RESTORATION to SUPPORT STEELHEAD RECOVERY in the LA RIVER

CALIFORNIA ENVIRONMENTAL FLOWS FRAMEWORK LOS ANGELES RIVER

Introduction

The Los Angeles River (LA River) California Environmental Flows Framework (CEFF) Project will work across disciplines to develop environmental flow recommendations for the LA River consistent with the diverse management goals within the LA River watershed. The project will explicitly quantify flow criteria necessary to achieve management goals, including biodiversity goals supporting recovery of endangered steelhead belonging to the Southern California Steelhead (*Oncorhynchus mykiss*) Distinct Population Segment (DPS). This briefing summarizes steelhead life cycle needs and factors limiting the recovery of the species in the LA River watershed, drawing from information developed for the City of LA's LA River Fish Passage and Habitat Structures (LAR FPHS) project, which studied the watershed-wide life cycle needs for steelhead and proposes modification of the LA River channel through downtown LA to accommodate steelhead migration. The City of LA and other project partners are working with multiple agencies to increase biodiversity and restore native fish habitat and migration corridors to upper tributaries with high intrinsic potential including spawning and rearing habitat areas for steelhead, arroyo chub, speckled dace, unarmored three-spine stickleback, and Santa Ana sucker. Click the image below to view the project video or paste this URL into your browser: https://youtu.be/QPkZTs5-RV0.

Mountains Recreation & Conservation Authority

Stillwater Sciences

History in the LA River Watershed

The LA River watershed historically supported a population of steelhead until the 1940s when they were extirpated due to channelization and damming of the LA River and tributaries that degraded migration opportunities, habitat, and other life cycle needs. Steelhead occupy neighboring Southern California watersheds and their recovery in the LA River watershed is one of the National Marine Fisheries Service's (NMFS') recovery goals for the regional steelhead population group (NMFS 2012), among other regional planning documents. Steelhead are listed as endangered under the federal Endangered Species Act and the California Endangered Species Act.

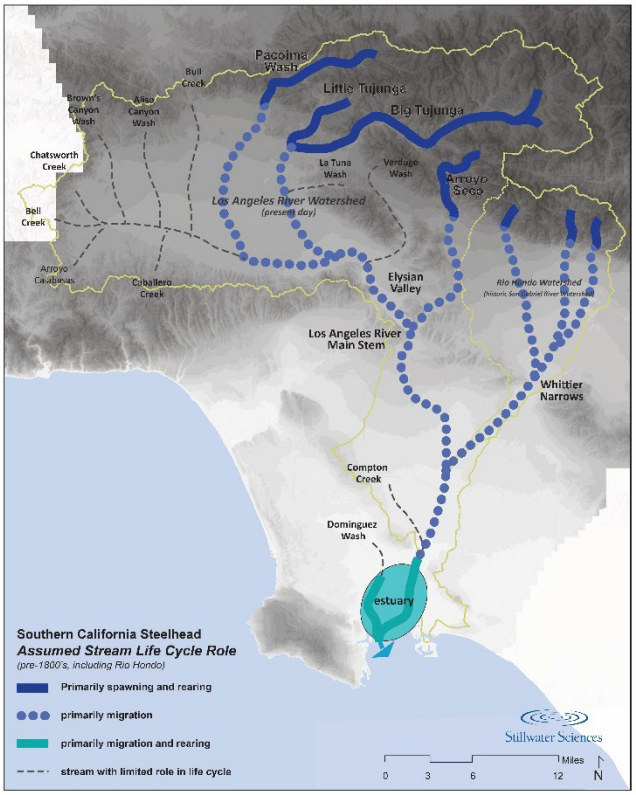

Figure 1. Likely historical steelhead migration routes and habitat availability in the LA River watershed. (Source: Stillwater Sciences).

Although steelhead have not been documented in the LA River watershed for many decades, native rainbow trout, the freshwater resident life history form of *O. mykiss*, are currently found in several headwater tributaries including Big Tujunga Creek and the Arroyo Seco above Devil's Gate Dam (SRMA 2020; CDFW 2023; J. Stanovich, CDFW, pers. comm., 19 June 2024). Recently, 469 *O. mykiss* were translocated into the Arroyo Seco during fish rescue operations in streams impacted by wildfire (CDFW 2020) and preliminary surveys of the Arroyo Seco in 2023 and 2024 indicate the population continues to thrive and reproduce successfully (CDFW 2023; J. Stanovich, CDFW , pers. comm., 19 June 2024).

