

Trinity River Restoration Program
Physical Science and Gravel Augmentation Workgroup
Potential Gravel Augmentation Site Summary

China Gulch

6/10/2020

Site Description

The China Gulch site is located just downstream of Poker Bar between River Mile (RM) 101 and 101.6 (Figure 1). China Gulch itself joins the Trinity River at the apex of a 180-degree forced meander bend. A TRRP ESL (Environmental Study Limit) polygon exists along the left (south) bank; however at present, the Trinity River Physical Workgroup believes that gravel truck access to the left bank is essentially infeasible due to resistance from adjacent landowners. The right (north) side of the river, along the outside of the bend, would be ideal for coarse sediment augmentation. However, access to the north side appears extremely difficult; it is very steep, and no roads reach the river. Two faint roads appear to terminate along the ridge tops adjacent to China Gulch 1,200 to 1,500 feet from the river. No site visit was made for this proposal and more research is required to develop an appropriate approach to China Gulch. While much of the ESL appears to be on private land along the south side, virtually the entire north side occurs on BLM property (Figure 2).

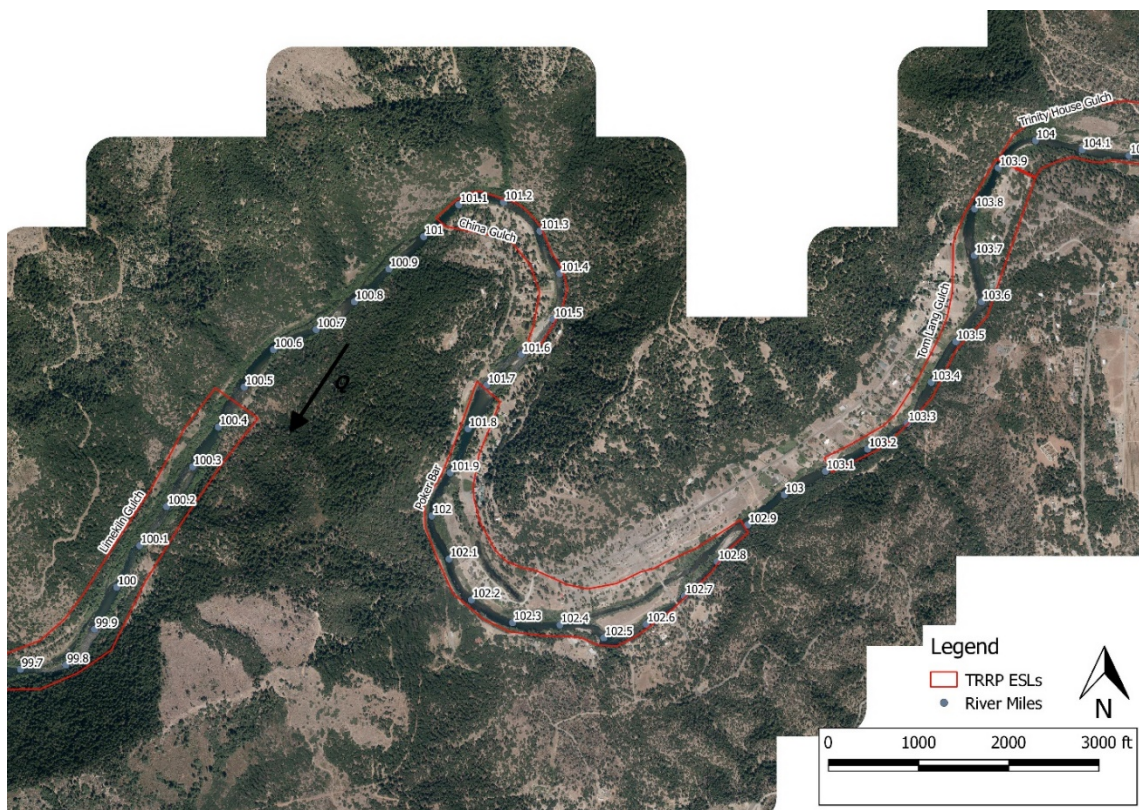


Figure 1. China Gulch location map. Flow is from right to left side of image.

