FINAL REPORT | MAY 2025

# Cooper's Creek and San Timoteo Creek Habitat Characterization and Sustainability Report

**PREPARED FOR**

City of Beaumont

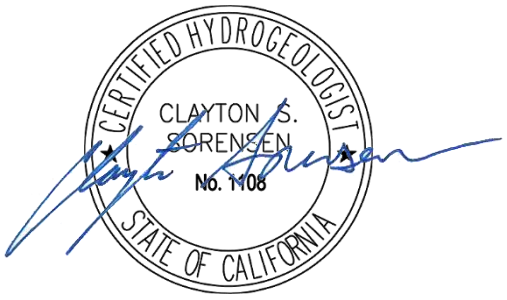
**PREPARED BY**

# Cooper's Creek and San Timoteo Creek Habitat Characterization and Sustainability Report

**Prepared for**

## City of Beaumont

**Project No. 1113-80-23-01**




| | |
|---|---|
| Prepared by: Clay Sorensen, CHG, CHG#1108 | May 21, 2025<br>Date |
| Prepared by: Veva Weamer | May 21, 2025<br>Date |
| QA/QC Review: Samantha Adams | May 21, 2025<br>Date |

# Table of Contents


**1.0 Introduction ..... 1**

1.1 Adaptive Management and Mitigation Plan (AMMP) ..... 1

1.2 Scope to Develop AMMP ..... 1

1.3 Report Outline ..... 2

**2.0 Background and Setting ..... 4**

2.1 Current and Historical Operations of the WWTP ..... 4

2.2 Regulatory Setting ..... 6

2.2.1 Regional Water Quality Control Board Requirements ..... 6

2.2.2 State Water Resource Control Board Requirements ..... 8

2.2.3 Existing Monitoring and Reporting Programs ..... 8

2.2.3.1 Maximum Benefit Monitoring Program ..... 9

2.2.3.2 Beaumont WWTP NPDES Permit Monitoring ..... 9

2.2.3.3 SAWA Biological Monitoring ..... 9

2.2.4 Water Rights ..... 9

2.3 Physical Setting ..... 11

2.3.1 Surface Water Hydrology ..... 11

2.3.1.1 Surface Water Bodies ..... 11

2.3.1.2 Climate and Precipitation ..... 11

2.3.2 Geologic Setting ..... 14

2.3.2.1 Local Geologic Setting ..... 14

2.3.2.2 Geologic Structure ..... 14

2.3.3 Hydrogeologic Setting ..... 14

2.3.3.1 Water Bearing Formations ..... 15

2.3.3.2 Groundwater Occurrence and Flow ..... 15

2.3.3.3 Groundwater Age and Quality ..... 15

**3.0 Initial Goals, Objective, and Performance Criteria ..... 17**

3.1 Goals and Objectives ..... 17

3.2 Performance Criteria ..... 18

**4.0 Historical and Existing Biological Resources ..... 19**

4.1 Regional Ecological Setting ..... 19

4.1.1 Regional Riparian Ecology ..... 19

4.2 Historical Biological Resources ..... 22

4.2.1 Cooper's Creek ..... 22

4.2.1.1 Riparian Plant Communities ..... 22

4.2.1.2 Wildlife ..... 23

4.2.2 San Timoteo Creek ..... 25

4.2.2.1 Riparian Plant Communities ..... 25

4.2.2.2 Wildlife ..... 25

4.3 Existing Biological Resources ..... 27

4.3.1 Methods ..... 28

# Table of Contents


4.3.1.1 Vegetation Sampling Surveys ..... 28
4.3.1.2 General Inventory of Biological Resources ..... 38
4.3.1.3 Focused Protocol Surveys ..... 38
4.3.2 Cooper's Creek ..... 38
4.3.2.1 Riparian Plant Communities ..... 38
4.3.2.2 Wildlife ..... 54
4.3.3 San Timoteo Creek ..... 55
4.3.3.1 Riparian Plant Communities ..... 55

**5.0 Historical Riparian Habitat Health (NDVI) ..... 70**

5.1 Overview of NDVI Analysis ..... 70

5.2 Overview of Riparian Zone, Study Segments, and Focus Areas ..... 71

5.3 Temporal Analysis of NDVI ..... 72
5.3.1 Cooper's Creek 1 Segment and Focused Areas (FA01 to FA06) ..... 75
5.3.2 San Timoteo 1 Segment and Focused Areas (FA07 and FA08). ..... 76
5.3.3 San Timoteo 2 Segment and Focused Areas (FA09 and FA10) ..... 77
5.3.4 Conclusions from Temporal Analysis ..... 77

**6.0 Hydrologic Characterization ..... 89**

6.1 WWTP Discharges ..... 89

6.2 Surface Water ..... 91
6.2.1 Surface Water Flows ..... 91
6.2.2 Surface Water Quality ..... 94
6.2.2.1 Nitrate as Nitrogen ..... 94
6.2.2.2 Total Dissolved Solids (TDS) ..... 97

6.3 Groundwater Levels ..... 98
6.3.1 Groundwater Elevation Time Series ..... 98
6.3.2 Groundwater Flow System ..... 99
6.3.3 Depth to Groundwater ..... 99

6.4 Groundwater Quality ..... 102
6.4.1 Nitrate ..... 102
6.4.2 Total Dissolved Solids ..... 105

**7.0 Factors that Impact Riparian Habitat ..... 106**

7.1 Surface Water Flows ..... 106
7.1.1 Cooper's Creek 1 Segment ..... 108
7.1.2 San Timoteo 1 Segment ..... 109
7.1.3 San Timoteo 2 Segment ..... 111
7.1.4 Summary ..... 113

7.2 Groundwater Levels ..... 113
7.2.1 Cooper's Creek 1 Segment ..... 114
7.2.2 San Timoteo 1 Segment ..... 114
7.2.3 San Timoteo 2 Segment ..... 115

# Table of Contents


7.2.4 Summary ..... 115

7.3 Hydrological Impacts to Biological Resources ..... 119
7.3.1 Surface Water ..... 119
7.3.2 Groundwater ..... 119

7.4 Other Climate Factors ..... 120

7.5 Wildfires ..... 121

7.6 Invasive Species and Pests ..... 121

7.7 Data Gaps ..... 123
7.7.1 Riparian Vegetation Data ..... 123
7.7.2 Groundwater Level Data ..... 123
7.7.3 Surveyed Elevations of Reference Points and Thalweg ..... 124
7.7.4 Frequency of Surface Water Flow Measurements ..... 124

**8.0 Baseline Monitoring and Data Collection Program ..... 126**

8.1 Riparian Habitat Monitoring ..... 126
8.1.1 Remote Sensing ..... 126
8.1.2 Drone Surveys ..... 126
8.1.3 Ground Surveys ..... 128

8.2 Surface Water Monitoring ..... 128

8.3 Groundwater Monitoring ..... 131

8.4 Reference Point and Thalweg Elevation Surveys ..... 131

8.5 Climate ..... 132

8.6 Feasibility of Reduced Discharge ..... 132

8.7 Implementation and Reporting ..... 133

**9.0 Conclusions and Performance Criteria ..... 134**

9.1 Conclusions ..... 134

9.2 Performance Criteria ..... 135

**10.0 References ..... 137**


## LIST OF TABLES


Table 2-1. Summary of Water Quality Objectives ..... 7

Table 4-1a. Sample Area 1 - Salix laevigata Forest & Woodland Alliance Percent Cover by Species ..... 32

Table 4-1b. Percent Native and Non-native Cover within Sample Area 1 ..... 33

Table 4-1c. Native Species Richness within Sample Area 1 ..... 33

Table 4-2a. Sample Area 2 - Salix gooddingii - Salix laevigata Forest & Woodland Alliance Percent Cover by Species ..... 34

Table 4-2b. Percent Native and Non-native Cover within Sample Area 2 ..... 35

Table 4-2c. Native Species Richness within Sample Area 2 ..... 35
Table 4-3a. Sample Area 3 - Salix gooddingii Forest & Woodland Alliance Percent Cover by Species ... 36
Table 4-3b. Percent Native and Non-native Cover within Sample Area 3 ..... 37
Table 4-3c. Native Species Richness within Sample Area 3 ..... 37
Table 4-4. List of Plant Species Observed ..... 50
Table 4-5. List of Wildlife Species Observed ..... 51
Table 5-1. Mann-Kendall Test Results of the Average-Growing Season NDVI Trends for Defined Areas in the Cooper's and San Timoteo Creeks ..... 73
Table 5-2. Characterization of Variability in the Average-Growing Season NDVI for Defined Areas in the Study Area ..... 74
Table 6-1. Historical WWTP Discharges ..... 90
Table 8-1. Hydrogeological Baseline Monitoring Program Enhanced Monitoring Locations ..... 130

## LIST OF FIGURES

Figure 2-1. Study Area and Water Quality Objectives Map ..... 5
Figure 2-2. Hydrogeological Monitoring Locations – Beaumont and Upper San Timoteo GMZs ..... 10
Figure 2-3. Hy6drologic and Hydrogeologic Features of the Timoteo Watershed ..... 12
Figure 2-4. Annual Precipitation in the San Timoteo Watershed – Water Year 1895 - 2023 ..... 13
Figure 4-1. Baseline Vegetation Sample Area 1 ..... 29
Figure 4-2. Baseline Vegetation Sample Area 2 ..... 30
Figure 4-3. Baseline Vegetation Sample Area 3 ..... 31
Figure 4-4a. Cooper's Creek Riparian Plant Communities ..... 40
Figure 4-4b. Cooper's Creek Riparian Plant Communities ..... 41
Figure 4-4c. Cooper's Creek Riparian Plant Communities ..... 42
Figure 4-4d. Cooper's Creek Riparian Plant Communities ..... 43
Figure 4-4e. Cooper's Creek Riparian Plant Communities ..... 44
Figure 4-4f. Cooper's Creek Riparian Plant Communities ..... 45
Figure 4-4g. Cooper's Creek Riparian Plant Communities ..... 46
Figure 4-4h. Cooper's Creek Riparian Plant Communities ..... 47
Figure 4-4i. Cooper's Creek Riparian Plant Communities ..... 48
Figure 4-4j. Cooper's Creek Riparian Plant Communities ..... 49
Figure 4-5a. San Timoteo Creek Riparian Plant Communities ..... 56
Figure 4-5b. San Timoteo Creek Riparian Plant Communities ..... 57

# Table of Contents

Figure 4-5c. San Timoteo Creek Riparian Plant Communities ..... 58
Figure 4-5d. San Timoteo Creek Riparian Plant Communities ..... 59
Figure 4-5e. San Timoteo Creek Riparian Plant Communities ..... 60
Figure 4-5f. San Timoteo Creek Riparian Plant Communities ..... 61
Figure 4-5g. San Timoteo Creek Riparian Plant Communities ..... 62
Figure 4-5h. San Timoteo Creek Riparian Plant Communities ..... 63
Figure 4-5i. San Timoteo Creek Riparian Plant Communities ..... 64
Figure 4-5j. San Timoteo Creek Riparian Plant Communities ..... 65
Figure 4-5k. San Timoteo Creek Riparian Plant Communities ..... 66
Figure 4-5l. San Timoteo Creek Riparian Plant Communities ..... 67
Figure 4-5m. San Timoteo Creek Riparian Plant Communities ..... 68
Figure 5-1. Riparian Zone, Study Segments, and Focus Areas ..... 79
Figure 5-2. Focus Areas FA01, FA02, FA03, FA04, and FA05 for NDVI Analysis ..... 80
Figure 5-3. Focus Areas FA06, FA07, and FA08 for NDVI Data Analysis ..... 81
Figure 5-4. Focus Areas FA09, FA10, and FA11 for NDVI Data Analysis ..... 82
Figure 5-5a. Time Series of NDVI for Cooper's Creek 1 Segment ..... 83
Figure 5-5b. Time Series of NDVI for Focus Areas along Cooper's Creek 1 ..... 84
Figure 5-6a. Time Series of NDVI for San Timoteo 1 Segment ..... 85
Figure 5-6b. Time Series of NDVI for Focus Areas along San Timoteo 1 ..... 86
Figure 5-7a. Time Series of NDVI for San Timoteo 2 Segment ..... 87
Figure 5-7b. Time Series of NDVI for Focus Areas along San Timoteo 2 ..... 88
Figure 6.1. Daily Effluent Discharge to Cooper's Creek and San Timoteo Creek at Beaumont WWTP DP-001 and Henry N Wochholz RWRF DP-001 ..... 92
Figure 6-2. Surface Water Flows at Select Surface Water Monitoring Locations ..... 93
Figure 6-3. Nitrate-Nitrogen Concentrations in Surface Water ..... 95
Figure 6-4. TDS Concentrations in Surface Water ..... 96
Figure 6-5. Groundwater Elevations at Select Well Locations ..... 100
Figure 6-6. Groundwater Elevation Spring 2022 ..... 101
Figure 6-7. Nitrate-Nitrogen Concentrations in Groundwater ..... 103
Figure 6-8. TDS Concentrations in Groundwater ..... 104
Figure 7-1. Precipitation, Surface Water Flow, and WWTP Discharge versus NDVI, Cooper's Creek 1 Segment for 1983-2023 ..... 107
Figure 7-2. Precipitation, Surface Water Flow, and WWTP Discharge versus NDVI, San Timoteo 1 Segment for 1983-2023 ..... 110

Figure 7-3. Precipitation, Surface Water Flow, and WWTP Discharge versus NDVI, San Timoteo 2 Segment for 1983-2023 ..... 112

Figure 7-4. Groundwater Levels and WWTP Discharge versus NDVI, Cooper's Creek 1 Segment for 1983-2023 ..... 116

Figure 7-5. Groundwater Levels and WWTP Discharge versus NDVI, San Timoteo 1 Segment for 1983-2023 ..... 117

Figure 7-6. Groundwater Levels and WWTP Discharge versus NDVI, San Timoteo 2 Segment for 1983-2023 ..... 118

Figure 8-1. Riparian Baseline Monitoring and Data Collection Locations ..... 127

Figure 8-2. Hydrogeological Baseline Monitoring and Data Collection Locations ..... 129

## LIST OF APPENDICES

Appendix A. Draft Technical Memorandum, Initial Goals, Objectives and Performance Criteria for the City of Beaumont Adaptive Management and Mitigation Program (AMMP), December 21, 2023

Appendix B. Letter, Least Bell's Vireo and Southwestern Willow Flycatcher Survey Results for the City of Beaumont, Cooper's Creek Wastewater Discharge Study, November 5, 2024

Appendix C. Normalized Differences Vegetation Index (NDVI)

Appendix D. Mann-Kendall Analysis of NDVI

# Table of Contents

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| afy | Acre-Feet Per Year |
| AMMP | Adaptive Management and Mitigation Program |
| BCVWD | Beaumont Cherry Valley Water District |
| CDFM | Cumulative departure from the mean |
| CDFW | California Department of Fish and Wildlife |
| Cfs | Cubic Feet Per Second |
| Change Petition | Wastewater Change Petition |
| City | City of Beaumont |
| CIWQS | California Integrated Water Quality System |
| CNDDB | California Natural Diversity Database |
| COYE | Common Yellowthroat |
| CSPA | Center Science Processing Architecture |
| DEM | Digital elevation Model |
| EROS | Earth Resources Observation and Science |
| FA | Focus Area |
| ft | Feet |
| Ft bgs | Feet Below Ground Surface |
| $ft^2$/day | Square Feet Per Day |
| GMZ | Groundwater management zones |
| GNSS | Global Navigation Satellite System |
| LBVI | Least Bell's Vireo |
| M | Meter |
| MBR | Membrane bioreactor |
| mgd | Million gallons per day |
| mgl | Milligrams per liter |
| NAVD88 | North American Vertical Datum |
| NDVI | Normalized Difference Vegetation Index |
| NPDES | National Pollutant Discharge Elimination System |
| RGB | Red, Green, and Blue |
| RHJV | Riparian Habitat Joint Venture |
| RO | Reverse osmosis |
| RWRF | Regional Water Recycling Facility |
| SARI | Santa Ana Regional Interceptor |
| SAWA | Santa Ana Watershed Association |
| SAWPA | Santa Ana Watershed Project Authority |
| SC | Specific Conductance |
| SMWD | South Mesa Water Company |
| SNMP | Salt and nutrient management plan |
| SOSP | Song Sparrow |
| SSC | Species of Special Concern |
| SWRCB | State Water Resources Control Board |

| | |
|---|---|
| TDA | Tom Dodson & Associates |
| TDS | Total Dissolved Solids |
| TIN | Total inorganic nitrogen |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | United States Geological Survey |
| UV | Ultraviolet |
| VegCAMP | Vegetation Classification and Mapping Program |
| Watershed | San Timoteo Watershed |
| WIFL | Willow Flycatcher |
| WIWA | Wilson's Warbler |
| WRC-MSHCP | Western Riverside County Multiple Species Habitat Conservation Plan |
| WWTP | Wastewater Treatment Plant |
| YBCH | Yellow-Breasted Chat |
| YBCU | Western yellow-billed cuckoo |
| YEWA | Yellow Warbler |
| YVWD | Yucaipa Valley Water District |

# Cooper's Creek and San Timoteo Creek Habitat Characterization and Sustainability Report

This *Cooper's Creek and San Timoteo Creek Habitat Characterization and Sustainability Report* (Report) was prepared in conjunction with HDR[1] for the City of Beaumont (City or Beaumont) to support their efforts to reduce recycled water discharges and prepare an Adaptive Management and Mitigation Plan (AMMP) for the riparian habitat along Cooper's Creek and San Timoteo Creek.

## 1.0 INTRODUCTION

This section describes: 1) the need for the City to develop an AMMP for the riparian habitat along Cooper's Creek and San Timoteo Creek; 2) the scope of work to develop the AMMP; and 3) the organization of this report.

## 1.1 Adaptive Management and Mitigation Plan (AMMP)

The City has initiated plans to reduce the discharge of treated wastewater (i.e. recycled water) from the Beaumont Wastewater Treatment Plant (WWTP) to Cooper's Creek, and divert that water for other beneficial uses. To reduce the volume of discharge to Cooper's Creek, the City must file a Wastewater Change Petition (Change Petition) under California Water Code Section 1211 with the State Water Resources Control Board (SWRCB), Division of Water Rights. When the City first discussed the plan to apply for a change petition with Division of Water Rights staff, they advised that the City develop an AMMP to aid in the process of approving the reduced discharge.

An AMMP is required to ensure there is a plan and program in place to assess and mitigate, if necessary, any riparian habitat impacts that result from reducing the WWTP discharge to Cooper's Creek. The AMMP defines the monitoring, adaptive triggers, and mitigation measures put in place to manage the effects of a reduced discharge to the Cooper's and San Timoteo Creeks.

The City contracted with Tom Dodson & Associates (TDA), West Yost, and HDR (collectively referred to as the Consultant Team) to develop the AMMP and support the change petition process.

## 1.2 Scope to Develop AMMP

The AMMP is being developed in three phases, as follows:

- Phase 1 – Characterize historical and current conditions to support development of the AMMP
- Phase 2 – Assess the feasibility of reduced discharge and perform initial baseline monitoring
- Phase 3 – Prepare the AMMP

[1] HDR Biologists assisted with the preparation of Section 4, Section 7, Section 8, and Section 9.

This report documents the results of Phase 1 and is the initial AMMP. The objective of Phase 1 was to characterize the historical and current conditions of the study area in support of the development of the AMMP. This was completed through the following tasks and steps:

- Task 1 – Project management and meetings
- Task 2 – Establish initial goals, objectives, and project performance criteria
- Task 3 – Characterize historical discharge and surface water flow hydrology
- Task 4 – Characterize historical riparian habitat health (NDVI)
- Task 5 – Characterize historical and existing biological resources
- Task 6 – Identify potential impacts to biological resources from reduced discharge to Cooper's Creek
- Task 7 – Assess available tools for analyzing surface water and groundwater impacts[2]
- Task 8 – Prepare *Cooper's Creek and San Timoteo Creek Habitat Characterization and Sustainability Report*

## 1.3 Report Outline

This Report summarizes the work completed during Phase 1 of the AMMP. The Report includes a description of the background and setting of the study area region and the Beaumont WWTP operations, characterizes historical data and information on the riparian habitat and hydrology, and a proposed baseline monitoring program reduced discharge of treated water to Cooper's Creek.

This Report is organized under the following sections:

- **Section 1 – Introduction.** This section provides an overview and purpose of the AMMP.
- **Section 2 – Background and Setting.** This section describes the history of the WWTP and its physical and regulatory setting.
- **Section 3 – Initial Goals, Objectives, and Performance Criteria.** This section describes the City's goals, objectives, and performance criteria for the development of the AMMP.
- **Section 4 – Historical and Existing Biological Resources.** This section characterizes the historical and existing biological resources in the study area.
- **Section 5 – Historical Riparian Habitat Health.** This section characterizes the historical health of the riparian habitat in the study area based on multiple data sources.
- **Section 6 – Historical Discharge, Surface Water Flow Hydrology, and Groundwater Characterization.** This section characterizes the historical hydrology of the Cooper's and San Timoteo Creeks, groundwater, and discharges.

[2] The assessment of available modeling tools for analyzing surface water and groundwater impacts is not included in this report. The available tools were identified and reviewed to the extent possible, however the Beaumont Basin Groundwater Model was not made available in time to complete the assessment for this report. The Task 7 scope will be completed in 2025 and the findings provided under separate cover. Any recommendations will be incorporated in the next adaptation of the AMMP.

- **Section 7 – Potential Impacts to Biological Resources from Reduced Discharge to Cooper's Creek.** This section describes the potential impacts to the riparian habitat that could result from reducing the City's WWTP discharge to Cooper's Creek and identifies data gaps in the understanding of the study area biologic and hydrogeologic setting.
- **Section 8 –Initial Baseline Monitoring and Data Collection Plan.** This section describes the biologic and hydrogeologic baseline monitoring and data collection program that the City should perform prior to reducing its discharge to Cooper's Creek.
- **Section 9 – Summary and Conclusions.** This section summarizes the Report and its conclusions.
- **Section 10 – References.** This section contains a list of references cited in the Report.

# 2.0 BACKGROUND AND SETTING

This section describes the 1) background on the current and historical operations of the Beaumont WWTP and its discharges, 2) regulatory setting of the WWTP, and 3) the physical setting of the AMMP (i.e. the "Study Area").

Figure 2-1 is a location map of the region showing the AMMP Study Area, the City jurisdictional boundary, local surface water steams and tributaries, WWTP discharge locations, and other jurisdictional and hydrological boundaries referenced herein. The Study Area includes the riparian habitat and adjacent areas along Cooper's Creek and San Timoteo Creek. The Study Area begins on Cooper's Creek just upstream of the Beaumont WWTP discharge location DP001 and continues northwest and downstream along Cooper's Creek and San Timoteo Creek, terminating at the site of the Henry N Wochholz Regional Water Recycling Facility (RWRF) discharge, which is operated by the Yucaipa Valley Water District (YVWD).

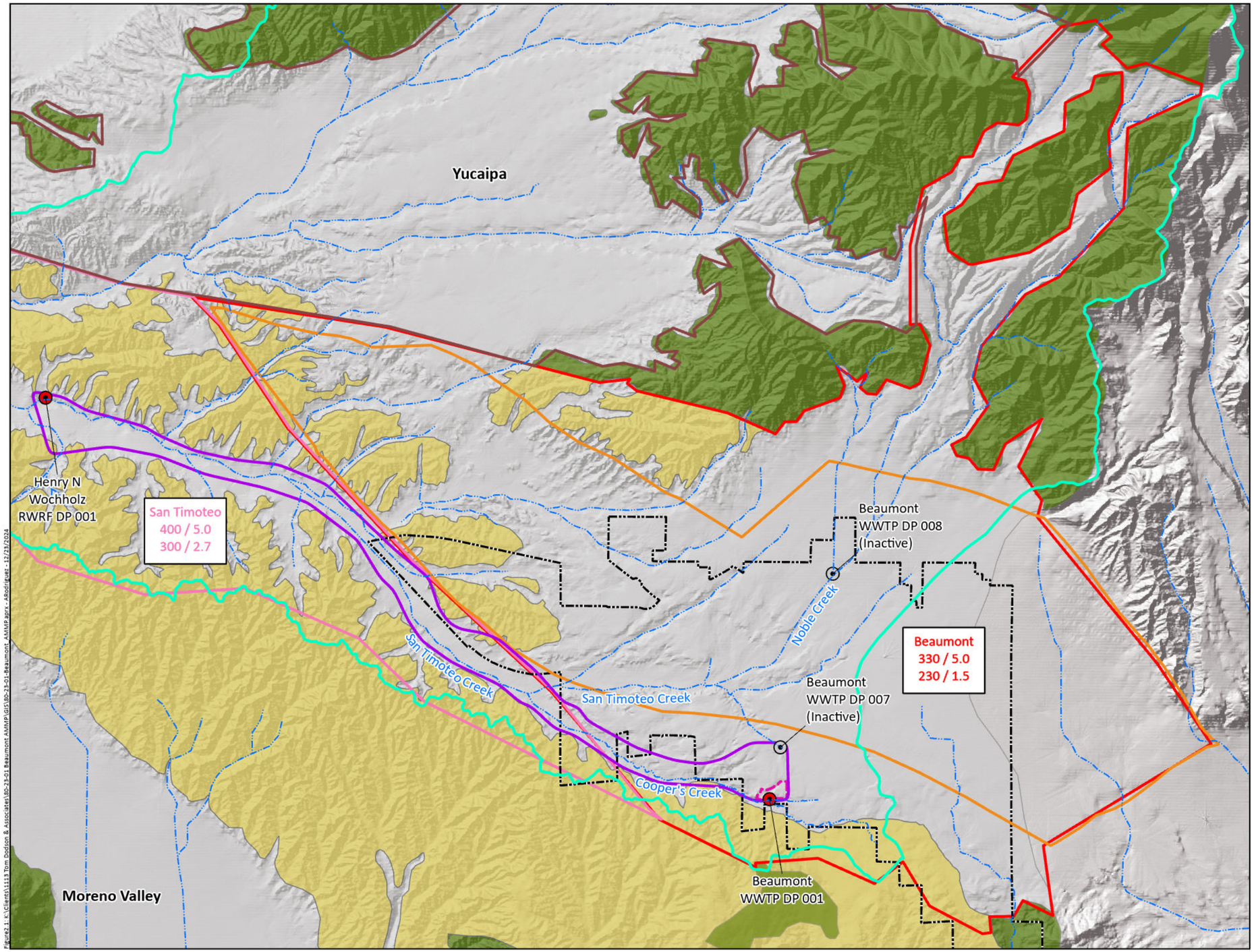
## 2.1 Current and Historical Operations of the WWTP

The City, located in Riverside County, owns and operates the Beaumont WWTP. The Beaumont WWTP is the only treatment plant for the City, which serves a population of approximately 53,000 people as of 2020 (US Census, 2020). The Beaumont WWTP receives and treats domestic and commercial/industrial wastewater generated within the City boundaries and Highland Springs, which is a portion of the unincorporated area of Cherry Valley. The treated wastewater is discharged to Cooper's Creek, which is a tributary to San Timoteo Creek. According to the City, discharge to Cooper's Creek from the original Beaumont WWTP began sometime in the 1920s. The WWTP and discharge operations have been modified over time with population growth and changing regulations. The discharge volume from the WWTP began to increase significantly around 2004, concurrent with rapid development throughout the City's service area.

In 2018, the City began construction to upgrade treatment at the Beaumont WWTP to add advanced treatment using a combination of membrane bioreactor (MBR), reverse osmosis (RO), and ultraviolet (UV) treatments (termed RO system). Operation of the RO system commenced in November 2020, and further upgrades to the RO system were completed at the end of 2022 with full operation in 2023. All water treated via the RO System is discharged to Cooper's Creek at rates generally ranging between 3.0 and 4.1 million gallons per day (mgd). Fewer fluctuations in the daily discharge are expected compared to past discharge operations due to the requirement to operate the RO system at more constant flow rates.

Brine waste generated from the RO system is pumped through a City-owned brine line approximately 23 miles in length that connects to the Inland Empire Brine Line, which was previously referred to as the Santa Ana Regional Interceptor (SARI) line. The Inland Empire Brine Line is owned and operated by the Santa Ana Watershed Project Authority (SAWPA) and pumps high-saline water to a wastewater treatment plant operated by the Orange County Sanitation District.

Currently, treated wastewater from the Beaumont WWTP is discharged via one outfall to Cooper's Creek: Discharge Point 001 (DP001 or DP-001). Cooper's Creek flows into San Timoteo Creek approximately three miles downstream of DP001. San Timoteo Creek flows into the Santa Ana River approximately 16 miles downstream in the City of San Bernardino. Historically, two additional wastewater discharge points were permitted within the City's limits: DP007 to an unnamed tributary of Marshall Creek and DP008 to Noble Creek. The City only operated outfall DP007 from March 2010 to August 2015 and there is no record of discharges to outfall DP008. YVWD also discharges treated wastewater to San Timoteo Creek from the Henry N Wochholz RWRF DP001.



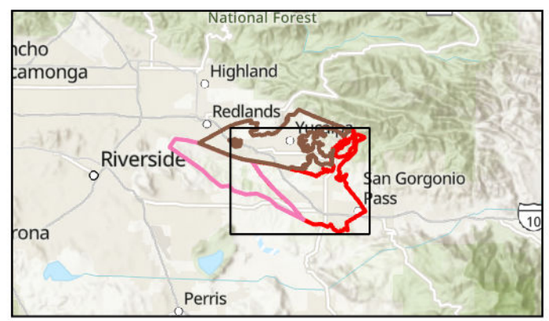

Streams
City of Beaumont
Study Area
Beaumont WWTP Boundary
Adjudicated Basin Boundary
San Timoteo GMZ
Yucaipa GMZ
Beaumont GMZ
San Timoteo Watershed Boundary
WWTP Discharge Point (active)
WWTP Discharge Point (inactive)

**Geology**

Water-Bearing Sediments
Unconsolidated to Semi-consolidated Quaternary Alluvium
Consolidated and Semi-Consolidated Formations
San Timoteo Formation
Undifferentiated Pre-Tertiary Igneous and Metamorphic Crystalline Rocks

Beaumont 330 / 5.0 230 / 1.5 — GMZ maximum benefit (top values) and antidegradation (bottom values) water quality objectives for TDS (left values) and nitrate as nitrogen (right values)

Notes:
1. GMZ - groundwater management zone
2. WWTP - wastewater treatment plant
3. TDS - total dissolved solids




N
0 6,000 12,000
Feet

Prepared by: WEST YOST

Prepared for:
**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

**Study Area and Water Quality Objectives Map**
*City of Beaumont AMMP*
**Figure 2-1**

Figure2-1 K:\Client\11113 Tom Dodson & Associates\30-23-01 Beaumont AMMP\GIS\30-23-01-Beaumont_AMMP.aprx - ARodriguez - 12/23/2024

## 2.2 Regulatory Setting

The following subsections describe the regulatory and monitoring programs related to operation of the Beaumont WWTP to which the City adheres.

### *2.2.1 Regional Water Quality Control Board Requirements*

The City of Beaumont is within the jurisdictional region of the Santa Ana Regional Water Quality Control Board (Santa Ana Water Board), the regulatory agency responsible for the protection of water quality in the Santa Ana Region. The Santa Ana Water Board regulates waste discharges to minimize and control the impacts on the quality of the region's groundwater and surface water resources. Discharge from the Beaumont WWTP is regulated by the Santa Ana Water Board in accordance with Order No. R8-2022-0042 (National Pollutant Discharge Elimination System [NPDES] No. CA0105376) (Santa Ana Water Board, 2022).

The Santa Ana Water Board has a Water Quality Control Plan for the Santa Ana River Basin (Basin Plan). The Basin Plan defines groundwater management zones (GMZ) and surface water bodies and the associated beneficial uses and water quality objectives that must be considered by the Regional Board in permitting waste discharges. The Basin Plan contains a detailed regional salt and nutrient management plan (SNMP) that supports the process to establish discharge limitations for total dissolved solids (TDS) and nitrate as nitrogen (nitrate-nitrogen) that are protective of the receiving water bodies. In some cases, the Basin Plan SNMP contains GMZ-specific SNMPs known as maximum-benefit SNMPs. These GMZ-specific SNMPs allow for less-stringent TDS and nitrate-nitrogen groundwater objectives to enable local agencies to maximize recycled water reuse for the benefit of water resources management. Access to the less-stringent maximum-benefit based water quality objectives requires the sponsoring agencies to implement a program of projects and management actions, known as Maximum Benefit commitments, to ensure the long-term protection of beneficial uses of the affected GMZs.

Cooper's Creek and San Timoteo Creek overly the Beaumont and San Timoteo GMZs, both of which have Maximum Benefit SNMPs defined in the Basin Plan. The boundaries of the Beaumont and San Timoteo GMZs, and their associated TDS and nitrate-nitrogen objectives, are shown on Figure 2-1 and summarized in Table 2-1.

**Table 2-1. Summary of Water Quality Objectives**

| Program | Constituent | Water Quality Objective, mg/L |
|---|---|---|
| NPDES Permit Effluent Limitations | | |
| DP001[(a)] | TDS | 400<br>300 |
| | TIN | 6<br>3.6 |
| Beaumont Groundwater Management Zone | | |
| Maximum Benefit | TDS | 330 |
| | Nitrate-nitrogen | 5 |
| Antidegradation | TDS | 230 |
| | Nitrate-nitrogen | 1.5 |
| San Timoteo Groundwater Management Zone | | |
| Maximum Benefit | TDS | 400 |
| | Nitrate-nitrogen | 5 |
| Antidegradation | TDS | 300 |
| | Nitrate-nitrogen | 2.7 |

(a) DP001 - Beaumont Wastewater Treatment Plant discharge point 001. 'Top' objectives are effluent limitations for discharges up to 1.8 mgd and 'bottom' objectives are effluent limitations for discharges above 1.8 mgd.

mg/L = milligrams per liter

NPDES = National Pollutant Discharge Elimination System

TDS = total dissolved solids

TIN = total inorganic nitrogen

The City is a joint responsible agency along with the YVWD, Beaumont Cherry Valley Water District (BCVWD), City of Banning, and San Gorgonio Pass Water Agency for the Beaumont GMZ Maximum Benefit SNMP. For the San Timoteo Maximum Benefit SNMP, the City is a joint responsible agency with the YVWD.

In 2014, the Maximum Benefit SNMPs for the Beaumont and San Timoteo GMZs were updated (Basin Plan Amendment R8-2014-0005) to revise the maximum benefit commitments for the responsible agencies. Under the amended Maximum Benefit SNMPs, the YVWD and the City were required to produce a non-potable (recycled water) supply with 10-year, volume-weighted running average TDS and nitrate-nitrogen concentrations that are less than or equal to the maximum benefit objectives shown in Table 2-1 for the underlying GMZs. The amended Maximum Benefit SNMP also triggered updates to the discharge permits for the City and YVWD discharges to the Beaumont and San Timoteo GMZs. In 2015, the discharge permit for the Beaumont WWTP was updated (R8-2015-0026, Santa Ana Water Board, 2015) and required the City to further limit the TDS and total inorganic nitrogen (TIN) concentrations to 300 mg/L and 3.6 mg/L, respectively, for discharges in excess of 1.8 mgd. The lower concentration requirements were based on the antidegradation objectives for the San Timoteo GMZ that existed prior to the adoption of the Maximum Benefit SNMP.

The most current NPDES permit for City's discharge, Order R8-2022-0042, was adopted by the Santa Ana Water Board in October 2022. Order R8-2022-0042 maintained the same TDS and TIN limits that include the lower concentration limit for discharges over 1.8 mgd:

- For discharges up to 1.8 mgd, the 12-month flow-weighted running average shall not exceed 400 mg/L for TDS and 6 mg/L TIN.
- For discharges exceeding 1.8 mgd, the 12-month flow-weighted running average shall not exceed 300 mg/L for TDS and 3.6 mg/L for TIN.

At the time of the adoption of the 2015 discharge permit (R8-2015-0026), the City's treated discharge was not in compliance with these effluent limitations for TDS and TIN. For this reason, the Santa Ana Water Board requires the City to account for and eventually "offset" the amount of TDS and nitrate loading that exceeds the limits specified in R8-2015-0026 and R8-2022-0042. The offset will be achieved by operating the RO system that was completed in 2020 to produce effluent with TDS and TIN concentrations that are lower than the permit limits for a period of time until the long-term average concentrations meets the required targets. The Santa Ana Water Board set a date of January 1, 2027 to fully offset the excess TDS and nitrate loading that occurred from 2015 until the RO system was completed (Santa Ana Water Board, 2022). To meet the obligation, the City has a goal to discharge effluent at a TDS concentration of 200 mg/L or less through 2027.

### *2.2.2 State Water Resource Control Board Requirements*

Now that the City's upgraded WWTP is fully operational and the offset process is underway, the City would like to develop a plan to utilize the highly-treated effluent supply to enhance is local water supply plan through reuse and/or groundwater recharge. The SWRCB Division of Water Rights regulates the diversion of surface waters within the State of California. For the City to reduce their discharge to Cooper's Creek and begin utilizing the recycled water for non-potable uses, they are required to file a Change Petition under California Water Code Section 1211. Upon notification from the City of its goal to move forward with plans to reduce the WWTP discharge to Cooper's Creek , the SWRCB directed them to complete a Change Petition, including initiating the process to develop an AMMP.

The recycled water will likely be used as a non-potable supply for City customers, and potentially other future projects such as groundwater recharge. However, at the time of drafting this report, no final decisions have been made on end use of the recycled water. Non-potable supply system infrastructure is in place and is owned by the BCVWD and is ready to receive recycled water supply. The primary limitation to moving forward with the non-potable supply deliveries is obtaining approval of the Change Petition from the Division of Water Rights. The development of the AMMP is a critical step in the approval of the Change Petition.

### *2.2.3 Existing Monitoring and Reporting Programs*

Several programs requiring monitoring and/or reporting of environmental data are active within the Study Area:

1. Groundwater level and quality, and surface water flow and quality data are collected in compliance with the Maximum Benefit Monitoring Program for the Beaumont and San Timoteo GMZs.
2. Beaumont WWTP effluent water quality and discharge data are collected pursuant to the Monitoring and Reporting Program under R8-2022-0042.

3. Biological surveys are performed by the Santa Ana Watershed Association (SAWA) along the San Timoteo Creek.

#### 2.2.3.1 Maximum Benefit Monitoring Program

The Maximum Benefit Monitoring Program is implemented in accordance with the Basin Plan. In both the Beaumont and San Timoteo GMZs, there are maximum benefit commitments which include conducting groundwater and surface water monitoring. The Maximum Benefit monitoring activities and data collected are described in Annual Reports that are submitted to the Santa Ana Water Board by April 15th each year by the responsible agencies (Dudek, 2021). The surface water and groundwater monitoring programs within the Beaumont and San Timoteo GMZ Maximum Benefit Monitoring Programs are summarized as follows and a subset of the monitoring locations are shown on Figure 2-2:

- **Surface Water Monitoring Program.** Surface water flow measurements and water quality grab samples are collected at 13 sites at a biweekly frequency, or for certain sites, following storms.
- **Groundwater Monitoring Program.** Groundwater levels are collected at 135 wells at least twice per year, and water quality samples are collected at 84 wells at least once every three years.

The last published Maximum Benefit Monitoring Program report relied on for this Report is from 2022.

#### 2.2.3.2 Beaumont WWTP NPDES Permit Monitoring

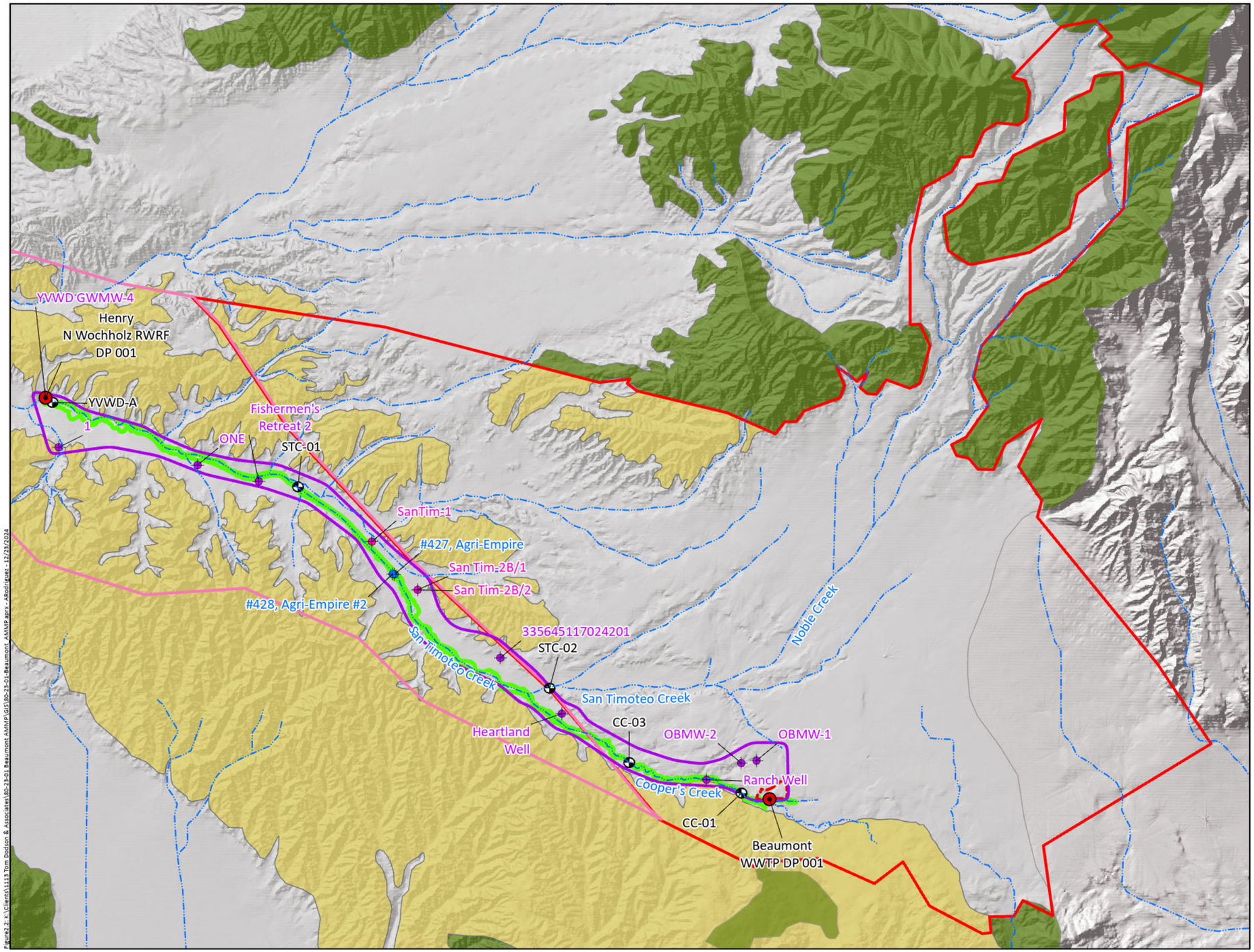
As part of their NPDES Permit reporting, the City monitors the volume and water quality of discharges from DP001 to Cooper's Creek. The data is reported to through the California Integrated Water Quality System Project (CIWQS).

#### 2.2.3.3 SAWA Biological Monitoring

SAWA performs biological monitoring activities within the San Timoteo Canyon area and produces monitoring reports on an annual basis. The last published report relied on for this Report is from 2022.

### *2.2.4 Water Rights*

Groundwater beneath portions of the City is within the adjudicated Beaumont Basin, to the north and east of the Study Area (see Figure 2-1). Pursuant to a Judgment issued in 2004, the Superior Court of the County of Riverside appointed a five-member Watermaster committee, the Beaumont Basin Watermaster, consisting of representatives from the City of Banning, BCVWD, the City, South Mesa Water Company (SMWD), and YVWD (ALDA Inc. and Thomas Harder & Co, 2024). The Judgment regulates the amount of water that can be pumped from the Basin and defines monitoring and management actions to ensure that pumpers in the Basin can utilize groundwater in accordance with their rights.

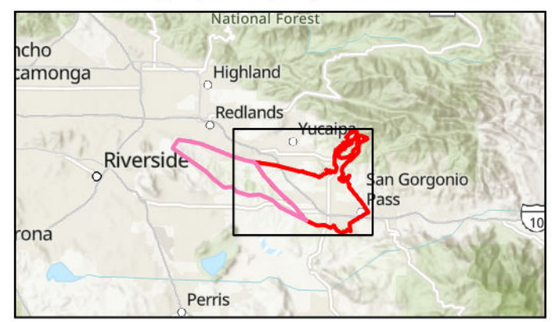



Streams
Beaumont WWTP Boundary
San Timoteo GMZ
Riparian Zone
Study Area
GW wells with WL and WQ data
GW wells with WL data
GW wells with WQ data
Stream Gage
WWTP Discharge Point

**Geology**

Water-Bearing Sediments
Unconsolidated to Semi-consolidated Quaternary Alluvium
Consolidated and Semi-Consolidated Formations
San Timoteo Formation
Undifferentiated Pre-Tertiary Igneous and Metamorphic Crystalline Rocks

Notes:
1. Riparian Zone was drawn using tree line.
2. GW - groundwater; SW - surface water
3. GMZ - groundwater management zone
4. WWTP - wastewater treatment plant
5. WL - water level; WQ - water quality




Prepared by:
WEST YOST

N
0 6,000 12,000
Scale in Feet

Prepared for:
**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*
BEAUMONT

**Hydrogeological Monitoring Locations - Beaumont and Upper San Timoteo GMZs**
*City of Beaumont AMMP*
**Figure 2-2**

Figure2-2: K:\Clients\11113 Tom Dodson & Associates\30-23-01 Beaumont AMMP\GIS\30-23-01-Beaumont_AMMP.aprx - ARodriguez - 12/23/2024

## 2.3 Physical Setting

This subsection describes the surface water hydrology, geologic setting, and hydrogeologic setting for the Study Area and its vicinity.

### *2.3.1 Surface Water Hydrology*

The following subsections describe the surface water bodies and climate of the Study Area region.

#### 2.3.1.1 Surface Water Bodies

Figure 2-3 shows the boundary of the San Timoteo Watershed (Watershed), within which the Study Area is located. The Watershed (also known as the San Timoteo Wash Watershed) drains an approximately 125-square mile area. The Watershed receives most of its water from the San Bernardino Mountains near Cherry Valley to the north, where many of the tributary headwaters are located. The eastern-most extent of the Watershed is located at a topographic high between the Cities of Beaumont and Banning. San Timoteo Creek is the main drainage of the Watershed, which flows northwest to its confluence with the Santa Ana River in San Bernardino, California.

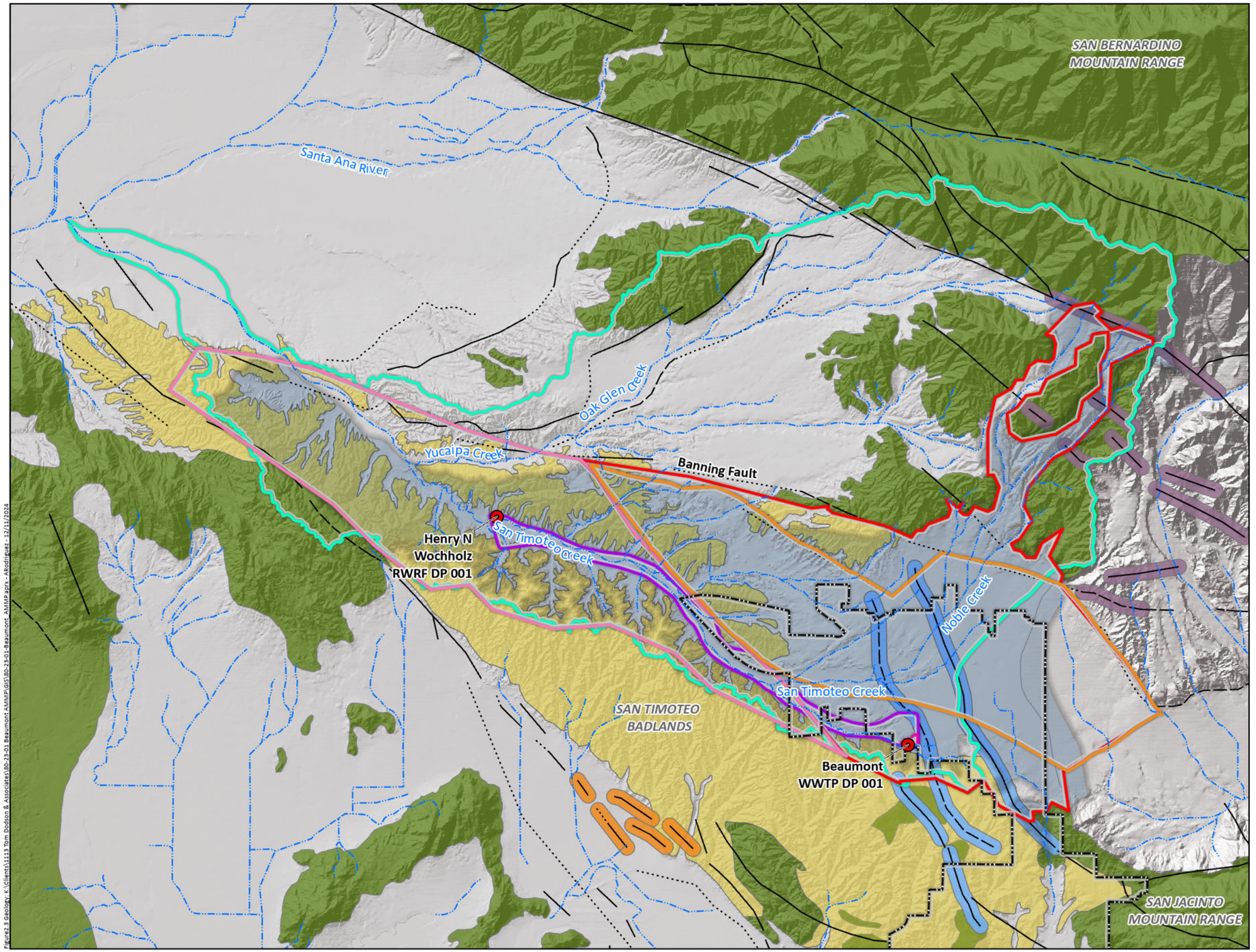
Several smaller creeks are tributary to San Timoteo Creek. Noble Creek flows southwest from its headwaters in the San Bernardino Mountain Range to its confluence with San Timoteo Creek in the western portion of the City's limits. Cooper's Creek flows northwest to its confluence with San Timoteo Creek near the western boundary of the City's limits. Yucaipa and Oak Glen Creek are the main drainages of the Yucaipa Valley. The headwaters of these creeks are located in the San Bernardino Mountains and they flow to the west and southwest through the Yucaipa Valley. The confluence of the Oak Glen and Yucaipa Creeks is just south of Interstate 10 and prior to the Live Oak Canyon. The confluence of Yucaipa Creek with the San Timoteo Creek is outside of the Study Area, just downstream of the Henry N. Wochholz DP001. Noble, San Timoteo, and Cooper's Creeks are the main drainages of the Beaumont GMZ, and San Timoteo is the main drainage of San Timoteo GMZ.

Historically, the streams in this region exhibited intermittent flow. WWTP discharges from the City and YVWD have altered the natural hydrology and streamflow is now apparent year-round. Streams that do not receive discharges are observed to be flashier in nature and more intermittent flows are apparent in the geomorphology and through observations from the Maximum Benefit Monitoring Program.

More details on surface water hydrology, including water quality, flows, and other characteristics are discussed in Section 6.2 of this Report.

#### 2.3.1.2 Climate and Precipitation

Climatically, the region is classified as hot-summer Mediterranean. Precipitation was analyzed within the Watershed for the period of record from WY 1986 to 2023. Average annual precipitation estimates were computed as a spatial average across the Watershed using rasterized data from the PRISM Climatic Group (based on an 800-meter by 800-meter grid). The long-term average annual precipitation in the Watershed is 19.3 inches per year (in/yr). Figure 2-4 is a time-history chart of the annual precipitation and cumulative departure from mean (CDFM) precipitation curve. The CDFM characterizes the occurrence and magnitude of wet and dry periods: positive sloping segments (trending upward to the right) indicate wet periods, and negative sloping segments (trending downward to the right) indicate dry periods. Thirty-three of the last forty years are considered 'dry' (1983 to 2023). The current dry period has extended from 1998 to 2023.




- Streams
- City of Beaumont
- Study Area
- Beaumont WWTP Boundary
- Adjudicated Basin Boundary
- San Timoteo GMZ
- Beaumont GMZ
- San Timoteo Watershed Boundary
- Upper Santa Ana Valley San Timoteo Subbasin
- WWTP Discharge Point (active)

**Geology**

Water-Bearing Sediments

- Unconsolidated to Semi-consolidated Quaternary Alluvium

Consolidated and Semi-Consolidated Formations

- San Timoteo Formation
- Undifferentiated Pre-Tertiary Igneous and Metamorphic Crystalline Rocks

**Faults**

- fault, approx. located
- fault, certain
- fault, concealed

**Fault Zones**

- San Gorgonio Pass Fault Zone
- Beaumont Plain Fault Zone
- San Jacinto Fault Zone

Notes:

1. GMZ - groundwater management zone
2. WWTP - wastewater treatment plant
3. The upper portion of the San Timoteo Formation is considered to be the lower/confined aquifer and generally and unconformably underlies the Quaternary-aged Alluvium. The San Timoteo Formation outcrops on the northern side of the San Timoteo Canyon.

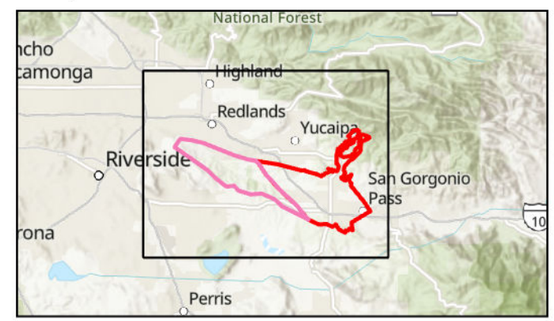



Figure2.3 Geology; K:\Clients\11113 Tom Dodson & Associates\BO-23-01 Beaumont AMMP\GIS\BO-23-01-Beaumont_AMMP.aprx - ARodriguez - 12/11/2024

Prepared by:

WEST YOST

N

0 2 4

Miles

Prepared for:

**City of Beaumont**

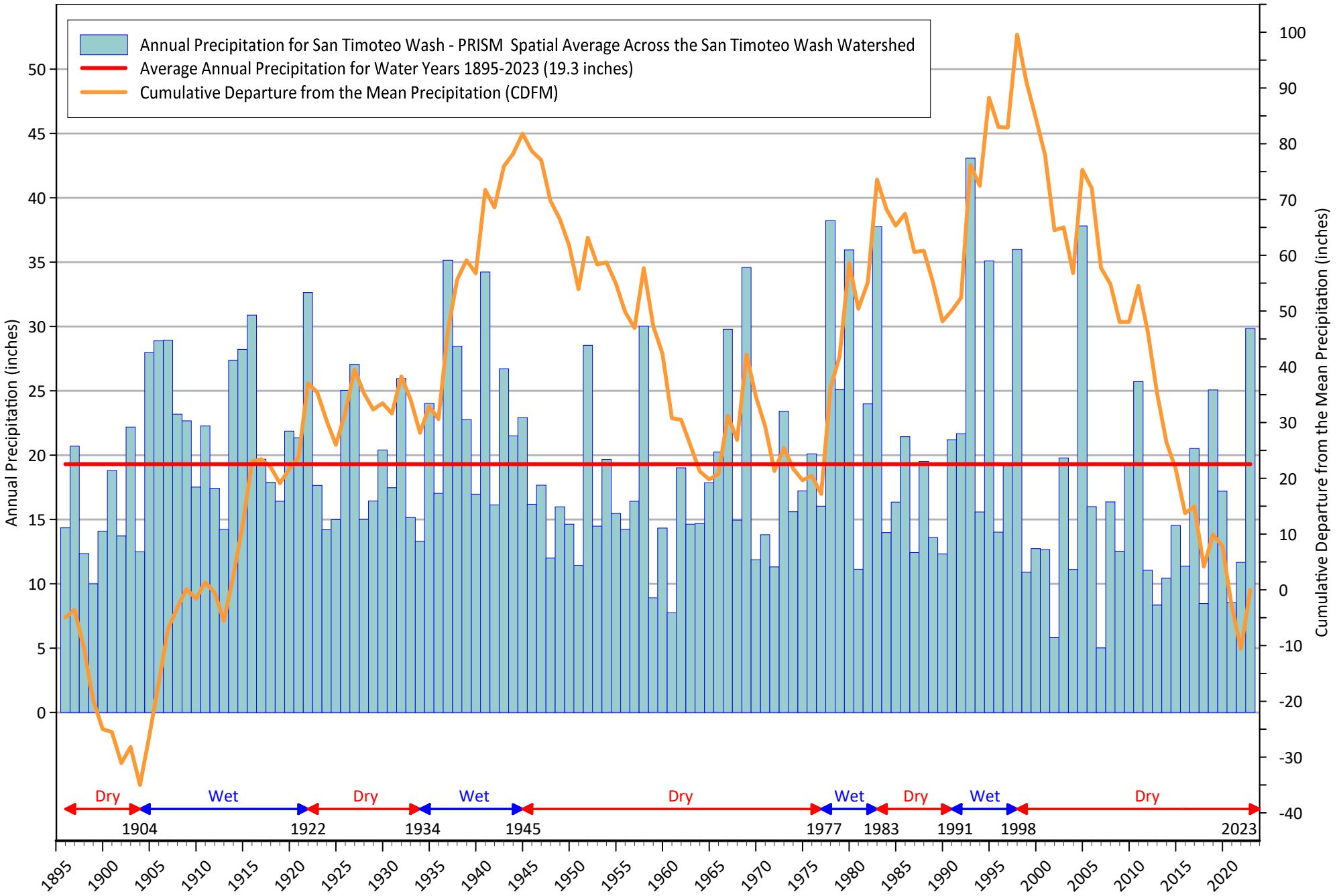
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT

**Hydrologic and Hydrogeologic Features of the San Timoteo Watershed**

*City of Beaumont AMMP*

**Figure 2-3**




WEST YOST
Water. Engineered.

Author: AK
Date: 20250102
File: Figure 2-4_Beaumont_CDFM.grf

**Annual Precipitation in the San Timoteo Watershed**
*Water Year 1895 - 2023*

**Figure 2-4**

### *2.3.2 Geologic Setting*

Figure 2-3 shows the geology of the Study Area and its surroundings. The Study Area is located within the Peninsular Range geomorphic province and sits in a low-relief highland (or plateau) between the San Bernardino Mountain Range to the north and the San Jacinto Mountain Range and San Timoteo Badlands to the south and southeast. Bedrock outcrops to the south of the City and within the San Jacinto Mountains are dominantly Mesozoic-aged plutonic rocks (various granitoid compositions) and older Paleozoic to Mesozoic-aged metasedimentary rocks (shown in dark green on Figure 2-3). The San Bernardino Mountains are comprised of mostly of plutonic granitoid rocks of Pre-Cambrian to Mesozoic ages and are heavily fractured and weathered (Fraser, 1931; Rewis et al., 2006). The San Timoteo Badlands are generally made up of terrestrial sedimentary bedrock of the Pliocene and Pleistocene aged San Timoteo Formation (shown in tan on Figure 2-3), with instances of sandstone, claystone, and conglomerate (Fraser, 1931).

#### 2.3.2.1 Local Geologic Setting

Much of the City and Study Area overlies Quaternary-aged alluvial surficial deposits (shown in gray on Figure 2-3) that are Holocene to Pleistocene in age comprised of unconsolidated to semi-consolidated gravels, sands, silts, and clays (Rewis et. al., 2006). The plateau (commonly referred to as the Yucaipa-Beaumont Plain), slopes generally to the south and west draining from the San Bernardino Mountains and San Gorgonio Pass area and has been incised by the San Timoteo Creek and its tributaries. The San Timoteo Formation generally underlies the alluvial deposits above and a topographic "high" or divide is located between the Cities of Banning and Beaumont where a bedrock high within the San Timoteo Formation occurs (shown as the watershed divide on Figure 2-3). The incised portion of the San Timoteo Canyon overlies Quaternary-aged alluvial surficial deposits, while the hillslopes are predominantly San Timoteo Formation (Rewis et al., 2006).

#### 2.3.2.2 Geologic Structure

Structurally, the Study Area is located within the San Andreas Fault Zone. The modern trace of the San Andreas Fault lies to the north. Several other fault zones are located in the area and help relieve stresses applied by the San Andreas Fault Zone – the Banning Fault and the San Gorgonio Pass Fault Zone to the north, the Beaumont Plain Fault Zone to the southeast, and the San Jacinto Fault Zone to the southwest (Rewis et al., 2006). General trends of these fault zones are to the northwest and southeast. A major anticlinal fold structure is present within the San Timoteo Formation and San Timoteo Badlands that plunges to the northwest.

### *2.3.3 Hydrogeologic Setting*

Figure 2-3 shows the hydrogeologic setting of the Study Area and its surroundings. As previously described, the Study Area is located within the San Timoteo Watershed and the Upper Santa Ana Valley San Timoteo Subbasin. The Study Area partially overlies the western portion of the adjudicated Beaumont Basin and portions of the Beaumont and San Timoteo GMZs. The southeastern portion of the Study Area is located within the Beaumont GMZ and the northwestern portion of the Study Area is within the San Timoteo GMZ. The Beaumont GMZ is generally within the Quaternary-aged alluvial sediments and is bordered by the Banning Fault to the north. The San Timoteo GMZ borders the southern boundary of the watershed and extends downstream toward the Santa Ana River. The northern extent of the San Timoteo GMZ is generally bordered by the Banning Fault to the north and the GMZ consists of Quaternary-aged alluvial sediments and the San Timoteo Formation.

#### 2.3.3.1 Water Bearing Formations

The local water-bearing formations generally consist of two formations: the older and upper portion of the Pliocene and Pleistocene San Timoteo Formation and the overlying younger Quaternary-aged alluvium. The alluvium is defined as the upper aquifer and the regional unconfined water table, while the San Timoteo Formation is defined as the lower aquifer and is confined (Dutcher and Garrett, 1963., Rewis et al., 2006). Thicknesses of these aquifers range from 400 to 800 feet (ft) (upper) and up to 400 ft (lower), respectively. The lower aquifer is observed to be more cemented and contains higher percentages of silts and clays. Transmissivity values average approximately 6,000 square feet per day ($ft^2$/day) in the upper aquifer and 2,000 $ft^2$/day in the lower aquifer. The upper aquifer generally contributes more than 75 percent of groundwater produced from wells in the area (Rewis et al., 2006).

#### 2.3.3.2 Groundwater Occurrence and Flow

Groundwater recharge replenishes the aquifer system via infiltration within unlined streams (e.g., Cooper's and San Timoteo Creeks), regional recharge basins, underflow from adjacent groundwater subbasins, mountain-front recharge, and deep percolation from precipitation. Groundwater discharge occurs from groundwater production, underflow to the west through the San Timoteo Canyon, and rising groundwater to the San Timoteo Creek and as springs within San Timoteo Canyon and Creek. Groundwater occurs under confined and unconfined conditions with the Study Area depending on location and depth (WEI, 2005).

Groundwater flow and gradient within the Study Area and adjudicated Beaumont Basin is variable and likely controlled by faulting and location (ALDA Inc. and Thomas Harder & Co, 2024). General observations for groundwater flow direction and gradient for the region are outlined below:

- Northward in the west central portion of the adjudicated Beaumont Basin (west of Beaumont Plains Fault Zone)
- West near Calimesa and toward the San Timoteo Creek
- West-northwest adjacent to the San Timoteo Badlands and through the San Timoteo Creek

Groundwater flow beneath the Study Area is to the northwest from the Beaumont Basin through the San Timoteo Canyon to the San Bernardino Valley. The numerous faults in the vicinity of the City and Study Area act as flow barriers, which are apparent in the difference in groundwater elevation across fault traces, up to 100s of feet in some areas.

