8.0	Run body
25	49.8		274	154	42,115	2.0	4.0	Run tail
26	49.7		527	139	72,991	1.5	2.0	Riffle
27	49.7	Yes	127	86	10,955	4.0	6.0	Pool head
28	49.6	Yes	161	89	14,345	6.0	9.0	Pool body
29	49.6	Yes	112	85	9,490	1.5	2.5	Pool tail
30	49.6		50	110	5,520	3.0	5.0	Run head
31	49.3		1440	115	166,115	2.5	3.5	Run body
32	49.3		132	137	18,071	2.0	2.5	Run tail
33	49.2		552	126	69,509	1.5	2.5	Riffle
34	49.2		112	65	7,283	2.0	3.0	Run head
35	49.1		321	82	26,475	3.0	5.0	Run body
36	49.1		44	103	4,532	1.5	2.0	Run tail
37	49.1		78	97	7,594	1.5	2.0	Riffle
38	49.1		43	83	3,559	2.0	3.5	Run head
39	49.1		240	81	19,424	2.5	4.0	Run body
40	49.0		23	95	2,180	2.5	3.0	Run tail
41	48.8		1080	114	122,953	1.5	3.0	Riffle

Habitat unit (NSO)	RM	March 2009 survey site	Length (ft)	Average width (ft)	Area (ft^2)	Average depth (ft)	Maximum depth (ft)	July 2008 habitat type
42	48.8		36	97	3,505	1.5	2.0	Run head
43	48.7		749	93	69,528	2.5	4.0	Run body
44	48.7		39	110	4,304	2.0	3.0	Run tail
45	48.4		1275	117	149,495	1.5	2.0	Riffle
46	48.4		92	102	9,378	1.5	2.0	Run head
47	48.3		915	111	101,397	3.5	5.0	Run body
48	48.2		153	127	19,368	1.5	2.0	Run tail
49	48.2		346	75	25,887	1.5	2.0	Riffle
50	48.2		40	60	2,392	2.0	2.0	Run head
51	48.1		380	53	20,027	5.0	8.0	Run body
52	48.1		114	56	6,430	3.0	3.5	Run tail
53	48.0	Yes	234	54	12,554	1.5	2.0	Riffle
54	48.0		164	89	14,569	5.0	7.0	Pool head
55	47.2		4036	143	579,150	7.0	15.0	Pool body
56	47.2		136	115	15,575	1.5	2.5	Pool tail
57	47.1		740	80	58,852	1.5	2.0	Riffle
58	47.0	Yes	136	85	11,535	2.0	3.0	Run head
59	46.9	Yes	472	76	36,067	4.0	6.0	Run body
60	46.9	Yes	137	86	11,760	1.5	2.5	Run tail
61	46.9		318	81	25,666	1.0	2.0	Riffle
62	46.9		64	85	5,428	1.5	2.0	Run head
63	46.8		188	90	16,848	2.0	3.0	Run body
64	46.8		126	131	16,480	1.0	2.5	Run tail
65	46.8		100	123	12,268	0.8	1.5	Riffle
66	46.8		153	96	14,675	1.5	2.0	Run head
67	46.0		3829	97	370,148	4.0	6.0	Run body
68	46.0		89	133	11,835	1.5	2.0	Run tail
69	45.9		234	95	22,286	4.0	7.0	Run body
70	45.9		277	76	21,181	1.5	2.0	Riffle
71	45.9		61	93	5,701	2.0		Run head
72	45.8		243	94	22,751	2.5	3.5	Run body
73	45.8		125	64	7,976	1.5	2.0	Run tail
74	45.7		243	40	9,820	0.8	1.8	Riffle
75	45.7		90	35	3,141	1.5	2.0	Run head
76	45.7		88	50	4,433	1.5	4.0	Run body
77	45.7		32	99	3,153	1.5	2.0	Run tail
78	45.6		675	109	73,797	1.5	2.0	Riffle
79	45.6		85	178	15,127	1.5	2.0	Run head
80	45.4		1040	120	124,357	3.5	5.0	Run body
81	45.3		301	101	30,519	7.0	11.0	Pool body
82	45.3	Yes	126	220	27,658	2.0	3.0	Run head
83	45.1	Yes	1182	97	114,144	4.0	6.0	Run body
84	45.1	Yes	94	113	10,640	1.5	5.0	Run tail
85	45.0		394	52	20,673	1.5	2.0	Riffle

Habitat unit (NSO)	RM	March 2009 survey site	Length (ft)	Average width (ft)	Area (ft^2)	Average depth (ft)	Maximum depth (ft)	July 2008 habitat type
86	45.0	Yes	53	41	2,181	2.0	3.0	Pool head
87	44.9	Yes	101	71	7,213	5.0	8.0	Pool body
88	44.9	Yes	80	121	9,661	3.0	4.0	Pool tail
89	44.8		734	59	43,114	1.5	2.5	Riffle
90	44.8		22	107	2,350	0.8	1.5	Run head
91	44.8		318	62	19,745	1.5	2.5	Run body
92	44.8		15	25	368	1.0	1.5	Run tail
93	44.7		100	30	3,032	1.5	2.0	Riffle
94	44.7		47	26	1,217	1.0	1.5	Run head
95	44.7		248	67	16,708	4.0	8.0	Run body
96	44.7		34	87	2,950	1.5	2.0	Run tail
97	44.6	Yes	417	52	21,741	1.5	2.5	Riffle
98	44.6		20	49	984	2.0	2.5	Run head
99	44.6		203	53	10,740	3.0	4.0	Run body
100	44.5		20	59	1,182	1.0	1.5	Run tail
101	44.5		472	59	27,744	1.5	2.0	Riffle
102	44.5		10	68	681	2.0	2.5	Run head
103	43.9		3209	82	261,993	3.0	3.0	Run body
104	43.7		683	144	98,065	6.0	15.0	Pool body
105	43.3		2173	146	316,376	4.0	6.0	Run body
106	43.3		50	110	5,487	1.5	2.0	Run tail
107	43.2	Yes	326	81	26,534	1.5	2.0	Riffle
108	43.2	Yes	41	74	3,020	1.0	2.0	Run head
109	43.1	Yes	906	62	56,464	2.5	6.0	Run body
110	43.1	Yes	36	49	1,771	2.0	2.5	Run tail
111	43.0	Yes	238	42	10,077	0.8	1.2	Riffle
112	43.0	Yes	50	48	2,392	1.5	2.5	Pool head
113	43.0	Yes	159	166	26,397	5.0	7.0	Pool body
114	43.0	Yes	46	169	7,767	1.5	5.0	Pool tail
115	43.0		33	154	5,097	2.0	3.0	Run head
116	42.9		309	124	38,258	4.0	10.0	Run body
117	42.9		18	84	1,518	1.0	1.5	Run tail
118	42.9	Yes	77	57	4,403	1.0	2.0	Riffle
119	42.9		31	45	1,395	2.0	2.5	Run head
120	42.7		978	87	84,726	1.0	8.0	Run body
121	42.7		12	78	932	1.5	2.5	Run tail
122	42.7		89	48	4,288	1.0	3.0	Riffle
123	42.7		18	55	991	2.5	3.0	Run head
124	42.4		1571	77	120,609	2.0	5.0	Run body
125	42.4		69	96	6,600	1.5	2.0	Run body
126	42.3		227	55	12,478	1.0	3.0	Riffle
127	42.3		84	23	1,953	1.5	4.0	Run body
128	42.3		265	32	8,417	1.5	2.3	Riffle
129	42.2		25	28	699	1.5	3.0	Run head

Habitat unit (NSO)	RM	March 2009 survey site	Length (ft)	Average width (ft)	Area (ft^2)	Average depth (ft)	Maximum depth (ft)	July 2008 habitat type
130	42.1		1066	62	65,871	2.0	4.0	Run body
131	42.0		53	60	3,196	1.0	1.5	Run tail
132	41.9		521	64	33,202	1.0	1.5	Riffle
133	41.9		41	46	1,877	2.0	2.5	Run head
134	41.8		940	82	77,063	2.0	4.0	Run body
135	41.8		47	96	4,525	0.8	1.5	Run tail
136	41.7		300	90	27,080	0.8	1.5	Riffle
137	41.7		59	70	4,133	1.5	2.0	Run head
138	41.2		2512	123	308,848	3.0	6.0	Run body
139	41.2		125	151	18,858	1.0	1.3	Run tail
140	41.1		312	107	33,422	1.0	1.5	Riffle
141	41.1		102	163	16,604	1.5	2.0	Run head
142	41.0		666	185	122,933	2.0	4.5	Run body
143	41.0		83	182	15,121	0.8	1.3	Run tail
144	40.9		189	32	6,116	0.8	1.5	Riffle
145	40.9		62	39	2,425	1.5	2.0	Run head
146	40.5		2207	101	223,893	5.0	9.0	Run body
147	40.5		54	53	2,861	1.5	2.0	Run tail
148	40.4		638	53	33,978	1.5	2.5	Riffle
149	40.4		37	83	3,076	1.5	2.0	Run head
150	40.3		502	94	47,268	2.5	4.0	Run body
151	40.3		34	81	2,767	1.0	1.5	Run tail
152	40.2		503	53	26,860	0.8	1.5	Riffle
153	40.2		51	68	3,462	1.5	2.0	Run head
154	39.7		2569	123	317,216	3.0	7.0	Run body
155	39.7		26	142	3,699	1.5		Run tail
156	39.7		219	91	19,859	0.8	1.0	Riffle
157	39.6	Yes	86	62	5,294	3.0	4.0	Run head
158	39.5	Yes	857	97	82,763	6.0	6.6	Run body
159	39.5	Yes	98	81	7,993	2.5	3.0	Run tail
160	39.4	Yes	84	62	5,246	1.0	1.5	Riffle
161	39.4		123	41	5,102	3.5	4.5	Run head
162	39.3		713	50	35,662	5.0	7.5	Run body
163	39.3		151	80	12,041	3.5	5.0	Run tail
164	39.2		104	98	10,131	1.0	1.5	Riffle
165	39.2		93	117	10,818	3.5	4.0	Pool head
166	38.9		1496	90	134,259	6.5	9.9	Pool body
167	38.9		99	91	9,033	3.0	4.0	Pool tail
168	38.9	Yes	73	92	6,682	1.5	3.0	Riffle
169	38.9		76	108	8,227	4.0	5.0	Run head
170	38.8		498	77	38,331	5.5	7.2	Run body
171	38.8		121	83	10,096	7.0	10.5	Pool body
172	38.8		87	98	8,506	3.0	4.0	Run head
173	38.7		324	85	27,545	4.0	5.0	Run body

Habitat unit (NSO)	RM	March 2009 survey site	Length (ft)	Average width (ft)	Area (ft^2)	Average depth (ft)	Maximum depth (ft)	July 2008 habitat type
174	38.7		99	100	9,935	3.0	4.0	Run tail
175	38.7	Yes	61	118	7,163	1.5	2.3	Riffle
176	38.6		148	105	15,607	2.5	3.5	Run head
177	38.6		219	91	19,976	4.0	4.8	Run body
178	38.6		115	57	6,513	2.0	2.5	Run tail
179	38.5		412	55	22,840	1.2	2.0	Riffle
180	38.5		75	68	5,113	4.0	6.0	Run head
181	38.4		657	39	25,600	4.0	5.0	Run body
182	38.3		205	68	13,869	8.5	10.5	Pool body
183	38.3		183	66	12,189	4.5	10.5	Pool tail
184	38.3		129	102	13,154	2.5	6.0	Run head
185	38.2		137	139	18,966	2.0	2.5	Run body
186	38.2		134	149	19,976	2.0	2.0	Run tail
187	38.2		285	143	40,886	1.0	1.5	Riffle
188	38.1	Yes	86	93	7,964	2.5	4.0	Pool head
189	38.1	Yes	235	81	19,027	6.0	10.0	Pool body
190	38.1	Yes	55	145	7,947	2.5	4.0	Pool tail
191	38.1		89	115	10,283	1.0	2.0	Riffle
192	38.1	Yes	46	89	4,147	4.0	6.0	Pool head
193	38.0	Yes	378	83	31,490	8.0	13.0	Pool body
194	38.0	Yes	81	91	7,365	2.0	3.5	Pool tail
195	38.0		63	64	4,010	3.0	3.5	Run head
196	37.9		271	72	19,591	4.0	5.5	Run body
197	37.9		84	92	7,736	3.0	3.5	Run tail
198	37.8		227	75	17,099	2.0	2.5	Riffle
199	37.8		115	42	4,779	4.0	4.5	Pool head
200	37.7		926	78	72,513	4.0	6.6	Pool body
201	37.6		114	117	13,311	3.0	4.0	Pool tail
202	37.6		163	97	15,857	0.8	1.5	Riffle
203	37.6		130	88	11,423	2.0	3.0	Run head
204	37.5		618	91	55,953	2.5	3.5	Run body
205	37.4		102	77	7,851	2.0	3.0	Run tail
206	37.3		769	50	38,658	1.7	2.5	Riffle
207	37.3		99	58	5,710	2.5	4.0	Run head
208	37.1		916	57	51,803	3.5	4.5	Run body
209	37.1		58	52	3,054	2.0	3.0	Run tail
210	37.0		266	40	10,767	1.5	2.0	Riffle
211	37.0		127	36	4,530	5.0	7.0	Run head
212	36.9		370	80	29,741	5.5	7.6	Run body
213	36.9		85	98	8,321	2.0	3.0	Run tail
214	36.9	Yes	70	83	5,779	3.0	5.0	Pool head
215	36.9	Yes	126	58	7,330	7.0	10.5	Pool body
216	36.9	Yes	94	48	4,471	4.0	5.0	Pool tail
217	36.8		357	60	21,436	1.5	2.0	Riffle

Habitat unit (NSO)	RM	March 2009 survey site	Length (ft)	Average width (ft)	Area (ft^2)	Average depth (ft)	Maximum depth (ft)	July 2008 habitat type
218	36.8	Yes	157	75	11,815	3.0	4.0	Run head
219	36.6	Yes	675	97	65,353	3.0	6.0	Run body
220	36.6	Yes	62	86	5,313	3.0	4.0	Run tail
221	36.6		178	74	13,173	1.0	1.5	Riffle
222	36.6		181	71	12,919	3.0	5.0	Run head
223	36.4		1047	90	94,576	6.5	8.3	Run body
224	36.3		115	97	11,107	3.0	3.5	Run tail
225	36.3		224	92	20,644	1.5	2.0	Riffle
226	36.3		69	79	5,484	2.0	2.5	Run head
227	36.3		213	65	13,878	2.0	2.5	Run body
228	36.2		70	58	4,092	1.5	2.0	Run tail
229	36.2		74	54	4,022	1.2	2.0	Riffle
230	36.2	Yes	89	72	6,363	4.0	9.8	Pool head
231	36.2	Yes	175	131	22,846	6.0	12.3	Pool body
232	36.2	Yes	106	107	11,336	4.0	6.0	Pool tail
233	36.1		211	78	16,529	2.0	3.0	Pool head
234	35.7		2458	72	177,862	9.0	13.4	Pool body
235	35.6		210	53	11,010	3.0	3.5	Pool tail
236	35.5		353	97	34,136	1.0	1.5	Riffle
237	35.5		368	126	46,431	2.0	3.0	Run head
238	35.2		1394	100	139,804	3.5	7.0	Run body
239	35.2		48	84	4,006	3.0	4.0	Run tail
240	35.2		81	79	6,351	2.0	3.0	Riffle
241	35.2		70	60	4,157	3.0	4.0	Run head
242	35.2		74	68	5,054	4.5	5.8	Run body
243	35.1		62	65	3,996	1.5	2.0	Run tail
244	35.1		501	54	27,305	2.0	3.0	Riffle
245	35.0		79	82	6,466	1.5	2.5	Run head
246	35.0		302	65	19,636	2.0	3.0	Run body
247	35.0		114	31	3,548	1.5	2.0	Run tail
248	34.9		62	50	3,125	1.5	2.0	Riffle
249	34.9		151	50	7,602	3.0	4.0	Run head
250	34.7		1255	62	78,340	3.5	7.0	Run body
251	34.6		351	66	23,058	6.5	10.5	Pool body
252	34.6		119	82	9,791	3.0	4.0	Pool tail
253	34.5		293	77	22,628	1.0	2.0	Riffle
254	34.5		61	63	3,879	8.0	12.0	Pool head
255	34.4		445	79	35,344	4.0	8.0	Pool body
256	34.1		1722	91	157,333	3.0	4.0	Run body
257	34.1		137	81	11,136	1.5	2.0	Run tail
258	34.1		130	70	9,152	1.0	1.5	Riffle
259	34.0	Yes	103	79	8,137	2.0	2.5	Run head
260	34.0	Yes	452	59	26,907	2.5	3.5	Run body
261	33.9	Yes	142	38	5,468	1.5	2.0	Run tail

Habitat unit (NSO)	RM	March 2009 survey site	Length (ft)	Average width (ft)	Area (ft^2)	Average depth (ft)	Maximum depth (ft)	July 2008 habitat type
262	33.8		505	32	16,314	1.0	1.5	Riffle
263	33.8		86	53	4,509	2.0	2.5	Run head
264	33.8		265	52	13,757	3.0	3.5	Run body
265	33.8		59	57	3,342	2.0	2.5	Run tail
266	33.7		524	43	22,663	2.0	4.0	Riffle
267	33.6		241	67	16,237	3.0	4.0	Run head
268	33.5		690	116	79,804	2.5	5.0	Run body
269	33.4		231	79	18,336	1.0	2.0	Run tail
270	33.4		163	63	10,208	1.0	1.5	Riffle
271	33.4	Yes	49	74	3,588	6.0	7.5	Pool head
272	33.2	Yes	898	71	63,477	9.0	12.0	Pool body
273	33.2	Yes	102	39	3,988	2.0	3.0	Pool tail
274	33.2		190	55	10,514	1.0	1.5	Riffle
275	33.2		103	71	7,311	1.5	2.5	Run head
276	33.1		343	105	35,908	2.0	2.5	Run body
277	33.1		136	118	16,054	1.5	2.0	Run tail
278	33.0		312	62	19,368	1.0	1.5	Riffle
279	33.0		209	35	7,298	3.5	6.0	Run head
280	32.1		4454	174	776,561	5.5	9.2	Run body
281	32.1		143	124	17,763	4.0	5.5	Run tail
282	32.0		293	100	29,228	1.0	1.5	Riffle
283	32.0		163	107	17,489	2.5	3.0	Run head
284	32.0		294	86	25,244	3.5	4.0	Run body
285	31.9		41	86	3,565	2.0	3.7	Run tail
286	31.9		290	87	25,317	1.0	2.0	Riffle
287	31.9	Yes	157	43	6,710	2.5	3.0	Run head
288	31.7	Yes	838	55	45,952	3.5	5.0	Run body
289	31.7	Yes	112	85	9,543	2.5	3.0	Run tail
290	31.6		181	100	18,051	1.0	2.0	Riffle
291	31.6		148	108	15,990	4.0	5.5	Run head
292	31.5		475	89	42,320	5.0	6.0	Run body
293	31.5		154	62	9,597	1.5	2.5	Run tail
294	31.5		175	74	13,012	1.0	1.5	Riffle
295	31.4		210	100	21,058	3.0	4.5	Run head
296	31.3		567	87	49,612	4.0	5.5	Run body
297	31.3		139	54	7,465	2.5	4.0	Run tail
298	31.2		538	44	23,863	1.5	2.5	Riffle
299	31.2		122	70	8,583	3.5	4.5	Run head
300	31.1		240	61	14,568	3.5	5.0	Run body
301	31.1		41	72	2,974	2.0	3.0	Run tail
302	31.1		206	66	13,664	1.3	2.0	Riffle
303	31.1		98	75	7,324	3.0	4.0	Run head
304	30.7		1892	85	160,847	4.0	5.5	Run body
305	30.7		200	102	20,508	1.5	2.5	Run tail

Habitat unit (NSO)	RM	March 2009 survey site	Length (ft)	Average width (ft)	Area (ft^2)	Average depth (ft)	Maximum depth (ft)	July 2008 habitat type
306	30.6		113	83	9,452	1.2	2.0	Riffle
307	30.6		113	69	7,775	2.0	3.5	Run head
308	30.5		513	74	37,874	3.5	6.5	Run body
309	30.5		157	95	14,947	2.5	3.5	Run tail
310	30.4		259	37	9,478	1.0	2.0	Riffle
311	30.4		71	40	2,836	2.5	3.0	Run head
312	30.4		188	47	8,790	2.5	3.0	Run body
313	30.4		59	49	2,887	1.5	3.0	Run tail
314	30.2		946	43	40,519	1.2	2.0	Riffle
315	30.2		263	49	12,952	2.5	3.0	Run head
316	30.1		123	60	7,371	2.5	5.0	Run body
317	30.1		52	71	3,674	2.0	3.0	Run tail
318	30.1		189	298	56,219	1.5	2.0	Riffle
319	30.0		329	171	56,219	2.0	3.0	Run head
320	29.7		1444	155	224,395	5.0	8.0	Run body
321	29.7		68	59	3,978	3.0	4.0	Run tail
322	29.6		681	329	223,763	11.0	15.7	Pool body
323	29.6		222	84	18,626	3.0	7.0	Pool tail
324	29.5	Yes	109	38	4,188	1.0	2.0	Riffle
325	29.5	Yes	110	55	6,041	4.0	5.0	Run head
326	29.5	Yes	190	51	9,726	3.0	4.0	Run body
327	29.5	Yes	52	63	3,270	2.0	3.0	Run tail
328	29.5		70	58	4,066	1.2	2.0	Riffle
329	29.4		88	40	3,575	3.5	4.0	Run head
330	29.4		301	53	15,958	3.5	4.5	Run body
331	29.4		169	79	13,387	1.5	2.5	Run tail
332	29.3		192	168	32,257	1.2	2.0	Riffle
333	29.3		131	139	18,145	2.0	3.8	Run head
334	29.2		402	110	44,240	3.0	5.0	Run body
335	29.2		51	135	6,896	2.0	3.5	Run tail
336	29.2		247	92	22,792	1.0	1.5	Riffle
337	29.1		103	88	9,057	2.5	3.0	Run head
338	29.1		168	89	14,954	3.5	4.5	Run body
339	29.0		331	127	42,219	2.0	2.5	Run tail
340	29.0		447	90	40,119	1.5	2.0	Riffle

Table D-2. Percent cover and type for habitat units within the study area.

