ALBERT A. WEBB ASSOCIATES

CITY OF INDIO

MASTER DRAINAGE PLAN UPDATE

Prepared for

CITY OF INDIO

Final November, 2019

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Prepared by:

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TABLE OF CONTENTS

SECTION 1 - EXECUTIVE SUMMARY

Located off the Interstate 10 (I-10) freeway in the Inland Empire low desert, the City of Indio is the largest and fastest growing City in Riverside County's Coachella Valley. Known as the "City of Festivals", Indio hosts numerous world-renowned festivals each year including, the Date Festival, the Riverside County Fair, Stagecoach and Coachella Valley Music and Arts Festival. Between 2010 and 2018, Indio was the 10th fastest growing city in California. The City's growth and development is expected to continue for the next few decades.

Recognizing the importance of having a well-planned infrastructure system to meet the demands of an expanding population, the City set the goal of updating its existing Master Drainage Plan (MDP) into a comprehensive document which will update the existing MDP dated 2005, in connection with the Complete Street, Green Street and Green Infrastructure and sustainable development and growth.

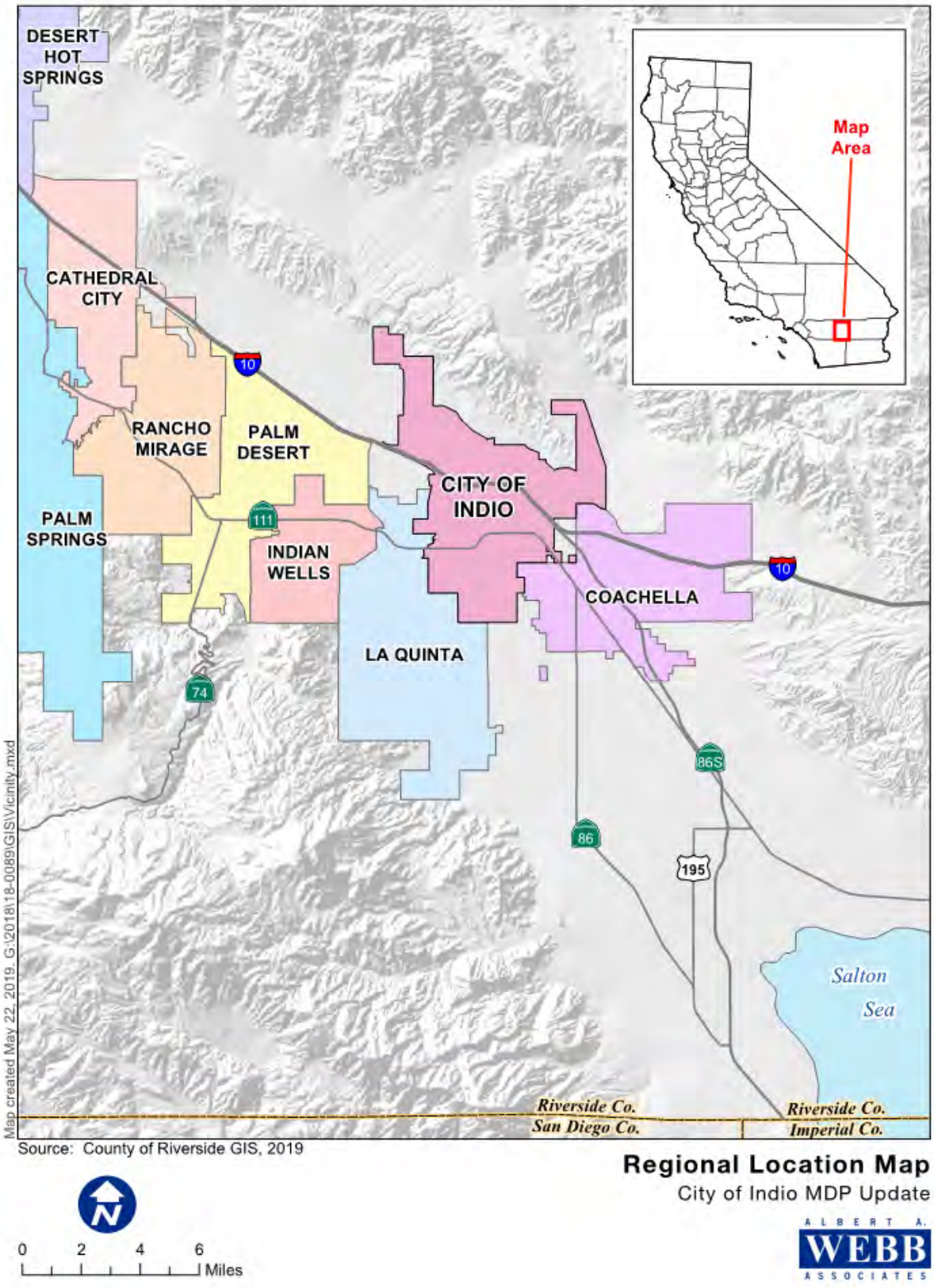
The updated MDP shall guide the planning, development and management of existing and proposed storm drain facilities throughout the City. The proposed MDP facilities and estimated cost of these facilities will also be utilized as a baseline document for the Storm Drain Development Impact Fee component of the Development Impact Fees update for the City. All future development in Indio is subject to Development Impact Fees under the auspices of Assembly Bill 1600, the Mitigation Fee Act.

■ Regional Settings

The City of Indio is located approximately 120 miles east of Los Angeles, 30 miles east of Palm Springs, and approximately 75 miles north of the California-Baja California Mexican border. Indio is the geographic mid-point of Riverside County. It is bordered by the City of Coachella to the east, City of La Quinta to the west and unincorporated areas of Riverside County to the north and the south. City of Indio, along with eight other cities comprises a geographical area commonly known as "The Coachella Valley". The Valley is 50 miles long and runs from Palm Springs to the Salton Sea. Indio is located within the Whitewater River watershed, Colorado River Basin (West) Region.

Figure 1-1 Whitewater River Watershed

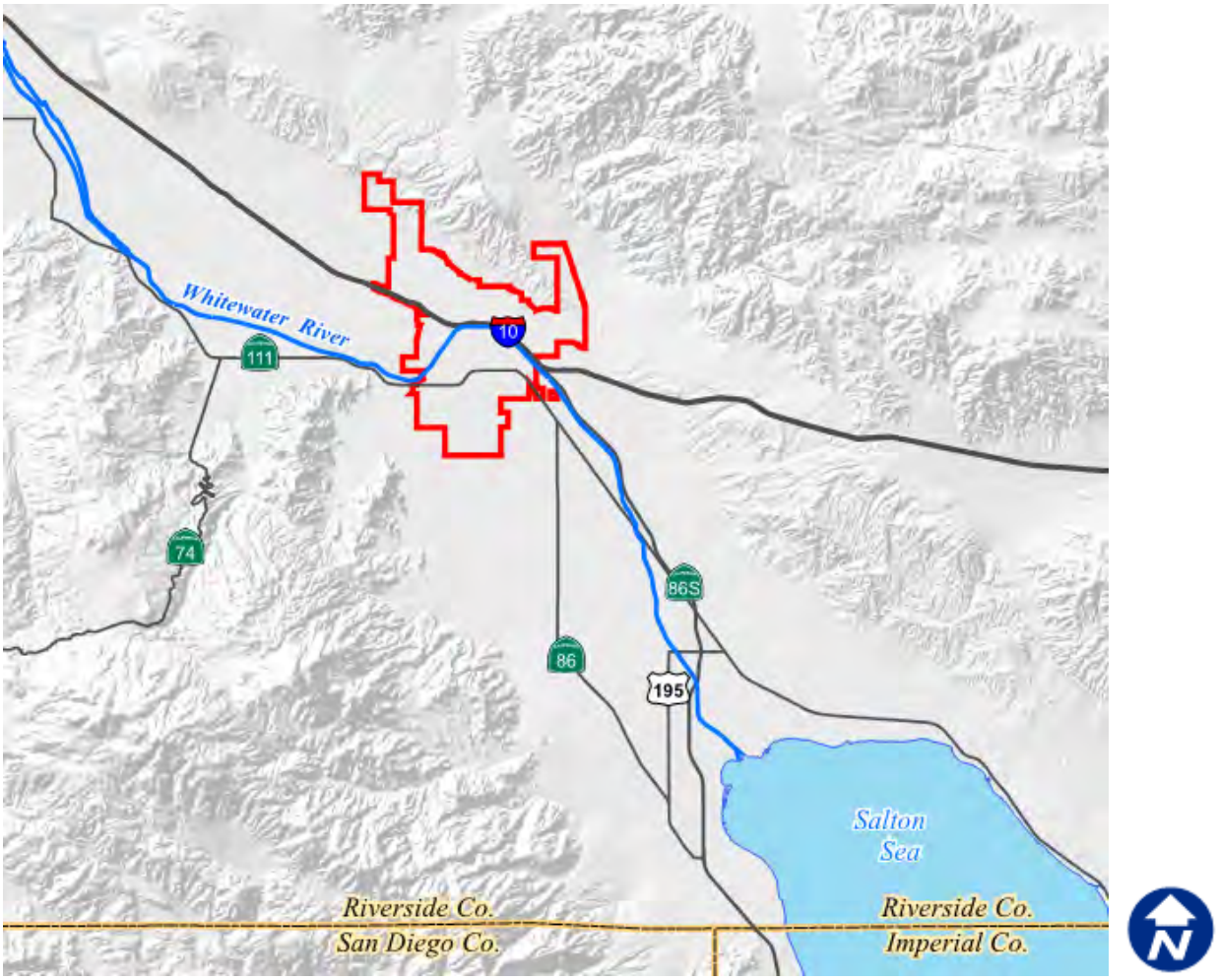
Figure 1-2 City of Indio Regional Location Map



The Salton Sea is the receiving water of Whitewater River/ Coachella Valley Stormwater Channel, and is the largest body of water in the Colorado River Basin Region. The Salton Sea, at elevation 230' below sea level, is replenished mainly by irrigation drainage and stormwater. It serves as a reservoir to receive and store agriculture drainage and seepage waters, and also provides important wildlife habitat and is used for recreational purposes.

The Whitewater River (River) is the major drainage course in the Coachella Valley. There is perennial flow from the San Bernardino Mountains north of the city and San Jacinto Mountains west of the city. Because of diversions and percolation into the ground basin, the River becomes dry further downstream. The constructed downstream extension of the River channel known as the Coachella Valley Storm Water Channel, serves as a drainage way for irrigation return flows, treated community wastewater and storm runoff.

Figure 1-3 City of Indio Receiving Water Map



The City of Indio and the Coachella Valley region have the driest and hotest climate in California. The winters are mild and summers are very hot; temperatures range from below freezing to over

120 degrees. However, frost is a rare occurrence, and crops are grown all year round with irrigation.

The typical mean precipitation is 3.3 inches annually in Indio. Precipitation occurs mostly from November through April, and August through September, but its distribution and intensity are often sporadic. Local thunderstorms may contribute all the average seasonal precipitation at one time or only a trace of precipitation for the entire season. At the Indio Fire Station, the record low annual precipitation was 0.35 inches in 1990, and 10.85 inches for a record high in 1939. The period of records is from 1894 to 2012 based on the data per National Oceanic and Atmospheric Administration (NOAA) National Weather Service.

STATION: (044259) INDIO FIRE STATION
From Year = 1894 To Year = 2012

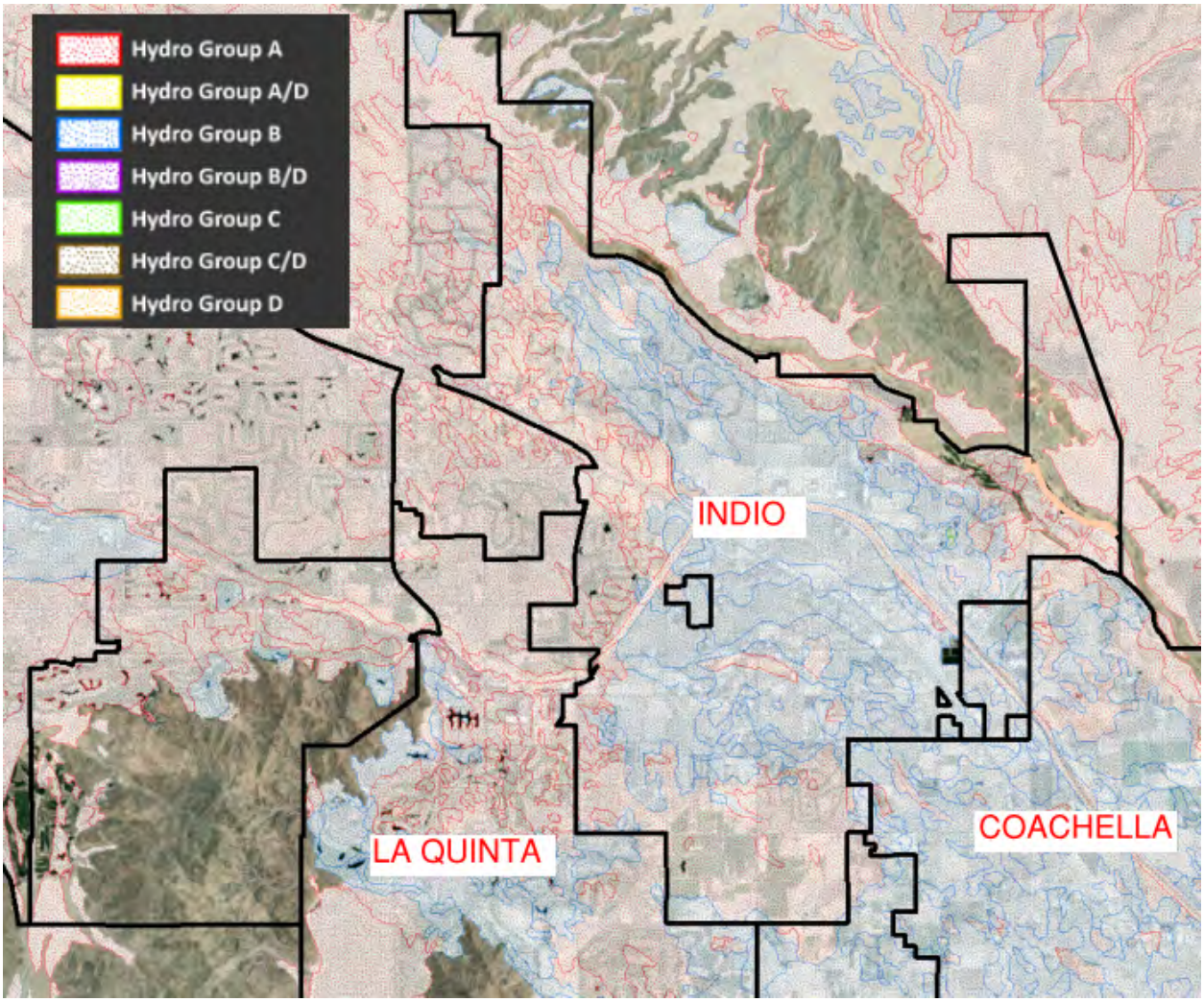
	Precipitation						
	Mean	High	Year	Low	Year	1 Day Max.	
	in.	in.	-	in.	-	in.	date
January	0.64	4.18	1993	0	1912	2	1/22/2010
February	0.51	3.93	1980	0	1910	1.65	2/14/1980
March	0.31	2.06	1906	0	1894	1.33	3/1/1943
April	0.11	2.17	1926	0	1894	0.76	4/1/1926
May	0.05	0.62	1981	0	1894	0.49	5/28/1981
June	0.01	0.28	1988	0	1906	0.19	6/16/1918
July	0.12	1.87	1936	0	1904	1.7	7/26/1936
August	0.25	3.87	1977	0	1911	3.61	8/24/1920
September	0.31	8.96	1939	0	1907	6.45	9/24/1939
October	0.2	1.6	1907	0	1904	1.13	10/16/1936
November	0.26	2.48	1965	0	1910	1.6	11/8/1952
December	0.54	3.44	1921	0	1910	2.36	12/24/1940
Annual	**3.29**	**10.85**	**1939**	**0.35**	**1990**	**6.45**	**1939**
Winter	1.69	7.15	1993	0	1912	2.36	1940
Spring	0.46	2.66	1981	0	1894	1.33	1943
Summer	0.37	3.9	1977	0	1928	3.61	1920
Fall	0.76	9.52	1939	0	1937	6.45	1939

In the Coachella Valley, ground water is stored in the unconsolidated Pleistocene sediments. The thickness of the water-bearing sediments exceeds 1,000 feet. Ground water is generally unconfined, except a clay aquitard extends from the Salton Sea to the west of Indio, overlying the domestic-use aquifers. This clay patch layer, a result of past sedimentation in the historic lake

bed, is also the cause of some areas of the City being impeded with low infiltration capability and surface water ponding.

As indicated in Figure 1-4, the soils within the city are mainly Hydro Group A and B, well drained, fine-grained sand with some fine clay.

Figure 1-4 City of Indio Soils Group Map

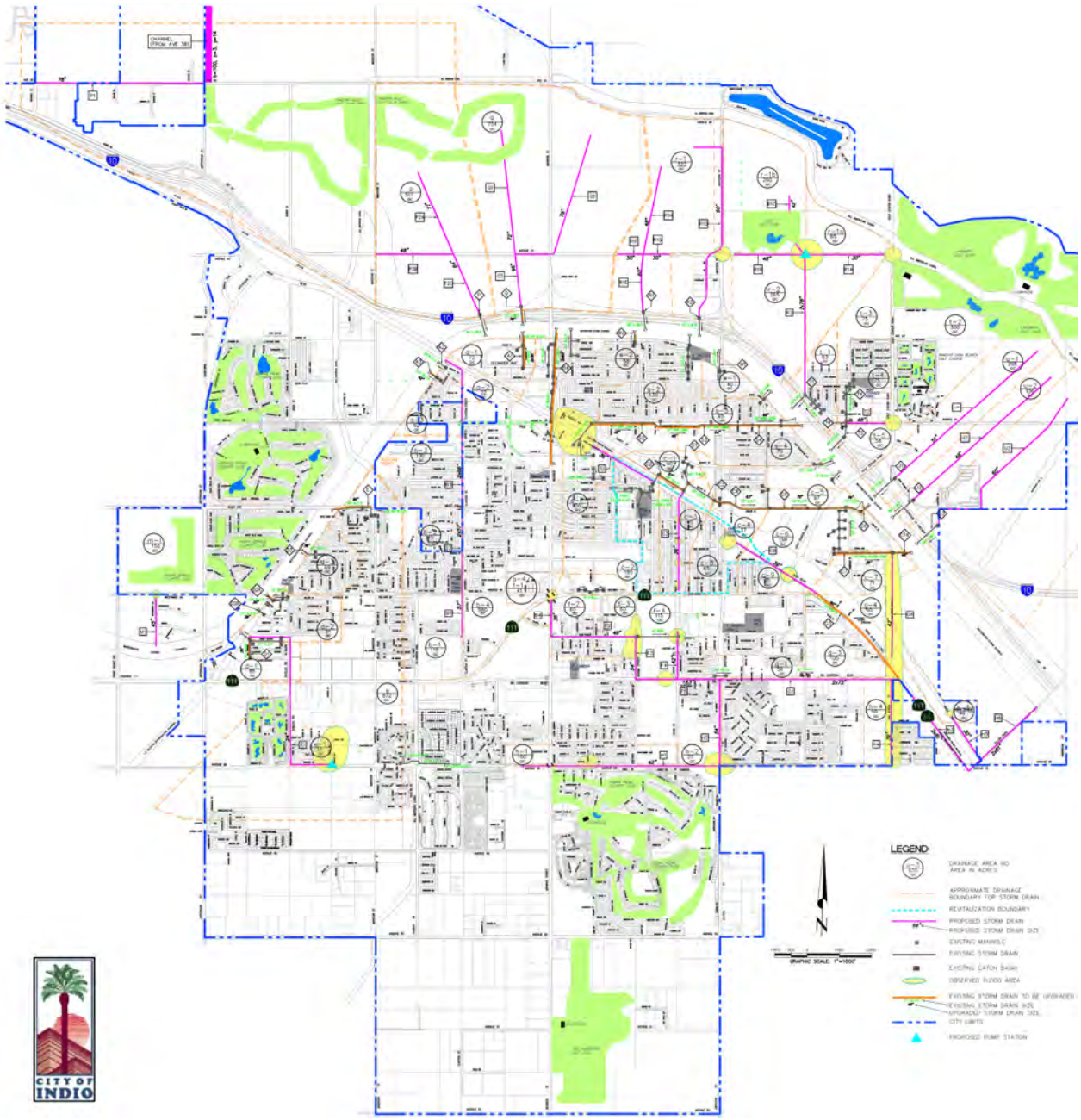


Efforts to recharge the ground water basin in the Coachella Valley began a century ago. Various facilities were constructed to capture natural flows and storm runoffs to recharge ground water basins. Colorado River water transported by the Colorado River Aqueduct and the Coachella Canal are used for recharge and replenish efforts regionally. With the recent statewide drought and implementing storm water and water quality management policies, ground water recharge is at the forefront of flood control infrastructure and water quality management. The Coachella Valley and the City of Indio have both the need and the means to achieve these goals.

■ Existing MDPs and Drainage Infrastructure

The existing city-wide Master Drainage Plan (MDP) prepared by Psomas was approved and adopted by the City in 2005. The drainage impact fee schedule associated with the 2005 MDP was analyzed and prepared by Bureau Veritas in 2006.

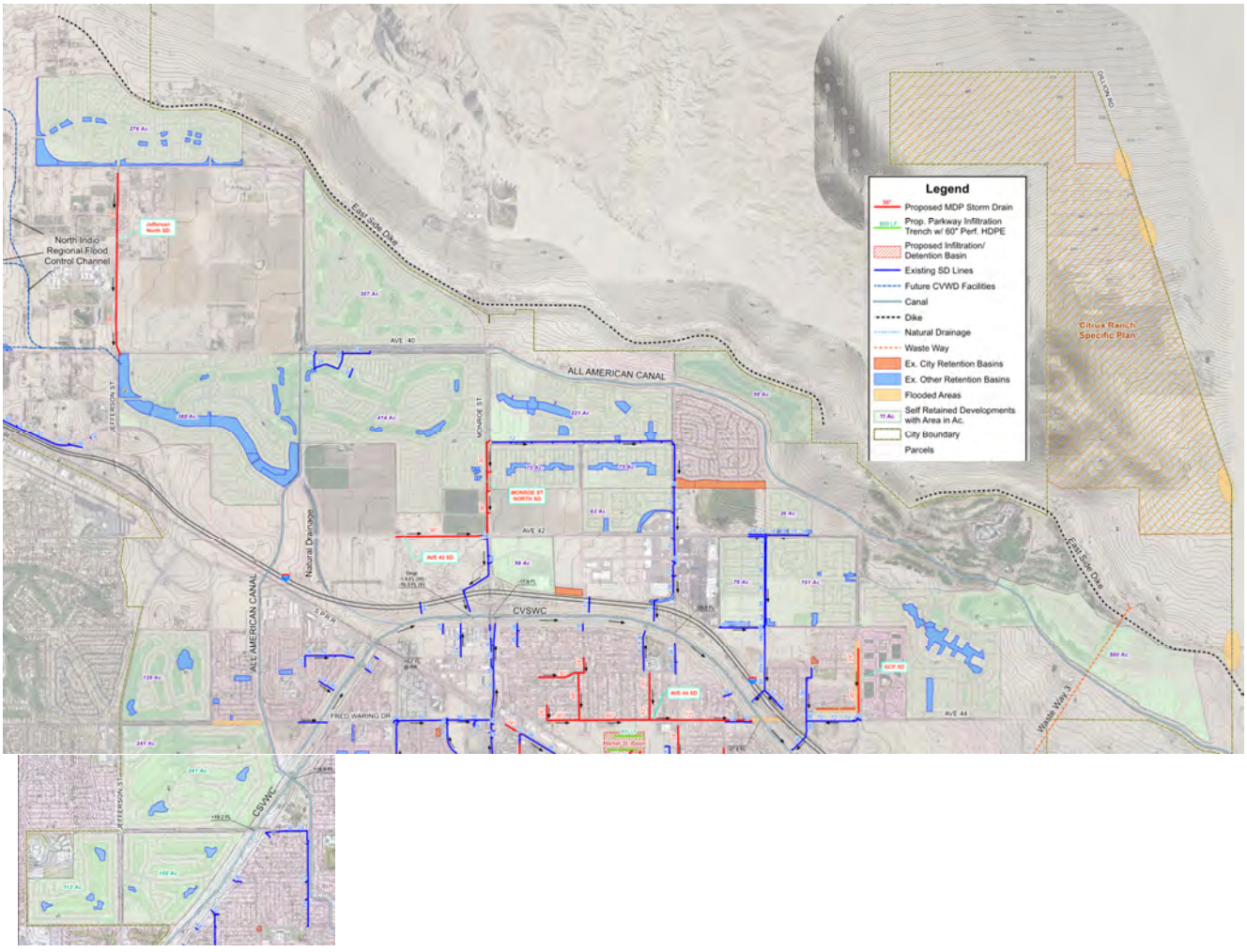
Figure 1-5 City of Indio 2005 MDP Map



Indio implements a storm water policy, which requires all new developments to retain its 100-year, 24-hour storm volume on-site. Many residential developments meeting this requirement

have been established in the City. The new developments mostly are gated communities with either a golf course, on-site lakes or retention/ infiltration basins. The majority of these developments are located north of the Whitewater River Channel (CVSWC), comprising approximately 3,280 acres, with the storm drain systems constructed on Jackson Street, Calhoun Street, Aztec Street and partially constructed on Monroe Street.