Groundwater depths below the ground surface vary throughout the Study Area, with shallower depths observed near Cooper's and San Timoteo Creeks and are deeper away from the Creeks. Based on 2022 groundwater elevations, depths to groundwater also fluctuate along the channel with shallower depths observed near the Beaumont and YVWD discharge points.

#### 2.3.3.3 Groundwater Age and Quality

Produced groundwater within the upper aquifer is less than 50 years old, while the age of groundwater produced from the lower aquifer is much older (USGS, 2006).

Generally, groundwater is of good quality. A primary focus of monitoring through the Maximum Benefit Program is TDS and nitrate-nitrogen concentrations. The program requires sampling at selected wells at a minimum once every three years in the area. Sources of TDS and nitrate-nitrogen in the region and the Study Area are from:

- Beaumont WWTP DP001 and YVWD Henry N. Wochholz WWTP DP001
- Imported water
- Recycled water use
- Stormwater runoff

Water quality indicators vary generally with depth and location. A 2006 United States Geological Survey (USGS) study in the region indicated TDS concentrations ranging from 177 mg/L to 823 mg/L, nitrate-nitrogen concentrations ranging from 1.0 mg/L to 11.3 mg/L, and fluoride concentrations ranging from 0.5 mg/L to 3.0 mg/L. The groundwater is generally characterized as calcium/magnesium-bicarbonate type water or sodium-bicarbonate type water (Rewis et al., 2006). Between 2020 and 2022, TDS concentrations ranged from 230 mg/L to 840 mg/L and nitrate-nitrogen concentrations ranged from non-detect to 16 mg/L in the San Timoteo GMZ (Dudek, 2022). Over this same time period, TDS concentrations ranged from 170 mg/L to 870 mg/L and nitrate-nitrogen concentrations ranged from 0.98 mg/L to 18 mg/L in the Beaumont GMZ.

Groundwater quality for the Study Area is discussed further in Section 6.4.

# 3.0 INITIAL GOALS, OBJECTIVE, AND PERFORMANCE CRITERIA

The following subsections describe the initial goals, objectives, and performance criteria the City would like to see during the drafting and implementation of the AMMP. A draft technical memorandum of initial goals, objectives, and performance criteria was delivered to the City in December 2023 and is included as Appendix A.

## 3.1 Goals and Objectives

The City's goals for the AMMP are as follows:

1. Obtain approval for the lowest feasible discharge volume to enable the City to maximize the amount of recycled water that can be used for planned non-potable supply projects in the City service area, as well as for potential future projects for non-potable supply or recharge in the Beaumont groundwater basin.
2. Appropriately characterize the various climate, hydrogeologic, and other factors that have contributed to the extent and health of the riparian habitat that may also have historically benefited from the City's discharges.
3. Avoid unmitigable degradation to riparian habitat that could result through development of a robust monitoring and mitigation plan to address degradation to riparian habitat health due to decreased discharge from DP001.
4. Utilize existing monitoring programs and analytical tools to the extent practical to avoid duplicative work and achieve cost efficiency.
5. Establish a dialogue with other dischargers in the area to promote collaboration, openness, sharing of ideas and actions, and to promote the success of the project with stakeholders and/or other dischargers. The other discharge in the region is the YVWD.
6. Establish a dialogue with the SWRCB Division of Water Rights to ensure the development of an AMMP that meets expectations and a process to gain approval of the Change Petition.

Given its many investments in the Beaumont WWTP upgrades and non-potable supply system infrastructure, goal number one is the primary goal for the City. While there is an important goal for cost efficiency and avoiding duplicative work efforts, designing an AMMP to meet the primary goal may require more robust modeling efforts in future phases of work to assess the long-term effects of reduced discharges as it pertains to riparian health, and to best assess effectiveness of potential mitigation actions. Goal number five for open communication with other local stakeholders and regulators will also be critical to achieving goal number one. A key local stakeholder is the YVWD due to their downstream discharges on San Timoteo Creek and co-responsible agency with the Maximum Benefit SNMP. Any changes to the City's discharge could impact how the YVWD manages its discharge and any requirements to manage riparian habitat.

The City plans to accomplish these goals through the development and implementation of the AMMP. The objectives in support of the City's goals for Phase 1 of the AMMP are as follows:

1. Quantify the extent and health of the riparian habitat in the immediate vicinity of DP001 and downstream areas that may benefit from the City's discharges
2. Quantify the climate and hydrogeologic factors that have contributed to the extent and health of the riparian habitat.

3. Characterize the range of hydrogeologic conditions that contribute to healthy riparian habitat.
4. Define the extent of riparian habitat that benefit from discharges from the City's WWTP on Cooper's Creek and identify the potential impacts to riparian habitat and hydrogeologic conditions from reduced discharges.
5. Define data gaps and uncertainties that exist in defining the baseline condition of the riparian and hydrogeologic conditions (e.g. current conditions based on current discharge rates at DP001).
6. Define a monitoring program necessary to fill the data gaps and uncertainties in the baseline conditions.
7. Define the analytical tools needed to assess impacts to the hydrogeologic system at various levels of reduced discharge.
8. Establish a process for external communication with stakeholders.

## 3.2 Performance Criteria

Performance criteria are defined as a specific set of measurable standards used to evaluate the success of the AMMP. Performance criteria should be based on the baseline riparian habitat and hydrologic characterizations described in this Report. The preliminary performance criteria are as follows and are discussed in further detail in Section 9 of this Report:

1. Riparian habitat will not be adversely affected by reduction in discharges.
2. Minimum discharges will be maintained to levels determined necessary to sustain habitat along the Study Area that have historically benefited from WWTP discharges.
3. The water table depth in the Riparian Zone should be monitored to ensure that reductions in surface water flows do not result in a drop in groundwater levels that will negatively impact riparian health.

# 4.0 HISTORICAL AND EXISTING BIOLOGICAL RESOURCES

This section characterizes historical and existing biological resources within the Study Area.

## 4.1 Regional Ecological Setting

For the purpose of the AMMP, historical and existing biological resources were evaluated in the Riparian Zone of the Study Area outlines on Figure 2-2. The Riparian Zone consists of the Cooper's Creek riparian corridor from the Beaumont WWTP DP001 outfall to the confluence with San Timoteo Creek and the riparian corridor along San Timoteo Creek to at the end of the Study Area boundary at Henry N. Wochholz RWRF DP001.

The Study Area is situated in the geographically based ecological classification known as the Inland Valleys – Level IV Ecoregion of the Southern California/Northern Baja Coast – Level III Ecoregion. Level IV Ecoregions are subregions within the larger Level III Ecoregions. The goal of regional ecological classifications is to reduce variability based on spatial covariance in climate, geology, topography, climax vegetation, hydrology, and soils. The Southern California/Northern Baja Coast (Ecoregion 85) includes coastal and alluvial plains, marine terraces, and some low hills in the coastal area of Southern California (Griffith et al., 2016). The Inland Valleys Ecoregion (Ecoregion 85k), which is a subregion of Ecoregion 85, consists of alluvial fans and basin floors immediately south of the San Gabriel and San Bernardino Mountains of Ecoregion 8, as well as the San Jacinto and Perris Valleys toward the south. Ecoregion 85k includes some floodplains along the Santa Ana River, including San Timoteo Creek. Vegetation historically included Riversidean coastal sage scrub, valley grasslands, and some riparian woodlands (Griffith et al., 2016). This Ecoregion also has less marine influence on climate than other valley regions to the west, such as the Los Angeles Plain.

### *4.1.1 Regional Riparian Ecology*

The riparian zones along streams and rivers in the arid and semi-arid regions in the western United States are typically narrow and linear, with steep gradients and narrow floodplains (Mitsch and Gosselink 2015). These narrow riparian zones contrast starkly with the surrounding upland habitats. The complexity of the riparian plant community structure and species composition depends on the influence of the local flood regime, sediment deposition, movement of the stream channel over time, and the hydroperiod (Griggs, 2009). Mature riparian habitats of the Inland Valleys Ecoregion are typically dominated by winter deciduous trees and have a maximum canopy height of 30 meters, with a canopy cover ranging from 20 to 80 percent (Grenfell, n.d.). A subcanopy tree layer and understory of shrubs and woody vines such as blackberry (*Rubus* spp.[3]), shrubby willows (*Salix* spp.), elderberry (*Sambucus mexicana*), poison oak (*Toxicodendron diversilobum*), and wild grape (*Vitis* spp.) is present. Very little herbaceous cover typically exists (around 1 percent cover) in these mature riparian habitats, with 30 to 50 percent of the ground cover coming from woody vine species like wild grape (Grenfell, n.d.). Herbaceous species that are present might include sedges (Cyperaceae), rushes (Juncaceae), grasses (Poaceae), and/or nettles (Urticaceae).

Riparian plant communities in the regional vicinity of the Study Area Riparian Zone are commonly dominated by Fremont cottonwood (*Populus fremontii*), California sycamore (*Platanus racemosa*), willows, mulefat (*Baccharis salicifolia*), and other phreatophytes adapted to a high water table along streams and rivers. These species require root access to the capillary fringe above the water table at all

[3] Spp. = species

stages of life and typically have a root system that extends down to around 5 meters or less (Kibler et al., 2021). Depending on soil texture, the vertical extent of the capillary fringe can range from 1.5 centimeters in gravelly soils, to 100 centimeters in very fine sands, to 750 centimeters in fine silty soils (Fetter, 1994). Due to requiring a relatively shallow depth to groundwater, phreatophytes are particularly vulnerable to water table declines (Williams et al., 2022). Maximum recorded rooting depths for Fremont cottonwood range from 0.8 meter to 2.1 meters (Zimmerman, 1969; Shafroth, Stromberg, and Patten, 2000; Rood, Bigelow, and Hall, 2011). Gooding's willow (*Salix gooddingii*) and red willow (*Salix laevigata*) have maximum recorded rooting depths of 2.1 meters and 1 meter, respectively (Stromberg, 2013; Stover et al., 2018). The maximum recorded rooting depth for mulefat is 0.6 meters (Gary, 1963; Stromberg, 2013).

Phreatophytes such as Fremont cottonwood and Gooding's willow are sensitive to drought conditions and the effects of water stress on cottonwood and willow species resulting from increased depth to groundwater can include the production of smaller leaves and reduced stomatal conductance, reduced shoot growth, leaf and branch shedding, canopy dieback, cavitation, and death. Dense, structurally diverse forests of these species typically only occur along intermittent or perennial streams, where the depth to groundwater is less than 4 meters (Lite and Stromberg, 2005). Although Fremont cottonwood can grow in areas that only have high water tables seasonally, this tends to result in sparse stands with low age class diversity. Gooding's willow and other similar *Salix* species require a permanently shallow saturation zone (Lite and Stromberg, 2005).

The seasonal growth, reproductive timing, and seedling establishment of riparian plant communities are determined by the regional climate and local hydroperiod. Fremont cottonwood and willow dominated riparian habitats such as those present in the Riparian Zone typically have an active growth period that extends from February through the end of September. Leaf abscission typically occurs in October/November, and a dormant period typically extends from October/November to February/March, depending on species and annual fluctuations in weather patterns (Griggs, 2009). Seed dispersal typically begins in late April to early May and may continue into July and August. Winter peak stream flows redistribute sediment and scour floodplain surfaces, creating exposed point bars comprised of moist sand and fine sediments that wind-blown seeds can land and germinate on. Seedlings develop rapidly growing taproots that follow the receding water table through the growing season, resulting in the establishment of 1.5- to 2-meter-tall saplings by the end of their first growing season (Griggs, 2009).

Riparian plant community descriptions were obtained for the Riparian Zone by a combination of field surveys conducted by HDR biologists in August of 2024 and existing plant community descriptions provided in the CNPS online edition (2024) of the "Manual of California Vegetation" for the plant communities identified in the Riparian Zone by the WRC-RCA's 2012 updated vegetation maps (AIS 2015). According to the results of the field surveys and the Manual of California Vegetation plant community descriptions for habitats mapped in the Riparian Zone, the dominant native riparian species present within the Riparian Zone are willows (multiple species), Fremont cottonwood, and mulefat. These species propagate via wind-dispersed seed and vegetative means including root and shoot sprouting. Seed germination and seedling establishment occurs when seed is carried by the wind or water and is deposited on exposed moist substrates such as flood deposited sandbars. Vegetative propagation occurs when roots, stumps, or branches from the parent trees sprout new shoots. Given the dense, mature tree cover and narrow floodplain along the Cooper's Creek portion of the Study Area, it is likely that recruitment occurs primarily via vegetative propagation as there is very little opportunity for seed germination and seedling establishment within the riparian zone. However, the San Timoteo Creek portion of the Study

Area has a broader floodplain and appears to be subject to more natural fluvial processes that would be conducive to the conditions required for seed germination and seedling establishment.

Healthy riparian zones with surface water and complex vegetation structure support high biodiversity and large numbers of wildlife that require riparian habitats for their survival, including those species that utilize riparian zones as regional migration routes (Griggs, 2009). Avian fauna diversity is a particularly important indication of the health of a riparian habitat, and the California Partners in Flight and Riparian Habitat Joint Venture (RHJV) have selected 17 riparian associated indicator species or "focal species" representative of a range of healthy riparian systems (RHJV, 2004). These focal species were selected based on the following factors:

- Riparian vegetation is used as their primary breeding habitat in most bioregions of California.
- These species warrant special management status i.e., endangered, threatened, or species of special concern on either the federal or state level.
- They have experienced population declines and a reduction in breeding range size from historical extent.
- They commonly breed throughout California's riparian areas, which allows for adequate sample sizes for statistical comparisons and therefore the ability to rapidly assess responses to changes in management.
- They have breeding requirements that represent the full range of successional stages of riparian ecosystems.

The 17 riparian-associated focal species selected by the California Partners in Flight and RHJV in their 2004 Riparian Bird Conservation Plan are:

- Swainson's Hawk (*Buteo swainsoni*)
- Spotted Sandpiper (*Actitis macularius*)
- Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)
- Willow Flycatcher (*Empidonax traillii*)
- Warbling Vireo (*Vireo gilvus*)
- Least Bell's Vireo (*Vireo bellii pusillus*)
- Bank Swallow (*Riparia riparia*)
- Tree Swallow (*Tachycineta bicolor*)
- Swainson's Thrush (*Catharus ustulatus*)
- Yellow Warbler (*Setophaga petechia*)
- Common Yellowthroat (*Geothlypis trichas*)
- Wilson's Warbler (*Cardellina pusilla*)
- Yellow-breasted Chat (*Icteria virens*)
- Song Sparrow (*Melospiza melodia*)
- Black-headed Grosbeak (*Pheucticus melanocephalus*)
- Blue Grosbeak (*Passerina caerulea*)
- Tricolored Blackbird (*Agelaius tricolor*)

## 4.2 Historical Biological Resources

Data regarding historical biological resources in the Study Area were obtained through literature review and desktop evaluation. Three main sources were reviewed and analyzed, including historical aerial imagery, the California Natural Diversity Database (CNDDB), and reports documenting wildlife occurrence along San Timoteo Creek.

Historical aerial imagery of the Study Area dating back to 1966 was reviewed to provide an understanding of the historical presence and development of riparian habitats along Cooper's Creek and San Timoteo Creek.

The most recent version of the CNDDB was searched for sensitive species data in the *Beaumont, El Casco,* and *Sunnymead* USGS 7.5-Minute Series Quadrangles.[4] This database contains records of reported occurrences of sensitive species and habitats that may occur in the vicinity of the Riparian Zone. This list of sensitive species and habitats tracked by CNDDB includes any state and/or federally listed—or proposed for listing—as threatened or endangered species, Candidate Species, California Fully Protected species, California Department of Fish and Wildlife (CDFW) designated Species of Special Concern (SSC), and otherwise "Special Animals." "Special Animals" is a general term that refers to all the taxa the CNDDB is interested in tracking, regardless of their legal or protection status. This list is also referred to as the list of "species at risk" or "special status species." The CDFW considers the taxa on this list to be those of greatest conservation need.

Historical data on wildlife usage of riparian habitat along San Timoteo Creek was also obtained from the Santa Ana Watershed Association (SAWA), through the Western Riverside County Regional Conservation Authority's (WRC-RCA's) Biological Monitoring Program annual reports from 2004 to 2022. These reports contain data collected by SAWA in support of the Western Riverside County Multiple Species Habitat Conservation Plan (WRC-MSHCP) annual monitoring and reporting requirements.

### *4.2.1 Cooper's Creek*

The following subsections describe the historical plant communities and wildlife within the Riparian Zone along the Cooper's Creek portion of the Study Area.

#### 4.2.1.1 Riparian Plant Communities

In its natural state, Cooper's Creek was an ephemeral stream that historically likely only supported sparse alluvial scrub plant communities adapted to infrequent flooding before the construction of the Beaumont WWTP and subsequent releases of treated wastewater. Prior to the early 1970s, the Riparian Zone along Cooper's Creek consisted of a narrow stand of riparian vegetation that extended less than 1 mile downstream (west) of the Beaumont WWTP DP001 outfall. By 1978, the Riparian Zone approximately doubled and extended downstream approximately to the crossing by California State Route 60 ([SR-60] approximately at the Beaumont and San Timoteo GMZs boundary ), and by 1985 the Riparian Zone appears to have extended all the way to the Cooper's Creek/San Timoteo Creek confluence. Based on the review of historical aerial imagery, it appears that the expansion of riparian habitats along Cooper's Creek can primarily be attributed to the increases in surface water flow due to increasing discharges of treated wastewater from the Beaumont WWTP. Historically, the developing Riparian Zone along Cooper's Creek would likely have consisted of early seral stage riparian plant

[4] https://wildlife.ca.gov/Data/CNDDB

communities dominated by shrubby willows, mulefat, and emergent Fremont cottonwood and California sycamore, with higher shrub and herbaceous cover than is currently present along the Cooper's Creek Riparian Zone.

#### 4.2.1.2 Wildlife

Little historical data is available on the occurrence of riparian wildlife within Cooper's Creek. It is expected that wildlife use of habitat along Cooper's Creek would have increased with the growth of riparian habitat that resulted from historical increases in surface water flow associated with the release of treated wastewater from the Beaumont WWTP. With increased urban expansion resulting in habitat loss, degradation, and fragmentation in the surrounding area, the Riparian Zone along Cooper's Creek likely became an important local habitat linkage and wildlife movement corridor to more expansive downstream habitats within San Timoteo Canyon. The establishment of riparian habitat along Cooper's Creek to its confluence with San Timoteo Creek by the mid-1980s would also have provided increased dispersal opportunities for riparian species.

The Riparian Zone along Cooper's Creek provides foraging, breeding, and dispersal habitat for numerous wildlife species that occur in the region, particularly avian fauna. Cooper's Creek also provides temporary refugia for many migratory bird species. In addition to common riparian wildlife expected to occur in the vicinity of Cooper's Creek, several threatened, endangered, or otherwise rare special status species have been documented along this Riparian Zone, including the riparian associated focal species discussed below.

**Least Bell's Vireo**

The state and federally listed endangered Least Bell's vireo (LBVI) is a small migratory songbird that nests and forages almost exclusively in riparian habitats. LBVI nesting habitat typically consists of a well-developed overstory, understory, and low densities of aquatic and herbaceous cover. This species typically nests in the understory, which frequently consists of dense sub-shrub or shrub thickets. These thickets are often dominated by plants such as sandbar willow (*Salix exigua*), mulefat, young individuals of other willow species such as arroyo willow (*Salix lasiolepis*) or Gooding's willow, and one or more herbaceous species. LBVI generally begin to arrive from their wintering range in southern Baja California and establish breeding territories by mid-March to late-May.

According to the CNDDB, four breeding pairs of LBVI were observed within the riparian habitat along Cooper's Creek in 2013. Although these four breeding pairs are the only historically documented LBVI occurrences along Cooper's Creek, suitable LBVI habitat has been present along Cooper's Creek from the Beaumont WWTP DP001 outfall to the confluence with San Timoteo Creek since around the mid-1980s. It is not known when exactly LBVI began occupying Cooper's Creek but based on the historical presence of suitable riparian habitat, it is likely that LBVI have used Cooper's Creek for breeding and/or migratory stopover habitat for at least the past several decades.

**Willow Flycatcher**

The willow flycatcher (WIFL) is a species of small passerine bird that consists of several recognized neotropical migrant subspecies. The southwestern willow flycatcher (*Empidonax traillii extimus*) is a subspecies of WIFL that breeds in the southwestern United States from mid-April to early-September. This subspecies is both state and federally listed as endangered. In the fall, it migrates south to its wintering grounds in portions of South America, Central America, and Mexico. WIFL typically nest in the understory of dense riparian habitats (at least 0.25 acres in size and at least 10 meters wide) along rivers, streams, and other wetlands at elevations ranging from sea level to 8,500 feet (Sogge, 2010). Plant species closely

associated with the WIFL include willows, boxelder (*Acer negundo*), and mulefat, with an overstory of Fremont cottonwood. Occupied habitat is generally dominated by shrubs and trees 4 to 7 meters or more in height, which provide dense lower and mid-story vegetation approximately 3 to 4 meters aboveground. This dense vegetation is often interspersed with open water, small openings, or sparse vegetation, creating a mosaic that is not uniformly dense.

According to the CNDDB, WIFL were detected along Cooper's Creek in 2004 in habitat dominated by arroyo willow, Fremont cottonwood, and stinging nettle (*Urtica dioica*) with a tree canopy height of 11 meters. A second WIFL observation was made along Cooper's Creek the same year, approximately 0.5 mile downstream (west) of the first observation (CNDDB, 2024). The second 2004 WIFL observation was within habitat dominated by arroyo willow, Gooding's willow, and mulefat. Although these two WIFL observations are the only documented WIFL occurrences along Cooper's Creek, suitable WIFL habitat has been present along Cooper's Creek from the Beaumont WWTP DP001 outfall to the confluence with San Timoteo Creek since around the mid-1980s. It is not known when exactly WIFL began occupying Cooper's Creek or if the two historical observations were territorial birds or migrating individuals but based on the historical presence of suitable riparian habitat, it is likely that WIFL have used Cooper's Creek for breeding and/or migratory stopover habitat for at least the past several decades.

**Yellow Warbler**

The yellow warbler (YEWA) is a small, almost uniformly yellow, migratory songbird that typically nests in the midstory of deciduous riparian plant species, such as willows and cottonwoods, but also breeds locally in wild rose and more xeric plant species and habitats (RHJV, 2004). YEWA generally inhabit wet areas within early successional riparian communities, or in remnant or regenerating canopy species stands (RHJV, 2004). Early successional riparian communities form after a disturbance (e.g., flooding) and are characterized by high productivity and a prevalence of pioneer shrubs, emergent trees, and herbaceous species that are adapted to frequent flooding and high soil moisture. Cottonwoods (*Populus* spp.) and willows (*Salix* spp.) are common early successional riparian species (NRCS 2007). YEWA typically arrives in California in April and is mostly gone by October, breeding from mid-April into early August, with peak activity in June (Green 2005a). YEWA have been designated as a California SSC.

According to the CNDDB, YEWA have been observed within the riparian habitat along Cooper's Creek several times from 2007 to 2016. Suitable YEWA habitat has been present along Cooper's Creek from the Beaumont WWTP DP001 outfall to the confluence with San Timoteo Creek since around the mid-1980s. It is not known when exactly YEWA began occupying Cooper's Creek but based on the historical presence of suitable riparian habitat, it is likely that YEWA have used Cooper's Creek for breeding and/or migratory stopover habitat for at least the past several decades.

**Other Special Status Species**

In addition to the riparian associated focal species discussed above, Cooper's hawk (*Accipiter cooperii* [COHA]) was observed nesting in riparian habitat dominated by arroyo willow, Gooding's willow, and mulefat along Cooper's Creek in 2004 (CNDDB, 2024). This species has been designated as a Watch List species by the CDFW, likely due to historical declines resulting from pesticide use and hunting. Suitable COHA breeding and hunting habitat has existed along Cooper's Creek for at least the past several decades.

### *4.2.2 San Timoteo Creek*

The following subsections describe the historical plant communities and wildlife within the Riparian Zone along San Timoteo Creek portion of the Study Area.

#### 4.2.2.1 Riparian Plant Communities

Historically, San Timoteo Creek supported a mix of riparian and alluvial scrub plant communities between the Cooper's Creek and San Timoteo Creek confluence and the Henry N. Wochholz RWRF DP001. A mix of both early and later seral stages of riparian habitats have been present along San Timoteo Creek since at least the mid-1960s. By 1985, little to no alluvial scrub habitat existed within San Timoteo Creek between the Cooper's Creek/San Timoteo Creek confluence and the Henry N. Wochholz RWRF DP001. Riparian habitat present along San Timoteo Creek in 1980[5] was described as Southern Cottonwood Willow Riparian Forest (CNDDB, 2024). Holland (1986) described Southern Cottonwood Willow Riparian Forest habitat as "Tall, open, broad-leafed winter-deciduous riparian forests dominated by *Populus fremontii*, [*Populus*] *trichocarpa*, and several tree willows." Plant species characteristic of this riparian community are listed as California mugwort (*Artemisia douglasiana*), mulefat, Chilicothe (*Marah macrocarpa*), California sycamore, Fremont cottonwood, black cottonwood (*Populus trichocarpa*), Gooding's willow, sandbar willow, Pacific willow (*Salix lasiandra*), arroyo willow, and stinging nettle.

#### 4.2.2.2 Wildlife

The Riparian Zone along San Timoteo Creek has long provided foraging, breeding, and dispersal habitat for numerous wildlife species that occur in the region, particularly avian fauna. San Timoteo Creek provides temporary refugia for many migratory bird species, as well as overwintering habitat for several raptor species including merlin (*Falco columbarius* [MERL]) and white-tailed kit (*Elanus leucurus* [WTKI]) (WRC-MSHCP, 2010b, 2018a, and 2021a). This Riparian Zone is also an important habitat linkage for carnivorous mammals including bobcat, coyote, and long-tailed weasel (WRC-MSHCP, 2009a; 2010a; 2011; and 2012a). Like Cooper's Creek, it is expected that wildlife use of habitat along San Timoteo Creek is likely to have increased with the expansion of riparian habitat that resulted from increased surface water flow associated with increases in the discharge of treated wastewater from the Beaumont WWTP, as well as other sources from the surrounding area such as increased surface runoff from development. With increased urban expansion resulting in habitat loss, degradation, and fragmentation in the surrounding area, the Riparian Zone along San Timoteo Creek will continue to be an important local habitat linkage and wildlife movement corridor.

In addition to common riparian wildlife expected to occur along San Timoteo Creek, several threatened, endangered, or otherwise rare special status species have been documented along this Riparian Zone, including the riparian associated focal species discussed below. San Timoteo Canyon is also a WRC-MSHCP "Core Area" for LBVI, WIFL, YEWA, yellow-breasted chat (YBCH), and COHA. The WRC-MSHCP defines Core Areas as, "[…] Habitat of appropriate size, configuration, and vegetation characteristics to generally support the life history requirements of one or more Covered Species."

[5] The only relevant riparian plant community descriptions available for the San Timoteo Creek portion of the Study Area are from a 1980 CNDDB entry describing the habitat as "Southern Cottonwood Willow Riparian Forest." The SAWA biological monitoring reports for the WRC-RCA's Biological Monitoring Program that were included in the literature review pertain to wildlife usage of riparian habitat along San Timoteo Creek.

### Least Bell's Vireo

According to the CNDDB, the earliest documented LBVI occurrence in San Timoteo Creek is from 1978. More recently, SAWA biologists have observed LBVI nesting in riparian habitat along San Timoteo Creek in every year that they surveyed from 2006 to 2020 (WRC-MSHCP, 2007; 2008; 2009b; 2012b; 2015; 2018b; and 2021b). In 2017, SAWA documented 66 LBVI nests along San Timoteo Creek, 52 (79%) of which were successful, resulting in 164 fledglings (WRC-MSHCP, 2018b).

### Willow Flycatcher

SAWA biologists observed a migrating WIFL along San Timoteo Creek in 2006 and a territorial WIFL (southwestern subspecies) in 2012 (WRC-MSHCP, 2007; and 2015). There are no other documented WIFL occurrences within San Timoteo Creek, despite there being seemingly suitable riparian habitat for this species present throughout this portion of the Study Area for possibly over 40 years.

### Yellow Warbler

According to the CNDDB, there were 146 YEWA detections along San Timoteo Creek from 2007 to 2016. SAWA biologists have observed YEWA nesting in riparian habitat along San Timoteo Creek in every year that they surveyed from 2006 to 2019 (WRC-MSHCP, 2007; 2008; 2009b; 2012b; 2015; and 2020).

### Wilson's Warbler

The Wilson's warbler (*Cardellina pusilla* [WIWA]) is a small migratory songbird that is bright yellow colored with a black cap. This species typically nests in the understory of deciduous riparian plant species, such as willows, alders, and riparian shrubs, as well as in grass, nettles, and ferns (RHJV, 2004). WIWA nest within 0.3 to 3 meters off the ground and usually within 1 meter of the ground and prefer areas with tall trees and moderate to thick canopy cover (RHJV, 2004). This species is a seasonal migrant in southern California, with most spring migrants from Mexico and Central America passing through southern California in late April/early May, and most fall migrants returning through southern California in late August/early September (Green, 1990a). WIWA has no special legal status but is considered a riparian associated focal species by the California Partners in Flight and Riparian Habitat Joint Venture in their 2004 Riparian Bird Conservation Plan.

SAWA biologists observed four WIWA along San Timoteo Creek in 2007 (WRC-MSHCP, 2008). The Riparian Zone along San Timoteo Creek likely provides important migratory stopover habitat for this species.

### Yellow-breasted Chat

The yellow-breasted chat (YBCH) is a medium sized migratory songbird that is olive-green dorsally, with a bright yellow breast. This species breeds in North America and primarily overwinters in Central America and Mexico. YBCH typically nest in the understory of riparian habitat and marsh margins, often in early successional riparian communities (RHJV, 2004). This species generally breeds from early May through early August, with peak activity in June (Green, 2005b). YBCH have been designated as a California SSC.

According to the CNDDB, there were 30 YBCH detections along San Timoteo Creek from 2012 to 2016. SAWA biologists have observed YBCH nesting in riparian habitat along San Timoteo Creek in every year that they surveyed from 2006 to 2019 (WRC-MSHCP, 2007; 2008; 2009b; 2012b; 2015; and 2020).

**Western Yellow-billed Cuckoo**

Western yellow-billed cuckoo (YBCU) have not been documented in either San Timoteo Creek or Cooper's Creek. Although the riparian habitat along San Timoteo Creek is of sufficient size and canopy height to support YBCU, this Riparian Zone is very linear and susceptible to edge effect, which may reduce the likelihood of it being occupied by species like YBCU that require large tracts of habitat (WRC-MSHCP, 2015).

**Other Special Status Species**

In addition to the riparian associated focal species discussed above, the following special status species have been documented within riparian habitats along San Timoteo Creek between the Cooper's Creek/San Timoteo Creek confluence and the Henry N. Wochholz RWRF DP001 outfall:

- MERL
- WTKI
- Southwestern pond turtle (*Actinemys pallida*)

MERL and WTKI have both been documented utilizing the riparian habitat along San Timoteo Creek for overwintering (WRC-MSHCP, 2010b; 2018a; and 2021a). WTKI have also been documented breeding along San Timoteo Creek and SAWA biologists have observed this species 30 times along San Timoteo Creek since 2005 (WRC-MSHCP, 2018a). MERL has been designated as a Watch List species by the CDFW and the WTKI is a California Fully Protected species.

The federally proposed as threatened southwestern pond turtle (pond turtle) has been documented once within San Timoteo Creek, near the Henry N. Wochholz RWRF DP001 at the westernmost (downstream) end of the Study Area (pers. obs., 2016; CNDDB, 2024). There are no other documented pond turtle observations within San Timoteo Creek, and it is not known how much suitable habitat for this species is currently present along San Timoteo Creek or the current population size. Pond turtles require both aquatic and terrestrial habitats. They use permanent and seasonal aquatic habitats including rivers, sloughs, lakes, reservoirs, ponds, and irrigation canals, with sites for basking, such as rocks, sand, mud, downed logs, submerged branches of near-shore vegetation, and emergent or submerged aquatic vegetation (Western Pond Turtle Range-wide, 2020). Pond turtles move onto land for nesting, overwintering, dispersal, and aestivation. Nesting typically occurs within 100 meters of aquatic habitat in areas with compact well-drained soil, sparse vegetation, and good solar exposure (Western Pond Turtle Range-wide, 2020). Pond turtle nesting may occur in small open areas along trails, levees, roadbeds, fields, grasslands, stream banks, and within utility rights-of-way. Overwintering sites include shrubby/forested areas, the bottom of muddy ponds and other aquatic habitats, and undercut banks along streams (Western Pond Turtle Range-wide, 2020). Many pond turtles overwinter on land at sites up to 500 meters from the water. Overwintering sites tend to have a deep layer of duff or leaf litter under trees or shrubs, and some pond turtles return to the same site each year.

## 4.3 Existing Biological Resources

Data regarding existing biological resources in the Study Area and Riparian Zone were obtained through literature review, desktop evaluation, and field investigations (discussed as 'Baseline Surveys' below). Available technical information on the biological resources of the Study Area was reviewed, including previous surveys and recent findings. Spatial data from the WRC-RCA's 2012 updated vegetation maps were obtained from the CDFW's Vegetation Classification and Mapping Program (VegCAMP) to help describe

riparian plant communities present within the Riparian Zone. Biological inventory for San Timoteo Creek was obtained from published data of the WRC-RCA and SAWA. Baseline Surveys included:

- **Vegetation Sampling Surveys:** characterization of the riparian plant communities along Cooper's Creek including total riparian vegetation cover, species richness, and percentage of non-native species cover.
- **General Inventory of Biological Resources:** literature review along the Cooper's Creek and San Timoteo Riparian Zone utilizing the 2012 WRC-RCA's vegetation map and SAWA biological monitoring reports.
- **Focused Protocol Surveys:** characterization of presence or absence of two special status riparian associated focal species: LBVI and WIFL.

### *4.3.1 Methods*

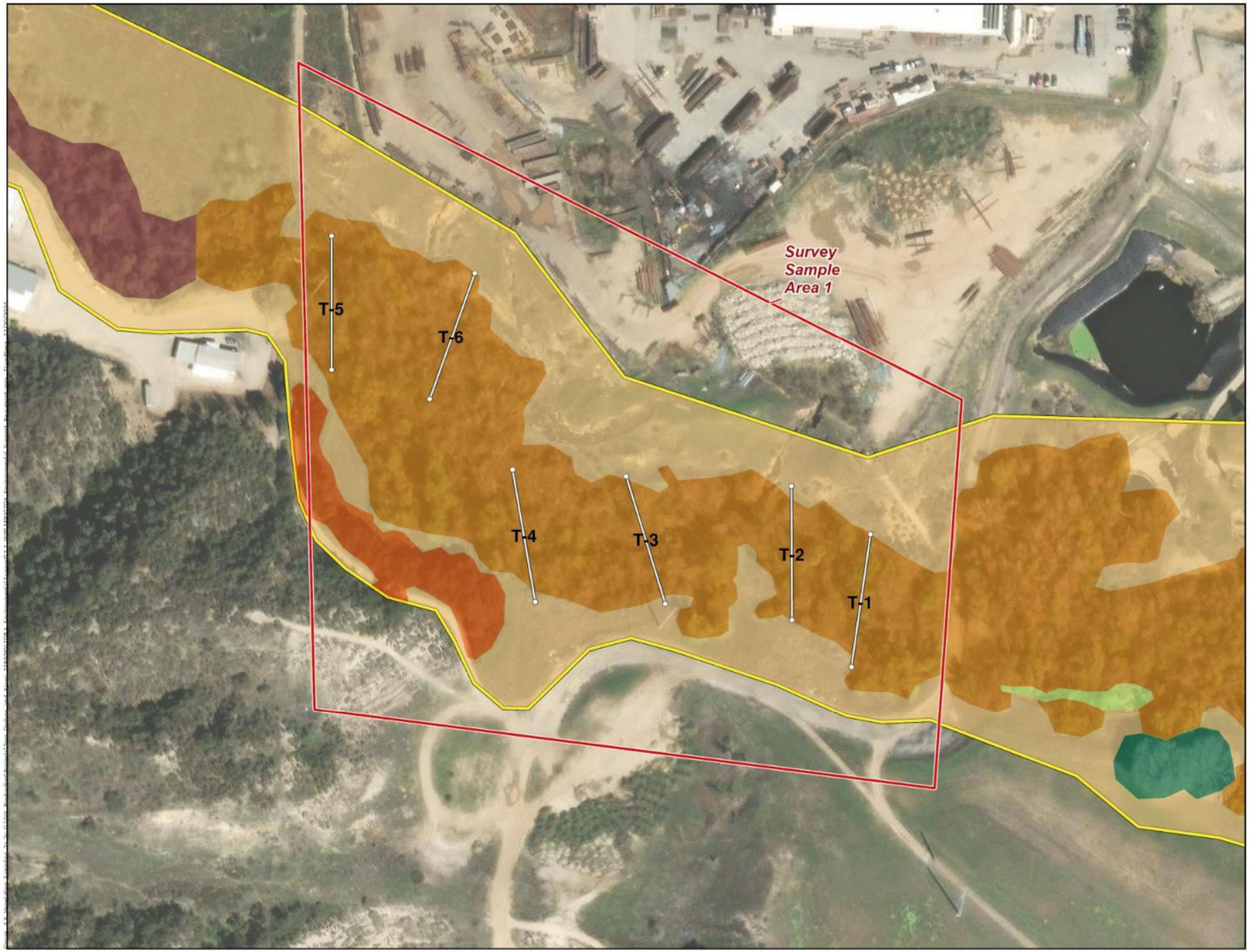
Each of the methods is described further in the following subsections.

#### 4.3.1.1 Vegetation Sampling Surveys

Baseline field vegetation sampling surveys were conducted in August of 2024 to characterize vegetation cover, species richness, and percentage of native and non-native species cover within the Cooper's Creek Riparian Zone. Three "Sample Areas" were established along Coopers' Creek (Sample Areas 1,2, and 3) and within each Sample Area a series of 25- to 50-meter long transects perpendicular to the creek channel were established (Figures 4-1 through 4-3). Using a line-point intercept method, species were recorded at 1-meter intervals along the sampling transects. A vertical point was projected at each 1-meter interval and any plant, stem, or canopy intercepting the point was recorded. Average percent cover for each species encountered as well as the total vegetation cover percentage was determined for each transect based on the number of intercepted points divided by the total number of points along the transect (Table 4-1a through 4-1c). The average percent cover for each transect in a given Sample Area was added up and divided by the total number of transects in the Sample Area to provide the average percent cover for the dominant species within each stratum, as well as the overall average vegetation cover within the Sample Area. This data was also used to calculate the percent native and non-native vegetation cover within the three Sample Areas (Table 4-2a through 4-2c). It should be noted that due to overlapping vegetation layers, the sum of absolute cover values for all species may exceed 100 percent.

Native species richness for each transect was determined by adding the total number of species encountered along a transect (Table 4-3a through 4-3c). The number of species recorded along all transects within a given Sample Area was added up and divided by the number of transects within the Sample Area to calculate the overall average native species richness observed within the Sample Area.

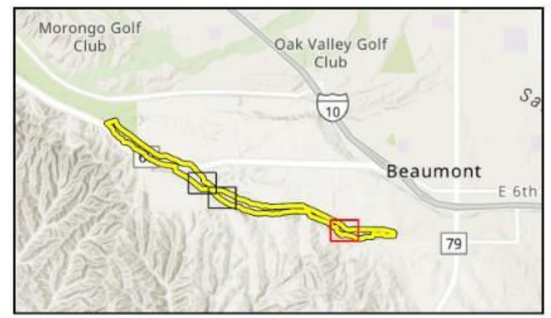
Transect endpoint locations were recorded with sub-meter accuracy in ArcGIS Field Maps using an iPhone connected to an EOS Arrow 100 Global Navigation Satellite System (GNSS) device via Bluetooth. Sample Areas were selected based largely on accessibility. No private property or restricted access areas were surveyed. It should be noted that there are several homeless encampments scattered along Cooper's Creek between the Beaumont WWTP DP001 outfall and the 4$^{th}$ Street crossing, and these areas were avoided during the surveys.




Vegetation Study Area
Survey Sample Areas
Transect Start and End Points
Transect Lines

**Vegetation Category**

- Cattail marshes
- Fremont Cottonwood Alliance
- Goodding's Willow - Red Willow Alliance
- Interior Live Oak Alliance
- Red Willow Alliance
- Upland habitat and disturbed areas



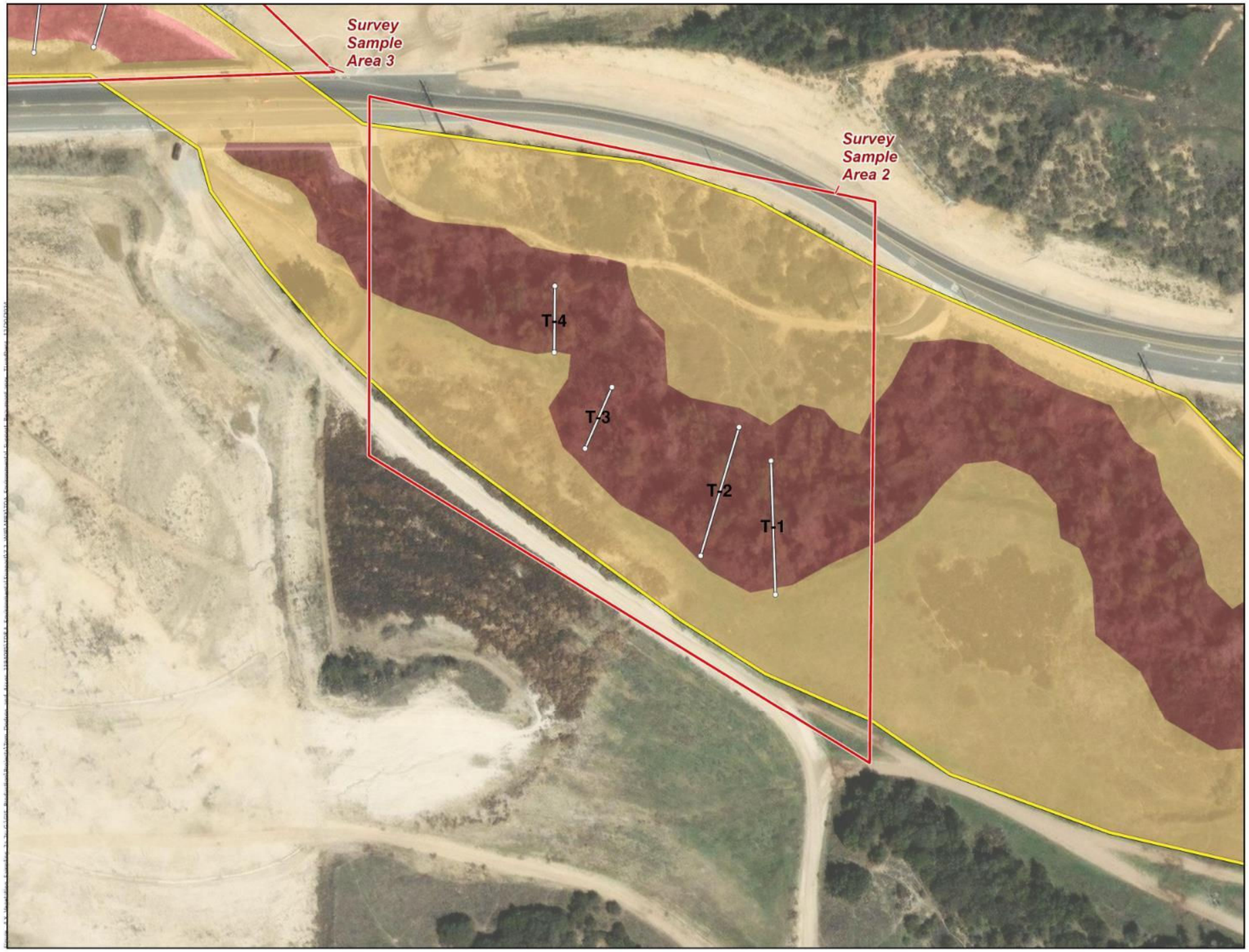

Prepared by: WEST YOST, HDR

N

0 150 300
Feet

Prepared for:
**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*
BEAUMONT

**Baseline Vegetation Sample Area 1**
*City of Beaumont AMMP*
**Figure 4-1**




Vegetation Study Area

Survey Sample Areas

Transect Start and End Points

Transect Lines

**Vegetation Category**

Godding's Willow Association

Goodding's Willow - Red Willow Alliance

Mulefat Alliance

Upland habitat and disturbed areas

Prepared by:

WEST YOST

HDR

N

0 150 300

Feet

Prepared for:

**City of Beaumont**

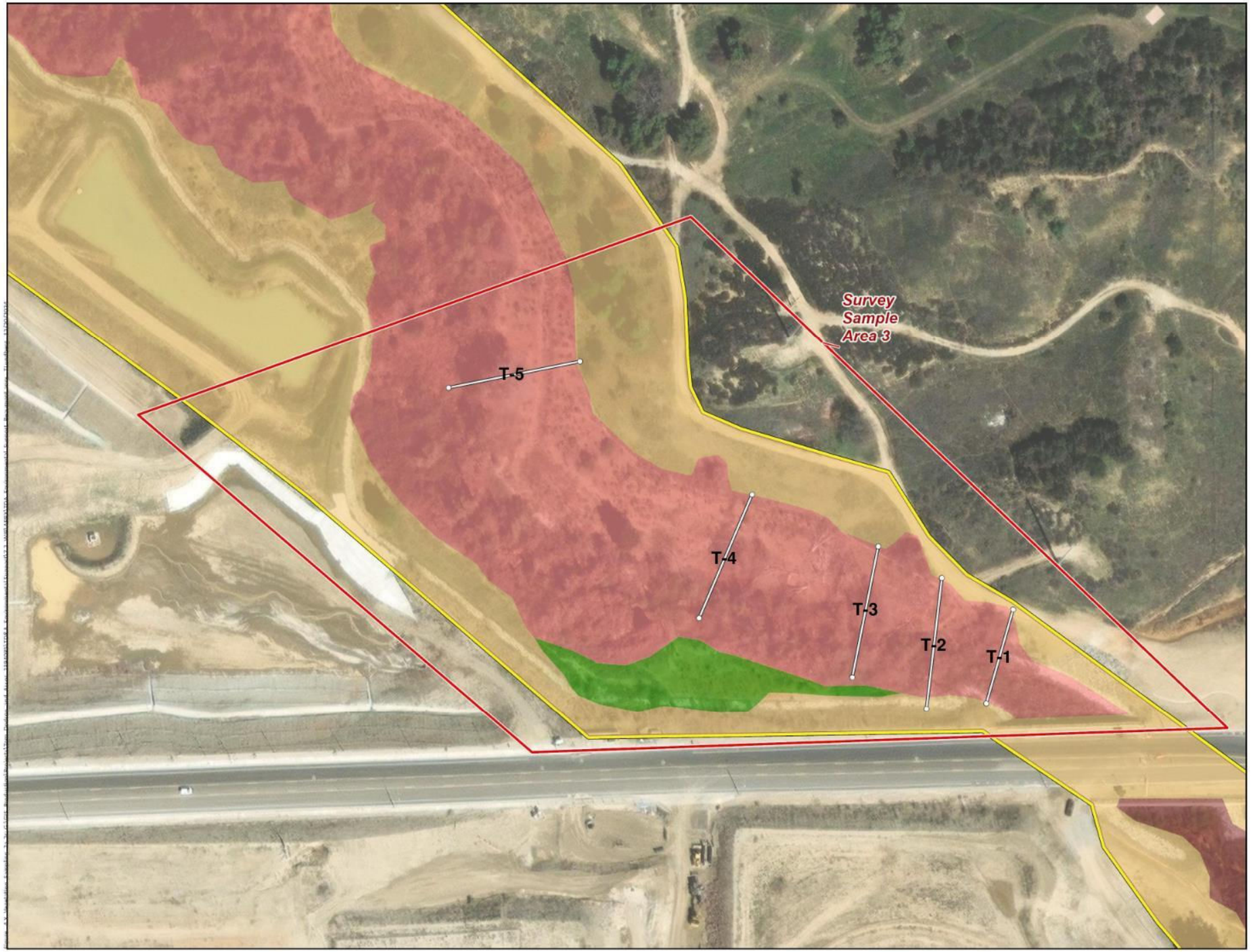
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT

**Baseline Vegetation Sample Area 2**

*City of Beaumont AMMP*

**Figure 4-2**




Vegetation Study Area

Survey Sample Areas

Transect Start and End Points

Transect Lines

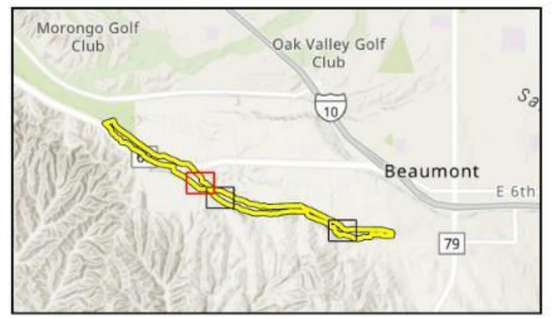
**Vegetation Category**

Godding's Willow Association

Goodding's Willow - Red Willow Alliance

Mulefat Alliance

Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 150 300

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT

**Baseline Vegetation Sample Area 3**

*City of Beaumont AMMP*

**Figure 4-3**

**Table 4-1a. Sample Area 1 - Salix laevigata Forest & Woodland Alliance Percent Cover by Species**

| Species | Transect 1 (50 m) | Transect 2 (50 m) | Transect 3 (50 m) | Transect 4 (50 m) | Transect 5 (50 m) | Transect 6 (50 m) | Average % Cover |
|---|---|---|---|---|---|---|---|
| Tree Stratum | | | | | | | |
| *Salix laevigata* (red willow) | 98 | 50 | 54 | 44 | 46 | 58 | 58.33 |
| *Salix lasiolepis* (arroyo willow) | | 20 | | 16 | | 8 | 7.33 |
| *Populus fremontii* (Fremont cottonwood) | | | | | | 28 | 4.67 |
| *Fraxinus velutina* (velvet ash) | | 22 | | | | | 3.67 |
| *Juglans californica* (southern California black walnut) | | 8 | 30 | 24 | 24 | | 14.33 |
| *Ailanthus altissima* (tree of heaven)[(a)] | 54 | | | | | | 9 |
| Shrub Stratum | | | | | | | |
| *Baccharis salicifolia* (mule fat) | | | | | | 20 | 3.33 |
| *Sambucus mexicana* (blue elderberry) | | | | | 6 | 6 | 2 |
| *Nicotiana glauca* (tree tobacco)[(a)] | | | | | | 10 | 1.67 |
| Herb Stratum | | | | | | | |
| *Datura wrightii* (jimsonweed) | | | 2 | | 2 | 2 | 1 |
| *Urtica dioica* (stinging nettle) | 8 | 2 | | 20 | 12 | | 7 |
| *Typha sp.* (cattail) | | | | | 8 | | 1.33 |
| *Cyperus eragrostis* (tall cyperus) | 8 | | | 2 | 2 | | 2 |
| *Elymus repens* (quack grass)[(b)] | | | | 6 | | | 1 |
| *Bromus diandrus* (ripgut grass)[(a)] | | | | | | 2 | 0.33 |
| **Total Vegetation Cover Percentage[(c)]** | **168** | **102** | **86** | **112** | **100** | **134** | **117** |

(a) Non-native, Invasive Species

(b) Non-native Species

(c) Due to overlapping vegetation layers, the sum of absolute cover values for all species may exceed 100 percent.

| Table 4-1b. Percent Native and Non-native Cover within Sample Area 1 | | |
|---|---|---|
| Transect Number and Length, m | Vegetation Type | Baseline percent Cover |
| Transect 1 (50 m) | Perennial | 168 |
| | Annual | 0 |
| | Non-native | 54 |
| | Invasive | 54 |
| Transect 2 (50 m) | Perennial | 102 |
| | Annual | 0 |
| | Non-native | 0 |
| | Invasive | 0 |
| Transect 3 (50 m) | Perennial | 86 |
| | Annual | 0 |
| | Non-native | 0 |
| | Invasive | 0 |
| Transect 4 (50 m) | Perennial | 112 |
| | Annual | 0 |
| | Non-native | 6 |
| | Invasive | 0 |
| Transect 5 (50 m) | Perennial | 100 |
| | Annual | 0 |
| | Non-native | 0 |
| | Invasive | 0 |
| Transect 6 (50 m) | Perennial | 132 |
| | Annual | 2 |
| | Non-native | 12 |
| | Invasive | 12 |
| **Overall** | **Perennial** | **116.67** |
| | **Annual** | **0.33** |
| | **Non-native** | **12** |
| | **Invasive** | **11** |

| Table 4-1c. Native Species Richness within Sample Area 1 | |
|---|---|
| Transect Number | Baseline Species Richness |
| Transect 1 | 3 |
| Transect 2 | 5 |
| Transect 3 | 3 |
| Transect 4 | 5 |
| Transect 5 | 7 |
| Transect 6 | 6 |
| **Overall Average** | **4.83** |
| **Total Unique Species** | **11** |

**Table 4-2a. Sample Area 2 - Salix gooddingii - Salix laevigata Forest & Woodland Alliance Percent Cover by Species**

| Species | Transect 1 (50 m) | Transect 2 (50 m) | Transect 3 (25 m) | Transect 4 (25 m) | Average % Cover |
|---|---|---|---|---|---|
| Tree Stratum | | | | | |
| *Salix gooddingii* (Gooding's willow) | 54 | 30 | 100 | 28 | 53 |
| *Salix laevigata* (red willow) | 28 | 52 | | 84 | 41 |
| *Juglans californica* (southern California black walnut) | | 4 | | 8 | 3 |
| Shrub Stratum | | | | | |
| *Baccharis salicifolia* (mule fat) | 8 | | | | 2 |
| *Nicotiana glauca* (tree tobacco)[(a)] | | 4 | | | 1 |
| Herb Stratum | | | | | |
| *Urtica dioica* (stinging nettle) | 6 | 20 | 24 | 32 | 20.5 |
| *Cyperus eragrostis* (tall cyperus) | | 6 | | | 1.5 |
| *Elymus repens* (quack grass)[(b)] | | 4 | | | 1 |
| Woody Vine Stratum | | | | | |
| *Vitis girdiana* (desert wild grape) | 100 | 100 | 56 | 92 | 87 |
| **Total Vegetation Cover Percentage[(c)]** | **196** | **220** | **180** | **244** | **210** |

(a) Non-native, Invasive Species

(b) Non-native Species

(c) Due to overlapping vegetation layers, the sum of absolute cover values for all species may exceed 100 percent.

| Table 4-2b. Percent Native and Non-native Cover within Sample Area 2 | | |
|---|---|---|
| Transect Number and Length, m | Vegetation Type | Baseline percent Cover |
| Transect 1 (50 m) | Perennial | 196 |
| | Annual | 0 |
| | Non-native | 0 |
| | Invasive | 0 |
| Transect 2 (50 m) | Perennial | 220 |
| | Annual | 0 |
| | Non-native | 8 |
| | Invasive | 4 |
| Transect 3 (25 m) | Perennial | 180 |
| | Annual | 0 |
| | Non-native | 0 |
| | Invasive | 0 |
| Transect 4 (25 m) | Perennial | 244 |
| | Annual | 0 |
| | Non-native | 0 |
| | Invasive | 0 |
| **Overall** | **Perennial** | **210** |
| | **Annual** | **0** |
| | **Non-native** | **2** |
| | **Invasive** | **1** |

| Table 4-2c. Native Species Richness within Sample Area 2 | |
|---|---|
| Transect Number | Baseline Species Richness |
| Transect 1 | 5 |
| Transect 2 | 6 |
| Transect 3 | 3 |
| Transect 4 | 5 |
| **Overall Average** | **4.75** |
| **Total Unique Species** | **7** |

**Table 4-3a. Sample Area 3 - Salix gooddingii Forest & Woodland Alliance Percent Cover by Species**

| Species | Transect 1 (36 m) | Transect 2 (50 m) | Transect 3 (50 m) | Transect 4 (50 m) | Transect 5 (50 m) | Average % Cover |
|---|---|---|---|---|---|---|
| Tree Stratum | | | | | | |
| *Salix gooddingii* (Gooding's willow) | 11.11 | 74 | 18 | 46 | | 29.82 |
| *Salix laevigata* (red willow) | 50 | | | | | 10 |
| *Populus fremontii* (Fremont cottonwood) | | 10 | 14 | 10 | 26 | 12 |
| *Platanus racemosa* (western sycamore) | | | | 8 | 46 | 10.8 |
| *Ulmus pumila* (Siberian elm)[(a)] | | 2 | 10 | 18 | | 6 |
| *Prunus cerasifera* (cherry plum)[(b)] | | | | | 10 | 2 |
| *Washingtonia robusta* (Mexican fan palm)[(b)] | | | | | 10 | 2 |
| *Juglans californica* (southern California black walnut) | | | 26 | | | 5.2 |
| Shrub Stratum | | | | | | |
| *Baccharis salicifolia* (mule fat) | 16.67 | 24 | 2 | 8 | 12 | 12.53 |
| *Baccharis pilularis* (coyote bush) | | | | | 6 | 1.2 |
| *Salix lasiolepis* (arroyo willow) | 33.33 | 10 | 24 | 28 | 8 | 20.66 |
| *Salix exigua* (sandbar willow) | 5.56 | | | | | 1.11 |
| *Sambucus mexicana* (blue elderberry) | | | 10 | 10 | 4 | 4.8 |
| *Artemisia californica* (California sagebrush) | | 4 | | | 12 | 3.2 |
| *Eriogonum fasciculatum* (California buckwheat) | | 6 | 6 | | | 2.4 |
| Herb Stratum | | | | | | |
| *Urtica dioica* (stinging nettle) | 11.11 | 2 | | 10 | 8 | 6.22 |
| *Oenothera elata* (evening primrose) | | 4 | 12 | | 26 | 8.4 |
| *Erigeron canadensis* (Canada horseweed) | | 4 | 2 | 2 | | 1.6 |
| *Ambrosia psilostachya* (western ragweed) | | 2 | | | 2 | 0.8 |
| *Heterotheca grandiflora* (telegraph weed) | | 2 | | | | 0.4 |
| *Datura wrightii* (jimsonweed) | | | | 6 | | 1.2 |
| *Marrubium vulgare* (white horehound)[(b)] | | | | 2 | | 0.4 |
| *Plantago major* (common plantain)[(a)] | | | | 2 | | 0.4 |
| *Juncus acutus* (spiny rush) | | 6 | | | 4 | 2 |
| *Cyperus eragrostis* (tall cyperus) | | | | 2 | | 0.4 |
| *Typha sp.* (cattail) | | | | 2 | | 0.4 |
| *Elymus repens* (quack grass)[(a)] | | 12 | | 4 | | 3.2 |
| *Bromus diandrus* (ripgut grass)[(b)] | | 8 | | | | 1.6 |
| Woody Vine Stratum | | | | | | |
| *Vitis girdiana* (desert wild grape) | 63.89 | 58 | 56 | 28 | 56 | 52.38 |
| *Rubus armeniacus* (Himalayan blackberry)[(b)] | | 42 | | | | 8.4 |
| **Total Vegetation Cover Percentage[(c)]** | **191.67** | **270** | **180** | **186** | **230** | **211.52** |

(a) Non-native Species

(b) Non-native, Invasive Species

(c) Due to overlapping vegetation layers, the sum of absolute cover values for all species may exceed 100 percent.

| Table 4-3b. Percent Native and Non-native Cover within Sample Area 3 | | |
|---|---|---|
| Transect Number and Length, m | Vegetation Type | Baseline percent Cover |
| Transect 1 (36 m) | Perennial | 191.67 |
| | Annual | 0 |
| | Non-native | 0 |
| | Invasive | 0 |
| Transect 2 (50 m) | Perennial | 256 |
| | Annual | 14 |
| | Non-native | 64 |
| | Invasive | 50 |
| Transect 3 (50 m) | Perennial | 178 |
| | Annual | 2 |
| | Non-native | 10 |
| | Invasive | 0 |
| Transect 4 (50 m) | Perennial | 184 |
| | Annual | 2 |
| | Non-native | 26 |
| | Invasive | 2 |
| Transect 5 (50 m) | Perennial | 230 |
| | Annual | 0 |
| | Non-native | 20 |
| | Invasive | 20 |
| **Overall** | **Perennial** | **207.93** |
| | **Annual** | **3.6** |
| | **Non-native** | **24** |
| | **Invasive** | **14.4** |

| Table 4-3c. Native Species Richness within Sample Area 3 | |
|---|---|
| Transect Number | Baseline Species Richness |
| Transect 1 | 7 |
| Transect 2 | 13 |
| Transect 3 | 10 |
| Transect 4 | 12 |
| Transect 5 | 12 |
| **Overall Average** | **8.4** |
| **Total Unique Species** | **22** |

#### 4.3.1.2 General Inventory of Biological Resources

Figure 4-1 through 4-3 depict the areas within the Cooper's Creek Riparian Zone that were sampled by HDR biologists in August of 2024 and riparian plant communities within these areas were mapped according to the results of the baseline field vegetation sampling surveys. The riparian plant communities present along the remainder of Cooper's Creek and San Timoteo Creek were mapped in accordance with the WRC-RCA's 2012 updated vegetation maps are included in Table 4-4. Wildlife species observed within the Cooper's Creek Riparian Zone during the 2024 surveys conducted by HDR are included in Table 4-5. Section 4.2.2.2 of this report describes the wildlife species documented within the San Timoteo Creek portion of the Study Area during the SAWA biological monitoring efforts that occurred from 2004 to 2022.

#### 4.3.1.3 Focused Protocol Surveys

The focused protocol LBVI and WIFL presence/absence surveys were conducted by HDR biologist Adam Lockyer (Permitted Biologist, TE55135D-0) in accordance with the U.S. Fish and Wildlife Service (USFWS) survey protocols for these species. However, during the first round of LBVI surveys conducted on April 25, 2024, LBVI were detected throughout all three of the survey areas. Following the confirmation of the presence of LBVI during the first survey, subsequent surveys were canceled because the purpose of the surveys was to determine only the presence or absence of LBVI in the survey areas. Five total protocol WIFL surveys were conducted from May 16 to July 5, 2024. After accessing Survey Area 1 on April 25, locks were placed on all gates with access to the survey area. No other probable access was possible, and the fence precluded any future surveys of this area. Subsequent WIFL surveys were conducted in Survey Areas 2 and 3 (Appendix B – LBVI-WFL Survey Report).

During each of the surveys, the biologist walked slowly along the edge of riparian habitat, stopping at 60- to 100-foot intervals to listen for LBVI and WIFL. During the WIFL surveys, a recording of WIFL vocalizations was played at 60- to 100-foot intervals along the survey route. The surveying biologist, with the aid of binoculars for viewing wildlife species, waited for several minutes after each playback to look and listen for WIFL. Surveys for LBVI were conducted by stopping at similar intervals along the survey route to watch and listen for LBVI. All surveys were completed between dawn and 11:00 AM for LBVI and by 10:30 AM for WIFL. No surveys were conducted during extreme weather conditions (i.e., winds exceeding 15 miles per hour, rain, or temperatures in excess of 95 degrees Fahrenheit).

### *4.3.2 Cooper's Creek*

The following subsections describe the existing plant communities and wildlife observed in the Riparian Zone of Cooper's Creek.

