Malibu Canyon Road Bridge
Hydraulic Analysis
Preliminary Results

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DRAFT – SUBJECT TO REVISION

Background

Public Works is proposing to replace the existing Malibu Canyon Road Bridge. The proposed bridge will be wider and consist of a 2-span design with a single pier support. Table 1 below summarizes pertinent data for the existing and proposed bridge. The information for the proposed bridge was based on the latest plans provided by Public Works' Design Division. This information is considered preliminary and subject to revision since the final design is still pending.

Table 1: Summary of Pertinent Bridge Data

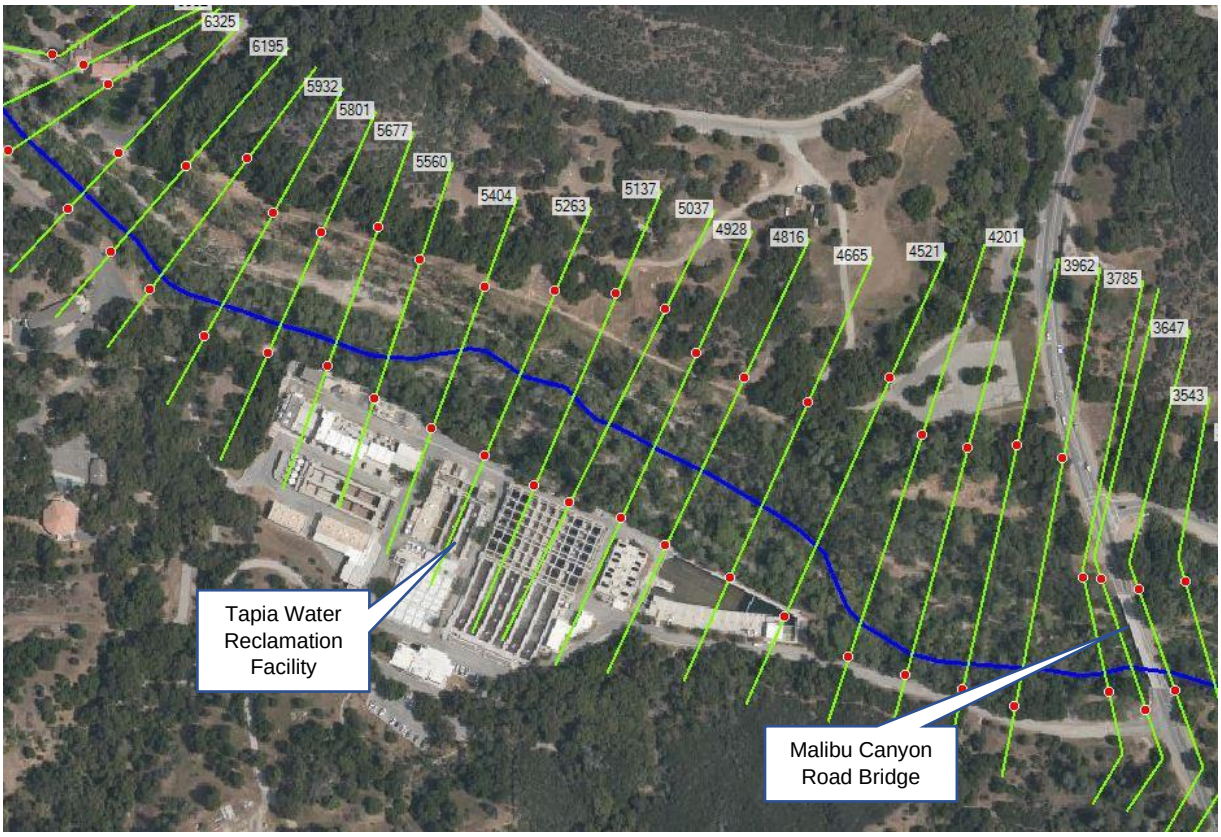
	Existing Bridge	Proposed Bridge*
No. of Spans	3	2
Total Bridge Length (feet)	212	270
Bridge Width (feet)	33.5	57
No. of Piers	2	1
Pier Width (feet)	2.5	3.0
Bottom Soffit Elevation at Pier based on Road C/L (feet, NAVD 88)	465.66	467.42