River mile	Habitat unit (NSO)	Habitat type	Habitat survey date	No cover (%)	Boulder (%)	Wood (%)	Ledge (%)	Overhang (%)	Aquatic vegetation (%)
51.8	1	Pool head	7/8/2008	90	5			5	
51.7	2	Pool body	7/8/2008	80					20
51.7	3	Pool tail	7/8/2008	100					
51.6	4	Pool head	7/8/2008	100					
51.6	5	Pool body	7/8/2008	90					10
51.5	6	Pool tail	7/8/2008	100					
51.5	7	Riffle	7/8/2008	90	5			5	
51.4	8	Run head	7/8/2008	85				5	10
51.1	9	Run body	7/8/2008	60	10				30
51.0	10	Run tail	7/8/2008	90					10
50.9	11	Pool body	7/8/2008	50					50
50.8	12	Run body	7/8/2008	45	5				50
50.8	13	Run tail	7/8/2008	90				10	
50.6	14	Riffle	7/8/2008	80	10		10		
50.6	15	Run head	7/8/2008	90	10				
50.5	16	Run body	7/8/2008	95				5	
50.4	17	Run tail	7/8/2008	90				5	
50.3	18	Riffle	7/8/2008	90	5				5
50.3	19	Run head	7/8/2008	90					10
50.1	20	Run body	7/8/2008	95				5	
50.1	21	Run tail	7/8/2008	90	5			5	
50.1	22	Riffle	7/8/2008	95					5
50.0	23	Run head	7/8/2008	95				5	
49.9	24	Run body	7/8/2008	95				5	
49.8	25	Run tail	7/8/2008	95				5	
49.7	26	Riffle	7/8/2008	90	5			5	
49.7	27	Pool head	7/8/2008	85	10			5	
49.6	28	Pool body	7/8/2008	85	10			5	
49.6	29	Pool tail	7/8/2008	85	10			5	
49.6	30	Run head	7/8/2008	100					
49.3	31	Run body	7/8/2008	95		5			
49.3	32	Run tail	7/8/2008	95				5	
49.2	33	Riffle	7/8/2008	90	5			5	
49.2	34	Run head	7/8/2008	85	5			10	
49.1	35	Run body	7/8/2008	85	5			10	
49.1	36	Run tail	7/8/2008	95				5	
49.1	37	Riffle	7/8/2008	95				5	
49.1	38	Run head	7/8/2008	90		5		5	
49.1	39	Run body	7/8/2008	90	5			5	
49.0	40	Run tail	7/8/2008	95				5	
48.8	41	Riffle	7/8/2008	95				5	
48.8	42	Run head	7/8/2008	75				5	20
48.7	43	Run body	7/8/2008	90				10	

River mile	Habitat unit (NSO)	Habitat type	Habitat survey date	No cover (%)	Boulder (%)	Wood (%)	Ledge (%)	Overhang (%)	Aquatic vegetation (%)
48.7	44	Run tail	7/8/2008	95				5	
48.4	45	Riffle	7/8/2008	90				10	
48.4	46	Run head	7/8/2008	90				10	
48.3	47	Run body	7/8/2008	90				10	
48.2	48	Run tail	7/8/2008	90				10	
48.2	49	Riffle	7/8/2008	90				10	
48.2	50	Run head	7/8/2008	90		5		5	
48.1	51	Run body	7/8/2008	95	5				
48.1	52	Run tail	7/8/2008	95	5				
48.0	53	Riffle	7/8/2008	95				5	
48.0	54	Pool head	7/8/2008	85	10			5	
47.2	55	Pool body	7/8/2008	85	10			5	
47.2	56	Pool tail	7/8/2008	95				5	
47.1	57	Riffle	7/8/2008	100					
47.0	58	Run head	7/8/2008	100					
46.9	59	Run body	7/8/2008	95				5	
46.9	60	Run tail	7/8/2008	90				10	
46.9	61	Riffle	7/8/2008	95				5	
46.9	62	Run head	7/8/2008	90				10	
46.8	63	Run body	7/8/2008	95				5	
46.8	64	Run tail	7/8/2008	95				5	
46.8	65	Riffle	7/8/2008	95				5	
46.8	66	Run head	7/8/2008	100					
46.0	67	Run body	7/8/2008	95				5	
46.0	68	Run tail	7/8/2008	95				5	
45.9	69	Run body	7/8/2008	100					
45.9	70	Riffle	7/8/2008	90				10	
45.9	71	Run head	7/8/2008	95				5	
45.8	72	Run body	7/8/2008	95				5	
45.8	73	Run tail	7/8/2008	100					
45.7	74	Riffle	7/8/2008	95				5	
45.7	75	Run head	7/9/2008	90				10	
45.7	76	Run body	7/9/2008	90				10	
45.7	77	Run tail	7/9/2008	100					
45.6	78	Riffle	7/9/2008	95				5	
45.6	79	Run head	7/9/2008	85				5	10
45.4	80	Run body	7/9/2008	80	15			5	
45.3	81	Pool body	7/9/2008	40		5		5	50
45.3	82	Run head	7/9/2008	45				5	50
45.1	83	Run body	7/9/2008	35		5		10	50
45.1	84	Run tail	7/9/2008	75		5		20	
45.0	85	Riffle	7/9/2008	70		5		25	
45.0	86	Pool head	7/9/2008	85		5		10	
44.9	87	Pool body	7/9/2008	90		5		5	
44.9	88	Pool tail	7/9/2008	95					5

River mile	Habitat unit (NSO)	Habitat type	Habitat survey date	No cover (%)	Boulder (%)	Wood (%)	Ledge (%)	Overhang (%)	Aquatic vegetation (%)
44.8	89	Riffle	7/9/2008	90				10	
44.8	90	Run head	7/9/2008	90		5		5	
44.8	91	Run body	7/9/2008	100					
44.8	92	Run tail	7/9/2008	85				15	
44.7	93	Riffle	7/9/2008	80				20	
44.7	94	Run head	7/9/2008	90				10	
44.7	95	Run body	7/9/2008	100					
44.7	96	Run tail	7/9/2008	95				5	
44.6	97	Riffle	7/9/2008	90				10	
44.6	98	Run head	7/9/2008	95				5	
44.6	99	Run body	7/9/2008	95				5	
44.5	100	Run tail	7/9/2008	95				5	
44.5	101	Riffle	7/9/2008	95				5	
44.5	102	Run head	7/9/2008	100					
43.9	103	Run body	7/9/2008	90				10	
43.7	104	Pool body	7/9/2008	65				5	30
43.3	105	Run body	7/9/2008	65				5	30
43.3	106	Run tail	7/9/2008	90				5	5
43.2	107	Riffle	7/9/2008	85		5		10	
43.2	108	Run head	7/9/2008	95				5	
43.1	109	Run body	7/9/2008	95				5	
43.1	110	Run tail	7/9/2008	90				10	
43.0	111	Riffle	7/9/2008	95				5	
43.0	112	Pool head	7/9/2008	65		5			30
43.0	113	Pool body	7/9/2008	60		10			30
43.0	114	Pool tail	7/9/2008	70		25		5	
43.0	115	Run head	7/9/2008	70		20		10	
42.9	116	Run body	7/9/2008	100					
42.9	117	Run tail	7/9/2008	95				5	
42.9	118	Riffle	7/9/2008	95				5	
42.9	119	Run head	7/9/2008	95				5	
42.7	120	Run body	7/9/2008	95				5	
42.7	121	Run tail	7/9/2008	95				5	
42.7	122	Riffle	7/9/2008	90				5	5
42.7	123	Run head	7/9/2008	95				5	
42.4	124	Run body	7/9/2008	95				5	
42.4	125	Run body	7/9/2008	95				5	
42.3	126	Riffle	7/9/2008	80				20	
42.3	127	Run body	7/9/2008	100					
42.3	128	Riffle	7/9/2008	75	5	5		15	
42.2	129	Run head	7/9/2008	90				10	
42.1	130	Run body	7/9/2008	90				10	
42.0	131	Run tail	7/9/2008	95				5	
41.9	132	Riffle	7/9/2008	95				5	
41.9	133	Run head	7/9/2008	95				5	

River mile	Habitat unit (NSO)	Habitat type	Habitat survey date	No cover (%)	Boulder (%)	Wood (%)	Ledge (%)	Overhang (%)	Aquatic vegetation (%)
41.8	134	Run body	7/9/2008	95				5	
41.8	135	Run tail	7/9/2008	95				5	
41.7	136	Riffle	7/9/2008	95				5	
41.7	137	Run head	7/9/2008	90				10	
41.2	138	Run body	7/9/2008	100					
41.2	139	Run tail	7/9/2008	95				5	
41.1	140	Riffle	7/9/2008	95				5	
41.1	141	Run head	7/9/2008	80					20
41.0	142	Run body	7/9/2008	95				5	
41.0	143	Run tail	7/9/2008	95				5	
40.9	144	Riffle	7/9/2008	95				5	
40.9	145	Run head	7/9/2008	100					
40.5	146	Run body	7/9/2008	65				10	25
40.5	147	Run tail	7/9/2008	85				15	
40.4	148	Riffle	7/9/2008	70				30	
40.4	149	Run head	7/9/2008	75				5	20
40.3	150	Run body	7/9/2008	100					
40.3	151	Run tail	7/9/2008	100					
40.2	152	Riffle	7/9/2008	95				5	
40.2	153	Run head	7/9/2008	100					
39.7	154	Run body	7/9/2008	95				5	
39.7	155	Run tail	7/9/2008	95				5	
39.7	156	Riffle	2/10/2009	95					5
39.6	157	Run head	2/10/2009	100					
39.5	158	Run body	2/10/2009	80					20
39.5	159	Run tail	2/10/2009	80					20
39.4	160	Riffle	2/10/2009	95					5
39.4	161	Run head	2/10/2009	95					
39.3	162	Run body	2/10/2009	95				5	
39.3	163	Run tail	2/10/2009	95				5	
39.2	164	Riffle	2/10/2009	95					5
39.2	165	Pool head	2/10/2009	100					
38.9	166	Pool body	2/10/2009	90					10
38.9	167	Pool tail	2/10/2009	100					
38.9	168	Riffle	2/10/2009	100					
38.9	169	Run head	2/10/2009	100					
38.8	170	Run body	2/10/2009	100					
38.8	171	Pool body	2/10/2009	90				5	5
38.8	172	Run head	2/10/2009	95				5	
38.7	173	Run body	2/10/2009	95				5	
38.7	174	Run tail	2/10/2009	100					
38.7	175	Riffle	2/10/2009	100					
38.6	176	Run head	2/10/2009	100					
38.6	177	Run body	2/10/2009	100					
38.6	178	Run tail	2/10/2009	100					

River mile	Habitat unit (NSO)	Habitat type	Habitat survey date	No cover (%)	Boulder (%)	Wood (%)	Ledge (%)	Overhang (%)	Aquatic vegetation (%)
38.5	179	Riffle	2/10/2009	100					
38.5	180	Run head	2/10/2009	90					10
38.4	181	Run body	2/10/2009	100					
38.3	182	Pool body	2/10/2009	80					20
38.3	183	Pool tail	2/10/2009	90				5	5
38.3	184	Run head	2/10/2009	100					
38.2	185	Run body	2/10/2009	100					
38.2	186	Run tail	2/10/2009	100					
38.2	187	Riffle	2/10/2009	95				5	
38.1	188	Pool head	2/10/2009	95				5	
38.1	189	Pool body	2/11/2009	90					10
38.1	190	Pool tail	2/11/2009	100					
38.1	191	Riffle	2/11/2009	100					
38.1	192	Pool head	2/11/2009	90					10
38.0	193	Pool body	2/11/2009	70					30
38.0	194	Pool tail	2/11/2009	100					
38.0	195	Run head	2/11/2009	100					
37.9	196	Run body	2/11/2009	100					
37.9	197	Run tail	2/11/2009	100					
37.8	198	Riffle	2/11/2009	100					
37.8	199	Pool head	2/11/2009	85		15			
37.7	200	Pool body	2/11/2009	100					
37.6	201	Pool tail	2/11/2009	100					
37.6	202	Riffle	2/11/2009	100					
37.6	203	Run head	2/11/2009	100					
37.5	204	Run body	2/11/2009	100					
37.4	205	Run tail	2/11/2009	100					
37.3	206	Riffle	2/11/2009	100					
37.3	207	Run head	2/11/2009	100					
37.1	208	Run body	2/11/2009	100					
37.1	209	Run tail	2/11/2009	100					
37.0	210	Riffle	2/11/2009	100					
37.0	211	Run head	2/11/2009	100					
36.9	212	Run body	2/11/2009	100					
36.9	213	Run tail	2/11/2009	100					
36.9	214	Pool head	2/11/2009	100					
36.9	215	Pool body	2/11/2009	100					
36.9	216	Pool tail	2/11/2009	100					
36.8	217	Riffle	2/11/2009	100					
36.8	218	Run head	2/11/2009	100					
36.6	219	Run body	2/11/2009	100					
36.6	220	Run tail	2/11/2009	100					
36.6	221	Riffle	2/11/2009	100					
36.6	222	Run head	2/11/2009	100					
36.4	223	Run body	2/11/2009	100					

River mile	Habitat unit (NSO)	Habitat type	Habitat survey date	No cover (%)	Boulder (%)	Wood (%)	Ledge (%)	Overhang (%)	Aquatic vegetation (%)
36.3	224	Run tail	2/11/2009	100					
36.3	225	Riffle	2/11/2009	100					
36.3	226	Run head	2/11/2009	100					
36.3	227	Run body	2/11/2009	100					
36.2	228	Run tail	2/11/2009	100					
36.2	229	Riffle	2/11/2009	100					
36.2	230	Pool head	2/11/2009	100					
36.2	231	Pool body	2/11/2009	100					
36.2	232	Pool tail	2/11/2009	100					
36.1	233	Pool head	2/11/2009	100					
35.7	234	Pool body	2/11/2009	100					
35.6	235	Pool tail	2/11/2009	100					
35.5	236	Riffle	2/11/2009	100					
35.5	237	Run head	2/11/2009	100					
35.2	238	Run body	2/11/2009	100					
35.2	239	Run tail	2/12/2009	95				5	
35.2	240	Riffle	2/12/2009	100					
35.2	241	Run head	2/12/2009	100					
35.2	242	Run body	2/12/2009	100					
35.1	243	Run tail	2/12/2009	100					
35.1	244	Riffle	2/12/2009	100					
35.0	245	Run head	2/12/2009	95				5	
35.0	246	Run body	2/12/2009	95				5	
35.0	247	Run tail	2/12/2009	100					
34.9	248	Riffle	2/12/2009	100					
34.9	249	Run head	2/12/2009	95		5			
34.7	250	Run body	2/12/2009	100					
34.6	251	Pool body	2/12/2009	75				5	20
34.6	252	Pool tail	2/12/2009	100					
34.5	253	Riffle	2/12/2009	95				5	
34.5	254	Pool head	2/12/2009	100					
34.4	255	Pool body	2/12/2009	100					
34.1	256	Run body	2/12/2009	100					
34.1	257	Run tail	2/12/2009	95				5	
34.1	258	Riffle	2/12/2009	100					
34.0	259	Run head	2/12/2009	100					
34.0	260	Run body	2/12/2009	100					
33.9	261	Run tail	2/12/2009	100					
33.8	262	Riffle	2/12/2009	100					
33.8	263	Run head	2/12/2009	100					
33.8	264	Run body	2/12/2009	100					
33.8	265	Run tail	2/12/2009	100					
33.7	266	Riffle	2/12/2009	100					
33.6	267	Run head	2/12/2009	100					
33.5	268	Run body	2/12/2009	100					

River mile	Habitat unit (NSO)	Habitat type	Habitat survey date	No cover (%)	Boulder (%)	Wood (%)	Ledge (%)	Overhang (%)	Aquatic vegetation (%)
33.4	269	Run tail	2/12/2009	100					
33.4	270	Riffle	2/12/2009	100					
33.4	271	Pool head	2/12/2009	100					
33.2	272	Pool body	2/12/2009	70					30
33.2	273	Pool tail	2/12/2009	100					
33.2	274	Riffle	2/12/2009	100					
33.2	275	Run head	2/12/2009	100					
33.1	276	Run body	2/12/2009	95					5
33.1	277	Run tail	2/12/2009	100					
33.0	278	Riffle	2/12/2009	100					
33.0	279	Run head	2/12/2009	100					
32.1	280	Run body	2/12/2009	60					40
32.1	281	Run tail	2/12/2009						
32.0	282	Riffle	2/12/2009						
32.0	283	Run head	2/12/2009						
32.0	284	Run body	2/12/2009						
31.9	285	Run tail	2/12/2009						
31.9	286	Riffle	2/12/2009						
31.9	287	Run head	2/12/2009						
31.7	288	Run body	2/12/2009						
31.7	289	Run tail	2/12/2009						
31.6	290	Riffle	2/12/2009						
31.6	291	Run head	2/12/2009						
31.5	292	Run body	2/12/2009						
31.5	293	Run tail	2/12/2009						
31.5	294	Riffle	2/12/2009	100					
31.4	295	Run head	2/12/2009	100					
31.3	296	Run body	2/12/2009	100					
31.3	297	Run tail	2/12/2009	100					
31.2	298	Riffle	2/12/2009	100					
31.2	299	Run head	2/13/2009	100					
31.1	300	Run body	2/13/2009	100					
31.1	301	Run tail	2/13/2009	100					
31.1	302	Riffle	2/13/2009	100					
31.1	303	Run head	2/13/2009	100					
30.7	304	Run body	2/13/2009	100					
30.7	305	Run tail	2/13/2009	90					10
30.6	306	Riffle	2/13/2009	100					
30.6	307	Run head	2/13/2009	100					
30.5	308	Run body	2/13/2009	100					
30.5	309	Run tail	2/13/2009	100					
30.4	310	Riffle	2/13/2009	85				15	
30.4	311	Run head	2/13/2009	100					
30.4	312	Run body	2/13/2009	100					
30.4	313	Run tail	2/13/2009	100					

River mile	Habitat unit (NSO)	Habitat type	Habitat survey date	No cover (%)	Boulder (%)	Wood (%)	Ledge (%)	Overhang (%)	Aquatic vegetation (%)
30.2	314	Riffle	2/13/2009	90				10	
30.2	315	Run head	2/13/2009	100					
30.1	316	Run body	2/13/2009	100					
30.1	317	Run tail	2/13/2009	100					
30.1	318	Riffle	2/13/2009	100					
30.0	319	Run head	2/13/2009	100					
29.7	320	Run body	2/13/2009	70					30
29.7	321	Run tail	2/13/2009	90					10
29.6	322	Pool body	2/13/2009	100					
29.6	323	Pool tail	2/13/2009	100					
29.5	324	Riffle	2/13/2009	100					
29.5	325	Run head	2/13/2009	95	5				
29.5	326	Run body	2/13/2009	85					15
29.5	327	Run tail	2/13/2009	100					
29.5	328	Riffle	2/13/2009	100					
29.4	329	Run head	2/13/2009	100					
29.4	330	Run body	2/13/2009	100					
29.4	331	Run tail	2/13/2009	100					
29.3	332	Riffle	2/13/2009	90				10	
29.3	333	Run head	2/13/2009	100					
29.2	334	Run body	2/13/2009	100					
29.2	335	Run tail	2/13/2009	100					
29.2	336	Riffle	2/13/2009	100					
29.1	337	Run head	2/13/2009	100					
29.1	338	Run body	2/13/2009	90					10
29.0	339	Run tail	2/13/2009	100					
29.0	340	Riffle	2/13/2009	100					

Table D-3. Substrate types for habitat units within the study area.

River mile	NSO #	Habitat type	Habitat survey date	Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Sand (%)	Silt (%)	Organic (%)
51.8	1	Pool head	7/8/2008	10	50	40				
51.7	2	Pool body	7/8/2008	50	40	10				
51.7	3	Pool tail	7/8/2008	20	30	50				
51.6	4	Pool head	7/8/2008	50	20	30				
51.6	5	Pool body	7/8/2008	50	20	25		5		
51.5	6	Pool tail	7/8/2008	40	30	30				
51.5	7	Riffle	7/8/2008		30	60	10			
51.4	8	Run head	7/8/2008		20	60	10	10		
51.1	9	Run body	7/8/2008	15	15	60	10			
51.0	10	Run tail	7/8/2008			60	30	10		
50.9	11	Pool body	7/8/2008	20	10	50		20		
50.8	12	Run body	7/8/2008	20	10	50		20		
50.8	13	Run tail	7/8/2008			60	30	10		
50.6	14	Riffle	7/8/2008			60	30	10		
50.6	15	Run head	7/8/2008		10	50	40			
50.5	16	Run body	7/8/2008	10	10	60	20			
50.4	17	Run tail	7/8/2008		20	60	20			
50.3	18	Riffle	7/8/2008		20	60	20			
50.3	19	Run head	7/8/2008		20	60	20			
50.1	20	Run body	7/8/2008		20	60	20			
50.1	21	Run tail	7/8/2008		20	60	20			
50.1	22	Riffle	7/8/2008		20	60	20			
50.0	23	Run head	7/8/2008		20	60	20			
49.9	24	Run body	7/8/2008		60	20	20			
49.8	25	Run tail	7/8/2008		40	40	20			
49.7	26	Riffle	7/8/2008		20	60	20			
49.7	27	Pool head	7/8/2008	20	20	40	10	10		
49.6	28	Pool body	7/8/2008	20	20	40	10	10		
49.6	29	Pool tail	7/8/2008	10	20	60	10			
49.6	30	Run head	7/8/2008		20	60	20			
49.3	31	Run body	7/8/2008		20	60	20			
49.3	32	Run tail	7/8/2008		10	70	20			
49.2	33	Riffle	7/8/2008		10	70	20			
49.2	34	Run head	7/8/2008		10	70	20			
49.1	35	Run body	7/8/2008		10	70	20			
49.1	36	Run tail	7/8/2008		10	70	20			
49.1	37	Riffle	7/8/2008		10	70	20			
49.1	38	Run head	7/8/2008		10	70	20			
49.1	39	Run body	7/8/2008		10	70	20			
49.0	40	Run tail	7/8/2008		10	70	20			
48.8	41	Riffle	7/8/2008		10	70	20			
48.8	42	Run head	7/8/2008		10	70	20			
48.7	43	Run body	7/8/2008		40	40	20			

River mile	NSO #	Habitat type	Habitat survey date	Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Sand (%)	Silt (%)	Organic (%)
48.7	44	Run tail	7/8/2008		40	40	20			
48.4	45	Riffle	7/8/2008		20	60	20			
48.4	46	Run head	7/8/2008		10	40	50			
48.3	47	Run body	7/8/2008		10	50	40			
48.2	48	Run tail	7/8/2008		10	70	20			
48.2	49	Riffle	7/8/2008		10	70	20			
48.2	50	Run head	7/8/2008		10	70	20			
48.1	51	Run body	7/8/2008	20	10	50	20			
48.1	52	Run tail	7/8/2008	20	10	50	20			
48.0	53	Riffle	7/8/2008		10	70	20			
48.0	54	Pool head	7/8/2008	20	10	60	5	5		
47.2	55	Pool body	7/8/2008	20	10	60	5	5		
47.2	56	Pool tail	7/8/2008		10	70	20			
47.1	57	Riffle	7/8/2008		10	70	20			
47.0	58	Run head	7/8/2008		10	70	20			
46.9	59	Run body	7/8/2008	20	10	50	20			
46.9	60	Run tail	7/8/2008		20	60	20			
46.9	61	Riffle	7/8/2008		10	70	20			
46.9	62	Run head	7/8/2008		10	70	20			
46.8	63	Run body	7/8/2008		10	70	20			
46.8	64	Run tail	7/8/2008		10	60	30			
46.8	65	Riffle	7/8/2008		10	60	30			
46.8	66	Run head	7/8/2008		10	50	30	10		
46.0	67	Run body	7/8/2008		20	50	20	10		
46.0	68	Run tail	7/8/2008		10	70	20			
45.9	69	Run body	7/8/2008		10	70	20			
45.9	70	Riffle	7/8/2008			20	70	10		
45.9	71	Run head	7/8/2008			30	40	30		
45.8	72	Run body	7/8/2008			40	40	20		
45.8	73	Run tail	7/8/2008			40	50	10		
45.7	74	Riffle	7/8/2008			40	50	10		
45.7	75	Run head	7/9/2008		10	60	20	10		
45.7	76	Run body	7/9/2008		10	60	20	10		
45.7	77	Run tail	7/9/2008		10	60	20	10		
45.6	78	Riffle	7/9/2008			70	20	10		
45.6	79	Run head	7/9/2008		10	10	30	50		
45.4	80	Run body	7/9/2008	20	20	30		30		
45.3	81	Pool body	7/9/2008	30	20	20		30		
45.3	82	Run head	7/9/2008			10	30	50	10	
45.1	83	Run body	7/9/2008	10	20	50	10	10		
45.1	84	Run tail	7/9/2008		10	70	20			
45.0	85	Riffle	7/9/2008		10	60	30			
45.0	86	Pool head	7/9/2008		10	60	30			
44.9	87	Pool body	7/9/2008			60	20	20		
44.9	88	Pool tail	7/9/2008			60	20	20		