#### 4.3.2.1 Riparian Plant Communities

Figures 4-4a through 4-4j are a series of ten maps that delineate the mapped extent of riparian plant communities along Cooper's Creek to its confluence with San Timoteo Creek. A total of seven riparian plant communities were mapped within the Cooper's Creek Riparian Zone:

- *Baccharis salicifolia* Shrubland Alliance (Mulefat Alliance)
- *Populus fremontii* Forest and Woodland Alliance (Fremont Cottonwood Alliance)
- *Populus fremontii – Salix* (*laevigata, lasiolepis, lucida* ssp. *lasiandra*) Association (Fremont Cottonwood / Willow spp. Association)
- *Salix laevigata* Forest and Woodland Alliance (Red Willow Alliance)

- *Salix gooddingii* Forest and Woodland Alliance (Gooding's Willow Association)
- *Salix gooddingii – Salix laevigata* Forest and Woodland Alliance (Gooding's Willow – Red Willow Alliance)
- *Typha* (*angustifolia, domingensis, latifolia*) Herbaceous Alliance (Cattail Marshes)

Two additional upland habitats were mapped adjacent the Riparian Zone for their proximity to the Riparian Zone and importance as potentially suitable foraging, breeding, and/or sheltering habitat for riparian associated wildlife species; these habitats appear in Figures 4-4a through 4-4c:

- *Quercus wislizeni* Forest and Woodland Alliance (Interior Live Oak Alliance)
- Non-native *Eucalyptus* spp. Groves

The current average width of the Cooper's Creek Riparian Zone is approximately 47 meters. The average width of the wetted portion of the stream channel (i.e., the portion of the channel with active surface flow) across all three Sample Areas was 3 meters at the time of survey. A characterization of the riparian plant communities identified within the three Sample Areas of the Cooper's Creek portion of the Study Area, including dominant species, baseline vegetation cover, species richness, and percentage of non-native species, is provided below.

**Riparian Zone Sample Area 1**

Sample Area 1 is located immediately downstream (west) of the Beaumont WWTP DP001 outfall and consists of six 50-meter long transects situated perpendicular to the active stream channel (Figure 4-1). The plant community identified within this sample area is Salix laevigata Forest and Woodland Alliance or "red willow alliance." The dominant species in the tree stratum within this riparian habitat is red willow, with an overall average cover of 58.33 percent observed in Sample Area 1 (Table 4-1a). The dominant species in the shrub stratum is mulefat, with an average cover of 3.33 percent, and the dominant herbaceous species within Sample Area 1 is stinging nettle, with an overall average cover of 7 percent. There was no woody vine stratum encountered on any of the transects in Sample Area 1. The shrub and herbaceous cover are sparse throughout most of this portion of the Cooper's Creek Riparian Zone due to the dense, closed canopy that characterizes this habitat within the Study Area. The red willow alliance that comprises the riparian habitat in Sample Area 1 is a mature or late seral stage riparian habitat, with only 12 percent bare ground and most of the ground cover consisting of woody debris. The tree canopy within this plant community is typically less than 30 meters in height (CNPS, 2024). Other native species conspicuous within Sample Area 1 include southern California black walnut and arroyo willow (Table 4-1a). Approximately 9.29 acres of red willow alliance riparian habitat exists within the Cooper's Creek portion of the Study Area.

The vegetation cover in Sample Area 1 consisted of an overall average of 116.67 percent perennial species cover and only 0.33 percent annual species cover (Table 4-2a). The overall baseline percent cover of non-native species within Sample Area 1 was 12 percent, with 11 percent invasive species cover. Invasive species present within Sample Area 1 included tree of heaven (*Ailanthus altissima*), tree tobacco (*Nicotiana glauca*), and ripgut grass (*Bromus diandrus*).

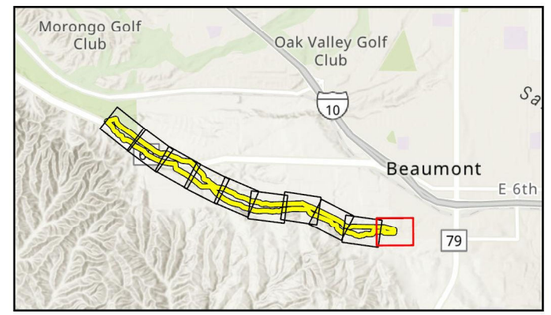
The red willow alliance habitat in Sample Area 1 is more species rich than the downstream Sample Area 2, but less species rich than the downstream Sample Area 3. The overall baseline species richness in Sample Area 1 was 11 native species, with an average native species richness of 4.83 species per transect (Table 4-3a).

Vegetation Study Area

**Vegetation Category**

Eucalyptus Groves

Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

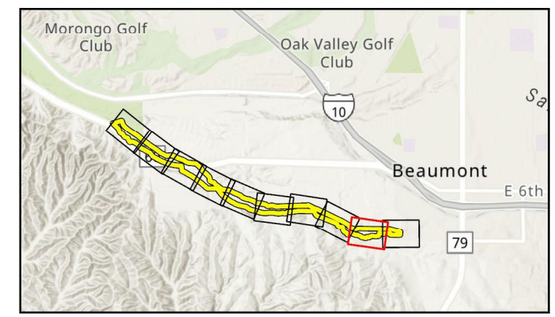
*City of Beaumont AMMP*

**Figure 4-4a**

Vegetation Study Area

**Vegetation Category**

- Cattail marshes
- Eucalyptus Groves
- Fremont Cottonwood Alliance
- Red Willow Alliance
- Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

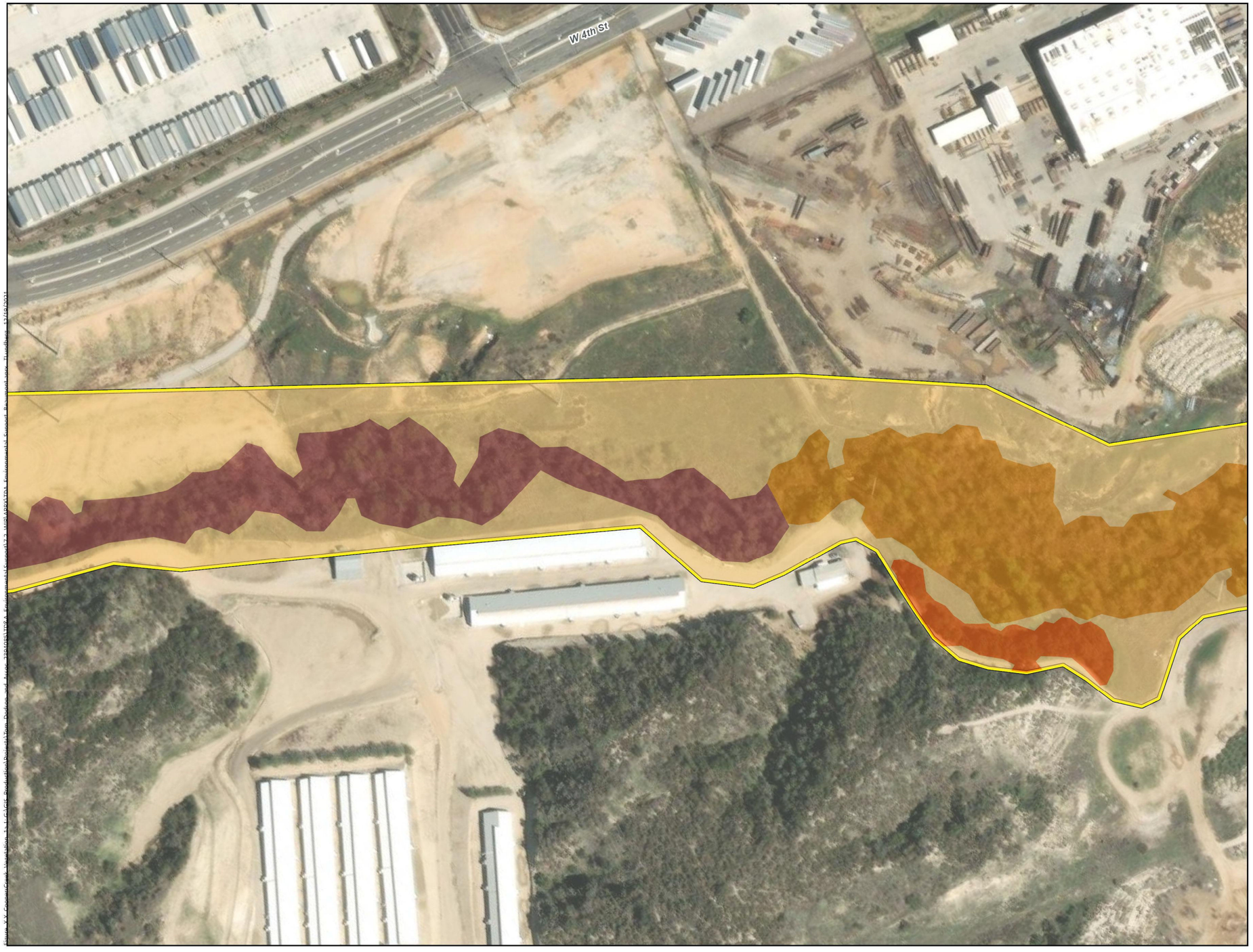
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

*City of Beaumont AMMP*

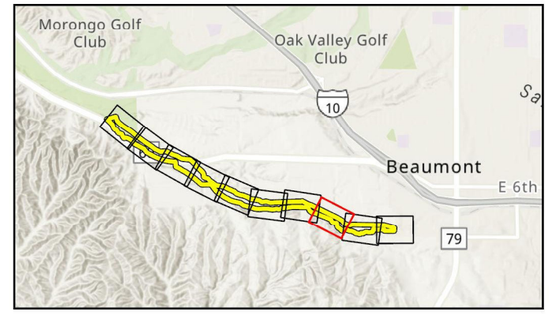
**Figure 4-4b**




Vegetation Study Area

**Vegetation Category**

- Goodding's Willow - Red Willow Alliance
- Interior Live Oak Alliance
- Red Willow Alliance
- Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

*City of Beaumont AMMP*

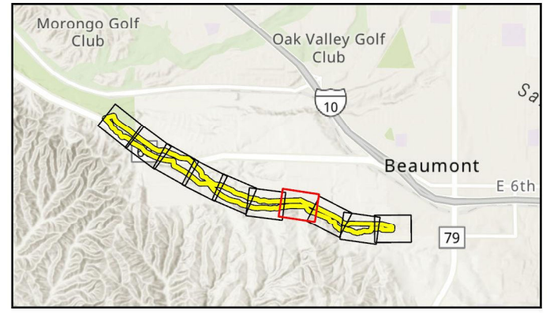
**Figure 4-4c**

Vegetation Study Area

**Vegetation Category**

Goodding's Willow - Red Willow Alliance

Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

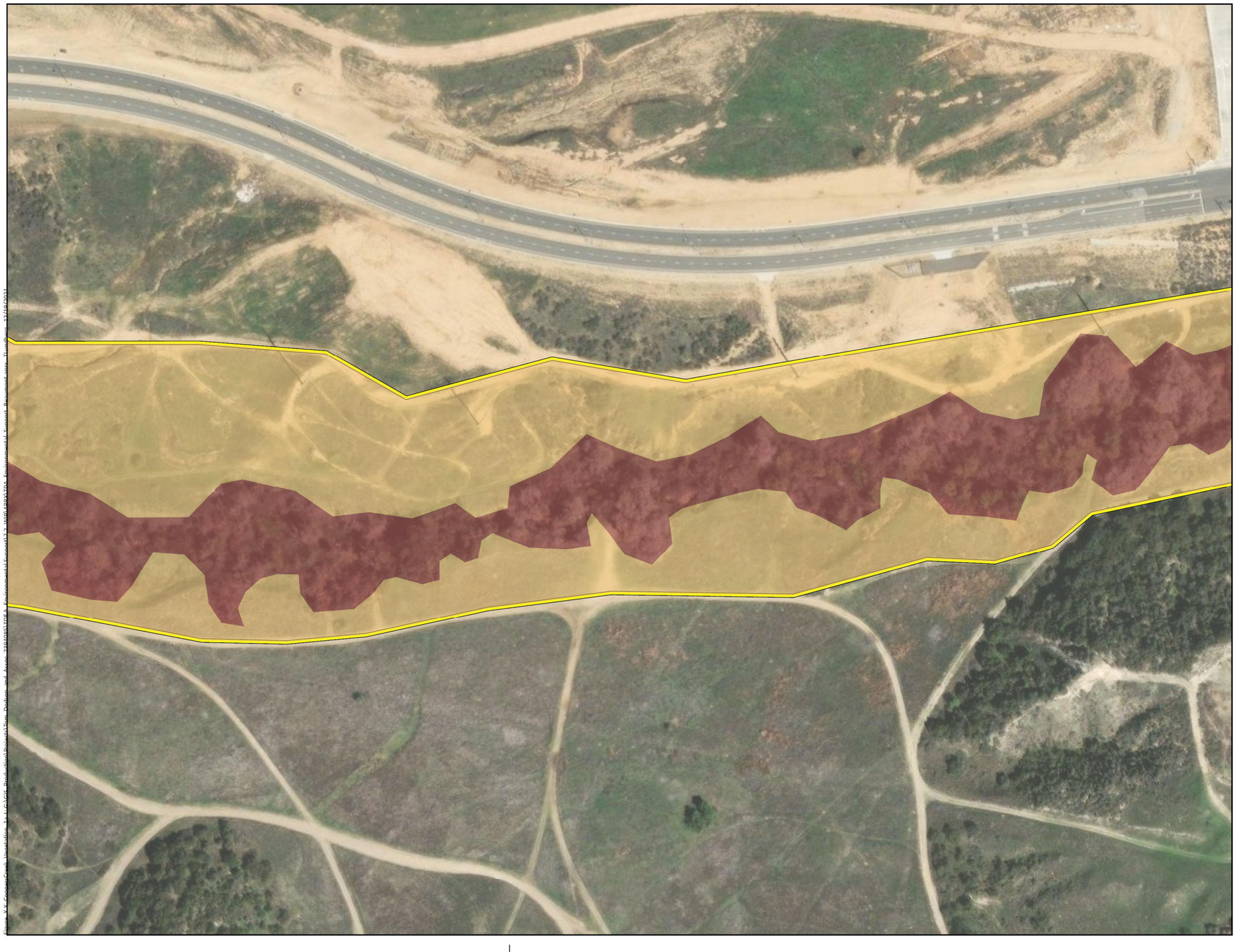
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

*City of Beaumont AMMP*

**Figure 4-4d**

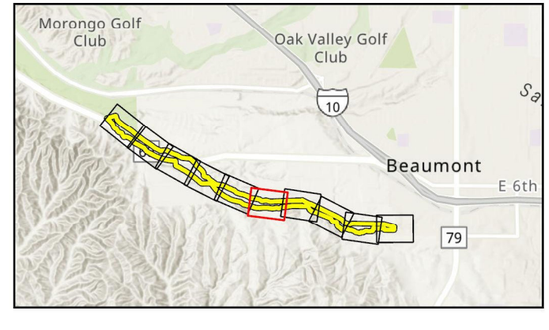


Vegetation Study Area

**Vegetation Category**

Goodding's Willow - Red Willow Alliance

Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

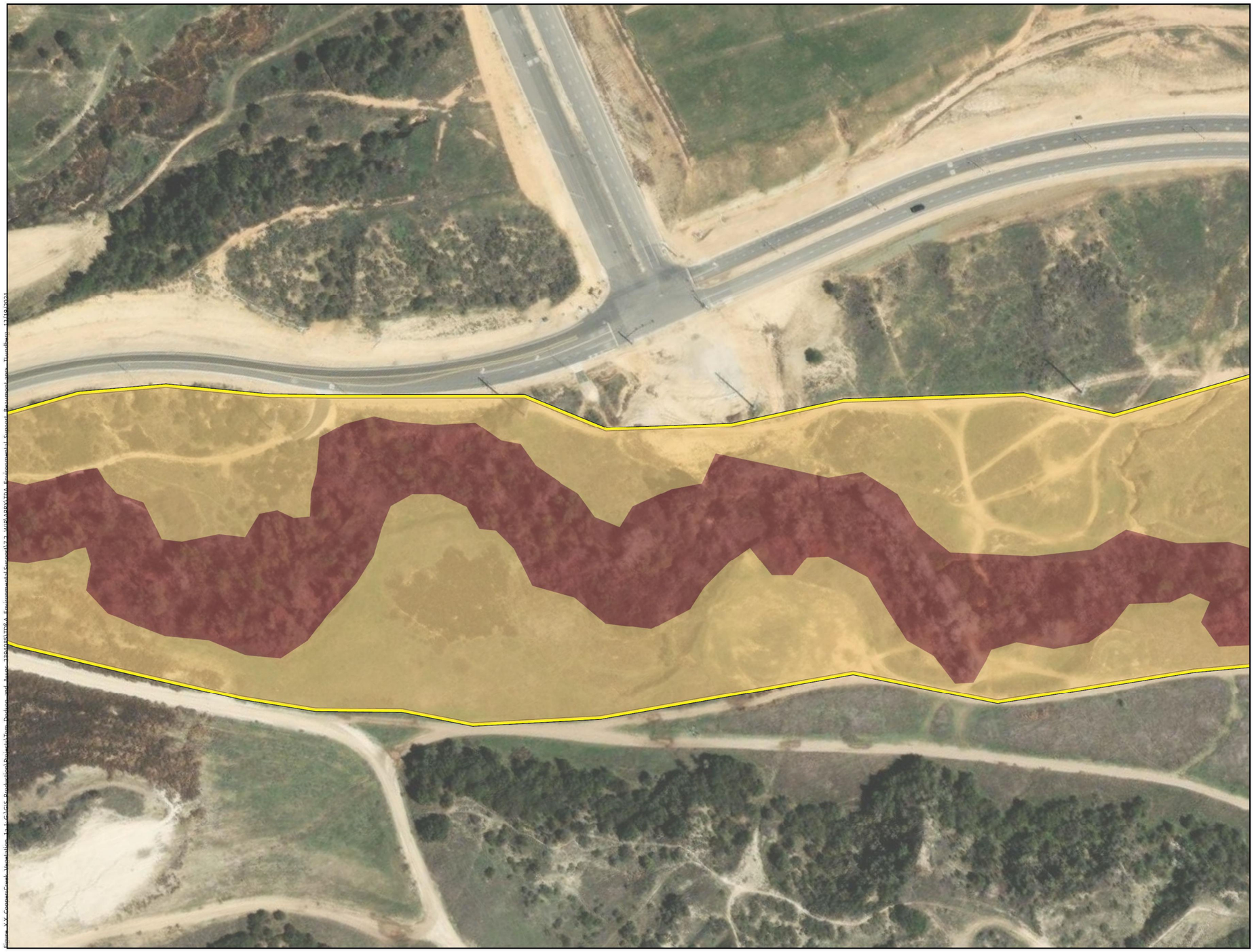
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

*City of Beaumont AMMP*

**Figure 4-4e**

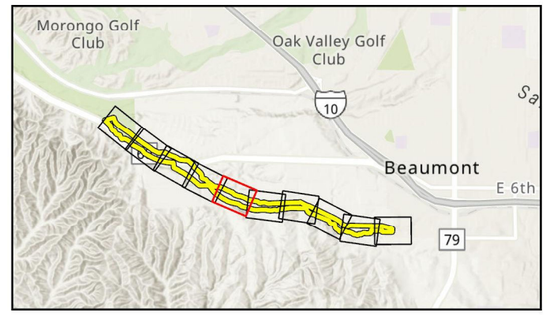


Vegetation Study Area

**Vegetation Category**

Goodding's Willow - Red Willow Alliance

Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

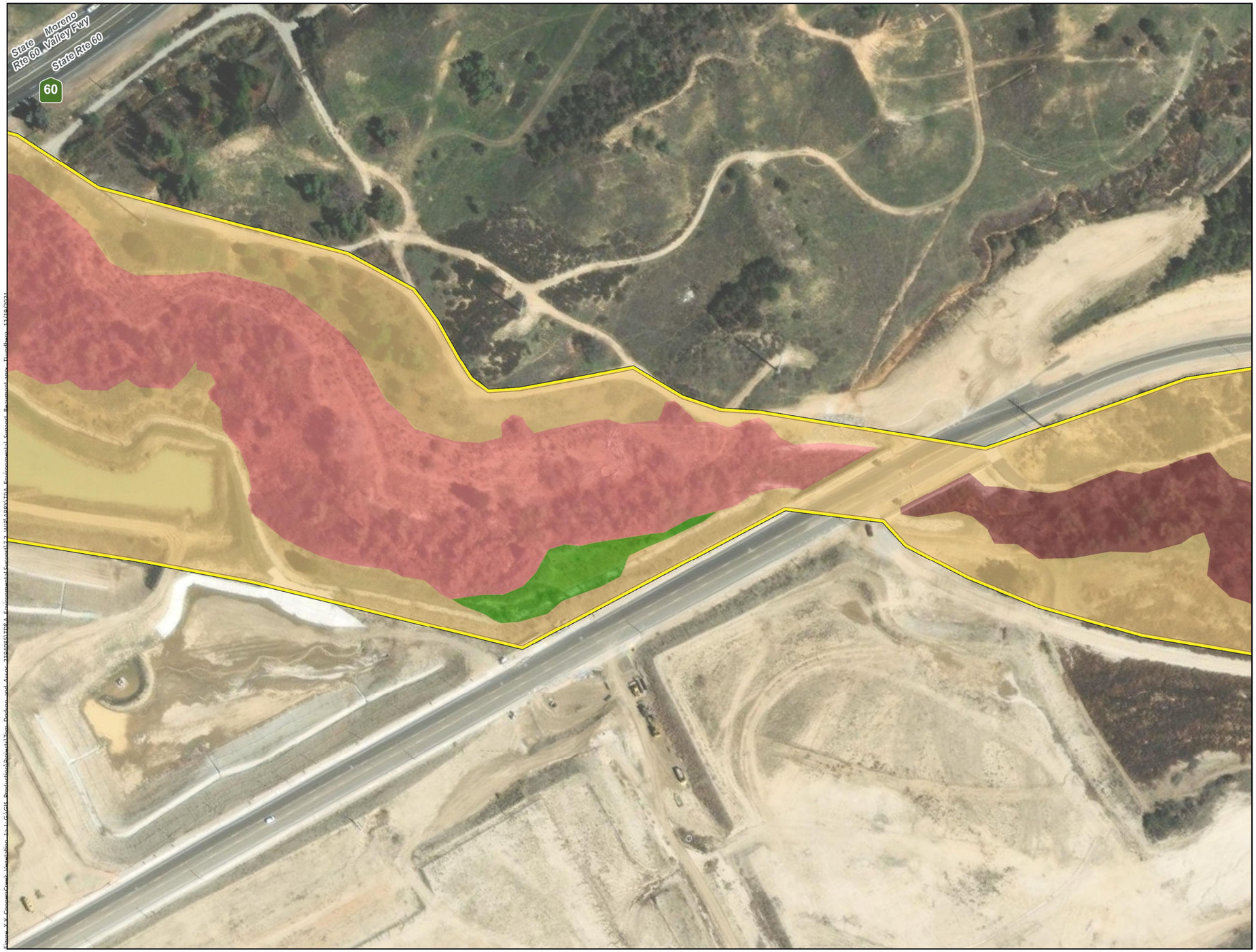
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

*City of Beaumont AMMP*

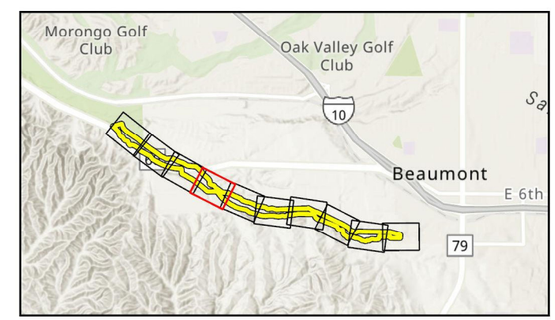
**Figure 4-4f**




Vegetation Study Area

**Vegetation Category**

- Godding's Willow Association
- Goodding's Willow - Red Willow Alliance
- Mulefat Alliance
- Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

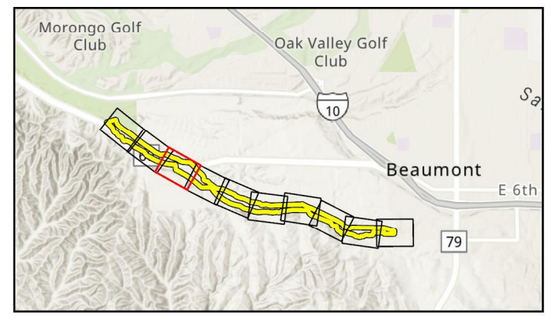
*City of Beaumont AMMP*

**Figure 4-4g**

Vegetation Study Area

**Vegetation Category**

- Fremont Cottonwood - Willow spp. Association
- Godding's Willow Association
- Upland habitat and disturbed areas




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

*City of Beaumont AMMP*

**Figure 4-4h**

Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood - Willow spp. Association

Upland habitat and disturbed areas

State Rte 60

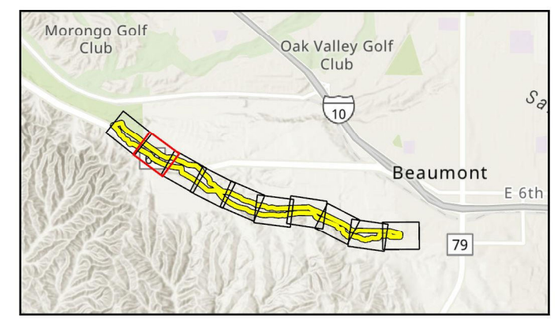
Moreno Valley Fwy

State Rte 60

60

Frontage Rd

Jack Rabbit Trl




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

*City of Beaumont AMMP*

**Figure 4-4i**

Vegetation Study Area

**Vegetation Category**

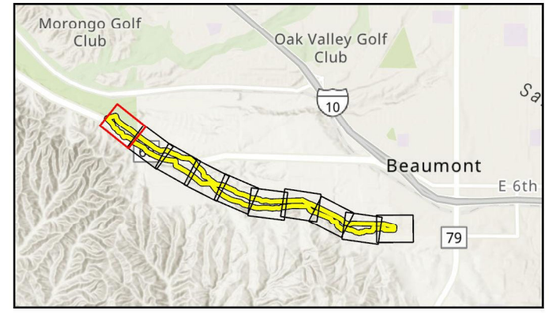
- Fremont Cottonwood - Willow spp. Association
- Mulefat Alliance
- Red Willow Alliance
- Upland habitat and disturbed areas

Moreno Valley Fwy

60

State Rte 60

State Rte 60




Prepared by:

WEST YOST

HDR

N

0 200 400

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Cooper's Creek Riparian Plant Communities**

*City of Beaumont AMMP*

**Figure 4-4j**

**Table 4-4. List of Plant Species Observed**

| Scientific Name | Common Name | Lifeform | CNPS Rank[a] | Cal-IPC Rating[b] |
|---|---|---|---|---|
| Apocynaceae | Dogbane Family | | | |
| *Apocynum cannabinum* | Indian hemp | perennial herb | -- | -- |
| Arecaceae | Palm Family | | | |
| *Washingtonia robusta* [c] | Mexican fan palm[c] | tree | -- | moderate |
| Asteraceae | Aster Family | | | |
| *Ambrosia psilostachya* | ragweed | perennial herb | -- | -- |
| *Artemisia californica* | California sagebrush | shrub | -- | -- |
| *Artemisia douglasiana* | California mugwort | perennial herb | -- | -- |
| *Artemisia dracunculus* | tarragon | perennial herb | -- | -- |
| *Baccharis pilularis* | coyote bush | shrub | -- | -- |
| *Baccharis salicifolia* | mulefat | shrub | -- | -- |
| *Centaurea melitensis* [c] | Tocalote[c] | annual herb | -- | moderate |
| *Erigeron canadensis* | Canada horseweed | annual herb | -- | -- |
| *Heterotheca grandiflora* | telegraph weed | annual or perennial herb | -- | -- |
| *Lactuca serriola* [d] | prickly lettuce[d] | annual herb | -- | -- |
| *Silybum marianum* [c] | milk thistle[d] | annual or perennial herb | -- | limited |
| *Sonchus oleraceus* [d] | sow thistle[d] | annual herb | -- | -- |
| *Xanthium strumarium* | cockleburr | annual herb | -- | -- |
| Brassicaceae | Mustard Family | | | |
| *Hirschfeldia incana* [c] | short podded mustard[c] | perennial herb | -- | moderate |
| Chenopodiaceae | Goosefoot Family | | | |
| *Salsola tragus* [c] | Russian thistle[c] | annual herb | -- | limited |
| Cucurbitaceae | Gourd Family | | | |
| *Cucurbita foetidissima* | Missouri gourd | perennial herb or vine | -- | -- |
| Cyperaceae | Sedge Family | | | |
| *Cyperus eragrostis* | tall flatsedge | perennial herb | -- | -- |
| Euphorbiaceae | Spurge Family | | | |
| *Croton setiger* | turkey-mullein | annual herb | -- | -- |
| Juglandaceae | Walnut Family | | | |
| *Juglans californica* | southern California black walnut | tree | 4.2 (limited distribution) | -- |
| Juncaceae | Rush Family | | | |
| *Juncus acutus* | spiny rush | perennial herb | -- | -- |
| Lamiaceae | Mint Family | | | |
| *Marrubium vulgare* [c] | white horehound[c] | perennial herb | -- | limited |
| Moraceae | Mulberry Family | | | |
| *Morus alba* [d] | white mulberry[d] | tree | -- | -- |
| Myrtaceae | Myrtle Family | | | |
| *Eucalyptus camaldulensis(c)* | red gum[c] | tree | -- | limited |
| Oleaceae | Olive Family | | | |
| *Fraxinus velutina* | velvet ash | tree | -- | -- |
| Onagraceae | Evening Primrose Family | | | |
| *Oenothera elata* | evening primrose | perennial herb | -- | -- |
| Papaveraceae | Poppy Family | | | |
| *Argemone munita* | Chicalote | annual or perennial herb | -- | -- |
| Plantaginaceae | Plantain Family | | | |
| *Plantago major* [d] | common plantain[d] | perennial herb | -- | -- |
| Platanaceae | Plane Family | | | |
| *Platanus racemosa* | California sycamore | tree | -- | |
| Poaceae | Grass Family | | | |
| *Arundo donax* [c] | giant reed[c] | perennial grass | -- | high |
| *Avena barbata* [c] | slender oat[c] | annual grass | -- | moderate |
| *Avena fatua* [c] | wild oat[c] | annual grass | -- | moderate |
| *Bromus diandrus* [c] | ripgut brome[c] | annual grass | -- | moderate |
| *Bromus madritensis* [d] | foxtail chess[d] | annual grass | -- | -- |
| *Elymus repens* [d] | quack grass[d] | perennial grass | -- | -- |
| *Polypogon monspeliensis* [c] | annual beard grass[c] | annual grass | -- | limited |
| Polygonaceae | Knotweed Family | | | |
| *Eriogonum fasciculatum* | California buckwheat | shrub | -- | -- |
| Rosaceae | Rose Family | | | |
| *Prunus cerasifera* [c] | cherry plum[c] | tree | -- | limited |
| *Rubus armeniacus* [c] | Himalayan blackberry[c] | shrub | -- | high |
| Rubiaceae | Bedstraw Family | | | |
| *Galium aparine* | cleavers | annual herb | -- | -- |
| Salicaceae | Willow Family | | | |
| *Populus fremontii* | Fremont cottonwood | tree | -- | -- |
| *Salix exigua* | sandbar willow | tree or shrub | -- | -- |
| *Salix gooddingii* | Gooding's willow | tree | -- | -- |
| *Salix laevigata* | red willow | tree | -- | -- |
| *Salix lasiolepis* | arroyo willow | tree or shrub | -- | -- |
| Simaroubaceae | Quassia Family | | | |
| *Ailanthus altissima* [c] | tree of heaven[c] | tree | -- | moderate |
| Solanaceae | Nightshade Family | | | |
| *Datura wrightii* | jimsonweed | perennial herb | -- | -- |
| *Nicotiana glauca* [c] | tree tobacco[c] | tree or shrub | -- | moderate |
| *Nicotiana acuminata var. multiflora* [d] | many flowered tobacco[d] | annual herb | -- | -- |
| Typhaceae | Cattail Family | | | |
| *Typha sp.* | cattail | perennial aquatic herb | -- | -- |
| Ulmaceae | Elm Family | | | |
| *Ulmus pumila* [d] | Siberian elm[d] | tree | -- | -- |
| Urticaceae | Nettle Family | | | |
| *Urtica dioica* | stinging nettle | perennial herb | -- | -- |
| Vitaceae | Grape Family | | | |
| *Vitis girdiana* | Southern california grape | vine or shrub | -- | -- |
| Viburnaceae | Viburnum Family | | | |
| *Sambucus mexicana* | elderberry | tree or shrub | -- | -- |

(a) Cal-IPC = California Invasive Plant Council
(b) CNPS = California Native Plant Council
(c) Non-native, Invasive Species
(d) Non-native Species

**Table 4-5. List of Wildlife Species Observed**

| Scientific Name | Common Name | Listing Status Federal/ State | Other Status | Riparian Habitat Focal Species |
|---|---|---|---|---|
| **BIRDS** | | | | |
| Accipitridae | Hawk Family | | | |
| *Accipiter cooperii* | Cooper's Hawk | -- | CDFW: WL[a,b] | -- |
| *Accipiter striatus* | Sharp-shinned Hawk | -- | CDFW: WL | -- |
| *Buteo jamaicensis* | Red-tailed Hawk | -- | -- | -- |
| *Buteo lineatus* | Red-shouldered Hawk | -- | -- | -- |
| Aegithalidae | Bushtit Family | | | |
| *Psaltriparus minimus* | Bushtit | -- | -- | -- |
| Anatidae | Swan, Goose, and Duck Family | | | |
| *Anas platyrhynchos* | Mallard | -- | -- | -- |
| Cathartidae | New World Vulture Family | | | |
| *Cathartes aura* | Turkey Vulture | -- | -- | -- |
| Charadriidae | Plover Family | | | |
| *Charadrius vociferus* | Killdeer | -- | -- | -- |
| Columbidae | Pigeon and Dove Family | | | |
| *Columba livia* [c] | Rock Pigeon[c] | -- | -- | -- |
| *Zenaida macroura* | Mourning Dove | -- | -- | -- |
| Corvidae | Jay and Crow Family | | | |
| *Aphelocoma californica* | California Scrub-Jay | -- | -- | -- |
| *Corvus corax* | Common Raven | -- | -- | -- |
| Falconidae | Falcon Family | | | |
| *Falco sparverius* | American Kestrel | -- | -- | -- |
| Fringillidae | Finch Family | | | |
| *Haemorhous mexicanus* | House Finch | -- | -- | -- |
| *Spinus psaltria* | Lesser Goldfinch | -- | -- | -- |
| *Spinus tristis* | American Goldfinch | -- | -- | -- |
| Icteridae | Blackbird and Oriole Family | | | |
| *Icterus bullockii* | Bullock's Oriole | -- | USFWS: BCC[d] | -- |
| *Icterus cucullatus* | Hooded Oriole | -- | -- | -- |
| *Molothrus ater* | Brown-headed Cowbird | -- | -- | -- |
| Mimidae | Mockingbird and Thrasher Family | | | |
| *Toxostoma redivivum* | California Thrasher | -- | USFWS: BCC | -- |
| Odontophoridae | New World Quail Family | | | |
| *Callipepla californica* | California Quail | -- | -- | -- |
| Parulidae | Wood-warbler Family | | | |
| *Geothlypis trichas* | Common Yellowthroat | -- | -- | Yes |
| *Leiothlypis celata* | Orange-crowned Warbler | -- | -- | -- |
| *Setophaga nigrescens* | Black-throated Gray Warbler | -- | USFWS: BCC | -- |
| *Setophaga petechia* | Yellow Warbler | -- | CDFW: SSC[e] | Yes |
| Passerellidae | New World Sparrow Family | | | |
| *Artemisiospiza belli* | Bell's Sparrow | -- | CDFW: WL | -- |
| *Chondestes grammacus* | Lark Sparrow | -- | -- | -- |
| *Melospiza melodia* | Song Sparrow | -- | -- | Yes |
| *Melozone crissalis* | California Towhee | -- | -- | -- |
| *Pipilo maculatus* | Spotted Towhee | -- | -- | -- |
| *Zonotrichia leucophrys* | White-crowned Sparrow | -- | -- | -- |
| Picidae | Woodpecker Family | | | |
| *Colaptes auratus* | Northern Flicker | -- | -- | -- |
| *Melanerpes formicivorus* | Acorn Woodpecker | -- | -- | -- |
| *Picoides nuttallii* | Nuttall's Woodpecker | -- | USFWS: BCC | -- |
| Ptiliogonatidae | Silky Flycatcher Family | | | |
| *Phainopepla nitens* | Phainopepla | -- | USFWS: BCC | -- |
| Rallidae | Rail and Coot Family | | | |
| *Fulica americana* | American Coot | -- | -- | -- |
| Strigidae | Owl Family | | | |
| *Bubo virginianus* | Great Horned Owl | -- | -- | -- |
| Sturnidae | Starling Family | | | |
| *Sturnus vulgaris** | European Starling* | -- | -- | -- |
| Sylviidae | Silviid Warblers Family | | | |
| *Chamaea fasciata* | Wrentit | -- | USFWS: BCC | -- |
| Threskiornithidae | Ibis and Spoonbill Family | | | |
| *Plegadis chihi* | White-faced Ibis | -- | CDFW: WL | -- |
| Trochilidae | Hummingbird Family | | | |
| *Calypte anna* | Anna's Hummingbird | -- | -- | -- |
| *Selasphorus sasin* | Allen's Hummingbird | -- | USFWS: BCC | -- |
| Troglodytidae | Wren Family | | | |
| *Thryomanes bewickii* | Bewick's Wren | | | |
| Tyrannidae | Tyrsnt Flycatcher Family | | | |
| *Empidonax traillii (migrant)* | Willow Flycatcher (migrant) | -- | -- | Yes |
| *Sayornis saya* | Say's Phoebe | -- | -- | -- |
| *Sayornis nigricans* | Black Phoebe | -- | -- | -- |
| *Tyrannus verticalis* | Western Kingbird | -- | -- | -- |
| Vireonidae | Vireo Family | | | |
| *Vireo bellii pusillus* | Least Bell's Vireo | Endangered/ Endangered | -- | Yes |
| **REPTILES** | | | | |
| Phrynosomatidae | North American Spiny Lizard Family | | | |
| *Sceloporus occidentalis longipes* | Great Basin Fence Lizard | -- | -- | -- |
| *Uta stansburiana elegans* | Western Side-blotched Lizard | -- | -- | -- |
| Teiidae | Whiptail and Racerunner Family | | | |
| *Aspidoscelis tigris stejnegeri* | San Diegan Tiger Whiptail | -- | CDFW: SSC | -- |
| Viperidae | Viper Family | | | |
| *Crotalus oreganus helleri* | Southern Pacific Rattlesnake | -- | -- | -- |
| **MAMMALS** | | | | |
| Cricetidae | Hamsters, Voles, Lemmings, New World Mice and Rat Family | | | |
| *Neotoma macrotis* | Big-eared Woodrat | -- | -- | -- |
| Felidae | Feline Family | | | |
| *Lynx rufus* | Bobcat | -- | -- | -- |
| Geomyidae | Pocket Gopher Family | | | |
| *Thomomys bottae* | Botta's Pocket Gopher | -- | -- | -- |
| Leporidae | Rabbit and Hare Family | | | |
| *Sylvilagus audubonii* | Desert Cottontail | -- | -- | -- |
| Sciuridae | Squirrel Family | | | |
| *Otospermophilus beecheyi* | California Ground Squirrel | -- | -- | -- |

(a) CDFW = California Department of Fish and Wildlife
(b) WL = Watch List
(c) Non-native, introduced
(d) USFWS: BCC
(e) CDFW: SSC

The current average width of the Riparian Zone in Sample Area 1 is approximately 53 meters. The average width of the wetted portion of the stream channel (i.e., the portion of the channel with active surface flow) within Sample Area 1 was 2 meters at the time of survey.

**Riparian Zone Sample Area 2**

Sample Area 2 is located upstream (east) of where 4th Street crosses Cooper's Creek and consists of two 50-meter long transects and two 25-meter long transects situated perpendicular to the active stream channel (Figure 4-2). The plant community identified within this sample area is *Salix gooddingii – Salix laevigata* Forest and Woodland Alliance or "Gooding's willow – red willow alliance." The dominant species in the tree stratum within this riparian habitat are Gooding's willow and red willow, with an overall average cover of 53 percent for Gooding's willow and 41 percent for red willow observed in Sample Area 2 (Table 4-1b). The dominant species in the shrub stratum are mulefat and tree tobacco, with an average cover of only 2 and 1 percent, respectively. The dominant herbaceous species within Sample Area 2 is stinging nettle, with an overall average cover of 20.5 percent. There is also a woody vine stratum consisting entirely of desert wild grape (*Vitis girdiana*), with an overall average cover of 87 percent. The shrub cover is sparse throughout most of this portion of the Cooper's Creek Riparian Zone due to the dense, closed canopy and high percent cover of woody vines that characterizes this habitat within the Study Area. The Gooding's willow – red willow alliance that comprises the riparian habitat in Sample Area 2 is a mature or late seral stage riparian habitat, with 0 percent bare ground and most of the ground cover consisting of woody debris and desert wild grape. The tree canopy within this plant community is typically less than 30 meters in height (CNPS 2024). Approximately 21.3 acres of Gooding's willow – red willow alliance riparian habitat exists within the Cooper's Creek portion of the Study Area.

The vegetation cover in Sample Area 2 consisted of an overall average of 210 percent perennial species cover, with no annuals (Table 4-2b). The overall baseline percent cover of non-native species within Sample Area 2 was 2 percent, with 1 percent invasive species cover. The only invasive species present within Sample Area 2 was tree tobacco.

The Gooding's willow – red willow alliance habitat in Sample Area 2 had the lowest species richness of all three areas sampled. The overall baseline species richness in Sample Area 2 was 7 native species, with an average native species richness of 4.75 species per transect (Table 4-3b).

Sample Area 2 had the narrowest Riparian Zone of all three areas sampled. The current average width of the Riparian Zone in Sample Area 2 is approximately 46 meters. The average width of the wetted portion of the stream channel (i.e., the portion of the channel with active surface flow) within Sample Area 2 was approximately 5.7 meters at the time of survey.

**Riparian Zone Sample Area 3**

Sample Area 3 is located downstream (west) of where 4th Street crosses Cooper's Creek and consists of four 50-meter long transects and one 36-meter long transect situated perpendicular to the active stream channel (Vegetation Sampling Figure 4-3). The plant communities identified within this sample area are *Salix gooddingii* Forest and Woodland Alliance or "Gooding's willow association" and *Baccharis salicifolia* Shrubland Alliance or "mulefat alliance." The mulefat alliance habitat present within Sample Area 3 was not sampled but was qualitatively assessed. This plant community consists of a continuous shrub canopy that is less than 5 meters in height (CNPS 2024). The dominant species in this plant community is mulefat, with little to no herbaceous layer and only scattered emergent Fremont cottonwoods and willows. Approximately 0.44 acres of mulefat alliance riparian habitat exists within the Cooper's Creek portion of the Study Area.

The dominant species in the tree stratum within the Gooding's willow association habitat present in Sample Area 3 is Gooding's willow, with an overall average cover of 29.82 percent observed in Sample Area 3 (Table 4-1c). The dominant species in the shrub stratum are arroyo willow and mulefat, with an average cover of 20.66 and 12.53 percent, respectively. The dominant herbaceous species within Sample Area 3 are evening primrose (*Oenothera elata*) and stinging nettle, with overall average covers of 8.4 and 6.22 percent, respectively. There is also a woody vine stratum dominated by desert wild grape, with an overall average cover of 52.38 percent. Other native species conspicuous within Sample Area 3 include Fremont cottonwood, California sycamore (*Platanus racemosa*), and red willow (Table 4-1c). Approximately 10.4 acres of Gooding's willow alliance riparian habitat exists within the Cooper's Creek portion of the Study Area.

The Gooding's willow association in Sample Area 3 is more complex in structure than the riparian habitats in Sample Areas 1 and 2, ranging from shrub and herbaceous dominated early and mid-seral stage habitat along the outer edges of the Riparian Zone, to mature, late seral stage riparian habitat closest to the active stream channel. The more complex vegetation structure observed within Sample Area 3 is due to habitat restoration/enhancement efforts that began in 2021 and included planting of various riparian species along the edges of the existing Gooding's willow association habitat. There is less ground cover within the early to mid-seral stage areas of the riparian habitat in Sample Area 3, with a higher density of shrubs and herbaceous species present. Whereas the ground cover within the late seral stage interior of the Sample Area 3 Riparian Zone consists mostly of downed woody debris and woody vines. The canopy height within Sample Area 3 ranges from less than 5 meters to over 30 meters.

The vegetation cover in Sample Area 3 consisted of an overall average of 207.9 percent perennial species cover and 3.6 percent annual species cover (Table 4-2c). The overall baseline percent cover of non-native species within Sample Area 3 was 24 percent, with 14.4 percent invasive species cover. Invasive species present within Sample Area 3 included cherry plum (Prunus cerasifera), Mexican fan palm (Washingtonia robusta), white horehound (Marrubium vulgare), ripgut grass, and Himalayan blackberry (Rubus armeniacus).

The Gooding's willow association habitat in Sample Area 3 had the highest species richness of all three areas sampled. The overall baseline species richness in Sample Area 3 was 22 native species, with an average native species richness of 8.4 species per transect (Table 4-3c).

Sample Area 3 had the widest Riparian Zone of all three areas sampled, due to the recent restoration/enhancement efforts and plantings. The current average width of the Riparian Zone in Sample Area 3 is approximately 64 meters. The average width of the wetted portion of the stream channel (i.e., the portion of the channel with active surface flow) within Sample Area 3 was approximately 2.5 meters at the time of survey.

**Summary of All 3 Sample Areas**

A total of 55 plant species were identified within the Cooper's Creek Riparian Zone including 31 native species and 24 non-native species, 16 of which are considered invasive species by the California Invasive Plant Council (CAL-IPC). Additionally, one special status species was observed – southern California black walnut (*Juglans californica*) – which has a California Native Plant Society (CNPS) ranking of 4.3 for its limited distribution in the state. A complete list of all riparian plant species observed within the Cooper's Creek Riparian Zone during the 2024 baseline year is provided in Table 4-4.

#### 4.3.2.2 Wildlife

Wildlife species were detected during 2024 baseline year field surveys by sight, calls, tracks, scat, and/or other sign. A total of 57 wildlife species (48 birds, four reptiles, five mammals) were observed within the Cooper's Creek Riparian Zone, including seven USFWS Birds of Conservation Concern (BCC), four CDFW "Watch List" species, two CDFW SSC, one state listed as endangered species (WIFL), and one state and federally listed endangered species (LBVI). Additionally, the following five riparian associated focal species were observed within the Cooper's Creek portion of the Study Area:

- LBVI
- WIFL
- YEWA
- Common Yellowthroat (COYE)
- Song Sparrow (SOSP)

A complete list of all wildlife species observed within the Cooper's Creek Riparian Zone during the 2024 baseline year is provided in Table 4-5.

**Least Bell's Vireo**

HDR biologists observed four LBVI within the Riparian Zone during the 2024 baseline focused LBVI presence/absence survey conducted on April 25, 2024. An additional six (10 total) LBVI were observed incidental to the focused protocol WIFL presence/absence survey visits (Appendix B – LBVI-WFL Survey Report). LBVI were also heard calling from all three Sample Areas during the 2024 baseline year vegetation surveys.

**Willow Flycatcher**

HDR biologists observed one WIFL in Survey Area 2 on June 4, 2024 during the 2024 baseline focused WIFL presence/absence survey (Appendix B – LBVI-WFL Survey Report). No other detections of WIFL were made during other survey visits and no nesting was observed. Because this individual was not detected during subsequent visits during the nesting survey windows, this one observation of a WIFL is not considered to be the southwestern willow flycatcher subspecies. All observations of WIFL and LBVI during focused presence/absence surveys conducted by HDR biologists for these species, along with the dates of observations, are included in Figures B-1, B-2, and B-3 of Appendix B – LBVI-WFL Survey Report. It should also be noted that HDR biologists observed an *Empidonax* flycatcher within riparian habitat near Sample Area 1 during baseline vegetation surveys conducted in late August of 2024, but were not able to identify it to species.

**Yellow Warbler**

HDR biologists observed multiple YEWA in red willow alliance riparian habitat with an understory of cattail marshes near the Beaumont WWTP DP001 outfall during the 2024 baseline year vegetation surveys conducted in late August of 2024.

**Common Yellowthroat**

The COYE is a small migratory songbird that is yellow and olive colored with a broad black mask. This species primarily breeds in North America and overwinters in Central America and Mexico but is also a year-round resident in parts of North America and Mexico, including southern California (Green, 1990b). COYE typically nest in the understory (usually within 8 centimeters off the ground) of wet meadows, freshwater emergent wetlands, saline emergent wetlands, and valley foothill riparian habitats (Green, 1990b; RHJV, 2004). This species generally breeds from early April to mid-July, with peak activity in May and June (Green, 1990b).

HDR biologists observed multiple COYE in cattail marsh habitat near the Beaumont WWTP DP001 outfall during the 2024 baseline year vegetation surveys conducted in late August of 2024.

**Song Sparrow**

The SOSP is a small migratory songbird that is russet and gray colored, with bold streaks down its white chest. Although some populations of this species breed in Canada and the northern United States and overwinter in the southern United States and Mexico, most that breed in California are year-round residents (Green, 1990c). SOSP nest in the understory (usually on the ground or within 1.3 meters off the ground) of early seral stage riparian habitats, wetlands, coastal scrub habitats, and marshes (Green, 1990c; RHJV, 2004). They require low, dense vegetation for protective cover, usually near water, in emergent vegetation, or in other moist areas (Green, 1990c).

HDR biologists observed multiple SOSP in all three Sample Areas during the 2024 baseline year vegetation surveys conducted in late August of 2024.

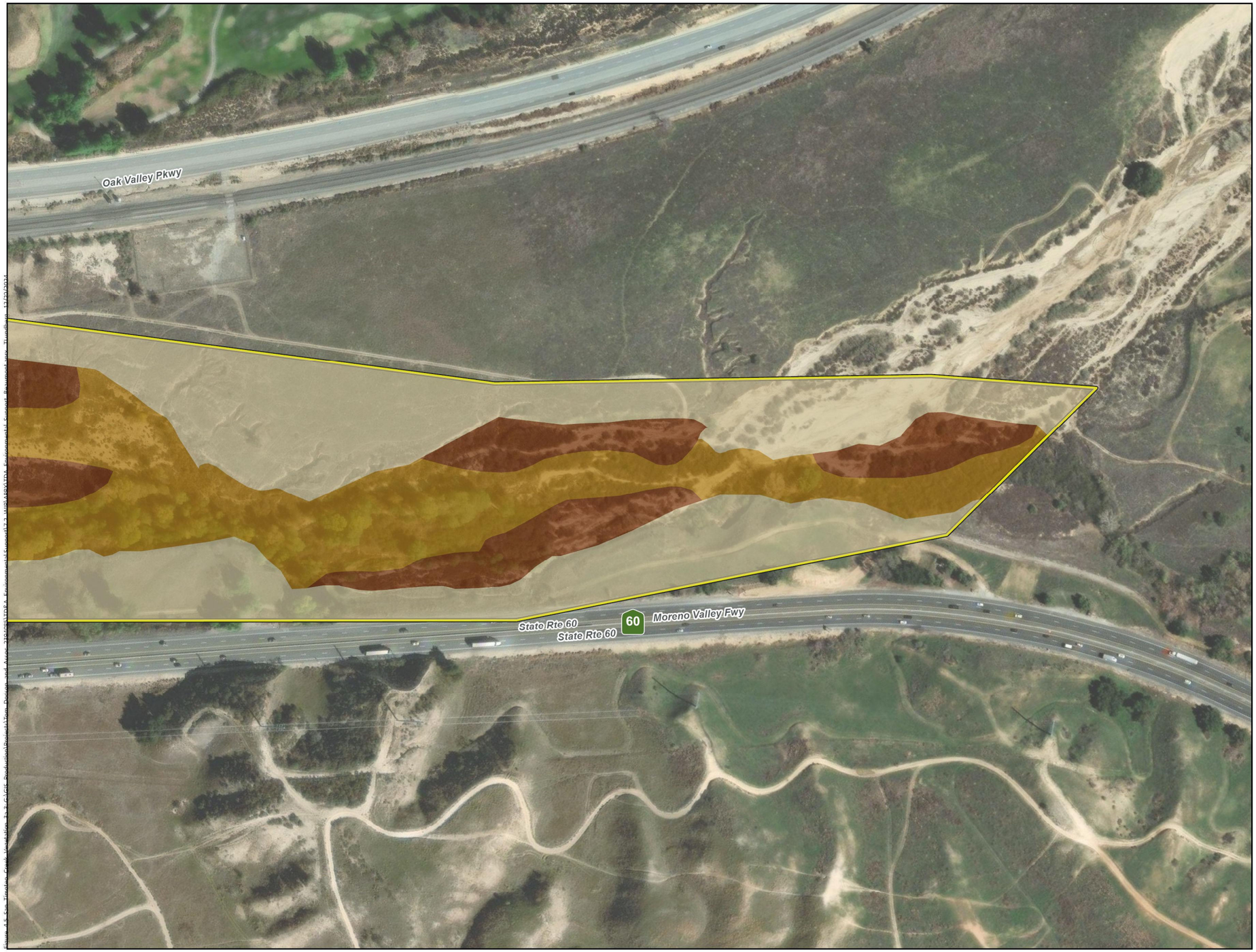
### *4.3.3 San Timoteo Creek*

The following subsections describe the existing plant communities in the Riparian Zone of San Timoteo Creek. Records of wildlife usage of the San Timoteo Creek Riparian Zone were obtained from the SAWA biological monitoring reports for surveys conducted from 2004 through 2022 as part of the WRC-RCA's Biological Monitoring Program, as well as from the CNDDB. Known wildlife usage of the San Timoteo Creek Riparian Zone is discussed in Section 4.2.2.2 of this report (above). Therefore, no further discussion of wildlife usage of the San Timoteo Creek Riparian Zone is included below.

#### 4.3.3.1 Riparian Plant Communities

Figures 4-5a through 4-5m are a series of 13 maps that delineate the mapped extent of riparian plant communities along the San Timoteo Creek Riparian Zone from the Cooper's Creek/San Timoteo Creek confluence to the Henry N. Wochholz RWRF DP001 outfall. A total of six riparian plant communities were mapped within the San Timoteo Riparian Zone :

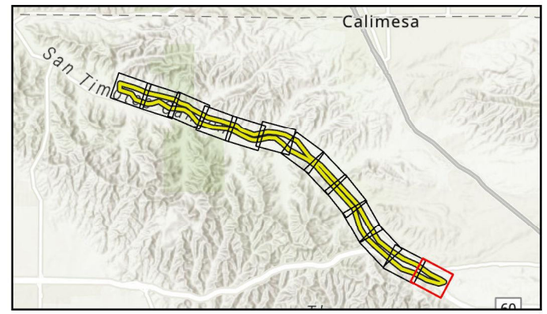
- *Baccharis salicifolia* Shrubland Alliance (Mulefat Alliance)
- *Populus fremontii – Baccharis salicifolia* Association (Fremont Cottonwood / Mulefat Association)
- *Populus fremontii* Forest and Woodland Alliance (Fremont Cottonwood Alliance)
- *Populus fremontii – Salix* (*laevigata, lasiolepis, lucida* ssp. *lasiandra*) Association (Fremont Cottonwood / Willow spp. Association)
- *Populus fremontii – Salix laevigata* Association (Fremont Cottonwood / Red Willow Association)
- *Salix laevigata* Forest and Woodland Alliance (Red Willow Alliance)




Vegetation Study Area

**Vegetation Category**

- Mulefat Alliance
- Red Willow Alliance
- Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

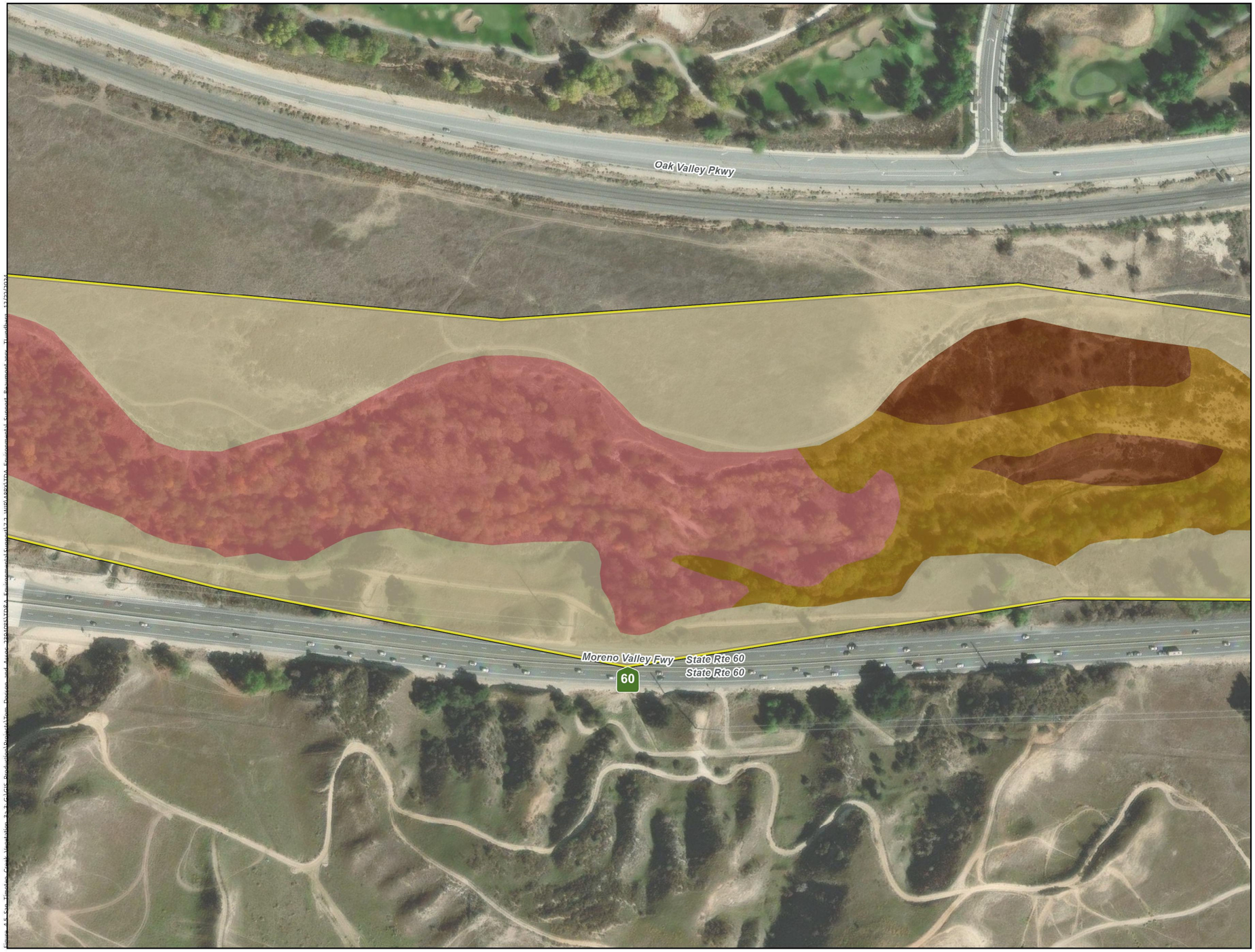
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

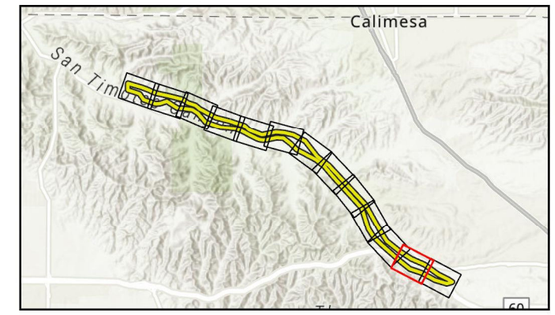
**Figure 4-5a**




Vegetation Study Area

**Vegetation Category**

- Fremont Cottonwood - Red Willow Association
- Mulefat Alliance
- Red Willow Alliance
- Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

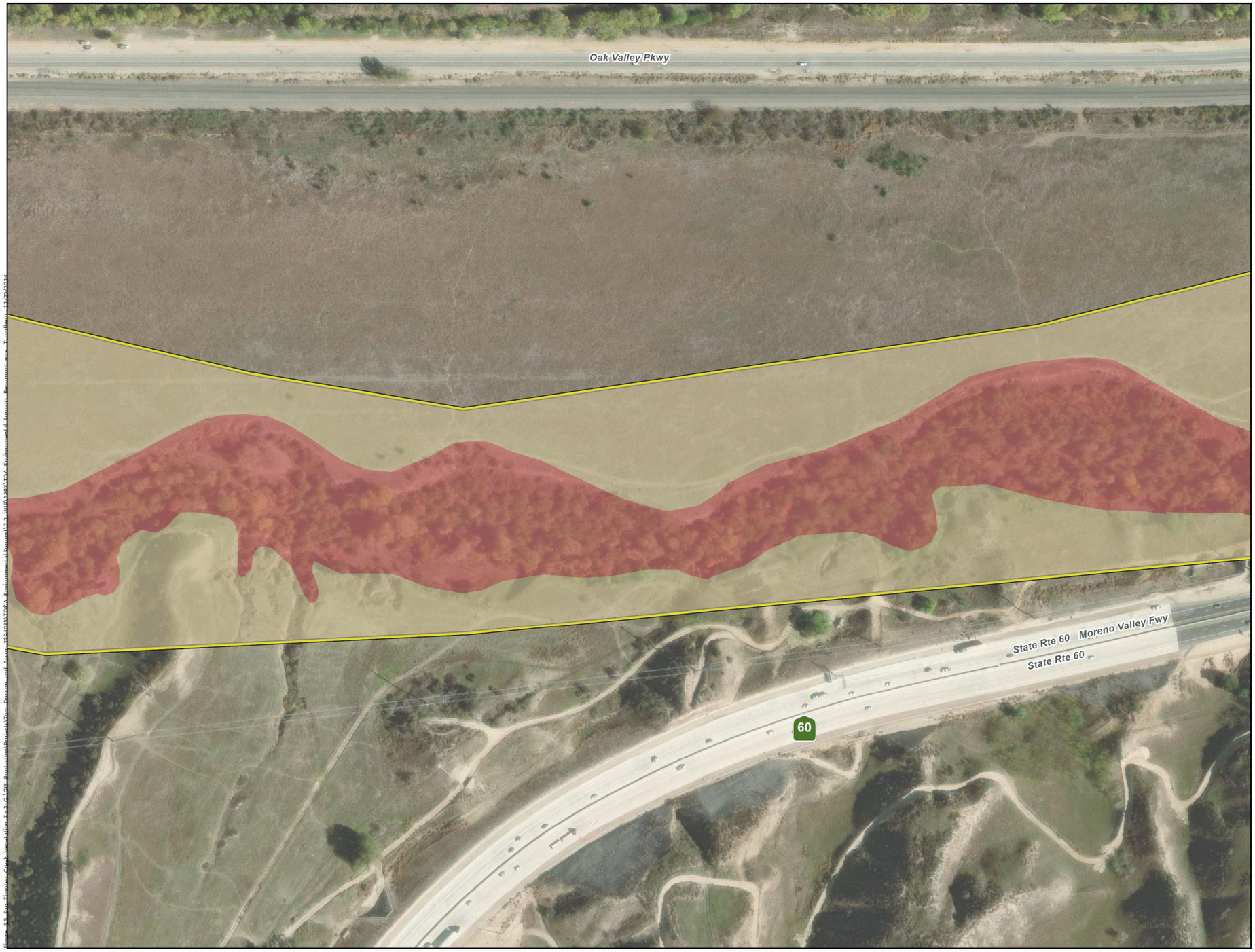
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

