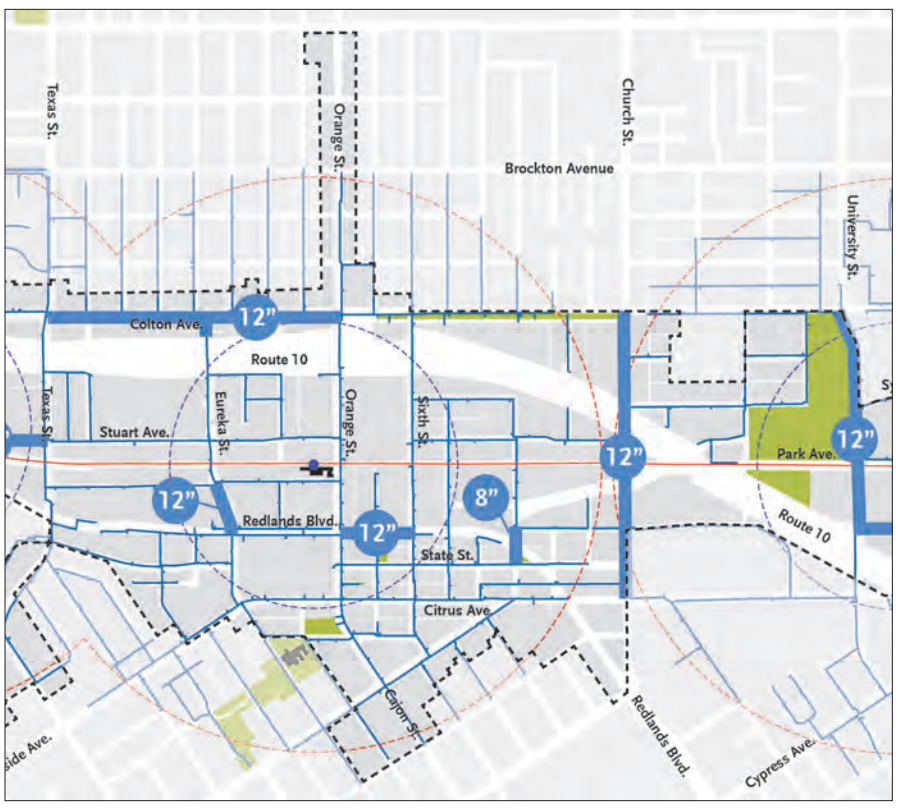
CHAPTER 8: INFRASTRUCTURE

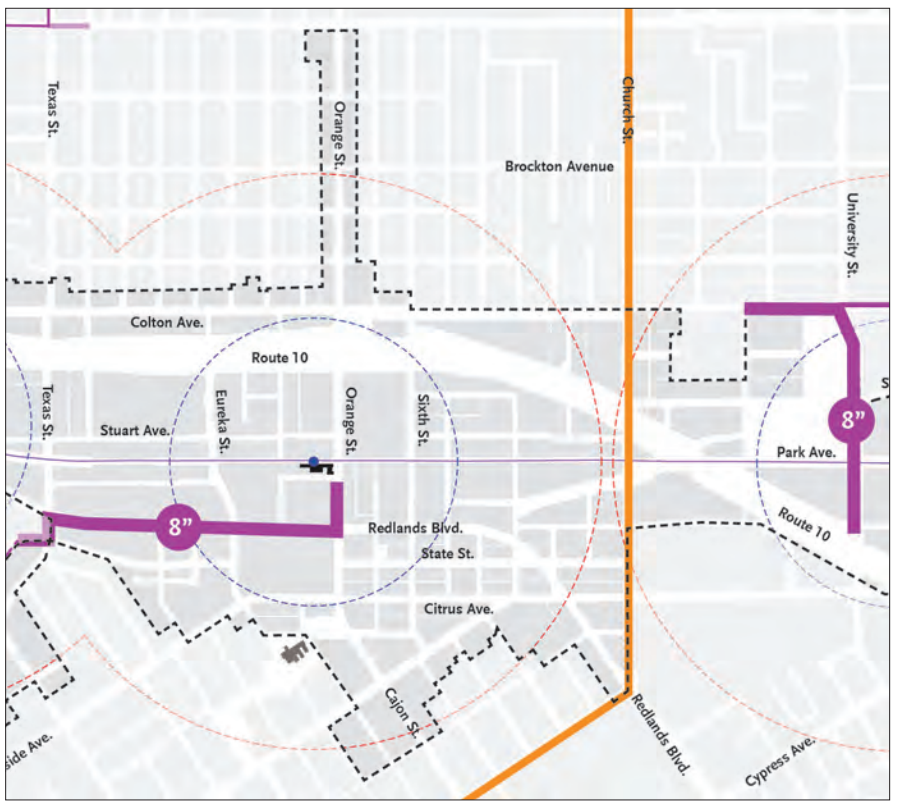
8.0. INTRODUCTION

This chapter discusses the existing and proposed distribution, location, and extent of the utilities infrastructure (potable and non-potable water, wastewater, and gas, electric, and phone), and other essential facilities needed to support the projected Specific Plan development program. It also proposes flood control measures to reduce the size and effects of the floodplain with the Downtown Station Area.

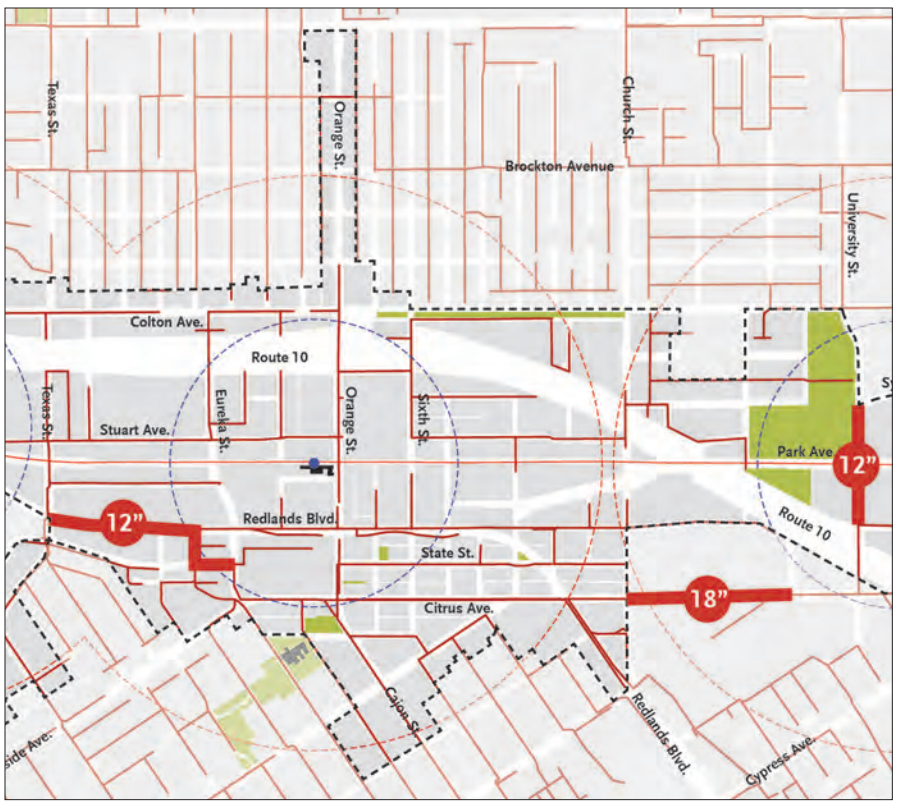
This Infrastructure Chapter is comprised of the following sections:



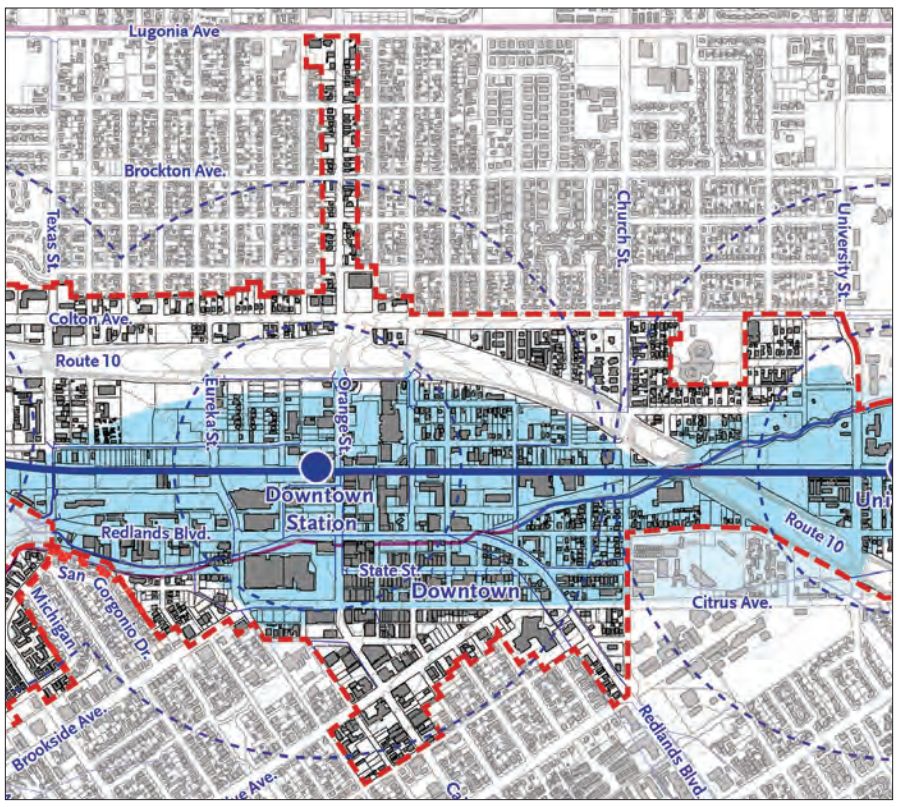
Detail of potable water network.



Detail of non-potable water network.



Detail of wastewater network.



Detail of existing flood plain.

8. INFRASTRUCTURE

8.1. INFRASTRUCTURE OBJECTIVES

The Specific Plan area has a mostly-complete utility infrastructure network with the ability to adequately service existing development per existing zoning. However, as the zoning is intensified to accommodate transit-oriented development around the three proposed stations, and as these areas are infilled over time, some upgrades to the utility network will be necessary to support the projected growth. In addition, much of the Plan Area – especially the parcels within a quarter mile of the three train stations – are within the 100-year flood plain. This Specific Plan:

- Ensures that the infrastructure systems are adequate to support the existing and proposed development in a sustainable manner.
- Propose methods for reducing the number of properties within the 100-year flood plain.

8.2. INFRASTRUCTURE IMPROVEMENTS

- In order to provide reliable fire suppression, some potable water mains should be upgraded due to their size and age.
- Non-potable water mains should be added to serve the New York Street/Esri and Downtown station areas. University of Redlands holdings should be served by an extended University-owned private non-potable system .
- Several segments of sewer main should be upgraded to avoid pinch-points in the system, which could otherwise be aggravated by intensive development.

8.3. POTABLE WATER

A. Existing Water Supply and Distribution.

1. **Potable Water Supply.** The City of Redlands currently serves approximately 24,000 customers with a five-year average potable water demand of 26,165 acre-feet per year. Currently, the majority of water is obtained from the Santa Ana River, Mill Creek, and groundwater. The City operates two surface water treatment plants, 20 wells, 37 booster pumps, 18 reservoirs, and 400 miles of transmission and distribution lines to provide water to its customers.

   Historical weather data from the National Oceanic and Atmospheric Administration (NOAA) and water production data for the City was used to identify water supply and demand trends, which most closely represent an average year, single-dry year, and multiple-dry year periods. Data available for analysis came from 1983-2015. Correlation of data indicates that during dry years, both single and multiple, demands can increase to 18.4% and supplies can decrease to 10.3%, cumulatively. Based on the City's available supplies, the City can continue to meet multiple and single dry year demands. (SBV RUWMP, 2016)

2. **Water Distribution.** Potable water mains exist in all streets of the plan area, but some are considered inadequate for fire protection due to size and age.

B. Domestic Water Distribution Improvements.

1. **Potable Water Demands.** Water Demands for Redlands are shown in Table 8-1.

2. **New Potable Water Demands** of the Specific Plan Program are depicted in Table 8-2.

3. **Potable Water System Improvements.**

   a. The present water system is generally adequate to serve existing development. The existing system consists of a wide variety of construction materials. Water mains within the project area are constructed of asbestos cement pipe, cement mortar lined and coated steel pipe, riveted steel pipe, cement lined riveted steel pipe, standard steel pipe, P.V.C. pipe, steel pipe, cast iron pipe and welded steel pipe. Generally, only the asbestos cement pipe, cement mortar lined and coated steel pipe, and cast-iron pipe are acceptable and can remain in place.

   b. Fire flow minimums will be established by the City for each building and water distribution system. Each installation must meet fire flow requirements.

   c. The City has had a couple of Master Plans for water distribution (Water Master Plan update by James M. Montgomery Consulting Engineers, Inc., February 1981 and Water Distribution Systems Master Plan by URS, August 2013) that recommend water main improvements. According to GIS data, some of the recommended upgrades have happened since the Water Master Plan (1981) was written and the following recommendations are adjusted accordingly. The Water Master Plan (2013) did not recommend any capital improvements within the TVSP area, so the following recommendations should be re-evaluated on a project-by-project basis.

   d. Water Master Plan (1981) recommendations for water mains which affect the TVSP area are (See Figure 8-1):

TABLE 8-1. *WATER DEMANDS*

Land Use Type	Water Demand	
	gpd/du	gpd/acre
Apartments	210	
Housing (single family)	280	
Hotel (100 gpd/room)	100	
Civic (0.10 gpd/sf)		4,536
Commercial (0,05 gpd/sf)		2,178
Parks (0.07 gpd/sf)		3,050

Based on City of Redlands "Water and Sewer Demands Spreadsheet" (May 8, 2019).

Irrigating with recycled water for landscapes and non-potable applications decreases dependence on groundwater pumping and imported water sources.

Stormwater flows through the Zanja as it passes through Sylvan Park.

- The 8” asbestos cement pipe and cast iron main in Colton Avenue from Texas Street to Orange Street should be replaced with a 12” asbestos cement pipe main (2,040 LF).
- Segments of the 8” asbestos cement pipe main in Eureka Street between Colton Avenue and Oriental Street should be replaced with a 12” steel cement lined and mortar coated main. Main shall be connected to existing 12” asbestos cement main that extends north from Redlands Boulevard (530 LF).
- The 2” steel and 2” PVC mains in Redlands Boulevard between Orange Street and Sixth Street should be replaced with a 12” steel cement lined and mortar coated main (660 LF).
- The 8” asbestos cement pipe main in Church Street between Colton Avenue and the alley between State and Citrus avenue should be replaced with a 12” steel cement lined and mortar-coated main (2,500 LF).
- The 8” cast iron mains in Stuart Avenue between Texas and New York Streets should be replaced with a 12” steel cement lined and mortar coated main (1,280 LF).
- The 8” steel main in Oriental Avenue between Eureka Street and Third Street should be replaced with an 8” steel cement lined and mortar coated main (600 LF).
- The existing 4” steel main in Ninth Street crossing Redlands Boulevard should be replaced with an 8” steel cement lined and mortar coated main (200 LF).