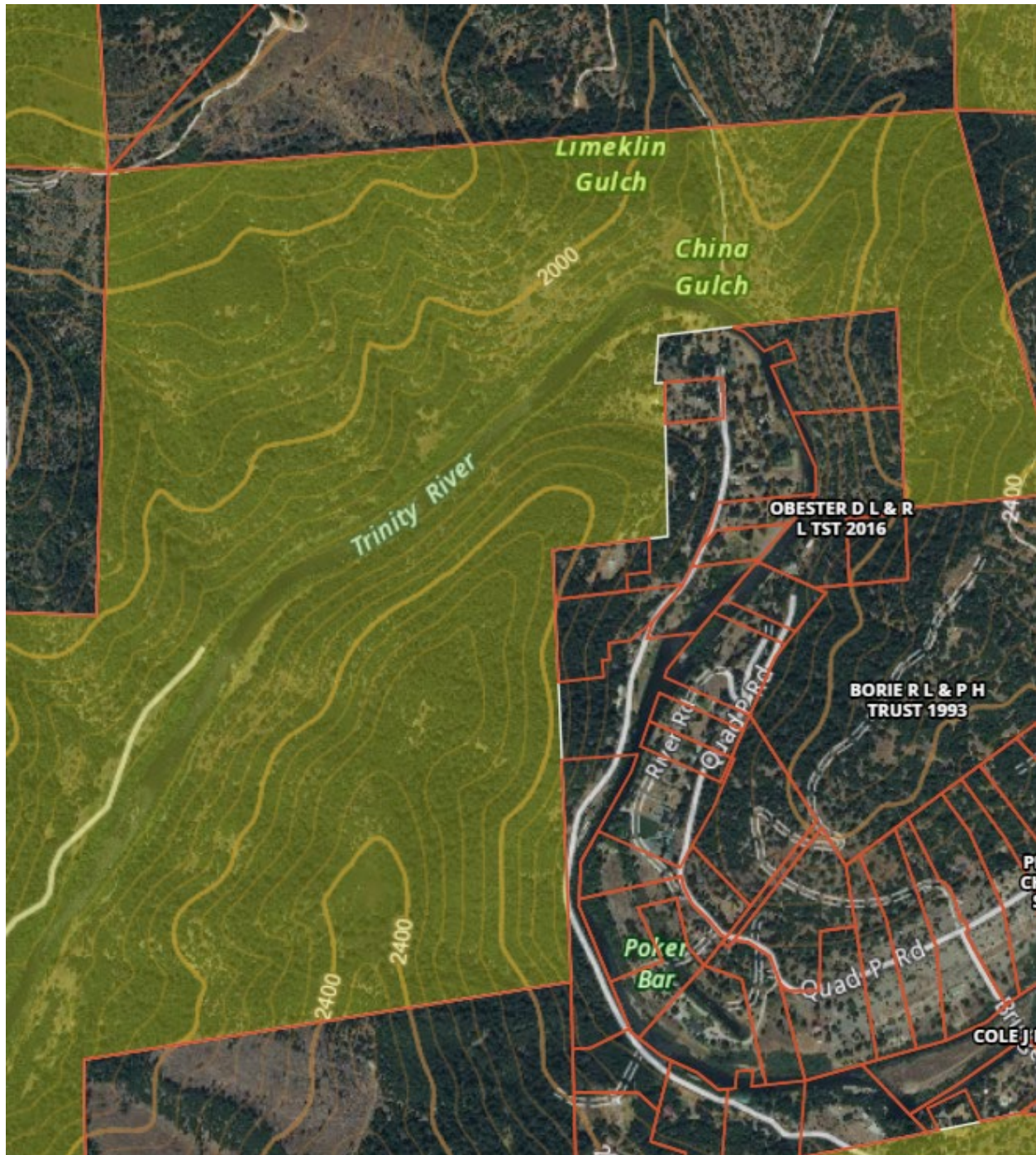


Figure 2. China Gulch land ownership (Source, OnX maps). Flow direction is toward left side of image.

Existing Site Conditions

The site is located approximately 3 miles into the 13-mile reach identified as having the lowest coarse sediment storage of all reaches below Lewiston Dam (Reach 4, McBain Associates 2015). Reach 4 begins just downstream of the 90-degree bend below Trinity House Gulch (RM 104) and extends 13 miles to Indian Creek, and is typified by a very coarse streambed, bedrock protrusions and steep, confining banks. McBain Associates (2015) describes Reach 4 as having “(l)ow tributary sediment supply and no

gravel augmentation (and) includes long, straight narrow segments with few obstructions.” Numerous naturally occurring split-flows and side channels occur below China Gulch and can be clearly discerned in Google Earth. In the 1.3-mile sub-reach from Trinity House Gulch down to Bridge Road at Poker Bar (RM 104 to 102.7), nascent bars and submerged, skeletal riffles occur on the inside of bends, at infrequent expansions and at the island complex near the bridge. These features may interact with augmented coarse sediments and enhance retention, increasing coarse sediment storage volume.

Approximately 3.7 miles upstream of China Gulch, coarse sediment augmentation has occurred since 2010 at the Lowden Ranch site (10,730 yd³) and one augmentation occurred in 2010 (1,530 yd³) at the Grass Valley Creek Delta, 3 miles upstream. Very little of the Lowden and Grass Valley Creek augmentations have likely reached China Gulch (Gaeuman 2020 and personal communication 2020). Augmenting coarse sediment at China Gulch aligns with the recommendations in McBain Associates (2015) for coarse sediment augmentation downstream of Lowden Ranch, as well as Gaeuman’s (2020) assertion that injected coarse sediments route slowly and additional augmentation sites should be developed to facilitate varying locations annually to maximize local geomorphic change and increase coarse sediment dispersion while reducing the risk of simplification due to over-supply.

Proposed Coarse Sediment Augmentation Action

Coarse sediment augmentation would be best accomplished from the south (left) bank via existing road access; however, we currently assume that this access would be difficult due to landowner opposition to gravel truck traffic on the road. In the absence of a south bank augmentation option, fish rock (3/8 to 4 inch) could be stockpiled at an adjacent ridgetop location on the north bank and then trucked with articulated, high clearance transport vehicles down a steep access road which currently does not exist. Gravel could then be graded into a berm along the right (north) bank. This approach is employed semi-annually by USBR on Clear Creek below Whiskeytown at the Dog Gulch site. Aerial imagery suggests 2,000 to 5,000 yd³ would easily fit at the China Gulch site. High flow augmentation is likely infeasible as access would be poor during the spring when soil moisture levels within the access road network are high.

It should also be noted that downstream of China Gulch, decommissioned roads appear to reach the river along the north bank on BLM lands (to the Limekiln Gulch rehabilitation site). These sites should be explored and assessed for feasibility. Any location between China Gulch and Steel Bridge (the next proposed augmentation site downstream) would be beneficial.

Another option to consider is using a yarder from the hillslope to haul gravel down the hill. A tail block would be placed on the south bank of the river and the yarder on the hill above the site. There would likely be low production using this method, but it could all be done on BLM land. Clearly more investigation of the road network, delivery methods and production rates is required.

