North Coast Streams Limit of Anadromy

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Summary

This report provides documentation for limits of anadromy in HCP plan area streams on the North Coast (Liddell, Laguna, and Majors Creeks). The report relies on previously collected information and a field survey May 24, 2017 by a team of biologists and engineers from California Department of Fish and Wildlife, NOAA Fisheries, City of Santa Cruz, and Hagar Environmental Science[1]. The team confirmed previously identified natural barriers as the limits of anadromy for each of the streams (Figure 1). The anadromous reach limit in Laguna Creek occurs at a boulder fall near the Y-creek confluence approximately 1.43 miles upstream of the mouth. In Liddell Creek, though there are significant migration issues at the Highway 1/railroad tunnel, the natural limit of anadromy occurs at a bedrock ledge about 1.16 miles upstream from the mouth and 0.13 miles downstream of the confluence of the East Branch with the Middle Branch. In Majors Creek the limit of anadromy is a long section of bedrock and boulder cascades beginning approximately 0.7 miles upstream of the mouth.

[1] The survey team included Randi Adair, CDFW; Zeke Bean, City of Santa Cruz; Chris Berry, City of Santa Cruz; Jeff Hagar, Hagar Environmental Science; Darren Howe, NMFS; Jon Jankovitz, CDFW; Monica Oey, CDFW; and Marcin Whitman, CDFW