Life Cycle Needs and Limiting Factors in the LA River Watershed

The LA River watershed historically provided suitable habitat to support steelhead migration, spawning, and rearing (Figure 1). At present, the modified LA River watershed includes physical, chemical, and biological changes associated with urbanization that reduce steelhead habitat availability and limit recovery potential. The flashy LA River hydrologic regime, exacerbated by channelization, reduces the duration of passable hydraulic conditions compared to historical conditions. These conditions can be mitigated by deepening the channel and adding structural elements to allow passage at lower flows, reduce velocities, and provide resting habitat for steelhead during their upstream migration. Steelhead life cycle needs and limiting factors were studied in the Conceptual Ecological Model and Limiting Factors Analysis for Steelhead in the Los

Angeles River Watershed (Stillwater Sciences 2020) and are summarized in Table 1. The life cycle of steelhead and resident rainbow trout is shown in Figure 2.

Table 1. Steelhead Life Cycle Need and Limiting Factors

Life History Event	Description	Limiting Factors
Upstream migration	The mainstem LA River is the only migration pathway to the spawning and rearing habitat in the upper tributaries. Conditions for upstream migration are suitable in winter and early spring when flows are high and water temperatures are cool.	• Passage barriers • Altered flow patterns • Elevated water temperature • Poor water quality
Spawning and incubation	Spawning and incubation habitat historically occurred and is still present in the upper tributaries. Steelhead spawn in winter and spring in cool, gravel-bottom streams.	• Reduced amount of suitable spawning habitat due to urbanization and habitat alteration • Reduced accessibility of spawning habitat due to migration barriers • Reduced quality of spawning habitat due to poor water quality, altered flows, sedimentation, and human use
Juvenile rearing	Rearing historically occurred throughout the watershed including tributaries, the estuary, and even in some mainstem locations. Suitable rearing habitat is now present only in the upper tributaries. Juvenile steelhead typically rear for 1–2 years in fresh water and migrate to the ocean at age 1+ or 2+.	• Reduced amount and quality of rearing habitat in upper tributaries • Low summer flows • Elevated summer water temperatures • Loss of estuary habitat
Outmigration	The mainstem LA River is the only outmigration pathway from the spawning and rearing habitat in the upper tributaries to the ocean. Steelhead outmigration can occur year-round, but in the mainstem LA River would only be possible during winter and early spring when water temperatures are suitably cool.	• Altered flow patterns • Elevated water temperatures from spring through fall • Nonnative predators

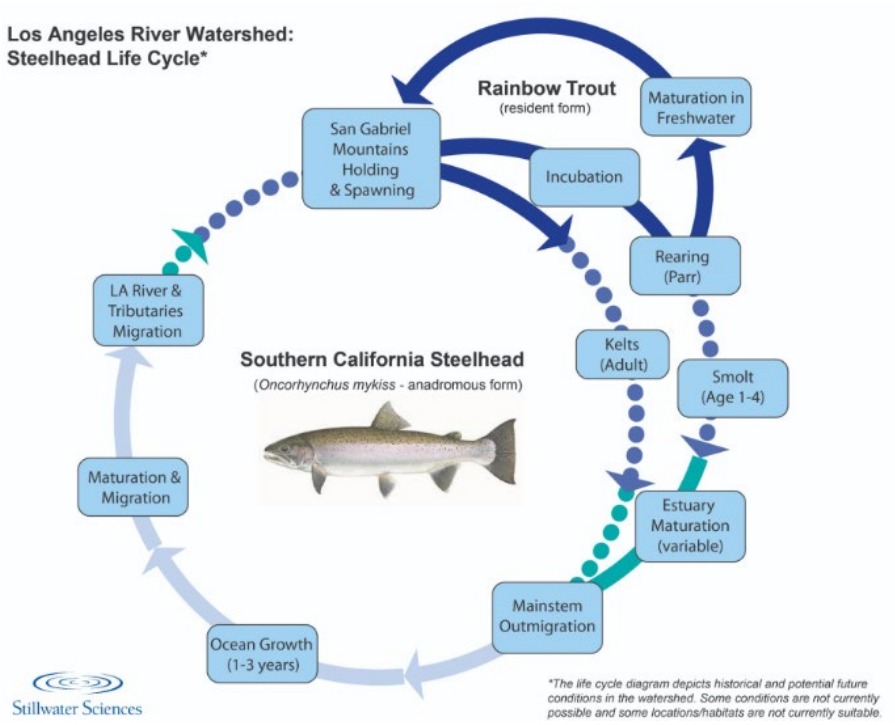

Figure 2. Simplified diagram of Oncorhynchus mykiss life cycle in the LA River watershed, including the anadromous (steelhead) and non-anadromous (rainbow trout) life history forms (Source: Stillwater Sciences).