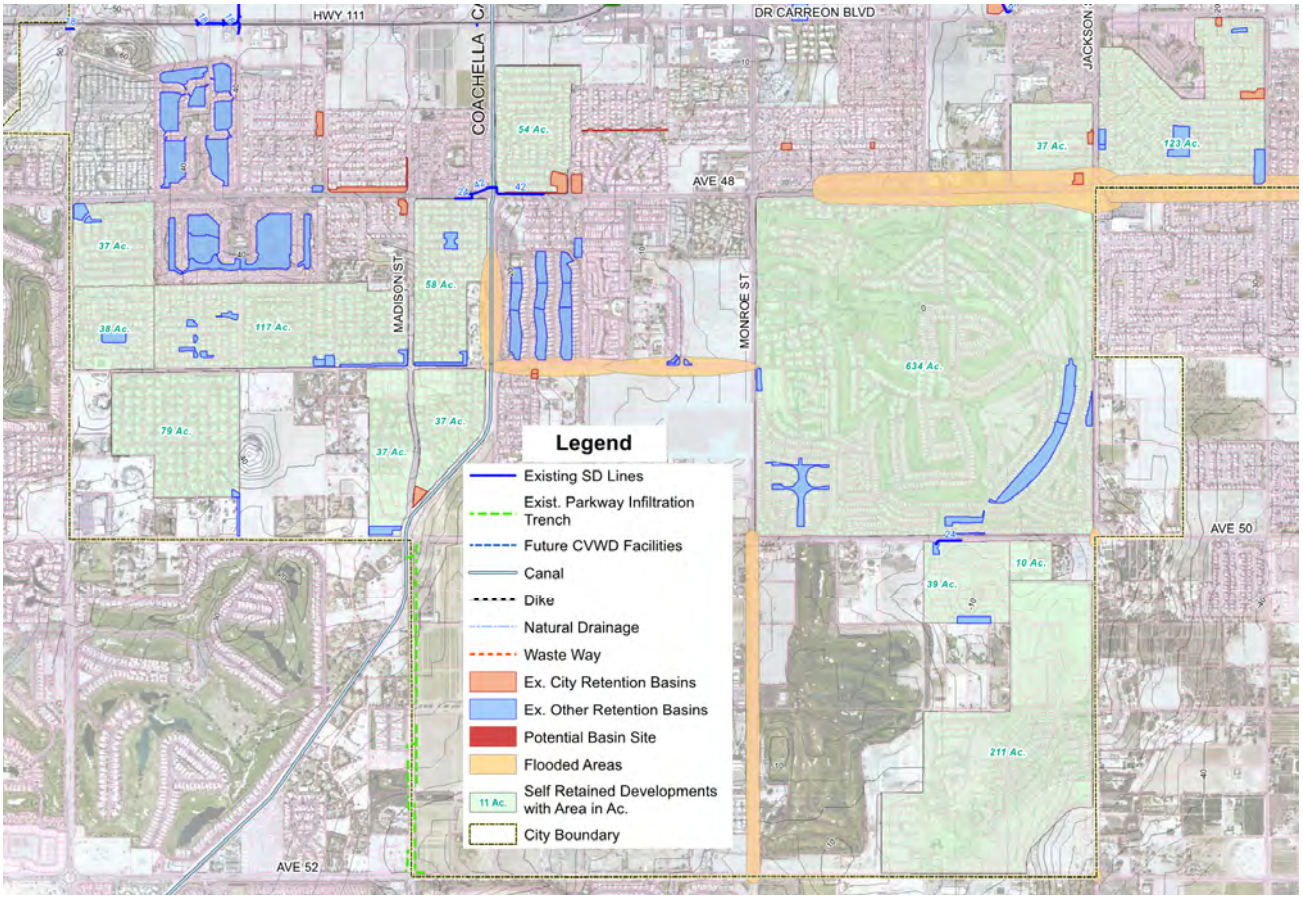
Figure 1-6 City of Indio New Developments North of CVSWC Channel



There are also three smaller developments located south of Dr. Carreon Blvd., north of Avenue 48 (214 acres) and some mix-sized developments located south of Avenue 48 (1,297 acres).

These self-contained developments, totaling 4,800 acres, changed the dynamics of the City in many aspects, and are fine examples of sustainable development, ground water recharge and flood control projects.

Figure 1-7 City of Indio New Developments South of Dr. Carreon



■ Purpose

The primary purpose of updating the Master Drainage Plan (MDP) is to provide a comprehensive storm water strategy that provides flood protection for both existing and future developments within the City.

The MDP will also; identify the drainage facilities needed to address the major drainage problems within the City; establish the estimated costs of those facilities; and identify the funding sources for the city-wide flood control and drainage infrastructure necessary to facilitate safe, orderly and economically development of the area. This study will also explore the opportunity for implementing Best Management Practices (BMPs), ground water recharge, green infrastructure, and water quality mitigation and treatment. This study will set guidelines for the future developments with the focus on nutrient reduction, enhancing the beneficial use of, and minimizing the negative impact to the Whitewater River Channel and Salton Sea water quality.

This MDP update study addresses the current and future drainage needs of the communities within the City. The proposed facilities include channels, storm drains, detention and infiltration basins, parkway infiltration trenches, and any other conveyances capable of economically

relieving flooding problems within the City.

In addition to providing a guide for the orderly development of the City, the MDP update also identifies facilities with an estimate of cost to resolve flooding issues within the city. Those costs will be used to update storm drain impact fees, a component of the Development Impact Fees, exacted under AB 1600, which prevent existing taxpayers from having to shoulder the burden of new land development projects' impacts costs.

The alignment and location of the facilities proposed in this MDP update are conceptual. Precise locations and size of the facilities will be dictated by site-specific conditions and other factors such as environmental, engineering, and economic considerations.

■ Scope of Study

The updated MDP study assesses and inventories the existing drainage infrastructures, incorporates updated city boundary, general plan land uses, and rainfall data, and produces a comprehensive master drainage plan for the entire city. The drainage fee schedule will correspond to each drainage system identified on MDP maps and exhibits.

In conjunction with this study, GIS data layers have been developed for the regional drainage facilities, existing storm drain systems (size 18" and larger), existing Maxwell or drywells, existing retention/ infiltration or detention basins both privately maintained and City maintained, and proposed MDP facilities. The new consolidated GIS data layers will be provided to the City and ready to integrate into the City GIS database.

The overall scope of the MDP update includes the following:

- Existing drainage facility data collection and field investigation of the flooded areas and conditions of drainage outlets to the Coachella Valley Stormwater Channel (also known as Whitewater River Channel)
- Establishing basic engineering design criteria
- Compiling existing available topography and land use plans for the project area
- Preparing hydrology analysis for the study area of the City and its tributary areas
- Identifying proposed drainage improvements for each MDP drainage system
- Identifying the feasibility and measures for ground water recharge, sustainable development, green infrastructure and green streets
- Investigation of alternatives for the proposed drainage facilities and cost estimates
- Estimating the city-wide annual Operation and Maintenance cost for the drainage facilities and new facility/ equipment needed for O & M
- Preparation of final report for MDP facility, estimated cost, and funding sources

■ Design Criteria

In August 2018, at an early stage of the MDP study, Webb prepared a draft Technical Memorandum for Indio MDP Design Guidelines and Hydrology & Hydraulics Study Criteria, and submitted the Memo to the City for review and comments. With the progress of the project study, certain design criteria was modified and updated. In March 2019, the Memo was updated and redistributed to the City. Below is a copy of the Memo dated March 11, 2019.

It is imperative to establish the criteria for the Hydrology and Hydraulics (H&H) study and MDP update design guidelines before proceeding with the detailed studies and design. We have reviewed the existing MDPs within or adjacent to the City of Indio to ensure the City of Indio MDP update will be compatible and consistent with the surrounding areas.

1. Hydrology

The hydrology for this MDP will be developed using two methods: the Rational Method and the Synthetic Unit Hydrograph Method. The Rational Method will be used to determine the peak discharges (cubic feet per second) generated from watersheds smaller than 300 to 500 acres in size. For watersheds larger than 300 to 500 acres, or the storm water volumes are needed for sizing the retention, detention or infiltration facilities, the Synthetic Unit Hydrograph Method will be used. Methodology and supportive data for both Rational and Synthetic hydrology, including estimation of loss rates/infiltration, may be found in the *Riverside County Flood Control and Water Conservation District Hydrology Manual*, dated April 1978 (District Hydrology Manual).

2. Land Use

Currently, the City of Indio General Plan is being updated. The existing Official Zoning Map is dated 2009, and Land Use Map is dated 2004.

We assume that the City will provide draft land use designations from the updated General Plan for this project use. If the draft land use is not available, the existing Zoning Map and Land Use Map will be used to develop the hydrology for this MDP update.

In addition to the City General Plan land use, there are many Specific Plans (SP) and Project Master Plans (PMP) within the city boundary, and each has its own land use designations. Some of these Specific Plans are almost built-out, while others are still evolving and going through amendments.

Due to the dynamic and complex nature of the land use designations and their actual impacts to the hydrology studies, we propose to consolidate the land use into 4 categories with assigned impervious percentage recommended per the RCFCD Hydrology Manual. For Specific Plans, if there are 10 planning areas with varied density, an average total may be used for MDP level of the studies. This approach will simplify the process without compromising the integrity of the study.

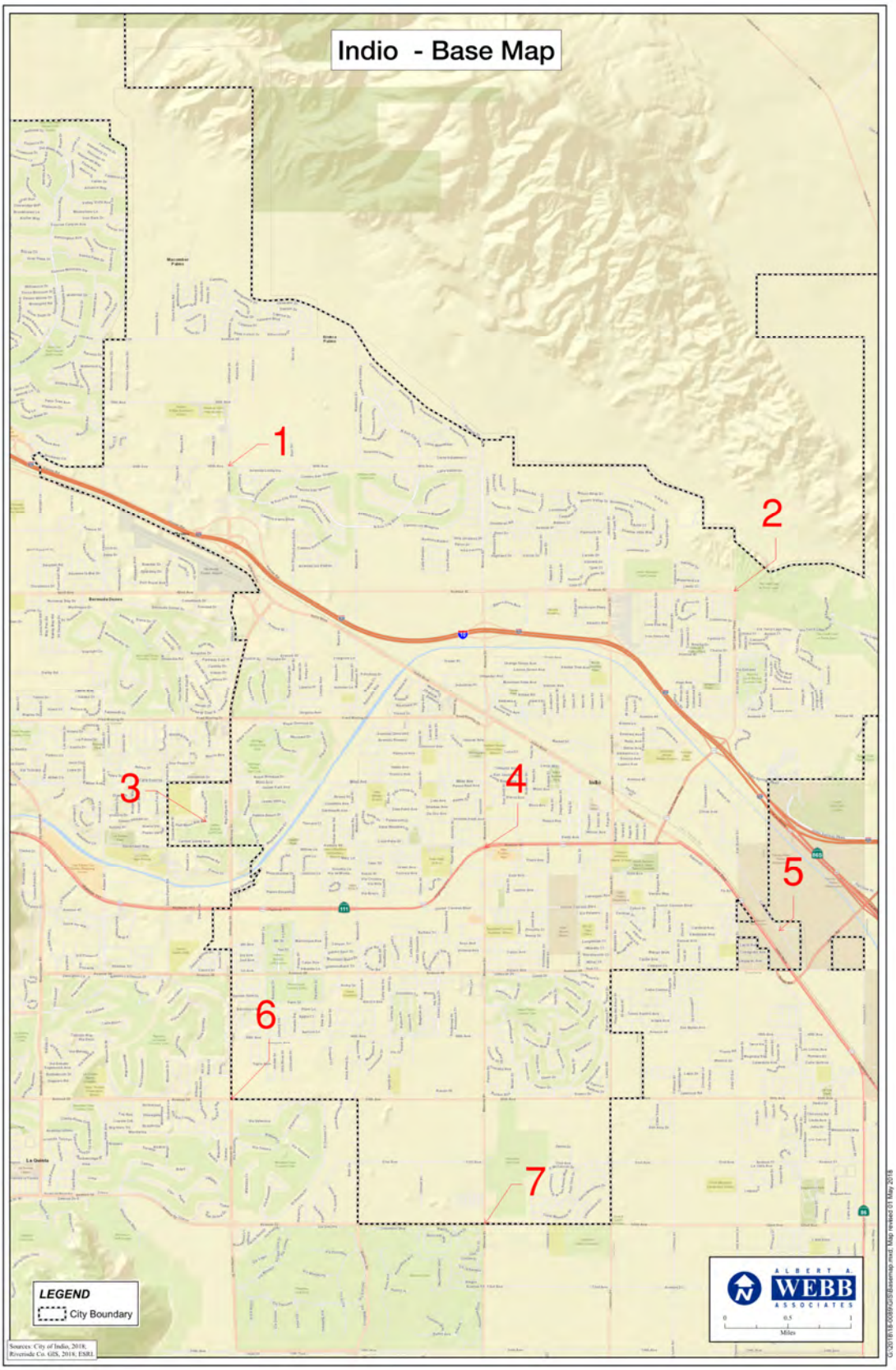
City of Indio MDP Land Use Summary

Land Use Group	Land Use per General Plan	RCFCD Hyd Manual Cover Type	Impervious Cover	Remarks
Open Space	OS-Open Space, F-Floodway, Conservation Bank, Park, Recreation, Golf Couse	Natural (Fair) or Urban Landscaping	10%	
MDR	R1-Single Family Residential, R2-Medium Density Residential, LMD-Low Medium Density Residential, MD-Medium Density Residential, MHD-Medium High Density Residential, Public Institutional, Schools	1/4 Acre Lots	50%	
HDR	High Density Residential, RMU-Residential Mixed Use, MC-Mobile Home community, EC-Existing Condo, EMH-Existing Mobile Home Complex	Condo, Apartments, Mobile Home Park	75%	
Commercial	Varies Commercial, Manufacturing M2, M3, BP-Business Professional, LI-Light Industrial	Commercial, Downtown Business or Industrial	90%	

3. Rainfall Values

To be consistent with the recently completed Eastern Coachella Valley Stormwater Master Plan and utilize latest available point precipitation data, the NOAA Atlas 14 rainfall data will be used in the hydrology calculations for this MDP update. The rainfall frequencies examined are the 2-year, (50% annual chance), 10-year (10% annual chance) and the 100-year (1% annual chance) recurrence intervals with 1, 3, 6 and 24 hour durations. The calculated slope of the intensity-duration curve is 0.6. The following NOAA Atlas 14, Volume 6, Version 2 point rainfall values will be used to develop the hydrology. A total of seven locations are selected throughout the city, and point precipitations for each location are tabulated. Since the rainfall data is consistent on all seven locations, a mean average will be used for the entire City.

NOAA Atlas 14 Point Precipitation Sample Location



NOAA Atlas 14 Point Precipitation Values

1 hour Storm Duration					
Location	Lat.	Long.	2-year	10-year	100-year
1	33.7583	-116.2691	.351''	.705''	1.47''
2	33.7439	-116.1994	.361''	.717''	1.45''
3	33.7174	-116.2722	.355''	.715''	1.50''
4	33.7145	-116.2338	.352''	.703''	1.43''
5	33.7047	-116.1932	.355''	.701''	1.38''
6	33.6854	-116.2687	.355''	.713''	1.48''
7	33.6711	-116.2339	.348''	.690''	1.38''
Average			**0.354**	**0.706**	**1.441**

3 hour Storm Duration					
Location	Lat.	Long.	2-year	10-year	100-year
1	33.7583	-116.2691	.557''	1.06''	2.12''
2	33.7439	-116.1994	.563''	1.07''	2.16''
3	33.7174	-116.2722	.561''	1.07''	2.16''
4	33.7145	-116.2338	.555''	1.06''	2.13''
5	33.7047	-116.1932	.550''	1.05''	2.13''
6	33.6854	-116.2687	.559''	1.06''	2.16''
7	33.6711	-116.2339	.544''	1.04''	2.10'
Average			**0.556**	**1.059**	**2.137**

6 hour Storm Duration					
Location	Lat.	Long.	2-year	10-year	100-year
1	33.7583	-116.2691	.731''	1.37''	2.71''
2	33.7439	-116.1994	.735''	1.39''	2.8''
3	33.7174	-116.2722	.735''	1.39''	2.76''
4	33.7145	-116.2338	.727''	1.37''	2.76''
5	33.7047	-116.1932	.719''	1.37''	2.78''
6	33.6854	-116.2687	.731''	1.38''	2.76''
7	33.6711	-116.2339	.712''	1.35''	2.74''
Average			**0.727**	**1.374**	**2.759**
2005 MDP*				**1.400**	**2.500**

24 hour Storm Duration					
Location	Lat.	Long.	2-year	10-year	100-year
1	33.7583	-116.2691	1.14''	2.23''	4.38''
2	33.7439	-116.1994	1.17''	2.28''	4.52''
3	33.7174	-116.2722	1.16''	2.27''	4.45''
4	33.7145	-116.2338	1.16''	2.26''	4.48''
5	33.7047	-116.1932	1.15''	2.24''	4.49''
6	33.6854	-116.2687	1.16''	2.26''	4.45''
7	33.6711	-116.2339	1.14''	2.22''	4.42''
Average			**1.154**	**2.251**	**4.456**

* 2005 Indio MDP utilized NOAA Atlas 2 precipitation data

As indicated in the table for 6 hour Storm Duration, 2005 Indio MDP utilized NOAA Atlas 2 precipitation data for the hydrology studies. The current NOAA Atlas 14 rainfall data for 10-year 6-hour storm appears to be almost same as the NOAA Atlas 2, however, 100-year 6-hour precipitation has 10 % increase.

4. Areas of Exclusion from Hydrology Studies

The City of Indio has required all new developments to provide full retention of 100-year 24-hour storm water volume. Most of the newer developments are gated residential communities with HOA maintaining the on-site storm drain and detention, retention or infiltration basins. These communities shall be classified as self-retaining areas and excluded from the hydrology study area. However, due to the 10% increase of 100-year precipitation and some inadequate design and maintenance of the retention basins, we propose to use 20% of 100-year peak flow or storm volume for these self-retaining areas.

5. MDP Facilities

Currently, the existing storm drain facilities within the city limits are maintained by various entities and agencies; including CVWD, City of Indio, and HOAs. To streamline the future design, maintenance, and funding, the City may consider establishing some guidelines and maintenance mechanisms (CFDs or Assessment Districts) and include the discussion in the MDP documents. Each maintenance entity will also dictate the design standards. For the purpose of MDP facility design and cost estimate, RCFCD standards and design guidelines will be used.

Regional Flood Control /Storm Drain Facilities

The main regional flood control facility in the City of Indio is the Coachella Valley Stormwater Channel. This channel is the main drainage course for the entire Coachella Valley region from north of Palm Springs to the Salton Sea. This channel meanders through the City in a west to east direction, partially along the Interstate 10 Freeway, and is maintained by CVWD. Additional existing regional drainage facilities include the East Side Dike along the foothills of north Indio and Waste Way 3.

Recently, CVWD completed design of the North Indio Regional Flood Control Channel. Phase I of the North Indio Channel is under construction, nearing completion. Phase II of the Channel is expected to be completed in 3-5 years.

Regional Flood Control Facilities

Underground Storm Drain System

All of the underground storm drain systems will be designed to convey the runoff from a 100-year storm, with RCP sized 24” and larger. Road culverts, laterals and collectors will not be identified as MDP facilities. The underground facilities proposed in this MDP will be located within existing or assumed future right-of-way, whenever possible. The typical MDP storm drain pipe or box design will have 3’ of cover with the slopes parallel to the existing ground.

Open Channels

Well defined natural channels, canyons and ravines are the most economical way to transport and convey the storm runoff, and pose the least impacts to potentially sensitive areas. The MDP study will focus on preserving and maximizing the utilization of natural water courses.

When natural water courses become less defined, flattened and spread out, they may cause flooding of roadways and properties, as well as adding constraints to future developments. Open channels may be used to continue transporting storm runoff to a safe outlet. The open channels not only serve as flow conveyors, they also provide an outlet for underground facilities. This MDP study will utilize two types of open channels, lined and unlined. Lined channels will be used in high velocity flow situations and are typically rectangular or trapezoidal shaped with concrete paving on the sides and bottom. Unlined channel will be utilized in low velocity flow situations, are typically trapezoidal in shape and have no protection for the bottom or side slopes. The unlined channels can also provide infiltration or filtration opportunities for water quality management.

The channel right-of-way required for both lined and unlined facilities must accommodate the full channel width along with adequate maintenance access. Channels with top widths less than 20 feet require one maintenance access road, and where the top width exceeds 20 feet, two maintenance access roads are necessary per RCFCD design standards. All of the open channels will be designed to convey the runoff from a 100-year storm.

The potential location of the drainage channels could be along the railroad tracks with the limited street crossing.

Detention / Retention / Infiltration Basins

Detention basins maybe utilized for this MDP. The purpose of the detention basin is to lower the peak flow rate through the use of temporary detention storage, thus reducing the size and cost of the downstream MDP facilities. It should be noted that the detention basin, if proposed, will be sized for the 1% annual chance ("100-year" storm) event. Flows exceeding the design capacity of the basin would pass over the emergency spillway or overflow structure and discharge into the downstream storm drain pipe or open channel. Detention Basins may also be used when existing downstream facilities have inadequate capacity.

Similar to the detention basins, retention basins are sized to retain complete 100-year, 24-hour storm runoff volume. Retention / infiltration basins which fully utilize the arid desert climate, sandy, well drained soil are an economical solution to achieve flood control, water quality management and ground water recharge. Currently, many localized retention/ infiltration basins exist in the city. To take advantage of the unique conditions of the desert, master plan level detention, retention and infiltration basins shall be considered.

The City has identified locations which may be utilized for retention / infiltration basins. One potential site is currently used as a park, located north of Miles Avenue, south of Leroy Way, east of Palm Street and west of Arabia Street, as shown below: The other optional site is located south of Avenue 44, north of Market Street and west of Jackson Street, a City-owned vacant property.

Optional Site for Detention/ Retention Basin (Miles Ave. Park)

Note: Miles Avenue Park was removed from the potential MDP detention basin list later in the MDP development process by the City. However, another city-owned parcel located west of Monroe Street and south of Avenue 49 was added, and was utilized in the MDP and identified as “Monroe Basin”.

The other optional site is a vacant city-owned parcel of land north of Market Street and west of Jackson Street, zoned for open spaces and park. See exhibit below:

Optional Site for Detention/ Retention Basin (Vacant)

MaxWell and Dry Well

Based on the data and plans provided by the City, we have identified over 100 existing and proposed (under construction) MaxWell Plus (two chamber dry well up to 40' below grade) and conventional Dry Well throughout the City.

The design capacity of a typical MaxWell Plus is between 0.06 CFS to 0.2 CFS; the flow tests conducted by Torrent Resources had average 0.12 CFS per MaxWell. That amount is insignificant to use for its capacity for 100-year storm runoffs. However, if strategically placed in an area with constant nuisance flow and landscape irrigation runoffs, one MaxWell Plus can infiltrate up to 20 ac-ft of the flow per year, assuming filled with the nuisance flow 50% of the time. The use of MaxWells and Dry Wells will provide a significant benefit for the water quality mitigation and ground water recharge.

Street Parkway Infiltration Trench

In the area south of Avenue 48, parkway infiltration trenches (60" perforated HDPE placed in the gravel trench and backfilled along the street parkway with catch basins) were utilized to de-water the street. Currently, the said infiltration trench drain is being constructed on Madison Street Improvement Project; and may be utilized for the proposed Jackson Street Improvement Project.

In general, this area of the City comprises approximately 5 Sections (3,200 acres). The existing drainage pattern is from the northwest to the southeast, towards the Coachella Valley Storm Water Channel (Whitewater River Channel) and Salton Sea.

The areas between the easterly boundaries of the City of Indio - Jackson Street to the receiving water at Whitewater River Channel, are within the City of Coachella and County of Riverside unincorporated area. Our research has shown that there are no existing master drainage facilities on Avenue 50 nor on Avenue 52. To construct 2.5 miles of MDP facility on Avenue 50, and 4 miles of MDP facility on Avenue 52 outside the Indio boundary are above and beyond Indio MDP responsibility and financially infeasible.

Since most of the existing developed areas are self-contained for 100-year storm, and all future developments are also required to retain the 100-year storm, the City and its consultant agreed that for this area, infiltration Trenches and MaxWells will be used for major street flood control, such as Avenue 50 & 52, Monroe Street and Jackson Street. The estimated 100-year, 24-hour storm volume of street flow and average infiltration rate will be used for sizing the length of infiltration trench.

(End of Design Criteria Memo)

SECTION 2 - EXISTING FACILITIES AND DRAINAGE ISSUES

Drainage issues include street and private property flooding, erosion, long-term ponding and standing water at some existing retention basins or street inlets. The existing drainage facilities include City-owned and maintained storm drains systems; Home Owner Association owned and maintained basins and in-tract storm drain systems; and regional flood control facilities maintained by Coachella Valley Water District (CVWD).

The field surveys and documentations provided in this report were collected from July to September of 2018. Webb also conducted a field visit during a rainstorm in February 2019.

Throughout the MDP development process, the City Engineer and maintenance staff provided valuable input, and identified most of the drainage issue locations based on past resident complaints and prior knowledge and experience in the area. During the field surveys, Webb collected all notes and pictures using the ArcGIS Collector mobile application. This application operates on any mobile phone or data-enabled tablet and uploads information to the GIS map in real-time.

All of the field surveys were conducted by at least one engineering staff member from Albert A. Webb Associates.

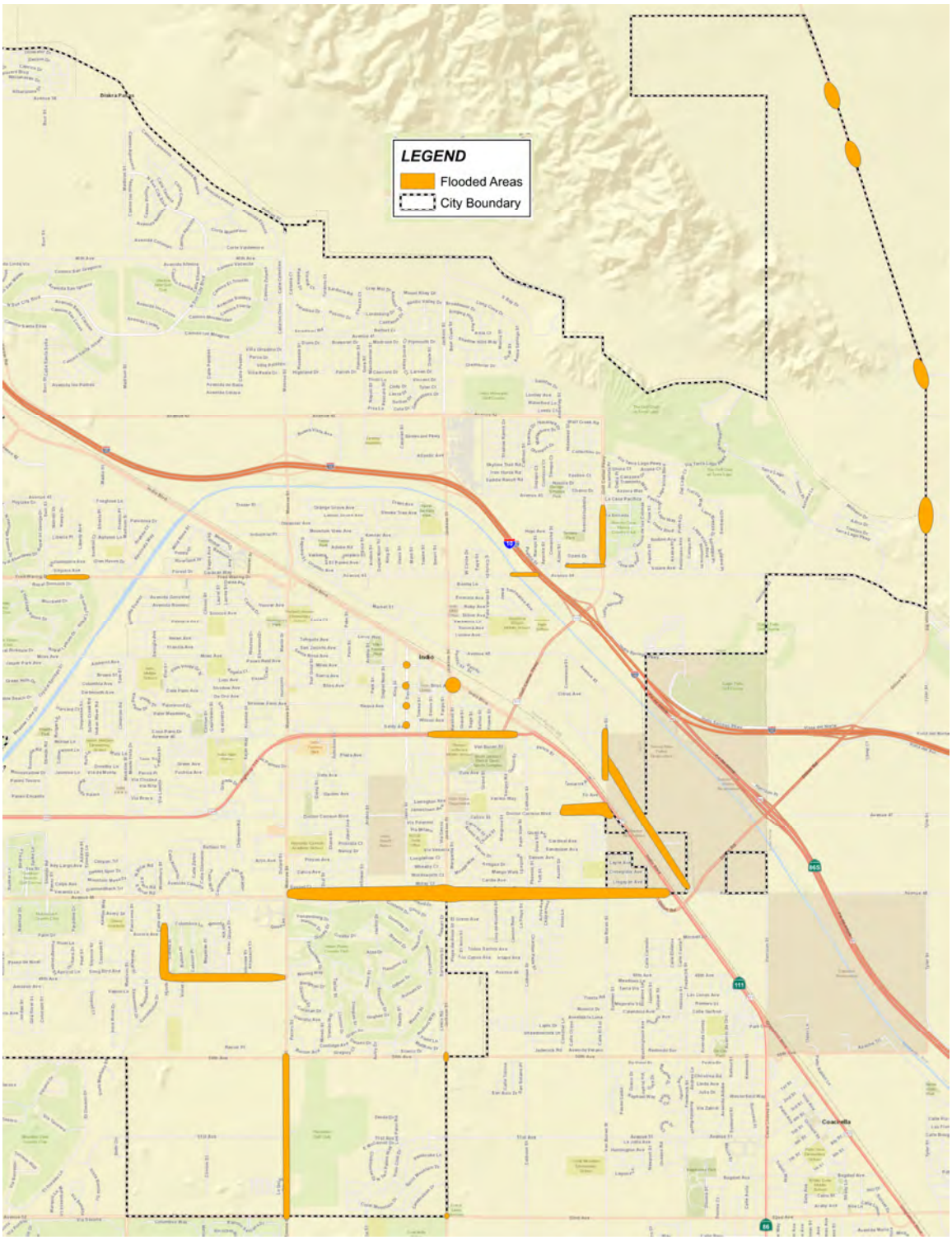
■ Flooding and Drainage Issues

The ground elevations for more than half of the City are below sea level, and most of the area in the city, especially south of CVSWC and north of Avenue 48, is very flat and lacks drainage infrastructures. A good portion of the city streets have average slope less than 0.3%, some streets have less than 0.1% slope. Typically municipalities require 0.5% minimum slope. Under these conditions, some city streets and surrounding areas are flooded during any rain showers or storms. With the assistance of the City Engineer and Maintenance and Operation staff, Webb surveyed and documented some of the drainage issue locations and identified the following locations with flooding and standing water:

1. Golf Center Parkway (from Via Entrada to Avenue 44, and Mojave Drive and two existing basins south of Mojave Drive and west of Golf Center Parkway)
2. Fred Waring Drive (from east of Burr Street to west of Coachella Canal)
3. Avenue 44 (dip section crossing CVSWC, west of I-10)
4. Oasis Street in downtown (from Miles Avenue to Saidy Avenue)
5. Jackson Street at the intersection of Civic Center Drive
6. Highway 111 (from east of Smurr Street to west of Calhoun Street)
7. Dr. Carreon Blvd. (from Van Buren Street to 1400 LF west)
8. Van Buren Street (from Enterprise Way to Cabazon Road)
9. Cabazon Road (from Commerce Street to Dillon Road)
10. Avenue 48 (from Monroe Street to Indio Blvd.)
11. Hiorth Street (from Avenue 49 to 1800 LF north)
12. Avenue 49 (from Hiorth Street to Monroe Street)
13. Monroe Street (from Avenue 50 to Avenue 52)

14. Jackson Street (at the Intersections of Avenue 50, and Avenue 52)
15. Dillon Road (at the intersection of Landfill Road, and north 3 locations where offsite drainage course cross the road)

Figure 2-1 City of Indio Areas Prone to Flooding



The above listed areas are also deliniated on the MDP map and Figure 2-1. Webb will also provide photos to the city (collected during a rainstorm event). These photos may be used for flood prevetion or road safety related funding applications.