River mile	NSO #	Habitat type	Habitat survey date	Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Sand (%)	Silt (%)	Organic (%)
44.8	89	Riffle	7/9/2008		20	60	20			
44.8	90	Run head	7/9/2008			40	50	10		
44.8	91	Run body	7/9/2008		10	60	30			
44.8	92	Run tail	7/9/2008		10	60	30			
44.7	93	Riffle	7/9/2008			60	30	10		
44.7	94	Run head	7/9/2008			60	30	10		
44.7	95	Run body	7/9/2008							
44.7	96	Run tail	7/9/2008			40	10	50		
44.6	97	Riffle	7/9/2008		10	50	40			
44.6	98	Run head	7/9/2008		10	50	40			
44.6	99	Run body	7/9/2008		10	40	40	10		
44.5	100	Run tail	7/9/2008		10	40	40	10		
44.5	101	Riffle	7/9/2008	10	10	50	30			
44.5	102	Run head	7/9/2008		10	50	30	10		
43.9	103	Run body	7/9/2008	40	10	30	10	10		
43.7	104	Pool body	7/9/2008	20	10	20		50		
43.3	105	Run body	7/9/2008	20	10	20		50		
43.3	106	Run tail	7/9/2008		10	60	20	10		
43.2	107	Riffle	7/9/2008		10	60	30			
43.2	108	Run head	7/9/2008		10	60	20	10		
43.1	109	Run body	7/9/2008		10	60	30			
43.1	110	Run tail	7/9/2008		10	60	30			
43.0	111	Riffle	7/9/2008		10	60	30			
43.0	112	Pool head	7/9/2008		10	50	30	10		
43.0	113	Pool body	7/9/2008		10	50	30	10		
43.0	114	Pool tail	7/9/2008		10	50	30	10		
43.0	115	Run head	7/9/2008		10	50	30	10		
42.9	116	Run body	7/9/2008		10	60	30			
42.9	117	Run tail	7/9/2008		10	60	30			
42.9	118	Riffle	7/9/2008		10	60	30			
42.9	119	Run head	7/9/2008		20	50	30			
42.7	120	Run body	7/9/2008		20	50	30			
42.7	121	Run tail	7/9/2008		10	60	30			
42.7	122	Riffle	7/9/2008		10	50	40			
42.7	123	Run head	7/9/2008		10	50	40			
42.4	124	Run body	7/9/2008		10	50	40			
42.4	125	Run body	7/9/2008		10	50	40			
42.3	126	Riffle	7/9/2008		10	50	40			
42.3	127	Run body	7/9/2008	50		40	10			
42.3	128	Riffle	7/9/2008	15	10	50	20	5		
42.2	129	Run head	7/9/2008	15	10	50	20	5		
42.1	130	Run body	7/9/2008		10	60	30			
42.0	131	Run tail	7/9/2008		10	50	40			
41.9	132	Riffle	7/9/2008		15	50	35			
41.9	133	Run head	7/9/2008	15	15	45	25			

River mile	NSO #	Habitat type	Habitat survey date	Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Sand (%)	Silt (%)	Organic (%)
41.8	134	Run body	7/9/2008	15	15	40	20	10		
41.8	135	Run tail	7/9/2008		10	60	30			
41.7	136	Riffle	7/9/2008		10	60	30			
41.7	137	Run head	7/9/2008	15	10	50	25			
41.2	138	Run body	7/9/2008	15	10	50	25			
41.2	139	Run tail	7/9/2008		10	60	20	10		
41.1	140	Riffle	7/9/2008		10	50	30	10		
41.1	141	Run head	7/9/2008		10	50	30	10		
41.0	142	Run body	7/9/2008		10	50	30	10		
41.0	143	Run tail	7/9/2008		10	60	20	10		
40.9	144	Riffle	7/9/2008		10	60	20	10		
40.9	145	Run head	7/9/2008		10	50	40			
40.5	146	Run body	7/9/2008		50	20		30		
40.5	147	Run tail	7/9/2008		10	60	30			
40.4	148	Riffle	7/9/2008		10	50	40			
40.4	149	Run head	7/9/2008		10	50	30	10		
40.3	150	Run body	7/9/2008							
40.3	151	Run tail	7/9/2008		20	50	30			
40.2	152	Riffle	7/9/2008		20	50	30			
40.2	153	Run head	7/9/2008		20	50	30			
39.7	154	Run body	7/9/2008	20	10	50	10	10		
39.7	155	Run tail	7/9/2008		10	50	40			
39.7	156	Riffle	2/10/2009			50	40	10		
39.6	157	Run head	2/10/2009			30	20	50		
39.5	158	Run body	2/10/2009			30	20	50		
39.5	159	Run tail	2/10/2009			30	20	50		
39.4	160	Riffle	2/10/2009			50	40	10		
39.4	161	Run head	2/10/2009		10	50	30	10		
39.3	162	Run body	2/10/2009		10	50	30	10		
39.3	163	Run tail	2/10/2009	5		55	30	10		
39.2	164	Riffle	2/10/2009			50	40	10		
39.2	165	Pool head	2/10/2009			30	60	10		
38.9	166	Pool body	2/10/2009			20	50	30		
38.9	167	Pool tail	2/10/2009			50	40	10		
38.9	168	Riffle	2/10/2009			50	40	10		
38.9	169	Run head	2/10/2009			60	25	15		
38.8	170	Run body	2/10/2009			30	40	30		
38.8	171	Pool body	2/10/2009		5	60	20	15		
38.8	172	Run head	2/10/2009			60	30	10		
38.7	173	Run body	2/10/2009			60	30	10		
38.7	174	Run tail	2/10/2009			60	30	10		
38.7	175	Riffle	2/10/2009			60	30	10		
38.6	176	Run head	2/10/2009			60	30	10		
38.6	177	Run body	2/10/2009			60	30	10		
38.6	178	Run tail	2/10/2009			60	30	10		

River mile	NSO #	Habitat type	Habitat survey date	Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Sand (%)	Silt (%)	Organic (%)
38.5	179	Riffle	2/10/2009			60	30	10		
38.5	180	Run head	2/10/2009			50	20	30		
38.4	181	Run body	2/10/2009			60	30	10		
38.3	182	Pool body	2/10/2009		5	45	20	30		
38.3	183	Pool tail	2/10/2009		5	60	20	15		
38.3	184	Run head	2/10/2009			60	30	10		
38.2	185	Run body	2/10/2009			70	20	10		
38.2	186	Run tail	2/10/2009			60	30	10		
38.2	187	Riffle	2/10/2009			70	20	10		
38.1	188	Pool head	2/10/2009			60	30	10		
38.1	189	Pool body	2/11/2009		5	60	25	10		
38.1	190	Pool tail	2/11/2009			60	20	10	10	
38.1	191	Riffle	2/11/2009			70	20	10		
38.1	192	Pool head	2/11/2009			50	20	20	10	
38.0	193	Pool body	2/11/2009	20		20	30	30		
38.0	194	Pool tail	2/11/2009			40	40	20		
38.0	195	Run head	2/11/2009			50	40	10		
37.9	196	Run body	2/11/2009			60	30	10		
37.9	197	Run tail	2/11/2009			60	30	5	5	
37.8	198	Riffle	2/11/2009			60	30	10		
37.8	199	Pool head	2/11/2009			60	30	10		
37.7	200	Pool body	2/11/2009	10			60	30		
37.6	201	Pool tail	2/11/2009			5	75	20		
37.6	202	Riffle	2/11/2009	5		5	80	10		
37.6	203	Run head	2/11/2009			10	60	20	10	
37.5	204	Run body	2/11/2009			30	60	10		
37.4	205	Run tail	2/11/2009			40	60			
37.3	206	Riffle	2/11/2009			40	60			
37.3	207	Run head	2/11/2009			50	40	10		
37.1	208	Run body	2/11/2009			50	40	10		
37.1	209	Run tail	2/11/2009			50	50			
37.0	210	Riffle	2/11/2009			60	40			
37.0	211	Run head	2/11/2009			50	40	10		
36.9	212	Run body	2/11/2009			10	60	30		
36.9	213	Run tail	2/11/2009			20	70	10		
36.9	214	Pool head	2/11/2009			20	70	10		
36.9	215	Pool body	2/11/2009			20	50	30		
36.9	216	Pool tail	2/11/2009			10	60	30		
36.8	217	Riffle	2/11/2009			30	60	10		
36.8	218	Run head	2/11/2009			40	50	10		
36.6	219	Run body	2/11/2009			20	40	40		
36.6	220	Run tail	2/11/2009			20	60	20		
36.6	221	Riffle	2/11/2009			30	60	10		
36.6	222	Run head	2/11/2009			40	60			
36.4	223	Run body	2/11/2009			20	60	20		

River mile	NSO #	Habitat type	Habitat survey date	Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Sand (%)	Silt (%)	Organic (%)
36.3	224	Run tail	2/11/2009			30	60	10		
36.3	225	Riffle	2/11/2009			30	60	10		
36.3	226	Run head	2/11/2009			30	60	10		
36.3	227	Run body	2/11/2009			30	60	10		
36.2	228	Run tail	2/11/2009			30	60	10		
36.2	229	Riffle	2/11/2009			30	60	10		
36.2	230	Pool head	2/11/2009			30	60	10		
36.2	231	Pool body	2/11/2009			30	60	10		
36.2	232	Pool tail	2/11/2009			20	60	20		
36.1	233	Pool head	2/11/2009				80	20		
35.7	234	Pool body	2/11/2009	25		20	40	15		
35.6	235	Pool tail	2/11/2009			30	60	10		
35.5	236	Riffle	2/11/2009			30	60	10		
35.5	237	Run head	2/11/2009			30	60	10		
35.2	238	Run body	2/11/2009		5	15	20	60		
35.2	239	Run tail	2/12/2009			30	60	5	5	
35.2	240	Riffle	2/12/2009			35	60	5		
35.2	241	Run head	2/12/2009			35	60	5		
35.2	242	Run body	2/12/2009			30	65	5		
35.1	243	Run tail	2/12/2009			20	80			
35.1	244	Riffle	2/12/2009			20	60	20		
35.0	245	Run head	2/12/2009			20	70	10		
35.0	246	Run body	2/12/2009			40	50	10		
35.0	247	Run tail	2/12/2009			20	70	10		
34.9	248	Riffle	2/12/2009			10	80	10		
34.9	249	Run head	2/12/2009			20	70	10		
34.7	250	Run body	2/12/2009	5		25	60	10		
34.6	251	Pool body	2/12/2009	40		20	20	20		
34.6	252	Pool tail	2/12/2009	30		30	20	20		
34.5	253	Riffle	2/12/2009	5		30	65			
34.5	254	Pool head	2/12/2009	40		10	20	30		
34.4	255	Pool body	2/12/2009			30	50	20		
34.1	256	Run body	2/12/2009			30	60	10		
34.1	257	Run tail	2/12/2009			40	60			
34.1	258	Riffle	2/12/2009			30	60	10		
34.0	259	Run head	2/12/2009			40	50	10		
34.0	260	Run body	2/12/2009			30	40	30		
33.9	261	Run tail	2/12/2009			30	50	20		
33.8	262	Riffle	2/12/2009			30	60	10		
33.8	263	Run head	2/12/2009			40	60			
33.8	264	Run body	2/12/2009			40	50	10		
33.8	265	Run tail	2/12/2009			40	60			
33.7	266	Riffle	2/12/2009			40	50	10		
33.6	267	Run head	2/12/2009			10	70	20		
33.5	268	Run body	2/12/2009			20	40	40		

River mile	NSO #	Habitat type	Habitat survey date	Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Sand (%)	Silt (%)	Organic (%)
33.4	269	Run tail	2/12/2009			20	50	30		
33.4	270	Riffle	2/12/2009			30	60	10		
33.4	271	Pool head	2/12/2009			40	40	20		
33.2	272	Pool body	2/12/2009	10		20	30	30	10	
33.2	273	Pool tail	2/12/2009			40	50	10		
33.2	274	Riffle	2/12/2009			40	50	10		
33.2	275	Run head	2/12/2009			50	40	10		
33.1	276	Run body	2/12/2009			25	60	5	10	
33.1	277	Run tail	2/12/2009			40	50	10		
33.0	278	Riffle	2/12/2009			20	70	10		
33.0	279	Run head	2/12/2009			20	40	40		
32.1	280	Run body	2/12/2009				50	50		
32.1	281	Run tail	2/12/2009	No data collected						
32.0	282	Riffle	2/12/2009	No data collected						
32.0	283	Run head	2/12/2009	No data collected						
32.0	284	Run body	2/12/2009	No data collected						
31.9	285	Run tail	2/12/2009	No data collected						
31.9	286	Riffle	2/12/2009	No data collected						
31.9	287	Run head	2/12/2009	No data collected						
31.7	288	Run body	2/12/2009	No data collected						
31.7	289	Run tail	2/12/2009	No data collected						
31.6	290	Riffle	2/12/2009	No data collected						
31.6	291	Run head	2/12/2009	No data collected						
31.5	292	Run body	2/12/2009	No data collected						
31.5	293	Run tail	2/12/2009	No data collected						
31.5	294	Riffle	2/12/2009			40	50		10	
31.4	295	Run head	2/12/2009			20	70	10		
31.3	296	Run body	2/12/2009			10	60	30		
31.3	297	Run tail	2/12/2009			10	60	30		
31.2	298	Riffle	2/12/2009			30	60	10		
31.2	299	Run head	2/13/2009			40	50	10		
31.1	300	Run body	2/13/2009			30	40	30		
31.1	301	Run tail	2/13/2009			30	60	10		
31.1	302	Riffle	2/13/2009			30	60	10		
31.1	303	Run head	2/13/2009	10		40	40	10		
30.7	304	Run body	2/13/2009	10		40	40	10		
30.7	305	Run tail	2/13/2009			40	40	20		
30.6	306	Riffle	2/13/2009			40	50	10		
30.6	307	Run head	2/13/2009			40	50	10		
30.5	308	Run body	2/13/2009			40	50	10		
30.5	309	Run tail	2/13/2009			40	50	10		
30.4	310	Riffle	2/13/2009			30	50	20		
30.4	311	Run head	2/13/2009			30	60	10		
30.4	312	Run body	2/13/2009			40	50	10		
30.4	313	Run tail	2/13/2009		5	35	50	10		

River mile	NSO #	Habitat type	Habitat survey date	Bedrock (%)	Boulder (%)	Cobble (%)	Gravel (%)	Sand (%)	Silt (%)	Organic (%)
30.2	314	Riffle	2/13/2009			30	60	10		
30.2	315	Run head	2/13/2009			30	60	10		
30.1	316	Run body	2/13/2009			30	60	10		
30.1	317	Run tail	2/13/2009			30	60	10		
30.1	318	Riffle	2/13/2009			40	50	10		
30.0	319	Run head	2/13/2009			5	15	80		
29.7	320	Run body	2/13/2009				30	70		
29.7	321	Run tail	2/13/2009				30	70		
29.6	322	Pool body	2/13/2009				20	80		
29.6	323	Pool tail	2/13/2009				30	70		
29.5	324	Riffle	2/13/2009			30	60	10		
29.5	325	Run head	2/13/2009			40	60			
29.5	326	Run body	2/13/2009				20	80		
29.5	327	Run tail	2/13/2009				60	40		
29.5	328	Riffle	2/13/2009			30	70			
29.4	329	Run head	2/13/2009			20	60	10	10	
29.4	330	Run body	2/13/2009			10	70	20		
29.4	331	Run tail	2/13/2009			10	70	20		
29.3	332	Riffle	2/13/2009			10	80	10		
29.3	333	Run head	2/13/2009			10	70	20		
29.2	334	Run body	2/13/2009			20	70	10		
29.2	335	Run tail	2/13/2009			10	70	20		
29.2	336	Riffle	2/13/2009			10	80	10		
29.1	337	Run head	2/13/2009			10	60	30		
29.1	338	Run body	2/13/2009	15		30	30	25		
29.0	339	Run tail	2/13/2009	40		20	20	20		
29.0	340	Riffle	2/13/2009	20		10	60	10		

Appendix E: Water Quality Data

Table E-1. Water quality data for the habitat units selected for snorkel sampling, March 2009.

RM	NSO	Habitat type	Sample date	Start time	Water temperature (C)	DO (ppm)	Specific conductivity (mS)	Horizontal visability (ft)	Vertical visability (ft)	Average depth (ft)	Maximum depth (ft)
51.6	4	Pool head	16-Mar	12:00	10.8	10.42	42.0	10	--	3.5	5.0
51.6	5	Pool body	16-Mar	11:20	10.8	10.42	42.0	10	17.0	9.0	29.0
51.5	6	Pool tail	16-Mar	11:00	10.8	10.42	42.0	10	--	5.0	9.0
51.5	7	Riffle	16-Mar	10:09	10.2	9.99	42.1	10	--	3.5	7.0
50.6	14	Riffle	16-Mar	15:00	11.9	11.71	41.9	8	--	1.0	2.5
50.6	15	Run head	16-Mar	14:30	11.9	11.71	41.9	8	--	3.0	4.5
50.5	16	Run body	16-Mar	13:30	11.8	10.03	42.5	8	--	6.0	9.5
50.4	17	Run tail	16-Mar	13:15	11.8	10.03	42.5	8	--	2.5	3.5
50.1	22	Riffle	17-Mar	11:20	11.7	9.07	42.0	12	--	1.0	2.0
49.7	27	Pool head	17-Mar	12:20	12.4	10.49	43.6	8	--	4.0	9.0
49.6	28	Pool body	17-Mar	12:00	12.4	10.49	43.6	8	8.0	6.0	15.0
49.6	29	Pool tail	17-Mar	11:50	12.4	10.49	43.6	8	--	1.5	3.0
48.0	53	Riffle	17-Mar	14:38	14.5	11.12	44.5	10	--	1.0	2.0
47.0	58	Run head	17-Mar	16:28	13.7	10.91	46.4	7	--	2.5	3.5
46.9	59	Run body	18-Mar	10:55	11.5	10.55	46.0	8	--	3.5	7.0
46.9	60	Run tail	18-Mar	11:35	11.5	10.55	46.5	8	--	1.7	3.0
45.3	82	Run head	18-Mar	15:05	13.8	12.14	49.3	9	--	6.0	11.0
45.1	83	Run body	18-Mar	14:20	13.8	12.14	49.3	9	--	5.0	10.0
45.1	84	Run tail	18-Mar	13:45	13.8	12.14	49.3	9	--	4.5	6.0
45.0	86	Pool head	19-Mar	11:53	13.2	11.08	49.3	12	--	0.7	1.5
44.9	87	Pool body	19-Mar	11:54	13.2	11.08	49.3	12	--	4.5	6.0
44.9	88	Pool tail	19-Mar	11:15	13.2	11.08	49.3	12	--	2.0	4.5
44.6	97	Riffle	19-Mar	13:22	13.9	11.64	50.0	7	--	2.0	4.0
43.2	107	Riffle	19-Mar	15:18	15.1	12.31	50.9	13	--	1.0	3.0
43.2	108	Run head	20-Mar	15:32	15.6	11.85	51.5	10	--	3.0	5.0
43.2	108	Run head	19-Mar	15:15	15.1	12.31	50.9	13	--	2.0	4.5
43.1	109	Run body	20-Mar	14:43	15.6	11.85	51.5	10	--	3.5	7.0
43.1	110	Run tail	20-Mar	14:40	15.6	11.85	51.5	10	--	2.5	3.5

RM	NSO	Habitat type	Sample date	Start time	Water temperature (C)	DO (ppm)	Specific conductivity (mS)	Horizontal visability (ft)	Vertical visability (ft)	Average depth (ft)	Maximum depth (ft)
43.0	111	Riffle	20-Mar	11:13	14.5	10.68	48.3	9	--	1.0	3.0
43.0	112	Pool head	19-Mar	16:43	15.4	12.08	51.9	9	--	1.0	2.0
43.0	113	Pool body	20-Mar	13:20	15.2	11.38	51.8	10	--	6.0	11.0
43.0	114	Pool tail	20-Mar	12:18	15.2	11.38	51.8	10	--	4.0	7.0
42.9	118	Riffle	20-Mar	10:30	13.7	10.55	52.4	11	--	0.8	2.0
39.6	157	Run head	22-Mar	11:22	13.8	10.14	67.1	9	--	2.0	3.5
39.5	158	Run body	22-Mar	11:35	13.7	9.85	70.3	9	--	5.0	6.5
39.5	159	Run tail	22-Mar	10:43	13.7	9.85	70.3	9	--	1.5	3.0
39.4	160	Riffle	22-Mar	10:35	13.6	9.9	68.3	9	--	1.0	3.0
38.9	168	Riffle	22-Mar	14:00	14.3	10.6	67.9	10	--	0.8	3.0
38.7	175	Riffle	22-Mar	14:30	14.3	10.62	68.5	10	--	1.2	2.5
38.1	188	Pool head	22-Mar	15:24	14.1	10.73	68.7	8	--	1.5	2.5
38.1	189	Pool body	22-Mar	15:14	14.1	10.73	68.7	8	--	4.5	9.5
38.1	190	Pool tail	22-Mar	15:10	14.1	10.73	68.7	8	--	0.8	1.5
38.1	192	Pool head	23-Mar	11:24	12.4	10.95	69.9	10	--	3.0	9.0
38.0	193	Pool body	23-Mar	11:11	12.4	10.95	69.9	10	--	5.0	15.0
38.0	194	Pool tail	23-Mar	10:55	12.4	10.95	69.9	10	--	2.0	3.5
36.9	214	Pool head	23-Mar	13:25	13.4	11.45	70.3	11	--	1.5	4.0
36.9	215	Pool body	23-Mar	13:20	13.4	11.45	70.3	11	--	5.0	15.0
36.9	216	Pool tail	23-Mar	13:15	13.4	11.45	70.3	11	--	1.0	3.0
36.8	218	Run head	25-Mar	12:36	14.5	12.14	72.8	9	--	3.0	4.5
36.6	219	Run body	25-Mar	11:09	14.5	12.14	72.8	9	--	4.5	11.3
36.6	220	Run tail	25-Mar	12:56	14.5	12.14	72.8	9	--	1.7	5.0
36.2	230	Pool head	23-Mar	15:12	14.2	11.16	70.6	10	--	4.0	8.0
36.2	231	Pool body	25-Mar	14:19	14.2	11.16	70.6	10	--	5.0	12.0
36.2	232	Pool tail	23-Mar	15:00	14.2	11.16	70.6	10	--	2.0	4.0
34.0	259	Run head	24-Mar	11:32	13.1	11.1	71.6	12	--	3.0	4.0
34.0	260	Run body	24-Mar	11:08	13.1	11.26	71.4	12	--	2.5	3.5
33.9	261	Run tail	24-Mar	10:55	13.1	11.26	71.4	12	--	0.5	2.5

RM	NSO	Habitat type	Sample date	Start time	Water temperature (C)	DO (ppm)	Specific conductivity (mS)	Horizontal visability (ft)	Vertical visability (ft)	Average depth (ft)	Maximum depth (ft)
33.4	271	Pool head	24-Mar	15:10	15.0	12.27	71.5	12	--	3.0	10.0
33.2	272	Pool body	24-Mar	14:39	15.0	12.27	71.5	12	--	4.5	10.8
33.2	273	Pool tail	24-Mar	14:28	15.0	12.27	71.5	12	--	1.8	3.5
31.9	287	Run head	24-Mar	17:07	15.3	12.51	73.7	11	--	3.0	4.0
31.7	288	Run body	24-Mar	16:42	15.3	12.51	73.7	11	--	4.0	8.0
31.7	289	Run tail	24-Mar	16:36	15.3	12.51	73.7	11	--	0.8	3.5
29.5	324	Riffle	21-Mar	16:28	17.3	10.53	85.2	5	--	1.5	2.0
29.5	325	Run head	21-Mar	16:19	17.3	10.53	85.2	5	--	2.5	3.5
29.5	326	Run body	21-Mar	16:12	17.3	10.53	85.2	5	--	3.0	4.5
29.5	327	Run tail	21-Mar	16:07	17.3	10.53	85.2	5	--	2.5	3.5

Table E-2. Water quality data for the habitat units selected for snorkel sampling, July 2009.

