FISH HABITAT ENHANCEMENT FEASIBILITY STUDY

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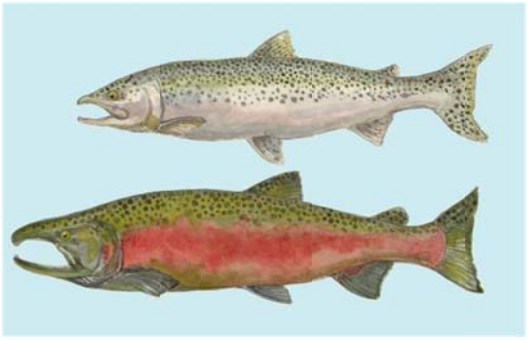

DRY CREEK
WARM SPRINGS DAM
TO THE RUSSIAN RIVER
SONOMA COUNTY, CA

PREPARED FOR

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EXECUTIVE SUMMARY

Introduction

The Dry Creek Fish Habitat Enhancement Feasibility Study is being conducted to facilitate fish habitat enhancement in Dry Creek, a major tributary to the Russian River in Sonoma County, California. Dry Creek is home to ESA-listed native fish, including Central California Coast (CCC) coho salmon (Onchorhynchus kisutch; endangered), steelhead trout (O. mykiss; threatened), and California Coastal (CC) Chinook salmon (O. tshawytscha; threatened). This effort will enhance channel and riparian conditions on lower Dry Creek to benefit juvenile life stages of ESA-listed coho salmon and steelhead trout, which will aid in their recovery within the region and satisfy requirements enumerated by the Final Biological Opinion for Water Supply, Flood Control and Channel Maintenance Activities for the Russian River Watershed (RRBO; NMFS 2008).

The feasibility study is being conducted in three phases including: (I) inventory and assessment of current conditions, (II) feasibility assessment of habitat enhancement approaches, and (III) conceptual design of habitat enhancement approaches deemed feasible. Current conditions were assessed based on a field inventory completed in summer 2009, detailed results of which can be found in the Current Conditions Inventory Report that concluded Phase I (Inter-Fluve 2010). Phase II, the focus of this report, is a feasibility study of habitat enhancement approaches over the entire 14 miles of Dry Creek flowing from Warm Springs Dam to its confluence with the Russian River. The feasibility study included the following primary components:

1. Field survey of Dry Creek to support development of a one-dimensional planning-level hydraulic model over the project reach.
2. Geotechnical subsurface exploration at select locations to inform the feasibility assessment.
3. Quantitative assessment of the hydraulic and geomorphic processes in Dry Creek.
4. Assessment of the feasibility of fish habitat enhancement based on geomorphic, hydraulic, engineering and construction considerations.

Hydrology & Geomorphology

Dry Creek's current hydrology results from regulation by Warm Springs Dam (WSD) and unregulated tributaries which enter Dry Creek below WSD. In general, regulation by WSD has reduced the magnitude of peak flows by several hundred percent while substantially elevating baseflow during the summer-fall period. Regional hydrology is dominated by winter rain events between November and March. Flood events still occur in the November to March timeframe, however the magnitude of such events are severely reduced compared to the unregulated period preceding dam construction.

The current geomorphology of lower Dry Creek is a result of the interaction of local geology, watershed characteristics, hydrology, and vegetative characteristics; the legacy of channel evolution and response to land management changes; and the ongoing influence of flow management. Lower Dry Creek is an incised, perennial, alluvial gravel bed stream that has responded to substantial human-induced hydrologic and geomorphic change over the past 150 years. Following base-level lowering, widespread systemic incision occurred which led to the development of an incised stream system flowing through a narrow active channel zone inset 10 – 30 feet below the adjacent agricultural valley floor.

The primary determinant of current geomorphic conditions is the influence of the dam, expressed through modified sediment supply, altered hydrology and the growth of riparian vegetation. Geomorphic function along Dry Creek varies according to the dominant processes at each location, and is determined by distance from WSD, location relative to unregulated tributaries downstream of WSD, and distance upstream of the Russian River. The unregulated tributaries moderate the influence of WSD on upstream sediment supply and flow regulation, while the backwater profile from the Russian River during floods directly affects the conditions in the downstream 3 miles of the study reach.

Hydraulic Modeling and Analyses

A planning-level one-dimensional hydraulic model was developed for the 13.9 mile study reach using bathymetric and topographic data collected during 2009 and 2010 field surveys, supplemented by LiDAR data. The model was calibrated to observed water surface elevations and surveyed high water marks. Model results were used to examine trends in sediment mobilization and effective discharge characteristics, and flood inundation patterns.