■ Drainage Issues - General Remedies

Most of the drainage issues occur from only a few causes. The most common causes of the surveyed drainage issues are low points on the street or property with inadequate or no drainage conveyance, lack of curbs and/or gutter facilities, and insufficient maintenance of existing facilities.

Street flooding is often caused by streets not having proper slopes and crowns, and lack of dewatering measures at low points. Some streets in the City were found to have low points within the traveled way. The slopes of the pavement can be improved by paving, but care should be taken to not simply put the water on the shoulder of the road. Water can often pond or erode dirt shoulders if not properly channelized.

The City uses a mix of asphalt concrete berm, curb, and curb/gutter combinations throughout the City to help channelize water that runs off of the street. However, many locations simply have dirt shoulders without any curb or gutter facility. This leads to ponding, dirt erosion, and dirt runoff. Constructing berms, curbs, and gutters can help channelize the water along the street and towards storm drain facilities.

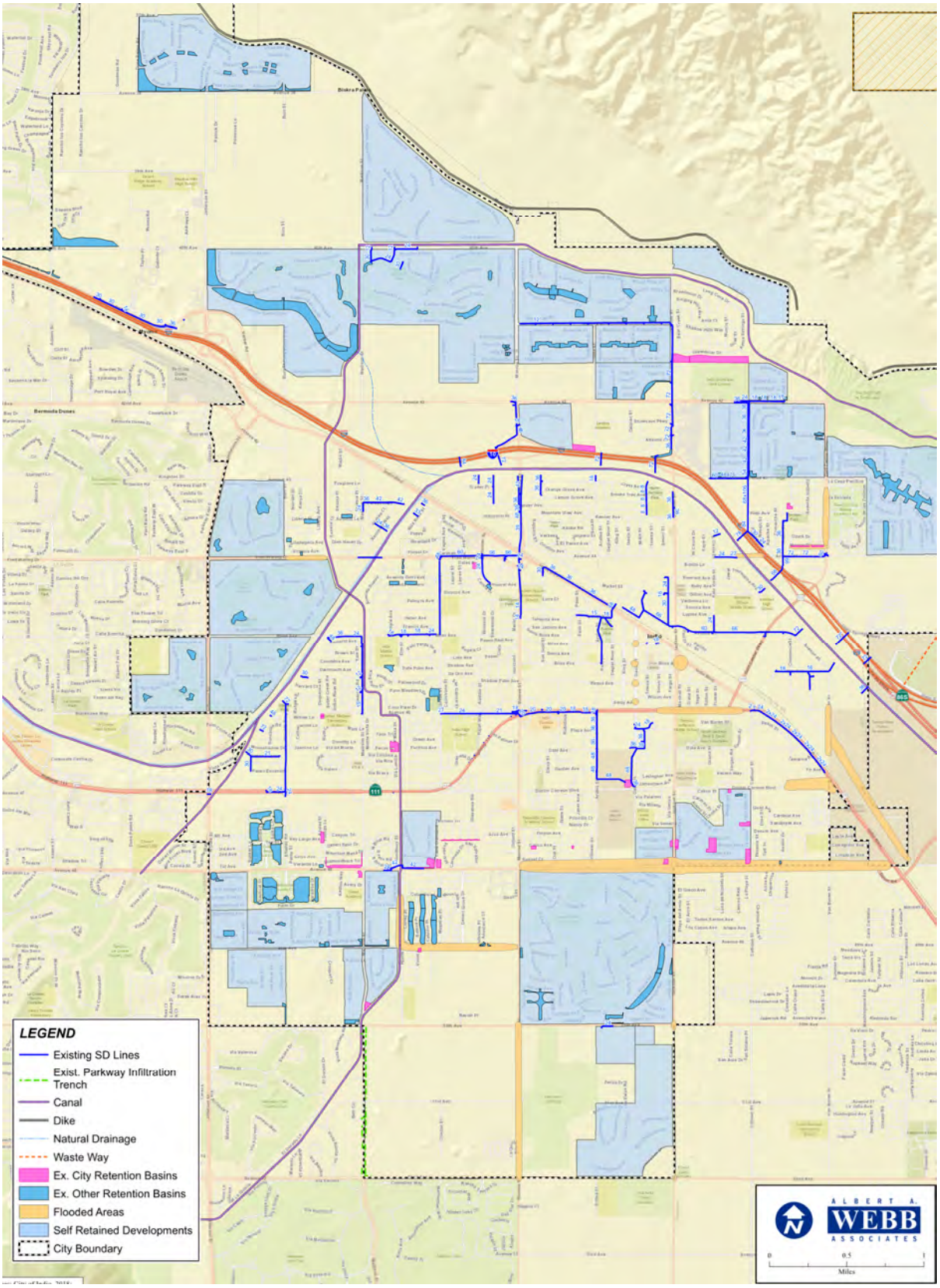
There are some vacant and unimproved lots and areas throughout the City imbedded in the older neighborhoods, which often leave gaps in curbs, gutters and sidewalks. The storm runoff from these lots often brings dirt and debris to the street and blocks the street flow, and fills catch basins or inlets with sediment and debris. More permanent solutions such as berms, curbs, and gutters can be added to the frontage of these lots to assist in drainage. Also, the addition and preservation of vegetation and plants can reduce the amount of water runoff and erosion from these areas. A special assessment fee or NPDES requirements for the vacant lots may be considered for funding of the maintenance.

It is clear that the majority of locations with flooding and drainage issues are in older neighborhoods of the City, areas with very few to no existing storm drain facilities. A few areas with erosion and flooding issues can be addressed by installing asphalt berm or concrete curb and gutter along the existing edge of pavement, a low cost solution. For the majority of the areas with flooding issues, the long-term solution is to establish a system of drainage facilities to convey storm runoff to the CVSWC or other receiving water or to infiltrate storm runoffs in the ground by dry well, MaxWell, or open air basins.

■ Inventory of Existing Drainage Facilities

The existing storm drain facilities within the City boundary and MDP study area can be separated to three major categories based on the maintenance responsibility:

Figure 2-2 City of Indio Existing Drainage Facilities



1. **City owned and maintained facilities** –The City owned and maintained drainage facilities range from underground pipe systems, storm drains converted from un-used irrigation lines, culverts, retention, infiltration or detention basins, drywells, infiltration trenches, catch basins and inlets. Webb reviewed the GIS data provided by the City, eliminated duplicates, and verified data with the storm drain plans listed below:

Existing Storm Drain Plan List

FOLDER NAME	Doc ID # or Project Name	YEAR
Avenue 40 bet Madison St & Monroe St	D1503 (TR 32390,-1)	2005 & 06
Avenue 41	D1586 (TR 31815)	2005
Avenue 42 & Calhoun St	none (Ave. 42 SD Line "G")	2007
Avenue 42 - Calhoun St	D1774	2007
Avenue 43 to Calhoun St	D1730 /06-243 (Indio TC)	2008
Avenue 44 - East of Monroe St	D-714, D-923	1974, 1981
Avenue 44 - west of Golf Center Pkwy	D-1154, D-1051, SD0602	1989, 1986, 2006
Avenue 45 & Market St Storm Drain	D-870, D 882, R-41	1980, 1980
Avenue 48 & Madison St	D884 (1981)	1981
Downtown Imps	none (Downtown Infrastructure)	2008
Fred Waring Dr & Hoover St & Monroe St	D-437, D-792, D1401	old, 1977, 1999
Fred Waring Drive	D1401 (duplicates from above)	1999
Historical	none (old atlas sheets)	Not dated, very old
Highway 111 & Jefferson St	37586 and none (Jefferson St)	2008, 2000
Highway 111 & Monroe St	D-1156 (Starbucks)	2004
Indio Blvd @ Deglet Noor St	SD 501 (Sun Gold)	2006
Jackson St	none (Jackson St/Atlantic Ave)	2006
Madison St South of Miles Ave	D-1379	2012
Miles Ave & Ave 45	duplicates (D-882, 9/10 sheets)	2008
Monroe St - Ave 49 to Ave 52	DR 12-09814	2005
Monroe St @ Ave 42	D1782 / IP# 07-030	2008
Shadow Ranch, Avenue 42, Calhoun St	D-1573	2005
TR 29998 - Las Brisas @ Ave 48	D-884 (1980), D-1481, D1436	1980, 2002, 2001
TR 30413 - Madison St & Paludosa St	D-1496	2003
Varner Rd	1684	2006
W-1 JJBDC Storm Drain	D-1868 /16-083	2017
W-2 Madison St SD	07053/37784-803, 39321-24	2018, 2016, 2013
W-3 North Indio Storm Drain	43038/15-030	2017
W-4 Hwy 111 SD and MaxWell.pdf	ST1305	2017
W-5 STATE HIGHWAY 111 2-24in SD.pdf	D-1382	1998
W-6 Miles Ave Storm Drain (Co. of Riv.)	1514 / 37556	2008
W-7 Jackson St. N I-10 72" SD As Built	D-1696, 1625, 0619	2006, 2007

2. **Privately owned and maintained facilities** –The privately owned and maintained drainage facilities consist of underground pipe systems, culverts, retention, infiltration or detention basins, drywells, catch basins and inlets. These facilities are located within communities, which are mostly gated, with golf courses, lakes or other recreational features and maintained, by HOA or other private entities. The communities designed or constructed mainly after year 2004 are required to retain the 100-year 24-hour storm volume. The in-tract storm drains are not identified on the MDP base map.

3. **CVWD owned and maintained regional facilities** – The main regional flood control facility in the City of Indio is the Coachella Valley Stormwater Channel. This channel meanders through the City in a west to east direction, partially along the Interstate 10 Freeway, and is maintained by CVWD. The CVSWC is an unlined earth channel. This channel was designed in 1971, with the design flow rate of approximately 75,000 CFS, right of way width of 550 feet and channel slopes between 0.23% and 0.26%, in the vicinity of Indio.

   Additional existing regional drainage facilities include the East Side Dike along the foothills of north Indio and Waste Way 3. Recently, CVWD completed design of the North Indio Regional Flood Control Channel. The North Indio Channel is a concrete lined channel with box culverts at the street crossings. The design capacity at the downstream end of the channel is 16,836 CFS for the 100-year storm. Phase I of the North Indio Channel is under the construction. Phase II of the Channel is expected to be completed in 3-5 years.

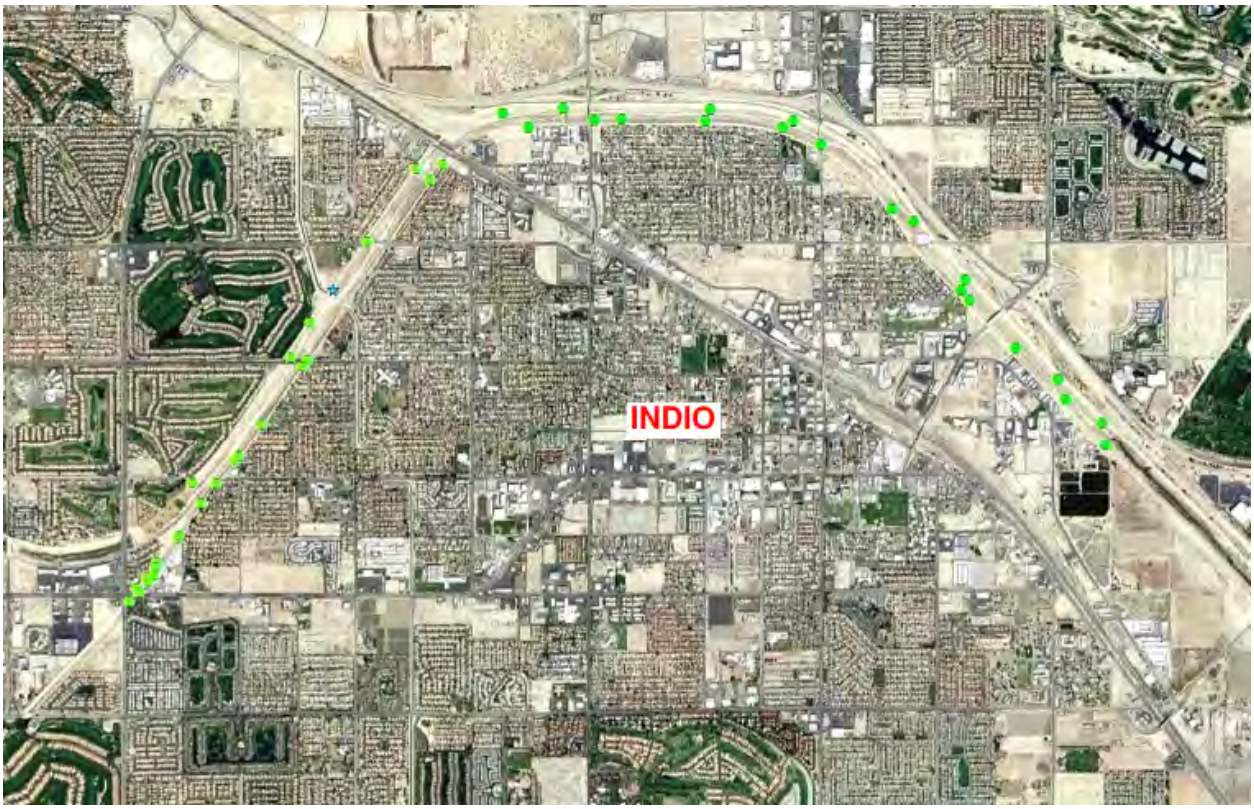
Figure 2-3 City of Indio Regional Drainage Facilities -CVWD

■ Field Investigation of Existing Drainage Outlets to the CVSWC

Webb team conducted a field survey of the documented existing storm drain outlets, which discharge to the CVSWC, in July and August 2018. Some of the outlets surveyed had various degrees of blockage due to sediment, debris, foliage, or a combination of the three. An effort should be made to clear all of the blocked outlets. In addition, regularly scheduled maintenance of the facilities is required in order to keep the facilities operating as intended.

With the assistance of the City O & M staff, Webb surveyed and documented approximately 43 storm drain outlet locations along the CVSWC to verify size, location, and condition of each. These outlets range in size from 14” to 84” in diameter. Figure 2-4 shows the locations of surveyed outlets within the City.

Figure 2-4 City of Indio Storm Drain Outlet Locations



Based on the field survey and observation, we recommend that the following measures be considered for drainage facility maintenance:

- Continue the current city established annual major drainage facility clean up schedule, complete clean up before the start of the rainy season, once a year minimum. Make modifications as needed

- Allocate funding and manpower for major cleanup and debris removal

- Organize local communities, volunteer groups, and school districts to participate in the cleanup

- Combine the cleanup with public outreach and public education for “Keep Our Water Clean”, “Only Rain in the Drain” and such

- Keep a record of sediment and debris removal load and frequency at the major inlets and outlets, Maxwell/ Dry Wells, detention or infiltration basins

- Identify the sources and evaluate any additional measures which can be implemented to reduce the sediment and debris load

- In conjunction with grading/ construction permit, require contractor to clean up the drainage inlet around construction site and immediately downstream of the site

SECTION 3 - HYDROLOGY & HYDRAULICS ANALYSIS

■ Methodology

The hydrologic analysis for the study area was performed using methodology consistent with the guidelines in the Riverside County Flood Control and Water Conservation District Hydrology Manual. The Modified Rational Method and Synthetic Unit Hydrograph Method were used to establish the peak discharge rates. The methodology for the hydrologic analysis is also discussed in Design Criteria of SECTION 1 of this report, and reviewed by the City Engineer prior to commencing the hydrology study and updated throughout the MDP development process and per the input received from the City.

■ Land Use & Specific Plans Consistency

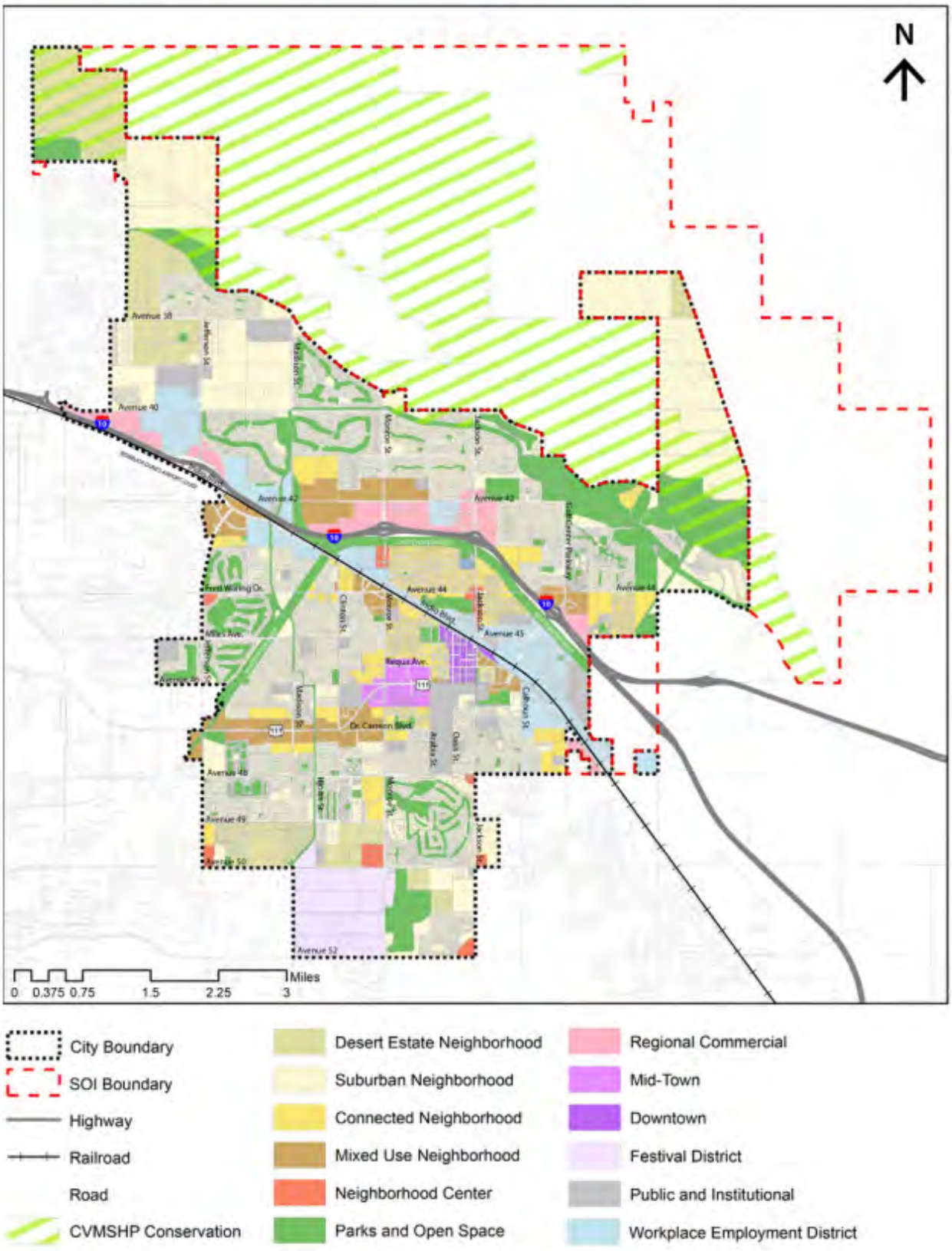
As established in Design Criteria of Section 1 of this report, the General Plan Land Use needs to be consolidated and reclassified based on the imperviousness for the hydrology study.

Currently, the City of Indio Planning Department is in the process of updating the Indio General Plan. The draft Indio General Plan Update is posted for public review dated June 2018. The City is anticipating to adopt the final General Plan Update in late 2019. The Updated General Plan will replace the existing Official Zoning Map dated 2009, and Land Use Map dated 2004.

It is anticipated that the future development trend, market demand, and environmental regulations will result in many additional General Plan amendments or updates. New Specific Plans will also bring changes in land use. It is understood that the citywide land use map is a dynamic, ever changing document. For the hydrology study, the exactness of the land use is less prevalent than imperviousness derived from the land use.

The land use and consolidated land use group is also discussed in Section I, under design criteria.

Figure 3-1 City of Indio General Plan Update 10-2018



■ Hydrologic Soil Group Map

Another major factor affecting infiltration and peak storm runoff is the nature of the soil. Soil types for this study were taken from the hydrologic soils classification maps of RCFCD Stomewater & Water Conservation website. An overall hydrologic soil group map is compiled for the study areas.

The four main hydrologic soils groups developed by the Soil Conservation Service of the U. S. Department of Agriculture were utilized by the District to classify soils types. Soils Group A has low runoff potential and high infiltration rates with mostly sandy soils. On the other end of the spectrum, Soils Group D has high runoff potential, very slow infiltration rates, consists of mostly clay soils and is nearly impervious. As shown in Figure 1-4, the majority of the study areas consist of Groups A and B soils. These types of soils are ideal for infiltration and ground water recharging.

■ Retention, Detention & Infiltration Basins

Retention, Detention and Infiltration Basins

The purpose of retention basins proposed in the MDP update is to reduce peak flow rates in the downstream storm drain system by use of retention storage. This peak flow reduction allows the use of smaller, less costly downstream facilities.

Typically, retention basins are used for the areas with no downstream storm drain facilities or where a full on-site containment is required. A calculated 100-year 24-hour storm volume will be retained in these basins. Based on the tested soils percolation rate (infiltration rate) at the basin sites, the basins will be sized to dewater within 72-hours of the storm for vector control.

Utilizing retention basins will also have the benefits of ground water recharge, water quality treatment and implementing green infrastructure. On the down side, retention basins require setting aside a larger parcel of land. These basins may not drain properly due to over compaction during construction and the clay layer patch in Indio.

Based on the past project experiences in the City, addition of a MaxWell or equivalent (deep dry well) or adding a section of infiltration trench at the bottom of the retention basin will help reduce or eliminate any ponding water.

When downstream storm drain is available, a detention basin may be utilized with an outlet set at a specified height from the basin bottom, and a controlled outflow. A detention basin is more effective at reducing the peak flow for the watershed. It requires less basin area or depth (less overall volume) compared to a retention basin, and still allows infiltration and ground water recharge with reduced capacity. Essentially, a detention basin out performs a retention basin in flood control function with a limited compromise on ground water recharge.

In Coordination with the City Engineer, the Webb team proposes two new basins - Market Street Detention basin and Monroe Street Retention Basin.

The existing Riverside County Fairgrounds Basin (retention/ infiltration) will be modified and converted to a detention basin with a 36" storm drain outlet. This conversion will increase the watershed size from original designed 109 acres to 310 acres.

The existing Basin at South Jackson Park Soccer Complex – a depressed soccer field, will also be modified to a detention basin, to increase its capacity and to reduce the duration of ponding after each storm.

MDP Detention / Infiltration Basin Summary							
Basin Name	Watershed Size (acre)	Basin Dimensions (ft)	Basin Area (acre)	Basin Depth (ft)	100-year Peak Q (CFS)	100-year Routed Q (CFS)	Basin Outlet Pipe Size
Market Street Basin	495.0	500'x1040'	12.0	5.0	480.0	22.7	18"
South Jackson Soccer Park Basin	138.0	400'x540'	5.0	4.0	175.3	12.0	18"
Riverside County Fairground Basin	310.0	310'x350'	2.7	11.0	319.6	63.9	36"
Monroe Street Basin	121.0	210'x400'	1.9	6.0	140.0	5.9	18"

■ Flood Plain and Flood Insurance Rate Maps (FIRMs)

Considering that it is near or below sea level, it is amazing that most of the City of Indio is outside of the 100-year Flood Zone per current FEMA Flood Insurance Rate Maps. Currently, only the northwesterly corner of the City and CVSWC are identified as within the 100-year flood plain. After CVWD's North Indio Regional Flood Control Channel construction is completed, and LOMR filed, additional areas will be removed from the flood plain.

Figure 3-2 is a compiled exhibit for the 100-year Flood Zone for the City of Indio, and Figure 3-3 is a copy of Flood Insurance Rate Map number 060255, panel 1620 with effective date 08/28/2008 for the northwest corner of the city within the flood plain.

