Tuolumne River Gravel Introduction
2000 – 2003

Tuolumne River
La Grange Gravel Addition, Phase II
Course Sediment Replenishment Program
Tuolumne River Salmonid Habitat Improvement Project
River Mile 49.9 to 50.7
Annual Report

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1.0 Introduction

The San Joaquin River and its tributaries once supported populations of both spring and fall-run Chinook salmon. Spring-run was extirpated from the San Joaquin Drainage by the late 1940's. Since then, fall-run salmon have declined by more than 90 percent and the populations remaining are in jeopardy of further decline. Documentation of steelhead trout within the drainage exists for the lower San Joaquin, Tuolumne, and Stanislaus rivers. In the past, steelhead trout probably existed in the Tuolumne River. In recent years, a few confirmed reports of steelhead trout in the San Joaquin River drainage have been received, suggesting a viable but very small population. Other anadromous fish (e.g., white sturgeon, American shad and striped bass) and resident fish species are also present in the system.

Irrigation, water storage and power projects, beginning prior to the turn of the century on the Stanislaus, Tuolumne, Merced and San Joaquin rivers, have reduced much historic anadromous salmonid spawning and rearing habitats. Altered hydrologic patterns and the amplitude of channel-forming stream flows have decreased coarse gravel recruitment, increased vegetation encroachment and added to the overall deterioration of remaining habitats below dams. Adjacent land use practices and sediment discharges into the river have increased the percent of sand and silt in the spawning substrate. Combined with low water flows, warm water temperatures and water diversions, the cumulative effect has increased mortality for most life stages of salmon in the San Joaquin River drainage.

Beginning in the mid 1800s and continuing today, dams on the Tuolumne River have blocked coarse sediment (gravels and cobbles) originating from the upper watershed from supplying the lower river. These gravels and cobbles form the channel. Removing the upstream coarse sediment supply forces the river to obtain its supply from the bed itself, resulting in bed degradation, bed coarsening and loss of alluvial deposits within the low water channel. Ultimately, salmon production has been negatively impacted by reduced quantity and quality of spawning and rearing habitat, and increased riparian fossilization of remaining alluvial deposits. Input of new gravel and long-term maintenance of gravel supplies are a critical part of salmonid spawning habitat restoration efforts. The California Department of Fish and Game (CDFG) and the California Department of Water Resources (CDWR) have been constructing gravel restoration projects in the San Joaquin basin for over a decade and have learned a great deal regarding project design, construction, and project life. It is now widely accepted within the Central Valley salmonid habitat restoration community that restoration project maintenance, which includes regular gravel supplementation and infusion to important spawning areas, is a significant component of any salmonid spawning habitat restoration project.

2.0 Contract Objectives

This CDFG/ U.S. Fish and Wildlife Service (USFWS) project will continue a gravel infusion program recommended in the Tuolumne River Corridor Habitat Restoration Plan. This plan is a product of the 1995 New Don Pedro FERC Settlement Agreement, which began in August 1999 (Phase 1 La Grange Gravel Addition Salmonid Habitat Improvement Project Tuolumne River, River Mile 50.1 to 50.3 B CDFG, 1998). The Phase 1 project added gravel to increase coarse sediment storage (riffles and bars) within the spawning reach of the Tuolumne River immediately below the Old La Grange Bridge. The proposed Phase 2 project will add gravel to additional locations within the expanded spawning reach and defines a plan for long-term coarse sediment introduction at a rate (to be determined by project monitoring) which is equal to the fluvial transport and will maintain the instream coarse sediment supply for this important salmonid spawning reach of the Tuolumne River.

CDFG policy mandates and promotes the premise that quality habitat is the key to healthy fish and wildlife populations. The State Salmon, Steelhead Trout, and Anadromous Fisheries Restoration Act (Chapter 1545/88) and the Federal "Central Valley Project Improvement Act" (PL102-575) are law. These two laws enjoined the state and federal government to implement measures that solve habitat problems for these fish and restore production to healthier levels by 2000 and 2002, respectively. This project helps to accomplish these objectives. This project's design mimics the natural process of coarse sediment supply transport and helps increase, and improve, degraded spawning habitat in the upper reach of the designated spawning area heavily used by fall-run Chinook salmon (State of California Fish and Game Code 1505).