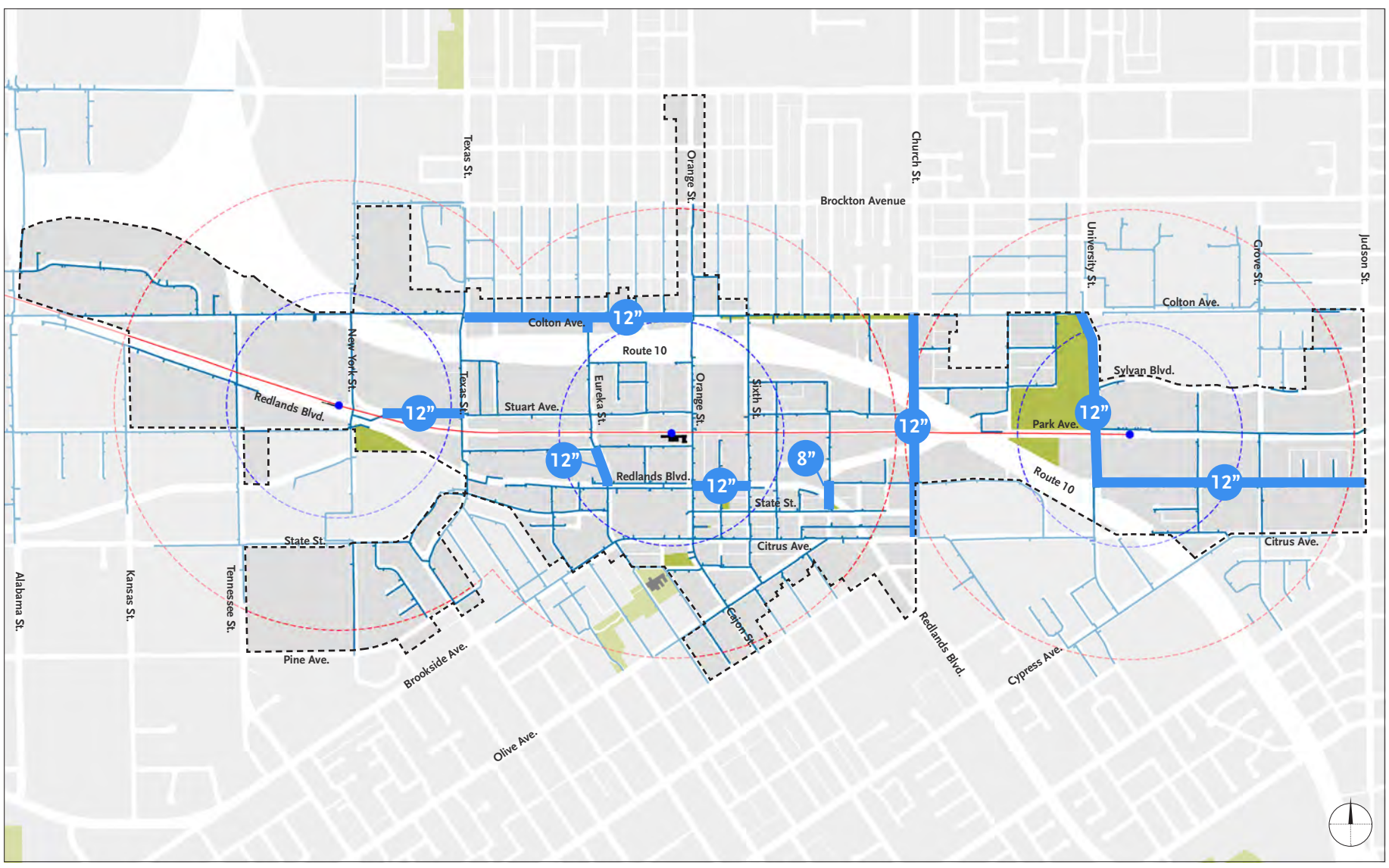
e. Additional recommendations to support the University Village Specific Plan build-out, based on review of the existing system (also see Figure 8-1), include:

- The 8” main in University Street between Colton Ave and Park Ave should be replaced with a 12” main (1,500 LF).
- The 4” main in Park Ave between University Street and Judson Street should be replaced with a 12” main (3,200 LF).

TABLE 8-2. *TVSP WATER DEMANDS*

Station Area	Development Area (acres)	Apartment Units (#)	Residential Water Demand (gpd)	Hotel Units (#)	Hotel Water Demand (gpd)	Commercial (acres)	Commercial Water Demand (gpd)	Parks (acres)	Parks Water Demand (gpd)	Civic (acres)	Civic Water Demand (gpd)	Total Water Demand (gpd)
New York/ Esri	19.20	489	102,690	0	–	2.31	5,031	0.63	1,922	0	–	**109,643**
Downtown	30.30	916	192,360	90	9,000	2.40	5,227	3.83	11,682	0	–	**218,269**
University	26.10	595	124,950	129	12,900	5.69	12,393	1.24	3,782	1.29	5,619	**159,644**
Total	**75.60**	**2,000**	**420,000**	**219**	**21,900**	**10.40**	**22,651**	**5.70**	**17,385**	**1.29**	**5,619**	**487,555**
											TOTAL WATER (GPM)	**339**
											TOTAL WATER (AFY)	**546**

FIGURE 8-1. *EXISTING AND PROPOSED DOMESTIC WATER DISTRIBUTION*



8. INFRASTRUCTURE

8.4. NON-POTABLE (RECYCLED) WATER SYSTEM

A. Existing Non-Potable Water System. A Study of Non-Potable Water System was prepared by Engineering Resources in January 2005. The City owns 29 wells that are part of the City's Non-Potable Water System. The 29 wells have varying levels of solvents, nitrates, pesticides, and ammonium perchlorate and cannot be used for potable water demands without treatment and/or blending. The wells can, however, be used for irrigation and other non-potable uses. In an effort to conserve potable water, the City has been constructing a non-potable water system that utilizes its non-potable water supply and reclaimed water from the City's Water Reclamation Facility (WRF) for irrigation, landscaping, and industrial uses. The city's non-potable distribution lines are located in the vicinity of the plan area, as shown in Figure 8-2. The New York Street/Esri and Downtown station areas are in Pressure Zone 2 with the nearest wells located just south of the Esri campus. The University Street station area is in Zone 3, with the University having its own private non-potable water system.

B. Domestic Non-Potable Water System Improvements. The Non-Potable Water System plan recommends that:

a. A 12" main be installed in New York Street (2,400 LF), and 20" mains be installed to connect to the two wells south of Esri. These improvements have already been completed.

b. An 8" main be installed from the State Street/Texas Street well east on State Street, north on Texas Street, and east on Oriental Avenue to serve the new Midtown Neighborhood Park and connect to the existing 8" main in Eureka Street (2,500 LF).

c. An 8" main be installed in Colton Avenue and University Street to accommodate expansion of the system to parks in the University Village area. See Figure 8-2.