CITY OF SANTA CRUZ STREAM DIVERSIONS AND DOWNSTREAM LIMITS OF ANADROMY

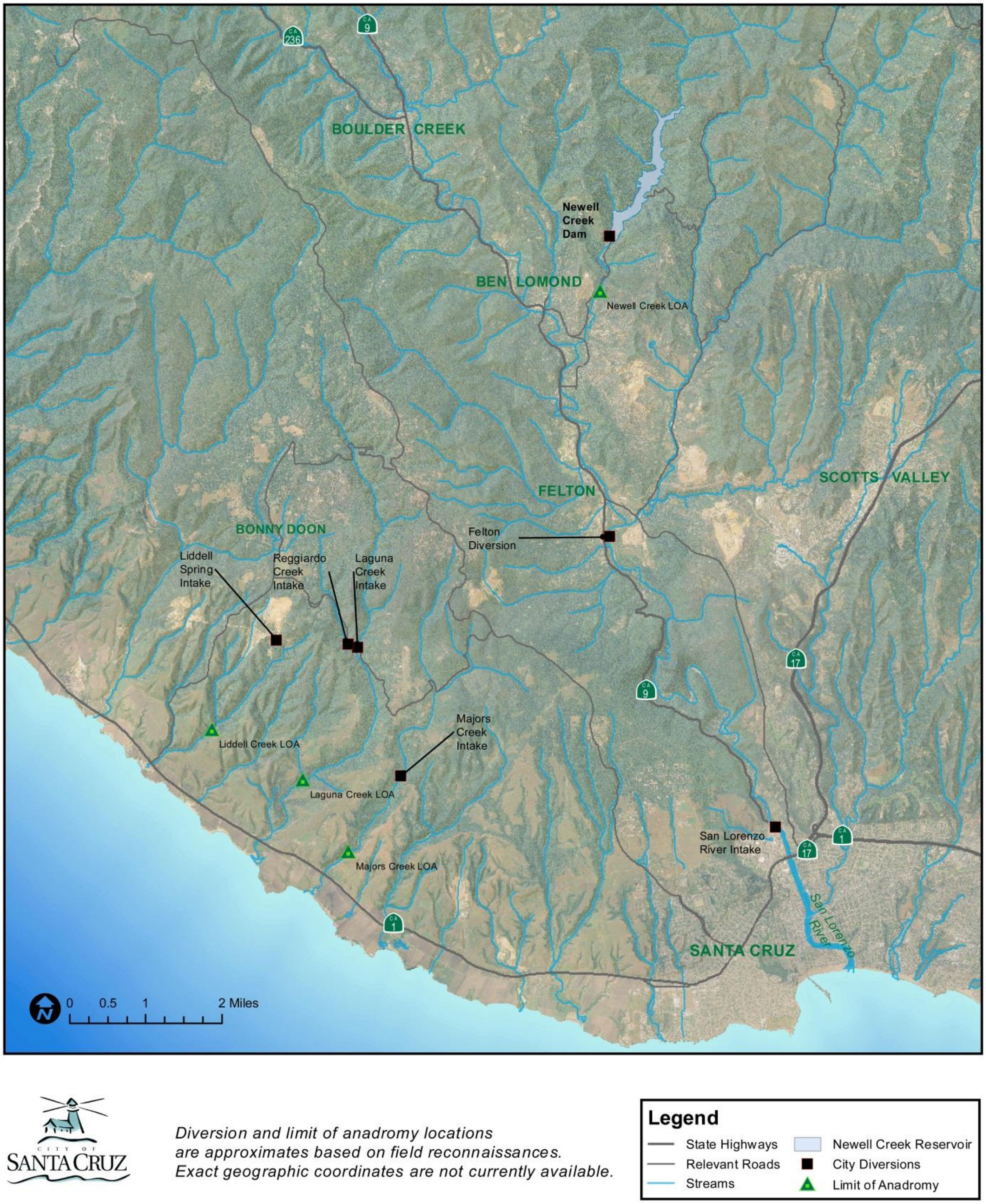

Figure 1. City of Santa Cruz stream diversions and limits of anadromy.

Laguna Creek

The channel from the Laguna Creek mouth to a point about 1.43 miles upstream is low gradient (~1.5 percent) and moderately confined. At this point (near Y Creek confluence), a series of large boulders fills the channel and forms at least one major cascade (Figure 2). This location forms a barrier to anadromous fish passage.

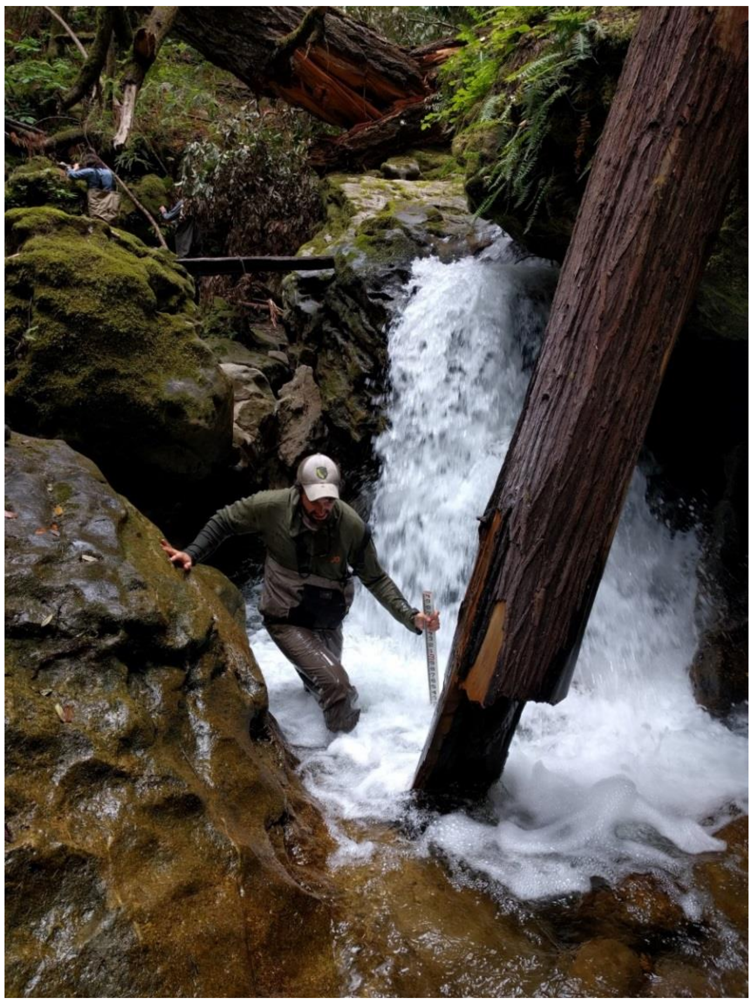

Figure 2. Boulder falls in Laguna Creek at Y Creek confluence.

Observations were made at this site on May 24, 2017 by a team of biologists and engineers from California Department of Fish and Wildlife, NOAA Fisheries, City of Santa Cruz, and Hagar

Environmental Science. The team concluded that there may be some flows where adult steelhead could ascend the boulder fall but that the frequency of such events would be insufficient to support an anadromous population upstream. City staff followed up with stream channel slope surveys subsequent to this site visit. Measurements were taken over a 90 foot section including the steepest section with cascade and 2-3 channel widths upstream and downstream of the high gradient section (Figure 3). The overall 90 ft. section had a gradient of 11.5 percent while the steepest 43 foot portion had a gradient of 28%, including one significant jump of 8.61 feet (streamflow approximately 7 cfs at the anadromous stream gage).