To evaluate general trends in the ability of Dry Creek to mobilize and convey sediment, channel competence-based calculations were completed. These calculations compared the shear stress needed to mobilize bed sediments with the shear stress exerted by flow in the channel at several discharge levels. The results suggest that surface substrate may be mobilized at all of the locations that were analyzed for the 2- and 10-year flood events, while moderately high flows occurring at a sub-annual frequency are able to mobilize surface sediments in select locations. The flow that is exceeded at least 20% of the time in winter months is able to transport the bed sediment load at many locations. These patterns are modified by the backwater profile created by the Russian River during large floods in the lower three miles of the study reach, which reduces the ability of Dry Creek to transport sediment in this stream segment.

Effective discharge, or the flow (or flow range) which transports the greatest cumulative volume of bed sediment of the long term, was estimated at several locations along the reach. The results reflect the influence of WSD and the unregulated tributaries below the dam on channel processes and are consistent with the results of the bed sediment mobility analysis. At select locations downstream of Pena Creek, the effective discharge is estimated to occur on a sub-annual basis. Between Pena Creek and WSD, the effective discharge is estimated in the range of a 2 – 3 year return interval flood event. The results of the effective discharge and sediment mobility calculations are consistent with field indications which suggest that Dry Creek has evolved to a condition which efficiently transports the bed sediment supplied to the reach despite the drastically reduced flood hydrology.

Fish Habitat Enhancement

The RRBO requires six miles of fish habitat enhancements to be implemented over the 13.9 study reach over three phases by 2020. Generally, Dry Creek currently lacks high quality main channel and off-channel habitats which are critical for juvenile coho and steelhead rearing. The proposed habitat enhancements aim to directly address these deficiencies. Specific criteria from the RRBO are summarized in the main section of the report. The methodology by which habitat benefits will measured is an important consideration in assessing the feasibility of meeting these criteria.

The primary types of habitat considered for enhancement include mainstem in-channel and off-channel habitats. Pool-riffle habitat is the primary desired in-channel habitat. As specified in the RRBO, optimal pool conditions for steelhead and coho rearing are 2 to 4 ft deep habitats with significant areas there water column velocities are less than 0.2 ft/s. Calculations were made to estimate the width of the channel needed to meet these criteria. A substantially wider channel than the current channel would be required to meet the criteria. The estimated required widths are wider than the existing channel corridor in many locations. As only a portion of the 13.9 miles of channel would be widened, this approach would create a multitude of hydraulic expansions and contractions, creating discontinuities in sediment transport and other processes. Furthermore, given current hydrology and vegetation patterns, it is estimated that a widened channel may ultimately evolve back towards a state similar to that currently observed in Dry Creek. These factors challenge the ability to meet the criteria listed above simply through pool-riffle enhancement, if the criteria are narrowly interpreted. Nevertheless, enhancements are feasible which will lead to improved fish rearing habitat conditions in the main channel. Strategic LWD placements can be used create fish cover and refugia from high velocities. Riffles can also be constructed to modify existing poorly-functioning pool habitats to reduce velocities. Riffle construction can be considered a tactical sediment augmentation approach to offset the reduced sediment supply due to regulation.

Off-channel habitat types appropriate for enhancement in Dry Creek include alcoves, backwater channels and side channels. Side channels, backwaters and alcoves are used heavily by juvenile salmonids when available to them. Due to the challenges in reaching optimal velocity criteria in the main channel, off-channel habitats provide notable opportunities for meeting depth, cover, complexity and velocity criteria. There are numerous locations where off-channel habitats may be considered to provide enhanced habitat. Feasibility considerations include potential for nuisance sedimentation, disconnection due to deposition of debris, or channel change stranding the habitat during summer baseflow. In pristine systems, individual off-channel habitats may be transient over the long term, or may be persistent through time. Often, in a healthy and unconstrained stream system, these habitats will be abandoned and recreated as an alluvial channel migrates across its floodplain, resulting in an approximately constant overall quantity of habitat over the long-term. Based on observations of persistent off-channel habitats in Dry Creek, general guidelines were developed to facilitate the longevity of these habitats if constructed for enhancement.

Construction feasibility considerations

The nature of land use and infrastructure along lower Dry Creek presents logistical challenges for the construction phase of the habitat enhancement effort. Existing transportation corridors consist of relatively narrow, winding two-lane roads and few heavy load capacity stream crossings, with substantial recreational and farm traffic. Furthermore, the narrow incised creek corridor and proximity to vineyard operations limit available access corridors and staging areas. Dust control is also a significant issue due to the sensitivity of vines growing in close proximity to the creek. Nevertheless, the logistical challenges can be planned for in developing detailed enhancement strategies.