3.0 PROJECT SETTING

The Tuolumne River from the Stanislaus County Bridge, J-59 (New La Grange Bridge), River Mile 49.9, to approximately 1400 feet above the Old La Grange Bridge, River Mile 50.7 (Figure 1). Both sides, of the Tuolumne River have a thin strip of riparian vegetation, with oak woodland upslope on either riverbank. The upslope area is categorized as an oak woodland/savanna biological community with a dominant over story composed mainly of valley oak, blue oak and interior live oak. California buckeye, Ceanothus and bush lupine are present in good numbers and California redbud, poison oak, toyon, California coffeeberry and manzanita species are also present. Many species of non-native annual grasses, as well as both native and non-native herbaceous plants, make up the grassland of this community.

The riparian species in the project area are cottonwoods, buttonbush, and several willow species. Sandbar willows are the most prevalent willow species. The Sandbar willows have become thick in some areas. Gasburg Creek drains the surrounding hills and enters into the Tuolumne River approximately 1/8 mile downstream of the project site. The project construction will not affect the emergent wetlands associated with Gasburg Creek and the Tuolumne River.

The project area is above the Old La Grange Bridge, near River Mile 50.7 (as the Tuolumne River flows out of the canyon) and extends downstream to just above the New La Grange Bridge, at River Mile 49.9 (Figure 1) in the Tuolumne River. The town of La Grange is due south of the middle 1/3 of the proposed gravel infusion site. The State, Stanislaus County, Tuolumne Irrigation District and/or Modesto Irrigation District own the property adjacent to the project, on both sides of the river. No privately owned property is in the immediate construction area and few residential properties are in the general area. Cattle grazing is currently prohibited in the project area and will not be a concern at this time.