Habitat Improvement Goals and Objectives

Increasing coarse sediment supply improves fluvial geomorphic dynamics, which creates complex aquatic habitats that can increase salmonid production. Augmenting coarse sediment at China Gulch would immediately increase coarse sediment storage locally and eventually increase storage farther downstream. Increased coarse sediment storage would create more dynamic bars and riffles with a

wider grain size distribution, more sorting of grains into patches which should be finer than the existing coarse material. Increased coarse sediment supply is expected to improve spawning habitat, increase alluvial bed coverage for benthic macroinvertebrate production, and potentially improve rearing habitat by facilitating the development of off-channel features associated with bar development, including split flows, alcoves, and side channels (McBain Associates 2020).

Monitoring Plan

Progress toward the objectives stated above can be assessed by:

1. Pre-, as built, and post-augmentation topographic/bathymetric surveys to support geomorphic change analyses to quantify changes in bed topography and to assess geomorphic evolution toward more functional condition (as defined by alluvial-function metrics, such as bar area and the development of off-channel features).
2. Hydraulic modeling and habitat mapping to assess changes in flow velocities and habitat capacity.
3. Substrate facies mapping and/or pebble counts and/or bulk sampling to evaluate changes in the surface substrate composition, changes in spawning habitat, and the proportion of the bed covered by coarse sediment versus boulders or bedrock.
4. Use of ongoing redd/carcass surveys to evaluate changes in spawning use in the area, correlate with changes in spawning habitat area.
5. Bedload monitoring at the Limekiln Gulch site could indicate when/if coarse sediment is routing from China Gulch to Limekiln Gulch.

References

Gaeuman, D. 2020. *WY2016-2017 Trinity River Gravel Augmentation Monitoring Report*. Trinity River Restoration Program Technical Report TR-TRRP-2014-1, Yurok Tribal Fisheries Program, Klamath CA, <http://www.trrp.net/library/document/?id=2464>.

McBain Associates 2015. *Trinity River active bar mapping, Lewiston Dam to the North Fork Trinity River confluence, summer 2014*, Prepared for Hoopa Valley Tribal Fisheries, Hoopa, CA 44 pp.

McBain Associates, 2020. *A Synthesis of Coarse Sediment Storage and Fish Habitat Evaluations, Lewiston Dam to North Fork Trinity River Confluence* – in preparation.

Trinity River Restoration Program
Physical Science and Gravel Augmentation Workgroup

1. Sediment Addition Site Description

a. Dark Gulch

The sediment addition location is at RM 106.7, located 1.2 RM downstream of Rush Creek. Site features include two large tailing piles with a potential processing area between them, a left bank side channel at RM 106.75, a large pool at the confluence of the side channel and mainstem flow at RM 106.6, and a multi-thread channel at RM 106.2-105.9.



- iii. Access agreements across private land may be required to reach site via existing roadways. The tailing piles may also be privately owned, so agreements may need to be made to add this material to the river.

2. Existing Conditions at Location of Proposed Sediment Additions

- a. Juvenile salmonid rearing habitat is available during high flows on a floodplain area located immediately upstream of the augmentation location. Rearing habitat during winter and summer baseflows appears lacking in the main channel at the augmentation location, but plentiful in the side channels mentioned above. Overall, fry and pre-smolt rearing capacity in the reach increases steadily with discharge (Figure 2). Spawning areas are predominantly limited to pool tails at RM 106.75 and 106.57, an incipient mid-channel bar and marginal areas at RM 106.4, and marginal areas at RM 106.2.

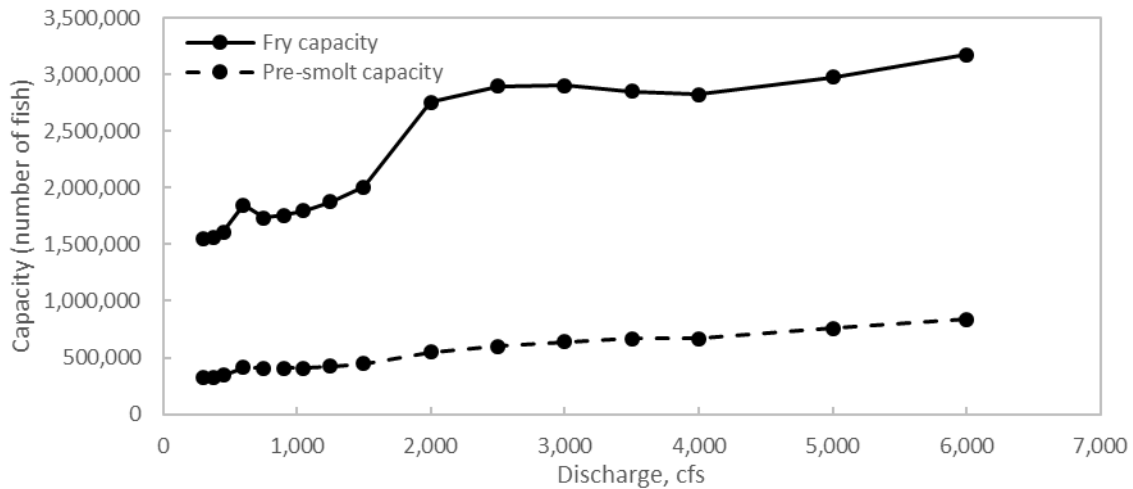


Figure 2. Draft estimates of fry and pre-smolt capacity in the Dark Gulch reach.