8.5. WASTEWATER SYSTEM

A. Existing Wastewater System.

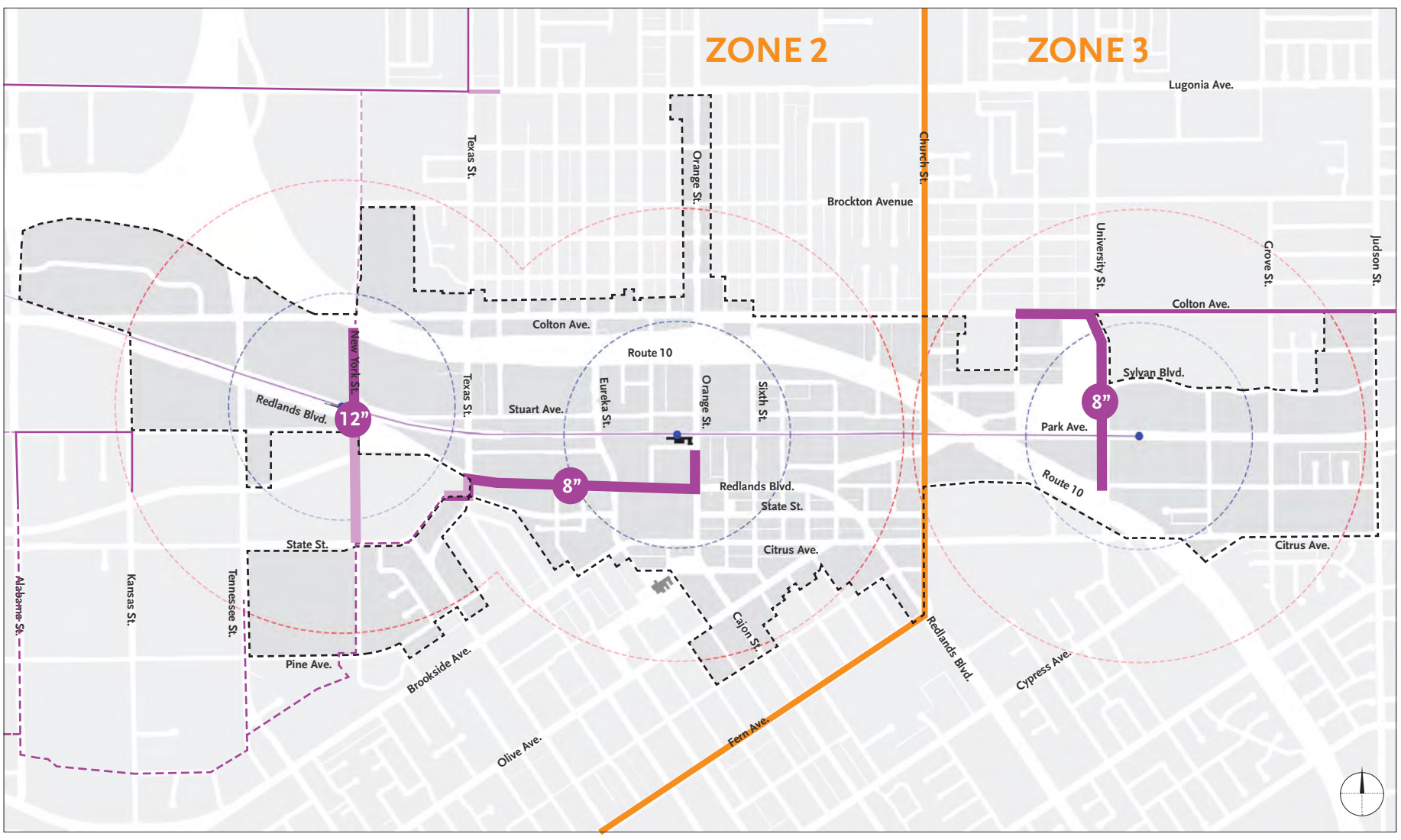
1. **Wastewater Treatment.** The City treats approximately 5.6 million gallons of wastewater daily. The Redlands Wastewater Treatment Facility is located in northwest Redlands adjacent to the Santa Ana River. The City's Wastewater Treatment Plant (WWTP) has the capability to treat 9 million gallons a day (MGD) to a secondary level. Of that, 7.2 MGD can be treated to a tertiary level. All wastewater collected and treated is from the City's service area and is discharged within the City's service area. The City utilizes all wastewater collected and treated at its WWTP in its service area for distribution to customers and Percolation into Bunker Hill. The City requires new commercial development to provide dual plumbing for irrigation systems in order to accommodate the use of recycled/non-potable water.

2. **Sanitary Sewer System.** City Sewer Mains, per the City of Redlands, service the plan area as shown in Figure 8-3. . In general, wastewater effluent from all of the TVSP flows westerly through the University, Downtown and New York Villages toward the treatment plant. Redlands Public Works does not have a sewer model, but is unaware of any problems with the system within the TVSP area.

3. **Sewer Demands.** Sewer Demands for Redlands are shown in Table 8-3.

4. **New Sewer Demands** generated by the TVSP development program are depicted in Table 8-4.

FIGURE 8-2. *EXISTING AND PROPOSED NON-POTABLE WATER SYSTEM*



LEGEND

- Specific Plan Boundary
- 1/4 Mile Pedestrian Shed
- 1/2 Mile Pedestrian Shed
- Existing Non-Potable Water Pipeline
- Proposed Non-Potable Water Pipeline
- x" TVSP Pipeline Upgrade
- Pressure Zone Boundary

B. Wastewater System Improvements.

1. Sewer System Improvements. New development within the TVSP will add a total peak hour flow of 1.81 CFS in the peak hour, which is roughly equivalent to the capacity of a 10" sewer. See Figure 8-3.

While a sewer model should be developed to confirm system dynamics, estimated improvements to the system include (see Figure 8-3):

a. A 12" sewer should replace the 8" sewer (or an 8" sewer should be added) in University Street from Park Avenue to the I-10 Freeway (725 LF).

b. An 18" sewer should replace the 15" sewer (or an 8" sewer should be added) in Citrus Avenue from Central Avenue to just past Church Street (1,750 LF).

c. A 12" sewer should be added in State Street from Eureka Street to 1st Street, thence north on 1st St to Redlands Boulevard, thence west on Redlands Boulevard to Texas Street (2,000 LF).

d. The 1986 Wastewater System Master Plan should be updated.

e. Prior to any street construction within the project area, the need for replacement of sewer mains to meet ultimate capacity or to replace for age or condition should be verified.

f. The condition of all trunk sewer within the TVSP area, and downstream to the WWTP (8" or above) should be verified.

g. Field data on invert elevations should be obtained and plotted on a scaled plan to enable rapid determination of capacity of all lines within the area.

TABLE 8-3. *SEWER DEMANDS*

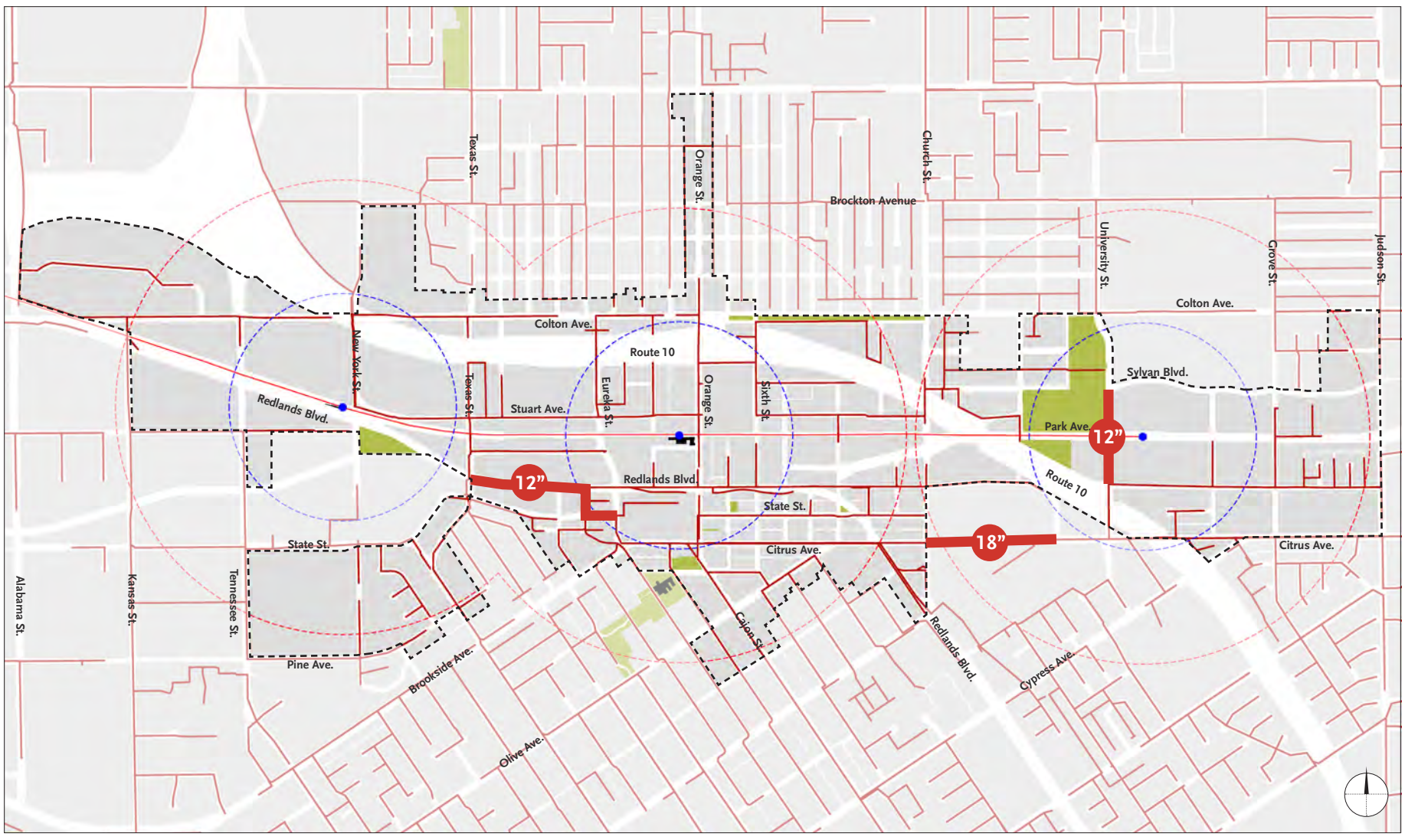
Land Use Type	Sewer Load	
	gpd/du	gpd/acre
Apartments	210	
Housing (single family)	280	
Hotel (100 gpd/room)	100	
Civic (0.10 gpd/sf)		4,536
Commercial (0,05 gpd/sf)		2,178
Parks (0.07 gpd/sf)		0

Based on City of Redlands "Water and Sewer Demands Spreadsheet" (May 8, 2019).