Figure 3-2 Flood Plain & Flood Insurance Rate Maps

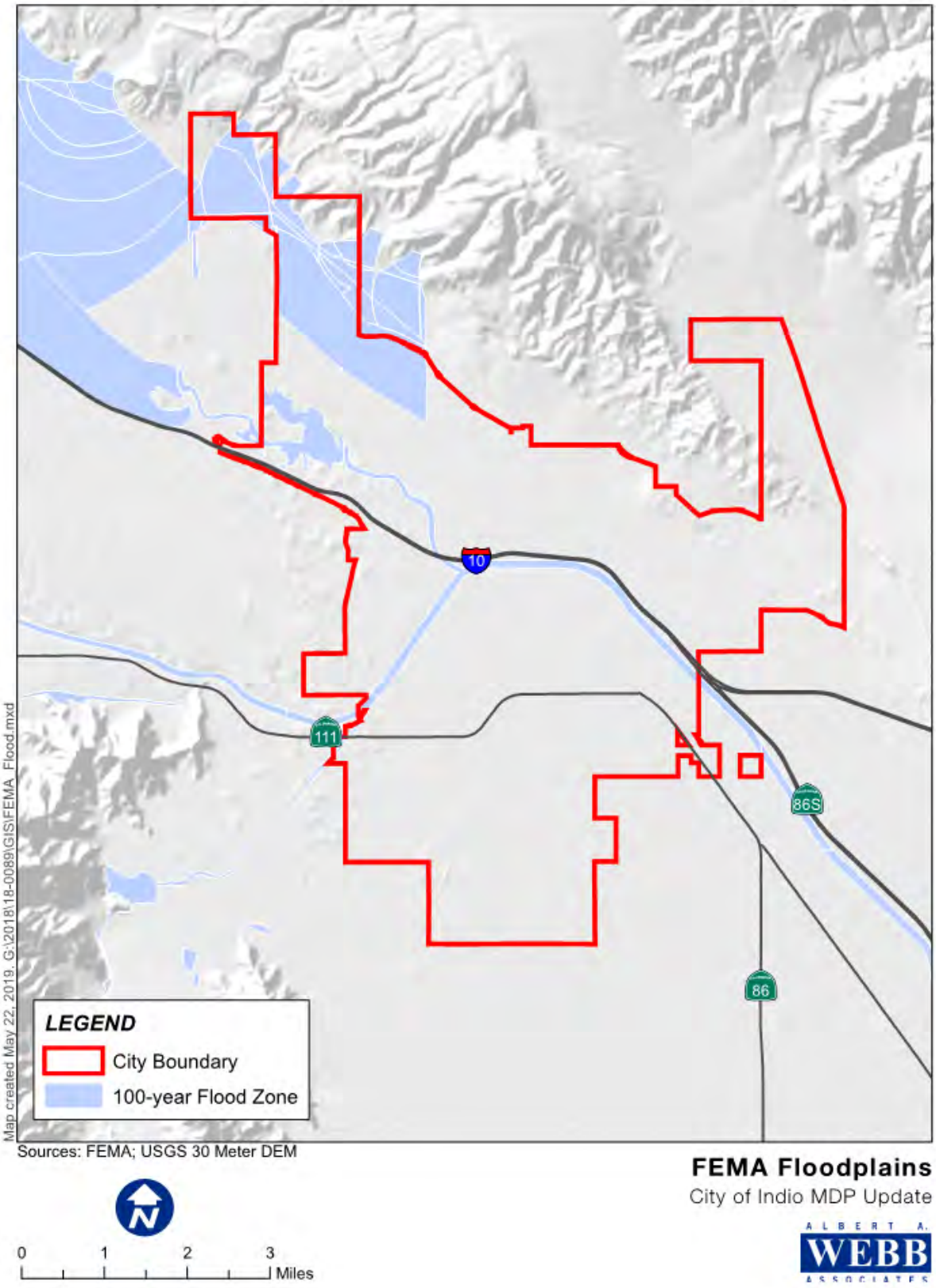
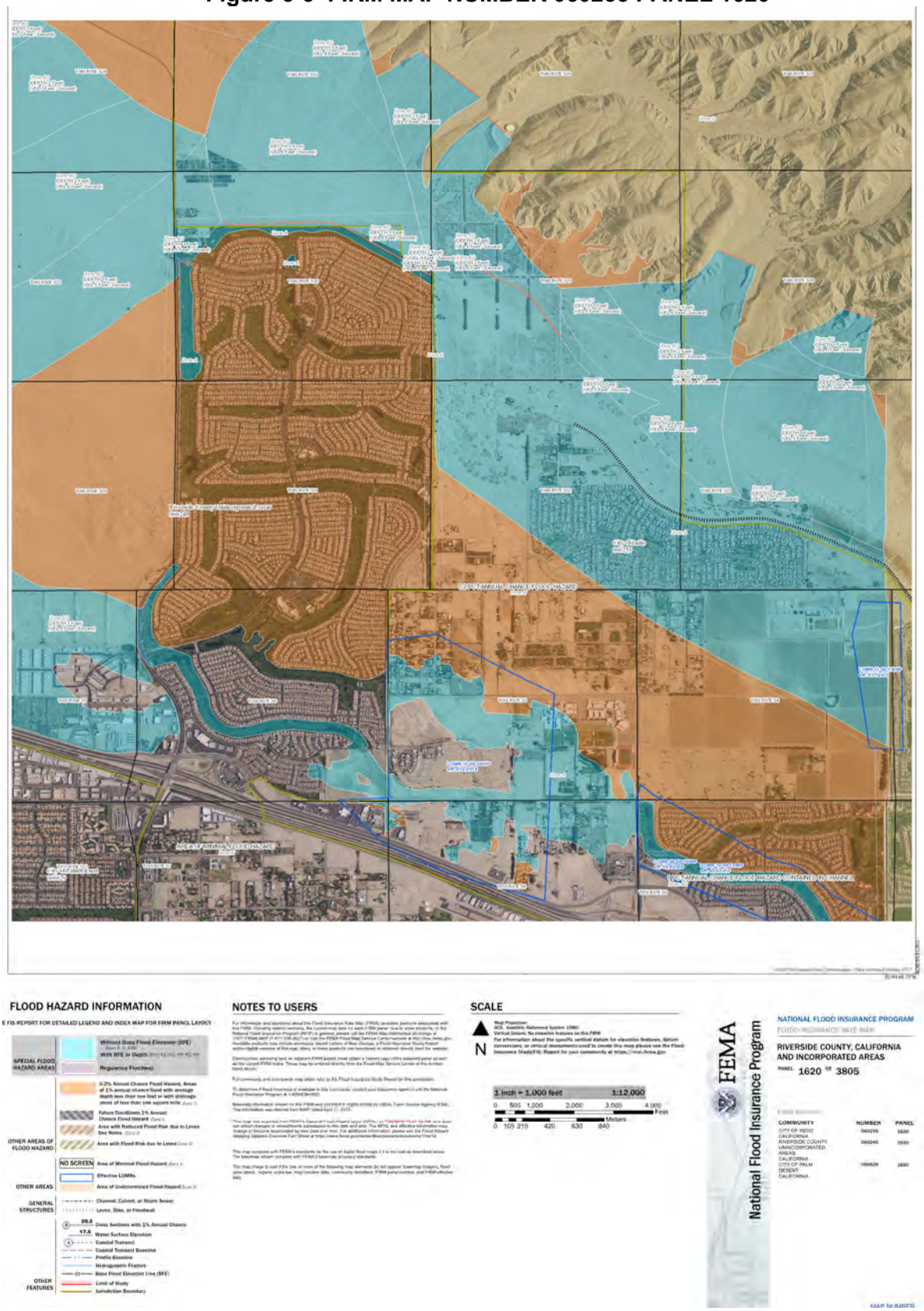


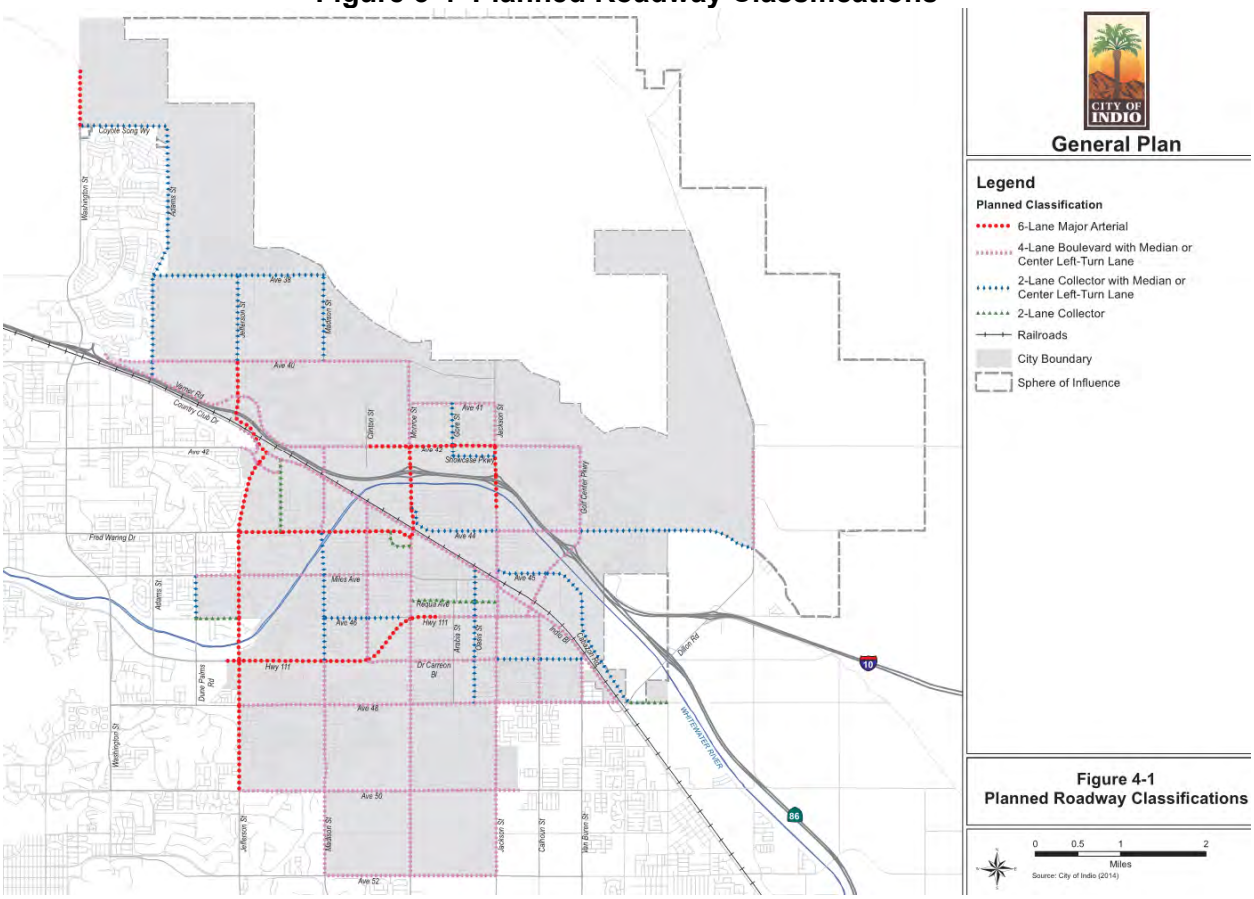
Figure 3-3 FIRM MAP NUMBER 060255 PANEL 1620



■ Typical 4-Lane Street Capacity

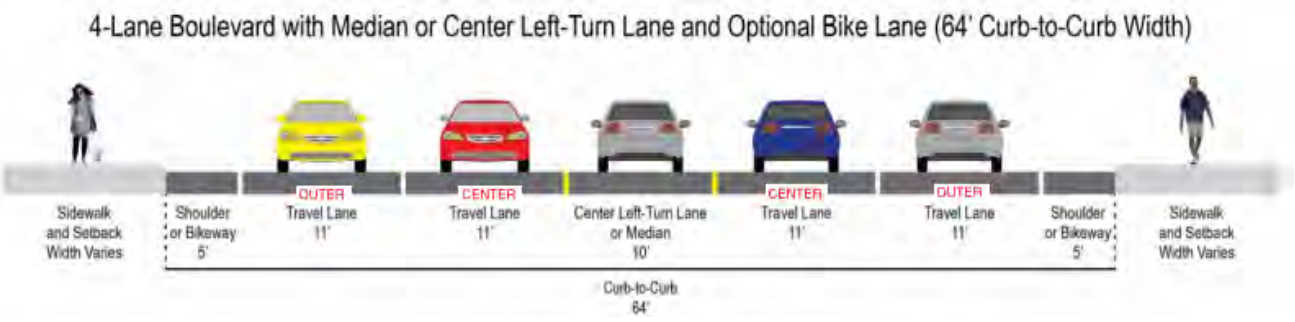
Per the inventory of frequently flooded streets in the city, most of these streets are existing 4-lane roads or 4-Lane Boulevard with Median or Center Left-turn Lane per the Planned Roadway Classifications of the General Plan Update, including Avenue 48, Dr. Carreon Blvd., Highway 111 East, Golf Center Parkway, Monroe Street and Jackson Street.

Figure 3-4 Planned Roadway Classifications



The street capacities per the typical section of 4-Lane Boulevard (see Figure 3-5) were calculated using Advanced Engineering Software, Hydraulic Elements I.

Figure 3-5 Planned 4-Lane Boulevard Typical Section



A summary of street capacity for 100-year Storm, ponding depth at typical right-of-way (88' width), with street longitudinal slopes range from S=0.001 to S=0.005, street cross slopes at 1.6% or 2.0% is provided below.

4-LANE STREET NORMAL DEPTH CAPACITY FOR 100-YEAR STORM

ID	Street Slope	Street Width (ft)	Street Curb Height (ft)	Ponding Depth @ R/W (88') (cfs)	Street Capacity 100-Year Storm (cfs)	Ponding Center/Left Lane (10') (in)	Ponding Center Travel Lane (11') (in)	Ponding @ Outer Travel Lane (11') (in)	Remarks
	STREET CROSS-SLOPE S=1.6%								
1	S=0.001	64.0	0.5	0.74	**37.5**	0-1"	1"-3"	3"-5.2"	
2	S=0.002	64.0	0.5	0.74	**53.0**	0-1"	1"-3"	3"-5.2"	
3	S=0.003	64.0	0.5	0.74	**64.9**	0-1"	1"-3"	3"-5.2"	
4	S=0.004	64.0	0.5	0.74	**75.0**	0-1"	1"-3"	3"-5.2"	
5	S=0.005	64.0	0.5	0.74	**83.8**	0-1"	1"-3"	3"-5.2"	
	STREET CROSS-SLOPE S=2.0%								
1	S=0.001	64.0	0.5	0.74	**28.2**	0-1.1"	1.1"-3.7"	3.7"-5.6"	
2	S=0.002	64.0	0.5	0.74	**40.0**	0-1.1"	1.1"-3.7"	3.7"-5.6"	
3	S=0.003	64.0	0.5	0.74	**48.9**	0-1.1"	1.1"-3.7"	3.7"-5.6"	
4	S=0.004	64.0	0.5	0.74	**56.4**	0-1.1"	1.1"-3.7"	3.7"-5.6"	
5	S=0.005	64.0	0.5	0.74	**63.1**	0-1.1"	1.1"-3.7"	3.7"-5.6"	

For street slopes steeper than 0.5%, street capacities will be increased, and project specific calculation shall be conducted to evaluate street flow capacities.

■ Storm Drain Pipe (HDPE) Normal Depth Capacity

High-Density Polyethylene Pipe (HDPE) is proposed for MDP underground drainage systems for its durability, lighter weight, and lower N value by comparison to RCP. The cost estimate for the storm drain system is compiled by utilizing RCFCD 2018 Planning Cost Sheet. In the RCFCD Cost Sheet, only the cost of RCP is specified. However, it shall be at the discretion of the City to allow using either HDPE or RCP for any specific storm drain projects.

The HDPE normal depth capacities were calculated using Advanced Engineering Software, Hydraulic Elements I, assuming pipe flows full, but not pressurized. The capacities were calculated for pipe size from 24" to 96", slope at 0.3% and 0.5%. The results were summarized in the table below for a quick conceptual reference.

HDPE PIPE NORMAL DEPTH CAPACITY

ID	HDPE PIPE SIZE (in)	Qcap at S=0.003 (cfs)	Sub-drainage Area (acre)	Qcap at S=0.005 (cfs)	Sub-drainage Area (acre)	Remarks
1	24	13.4	12.2	17.3	15.7	
2	30	25.4	23.1	31.4	28.5	
3	36	39.6	36.0	51.1	46.5	
4	42	59.7	54.3	77.1	70.1	
5	48	85.2	77.5	110	100.0	
6	54	116.7	106.1	150.6	136.9	
7	60	154.5	140.5	199.5	181.4	
8	66	199.3	181.2	257.2	233.8	
9	72	251.3	228.5	324.4	294.9	
10	78	311.1	282.8	401.6	365.1	
11	84	395.0	359.1	489.4	444.9	
12	90	455.6	414.2	588.2	534.7	
13	96	541.2	492.0	698.7	635.2	

N=0.012

Average Development Area 100-year Peak Q=1.1*(Area in AC)

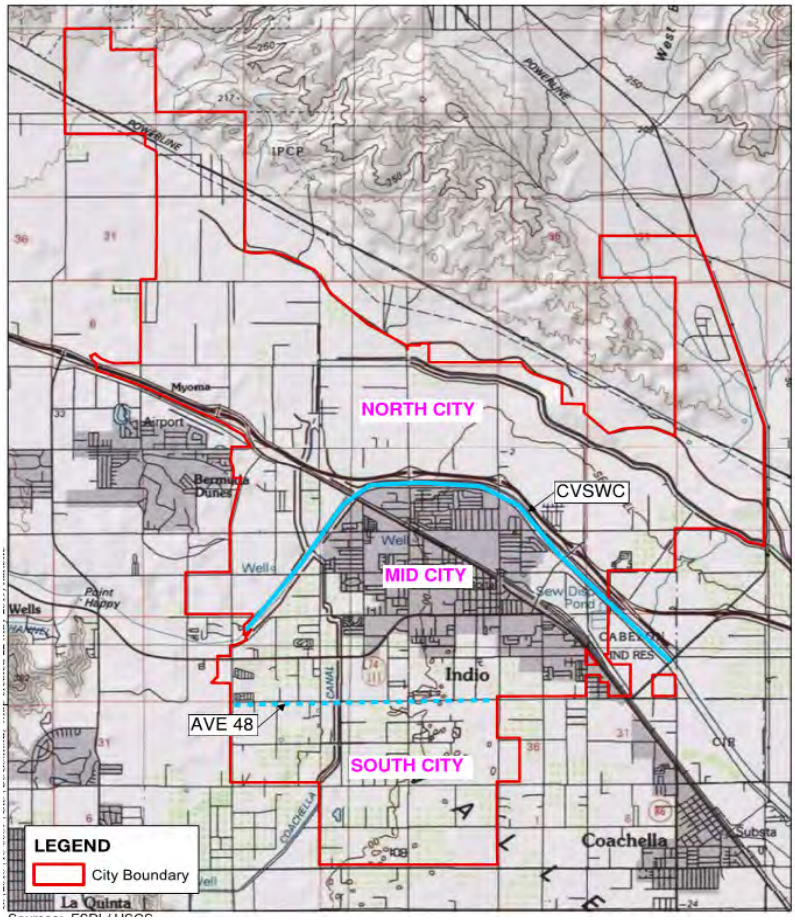
SECTION 4 - PROPOSED MDP FACILITIES AND ALTERNATIVES

A master drainage plan addresses the current and future drainage needs of a given community. The proposed facilities may include channels, storm drains, levees, basins, dams, wetlands or any other conveyance capable of economically relieving flooding problems within the plan area. The plan includes an estimate of facility capacity, sizes and costs.

MDPs are prepared for a variety of purposes. First, the plans provide a guide for the orderly and sustainable development of the City and resolution of flooding issues. Second, they provide an estimate of costs of construction for each MDP storm drain system. These plans are used by the City's Management, Community Development and Public Works Departments, Planning Commissioners and the City Council to guide development and determine Capital Project expenditures for each budget year. Finally, the plans will be used as a baseline reference to establish Development Impact Fees (DIF), which provide for equitable distribution of facility cost.

The natural setting of the city and its historical and recent developments divide the city into three sections. The Whitewater River Channel (CVSWC) meandering west to east through the City is also served as a natural divider. The storm runoffs and any drainage facilities north of the channel will not have any direct impact to the areas south of the channel.

Figure 4-1 City of Indio USGS Map



North City - The areas north of CVSWC are mostly newer residential developments with recreational amenities. The East Side Dike, originally constructed by CVWD to protect All American Canal from debris and flooding, also protected this area from storm runoffs of the San Bernardino Mountains. Unlike the areas south of CVSWC, the north city area has more natural topographical relief. The streets within this area are less prone to flooding.

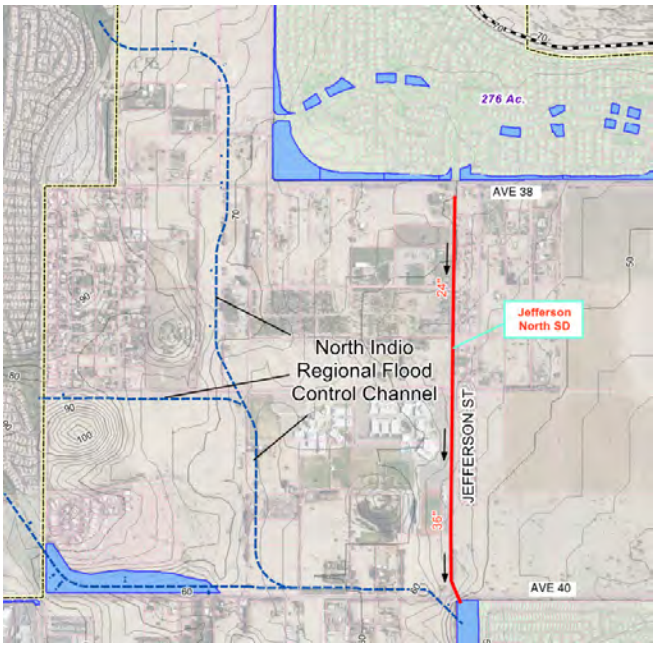
Mid City – The Mid City is delineated as areas located between CVSWC and Avenue 48. This part of the city is also bisected by Southern Pacific Railroad tracks travelling from northwest to southeast, and by the Coachella Canal near Madison Street, in a north-south direction. The mid city areas are mostly older, historical neighborhoods with inadequate drainage facilities. Most of the flood-prone streets are located in this area.

South City - The South City areas located between Avenue 48 and Avenue 52. In general, this area of the City comprises approximately 5 Sections, 3,200 acres. The existing drainage pattern is from the northwest to the southeast, towards the CVSWC and Salton Sea. More than half of the areas are newer, self-contained residential developments and golf courses. The future developments will also be required to retain on-site 100-year, 24-hour storm volume. The areas between the easterly boundaries of the City (Jackson Street) and CVSWC have no known drainage infrastructure. The City recommends that street parkway infiltration trench be used for street runoffs only. Similar drainage design was also used for recently constructed Madison Street Drainage Systems.

■ North City MDP Facilities

With its close proximity to the CVSWC, and existing regional drainage facilities, the drainage design for the north city area is fairly straight forward. There are four MDP systems proposed for this area.

Jefferson North Storm Drain System

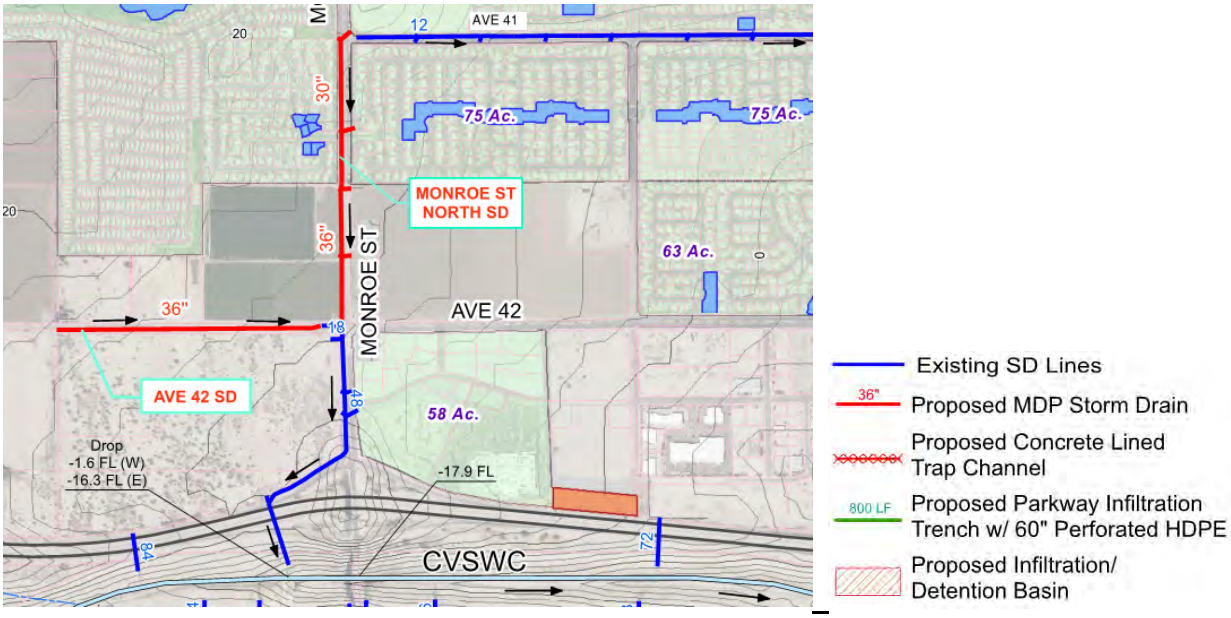


Jefferson North Storm Drain system consists of a mainline storm drain, catch basins and laterals, and is located between Avenue 38 and Avenue 40, on Jefferson Street. The upstream end of the drainage system starts at the south side of Avenue 38, collects runoff from the street flow on Jefferson Street to the south in a 24" to 36" storm drain, and discharges into the existing drainage channel south of Avenue 40.

The estimated cost for the proposed Jefferson North Storm Drain system is approximately $2,544,000.

The components of the estimated cost include construction, right-of-way acquisition, 22% of lump sum items such as mobilization, water control, traffic control, etc., 12% of contingencies and 28% of combined engineering, administration and mitigation.

Avenue 42 and Monroe Street North Storm Drain Systems



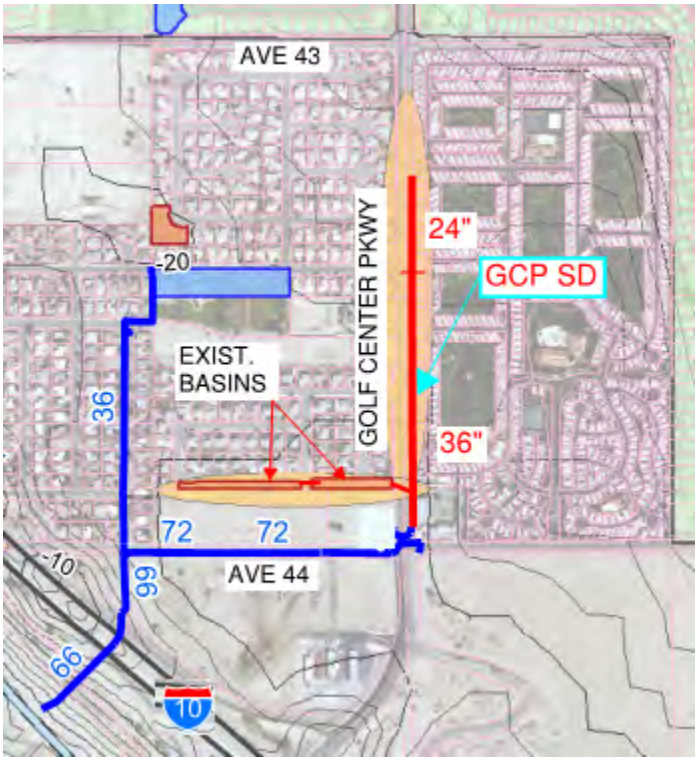
Avenue 42 Storm Drain system is a 36" single line storm drain, with catch basins and laterals. It is located north of the I-10 Freeway, between Clinton Street and Monroe Street. The upstream end of the drainage system starts at the intersection of Clinton Street and Avenue 42, collects runoff from the street flow on Avenue 42 to the east, and connects to the existing 36" storm drain stub-out per storm plan D-1782.