**Figure 4-5b**

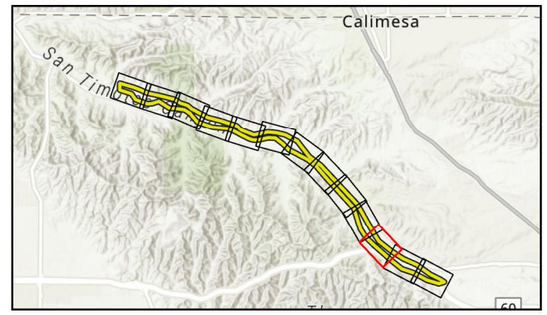



Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood - Red Willow Association

Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

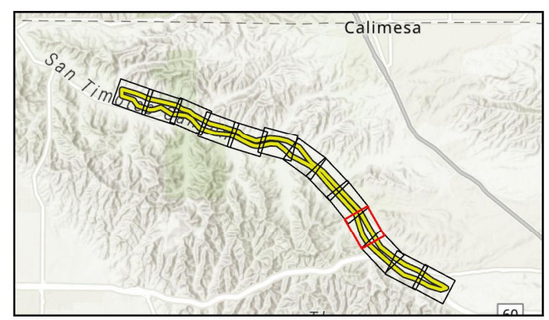
**Figure 4-5c**

Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood - Red Willow Association

Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

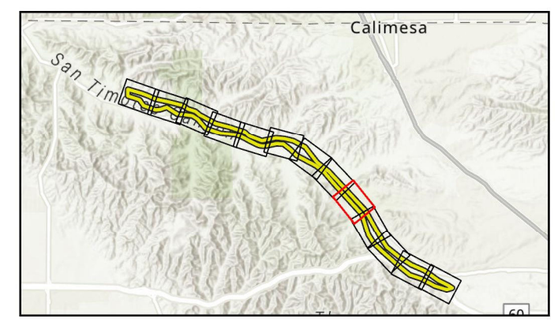
**Figure 4-5d**

Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood - Red Willow Association

Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

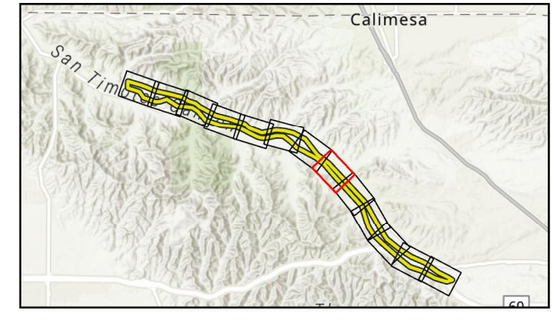
**Figure 4-5e**

Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood - Red Willow Association

Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

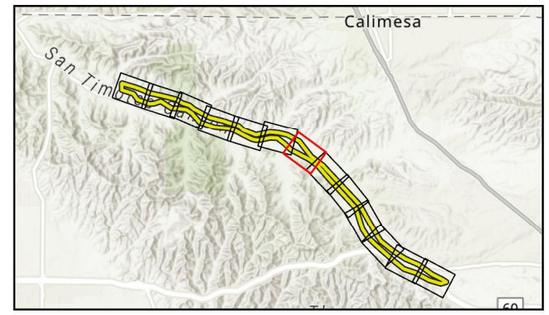
**Figure 4-5f**

Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood - Red Willow Association

Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

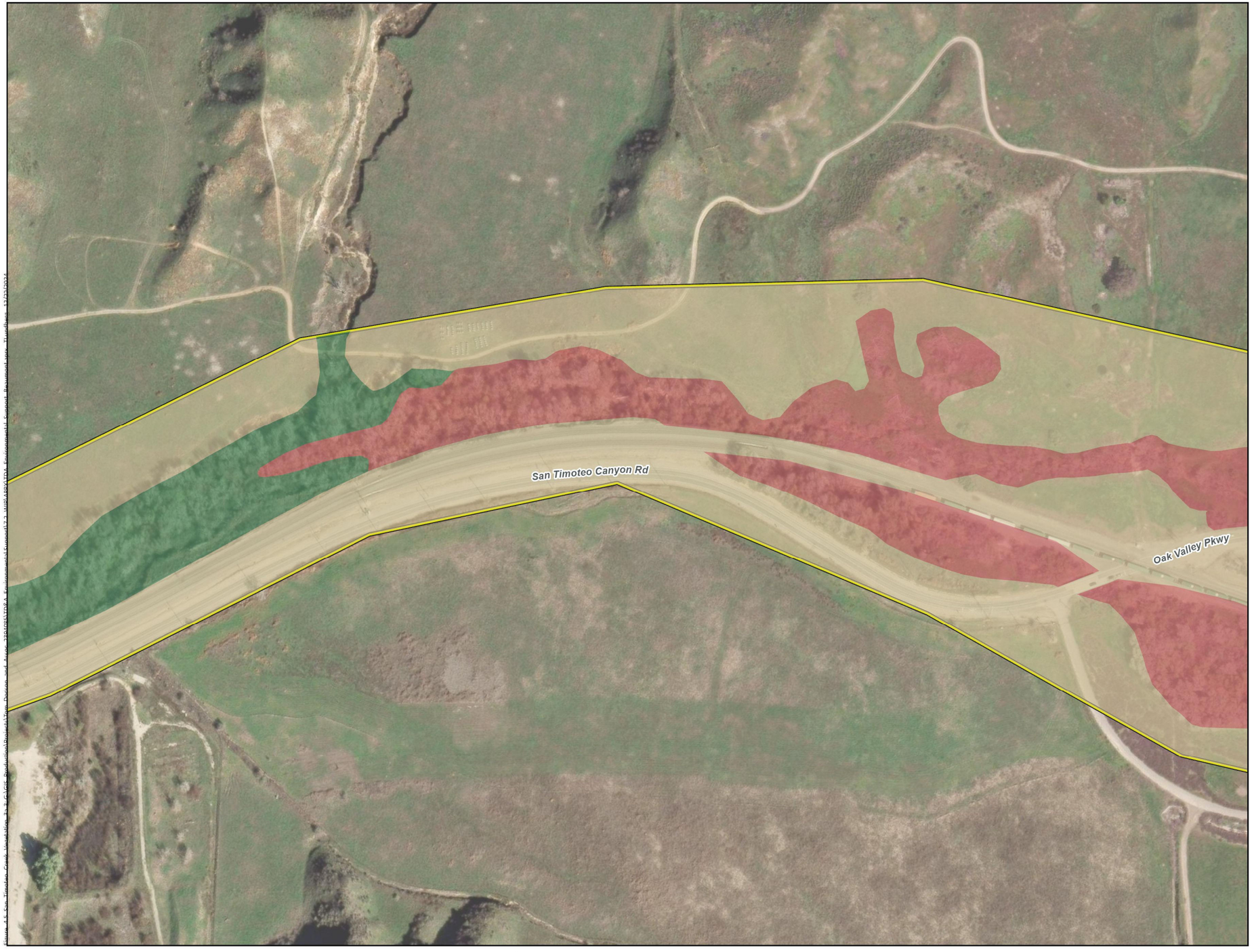
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

**Figure 4-5g**



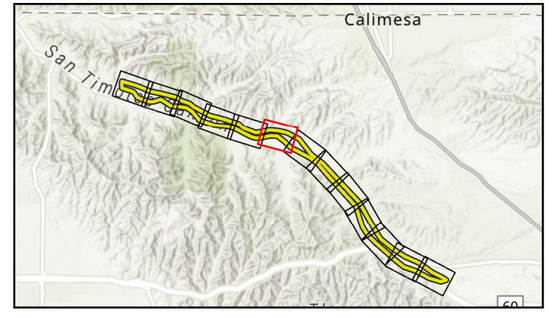

Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood - Red Willow Association

Fremont Cottonwood / Mulefat Association

Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

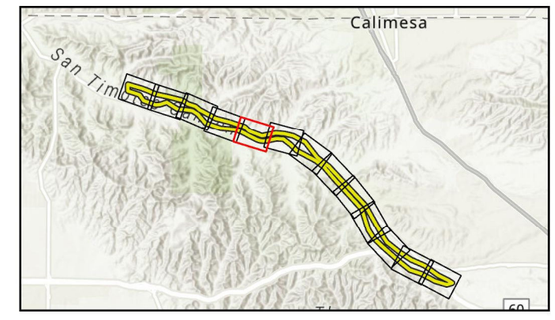
**Figure 4-5h**

Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood / Mulefat Association

Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

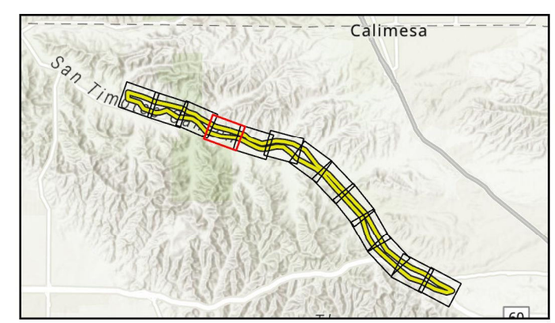
**Figure 4-5i**

Vegetation Study Area

**Vegetation Category**

Fremont Cottonwood / Mulefat Association

Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

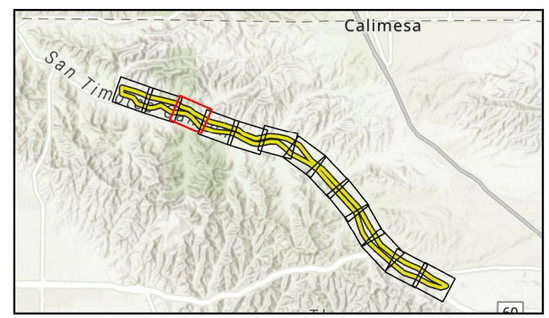
*City of Beaumont AMMP*

**Figure 4-5j**

Vegetation Study Area

**Vegetation Category**

- Fremont Cottonwood - Willow spp. Association
- Fremont Cottonwood / Mulefat Association
- Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

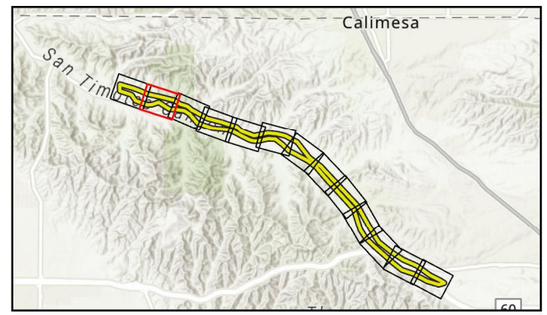
*City of Beaumont AMMP*

**Figure 4-5k**

Vegetation Study Area

**Vegetation Category**

- Fremont Cottonwood - Willow spp. Association
- Fremont Cottonwood / Mulefat Association
- Fremont Cottonwood Alliance
- Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

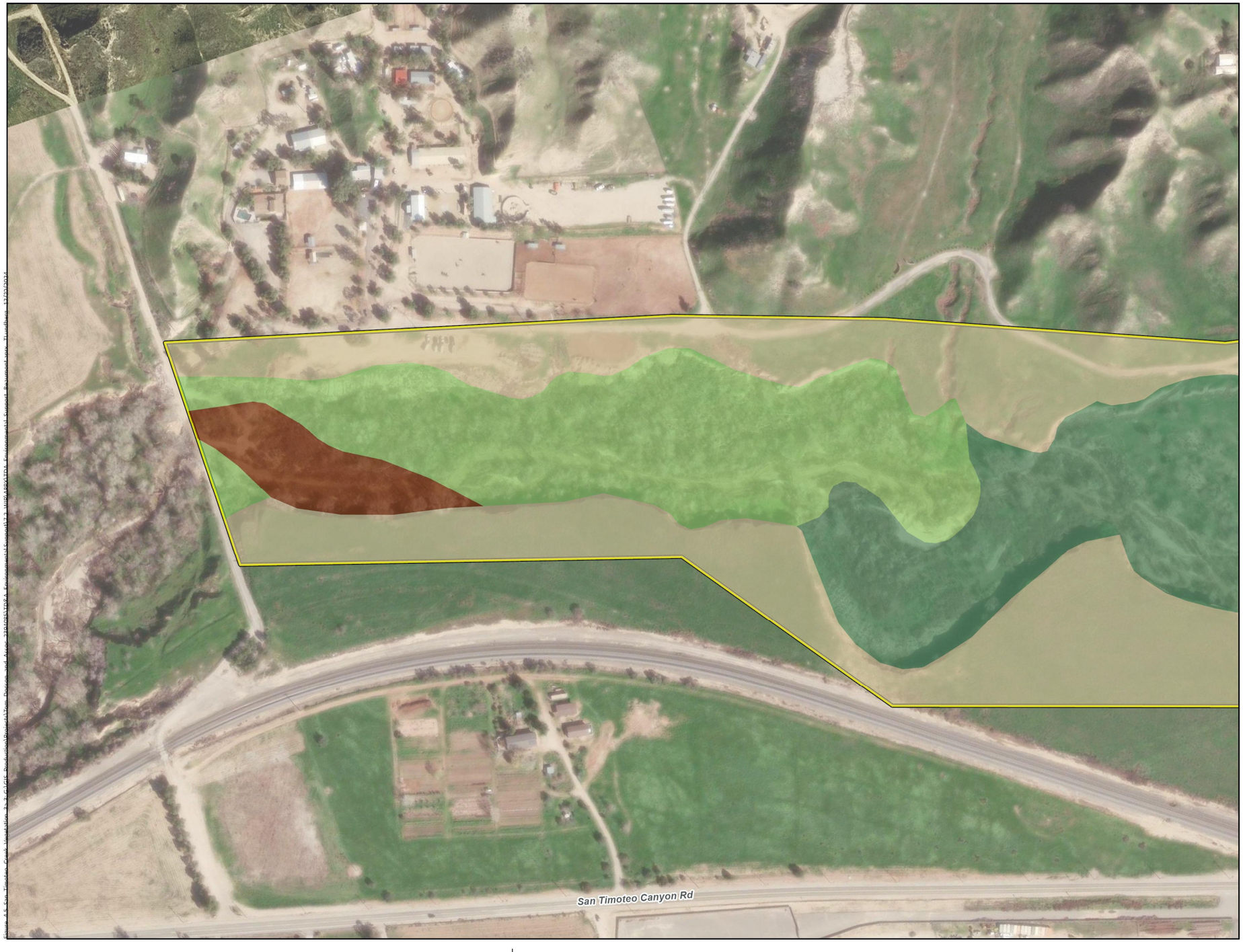
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

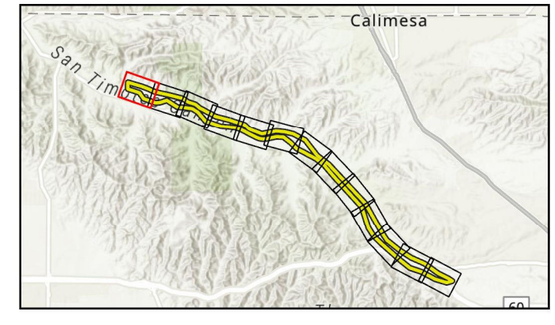
**Figure 4-5l**




Vegetation Study Area

**Vegetation Category**

- Fremont Cottonwood - Willow spp. Association
- Fremont Cottonwood / Mulefat Association
- Mulefat Alliance
- Upland and Disturbed Areas




Prepared by:

WEST YOST

HDR

N

0 250 500

Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**San Timoteo Creek Riparian Plant Communities**

*City of Beaumont AMMP*

**Figure 4-5m**

The current average width of the San Timoteo Creek Riparian Zone within the Study Area is approximately 79 meters. Descriptions of the riparian plant communities mapped within the San Timoteo Creek portion of the Study Area are provided below from the CNPS online edition (2024) of the "Manual of California Vegetation."[6]

***Baccharis salicifolia* Shrubland Alliance (Mulefat Alliance)**

This habitat alliance is dominated or co-dominated by mulefat in the shrub canopy with *Artemisia californica, Baccharis emoryi, Baccharis pilularis, Malosma laurina, Nicotiana glauca, Pluchea sericea, Rubus spp., Salix exigua, Salix lasiolepis, Sambucus nigra* and *Tamarix* spp. Emergent trees may be present at low cover, including *Pinus sabiniana, Platanus racemosa, Populus fremontii, Quercus* spp. or *Salix* spp. Mulefat alliance riparian habitat consists of a continuous shrub canopy that is less than 5 meters in height and has a sparse herbaceous layer. It is typical of canyon bottoms, floodplains, irrigation ditches, lake margins, and stream channels. Approximately 10.27 acres of mulefat alliance riparian habitat exists within the San Timoteo Creek portion of the Study Area.

***Populus fremontii – Baccharis salicifolia* Association (Fremont Cottonwood / Mulefat Association)**

This habitat association has a simple tree canopy dominated by Fremont cottonwood, with an intermittent to open shrub layer dominated by mulefat, and a variable herbaceous layer. The canopy height is less than 25 meters. Fremont cottonwood / mulefat association riparian habitat is typical of floodplains, along low-gradient rivers, perennial or seasonally intermittent streams, springs, in lower canyons in desert mountains, in alluvial fans, and in valleys with a dependable subsurface water supply that varies considerably during the year. Approximately 50.36 acres of Fremont cottonwood / mulefat association riparian habitat exists within the San Timoteo Creek portion of the Study Area.

***Populus fremontii – Salix* (*laevigata, lasiolepis, lucida* ssp. *lasiandra*) Association (Fremont Cottonwood / Willow spp. Association)**

This habitat association has a mixed tree canopy co-dominated by Fremont cottonwood and one or more of red willow, arroyo willow, and Pacific willow, with an intermittent to open shrub layer, and a variable herbaceous layer. The canopy height is less than 25 meters. Fremont cottonwood / willow spp. association riparian habitat is typical of floodplains, along low-gradient rivers, perennial or seasonally intermittent streams, springs, in lower canyons in desert mountains, in alluvial fans, and in valleys with a dependable subsurface water supply that varies considerably during the year.

[6] https://vegetation.cnps.org/

# 5.0 HISTORICAL RIPARIAN HABITAT HEALTH (NDVI)

The following subsections describe the historical characterization of riparian habitat health utilizing remote sensing data and the normalized difference vegetation index (NDVI), including methods and results.

## 5.1 Overview of NDVI Analysis

NDVI, a metric derived from remote sensing measurements by Landsat Program satellites, is used to assess the extent and quality of the riparian vegetation in the Study Area over a long-term historical period. NDVI is a commonly used numerical indicator of vegetation health that can be calculated from satellite remote-sensing measurements (Ke et al., 2015; Xue, J. and Su, B., 2017). NDVI is calculated from visible and near-infrared radiation reflected by vegetation and is an index of "greenness" correlated with photosynthesis that can be used to assess spatial and temporal changes in the distribution and productivity of vegetation (Pettorelli, 2013). Areas where the NDVI is higher have greener (e.g. healthier) vegetation than areas where NDVI is lower, allowing for spatial analysis of overall vegetation health over large areas. NDVI estimates range between -1.0 and 1.0. Negative NDVI estimates correspond to standing water, and low positive values (0 to 0.1) correspond to non-vegetated areas, such as barren rock and sand, snow, and water. NDVI estimates ranging from 0.1 to 1.0 correspond to vegetated areas, with very low-end estimates indicating sparse, unhealthy, or dormant vegetation, and increasing estimates towards 0.9 indicating higher amounts of dense, healthy green vegetation.

Although NDVI does not provide species-specific vegetation information, the regional scale of NDVI makes it an appropriate "first indicator" of regional changes in the extent and quality of riparian vegetation. Remote sensing data to calculate NDVI are available for the entire extent of the Study Area from the early 1980s to present, which allow for a robust, long-term characterization of the spatial extent and quality of the riparian vegetation prior to the implementation of the start of the AMMP. The Landsat remote sensing data is freely available and can be used on an ongoing basis to continue to track NDVI trends over time and will be an important tool in the AMMP.

A limitation of NDVI data is that it is a composite view of plant species diversity, form, structure, density, and vigor. As such, changes in NDVI may be the result of any number of factors that impact the extent of riparian habitat (Markon et al., 1995; Markon and Peterson, 2002). In other words, NDVI does not provide a complete picture of how and why vegetative changes are occurring; it simply indicates a change in vegetation health. The changes need to be ground-truthed using other types of monitoring. Appendix C provides background information on NDVI, further explains why NDVI was chosen as an analytical tool for the development and on-going monitoring of the AMMP, discusses additional advantages and limitations of NDVI, and describes how NDVI estimates were used for the Study Area.

NDVI estimates were collected from the United States Geological Survey (USGS) using the Earth Resources Observation and Science (EROS) Center Science Processing Architecture (CSPA) On Demand Interface[7] (USGS, 2017b) for the period of March 1984 through October 2023. Of importance to this type of analysis are the satellite date for the entire annual vegetation growing-season of March to October. To obtain complete spatial coverage of the Study Area, NDVI estimates were requested for all Landsat scenes for Path 040, Rows 036 and 037 from the Landsat 4, 5, 7, Landsat 8, and Landsat 9 satellites. The NDVI were processed and uploaded to a centralized relational database, HydroDaVE$^{SM}$, which includes tools to

[7] ESPA USGS

manage, review, and extract NDVI estimates. The frequency of NDVI estimates from the Landsat 4, 5, 7, 8 and 9 satellites is every one to eight days. However, not all NDVI estimates are useable due to disturbances that can be caused by cloud cover, unfavorable atmospheric conditions, or satellite equipment malfunction. NDVI estimates were reviewed for these disturbances and any estimates determined erroneous due to these disturbances were excluded from analysis. Appendix C describes how the NDVI estimates were collected, reviewed, and assembled for the characterization of historical riparian health for this Report.

## 5.2 Overview of Riparian Zone, Study Segments, and Focus Areas

To evaluate the health of the riparian habitat, a Riparian Zone, Segments, and Focus Areas were established for the extent of the Study Area. A "Riparian Zone" was delineated within the Study Area along the Cooper's and San Timoteo Creeks by drawing a polygon around the tree line. Next the Riparian Zone was divided into smaller sections called "Segments". Segments were generally established to be comparable in length and to capture changes or inputs to the hydrologic system. A total of three segments were generated— Cooper's Creek 1, San Timoteo 1, and San Timoteo 2. Next, "Focus Areas" were established based on the following criteria:

- Generally distributed evenly throughout the Segment; and/or
- Co-located with surface or groundwater monitoring locations; and/or
- Placed in areas where changes to the system are presumed (such as upstream or downstream from the discharge point of a WWTP).

Figure 5-1 shows the Riparian Zone, Segments, and Focus areas analyzed for this study. A total of 10 Focus Areas were generated—FA01 through FA10. Six Focus Areas were established within Cooper's Creek 1 Segment, and two each within the San Timoteo 1 and 2 Segments, respectively. Figures 5-2, 5-3, and 5-4 show the placement of the Focus Areas for each Segment. The Focus Areas are described further below:

**Cooper's Creek 1 Segment:**

- FA01 –upstream of the Beaumont WWTP discharge point
- FA02 – a second location upstream of the Beaumont WWTP discharge point
- FA03 –directly downstream of the Beaumont WWTP discharge point
- FA04 –adjacent to a groundwater monitoring site where depth to water measurements are available
- FA05 –just upstream of a culvert that appears to constrict flow and supports habitat health
- FA06 – just downstream of the confluence with San Timoteo Creek.

**San Timoteo 1 Segment:**

- FA07 –the upstream end of the Segment and near groundwater monitoring sites where depth to water measurements are available
- FA08 –the downstream end of the Segment and near groundwater monitoring sites location where depth to water measurements are available

**San Timoteo 2 Segment:**

- FA09 –the upstream end of the Segment and near surface water and groundwater monitoring sites
- FA10 –the downstream end of the Segment near the YVWD discharge point, and groundwater and surface water monitoring sites.

NDVI data was then extracted for each Segment and Focus Area and evaluated as described in Appendix C. The following subsections describe the results of the NDVI data analysis.

## 5.3 Temporal Analysis of NDVI

NDVI pixels[8] within defined areas throughout the Study Area were analyzed for temporal trends in NDVI estimates via creation of time-series charts for the entire historical record of 1984 to 2023. The defined areas include riparian habitat areas of three Segments (large areas) and ten Focus Areas (small areas) as shown on Figures 5-1, 5-2, 5-3, and 5-4 and described in Section 5.2. The time series charts are used to characterize long- and short-term changes in NDVI in specific areas and provide context for interpreting the observed trends and changes in riparian habitat health.

Figures 5-5a, 5-6a, and 5-7a are time-series charts from 1984 to 2023 of the spatial average NDVI for pixels within the three large Segments: Cooper's Creek 1 Segment (0.16 $mi^2$ – 5,759 NDVI pixels), San Timoteo 1 Segment (0.18 $mi^2$ – 4,573 NDVI pixels), and San Timoteo 2 Segment (0.15 $mi^2$ – 3,093 NDVI pixels). Also shown in the figures is an NDVI map of riparian extent and health as of 2023. Figures 5-5a, 5-6a, and 5-7a show two datasets that illustrate trends in the NDVI estimates:

**Spatial Average NDVI (green dots)**

- The "Spatial Average NDVI" represents the average NDVI estimate of all NDVI pixels within the entire defined area (e.g. the Segment) for each day/date (e.g. 10/15/2023) of the available remote sensing data. These data provide a snapshot of the riparian habitat health for each day and can thus be used to characterize seasonal and long-term trends in NDVI for each defined area. The charts illustrate that the Spatial Average NDVI exhibits an oscillatory pattern caused by seasonal changes in the riparian habitat. This NDVI time-series pattern is typical for a deciduous forest, where NDVI values are higher in the growing season from March through October and lower in the dormant season from November through February.

**Average Growing-Season NDVI (black dots and black curve)**

- The "Average Growing-Season NDVI" represents the annual average of all Spatial Average NDVI estimates within the growing season from March through October each year. This curve illustrates year-to-year changes in NDVI and can be used to assess long-term trends for the riparian habitat.

Figures 5-5b, 5-6b, and 5-7b are time-series charts for 1984 to 2023 of the Average Growing-Season NDVI (points and curve) for each of the smaller defined Focus Areas within the Cooper's Creek 1 Segment, San Timoteo 1 Segment, and San Timoteo 2 Segment, respectively. Each Focus Area is represented by one NDVI pixel. These Focus Areas compare short- and long-term trends in NDVI on a smaller spatial scale at

[8] Each NDVI pixel is 30 x 30 meters.

strategically locations within the larger Segment areas related to monitoring points, discharge points, or points where changes in 'inputs' to the system occur, such as confluences of creeks.

To statistically characterize long-term trends in NDVI, the Mann-Kendall statistical trend test (Mann-Kendall test) was performed on the Average Growing-Season NDVI for all defined areas over the following three periods:

- **1984 to 2023:** the entire period of record.
- **1984 to 2003**: period of historically lower discharges from the Beaumont WWTP prior to an increase in Beaumont WTTP discharges that occurred at an increased rate starting in 2004 (trends in Beaumont WTTP discharges are described in more detail in Section 6.1).
- **2004 to 2023:** period of increased Beaumont WWTP discharges from the period prior to 2004 (1984 to 2003).

The Mann-Kendall test utilizes a ranking formula to analyze if there is a statistically significant trend (e.g. increasing trend, decreasing trend, or no trend) in the NDVI time-series. Appendix D describes the Mann-Kendall test methods and results. The Mann-Kendall test result for each Segment and Focus Area is shown on each time-series chart and summarized in Table 5-1.

**Table 5-1. Mann-Kendall Test Results of the Average-Growing Season NDVI Trends for Defined Areas in the Cooper's and San Timoteo Creeks**

| Defined Area | Figure Number | Mann Kendal Test Result[(a)] | | |
|---|---|---|---|---|
| | | Period of Record 1984 to 2023 | Prior to Increased Discharge 1984 to 2003 | Post Increased Discharge 2004 to 2023 |
| Cooper's Creek 1 | 5-5a | Increasing | Increasing | Increasing |
| FA01 | 5-5b | Increasing | Increasing | Increasing |
| FA02 | 5-5b | Increasing | No Trend | Increasing |
| FA03 | 5-5b | Increasing | Increasing | Increasing |
| FA04 | 5-5b | Increasing | No Trend | Increasing |
| FA05 | 5-5b | Increasing | No Trend | Increasing |
| FA06 | 5-5b | Increasing | No Trend | Increasing |
| San Timoteo 1 | 5-6a | Increasing | No Trend | Increasing |
| FA07 | 5-6b | Increasing | No Trend | Increasing |
| FA08 | 5-6b | Increasing | Increasing | No Trend |
| San Timoteo 2 | 5-7a | No Trend | No Trend | Increasing |
| FA09 | 5-7b | Increasing | Decreasing | Increasing |
| FA10 | 5-7b | Increasing | Increasing | No Trend |

(a) See Appendix D for a description of the Mann-Kendall statistical trend test and results.

Table 5-2 summarizes the Average Growing-Season NDVI for 1984, 2004, and 2023 and the change in NDVI from 1984 to 2003, 2004 to 2023, and 1984 to 2023. Table 5-2 also shows the maximum year-over-year change to the Average Growing-Season NDVI for the historical period.

**Table 5-2. Characterization of Variability in the Average-Growing Season NDVI for Defined Areas in the Study Area**

| Defined Area | Figure Number | Average Growing Season NDVI | | | Difference in Average NDVI from 1984-2004 | Difference in Average NDVI from 2004-2023 | Difference in Average NDVI from 1984-2023 | Maximum Change in NDVI in Any Given Year |
|---|---|---|---|---|---|---|---|---|
| | | 1984 | 2004 | 2023 | | | | |
| Cooper's Creek 1 | 5-5a | 0.35 | 0.37 | 0.14 | 0.03 | 0.14 | 0.17 | 0.09 |
| FA01 | 5-5b | 0.37 | 0.42 | 0.22 | 0.04 | 0.22 | 0.26 | 0.11 |
| FA02 | 5-5b | 0.32 | 0.28 | 0.17 | -0.03 | 0.17 | 0.14 | 0.15 |
| FA03 | 5-5b | 0.22 | 0.24 | 0.39 | 0.02 | 0.39 | 0.41 | 0.15 |
| FA04 | 5-5b | 0.32 | 0.32 | 0.23 | -0.01 | 0.23 | 0.23 | 0.09 |
| FA05 | 5-5b | 0.57 | 0.64 | 0.13 | 0.07 | 0.13 | 0.19 | 0.13 |
| FA06 | 5-5b | 0.16 | 0.27 | 0.20 | 0.11 | 0.20 | 0.30 | 0.15 |
| San Timoteo 1 | 5-6a | 0.42 | 0.43 | 0.15 | 0.01 | 0.15 | 0.16 | 0.09 |
| FA07 | 5-6b | 0.59 | 0.54 | 0.16 | -0.05 | 0.16 | 0.11 | 0.15 |
| FA08 | 5-6b | 0.53 | 0.62 | 0.07 | 0.10 | 0.07 | 0.16 | 0.11 |
| San Timoteo 2 | 5-7a | 0.40 | 0.36 | 0.16 | -0.04 | 0.16 | 0.12 | 0.15 |
| FA09 | 5-7b | 0.53 | 0.40 | 0.30 | -0.14 | 0.30 | 0.17 | 0.13 |
| FA10 | 5-7b | 0.51 | 0.49 | 0.13 | -0.01 | 0.13 | 0.11 | 0.25 |

The data and results summarized in Tables 5-1 and 5-2 will be used for the analysis of NDVI by Segment in the following subsections.

### *5.3.1 Cooper's Creek 1 Segment and Focused Areas (FA01 to FA06)*

The Beaumont WWTP discharges within the upstream area of the Cooper's Creek 1 Segment and is the Segment most directly impacted by the discharge. There are two Focus Areas upstream of DP001 (FA01 and FA02) and four downstream (FA03 to FA06), with FA03 being directly downstream of DP001. Figure 5-5a and Tables 5-1 and 5-2 show that for this Segment:

- The Average Growing-Season NDVI ranged from 0.35 to 0.52 and varied from year-to-year by no more than 0.09.
- The Average Growing-Season NDVI increased by 0.17 over the entire period of record (entire period), increased by 0.03 for the period prior to increased discharge at the Beaumont WTTP (1984 to 2003), and increased by 0.14 for the period of increased discharge at the Beaumont WTTP (2004 to 2023).
- The Mann-Kendall test of the Average Growing-Season NDVI indicates an "increasing trend" over the entire period, 1984 to 2003, and 2004 to 2023.

Figure 5-5b and Tables 5-1 and 5-2 show that for the six Focus Areas:

- The Average Growing-Season NDVI ranged from 0.16 to 0.78 and varied from year-to-year by no more than 0.15.
- For all six Focus Areas, the Mann-Kendall test result on the Average Growing-Season NDVI indicates:
  - an "increasing trend" for the entire period,
  - an "increasing trend" or "no trend" for 1984 to 2003,
  - and an "increasing trend" for 2004 to 2023
- For the entire period, the Average Growing-Season NDVI increased at all Focus Areas, with the highest increase of 0.41 occurring at FA03, which is located immediately downstream of Beaumont WWTP DP001.
- For 1984 to 2003:
  - the Average Growing-Season NDVI decreased at two of the Focus Areas by 0.01 and 0.03 (FA04 and FA02),
  - and increased at four of the Focus Areas by 0.04, 0.02, 0.07, and 0.11 (FA01, FA03, FA05, and FA06).
- For 2004 to 2023, the Average Growing-Season NDVI increased at all of the Focus Areas. The highest increase is 0.39 at FA03 just downstream of Beaumont WWTP effluent discharge outfall.
- The NDVI for FA05 exhibits different values and historical trends than the other Focus Areas along Cooper's Creek. For the 1984 to 2003 period, the Average Growing-Season NDVI for FA05 are much higher than the other Focus Areas (between about 0.4 to 0.2 higher). For the 2004 to 2023 period correlating with increased discharge from the Beaumont WWTP, FA05 does not show an increasing trend in NDVI until the later years (2019-2023), while the other Focus Areas exhibit a progressively increasing trend in NDVI from 2004-2023. However,

since 2004 NDVI for the other Focus Areas are still generally below FA05, except for FA03 located immediately downstream of Beaumont WWTP DP001. This suggests that there may be a different factor, other than surface water discharge, supporting the riparian vegetation at FA05.

These trends observed at the six Focused Areas are comparable to the trends observed for the entire Cooper's Creek 1 Segment.

### *5.3.2 San Timoteo 1 Segment and Focused Areas (FA07 and FA08).*

The San Timoteo 1 Segment is downstream of Cooper's Creek 1 Segment and just downstream of the confluence between Cooper's and San Timoteo Creeks. There are two Focus Areas sited in proximity to groundwater monitoring sites where water level measurements are available. Figure 5-6a and Tables 5-1 and 5-2 show that for this Segment:

- The Average Growing-Season NDVI ranged between 0.47 and 0.58 and varied from year-to-year by no more than 0.09.
- The Average Growing-Season NDVI increased by 0.16 over the entire period, increased by 0.01 for 1984 to 2003, and increased by 0.15 for 2004 to 2023.
- The Mann-Kendall test of the Average Growing Season NDVI indicates an "increasing trend" over the entire period and 2004 to 2023, and "no trend" over 1984 to 2003.

Figure 5-6b and Tables 5-1 and 5-2 show that for the two Focus Areas:

- The Average Growing-Season NDVI ranged between 0.46 and 0.74 and varied from year-to-year by no more than 0.15.
- The Mann-Kendall test result on the Average Growing-Season NDVI indicates:
  - an "increasing trend" for the entire period,
  - an "increasing trend" and "no trend" for 1984 to 2003,
  - and an "increasing trend" and "no trend" for 2004 to 2023.
- For the entire period, the Average Growing-Season NDVI increased by 0.11 at FA07 and by 0.16 at FA08.
- For 1984 to 2003, the Average Growing-Season NDVI decreased by 0.05 at FA07 and increased by 0.10 at FA08.
- For 2004 to 2023, the Average Growing-Season NDVI increased by 0.16 at FA07 and increased by 0.07 at FA08.
- These trends observed in the two Focused Areas are comparable to the trends observed for the entire reach of San Timoteo Creek 1.

### 5.3.3 San Timoteo 2 Segment and Focused Areas (FA09 and FA10)

The San Timoteo 2 Segment is downstream of the San Timoteo 1 Segment and just upstream of the YVWD Henry N. Wochholz DP001. There are two Focus Areas sited in proximity to groundwater monitoring sites where water level measurements are available. Figure 5-7a and Tables 5-1 and 5-2 show that for this Segment:

- The Average Growing-Season NDVI ranged between 0.31 and 0.52 and varied from year-to-year by no more than 0.15.
- The Average Growing-Season NDVI increased by 0.12 for the entire period, decreased by 0.04 for 1984 to 2003, and increased by 0.16 for 2004 to 2023.
- The Mann-Kendall test result on the Average Growing-Season NDVI indicates an "increasing trend" for 2004 to 2023, and "no trend" for 1984 to 2003 and the entire period.

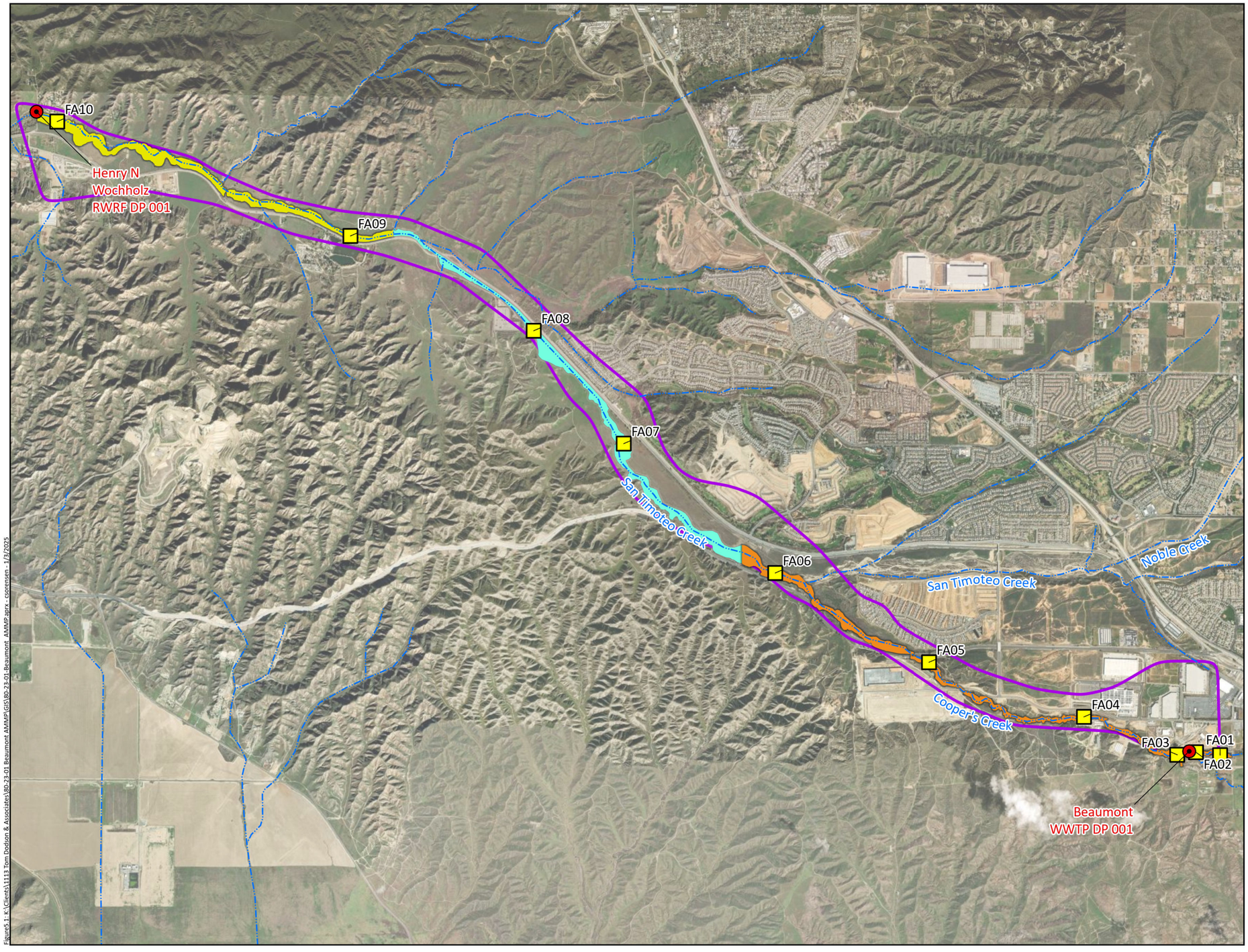
Figure 5-7b is a NDVI time-series chart for 1984 to 2023 of the Average Growing-Season NDVI for one NDVI pixel for each of the two Focus Areas within the San Timoteo 2 Segment, called FA09 and FA10. Figure 5-7b and Tables 5-1 and 5-2 show that:

- The Average Growing-Season NDVI ranged between 0.30 and 0.70 and varied from year-to-year by no more than 0.25.
- The Mann-Kendall test result on the Average Growing-Season NDVI indicates:
  - an "increasing trend" for the entire period,
  - an "increasing trend" and "decreasing trend" for 1984 to 2003,
  - and an "increasing trend" and "no trend" for 2004 to 2023.
- For the entire period, the Average Growing-Season NDVI increased by 0.17 at FA09 and by 0.11 at FA10.
- For 1984 to 2003, the Average Growing-Season NDVI decreased by 0.14 at FA09 and decreased by 0.01 at FA10.
- For 2004 to 2023, the Average Growing-Season NDVI increased by 0.30 at FA09 and increased by 0.13 at FA10.
- These trends observed in the two Focused Areas are comparable to the trends observed for the entire reach of San Timoteo Creek 2.

### 5.3.4 Conclusions from Temporal Analysis

- The Average Growing-Season NDVI observed amongst all the defined Segments and Focus Areas ranges between 0.16 to 0.78, with the largest range along the Cooper's Creek 1 Segment and Focus Areas.
- Over the entire period, the Average Growing-Season NDVI increased at all Segments and Focus Areas across the Study Area, indicating an overall increase in the riparian habitat health over the historical period. The Mann-Kendall test results corroborate the Average Growing-Season NDVI trends indicating an "increasing trend" at all the Segments and Focus Areas for the entire period, expect for the San Timoteo 2 Segment where there was "no trend".

- Over the entire period, the Average Growing-Season NDVI increased at all Segments and Focus Areas across the Study Area, indicating an overall increase in the riparian habitat health over the period of increased discharge at the Beaumont WWTP. The Mann-Kendall test results corroborate the Average Growing-Season NDVI trends indicating an "increasing trend" at all the Segments and Focus Areas for 2004 to 2023 expect at FA08 and FA09 where there was "no trend".
- The significantly larger increases in NDVI (> 0.20) observed for the 2004 to 2023 period in the Study Area are:
  - 0.22 at FA01, the Focus Area most upstream of the Beaumont WWTP discharge along Cooper's Creek 1 Segment.
  - 0.39 at FA03, the Focus Area located immediately downstream of Beaumont WWTP discharge along Cooper's Creek 1 Segment.
  - 0.23 at FA04, the next Focus Area located downstream of Beaumont WWTP discharge along Cooper's Creek 1 Segment.
  - 0.30 at FA09, which is the upstream Focus Area along the San Timoteo 2 Segment.




Cooper's Creek 1 Segment
San Timoteo 1 Segment
San Timoteo 2 Segment
Study Area
Focus Areas
WWTP Discharge Point
Streams

Notes:
1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant

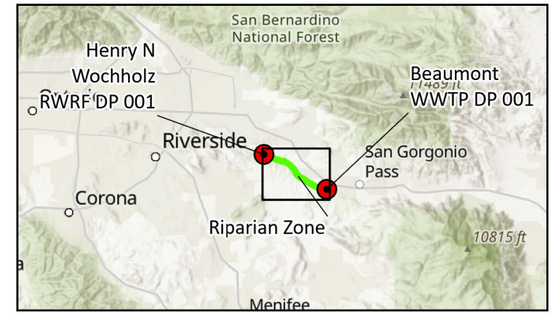



Figure5 1: K:\Clients\1113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01-Beaumont_AMMP.aprx - csorensen - 1/3/2025

Prepared by:

WEST YOST

N

0 2 Miles

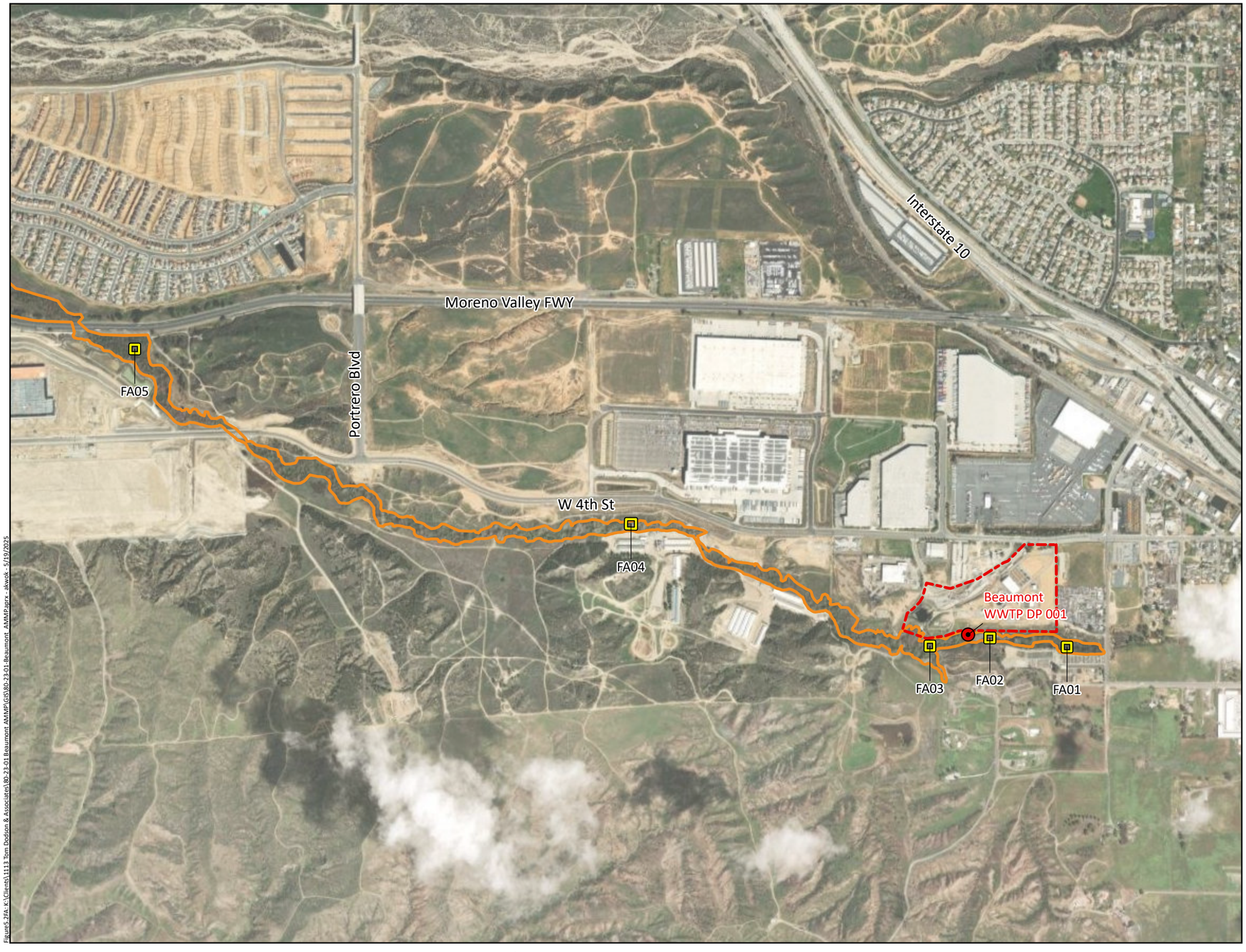
0 2 Km

Prepared for:

**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Riparian Zone, Study Segments, and Focus Areas**
*City of Beaumont AMMP*
**Figure 5-1**




Riparian Zone and Study Segments

- Cooper's Creek 1
- Focus Areas
- WWTP Discharge Point
- Beaumont WWTP Boundary

Notes:

1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant

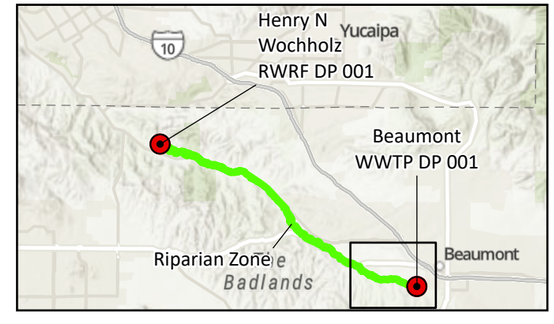



Figure5.2FA-K:\Clients\1113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01-Beaumont_AMMP.aprx - akwok - 5/19/2025

Prepared by:

WEST YOST

N

0 1 Miles

0 1,000 2,000 Feet

Prepared for:

**City of Beaumont**

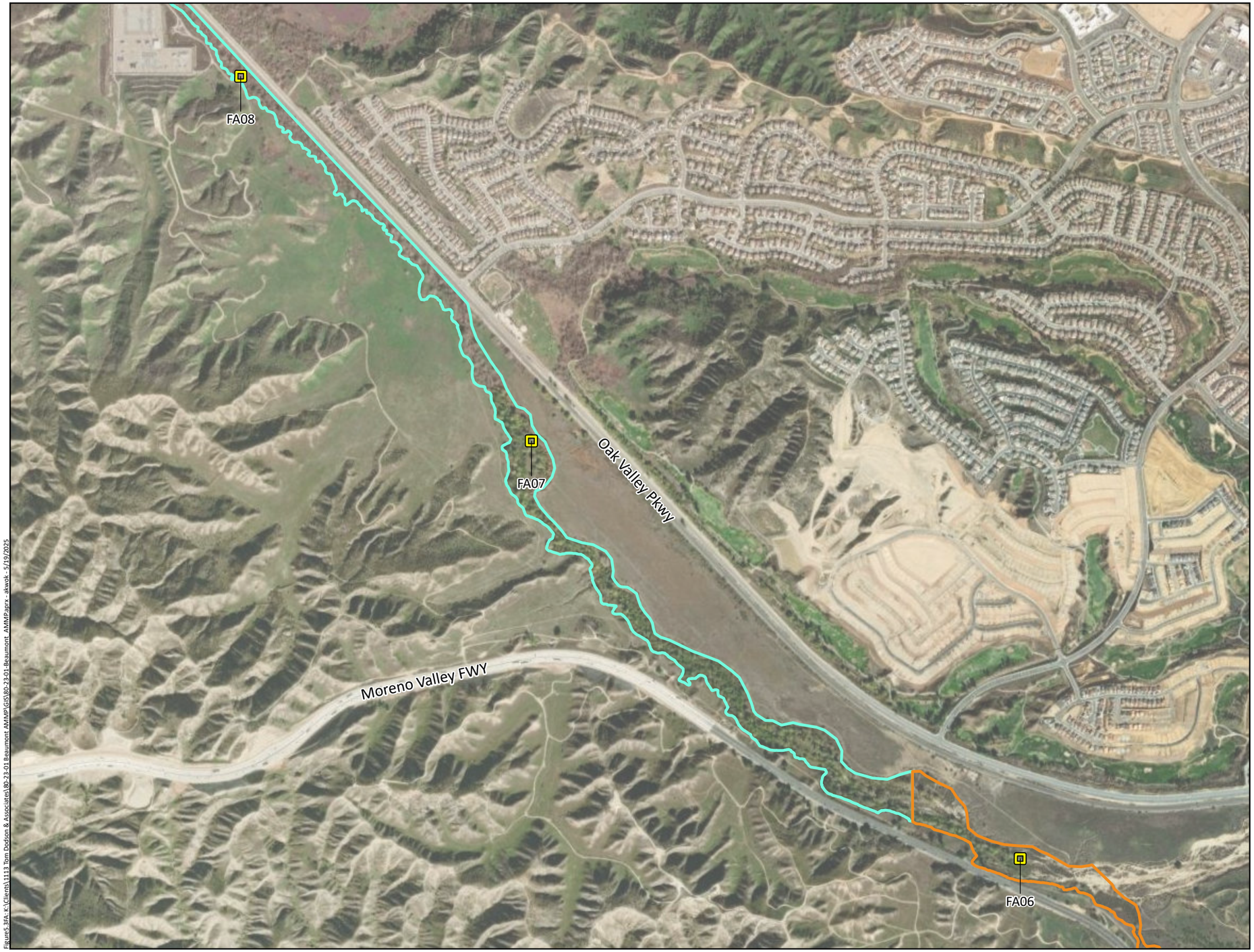
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Focus Areas FA01, FA02, FA03, FA04, and FA05 for NDVI Analysis**

*City of Beaumont AMMP*

**Figure 5-2**




Riparian Zone and Study Segments

- Cooper's Creek 1
- San Timoteo 1
- Focus Areas

Notes:

1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant

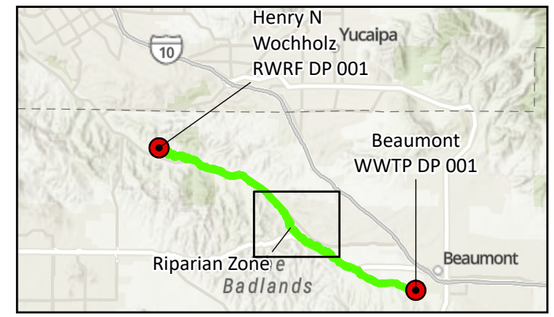



Figure5_3FA_K:\Client\1113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01-Beaumont_AMMPaprx - akwok - 5/19/2025

Prepared by:

WEST YOST

N

0 1 Miles

0 1,000 2,000 Feet

Prepared for:

**City of Beaumont**

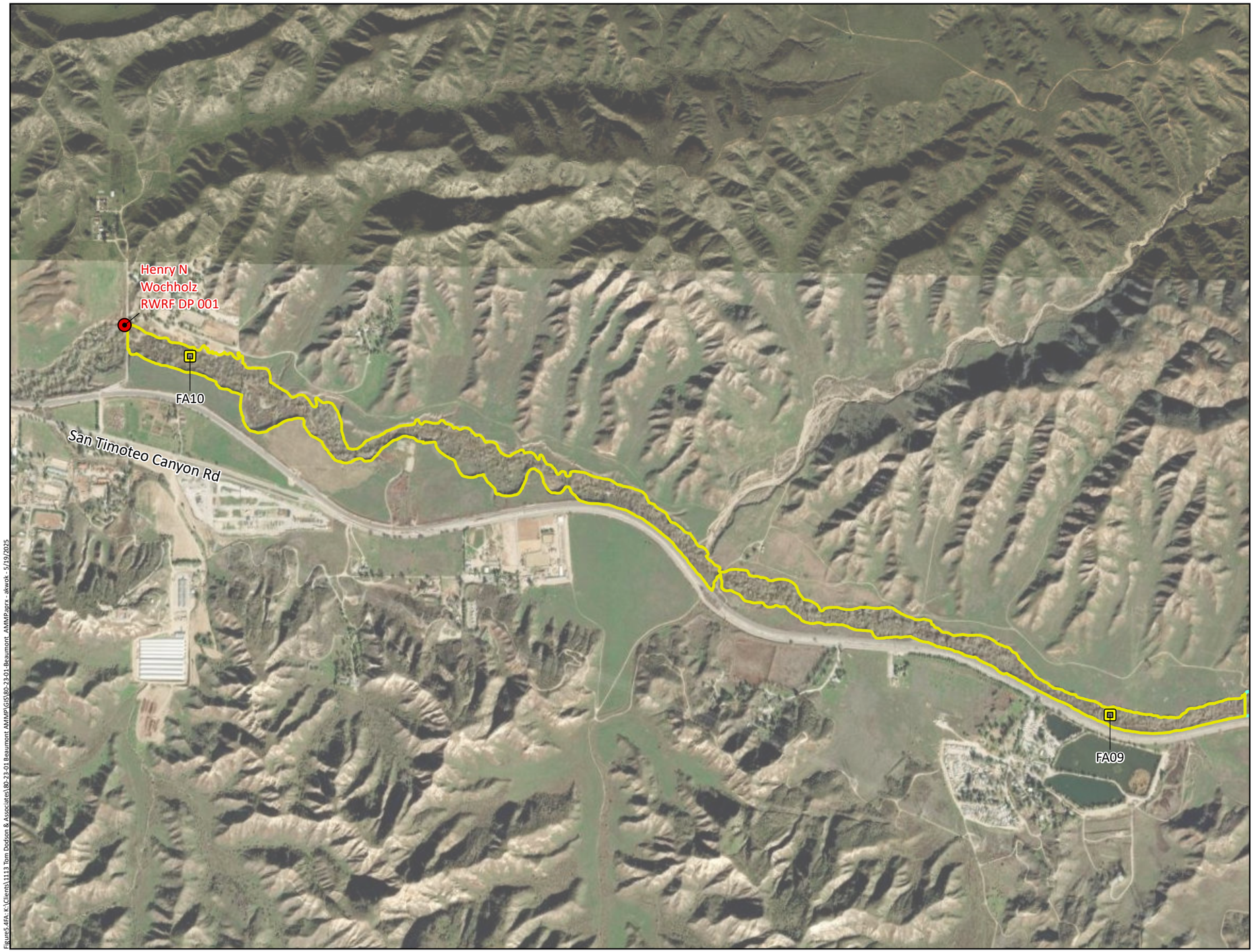
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Focus Areas FA06, FA07, and FA08 for NDVI Data Analysis**

*City of Beaumont AMMP*

**Figure 5-3**

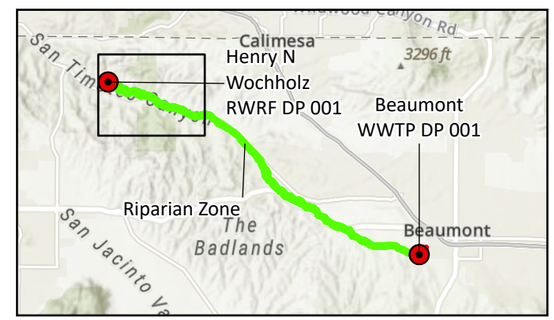



Riparian Zone and Study Segments

- San Timoteo 1
- San Timoteo 2
- Focus Areas
- WWTP Discharge Point

Notes:

1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant




Prepared by:

WEST YOST

N

0 1,200 2,400

Scale in Feet

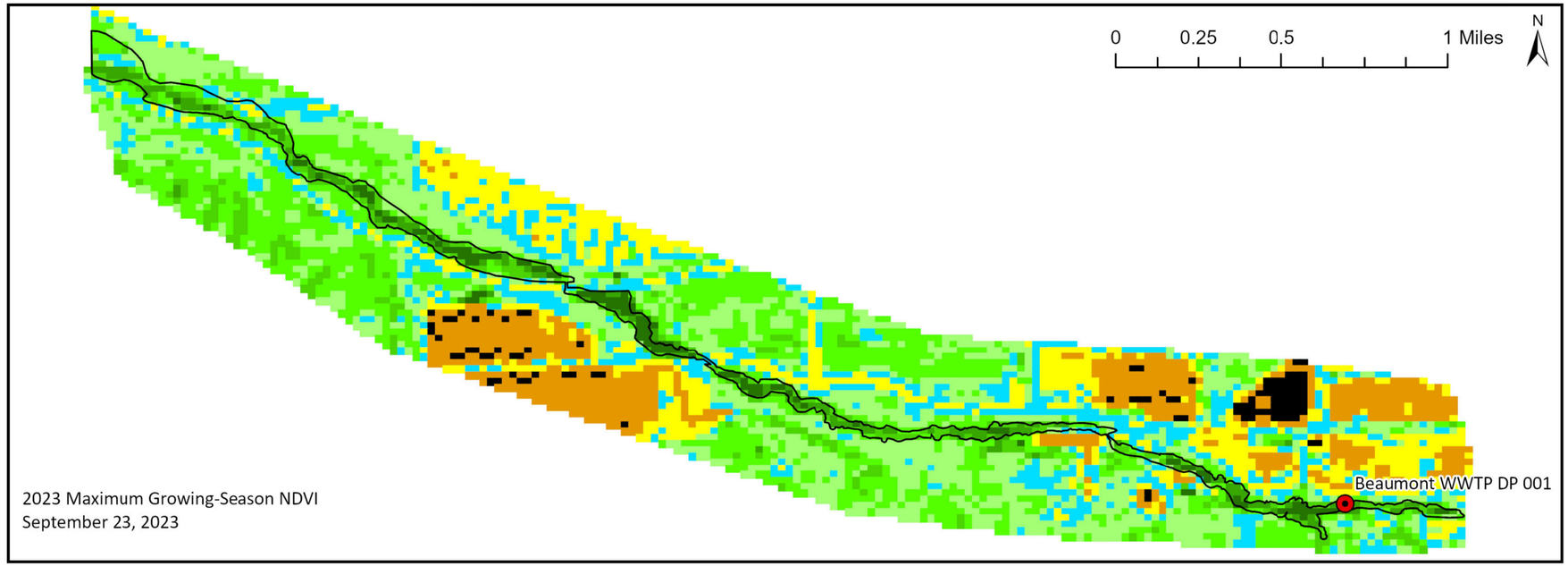
Prepared for:

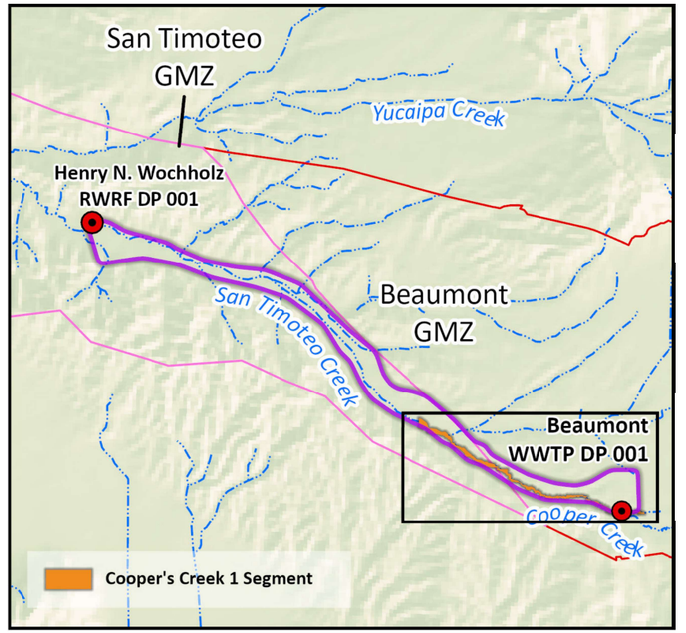
**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

**Focus Areas FA09 and FA10 for NDVI Data Analysis**
*City of Beaumont AMMP*

**Figure 5-4**

Figure5.4FA.K:\Client\11113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01-Beaumont_AMMP.aprx - akwok - 5/19/2025

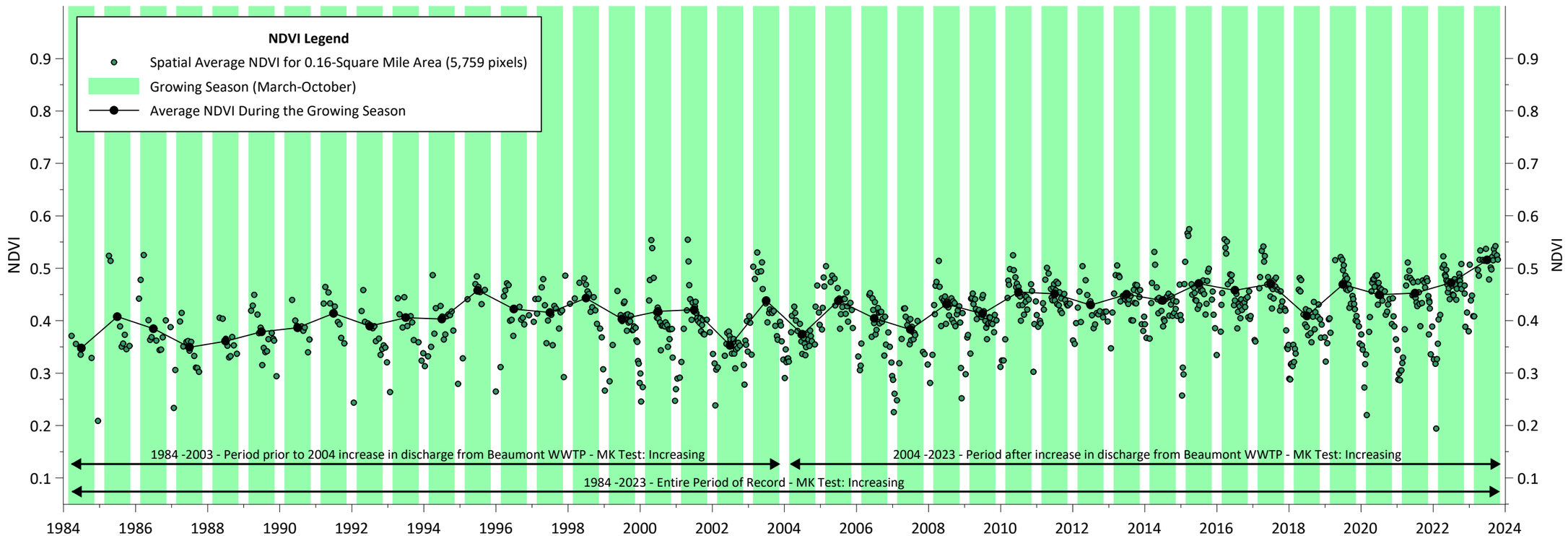



NDVI

- > -1 and ≤ 0
- > 0 and ≤ 0.1
- > 0.1 and ≤ 0.2
- > 0.2 and ≤ 0.3
- > 0.3 and ≤ 0.4
- > 0.4 and ≤ 0.5
- > 0.5 and ≤ 0.6
- > 0.6 and ≤ 0.7
- > 0.7 and ≤ 1

Cooper's Creek 1

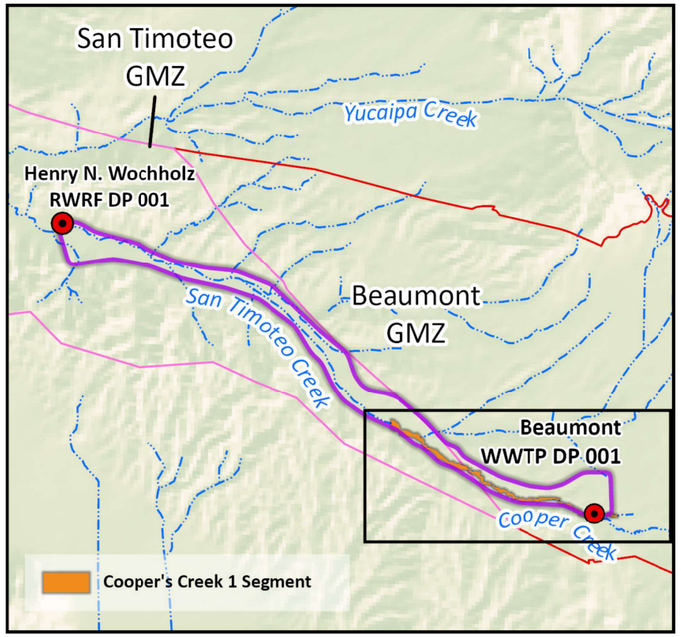


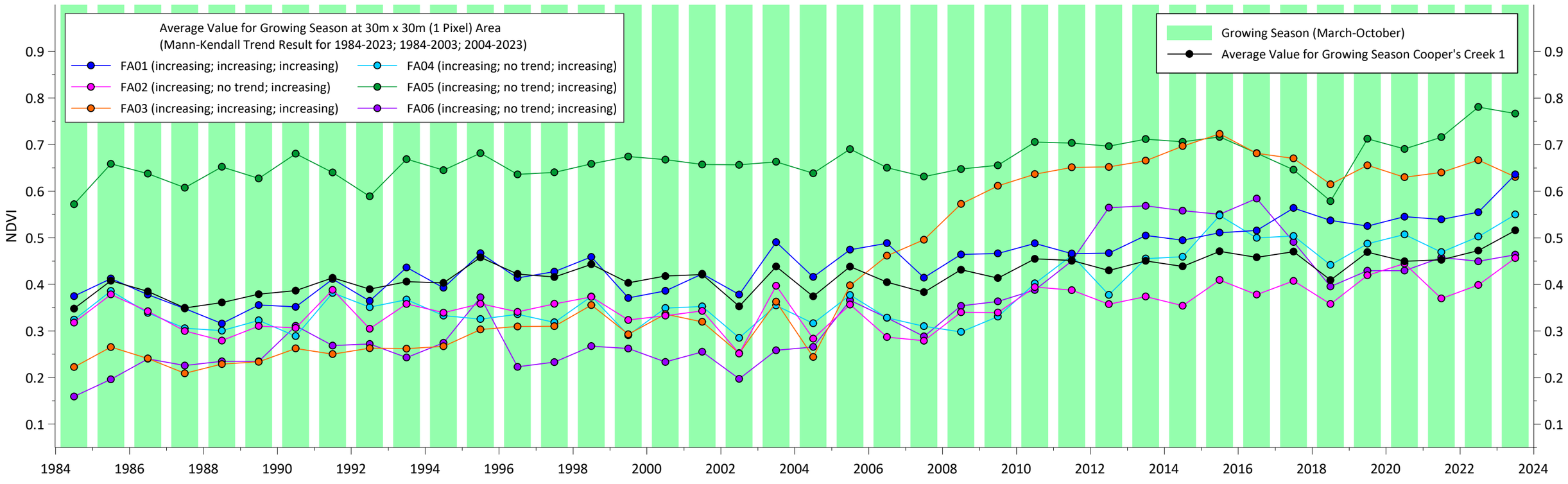

WEST YOST
Water. Engineered.