RM	NSO	Habitat type	Sample date	Start time	Water temperature (C)	DO (ppm)	Specific conductivity (mS)	Horizontal visability (ft)	Vertical visability (ft)	Average depth (ft)	Maximum depth (ft)
51.8	1	Pool head	11-Jul	12:17	11.8	12.0	35.5	21.0	5.0	3.5	5.0
51.7	2	Pool body	11-Jul	11:52	11.8	12.0	35.5	21.0	28.0	20.0	35.0
51.6	4	Pool head	11-Jul	10:57	11.8	12.0	35.5	21.0	6.0	3.5	6.0
51.6	5	Pool body	11-Jul	9:57	11.8	12.0	35.5	21.0	26.5	12.0	26.5
50.6	14	Riffle	9-Jul	10:45	12.0	11.8	36.2	16.0	4.0	1.5	4.0
50.6	15	Run head	9-Jul	10:35	12.4	11.7	36.3	16.0	4.0	2.0	4.0
50.3	19	Run head	9-Jul	11:35	14.8	12.1	36.6	16.0	8.0	5.0	8.0
50.1	20	Run body	9-Jul	11:05	14.8	12.1	36.6	16.0	8.0	2.5	8.0
50.1	22	Riffle	9-Jul	15:51	15.6	12.0	37.3	16.0	2.5	0.5	2.5
49.7	27	Pool head	10-Jul	12:00	14.9	11.8	37.3	13.0	3.5	2.0	3.5
49.6	28	Pool body	10-Jul	11:52	14.9	11.8	37.3	13.0	18.0	6.0	18.0
49.2	33	Riffle	10-Jul	10:42	14.6	11.6	37.8	13.0	4.0	1.0	4.0
49.2	34	Run head	10-Jul	10:16	14.3	11.4	38.2	13.0	3.0	1.5	3.0
49.1	35	Run body	10-Jul	10:07	14.3	11.4	38.2	13.0	6.5	2.5	6.5
48.2	49	Riffle	10-Jul	14:20	18.9	12.1	38.5	16.0	3.0	1.0	3.0
48	54	Pool head	10-Jul	13:41	18.0	12.2	38.7	16.0	7.5	4.0	7.5
47	58	Run head	12-Jul	12:09	16.7	11.1	39.5	9.0	4.0	2.0	4.0
46.9	59	Run body	12-Jul	11:54	16.7	11.1	39.5	9.0	6.5	3.5	6.5
45.7	74	Riffle	12-Jul	15:05	19.5	11.4	40.5	12.0	1.5	0.5	1.5
45.7	75	Run head	12-Jul	14:40	19.5	11.4	40.5	12.0	2.0	1.0	2.0
45.7	76	Run body	12-Jul	14:35	19.5	11.4	40.5	12.0	2.5	1.5	2.5
45	86	Pool head	13-Jul	12:12	19.5	11.1	41.4	8.0	9.0	5.0	9.0
44.9	87	Pool body	13-Jul	12:06	19.5	11.1	41.4	8.0	9.0	3.0	9.0
44.5	101	Riffle	13-Jul	13:18	21.5	11.3	42.2	8.0	3.0	1.5	3.0
43.2	108	Run head	14-Jul	15:59	23.1	11.0	43.7	9.0	3.5	2.0	3.5
43.1	109	Run body	14-Jul	12:37	23.1	11.0	43.7	9.0	4.5	2.0	4.5
43	111	Riffle	14-Jul	12:27	23.1	11.0	43.7	9.0	2.5	1.0	2.5
43	112	Pool head	11-Jul	15:28	21.9	10.5	43.9	6.0	2.5	1.5	2.5

RM	NSO	Habitat type	Sample date	Start time	Water temperature (C)	DO (ppm)	Specific conductivity (mS)	Horizontal visability (ft)	Vertical visability (ft)	Average depth (ft)	Maximum depth (ft)
43	113	Pool body	11-Jul	15:02	21.9	10.5	43.9	6.0	9.0	4.0	9.0
41.9	132	Riffle	14-Jul	10:50	21.5	9.9	48.3	10.5	3.0	1.5	3.0
41.9	133	Run head	14-Jul	10:46	21.5	9.9	48.3	10.5	3.0	2.0	3.0

Appendix F: Water Temperature Data

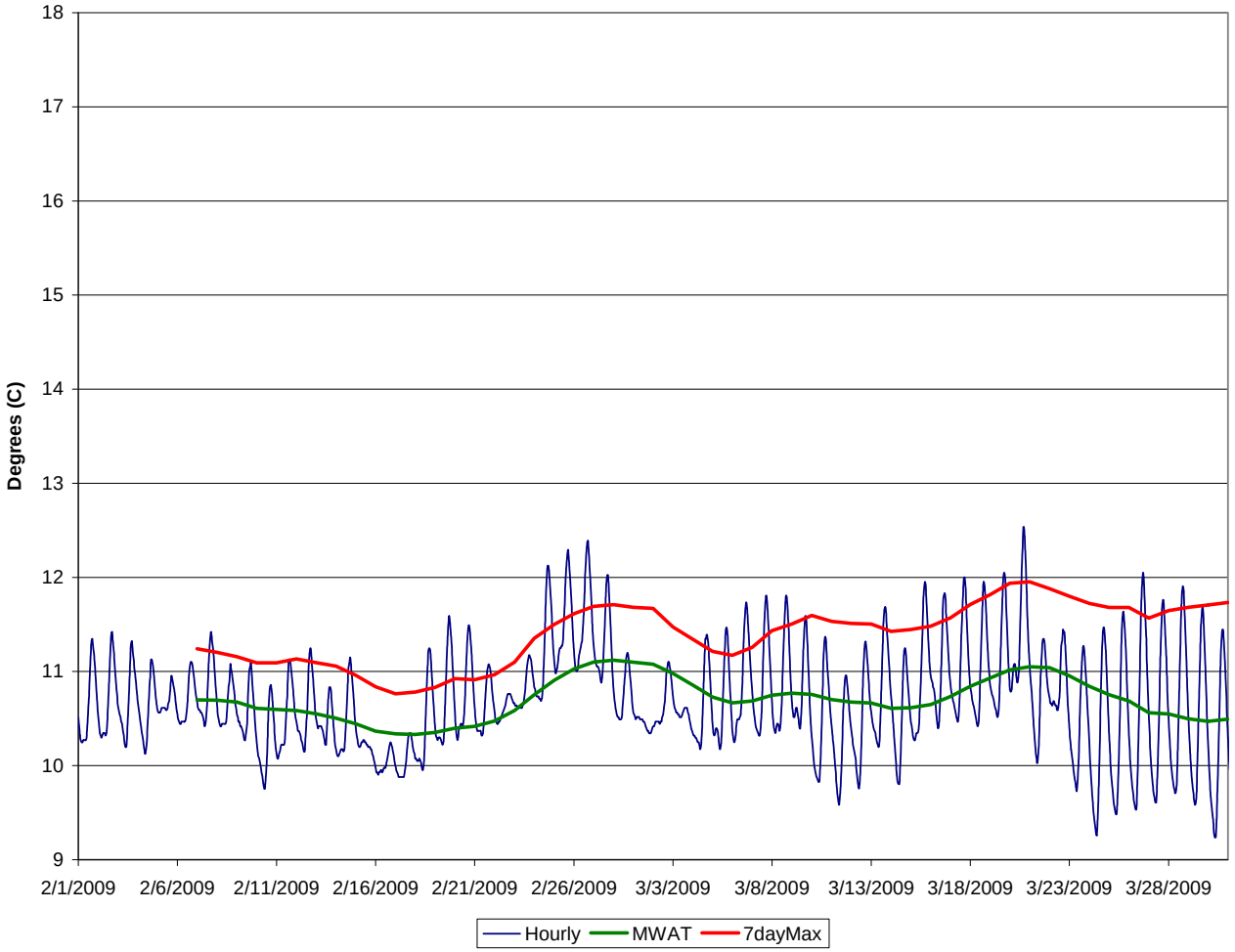

Figure F-1. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Riffle A7 (RM 50.8), February–March 2009.

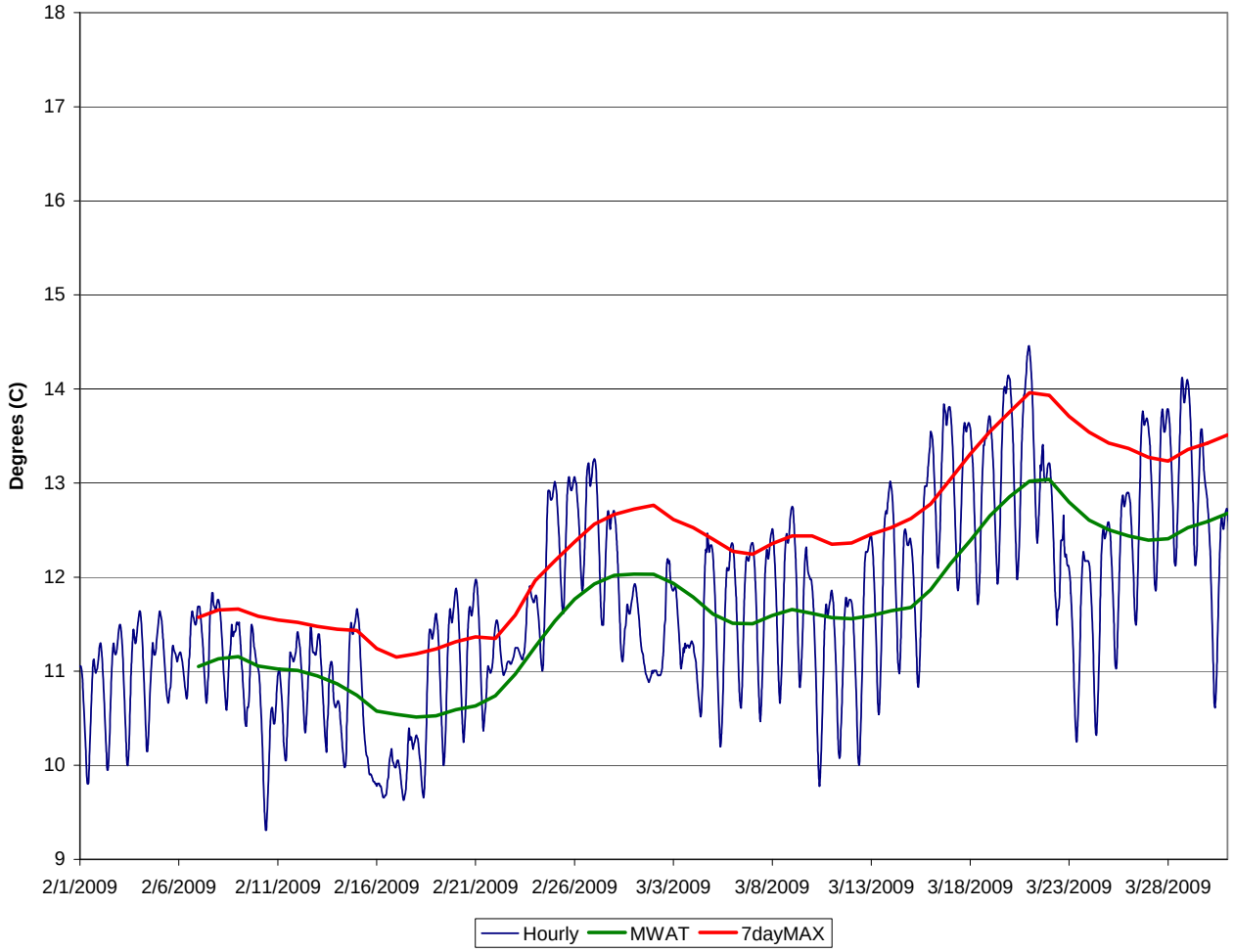

Figure F-2. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Riffle 13B (RM 45.5), February–March 2009.

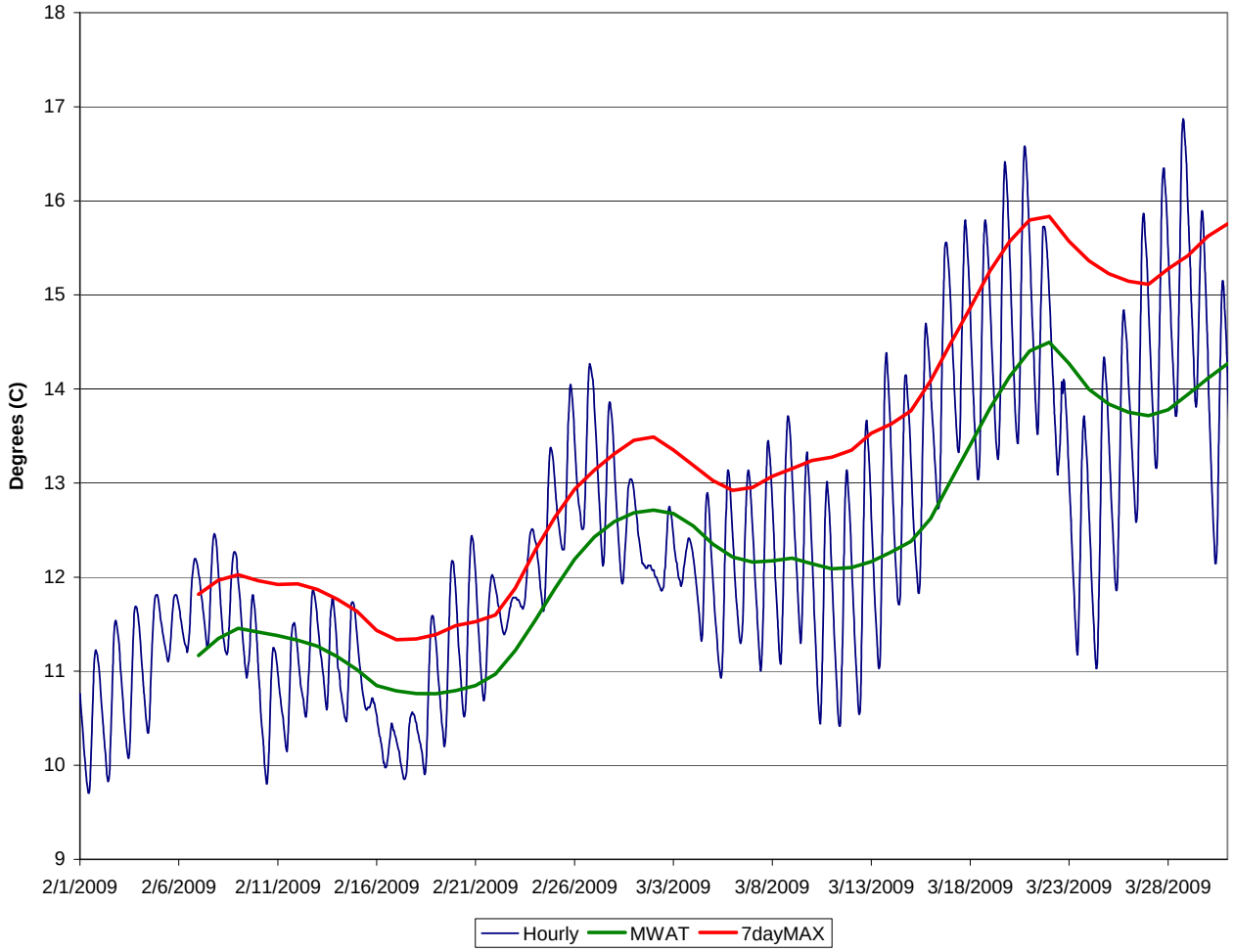

Figure F-3. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Roberts Ferry Bridge (RM 39.6), February–March 2009.

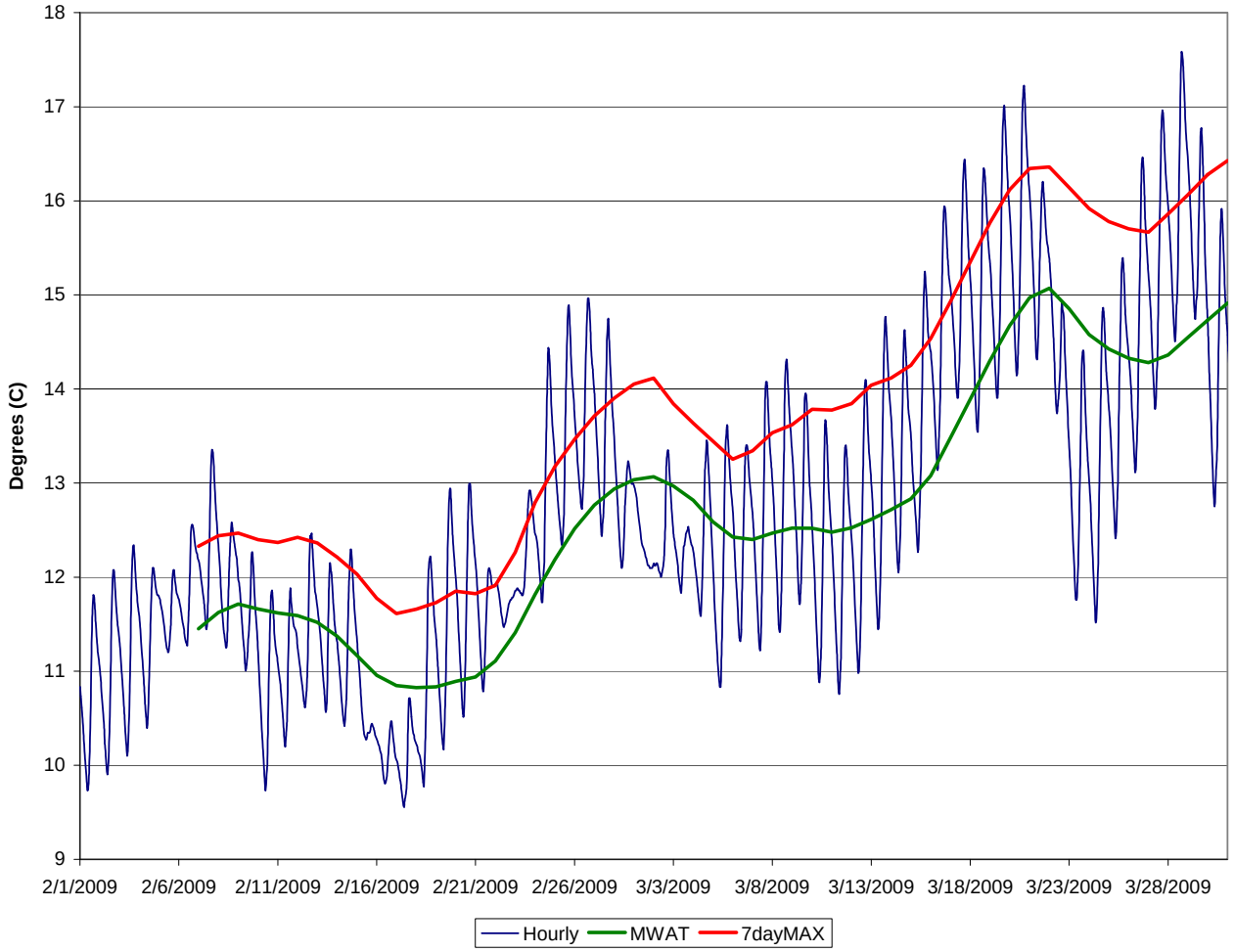

Figure F-4. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Ruddy Gravel (RM 36.5), February–March 2009.

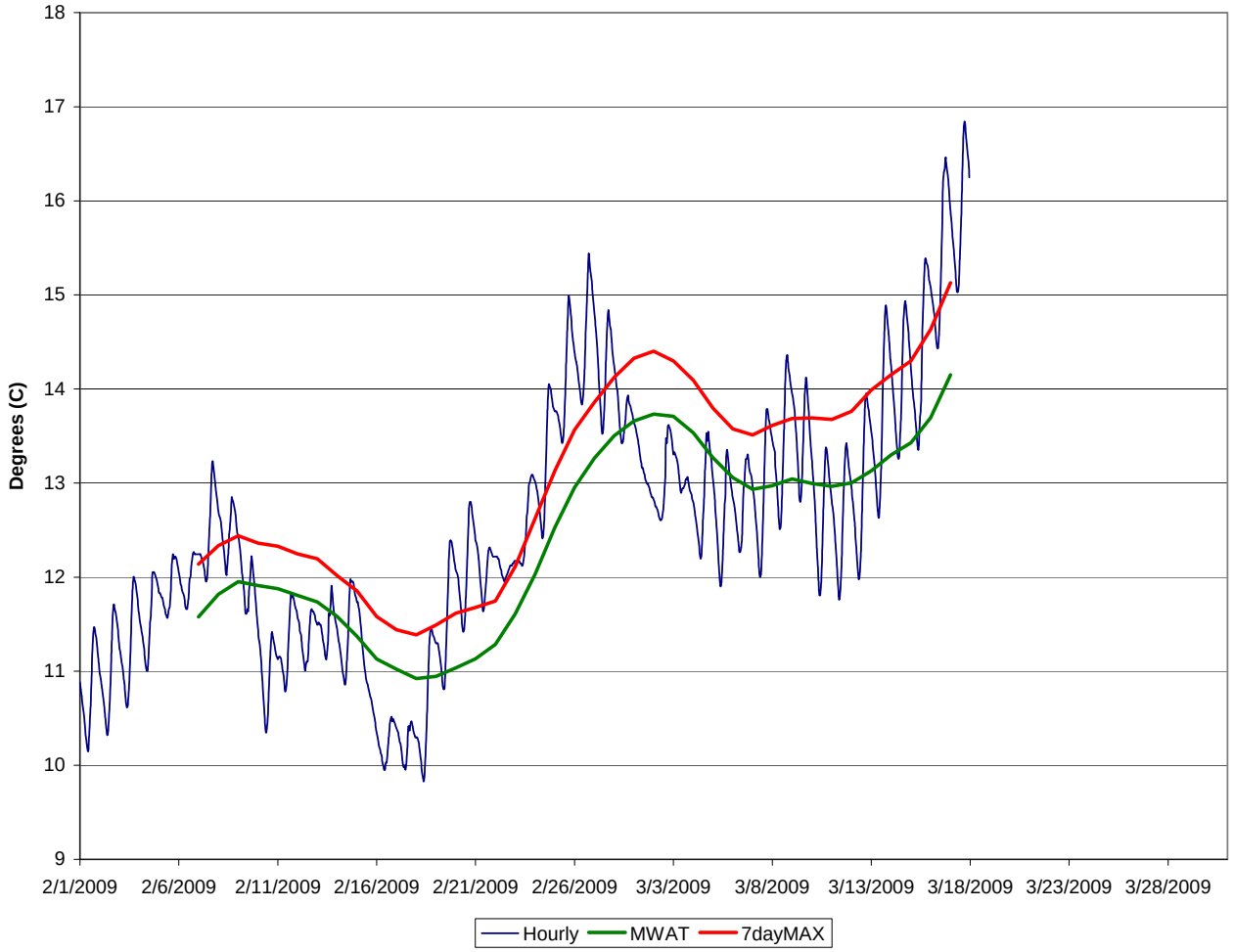

Figure F-5. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Waterford RST (RM 29.8), February–March 2009.