TABLE 8-4. *TVSP NEW SEWER LOADS*

Station Area	Development Area (acres)	Apartment Units (#)	Residential Sewer Load (gpd)	Hotel Units (#)	Hotel Sewer Load (gpd)	Commercial (acres)	Commercial Sewer Load (gpd)	Civic (acres)	Civic Sewer Load (gpd)	Total Sewer Load (gpd)
New York/ Esri	19.20	489	102,690	0	–	2.31	5,031	0	–	**107,721**
Downtown	30.30	916	192,360	90	9,000	2.40	5,227	0	–	**206,587**
University	26.10	595	124,950	129	12,900	5.69	12,393	1.29	5,619	**154,177**
Total	**75.60**	**2,000**	**420,000**	**219**	**21,900**	**10.40**	**22,651**	**1.29**	**5,619**	**468,486**

FIGURE 8-3. *SANITARY SEWER SYSTEM AND PROPOSED UPGRADES*



LEGEND

- Specific Plan Boundary
- 1/4 Mile Pedestrian Shed
- 1/2 Mile Pedestrian Shed
- Existing Sewer Pipeline
- x" TVSP Sewer Pipeline Upgrade

8. INFRASTRUCTURE

8.6. FLOODWATERS AND DRAINAGE

A. Existing Floodwaters and Drainage.

1. **Flooding.** The TVSP area has historically experienced flooding during moderate storm events. Portions of the plan area – particularly the majority of the parcels within a quarter mile of the three stations – are located within the Flood Zone (see Figure 8-4). Per the Redlands Floodplain Regulations, in a FEMA Floodzone any new "occupiable" finished floor must be at least two feet above the 1% (100-year) base flood elevation. In addition, any floodplain cross-section modifications (earthen platforms) may not cause more than a one-foot water surface elevation increase upstream. These floodplain conditions create significant challenges to existing and new development, especially in commercial zones where zero-step entries are required.

2. **Drainage.** Per the 2014 Master Plan of Drainage (MPD) Executive Summary, the causes of the flooding include both local and regional storm drain deficiencies. The main cause of the flooding is a lack of conveyance capacities in the Mission Zanja (Zanja), the Redlands Boulevard storm drain, and the Oriental storm drain. With a capacity of approximately 2,400 cubic feet per second (CFS), the Redlands Boulevard storm drain receives over 4,200 CFS from the Zanja and the Carrot storm drain and 4,000 CFS from Reservoir Canyon and the Oriental storm drains. All four of these tributaries experience a confluence near the intersection of Redlands Boulevard and Ninth Street. Over the past three decades, the focus of several studies has been to reduce the flood potential from the Zanja and Reservoir Canyon storm drain. Several alternatives have been investigated and proposed, ranging from multiple detention basins, to a downtown "bypass" structure that would direct Zanja flows around the Redlands Boulevard storm drain.

The May 2014 MPD Proposed Priorities (see Figure 8-5) show proposed high priority improvements for the plan area. The MPD also provides details and cost estimates.

In addition, the MPD describes the two following alternatives for dramatically reducing flood events in the downtown area:

- Alternate 1. A 15'W x 9'H RCB added in Redlands Boulevard (see Figure 8-6).
- Alternate 2. A 12'W x 8'H RCB located midblock north of Redlands Boulevard that by-passes Redlands Boulevard (see Figure 8-7).

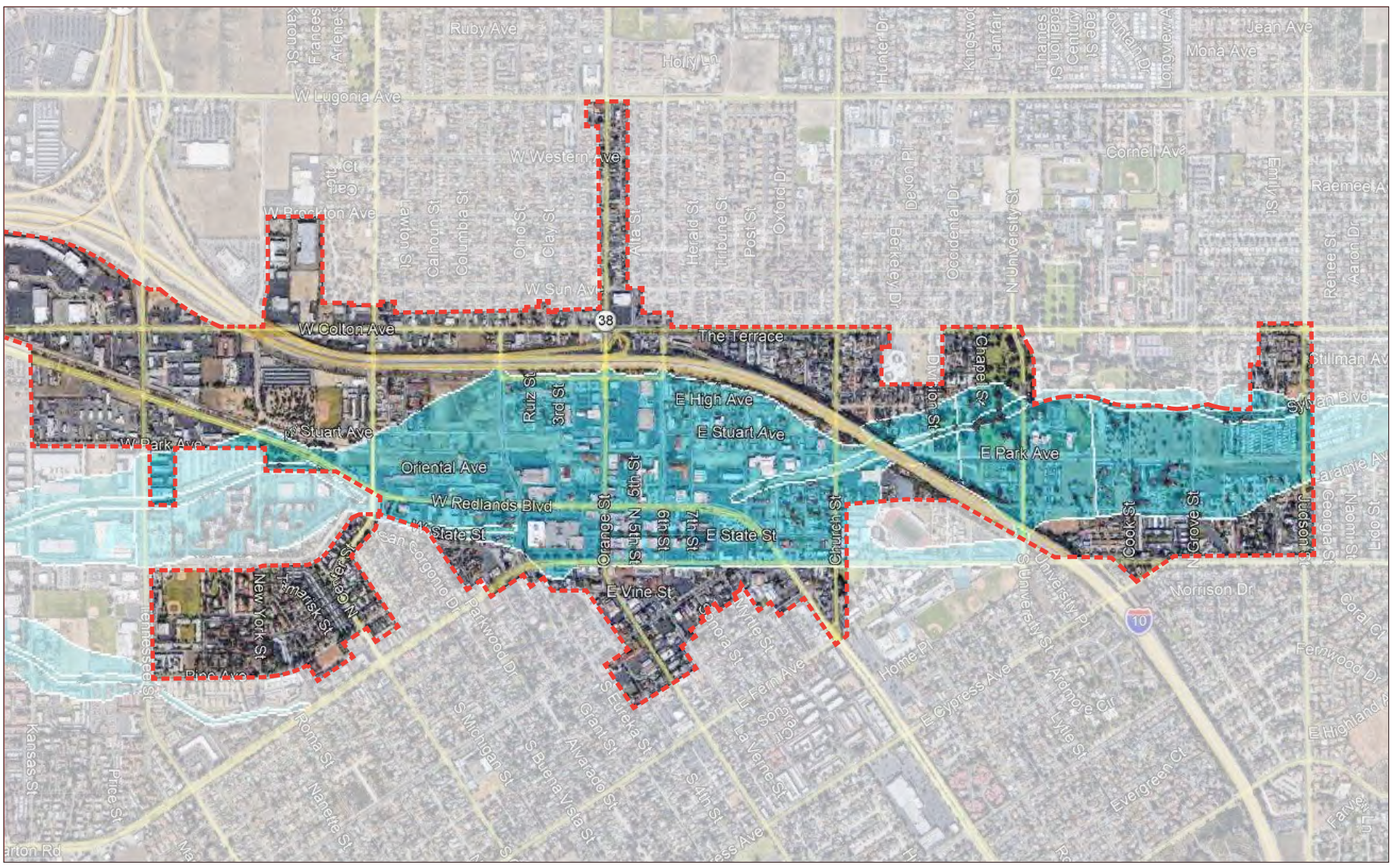
B. Flooding and Drainage Improvements.