Author: AK
Date: 20241212
File: Figure 5-5a_NDVI_StudyArea-A.grf

**Time Series of NDVI for Cooper's Creek 1 Segment**
**City of Beaumont AMMP**

**Figure 5-5a**



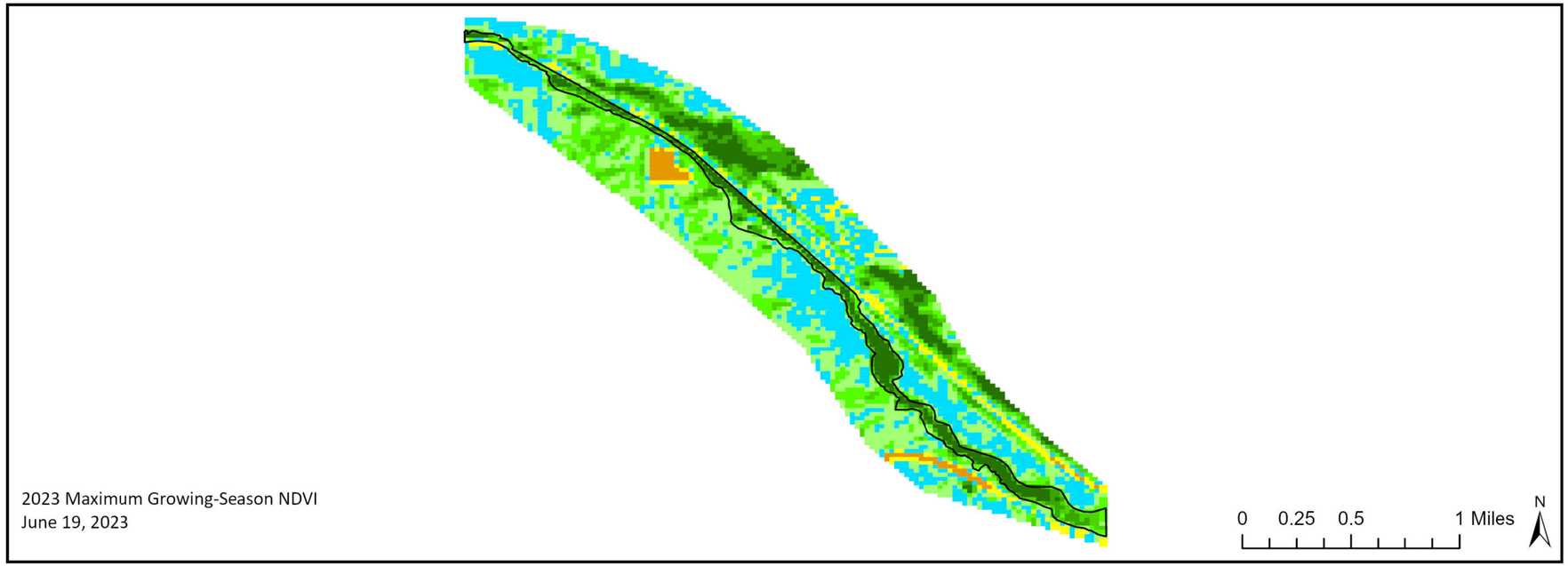



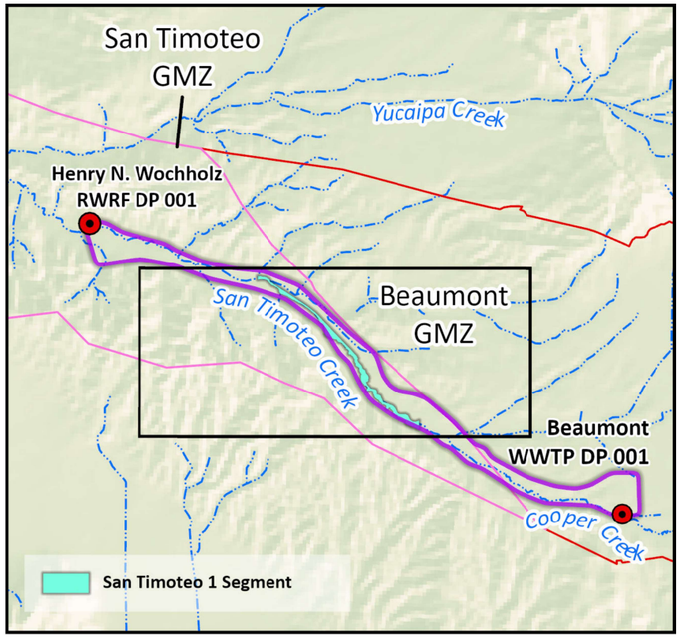

WEST YOST
Water. Engineered.

Author: AK
Date: 20241216
File: Figure 5-5b_NDVI_StudyArea-A-sm areas.grf

**Time Series of NDVI for Focus Areas along Cooper's Creek 1**
**City of Beaumont AMMP**

**Figure 5-5b**

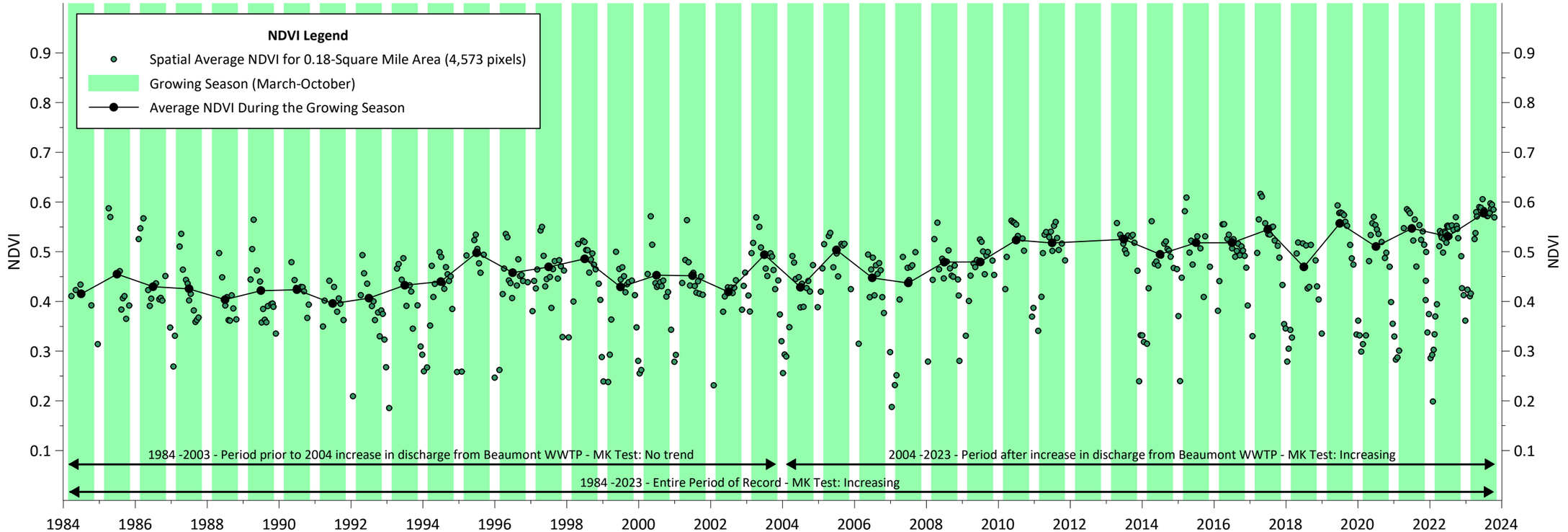



NDVI

- > -1 and ≤ 0
- > 0 and ≤ 0.1
- > 0.1 and ≤ 0.2
- > 0.2 and ≤ 0.3
- > 0.3 and ≤ 0.4
- > 0.4 and ≤ 0.5
- > 0.5 and ≤ 0.6
- > 0.6 and ≤ 0.7
- > 0.7 and ≤ 1

San Timoteo 1

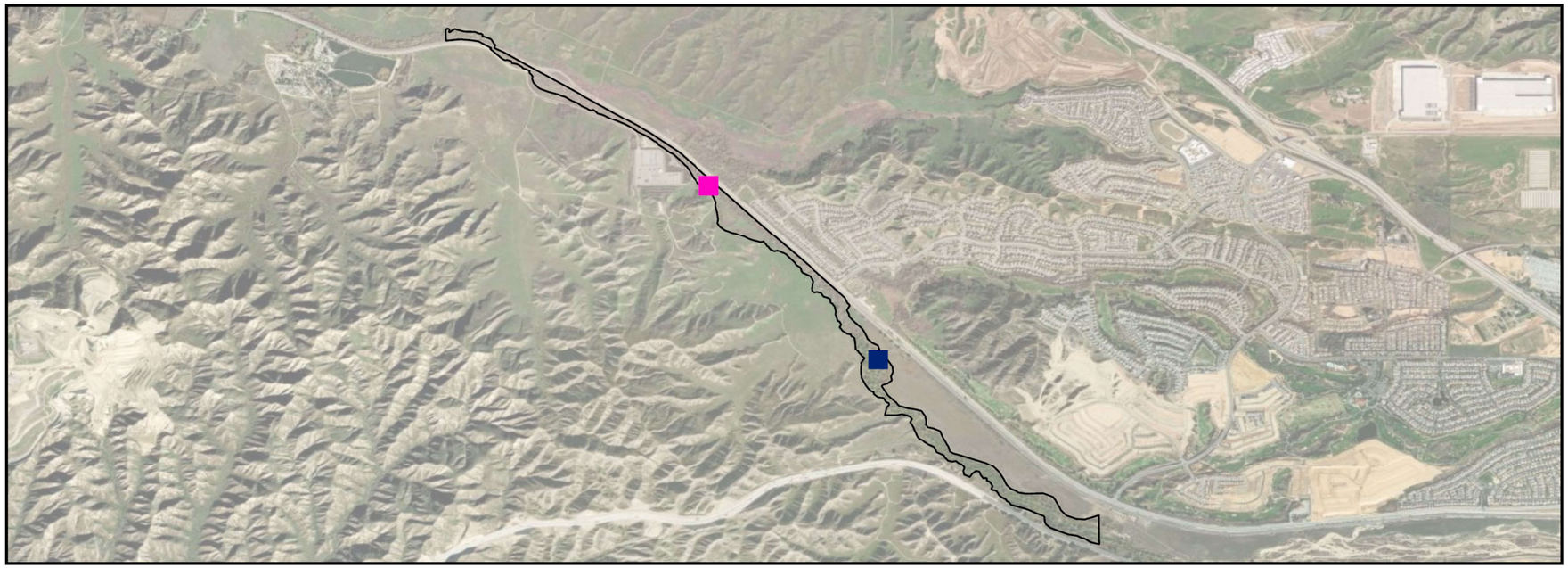


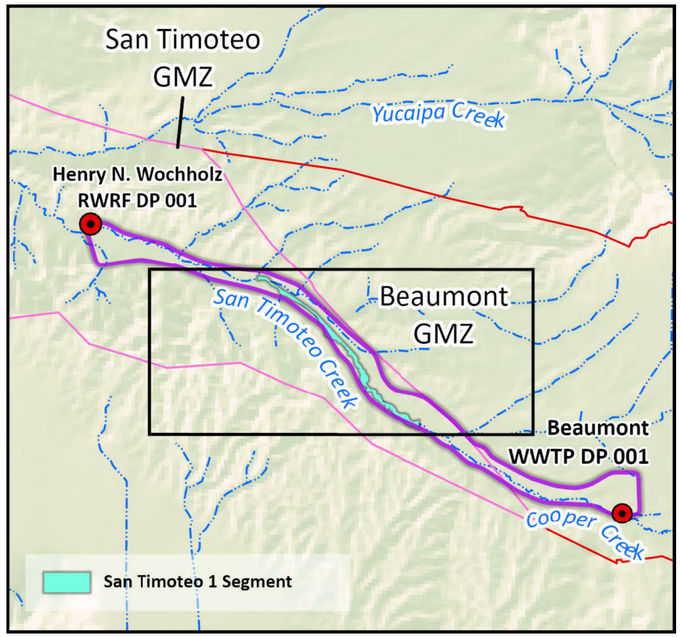

WEST YOST
Water. Engineered.

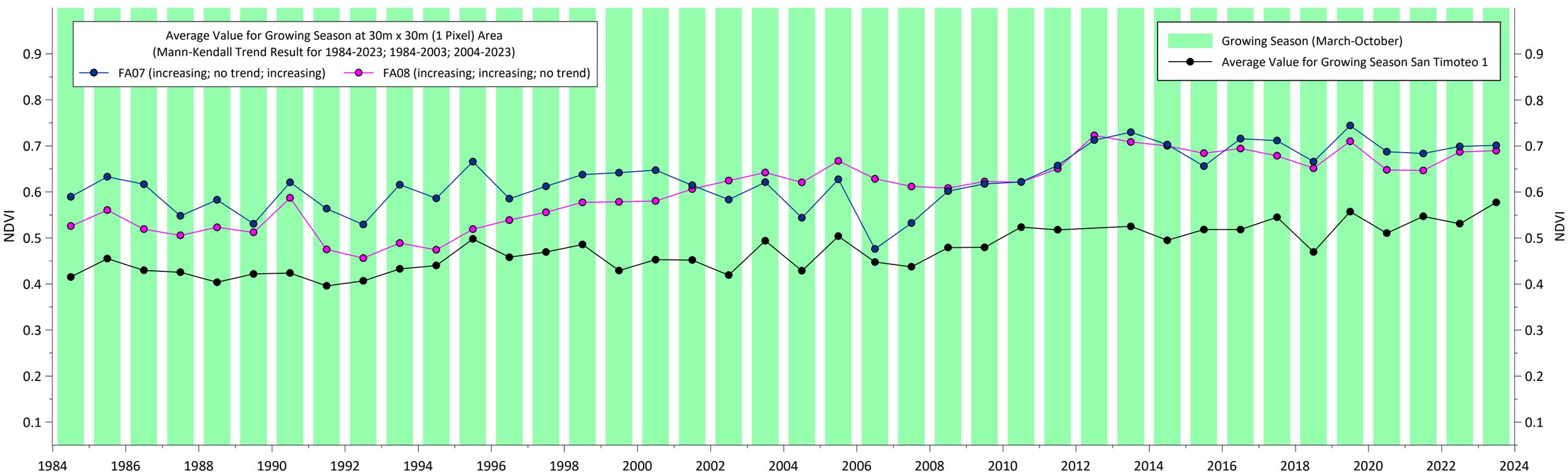
Author: AK
Date: 20241212
File: Figure 5-6a_NDVI_StudyArea-B.grf

**Time Series of NDVI for San Timoteo 1 Segment**
**City of Beaumont AMMP**

**Figure 5-6a**





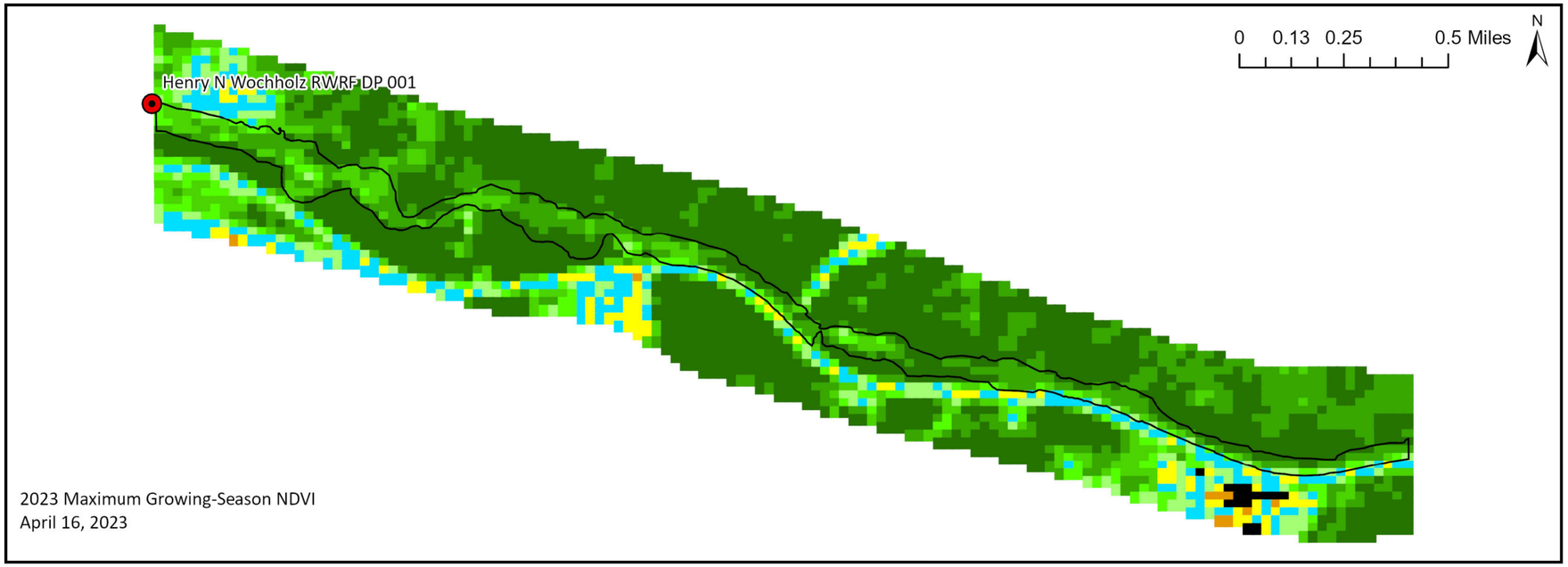



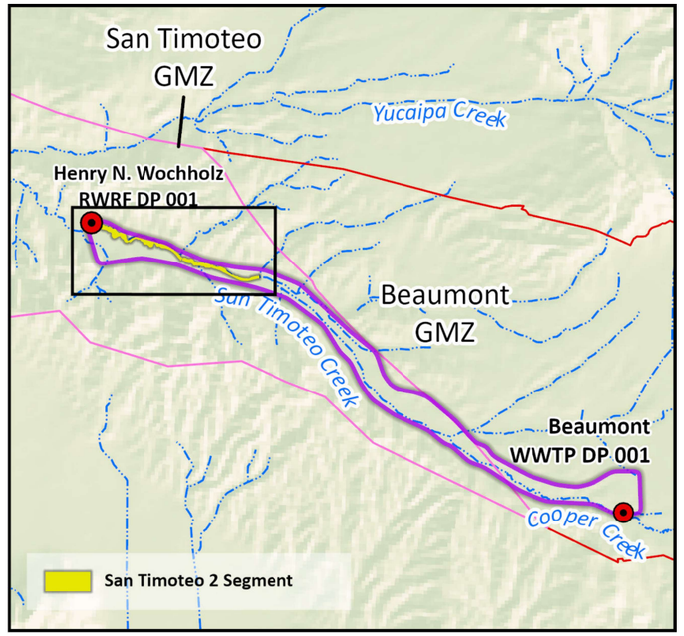

WEST YOST
Water. Engineered.

Author: AK
Date: 20241213
File: Figure 5-6b_NDVI_StudyArea-B-sm areas.grf

**Time Series of NDVI for Focus Areas along San Timoteo 1**
**City of Beaumont AMMP**

**Figure 5-6b**

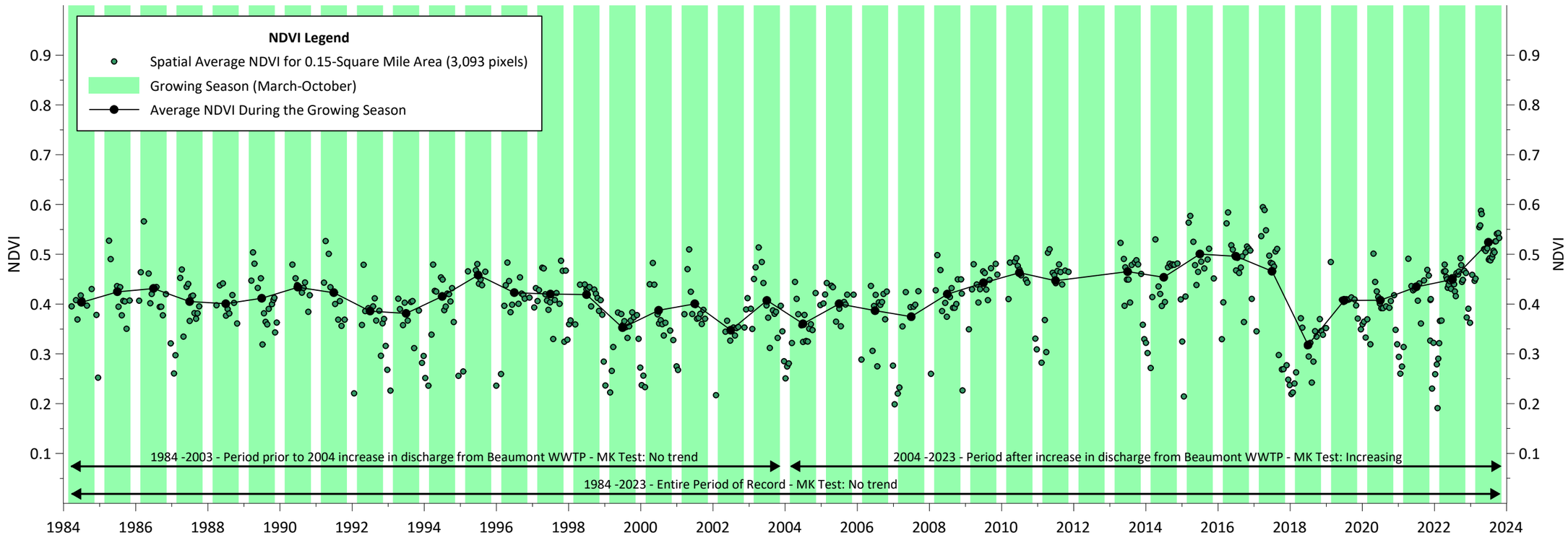



NDVI

- > -1 and ≤ 0
- > 0 and ≤ 0.1
- > 0.1 and ≤ 0.2
- > 0.2 and ≤ 0.3
- > 0.3 and ≤ 0.4
- > 0.4 and ≤ 0.5
- > 0.5 and ≤ 0.6
- > 0.6 and ≤ 0.7
- > 0.7 and ≤ 1

San Timoteo 2

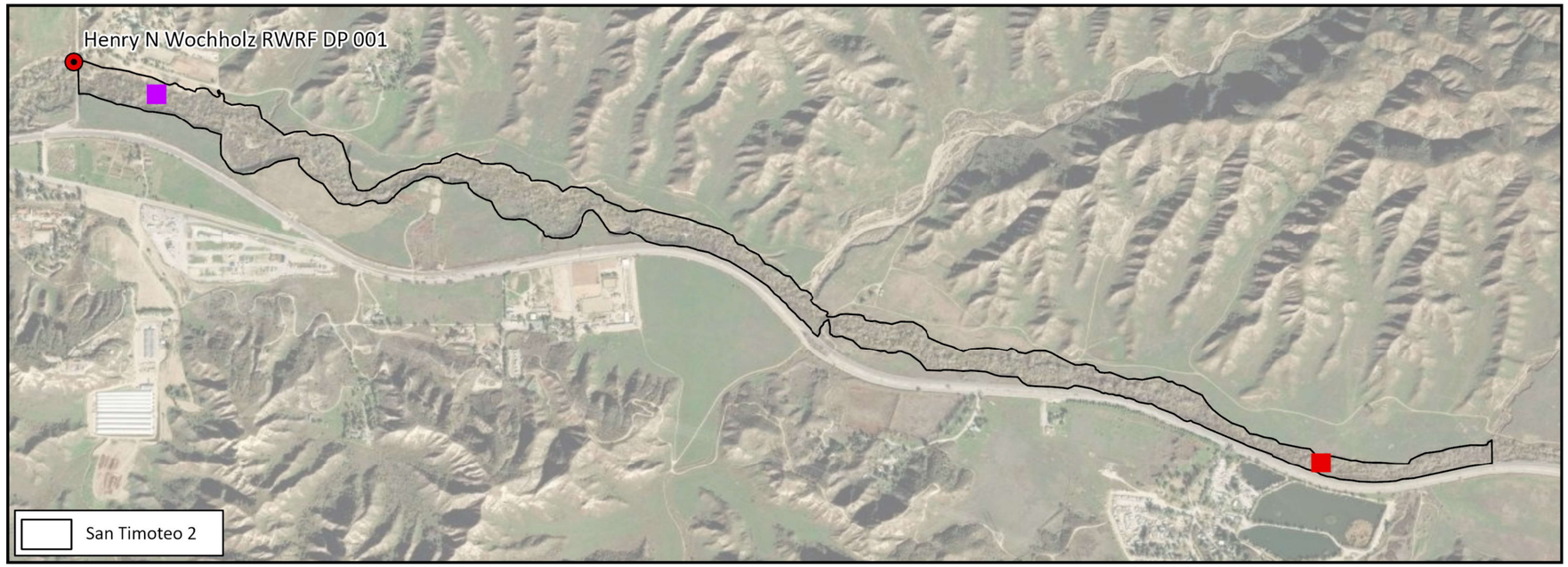


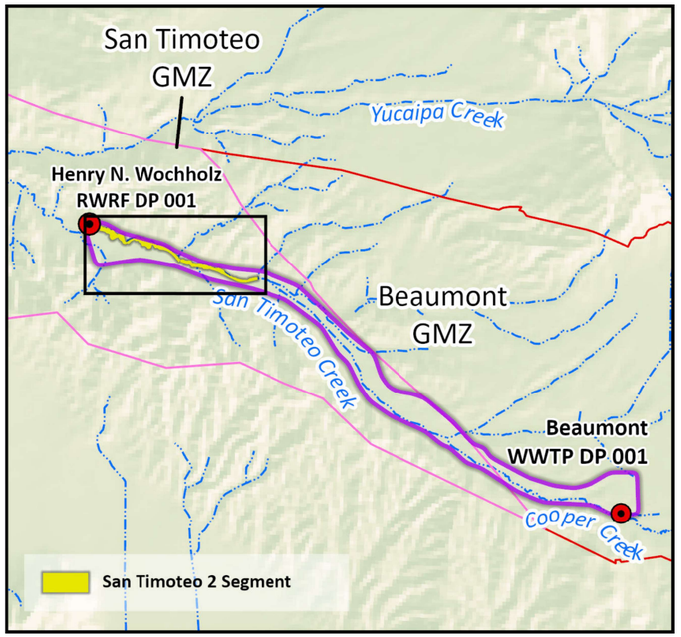

WEST YOST
Water. Engineered.

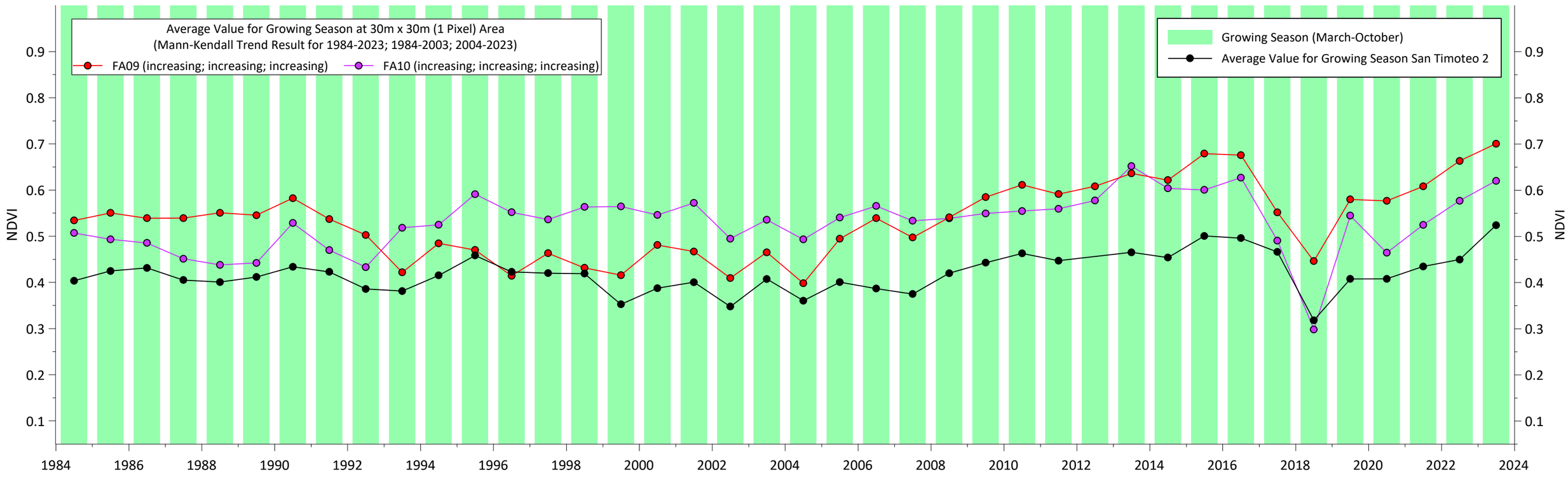
Author: AK
Date: 20241212
File: Figure 5-7a_NDVI_StudyArea-C.grf

**Time Series of NDVI for San Timoteo 2 Segment**
**City of Beaumont AMMP**

**Figure 5-7a**




WEST YOST
Water. Engineered.

Author: AK
Date: 20241216
File: Figure 5-7b_NDVI_StudyArea-C-sm areas.grf

**Time Series of NDVI for Focus Areas along San Timoteo 2**
**City of Beaumont AMMP**

**Figure 5-7b**

# 6.0 HYDROLOGIC CHARACTERIZATION

This section describes the characterization of WWTP historical discharges, surface water flows, surface water quality, groundwater levels, and groundwater quality for the Study Area.

## 6.1 WWTP Discharges

The location of currently active and inactive WWTP discharge points within and adjacent to the Study Area are shown on Figure 2-1. Table 6-1 shows the total annual discharges (in acre-feet per year [afy]) for three WWTP discharge points that were active during the period of record shown from 1986 to 2023:

- Active – Beaumont WWTP DP001 and YVWD Henry N. Wochholz RWRF DP001
- Inactive – Beaumont WWTP DP007

Two active WWTP discharge points bracket the Study Area –Beaumont WWTP (DP001) at the upstream extent of the Study Area in Cooper's Creek, and the Henry N. Wolchholz RWRF DP001 at the downstream extent of Study Area on San Timoteo Creek (Figure 2-1). Figure 6-1 is a time series chart of the discharge for the two active WWTP discharge locations in the Study Area. The figure includes the annual total discharge in afy (afy, bars); the daily discharge in mgd, where available (light lines); and the 30-day moving average discharge in mgd (bold lines). Generally, the discharges from the City and YVWD have increased over time and mirror the increase in population growth for the region:

- **Beaumont WWTP DP001.** Total annual discharges increased monotonically year-to-year from 1989[9] to 2003, from about 1,200 to 1,900 afy, a 55 percent increase over 15 years. In 2004, the rate of increase in the annual discharge increased. For the 17 year period from 2004 to 2020, discharges increased from about 2,000 afy to 4,300 afy in 2020, a 100 percent increase. In 2023, total discharge was 3,837af and daily discharge averaged about 3.3 mgd.
- **YWVD Henry N. Wochholz DP001.** Annual discharges show a similar increasing trend as the Beaumont WWTP where discharge steadily increased from 1987 to 2003 from about 1,040 afy to 3,600 afy, a 60 percent increase over 15 years. For the 15-year period from 2004 to 2018, discharges increased from about 3,900 afy to 4,500 afy, a 15 percent increase. In 2023, total discharge was 3,783 af and daily discharge averaged about 3.7 mgd.

There were two historical Beaumont WWTP discharge locations, one located on Noble Creek (DP008) and the other on a tributary to Noble Creek (DP007). These locations are shown on Figure 2-1. The City has no record of discharging from DP008, and discharges at DP007 occurred between 2010 and 2014 averaging about 543 afy. As shown on Figure 6-1, there was a reduction in the annual discharge from DP001 during these five years when the DP007 was active.

[9] Data is unavailable prior to 1989

**Table 6-1. Historical WWTP Discharges[a]**

| Year | Beaumont WWTP | | YVWD WWTP[d] |
|---|---|---|---|
| | DP-001, af[b,c] | DP-007, af | Henry N. Wochholz, af[e] |
| 1987 | -- | -- | 1,041.21 |
| 1988 | -- | -- | 2,067.97 |
| 1989 | 1,232.30 | -- | 2,269.41 |
| 1990 | 1,299.79 | -- | 2,423.38 |
| 1991 | 1,292.81 | -- | 2,516.70 |
| 1992 | 1,353.32 | -- | 2,596.22 |
| 1993 | 1,370.77 | -- | 2,615.18 |
| 1994 | 1,346.34 | -- | 2,673.92 |
| 1995 | 1,403.36 | -- | 2,579.31 |
| 1996 | 1,475.50 | -- | 2,655.91 |
| 1997 | 1,517.39 | -- | 2,793.39 |
| 1998 | 1,579.07 | -- | 3,135.79 |
| 1999 | 1,593.03 | -- | 3,142.05 |
| 2000 | 1,605.83 | -- | 3,321.55 |
| 2001 | 1,601.18 | -- | 3,349.26 |
| 2002 | 1,711.72 | -- | 3,263.32 |
| 2003 | 1,909.54 | -- | 3,600.21 |
| 2004 | 2,162.05 | -- | 3,890.71 |
| 2005 | 2,427.36 | -- | 3,896.05 |
| 2006 | 2,622.86 | -- | 3,978.78 |
| 2007 | 2,910.04 | -- | 4,106.08 |
| 2008 | 2,860.21 | -- | 4,023.56 |
| 2009 | 2,869.93 | -- | 4,010.18 |
| 2010 | 2,422.85 | 573.68 | 4,128.54 |
| 2011 | 2,371.03 | 660.18 | 4,224.75 |
| 2012 | 2,537.27 | 542.91 | 4,132.78 |
| 2013 | 2,628.21 | 518.11 | 4,200.43 |
| 2014 | 2,994.87 | 420.02 | 4,055.50 |
| 2015 | 3,356.84 | -- | 3,363.70 |
| 2016 | 3,547.84 | -- | 4,098.49 |
| 2017 | 3,663.22 | -- | 4,201.71 |
| 2018 | 3,799.72 | -- | 4,469.49 |
| 2019 | 4,103.63 | -- | 4,072.07 |
| 2020 | 4,343.66 | -- | 4,236.57 |
| 2021 | 3,839.48 | -- | 4,149.02 |
| 2022 | 3,637.96 | -- | 3,987.05 |
| 2023 | 3,836.55 | -- | 3,783.25 |
| Summary Statistics | | | |
| **Minimum** | **1,232.30** | **420.02** | **1,041.21** |
| **Mean** | **2,435.07** | **542.98** | **3,433.88** |
| **Maximum** | **4,343.66** | **660.18** | **4,469.49** |

(a) WWTP - Waste Water Treatment Facility
(b) af - acre-foot.
(c) From November 1, 2022, to January 31, 2023, the discharge data for Beaumont WWTP DP-001 was estimated based on October 2022 discharge.
(d) Yucaipa Valley Water District
(e) Discharge is estimated for November 2023 using October 2023 discharge volumes.

## 6.2 Surface Water

The following subsections describe the historical surface water flows and quality for the Study Area.

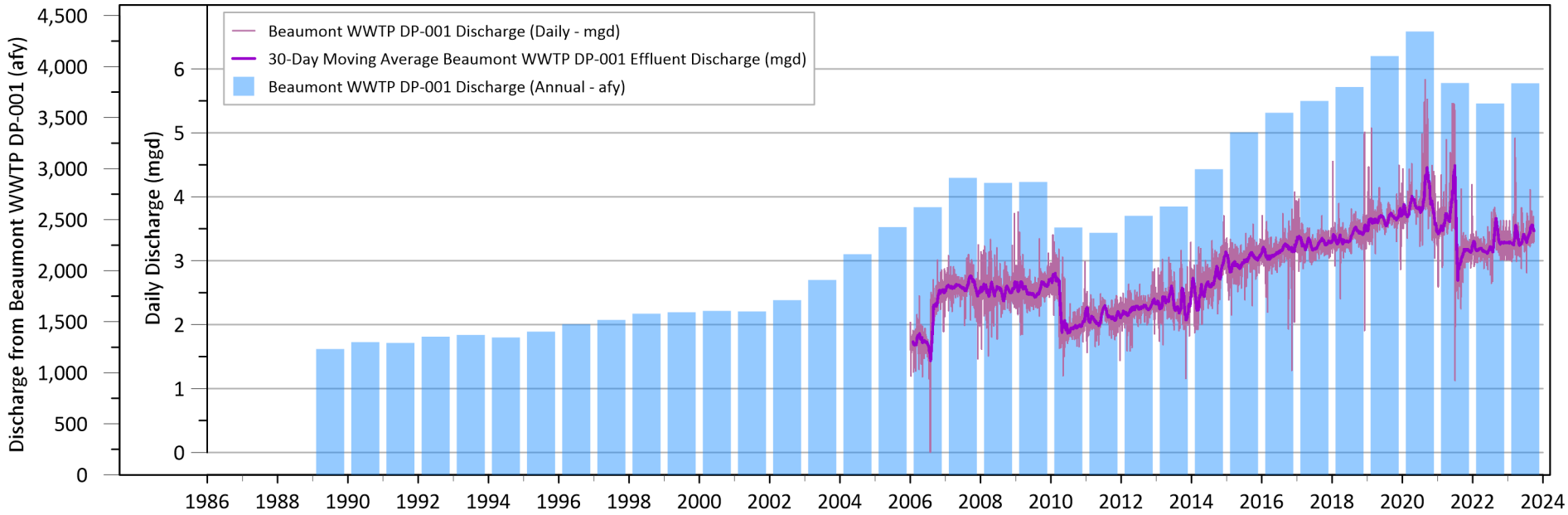
### *6.2.1 Surface Water Flows*

There are five surface water monitoring sites within and adjacent to the Study Area: CC-01, CC-03, STC-02, STC-01, and YVWD-A. Figure 6-2 shows the location of sites with the Study Area (and relative to the NDVI analysis Segments) and the available flow data from 2005 to 2023. The surface water flow measurements are collected bi-weekly for the Maximum Benefit Monitoring Program and the surface water flow measurements are grouped and plotted by Segment from upstream to downstream. The data show:

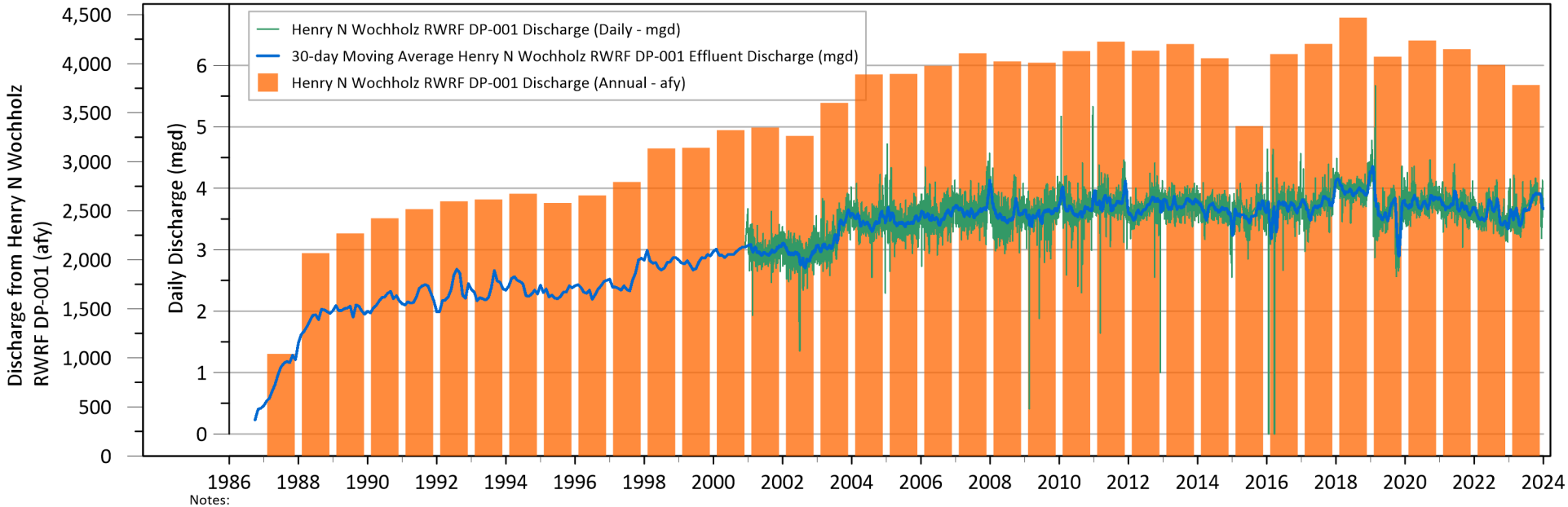
- **Cooper's Creek 1 Segment –** Two surface water monitoring stations (CC-01 and CC-03) are within this Segment and Cooper's Creek. Both stations are located downstream of the Beaumont WWTP DP001. An additional surface water monitoring station is located in the San Timoteo Creek and adjacent to the Cooper's Creek 1 Segment (STC-02); however, no streamflow has been observed at this station. Since 2005, surface water flows ranged from about 0 to 36 cubic feet per second (cfs). Flow in Cooper's Creek generally decreases downstream along the Segment between CC-01 and CC-03. Overall, the volume of surface water flows has increased since 2005, which is likely attributable to increased discharges from Beaumont WWTP DP001.
- **San Timoteo 1 Segment** – One surface water monitoring station (STC-01) is within this Segment. Since 2005, surface water flows ranged from about 0 to 51 cfs. Surface water flow at STC-01 is generally less than flow at the upstream CC-03 site. Overall, the volume of surface water flows increased at STC-01 since 2005, which could be attributable to increased discharges from Beaumont WWTP DP001.
- **San Timoteo 2 Segment** – One surface water monitoring station (YVWD-A) is within this Segment. Since 2005, surface water flows ranged from about 0 to 57 cfs. Surface water flow at YVWD-A is generally less than flow at the upstream STC-01 site. Overall, the volume of surface water flows increased at YVWD-A since 2005, which could be attributable to increased discharges from Beaumont WWTP DP001.

Overall, based on the available data, surface water flow generally decreases from upstream to downstream through the Study Area. Flows have increased over time at all sites. The increase in surface flows is likely due to increased discharges from Beaumont WWTP DP001. Both San Timoteo 1 and San Timoteo 2 Segments exhibit larger winter storm peak flows when compared to Cooper's Creek 1 Segment, and may be attributable to flashier flows originating in Noble and San Timoteo Creeks. There were very few instances of no-flow conditions throughout the Study Area over the period of record. However, during drought periods (such as 2013 and 2014), there were instances of no-flow conditions in the creeks within the Study Area reaches, particularly in San Timoteo 1 and San Timoteo 2 Segments.

**Beaumont WWTP DP-001**




**Henry N Wochholz RWRF DP-001**



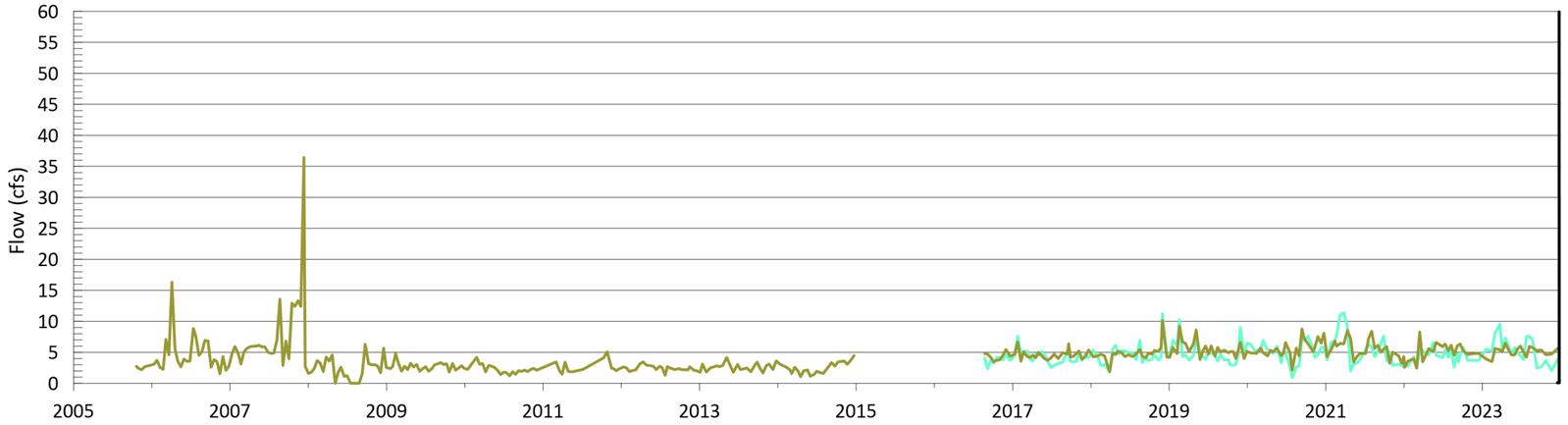

Notes:
1. Waste Water Treatment Plant (WWTP)
2. Regional Water Recycling Facility (RWRF)
3. acre-foot per year (afy)
4. million gallons per day (mgd)
5. From November 1, 2022, to January 31, 2023, the discharge data for Beaumont WWTP DP-001 was estimated based on October 2022 discharge
6. From November 1, 2023, to November 30, 2023, the discharge data for Henry N Wochholz RWRF DP-001 was estimated based on October 2023 discharge
7. Henry N Wochholz RWRF DP-001 discharge was reported as a monthly average mgd from 1986-2000

WEST YOST
Water. Engineered.

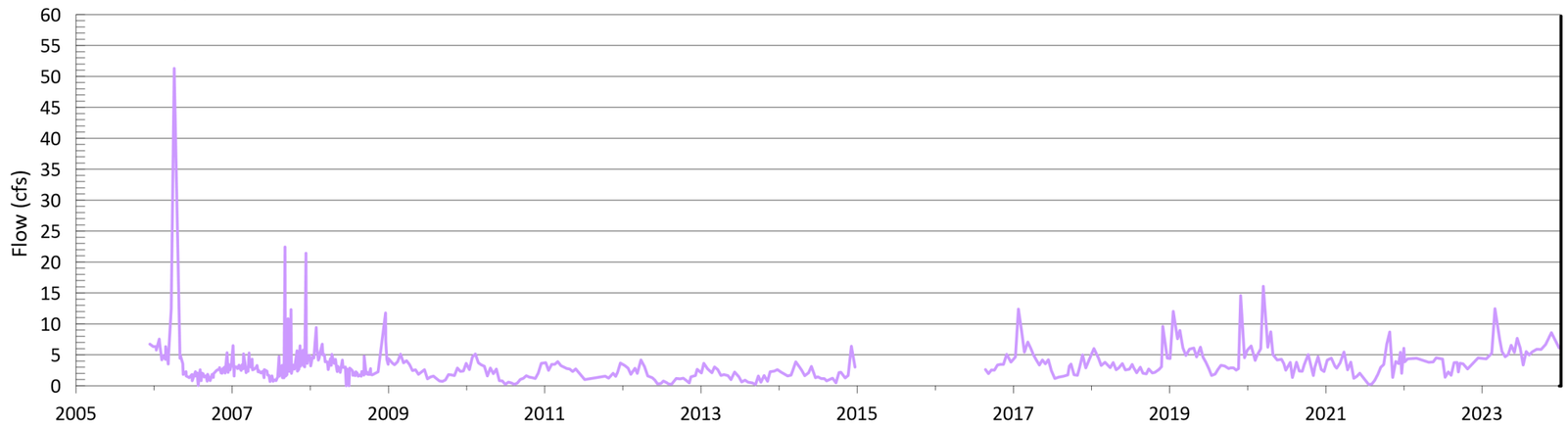
Author: AK
Date: 20241219
File: Figure 6-1_DailyEffluentDischarge_WWTP.grf

**Daily Effluent Discharge to Cooper's Creek and San Timoteo Creek at Beaumont WWTP DP-001 and Henry N Wochholz RWRF DP-001**
**City of Beaumont AMMP**
*1986-2023*
**Figure 6-1**

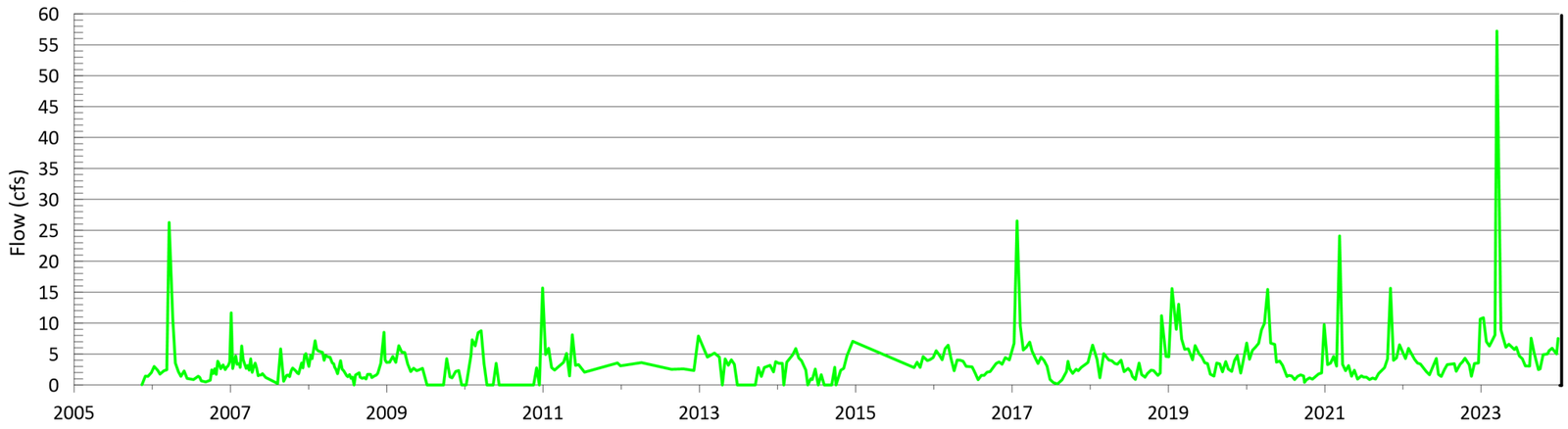
**Cooper's Creek 1 Segment**




**San Timoteo 1 Segment**




**San Timoteo 2 Segment**




**Upper Cooper's Creek 1 Segment**

Surface Water Flow (cfs)[1, 2]

- CC-01
- CC-03

**San Timoteo 1 Segment**

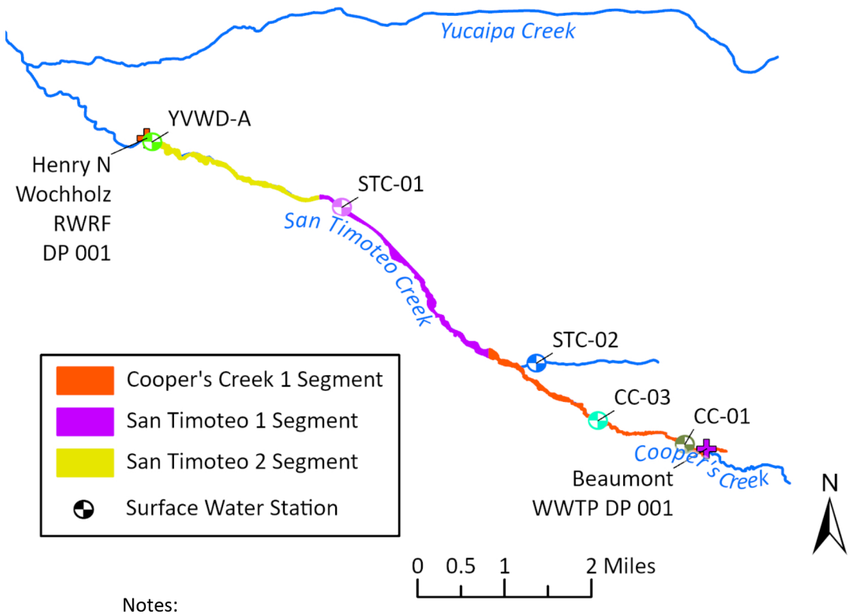
Surface Water Flow (cfs)[1, 2]

- STC-01

**San Timoteo 2 Segment**

Surface Water Flow (cfs)[1, 2]

- YVWD-A




Notes:

1. cfs = cubic feet per second
2. No surface water flow data for STC-02

WEST YOST
Water. Engineered.

Author: AK
Date: 20241212
File: Figure 6-2_SWL_3_Segments.grf

**Surface Water Flows at Select Surface Water Monitoring Locations**
**City of Beaumont AMMP**

**Figure 6-2**

### *6.2.2 Surface Water Quality*

Surface water quality data is collected at the same five surface water sites in the Study Area (CC-01, CC-03, STC-02, STC-01, and YVWD-A) as part of the Maximum Benefit Monitoring Program and is generally available since 2003. Surface water samples are collected bi-weekly, when flows are present. Figures 6-3 and 6-4 show the time history of nitrate (as -nitrogen) and total dissolved solids (TDS) concentrations for each surface water site, and the two active WWTP discharges. The surface water quality data are plotted by NDVI analysis Segment from upstream to downstream in the Study Area.

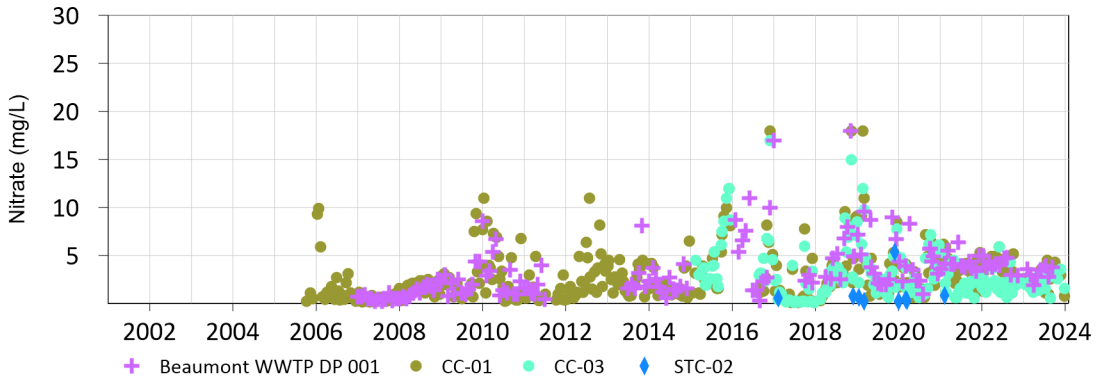
#### 6.2.2.1 Nitrate as Nitrogen

Review of the surface water nitrate data shown in Figure 6-3 indicates the following for each Study Area Segment:

- **Cooper's Creek 1 Segment –** Overall, the nitrate concentration at CC-01 and CC-03 mimic the concentrations of the discharge from Beaumont WWTP DP001. The Beaumont WWTP concentrations range from non-detect to 18 mg/L and have a long-term average of 4.2 mg/L. Nitrate concentrations at CC-01 and CC-03 are generally less than the WWTP concentrations and have a long-term average of 2.8 and 3.0 mg/L, respectively. There appears to be a seasonal trend in nitrate concentrations and occasionally over the period of record there are increases in the nitrate concentration at the WWTP, CC-01, and CC-02. The available data for STC-02 show nitrate concentrations ranged from non-detect to 5.4 mg/L and averaged 1.0 mg/L.
- **San Timoteo 1 Segment –** STC-01 is the sole surface water monitoring location along this Segment. Nitrate concentrations at STC-01 range from non-detect to 11 mg/L and have a long-term average of 1.5 mg/L. The nitrate concentrations are less than those observed in upstream Segment Cooper's Creek 1, but generally follow the same trends.
- **San Timoteo 2 Segment –** The surface water monitoring station YVWD-A is just upstream of the YVWD Henry N Wochholz RWRF DP001, both of which are at the downstream end point of this Segment. Generally, nitrate concentrations at YVWD-A are lower than the Henry N Wochholz RWRF discharge. Nitrate concentrations at YVWD-A range from non-detect to 9.7 mg/L and have a long-term average of 1.4 mg/L, while nitrate concentration for the Henry N Wochholz RWRF discharge range from non-detect to 27.7 mg/L and have a long-term average of 4.9 mg/L. Nitrate concentrations were much higher in the effluent of the Henry N. Wochholz RWRF DP001 prior to the implementation of a new denitrification process at the plant in 2009, and averaged 15 mg/L at that time. Since 2009, nitrate concentrations at Henry N. Wochholz RWRF averaged 2.6 mg/L.

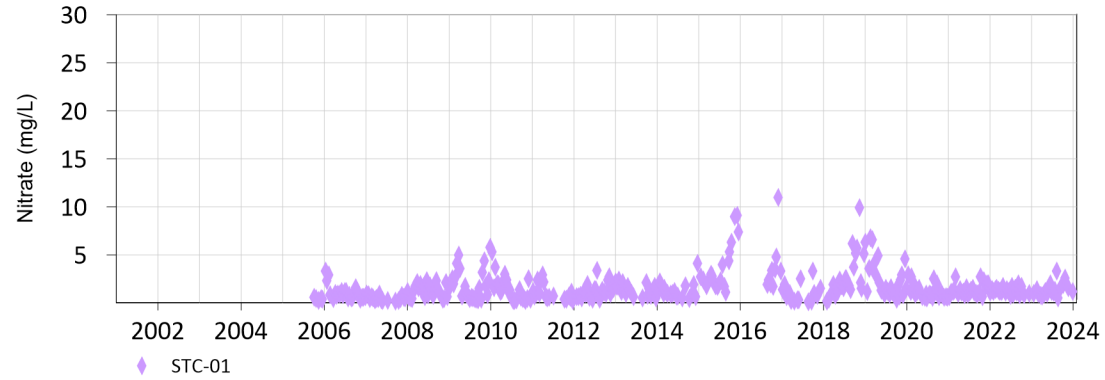
Overall, nitrate concentrations at the surface water monitoring locations decrease from upstream to downstream and follow the trends of the Beaumont WWTP discharge.