The estimated cost for the proposed Avenue 42 Storm Drain system is approximately $1,484,000.

Monroe Street North Storm Drain system consists 30"-36" storm drain mainline from the existing 48" stub out at intersection of Monroe Street and Avenue 42 extending to Avenue 41 with catch basins and laterals.

The estimated cost for the proposed Monroe Street North Storm Drain system is approximately $1,506,000.

Golf Center Parkway (GCP) Storm Drain System



Golf Center Parkway Storm Drain system consists of 24”- 36” mainline storm drain, catch basins and laterals, and is located northeasterly of the I-10 Freeway, between Via Entrada and Avenue 44. This segment of Golf Center Parkway and areas at the existing basins are prone to flooding during rainstorm as identified by the O & M staff of the city. The upstream end of the drainage system starts at the intersection of Golf Center Parkway and Via Entrada, collects runoff from the street flow on GCP, and continues south near Avenue 44, where it connects to the existing 60” storm drain stub out per storm plan D-0602, dated 2006. The existing city maintained basins also need to be modified with a connector pipe between the two basins and adding an outlet to the 36” SD at the easterly basin. After these drainage improvements are constructed, the flooding occurrence on Golf Center Parkway will be eliminated.

The estimated cost for the proposed Golf Center Parkway Storm Drain system is approximately $1,128,000.

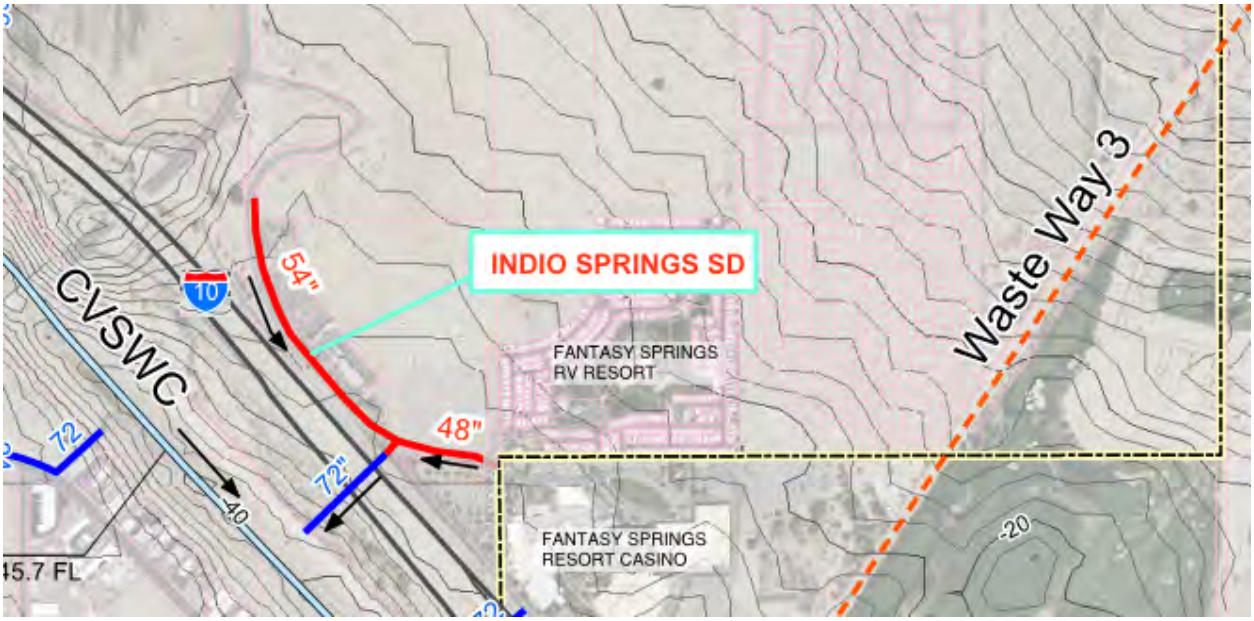
The other flood-prone street is Fred Waring Drive, west of the Coachella Canal. The City plans to discuss the issue with the HOA of Heritage Palms Golf Club (the development south of Fred Waring Drive), and to explore the solutions.

Within the north city area, Dillion Road also has a few locations prone to flooding at Landfill Road and north. This segment of Dillion Road is a two-lane paved road with a steep grade, but no curb, gutter or any drainage facilities. There are a few offsite drainage courses, which cross the road

on the roadway surface. These at-grade crossings bring the sediment and debris to the road. Dillion Road is also at the eastern boundary of the city, half of the roadway is in the County of Riverside unincorporated area. These drainage issues will not directly impact the rest of the City. The drainage mitigation measures will be deferred to the development of the Citrus Ranch or any other development project, west of Dillion Road.

Indio Springs Storm Drain System

Indio Springs Parkway is an access road to the Fantasy Springs Resort Casino, Indio Springs RV Resort and two motels (Holiday Inn and Quality Inn). It is located northeasterly of the I-10 Freeway and CVSWC.



Indio Springs Storm Drain system consists of 48”- 54” mainline storm drain, catch basins and laterals, and is connected to the existing 72” culvert under the I-10 Freeway, discharged to CVSWC.

The estimated cost for the proposed Indio Springs Storm Drain system is approximately $2,088,000.

■ Mid City MDP Facilities

Mid city area has the most flood-prone streets and requires the majority of the drainage improvements. Some of the existing storm drains were built a long time ago, with 15” free flow truss pipe, 14” steel pipe or 12” concrete drain tile. These facilities were marked on the atlas map, no date referenced.

To discharge the storm drain to the CVSWC, most proposed drainage facilities in this area will need to be jacked and bored or use micro tunneling technology to undercross SPRR tracks. Which increases the construction cost and difficulties, also needs California Public Utility Commission (CPUC) and Railroad permits. Currently, three existing storm drains undercrosss the R/R tracks at Monroe Street, Deglet Noor Street and near Van Buren Street. Three new R/R crossings are proposed for the MDP update.

Avenue 44 Storm Drain System

Avenue 44 storm drain system includes storm drain mainline on Avenue 44 from Yucca Street to the east, and discharge into CVSWC, with laterals and catch basins.

Avenue 44 storm drain system begins as a 24” pipe and extends southerly along Yucca Street for a distance of approximately 400 feet, turns easterly on Avenue 44 and transitions into a 36” pipe. At Sola Street, the 36” storm drain junctions with Sola Street Lateral, transitions into a 60” pipe and follows Avenue 44 in an easterly direction for a distance of approximately 2,000 feet. From there, the 60” pipe junctions with Towne Street Lateral and transitions into a 72” pipe and extends on Avenue 44 for approximately 3,000 feet and outlets into the CVSWC.

Currently, Avenue 44 crosses CVSWC as an at-grade crossing, and is subject to flooding. A bridge at the channel crossing is being constructed. After completion of the Avenue 44 Bridge, this flooded area will be removed.

The estimated cost for the proposed Avenue 44 Storm Drain System is approximately $8,894,000.

Avenue 45 Storm Drain System

Avenue 45 storm drain system is a mixture of existing storm drains, proposed storm drains and a proposed detention basin system.

For easier identification purposes, the upstream portion of the system including Market Street Basin is labeled as Ave 45 SD System 1. The storm drains from the basin outlet to CVSWC is Ave 45 SD System 2.

Ave 45 SD System 1

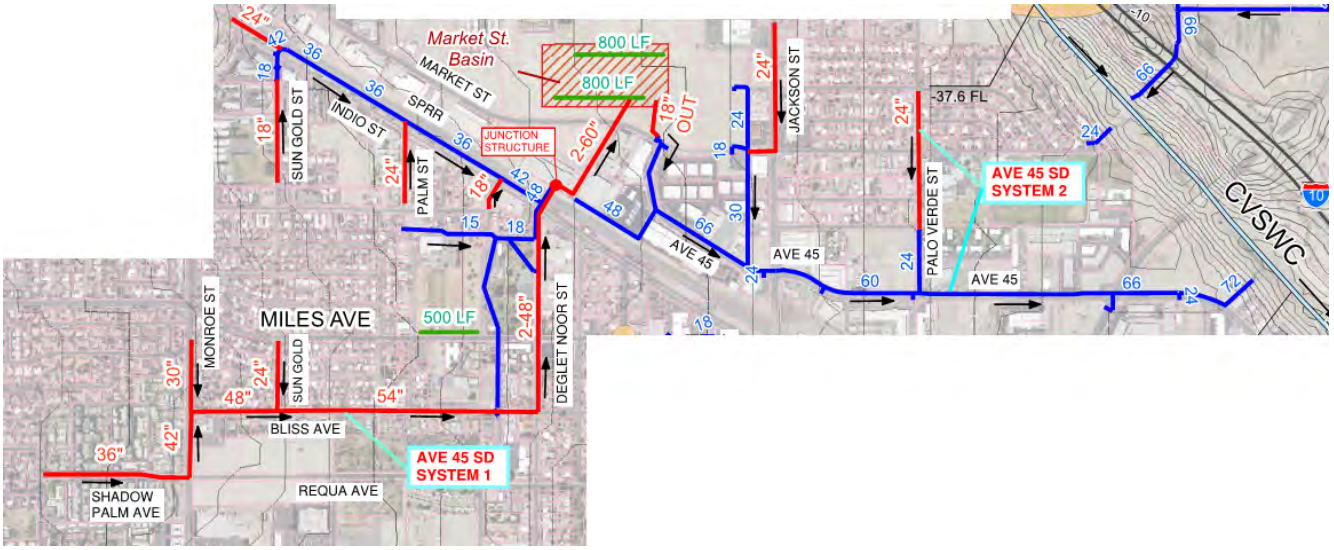
System 1 consists of existing drainage facilities, proposed storm drains and proposed Market Street Detention Basin.

Existing Storm Drain Facilities:

- Existing 15” truss pipe and 15” to 18” CSP pipe on northeast of Miles Avenue vicinity, per historical record on atlas map, not dated
- Existing 36” to 48” storm drain on Indio Blvd. per (D 882)

Proposed Storm Drain Facilities:

- 36” storm drain on Shadow Palm Avenue
- 42” storm drain main and 30” lateral on Monroe Street
- 48” to 54” storm drain main on Bliss Avenue
- 54” storm drain transition to 2-48” at intersection of Bliss Avenue and Deglet Noor Street
- 2-48” storm drains which will travel north on Deglet Noor Street, cross Indio Blvd. and SPRR tracks (the existing 48” storm drain will join these at a Junction Structure, and redirected flow to the proposed Market Street Basin)



The Market Street Detention Basin is proposed on the city owned vacant lots, zoned for parks and open spaces. It is located north of Market Street, west of Jackson Street. This basin is designed to accept 100-year storm runoffs from a 495-acre watershed in the Sun Gold area, and will reduce the 100-year peak flow from 480 CFS to 23 CFS. When the park site is developed, the 500’x1040’ (12 acres) basin can also be utilized as a depressed soccer field.

MARKET DETENTION/INFILTRATION BASIN SUMMARY

RETURN PERIOD (YR.)	STORM EVENT (HR.)	TOTAL VOL (AC-FT)	PEAK Q (CFS)	ROUTED Q (CFS)	BASIN DEPTH (FT)
100	3	52.8	479.7	22.3	4.2
	6	55.9	403.0	22.7	4.4
	24	62.4	145.1	22.1	4.1
10	3	21.4	213.7	9.0	1.7
	6	23.1	177.3	9.0	1.8
	24	25.9	38.9	9.0	1.6

The purpose of this detention basin is to reduce peak flow rates in the downstream storm drain system using temporary detention storage. This peak flow reduction allows the use of smaller, less costly downstream facilities. A combination detention/ infiltration basin is proposed for the added benefit of ground water recharge. The basin will reduce the downstream flow rate due to the temporary storage effect (hydrograph attenuation) and due to ground infiltration.

The proposed two-800 feet long infiltration trenches will allow the basin in-flow storm drain flowline to be much lower than the basin depth of 5 feet. It will also allow the nuisance flow and low flow

to stay in the underground pipe, for vector control and recreational use of the basin. It will be much easier and less costly to clean out a basin than it would be to clean out an underground drainage system.

The exact location and size of Market Basin can be adjusted based on the future park planning.

Ave 45 SD System 2

Avenue 45 SD System 2 is from the basin outlet to the CVSWC, consisting of mostly existing CSP storm drains per drawing D-882 and D-870, constructed in 1980. Since the Market Basin intercepts and reduces the upstream portion of the flow, this segment of the existing storm drains will have additional capacity to convey the surface storm runoffs to the channel. The MDP update proposes to extend the storm drain on Palo Verde Street, add a lateral on Jackson Street and add catch basins and laterals along Avenue 45 as needed.

The estimated cost for the proposed Avenue 45 Storm Drain System including the Market Street Detention Basin is approximately $12,867,000.

Civic Center Storm Drain System

Civic Center Storm Drain System is a localized minor drainage system, designed to address the flooding conditions in this area.

The Civic Center / City Hall area has no existing storm drain system. Many street intersections were identified as flood-prone areas. In 2008, a few drainage inlets with dry wells were installed at two intersections: Miles Avenue /Towne Street and Miles Avenue / Smurr Street, which removed ponding water from these two locations.

The Civic Center storm drain system includes a storm drain mainline on Requa Avenue from Oasis Street to Jackson Street, and outlets into the infiltration trench in the parkway/ green belt area between Jackson Street and Marshall Street. The laterals and catch basins on Oasis Street,

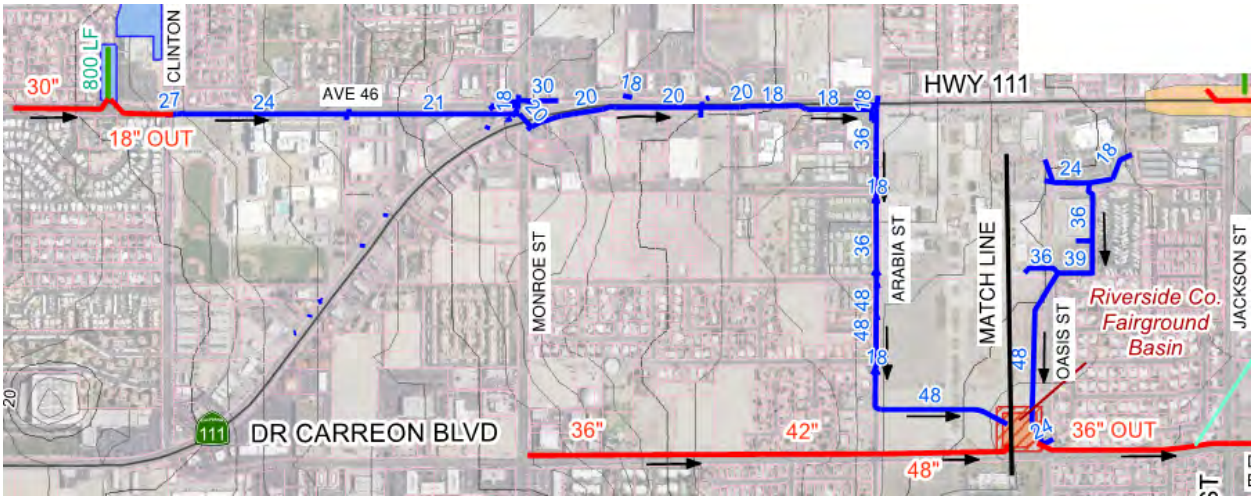
Miles Avenue and Smurr Street, as well as on Jackson Street, connect to the mainline on Requa Avenue. The proposed drainage system will improve street accessibility, roadway safety during rainstorm and storm water quality for the watershed.

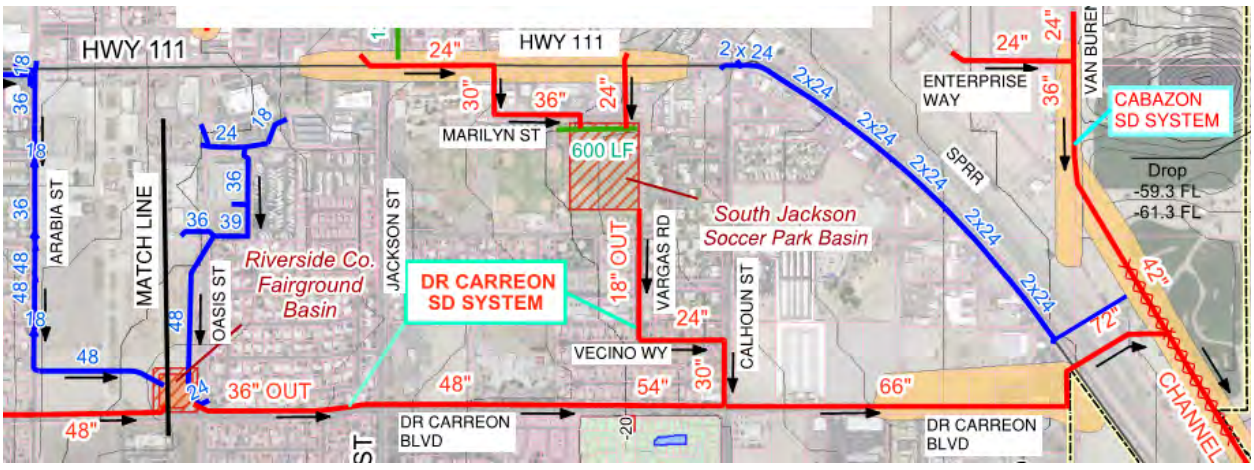
The estimated cost for the proposed Civic Center Storm Drain System is approximately $3,294,000.

Dr. Carreon Blvd Storm Drain System

The Dr. Carreon Blvd storm drain system is a mixture of existing storm drains, proposed storm drains and two modified detention basin systems.

The upstream portion of the system is existing CVWD irrigation lines along Avenue 46 and Highway 111, from Clinton Street to Arabia Street, which have been converted for drainage use. The existing pipe size starts with 27" and reduces to 18", and has a limited capacity. To mitigate the inadequacy of the existing storm drain, we propose to modify the existing basin on northeasterly corner of Avenue 46 and Palm Meadows Drive, by adding a segment of 800 LF of infiltration trench under the basin to increase its capacity. 800 LF of 30" storm drain and catch basins on Avenue 46 east of the basin will be added to reduce the street flow. The 18" basin outlet pipe will connect to the existing 27" pipe.



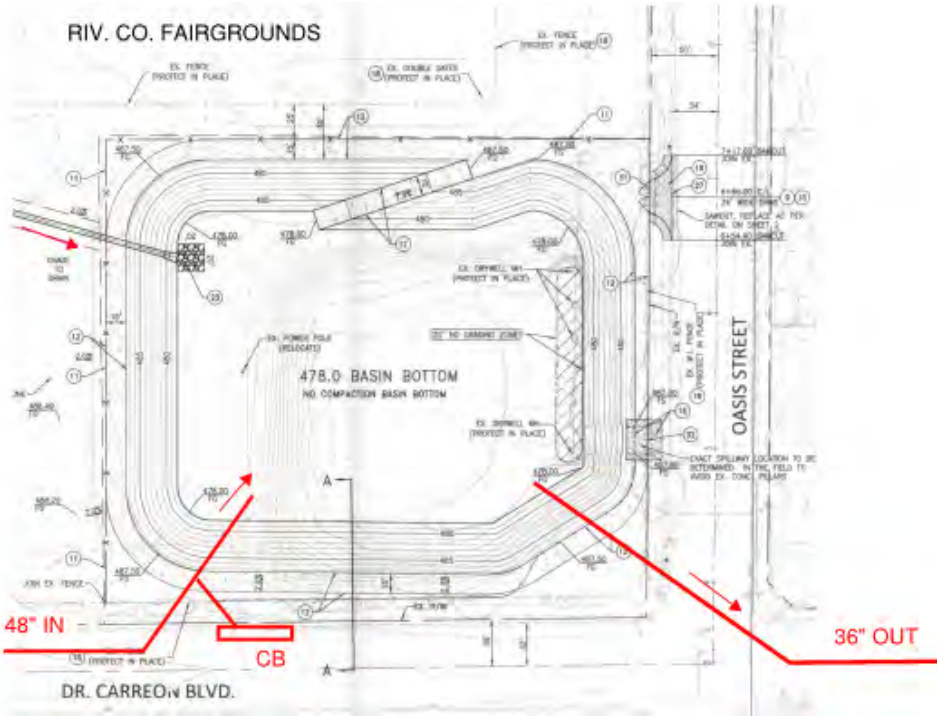


In 2018, in conjunction with the improvements of the East County Detention Center, new 36”-48” mainline storm drain on Arabia Street with its catch basins and laterals was constructed. The existing Fairground Basin was modified and enlarged to accept the storm runoff from Hwy 111 and Arabia Street. The Riverside County Fairground Basin is a retention/ infiltration basin due to lack of an outlet facility. These recent drainage improvements eliminated existing ponding conditions at Hwy 111 and Arabia Street, and at John Noble Street and Arabia Street.

With the Dr. Carreon Blvd storm drain system improvements, the Riverside County Fairgrounds Basin will be modified and converted to a detention/ infiltration basin with a 36” storm drain outlet. This conversion will increase the watershed size from the original designed 109 acres to 310 acres, and will have the capacity to route the additional storm runoff collected by the proposed Dr. Carreon Blvd. storm drain from Monroe Street to the west of the basin.

RIVERSIDE COUNTY FAIRGROUNDS DETENTION/ INFILTRATION BASIN SUMMARY

RETURN PERIOD (YR.)	STORM EVENT (HR.)	TOTAL VOL (AC-FT)	PEAK Q (CFS)	ROUTED Q (CFS)	BASIN DEPTH (FT)
100	3	28.6	319.6	63.9	10.5
	6	30.5	265.8	56.4	10.1
	24	32.5	74.8	34.4	6.5
10	3	12.3	146.0	29.2	5.1
	6	13.4	116.1	28.5	5.0
	24	16.2	24.8	18.2	3.1



From the outlet of the Riverside County Fairgrounds Basin, the proposed Dr. Carreon Blvd. mainline storm drain will continue east to Calhoun Street, its size will increase from 36" to 54" pipe. After the junction with Calhoun Street lateral (an outlet for the South Jackson Soccer Park Detention Basin), the Dr. Carreon Boulevard mainline will travel east to Van Buren Street and turn north on Van Buren Street at the intersection of Indio Blvd. and Van Buren Street, cross Indio Blvd. and the SPRR tracks, and discharge into the Cabazon storm drain channel.

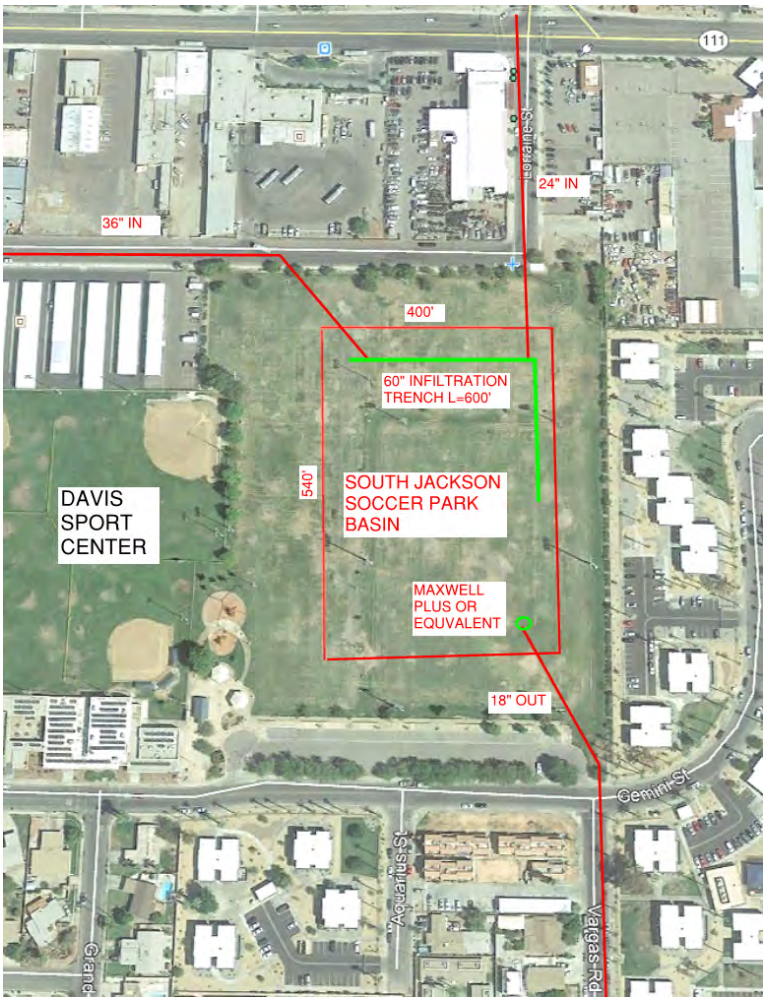
The Calhoun Street lateral is a sub-drainage system of the Dr. Carreon Boulevard storm drain system. It will modify the existing depressed soccer field located in the South Jackson Soccer Park; convert it from a drainage pond to a detention basin. This sub-system will add 24" to 36" storm drains and catch basins on Hwy 111 and will convey the storm runoff to the basin, and mitigate the street flooding/ ponding water conditions on Hwy 111.

South Jackson Soccer Park Basin is approximately 400' x 540' x4' Deep, (5 acres), it will mitigate 138 acres of watershed. The 100-year peak in-flow is 175 CFS; routed outflow reduced it to 12 CFS. The 100-year maximum ponding depth at the basin is 2.8'.

The proposed 600-foot long infiltration trenches will allow the basin in-flow storm drain flowline to be much lower than the basin depth of 4 feet. It will also allow the nuisance flow and low flow to stay in the underground pipe, for vector control and recreational use of the basin. A MaxWell Plus or equivalent, will be added at the basin's outlet, to further reduce the localized ponding.