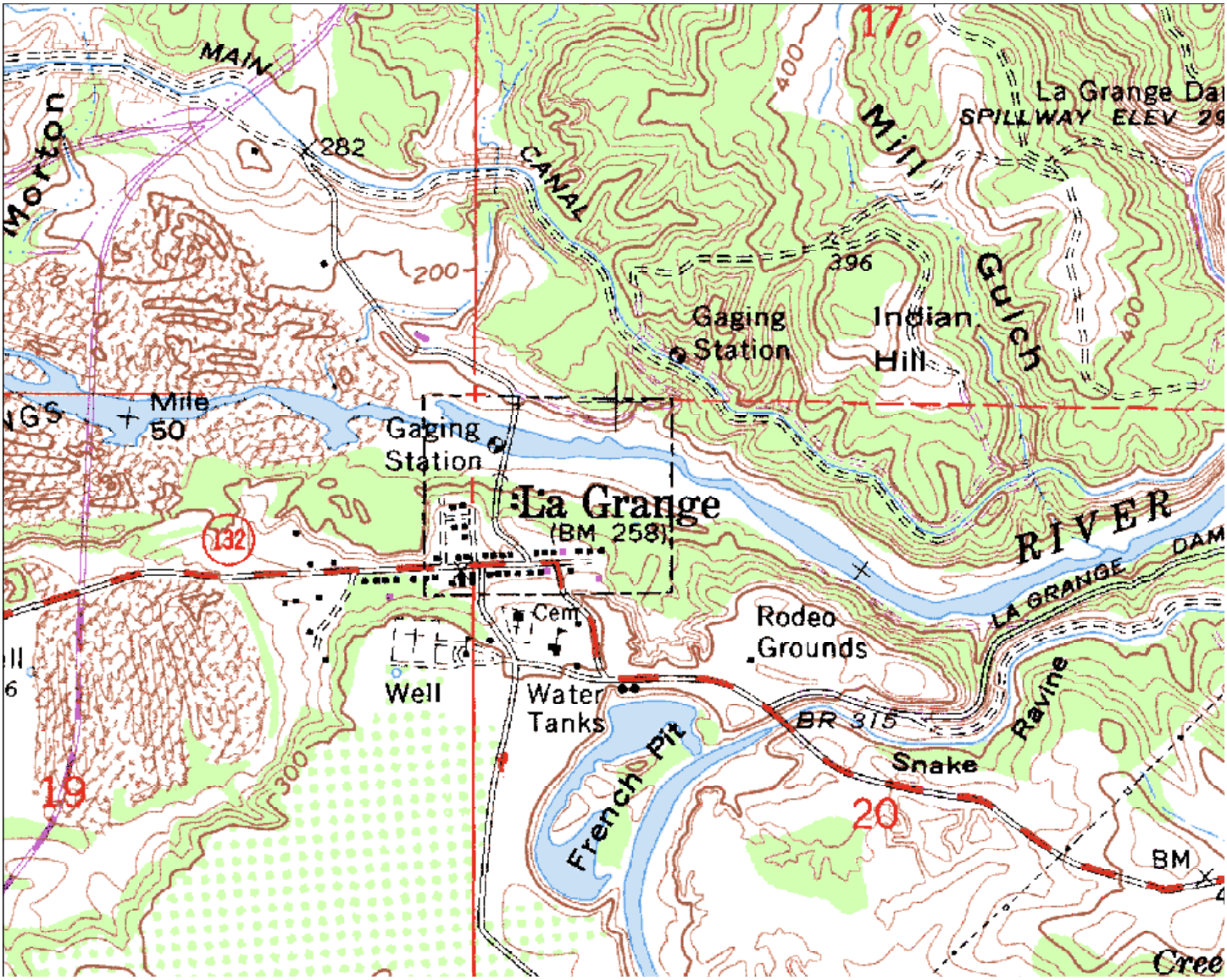

Figure 1, Project Location

4.0 PROJECT OBJECTIVES

The purpose of this project is to begin restoration of the coarse sediment supply to the Tuolumne River. In several phases clean, spawning size gravels are introduced into the Tuolumne River above the Old La Grange Bridge down to the New La Grange Bridge (Figure 1) starting in August 1999. Phase 2 began in August 2001 and the proposed gravel infusion and maintenance program will continue through 2005.

4.1 The primary goal of this project is:

- To improve the quality and quantity of spawning habitat for Chinook salmon (and other salmonids) in the upper portion of the Tuolumne River designated salmon spawning area.

4.2 Secondary objectives of the Phase 2 coarse sediment introduction program are:

- Increase in stream storage of spawning sized gravels by developing a long-term gravel infusion program;
- Improve Chinook salmon productivity by increasing the quality and quantity of the physical habitat;
- Encourage marginal fluvial transport of these gravels for replenishing downstream alluvial deposits and channel formation, ultimately improving downstream Chinook salmon spawning and rearing habitat;
- Utilize the project as an indicator of instream gravel movement and subsequent gravel additions in this reach.

The project proponents (DFG and USFWS) believe that this program will improve salmon spawning habitat, resulting in increased salmon productivity. The project will also improve the ability of the Tuolumne River to increase both spawning and rearing habitat as the river adjusts the increased coarse sediment supply. Monitoring and evaluation of this project will provide pertinent information for future gravel introductions at this site and others on the Tuolumne River.