- b. Bulk samples of the active layer and subsurface sediments taken 2001-2018 at a location 0.1 miles upstream of Salt Flat Bridge indicate a slight fining of the bed and somewhat improved sorting of surface grains through time. Fine sediments at the above sample location and at sampling sites located as far downstream as RM 99.0 have met fine sediment targets for salmonid egg incubation and macroinvertebrate production, but have been in deficit relative to targets for particle mobility in both the surface and subsurface domains (Fine sediment synthesis report, draft).

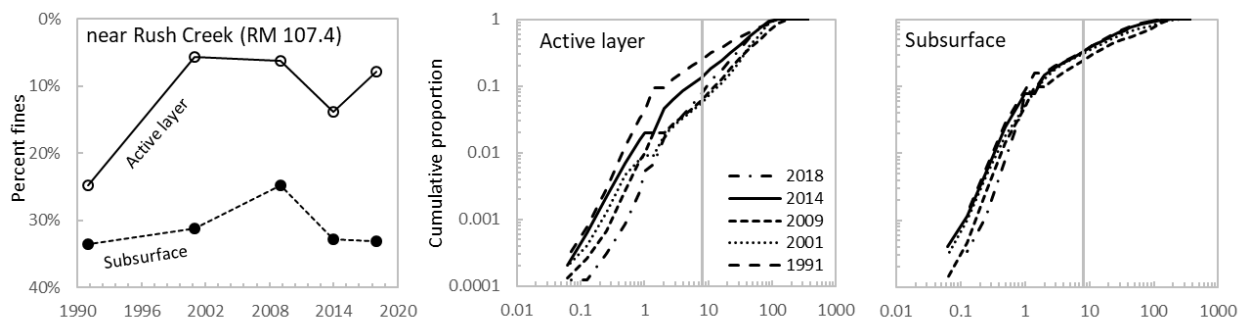


Figure 3. Grain-size distributions from bulk samples of the active layer and subsurface domain near Rush Creek.

Table 1. Grain sizes that are coarser than 84%, 50%, and 16% of bulk sampled material (by weight). Sorting is computed as $\sqrt{D_{84}/D_{16}}$. Lower values indicate improved sorting.

Domain	Year	D84	D50	D16	Sorting
Surface	2018	79	33	15	0.43
	2014	78	39	9	0.35
	2009	122	66	20	0.40
	2001	85	54	23	0.52
Subsurface	2018	60	17	2	
	2014	60	17	2	
	2009	117	33	4	
	2001	101	21	3	

3. Habitat Improvement Goal(s)

- a. Sediment additions would target increasing topographic diversity in the channel and fine sediment storage in lee areas of the channel margins and bars and on floodplains. Expected changes in channel topography include increased pool tail area at RM 106.55, mid-channel bar construction at RM 106.4, and enlargement of the mid-channel bar at RM 106.1. Augmented material is also predicted to measurably enhance existing riffles and lateral deposits as far downstream as RM 105.55 and deposit fine sediments on existing coarse substrates in the channel that lack fine material and on floodplain surfaces to promote plant initiation.

These changes are expected to benefit habitat for juvenile salmonid rearing by increasing hydraulic diversity in the channel to provide feeding and resting stations, enhance adult spawning areas on the enlarged bars, and bolster ammocoete rearing in fine depositional areas that are expected to increase in size and number in the topographically diverse channel that is expected to form. Bar formation will increase shear stress on banks and recruit additional sediments to the channel from channel migration that will help form riparian vegetated areas on the new and enhanced bar features. Ideally, plants will establish on the enlarged bars to increase channel edge length and future wood supplies in the channel.

Channel aggradation is a hoped-for outcome of the augmentations, and this along with increased form roughness from bar formations will increase juvenile fish access to floodplains for rearing. The increased water heights relative to floodplain elevations may also lengthen the riparian fringe from the channel to benefit plant populations and growth, bird nesting, and browse and cover for deer and other mammals. Turtles and frogs are not expected to substantially benefit from the sediment augmentations because the river water is too cold this close to Lewiston Dam to heat to temperatures that would benefit these species.

4. Sediment Addition Proposal

- a. Description

Volumes of sediment additions: A common belief in the TRRP is the expansive backwater pool upstream of Rush Creek delta passes most fine sediment but

stores coarse sediment from upstream. Assuming this is correct, continuity in coarse sediment transport is interrupted at the backwater pool and likely needs to be replenished at Dark Gulch to meet goals for habitat creation in the reach. To this end, average and low to high volumes of sediment additions tabulated below are presented as guidelines. Actual volumes for addition should be computed for the annual flow schedule using methods described in the proposal for sediment additions near Trinity Hatchery, with adjustments made for the increase in discharge between these locations and sediment transport on Rush Creek. Lower volumes of sediment should be added to the channel when Rush Creek substantially adds to its delta or experiences high flows in the preceding winter relative to that expected by water year type; high additions should be made when few sediments are contributed to the delta or flows are low relative to past water years of the same type.

Water year type	Low (cy)	Average (cy)	High (cy)
Extremely wet	2,920	3,460	5,860
Wet	1,290	1,660	2,740
Normal	680	1,120	2,000
Dry	50	260	640

- i. Grain-size distribution: The proposed size distribution of grains for addition to the channel is based on subsurface grain-size distributions measured in past years at the nearest upstream sampling location (RM 107.4). At this location, biologic targets for fine sediment storage are met, but fines are insufficiently present to meet targets for bed mobility. A fine-sediment free distribution of grains is therefore not recommended. Rather, fines are suggested to be added to the channel at slightly higher percentages than found upstream to promote grain mobility, floodplain soil development and riparian plants, and ammocoete rearing without affecting salmonids and the stream food base. Coarse sediment recommended for addition will additionally provide substrate for bar construction, macroinvertebrates, and salmonid spawning and incubation. The targeted framework particle size (i.e., D84) in the proposed distribution is 77 mm and the median grain size is 22 mm. Based on data in Riebe et al. (2014) that relates salmonid length to largest particle moved in redd construction, the median Trinity River Chinook (650 mm fork length; 2018 data) can mobilize a particle that is 121 mm in diameter. This indicates that spawners will be able to incorporate on average around 90% of the added sediment into their nests.