1. **Downtown Station Area Improvements.**

   a. **Prepare and Process a Letter of Map Revision (LOMR).** Additional advanced hydrologic modeling (see Appendix A) was performed to investigate the parameters of the existing Flood Insurance Rate Map (FIRM) and determine the feasibility of removing properties from the Floodplain. It was found that modeling using new precise LIDAR topography and advanced hydrology software could result in a potentially reduced Floodplain Area. See Figure 8-8 as compared to Figure 8-4.

   While the LOMR process may cost the City $100,000, it a) could potentially result in the removal of approximately 155 core properties from being subject to the City's Floodplain Regulations, b) would subsequently eliminate the associated private Floodplain Insurance costs these property owners pay on an annual basis (estimated at $2,000 per property per year), c) would accordingly encourage and facilitate

FIGURE 8-4. *EXISTING 100-YEAR FEMA FLOOD PLAIN*



LEGEND

- Specific Plan Boundary
- Flood Plain

development on these properties, and d) would result in street-oriented, pedestrian-friendly buildings since new buildings would not need to be raised two feet above the floodplain.

b. **Implement MPD Alternative 1 for Downtown.** The additional advanced hydrologic modeling found that implementation of Alternative 1 from the MPD resulted in further significant reduction of the Floodplain area. See Figure 8-9.

   While the MPD Alternative 1 process and construction may cost the City $15 million, it a) could remove an additional 231 core properties from being subject to the City's Floodplain Regulations, b) would eliminate the associated private Floodplain Insurance costs these property owners pay on an annual basis (estimated at $2,000 per property per year), c) would accordingly encourage and facilitate development on these properties, and d) would result in street-oriented, pedestrian-friendly buildings since new buildings would not need to be raised two feet above the floodplain.

2. **University Street Station Area Improvements.** The Zanja channel that runs through this station area is undersized. It is recommended that a diversion drainage system be explored that intercepts flows near or east of North Grove Street where it would be conveyed parallel to the Zanja and discharged (into the Zanja) just upstream of the I-10 underpass.

3. **New York Street/Esri Station Area Improvements.** The Zanja channel (Mission Creek) that runs through this station area is undersized, yet some flood conveyance capacity could be improved by increasing the sizes of the Kansas Street, New York Street, and Tennessee Street crossings. At Tennessee Street, the crossing height is restricted most likely due to utility crossings. It is recommended that the City evaluate the crossings downstream of the Esri campus within the Mission Creek (Zanja channel) to potentially increase the flow capacity to the channel. This task would include evaluating/improving the crossings from approximately Alabama Street to New York Street.

4. **Improvements for Properties Subject to Floodplain Regulations.** As mentioned above, all new retail, commercial, and multi-family development on properties within the floodplain must, per the City's Floodplain Regulations, employ flood mitigation measures that raise the ground floors to safe levels. However, until this happens, there are a number of design responses that can ensure that these mitigation measures maintain a street-oriented, pedestrian-friendly urban character. These urban regulations are as follows:

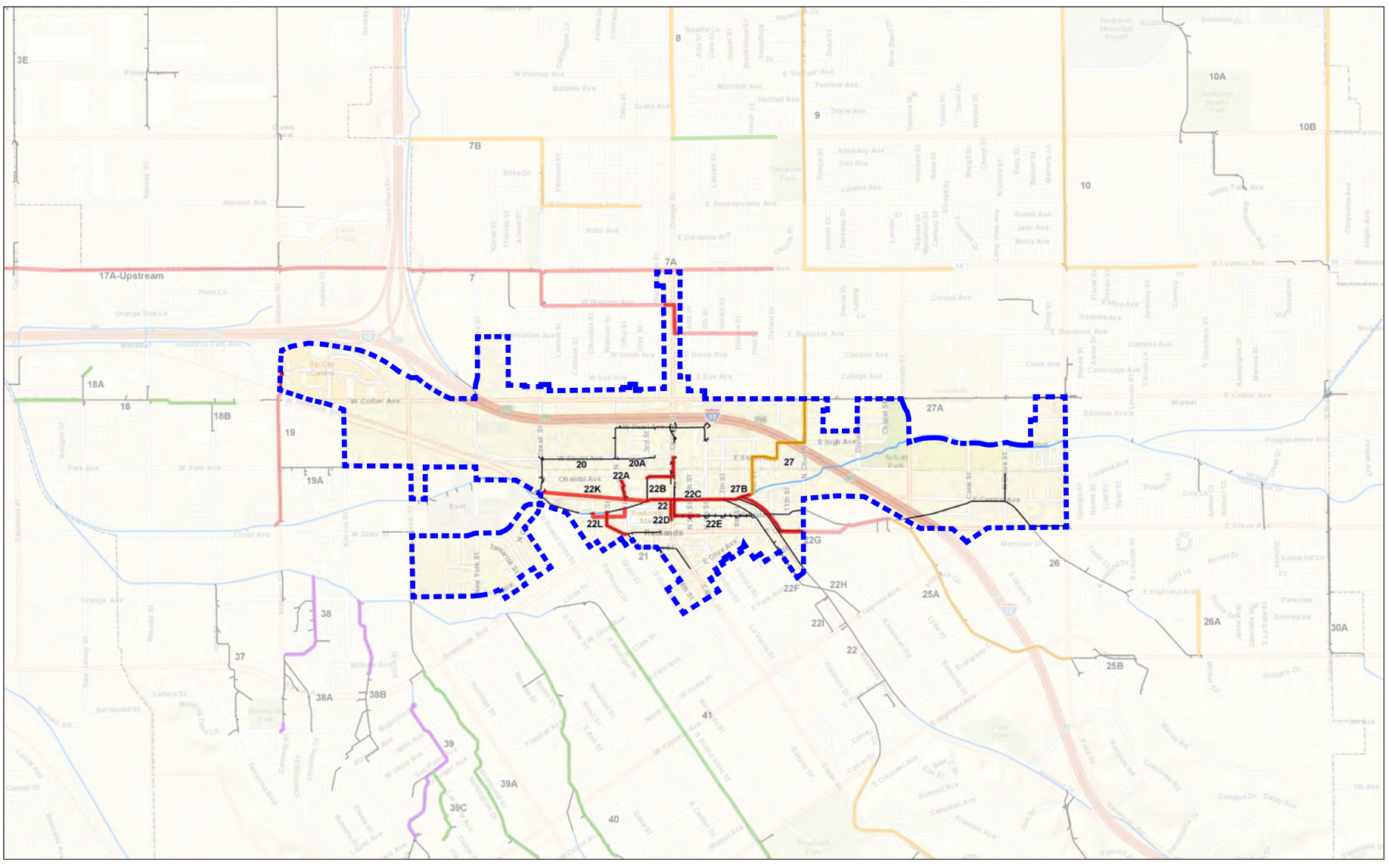
   a. Provide flood control mitigations that raise the ground floors on all new retail, commercial, and multi-family development so that measures implemented are seamless with existing fabric in terms of scale, frontage, and fenestration.

   b. Ensure that measures implemented do not detract from the experience of the pedestrian and that the measures encroach as little as possible into the public right of way, while at the same time remain as accessible as possible.

   c. All development in the TVSP area must adhere to these standards:

      - Measures undertaken must raise ground levels to comply with safe levels as established by City of Redlands Floodplain Regulations and FEMA Flood Zone maps. "Safe Levels" will be established on a case by case basis

FIGURE 8-5. REDLANDS MASTER PLAN OF DRAINAGE PROPOSED PRIORITIES.