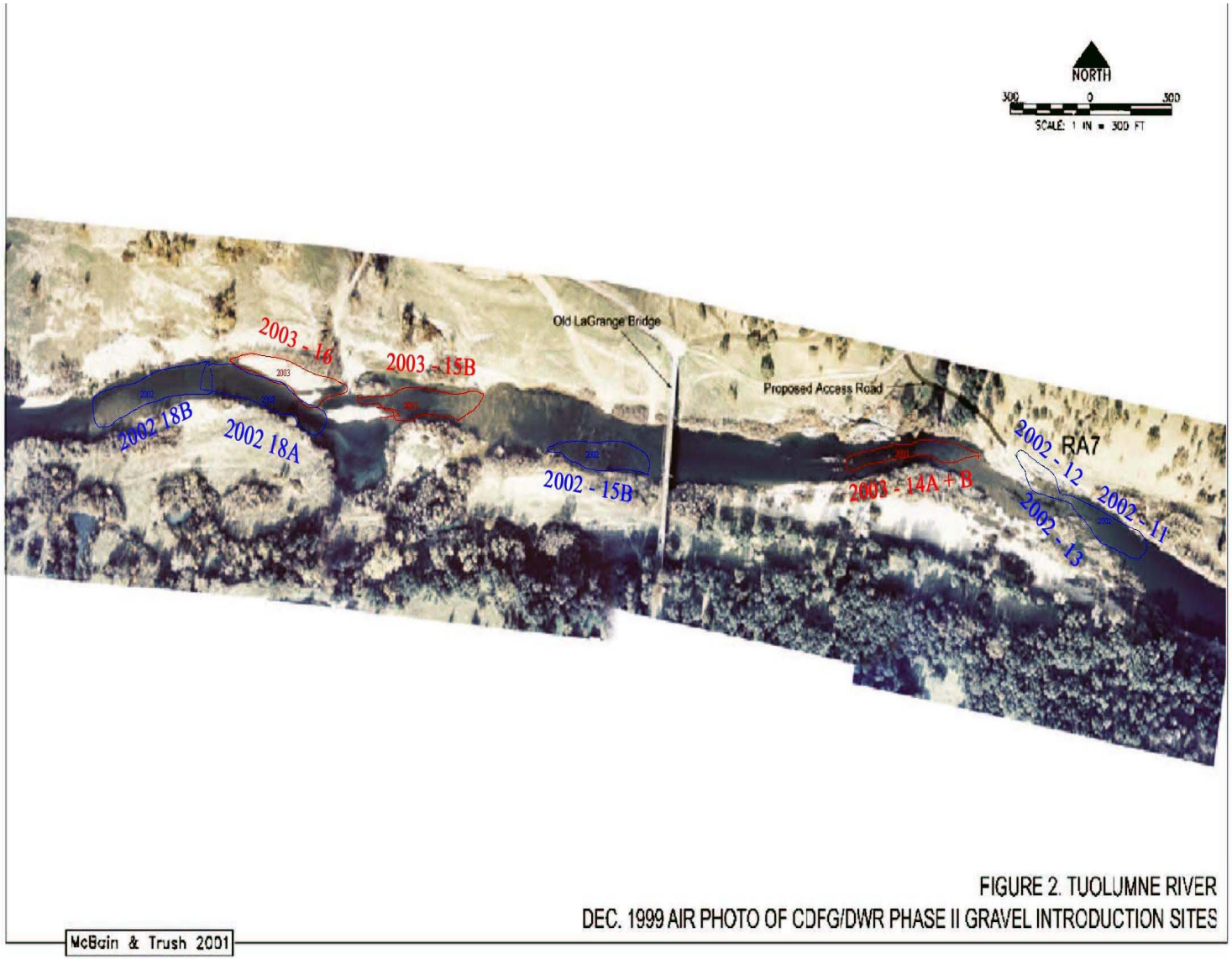

Figure 2 – McBain and Thrush Aerial Photograph Riffle Map

5.0 PROJECT DESCRIPTION

This project is the second phase, of a multi-phase gravel management program, recommended in the Tuolumne River Corridor Habitat Restoration Plan. Phase 1 added gravel to increase coarse sediment storage within the spawning reaches of the Tuolumne River. Phase 2 began a long-term coarse sediment introduction to maintain the instream coarse sediment. During Phase 1, project personnel placed approximately 18,750 tons (12,500 cu yds) of spawning size gravel at riffle 1A, just downstream of the Old La Grange Rd. Bridge.

5.1 – 2001 Tuolumne River Gravel Purchase

- Project personnel acquired the necessary permits and set the size criteria, for the Phase 2 introductions.
- Project personnel purchased and stockpiled, approximately 14,400 tons (9,600 cu yds) of spawning size gravel distribution in 2002 (Table 1).