Grain size, mm	256	128	64	31.5	16	8	4	2	1	0.5	0.25
Percent finer	100%	92%	82%	60%	44%	28%	18%	11%	5%	1%	0%

- ii. Methods for additions: Sediment placed in the first several years of additions at this site would be in large piles in the channel during the early rising limb of hydrographs at the location indicated above. As the expected bar construction proceeds, sediment additions may occur later in the rising limb to promote deposition on higher surfaces in the channel. Monitoring and adaptive management would be used to modify these methods as needed to best achieve the goals of the sediment additions.

- iii. Sediment source: The best source for sediment additions to the channel is the tailing piles that exist on site. An alternate site is the Sawmill processing area located 2.2 miles away. Fine sediments, if lacking in these source areas, can be obtained from the material pile located near Hamilton ponds on Grass Valley Creek, located 4.2 miles away.
 - iv. Additional actions: If mid-channel bar development does not substantially occur at RM 106.4, a large woody debris structure may be constructed or over-sized material placed at a location approximately one-third of the total bar length downstream from its upstream edge to capture sediment from upstream, or sediment may be directly placed and the channel widened at this location by excavation of material from the right bank. Wood additions may also be required at the entry to side channels at RM 106.1 and RM 106.2 to promote local scour and prevent plugging by sediment. No further actions are expected to be required to meet goals of the sediment additions.
- b. Desired outcomes
 - i. Deposition of added sediment in bars to increase the topographic diversity in the reach is desirable. The bars are hoped to increase bank erosion to widen the channel and form a mid-channel bar in the reach that would vegetate with woody plants. This sequence of events is especially hoped to create a split flow at RM 106.4.
 - ii. Bar formation would increase form drag in the channel and further promote deposition in the reach. This is expected to promote aggradation of the bed and increase the frequency and duration of floodplain inundation.
 - iii. At some level, aggradation in the reach is expected to balance with an increase in energy slope to limit the amount of sediment deposited in the reach. This, in turn, will promote sediment dispersion to increase the downstream supply of sediments.
 - iv. Bar formation and increased access of flow in floodplain areas will bolster the habitat available for juvenile salmonid rearing and species mentioned above.
- c. Hypothesized cause (sediment additions) and effect (habitat creation) outcomes from the proposed action are explained above.
- d. The addition of fines with coarse sediment to the channel will violate current turbidity standards for sediment additions. Permitting is therefore needed to relax these standards to enable an appropriate grain-size distribution to be added to the channel.

Potential negative outcomes of the proposed sediment addition are the reverse of the positive outcomes that are expected. For example, if added material is not captured to form bars in the reach, its usefulness creating local habitat will not be realized. Additionally, if bed slope does not increase with aggradation in the reach, channel filling may form a simple, planar bed that is relatively void of habitat.

5. Monitoring Plan

- a. Survey bathymetry with multibeam sonar and floodplain elevations with Structure from Motion and conventional surveys from RM 106.9 to 105.8 prior to commencement of sediment additions and annually in summer after dry and wetter water years when augmentations are made at this site. In this same periodicity, conduct bulk sampling of active layer and subsurface domain at RM 107.4, 106.4, 106.3, and 106.1, and survey

the extent of deposits of fine sediment $>2 \text{ m}^2$ between RM 106.9 and 105.7. These data would be available in fall the year that sediment additions are made so they can be used to adjust the following year's additions with contemporary data.

Trinity River Restoration Program
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Steel Bridge Day Use Site

Site Description

The Steel Bridge Day Use site is located just off Steel Bridge Road, 1.9 miles from State Highway 299. The turn-off onto Steel Bridge Road from Highway 299 is approximately 2.8 miles east of Douglas City, CA. The augmentation site spans about 200 ft along the left bank of the river at RM 98.55 in the middle of nearly 180-degree bend in the river valley approximately 0.4 miles downstream from the Steel Bridge boat launch.

All access is via Steel Bridge Road, which a public County road. It is paved but narrow (single lane) and has numerous residences along it. The road has a 180-degree bend where the pavement could be susceptible to damage from trucks with heavy loads making that turn. Hauling during wet periods when the road foundation is saturated may also result in damage to the pavement. Local residents are likely to object to the heavy truck traffic required to bring in gravel. The site itself is on BLM land immediately adjacent to residential properties.

Existing Site Conditions

This location was considered as a potential rehabilitation site in 2008. No action was taken because habitat conditions were deemed acceptable. The site currently offers slow shallow-water habitat with cover along the convex (left) bank, relatively deep pools along the concave (right) bank, and a well-developed bedrock-controlled riffle at the downstream end of the bend. Downstream from that riffle the channel is almost perfectly straight and has a substrate dominated by bedrock and boulders for about a half a mile before the next bend in the valley is reached.

Very little gravel is present among the boulders and bedrock that comprise the stream bed in the straight reach downstream from the proposed augmentation site. That reach is also situated near the middle of a stretch of river identified by Gaeuman (2014) as the Steel Bridge segment, where the substrate tends to be coarser than in upstream or downstream river segments. He was unable, however, to definitively link that observation to a supply deficit and noted that factors such as differences in stream power or local bedrock lithology could account for the coarser substrate observed in the area.