The typical in-water work period for the region is June 15 to October 15 in order to minimize impacts on migrating adult salmonids and to concentrate ground disturbing activity during the dry season. In order to satisfactorily construct the enhancements and prevent excessive turbidity to the active flowing stream, it may be necessary to divert the stream around and/or dewater active work zones. Pumped diversion systems provide the benefits of moving the water out of the creek

corridor, and maximize the available work space in the corridor, which will facilitate efficient and competent completion of the work, including concurrent completion of work at multiple sites within a reach. However, the high daily expense of a pumped diversion system will need to be weighed against the potential limitations of less expensive approaches as each project nears implementation.

Feasibility of habitat enhancement by primary creek segment

Channel processes and dynamics vary along the length of Dry Creek, which suggest tailoring the enhancement approach in each segment to match the prevailing fluvial processes at each location. In general, the approaches may fall in a range defined by strongly process-reliant at one end, and direct habitat construction at the other end. Accordingly, Lower Dry Creek has been split into three segments based on dominant physical processes and other shared characteristics: 1) upstream of Pena Creek (RM 11 to 13.7), 2) Pena Creek to the grade control sills (RM 3 to 11), and 3) from the grade control sills to the Russian River confluence (RM 0 to 3). Generally, enhancement projects will be identified to include a series of main channel and off-channel enhancements which link together.

- Upstream of Pena Creek, construction of late-successional habitat was assessed to be feasible with low risk of the constructed habitat being compromised due to nuisance sediment deposition or other factors. Conversely, relying on channel processes to create the habitat was deemed to have low feasibility due to the lack of sediment supply and highly regulated hydrology. Generally, enhancement through direct habitat construction can be considered as having low risk of failure in this segment relative to other segments.

- The middle segment stretching from RM 3 - 11 has greater sediment supply than the upstream reach due to the unregulated tributaries which enter Dry Creek below WSD. This increases the risk for nuisance sedimentation impacts to potential directly-constructed off-channel habitat. This risk can be mitigated through appropriate site selection and other considerations discussed in this report. In this segment, off-channel enhancements may shift in character due to channel processes, again dependent on the characteristics of each site. Conversely, several large off-channel opportunities may lend themselves to a more dynamic, process-focused approach, or combined approach. In summary, the preferred enhancement approach to each site is more variable in this segment than the other two segments, and careful consideration of the attributes of each proposed location will determine the corresponding advisable enhancement strategy.

- In the downstream segment (RM 0-3), there is high risk that a direct habitat construction approach would be compromised by sedimentation due to the backwater influence of the Russian River. Conversely, enhancement that relies on a modified process-driven approach likely provides the best option in this segment. Based on observations of existing intact rearing habitats, it is possible that fluvial processes may be sufficiently intact to create target habitats over time provided the stage is set for habitat development to occur.

Conclusions related to the feasibility of fish habitat enhancement in Dry Creek

The following are the primary conclusions resulting from the study:

- It is feasible to enhance fish habitat in Dry Creek to benefit juvenile life stages of coho salmon and steelhead trout.
- The ability of fish habitat enhancement efforts to meet the targets spelled out in the RRBO will be influenced by the scoring methods developed to evaluate project success.
- Both instream and off-channel habitat enhancement can be considered.
- Off-channel habitats are likely best able to meet specific juvenile habitat preference criteria contained in the RRBO.
- Instream habitats can be improved, but are unlikely to meet habitat preference criteria contained in the RRBO if the criteria are narrowly interpreted.
- Because the dominant physical processes vary over the length of lower Dry Creek, the viable approaches to enhance fish habitat will also vary at each location. These approaches can be generally grouped as described above, and also in greater detail in Section 5 of the report.
- Numerous fish habitat enhancement opportunities were identified. On the basis of adjacent stream length, these off-channel and mainstem opportunities are distributed over 1.6, 2.1, and 5 miles above Pena Creek, below the grade control sills, and middle channel segments, respectively. It should be noted that the length of enhancement that can be credited based on the identified opportunities will depend on the habitat benefit scoring methodology.

Next Steps

Following the conclusion of the feasibility study phase, concept designs will be developed for enhancement opportunities identified to be feasible in this report. Concept design development will be completed during the summer 2011. In development of concept designs, project enhancement reaches will be identified which will be comprised of multiple feature sites (i.e. backwater channel, alcove, main channel pool enhancement, riffle construction). Following the development of concept designs, the enhancement reaches will be ranked based on their habitat potential and geomorphic risk and characterized in terms of their costs, and other considerations which may impede or facilitate implementation.