2001 Chinook Salmon Spawning Gravel Size Criteria

Particle Size (inches)	Percent Passing	Percent Retained
5”	100%	0%
2”	75%-85%	25%-15%
1”	40%-50%	60%-50%
3/4”	10%-20%	90%-80%
1/2”	0%	100%

Table 1

5.2 – 2002 Tuolumne River Gravel Placement

- In 2002, project personnel placed approximately 14,400 tons (9,600 cu yds) of gravel, purchased in 2001, into the Tuolumne River near the town of La Grange.
- Project personnel placed the gravel at various locations through the project site (Table 2).

2002 Location and Volume of Gravel Placed

2002 La Grange Gravel			
Area	Cu Yds		Tons
11	1,200		1,800
12	600		900
13	3,100		4,650
15a	3,500		5,250
18a	1,200		1800
	9,600		14,400

Table 2

5.3 – 2003 Tuolumne River Gravel Purchase and Placement

- Project personnel reduced the size criteria, for the gravel, to accommodate Steelhead trout (Oncorhynchus mykiss) (Table 3).

2003 Steelhead Spawning Gravel Size Criteria

Particle Size	Percent Passing	Percent Retained
4”	100%	0%
2”	30%-40%	60%-70%
1”	15%-25%	75%-85%
3/4”	10%-20%	90%-80%
1/2”	0%	100%

Table 3

- The Department of Water Resources (DWR) purchased approximately 8,000 tons (5333 cu yds) of gravel. Gravel was introduced at areas 14a, 14b, 16, 15b and 18b (Table 4).

2003 Location and Volume of Gravel Placement

2003 La Grange Gravel			
Area	Cu Yds		Tons
14a	1,333		2,000
14b	1,667		2,500
15b	333		500
16	1133		1700
18b	867		1,300
	5,333		8,000

Table 4

5.4 – Criteria for Site Choice for Gravel Introductions

- The recommendations made in the Tuolumne River Phase II Gravel Introduction Technical Memorandum, prepared by McBain and Trush on behalf of the Tuolumne River Technical Advisor Committee.
- The amount of gravel purchased, with available funds.
- Salmon use based on CDFG staff observations of spawning use.
- Likely material transport patterns as identified by project engineers (CDWR & CDFG, 28Feb01; CDWR, July 2000).
- Other identified areas will have gravel added later as funding and engineering becomes available.

The spawning gravel is smaller than the gravels currently on the riverbed. This allows the current regulated river flow regime to move gravel downstream and maintain quality salmonid habitat over time, mimicking a more natural process of course sediment loading and transport. The in-transit gravel will be deposited as bars and spawning habitat. It is expected that this gravel will be, again, redeposited further downstream over time through dam regulated hydrologic flows. This slow downstream routing of gravel will provide long-term benefits to spawning habitat and salmonid productivity. It is expected that all gravels placed during the project, will move downstream during normal high flow events and dam releases.

6.0 PROJECT ACCOMPLISHMENTS

6.1 – 2001 Preconstruction

- Project personnel obtained the necessary permits for the gravel introduction project,
- A size criterion, for the gravel, was developed.
- Through a Purchase Estimate, the Department of General Services (DGS), solicited bid for the gravel purchase and delivery.
- DGS awarded the contract, for approximately 14,400 tons (10,000 cu yds) of gravel purchase, to Merced Aggregates. Gravel deliveries began the middle of July 2001 and ended the end of August 2001.
- Riffles 11, 12 and 13 will have approximately 4900 cu yds (7350 tons), 15a will have approximately 3500 cu yds (5250 tons) and 18a will have approximately 1200 cu yds (1800 tons) stockpiled, east and south of the Old La Grange Rd. for introduction in 2002.

6.2 – 2002 Construction and Monitoring

- Introduction of the 14,400 tons (9600 cu yds) gravel, delivered in 2001, began starting the week of July 8, 2002. Project personnel finished construction activities, September 6, 2002.
- Riffles 11, 12 and 13 are located just east (upstream) of the Old La Grange Rd. Bridge at river-mile 50.7, approximately 0.5 miles upstream from the Old La Grange Rd. Bridge in Section 17 of T5S, R14E (Figure 3). The Modesto Irrigation District (MID) built a temporary access road, from the existing access road, to the river at riffle 12. Riffles 11 received approximately 1200 cu yds (1800 tons), 12 received approximately 600 cu yds (900 tons) and 13 received approximately 3100 cu yds (4650 tons) from stockpiled gravel (Figure 3). Two front-end loaders placed the gravel and created riffle 12 to gain access to the river by filling in existing washed out bedrock areas. Riffle 13 was extended upstream were Riffle 11 began. Riffle construction started from the top of riffle 13 upstream, to riffle 11.