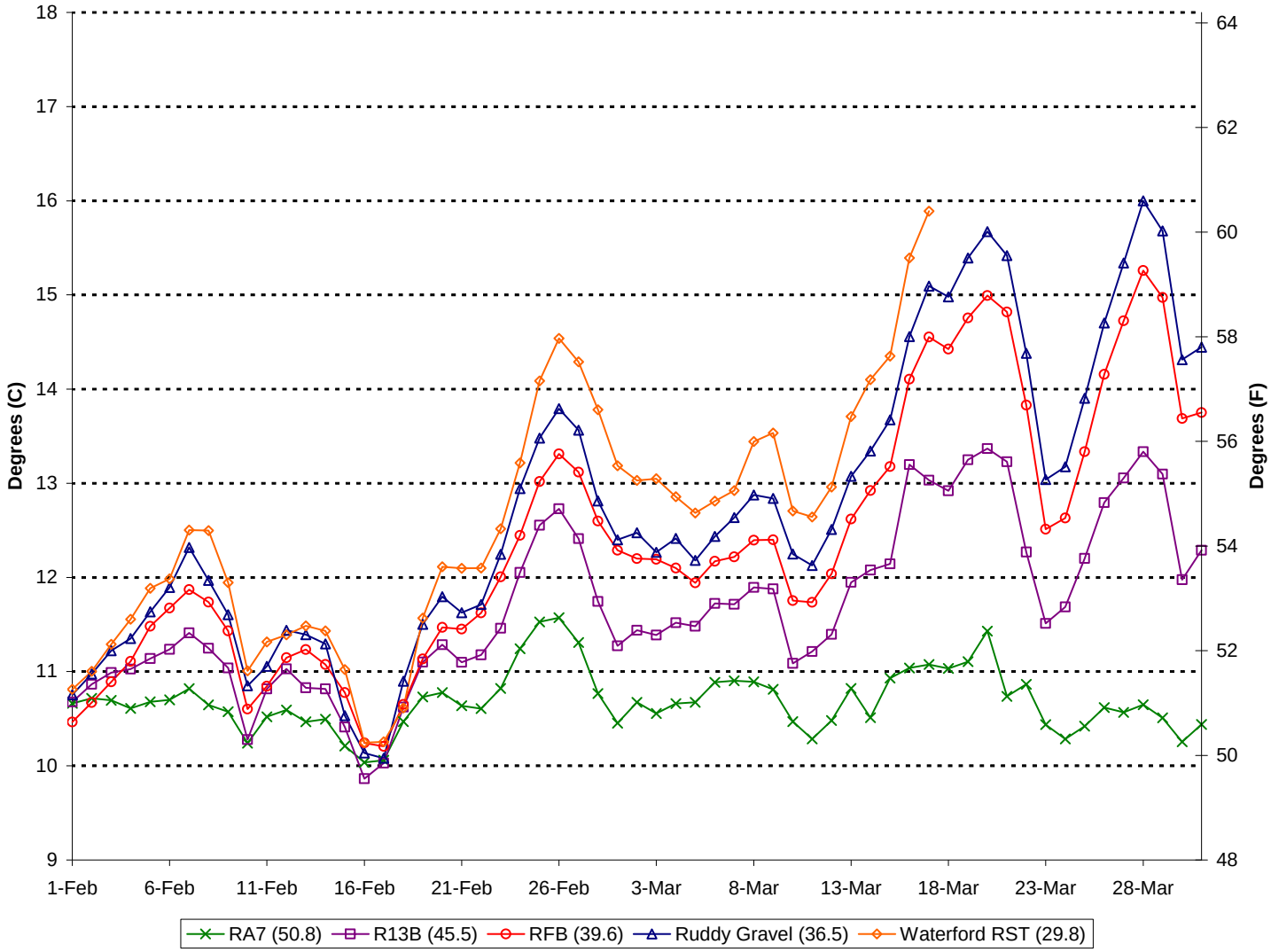

Figure F-6. Average daily water temperature from thermographs, February–March 2009.

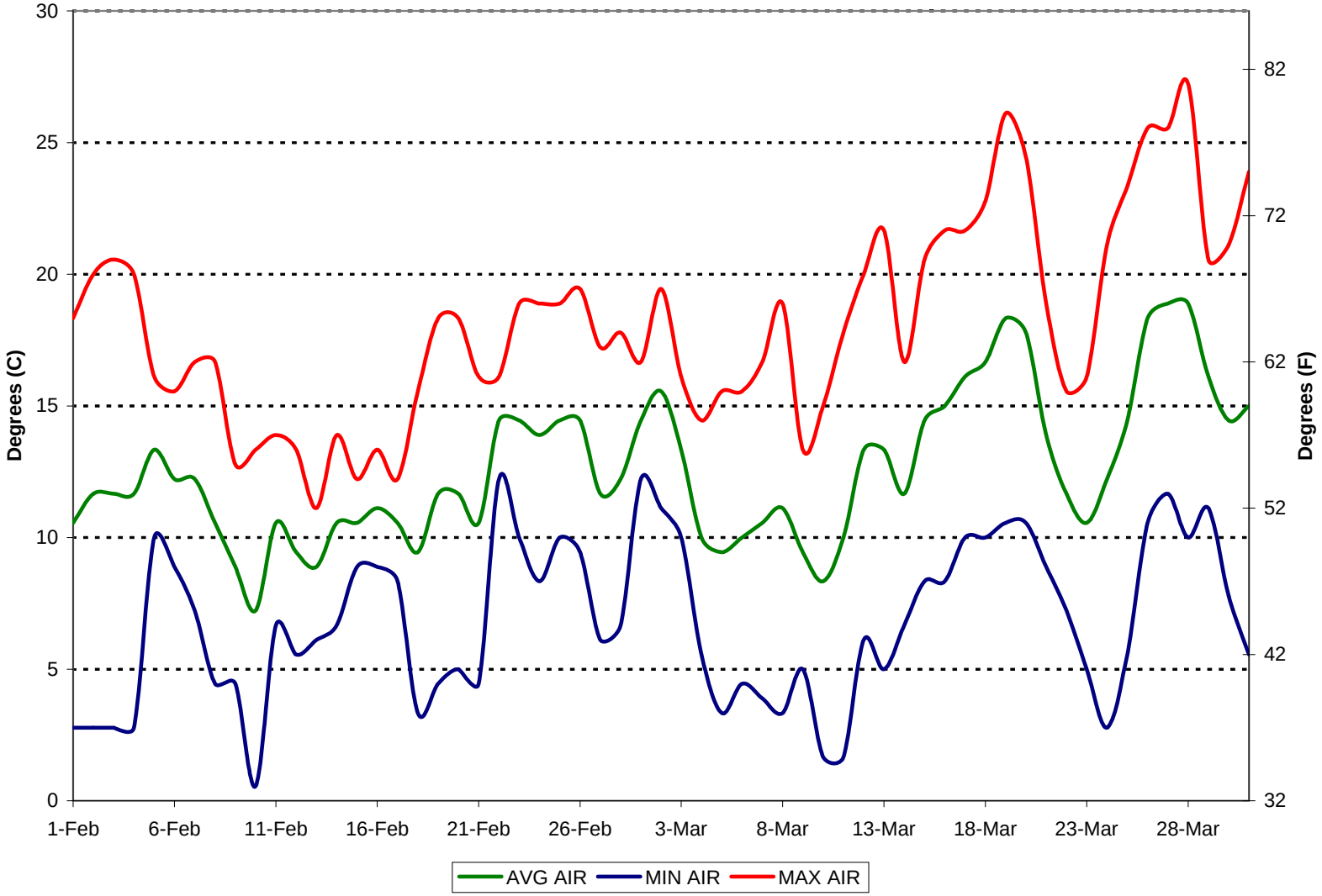

Figure F-7. Daily average, minimum, and maximum air temperature at the Modesto Airport, February-March 2009.

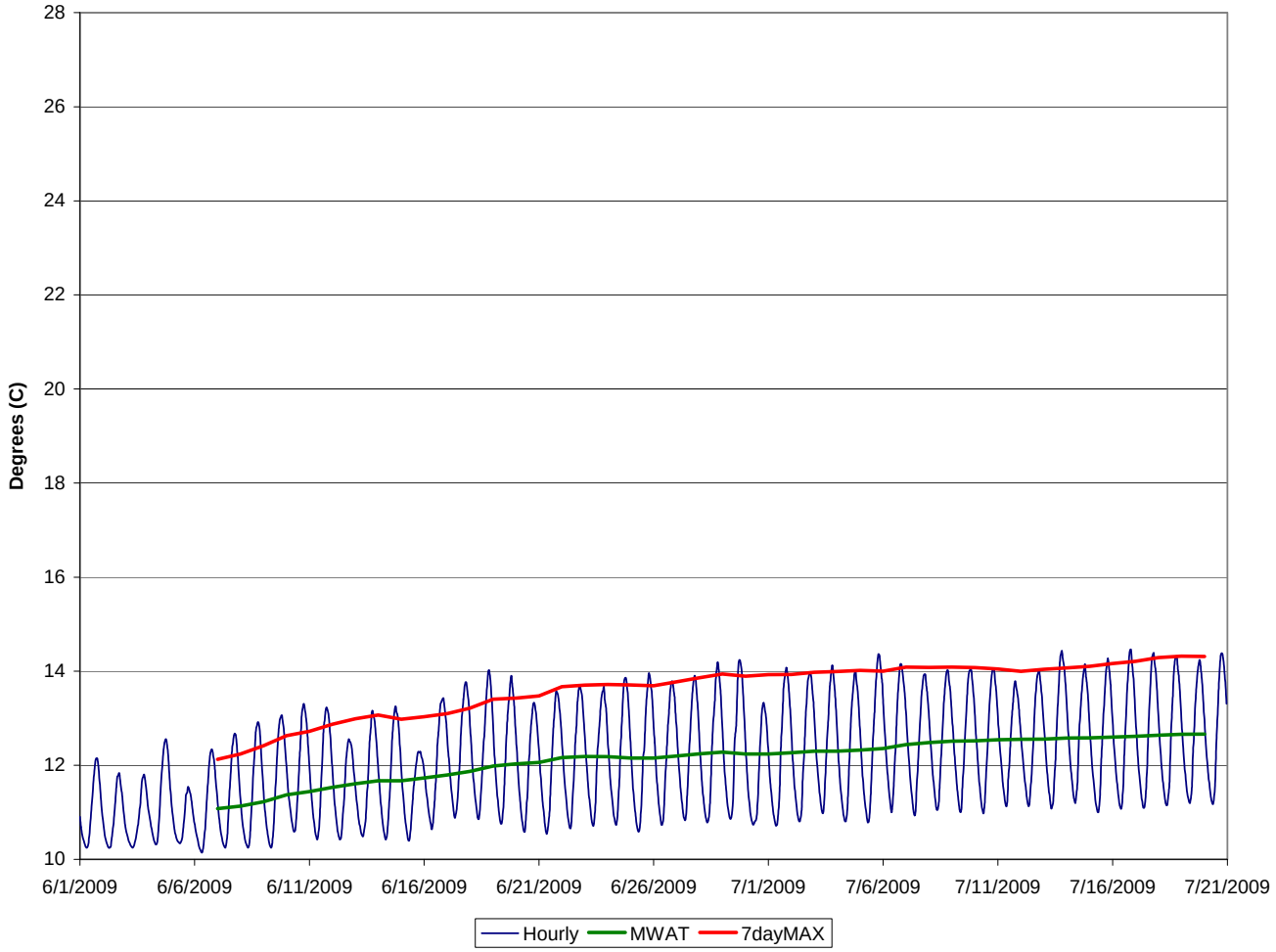

Figure F-8. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Riffle A7 (RM 50.8), June–July 2009.

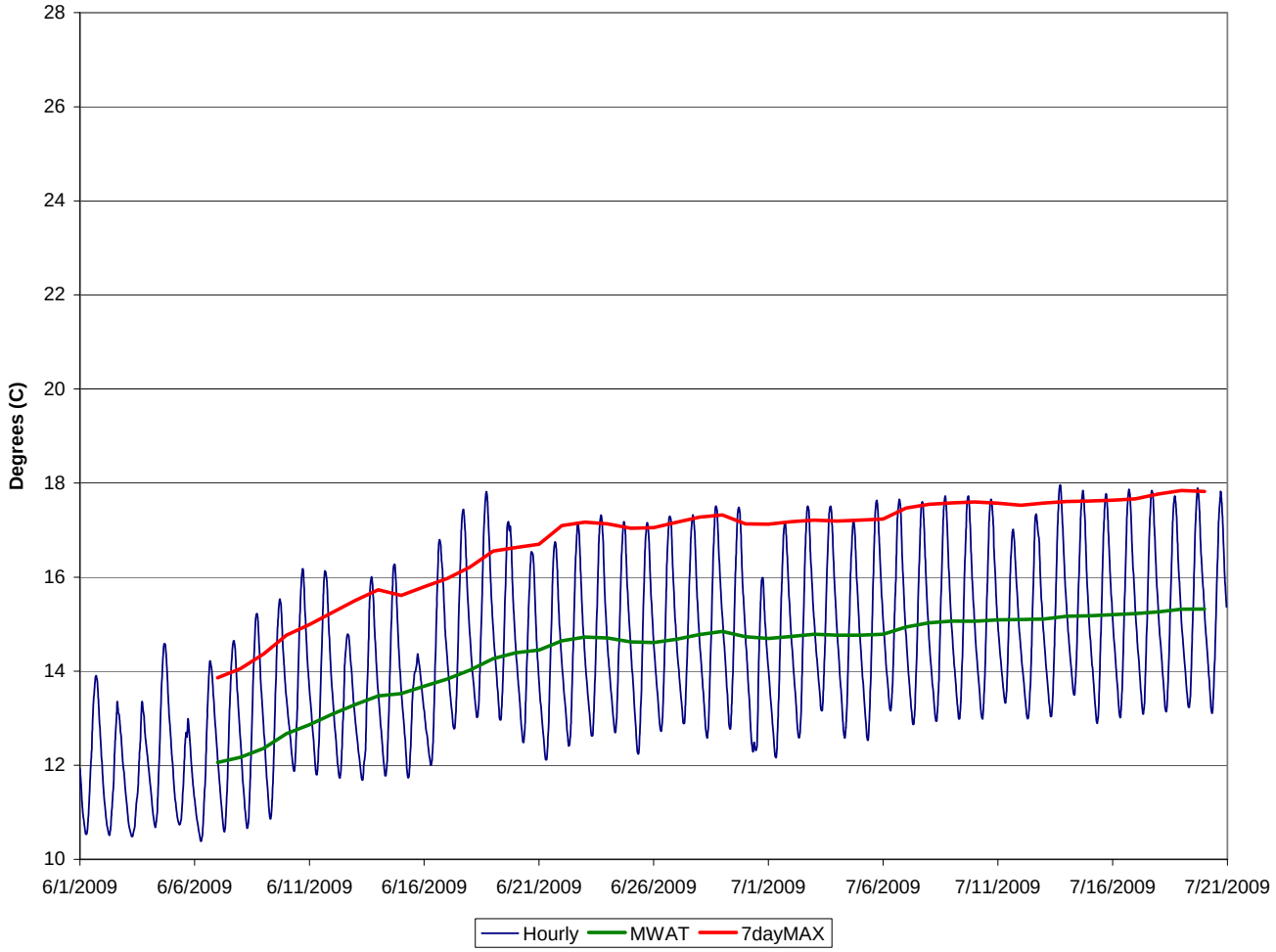

Figure F-9. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Riffle 3B (RM 49.0), June–July 2009.

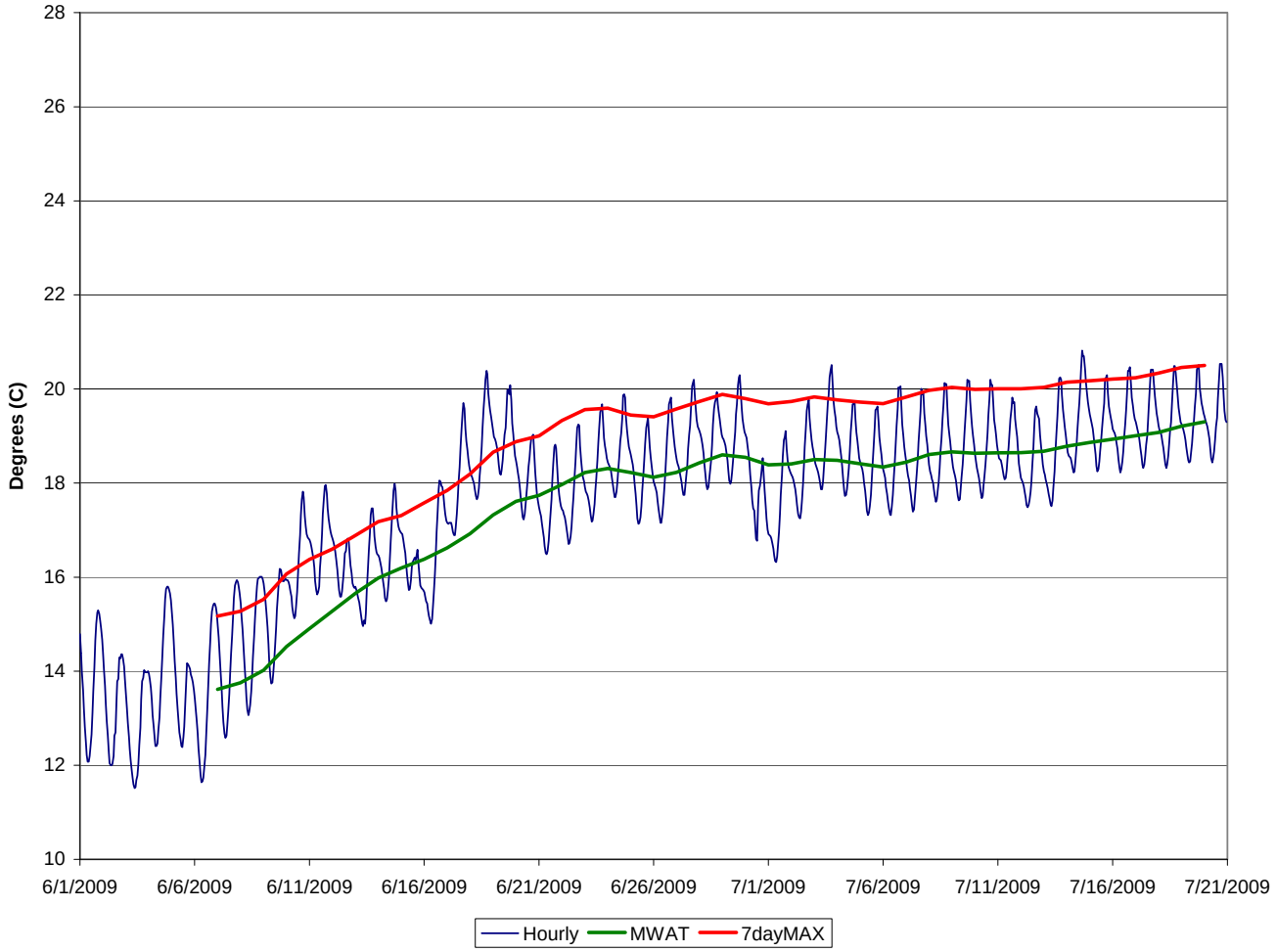

Figure F-10. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Riffle 13B (RM 45.5), June –July 2009.

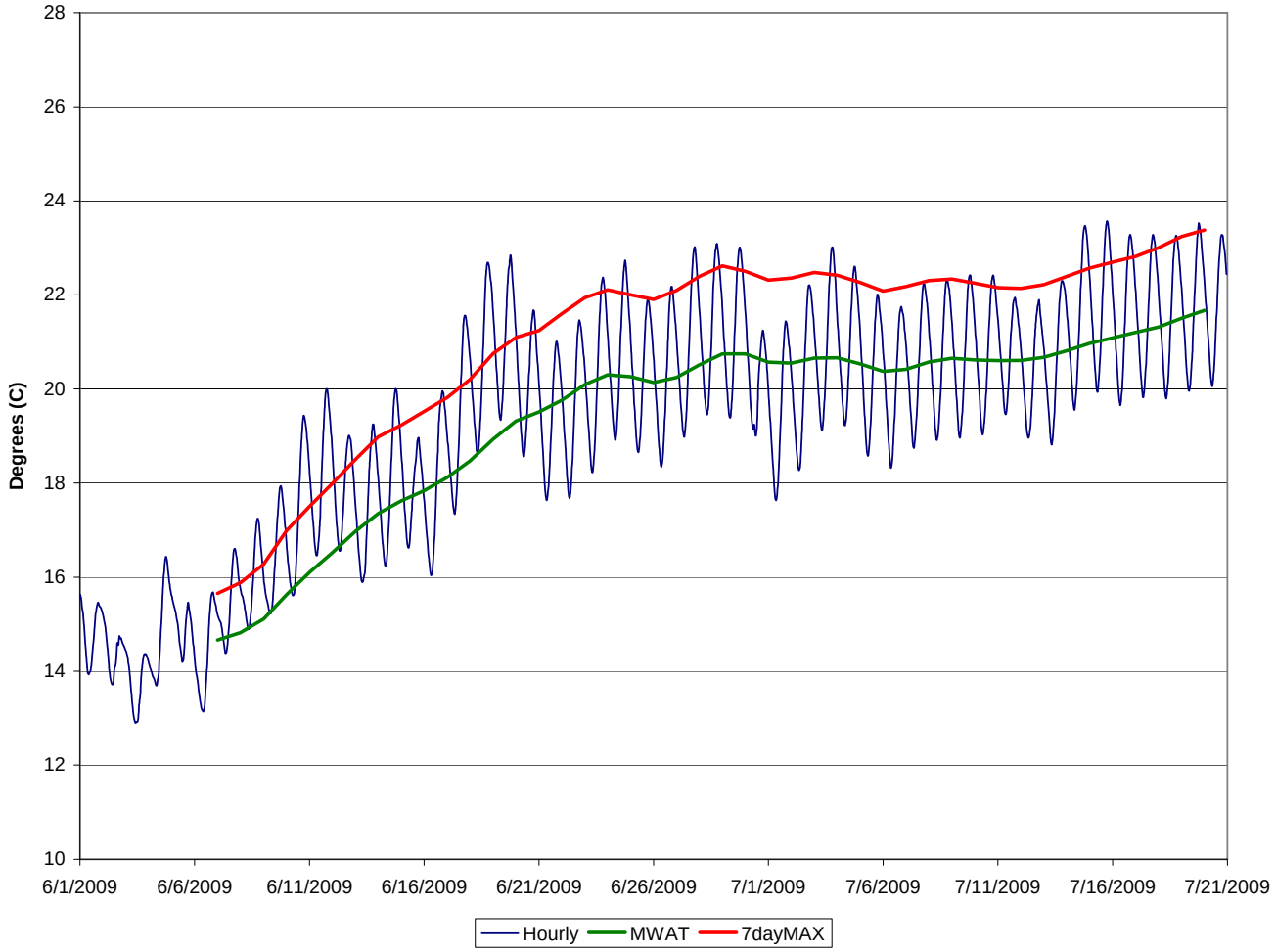

Figure F-11. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Riffle 21 (RM 42.9), June–July 2009.

