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DRAINAGE REPORT

CITY OF HESPERIA

C.O. 7094

RANCHERO ROAD AQUEDUCT CROSSING

Ranchero Road

Hesperia, CA 92345

Prepared for:

City of Hesperia
9700 Seventh Avenue
Hesperia, CA 92345

Prepared by:

Cordoba Corporation
1611 East 17th Street
Santa Ana, CA 92705

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SECTION 1
PROJECT DESCRIPTION

1.1 INTRODUCTION

The City of Hesperia has proposed to reconstruct the Ranchero Road Bridge over the California Aqueduct through the Ranchero Road Aqueduct Crossing Project. The purpose of this study is to analyze the hydrology and hydraulics for the Ranchero Road Aqueduct Crossing Project. The project consists of several improvements to the existing Ranchero Road corridor within the City of Hesperia. The project limits will extend approximately 2000 feet along Ranchero Road from Kern Avenue to approximately 350 feet east of Via Antiqua Street. The entire length of the corridor improvement is located within the City of Hesperia jurisdiction. Residential and commercial facilities exist along the north side and south side of the entire corridor length. The California Aqueduct flows through the corridor approximately 1000 feet east of the westerly project limit. The Project is approximately 2100 linear feet from Kern Avenue on the west end to Via Antiqua on the east end.

1.2 PROJECT SCOPE

The project includes roadway geometry improvements, asphalt pavement reconstruction, curb and gutter reconstruction, concrete pavement construction, drainage facility improvements, existing bridge removal and replacement, and signing and striping improvements. The existing corridor, which consists of an asphalt concrete surface over crushed aggregate base, is to be entirely removed and reconstructed. The Project improvements will accommodate two traffic lanes in each direction with a stripped median and 16-foot pedestrian pathways and a bike lane. A new single span structure will be approximately 137 feet wide and 158 feet long. The proposed bridge will be built to accommodate seven lanes of traffic. In addition to the widening, the profile of the street through the existing bridge is to be raised. The vertical alignment of the bridge and roadway will also require construction of new catch basins and inlets where necessary. A proposed catch basins will capture storm runoff and convey it through a proposed drainage system that will discharge into a proposed detention basin east of the aqueduct.

In addition to the improvements on Ranchero Road, a cul-de-sac is proposed approximately 1520 feet east of Kern Avenue. This portion of the project includes pavement and curb and gutter improvements. The proposed cul-de-sac will drain via outlet at the north end of the street which will dissipate onto a City owned parcel. The appropriate BMPs will be part of the final drainage improvements.

1.3 EXECUTIVE SUMMARY

The calculations presented in this Drainage Report are based on the topography survey provided by TranSystems and as-built drawings provided by City of Hesperia. The San Bernardino County Flood Control District Hydrology Manual and the Hesperia Master Plan of Drainage (MPD) were used to obtain project site data and criteria for determining peak flows and sizing proposed drainage facilities. Boundaries for tributary areas were determined by the project scope limits as well as the parcel information for properties adjacent to the Project. Existing drainage facilities were also taken into consideration for defining the tributary area boundaries. For tributary areas, refer to the Appendix A, Hydrology Maps.

SECTION 2
SITE DESCRIPTION

2.1 TOPOGRAPHY

The project site is located within the western part of the Mojave Desert physiographic province, which consists of flat desert plains surrounded by wide valleys mountain ranges, and two main fault trends. The site covers approximately 0.009 square miles that varies between 62 feet and 70 feet to the north and south from the Ranchero Road centerline. Elevations range from a minimum of 3,470 feet to a maximum of 3,485 feet. The proposed corridor has an average longitudinal slope of 2.0% and an average cross-slope of 2.0% on tangents.

2.2 GEOLOGY AND SOILS

A Foundation Report was completed by Earth Mechanics, Incorporated (EMI) on January 29, 2018. The field investigation was performed by EMI on June 9, 2016 and June 10, 2016 and consisted of 5 borings to varying depths of 30 feet to 70 feet. The survey states that EMI encountered granular soils consisting of sands with varying amounts of fines and gravels. The gravels were classified as angular to subrounded and may be fragments of cobbles. Groundwater was not encountered for any of the borings.

2.3 LAND USE

The land use along Ranchero Road consist of residential and commercial businesses. The California Aqueduct, which is owned and maintained by Department of Water Resources (DWR), runs northwest to southeast crossing Ranchero Road. The majority of traffic traveling along Ranchero Road is residential.