## Cooper's Creek 1 Segment

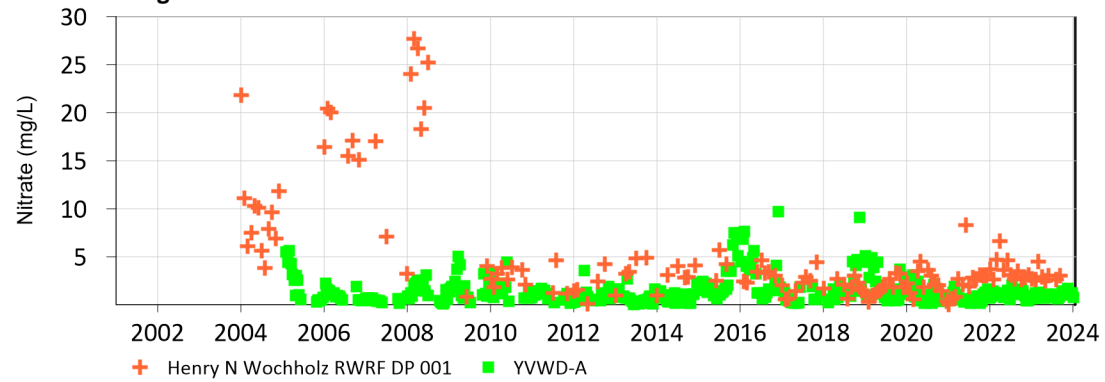



Note: Beaumont WWTP nitrate data starting in 2017 is total inorganic nitrogen (TIN) concentrations and likely over estimate nitrate-nitrogen

## San Timoteo 1 Segment

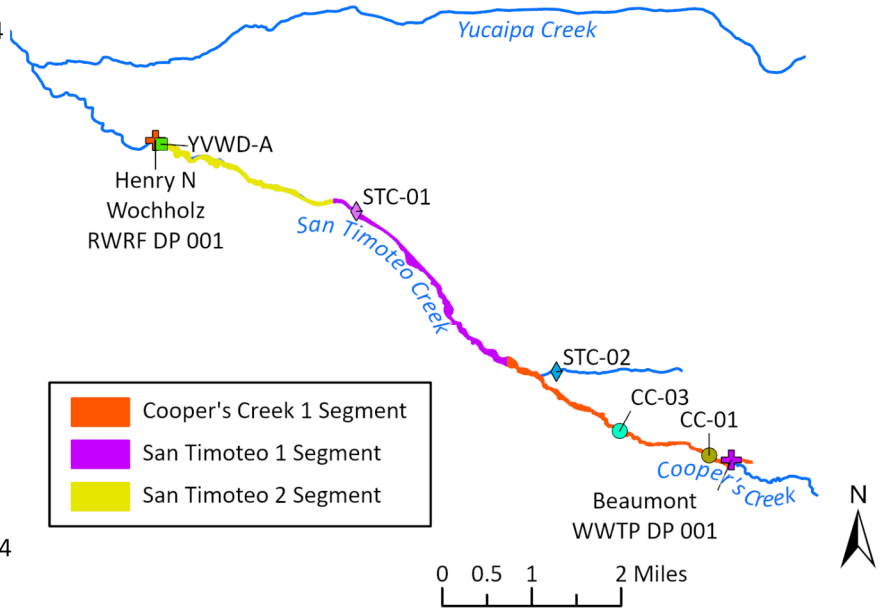



## San Timoteo 2 Segment




## Legend

- Nitrate concentration in groundwater (variable shapes)




Notes:

1. Nitrate is reported as Nitrate-Nitrogen
2. milligrams per liter (mg/L)
3. Beaumont WWTP nitrate data starting in 2017 is represented as total inorganic nitrogen (TIN)
4. Henry N. Wochholz RWRF data is represented as monthly averages

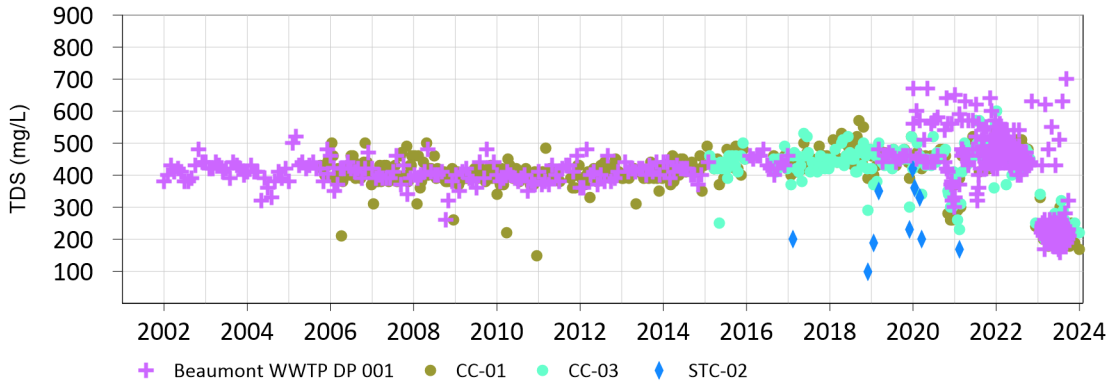
WEST YOST
Water. Engineered.

Author: AK
Date: 20241212
File: Figure 6-3_Nitrate TimeSeries_SWWQ.grf

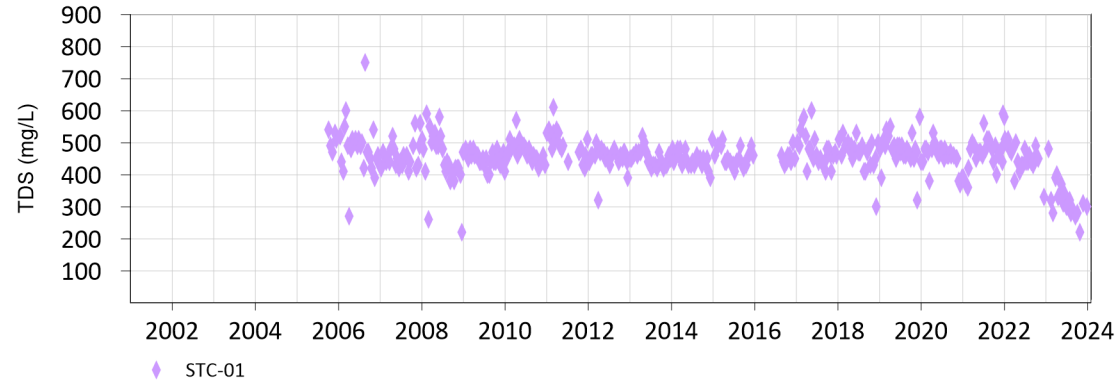
**Nitrate-Nitrogen Concentrations in Surface Water**
**City of Beaumont AMMP**

**Figure 6-3**

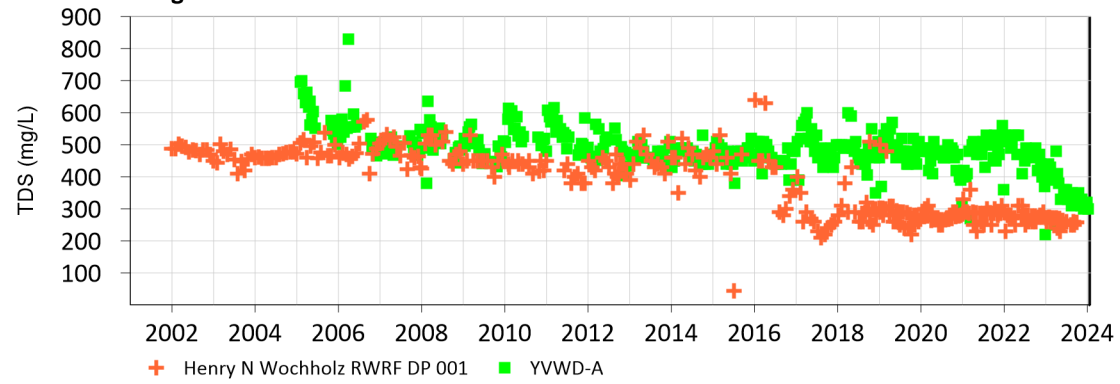
**Cooper's Creek 1 Segment**




**San Timoteo 1 Segment**

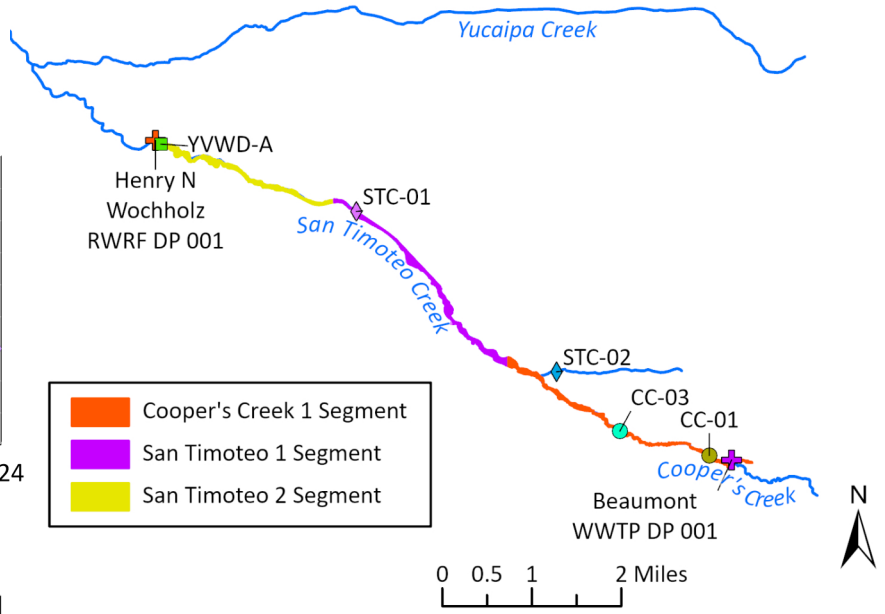



**San Timoteo 2 Segment**




**Legend**

- TDS concentration in groundwater (variable shapes)




Notes:
1. Total Dissolved Solids (TDS)
2. milligrams per liter (mg/L)

WEST YOST
Water. Engineered.

Author: AK
Date: 20241212
File: Figure 6-4_TDS TimeSeries_SWWQ.grf

**TDS Concentrations in Surface Water**
**City of Beaumont AMMP**

**Figure 6-4**

### 6.2.2.2 Total Dissolved Solids (TDS)

Review of the surface water TDS data shown in Figure 6-4 indicates the following for each Study Area Segment:

- **Cooper's Creek 1 Segment –** The Beaumont WWTP DP001 discharges into Cooper's Creek in the upstream portion of this Segment, and surface water stations CC-01 and CC-03 are downstream of the discharge. Overall, the TDS concentration at CC-01 and CC-03 mimic the concentrations of the discharge from Beaumont WWTP DP001. The WWTP concentrations range from 160 to 700 mg/L and have a long-term average of 455 mg/L. TDS concentrations at CC-01 and CC-03 are less and have long-term averages of 416 and 422 mg/L, respectively. Since 2023, when the Beaumont WWTP began full implementation of the RO system, the TDS concentrations decreased from an average of about 450 mg/L to an average of about 240 mg/L. A reduction in the TDS concentrations is also reflected in the downstream sites at CC-01 and CC-03 after 2023.

  STC-02 is located in San Timoteo Creek tributary to Cooper's Creek and is often dry and only sampled after storm events. The available data for STC-02 show TDS concentrations ranged from 170 mg/L to 420 mg/L and averaged 255 mg/L. This site is not influenced by the Beaumont WWTP because it is on a different stream system.
- **San Timoteo 1 Segment –** STC-01 is the sole surface water monitoring location along this Segment. TDS concentrations at STC-01 range from 220 mg/L to 750 mg/L and have a long-term average of 457 mg/L. Concentrations in this segment are slightly higher than the TDS concentrations observed in upstream Segment Cooper's Creek 1. Since 2023, the TDS concentrations at STC-01 decreased from an average of about 460 mg/L to an average of about 320 mg/L, in response to the decrease in TDS concentration from the Beaumont WWTP.
- **San Timoteo 2 Segment –** The surface water monitoring station YVWD-A is just upstream of the YVWD Henry N Wochholz RWRF DP001, both of which are at the downstream end point of this Segment. Generally, TDS concentrations at YVWD-A are higher than the two upstream segments and the Henry N Wochholz RWRF discharge. TDS concentrations at YVWD-A range from 220 mg/L to 750 mg/L and have a long-term average of 457 mg/L. TDS concentrations of the Henry N Wochholz RWRF discharge range from 230 mg/L to 640 mg/L and have a long-term average of 412 mg/L. TDS concentrations were higher in the effluent of the Henry N. Wochholz RWRF DP001 prior to the installation of a RO treatment system that began operating in 2016. Since 2016, TDS concentrations at Henry N. Wochholz RWRF averaged 290 mg/L.

Overall, TDS concentrations slightly increase as you move downstream from the Beaumont WWTP discharge in Cooper's Creek to YVWD-A in San Timoteo Creek just above the Henry N. Wochholz RWRF DP001. Additionally, concentrations in the Cooper's Creek surface water appear to follow the trends of the Beaumont WWTP DP001 TDS concentrations.

## 6.3 Groundwater Levels

The following subsections describe historical groundwater levels and quality in the vicinity of the Study Area.

### *6.3.1 Groundwater Elevation Time Series*

Figure 6-5 is a time series plot of groundwater levels (as elevation) for select monitoring, domestic, and agricultural wells in the Study Area. Figure 6-5 includes a map of the location of the wells within the NDVI analysis Segments and plots the data by Segment from upstream to downstream. The 11 wells included in Figure 6-5 were selected because they have a long historical record, are within the Study Area, and are in close proximity to the creeks. The groundwater level measurements are collected as part of the Maximum Benefit Monitoring Program. Most of the wells have data between 2005 and 2022, while some have a longer period of record dating back as far as the mid-1990's. Since 2015, the monitoring frequency at all the wells is semi-annual. Prior to 2015, water level measurements were more frequent at most of the wells, with either monthly manual measurements or high-frequency transducer readings (e.g. 1-hour to 15-minute intervals). The groundwater elevation data are summarized below.

- **Cooper's Creek 1 Segment –** Since 2005, static groundwater levels at wells OBMW-1, OBMW-2, Ranch Well, Heartland Well, and 335645117024201 ranged from approximately 2,070 to 2,437 feet NAVD88.[10] Groundwater elevations are higher in wells OBMW-1 and OBMW-2 than the Ranch Well indicating a groundwater flow gradient towards the creek. Groundwater elevations are about 100 and 200 feet (ft) lower at the Heartland Well and 335645117024201 compared to Ranch Well indicating a groundwater flow gradient parallel to Cooper's Creek along profile. Groundwater elevations at the Heartland Well show pumping levels can decline up to 300 ft however static groundwater levels have remained relatively stable over the period of record. Overall, groundwater levels remained about the same at OBMW-1, OBMW-2, 335645117024201, and Heartland Well, and increased about 20 ft at Ranch Well. The larger increase in groundwater levels at the Ranch Well could be attributable to a decrease in groundwater pumping at this well.
- **San Timoteo Creek 1 Segment –** Over the available period of record since 1994, groundwater levels at #427, Agri-Empire and #428, Agri-Empire #2 remained stable, ranging from approximately 2,124 to 2,125 ft NAVD88. These wells are screened in the lower aquifer and exhibit artesian conditions— hence groundwater is observed to be at or just below the top of casing. Although these wells are included in this analysis, they are not representative of shallow groundwater conditions along the creeks and a data gap exists for shallow groundwater levels within San Timoteo Creek 1 Segment.
- **San Timoteo Creek 2 Segment –** Over the available period of record since 2006, static groundwater levels at wells Fishermen's Retreat 2, ONE, "1," and YVWD GWMW-4 wells ranged from approximately 1,689 to 1,938 ft NAVD88. Groundwater elevations are higher in YVWD GMWM-4 compared to "1" indicating a groundwater flow gradient toward the creek. Groundwater elevations are lower in YVWD GWMW-4 compared to Fishermen's Retreat 2 indicating a groundwater flow gradient along the channel and moving downstream. Overall, groundwater levels remained about the same at ONE, and decreased by about 5 ft at YVWD

[10] Elevation data is referenced to the North American Vertical Datum of 1988 (NAVD88) in feet.

GWMW-4, by about 8 ft at "1," and by about 34 ft at Fishermen's Retreat 2.[11] The decrease in water level at Fishermen's Retreat 2 could be attributable to increased pumping and less frequent measurements that are not representative of static conditions.

Generally, groundwater elevations are highest in the Cooper's Creek Segment and decrease along Cooper's and San Timoteo Creeks, indicating a groundwater gradient moving downstream. Groundwater elevations have generally remained stable over the period of record with some wells slightly increasing and others slightly decreasing. Wells in proximity of Cooper's and San Timoteo Creeks exhibit slight responses to storm surface water flows with groundwater levels slightly increasing following storms. Ranch Well, Heartland Well, Fishermen's Retreat 2, and One wells all exhibit large ranges in groundwater elevations due to static and pumping depth to water measurements. A data gap exists within San Timoteo 1 Segment for groundwater elevations in the shallow unconfined aquifer.

### *6.3.2 Groundwater Flow System*

Figure 6-6 is a groundwater elevation contour map for spring 2022 which illustrates the current groundwater flow system in the Study Area. To develop the contours, groundwater elevations measured at selected wells in the spring of 2022 were plotted and interpolated across the Study Area to generate a potentiometric surface of the shallow water table. As discussed above, historical groundwater elevations have not fluctuated to a great extent over time. Therefore, the spring 2022 groundwater elevation contour map is representative of the flow system for the period of record of available data back to about 2005. The consistency of groundwater elevations over time, and thus the flow system, is illustrated on Figure 6-5, which is a time history chart of elevations at 11 wells in the Study Area. The groundwater elevation contour map indicates that the direction of groundwater flow through the Study Area is towards the northwest and along the Cooper's and San Timoteo Creek channels from upstream to downstream.

### *6.3.3 Depth to Groundwater*

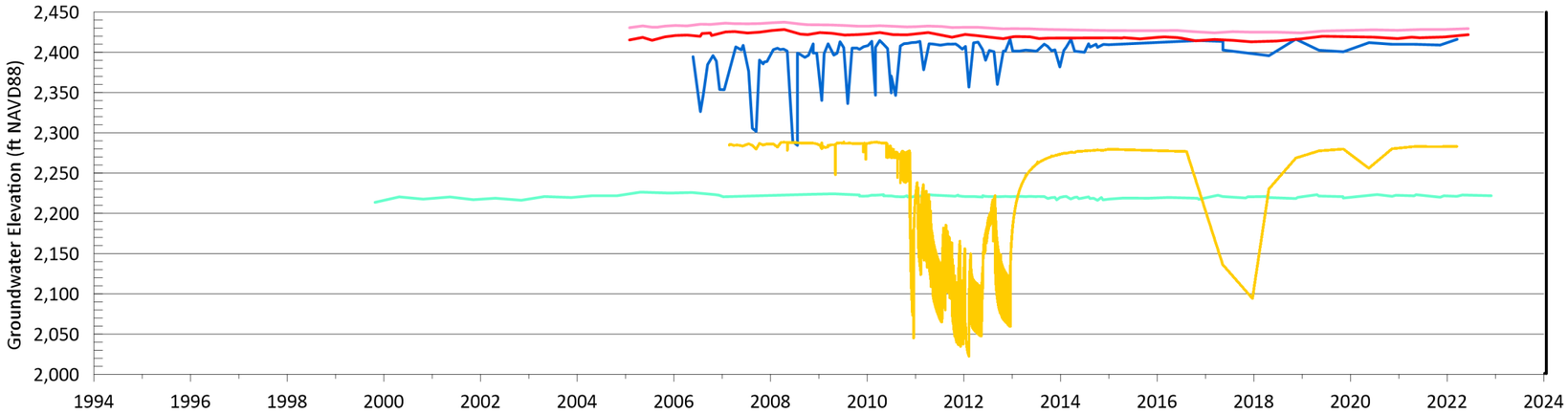
Figure 6-6 shows the Spring 2022 depth to groundwater measurement at each of the wells in the Study Area used to prepare groundwater elevation contours.[12] Depth to groundwater measurements ranged from approximately 23 feet below ground surface (ft bgs) to 123 ft bgs within the Study Area.

Depth to groundwater was evaluated both perpendicular to and along the stream channels. Depths to groundwater along contour lines that are perpendicular to the stream channel indicate that groundwater is shallower near the stream channel and deepens with distance away from the Study Area. For example, at the Ranch Well, which is immediately adjacent to the stream, depth to water is about 23 ft bgs as compared to the OBMW wells away from the stream channel with depths to water of about 90 to 120 ft bgs. Another example pair of wells at the opposite end of the Study Area is YVWD GWMW-4 and well "1."

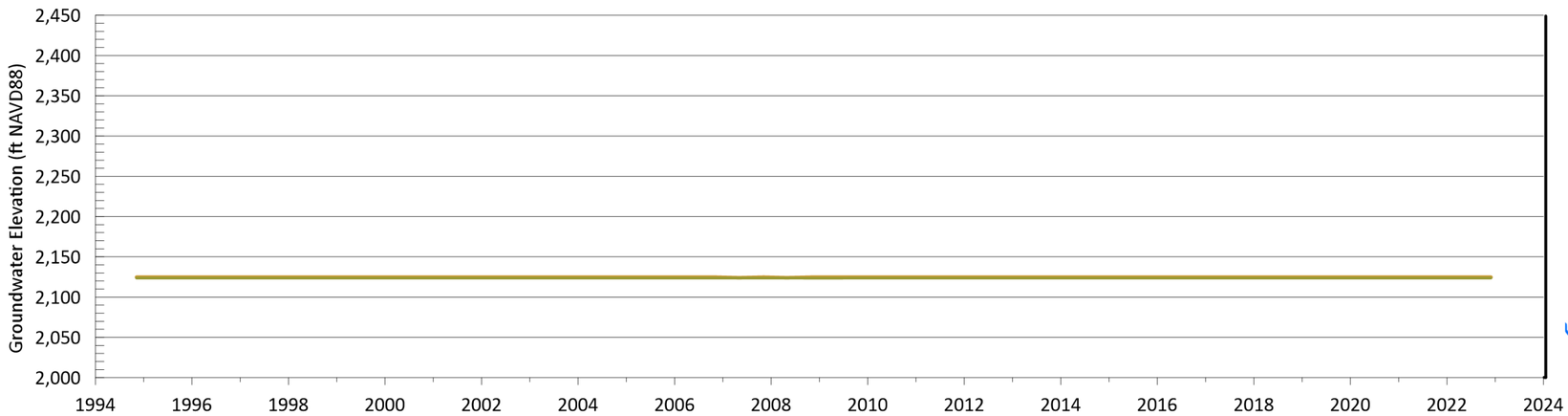
[11] It should be noted that the reported difference in elevation at Fishermen's Retreat 2 is around 78 ft over the period of record, however the groundwater elevations between 2019 and 2022 likely do not represent static water levels. Based on historical trends, we estimated a static level for spring 2022 to be approximately 1900 feet NAVD88.

[12] Depth to water contours were not developed because they would be estimated using the available 10-meter USGS digital elevation model (DEM) of the ground surface. A 10-meter resolution does not provide a high enough resolution needed of the ground surface elevation for these narrow areas along the creek in the Study Area

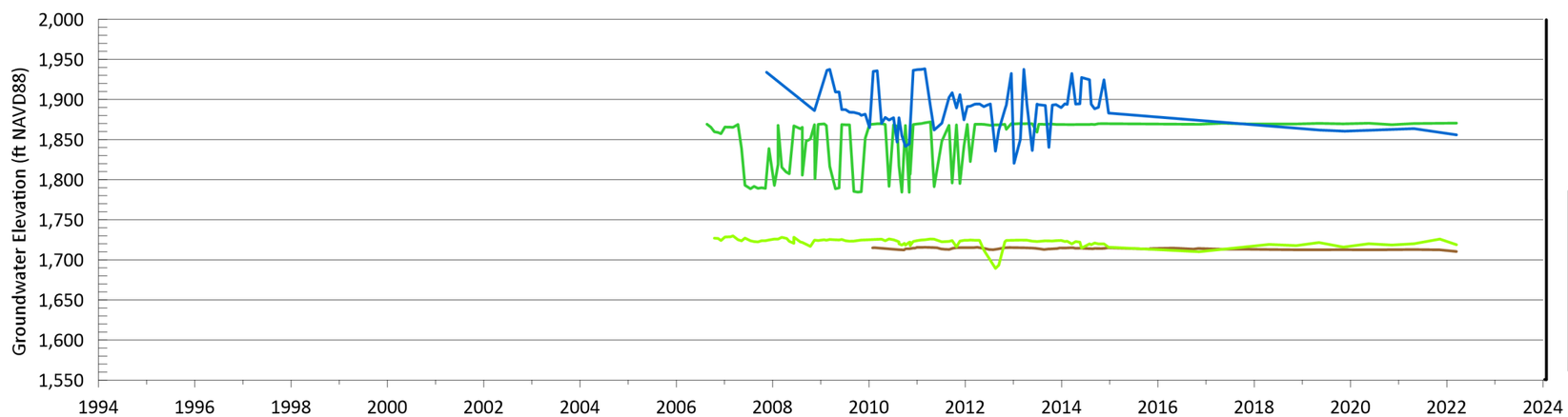
**Cooper's Creek 1 Segment**




**San Timoteo 1 Segment**




**San Timoteo 2 Segment**




**Cooper's Creek 1 Segment**

Groundwater Elevations at Wells (Perforated Interval Depth)

- OBMW-1 (142.8-162.8 ft-bgs)
- OBMW-2 (97.6-117.6 ft-bgs)
- Ranch Well (n/a)
- 335645117024201 (n/a)
- Heartland Well (160-540 ft-bgs)

**San Timoteo 1 Segment**

Groundwater Elevations at Wells (Perforated Interval Depth)

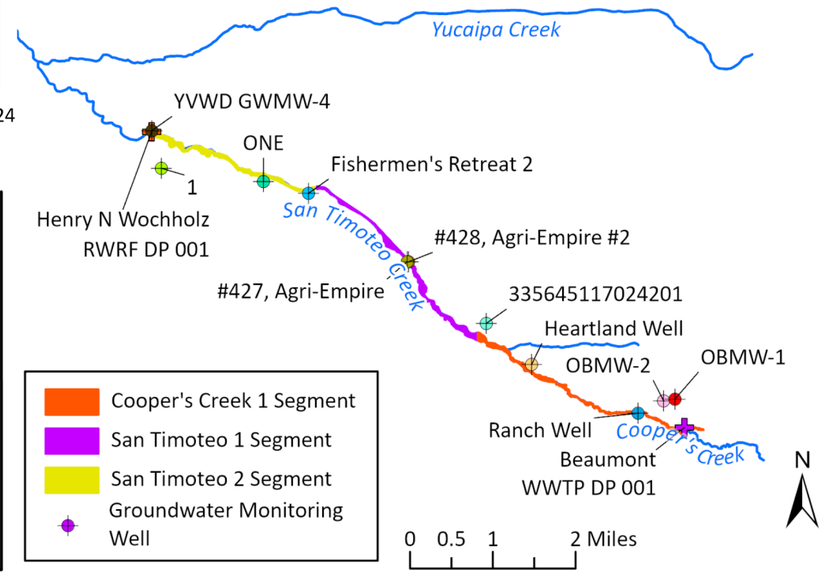
- #427, Agri-Empire (n/a)
- #428, Agri-Empire #2 (n/a)

**San Timoteo 2 Segment**

Groundwater Elevations at Wells (Perforated Interval Depth)

- Fishermen's Retreat 2 (70-615 ft-bgs)
- One (110-590 ft-bgs)
- 1 (140-245 ft-bgs)
- YVWD GWMW-4 (65-80 ft-bgs)

Notes:
1. Feet below ground surface (ft-bgs)
1. Wells listed in order of decreasing elevation downstream
3. #427, Agri-Empire and #428, Agri-Empire #2 are screened in the deeper confined aquifer and exhibit artesian conditions

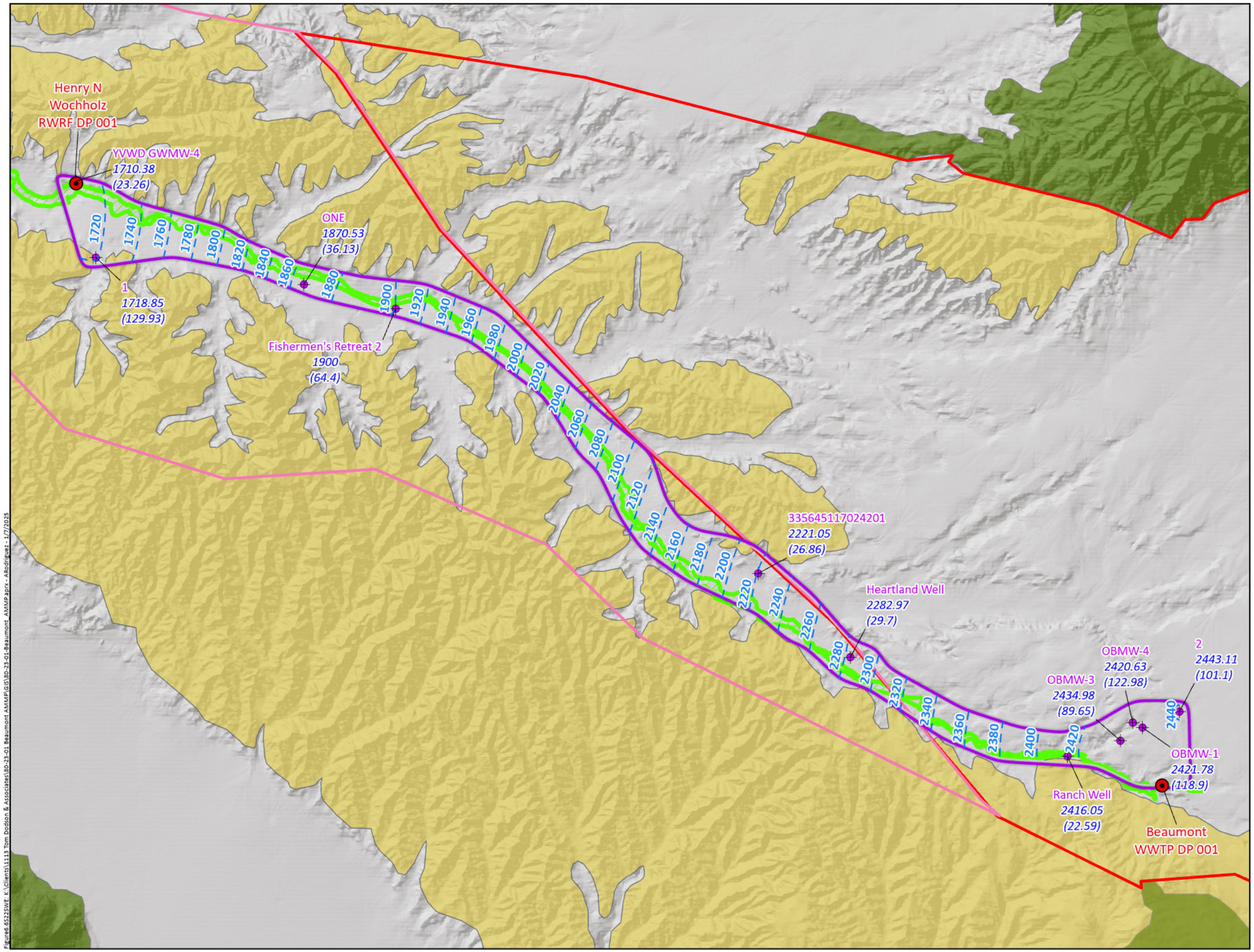



WEST YOST
Water. Engineered.

Author: AK
Date: 20241212
File: Figure 6-5_GWL_3_Segments_r2.grf

**Groundwater Elevations at Select Well Locations**

**Figure 6-5**




OBMW-1
2421.78
(118.9)
Well Identification
Groundwater elevation (ft)
Depth to Water (ft bgs)

2420
20-ft Estimated Groundwater Elevation- Spring 2022

WWTP Discharge Point (active)

Contouring Well

Study Area

San Timoteo GMZ

Beaumont GMZ

Riparian Zone

**Geology**

Water-Bearing Sediments

Unconsolidated to Semi-consolidated Quaternary Alluvium

Consolidated and Semi-Consolidated Formations

San Timoteo Formation

Undifferentiated Pre-Tertiary Igneous and Metamorphic Crystalline Rocks

Notes:
1. Riparian Zone was drawn using tree line.
2. GMZ - groundwater management zone
3. WWTP - wastewater treatment plant
4. Spring 2022 groundwater elevation and depth to water for Fishermen's Retreat 2 well was estimated.
5. Elevation data is referenced to the North American Vertical Datum of 1988 (NAVD 88).

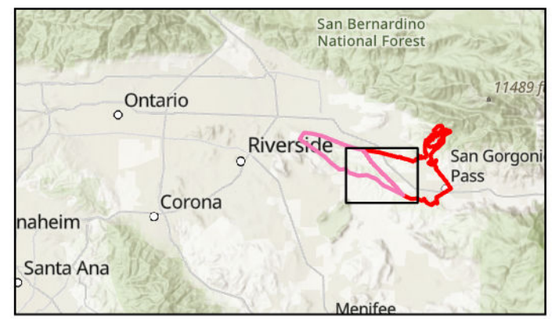



Figure6 652215WE K:\Clients\11113 Tom Dodson & Associates\SD-23-01 Beaumont AMMP\GIS\SD-23-01-Beaumont_AMMP.aprx - ARodriguez - 1/7/2025

Prepared by:
WEST YOST

0 2 Miles
N
0 2,000 4,000 Feet

Prepared for:
**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*
BEAUMONT CALIFORNIA

**Groundwater Elevation**
**Spring 2022**
*City of Beaumont AMMP*
**Figure 6-6**

Along the stream channels, Ranch Well, Heartland Well, 335645117024201, ONE, and YVWD GWMW-4 wells all exhibit shallow depth to waters (within 40 feet of ground surface). Fishermen's Retreat 2 well exhibits a slightly deeper depth to groundwater even though it is adjacent to the San Timoteo Creek. This is an estimated value and all recent data collected suggests that depth to groundwater measurements have been influenced by nearby pumping activities. Based on the monitoring sites, depth to groundwater appears to be shallowest near the outfalls of the Beaumont WWTP DP001 and Henry N. Wochholz RWRF DP001.

## 6.4 Groundwater Quality

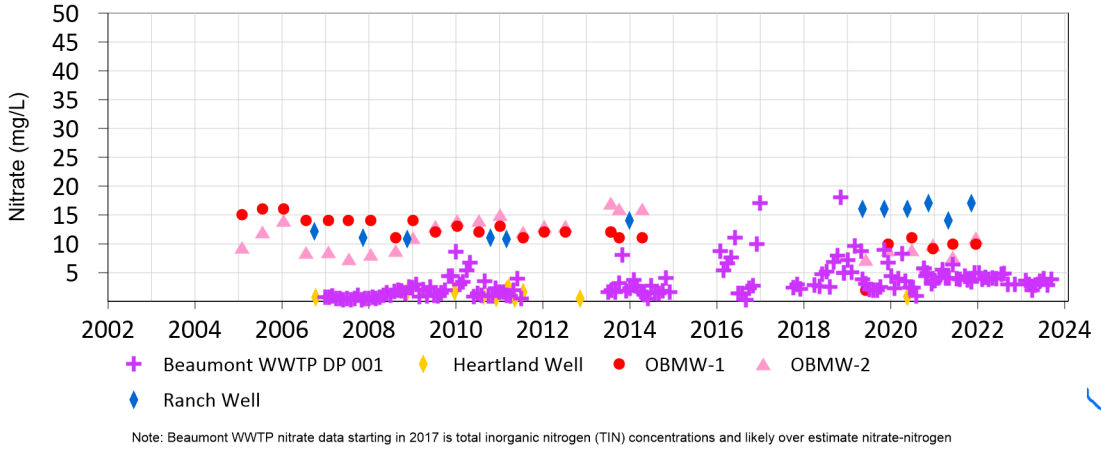
Groundwater quality data is collected at wells throughout the Study Area as part of the Maximum Benefit Monitoring Program. Water quality monitoring is performed at wells at a minimum frequency of once every three years. Twelve wells were selected to characterize groundwater quality in this Report because they have a long historical record, are within the Study Area, and close proximity to the creeks. These wells are a mix of agriculture, monitoring, and domestic wells. Figures 6-7 and 6-8 show the location of the wells relative to the Study Area and NDVI analysis Segments, and time-histories of the nitrate and TDS concentrations for each well, by Segment. Also shown in the time history charts are the nitrate and TDS concentrations of the Beaumont WWTP and Henry N Wochholz RWRF discharges. The period of record of available data is generally from 2005 to 2022, but data is available at some sites as far back as 2001.

### *6.4.1 Nitrate*

Review of the nitrate data on Figure 6-7 indicates the following for each Study Area Segment:

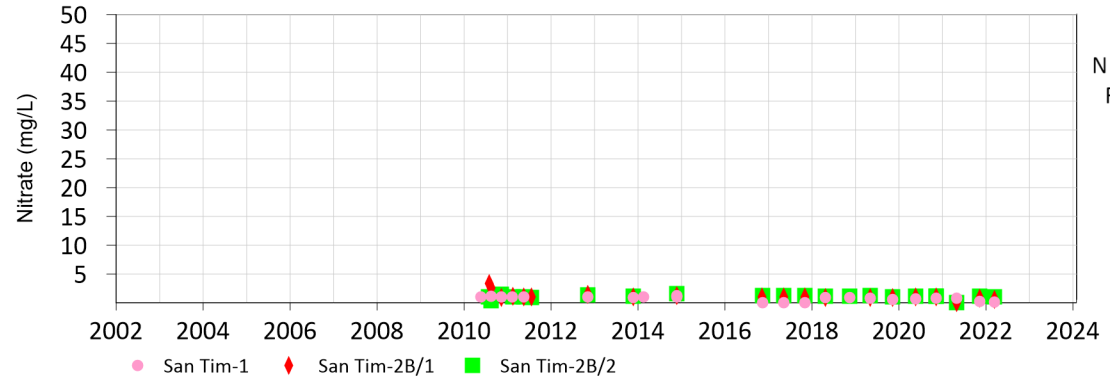
- **Cooper's Creek 1 Segment –**Since 2005, nitrate concentrations ranged from 0.48 mg/L to 17 mg/L at the wells along this Segment. Generally, nitrate concentrations are higher at the wells upstream (OBMW-1, OBMW-2, and Ranch Well) than the downstream well (Heartland Well). No nitrate data is available for 335645117024201. Over the historical period of record, nitrate concentrations increased at Ranch Well and OBMW-2, decreased at OBMW-1, and remained about the same at Heartland Well. Nitrate concentrations were generally lower than the Beaumont WWTP discharge long-term average concentration of 4.2 mg/L at all wells with the exception of Heartland Well.
- **San Timoteo Creek 1 Segment –** Since 2005, nitrate concentrations ranged from non-detect to 3.4 mg/L at the wells along this Segment. Generally, nitrate concentrations are lower when compared to the upstream segment and are higher in the upstream wells (San Tim-2B/1 and San Tim-2B/2) than the downstream well (SanTim-1). Over the historical period, nitrate concentrations decreased at San Tim-2B/1 and SanTim-1 and remained about the same at San Tim-2B/2. Nitrate concentrations at all wells were generally lower than the Beaumont WWTP discharge long-term average concentration of 4.2 mg/L.
- **San Timoteo Creek 2 Segment –**Since 2005, nitrate concentrations ranged from non-detect to 47 mg/L at the wells along this Segment. Generally, nitrate concentrations are lower than the upstream segments with the exception of well "1." Concentrations are highest farther from the channel (well "1") compared to those closer (Fishermen's Retreat 2, ONE, and YVWD GWMW-4). No noticeable trends are apparent within this Segment. With the exception of well "1," nitrate concentrations at all wells were generally lower than the Beaumont WWTP discharge long-term average concentration of 4.2 mg/L.

## Cooper's Creek 1 Segment

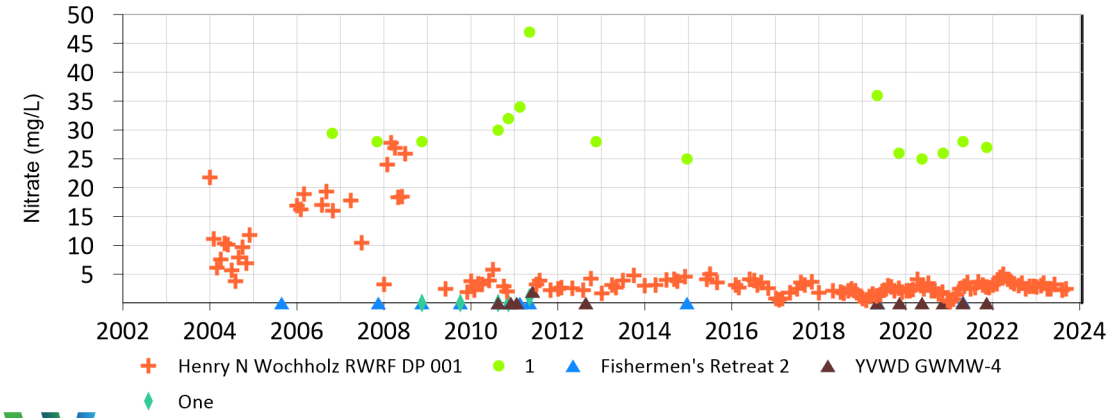



Note: Beaumont WWTP nitrate data starting in 2017 is total inorganic nitrogen (TIN) concentrations and likely over estimate nitrate-nitrogen

## San Timoteo 1 Segment

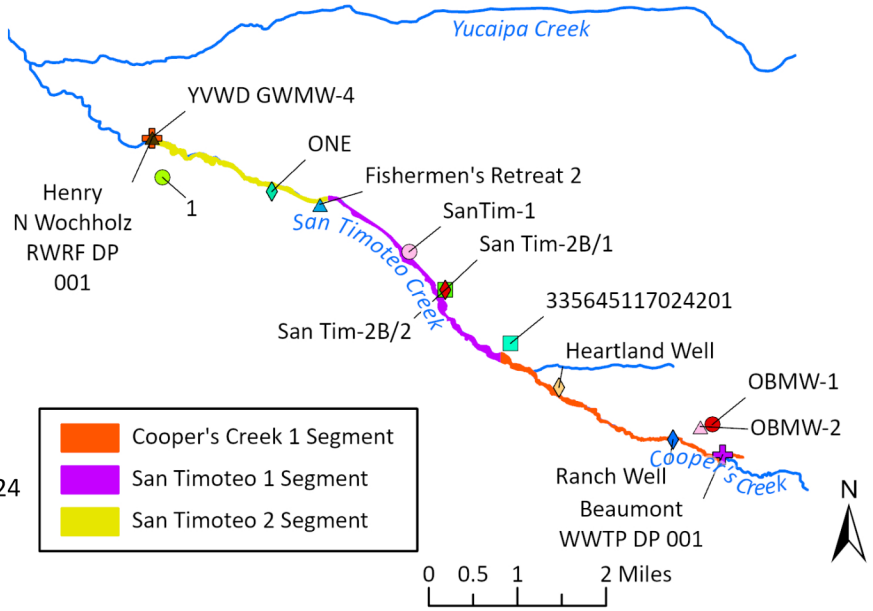



## San Timoteo 2 Segment




## Legend

- Nitrate concentration in groundwater (variable shapes)




Notes:

1. Nitrate is reported as Nitrate-Nitrogen
2. milligrams per liter (mg/L)
3. Beaumont WWTP nitrate data starting in 2017 is represented as total inorganic nitrogen (TIN)
4. Henry N. Wochholz RWRF data is represented as monthly averages

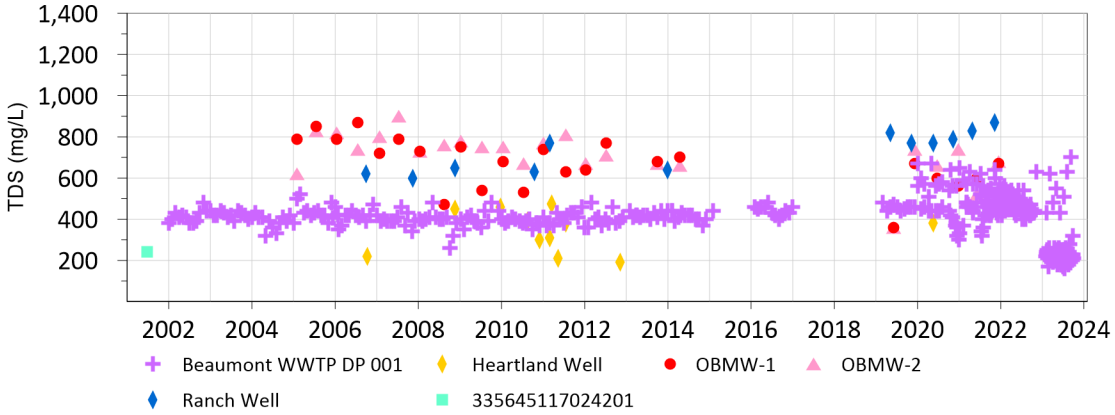
WEST YOST
Water. Engineered.

Author: AK
Date: 20241212
File: Figure 6-7_Nitrate TimeSeries_GWWQ.grf

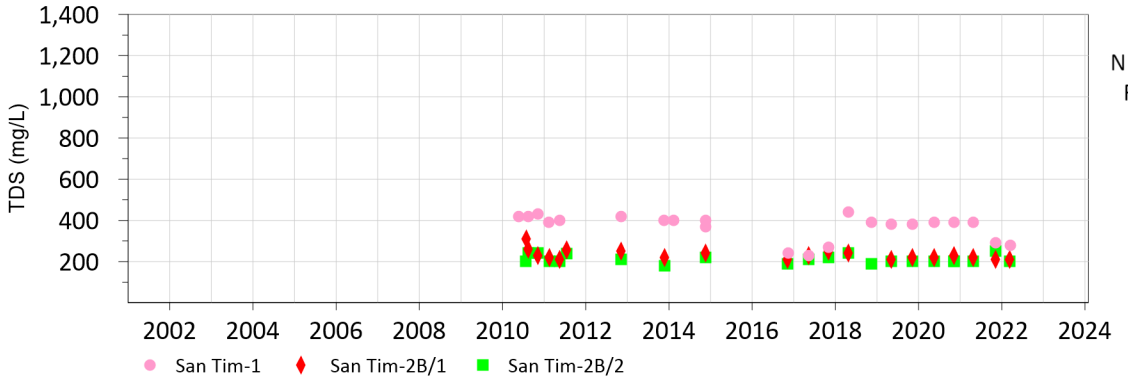
**Nitrate-Nitrogen Concentrations in Groundwater**
**City of Beaumont AMMP**

**Figure 6-7**

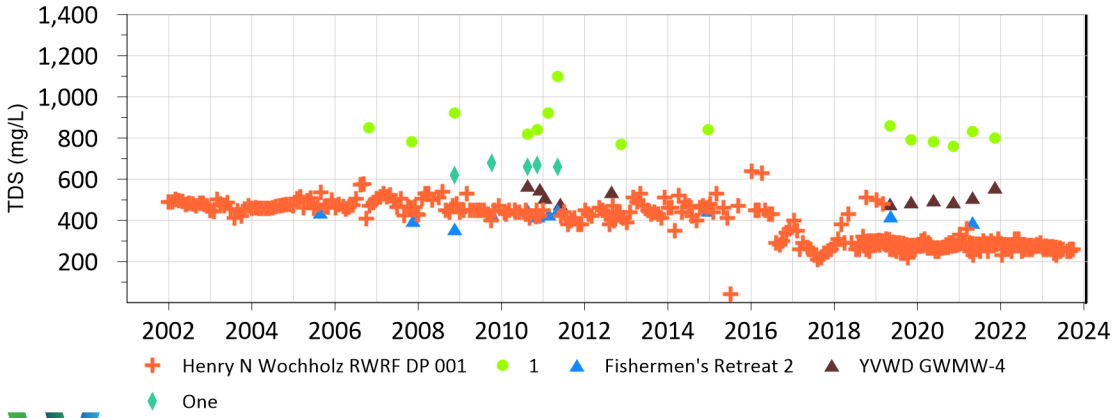
## Cooper's Creek 1 Segment




## San Timoteo 1 Segment

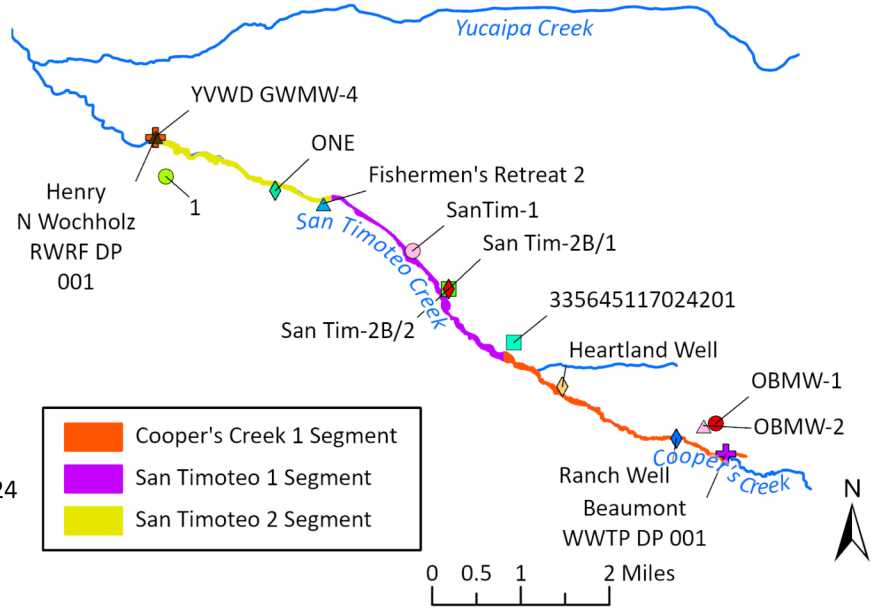



## San Timoteo 2 Segment




## Legend

- TDS concentration in groundwater (variable shapes)




Notes:
1. Total Dissolved Solids (TDS)
2. milligrams per liter (mg/L)

WEST YOST
Water. Engineered.

Author: AK
Date: 20241212
File: Figure 6-8_TDS TimeSeries_GWWQ.grf

**TDS Concentrations in Groundwater**
**City of Beaumont AMMP**

**Figure 6-8**

Generally, nitrate concentrations are lower at monitoring locations adjacent to the creek channels and higher away from the channels. The exception to this is Ranch Well (located adjacent to Cooper's Creek 1 Segment and near the channel). Concentrations here consistently are higher than the Beaumont WWTP discharge long-term average concentration and upgradient wells (OBMW-1 and OBMW-2). The source of this localized nitrate is likely from agricultural practices at the site of the well. Well "1" also exhibits high concentrations of nitrate, which is also likely due to agricultural practices near the well site. Low nitrate surface water recharge of the aquifers via the stream bed is likely the cause for the observed gradient in nitrate concentrations in groundwater with proximity to the creeks.

### *6.4.2 Total Dissolved Solids*

Review of the TDS data on Figure 6-8 indicates the following for each Study Area Segment:

- **Cooper's Creek 1 Segment –** Since 2001, TDS concentrations ranged from 190 mg/L to 900 mg/L at the wells along this Segment. Generally, TDS concentrations are higher at the wells upstream (OBMW-1, OBMW-2, and Ranch Well) than the downstream well (Heartland Well). Only one TDS sample result is available for downstream well 335645117024201. Over the historical period, TDS concentrations increased at Ranch Well, decreased at OBMW-1, and remained about the same at OBMW-2 and Heartland Well. TDS concentrations were generally higher than the Beaumont WWTP discharge long term average concentration of 455 mg/L, with the exception of Heartland Well, which was generally lower.
- **San Timoteo 1 Segment –**Since 2010, TDS concentrations ranged from 180 mg/L to 474 mg/L at the wells along this Segment. Generally, TDS concentrations are lower when compared to the upstream segment and higher at the downstream well within this Segment (SanTim-1) compared to the upstream wells (SanTim-2B/1 and SanTim-2B/2). Over the historical period of record, TDS concentrations remained relatively stable at the wells within the San Timoteo 1 Segment and were generally lower than the Beaumont WWTP discharge long term average concentration of 455 mg/L.
- **San Timoteo 2 Segment –** Since 2007, TDS concentrations ranged from 360 mg/L to 1,100 mg/L at the wells along this Segment. Generally, TDS concentrations are higher than the San Timoteo 1 Segment and comparable to Cooper's Creek 1 Segment. Within the Segment, TDS concentrations are higher at the middle and downstream wells (One and YVWD GWMW-4) and lower at the upstream well (Fishermen's Retreat 2). Well "1" is located off the channel of the creek and exhibits the highest concentrations within the three Segments. Over the historical period of record TDS concentrations remained relatively stable at the wells within the San Timoteo 2 Segment and were generally higher than the Beaumont WWTP discharge long term average concentration of 455 mg/L, with the exception of Fishermen's Retreat 2 which was generally below.

Generally, TDS concentrations are lower at monitoring locations adjacent to the creek channels and higher away from the channels. This is likely due to low-TDS surface water recharging the shallow groundwater via the stream bed. The exception to this is Ranch Well, which is located adjacent to Cooper's Creek 1 Segment and near the channel. Concentrations at Ranch Well are consistently high and likely due to a local agricultural source. Well "1" exhibits the highest concentrations of TDS in all three segments which is located off the channel and adjacent to San Timoteo 2. As discussed above, local agricultural is likely the cause of the high TDS at well "1."

# 7.0 FACTORS THAT IMPACT RIPARIAN HABITAT

This section describes the physical factors that have potential to impact the health and extent of the riparian habitat in the Study Area, and how historical changes in these factors over time relate to observed changes in NDVI. For the AMMP, it will be important to understand the relationship of these physical factors to reductions in Beaumont WWTP discharge to Cooper's Creek to demonstrate if and how reduced discharge is affecting the riparian habitat. The following factors that can impact the Study Area riparian habitat and analyzed for this Report include:

1. Surface water flows
2. Groundwater levels
3. Hydrological impacts to biological resources
4. Other climate factors
5. Wildfires
6. Invasive species and pests

This section also identifies any datasets related to these factors that are unavailable or sparse and that if collected through the AMMP could improve the characterization of the factors that are potentially influencing any observed changes in riparian habitat extent and health over time.

## 7.1 Surface Water Flows

Contributing sources to surface water flow of the Study Area creeks include wastewater discharges, precipitation runoff (storm flows), and potentially rising groundwater. As discussed in Sections 2 and 6, absent wastewater discharges, the creeks in the Study Area would be ephemeral. Thus, a reduction in Beaumont WWTP discharges to Cooper's Creek will likely result in lower surface water flows in Cooper's Creek and San Timoteo Creek.

To evaluate the historical relationship of surface water flow and riparian habitat health, precipitation, surface water flow, and Beaumont WWTP discharge were compared to the historical NDVI. Figures 7-1 through 7-3 are time series charts that compare the following datasets for each NDVI analysis Segment defined in Section 5 of this Report (Cooper's Creek 1, San Timoteo 1, and San Timoteo 2) for the period of 1984 to 2023 (where available):

- Annual precipitation totals (inches) for the San Timoteo Watershed (described in Section 2.3.1). Also shown is the long-term average precipitation and CDFM based on the entire 128-year period of record available from the PRISM dataset of 1895 to 2023.
- Annual (afy) and daily (mgd) Beaumont WWTP discharge at DP001 to Cooper's Creek (described in Section 6.1). Annual records are available since 1989 and daily records since 2006.
- Bi-weekly surface water flow measurements (cfs) collected for the Maximum Benefit Monitoring Program (described in Section 6.2.1). Note that this dataset is not available until 2005, after the volume of Beaumont WWTP discharges began to increase at a high rate.
- Average Growing Season NDVI (described in Section 5.3) for the Focus Areas within each Segment

The analysis of the data is described below for each Segment.

Precipitation (inches)

Cumulative Departure From the Mean Precipitation (CDFM)

Annual Precipitation

Average Annual Precipitation for Water Years 1895-2023 (19.3 inches)

CDFM (inches)

Surface Water Flow

CC-01 (cfs)

CC-03 (cfs)

Beaumont WWTP DP-001 Daily Discharge (Daily - cfs)

Beaumont WWTP DP-001 Discharge (Annual - mgd)

Average Growing Season NDVI
(Mann-Kendall Trend Result for 1984-2023; 1984-2003; 2004-2023)

FA01 (increasing; increasing; increasing)

FA02 (increasing; no trend; increasing)

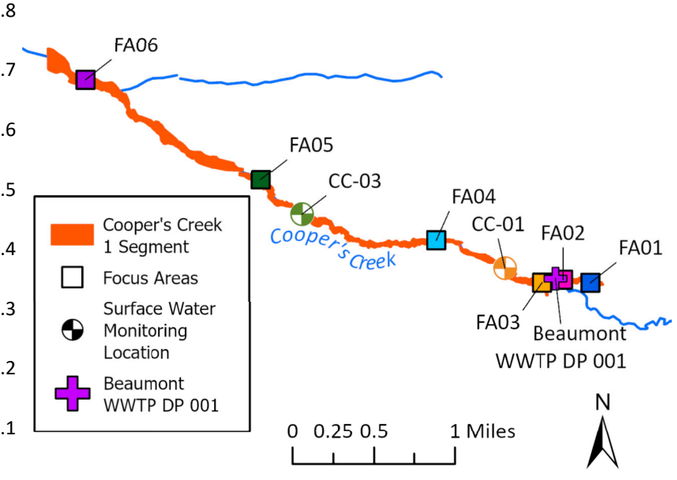
FA03 (increasing; increasing; increasing)

FA04 (increasing; no trend; increasing)

FA05 (increasing; no trend; increasing)

FA06 (increasing; no trend; increasing)

Cooper's Creek 1 (increasing; increasing; increasing)




**Precipitation, Surface Water Flow, and WWTP Discharge versus NDVI**

*Cooper's Creek 1 Segment for 1983-2023*

**City of Beaumont AMMP**

**Figure 7-1**

WEST YOST
Water. Engineered.

Author: AK
Date: 20241212
File: Figure 7-1 Discharge GWLs StudyArea-A v2.grf

### *7.1.1 Cooper's Creek 1 Segment*

Based on the interpretations previously described in Sections 2, 5, and 6, and integrated together in Figure 7-1, the relationship of surface flows and Beaumont WWTP discharges in the Cooper's Creek 1 Segment appears as follows:

- Since the start of the available record in 2005, surface flow at CC-01 generally mimics the daily discharge at Beaumont DP001 and increases as discharge increases from the plant. It is important to note that the bi-weekly measurements are an instantaneous measurement in time, whereas the DP001 data is the average flow rate over a 24-hour period. Thus, differences between the two sites could be attributable to daily fluctuations in discharge rates. Peak deviations from the discharge rate occur during precipitation events.
- Since the start of the available record in 2013, surface flow at CC-03 generally mimics the daily discharge at DP001 and CC-01 and also shows peak deviations from the discharge rate occur during precipitation events. The flow is generally less than at CC-01 indicating that the reach from CC-01 to CC-03 is a losing reach, such that flow is being lost as infiltration to groundwater and/or riparian vegetation uptake.
- Based on the available surface water flow data, it is not possible to determine how much the surface flow increased due to the post-2004 increase in Beaumont WWTP discharges.
- The CDFM illustrates that there has been a long-term dry period in the Study Area that has persisted since about 1999 as shown by the downward trending CDFM. The dryness of the climate does not appear to have an impact on surface flows given they have remained relatively consistent with the DP001 discharges. Thus, indicating that the Beaumont WWTP discharge is the primary driver of year-round surface flow in the Study Area and not precipitation.
- All NDVI Focus Areas have statistically increasing trends over the entire 1984 to 2023 period of record. However, only two of the sites show a statistically increasing trend for the 1984 to 2003 period: FA01 and FA03. The remaining four areas—FA02, FA04, FA05, and FA05—had "no trend" in this early half of the data record, indicating stable NDVI estimates from 1984 to 2003. This suggests that Beaumont WWTP flows only began to significantly improve riparian habitat extent beyond the immediate vicinity of DP001 at the post-2004 increased discharge rates.
- Since 2004, the NDVI of all Focus Areas had a statistically increasing trend. These increases occurred at the same time that the discharge from Beaumont WWTP was increasing. The largest increase in NDVI within this time period was at FA03, which is located immediately downstream of the Beaumont WWTP DP001, indicating a direct relationship between Beaumont WWTP discharges and riparian habitat health and extent as measured by NDVI.
- The two Focus Areas with the greatest increase in NDVI since 1984 are FA03 and FA06. Both had an NDVI of less than 0.3 in 1984 and increased to a maximum of about 0.60 and 0.70, respectively, around 2015/2026. While it is clear that the Beaumont WWTP is the direct cause of the significantly increased NDVI at FA03, there may be other factors supporting riparian habitat at FA06, such as increased surface flow resulting from urban development. However, absent historical records of surface water flow prior to 2005, it is difficult to make any conclusion about the relative impact each factor could have had on surface flow and thus riparian health at FA06.

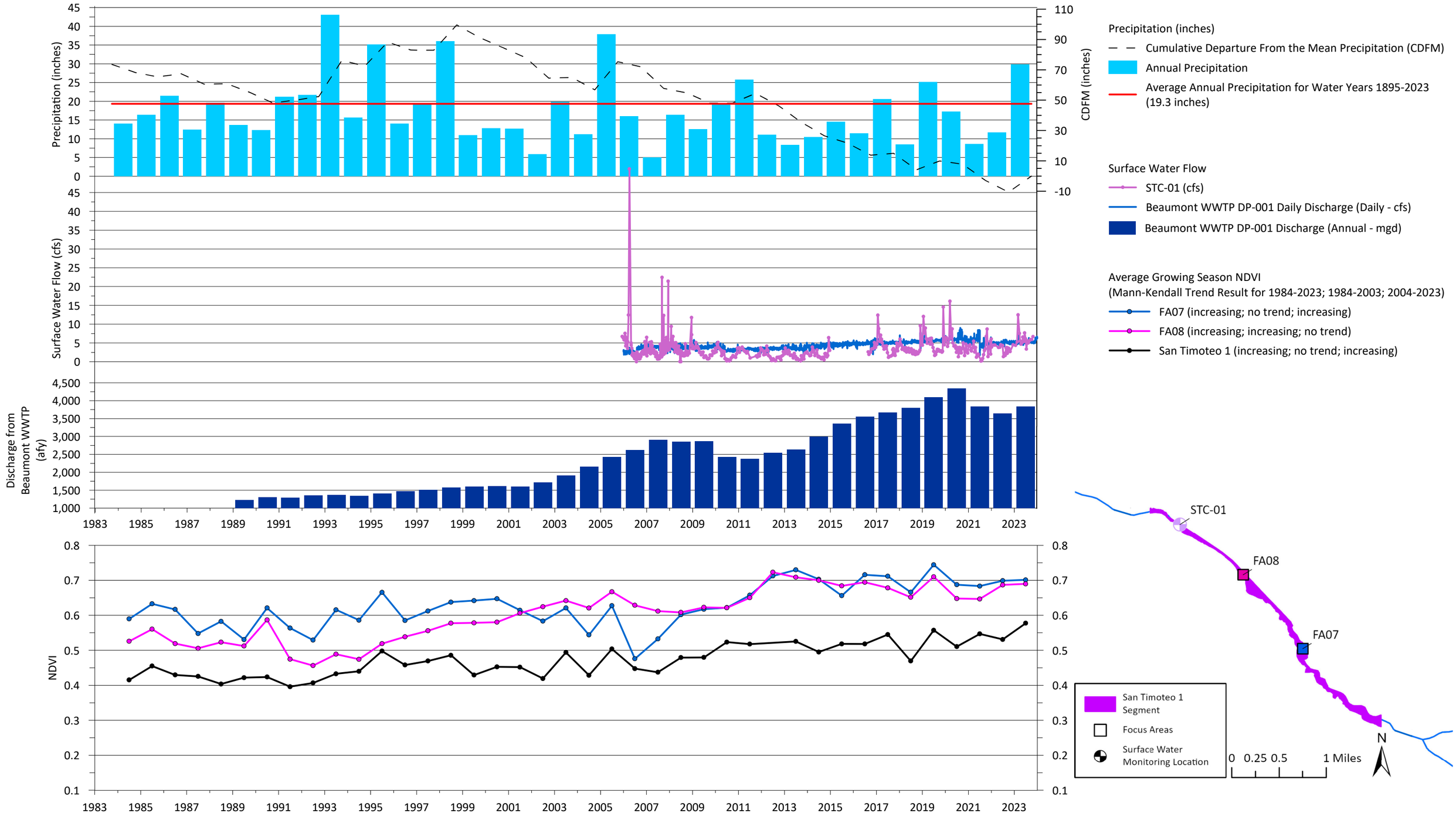
- FA05 was the only Focus Area to have robust and consistent riparian habitat health with an NDVI ranging from about 0.6 to 0.7 prior to about 2007. All other sites were below 0.5 prior to 2007. This suggests that Beaumont WWTP flows are not the primary source of water supporting riparian habitat at FA05.
- The Beaumont WWTP annual discharge decreased by approximately 500 af over the 2020 to 2023 period. There was no concurrent decrease in NDVI at the Focus Areas over this period, except for a decrease of less than 0.05 at FA03 and FA05 from 2022 and 2023. Though it may take more time for an impact to the riparian health to manifest, the data initially suggest that the recent decreases in discharge did not negatively impact riparian habitat health in the Study Area.