Proposed Gravel Augmentation Action

Up to 1500 cy of fish rock (3/8" to 4") would be stockpiled within the baseflow channel prior to the rise of the spring flow release. The stockpile would extend about 30' into the channel along about 200' of bank. Placing material in the water during low-flow conditions, as is required by this augmentation method, can create high turbidity levels. Turbidity issues associated with in-channel gravel placements are typically controlled by slowing the rate of in-water gravel placement and/or by placing washed rock. There is adequate space at the proposed site to stockpile the augmentation material prior to placement. Stockpiling, however, could interfere with recreational use of the site and would need to be worked out with BLM.

Habitat Improvement Goals and Objectives

As always, the goal is increased salmonid production. The objectives of gravel augmentation in attaining that goal include promoting gravel deposition in the boulder straight reach downstream from the Steel Bridge Day Use site, which would presumably improve spawning conditions in that reach and perhaps increase the availability of habitat for juvenile salmon through the formation of gravel bars. Conversely, the boulder bed in the reach downstream from the proposed augmentation location is topographically complex at present, and it is possible that gravel could fill deeper pockets and result in decreased bed relief or decreased hydraulic roughness that might lead to higher mean flow velocities.

Monitoring Plan

Progress toward the objectives stated above can be assessed by:

1. Pre- and post-action multibeam sonar surveys in the straight reach downstream from the site to quantify changes in bed topography, such as bar development (positive changes) or filling of deep pockets (negative changes).
2. Hydraulic modeling (or empirical measurements) in the straight reach downstream from the site to assess changes in stage, flow velocities, and habitat capacity.
3. Use of ongoing redds/carcass surveys to evaluate changes in spawning success in the area.
4. Substrate facies mapping to evaluate changes in the surface substrate composition and the proportion of the bed covered by gravel versus boulders or bedrock.

References

Gaeuman, D. 2014b. *Analyses to support gravel augmentation recommendations for the Trinity River, California*. Trinity River Restoration Program Technical Report TR-TRRP-2014-1, Weaverville, CA, <http://www.trrp.net/library/document/?id=2197>.

Trinity River Restoration Program
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Potential Gravel Augmentation Site Summary

Trinity House Gulch
6/10/2020

Site Description

The Trinity House Gulch site is located just downstream of the Grass Valley Creek confluence between River Mile (RM) 104 and 104.3, along the north (right) bank (Figure 1). This was a TRRP channel rehabilitation project in 2010, and consisted of a constructed side channel, floodplain lowering, modest channel realignment, constructed point bars, and gravel (coarse sediment) augmentation (3,500 yd³). Access to the site is provided by (1) from Browns Mountain Road on the north side of the river, or (2) the BLM access gate to Lowden Ranch off Lewiston Road on the south side of the river. Access from Browns Mountain Road occurs via the bridge near the Bucktail launch site. The Lowden Ranch access is on the south side of the river (on the opposite bank from Trinity House Gulch) and is appropriate only for low flow walking site visits, not truck access.

The native-surface (mostly de-commissioned) road into the site from the north bank is blocked by two gates from Browns Mountain Road. It is partially eroded by the migrating side channel and is in poor condition. The road must be improved or even relocated to provide gravel truck access to the river. The site itself is on BLM land immediately adjacent to residential properties, and residents may object to truck traffic. Efforts to coordinate with landowners (i.e. help pull pumps during restoration actions) may improve public acceptance.



Figure 1. Trinity House Gulch location map. Blue polygon describes location, not project boundary. Flow is from right to left side of image.

Existing Site Conditions

The site is located at the upstream end of a reach identified as having the lowest coarse sediment storage of all reaches below Lewiston Dam (Reach 4, McBain Associates 2015). Reach 4, which begins just downstream of the 90-degree bend below Trinity House Gulch (left side of Figure 1) and extends 13 miles to Indian Creek, is typified by a very coarse streambed, bedrock protrusions and steep, confining banks. A 2015 coarse sediment mapping study (McBain Associates 2015) describes Reach 4 as having “(l)ow tributary sediment supply and no gravel augmentation (and) includes long, straight narrow segments with few obstructions.” In the 1.3-mile sub-reach from Trinity House Gulch down to Bridge Road at Poker Bar (RM 104 to 102.7), nascent bars and submerged, skeletal riffles occur on the inside of bends, at infrequent expansions and at the island complex near the bridge. These features may interact with augmented coarse sediments and enhance retention, increasing coarse sediment storage volume.

Coarse sediment augmentation has occurred since 2010 at the Lowden Ranch (10,730 yd³) site 0.67 miles upstream and one augmentation occurred in 2010 (1,530 yd³) at the Grass Valley Creek Delta, less than 0.1 mile above Trinity House Gulch on the south bank of the river. While very little of the Lowden augmentation has likely reached Trinity House Gulch (Gaeuman 2020), due to channel rehabilitation and coarse sediment augmentation in 2010 and the Grass Valley Creek delta coarse sediment augmentation in 2010, local coarse sediment storage near Trinity House Gulch is higher than in the reach immediately downstream based on observations of recent aerial photographs. Local point bar grain sizes appear to be in the desired range for salmonid spawning use, with a D₈₄ ranging from 120-148mm and the D₅₀ ranging from 71 to 74mm (2011 pebble count data from McBain Associates). Augmenting coarse sediment at the downstream end of the Trinity House Gulch site aligns with the recommendations in McBain Associates (2015) for coarse sediment augmentation downstream of Lowden Ranch, as well as Gaeuman’s (2020) assertion that injected coarse sediments route slowly and additional augmentation sites should be developed to facilitate varying locations annually to maximize local geomorphic change and increase coarse sediment dispersion while reducing the risk of simplification due to over-supply.