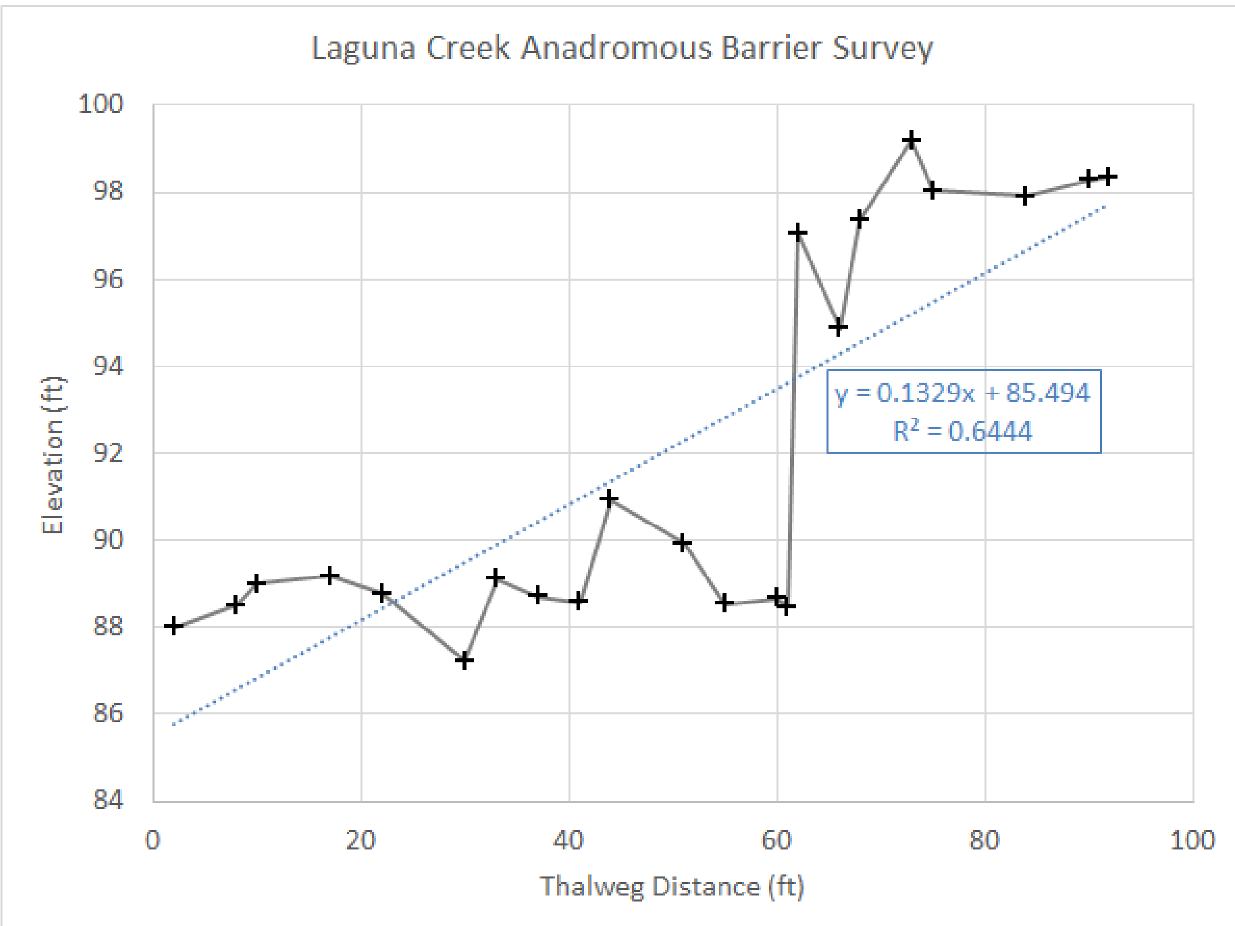

Figure 3. Thalweg survey results for Laguna Creek boulder fall.

In the anadromous reach, substrate is a mixture of sand, gravel, and cobbles, and aquatic instream cover is abundant and diverse. Above mile 1.43 to the City diversion, the channel gradient steepens to about 3.4 percent and the valley walls become more confined. The majority of the channel between the anadromous reach and the diversion is mixed bedrock and boulders with patches of sand and gravel deposits (ENTRIX, Inc. 2004).