The observed responses of the riparian habitat health in Cooper's Creek 1 Segment indicate there is a positive relationship between riparian habitat health and increased surface water flows, and more specifically to Beaumont WWTP discharges that appear to be the main contributor of flow in the Study Area.

### *7.1.2 San Timoteo 1 Segment*

Based on the interpretations previously described in Sections 2, 5, 6, 7.1.1., and integrated together on Figure 7-2, the relationship of surface flows and Beaumont WWTP discharges in the San Timoteo 1 Segment appears as follows:

- Since the start of the available record in 2005, surface water flow at STC-01 generally mimics the daily discharge at Beaumont WWTP DP001 and the upstream surface water monitoring locations (CC-01 and CC-03). The streamflow record shows peak deviations from the discharge rate occur during precipitation events, as well as additional 'trough' deviations from inter-storm periods. The flow is generally less than the upstream stations, indicating that the reach between CC-03 and STC-01 is a losing reach, such that flow is being lost to infiltration and/or riparian vegetation uptake.
- Based on the available surface water flow data, it is not possible to determine how much the surface water flow increased due to the post-2004 increased in Beaumont WWTP discharges.
- The CDFM illustrates that there has been a long-term dry period in the Study Area that has persisted since about 1999 as shown by the downward trending CDFM. They dryness of the climate does not appear to have an impact on surface flows given they have remained relatively consistent with the DP001 discharges. Thus, indicating that the Beaumont WWTP discharge is the primary driver of year-round surface flow in the Study Area and not precipitation.
- All NDVI Focus Areas have statistically increasing trends over the entire 1984 to 2023 period of record. However, only one of the sites showed an increasing trend for the 1984 to 2003 period: FA08. The remaining Focus Area, FA07, had "no trend" in this early half of the data record, indicating stable NDVI estimates from 1984 to 2003. This suggests that Beaumont WWTP flows only began to improve riparian habitat extent beyond the immediate vicinity of DP001 at the post-2004 increased discharge rates.
- Since 2004, the NDVI of the upstream Focus Area (FA07) had a statistically increasing trend, while the downstream Focus Area (FA08) had "no trend." The trends occurred while the discharge from Beaumont WWTP was increasing.




**Precipitation, Surface Water Flow, and WWTP Discharge versus NDVI**
*San Timoteo 1 Segment for 1983-2023*
**City of Beaumont AMMP**

**Figure 7-2**

WEST YOST
Water. Engineered.

Author: AK
Date: 20241216
File: Figure 7-2 Discharge GWLs StudyArea-B v2.grf

- Increases in NDVI at both Focus Areas (FA07 and FA08) since 1984 are generally lower when compared to Cooper's Creek 1 Segment. Both had an NDVI of less than 0.6 in 1984 and increased to about 0.70 and 0.69, respectively, by 2023. Because of the higher initial value of NDVI and lower response to Beaumont WWTP discharges, there may be other factors supporting riparian habitat at these Focus Areas, such as increased surface flow resulting from urban development. However, absent historical records of surface water flow prior to 2005, it is difficult to make any conclusion about the relative impact each factor could have had on surface flow and thus riparian health at FA07 and FA08.
- The Beaumont WWTP annual discharge decreased by approximately 500 af over the 2020 to 2023 period. There was no concurrent decrease in NDVI at the Focus Areas over this period. Though it may take more time for an impact to the riparian health to manifest, the data initially suggest that the recent decreases in discharge did not negatively impact riparian habitat health in the Study Area.

The observed responses of the riparian habitat health in San Timoteo 1 Segment indicate there is a positive relationship between riparian habitat health and increased surface water flows, and more specifically to Beaumont WWTP discharges that appear to be the main contributor of flow in the Study Area. However, the response in this Segment is noticeably less than that of Cooper's Creek 1, indicating less of an influence from Beaumont WWTP discharges.

### *7.1.3 San Timoteo 2 Segment*

Figure 7-3 has the added dataset of the Henry N. Wochholz RWRF discharge that occurs at the downstream end of the Segment. Based on the interpretations previously described in Sections 2, 5, 6, 7.1.1, and integrated together in Figure 7-3, the relationship of surface flows and Beaumont WWTP discharges in the San Timoteo 1 Segment appears as follows:

- Since the start of the available record in 2005, surface water flow at YVWD-A generally mimics the daily discharge at Beaumont WWTP DP001 and the upstream surface water monitoring locations (STC-01, CC-01, and CC-03). The streamflow record shows peak deviations from the discharge rate occur during precipitation events, as well as additional 'trough' deviations from inter-storm periods. The flow is generally less than the upstream stations, indicating that the reach between STC-01 and YVWD-A is a losing reach, such that flow is being lost to infiltration and/or riparian vegetation uptake.
- Based on the available surface water flow data, it is not possible to determine how much the surface water flow increased due to the post-2004 increased in Beaumont WWTP discharges.
- The CDFM illustrates that there has been a long-term dry period in the Study Area that has persisted since about 1999 as shown by the downward trending CDFM. They dryness of the climate does not appear to have an impact on surface flows given they have remained relatively consistent with the DP001 discharges. Thus, indicating that the Beaumont WWTP discharge is the primary driver of year-round surface flow in the Study Area and not precipitation.
- All NDVI Focus Areas had statistically increasing trends over the entire 1984 to 2023 period of record. However, only one of the sites showed an increasing trend for the 1984 to 2003 period: FA10. The remaining focus area, FA09, had a decreasing trend in this early half of the data record, indicating decreasing NDVI estimates from 1984 to 2003. This suggests that Beaumont WWTP flows only began to improve riparian habitat extent beyond the immediate vicinity of DP001 at the post-2004 increased discharge rates.

Precipitation (inches)

Cumulative Departure From the Mean Precipitation (CDFM)

Annual Precipitation

Average Annual Precipitation for Water Years 1895-2023 (19.3 inches)

CDFM (inches)

Surface Water Flow

Henry N Wochholz Daily Discharge (cfs)

YVWD-A (cfs)

Beaumont WWTP DP-001 Daily Discharge (Daily - cfs)

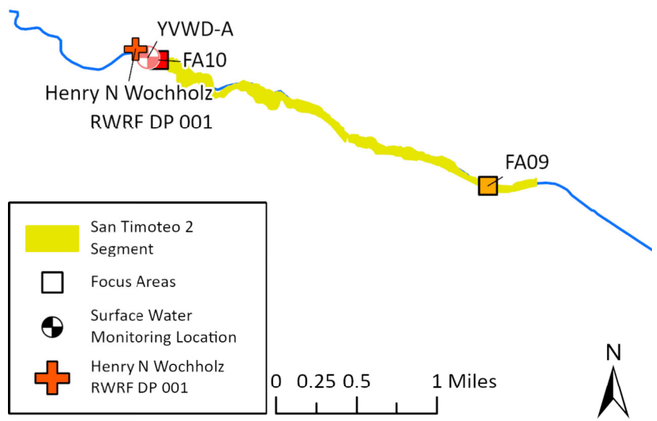
Beaumont WWTP DP-001 Discharge (Annual - mgd)

Average Growing Season NDVI
(Mann-Kendall Trend Result for 1984-2023; 1984-2003; 2004-2023)

FA09 (increasing; decreasing; increasing)

FA10 (increasing; increasing; no trend)

San Timoteo 2 (no trend; no trend; increasing)




**Precipitation, Surface Water Flow, and WWTP Discharge versus NDVI**

*San Timoteo 2 Segment for 1983-2023*

**City of Beaumont AMMP**

**Figure 7-3**

WEST YOST Water. Engineered.

Author: AK
Date: 20241216
File: Figure 7-3_Discharge_GWLs_StudyArea-C_v2.grf

- Since 2004, the NDVI of the upstream Focus Area (FA09) had a statistically increasing trend, while the downstream Focus Area (FA10) had "no trend." The trends occurred while the discharge from Beaumont WWTP was increasing.
- Increases in NDVI at both Focus Areas (FA09 and FA10) since 1984 are generally lower when compared to Cooper's Creek 1 Segment and comparable when compared to San Timoteo 1 Segment. Both had an NDVI of less than 0.6 in 1984 and increased to about 0.70 and 0.62, respectively, by 2023. Because of the higher initial value of NDVI and lower response to Beaumont WWTP discharges, there may be other factors supporting riparian habitat at these Focus Areas, such as increased surface flow resulting from urban development. However, absent historical records of surface water flow prior to 2005, it is difficult to make any conclusion about the relative impact each factor could have had on surface flow and thus riparian health at FA09 and FA10.
- The Beaumont WWTP annual discharge decreased by approximately 500 af over the 2020 to 2023 period. There was no concurrent decrease in NDVI at the Focus Areas over this period. Though it may take more time for an impact to the riparian health to manifest, the data initially suggest that the recent decreases in discharge did not negatively impact riparian habitat health in the Study Area.

The observed responses of the riparian habitat health in San Timoteo 2 Segment indicate there is a positive relationship between riparian habitat health and increased surface water flows, and more specifically to Beaumont WWTP discharges that appear to be the main contributor of flow in the Study Area. However, the response in this Segment is noticeably less than that of Cooper's Creek 1, indicating less of an influence from Beaumont WWTP discharges.

### *7.1.4 Summary*

Based on the data and observations across all Segments in the Study Area, Beaumont WWTP discharges are the primary source of surface water flow in the Study Area. Given that surface water flow has a direct and important relationship to the extent and health of riparian habitat in the Study Area, reductions in discharge have the potential to negatively impact the extent and health of riparian habitat in the Study Area.

## 7.2 Groundwater Levels

Groundwater is likely a source of water to riparian vegetation in the Study Area whose root depths extend to the depth of the water table. Groundwater levels are primarily impacted by pumping and recharge. There are an estimated 10 pumping wells within or immediately adjacent to the Study Area. Contributing sources to groundwater recharge in the Study Area are infiltration of surface water flow in Cooper's and San Timoteo Creeks, deep percolation of precipitation and applied water, and groundwater underflow from outside the Study Area. When groundwater levels are high, groundwater can rise and become surface water flow. It is likely that within the Study Area there are both reaches with rising groundwater and reaches with infiltrating surface water.

A reduction in Beaumont WWTP discharges to Cooper's Creek, which would reduce surface flow, could result in reduced recharge and subsequent lowering of groundwater levels in the vicinity of streambed reaches with infiltrating surface water. Declining groundwater levels have potential to impact the extent and quality of riparian vegetation that relies on groundwater.

To evaluate the historical relationship of groundwater levels and riparian habitat extent and health, groundwater levels and Beaumont WWTP discharges were compared to historical NDVI. Figures 7-4 through 7-6 are time series charts that compare the following datasets for each NDVI analysis Segment for the period of 1984 to 2023 (where available):

- Groundwater elevations for wells in the Study Area in close proximity to the riparian habitat along the creeks (described in Section 6.3.1). At most wells, the data record starts in 2005, but a few wells have data back to the 1990s.
- Annual (afy) and daily (cfs) Beaumont WWTP discharge at DP001 to Cooper's Creek (described in Section 6.1). Annual records are available since 1989 and daily records since 2006.
- Average Growing Season NDVI (described in Section 5.3) for the Focus Areas within each Segment.

The analysis of the data is described below for each Segment.

### *7.2.1 Cooper's Creek 1 Segment*

Based on the interpretations previously described in Sections 2, 5, 6, 7.1 and integrated together on Figure 7-4, the relationship of groundwater levels and Beaumont WWTP discharges appears as follows:

- As described in Section 6.3.1 and shown in Figure 7-4, groundwater levels have generally been stable since the early 2000s along Cooper's Creek 1 Segment.
- Even as Beaumont WWTP discharge (and presumable surface flow) increased after 2004, groundwater levels remained stable, indicating that the groundwater system could not accept additional streambed recharge. This suggests that the groundwater basin is at capacity or "full" within this Segment of the Study Area. A full groundwater condition could result in rising groundwater conditions within the creek channel within or downstream of this Segment.
- Given the stable groundwater levels over the last 20 plus years, it is unlikely that groundwater levels have a direct impact on the increasing trend observed in the Average Growing Season NDVI of all Focus Areas in the Segment.

### *7.2.2 San Timoteo 1 Segment*

Based on the physical setting and data interpretations previously described in Sections 2, 5, 6, 7.1 and integrated together in Figure 7-5, the relationship of groundwater levels and Beaumont WWTP discharges appears as follows in the San Timoteo 1:

- As described in Section 6.3.1 and shown in Figure 7-5, groundwater levels have generally been stable since the early 2000s along San Timoteo 1 Segment. However, it should be noted that wells in this Segment are screened in the deeper aquifer and not representative of trends in shallow groundwater. Shallow groundwater levels in this Segment are a data gap that is discussed in a subsequent section.
- Even as Beaumont WWTP discharge (and presumable surface flow) increased after 2004, groundwater levels remained stable, indicating that the groundwater system could not accept additional streambed recharge. This suggests that the groundwater basin is at capacity or "full" within this Segment of the Study Area. A full groundwater condition could

result in rising groundwater conditions within the creek channel within or downstream of this Segment.

- Given the stable groundwater levels over the last 20 plus years, it is unlikely that groundwater levels have a direct impact on the increasing trend and no trend observed in the Average Growing Season NDVI of the two Focus Areas in the Segment.

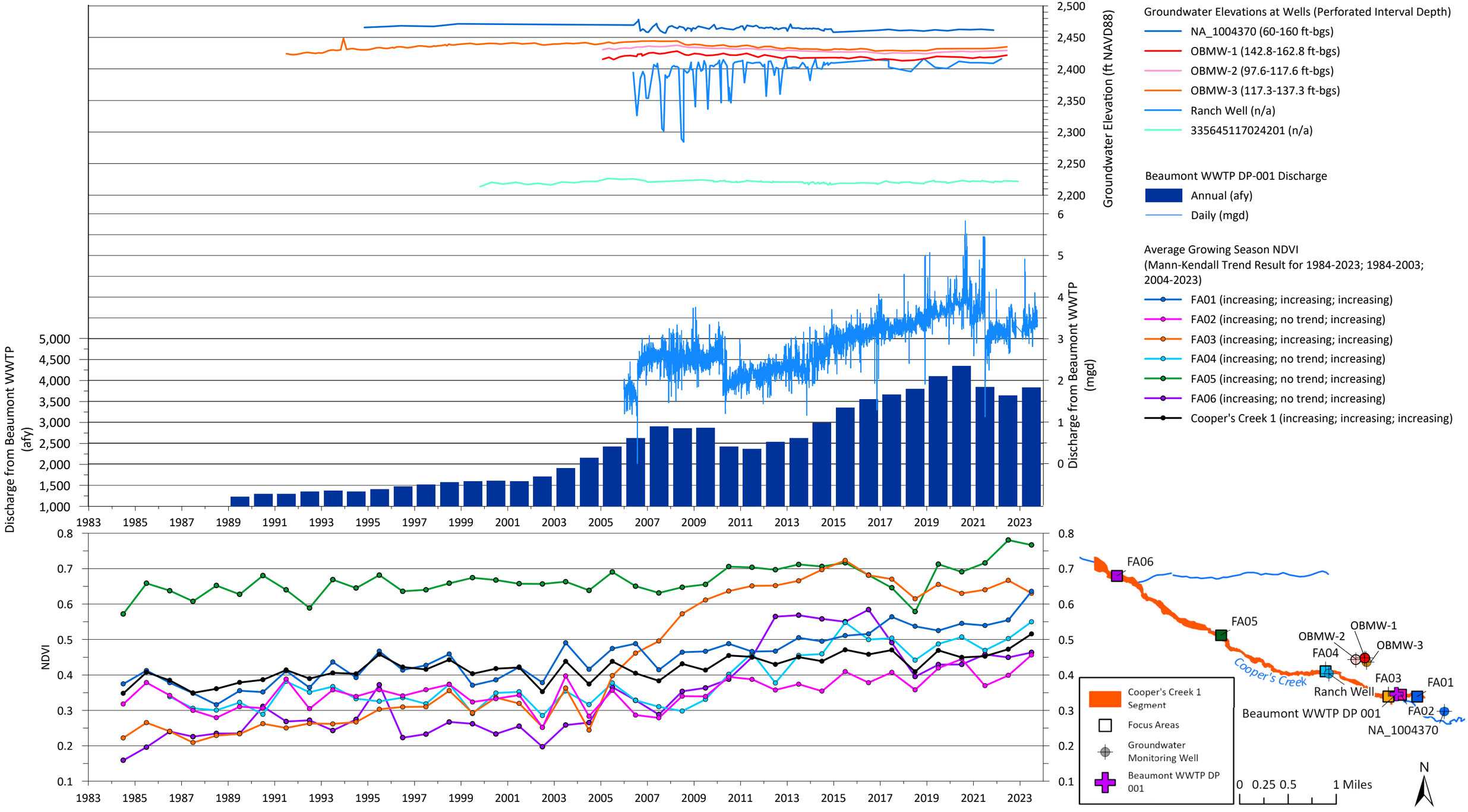
### *7.2.3 San Timoteo 2 Segment*

Figure 7-6 has the added dataset of the Henry N. Wochholz RWRF discharge that occurs at the downstream end of the Segment. Based on the physical setting and data interpretations previously described in Sections 2, 5, 6, 7.1 and integrated together in Figure 7-6, the relationship of groundwater levels and Beaumont WWTP discharges appears as follows in the San Timoteo 2 Segment:

- As described in Section 6.3.1 and shown in Figure 7-6, groundwater levels have generally been stable since the early 2000s along San Timoteo 2 Segment.
- Even as Beaumont WWTP discharge (and presumable surface flow) increased after 2004, groundwater levels remained stable, indicating that the groundwater system could not accept additional streambed recharge. This suggests that the groundwater basin is at capacity or "full" within this Segment of the Study Area. A full groundwater condition could result in rising groundwater conditions within the creek channel within or downstream of this Segment.
- Discharges at Henry N. Wochholz RWRF DP001, located in the vicinity of YVWD GWMW-4, has increased over the period of record. Even with the increased discharge and potential for increased recharge to groundwater beneath the discharge point, groundwater levels have remained relatively stable over the period of record.
- Given the stable groundwater levels over the last 20 plus years, it is unlikely that groundwater levels have a direct impact on the increasing trend and no trend observed in the Average Growing Season NDVI of the two Focus Areas in the Segment.

### *7.2.4 Summary*

Based on the data and observations across all Segments in the Study Area, Beaumont WWTP discharges assist in recharging the groundwater in the Study Area through surface water flow and streambed infiltration. However, the groundwater aquifers appear to be near or at capacity and therefore exhibit stable groundwater elevations over time. Although groundwater might not have a direct impact on riparian habitat health, reductions in Beaumont WWTP discharges might indirectly decrease a source of groundwater recharge through the reduction of surface water flow within the Study Area and therefore has the potential to negatively impact the extent and health of the riparian habitat.




**Groundwater Levels and WWTP Discharge versus NDVI**

*Cooper's Creek 1 Segment for 1983-2023*

**City of Beaumont AMMP**

**Figure 7-4**

WEST YOST
Water. Engineered.

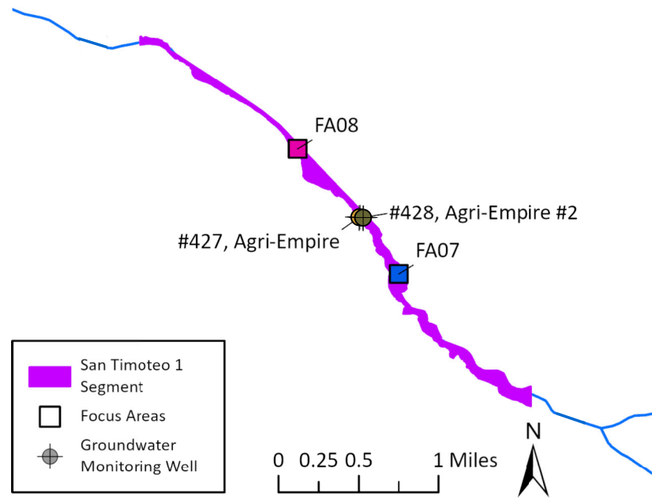
Author: AK
Date: 20241216
File: Figure 7-4_Discharge_GWLs_StudyArea-A.grf

Groundwater Elevations at Wells (Perforated Interval Depth)
#427, Agri-Empire (n/a)
#428, Agri-Empire #2 (n/a)

Beaumont WWTP DP-001 Discharge
Annual (afy)
Daily (mgd)

Average Growing Season NDVI
(Mann-Kendall Trend Result for 1984-2023; 1984-2003; 2004-2023)
FA07 (increasing; no trend; increasing)
FA08 (increasing; increasing; no trend)
San Timoteo 1 (increasing; no trend; increasing)

Discharge from Beaumont WWTP (afy)
Groundwater Elevation (ft NAVD88)
Discharge from Beaumont WWTP (mgd)
NDVI




**Groundwater Levels and WWTP Discharge versus NDVI**
*San Timoteo 1 Segment for 1983-2023*
**City of Beaumont AMMP**

**Figure 7-5**

WEST YOST Water. Engineered.

Author: AK
Date: 20241216
File: Figure 7-5_Discharge_GWLs_StudyArea-B.grf

Groundwater Elevation (ft NAVD88)

Discharge from Beaumont WWTP (afy)

Discharge from Beaumont WWTP and Henry N Wochholz RWRF (mgd)

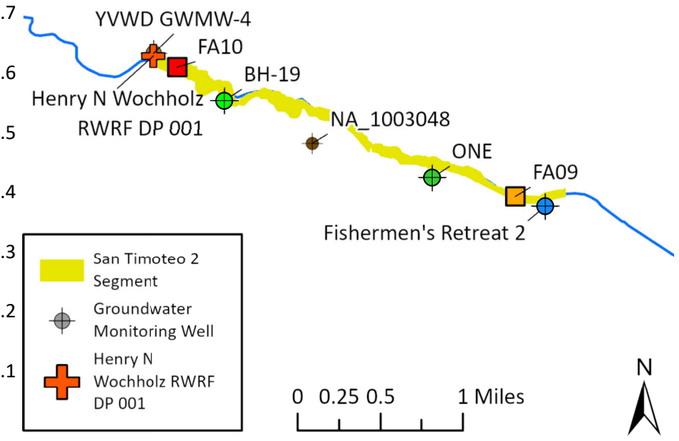
NDVI

Groundwater Elevations at Wells (ft NAVD88)
- YVWD GWMW-4 (65-80 ft-bgs)
- BH-19 (50-150 ft-bgs)
- Fisherman's Retreat 2 (70-615 ft-bgs)
- One (110-590 ft-bgs)
- NA_1003048

Beaumont WWTP DP-001 Discharge
- Annual (afy)
- Daily (mgd)

Henry N Wochholz RWRF DP-001 Discharge
- Daily (mgd)

Average Growing Season NDVI
(Mann-Kendall Trend Result for 1984-2023; 1984-2003; 2004-2023)
- FA09 (increasing; decreasing; increasing)
- FA10 (increasing; increasing; no trend)
- San Timoteo 2 (no trend; no trend; increasing)




**Groundwater Levels and WWTP Discharge versus NDVI**
*San Timoteo 2 Segment for 1983-2023*
**City of Beaumont AMMP**

**Figure 7-6**

WEST YOST
Water. Engineered.

Author: AK
Date: 20241216
File: Figure 7-6_Discharge_GWLs_StudyArea-C.grf

## 7.3 Hydrological Impacts to Biological Resources

The biological resources of the riparian habitat are dependent upon the habitat's health. The AMMP is primarily concerned with a change to the habitat and its biological resources that could result from the reduction of Beaumont WWTP discharges. This section describes the relationship of surface water and groundwater to the biological resources of the Study Area.

As described in Section 4, the dominant native riparian species present within the Riparian Zone are phreatophyte species of willows (multiple species), Fremont cottonwood, and mulefat. This riparian vegetation creates a habitat suitable for a variety of important bird species, including least Bell's vireo, willow flycatcher, and yellow warbler.

### *7.3.1 Surface Water*

The duration and timing of surface water flows have a direct impact on the biological resources within the Riparian Zone. Studies on the surface water and groundwater thresholds required to support riparian stands of Fremont cottonwood / Gooding's willow habitat in the Southwestern U.S. have found that surface flow permanence is perhaps the most important hydrologic factor required to maintain this riparian habitat association. According to Lite and Stromberg (2005) stream reaches that sustain surface water flows for more than 76 percent of the year are required for maintaining tall, dense stands of Fremont cottonwood / Gooding's willow riparian habitat in the Southwest. Some of the benefits of surface water flows to riparian plant communities include providing water directly to young trees with shallower root systems, sustaining ground water levels, and increasing humidity within the riparian zone, which can buffer high evaporation and improve photosynthetic rates in arid regions. The timing of surface water flows is also important for seed dispersal and seedling establishment in that seeds transported downstream during winter flood events and deposited on suitable substrates can then potentially germinate and establish during the early part of the growing season.

The importance of surface water flows to riparian habitat in the Study Area is evident in the data presented in Sections 7.1 which demonstrates the direct relationship between concurrent increases in discharge, surface water flows, and riparian habitat extent and health. Thus, a reduction in Beaumont WWTP discharges will reduce the surface flows of the Study area and could potentially impact the current extent of the riparian habitat.

### *7.3.2 Groundwater*

Depth to groundwater and groundwater level fluctuations also impact the biological resources within the Riparian Zone, but are of lesser importance than surface water flow. The dominant phreatophyte species in the Study Area require a shallow depth to groundwater, with little fluctuation in groundwater levels. The fine roots that are primarily responsible for water uptake in cottonwood and willow species occur in the capillary fringe immediately above the groundwater saturation zone (i.e. the water table). A receding water table can cause the roots of phreatophytic species to be stranded above the saturated zone and result in reduced productivity or death (Mahoney and Rood, 1992). The maximum recorded groundwater depth required for adult Fremont cottonwood survival in the Southwestern U.S. is about 5.1 meters bgs (or about 16.7 ft bgs), while the maximum recorded groundwater depth required for adult Gooding's willow survival is about 3.2 meters bgs (or about 10.5 ft bgs) (Stromberg, Tiller, and Richter, 1996). Other willow species (e.g., red willow) have similar rooting depths and depth to groundwater requirements. Saplings have shallower rooting depths and thus have shallower depth to groundwater requirements to become established. The maximum recorded groundwater depth required for sapling Fremont cottonwood survival is approximately 3 meters bgs (or about 10 ft bgs), while the maximum recorded

groundwater depth required for sapling Gooding's willow survival is approximately 2 meters bgs (or about 6.6 ft bgs) (Stromberg et al.,1996). Lite and Stromberg (2005) found that the maximum depth to groundwater required to maintain tall, dense stands of Fremont cottonwood / Gooding's willow forest and woodland associations in the Southwest is typically less than an average of 2.6 meters bgs (or about 8.5 ft bgs).

Both juvenile and adult trees are susceptible to stress resulting from rapid changes in groundwater levels. Tall, dense stands of Fremont cottonwood / Gooding's willow riparian habitat typically require annual groundwater level fluctuations of less than 0.5 meters (about 1.6 feet) from January to June (Lite and Stromberg, 2005). Adult cottonwood trees can be killed by abrupt and prolonged groundwater level increases of just 1 meter (about 3.3 feet) and saplings of both cottonwood and willow species can die from seasonal water table declines of the same amount (Shafroth et al., 2000; Lite and Stromberg, 2005). Seedling cottonwoods can die when groundwater depths decline by more than 1 to 4 centimeters per day (about a third of an inch to 1.5 inches) and may not survive on sites with a depth to groundwater that is greater than 1 to 1.3 meters bgs (about 3.2 to 4.3 ft) by the end of the first growing season (Lite and Stromberg, 2005). However, it should be noted that some minimal fluctuations in depth to groundwater are beneficial to sapling survivorship. Fremont cottonwood and Gooding's willow saplings have been observed to have higher survivorship in areas that had greater depth to groundwater when subjected to regular and minor fluctuations than saplings in areas with shallower, more stable water tables (Shafroth et al., 2000).

This illustrates the importance of the historically stable groundwater level conditions observed in the Study Area. However, there are no wells in close enough proximity to the riparian vegetation along the Creek to demonstrate how the historical range in groundwater levels compares to the requirements suggested by the literature for similar habitats in the Southwest. As discussed in Section 6.3.3, the shallowest depth to water at wells in the Study Area was about 23 feet bgs, which is about three times deeper than the average depth needed to maintain tall, dense stands of Fremont cottonwood / Gooding's willow forest and woodland associations in the Southwest.

## 7.4 Other Climate Factors

Other climatic factors that could impact riparian habitat health include changes to temperature and precipitation patterns in the Region. Climate change is expected to impact the frequency and intensity of precipitation events, the duration of dry (drought) periods, and increase air temperatures. Changes to air temperature can affect evapotranspiration rates, humidity, and vegetation stress levels.

Although not analyzed for this Report, based on the analysis of NDVI presented in Section 5, there are no areas with decreasing NDVI, and so these are not factors impacting the riparian habitat at this time.

Data on air temperature, humidity, and evaporation data are available from local and regional climate data sources and should be analyzed in the future to determine if these climatic factors can be correlated to any future changes in NDVI.

## 7.5 Wildfires

Wildfires can occur periodically and affect the extent and quality of riparian habitat. Data on the location of historical wildfires were collected from the California Department of Forestry and Fire Protection database.[13] Data on historical fires are available back to 2016. There is one wildfire that occurred historically and impacted the Study Area riparian habitat in 2017 and 2018. The Palmer Fire started on September 2, 2017 and was contained by January 9, 2018. It burned a total of approximately 3,800 acres within and adjacent to the Study Area and impacted the riparian vegetation in the Study Area. The wildfire was the likely cause of the decrease in the Average Growing Season NDVI (shown on Figures 5-5b, 5-6b, and 5-7b) for all Segments and Focus Areas. The largest decreases in NDVI occurred in Focus Areas FA09 and FA10 within San Timoteo Segment 2. Riparian habitat in the Study Area began to recover by 2019 as shown by an increase in the NDVI between 2018 and 2019.

## 7.6 Invasive Species and Pests

Invasive species and pests can displace native species and reduce biodiversity within the Riparian Zone and surrounding habitats. Riparian habitats can be particularly susceptible to invasive species during times of drought or other stresses to water availability. A decrease in surface water flow permanence, increases in depth to groundwater, and dramatic fluctuations in groundwater levels all tend to cause declines in native riparian tree species cover and increase the ability for more drought-tolerant invasive species like salt cedar (*Tamarix* spp.) to establish and spread (Lite and Stromberg, 2005). Over time, the riparian habitat structure, functions, and hydrologic processes can be adversely affected by invasive species, which may or may not be discernable in NDVI data. Riparian habitats with a prevalence of invasive species are typically also more susceptible to wildfires. A total of 16 invasive species were identified along the Cooper's Creek portion of the Study Area during the August 2024 field survey, as noted in Table 4-4. Only one invasive species was identified for the San Timoteo Creek portion of the Study Area. The most prevalent invasive species in the Cooper's Creek portion of the Study Area are: tree of heaven (*Ailanthus altissima*), tree tobacco (*Nicotiana glauca*), and Himalayan blackberry (*Rubus armeniacus*). Arundo was identified in the San Timoteo Creek portion of the Study Area. Overall, the current baseline cover of invasive species within the sampled areas of the Cooper's Creek portion of the Study Area is 11 percent in Sample Area 1, 1 percent in Sample Area 2, and 14.4 percent in Sample Area 3, respectively (refer to Tables 4-1b, 4-2b, and 4-3b).

[13] https://www.fire.ca.gov/incidents/2017

Tree of heaven is most prevalent within Sample Area 1 of the Cooper's Creek portion of the Study Area (Table 4-1a). This species has a CAL-IPC rating of moderate[14] due to its ability to quickly become established and spread through an area, forming dense stands, and displacing native plant species. This species produces large quantities of seed and can spread vegetatively with root suckers. Tree of heaven also has allelopathic properties that suppress the growth of surrounding vegetation (CAL-IPC, 2024). This species is more tolerant of dry conditions than native riparian species and can occur in both uplands and riparian zones. An additional concern with tree of heaven invasion is that this species is the preferred host of the spotted lanternfly (*Lycorma delicatula*), which is invasive insect pest (CAL-IPC, 2024).

Tree tobacco was observed in small numbers within all Sample Areas of the Cooper's Creek portion of the Study Area (Tables 4-1a, 4-2a, and 4-3a). This species also has a CAL-IPC rating of moderate and can form dense stands that displace native species and can negatively affect stream hydrology. Tree tobacco is also drought-tolerant and can occur in many habitats and landscapes.

Himalayan blackberry was observed in Sample Area 3 (Table 4-3a), as well as immediately downstream of the Beaumont WWTP DP001 outfall. This species has a CAL-IPC rating of high due to its ability to rapidly displace native plant species and produce dense canopies that prevent the growth of other understory plants (CAL-IPC, 2024). Himalayan blackberry can resprout from the root crown and rhizomes, and its seeds are spread by wildlife that forage on its fruit.

It should also be noted that a small stand of giant reed (*Arundo donax*) was observed within the Cooper's Creek portion of the Study Area (Table 4-4) and this species has been documented along San Timoteo Creek (Howe, 2014). Giant reed has a CAL-IPC rating of high and is a particularly damaging invasive species in riparian ecosystems throughout the Southwest. This species forms dense monotypic stands that can significantly alter stream hydrology and is likely the most damaging invasive plant species affecting southern California riparian ecosystems (Bell, 2002). Riparian areas dominated by giant reed also support lower biodiversity and are more prone to wildfire.

[14] CAL-IPC ratings are as follows:

**High** – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

**Moderate** – These species have substantial and apparent-but generally not severe-ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

**Limited** – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

**Alert** – An Alert is listed on species with High or Moderate impacts that have limited distribution in California but may have the potential to spread much further.

**Watch** – These species have been assessed as posing a high risk of becoming invasive in the future in California.

Based on the analysis of NDVI presented in Section 5, there are no areas with decreasing NDVI, and so this is not a factor impacting the riparian habitat at this time. However, continuing to track the occurrence and prevalence of invasive species and pests will be important to the AMMP going forward so that the relationship between their presence can be assessed relative to future changes in NDVI, or other factors that cause changes to NDVI (such as reduced discharge and surface water flow).

## 7.7 Data Gaps

Based on the analysis of available data and the discussion of potential impacts to riparian habitat and health, the following data gaps[15] were identified and should be prioritized for a robust AMMP.

1. Riparian vegetation data, specifically additional baseline vegetation sampling surveys along Cooper's Creek.
2. Groundwater level data, specifically groundwater levels immediately adjacent to Cooper's and San Timoteo Creeks and within the riparian habitat.
3. Study Area elevations, specifically for monitoring well reference points and the thalweg along Cooper's and San Timoteo Creeks.
4. Surface water flow measurements, specifically an increase in flow measurement frequency.

These data gaps are described further below.

### *7.7.1 Riparian Vegetation Data*

Additional baseline vegetation sampling surveys are needed to characterize vegetation cover, species richness, and percentage of native and non-native species cover west of the SR-60 crossing of Cooper's Creek (see Sample Area 4 on Figure 8-1). Additional baseline vegetation sampling along the same transects surveyed in August 2024 (Sample Areas 1 through 3) is also recommended to improve the statistical confidence of baseline species richness and provide woody plant density results. Additionally, future vegetation monitoring should include measurements of canopy height utilizing either ground-based methods (i.e., a clinometer) or aerial methods (i.e., drone survey).

### *7.7.2 Groundwater Level Data*

There is limited spatial and temporal groundwater level data within the Study Area. For this Report, groundwater levels for selected representative wells for the Maximum Benefit Monitoring Program were used to analyze local groundwater conditions. The data were available at variable frequencies over time but are now only measured twice per year in the spring and fall. And, as described in Section 7.2.2, there are no wells currently monitored along the San Timoteo 1 Segment that are within the upper shallow aquifer. There are several wells that could potentially be utilized to monitor shallow groundwater elevations within this Segment, including SanTim-1, San Tim-2B/1, and San Tim-2B/2 (if found to be in suitable condition).

The frequency of water level monitoring at the representative wells along Cooper's and San Timoteo Creeks is currently bi-annual (two times per year). High-frequency groundwater level measurements will improve the understanding of seasonal and longer-term fluctuations in groundwater elevations and depth to groundwater, as well as provide a more robust understanding of the important groundwater and

[15] Data gaps exist when there are no entities already collecting and publishing the noted data.

surface water interactions along the Creeks, the delicate balance of which may be supporting the riparian habitat extent and health. High-frequency data would ideally involve the installation of continuously recording pressure transducers that can capture sub-daily changes in water levels.

### *7.7.3 Surveyed Elevations of Reference Points and Thalweg*

Currently, there is limited or imprecise elevation data within the Study Area to accurately characterize the small changes in groundwater levels and their relation to the stream channel elevation. As discussed in Section 7.3.2, riparian habitat health can be impacted by fluctuations in groundwater levels of as little as 0.5 meters (about 1.6 feet) from January to June. For this reason, it is important to have high precision in the reference points used to calculate elevations so that sites across the study area can more accurately be compared and used to understand the groundwater and surface water hydrology.

- **Reference Point Elevations.** A reference point is the location on a well, such as the top of a sounding tube, where the depth to groundwater measurement is made and referenced to calculate the groundwater elevation (Reference Point Elevation minus Depth to Water = Groundwater Elevation). Currently the reference point elevations for wells in the Study Area are typically estimates that have been derived from a 10-meter resolution DEM. To support this AMMP, the reference point elevations should be professionally benchmarked and surveyed.
- **Thalweg Elevations**. The "thalweg" is the bottom elevation of a stream channel. The thalweg elevation can be compared to the groundwater elevations in nearby monitoring wells to better characterize groundwater/surface-water interactions within the Study Area. It is important to have thalweg elevations and groundwater elevations that can accurately be compared to each other. For this reason, the thalweg elevation across Cooper's and San Timoteo Creeks should also be professionally surveyed.
- **DEM of the Ground Surface Elevation.** Depth to water contours were not developed for this report because they would have to be estimated based on the limited available reference point data at the wells and would rely on a USGS 10-meter DEM of the ground surface. As described in Section 6.3.3, a 10-meter resolution does not provide a high enough resolution of the ground surface elevation for these narrow areas along the creek of importance in the Study Area. A higher resolution DEM (i.e. 1-meter) would provide a more accurate delineation of the ground surface elevation and could be used to develop depth to water contours of the Study Area. The DEM should be prepared from professional survey using LiDAR[16] in the same vertical datum as the surveyed reference point and thalweg elevations described in the bullets above.

### *7.7.4 Frequency of Surface Water Flow Measurements*

Surface water flow measurements are currently measured within the Study Area on a bi-weekly basis or following storms in the case of STC-02 on Cooper's and San Timoteo Creek within the Beaumont GMZ. Although these are beneficial datasets, there is an insufficient frequency of data to develop a more robust understanding of surface water flows in response to storms and daily fluctuations in discharge from the Beaumont WWTP. Higher-frequency surface water flow data coupled with high-frequency groundwater

[16] Light Detection and Ranging (LiDAR), is a remote sensing technique that uses a pulsed laser to measure distances and create 3D models of the Earth's surface

level measurements could also improve the understanding of groundwater/surface water interactions along the creeks. Additionally, the higher frequency surface water dataset could be used to assist with the calibration of future modeling tools that may be needed to simulate the impact of reduced discharges to surface water flow and groundwater levels in the Study Area.

Permanent stream gages would be needed to increase the frequency of surface water flow measurements. This can be costly and may not be practical to do without grant funding.

# 8.0 BASELINE MONITORING AND DATA COLLECTION PROGRAM

This section describes the recommended Baseline Monitoring and Data Collection Program (Baseline Monitoring Program) to initiate the AMMP. The objective of the Baseline Monitoring Program is to establish a more comprehensive characterization of the current conditions of the Study Area prior to reducing discharge from the Beaumont WWTP. The baseline data will be compared to data collected as the discharge is reduced to detect any changes in riparian habitat health that are attributable to the reduced discharge. And, if any unacceptable changes to riparian habitat are attributable to reducing discharge, the information can be used to support the development of mitigation actions.

The Baseline Monitoring Program includes collection of riparian habitat, surface water, groundwater, climate, and elevation data. Where feasible to meet the AMMP objectives, the Baseline Monitoring Program will utilize and leverage data from the existing monitoring programs described in Section 2.2.3 of this Report.

## 8.1 Riparian Habitat Monitoring

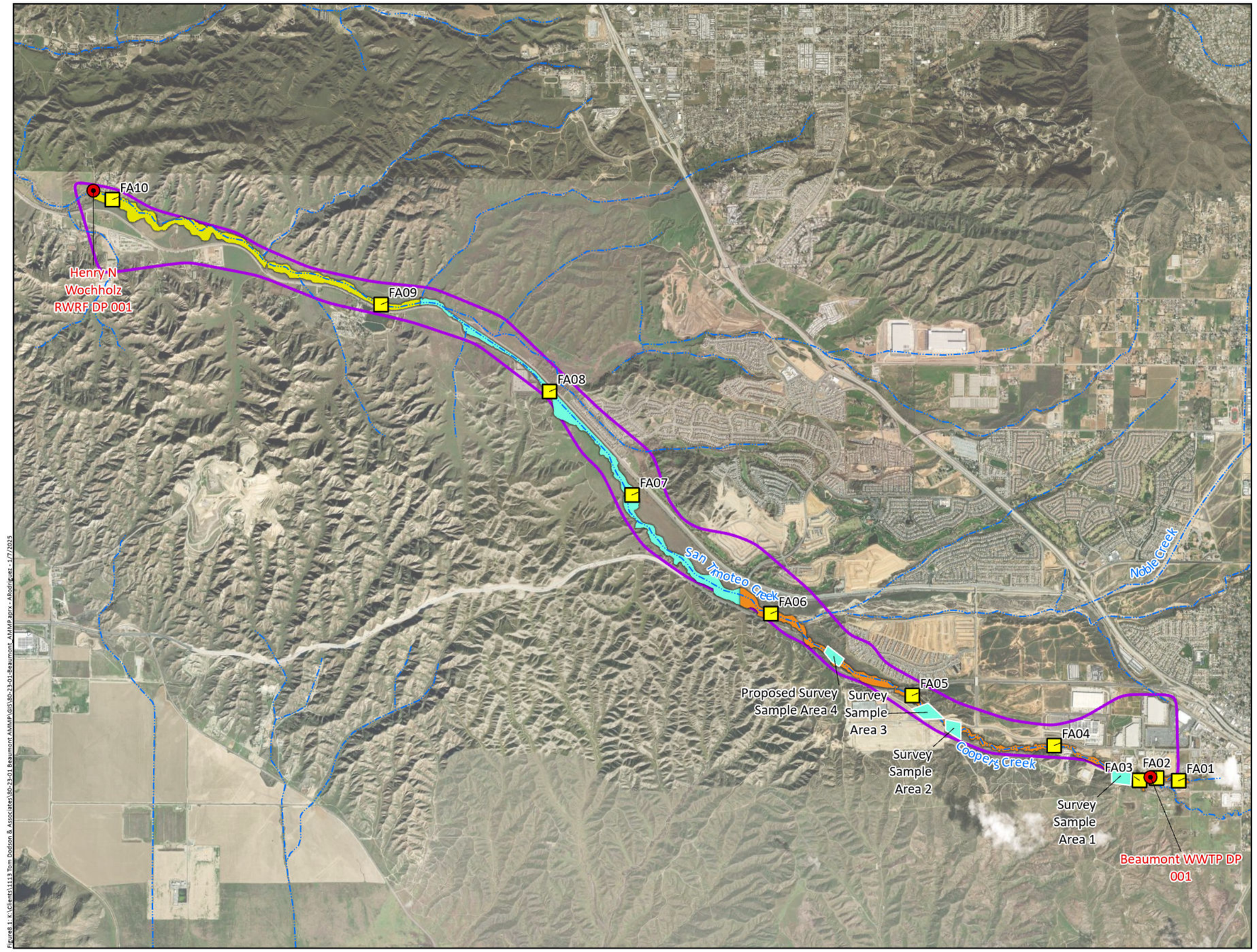
Figure 8-1 shows the recommended sites for riparian habitat monitoring for the Baseline Monitoring Program. Riparian habitat monitoring will consist of a combination of remote sensing, drone surveys, and ground survey techniques as specified below.

### *8.1.1 Remote Sensing*

Similar to the historical characterization described in Section 5 of this Report, remote sensing data from the Landsat Satellite will be used to analyze NDVI to evaluate riparian habitat health in the Study Area. NDVI will continue to be collected and analyzed for the three Segments and ten Focus Areas defined in this report. The current frequency of the remote sensing measurements of NDVI is between one and eight days. NDVI time series data will be prepared and analyzed for these Segments and Focus Areas and the trends and results for three distinct time periods will be evaluated: 1) the early growing season (around March), 2) peak growing season (sometime between April and September), and 3) late growing season (October). An average NDVI for each period will be compared to assess short-term and long-term changes in NDVI for each Focus Area and Segment.

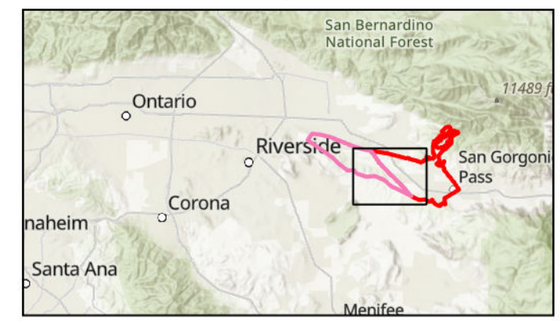
### *8.1.2 Drone Surveys*

Drone surveys of the entire Cooper's Creek portion of the Study Area (from the Beaumont WWTP DP001 outfall to the confluence with San Timoteo Creek) will be conducted annually during peak growing season (typically April/May). Surveys are not recommended for the San Timoteo Creek portion of the Study Area due to the SAWA biological surveys that occur annually and because of an overabundant amount of additional factors (such as influence from other stream systems) that could influence changes in riparian habitat health. The drone survey will collect high-resolution orthoimagery for both red, green, and blue (RGB) and near-infrared spectrometric data that can be used to calculate much higher resolution NDVI values than available from the satellite imagery. The orthoimagery will also provide the necessary data to assess vegetation cover, canopy height, species richness, density, and plant health over a much broader area than ground surveys alone can provide.






Notes:
1. GMZ - groundwater management zone
2. WWTP - wastewater treatment plant




Prepared by:
WEST YOST

N
0 2 Miles
0 2 Km

Prepared for:
**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

**Riparian Baseline Monitoring and Data Collection Locations**
*City of Beaumont AMMP*
**Figure 8-1**

Figure8_1: K:\Clients\11113 Tom Dodson & Associates\BD-23-01 Beaumont AMMP\GIS\BD-23-01-Beaumont_AMMP.aprx - ARodriguez - 1/7/2025

### *8.1.3 Ground Surveys*

Ground surveys will be conducted to assess habitat use by focal species and other wildlife within the riparian habitat. Ground surveys will include:

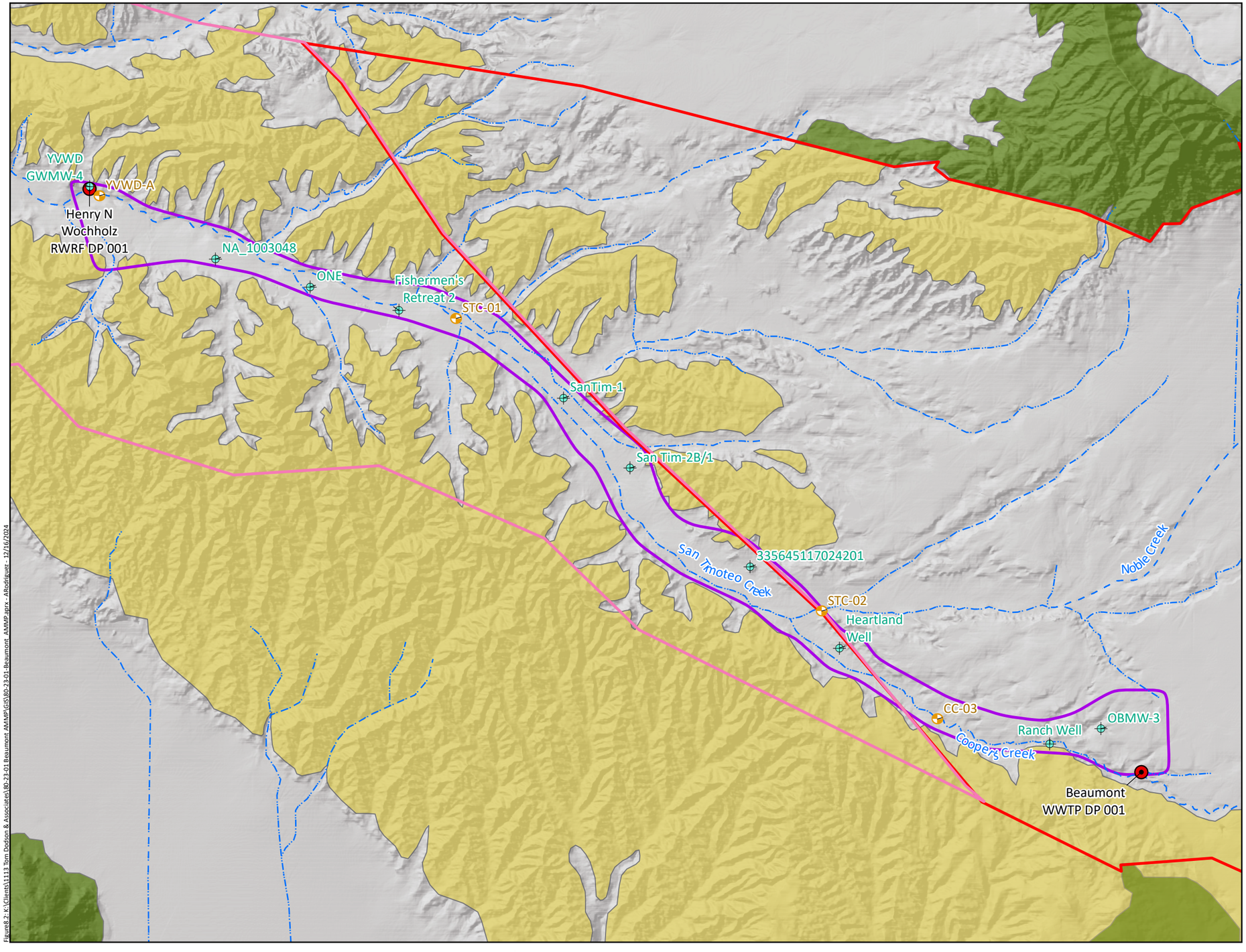
- Periodic vegetation sampling surveys to characterize riparian habitats along the Cooper's Creek Riparian Zone at Sample Areas 1 through 4. Vegetation sampling surveys should be conducted once every 2-3 years within the Cooper's Creek portion of the Study Area and Riparian Zone to ground-truth vegetation data collected during the annual drone surveys and remote sensing data. Ground based vegetation sampling surveys should be conducted within the three Sample Areas established during the initial 2024 baseline vegetation sampling efforts plus one additional sample area, Sample Area 4 located downstream (west) of the SR-60 crossing of Cooper's Creek (Figure 8-1). The surveys would consist of the same vegetation sampling methods used during the 2024 baseline year to document any changes that may occur within the Riparian Zone over time.
- Bi-annual (every two years) inventory of biological resources to document all plant and wildlife species observed along the Cooper's Creek Riparian Zone. This inventory will produce a description of plant species composition and wildlife use from the Beaumont WWTP DP001 to the confluence with San Timoteo Creek. Faunal surveys will be conducted during the focal species' breeding season (i.e., March-August). Focused protocol LBVI and WIFL presence/absence surveys will be conducted by permitted/qualified biologists in accordance with the USFWS survey protocols for these species.
- SAWA biological monitoring reports will continue to be used to document wildlife species use of riparian habitat, including the presence of focal species, within the San Timoteo Creek Riparian Zone from the Cooper's Creek / San Timoteo Creek confluence to the Henry N. Wochholz RWRF DP001.

## 8.2 Surface Water Monitoring

Figure 8-2 and Table 8-1 summarize the recommended surface water monitoring sites for the Baseline Monitoring Program.

Surface water monitoring will include high-frequency monitoring of stage, flow, temperature, and specific conductance (SC)[17] at 4 locations along Cooper's and San Timoteo Creeks. These locations are CC-03, ST-02, STC-01, and YVWD-A. These are the monitoring locations for the Maximum Benefit Monitoring Program where bi-weekly measurements of flow and surface water quality are collected. To collect the high-frequency data, stilling wells will be installed and equipped with pressure transducers with data loggers and sensors that will record data at 15-minute intervals. A staff plate will be installed in the vicinity of the stilling wells and both the stilling wells and staff plates will be installed in an area that protects the equipment from higher storm flows. The bi-weekly flow measurements collected for the Maximum Benefit Monitoring Program will be used to develop a rating curve for each site. The rating curve is a tool to translate stream stage (measured by the transducer) to stream flow (measured manually).

[17] Specific conductance, or electrical conductivity, is a measure of the salinity of water. SC data can be correlated with laboratory measurements of TDS to develop a translator of SC to TDS.




Proposed Transducer Deployment Location - Streamgage

Proposed Transducer Deployment Location - Groundwater Well

WWTP Discharge Point

Beaumont GMZ

San Timoteo GMZ

Study Area

Streams

**Geology**

Water-Bearing Sediments

Unconsolidated to Semi-consolidated Quaternary Alluvium

Consolidated and Semi-Consolidated Formations

San Timoteo Formation

Undifferentiated Pre-Tertiary Igneous and Metamorphic Crystalline Rocks

Notes:
1. GMZ - groundwater management zone
2. WWTP - wastewater treatment plant

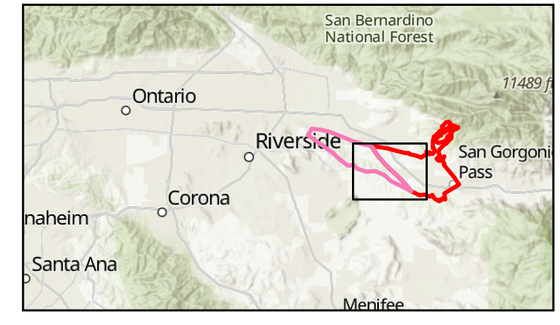



Figure8.2: K:\Clients\11113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01 Beaumont_AMMP.aprx - ARodriguez - 12/16/2024

Prepared by:

WEST YOST

0 2 Miles

0 2 Km

Prepared for:

**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Hydrogeological Baseline Monitoring and Data Collection Locations**

*City of Beaumont AMMP*

**Figure 8-2**

**Table 8-1. Hydrogeological Baseline Monitoring Program Enhanced Monitoring Locations**

| Monitoring Location | Regulatory Program | Existing Monitoring | | | Proposed Monitoring | | |
|---|---|---|---|---|---|---|---|
| | | Frequency[a] | Data Type[b] | Sampling Method[c] | Frequency | Data Type[d] | Sampling Method |
| Groundwater | | | | | | | |
| OBMW-3 | Maximum Benefit | SA and 3 years | WL and WQ | M and L | Hourly | WL, T, and SC | Transducer |
| Ranch Well | Maximum Benefit | SA and 3 years | WL and WQ | M and L | Hourly | WL, T, and SC | Transducer |
| Heartland Well | Maximum Benefit | SA and 3 years | WL and WQ | M and L | Hourly | WL, T, and SC | Transducer |
| 335645117024201 | Maximum Benefit | SA | WL | M and L | Hourly | WL, T, and SC | Transducer |
| San Tim-2B/1 | Maximum Benefit | 3 years | WQ | M and L | Hourly | WL, T, and SC | Transducer |
| SanTim-1 | Maximum Benefit | 3 years | WQ | M and L | Hourly | WL, T, and SC | Transducer |
| Fishermen's Retreat 2 | Maximum Benefit | SA and 3 years | WL and WQ | M and L | Hourly | WL, T, and SC | Transducer |
| ONE | Maximum Benefit | SA and 3 years | WL and WQ | M and L | Hourly | WL, T, and SC | Transducer |
| NA_1003048 | Maximum Benefit | SA and 3 years | WL and WQ | M and L | Hourly | WL, T, and SC | Transducer |
| YVWD GWMW-4 | Maximum Benefit | SA and 3 years | WL and WQ | M and L | Hourly | WL, T, and SC | Transducer |
| Surface Water | | | | | | | |
| CC-03 | Maximum Benefit | Bi-weekly | Flow and WQ | M and L | 15 minutes | Stage, flow, T, and SC | Transducer |
| STC-02 | Maximum Benefit | Following storms | Flow and WQ | M and L | 15 minutes | Stage, flow, T, and SC | Transducer |
| STC-01 | Maximum Benefit | Bi-weekly | Flow and WQ | M and L | 15 minutes | Stage, flow, T, and SC | Transducer |
| YVWD-A | Maximum Benefit | Bi-weekly | Flow and WQ | M and L | 15 minutes | Stage, flow, T, and SC | Transducer |

(a) The Maximum Benefit Program requires groundwater levels to be collected at a minimum twice a year (semi-annually [SA]) and groundwater quality every 3 years.
(b) WL - water level, WQ - water quality
(c) M - manual (water levels and surface water flow), L - laboratory analysis (water quality)
(d) T - temperature, SC - specific conductance

The high-frequency flow, temperature, and SC data will provide a more comprehensive understanding of the long-term and short-term trends in surface water flow in the study area and help understand surface water conditions in response to storms and discharges from the Beaumont WWTP. The high-frequency data will also help discern groundwater and surface water interactions along the Study Area.

The Baseline Monitoring Program will also utilize the bi-weekly water quality data collected for the Maximum Benefit Monitoring Program, and the flow and water quality data collected for compliance with the Beaumont WWTP NPDES discharge permit monitoring program.

## 8.3 Groundwater Monitoring

Figure 8-2 and Table 8-1 summarize the recommended groundwater monitoring sites for the Baseline Monitoring Program.

Groundwater monitoring will include high-frequency collection of groundwater levels, temperature, and SC at 10 existing wells located along Cooper's and San Timoteo Creeks. The wells include OBMW-3, Ranch Well, Heartland Well, 335645117024201, San Tim 2B/1, SanTim-1, Fishermen's Retreat 2, ONE, NA-1003048, and YVWD GWMW-4. These wells were selected because they are distributed throughout the Study Area and provide coverage in all three NDVI analysis Segments. Most of these wells are currently monitored for water levels on a semi-annual basis for the Maximum Benefit Monitoring Program. Two of the wells (San Tim 2B/1, SanTim-1) are not currently monitored for water levels and are recommended for inclusion to fill the spatial data gaps described in Section 7.7.1. Pressure transducers with data loggers will be installed in the wells to collect 15-minute readings of water level, temperature, and SC. Access and agreements will need to be coordinated with the individual well owners for the installation of this monitoring equipment. A well canvas will need to be conducted to confirm if transducers can be installed within the wells.

The high-frequency water level, temperature, and SC data will provide for a more comprehensive understanding of the long-term and short-term trends in groundwater levels in the study area and the relationship of discharges from the Beaumont WWTP and groundwater levels. The high-frequency data will also help discern groundwater and surface water interactions along the Study Area.

The Baseline Monitoring Program will also utilize the water quality samples collected at these wells for the Maximum Benefit Monitoring Program.

## 8.4 Reference Point and Thalweg Elevation Surveys

To address the data gaps described in Section 7.7.3, professional elevation surveys should be conducted on the following:

- Well reference points for the wells in the Baseline Monitoring Program.
- Stream gaging sites, including staff plates, for monitoring locations in the Baseline Monitoring Program.
- Points along the channel thalweg that are adjacent to the monitoring wells. The thalweg elevation surveys will be done for the lowest point in the creek at a location perpendicular to the adjacent monitoring wells.

The thalweg, stream, and groundwater elevations will be compared to better characterize groundwater/ surface-water interactions within the Study Area and determine how the groundwater/surface-water

interactions are correlated with Beaumont WWTP discharges and riparian habitat health. The collection of a finer resolution (i.e., 1-meter) DEM is not recommended as part of the Baseline Monitoring Program but may be recommended in the future.

## 8.5 Climate

Publicly available data on precipitation, temperature, and evapotranspiration will be collected and utilized as part of the Baseline Monitoring Program. This includes the PRISM Climate group gridded dataset (for precipitation and temperature), National Oceanic and Atmospheric Administration (NOAA) precipitation gages, other gridded datasets, and/or CIMIS weather stations, in the area.[18] Climate data will be used to analyze the relationship between climate conditions and riparian habitat and hydrologic datasets.

## 8.6 Feasibility of Reduced Discharge

Phase 1 initially included assessing available modeling tools that could be used to analyze surface water and groundwater responses to reducing Beaumont WWTP discharges. This task will now be part of the Baseline Monitoring Program and should generally follow the steps outlined for Phases 1 and 2, as described below.

The first step of this effort is to collect and assess all available surface and groundwater models or analytical tools that could potentially be used to assess hydrogeologic impacts of reduced discharge to Cooper's Creek. An outcome of this task will be articulation of the level of analysis necessary to support development of the AMMP (i.e. what is the "right size" scope of work to support the City's project) and scope of work and cost estimate to use the existing surface and groundwater models/tools, or construct new ones, to test the feasibility of various levels of reduced discharge to Cooper's Creek.

The second step of this effort is to use the surface and groundwater modeling tools (numerical or analytical) to perform predictive model simulations of the surface-water and groundwater hydrology of the Study Area with and without the Beaumont WWTP discharges and comparing the model results against the preliminary metrics for habitat sustainability, as defined in Section 9 of this Report. Depending on the state of existing models and tools, this effort may require the City to:

- Construct and calibrate (or update) a surface-water model that is capable of simulating: 1) historical surface water flow in Cooper's Creek and San Timoteo Creek and 2) future surface water flow in under climate change, water conservation, and various future wastewater discharge scenarios.
- Construct and calibrate (or update) a groundwater-flow model that is capable of simulating: 1) historical groundwater levels and GW/SW interactions within the alluvial aquifer and regional aquifer beneath the Study Area and 2) future groundwater levels and GW/SW interactions under climate change, water conservation, and various future wastewater discharge scenarios.