* Proposed bridge data is preliminary since the final design is still pending

Modeling Approach

The U.S. Army Corps of Engineers' HEC-RAS 5.0.5 computer program was used to perform a steady-state one-dimensional hydraulic analysis. A topographic survey was conducted around the proximity of the bridge and merged with a 3-foot spatial resolution Digital Elevation Model (DEM) derived from Light Detection and Ranging (LiDAR) data collected in 2015 and 2016 by the Los Angeles Regional Imagery Acquisition Consortium (LAR-IAC). This provided the terrain necessary for the hydraulic model in HEC-RAS. Bank lines, flow paths, and cross sections were then drawn to configure and capture the geometry of Malibu Creek. Figure 1 shows the location of cross sections defined adjacent to the Tapia Water Reclamation Facility. Separate geometries were setup for the existing and proposed bridge conditions. To account for accumulation of debris around the piers, two feet of debris on each side of each pier for the full depth of flow was assumed.

Figure 1: HEC-RAS River Station Location



Roughness coefficients for Malibu Creek were estimated using a procedure developed by Cowan and published in U.S. Geological Survey Water Supply Paper 2339. For this procedure, a base roughness coefficient or n value is selected which is representative of a straight uniform channel. The selected n value is adjusted accordingly by adding increments of roughness for each condition that increases the roughness. Conditions that increase the roughness of the channel include channel irregularities, alignment, obstructions, vegetation, and meandering. A field site visit was conducted in August 2019 to document channel conditions. This information was used to select appropriate correction factors and determine channel roughness coefficients. for the left overbank, main channel, and right overbank. Table 2 below summarizes the roughness coefficients used in the HEC-RAS analysis in the vicinity of the Tapia Water Reclamation Facility.

Table 2: Summary of Roughness Coefficients

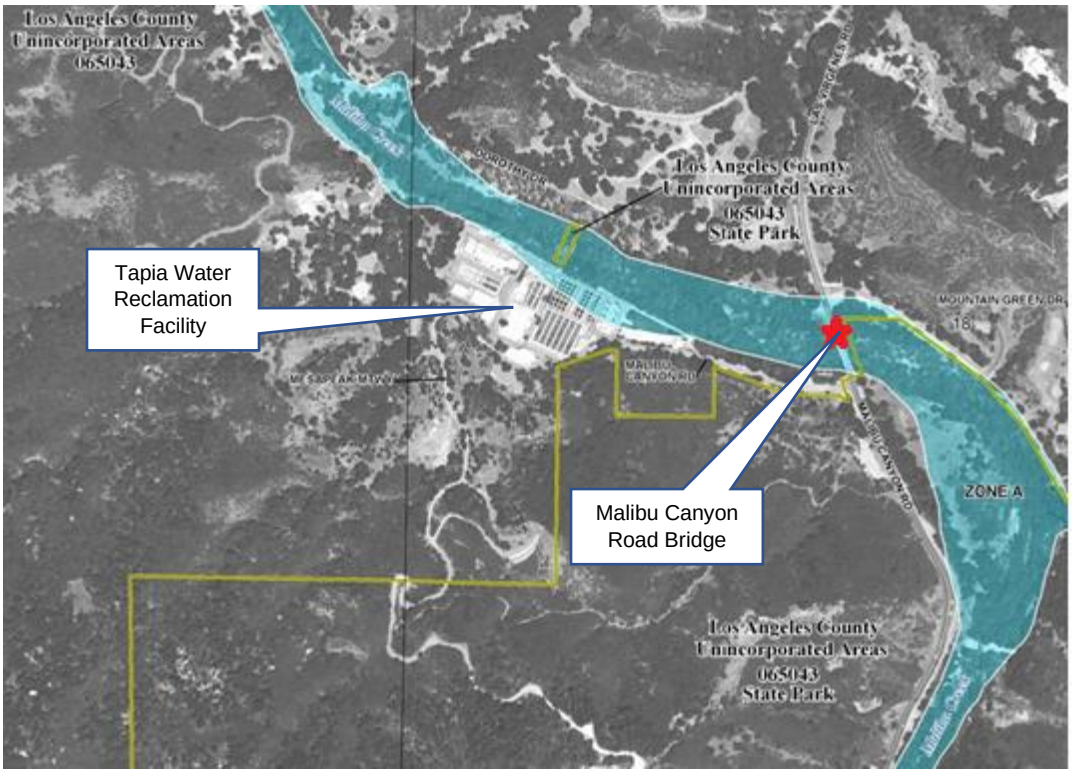
River Station*	Left Overbank	Main Channel	Right Overbank
4521	0.060	0.050	0.030
4665	0.050	0.050	0.030
4816	0.060	0.045	0.030
4928	0.050	0.045	0.030
5037	0.030	0.045	0.030
5137	0.050	0.045	0.030
5263	0.060	0.045	0.030
5404	0.070	0.045	0.030
5560	0.060	0.045	0.030
5677	0.070	0.040	0.030

