



TECHNICAL MEMORANDUM

# STORM DRAIN MASTER PLAN DRAINAGE ASSESSMENT

PREPARED FOR  
*City of Santa Ana*

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# City of Santa Ana Storm Drain Master Plan – Drainage Assessment

PREPARED FOR: City of Santa Ana

PREPARED BY: Fuscoe Engineering, Inc.

DATE: March 31, 2023

## Purpose

The purpose of the technical memorandum is to present the results of Fuscoe’s review of a portion of the 2018 Storm Drain Master Plan (SDMP). The SDMP has been prepared and published by the City of Santa Ana. The watershed under review is the Gardens Watershed, which is tributary to the Orange County Flood Control Department (OCFCD) Gardens Channel.

The specific portion of the Gardens Watershed that was reviewed included an area within Subarea 40, located at the downstream end of the Gardens Channel Watershed. The study area is bounded to the north by MacArthur Boulevard, to the south by Sunflower Avenue, to the east by Bristol Street, and to the west by Plaza Drive and existing commercial development. The SDMP shows the drainage pattern of this area as draining southerly, toward Sunflower Avenue. However, based on our review, a portion of this area drains northerly, toward MacArthur Boulevard. Additionally, our review also discovered that an area in the Bristol Street vicinity does not enter Sunflower Avenue, but actually drains into the Gardens Channel through an existing storm drain in Bristol Street. An excerpt of the study area is included as Figure 1.1 below. Please see Attachment 1 for exhibit showing entire watershed.



Figure 1.1 – Gardens Watershed Subarea Exhibit



The goal of this study is to determine if the recommended storm drain improvements identified in the SDMP are warranted, or if any of them could be eliminated, or sizes reduced, based on this updated hydrologic and hydraulic evaluation.

## **Background**

The study area described above, and shown on Figure 1.1 is within Subarea 40 of the Gardens Watershed, as identified in the City's 2018 Storm Drain Master Plan (SDMP). The watershed is tributary to the Orange County Flood Control District (OCFCD) Gardens Channel, Facility No. F02. The Gardens Channel is a graded earthen channel from upstream at 1<sup>st</sup> Street to Alton Avenue. Downstream of Alton Avenue, the channel is a reinforced rectangular concrete section, with a triple-barrel culvert at MacArthur Boulevard and Bristol Street. The Gardens Channel confluences with the Delhi Channel at Sunflower Avenue, east of Bristol Street, and continues flowing southerly toward Upper Newport Bay.

The SDMP recommends upsizing the existing storm drain systems in Sunflower Avenue and Plaza Drive. The existing 54"/60" storm drain line in Sunflower Avenue is originally recommended to be upgraded to a 72"-diameter line. The existing RCP ranging from 18" to 42" in size in Plaza Drive is originally recommended to be upgraded to a 60"-diameter, along with additional pipe-size upgrades. These original SDMP-recommended upgrades are shown on the SDMP exhibit in Attachment 1. Fuscoe's evaluation would determine the required pipe sizes and extent of upgrades for these locations. Additionally, Fuscoe prepared hydraulic analyses of the drains in MacArthur Boulevard and Bristol Street to confirm hydraulic adequacies of those drains to accept the flows associated with the updated hydrologic analyses.

## **Methodology**

Fuscoe requested and received the 10-year Rational Method hydrologic files and drainage exhibit for the SDMP from the city of Santa Ana. This information (10-year Rational Method hydrology for Gardens Watershed) was used as a starting point for our hydrologic and hydraulic evaluation, as discussed in the following sections.

This study was prepared in accordance with the Orange County Hydrology Manual and the Orange County Local Drainage Manual and utilized the existing Rational Method analysis performed for the storm event return period of 10-year for the Gardens Channel Watershed, as confirmed by city staff.

Using existing topography, as-built storm drain plans and atlas maps, and results of underground utility scanning, the city's Rational Method model was adjusted to incorporate the actual field and as-built topographic and storm drain conditions. The city of Santa Ana storm drain atlas maps and reference plans are included as Attachment 2. The OCFCD Gardens Channel as-built plan is included as Attachment 3.

The results of the updated Rational Method hydrologic model for Subarea 40 were used to annotate the city's original SDMP drainage exhibit. The tributary drainage areas, and Q's were added to the annotated city's SDMP exhibit. The updated SDMP drainage exhibit (hydrology map) is included in Attachment 4. The updated 10-year Rational Method hydrology calculations are included in Attachment 5.

Following the updates to the Rational Method hydrology analysis and exhibit labeling, the updated Q10 results were used to prepare storm drain hydraulics for the existing storm drain systems in Plaza Drive, Sunflower Avenue, MacArthur Boulevard, and Bristol Street. The purpose of these hydraulic analyses (Attachment 8) is to determine and confirm the hydraulic capacities of the existing city storm drain systems to adequately convey the Q10 stormwater. The water surface elevations (WSE's) were plotted on the profiles of the city of Santa Ana's storm drain as-built plans. The annotated as-built plans with WSE's are included as Attachment 6. The Water Surface Pressure Gradient (WSPG) hydraulic calculations are included as Attachment 7.

Computer programs were used to perform hydrologic and hydraulic analyses. Advanced Engineering Software (AES) HydroWIN Rational Method and Civil Design's Water Surface Pressure Gradient (WSPG) were utilized to compile the hydrologic data, calculate peak flow discharge rates, and determine the hydraulic grade line (water surface depth) in the storm drain pipes.

### **Results of Analyses**

The results of the hydrologic and hydraulic analyses are discussed in the sections below.