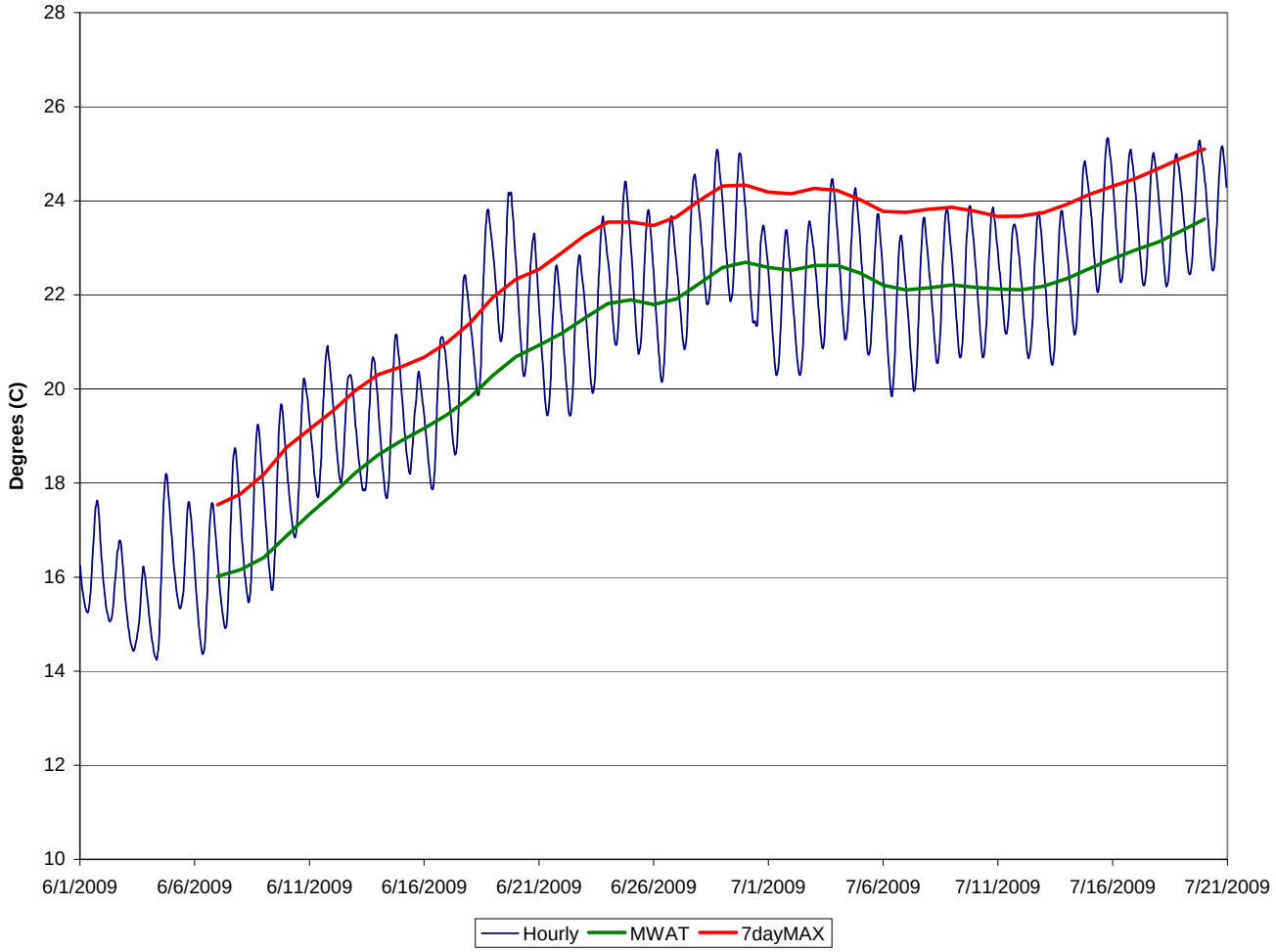

Figure F-12. Hourly, mean weekly average, and 7-day average of daily maximum temperatures at Roberts Ferry Bridge (RM 39.6), June–July 2009.

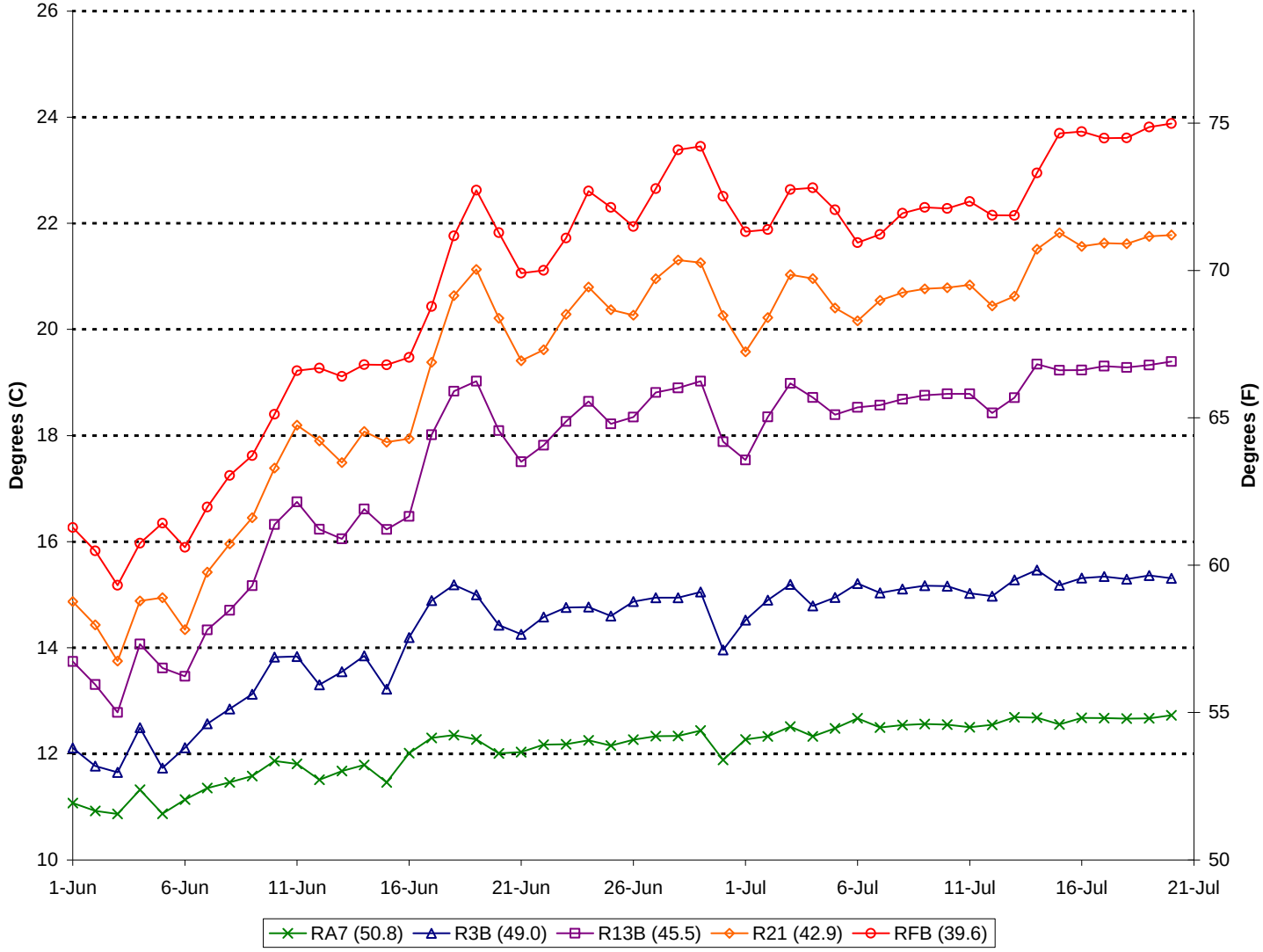

Figure F-13. Average daily water temperature from thermographs, June–July 2009.

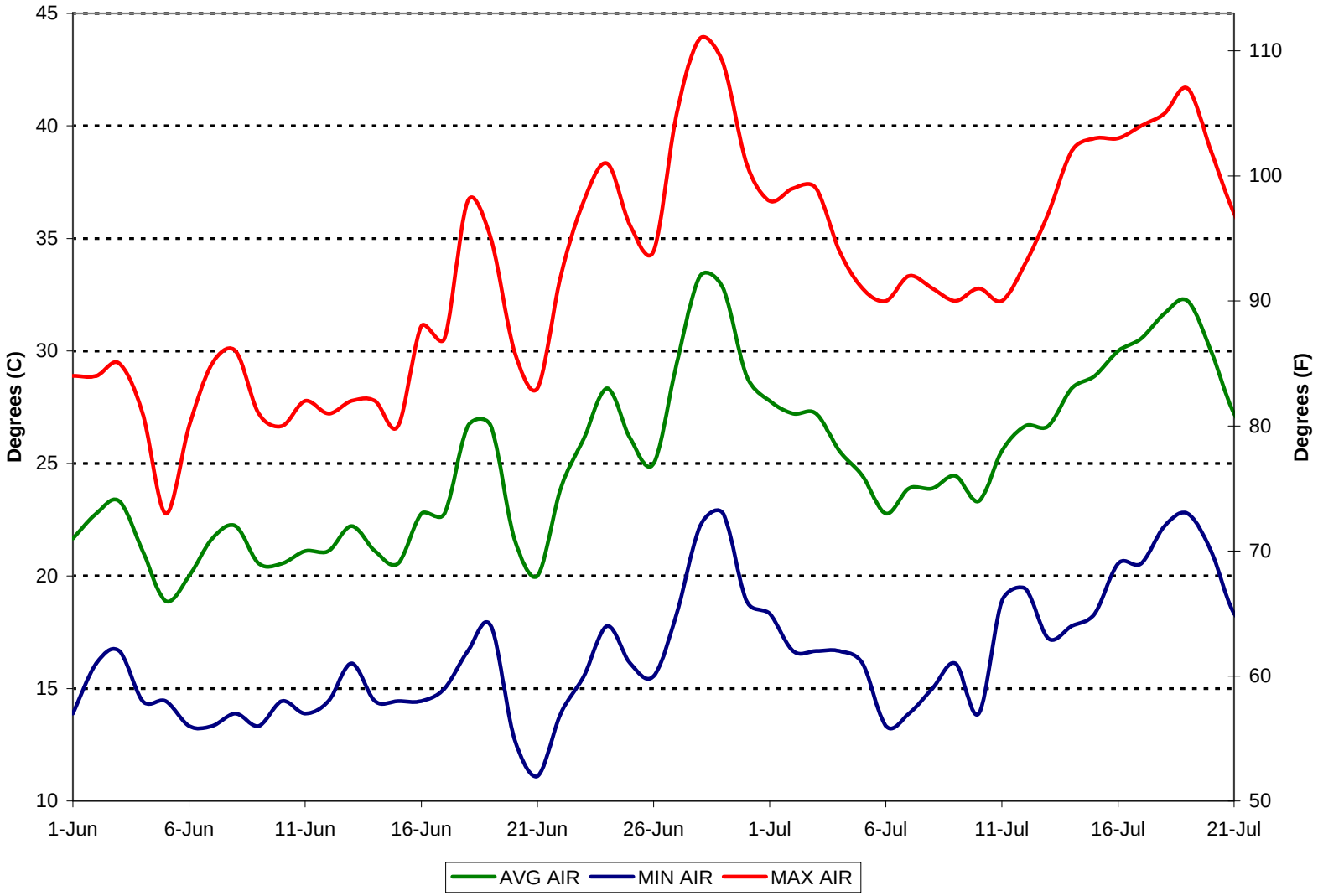

Figure F-14. Daily average, minimum, and maximum air temperature at the Modesto Airport, June-July 2009.

Appendix G: Fish Observation Data

Table G-1. *O. mykiss* observation data for the study area, March 2009.

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
51.6	4	Pool head	S	1	0	--
51.6	5	Pool body	S	1	0	--
51.5	6	Pool tail	S	1	0	--
51.5	7	Riffle	S	1	2	50–99
50.6	14	Riffle	S	1	1	300–349
50.6	14	Riffle	S	1	3	400–449
50.6	15	Run head	S	1	0	--
50.5	16	Run body	S	1	0	--
50.4	17	Run tail	S	1	0	--
50.1	22	Riffle	S	1	0	--
49.7	27	Pool head	S	1	1	450–499
49.6	28	Pool body	S	1	0	--
49.6	29	Pool tail	S	1	0	--
48.0	53	Riffle	M	1	1	300–349
48.0	53	Riffle	M	2	0	--
48.0	53	Riffle	M	3	1	300–349
47.0	58	Run head	M	1	0	--
47.0	58	Run head	M	2	0	--
47.0	58	Run head	M	3	0	--
46.9	59	Run body	S	1	0	--
46.9	60	Run tail	M	1	0	--
46.9	60	Run tail	M	2	0	--
46.9	60	Run tail	M	3	0	--
45.3	82	Run head	S	1	0	--
45.1	83	Run body	S	1	0	--
45.1	84	Run tail	M	1	0	--
45.1	84	Run tail	M	2	0	--
45.1	84	Run tail	M	3	0	--
45.0	86	Pool head	S	1	0	--
44.9	87	Pool body	S	1	0	--
44.9	88	Pool tail	M	1	0	--
44.9	88	Pool tail	M	2	0	--
44.9	88	Pool tail	M	3	0	--
44.6	97	Riffle	S	1	0	--
43.2	107	Riffle	S	1	3	50–99
43.2	108	Run head	S	1	0	--
43.2	108	Run head	S	1	0	--
43.1	109	Run body	S	1	0	--
43.1	110	Run tail	S	1	0	--

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
43.0	111	Riffle	M	1	1	200–249
43.0	111	Riffle	M	2	0	--
43.0	111	Riffle	M	3	0	--
43.0	112	Pool head	M	1	0	--
43.0	112	Pool head	M	2	0	--
43.0	112	Pool head	M	3	0	--
43.0	113	Pool body	M	1	0	--
43.0	113	Pool body	M	2	0	--
43.0	113	Pool body	M	3	0	--
43.0	114	Pool tail	S	1	0	--
42.9	118	Riffle	S	1	0	--
39.6	157	Run head	S	1	0	--
39.5	158	Run body	M	1	0	--
39.5	158	Run body	M	2	0	--
39.5	158	Run body	M	3	0	--
39.5	159	Run tail	S	1	0	--
39.4	160	Riffle	S	1	0	--
38.9	168	Riffle	S	1	0	--
38.7	175	Riffle	S	1	0	--
38.1	188	Pool head	S	1	0	--
38.1	189	Pool body	S	1	0	--
38.1	190	Pool tail	S	1	0	--
38.1	192	Pool head	M	1	0	--
38.0	193	Pool body	S	1	0	--
38.0	194	Pool tail	M	1	0	--
38.0	194	Pool tail	M	2	0	--
38.0	194	Pool tail	M	3	0	--
36.9	214	Pool head	S	1	0	--
36.9	215	Pool body	S	1	0	--
36.9	216	Pool tail	S	1	0	--
36.8	218	Run head	S	1	0	--
36.6	219	Run body	M	1	0	--
36.6	219	Run body	M	2	0	--
36.6	219	Run body	M	3	0	--
36.6	220	Run tail	S	1	0	--
36.2	230	Pool head	S	1	0	--
36.2	231	Pool body	M	1	0	--
36.2	232	Pool tail	S	1	0	--
34.0	259	Run head	M	1	0	--
34.0	259	Run head	M	2	0	--
34.0	259	Run head	M	3	0	--

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
34.0	260	Run body	S	1	0	--
33.9	261	Run tail	S	1	0	--
33.4	271	Pool head	S	1	0	--
33.2	272	Pool body	S	1	0	--
33.2	273	Pool tail	S	1	0	--
31.9	287	Run head	S	1	0	--
31.7	288	Run body	S	1	0	--
31.7	289	Run tail	S	1	0	--
29.5	324	Riffle	S	1	0	--
29.5	325	Run head	S	1	0	--
29.5	326	Run body	S	1	0	--
29.5	327	Run tail	S	1	0	--

Table G-2. *O. mykiss* observation data for the study area, July 2009.

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
51.8	1	Pool head	S	1	2	200–250
51.8	1	Pool head	S	1	8	400–450
51.8	1	Pool head	S	1	4	450–500
51.7	2	Pool body	S	1	1	300–350
51.7	2	Pool body	S	1	2	350–400
51.7	2	Pool body	S	1	1	400–450
51.6	4	Pool head	M	1	2	300–350
51.6	4	Pool head	M	1	1	350–400
51.6	4	Pool head	M	2	1	300–350
51.6	4	Pool head	M	2	2	350–400
51.6	4	Pool head	M	3	1	300–350
51.6	4	Pool head	M	3	1	350–400
51.6	5	Pool body	M	1	36	0–50
51.6	5	Pool body	M	1	60	100–150
51.6	5	Pool body	M	1	2	350–400
51.6	5	Pool body	M	1	188	50–100
51.6	5	Pool body	M	2	30	0–50
51.6	5	Pool body	M	2	90	100–150
51.6	5	Pool body	M	2	2	350–400
51.6	5	Pool body	M	2	174	50–100
51.6	5	Pool body	M	3	45	0–50
51.6	5	Pool body	M	3	100	100–150
51.6	5	Pool body	M	3	2	250–300
51.6	5	Pool body	M	3	2	350–400
51.6	5	Pool body	M	3	144	50–100
50.6	14	Riffle	S	1	35	100–150
50.6	14	Riffle	S	1	3	150–200
50.6	14	Riffle	S	1	1	350–400
50.6	14	Riffle	S	1	13	50–100
50.6	15	Run head	S	1	2	100–150
50.3	19	Run head	S	1	3	250–300
50.3	19	Run head	S	1	1	350–400
50.1	20	Run body	M	1	1	100–150
50.1	20	Run body	M	1	1	200–250
50.1	20	Run body	M	1	4	50–100
50.1	20	Run body	M	2	1	300–350
50.1	20	Run body	M	2	1	400–450
50.1	20	Run body	M	3	3	250–300
50.1	22	Riffle	M	1	3	0–50

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
50.1	22	Riffle	M	1	29	100–150
50.1	22	Riffle	M	1	2	250–300
50.1	22	Riffle	M	1	1	300–350
50.1	22	Riffle	M	1	43	50–100
50.1	22	Riffle	M	2	5	0–50
50.1	22	Riffle	M	2	43	100–150
50.1	22	Riffle	M	2	2	250–300
50.1	22	Riffle	M	2	1	300–350
50.1	22	Riffle	M	2	47	50–100
50.1	22	Riffle	M	3	3	0–50
50.1	22	Riffle	M	3	40	100–150
50.1	22	Riffle	M	3	1	350–400
50.1	22	Riffle	M	3	43	50–100
49.7	27	Pool head	S	1	1	100–150
49.7	27	Pool head	S	1	1	150–200
49.7	27	Pool head	S	1	1	250–300
49.7	27	Pool head	S	1	2	300–350
49.7	27	Pool head	S	1	2	50–100
49.6	28	Pool body	S	1	2	100–150
49.6	28	Pool body	S	1	5	150–200
49.6	28	Pool body	S	1	3	200–250
49.6	28	Pool body	S	1	8	50–100
49.2	33	Riffle	S	1	17	100–150
49.2	33	Riffle	S	1	6	150–200
49.2	33	Riffle	S	1	11	200–300
49.2	33	Riffle	S	1	3	300–350
49.2	33	Riffle	S	1	1	400–450
49.2	33	Riffle	S	1	11	50–100
49.2	34	Run head	S	1	5	100–150
49.2	34	Run head	S	1	3	150–200
49.2	34	Run head	S	1	1	250–300
49.2	34	Run head	S	1	1	300–350
49.2	34	Run head	S	1	21	50–100
49.1	35	Run body	S	1	0	--
48.2	49	Riffle	S	1	40	100–150
48.2	49	Riffle	S	1	2	150–200
48.2	49	Riffle	S	1	4	200–250
48.2	49	Riffle	S	1	6	250–300
48.2	49	Riffle	S	1	1	350–400
48.2	49	Riffle	S	1	25	50–100
48.0	54	Pool head	S	1	1	200–250

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
48.0	54	Pool head	S	1	1	300–350
47.0	58	Run head	M	1	1	150–200
47.0	58	Run head	M	2	4	100–150
47.0	58	Run head	M	2	2	50–100
47.0	58	Run head	M	3	5	100–150
46.9	59	Run body	S	1	0	--
45.7	74	Riffle	S	1	2	0–50
45.7	74	Riffle	S	1	5	100–150
45.7	74	Riffle	S	1	1	150–200
45.7	74	Riffle	S	1	6	50–100
45.7	75	Run head	M	1	0	--
45.7	75	Run head	M	2	0	--
45.7	75	Run head	M	3	1	50–100
45.7	76	Run body	S	1	0	--
45.0	86	Pool head	M	1	0	--
45.0	86	Pool head	M	2	0	--
45.0	86	Pool head	M	3	0	--
44.9	87	Pool body	S	1	0	--
44.5	101	Riffle	M	1	15	100–150
44.5	101	Riffle	M	1	3	150–200
44.5	101	Riffle	M	1	4	50–100
44.5	101	Riffle	M	2	14	100–150
44.5	101	Riffle	M	2	1	150–200
44.5	101	Riffle	M	2	3	50–100
44.5	101	Riffle	M	3	13	100–150
44.5	101	Riffle	M	3	1	150–200
44.5	101	Riffle	M	3	9	50–100
43.2	108	Run head	S	1	0	--
43.1	109	Run body	M	1	12	100–150
43.1	109	Run body	M	1	5	150–200
43.1	109	Run body	M	1	1	50–100
43.1	109	Run body	M	2	8	100–150
43.1	109	Run body	M	2	1	150–200
43.1	109	Run body	M	2	4	50–100
43.1	109	Run body	M	3	9	100–150
43.1	109	Run body	M	3	1	150–200
43.1	109	Run body	M	3	5	50–100
43.0	111	Riffle	S	1	6	100–150
43.0	111	Riffle	S	1	2	150–200
43.0	111	Riffle	S	1	1	50–100
43.0	112	Pool head	S	1	1	50–100

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
43.0	113	Pool body	M	1	0	--
43.0	113	Pool body	M	2	0	--
43.0	113	Pool body	M	3	0	--
41.9	132	Riffle	S	1	1	100–150
41.9	132	Riffle	S	1	1	200–250
41.9	133	Run head	S	1	0	--

Table G-3. *O. tshawyschta* observation data for the study area, March 2009.