At the upstream end of the project, a constructed side channel on the north bank precludes coarse sediment augmentation (it might plug the entrance) and through most of the reach, the side channel would have to be crossed and coarse sediment would be placed in a poor location for entrainment (along the inside of a bend). This leaves the downstream end of the site, below the side channel return, as the most logical location to place coarse sediment. This site would also avoid any significant disturbance to existing riparian vegetation.

Proposed Coarse Sediment Augmentation Action

A large volume of spoiled material (the TRRP Data Portal provides “37,100 CY fill”) is sequestered in a clearing along the north bank near the downstream end of the project. This material could be screened on-site to provide fish rock (3/8 to 4 inch) for coarse sediment augmentation. Removing this material and grading the spoils-site to a lower elevation creates an opportunity to build a new floodplain which would be more connected to groundwater, more frequently inundated, and increase floodplain rearing habitat for salmonids. Lowering adjacent surfaces and perhaps creating more complex off channel features such as alcoves or wetlands is in alignment with broader-scale TRRP restoration goals. Sequencing would require developing a plan to phase grading, spoils screening, and coarse sediment placement and would facilitate riparian recruitment on lowered surfaces, as well as accommodating future coarse sediment augmentation. Screened material could be washed to reduce turbidity increases

during low flow placement. Fines (<3/8 inch) could be spoiled in upslope areas on-site. Once this local supply of 2010 spoils material is depleted, fish rock would have to be imported from off-site.

Approximately 2,000 yd³ of fish rock (3/8" to 4") could be augmented as a lateral berm along the right margin of the channel prior to the rise of the spring high flow release. The lateral berm would extend approximately 300 feet downstream and would be 20 feet wide. The height of the berm should not exceed the elevation of the top of the right bank. Dimensions and exact locations can be adjusted to facilitate site conditions. Figure 2 provides a conceptual layout, which would avoid any significant disturbance of existing vegetation. The surface area of this spoils area is 7,500 yd², so if the spoils were 50% usable (3/8" to 4"), and the surface was lowered 3 feet, it would generate approximately 3,750 yd³ of fish rock. Adding side channels and other complex features could increase this volume of local fish rock.

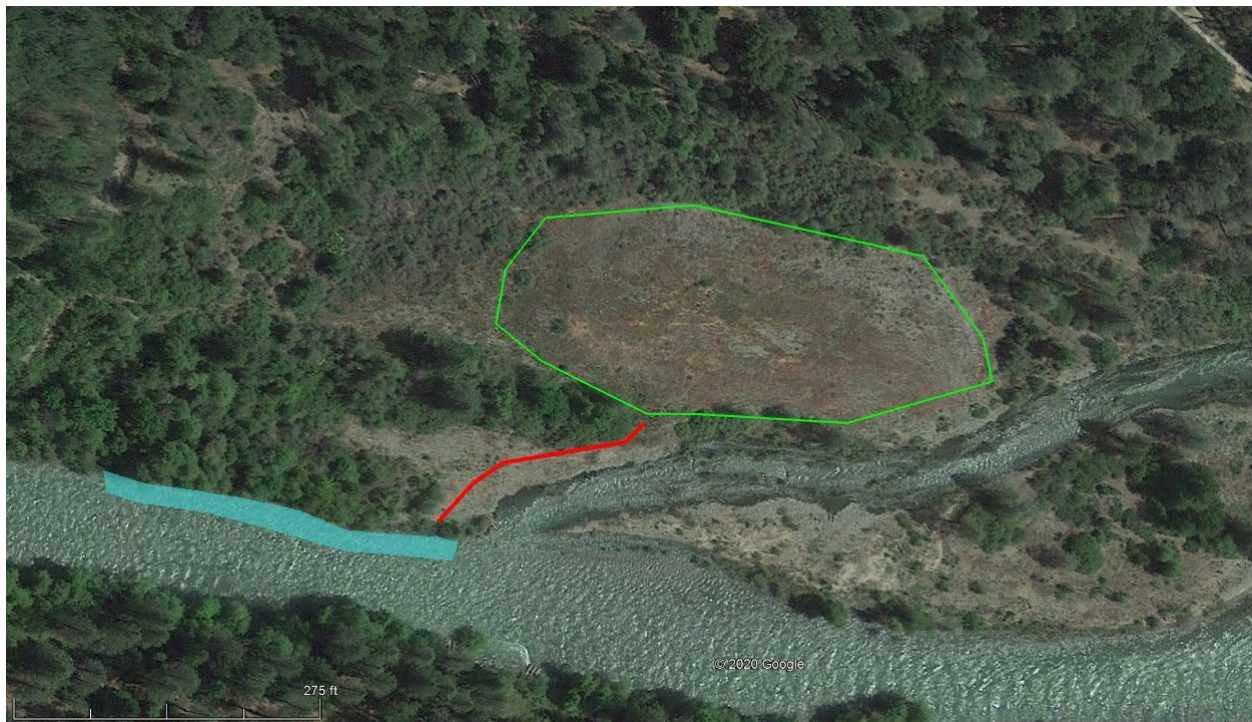


Figure 2. Trinity House Gulch: Staging/grading/screening/washing area (green polygon), access route (red line), and berm location (blue polygon).

An alternate approach would be to augment during high flows, such as is done at the Diversion Pool and at Lowden Ranch, using either a conveyor system or by placing directly into the channel using front-end loaders or excavators. This approach would lessen the need for washing (as background turbidity would be higher) and may even enable the inclusion of fines (<3/8") with augmented coarse sediments. This would simplify logistics, reduce augmentation cost, reduce dust and noise for adjacent landowners, and align with the emerging awareness that modest increases in fine sediment supply may be beneficial to the Trinity River within the 40-mile restoration reach (Trinity River Physical Workgroup discussion March 2, 2020).