First Implementation of the LAR FPHS Project, LA River Reach 8A

The LA River Reach 8A Restoration project proposes channel modifications to increase the potential for steelhead passage in a channelized reach of the LA River. Reach 8A is ¼ mile of the LA River channel, downstream of the North Main Street Bridge. The design phase of the project included hydrologic analysis to generate design flow rates and hydraulic modeling of the proposed channel to predict depth and velocities at the design flows. Proposed channel modifications include adding roughness and depth to the channel, focused on the low-flow channel notch and in the form of deepening and widening the low-flow channel, adding anchored boulders to the channel lining, steelhead resting pockets, and herbaceous vegetation.

The fish passage design flows considered for the LA River Reach 8A Restoration project are summarized in Table 2 and are based on a review of NMFS and California Department of Fish and Wildlife (CDFW) guidance as well as input received from NMFS and CDFW during technical meetings. The hydraulic model results for depth and velocity at each of these flow rates were compared to published values for steelhead swimming abilities based on velocity (CDFW 2004) and adult depth criteria (CDFG 2002 and NMFS 2001) to evaluate the potential for a continuous upstream passage corridor as a result of the project. This comparison revealed that a continuous upstream passage corridor is predicted for all but the lowest and highest flow rates.

The current, altered LA River watershed creates a flashy hydrologic regime, where storm flows rise and recede quickly. This reduces the amount of time steelhead can migrate upstream during each storm when compared to historical conditions. Additionally, the channelized river has eliminated resting areas that provide low-velocity refuge for fish to pause during migration until acceptable conditions resume, which combined with the flashy hydrology and lower duration of passable conditions, increases the need to provide additional passage opportunities during base flow, or between storm events. Base flows in the LA River (50–95% exceedance values) are presently dominated by reclaimed water discharge. The lowest design flow in Table 2 (25 cfs) recognizes that these reclaimed water flows could be diverted in the future for other uses, reducing base flow compared to current conditions (at present, base flow is approximately 70 cfs based on the 95% exceedance flow for the year). This lowest value can provide a useful test of the effects of a potentially reduced base flow on passage conditions but is not based on any actual projections of future flow conditions.

Table 2. Fish passage design and intermediate flows applicable to the Project Reach; low (Qlfp) and high (Qhfp) adult salmonid design flows are shaded.

Flow Duration Characteristics	Source	Design flow (cfs)
Potential future base flow	Future low flow	25
95% Exceedance (Migration season base flow)	Salmonids low fish passage design flow for fishway (NMFS 2011)	75
50% Exceedance (Annual) (Qlfp)	Adult salmonids low fish passage design flow at road crossings (CDFG 2002, NMFS 2001)	121
None	Intermediate flow	360
None	Intermediate flow	595
5% Exceedance (Annual)	Native non-salmonid high fish passage design flow at road crossings (CDFG 2002)	830
5% Exceedance (Migration season)	Salmonids high fish passage design flow for fishway (NMFS 2011)	1,553
1% Exceedance (Annual) (Qhfp)	Adult salmonids high fish passage design flow at road crossings (CDFG 2002, NMFS 2001)	4,660
1% Exceedance (Migration season) (Qhfp)	Adult salmonids high fish passage design flow at road crossings (NMFS 2019)	6,544

Figure 3 summarize results from a migration path analysis of Reach 8A using hydraulic model results. At the lowest modeled flow (25 cfs), which represents a possible future condition if there is increased reuse of wastewater treatment effluent, about 35% of the modeled reach is classified as unsuitable because of shallow depths, meaning an adult steelhead would not have a continuous path through the reach using the ideal migration path. More detailed information on the hydrologic and hydraulic analysis of the LA River Reach 8A Restoration project can be found in the Los Angeles

River Fish Passage and Habitat Structures Design. 60% Basis of Design Report (Stillwater Sciences 2022)

The Reach 8A design is predicted to provide fish passage through a broad range of flows and significantly improve the existing fish passage condition from virtually none to acceptable velocity and depth conditions for most flows occurring annually. The design is predicted to provide upstream passage between 75 and 4,660 cfs. Passage may also be possible at 6,544 cfs for larger steelhead, although conditions are challenging due to high velocities and may require increasing the extent of roughened channel area or adding more resting areas that are effective at this highest flow. At the lowest flow evaluated (25 cfs), model results demonstrated that upstream steelhead passage could be challenging due to shallow depths and may require a deeper channel to achieve depths sufficient for adult steelhead upstream passage.