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
51.6	4	Pool head	S	1	80	0–49
51.6	4	Pool head	S	1	45	50–99
51.6	5	Pool body	S	1	0	--
51.5	6	Pool tail	S	1	6	0–49
51.5	6	Pool tail	S	1	4	50–99
51.5	7	Riffle	S	1	250	0–49
51.5	7	Riffle	S	1	1	500–549
51.5	7	Riffle	S	1	119	50–99
50.6	14	Riffle	S	1	910	0–49
50.6	14	Riffle	S	1	505	50–99
50.6	15	Run head	S	1	112	0–49
50.6	15	Run head	S	1	144	50–99
50.5	16	Run body	S	1	149	0–49
50.5	16	Run body	S	1	1	500–549
50.5	16	Run body	S	1	208	50–99
50.4	17	Run tail	S	1	71	0–49
50.4	17	Run tail	S	1	50	50–99
50.1	22	Riffle	S	1	32	0–49
50.1	22	Riffle	S	1	12	50–99
49.7	27	Pool head	S	1	60	50–99
49.6	28	Pool body	S	1	0	--
49.6	29	Pool tail	S	1	7	50–99
48.0	53	Riffle	M	1	60	0–49
48.0	53	Riffle	M	1	105	50–99
48.0	53	Riffle	M	2	70	0–49
48.0	53	Riffle	M	2	110	50–99
48.0	53	Riffle	M	3	80	0–49
48.0	53	Riffle	M	3	100	50–99
47.0	58	Run head	M	1	12	0–49
47.0	58	Run head	M	1	3	50–99
47.0	58	Run head	M	2	30	0–49
47.0	58	Run head	M	2	15	50–99
47.0	58	Run head	M	3	30	0–49
47.0	58	Run head	M	3	11	50–99
46.9	59	Run body	S	1	2	0–49
46.9	60	Run tail	M	1	0	--
46.9	60	Run tail	M	2	4	0–49
46.9	60	Run tail	M	3	6	0–49
45.3	82	Run head	S	1	0	--

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
45.1	83	Run body	S	1	2	0–49
45.1	83	Run body	S	1	3	50–99
45.1	84	Run tail	M	1	0	--
45.1	84	Run tail	M	2	0	--
45.1	84	Run tail	M	3	0	--
45.0	86	Pool head	S	1	0	--
44.9	87	Pool body	S	1	15	50–99
44.9	87	Pool body	S	1	1	650–699
44.9	88	Pool tail	M	1	7	50–99
44.9	88	Pool tail	M	2	35	50–99
44.9	88	Pool tail	M	3	35	50–99
44.6	97	Riffle	S	1	31	0–49
44.6	97	Riffle	S	1	103	50–99
43.2	107	Riffle	S	1	65	0–49
43.2	107	Riffle	S	1	80	50–99
43.2	108	Run head	S	1	7	0–49
43.2	108	Run head	S	1	50	0–49
43.2	108	Run head	S	1	30	50–99
43.1	109	Run body	S	1	180	0–49
43.1	109	Run body	S	1	241	50–99
43.1	110	Run tail	S	1	2	50–99
43.0	111	Riffle	M	1	41	0–49
43.0	111	Riffle	M	1	42	50–99
43.0	111	Riffle	M	2	34	0–49
43.0	111	Riffle	M	2	36	50–99
43.0	111	Riffle	M	3	30	0–49
43.0	111	Riffle	M	3	24	50–99
43.0	112	Pool head	M	1	26	0–49
43.0	112	Pool head	M	1	24	50–99
43.0	112	Pool head	M	2	26	0–49
43.0	112	Pool head	M	2	22	50–99
43.0	112	Pool head	M	3	22	0–49
43.0	112	Pool head	M	3	20	50–99
43.0	113	Pool body	M	1	0	--
43.0	113	Pool body	M	2	0	--
43.0	113	Pool body	M	3	0	--
43.0	114	Pool tail	S	1	0	--
42.9	118	Riffle	S	1	7	0–49
42.9	118	Riffle	S	1	14	50–99
39.6	157	Run head	S	1	0	--
39.5	158	Run body	M	1	0	--

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
39.5	158	Run body	M	2	0	--
39.5	158	Run body	M	3	0	--
39.5	159	Run tail	S	1	2	50–99
39.4	160	Riffle	S	1	1	50–99
38.9	168	Riffle	S	1	10	0–49
38.9	168	Riffle	S	1	8	50–99
38.7	175	Riffle	S	1	1	0–49
38.1	188	Pool head	S	1	0	--
38.1	189	Pool body	S	1	0	--
38.1	190	Pool tail	S	1	0	--
38.1	192	Pool head	M	1	0	--
38.0	193	Pool body	S	1	60	50–99
38.0	194	Pool tail	M	1	0	--
38.0	194	Pool tail	M	2	0	--
38.0	194	Pool tail	M	3	0	--
36.9	214	Pool head	S	1	1	50–99
36.9	215	Pool body	S	1	0	--
36.9	216	Pool tail	S	1	0	--
36.8	218	Run head	S	1	0	--
36.6	219	Run body	M	1	1	800–849
36.6	219	Run body	M	2	0	--
36.6	219	Run body	M	3	9	50–99
36.6	220	Run tail	S	1	10	50–99
36.2	230	Pool head	S	1	0	--
36.2	231	Pool body	M	1	0	--
36.2	232	Pool tail	S	1	0	--
34.0	259	Run head	M	1	19	0–49
34.0	259	Run head	M	1	7	50–99
34.0	259	Run head	M	2	28	0–49
34.0	259	Run head	M	2	21	50–99
34.0	259	Run head	M	3	34	0–49
34.0	259	Run head	M	3	20	50–99
34.0	260	Run body	S	1	3	0–49
34.0	260	Run body	S	1	2	50–99
33.9	261	Run tail	S	1	17	0–49
33.9	261	Run tail	S	1	12	50–99
33.4	271	Pool head	S	1	8	0–49
33.2	272	Pool body	S	1	7	0–49
33.2	273	Pool tail	S	1	4	0–49
31.9	287	Run head	S	1	55	0–49
31.9	287	Run head	S	1	13	50–99

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
31.7	288	Run body	S	1	56	0–49
31.7	288	Run body	S	1	18	50–99
31.7	289	Run tail	S	1	10	0–49
31.7	289	Run tail	S	1	5	50–99
29.5	324	Riffle	S	1	0	--
29.5	325	Run head	S	1	0	--
29.5	326	Run body	S	1	0	--
29.5	327	Run tail	S	1	0	--

Table G-4. *O. tshawyschta* observation data for the study area, July 2009.

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
51.8	1	Pool head	S	1	0	--
51.7	2	Pool body	S	1	0	--
51.6	4	Pool head	M	1	0	--
51.6	4	Pool head	M	2	1	>600
51.6	4	Pool head	M	3	0	--
51.6	5	Pool body	M	1	250	0–50
51.6	5	Pool body	M	1	280	50–100
51.6	5	Pool body	M	2	230	0–50
51.6	5	Pool body	M	2	275	50–100
51.6	5	Pool body	M	3	230	0–50
51.6	5	Pool body	M	3	1	400–450
51.6	5	Pool body	M	3	292	50–100
50.6	14	Riffle	S	1	2	>600
50.6	14	Riffle	S	1	570	0–50
50.6	14	Riffle	S	1	120	100–150
50.6	14	Riffle	S	1	2	500–600
50.6	14	Riffle	S	1	1410	50–100
50.6	15	Run head	S	1	30	0–50
50.6	15	Run head	S	1	55	50–100
50.3	19	Run head	S	1	20	100–150
50.3	19	Run head	S	1	480	50–100
50.1	20	Run body	M	1	38	0–50
50.1	20	Run body	M	1	136	50–100
50.1	20	Run body	M	2	116	0–50
50.1	20	Run body	M	2	249	50–100
50.1	20	Run body	M	3	94	0–50
50.1	20	Run body	M	3	197	50–100
50.1	22	Riffle	M	1	17	0–50
50.1	22	Riffle	M	1	68	50–100
50.1	22	Riffle	M	2	24	0–50
50.1	22	Riffle	M	2	123	50–100
50.1	22	Riffle	M	3	18	0–50
50.1	22	Riffle	M	3	139	50–100
49.7	27	Pool head	S	1	3	100–150
49.7	27	Pool head	S	1	3	50–100
49.6	28	Pool body	S	1	2	100–150
49.6	28	Pool body	S	1	100	50–100
49.2	33	Riffle	S	1	6	100–150
49.2	33	Riffle	S	1	97	50–100

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
49.2	34	Run head	S	1	95	0–50
49.2	34	Run head	S	1	5	100–150
49.2	34	Run head	S	1	325	50–100
49.1	35	Run body	S	1	0	--
48.2	49	Riffle	S	1	32	0–50
48.2	49	Riffle	S	1	7	100–150
48.2	49	Riffle	S	1	89	50–100
48.0	54	Pool head	S	1	1	0–50
47.0	58	Run head	M	1	2	100–150
47.0	58	Run head	M	1	2	50–100
47.0	58	Run head	M	2	2	100–150
47.0	58	Run head	M	2	2	50–100
47.0	58	Run head	M	3	0	--
46.9	59	Run body	S	1	0	--
45.7	74	Riffle	S	1	3	0–50
45.7	74	Riffle	S	1	3	100–150
45.7	74	Riffle	S	1	35	50–100
45.7	75	Run head	M	1	0	--
45.7	75	Run head	M	2	1	50–100
45.7	75	Run head	M	3	1	50–100
45.7	76	Run body	S	1	11	50–100
45.0	86	Pool head	M	1	0	--
45.0	86	Pool head	M	2	0	--
45.0	86	Pool head	M	3	4	50–100
44.9	87	Pool body	S	1	3	50–100
44.5	101	Riffle	M	1	2	0–50
44.5	101	Riffle	M	1	18	100–150
44.5	101	Riffle	M	1	69	50–100
44.5	101	Riffle	M	2	4	0–50
44.5	101	Riffle	M	2	13	100–150
44.5	101	Riffle	M	2	54	50–100
44.5	101	Riffle	M	3	4	0–50
44.5	101	Riffle	M	3	11	100–150
44.5	101	Riffle	M	3	67	50–100
43.2	108	Run head	S	1	0	--
43.1	109	Run body	M	1	1	100–150
43.1	109	Run body	M	1	6	50–100
43.1	109	Run body	M	2	2	100–150
43.1	109	Run body	M	2	10	50–100
43.1	109	Run body	M	3	2	100–150
43.1	109	Run body	M	3	5	50–100

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Sum of count	Size range
43.0	111	Riffle	S	1	1	50–100
43.0	112	Pool head	S	1	2	50–100
43.0	113	Pool body	M	1	0	--
43.0	113	Pool body	M	2	0	--
43.0	113	Pool body	M	3	0	--
41.9	132	Riffle	S	1	1	0–50
41.9	132	Riffle	S	1	4	100–150
41.9	132	Riffle	S	1	19	50–100
41.9	133	Run head	S	1	2	50–100

Table G-5. Non-salmonid fish observation data for the study area, March 2009.

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
51.6	4	Pool head	S	1	Sacramento sucker	1	300–400
51.6	4	Pool head	S	1	Sacramento sucker	1	50–75
51.5	7	Riffle	S	1	Sacramento sucker	6	50–75
50.6	14	Riffle	S	1	Sacramento sucker	3	25–50
50.6	14	Riffle	S	1	Sacramento sucker	41	400–450
50.6	14	Riffle	S	1	Sacramento sucker	12	400–500
50.6	14	Riffle	S	1	Sacramento sucker	4	50–75
50.6	14	Riffle	S	1	Salmonid sp.	2	--
50.6	15	Run head	S	1	Sacramento sucker	8	350–400
50.6	15	Run head	S	1	Sacramento sucker	11	400–500
50.5	16	Run body	S	1	Sacramento sucker	47	300–400
50.5	16	Run body	S	1	Sacramento sucker	20	400–500
50.5	16	Run body	S	1	Unknown	1	25–50
50.4	17	Run tail	S	1	Sacramento sucker	2	50–75
50.1	22	Riffle	S	1	Sacramento sucker	7	150–200
49.7	27	Pool head	S	1	Sacramento sucker	2	300–350
49.7	27	Pool head	S	1	Sacramento sucker	3	400–500
49.6	28	Pool body	S	1	Sacramento sucker	15	400–500
49.6	28	Pool body	S	1	Sacramento sucker	1	--
48.0	53	Riffle	M	1	Sacramento sucker	10	400–600
48.0	53	Riffle	M	2	Sacramento sucker	4	400–600
48.0	53	Riffle	M	2	Sculpin sp.	1	--
48.0	53	Riffle	M	3	Sacramento sucker	6	400–600
48.0	53	Riffle	M	3	Sculpin sp.	3	75–100

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
48.0	53	Riffle	M	3	Sculpin sp.	1	--
48.0	53	Riffle	M	3	Sacramento sucker	1	--
47.0	58	Run head	M	1	Sacramento sucker	12	350–500
47.0	58	Run head	M	1	Sacramento sucker	1	--
47.0	58	Run head	M	2	Sacramento sucker	10	350–500
47.0	58	Run head	M	2	Sacramento sucker	2	75–100
47.0	58	Run head	M	3	Sacramento sucker	4	25–50
47.0	58	Run head	M	3	Sacramento sucker	10	350–500
47.0	58	Run head	M	3	Sacramento sucker	2	500–600
47.0	58	Run head	M	3	Sacramento sucker	2	75–100
46.9	59	Run body	S	1	Hardhead/ Pikeminnow	2	400–450
46.9	59	Run body	S	1	Sacramento sucker	1	--
45.3	82	Run head	S	1	Largemouth bass	5	300–400
45.3	82	Run head	S	1	Hardhead/ Pikeminnow	8	400–500
45.3	82	Run head	S	1	Sacramento sucker	9	400–600
45.3	82	Run head	S	1	Sacramento sucker	4	40–500
45.3	82	Run head	S	1	Hardhead/ Pikeminnow	1	50–75
45.1	83	Run body	S	1	Hardhead/ Pikeminnow	10	100–125
45.1	83	Run body	S	1	Hardhead/ Pikeminnow	2	125–150
45.1	83	Run body	S	1	Hardhead/ Pikeminnow	6	50–75
45.1	83	Run body	S	1	Hardhead/ Pikeminnow	20	75–100
45.1	83	Run body	S	1	Largemouth bass	1	--
45.1	83	Run body	S	1	Hardhead/ Pikeminnow	2	--
45.0	86	Pool head	S	1	Hardhead/ Pikeminnow	2	100–150
45.0	86	Pool head	S	1	Hardhead/ Pikeminnow	7	25–50

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
45.0	86	Pool head	S	1	Hardhead/ Pikeminnow	5	50–100
45.0	86	Pool head	S	1	Hardhead/ Pikeminnow	2	75–100
45.0	86	Pool head	S	1	Sacramento sucker	1	--
44.9	87	Pool body	S	1	Hardhead/ Pikeminnow	1	--
44.9	88	Pool tail	M	1	Hardhead/ Pikeminnow	1	--
44.9	88	Pool tail	M	2	Hardhead/ Pikeminnow	4	100–150
44.9	88	Pool tail	M	2	Hardhead/ Pikeminnow	15	25–50
44.9	88	Pool tail	M	2	Largemouth bass	1	--
44.9	88	Pool tail	M	3	Hardhead/ Pikeminnow	4	100–150
44.9	88	Pool tail	M	3	Hardhead/ Pikeminnow	20	25–50
44.9	88	Pool tail	M	3	Hardhead/ Pikeminnow	7	50–100
44.9	88	Pool tail	M	3	Hardhead/ Pikeminnow	1	--
44.6	97	Riffle	S	1	Sacramento sucker	9	400–600
44.6	97	Riffle	S	1	Hardhead/ Pikeminnow	94	50–100
44.6	97	Riffle	S	1	Sacramento sucker	1	--
43.2	107	Riffle	S	1	Hardhead/ Pikeminnow	5	100–125
43.2	107	Riffle	S	1	Hardhead/ Pikeminnow	2	125–150
43.2	107	Riffle	S	1	Sacramento sucker	4	400–500
43.2	107	Riffle	S	1	Sacramento sucker	3	400–600
43.2	107	Riffle	S	1	Hardhead/ Pikeminnow	19	75–100
43.2	108	Run head	S	1	Hardhead/ Pikeminnow	20	100–150
43.2	108	Run head	S	1	Hardhead/ Pikeminnow	30	100–200
43.2	108	Run head	S	1	Sacramento sucker	9	300–500
43.2	108	Run head	S	1	Sacramento sucker	9	400–600
43.1	109	Run body	S	1	Hardhead/ Pikeminnow	60	100–200

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
43.1	109	Run body	S	1	Hardhead/ Pikeminnow	20	150–200
43.1	109	Run body	S	1	Sacramento sucker	6	500–600
43.1	109	Run body	S	1	Hardhead/ Pikeminnow	117	50–75
43.1	109	Run body	S	1	Hardhead/ Pikeminnow	39	75–100
43.1	110	Run tail	S	1	Sacramento sucker	8	500–600
43.1	110	Run tail	S	1	Hardhead/ Pikeminnow	3	50–100
43.0	111	Riffle	M	1	Sacramento sucker	4	400–500
43.0	111	Riffle	M	2	Hardhead/ Pikeminnow	4	50–100
43.0	111	Riffle	M	2	Hardhead/ Pikeminnow	1	--
43.0	111	Riffle	M	3	Hardhead/ Pikeminnow	3	150–200
43.0	112	Pool head	M	1	Hardhead/ Pikeminnow	3	25–50
43.0	112	Pool head	M	1	Hardhead/ Pikeminnow	7	50–75
43.0	112	Pool head	M	2	Hardhead/ Pikeminnow	3	25–50
43.0	112	Pool head	M	2	Hardhead/ Pikeminnow	2	50–75
43.0	112	Pool head	M	2	Sacramento sucker	2	50–75
43.0	112	Pool head	M	2	Lamprey sp.	1	--
43.0	112	Pool head	M	3	Hardhead/ Pikeminnow	4	25–50
43.0	112	Pool head	M	3	Hardhead/ Pikeminnow	2	50–75
43.0	112	Pool head	M	3	Sculpin sp.	1	--
43.0	113	Pool body	M	1	Sacramento sucker	100	0–25
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	3	150–200
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	5	250–300
43.0	113	Pool body	M	1	Sacramento sucker	3	300–500
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	80	50–100
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	1	--

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
43.0	113	Pool body	M	1	Sacramento sucker	1	--
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	3	250–300
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	62	50–100
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	1	--
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	1	--
43.0	113	Pool body	M	2	Sacramento sucker	1	--
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	3	100–200
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	6	150–200
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	5	200–300
43.0	113	Pool body	M	3	Sacramento sucker	3	300–500
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	50	50–100
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	1	--
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	1	--
43.0	113	Pool body	M	3	Sacramento sucker	1	--
43.0	114	Pool tail	S	1	Hardhead/ Pikeminnow	3	100–150
42.9	118	Riffle	S	1	Sacramento sucker	2	400–600
39.6	157	Run head	S	1	Sacramento sucker	14	400–600
39.5	158	Run body	M	1	Hardhead/ Pikeminnow	2	350–450
39.5	158	Run body	M	1	Sacramento sucker	30	400–600
39.5	158	Run body	M	1	Hardhead/ Pikeminnow	2	500–600
39.5	158	Run body	M	1	Largemouth bass	1	--
39.5	158	Run body	M	1	Hardhead/ Pikeminnow	2	--
39.5	158	Run body	M	1	Smallmouth bass	1	--
39.5	158	Run body	M	1	Unknown	50	--
39.5	158	Run body	M	2	Smallmouth bass	2	300–350

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
39.5	158	Run body	M	2	Hardhead/ Pikeminnow	3	350–450
39.5	158	Run body	M	2	Sacramento sucker	53	400–600
39.5	158	Run body	M	2	Largemouth bass	2	--
39.5	158	Run body	M	2	Hardhead/ Pikeminnow	1	--
39.5	158	Run body	M	2	Smallmouth bass	1	--
39.5	158	Run body	M	2	Unknown	20	--
39.5	158	Run body	M	3	Hardhead/ Pikeminnow	2	350–400
39.5	158	Run body	M	3	Sacramento sucker	2	400–500
39.5	158	Run body	M	3	Sacramento sucker	53	400–600
39.5	158	Run body	M	3	Largemouth bass	1	--
39.5	158	Run body	M	3	Hardhead/ Pikeminnow	2	--
39.5	158	Run body	M	3	Smallmouth bass	2	--
39.5	158	Run body	M	3	Striped bass	1	--
39.5	158	Run body	M	3	Unknown	70	--
39.5	159	Run tail	S	1	Sacramento sucker	20	0–50
39.4	160	Riffle	S	1	Hardhead/ Pikeminnow	15	150–200
39.4	160	Riffle	S	1	Unknown	3	50–100
39.4	160	Riffle	S	1	Largemouth bass	1	--
39.4	160	Riffle	S	1	Hardhead/ Pikeminnow	1	--
38.9	168	Riffle	S	1	Sacramento sucker	5	400–600
38.9	168	Riffle	S	1	Sacramento sucker	6	500–600
38.9	168	Riffle	S	1	Sculpin sp.	1	--
38.1	189	Pool body	S	1	Hardhead/ Pikeminnow	2	200–250
38.1	189	Pool body	S	1	Sacramento sucker	4	400–500
38.1	189	Pool body	S	1	Largemouth bass	1	--

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
38.1	189	Pool body	S	1	Sacramento sucker	1	--
38.1	192	Pool head	M	1	Sacramento sucker	1	--
38.0	193	Pool body	S	1	Sacramento sucker	3	300–350
38.0	193	Pool body	S	1	Sacramento sucker	17	400–600
38.0	193	Pool body	S	1	Largemouth bass	1	--
36.9	215	Pool body	S	1	Sacramento sucker	35	400–600
36.9	215	Pool body	S	1	Sacramento sucker	18	500–600
36.9	215	Pool body	S	1	Hardhead/ Pikeminnow	1	--
36.8	218	Run head	S	1	Sacramento sucker	9	400–600
36.6	219	Run body	M	1	Hardhead/ Pikeminnow	2	300–400
36.6	219	Run body	M	1	Hardhead/ Pikeminnow	5	300–500
36.6	219	Run body	M	1	Sacramento sucker	6	300–600
36.6	219	Run body	M	1	Hardhead/ Pikeminnow	2	400–600
36.6	219	Run body	M	1	Sacramento sucker	7	400–600
36.6	219	Run body	M	1	Black bass	1	--
36.6	219	Run body	M	1	Largemouth bass	2	--
36.6	219	Run body	M	2	Hardhead/ Pikeminnow	2	300–500
36.6	219	Run body	M	2	Sacramento sucker	5	400–600
36.6	219	Run body	M	2	Hardhead/ Pikeminnow	1	--
36.6	219	Run body	M	3	Smallmouth bass	2	200–300
36.6	219	Run body	M	3	Hardhead/ Pikeminnow	7	300–350
36.6	219	Run body	M	3	Hardhead/ Pikeminnow	5	300–400
36.6	219	Run body	M	3	Hardhead/ Pikeminnow	6	300–500
36.6	219	Run body	M	3	Sacramento sucker	6	300–600
36.6	219	Run body	M	3	Sacramento sucker	12	400–600

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
36.6	219	Run body	M	3	Hardhead/ Pikeminnow	3	50–75
36.6	219	Run body	M	3	Hardhead/ Pikeminnow	1	--
36.2	231	Pool body	M	1	Sacramento sucker	1	--
36.2	231	Pool body	M	1	Unknown	1	--
34.0	259	Run head	M	1	Sacramento sucker	35	300–600
34.0	259	Run head	M	1	Smallmouth bass	1	--
34.0	259	Run head	M	2	Sacramento sucker	3	300–600
34.0	259	Run head	M	2	Smallmouth bass	1	--
34.0	259	Run head	M	2	Sacramento sucker	1	--
34.0	259	Run head	M	3	Smallmouth bass	1	--
34.0	259	Run head	M	3	Sacramento sucker	1	--
34.0	260	Run body	S	1	Sacramento sucker	30	300–600
34.0	260	Run body	S	1	Hardhead/ Pikeminnow	2	--
34.0	260	Run body	S	1	Smallmouth bass	1	--
33.9	261	Run tail	S	1	Sacramento sucker	2	300–350
33.4	271	Pool head	S	1	Black bass	3	300–400
33.2	272	Pool body	S	1	Largemouth bass	1	--
33.2	273	Pool tail	S	1	Lamprey sp.	1	--
31.9	287	Run head	S	1	Sacramento sucker	17	400–600
31.9	287	Run head	S	1	Sacramento sucker	40	400–700
31.9	287	Run head	S	1	Hardhead/ Pikeminnow	1	--
31.7	288	Run body	S	1	Sacramento sucker	35	400–650
31.7	288	Run body	S	1	Sacramento sucker	46	400–700
31.7	288	Run body	S	1	Smallmouth bass	1	--
31.7	289	Run tail	S	1	Hardhead/ Pikeminnow	1	--

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
29.5	324	Riffle	S	1	Sacramento sucker	1	--
29.5	325	Run head	S	1	Bluegill	10	150–200
29.5	325	Run head	S	1	Sacramento sucker	4	400–600
29.5	325	Run head	S	1	Bluegill	1	--
29.5	325	Run head	S	1	Smallmouth bass	1	--
29.5	326	Run body	S	1	Bluegill	1	--
29.5	327	Run tail	S	1	Bluegill	3	50–75
29.5	327	Run tail	S	1	Largemouth bass	1	--

Table G-6. Non-salmonid fish observation data for the study area, July 2009.