Habitat Improvement Goals and Objectives

Increasing coarse sediment supply improves fluvial geomorphic dynamics, which creates complex aquatic habitats that can increase salmonid production. Augmenting coarse sediment at Trinity House Gulch would immediately increase coarse sediment storage locally and eventually increase storage farther downstream and create more dynamic bars and riffles with a wider grain size distribution, more sorting of grains into patches which should be finer than the coarse material existing currently. Increased coarse sediment supply is expected to improve spawning habitat, increase bar area for benthic macroinvertebrate production, and potentially improve rearing habitat by facilitating the development of off-channel features associated with bar development, including split flows, alcoves, and side channels (McBain Associates 2020).

Monitoring Plan

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1. Pre-, as built, and post-augmentation topographic/bathymetric surveys to support geomorphic change analyses to quantify changes in bed topography and to assess geomorphic evolution toward more functional condition (as defined by alluvial-function metrics, such as bar area and the development of off-channel features).
2. Hydraulic modeling and habitat mapping to assess changes in flow velocities and habitat capacity.
3. Substrate facies mapping and/or pebble counts and/or bulk sampling to evaluate changes in the surface substrate composition, changes in spawning habitat, and the proportion of the bed covered by coarse sediment versus boulders or bedrock.
4. Use of ongoing redd/carcass surveys to evaluate changes in spawning use in the area, correlate with changes in spawning habitat area.

References

Gaeuman, D. 2020. *WY2016-2017 Trinity River Gravel Augmentation Monitoring Report*. Trinity River Restoration Program Technical Report TR-TRRP-2014-1, Yurok Tribal Fisheries Program, Klamath CA, <http://www.trrp.net/library/document/?id=2464>.

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Vitzthum Gulch Site

Site Description

The proposed Vitzthum Gulch site is located at an unpaved turn-out on the west-bound side of State Highway 299 about 2.5 miles east of the junction of Highway 299 with State Highway 3 at Douglas City, CA. The turn-out is presently about 330 ft long and 40 ft wide but could be widened to at least 60 ft by removing a small amount of riparian vegetation. The Highway right-of-way is immediately adjacent to the Trinity River at this location and the turn-out overlooks the river, which is at the base of a steep slope about 20 ft below the Highway elevation.

Existing Site Conditions

The Vitzthum Gulch site is located near the center of a nearly 180-degree bend in the river valley where the river is confined between a reinforced embankment occupied by Highway 299 on river left and a heavily-vegetated convex bank with a well-developed natural levee on the right. The other side of the Highway is adjacent to a steep, rocky, canyon-like valley wall. The stream substrate within the bend is relatively coarse, with abundant large cobbles and occasional bedrock ribs. However, gravel bars composed of finer material exist both upstream and downstream from the bend. The proposed augmentation point is within the Vitzthum Gulch portion of the Indian Creek rehabilitation project constructed in 2007. Most of the work associated with that project occurred farther downstream adjacent to River Ranch Road, and work within this bend was limited to excavation of a series of “notches” in the levee along the right bank. The notches were beneficial to the extent that they facilitated connectivity between the main channel and a narrow floodplain beyond the levee at lower discharge levels, but they were ineffective for stimulating additional erosion of the levee, as some project proponents expected.

Proposed Action

The proposed action is to push up to 2000 cy of coarse sediment with a particle size distribution ranging from fine gravel to boulders up to 14 inches in diameter into the channel. A suitable gradation could be obtained by mixing fish rock (3/8” to 4”) and oversize material generated during gravel processing in approximately a 1:1 ratio. The augmentation could be implemented either by stockpiling material in the channel during low-flow conditions or by pushing it in when discharge is moderately high, preferably on the rising limb of a flow release. A drawback of low-flow stockpiling in the channel is that measures are needed to control turbidity levels. Placement at higher flows, on the other hand, can suffer from time constraints. Due to the lack of space for terrestrial stockpiling prior to a flow release, end dump trucks would need to deliver the material to the turn-out while a loader or dozer push it into the river as it arrives. Assuming a 1-hour round trip between the turn-out and the source of the material (Lowden Ranch would be a likely source), it would likely take four trucks three days to complete the task.

Habitat Improvement Goals and Objectives

As always, the goal is increased salmonid production. The objective of this proposed coarse sediment augmentation differs from the objectives of most augmentation activities in that the aim is not to supply mobile material to a presumably sediment starved downstream reach. To the contrary, this site is quite close to the confluence with Indian Creek where the supply of gravel is thought to be adequate. The objective for this site is to disrupt the existing channel by introducing an obstruction that forces erosion of the opposite bank. Such a disruption would likely improve local habitat conditions by introducing planform and topographic complexity within what is currently a very long monotonous bend, and by recruiting wood as a portion of the vegetated levee is eroded. Conceptually, this sediment addition is similar to natural landslides that periodically deliver coarse sediment to streams in areas with steep topography adjacent to the channel, which is the case at this location.

Monitoring Plan

The objectives stated above can be assessed by:

1. Pre- and post-action topographic surveys at and near the augmentation location to quantify changes in bed topography and channel planform.
2. Mapping changes to the riparian zone and to in-stream cover at and near the augmentation location to evaluate ecological benefits and as input for habitat modeling.
3. Hydraulic modeling (or empirical measurements) at and near the augmentation location to assess changes in stage, flow velocities, and habitat capacity.