- Riffle 15a is located just west of the Old La Grange Rd. Bridge and across from the Fish and Game office in Section 9 of T5S, R14E (Figure 3). Riffle 15a, accessed from across from the DFG's office, received approximately 3100 cu yds (5250 tons) of gravel from stockpiled gravel, creating a new floodplain and narrowing Riffle 15a (Figure 3). Two front-end loaders placed the gravel. During Phase 1, project personnel filled a large hole creating a new riffle. The riffle was too flat and wide, which the salmon did not use. Riffle 15a stockpiled gravel for future fluvial transport and narrowed the channel. The narrowed increased the depth and velocity.

- Riffle 18a is located west of the Old La Grange Rd. Bridge and south of the Fish and Game office at river-mile 50.4, Section 9 of T5S, R14E (Figure 3). Access for Riffle 18a was from an area downstream of Gasburg Creek. Approximately 1200 Cu Yds, 1800 tons, was place in this riffle by two front-end loaders. This was a series of deep holes scoured by the 1997 high water event. Filling these holes created Riffle 18a.

- The 2002 spawning season, produced no new activity in Riffles 10, 11, 15a and 18a.

- Site Monitoring for Riffles10 and 11

    - The 2003 spawning season produced approximately eight redds in this area.
    - The majority of redd construction occurred in site 11 with some activity in the lower end of site 10.

- Site Monitoring for Riffles 15a

    - Fish were observed in 2002 using this area, no completed redds were observed in 2002 spawning season.

- Site Monitoring for Riffles 18b

    - No completed redds were observed in 2002 spawning season.

6.3 – 2003 Construction and Monitoring

- DWR purchased approximately 8,000 tons (5,333 cu yds), in 2003. The gravel placement began the week of July 7, 2003 and finished September 12, 2003 placing, it in the river, as it was delivered. Gravel placement created new riffles, troughs and resting places for Steelhead trout (Oncorhynchus mykiss).

- Riffles 14a and 14b are located just east (upstream) of the Old La Grange Rd. Bridge at river-mile 49.9, approximately 0.2 miles upstream from the Old La Grange Rd. Bridge in Section 17 of T5S, R14E. Riffles 14a received approximately 1300 cu yds (2000 tons) and 14b received approximately 1,667 cu yds (2,500 tons) of gravel. This gravel was placed in these riffles by two front-end loaders. Riffles 14a and 14b were

accessed from the temporary road built in 2001 and at Riffle 12. Riffle 14a was accessed from the bottom of Riffle 12, working downstream. Riffle 14a was built first, providing an access to the river and Riffle 14b. Riffle 14b is a continuation of Riffle 14a (Figure 3).

- Riffle 15b is located just west of the Old La Grange Rd. Bridge and south of the Fish and Game office, in Section 9 of T5S, R14E (Figure 3). Riffle 15b, was a series of deep slow water and compacted gravel, received approximately 333 cu yds (500 tons) of gravel. Gravel was added to raise the bed thus lowering the water level and increasing the flow through the area. Riffle 15b was accessed from the north side of the River, west of the Old La Grange Rd. Bridge, south of the Fish and Game office.

- Riffle 16 is an extension of 15b (Figure 3) and received approximately 1,133 cu yds (1,700 tons) of gravel, placed in this riffle by two front-end loaders. Riffle 16, a series of deep slow water runs with compacted gravel, starts at the bottom of 15a and continues to 18b. Adding gravel, to raise the bed, thus lowers the water level and increases the flow through the area. Riffle 16 was accessed from the north side of the River, west of the Old La Grange Rd. Bridge and south of the Fish and Game office.