Twenty-two migration passage issues were identified in the 2.45 miles between the anadromous limit and the City diversion (HES 2014). These included two dams, a culvert, 12 cascades or falls, and 7 logjams. Logjams were often associated with an upstream sediment wedge that contributed to the passage issue but may be transient with changing flows. In fact, the logjams themselves are likely to be more or less transient as they can shift and move under high flow conditions, although some appeared to be relatively stable, particularly when associated with large boulders and bedrock formations. In some locations a logjam occurred in conjunction with a cascade. Eight of the locations were judged to present an obstacle to passage but not a complete barrier. The degree of difficulty would vary with flow with many of these being more an issue at lower flows and for smaller fish. The other 14 locations were considered barriers to resident trout movement. The passage issues tended to group together at several locations, for example about halfway through the surveyed reach between 7,000 and 8,000 feet upstream from Y Creek.

Liddell Creek

In Liddell Creek a natural migration barrier is formed where the stream passes over a bedrock ledge about 1.16 miles upstream from the mouth and 0.13 miles downstream of the confluence of the East Branch with the Middle Branch[2]. Observations were made at this site on May 24, 2017 by a team of biologists and engineers from California Department of Fish and Wildlife, NOAA Fisheries, City of Santa Cruz, and Hagar Environmental Science. Flow at the time of the survey was approximately 5 cfs at the anadromous gage. The ledge was approximately 30 feet in length with a slope of about 14% in the downstream direction (Figure 4).

Figure 4. Bedrock ledge in Liddell Creek 1.16 miles from mouth.

[2] It should be noted however, that there are significant problems with migration passage at the mouth due to fill placed in the original channel for the railroad and Hwy 1, and rerouting of the creek through an artificial tunnel. The mouth of Liddell Creek is blocked during the dry season and low flow periods by the beach berm. There is not a well-developed lagoon. The channel behind the beach, downstream of the Highway 1 culvert, is often braided, shallow, and choked with aquatic plants. Passage through this section may require substantial flow to open the mouth and provide sufficient depth for adult salmonids to migrate through the shallow, braided section. At the Highway 1 crossing the Main Branch of Liddell Creek passes under the highway and adjacent railroad tracks through a bedrock bore (reinforced with concrete). The outfall of the Highway 1 tunnel contains two concrete barriers that partially close the opening. This crossing may pose a passage problem to migrating salmonids during certain hydrologic conditions. During the winter when the beach sand is scoured away, a vertical drop of up to 3 feet (with no significant plunge pool) may form at the culvert exit point.

At the lower end of the bedrock shelf there was a 2 foot drop with maximum depth of flow of only about 1.5 feet in the stream immediately below it. The stream channel cuts upstream along the edge of the bedrock on the west side, with another cascade at the top. This upper cascade had a vertical drop of about 6 feet with no pool and shallow depth of flow below. There was a debris jam at the top of the ledge. Average depth of flow across the bedrock ledge was 0.5 feet. The downstream channel was relatively unconfined and there was no indication on the banks of significant backwatering below the ledge (Figure 5). This location was judged to be a total barrier to migration of all life-stages of steelhead and coho salmon and the limit of anadromy in Liddell Creek.

Figure 5. Stream channel downstream of Liddell bedrock ledge.

Seventeen additional passage issues were identified in the reach of Liddell Creek between the bedrock shelf and the tributary from the City diversion, a distance of 1.33 miles (HES 2014). These included a culvert, 8 logjams, and 8 cascades. The majority of locations were considered obstacles (10 plus one possible barrier) and four of the barriers were judged to be a problem only at low flows (i.e., dry season). This reach has a very narrow active channel that is entrenched in many areas and thickly overgrown with willow and poison oak. The average gradient is about 2.8%.

Majors Creek

About 0.7 miles upstream of the mouth, Majors Creek enters a short reach (0.15 mi) of very steep (>10 percent gradient) bedrock and boulder cascades. This reach forms a barrier for fish passage at a distance of 0.71 miles upstream from the creek mouth (Figure 6).

Figure 6. Beginning of boulder cascades in Majors Creek.

Observations were made at this site on May 24, 2017 by a team of biologists and engineers from California Department of Fish and Wildlife, NOAA Fisheries, City of Santa Cruz, and Hagar Environmental Science. Follow up measurements made by City staff show the overall reach of stream containing the first several cascades extends for 261 feet at an average gradient of about 42%[3] (Figure 7). The City's survey indicated the presence of seven discreet obstacles in this section (Table 1).

[3] Stream flow measured at the anadromous gage was approximately 3 cfs at the time of this survey.