SOUTH JACKSON SOCCER PARK DETENTION/INFILTRATION BASIN SUMMARY

RETURN PERIOD (YR.)	STORM EVENT (HR.)	TOTAL VOL (AC-FT)	PEAK Q (CFS)	ROUTED Q (CFS)	BASIN DEPTH (FT)
100	3	13.4	175.3	11.5	2.7
	6	14.3	146.7	12.0	2.8
	24	15.3	39.6	9.4	2.3
10	3	5.4	79.0	4.1	1.1
	6	5.9	62.8	4.3	1.2
	24	7.2	11.5	3.8	1.1

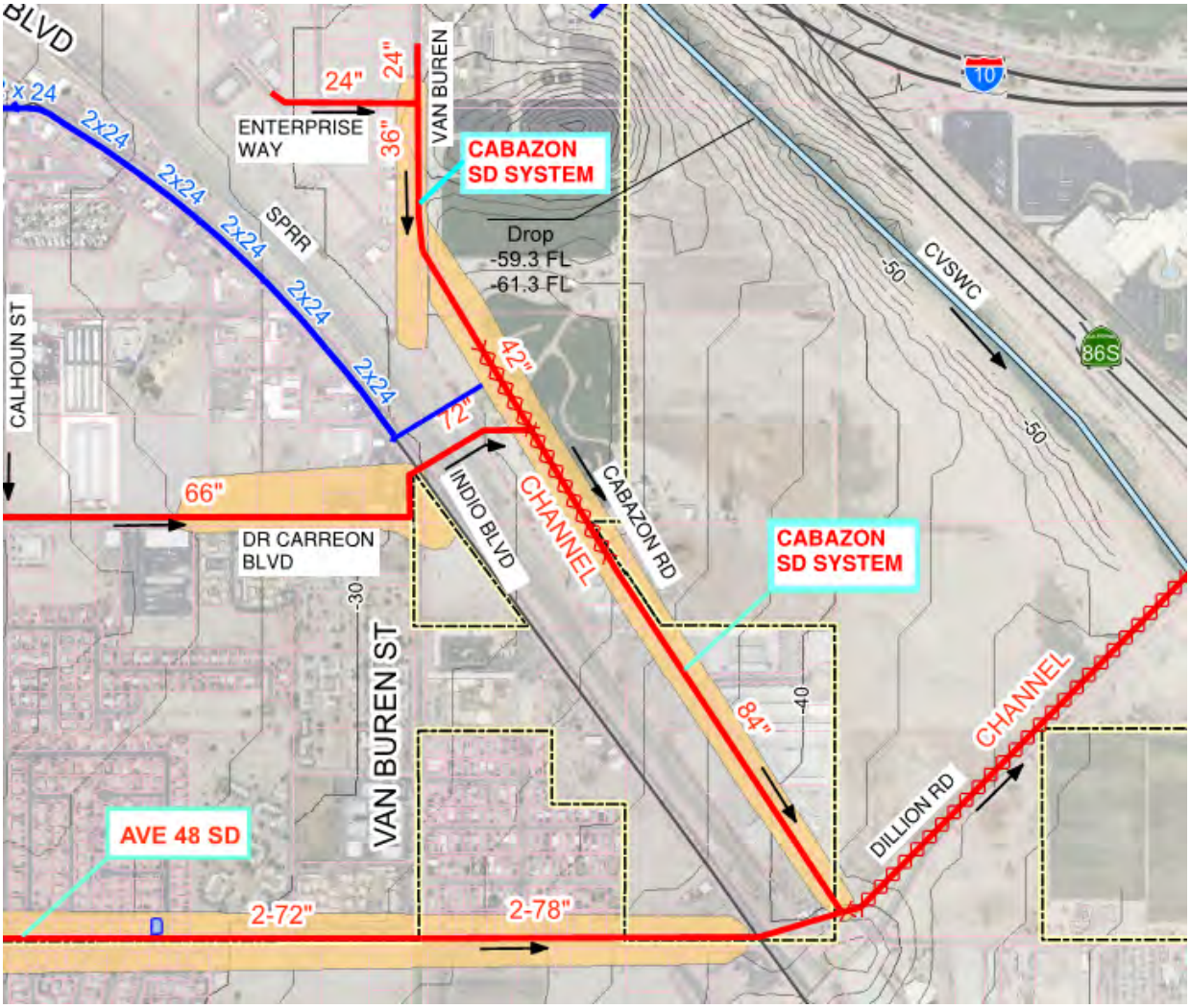


SOUTH JACKSON SOCCER PARK BASIN - 5 ACRES, 4' TOTAL DEPTH, MITIGATING 138 ACRES WATERSHED. 100-YEAR PEAK IN-FLOW =175 CFS, OUT-FLOW = 12 CFS, MAX. PONDING DEPTH 2.8'

The estimated cost for the proposed Dr. Carreon Blvd. Storm Drain System is approximately $13,914,000.

Cabazon Road Storm Drain System

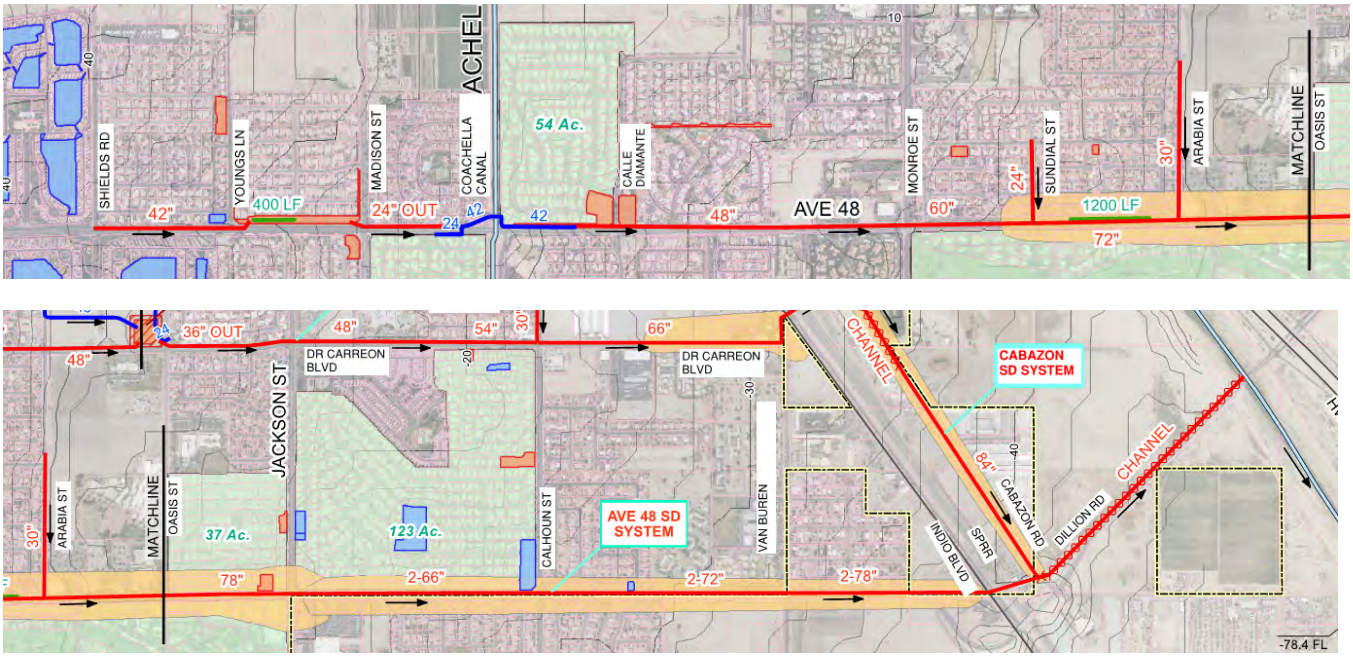
The Cabazon Road storm drain system is mainly a proposed drainage facility, including storm drain pipe and approximately 1,600 feet of concrete trap channel. The system will begin north of Enterprise Way on Van Buren Street, will travel along Van Buren Street, and Cabazon Road, in a southeasterly direction, to Dillon Road and discharge into the proposed Avenue 48 Concrete Trap Channel on Dillion Road.



The estimated cost for the proposed Cabazon Road Storm Drain System is approximately $6,125,000. If using Concrete Trap Channel is not feasible due to other restrictions or considerations, RCP or HDPE pipe can be substituted for the channel, and the estimated cost will be increased to $7,712,000 for the system. After this system is constructed, the current flooding conditions will be minimized or eliminated.

Avenue 48 Storm Drain System

Avenue 48 has the worst street flooding occurrences in the City. The entire length of Avenue 48 is approximately 4.5 miles long, from the westerly city boundary to the intersection with Indio Blvd. and the SPRR tracks. The only existing storm drain is a 42” storm drain siphoned under the All-American Channel and daylighted at a catch basin located 400 feet west of Calle Diamante.



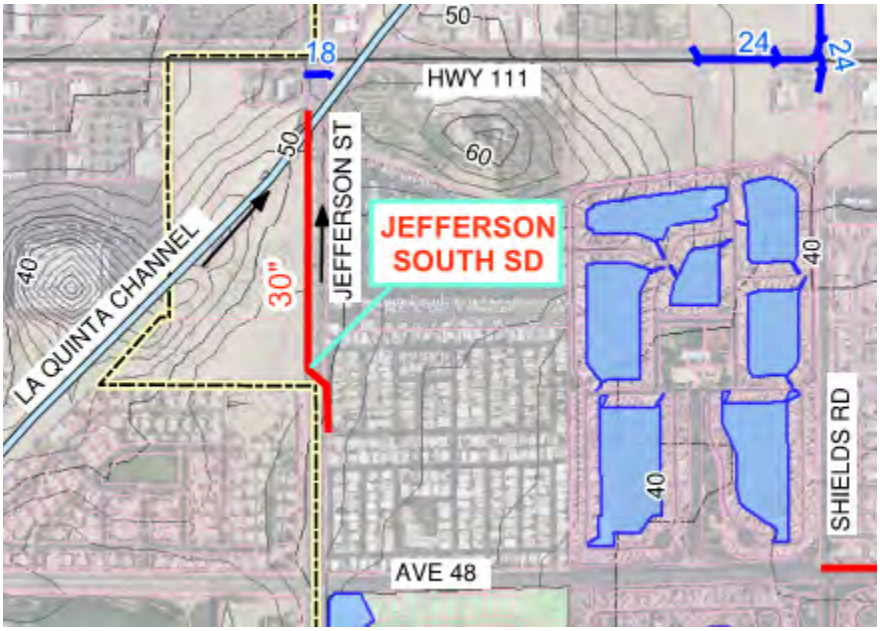
The Avenue 48 storm drain system is the mostly urgently needed, high priority system. Due to its very long alignment and high cost of construction ($ 29 to $34 million), it is difficult to obtain the funding and tackle the entire system as a single project. If the Avenue 48 storm drain system is being phased, the design and construction shall start at downstream end, from CVSWC. Since all the areas immediately north or south of Avenue 48 are all developed, there are no opportunities to use detention or retention basins to reduce the peak flow. The other challenge will be to fit a storm drain into the street full of the existing sewers, waters and all other dry utilities.

Other than the above-mentioned challenges, Avenue 48 storm drain system is a relatively simple system. The storm drain mainline will be on Avenue 48, its size will be from 42” pipe at the westerly end to two-78” pipes at the SPRR track crossing. After a confluence with Cabazon Road storm drain at Dillion Road, the system will transition to a concrete lined trap channel parallel to Dillion Road, and will discharge into the CVSWC. The proposed trap channel section is approximately 3,000 feet in length, with a channel base width of 10 feet, depth of 6 feet. Side slope at 1.5:1 ratio, the estimated top width is 30’; and it will require at least 47 feet of right of way width.

The estimated cost for the proposed Avenue 48 Storm Drain System is approximately $29,096,000. If utilizing Concrete Trap Channel is not feasible due to other restrictions, RCB may be substituted for the channel, and the system estimated cost would be increased to $34,000,000. After this system is constructed, the current flooding conditions will be minimized or eliminated.

Jefferson Street South Storm Drain System

Jefferson Street South Storm Drain system consists of a 30” mainline storm drain, catch basins and laterals, and is located between Highway 111 and Avenue 48, on Jefferson Street.



The upstream end of the drainage system starts at the north side of Avenue 48, collects runoff from the street flow on Jefferson Street to the north in a 30" storm drain, and discharges into the existing La Quinta Channel. Please also see Jefferson Street Storm Drain (infiltration trenches) on page 4-18 for alternative considerations.

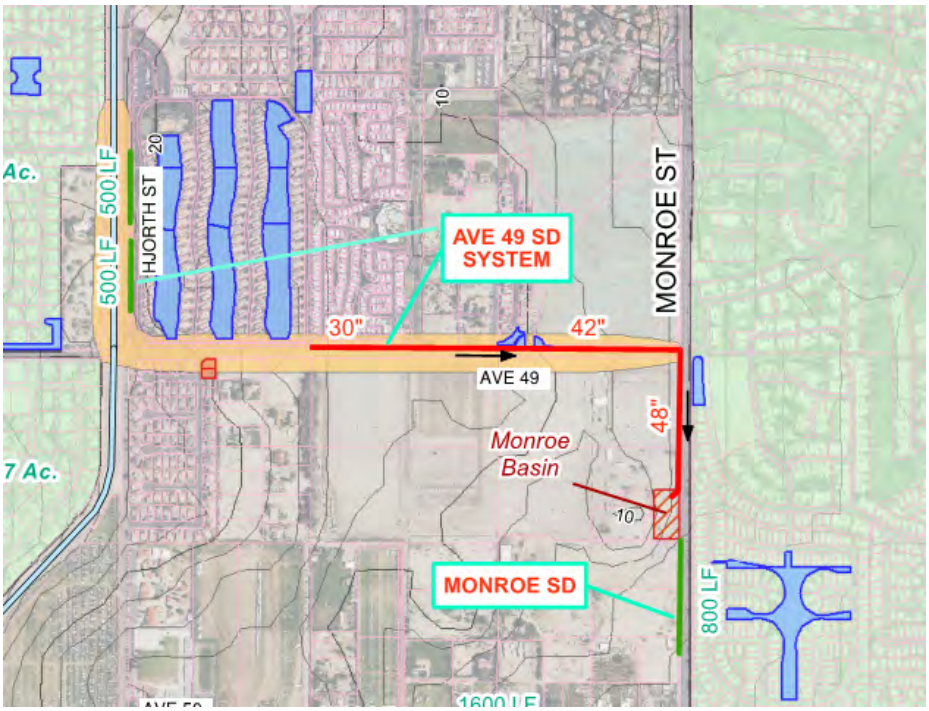
The estimated cost for the proposed Jefferson Street South Storm Drain system is approximately $656,000.

Avenue 49 Storm Drain System

Avenue 49 between the All-American Canal and Monroe Street and Hjorth Street north of Avenue 49 were identified as a flood-prone street by the City. To address the flooding issues, the Avenue 49 storm drain system is proposed.

The Avenue 49 storm drain system is a combination of the storm drain, the Monroe Street detention basin and two segments of infiltration trench on Hjorth Street. A segment of infiltration trench on Monroe Street south of the basin, serves the multi-purposes for basin outlet/ overflow and infiltrating Monroe Street low flows south of the basin, the cost of Monroe Street infiltration trench is included in the Monroe Street storm drain cost.

The proposed Monroe Basin is on the vacant lots owned by the city and zoned for parks and open spaces. This basin is an interim design with a depth of 6 feet, 210'x400' (1.93 acres). It will mitigate 121 acres of watershed. The 100-year peak in-flow is 140 CFS; routed outflow reduced it to 19 CFS. The 100-year maximum ponding depth at the basin is 5.9'. The Monroe Street detention basin outlets to a proposed infiltration trench on Monroe Street. The basin size can be enlarged to reduce the ponding depth and outflow.



To maximize the basin capacity, the preliminary basin design has an 18" pipe outlet located 1' above the basin bottom (to allow infiltration), this 18" outlet pipe will connect to the proposed Monroe Street infiltration trench. When infiltration trench reaches its full capacity, basin outflow will spill out from the catch basins connected to the infiltration trench, and flow will be conveyed by the street towards the southeasterly direction to the CVSWC.

MONROE DETENTION/INFILTRATION BASIN SUMMARY

RETURN PERIOD (YR.)	STORM EVENT (HR.)	TOTAL VOL (AC-FT)	PEAK Q (CFS)	ROUTED Q (CFS)	BASIN DEPTH (FT)
100	3	12.3	140.2	18.5	5.9
	6	13.1	116.6	18.6	5.9
	24	14.3	35.4	14.9	4.4
10	3	4.9	63.1	8.9	2.7
	6	5.4	50.4	9.3	2.7
	24	6.3	9.8	6.0	2.1

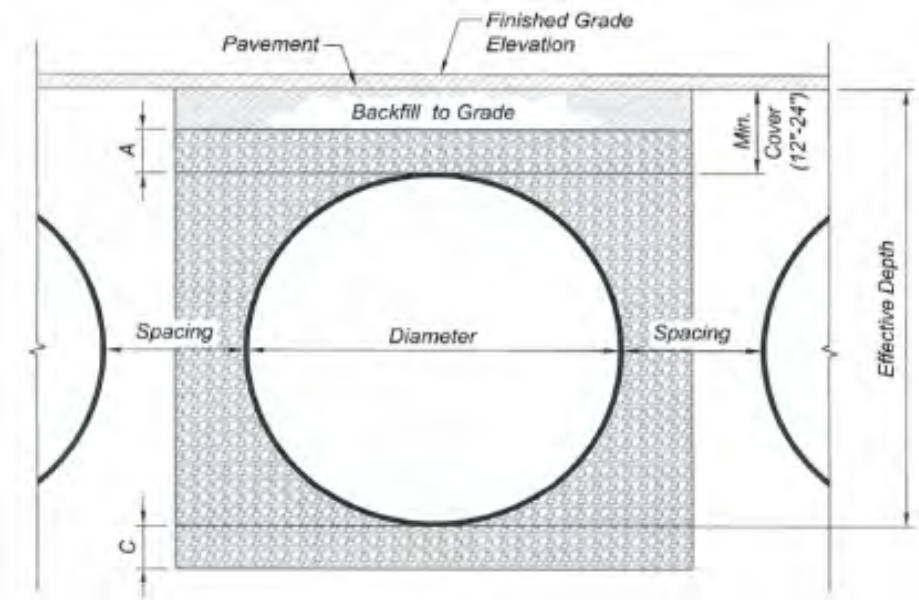
The estimated cost for the proposed Avenue 49 storm drain system is approximately $3,289,000.

■ South City MDP Facilities

As discussed in Section 1, Design Criteria Memo, the south city MDP facilities will have a different approach. Since most of the existing developed areas are self-contained for the 100-year storm volume, and all future developments are also required to retain the 100-year storm, the City and its consultant agreed that for this area, infiltration trenches and MaxWells drywells or equivalent would be used for major street flood control, such as Avenue 50 & 52, Jefferson Street, Monroe Street and Jackson Street. The estimated 100-year, 24-hour storm volume of street flow and average infiltration rate will be used for sizing the length of infiltration trench. The similar approach was also used for a recently completed Madison Street Improvement project.

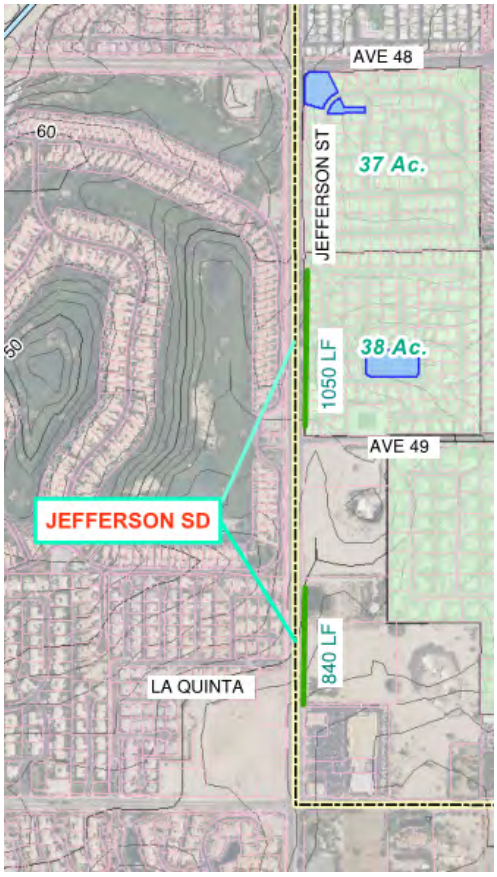
Typically, infiltration trench with a 60" diameter perforated HDPE will be used to store and infiltrate 100-year, 24-hour storm volume of the major street flow. A Contech calculation sheet is used to estimate the length of the infiltration trench required for the 100-year, 24-hour street flow volume. As shown below, 322 feet of infiltration trench will provide 10,000 cubic feet of storage volume.

Corrugated Metal Pipe Calculator			
Storage Volume Required (cf):	10,000		
Limiting Width (ft):	8.00		
Invert Depth Below Asphalt (ft):	8.00		
Solid or Perforated Pipe:	Perforated		
Shape Or Diameter (in):	60	19.63 ft^2 Pipe Area	
Number Of Headers:	0		
Spacing between Barrels (ft):	2.00		
Stone Width Around Perimeter of System (ft):	1.5		
Depth A: Porous Stone Above Pipe (in):	6		
Depth C: Porous Stone Below Pipe (in):	6		
Stone Porosity (0 to 40%):	40		
System Sizing			
Pipe Storage:	6,322	cf	
Porous Stone Storage:	3,711	cf	
Total Storage Provided:	10,033	cf	100.3% Of Required Storage
Number of Barrels:	1	barrels	
Length per Barrel:	322.0	ft	
Length Per Header:	0.0	ft	
Rectangular Footprint (W x L):	8. ft x 325. ft		
CONTECH Materials			
Total CMP Footage:	322	ft	
Approximate Total Pieces:	14	pcs	
Approximate Coupling Bands:	13	bands	
Approximate Truckloads:	4	trucks	
Construction Quantities**			
Total Excavation:	771	cy	
Porous Stone Backfill For Storage:	344	cy stone	
Backfill to Grade Excluding Stone:	193	cy fill	
***Construction quantities are approximate and should be verified upon final design*			



Jefferson Street Storm Drain System

The Jefferson Street storm drain system consists two segments of infiltration trench on the east side of the street, between Avenue 48 and Avenue 50.



Below is a summary of Jefferson Street proposed infiltration trench design perimeters:

Jefferson Street Proposed Infiltration Trench Summary

ID	Street Section	Half Street Width (ft)	Roadway Drainage Length (ft)	Sub-drainage Area (acre)	100-Y Peak Q (cfs)	100-Y 24-H Storm Volume (cf)	HDPE Estimated Length (ft)	24-H Infiltration Volume * (cf)	Design Storage Volume (cf)	Req'd 60" HDPE Storage (lf)	60" HDPE Proposed (lf)	Remarks
1	Hwy 111 to La Quinta Bndy West	67	1660	2.6	3.3	33703	700	13440	20263	654	660	West side C&G, S/W, 1-CB near Hwy 111, a dbl grate inlet 300' north of bndy, outlet unknow **
2	Hwy 111 to Ave. 48 East	67	2400	3.7	4.8	48727	1,000	19200	29527	952	1000	East side C&G, raised median, trees, wall, narrow Pkwy, 1-CB near Hwy 111, no other CB, no space for Infiltration Trench**
3	Avenue 48 to 49 East	67	2640	4.1	5.3	53600	1,100	21120	32480	1048	**1050**	Eastside C&G, S/W, landscaped Pkwy, 2-drywells on Pkwy
4	Avenue 49 to 50 East	67	2000	3.1	4.0	40606	800	15360	25246	814	**850**	East side C&G, S/W, Landscaped 680 LF & 1 CB north of Ave 50, 1-Grate Inlet may be connected to CB x-street
**	Alternative SD- 1200 LF of 30" RCP or HDPE along west side with 2-14' CB one on each side street, outlet to the La Quinta Channel, replace 1&2, see cost per Jefferson St South SD											
	Jefferson South Total		**8,700**	**13.4**	**17**	**176,636**	**3,600**	**69,120**	**107,516**	**3,468**	**3,560**	

*24-Hour Infiltration Volume = Estimated HDPE Length (80% Trench Width) [(Infiltration Rate 1.5 inches/Hour) /12] (24 Hour)

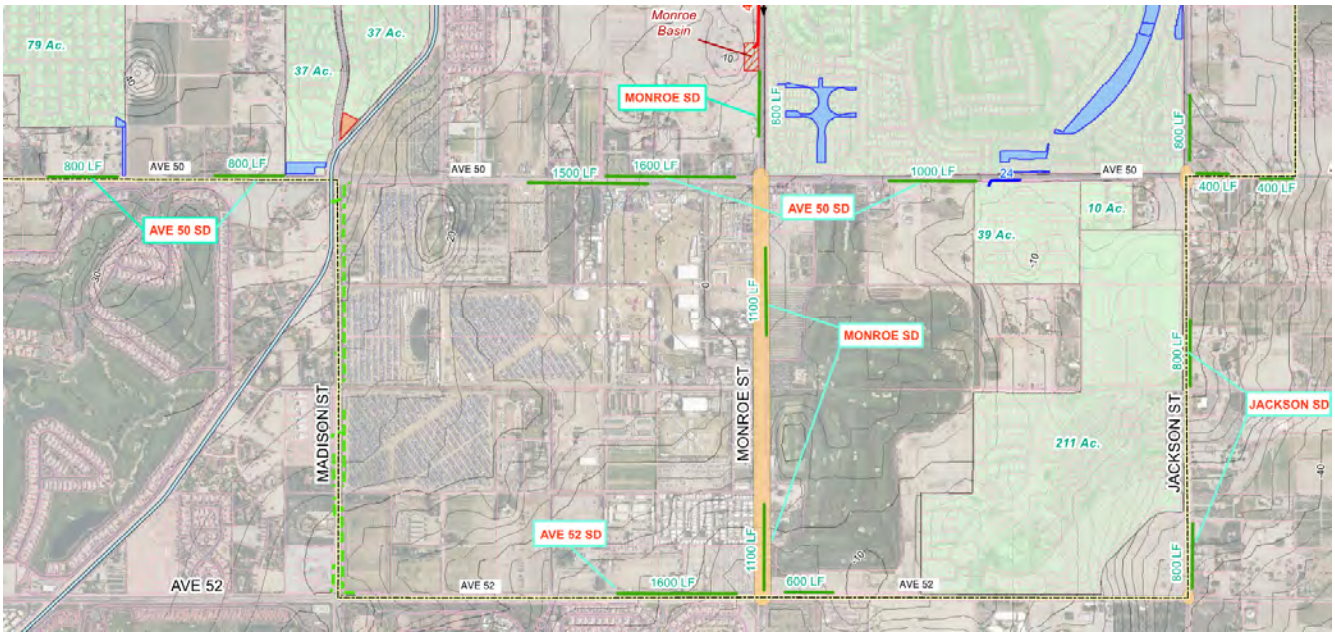
Average Street 100-year Q=1.3*(Area in Acre)

Average Storm 100-year 24-Hour Volume =13200*(Area in Acre)

Facility Location	Construction Sub Total	Mobilization, Water Control, etc. (22%)	Contingencies (12%)	Construction Total	Engineering & Admin. Mitigation (28%)	Subtotal
Jefferson St	$ 664,220	$ 146,128	$ 79,706	$ 890,055	$ 208,299	$ 1,098,400

The estimated cost for the proposed Jefferson Street Storm Drain is approximately $1,098,400.

Avenue 50 & 52, Monroe Street and Jackson Street Infiltration Trenches



The proposed drainage systems for Avenue 50 and 52, Monroe Street and Jackson Street are all infiltration trenches. The location of the infiltration trench will need to be evaluated for each street based on existing drainage facilities, street grade, localized low point, utility locations, parkway width and right of way width and such. Typically, along the city boundary, the half street outside the boundary will not be considered, such as Avenue 52 and Jefferson Street. The exceptions are Jackson Street and Avenue 50, due to the proposed jointly funded improvement projects.

The infiltration trench design parameters and summaries are listed below for each street.