- Riffle 18b is located west of the Old La Grange Rd. Bridge and south of the Fish and Game office, river-mile 50.2, approximately ¼ mile upstream from the J-59, New La Grange Road, Bridge in Section 9 of T5S, R14E (Figure 3). The remainder of the gravel, approximately 1033 cu yds (1550 tons), was place in this riffle by two front-end loaders. The 2002 gravel introduction, to this site, left a riffle that was too wide and spread out. In 2003, the project narrowed the riffle by creating a new gravel bar. Riffle 16 was accessed from the north side of the River, west of the Old La Grange Rd. Bridge, south of the Fish and Game office and downstream of Gasburg Creek.

    - Site Monitoring for Riffles 14a & 14b:
        - No spawning occurred on the new gravel during the 2003 spawning season.

    - Site Monitoring for Riffle 15a
        - During the 2003 spawning season no redds were observed.

    - Site Monitoring for Riffle 15b:
        - One redd was observed in this area.

    - Site Monitoring for Riffle 16
        - No redds were observed in this area.

    - Site Monitoring for Riffles l8b.
        - The 2003 spawning season produced three redds in this area

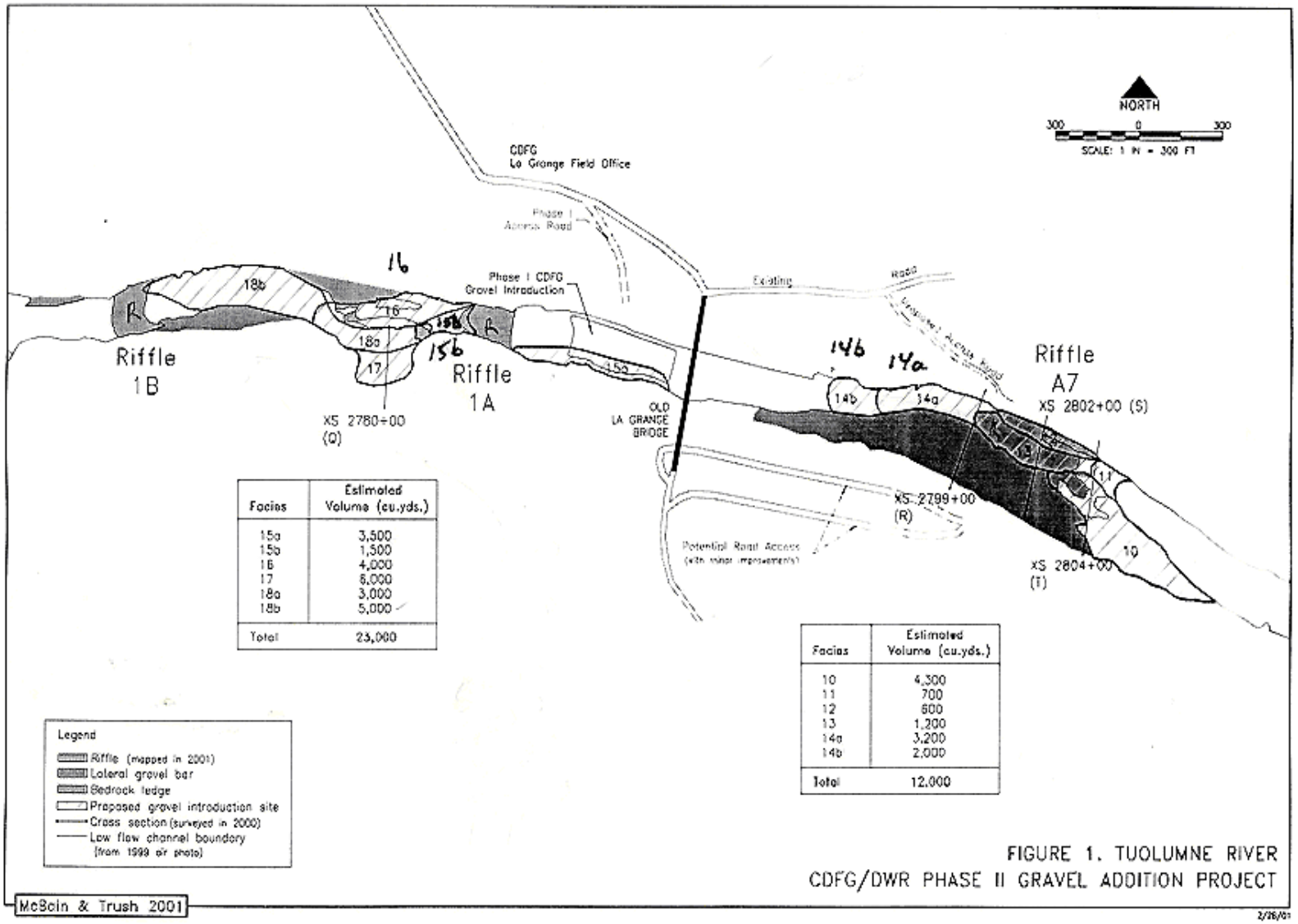

Figure 3 Tuolumne River, La Grange, Gravel Introduction Sites

7.0 Conclusions and Recommendations

We were able to place approximately 22,400 tons (15,000 cu yds) of spawning size gravel into the Tuolumne River at La Grange. There has been minimal use of the gravel to date. Part of the reason is that the 2002/2003 and the 2003/2004 season had reduced numbers of returning adults, thus less competition for spawning areas. The gravel introduction reduced the areas, which held predators, and should lead a higher survival rate of the young of the year.