#### **Sunflower Avenue Storm Drain (Subarea 40)**

The existing storm drain infrastructure in Sunflower Avenue includes a 54" RCP from Plaza Drive to Bristol Street, and a 60" RCP from Bristol Street to the OCFCD Gardens Channel. The updated existing 10-year hydrologic analysis showed the Q10 at the downstream connection to the channel to be reduced to 118 cfs (from 195 cfs) at node 398. The WSPG hydraulic analysis shows that the existing 54" RCP is undersized for the tributary Q10, based on current (existing) conditions, however, and a 72"-diameter storm drain will be required from Plaza Drive to the Gardens Channel connection.

The total length of new storm drain in Sunflower Avenue would be 2,230 lineal feet (LF) of 72" RCP replacement.

#### **Plaza Drive Storm Drain (Subarea 40)**

The existing storm drain infrastructure in Plaza Drive includes 18" storm drain laterals originating at Callens Common and mainline RCP's varying from 36" to 42" at the connection in Sunflower Avenue. The updated 10-year hydrologic analysis shows the Q10 at the downstream connection to the channel to be increased to 67 cfs from 66 cfs in the SDMP at node 396 - 397. The hydraulic analysis based on the updated Q10 shows that the existing 42" pipe portion is undersized for the tributary Q10, based on current (existing) conditions, and needs to be upsized to 60" RCP to provide the required hydraulic capacity. However, the upstream segments that the original SDMP shows to require upgrades appear to have adequate capacity to handle the existing condition Q10 discharges.

Due to the reduced amount in the Sunflower Avenue storm drain, the hydraulic grade line (HGL) was reduced in the Sunflower Avenue mainline, which further reduced the HGL in Plaza Drive.

The total length of storm drain improvements in Plaza Avenue would be 320 lineal feet of 60" RCP.

### MacArthur Boulevard Storm Drain (Subarea 37)

Although Subarea 37 receives additional drainage from the south, as compared to the original SDMP, our evaluation of the northerly portion of this Subarea 37 actually drains northerly toward a storm drain to the north in Subarea 36. Therefore, the increase in acreage to Subarea 37 was minimal. The subareas are depicted on the SDMP exhibit in Attachment 1. The drainage in this vicinity is shown on the storm drain atlas map and as-built storm drain plans in Attachment 2. The updated areas are delineated in the updated SDMP Hydrology Map Exhibit in Attachment 4.

The existing storm drain infrastructure in MacArthur Boulevard includes a 63" RCP from Plaza Drive to the OCFCD Gardens Channel. The updated 10-year existing hydrologic analysis showed the Q10 at the downstream connection to the channel to be increased to 108 cfs from original Q10 of 103 cfs in the SDMP. Although the updated hydrology shows an increase in tributary drainage to this system, the hydraulic analysis based on the updated Q10 shows that the existing 63" RCP is sufficiently sized, and will not need to be upsized. Additionally, the existing 30"-mid-block lateral is also hydraulically adequate.

### Bristol Street Storm Drain (Subarea 40)

There is an existing storm drain in Bristol Street, northerly of mid-block between Sunflower Avenue and MacArthur Boulevard. The storm drain consists of 24" RCP and 30" RCP, and connects into the OCFCD Gardens Channel, just south of MacArthur Boulevard. Although this storm drain system was not analyzed hydraulically in the SDMP, a hydraulic analysis was performed based on the updated existing condition 10-year hydrology results. The results of the WSPG hydraulic analysis show that this storm drain system has adequate hydraulic capacity, and will not need to be upsized.

## Conclusion

The hydrologic and hydraulic analyses performed in this study show that the existing 54"/60" RCP in Sunflower Avenue from Plaza Drive to OCFCD Gardens Channel, east of Bristol Street is hydraulically deficient for the current conditions. Additionally, the downstream 42"-diameter of the Plaza Drive RCP is also hydraulically deficient. Therefore, the following upgrades to the city of Santa Ana storm drain systems are recommended:

1. Sunflower Avenue: 2,230 lineal feet of 72" RCP is recommended to replace existing deficient 54"/60" RCP.
2. Plaza Drive: 320 lineal feet of 60" RCP is recommended to replace existing deficient 42"-diameter reach. The remainder upstream reaches are hydraulically satisfactory.
3. MacArthur Boulevard: The existing 63" RCP and 30" RCP mid-block lateral are hydraulically satisfactory.
4. Bristol Street: The existing 30"/24" RCP is hydraulically satisfactory.

| <b>Proposed Storm Drain Upgrades</b> |                           |   |  |
|--------------------------------------|---------------------------|---|--|
| <b>Reach</b>                         | <b>Existing Pipe Size</b> | <b>Length of Recommended Upgrade (LF)</b> | <b>Proposed Pipe Size of Recommended Upgrade</b> |
| Sunflower Avenue                     | 54"/60"                   | 2,230                                     | 72"  |
| Plaza Drive                          | 42"                       | 320                                       | 60"  |
| MacArthur Boulevard                  | 63"/30"                   | -   | -  |
| Bristol Street                       | 30"/24"                   | -   | -  |

## **Attachments**

Attachment 1 – City of Santa Ana Storm Drain Master Plan 2018 Excerpts

Attachment 2 – Storm Drain Atlas Maps & Reference Plans

Attachment 3 – OCFCD Gardens Channel As-Built Plan

Attachment 4 – Exhibit 2 Santa Ana MPD Gardens Watershed Hydrology Map

Attachment 5 – Rational Method Hydrology Calculations – Q10

Attachment 6 – City of Santa Ana As-Built Plans with Updated WSE's

Attachment 7 – WSPG Calculations

Attachment 8 – Exhibit – Gardens Watershed – Existing Condition Recommended Storm Drain Improvements

Attachment 9 – Soil Type Documentation