* These are the river stations that coincide with the Tapia Water Reclamation Facility

Public Works' policy describes which discharges should be used for certain conditions and types of structures. The policy specifies that bridges should be analyzed for the Capital Flood. A comprehensive hydrology study was completed by Public Works in 2007 for the Malibu Creek Watershed. The study was based on Public Works' Modified Rational Method and was performed using the Watershed Modeling System program. The study determined the Capital Flood, which is the runoff produced by a 50-year frequency design storm falling on a saturated watershed. Since Malibu Creek consists of a mountainous area and it is generally in a natural state, the hydrology needs to consider the effects of fires which can increase runoff. This was accomplished by adjusting runoff coefficients for a burned watershed condition as described in Public Works' Hydrology Manual. In addition, the Capital Flood was bulked to reflect increases in runoff volumes and peak flows due to the inclusion and transport of sediment and debris. The Capital Flood determined for this reach of Malibu Creek is 69,400 cubic feet per second (cfs).

The latest revised preliminary Flood Insurance Rate Map (FIRM) (#06037C1529G dated December 21, 2018) from the Federal Emergency Management Agency (FEMA) for Los Angeles County shows that the Malibu Canyon Road Bridge over Malibu Creek falls under FEMA Zone A as seen in Figure 2. Zone A is the area inundated by 1% annual chance flooding for which no Base Flood Elevations have been determined. The 1% annual chance flood is often referred to as the 100-year flood. FEMA regulations require project proponents to perform a hydraulic analysis to quantify changes to the existing flood zone that may result from a proposed project. The FEMA published peak discharge for the 100-year flood is 40,544 cfs and was used in the hydraulic analysis.

Figure 2: FEMA FIRM #06037C1529G



Public Works currently does not have a process or method in place to quantify changes in hydrology due to climate change. Public Works is currently working to partner with experts to conduct research on the impact of climate change on design storms for the Los Angeles area.

Preliminary Results

The Capital Flood and the FEMA 100-year flood were used in the hydraulic analysis to analyze the existing and proposed bridge conditions. Preliminary results for the two conditions were compared to determine the impact of the proposed bridge compared with the existing bridge. The analyses showed that flows overtop the existing and proposed bridge for the FEMA and Capital Flood flow rates. A comparison of preliminary water surface elevations for the FEMA 100-year flood showed that the proposed condition did not result in any increase when compared to the existing bridge condition. However, a comparison of preliminary water surface elevations for the Capital Flood showed a slight increase for the proposed bridge condition when compared to the existing bridge condition. The increases, which are all less than one inch, are not considered significant. A summary of preliminary results of the hydraulic analyses in the vicinity of the Tapia Water Reclamation Facility is provided in Table 3 and Table 4.

Table 3: Summary of WSE Results for FEMA Flow Rate

River Station*	Existing Bridge WSE (feet, NAVD 88)	Proposed Bridge WSE (feet, NAVD 88)	Difference (feet)
4521	475.88	475.57	-0.31
4665	475.95	475.65	-0.30
4816	476.11	475.84	-0.27
4928	476.36	476.12	-0.24
5037	476.40	476.16	-0.24
5137	476.60	476.38	-0.22
5263	476.80	476.59	-0.21
5404	477.56	477.40	-0.16
5560	477.97	477.84	-0.13
5677	478.15	478.02	-0.13

* These are the river stations that coincide with the Tapia Water Reclamation Facility

Table 4: Summary of WSE Results for Capital Flood Flow Rate

River Station*	Existing Bridge WSE (feet, NAVD 88)	Proposed Bridge WSE (feet, NAVD 88)	Difference (feet)
4521	480.21	480.28	0.07
4665	480.19	480.26	0.07
4816	480.33	480.40	0.07
4928	480.48	480.54	0.06
5037	480.45	480.51	0.06
5137	480.64	480.70	0.06
5263	480.84	480.90	0.06
5404	481.92	481.96	0.04
5560	482.21	482.25	0.04
5677	482.58	482.61	0.03

* These are the river stations that coincide with the Tapia Water Reclamation Facility