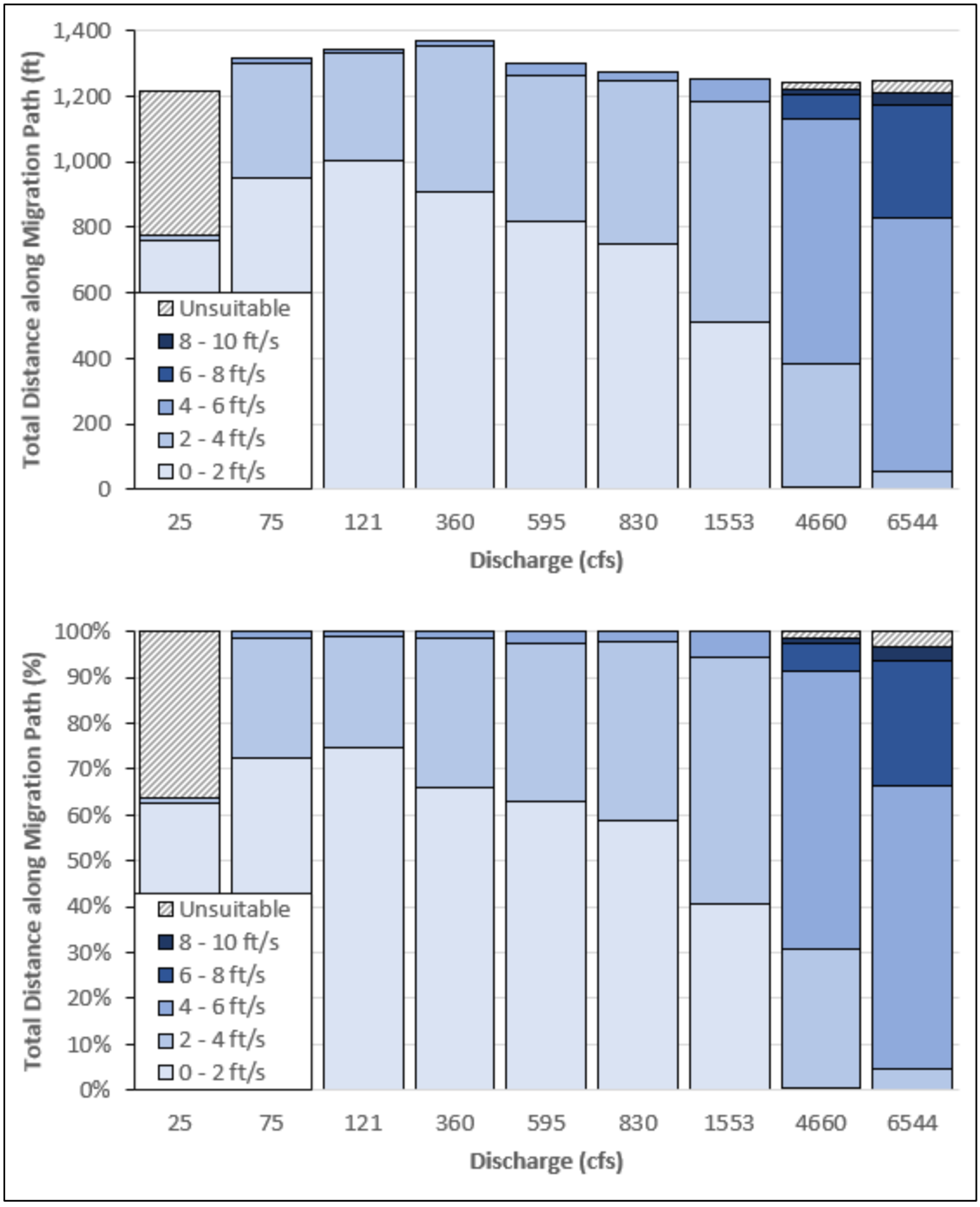

Figure 3. Velocity distribution along assumed migration path for each modeled discharge.

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