SECTION 3
DRAINAGE CONDITIONS AND FACILITIES

3.1 EXISTING DRAINAGE CONDITIONS AND FACILITIES

For the section of the Ranchero Road corridor to be improved, the stormwater runoff flows over asphalt concrete pavement with an average cross-slope of 2.0%. The flow drains from the crown line, located along the Ranchero Road centerline, to the curb and gutter lines on the north and south sides of the roadway. Drainage flows west of the aqueduct is conveyed to impound trenches located along the aqueduct. The stormwater runoff east of the aqueduct is conveyed via curb and gutter until reaching existing catch basin inlets at the intersection of Ranchero Road and Seventh Avenue.

Prior to the four lateral connections which connect to the main system via 30” and 36” laterals, the 60” RCP receives flow from a 54” RCP storm drain which runs along Via Cartagena. The 60” drainage system continues east under Ranchero Road until reaching a pipe transition to an 84” RCP. This 84” RCP then continues easterly until outletting into an existing wash via a concrete box culvert located under Ranchero Road. The existing basin is located approximately 2500 feet east of Sante Fe Ave E. Runoff collected in the existing basin then flows through the Antelope Valley Wash until discharging into the Mojave River. Refer to Appendix A for the Existing Drainage Facility Exhibit.

3.2 PROPOSED DRAINAGE CONDITIONS AND FACILITIES

Drainage improvements are determined by the proposed improvements to the new bridge and its vertical alignment along Ranchero Road. As per the existing conditions, the bridge serves as high point elevation along the Ranchero Road improvements. The proposed alignment will result in a high elevation point approximately 50 feet west of the aqueduct bridge. The stormwater runoff is directed from said high point to the east and west along Ranchero Road. Runoff will sheet flow from the crownline, located at the Ranchero Road centerline, to the curb and gutters on the north and south sides of the roadway. Average cross-slope for the roadway is 2.0%.

West of the bridge, runoff will discharge into one of two proposed curb opening catch basins. The proposed catch basins will be placed at the sag of the road (low point) on the north side and the south side of Ranchero Road, approximately 560 feet west of the California Aqueduct bridge crossing. The north side catch basin will discharge into a proposed 18" RCP lateral connecting with the south side catch basin. The stormwater runoff is then conveyed to a proposed 24" RCP main storm drain line. However, a portion of the storm drain system is 24" HDPE as it crosses the proposed bridge. The 24" storm drain line will then discharge into a proposed detention basin. The proposed detention basin will be constructed on the south side of Ranchero Road, approximately 400 feet east of the California Aqueduct bridge. Once the detention basin reaches full capacity, overflow will discharge through two parkway drains. The runoff conveys back to the south side of Ranchero Road via curb and gutter flowing easterly to existing catch basins located just west of the Ranchero Road-Seventh Avenue intersection. The flow enters the catch basin and continues through a larger existing system as shown on the "Existing Drainage Facility Exhibit.

East of the bridge, runoff will be conveyed via proposed curb and gutter until it discharges outside of the proposed project limits which then matches existing flow conditions which continue easterly toward existing catch basins at the intersection of Ranchero Road and Severth Avenue. However, a portion of the stormwater runoff on the northside will be conveyed along curb and gutter and discharge via curb outlet at the end of new proposed cul-de-sac. The hydrology maps are located in Appendix A.

SECTION 4
HYDROLOGIC ANALYSIS

4.1 DESIGN CRITERIA

The hydrologic analysis was completed based on the guidelines and procedures described in the San Bernardino County (SBC) Hydrology Manual. Proposed catch basins are designed to efficiently capture stormwater runoff to ensure safe passage of vehicles within the allowable flooded width. The design storm frequencies used are as follows:

- **Public ROW = 100-year**
- **Street Capacity = 10-year**
- **Storm Drain = 25-year**
- **Catch Basins = 50-year** (due to sag conditions for this Project)
- **Detention Basin –** Sized for difference between pre-peak flow conditions versus post peak flow conditions

4.2 SOIL TYPES AND GROUPS

Soil types were based on the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey and the USDA National Engineering Handbook. It was determined from the Web Soil Survey that the following soil type exists on site:

- 134 – Hesperia Loamy Fine Sand

Per the NRCS classification, the hydrologic soil group for Type 134 soil is Soil Group A. This soil group consists of soils, which typically have at least 90 percent sand or gravel and less than 10 percent clay. This group may also include soils having loamy sand, sandy loam, loam, or silt loam. The hydraulic conductivity for this soil group is high. The soil group has low runoff ptential when thoroughly wet.