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
51.7	2	Pool body	S	1	Hardhead/ Pikeminnow	2	300–400
51.7	2	Pool body	S	1	Hardhead/ Pikeminnow	2	--
51.7	2	Pool body	S	1	Sacramento sucker	4	400–500
51.7	2	Pool body	S	1	Sacramento sucker	1	--
51.6	5	Pool body	M	1	Sacramento sucker	2	0–50
51.6	5	Pool body	M	3	Sacramento sucker	2	0–50
50.6	14	Riffle	S	1	Hardhead/ Pikeminnow	1	--
50.6	14	Riffle	S	1	Sculpin sp.	2	0–50
50.6	14	Riffle	S	1	Sculpin sp.	1	50–100
50.6	14	Riffle	S	1	Sacramento sucker	4	0–50
50.6	14	Riffle	S	1	Sacramento sucker	8	200–400
50.6	14	Riffle	S	1	Sacramento sucker	22	400–600
50.6	15	Run head	S	1	Sacramento sucker	2	200–400
50.3	19	Run head	S	1	Sacramento sucker	2	400–500
50.1	20	Run body	M	1	Hardhead/ Pikeminnow	1	400–500
50.1	20	Run body	M	1	Hardhead/ Pikeminnow	1	--
50.1	20	Run body	M	1	Sacramento sucker	20	0–50
50.1	20	Run body	M	1	Sacramento sucker	17	200–300
50.1	20	Run body	M	1	Sacramento sucker	30	300–400
50.1	20	Run body	M	1	Sacramento sucker	12	400–500
50.1	20	Run body	M	1	Sacramento sucker	18	50–100
50.1	20	Run body	M	1	Sacramento sucker	1	--
50.1	20	Run body	M	2	Hardhead/ Pikeminnow	3	400–500
50.1	20	Run body	M	2	Sculpin sp.	9	0–100
50.1	20	Run body	M	2	Sacramento sucker	6	0–100

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
50.1	20	Run body	M	2	Sacramento sucker	10	100–150
50.1	20	Run body	M	2	Sacramento sucker	19	200–300
50.1	20	Run body	M	2	Sacramento sucker	36	300–400
50.1	20	Run body	M	2	Sacramento sucker	2	400–500
50.1	20	Run body	M	2	Sacramento sucker	42	50–100
50.1	20	Run body	M	3	Hardhead/ Pikeminnow	2	300–400
50.1	20	Run body	M	3	Sculpin sp.	8	0–100
50.1	20	Run body	M	3	Sculpin sp.	1	50–100
50.1	20	Run body	M	3	Sacramento sucker	4	0–100
50.1	20	Run body	M	3	Sacramento sucker	30	0–50
50.1	20	Run body	M	3	Sacramento sucker	15	200–300
50.1	20	Run body	M	3	Sacramento sucker	27	300–400
50.1	20	Run body	M	3	Sacramento sucker	20	400–500
50.1	20	Run body	M	3	Sacramento sucker	60	50–100
50.1	22	Riffle	M	1	Sacramento sucker	7	0–50
50.1	22	Riffle	M	1	Sacramento sucker	1	50–100
50.1	22	Riffle	M	2	Sacramento sucker	7	0–50
50.1	22	Riffle	M	2	Sacramento sucker	3	50–100
50.1	22	Riffle	M	3	Sacramento sucker	8	0–50
50.1	22	Riffle	M	3	Sacramento sucker	15	50–100
49.7	27	Pool head	S	1	Hardhead/ Pikeminnow	1	--
49.7	27	Pool head	S	1	Sacramento sucker	3	0–50
49.7	27	Pool head	S	1	Sacramento sucker	1	300–400
49.7	27	Pool head	S	1	Sacramento sucker	3	50–100
49.6	28	Pool body	S	1	Hardhead/ Pikeminnow	2	--
49.6	28	Pool body	S	1	Sculpin sp.	1	50–100

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
49.6	28	Pool body	S	1	Sculpin sp.	1	--
49.6	28	Pool body	S	1	Sacramento sucker	12	400–500
49.2	33	Riffle	S	1	Sacramento sucker	1	0–100
49.2	34	Run head	S	1	Hardhead/ Pikeminnow	1	100–200
49.2	34	Run head	S	1	Hardhead/ Pikeminnow	2	300–400
49.2	34	Run head	S	1	Hardhead/ Pikeminnow	5	50–100
49.2	34	Run head	S	1	Sacramento sucker	4	0–50
49.2	34	Run head	S	1	Sacramento sucker	6	50–100
49.1	35	Run body	S	1	Hardhead/ Pikeminnow	2	300–400
49.1	35	Run body	S	1	Sacramento sucker	1	--
48.2	49	Riffle	S	1	Hardhead/ Pikeminnow	2	100–150
48.2	49	Riffle	S	1	Hardhead/ Pikeminnow	8	100–200
48.2	49	Riffle	S	1	Hardhead/ Pikeminnow	6	50–100
48.2	49	Riffle	S	1	Sacramento sucker	17	300–500
48.2	49	Riffle	S	1	Sacramento sucker	3	400–600
48.2	49	Riffle	S	1	Sacramento sucker	6	50–100
48.0	54	Pool head	S	1	Largemouth bass	8	100–200
48.0	54	Pool head	S	1	Hardhead/ Pikeminnow	2	100–200
48.0	54	Pool head	S	1	Hardhead/ Pikeminnow	7	200–300
48.0	54	Pool head	S	1	Hardhead/ Pikeminnow	2	400–500
48.0	54	Pool head	S	1	Hardhead/ Pikeminnow	1	50–100
48.0	54	Pool head	S	1	Hardhead/ Pikeminnow	4	100–200
48.0	54	Pool head	S	1	Smallmouth bass	4	100–200
48.0	54	Pool head	S	1	Smallmouth bass	1	--
48.0	54	Pool head	S	1	Sacramento sucker	41	300–500
48.0	54	Pool head	S	1	Sacramento sucker	6	400–500

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
47.0	58	Run head	M	1	Hardhead/ Pikeminnow	63	100–200
47.0	58	Run head	M	1	Hardhead/ Pikeminnow	3	200–300
47.0	58	Run head	M	1	Hardhead/ Pikeminnow	7	50–100
47.0	58	Run head	M	1	Sacramento sucker	22	100–200
47.0	58	Run head	M	1	Sacramento sucker	1	200–300
47.0	58	Run head	M	1	Sacramento sucker	4	300–400
47.0	58	Run head	M	1	Sacramento sucker	20	400–600
47.0	58	Run head	M	1	Sacramento sucker	10	50–100
47.0	58	Run head	M	2	Hardhead/ Pikeminnow	6	0–100
47.0	58	Run head	M	2	Hardhead/ Pikeminnow	3	100–150
47.0	58	Run head	M	2	Hardhead/ Pikeminnow	45	100–200
47.0	58	Run head	M	2	Hardhead/ Pikeminnow	4	200–300
47.0	58	Run head	M	2	Sacramento sucker	2	0–100
47.0	58	Run head	M	2	Sacramento sucker	14	100–200
47.0	58	Run head	M	2	Sacramento sucker	12	400–600
47.0	58	Run head	M	2	Sacramento sucker	2	500–600
47.0	58	Run head	M	2	Sacramento sucker	3	50–100
47.0	58	Run head	M	3	Hardhead/ Pikeminnow	3	0–100
47.0	58	Run head	M	3	Hardhead/ Pikeminnow	51	100–200
47.0	58	Run head	M	3	Hardhead/ Pikeminnow	1	200–300
47.0	58	Run head	M	3	Sacramento sucker	13	0–100
47.0	58	Run head	M	3	Sacramento sucker	5	100–200
47.0	58	Run head	M	3	Sacramento sucker	3	300–400
47.0	58	Run head	M	3	Sacramento sucker	5	400–600
47.0	58	Run head	M	3	Sacramento sucker	4	500–600
47.0	58	Run head	M	3	Sacramento sucker	2	50–100

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
46.9	59	Run body	S	1	Largemouth bass	1	200–300
46.9	59	Run body	S	1	Hardhead/ Pikeminnow	4	100–200
46.9	59	Run body	S	1	Hardhead/ Pikeminnow	6	200–300
46.9	59	Run body	S	1	Hardhead/ Pikeminnow	3	500–600
46.9	59	Run body	S	1	Hardhead/ Pikeminnow	5	50–100
46.9	59	Run body	S	1	Sacramento sucker	10	200–300
46.9	59	Run body	S	1	Sacramento sucker	15	400–600
46.9	59	Run body	S	1	Sacramento sucker	15	50–100
45.7	74	Riffle	S	1	Hardhead/ Pikeminnow	14	0–100
45.7	74	Riffle	S	1	Hardhead/ Pikeminnow	22	100–200
45.7	74	Riffle	S	1	Hardhead/ Pikeminnow	6	50–100
45.7	75	Run head	M	1	Hardhead/ Pikeminnow	6	100–200
45.7	75	Run head	M	1	Largemouth bass	1	100–200
45.7	75	Run head	M	1	Hardhead/ Pikeminnow	52	0–100
45.7	75	Run head	M	1	Hardhead/ Pikeminnow	29	100–200
45.7	75	Run head	M	1	Hardhead/ Pikeminnow	2	300–400
45.7	75	Run head	M	1	Hardhead/ Pikeminnow	30	50–100
45.7	75	Run head	M	1	Sacramento sucker	7	0–100
45.7	75	Run head	M	1	Sacramento sucker	36	100–200
45.7	75	Run head	M	1	Sacramento sucker	5	200–300
45.7	75	Run head	M	2	Hardhead/ Pikeminnow	2	0–100
45.7	75	Run head	M	2	Hardhead/ Pikeminnow	7	100–200
45.7	75	Run head	M	2	Hardhead/ Pikeminnow	48	0–100
45.7	75	Run head	M	2	Hardhead/ Pikeminnow	20	0–200
45.7	75	Run head	M	2	Hardhead/ Pikeminnow	48	100–200

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
45.7	75	Run head	M	2	Hardhead/ Pikeminnow	7	200–300
45.7	75	Run head	M	2	Hardhead/ Pikeminnow	2	300–400
45.7	75	Run head	M	2	Sacramento sucker	2	0–100
45.7	75	Run head	M	2	Sacramento sucker	47	100–200
45.7	75	Run head	M	2	Sacramento sucker	2	200–300
45.7	75	Run head	M	3	Hardhead/ Pikeminnow	9	0–100
45.7	75	Run head	M	3	Hardhead/ Pikeminnow	5	100–200
45.7	75	Run head	M	3	Largemouth bass	1	100–200
45.7	75	Run head	M	3	Hardhead/ Pikeminnow	54	0–100
45.7	75	Run head	M	3	Hardhead/ Pikeminnow	71	100–200
45.7	75	Run head	M	3	Hardhead/ Pikeminnow	2	200–300
45.7	75	Run head	M	3	Hardhead/ Pikeminnow	2	300–400
45.7	75	Run head	M	3	Sacramento sucker	5	0–100
45.7	75	Run head	M	3	Sacramento sucker	10	0–200
45.7	75	Run head	M	3	Sacramento sucker	35	100–200
45.7	75	Run head	M	3	Sacramento sucker	6	200–300
45.7	76	Run body	S	1	Hardhead/ Pikeminnow	40	0–100
45.7	76	Run body	S	1	Hardhead/ Pikeminnow	21	100–200
45.7	76	Run body	S	1	Hardhead/ Pikeminnow	12	50–100
45.7	76	Run body	S	1	Sacramento sucker	30	0–100
45.7	76	Run body	S	1	Sacramento sucker	10	100–200
45.0	86	Pool head	M	1	Hardhead/ Pikeminnow	79	0–100
45.0	86	Pool head	M	1	Hardhead/ Pikeminnow	38	100–200
45.0	86	Pool head	M	1	Hardhead/ Pikeminnow	10	200–300
45.0	86	Pool head	M	1	Sacramento sucker	3	100–200
45.0	86	Pool head	M	2	Hardhead/ Pikeminnow	60	0–100

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
45.0	86	Pool head	M	2	Hardhead/ Pikeminnow	50	100–200
45.0	86	Pool head	M	2	Hardhead/ Pikeminnow	8	200–300
45.0	86	Pool head	M	2	Hardhead/ Pikeminnow	1	--
45.0	86	Pool head	M	2	Sacramento sucker	4	100–200
45.0	86	Pool head	M	2	Sacramento sucker	1	200–300
45.0	86	Pool head	M	3	Hardhead/ Pikeminnow	70	0–100
45.0	86	Pool head	M	3	Hardhead/ Pikeminnow	34	100–200
45.0	86	Pool head	M	3	Hardhead/ Pikeminnow	4	200–300
45.0	86	Pool head	M	3	Hardhead/ Pikeminnow	2	300–400
45.0	86	Pool head	M	3	Hardhead/ Pikeminnow	1	--
45.0	86	Pool head	M	3	Sacramento sucker	2	0–100
45.0	86	Pool head	M	3	Sacramento sucker	3	100–200
44.9	87	Pool body	S	1	Hardhead/ Pikeminnow	65	0–100
44.9	87	Pool body	S	1	Hardhead/ Pikeminnow	20	100–200
44.9	87	Pool body	S	1	Hardhead/ Pikeminnow	1	200–300
44.9	87	Pool body	S	1	Hardhead/ Pikeminnow	1	300–400
44.5	101	Riffle	M	1	Hardhead/ Pikeminnow	5	100–200
44.5	101	Riffle	M	1	Largemouth bass	1	100–200
44.5	101	Riffle	M	1	Hardhead/ Pikeminnow	124	0–100
44.5	101	Riffle	M	1	Hardhead/ Pikeminnow	81	100–200
44.5	101	Riffle	M	1	Hardhead/ Pikeminnow	8	200–300
44.5	101	Riffle	M	1	Sculpin sp.	1	0–100
44.5	101	Riffle	M	1	Sacramento sucker	7	0–100
44.5	101	Riffle	M	1	Sacramento sucker	9	100–200
44.5	101	Riffle	M	1	Sacramento sucker	2	200–300
44.5	101	Riffle	M	1	Sacramento sucker	3	300–500

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
44.5	101	Riffle	M	1	Sacramento sucker	1	400–500
44.5	101	Riffle	M	1	Sacramento sucker	4	50–100
44.5	101	Riffle	M	1	Sacramento sucker	2	--
44.5	101	Riffle	M	2	Hardhead/ Pikeminnow	3	100–200
44.5	101	Riffle	M	2	Largemouth bass	1	100–200
44.5	101	Riffle	M	2	Hardhead/ Pikeminnow	93	0–100
44.5	101	Riffle	M	2	Hardhead/ Pikeminnow	86	100–200
44.5	101	Riffle	M	2	Hardhead/ Pikeminnow	17	200–300
44.5	101	Riffle	M	2	Smallmouth bass	1	100–200
44.5	101	Riffle	M	2	Smallmouth bass	1	--
44.5	101	Riffle	M	2	Sacramento sucker	12	0–100
44.5	101	Riffle	M	2	Sacramento sucker	9	100–200
44.5	101	Riffle	M	2	Sacramento sucker	1	200–300
44.5	101	Riffle	M	2	Sacramento sucker	1	400–500
44.5	101	Riffle	M	2	Sacramento sucker	2	400–600
44.5	101	Riffle	M	2	Sacramento sucker	1	50–100
44.5	101	Riffle	M	3	Hardhead/ Pikeminnow	7	100–200
44.5	101	Riffle	M	3	Largemouth bass	1	100–200
44.5	101	Riffle	M	3	Hardhead/ Pikeminnow	111	0–100
44.5	101	Riffle	M	3	Hardhead/ Pikeminnow	64	100–200
44.5	101	Riffle	M	3	Hardhead/ Pikeminnow	13	200–300
44.5	101	Riffle	M	3	Smallmouth bass	3	100–200
44.5	101	Riffle	M	3	Sacramento sucker	9	0–100
44.5	101	Riffle	M	3	Sacramento sucker	7	100–200
44.5	101	Riffle	M	3	Sacramento sucker	1	200–300
44.5	101	Riffle	M	3	Sacramento sucker	1	400–500

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
44.5	101	Riffle	M	3	Sacramento sucker	3	400–600
44.5	101	Riffle	M	3	Sacramento sucker	3	50–100
43.2	108	Run head	S	1	Hardhead/ Pikeminnow	11	100–200
43.2	108	Run head	S	1	Hardhead/ Pikeminnow	4	200–300
43.2	108	Run head	S	1	Largemouth bass	2	0–100
43.2	108	Run head	S	1	Hardhead/ Pikeminnow	9	100–200
43.2	108	Run head	S	1	Hardhead/ Pikeminnow	8	200–300
43.2	108	Run head	S	1	Sacramento sucker	7	400–500
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	38	0–100
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	12	100–200
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	8	0–100
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	80	100–200
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	53	200–300
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	14	300–400
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	3	400–500
43.1	109	Run body	M	1	Largemouth bass	3	0–100
43.1	109	Run body	M	1	Largemouth bass	22	100–200
43.1	109	Run body	M	1	Largemouth bass	9	200–300
43.1	109	Run body	M	1	Largemouth bass	2	300–400
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	114	0–100
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	182	100–200
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	75	200–300
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	10	300–400
43.1	109	Run body	M	1	Hardhead/ Pikeminnow	4	400–500
43.1	109	Run body	M	1	Black bass	10	100–200
43.1	109	Run body	M	1	Sacramento sucker	27	100–200

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
43.1	109	Run body	M	1	Sacramento sucker	9	200–300
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	18	0–100
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	12	0–100
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	47	100–200
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	61	200–300
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	26	300–400
43.1	109	Run body	M	2	Largemouth bass	11	0–100
43.1	109	Run body	M	2	Largemouth bass	23	100–200
43.1	109	Run body	M	2	Largemouth bass	14	200–300
43.1	109	Run body	M	2	Largemouth bass	1	300–400
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	118	0–100
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	168	100–200
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	46	200–300
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	11	300–400
43.1	109	Run body	M	2	Hardhead/ Pikeminnow	3	400–500
43.1	109	Run body	M	2	Black bass	13	100–200
43.1	109	Run body	M	2	Smallmouth bass	4	100–200
43.1	109	Run body	M	2	Sacramento sucker	25	0–100
43.1	109	Run body	M	2	Sacramento sucker	10	100–200
43.1	109	Run body	M	2	Sacramento sucker	25	200–300
43.1	109	Run body	M	2	Sacramento sucker	11	300–400
43.1	109	Run body	M	2	Sacramento sucker	4	400–500
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	9	0–100
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	18	100–200
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	22	0–100
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	120	100–200

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	67	200–300
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	11	300–400
43.1	109	Run body	M	3	Largemouth bass	13	0–100
43.1	109	Run body	M	3	Largemouth bass	23	100–200
43.1	109	Run body	M	3	Largemouth bass	11	200–300
43.1	109	Run body	M	3	Largemouth bass	2	300–400
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	115	0–100
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	134	100–200
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	104	200–300
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	11	300–400
43.1	109	Run body	M	3	Hardhead/ Pikeminnow	2	400–500
43.1	109	Run body	M	3	Black bass	6	0–100
43.1	109	Run body	M	3	Smallmouth bass	2	0–100
43.1	109	Run body	M	3	Smallmouth bass	4	100–200
43.1	109	Run body	M	3	Smallmouth bass	1	200–300
43.1	109	Run body	M	3	Sacramento sucker	11	0–100
43.1	109	Run body	M	3	Sacramento sucker	19	100–200
43.1	109	Run body	M	3	Sacramento sucker	19	200–300
43.1	109	Run body	M	3	Sacramento sucker	4	300–400
43.0	111	Riffle	S	1	Hardhead/ Pikeminnow	15	0–100
43.0	111	Riffle	S	1	Hardhead/ Pikeminnow	5	100–200
43.0	111	Riffle	S	1	Largemouth bass	1	--
43.0	111	Riffle	S	1	Hardhead/ Pikeminnow	16	0–100
43.0	111	Riffle	S	1	Hardhead/ Pikeminnow	20	100–200
43.0	111	Riffle	S	1	Hardhead/ Pikeminnow	6	200–300
43.0	111	Riffle	S	1	Sacramento sucker	1	400–600

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
43.0	112	Pool head	S	1	Hardhead/ Pikeminnow	6	100–200
43.0	112	Pool head	S	1	Hardhead/ Pikeminnow	5	100–300
43.0	112	Pool head	S	1	Hardhead/ Pikeminnow	2	50–100
43.0	112	Pool head	S	1	Hardhead/ Pikeminnow	1	--
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	32	100–200
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	10	200–300
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	2	300–400
43.0	113	Pool body	M	1	Largemouth bass	1	0–100
43.0	113	Pool body	M	1	Largemouth bass	6	100–200
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	48	100–200
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	20	100–300
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	13	200–300
43.0	113	Pool body	M	1	Hardhead/ Pikeminnow	5	300–400
43.0	113	Pool body	M	1	Smallmouth bass	1	--
43.0	113	Pool body	M	1	Sacramento sucker	10	100–200
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	45	100–200
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	21	200–300
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	2	300–400
43.0	113	Pool body	M	2	Largemouth bass	5	0–100
43.0	113	Pool body	M	2	Largemouth bass	9	100–200
43.0	113	Pool body	M	2	Largemouth bass	1	50–100
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	44	100–200
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	21	100–300
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	8	200–300
43.0	113	Pool body	M	2	Hardhead/ Pikeminnow	5	300–400

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	2	100–200
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	27	100–200
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	5	200–300
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	4	300–400
43.0	113	Pool body	M	3	Largemouth bass	3	0–100
43.0	113	Pool body	M	3	Largemouth bass	9	100–200
43.0	113	Pool body	M	3	Largemouth bass	2	50–100
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	46	100–200
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	11	200–300
43.0	113	Pool body	M	3	Hardhead/ Pikeminnow	2	300–400
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	90	0–100
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	45	100–200
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	8	0–100
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	43	100–200
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	19	200–200
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	30	200–300
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	10	300–400
41.9	132	Riffle	S	1	Largemouth bass	1	100–200
41.9	132	Riffle	S	1	Largemouth bass	1	--
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	100	0–100
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	105	100–200
41.9	132	Riffle	S	1	Hardhead/ Pikeminnow	72	200–300
41.9	132	Riffle	S	1	Hardhead/Pikeminnow	5	300–400
41.9	132	Riffle	S	1	Sacramento sucker	12	100–200
41.9	132	Riffle	S	1	Sacramento sucker	15	200–300

RM	NSO	Habitat	Single (S) or multiple (M) pass	Pass	Species	Sum of count	Size range
41.9	132	Riffle	S	1	Sacramento sucker	4	400–600
41.9	133	Run head	S	1	Hardhead/ Pikeminnow	40	0–100
41.9	133	Run head	S	1	Hardhead/ Pikeminnow	3	0–100
41.9	133	Run head	S	1	Hardhead/ Pikeminnow	20	100–200
41.9	133	Run head	S	1	Hardhead/ Pikeminnow	8	200–300
41.9	133	Run head	S	1	Largemouth bass	2	0–100
41.9	133	Run head	S	1	Hardhead/ Pikeminnow	12	0–100
41.9	133	Run head	S	1	Hardhead/ Pikeminnow	31	100–200
41.9	133	Run head	S	1	Hardhead/ Pikeminnow	8	200–300
41.9	133	Run head	S	1	Hardhead/ Pikeminnow	1	--
41.9	133	Run head	S	1	Sacramento sucker	6	0–100
41.9	133	Run head	S	1	Sacramento sucker	28	200–400
41.9	133	Run head	S	1	Sacramento sucker	8	400–600