Avenue 50

Ave 50 Proposed Infiltration Trench Summary

ID	Street Station	Half Street Width	Roadway Drainage Length	Sub-drainage Area	100-Y Peak Q	100-Y 24-H Storm Volume	HDPE Estimated Length	24-H Infiltration Volume *	Design Storage Volume	Req'd 60" HDPE Storage	60" HDPE Proposed Length	Remarks
		(ft)	(ft)	(acre)	(cfs)	(cf)	(ft)	(cf)	(cf)	(lf)	(lf)	
1	Jefferson to Madison (N)	50	5280	6.1	7.9	80000	1,600	30720	49280	1590	**1600**	South side is in La Quinta
2	Madison to Monroe (N)	50	5280	6.1	7.9	80000	1,600	30720	49280	1590	**1600**	
3	Madison to Monroe (S)	50	4950	5.7	7.4	75000	1,500	28800	46200	1490	**1500**	330' drains south to Madison
4	Monroe to Jackson (N)	50	0	0.0	0.0	0	0	0	0	0	**0**	Fully developed with C&G, CB
5	Monroe to Jackson (S)	50	3280	3.8	4.9	49700	1,000	19200	30500	984	**1000**	2000' developed with C&G, CB.
6	Jackson to City limit (N)	50	1300	1.5	1.9	19700	400	7680	12020	388	**400**	
7	Jackson to City limit (S)	50	1300	1.5	1.9	19700	400	7680	12020	388	**400**	
	Ave. 50 Total		**21,390**	**24.6**	**32**	**324,100**	**6,500**	**124,800**	**199,300**	**6,429**	**6,500**	

*24-Hour Infiltration Volume = Estimated HDPE Length (80% Trench Width) [(Infiltration Rate 1.5 inches/Hour) /12] (24 Hour)

Average Street 100-year Q=1.3*(Area in AC)

Average Storm 100-year 24-Hour Volume =13200*(Area in AC)

Avenue 52

Avenue 52 Proposed Infiltration Trench Summary

ID	Street Section	Half Street Width	Roadway Drainage Length	Sub-drainage Area	100-Y Peak Q	100-Y 24-H Storm Volume	HDPE Estimated Length	24-H Infiltration Volume *	Design Storage Volume	Req'd 60" HDPE Storage	60" HDPE Proposed	Remarks
		(ft)	(ft)	(acre)	(cfs)	(cf)	(ft)	(cf)	(cf)	(lf)	(lf)	
1	Madison to Monroe (N)	50	5280	6.1	7.9	80000	1,600	30720	49280	1590	**1600**	South side in La Quinta developed with C&G, CB & landscape median
2	Monroe to Jackson (N)	50	2000	2.3	3.0	30300	600	11520	18780	606	**600**	South side in La Quinta, north 3300 LF developed with C&G, CB
	Avenue 52 Total		**7,280**	**8.4**	**11**	**110,300**	**2,200**	**42,240**	**68,060**	**2,195**	**2,200**	

Monroe Street

Monroe Street Proposed Infiltration Trench Summary

ID	Street Station	Half Street Width (ft)	Roadway Drainage Length (ft)	Sub-drainage Area (acre)	100-Y Peak Q (cfs)	100-Y 24-H Storm Volume (cf)	HDPE Estimated Length (ft)	24-H Infiltration Volume * (cf)	Design Storage Volume (cf)	Req'd 60" HDPE Storage (lf)	60" HDPE Proposed (lf)	Remarks
1	Avenue 48 to 50 East	50	0	0.0	0.0	0	0	0	0	0	**0**	East side C&G, S/W, Landscaped, a small CB at north of Ave 50
2	Avenue 48 to 49 West	50	0	0.0	0.0	0	0	0	0	0	**0**	West side C&G, S/W, CB, 1000 LF Landscaped
3	Avenue 49 to 50 West	50	1100	1.3	1.6	16667	300	5760	10907	352	**800**	West side C&G, D/W, Trees, Fence & walls, CB 1200' S of Ave 49 w/ basin per ST 1301, add 400 LF for Monroe Basin outlet
4	Avenue 50 to 52 East	50	2640	3.0	3.9	40000	1,100	18480	21520	1010	**1100**	East side C&G, S/W, D/W, CBs along Curb, CB w/Maxwell at N Ave 52 & S Ave 50 per ST 1301
5	Avenue 50 to 52 West	50	2640	3.0	3.9	40000	1,100	18480	21520	1010	**1100**	Westside C&G, D/W, trees and walls, 2 CBs at north of Ave 52 w/ maxwells, 1 CB at 700 LF south of Ave 50 w/ Maxwells per ST 1301
	Monroe Total		**6,380**	**7.3**	**10**	**96,667**	**2,500**	**42,720**	**53,947**	**2,372**	**3,000**	

Jackson Street

Jackson Street Proposed Infiltration Trench Summary

ID	Street Station	Street Width (ft)	Roadway Drainage Length (ft)	Sub-drainage Area (acre)	100-Y Peak Q (cfs)	100-Y 24-H Storm Volume (cf)	HDPE Estimated Length (ft)	24-H Infiltration Volume * (cf)	Design Storage Volume (cf)	Req'd 60" HDPE Storage (lf)	60" HDPE Proposed (lf)	Remarks
1	Avenue 48 to 50 West	50	0	0.0	0.0	0	0	0	0	0	**0**	West side C&G, S/W, Landscaped, CBs throughout
2	Avenue 48 to Odlum (49) East	50	0	0.0	0.0	0	0	0	0	0	**0**	East side Coachella, C&G, S/W, CB, Landscaped, wall
3	Avenue 49 to 50 East	50	2640	3.0	3.9	40000	800	15360	24640	795	**800**	Eastside Indio, some fences, need street widening
4	Avenue 50 to 52 West	50	0	0.0	0.0	0	0	0	0	0	**0**	West side C&G, S/W, Landscaped, CBs throughout
5	Avenue 50 to 52 East	50	5280	6.1	7.9	80000	1,600	30720	49280	1590	**1600**	Eastside County, C&G, D/W, landscaped 600 LF north of Ave.
	Ave. 50 Total		**7,920**	**9.1**	**12**	**120,000**	**2,400**	**46,080**	**73,920**	**2,385**	**2,400**	

The summary of the estimated cost for the above listed Parkway Infiltration Trench is listed below.

MDP PARKWAY INFILTRATION TRENCH SUMMARY						
Facility Location	Construction Sub Total	Mobilization, Water Control, etc. (22%)	Contingencies (12%)	Construction Total	Engineering & Admin. Mitigation (28%)	Subtotal
Avenue 50	$ 2,174,000	$ 478,280	$ 260,880	$ 2,913,160	$ 681,766	$ 3,594,900
Avenue 52	$ 741,840	$ 163,205	$ 89,021	$ 994,066	$ 232,641	$ 1,226,700
Monroe St	$ 1,090,360	$ 239,879	$ 130,843	$ 1,461,082	$ 341,937	$ 1,803,000
Jackson St	$ 841,450	$ 185,119	$ 100,974	$ 1,127,543	$ 263,879	$ 1,391,400
Total	**$ 4,847,650**	**$ 1,066,483**	**$ 581,718**	**$ 6,495,851**	**$ 1,520,223**	**$ 8,016,000**
(1) Parkway infiltration trench based on 60" HDPE perforated pipe in a 8' wide gravel trench						
(2) There may be some R/W cost on Avenue 50 and Jackson Street						

■ Alternative Studies

Segments of the proposed Cabazon Road Storm Drain and Avenue 48 storm drain system will utilize a concrete lined trapezoidal channel for storm runoff conveyance. This type of channel is less costly, can accept sheet flow from the adjacent areas without adding inlet structures and laterals, are relatively easy to maintain and are easily placed in areas with similar existing natural conditions. Nevertheless, they are not aesthetically pleasing, are less safe for the public compared to underground facilities, dissect the land, pose more restrictions to future developments, and require additional right of way. The alternatives of using Reinforced Concrete Box or earthen channels are examined and analyzed for their feasibility, both hydraulically and economically.

a. Reinforced Concrete Box (RCB)

This alternative uses Reinforced Concrete Box. RCB is the most costly and the most versatile system. Typically, it is installed within street right of way, its capacity and size (width and height) is more flexible. It requires additional inlets, catch basins and laterals to collect storm runoffs and is costly to construct. This alternative is used for Avenue 48 storm drain system, to replace the

concrete trap channel along Dillion Road. The RCB alternative will increase the estimated cost by approximately $4.9 million.

b. Un-lined Trapezoidal Earthen Channel

An earthen channel will require 4:1 side slope and a much wider bottom base width to achieve a non-erosive velocity. If earthen channels are used to replace the concrete lined trap channel, the bottom width of the earthen channels will range from 30' to 90', the total width of the channel will need to be as wide as 190'. Conceptually, the earthen channel may provide opportunity for infiltration and bio-treatment within the channel footprints, and be less costly. However, due to its width, it requires much longer transition structures at roadway crossings, and acquisition of more Right-of-Way. Since the channel segment of the Avenue 48 System is on tribal land, this option is not considered a viable alternative.

Conclusions

The above alternatives and their associated costs were presented to the City for consideration. The summary of the cost and estimated cost for each storm drain system are presented in the Appendix C for reference.

It is important to understand that the proposed MDP facilities alone will not adequately protect the area from flood hazards, unless either the upstream facilities (catch basins, inlets, and their laterals) are in place to collect and convey the storm flow to the designated collection/ discharge points, or the interim intercepting / collecting facilities are constructed to serve the same purposes.

SECTION 5 - GREEN INFRASTRUCTURE

The primary purpose of the MDP update is to identify engineering solutions and the suitable and sustainable approach that will control flooding and will address drainage issues within the City. In addition, the MDP identifies potential locations and methods for water quality treatment, ground water recharge facilities; estimates the cost of facilities; and identifies funding sources to facilitate orderly and economically prudent development of the area.

In addition, the MDP also addresses watershed-based BMPs, regional and master plan level water quality mitigation and treatment. The mitigation measures will focus on trash and debris removal, nutrient reduction, infiltration and ground water recharge to enhance the beneficial use. Implimenting MDP will promote using Low Impact Development (LID) techniques to complement a complete street design and will minimize the negative impact to the water quality from the current and future developments.

It should be noted that individualized analysis on a project-by-project basis pursuant to the regulations at the time, would be necessary once specific facility sites have been identified to determine the site-specific environmental constraints.

■ Green Street

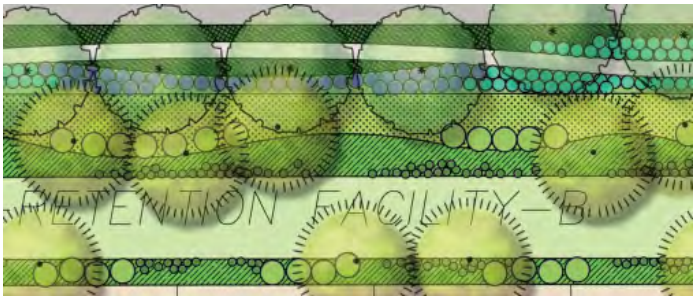
The MDP update document is developed in conjunction with the Complete Street Plan, Green Street and Green Infrastructure. To develop and implement “Green” aspect of MDP is crucial for the City to reach its short term and long goal of sustainable growth and smart green infrastructure.

The design guidelines for the development of sustainable landscape systems in Green Streets will be developed as a part of the Complete Street Plan. The Green Street design approaches will be discussed in details, such as site appropriate vegetation, efficient irrigation methods, pedestrian and bicycle circulation, shading, gathering spaces, site lighting, solar powered lighting and equipments, pervious paving, and other landscape site amenities and fixtures.

Green Street - Reduce the amount of impervious surface (concrete and asphalt) by using minimum travel lane width in the residential neighborhood and downtown commercial area, increase the parkway width for street tree planting, incorporate vegetated swale and bio-retention to promote Traffic calming, foot traffic, pedestrian and bicycle use and water quality mitigations.

Street Landscaping –Select plant material suitable for vegetated stormwater management. Appropriate plants are typically natives that flourish in the local climate conditions, adapted to periodic flooding, and low maintenance. Plant selection should also consider plant height with regard to driver visibility, safety, and security. Plant suggestions will work to remove air pollutants, increase animal habitat, reduce heat island affect, and assist in encouraging pedestrian activity.

Street Plaza and Parklit Furniture and Fixtures – Create outdoor spaces to encourage pedestrian activity. Outdoor lighting fixture types and optimum layout locations standards shall be developed for the purposes of reducing light pollution. All materials shall be energy efficient, from a local source, and of recycled material whenever possible.



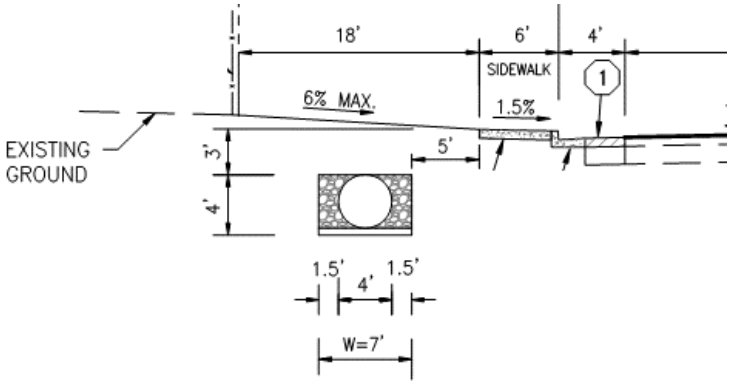
It will be beneficial to design a Demonstration Project at the City designated location, to showcase the concept and execution of City's vision for Complete Street, Green Infrastructure and Green Street.

■ Green Infrastructure

Water is a very precious resource and commodity for the City and in the desert area in general. Throughout MDP update process, Webb team identified and maximized the opportunity for utilizing the city's natural resources - sandy soils for infiltration and ground water recharge.

Basins (Retention, detention and infiltration) - The City of Indio has many privately owned or city owned retention, detention/ infiltration facilities (basins). Per the information provided by the city, the total acreage of the privately owned and maintained basins is approximately 293 acres; and city maintained basins is approximately 35 acres. All new development projects will be required to retain its on-site 100-year, 24-hour storm volume by means of retention/ infiltration basin. As a component of MDP facility, two new basins (Market Street Basin and Monroe Street Basin) will be added, and two existing basins (Riverside County Fairgrounds Basin and South Jackson Soccer Park Basin) will be modified to increase the capacities. These basins are a major component of the green infrastructure of the city for conserve and reuse of the storm water for ground water recharge.

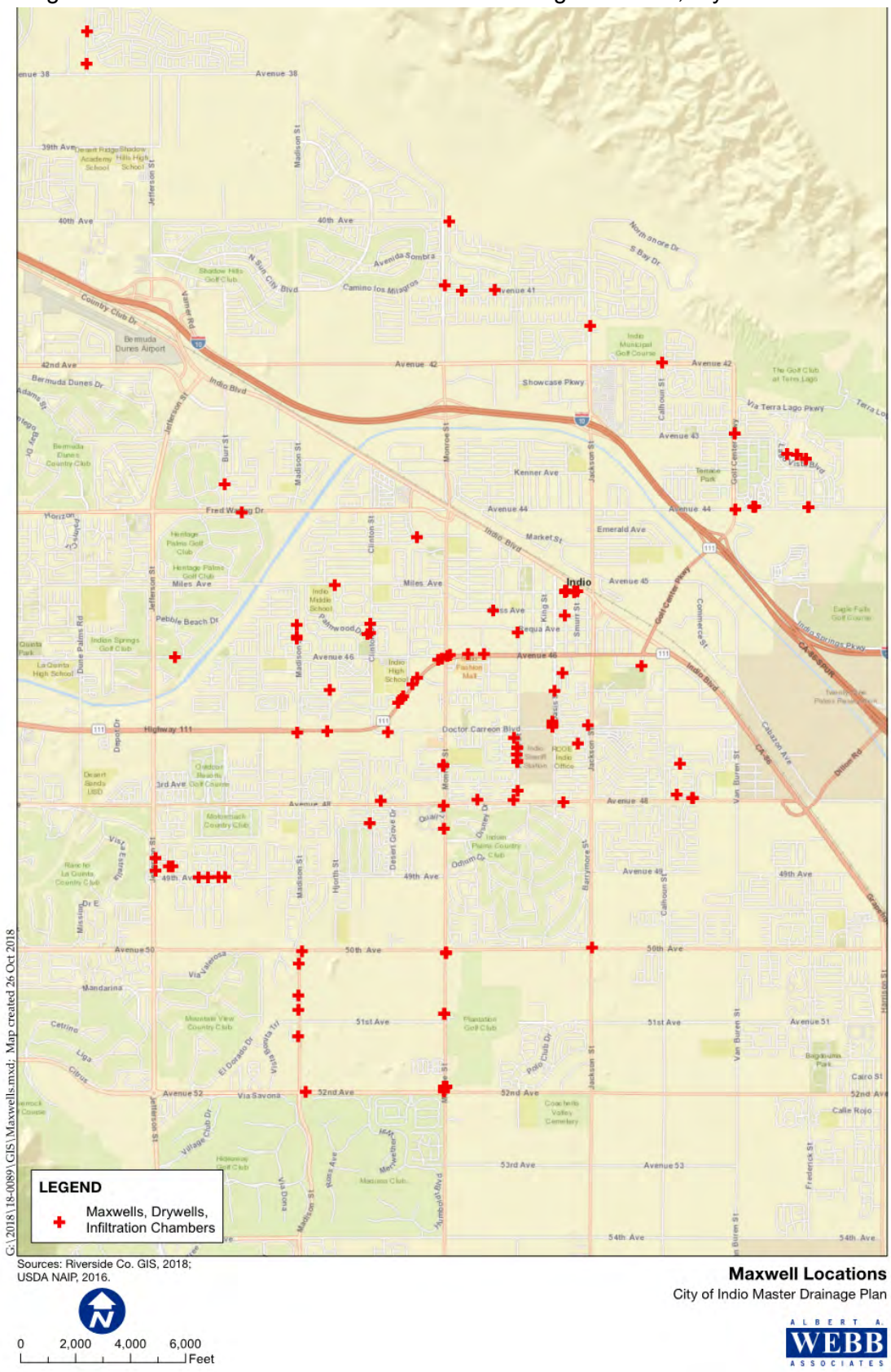
Parkway Infiltration Trench – Recently, the City just successfully completed the Madison Street Improvement project. Madison Street project utilized parkway infiltration trenches for its storm water management. This system is independent from any downstream facilities, and has dual functions of flood control and ground water recharge.



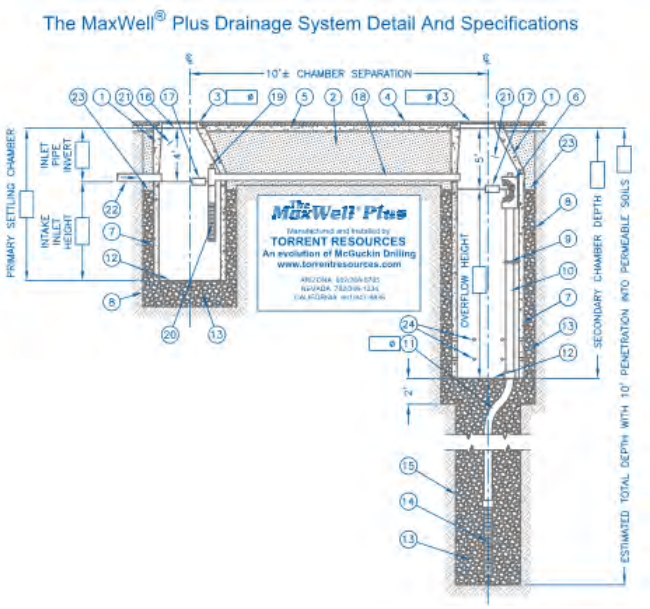
The similar infiltration trenches are also proposed for the upcoming Jackson Street Improvement project and identified as MDP facilities for the south city area.

MaxWell or Equivalent and Dry Well - Based on the GIS data and plans provided by the City, we have identified approximately 112 of existing and proposed (under construction) MaxWell Plus (two-chamber dry well up to 40' below grade) and conventional Dry Well throughout the City. We consulted with Engineer staff at Torrent Resources, per their research, 47 of the 112 were identified as MaxWell or MaxWell Plus.

Figure 5-1 The locations and distribution of existing MaxWells, dry well



The design capacity of a typical MaxWell Plus is between 0.06 CFS to 0.2 CFS; the flow tests conducted by Torrent Resources had average 0.12 CFS per MaxWell. It is insignificant to use for its capacity for 100-year drainage design. However, if strategically placed in the area with constant nuisance flow and landscape irrigation runoffs, one MaxWell Plus can infiltrate up to 20 ac-ft of the flow per year with 50% of the time filled with the nuisance flow. The use of MaxWell and Dry Well will provide significant benefit for the water quality mitigation and ground water recharge.



MaxWell Plus by Torrent Resources or Equivalent

Maxwell shall be placed a minimum 10’ away from any building structures. Installing Maxwell will also need overhead clearance for drilling.

The maintenance of Maxwell Plus is simple. In every 3-5 years, sediment and debris shall be removed from pre-treatment well by using vacuum truck, and Absorbent pillows (Hydrophobic Petrochemical Sponge) shall be inspected and replaced in both primary settling chamber and secondary chamber.

All existing drywells shall be inspected first, and compare the current depth with the initial installation depth. If the drywell has already filled with silt and debris, removing silt and debris is not likely to restore its functionality, due to migrating fines will fill in the void of surrounding sand and gravel. For example, the four drywells in the retention/ infiltration basin on Riverside County Fairgrounds were constructed in 1994-1995, with the depth of 22 feet. Recently, the Riverside County Fairgrounds Basin was enlarged. The field verified drywell depth now are ranging from 3’-6’ depth in February 2019. The engineer at Torrent Resources recommended that new drywell or MaxWell should be installed instead of cleaning and restoring the existing drywells.

■ Water Quality Management

All efforts shall be made to filter out nonpoint source pollution to improve water quality of the city and the region. In addition to the Green Street, Green Infrastructures discussed above, other BMPs shall be employed, such as bio-retention, vegetated swales, pervious pavement, filters for catch basin and drainage inlet for sediment and debris removal, public education, training for city staff and residents and such.

■ Other Environmental Considerations

Construction and operation of any MDP facility would be required to comply with State law concerning accidental findings of human remains per State Health and Safety Code §7050.5. If human remains are encountered during construction, no further disturbance shall occur until the Riverside County Coroner has made a determination of origin and disposition pursuant to Public Resources Code §5097.98. If the County Coroner determines that the remains are not historic, but prehistoric, the Native American Heritage Commission must be contacted to determine the most likely descendent for this area. Once the most likely descendent is determined, treatment of the Native American human remains will proceed pursuant to Public Resources Code 5097.98

As each component of the MDP is designed, appropriate project-specific analyses of cultural resources and project impacts during both construction and operational phases, may be needed. Compliance with Assembly Bill 52 (AB 52), which requires tribal consultation may also be required.

All environmental concerns addressed in the Indio General Plan Update (expected to be adopted in fall, 2019) must be taken into consideration during any design and construction associated with the MDP facility.

As each component of the MDP proceeds with design and construction, consideration may be needed for one or more of the following topics during project design:

- Agriculture Resources
- Hazardous Materials
- Land Use and Planning
- Mineral Resources
- Noise
- Population and Housing
- Public Services
- Recreation
- Utilities and Service Systems

SECTION 6 - COST SUMMARY AND FUNDING MECHANISMS

■ MDP Cost Summary

Probable cost estimates were prepared as part of the MDP. A cost summary for the MDP facilities is shown in table below. The estimated costs were based on the 2018 Planning Cost Sheets of the Riverside County Flood Control and Water Conservation District (District). The components of the cost include construction, right-of-way acquisition, 22% of lump sum items such as mobilization, water control, traffic control, etc., 12% of contingencies and 28% of combined engineering, administration and mitigation.

The estimated costs for each MDP facility are listed below:

Indio MDP Cost Estimate Summary

ID No.	MDP Facility ID	Construction Sub Total	Mobilization, Water Control, etc. (22%)	Contingencies (12%)	Construction Cost Total	Administration, Engineering, Mitigation	Subtotal (1)	Detention Basin (2)	Right-of-Way (3)	MDP Cost Total	Remarks
1	Jefferson St North SD	$ 1,538,560	$ 338,483	$ 184,627	$ 2,061,670	$ 482,492	$ 2,544,163			$ 2,544,000	For Jefferson (N) St. Flow only
2	Avenue 42 SD	$ 897,160	$ 197,375	$ 107,659	$ 1,202,194	$ 281,349	$ 1,483,544			$ 1,484,000	West of Monroe Street
3	Monroe St North SD	$ 911,040	$ 200,429	$ 109,325	$ 1,220,794	$ 285,702	$ 1,506,496			$ 1,506,000	For Monroe (N)St. Flow only
4	Indio Springs St SD	$ 1,262,820	$ 277,820	$ 151,538	$ 1,692,179	$ 396,020	$ 2,088,199			$ 2,088,000	East of CVSWC
5	Avenue 44 SD	$ 5,378,760	$ 1,183,327	$ 645,451	$ 7,207,538	$ 1,686,779	$ 8,894,318			$ 8,894,000	West of CVSWC
6	Avenue 45 SD System	$ 7,106,420	$ 1,563,412	$ 852,770	$ 9,522,603	$ 2,228,573	$ 11,751,176	$ 1,116,200		$ 12,867,000	Including Market Basin
7	Civic Center SD System	$ 1,991,800	$ 438,196	$ 239,016	$ 2,669,012	$ 624,628	$ 3,293,640			$ 3,294,000	Including Modify Marshall Parkway
8	Dr. Carreon SD System	$ 8,414,600	$ 1,851,212	$ 1,009,752	$ 11,275,564	$ 2,638,819	$ 13,914,383			$ 13,914,000	Including Modify Fairgnd & Davis Basin
9	Cabazon Road SD	$ 3,670,640	$ 807,541	$ 440,477	$ 4,918,658	$ 1,151,113	$ 6,069,770		$ 55,000	$ 6,125,000	Including R/W for Channel
10	Avenue 48 SD System	$ 17,483,660	$ 3,846,405	$ 2,098,039	$ 23,428,104	$ 5,482,876	$ 28,910,980		$ 185,000	$ 29,096,000	Including R/W for Channel
11	Avenue 49 SD	$ 1,829,760	$ 402,547	$ 219,571	$ 2,451,878	$ 573,813	$ 3,025,691	$ 263,600		$ 3,289,000	Including Monroe Basin
12	Jefferson St South SD	$ 396,600	$ 87,252	$ 47,592	$ 531,444	$ 124,374	$ 655,818			$ 656,000	For Jefferson (S) St. Flow only
13	Areas South of Ave. 48 (5)	$ 5,511,870	$ 1,212,611	$ 661,424	$ 7,385,906	$ 1,728,522	$ 9,114,428			$ 9,114,000	Summary of Parkway Infiltration Trenchs
14	Golf Center Pkwy SD (GCP)	$ 682,160	$ 150,075	$ 81,859	$ 914,094	$ 213,925	$ 1,128,020			$ 1,128,000	East of CVSWC
	Indio MDP Total	**$ 57,075,850**	**$ 12,556,687**	**$ 6,849,102**	**$ 76,481,639**	**$ 17,898,987**	**$ 94,380,626**	**$ 1,379,800**	**$ 240,000**	**$ 95,999,000**	
	Alternative (4)										
15	Cabazon Road SD Alt 1	$ 4,663,940	$ 1,026,067	$ 559,673	$ 6,249,680	$ 1,462,612	$ 7,712,291			$ 7,712,000	Use RCP inplace of Concrete Trap Channel
16	Avenue 48 SD Alt 1	$ 20,560,995	$ 4,523,419	$ 2,467,319	$ 27,551,733	$ 6,447,928	$ 33,999,661			$ 34,000,000	Use RCB inplace of Concrete Trap Channel

(1) Cost based on RCFC&WCD 2018 Project Planning Costs Worksheet
(2) Total Construction Cost with Eng & Admin for new Detention Basins
(3) $50,000 per acre Raw Land Cost for Right-of-Way cost, only for Trap. Channels
(4) Concrete Trap Channel being replaced by RCP or RCB, no R/W take, add additional Catch Basins to intercept runoffs
(5) Summary of the infiltration trenches for the areas south of Avenue 48, include Ave 50, Ave 52, Jefferson Street, Monroe Street and Jackson Street

The item 13 listed above shows the summary of the areas south of Avenue 48 infiltration trench, which consists total five streets; see below for the cost breakdown for each street.