4.3 RATIONAL METHOD

The storm runoff discharge was calculated by the Rational Method equation. The equation is expressed as:

$$Q = CIA$$

Where:

Q = Discharge in cubic feet per second (cfs)

C = Developed runoff coefficient (dimensionless)

I = Average rainfall intensity in inches per hour (in/hr)

A = Drainage area (acres)

The average rainfall intensity was obtained for 10-year, 25-year, and 100-year storm event per Section B of the SBC Hydrology Manual. All the data calculations are summarized in Appendix B. The rational method peak flow rates were used to evaluate the proposed drainages facilities. The runoff coefficient used for the analysis is based on future development within the area and not the existing conditions.

The peak flow rate for stormwater runoff was calculated using the hydrologic calculator (HydroCalc) developed by the Los Angeles County Department of Public Works (LACDPW). This calculator performs the entire modified rational method calculation and outputs peak volumes and flow rates for inputted individual subareas. Parameters determined by the design criteria were used with the HydroCalc software to calculate the peak flows for each subarea. All calculation input and output parameters, as well as a calculation results summary, are provided in Appendix B.

4.4 DESIGN APPROACH

Storm drainage design adheres to the guidelines and procedures of the SBC Hydrology Manual. Drainage areas have been divided based on the existing and proposed drainage improvements. Proposed catch basin locations were determined based on the project roadway design. The following items were determined for the proposed drainage facilities:

- Proposed drainage areas (See Hydrology Map)
- Total peak flow to the proposed and/or existing catch basins
- Depth of Flow
- Flooded Width
- Total peak runoff volume to the proposed detention basin

SECTION 5
HYDRAULIC DESIGN

5.1 DESIGN CRITERIA

Drainage design was performed with the purpose of storm water runoff facilitation. Resulting peak flows from the hydrology study were implemented in the evaluation of proposed drainage facility types and sizes. For all proposed catch basins the 50-year design storm calculation results were utilized due to sag conditions

5.2 METHODOLOGY AND COMPUTATION PROCEDURES

Hydraulic analysis and calculations for laterals and main collectors were performed using StormCAD V8 by Bentley. This software uses the methodology of Hydraulic Engineering Circular No. 22 (HEC-22) to model, analyze, and design highway and urban drainage facilities. Each drainage facility meets the minimum size criteria and were analyzed to determine its drainage capacity and design flow rate. The drainage systems were designed with the following minimum sizes and slopes:

1. Laterals - 18” RCP / 0.5%
2. Main Collectors – 24” RCP / 0.5%

5.3 DESIGN APPROACH

Catch basin size and type was determined using the Standard Plans for Public Works Construction (SPPWC) Standard Plan 300-3, as well as the guidelines of the SBC Hydrology Manual. Catch basin “V” depth, right of way limitations, and existing drainage facilities were all taken into consideration in the proposed catch basin types. All proposed lateral drainage systems and main collectors were designed to ensure minimal occurrence of flooding in the roadway and no back flows out of catch basins.

SECTION 6
CONCLUSION

The hydrology and hydraulics results for the proposed drainage facilities can be found in the appendices of this drainage report. Procedures and guidelines outlined in the SBC Hydrology Manual and SPPWC Standard Plan 300-3 were followed for the design of all drainage facilities.

Implementation of these proposed drainage facilities will provide sufficient drainage along the Ranchero Road corridor and will minimize flooding within corridor improvements.

SECTION 7
REFERENCES

Technical Reports

- Hesperia Master Plan of Drainage, 1996

Design Manuals

- San Bernardino County Hydrology Manual, 2006
- NRCS National Engineering Handbook, 2007

Codes and Standards

- Standard Plans for Public Works Construction 2012 edition (SSPWC)
- Green Book Standard Specifications for Public Works Construction, 2015 edition

Geographic Information Systems (GIS)

- Natural Resources Conservation Service (NRCS) Web Soil Survey, 2017

Design Software

- Bentley FlowMaster V8i
- Bentley StormCad

Appendix A

Project Data

Appendix B

Hydrology Calculations

Appendix C

Hydraulic Calculations