There are several possibilities for future gravel introductions. Site 17 is an abandoned large gravel pit that connects to the river. Filling this, would help to reduce predator habitat. It is also possible to add additional gravel to the heads of Sites 11 and the bottom of 18b. These are included in the McBain-Trush Report. There additional riffle sites, that need gravel infusion, located just below the La Grange Dam. Access could be a problem, but it is worth investigating. There are several possibilities for gravel infusion from the New La Grange Rd. Bridge (J-59) downstream to the Basso Bridge (Hwy 132).

Riffles 11 and 13

Picture 1
2002 – Building New Riffles by Extending Riffle 13 and Creating Riffle 11

Picture 2
2002 – Building New Riffle 11

Picture 3
2002 – New Riffle 11

Riffle 12

Picture 4
2002 – Riffle 12 is Bedrock Prior to Placing Gravel

Picture 5
2002 – Riffle 12, Front-end Loader is Ready to Place the Gravel

Picture 6
2002 – Riffle 12, Front-end Loader Places the Gravel

Picture 7
2002 – Riffle 12 Finished, Stockpiling Gravel to Move during a High Water Event

Picture 8
2002 – Riffle 12 Finished, Stockpiling Gravel to Move during a High Water Event

Riffles 14a and 14b

Picture 9
2003 – Riffle 14a – Placing the Gravel

Picture 10
2003 – Riffle 14a, Front-end Loader Returning for another Load

Picture 11
2003 – Riffle 14a, Water Flowing into Deep Overhanging Pools

Picture 12
2003 – Riffle 14a, Created Riffles, Exposed During Low Water

Riffle 15a

Picture 13
2002 – Riffle 15a, Slow, Flat Water as Construction Begins

Picture 14
2002 – Riffle 15a, Front-end Loader Building Riffle

Picture 15
2002 – Riffle 15a Finished Creating a Source of Future Gravel and Narrowing the Channel

Riffles 15b and 16

Picture 16
2003 – Riffles 15b and 16, Front-end Loader Carrying Gravel for Placement

Picture 17
2003 – Riffle 15 b and 16, Front-end Loader Placing Gravel

Picture 18
2003 – Riffle 15b Deep Water Holding Areas Created For Steelhead Trout

Riffle 18a and 18b

Picture 19
2003 – Riffles 18a and 18b, Building Gravel Bar

Picture 20
2003 – Riffle 18a and 18b, Gravel Bar Takes Shape

Picture 21
2003 – Riffle 18a and 18 b, Gravel Bar Created,
Narrowing the Channel and Stockpiling a Source of Gravel to Migrate Downstream