LEGEND

- Specific Plan Boundary
- Open Channel
- Existing Storm Drain
- 2 Storm Drain Facility ID
- Proposed Main Line Priority
  - 1A
  - 1B
  - 2
  - 3

8. INFRASTRUCTURE

8.6. FLOODWATER AND STORMWATER (CONTINUED)

FIGURE 8-6. *MASTER PLAN OF DRAINAGE ALTERNATIVE 1*

FIGURE 8-7. *MASTER PLAN OF DRAINAGE ALTERNATIVE 2.*

FIGURE 8-8. *100-YEAR FLOOD PLAIN MODELED WITH LIDAR TOPOGRAPHY AND ADVANCED HYDRAULIC MODELING*

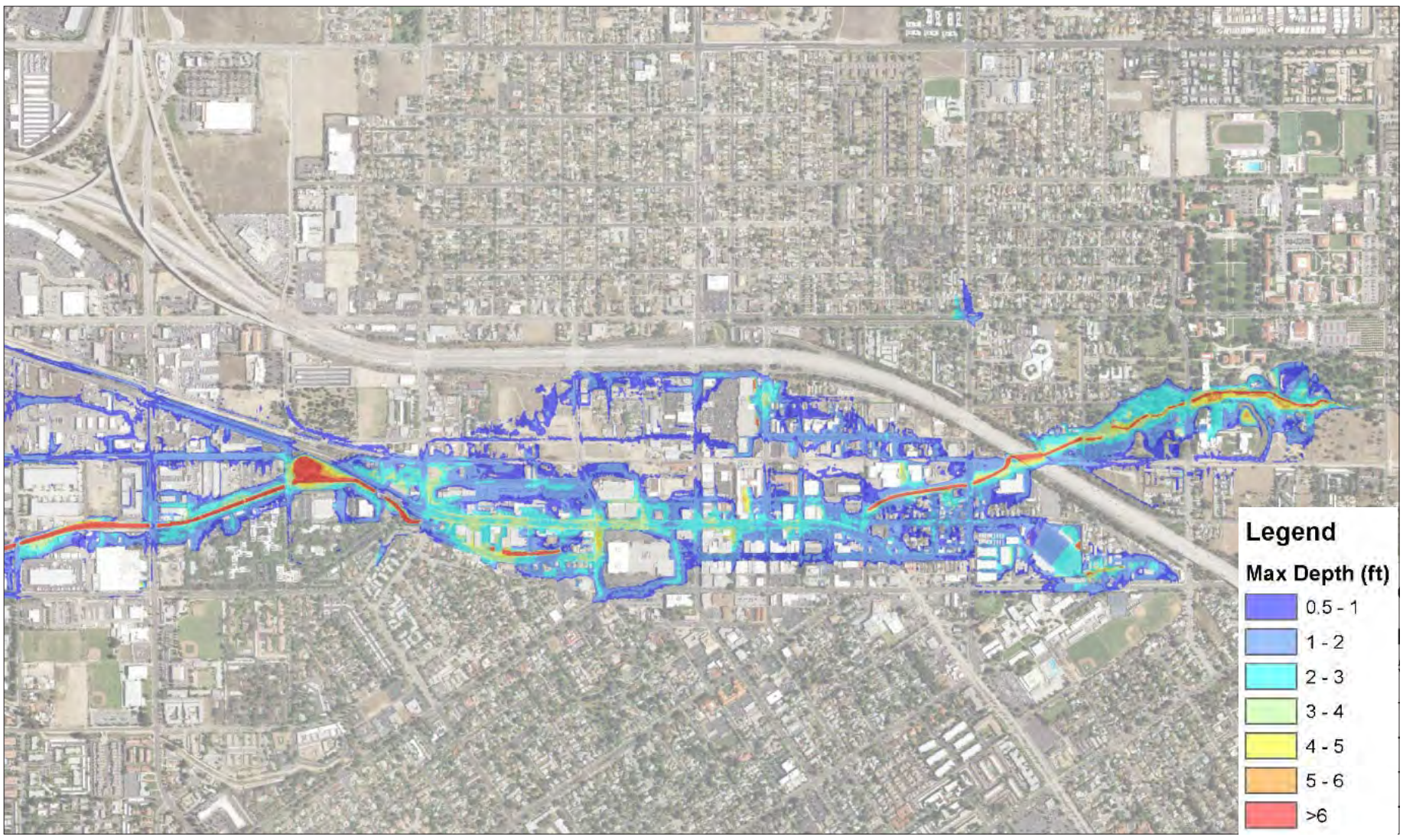
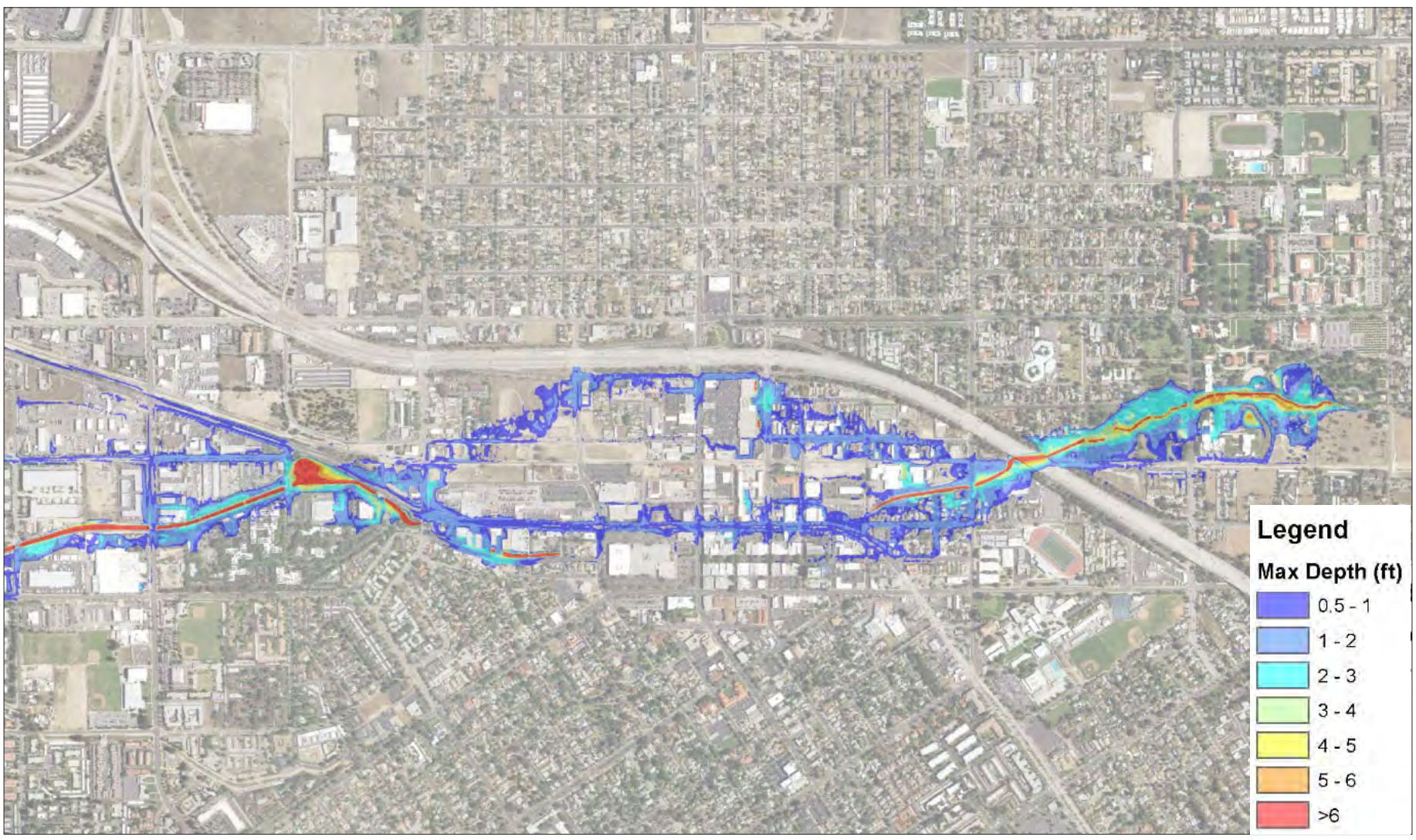


FIGURE 8-9. *100-YEAR FLOOD PLAIN WITH IMPLEMENTATION OF MPD ALTERNATIVE 1 (CULVERT IN REDLANDS BOULEVARD.*



by the Project Engineer and reviewed and approved by the Chief Building Official.