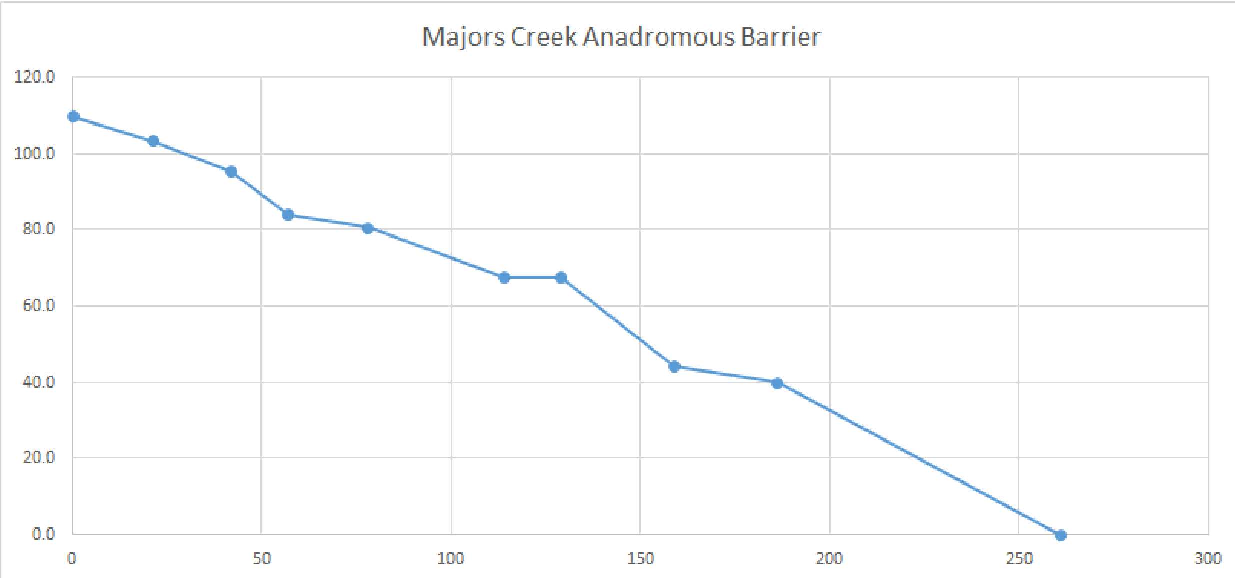

Figure 7. Slope estimates for Majors Creek boulder fall.

Table 1. Discreet passage obstacles in Majors Creek barrier reach (City of Santa Cruz survey).

Feature ID	Station (ft.)	Bottom Pool Depth (ft.)	Barrier Height (ft.)	Upper Landing Pool Depth (ft.)	Jump Length (ft.)	Notes
1	21	3.9	3.1	0.9	2	Large cut redwood log in bedrock notch
2	37.1	2.3	4	1.35	9.6	Landing at station 37.1
3	62.6	1	5.6	0.7	4	Landing at 62.6; bedrock and boulder
4	91	2.5	5.5	1.45	3.8	Bedrock chute
5	122	2.54	11	0.55	13	
6	204.5	3	13.5	1.34	3	tall waterfall, with log
7	239.4	1.58	6.5	1.28	4	
end	285					end just downstream of last feature, clear break in slope (flattens out downstream)

The initial cascade drops 18 feet over a distance of 49 feet (Figure 8). The pool below this cascade was 3 feet deep at its deepest point. Although there may be some backwatering below the cascades at higher flows the channel immediately downstream of the lower cascade is relatively steep, limiting the potential increase in stage (Figure 9). Measurements off USGS topographic map show a 28% gradient over a distance of 630 feet in the vicinity of these cascades.

Figure 8. Initial cascade in Majors Creek boulder cascade complex.

Figure 9. Stream reach immediately downstream of Majors Creek boulder cascade complex.

The stream section was judged a total barrier to all life-stages of steelhead and coho salmon under conditions at the time of observation. There may be passages that open during certain high flow conditions that would allow an individual steelhead to occasionally ascend through this section. However, such conditions would likely occur infrequently and the overall extended steep gradient of this section, the number and complexity of obstacles, and the likely infrequent periods when flow conditions would allow ascent, support the conclusion that this would be considered the limit of anadromy in Majors Creek. The California Salmonid Stream Habitat Restoration Manual considers the limit of anadromy to be a sustained channel slope of eight to ten percent (Flossi et al. citing Robison et al. 2000 and SSHEAR 1998).

The stream reach downstream of the cascades is relatively low gradient and supports steelhead. In this lower section, the channel gradient decreases and the channel becomes less entrenched as the valley walls widen. Upstream of the boulder falls area to the City diversion, a distance of about 1.60 miles, the average gradient is about 4.2% with several steeper sections of boulder falls, cascades, and logjams (HES 2014). Eight distinct passage issues were identified in the upstream reach, all logjams except for one cascade (HES 2014). Three were considered complete barriers while 5 were primarily barriers at low flows.

Documents Cited

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