MDP South of Avenue 48 Parkway Infiltration Trench Cost Summary							
ID No.	Facility Location	Construction Sub Total	Mobilization, Water Control, etc. (22%)	Contingencies (12%)	Construction Total	Engineering & Admin. Mitigation (28%)	Subtotal
A	Avenue 50	$ 2,174,000	$ 478,280	$ 260,880	$ 2,913,160	$ 681,766	$ 3,594,900
B	Avenue 52	$ 741,840	$ 163,205	$ 89,021	$ 994,066	$ 232,641	$ 1,226,700
C	Jefferson St	$ 664,220	$ 146,128	$ 79,706	$ 890,055	$ 208,299	$ 1,098,400
D	Monroe St	$ 1,090,360	$ 239,879	$ 130,843	$ 1,461,082	$ 341,937	$ 1,803,000
E	Jackson St	$ 841,450	$ 185,119	$ 100,974	$ 1,127,543	$ 263,879	$ 1,391,400
	Total	**$ 5,511,870**	**$ 1,212,611**	**$ 661,424**	**$ 7,385,906**	**$ 1,728,522**	**$ 9,114,400**
	(1) Parkway infiltration trench based on 60" HDPE perforated pipe in a 8' wide gravel trench						
	(2) There may be some R/W cost on Avenue 50 and Jackson Street						

The total cost of the recommended improvements, including construction, right-of-way acquisition, engineering, administration and contingencies is estimated to be **$ 95,999,000.**

The detailed costs for each storm drain system are presented in the Appendix C for reference.

■ Drainage Facility Operation & Maintenance Costs

Properly maintaining the existing drainage facilities will prevent flooding, reduce the pollution and extend the life span of the facilities. It is important that the manpower, resources and budget be allocated. After in-depth discussion with the City Engineer and City O & M Manager, compile the total number of the facilities, Webb team prepared the estimated annual cost for maintaining the existing drainage facilities.

CITY OF INDIO DRAINAGE OPERATION & MAINTENANCE ANNUAL COST SUMMARY FOR THE EXISTING DRAINAGE FACILITIES					
NO.	**ITEM**	**UNIT**	**ESTIMATED QUANTITY**	**UNIT COST**	**AMOUNT**
	ANNUAL O & M				
1	MAINTAIN CATCH BASIN, DRAINAGE INLET (2008 SURVEY 800 +/-, USE 900). ESTIMATED $400/EACH, TWICE A YEAR TO REMOVE DEBRIS.	EA	900	$400	$360,000
2	DRY WELL AND MAXWELL, REMOVE DEBRIS AND REPLACE ABSORBENT SPONGE (HYDROPHOBIC PETROCHEMICAL) EVERY 3 YEARS. CITY TOTAL 120+/-, ROTATE 40/YEAR	EA	40	$3,000	$120,000
3	STORM DRAIN OUTLET STRUCTURE TO CVSWC (WHITE WATER CHANNEL)	EA	40	$400	$16,000
4	DETENTION/ RETENTION BASINS	AC	35	$8,000	$280,000
5	INSTALL CATCH BASIN INLET FILTER 100 EACH PER YEAR	EA	100	$400	$40,000
6	INFILTRATION TRENCH/ CHAMBER	EA	20	$2,000	$40,000
7	REPAIR DRAINAGE OUTLET STRUCTURE TO CHANNEL OR BASIN, ADD RIP-RAP	LS	1	$20,000	$20,000
		ANNUAL O & M SUBTOTAL			**$876,000**

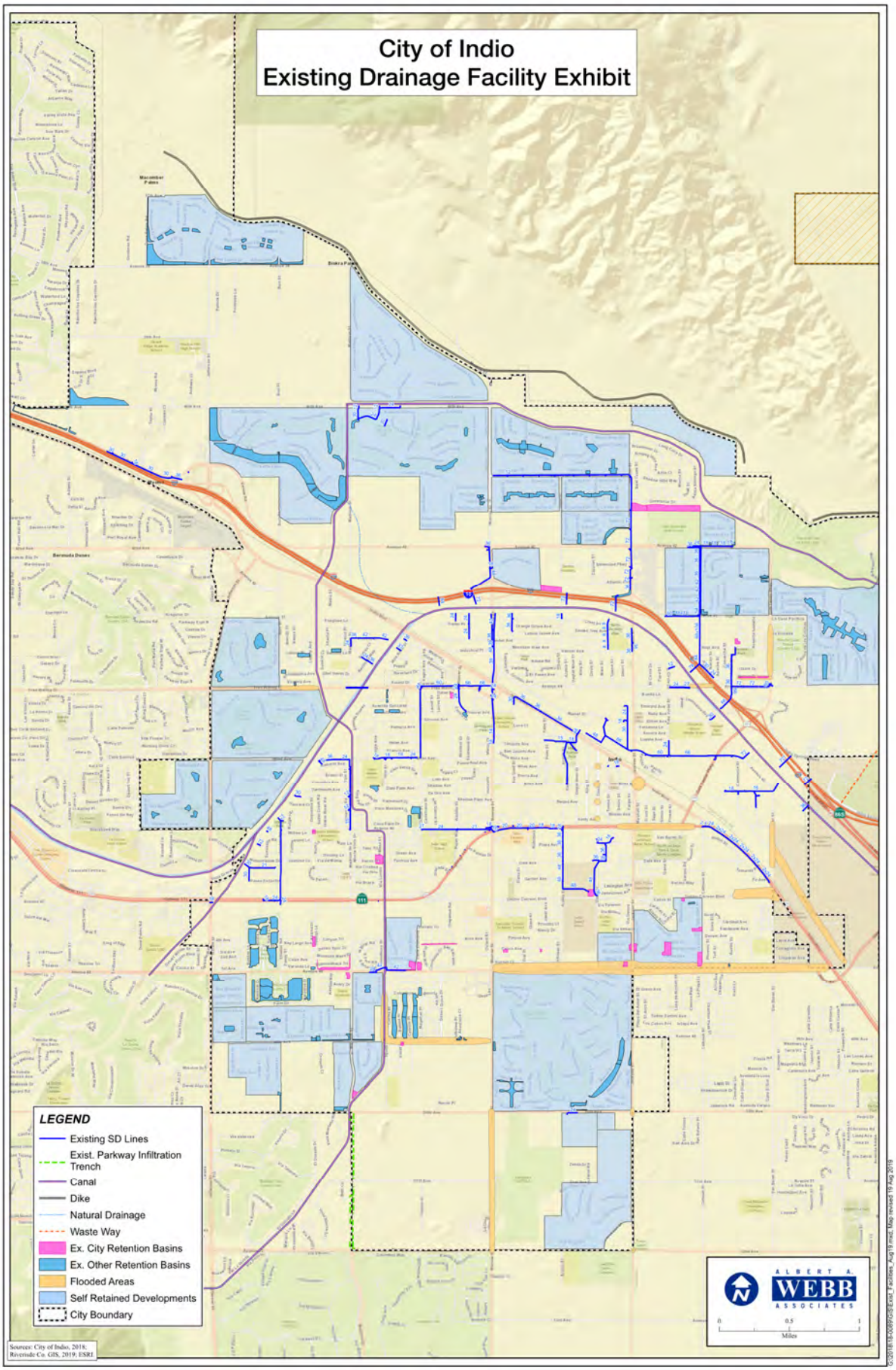
This cost shall be increased with the new facility added each year and inflation on labors and materials.

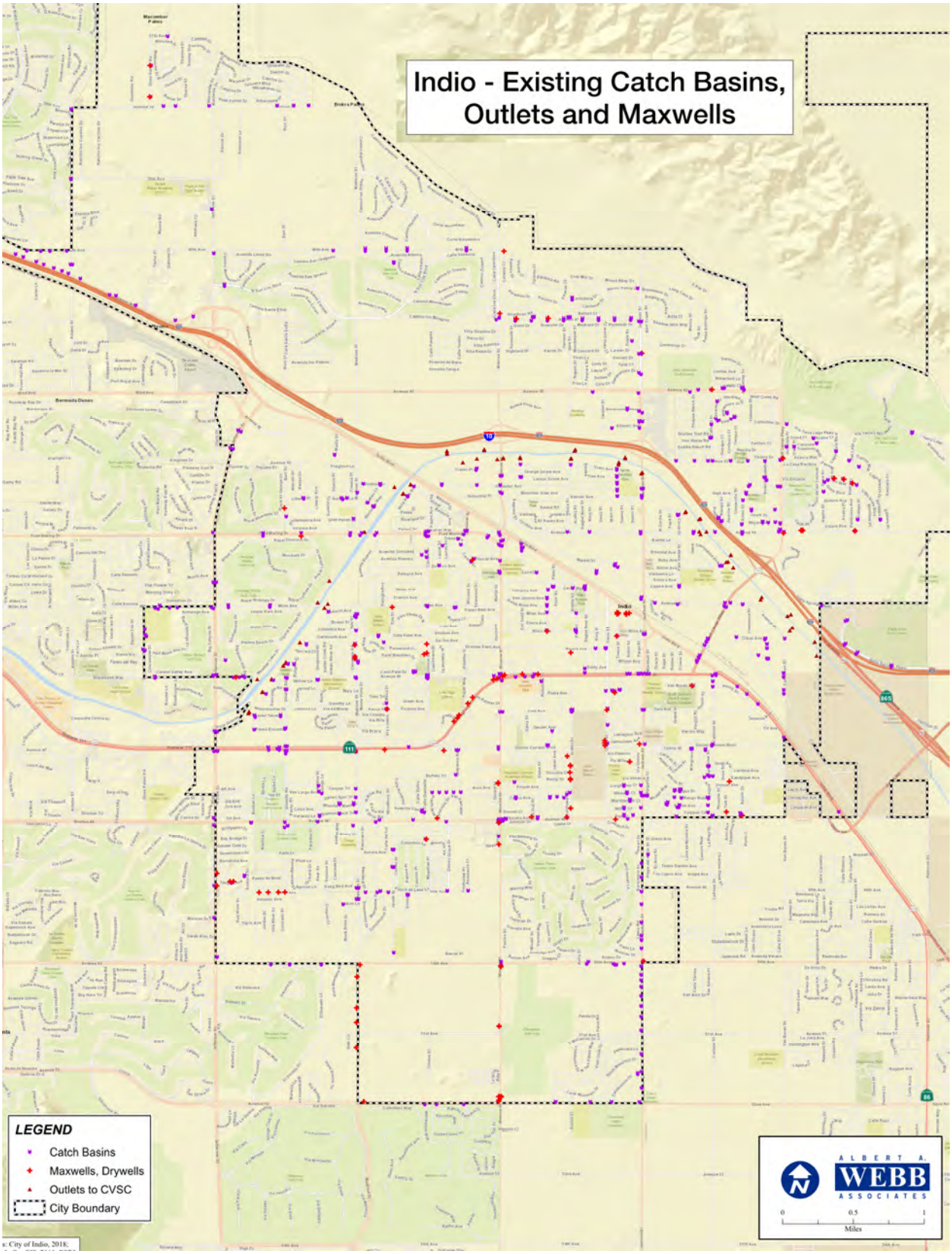
There are also new facilities and equipment needed, two items and their initial investments are identified. Assuming this initial cost will be distributed in 6 years evenly.

	NEW FACILITY & EQUIPMENT (INITIAL INVESTMENT)				
1	CONSTRUCT NEW CLARIFIER	EA	1	$2,000,000	$2,000,000
2	NEW VACTOR VACUUM TRUCK	EA	2	$575,000	$1,150,000
		NEW F & E SUBTOTAL			**$3,150,000**
		ANNUAL F & E (6-YEAR DISTRIBUTION)			**$525,000**

The combined O & M and Facility & Equipment budget needed for the current year is $1,401,000.

The overall existing drainage facilities are shown on two exhibits below.


City of Indio
Existing Drainage Facility Exhibit
LEGEND
Existing SD Lines
Exist. Parkway Infiltration Trench
Canal
Dike
Natural Drainage
Waste Way
Ex. City Retention Basins
Ex. Other Retention Basins
Flooded Areas
Self Retained Developments
City Boundary
Sources: City of Indio, 2018; Riverside Co. GIS, 2019; ESRI
ALBERT A. WEBB ASSOCIATES
0
0.5
1
Miles


Indio - Existing Catch Basins, Outlets and Maxwells
LEGEND
Catch Basins
Maxwells, Drywells
Outlets to CVSC
City Boundary
ALBERT A. WEBB ASSOCIATES
0
0.5
1
Miles

■ GIS Data Base

Utilizing and developing the GIS database is an integral and essential part of the MDP developments.

Throughout the MDP update process, Webb's GIS experts have been facilitating and supporting the MDP study effort. A GIS Data Collector was created and utilized for geo-referencing locations and facilities of field investigation photos and field notes. A base map for the MDP was created utilizing the City's topographic contours and GIS database for parcels, General Plan Land Use and existing drainage facilities.

New feature classes for MDP facilities, known drainage issue locations, and storm drain outlets to Coachella Valley Stormwater Channel were created and will be added to City's Storm Drain geodatabase as a new Feature Dataset.

■ Additional Funding Sources

The MDP estimated cost, as a component of Development Impact Fees (DIF) will be imposed on the development projects in conjunction with conditions of approval of the projects as the Drainage Mitigation Fee.

In addition to DIF, other funding sources may be available to the community for flood protections, water quality mitigation and ground water recharge.

FEDERAL PROGRAMS

Economic Development Administration, Public Works and Economic Adjustment Assistance Program

This program is "designed to leverage existing regional assets and support the implementation of economic development strategies that advance new ideas and creative approaches to advance economic prosperity in distressed communities." The program, "solicits applications from rural and urban communities to develop initiatives that advance new ideas and creative approaches to address rapidly evolving economic conditions."

Deadline: None

Award max: $3,000,000

Website: https://www.grants.gov/web/grants/search-grants.html?keywords=economic%20adjustment

Federal Emergency Management Agency (FEMA), Flood Mitigation Assistance Program

This program has "the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP)."

Deadline: Please consult with the website list below

Award limit: $100,000 to $10,000,000

Website: https://www.fema.gov/flood-mitigation-assistance-grant-program

Federal Emergency Management Agency (FEMA), Pre-Disaster Mitigation Program

This program provides assistance to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters.

Deadline: Please consult with the website list below

Award limit: $150,000 to $4,000,000

Website: https://www.fema.gov/pre-disaster-mitigation-grant-program

Federal Emergency Management Agency (FEMA), Hazard Mitigation Grant Program (HMGP)

The program provides funding to, "protect public or private property through various mitigation measures".

Hazard mitigation measures are any sustainable action taken to reduce or eliminate long-term risk to people and property from future disasters. FEMA offers a variety of disaster assistance programs with different eligibility requirements. HMGP provides funds to states, tribes, and local communities after a disaster declaration to protect public or private property through various mitigation measures. Hazard mitigation includes long-term efforts to reduce the impact of future events. HMGP recipients (states, Federally-recognized tribes, or territories) have the primary responsibility for prioritizing, selecting, and administering state and local hazard mitigation projects.

Deadline: N/A

Award max: 75% of project cost

Website: https://www.fema.gov/hazard-mitigation-grant-program

Federal Emergency Management Agency (FEMA), Emergency Management Performance Grant (Region 9)

Program just announced for 2018, aimed to "assist state, local, tribal, territorial governments in enhancing and sustaining all-hazards emergency management capabilities." Only available following Presidential Major Disaster Declaration.

Deadline: 12 months from Presidential Declaration

Award max:

Website:
https://www.grants.gov/web/grants/searchgrants.html?keywords=emergency%20management

U.S. Department of Housing and Urban Development, Community Development Block Grants/Entitlement Grants

"The objective of this program is to develop viable urban communities, by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for persons of low and moderate income. Recipients may undertake a wide range of activities directed toward neighborhood revitalization, economic development and provision of improved community facilities and services." Eligible activities include, "construction of public facilities and improvements, such as water and sewer facilities, streets, neighborhood centers, and the conversion of school buildings for eligible purposes."

Deadline: N/A

Award max; N/A

Website: https://www.hudexchange.info/programs/cdbg-entitlement/

U.S. Department of Housing and Urban Development, Community Development Block Grants/Section 108 Loan Guarantee Program

The program loan "provides communities with a source of financing for economic development, housing rehabilitation, public facilities, and other physical development projects, including improvements to increase their resilience against natural disasters."

Deadline: N/A

Loan max: $500,000 to $140,000,000

Website: https://www.hudexchange.info/programs/section-108/

U.S. Department of the Interior, Bureau of Reclamation, Small Scale Water Efficiency Projects

The program, "invite states, Indian tribes, irrigation districts, water districts, and other organizations with water or power delivery authority to leverage their money and resources by cost sharing with Reclamation on small-scale on-the-ground projects that seek to conserve, better manage, or otherwise make more efficient use of water supplies." *Based on the scale, the project may not qualify.*

Deadline: Please consult with the website list below

Award Max: 50% of project cost

Website: https://www.usbr.gov/watersmart/swep/index.html

U.S. Environmental Protection Agency, Clean Water State Revolving Fund

The fund “provides a permanent source of low-cost financing for a wide range of water quality infrastructure projects. These projects include municipal wastewater treatment and collection, nonpoint source pollution controls, decentralized wastewater treatment systems, green infrastructure, estuary management.”

Deadline: Please consult with the website list below

Website: https://www.epa.gov/cwsrf

U.S. Environmental Protection Agency, Water Infrastructure Finance and Innovation Act (WIFIA) Loan

The program, “accelerates investment in our nation’s water infrastructure by providing long-term, low-cost supplemental loans for regionally and nationally significant projects.” Eligible projects include, “ Clean Water SRF, Drinking Water SRF, efficiency projects at drinking water or wastewater facilities, aquifer recharge, alternative water supply, water recycling, and Drought prevention, reduction, or mitigation projects” among others. *Funding might conflict with Clean and Drinking water SRF. Minimum project size $20 million for large communities*

Deadline: Please consult with the website list below

Award max: 49% of eligible project costs

Website: https://www.epa.gov/wifia/learn-about-wifia-program

United States Department of Agriculture (USDA), Watershed and Flood Prevention Operations Program

The program offers assistance for the following: “Erosion and sediment control, Watershed protection, Flood prevention, Water quality Improvements, Rural, municipal and industrial water supply, Water management, Fish and wildlife habitat enhancement, Hydropower sources”

Deadline: N/A

Award max: N/A

Website: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/

STATE PROGRAMS

California Department of Water Resources, Integrated Water Management (IRWM) Implementation Grants

Program aims to "[Assist] water infrastructure systems adapt to climate change; [Provide] incentives throughout each watershed to collaborate in managing the region's water resources and setting regional priorities for water infrastructure"

Deadline: Tentative August 22, 2019

Award max: N/A

Website: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs/Proposition-1

California Department of Water Resources, Flood Control Subventions Program

This program "provides financial assistance to local agencies cooperating in the construction of federally authorized flood control projects."

Deadline: N/A

Website: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Flood-Control-Subventions-Program

California Department of Water Resources, Urban Streams Restoration Program

This program, "provides grants to local communities for projects to: Reduce flooding, erosion, and associated property damage, Restore, enhance, and/or protect the natural ecological values of streams, and Promote community involvement, education, and stewardship." *The White Water River flows through the city opening this as a potential funding source.*

Deadline: N/A

Award max: $1,000 to $1,000,000

Website: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Urban-Streams

California Department of Water Resources, Sustainable Groundwater Planning Grant

The program, "provides funds to develop and implement sustainable groundwater planning and projects." *A focus on infiltration into the groundwater would be helpful for a desert city.*

Deadline: Please consult with the website list below

Award max: $2,000,000

Website: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Sustainable-Groundwater

California State Water Resources Control Board, Clean Water State Revolving Fund Program (CWSRF)

This program assists in financing projects, which include, but are not limited to the construction of publicly owned treatment facilities, such as: wastewater treatment, local sewers, sewer interceptors, water reclamation and distribution, storm water treatment, combined sewers, and landfill leachate treatment.

Deadline: Please consult with the website list below

Website: http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/index.shtml

California State Water Resources Control Board, Drinking Water State Revolving Fund Program (DWSRF)

This program funds the planning/design and construction of drinking water infrastructure projects including: treatment systems, distribution systems, interconnections, consolidations, pipeline extensions, water sources, water meters, and water storages.

Deadline: N/A

Website: http://www.waterboards.ca.gov/drinking_water/services/funding/SRF.shtml

California State Water Resources Control Board, Storm Water Grant Program (SWGP)

The program promotes the beneficial use of storm water and dry weather runoff by funding storm water and dry weather runoff projects advancing water quality and realizing multiple benefits from the storm water and dry weather runoff as a resource.

Deadline: Please consult with the website list below

Award max: $90,000,000 program total

Website:
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/swgp/prop1/index.shtml

California Infrastructure and Economic Development Bank (I-Bank) State Revolving Fund (ISRF Loan Program)

The program provides a loan program for infrastructure projects and economic expansion projects. Infrastructure projects include city streets, county highways, drainage, water supply and flood control, educational facilities, environmental mitigation measures, parks and recreational facilities, port facilities, power and communications, public transit, sewage collection and treatment, solid waste collection and disposal, water treatment and distribution, defense conversion, public safety facilities, state highways, military infrastructure, and goods movement-related infrastructure.

Deadline N/A

Award max: $50,000 to $25,000,000

Website: http://www.ibank.ca.gov/infrastructure-state-revolving-fund-isrf-program/

California State Water Resources Control Board, Agriculture Drainage Program

Program created to, "address treatment, storage, conveyance, or disposal of agricultural drainage water that threatens waters of the State."

Deadline: N/A

Award max: $6,660,000 program total

Website: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/agdrain/agdrain_loan.shtml

LOAN FINANCING PROGRAMS

Pay-as-you-go

"Under a pay-as-you-go approach, revenues from impact fees would generate funding for construction. Impact fees would be collected and deposited in a special fund until enough money accumulates to begin a construction project. The size of the construction outlay may make pay-as-you-go a difficult approach or, at a minimum, require project phasing and supplementary funding from other sources. A drainage fee per acre (developer impact fee) could be established for new development or redevelopment projects for this purpose. The impact fee amount would be regulated by Section 66000 of the California Government Code, which governs impact fees relative to not being more than the costs that can be attributed to each new user."

Assessment Districts

"Assessment Districts formed under the conventional statutes (Improvement Acts of 1911, Municipal Improvement Act of 1913, and the Improvement Bond Act of 1915) provide some of less costly financing available because of the real estate security. Assessment districts do not require a vote, but do require notice and a protest at a required hearing by more than 50 percent of the property owners within the proposed district can stop the proceedings. Assessment districts can be initiated by a petition of property owners or by City Council action. Only improvements that provide a special benefit to properties can be assessed to a property. Improvements that provide a general regional benefit to property outside the district would not be eligible to include in an assessment district or would have to be funded by contributions outside the assessment district."

SECTION 7 - CONCULSIONS AND RECOMMENDATIONS

■ Conclusions and Recommendations

Based on the studies and investigations made for this report, it is concluded that:

1. The City of Indio has experienced serious flooding problems in the past. As the City continues to urbanize, the risk of flood damage is expected to increase unless the flood protection and drainage facilities identified in this report are constructed in an orderly manner.

2. A drainage system is required to safely convey stormwater runoff through the City with the least interruption to public services. The MDP presented in this report is such a system and is deemed the most feasible of the alternative studies.

3. The proposed MDP lends itself to staged construction as funds become available.

4. The proposed MDP offers a comprehensive long-term plan to provide stormwater facilities that are necessary to protect life and property from flood hazards in the City.

5. The total cost of the recommended improvements, including construction, right-of-way acquisition, engineering, administration and contingencies is estimated to be **$95,999,000**.

It is recommended that: the Master Drainage Plan be updated as set forth herein, be adopted by the City Council and be used as a planning level guide for future developments in the study area.

Implementation of the above recommendations will provide the City of Indio with a properly functioning storm drain system.

■ Future Growth of the City

Future growth of the City may be reflected in many aspects, such as an increase in the population; amendment of the approved specific plans; change of land uses; change of development densities; filing and approval of the new specific plans and tentative tract/ parcel maps and expanding of the city boundary through the annexation process. Since this report is based on the current land use and city boundary, land use change and new annexations will have an impact on the MDP. When these impacts become significant, the City shall develop the DIF policies for the newly annexed properties or conduct a new MDP update or partial update to accommodate the changes.

■ Limitations

The hydrologic analysis presented herein has been prepared in accordance with guidelines established by the Riverside County Flood Control and Water Conservation District. The design

criteria established for this study were discussed with the City and pre-approved by the City Engineer.

This document has been prepared at a level of detail appropriate for the scope of work. The methodology employed in the analysis was selected as suitable for the characteristic of the watershed; designated land use and proposed developments and existing drainage infrastructure. Our field investigation identified current flooding issues and deficiencies. This report presents some short-term solutions and future drainage improvements to alleviate flooding.

The MDP facilities described herein are conceptual in nature. The MDP provides a conceptual solution that addresses drainage problems within the City based on various engineering, environmental and economic considerations. By no means does the MDP represent the only feasible solution. The alignment and location of the facilities proposed in this report are general. Precise facility locations will be dictated by conditions and other factors existing at the time of design. More detailed analysis performed at the design stage will determine final facility sizing.

The use of this document is limited to addressing the purpose and scope previously defined by the City of Indio. The analyses presented in this report are not intended to be used for the detailed design. Webb shall not be held responsible for any unauthorized application of the report and the contents herein.

The opinions and conclusions presented in this report have been derived in accordance with the current standards of civil engineering practice, and from information and feedbacks provided by the City of Indio. No other warranty is expressed or implied.

APPENDIX A – MAPS AND EXHIBITS

- MDP Overall Facility Maps
- Existing Storm Drain Facilities
- Existing Catch Basins, Inlets, Drywells and Outlet to Whitewater Channel
- Drainage Issue / Flood-Prone Areas
- MDP Base Map - North 1”=2000’
- MDP Base Map – South 1”=2000’

APPENDIX B – HYDROLOGY AND HYDRAULICS CALCULATIONS

APPENDIX C – MDP FACILITY COST ESTIMATE