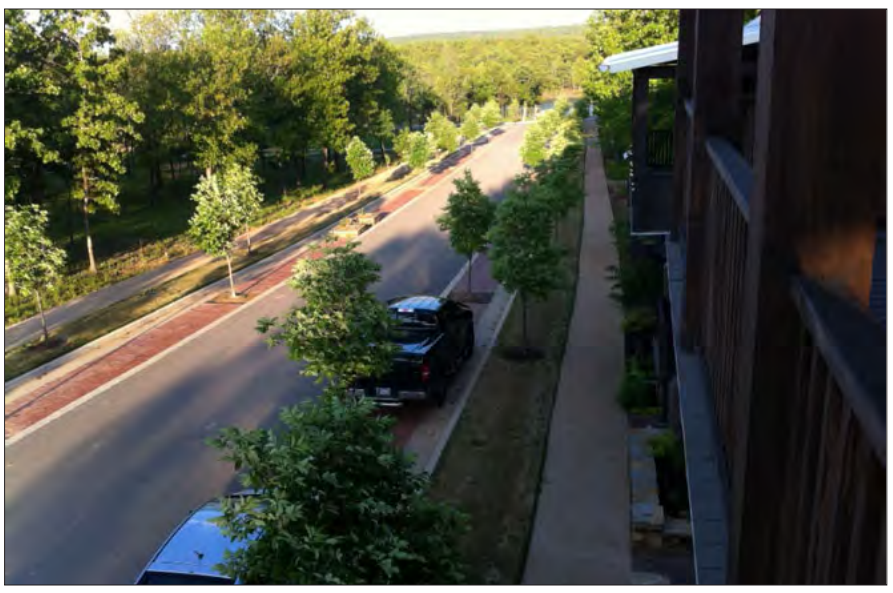
- Measures undertaken shall comply with the American Disabilities Act and the State Building Code. These shall provide appropriate ramping for handicapped access.
- Wheelchair ramps may extend or project into a required rear or sideyard but shall be designed to minimize the encroachment in the required front yard.
- Measures undertaken shall not present large blank walls to the public right-of-way. At least 75% of a building's frontage should be activated with steps, landscaping, street furniture, etc.
- There shall be breaks in any flood control intervention such as raised sidewalks, every 30 feet. Examples of features that can break up the monotony of flood control interventions include stairways, entrances, and planting features.
- Windowsills of new buildings shall be in character (in terms of height and placement) with adjacent buildings.
- A ramp may only occupy up to 15 % of building frontage. Properties with limited frontage may be exempted from this through design review by the Development Services Department.
- Ramps and ramp handrails on all ramps greater than 20 feet in length must be hidden behind street walls or landscaping features such as hedges.
- Elevated sidewalks, arcades, and galleries can only be utilized when the new development is greater than 120' in width.

Removing properties from the flood plain is essential for creating an urban, pedestrian-friendly environment where buildings – especially those with retail ground floors – can be accessed directly from the sidewalk, as is currently the case in Redlands' Downtown commercial district. Directly sidewalk access into buildings is the defining characteristic of virtually every successful American downtown and is critical for generating active, vibrant streets. Per existing standards, new buildings that are introduced along streets such as State Street east of Orange Street, where properties are currently located one foot below the floodplain, would need to have ground floors that are three feet above adjacent existing buildings (since, per City standards, the new ground floors must be located two feet above the floodplain). As seen in Figure 8-9, implementation of MPD Alternative 1 removes all the properties along State Street from the floodplain. It also raises above the floodplain the parking lots along Citrus Avenue that could accommodate future infill, resulting in development with ground floor levels consistent with existing, surrounding Downtown buildings.

Similarly, creating a walkable environment around the three stations (especially the Downtown and University Village stations, which are both located below the floodplain) is essential to generating successful, transit-oriented places. Like Downtown, a mixed-use retail environment is planned for the are around the University Street station.

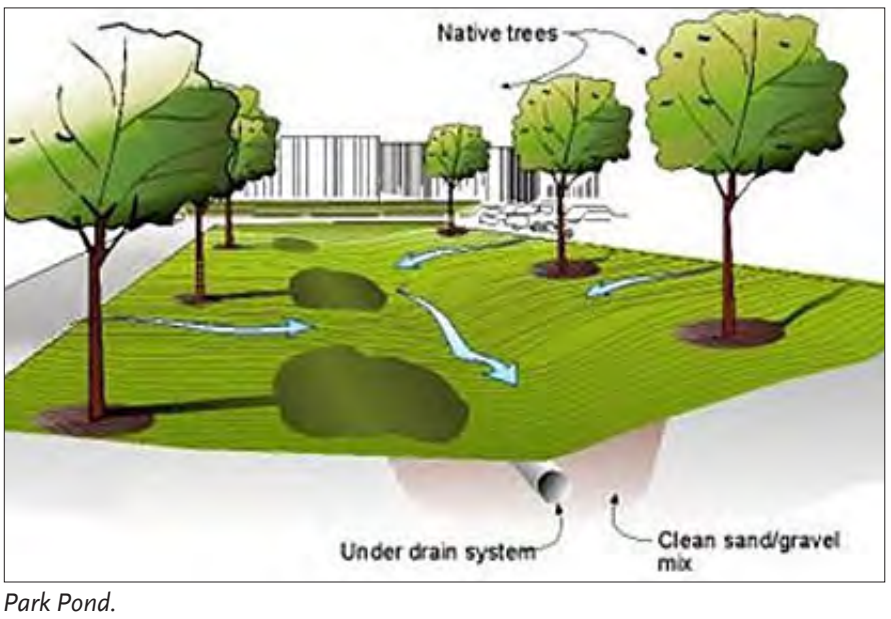
Finally, removing properties from the floodplain – especially if the implementation costs are paid for by State or Federal grants – would lower the cost of development and accordingly encourage and facilitate development. Once built, the new development will generate tax revenues for the City.

Tree Pocket and Pervious Pavers.



Tree Zippers.

Simple Green Street.



Park Pond.

8.7. SUSTAINABLE STORMWATER MANAGEMENT AND STRATEGIES

A. Conventional Stormwater Management. Also known as pave-pipe-and-dump, conventional engineering treats rainwater as a waste product and tries to collect, channelize, and dump it in pipes and rivers.

B. Green Infrastructure Rainwater Management. Also known as low impact design, green infrastructure attempts to mimic nature by capturing and infiltrating rainwater near to where it falls, thus reducing pipe sizes and increasing groundwater recharge while creating spaces that people enjoy.

1. Green Infrastructure Best Management Practices (BMPs).

    a. Tree Pockets and Tree Zippers. This is a road diet practice in which pavement is removed in order to plant trees. A tree pocket is often installed every couple of parking spaces, and a tree zipper involves removing a strip of asphalt and planting trees along the strip – often to create a protected bike lane.

    b. Simple Green Streets. This is a green infrastructure practice in which the street side planting strip is scooped out, trees are planted, and curbs are slotted to allow rainwater to enter and leave the planting strip.

    c. Park Ponds. This is a multi-purpose green infrastructure in which parks are depressed so that they can serve a dual role as a retention pond.

    d. Pervious Pavers. Pervious pavers allow rainwater to infiltrate between the pavers and into the gravels and soils underneath the pavers.

In general, conventional stormwater management addresses the large storm events that cause flooding while green infrastructure addresses the smaller events that cause nuisance flows and first-flush pollution. It should be noted that the smaller events comprise, typically, over 85% of the annual rainfall. Thus, BMPs need to be evaluated and selected on a project-by-project basis.

8.8. DRY UTILITIES

A. Dry Utilities. As new development occurs, undergrounding of utilities shall be required for lines that are less than 66 kV. For lines 66kV or greater, the City may consider working with a developer to utilize existing undergrounding funds in order to underground these larger utilities. GTE (telephone), Southern California Edison (electrical) and Southern California Gas (gas)) have indicated that their existing facilities and policies are adequate to serve the existing and future development.

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