The first step began in Phase 1 and will be completed in 2025, including a technical memorandum documenting the outcomes and recommendations.

[18] https://www.ncdc.noaa.gov/cdo-web/search

## 8.7 Implementation and Reporting

Implementation of the recommended Baseline Monitoring Program should begin in 2025 and continue until such time the City will begin diverting recycled water for beneficial uses. The data collected for the Baseline Monitoring Program should be compiled and analyzed annually. An annual report will be prepared to document the following information:

- Summary of the data collected and available for the reporting period
- An analysis of the following, as appropriate based on monitoring frequency of the data sets:
  - Riparian habitat health based on NDVI, drone surveys, and/or biological ground surveys performed during the reporting period
  - Trends in precipitation, wastewater discharge, surface water flow, and groundwater elevation
  - Analysis of surface and groundwater interactions
  - Identification and analysis of other factors that may be affecting riparian habitat health, including climate, wildfires, and invasive species/pests
- A description of the latest activities related to the City's recycled water program, the procurement of the discharge change petition, and other activities related to the development of the AMMP
- Recommended changes to the Baseline Monitoring Program
- A schedule of future activities related to the AMMP

The annual report reporting period will be based on the water year. The first annual report of the AMMP Baseline Monitoring Program will be for WY 2026 (e.g. the period ending September 30, 2026) and should be completed by April 30th following the end of the water year (eg., April 20, 2027 for the first annual report). Producing the first annual report in for WY 2026 will allow time in 2025 for ramp-up of certain activities, such as installation of stream gages and elevation surveys and provide an opportunity to assess a full water-year worth of data for new data sets.

When the City is ready to begin reducing discharges to Cooper's Creek, the data and analysis contained in the annual reports will be used as the basis for updating the AMMP for the next phase of implementation.

# 9.0 CONCLUSIONS AND PERFORMANCE CRITERIA

This Report was prepared as part of the development of the City's AMMP, to document the detailed characterization of historical riparian habitat in the Study Area and the physical factors that can impact its health and extent. This characterization provides an initial baseline understanding of the relationship of Beaumont WWTP discharges and riparian habitat extent and health. This section summarizes the main conclusions drawn from the analyses presented herein and the recommend performance criteria to measure the success of the AMMP in the future.

## 9.1 Conclusions

The main conclusions of the Report are:

- The Riparian Zone along Cooper's Creek and San Timoteo Creek developed over the course of several decades beginning in the late 1960s or 1970s. Riparian plant communities dominated by phreatophytes such as cottonwoods, willows, and mulefat established along Cooper's Creek and San Timoteo Creek between Beaumont WWTP DP001 and Henry N. Wochholz RWRF DP001 as a result of increasing discharges from the Beaumont WWTP over time.
- Baseline vegetation surveys and available habitat mapping data identified a total of seven riparian plant communities currently present within the Cooper's Creek Riparian Zone and six riparian plant communities within the San Timoteo Creek Riparian Zone. The current average width of the Cooper's Creek Riparian Zone is approximately 47 meters, and the current average width of the San Timoteo Creek Riparian Zone is approximately 79 meters. Baseline vegetation surveys conducted within the Cooper's Creek Riparian Zone found a complete vegetation coverage across the areas of the Riparian Zone sampled. Invasive species cover within the sampled areas ranged from about 1 percent to 14 percent and native species richness ranged from 7 to 22 species across the sampled areas. In total, of the 55 plant species identified within the Cooper's Creek Riparian Zone, 31 were native species and 24 were non-native species. 16 of the non-native species are considered invasive species.
- Historical wildlife usage of the Cooper's Creek and San Timoteo Creek Riparian Zones includes several riparian associated "focal species" that indicate riparian habitat health by their presence. A total of 57 wildlife species (48 birds, 4 reptiles, 5 mammals) were observed within the Cooper's Creek Riparian Zone during baseline faunal inventory surveys, including seven USFWS BCC, four CDFW "Watch List" species, two CDFW SSC, one state listed as endangered species (WIFL), and one state and federally listed endangered species (LBVI). Additionally, five riparian associated focal species were observed within the Cooper's Creek Riparian Zone. Biological monitoring surveys conducted by SAWA have documented six riparian associated focal species within the San Timoteo Creek Riparian Zone.
- Based on the analysis of NDVI time series, the quality (greenness) of the riparian habitat vegetation increased across most of the Study Area from 2004 to 2023. These increases occurred during a time of below average precipitation, increasing Beaumont WWTP discharges, and increasing surface water flows. The largest increases in NDVI occurred in the area just downstream and closest to the Beaumont WWTP DP001 discharge point along the Cooper's Creek 1 Segment.

- Since the available period of record of surface water flows in 2005, surface water flow increased concurrently with increases in discharge from the Beaumont WWTP. Monitoring sites in closer proximity to Beaumont WWTP DP001 exhibited more constant flows (i.e., less peaks and troughs), while those farther away exhibited more seasonality in flows (i.e., more peaks and troughs). Generally, the pattern of flow at all sites mimic the pattern of discharge from the Beaumont WWTP, except during precipitation events that result in short-term peak flows.
- Since the early 2000's, groundwater levels within the Study Area have remained relatively stable, even through dry climate conditions and extended periods of below average precipitation.
- The depth to groundwater at wells in the Study Area ranges from 23 ft bgs to 123 ft bgs and is shallower at sites closer to the Cooper's Creek and San Timoteo Creek channels. Depth to groundwater is variable along the axis of the Study Area reaches, with shallower depths occurring near the wastewater discharges at Beaumont WWTP and Henry N. Wochholz RWRF.
- Surface water flows appear to have the largest impact on riparian habitat health based on the available data. However, it should be noted that because groundwater levels remain steady throughout the common period of record, year-round surface water flows could have a key role in recharging and sustaining the shallow groundwater. The shallow groundwater in turn could have a secondary role in maintaining riparian habitat health.
- Data gaps related to groundwater levels, surface water flows, and elevation surveys are apparent and should be addressed with baseline monitoring activities prior to reducing discharges from the Beaumont WWTP.
- The recommended Baseline Monitoring Program includes high-frequency monitoring of groundwater and surface water to measure water levels, surface stage, water temperature, and SC. The high-frequency data will provide a more accurate and comprehensive understanding of the long-term and short-term trends in surface water flow and groundwater levels and their relationship to each other, Beaumont WWTP discharges, and riparian habitat health. This data will be necessary to accurately assess the factors that are causing changes to riparian habitat health as WWTP discharges are decreased.
- The recommended Baseline Monitoring Program should be implemented until such time the City will begin diverting recycled water for beneficial uses and provides for annual reporting of data and key findings that will shape the long term AMMP that will be implemented as the discharges are reduced.

## 9.2 Performance Criteria

As described in Section 3.2, performance criteria are defined as the specific set of measurable standards that can be used to evaluate the success of the AMMP. Performance criteria should be based on the baseline riparian habitat and hydrologic characterization described in this Report and improvements in understanding gained through the Baseline Monitoring Program. The initial recommended performance criteria for inclusion in the AMMP following the completion of the Baseline Monitoring Program are discussed below:

1. Riparian habitat will not be adversely affected by reduction in Beaumont WWTP discharges. Riparian habitat health will be evaluated utilizing remote sensing data and biological surveys to determine if riparian health indicates declining trends and if the declining trends are

attributable to reduced discharge. Indications of declining trends in riparian habitat may include:

a. Declines in riparian plant health indicated by lower NDVI values
b. Decreases in native riparian vegetation cover and species richness
c. Increased prevalence of invasive species
d. Declines in observed wildlife diversity, particularly decreased use by focal species

Attribution of the declining riparian habitat trend to reduced discharges from the Beaumont WWTP would be evident if the decrease in discharge is directly correlated with decreases in surface water flow and/or groundwater level.

2. Beaumont WWTP discharges will be maintained a the minimum level necessary to sustain the riparian habitat along Cooper's and San Timoteo Creeks that have historically benefited from Beaumont WWTP. To the extent practical, reductions in discharge should be done in a manner that results in surface water flows that mimic the natural seasonal flow system, which typically begins to decay around the end of April. Higher surface water flows should be maintained in the early and peak growing season (i.e. March through May) and should taper off toward the end of the growing season (i.e. June through October). Lower flows should be maintained during the dormant season (November through February). Reductions in discharge should be implemented gradually and in no case entirely ceased. Discharges should be modulated to maintain surface water flows within the Study Area for at least 76 percent of the year, with peak flows remaining relatively stable from January to June and gradually decreasing as the summer progresses toward late growing season and dormancy. Beaumont WWTP discharges, surface water flow, and groundwater levels will be monitored and compared to riparian habitat health to assess if there is a potential for the riparian habitat to be affected by reduced surface water flows (solely or in combination with other factors at play such as groundwater levels, climate conditions, wildfires, etc.).
3. To the extent practical, reductions in discharge should be done in a manner that maintains sufficient surface water flows to support groundwater levels consistent with the needs of the dominant phreatophyte species. To sustain healthy riparian plant communities throughout the Study Area, groundwater levels should initially be maintained at the historical steady levels that have likely supported the riparian habitat vegetation. High-frequency groundwater level data will be analyzed to ensure that neither rapid and extended increases or decreases in depth to groundwater occur that can adversely impact riparian vegetation at all life stages. The Baseline Monitoring Program will fill groundwater level data gaps to provide better data to characterize the relationship between groundwater levels, surface water flow, and Beaumont WWTP discharges, and help discern groundwater/surface water interactions along the Study Area. Groundwater levels will be measured at high-frequency and compared to riparian habitat health to assess if there is a potential for the riparian habitat to be affected by reduced groundwater levels (solely or in combination with other factors at play such as surface flow, climate conditions, wildfires, etc.).

## 10.0 REFERENCES

Aerial Information Systems, Inc. (AIS). 2015. Vegetation - Western Riverside County Update - 2012 [ds1196]. Vegetation Classification and Mapping Program (VegCAMP), California Department of Fish and Wildlife. Biogeographic Information and Observation System (BIOS). Retrieved November 25, 2024, from http://bios.dfg.ca.gov.

ALDA Inc. and Thomas Harder & Co. prepared for Beaumont Basin Watermaster, October 2, 2024. *2023 Consolidated Annual Report and Engineering Report.*

Bell, G.P. 2002. Ecology and management of Arundo donax, and approaches to riparian habitat restoration in southern California. The Nature Conservancy of New Mexico. 10 pp.

California Invasive Plant Council (CAL-IPC). 2024. The Cal-IPC Inventory [internet]. Available at: https://www.cal-ipc.org/.

California Native Plant Society (CNPS). 2024. A Manual of California Vegetation, Online Edition. http://www.cnps.org/cnps/vegetation/; searched on November 25, 2024. California Native Plant Society, Sacramento, CA.

California Natural Diversity Database (CNDDB). 2024. RareFind 5 [internet]. California Department of Fish and Wildlife, Version 5.3.0. Retrieved November 25, 2024, from https://wildlife.ca.gov/Data/CNDDB/Maps-and-Data.

Dudek. 2021. *Maximum Benefit Monitoring Program 2020 Annual Report for the Beaumont, San Timoteo and Yucaipa Groundwater Management Zones*. Prepared for Yucaipa Valley Water District, 12770 Second Street, Yucaipa, California. April 9.

Dutcher, L.C. and Garrett, A.A. 1963. United States Geological Survey. *Geologic and Hydrologic Features of the San Bernadino Area California.*

Fetter, C.W. 1994. Applied Hydrogeology, third ed. Prentice-Hall Inc., Upper Saddle River, NJ, USA.

Fraser, D.M. 1931. California Division of Mines and Geology. Mining in California v. 27 [p. 494-539]. *Geology of San Jacinto quadrangle south of San Gorgonio Pass, California*

Griffith, G. E., J. M. Omernik, D. W. Smith, T. D. Cook, E. Tallyn, K. Moseley, and C. B. Johnson. 2016. Ecoregions of California (poster): U.S. Geological Survey Open-File Report 2016–1021, with map, scale 1:1,100,000, http://dx.doi.org/10.3133/ofr20161021.

Gary, H. L. 1963. Root distribution of five-stamen tamarisk, seepwillow, and arrowweed For. Sci. 9 311–4.

Green, M. 1990a. Life history account for Wilson's warbler (Wilsonia pusilla) from California Wildlife Habitat Relationships System, California Department of Fish and Game, California Interagency Wildlife Task Group. Originally published in Zeiner, D. C., W. F. Laudenslayer, K. E. Mayer, and M. White, eds. 1988-1990. California's Wildlife. Vol. I-III. California Department of Fish and Game, Sacramento, California.

Green, M. 1990b. Life history account for common yellowthroat (Geothlypis trichas) from California Wildlife Habitat Relationships System, California Department of Fish and Game, California Interagency Wildlife Task Group. Originally published in Zeiner, D. C., W. F. Laudenslayer, K. E. Mayer, and M. White, eds. 1988-1990. California's Wildlife. Vol. I-III. California Department of Fish and Game, Sacramento, California.

Green, M. 1990b. Life history account for song sparrow (Melospiza melodia) from California Wildlife Habitat Relationships System, California Department of Fish and Game, California Interagency Wildlife Task Group. Originally published in Zeiner, D. C., W. F. Laudenslayer, K. E. Mayer, and M. White, eds. 1988-1990. California's Wildlife. Vol. I-III. California Department of Fish and Game, Sacramento, California.

Green, M. 2005a (updated). Life history account for yellow warbler (Dendroica petechia) from California Wildlife Habitat Relationships System, California Department of Fish and Game, California Interagency Wildlife Task Group. Originally published in Zeiner, D. C., W. F. Laudenslayer, K. E. Mayer, and M. White, eds. 1988-1990. California's Wildlife. Vol. I-III. California Department of Fish and Game, Sacramento, California.

Green, M. 2005b (updated). Life history account for yellow-breasted chat (Icteria virens) from California Wildlife Habitat Relationships System, California Department of Fish and Game, California Interagency Wildlife Task Group. Originally published in Zeiner, D. C., W. F. Laudenslayer, K. E. Mayer, and M. White, eds. 1988-1990. California's Wildlife. Vol. I-III. California Department of Fish and Game, Sacramento, California.

Grenfell, W. E. n.d. Description for valley foothill riparian [technical report]. California Wildlife Habitat Relationships System. California Department of Fish and Game, California Interagency Wildlife Task Group.

Griggs, F.T. 2009. California riparian restoration handbook. Second Edition. Sacramento, CA: Riparian Habitat Joint Venture. 77p. Retrieved November 25, 2024, from https://riverpartners.org/initiatives/riparian-restoration-handbook/.

Holland, R. F. 1986. Preliminary descriptions of the terrestrial natural communities of California. Unpublished report, California Department of Fish and Game, Sacramento, CA.

Howe, C. E, 2014. A review of the removal of Arundo donax from a riparian area within San Timoteo Canyon. Electronic Theses, Projects, and Dissertations 106.

Ke, Y., Im, J., Lee, J., Gong, H., and Ryu, Y. 2015. *Characteristics of Landsat 8 OLI-derived NDVI by Comparison with Multiple Sensors and In-Situ Observations. Remote Sensing of Environment v. 164, pg. 298-313.*

Kibler, E. M., E. C. Schmidt, D. A. Roberts, J. C. Stella, L. Kui, A. M. Lambert, and M. B. Singer. 2021. A brown wave of riparian woodland mortality following groundwater declines during the 2012–2019 California drought. Environmental Research Letters 16(8), 084030.

Lite, S.J., J.C. Stromberg. 2005. Surface water and ground-water thresholds for maintaining Populus–Salix forests, San Pedro River, Arizona. Biological Conservation 125 153-167.

Mahoney, J.M. and S.B. Rood. 1992. Response of a hybrid poplar to water table decline in different substrates. Forest Ecology and Management 54 141–156.

Mitsch, W.J. and Gosselink, J.G. 2015. Wetlands. Fifth Edition, John Wiley & Sons, Inc., Hoboken, New Jersey.

Markon, C., Fleming, M., and Binnian, E. 1995. *Characteristics of Vegetation Phenology over Alaskan Landscape using AVHRR Time-Series Data. Polar Records v. 31, pg.179-190.*

Markon, C., and Peterson, K. 2002. *The Utility of Estimating Net Primary Productivity over Alaska Using Baseline AVHRR Data. International Journal of Remote Sensing, v.23, pg. 4571-4596.*

Morton, D.M. and Miller, F.K. 2006. United States Geological Survey. *Geologic Map of the San Bernadino and Santa Ana 30' x 60' Quadrangles, California.*

Natural Resources Conservation Service (NRCS). 2007. Early successional habitat. Fish and Wildlife Habitat Management Leaflet 41 1-16.

Pettorelli, N. 2013. *The Normalized Difference Vegetation Index. First edition*. Published 2013 by Oxford University Press.

Prism Climate Group. 2024. Accessed at https://prism.oregonstate.edu/recent/ on October 1, 2023.

Rewis, D.L., Christensen, A.H., Matti, J.C., Hevesi, J.A., Nishikawa, T. and Martin, P. 2006. United States Geological Survey. Scientific Investigations Report 2006–5026. *Geology, Ground-Water Hydrology, Geochemistry, and Ground-Water Simulation of the Beaumont and Banning Storage Units, San Gorgonio Pass Area, Riverside County, California.*

Riparian Habitat Joint Venture (RHJV). 2004. Version 2.0. The riparian bird conservation plan: a strategy for reversing the decline of riparian associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/pdfs/riparian.v-2.pdf.

Rood, S. B., S. G. Bigelow, and A. A. Hall. 2011. Root architecture of riparian trees: river cut-banks provide natural hydraulic excavation, revealing that cottonwoods are facultative phreatophytes. Trees 25 907–17.

Shafroth, P. B., J. C. Stromberg, and D. T. Patten. 2000. Woody riparian vegetation response to different alluvial water table regimes. West. N. Am. Nat. 60 66–76.

Sogge, M.K., D. Ahlers, and S. J. Sferra. 2010. A natural history summary and survey protocol for the Southwestern Willow Flycatcher: U.S. Geological Survey Techniques and Methods 2A-10, 38 p.

State of California Regional Water Quality Control Board, Santa Ana Region. 2015. *Waste Discharge Requirements and Master Reclamation Permit for the City of Beaumont Beaumont Wastewater Treatment Plant Riverside County.* Order No. R-2015-0026, NPDES No. CA 0105376.

Stover, J., E. Keller, T. Dudley, and E. Langendoen. 2018. Fluvial geomorphology, root distribution, and tensile strength of the invasive giant reed, Arundo donax and its role on stream bank stability in the Santa Clara River. Southern California Geosciences 8 304.

Stromberg, J.C., R. Tiller, B. Richter. 1996. Effects of ground water decline on riparian vegetation of semi-arid regions: The San Pedro River, AZ. Ecological Applications 6 113–131.

Stromberg, J. 2013. Root patterns and hydrogeomorphic niches of riparian plants in the American Southwest. Journal of Arid Environments 94 1-9. Appendix B. Rooting data for shrubs and trees.

United States Census, 2020. Accessed at https://data.census.gov/profile/Beaumont_city,_California?g=160XX00US0604758 on November 8, 2024.

United State Geological Survey. 2017b. User Guide – Earth Resources Observation and Science (EROS) Center Science Processing Architecture (ESPA) On Demand Interface. Version 3.7. January 2017.

Western Pond Turtle Range-wide Conservation Coalition. 2020. Western Pond Turtle Range-wide Management Strategy. 24 pp.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2007. WRC-MSHCP Biological Monitoring Program, Riparian Bird Survey Report 2006 [technical report], April 23, 2007.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2008. WRC-MSHCP Biological Monitoring Program, Riparian Bird Survey Report 2007 [technical report], 13 March 2008.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2009a. WRC-MSHCP Biological Monitoring Program, Carnivore Survey Report 2008 [technical report], 15 April 2009.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2009b. WRC-MSHCP Biological Monitoring Program, Coastal California Gnatcatcher, Least Bell's Vireo, Southwestern Willow Flycatcher, Yellow-breasted Chat, and Yellow Warbler Nesting Report 2008 [technical report], 19 April 2009.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2010a. WRC-MSHCP Biological Monitoring Program, Carnivore Survey Report 2009 [technical report], 23 April 2010.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2010b. WRC-MSHCP Biological Monitoring Program, Overwintering Raptor Survey Report 2009 [technical report], 23 April 2010.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2011. WRC-MSHCP Biological Monitoring Program, Carnivore Survey Report 2010 [technical report], 23 March 2011.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2012a. WRC-MSHCP Biological Monitoring Program, Carnivore Survey Report 2011 [technical report], 20 April 2012.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2012b. WRC-MSHCP Biological Monitoring Program, Riparian Bird Surveys and Nest Monitoring, 2011 [technical report], 2 April 2012.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2015. WRC-MSHCP Biological Monitoring Program, 2014 Riparian Bird Survey Report [technical report], 15 June 2015.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2018a. WRC-MSHCP Biological Monitoring Program, 2017 White-tailed Kite (Elanus leucurus) Survey Report [technical report], 4 April 2018.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2018b. WRC-MSHCP Biological Monitoring Program, 2017 Riparian Bird Surveys and Nest Monitoring Report [technical report], 4 April 2018.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2020. WRC-MSHCP Biological Monitoring Program, 2019 Riparian Birds Survey and Nest Monitoring Report [technical report], 15 April 2020.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2021a. WRC-MSHCP Biological Monitoring Program, 2020 White-tailed Kite (Elanus leucurus) Survey Report [technical report], 28 April 2021.

Western Riverside County – Multiple Species Habitat Conservation Plan (WRC-MSHCP). 2021b. WRC-MSHCP Biological Monitoring Program, 2020 Least Bell's Vireo Surveys and Nest Monitoring [technical report], June 2021.

Wildermuth Environmental, Inc. prepared for San Timoteo Watershed Management Authority. June 2005. *Integrated Regional Water Management Program for the San Timoteo Watershed (Formerly, San Timoteo Watershed Management Program).*

Williams, J. J. C. Stella, S. L. Voelker, A. M. Lambert, L. M. Pelletier, J. E. Drake, J. M. Friedman, D. A. Roberts, M. B. Singer. 2022. Local groundwater decline exacerbates response of dryland riparian woodlands to climatic drought. Glob. Chang. Biol. 28 6771–6788.

Zimmerman, R. C. 1969. Plant Ecology of an Arid Basin: Tres Alamos-Redington Area, Southeastern Arizona (U.S. Department of the Interior) Geological Survey Professional Paper No. 485, available at: https://pubs.usgs.gov/pp/0485d/report.pdf.

# Appendix A

## Draft Technical Memorandum, Initial Goals, Objectives and Performance Criteria for the City of Beaumont Adaptive Management and Mitigation Program (AMMP), December 21, 2023

WEST YOST
Water. Engineered.

23692 Birtcher Drive
Lake Forest CA 92630

949.420.3030 phone
530.756.5991 fax
westyost.com

# TECHNICAL MEMORANDUM

DATE: December 21, 2023

Project No.: 1113-80-23-01
SENT VIA: EMAIL

TO: Thaxton VanBelle (City of Beaumont)
Sunshine Sanchez (City of Beaumont)

CC: Kaitlyn Dodson-Hamilton (Tom Dodson & Associates)
Lisa Patterson (HDR)

FROM: Clay Sorensen, PG, CHG

REVIEWED BY: Samantha Adams

SUBJECT: Initial Goals, Objectives, and Performance Criteria for the City of Beaumont Adaptive Management and Mitigation Program (AMMP)

DRAFT

## INTRODUCTION

The City of Beaumont (City or Beaumont) plans to reduce the discharge of treated wastewater from the Beaumont Wastewater Treatment Plant (WWTP) to Cooper's Creek. To reduce the volume of discharge, the City must file a Wastewater Change Petition (Change Petition) with the State Water Resources Control Board (SWRCB), Division of Water Rights. When the City first discussed the plan to apply for a change petition with the SWRCB, the Division of Water Rights staff advised that the City develop an Adaptive Management and Mitigation Program (AMMP) to aid in the process of approving the reduced discharge. The purpose of the AMMP is to ensure there is a plan and program in place to assess and mitigate, if necessary, any impacts that result from reducing the WWTP discharge to Cooper's Creek. The City contracted with Tom Dodson & Associates (TDA), West Yost, and Lisa Patterson of HDR (collectively referred to as the Consultant Team) to develop the AMMP and support the change petition process.

The AMMP will be developed in three phases, as follows:

- Phase 1 – characterize historical and current conditions to support development of the AMMP.
- Phase 2 – assess the feasibility of reduced discharge and perform initial baseline monitoring.
- Phase 3 – prepare the AMMP.

The Consultant Team is currently performing Phase 1 of the AMMP. The objective of Phase 1 is to characterize the historical and current conditions of the study area in support of the development of the AMMP. This will be completed through the following tasks/steps:

- Task 2 – Establish initial goals, objectives, and project performance criteria.
- Task 3 – Characterize historical discharge and surface water flow hydrology.

- Task 4 – Characterize historical riparian habitat health (NDVI).
- Task 5 – Characterize historical and existing biological resources.
- Task 6 – Identify potential impacts to biological resources from reduced discharge to Cooper's Creek.
- Task 7 – Assess available tools for analyzing surface water and groundwater impacts.
- Task 8 – Prepare *Cooper's Creek Habitat Characterization and Sustainability Report*.

The City and Consultant Team held a kick-off meeting on September 20, 2023 and a follow-up meeting on October 31, 2023 to discuss the general requirements of the AMMP and the goals for the City in obtaining the Change Petition. This Technical Memorandum (TM) outlines the initial goals, objectives, and performance criteria. This TM should be considered a "living document" and may be updated during the Phase 1 portion of the project as the Consultant Team learns more or the goals of the City change based on new information.

Ultimately, the information in this TM will be incorporated into the Phase 1 deliverable that will be completed in 2024 – *Cooper's Creek Habitat Characterization and Sustainability Report*. The remainder of this TM is organized into the following sections:

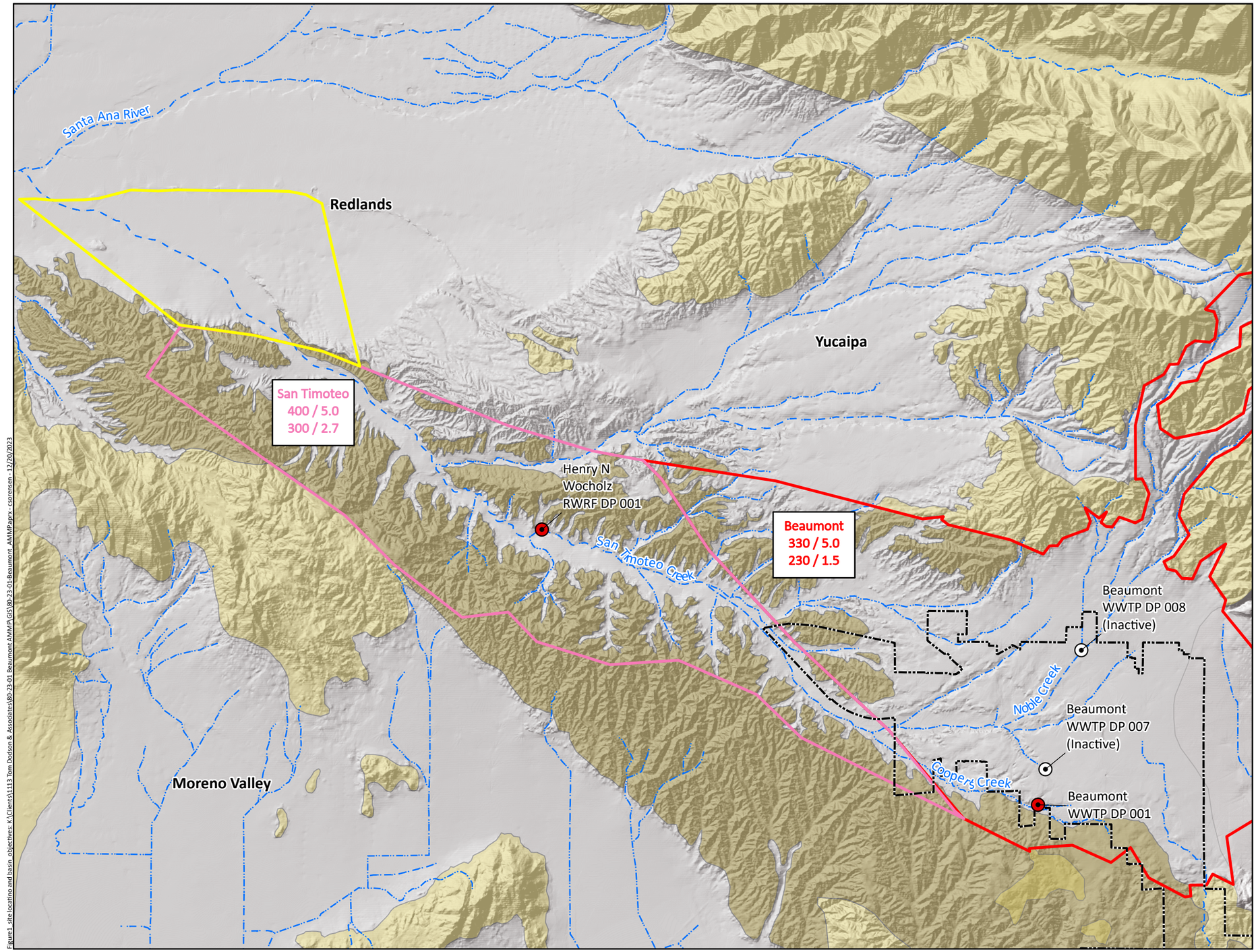
- Introduction
- Background and Regulatory Setting
- Initial Goals, Objectives, and Performance Criteria
- Study Area and Available Data
- Next Steps

## BACKGROUND AND REGULATORY SETTING

Beaumont owns and operates the only WWTP for the City. According to the City, discharge to Cooper's Creek from the original WWTP began sometime in the 1920s. The WWTP and discharge operations have been modified over time with population growth and changing regulations. The discharge volume from the WWTP began to increase significantly around 2004, concurrent with rapid development throughout the City service area. In 2020, the WWTP was upgraded to include advanced treatment of a portion of the tertiary treated effluent. The WWTP now treats and disinfects wastewater using a combination of membrane bioreactor (MBR), reverse osmosis (RO), and ultraviolet (UV) treatments. All tertiary and advanced treated water is blended and then discharged to Cooper's Creek at rates ranging between 3.5 and 3.7 million gallons per day (MGD). Brine generated from the RO system is pumped through a City-owned private brine line approximately 23 miles in length that connects to the Santa Ana Regional Interceptor (SARI) line. The SARI line is owned and operated by the Santa Ana Watershed Project Authority (SAWPA).

The treated wastewater is discharged via one outfall to Cooper's Creek: Discharge Point 001 (DP-001). Historically, two additional wastewater discharge points were permitted within the City's limits: DP-007 to an unnamed tributary of Marshall Creek and DP-008 to Noble Creek. The City only operated outfall DP-007 from March 2010 to August 2015 and there is no record of discharges to outfall DP-008. Cooper's Creek flows into San Timoteo Creek approximately 3 miles downstream of DP-001. San Timoteo Creek is tributary to the Santa Ana River in Colton, California. Figure 1 is a location map of the region showing the City boundary, Beaumont WWTP, local surface water tributaries, and current and historical DPs.

DRAFT




WWTP Discharge Point (active)

WWTP Discharge Point (inactive)

Streams

City of Beaumont

Bunker Hill GMZ (portion)

San Timoteo GMZ

Beaumont GMZ

**Beaumont**
**330 / 5.0**
**230 / 1.5**

GMZ maximum benefit (top values) and antidegradation (bottom values) water quality objectives for TDS (left values) and nitrate as nitrogen (right values)

Notes:
1. GMZ - groundwater management zone
2. WWTP - wastewater treatment plant
3. TDS - total dissolved solids

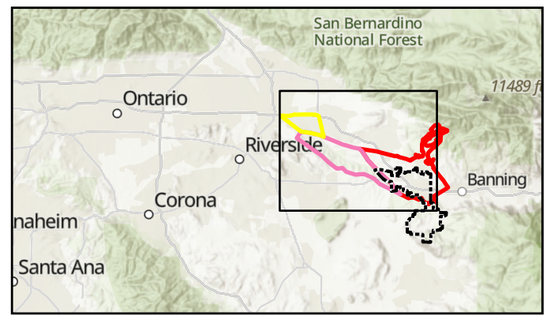



Figure1_site location and basin_objectives; K:\Clients\1113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01 Beaumont AMMP.aprx - csorensen - 12/20/2023

Prepared by:

WEST YOST

N

0 2 Miles

0 2 Km

Prepared for:

**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Site Location and Water Quality Objectives Map**
*City of Beaumont AMMP*

**DRAFT Figure 1**

Discharge from the Beaumont WWTP is regulated by the Santa Ana Regional Water Quality Control Board (Santa Ana Water Board) in accordance with the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan). The Basin Plan defines groundwater management zones (GMZs) and surface water bodies with beneficial uses and water quality objectives which must be considered by the Regional Board in permitting discharges. The Basin Plan contains a detailed regional salt and nutrient management plan (SNMP) that supports the Water Board's process to establish discharge limitations for total dissolved solids (TDS) and nitrate that are protective of receiving water bodies, namely surface water and GMZs of the Santa Ana region. In some cases, the Basin Plan SNMP contains GMZ-specific SNMPs known as maximum-benefit SNMPs. These GMZ-specific SNMPs allow for less-stringent TDS and nitrate groundwater objectives to enable local agencies to maximize recycled water reuse for the benefit of water resources management. Access to the less-stringent maximum-benefit based water quality objectives requires the sponsoring agencies to implement a program of projects and management actions, known as Maximum Benefit commitments, to ensure the long-term protection of beneficial uses of the affected GMZs.

The City's discharge activities are located within the Beaumont and San Timoteo GMZs, both of which have Maximum Benefit SNMPs defined in the Basin Plan. The boundaries of the Beaumont and San Timoteo GMZs, and their associated TDS and nitrate Maximum Benefit objectives, are shown on Figure 1. The City is a joint responsible agency for the Beaumont and San Timoteo Maximum Benefit SNMPs. The other joint responsible agencies for the Beaumont GMZ include the Yucaipa Valley Water District (YVWD), the Beaumont Cherry Valley Water District (BCVWD), the City of Banning, and the San Gorgonio Pass Water Agency. The other joint responsible agency for the San Timoteo GMZ is the YVWD. YVWD also has treated wastewater discharges to San Timoteo Creek, from the Henry N Wocholz Regional Water Recycling Facility.

In 2014, the Maximum Benefit SNMPs for the Beaumont and San Timoteo were updated (Basin Plan Amendment R8-2014-0005). Under the amended SNMP for the San Timoteo GMZ, both YVWD and the City were required to produce a non-potable (recycled water) supply with a 10-year volume-weighted running average TDS concentration of 400 milligrams per liter (mgl) or less and nitrate-nitrogen concentration of 6.7 mgl or less. The City was further required to limit the TDS and TIN concentration for discharges in excess of 1.8 mgd to 300 mgl and 3.6 mgl. The lower limits are based on the original antidegradation objectives for TDS and nitrate that existed prior to the adoption of the Maximum Benefit SNMP for the San Timoteo GMZ. The amendment also triggered updates to the permits for the City and YVWD discharges to the Beaumont and San Timoteo GMZs. At the time of amendment, the City's treated effluent had a TDS concentration of about 430 mgl TDS and 1.70 mgl TIN.

In 2015, the Santa Ana Water Board adopted National Pollutant Discharge Elimination System (NPDES) Permit No. CA0105376 to regulate the City's discharge in accordance with the amended Basin Plan. The permit is valid through October 31, 2027. The updated NPDES permit requires the City to document all flow and concentrations that exceeded the 400 mgl TDS and 6.7 mgl TIN limits (up to 1.8 MGD) and 300 mgl (for flows exceeding 1.8 MGD) and "offset" the total amount that was discharged above these limits (Santa Ana RWQCB, 2015). The offset will be achieved by discharging at TDS and TIN concentrations lower than the limits for a period of time until the long-term average meets the required targets. The RWQCB acknowledged that the City would be unable to offset its TDS liabilities until the new RO system was constructed (Santa Ana RWQCB, 2015). The RWQCB set a date of January 1, 2025 to fully offset of the excess salts discharged. Due to delays in completing construction of the upgraded Beaumont WWTP, the City estimates that the offsets will not be completed until 2027 (Santa Ana RWQCB, 2015). To meet the obligation, the City has a goal to discharge effluent at TDS concentrations of 200 mgl or less through 2027.

DRAFT

Now that the City's upgraded WWTP is fully operational and the offset process is underway, the City wants to move forward with its plans to reduce the discharge to Cooper's Creek so that the recycled water may be put to maximum beneficial use within the Beaumont GMZ. The recycled water will be used as a not-potable supply for City customers, and potentially other future projects such as groundwater recharge. All of the non-potable supply system infrastructure is in place and ready to receive the recycled water supply. The primary limitation to moving forward with the non-potable supply deliveries is obtaining the Change Petition from the SWRCB Division of Water Rights. The development of the AMMP is a critical step in the approval of a Change Petition.

## INITIAL GOALS, OBJECTIVES, AND PERFORMANCE CRITERIA

The following subsections describe the established initial goals, objectives, and performance criteria the City would like to see during the drafting and implementation of the AMMP.

### Description of Established Goals and Objectives

The City's goals for the AMMP are as follows:

1. Obtain approval for the lowest feasible discharge volume to enable the City to maximize the amount of recycled water that can be used for planned non-potable supply projects in the City service area, as well as for potential future projects for non-potable supply or recharge in the Beaumont groundwater basin.
2. Appropriately characterize the various climate, hydrogeologic, and other factors that have contributed to the extent and health of the riparian habitat that may also have historically benefited from the City's discharges.
3. Avoid unmitigable degradation to riparian habitat that could result through development of a robust monitoring and mitigation plan to address degradation to riparian habitat health due to decreased discharge from DP-001.
4. Utilize existing monitoring programs and analytical tools to the extent practical to avoid duplicative work and achieve cost efficiency.
5. Establish a dialogue with other dischargers in the area to promote collaboration, openness, sharing of ideas and actions, and to promote the success of the project with stakeholders and/or other dischargers. The other discharge in the region is the YVWD.
6. Establish a dialog with the SWRCB Division of Water Rights to ensure the development of an AMMP that meets expectations and a process to gain approval of the Change Petition.

Given its many investments in the Beaumont WWTP upgrades and non-potable supply system infrastructure, goal number one is the primary goal for the City. Designing an AMMP to minimize discharge to meet this goal will likely mean more robust mitigation actions be considered in the AMMP. This will in turn potentially require more robust modeling efforts to assess the long-term effects of reduced discharges as it pertains to riparian health. The goals for open communication with other local stakeholders and regulators will also be critical to achieving goal number one. A key local stakeholder is the YVWD due to its downstream discharges on San Timoteo Creek. Any changes to the City's discharge could impact how the YVWD manages its discharge and any requirements to manage riparian habitat.

The City plans to accomplish these goals with the support of the Consultant Team through the development and implementation of the AMMP. The Consultant Teams objectives in support of the City's goals for Phase 1 of the AMMP are as follows:

1. Quantify the extent and health of the riparian habitat in the immediate vicinity of DP-00 and downstream areas that may have benefitted from the City's discharges.
2. Quantify the climate and hydrogeologic factors that have contributed to the extent and health of the riparian habitat.
3. Characterize the range of hydrogeologic conditions that contribute to healthy riparian habitat.
4. Define the extent of riparian habitat that benefited from discharges from the City's WWTP on Cooper's Creek and identify the potential impacts to riparian habitat and hydrogeologic conditions from reduced discharges.
5. Define data gaps and uncertainties that exist in defining the baseline condition of the riparian and hydrogeologic conditions (e.g., current conditions based on current discharge rates at DP-001).
6. Define a monitoring program necessary to fill the data gaps and uncertainties in the baseline conditions.
7. Define the analytical tools needed to assess impacts to the hydrogeologic at various levels of reduced discharge.
8. Establish a process for external communication with stakeholders.

## Performance Criteria

Performance criteria are defined as a specific set of measurable standards used to evaluate the success of the AMMP. For the purposes of this study, the performance criteria will be defined following completion of Task 3 – historical characterization of the hydrology, and Task 4 – historical characterization of riparian habitat health. This document may be updated with specific performance criteria as more is understood following historical characterization of riparian habitat health and comparison to the hydrology that supports it.

# STUDY AREA AND AVAILABLE DATA

This section describes the study are and available data that will be analyzed on by the Consultant Team in achieving the objectives outlined above.

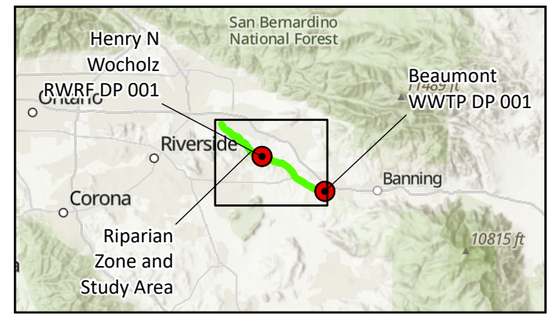
The study area is broken into two components – the riparian ecosystem and the hydrogeologic system. The riparian habitat zone is defined as the extent of the tree line along the surface water systems of Cooper's Creek just upstream of the Beaumont WWTP (upstream extent) to San Timoteo Creek where the channel transitions from a natural bottom to a concrete-lined channel near the intersection of Barton Road and Romero Road in Redlands, CA. The hydrogeological study area boundary is defined as the Beaumont GMZ, San Timoteo GMZ, and a portion of the Bunker Hill-B GMZ, which are the groundwater systems that are potentially interconnected with the surface water system. The Bunker Hill-B GMZ is included in the study area, at least initially, because the downstream end of the unlined portion of San Timoteo creek extends into this GMZ. The two study area extents are shown on Figures 1 and 2.

Riparian Zone and Study Segments

- Cooper's Creek 1
- San Timoteo 1
- San Timoteo 2
- San Timoteo 3
- San Timoteo 4
- Focus Areas
- WWTP Discharge Point
- Streams

Notes:

1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant




Prepared by:

WEST YOST

N

0 2 4 Miles

0 2 4 Km

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

**Riparian Zone, Study Segments, and Focus Areas**

*City of Beaumont AMMP*

**DRAFT Figure 2**

Figure2NDVI_Overview, K:\Clients\1113 Tom Dodson & Associates\60-23-01 Beaumont AMMP\GIS\60-23-01-Beaumont_AMMP.aprx - <coreyen - 12/20/2023

## Existing and Historical Characterization of Riparian Habitat

Existing characterization of riparian habitat will occur through biological resource assessments along the riparian corridor of the study area. Based on discussions with the Consultant Team's Biologist, this will occur in two ways:

1. Coordination with the Santa Ana Watershed Association (SAWA), who conducts biological monitoring activities within the San Timoteo Canyon area and reports yearly on the biological health of the entire Santa Ana Watershed. The current monitoring data spans from 2000 to 2021.
2. The Consultant Team Biologist will perform targeted biological resource assessments within the Cooper's Creek riparian corridor and outside of the scope of the SAWA biological activities.

Additionally, the historical and current extent and quality of the riparian habitat will be characterized using Normalized Difference Vegetation Index (NDVI) data, which is available for free from the United States Geological Survey (USGS) Landsat database.[1] NDVI is a numerical value ranging from -1 to 1 that represents vegetation health. NDVI is derived from satellite imagery and is the normalized difference between the near-infrared (reflected by vegetation) and red light (absorbed by vegetation). Larger NDVI values (NDVI of 0.6 or higher) indicate healthier vegetation, while NDVI values closer to zero indicate bare soil or unhealthy vegetation. A negative NDVI value may indicate a waterbody. The NDVI data for the study area is available and of good quality dating back to 1982. Current NDVI data is available from USGS at approximately two to four times per month.

Two scales of NDVI data will be evaluated for this study for the period of Water Year 1983 to 2023. The two scales are described below:

- **Study Segments** are defined as sub-segments of the riparian habitat boundary extent. The segments are delineated based on hydrological characteristics, changes to the observed riparian vegetation, or inputs to the stream(s) such as confluences with other creeks. There are a total of five study segments, ranging from approximately 4.7 to 12 miles in length. The segments will be evaluated and compared against each other to characterize riparian health on a broad scale. The Study Segments are named as follows:
  - Cooper's Creek 1
  - San Timoteo 1
  - San Timoteo 2
  - San Timoteo 3
  - San Timoteo 4

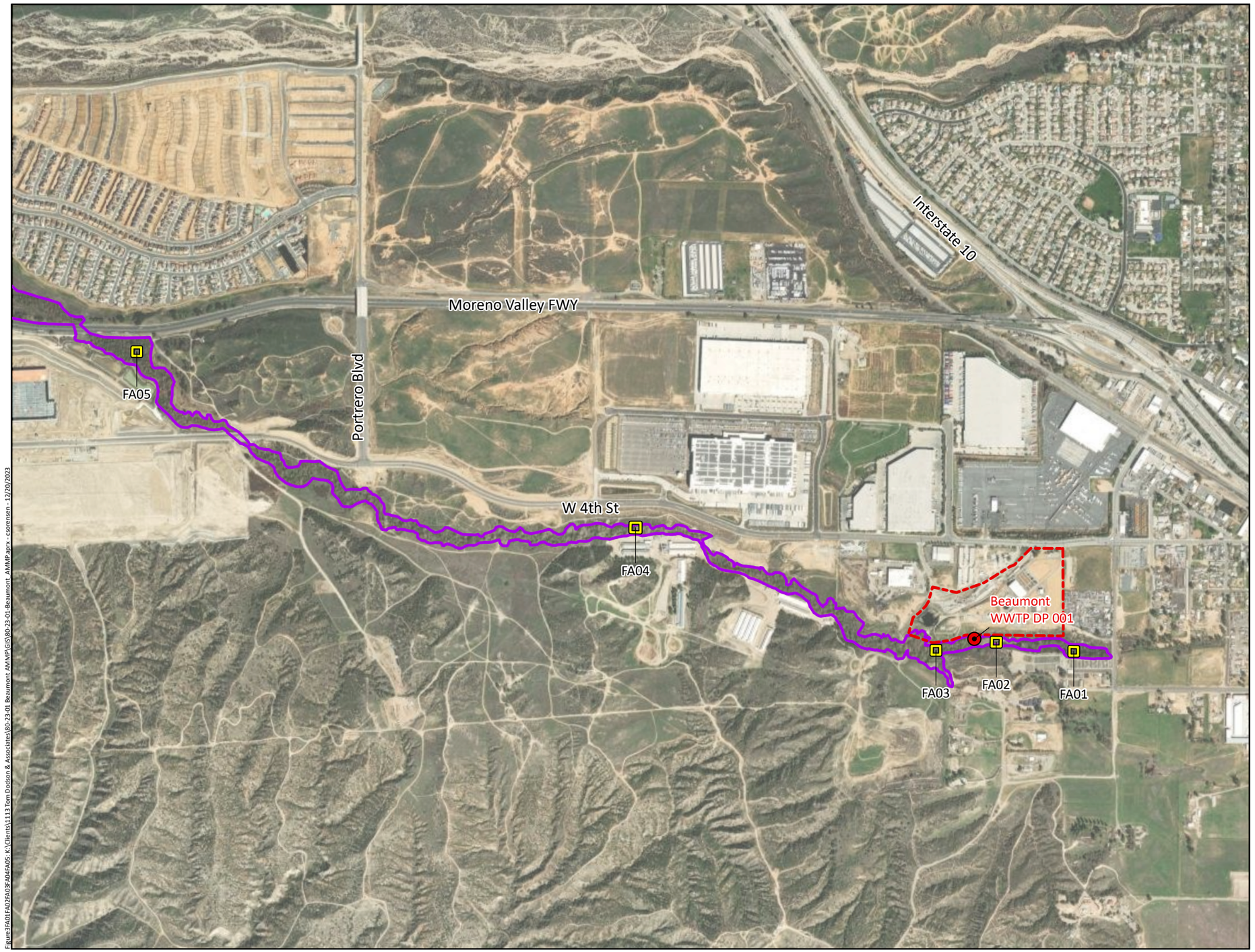
- **Focus Areas** are defined as small 30-by-30-meter areas (made up of individual NDVI pixels) along the riparian habitat Study Segments. There are a total of 13 focus areas that will be used to evaluate riparian health at a finer scale. The focus areas were generally placed before or after inputs to the study area such as WWTP discharge points, stream confluences, or visible changes to the riparian vegetation. Additional focus points were sited at an approximate spacing of 11,000 feet in between the input focus points.

[1] https://www.usgs.gov/landsat-missions/landsat-data-access

The Study Segments and Focus Areas are shown on Figure 2. Maps of the individual Study Segments and associated Focus Areas are shown on the following figures:

- Figure 3: Focus Areas 1 through 5 and a portion of Study Segment Cooper's Creek 1
- Figure 4: Focus Areas 6 through 8 and portions of Study Segments Cooper's Creek 1 and San Timoteo 1
- Figure 5: Focus Areas 9 through 11 and portions of Study Segments San Timoteo 2 and 3
- Figure 6: Focus Areas 12 and 13 and portions of Study Segments San Timoteo 3 and 4

DRAFT

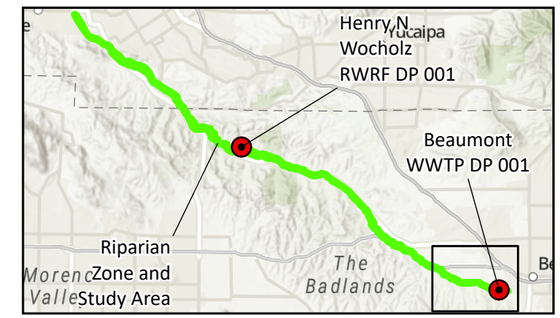



Riparian Zone and Study Segments

- Cooper's Creek 1
- Focus Areas
- WWTP Discharge Point
- Beaumont WWTP Boundary

Notes:

1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant




Prepared by:

WEST YOST

N

0 1 Miles

0 1,000 2,000 Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Focus Areas FA01, FA02, FA03, FA04, and FA05 for NDVI Analysis**

*City of Beaumont AMMP*

**DRAFT Figure 3**

Figure3FA01FA02FA03FA04FA05.mxd Client\11113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01-Beaumont_AMMP.aprx - csorensen - 12/20/2023

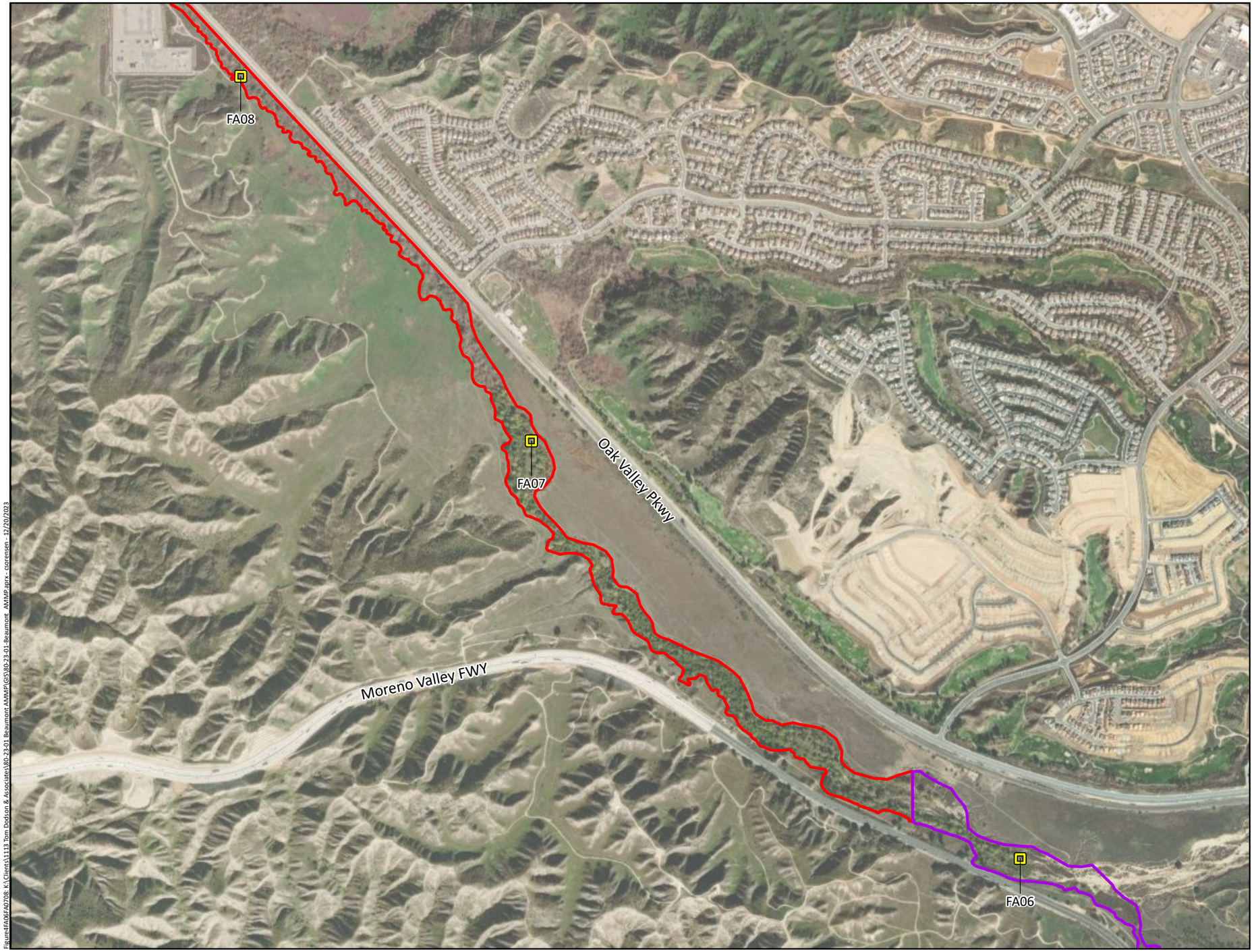


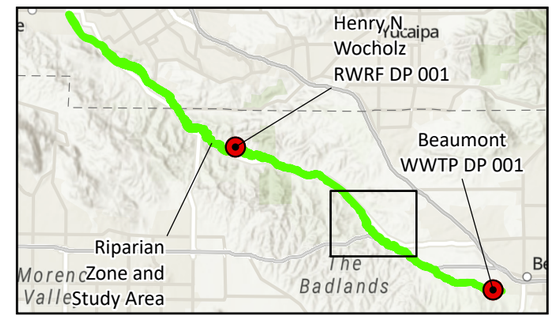

Figure4FA06FA07&8; K:\Clients\11113 Tom Dodson & Associates\60-23-01 Beaumont AMMP\GIS\60-23-01-Beaumont_AMMP.aprx - cconnon - 12/20/2023

## Riparian Zone and Study Segments

- Cooper's Creek 1
- San Timoteo 1
- Focus Areas

Notes:

1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant




Prepared by:

WEST YOST

N

0 1 Miles

0 1,000 2,000 Feet

Prepared for:

**City of Beaumont**

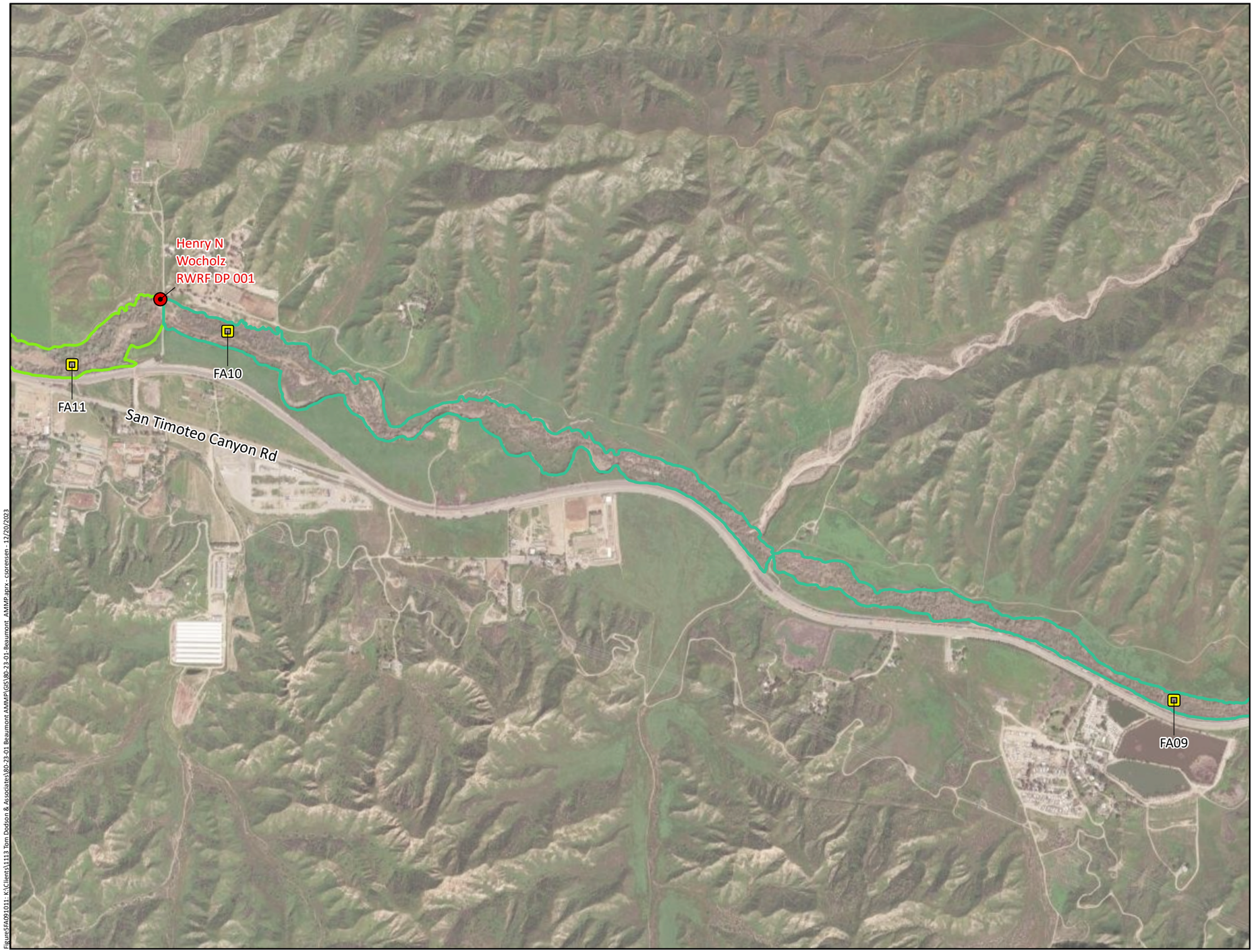
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Focus Areas FA06, FA07, and FA08 for NDVI Data Analysis**

*City of Beaumont AMMP*

**DRAFT Figure 4**

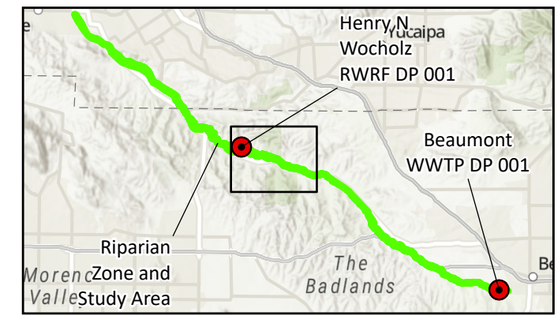



## Riparian Zone and Study Segments

- San Timoteo 2
- San Timoteo 3
- Focus Areas
- WWTP Discharge Point

Notes:

1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant




Prepared by:

WEST YOST

N

0 1 Miles

0 1,000 2,000 Feet

Prepared for:

**City of Beaumont**

*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Focus Areas FA09, FA10, and FA11 for NDVI Data Analysis**

*City of Beaumont AMMP*

**DRAFT Figure 5**

Figure5FA091011: K:\Client\11113 Tom Dodson & Associates\30-23-01 Beaumont AMMP\GIS\30-23-01-Beaumont_AMMP.aprx - csorensen - 12/20/2023

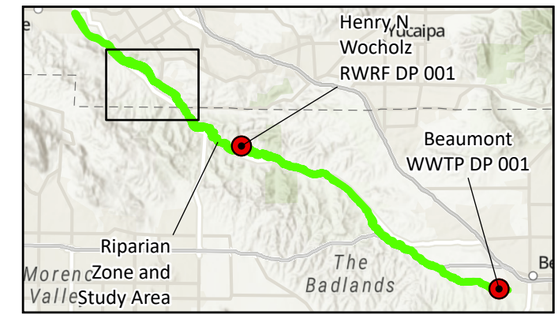
Figure6FA12FA13: K:\Clients\1113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01-Beaumont_AMMP.aprx - csorensen - 12/20/2023

## Riparian Zone and Study Segments

- San Timoteo 3
- San Timoteo 4
- Focus Areas

Notes:

1. Riparian Zone was drawn using tree line.
2. Study Segments are sections of the riparian corridor that will be studied on a larger scale using the NDVI dataset.
3. Focus Areas are spaced approximately 11,000 feet along the extent of the study area as well as before and after important features such as waste discharge points and stream confluences.
4. Focus Areas are defined as a one pixel area (30 meters x 30 meters) of NDVI data.
5. WWTP - wastewater treatment plant




Prepared by:

WEST YOST

N

0 1 Miles

0 1,000 2,000 Feet

Prepared for:

**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Focus Areas FA12 and FA13 for NDVI Data Analysis**
*City of Beaumont AMMP*

**DRAFT Figure 6**

# Existing and Historical Characterization of Climate and Hydrogeology

## *Climate Data Sources*

The Consultant Team will prepare a characterization of the historical and current climate conditions that can be used to evaluate how the conditions may or may not correlate to the riparian habitat extent and health and to hydrogeologic conditions. Climate conditions will be evaluated at the regional scale of the study using a long-term, gridded data set from the PRISM climate group.[2] The gridded dataset is a based on all available precipitation and climate gages in the region to create a long-term record of precipitation and temperature.

## *Hydrogeology Data Sources*

Surface water and groundwater monitoring has been performed for various purposes over time within the study areas. Figures 7 and 8 show the location of know historical and current surface and groundwater monitoring stations in the hydrogeologic study area that are proximate to the riparian habitat study area[3]. The Consultant Team will prepare a characterization of the historical and current climate and hydrogeologic conditions that can be used to evaluate how the conditions may or may not correlate to the riparian habitat extent and health.

Table 1 lists the groundwater monitoring locations and Table 2 lists the surface water monitoring locations shown in Figures 8 and 9. Tables 1 and 2 also describe the availability of historical data of interest within the existing records of the Consultant Team, including groundwater levels and quality, surface water flow and quality, and YVWD and Beaumont WWTP discharge and quality. The water quality parameters of interest to the study include TDS, nitrate, and the major anions and cations that can be used to perform simple source-water fingerprinting (calcium, sodium, magnesium, potassium, alkalinity, chloride, and sulfate). The objective of source water fingerprinting is to understand surface and groundwater interactions (and how they've changed over time) – including understanding the influence of the recycled water discharge on the quality of both water systems.

Tables 1 and 2 show data available within West Yost's database. The availability of data within West Yost's database is shown on Tables 1 and 2 and are summarized generally below:

<u>Groundwater (Table 1):</u>

- TDS and nitrate water quality data is generally available until December 2021, but general minerals data is only available through December 2014.
- Water level data is generally available until December 2014.

<u>Surface water (Table 2):</u>

- Water quality data is generally available until 2013 for surface water discharge and July 2018 for WWTP effluent.

[2] https://prism.oregonstate.edu/

[3] There are more monitoring sites in the GMZs, but these are excluded because they are not in proximity to the riparian habitat boundary.

- Flow data is generally available until 2013, while effluent data until July 2018.

The Consultant Team has determined that the data needed to fill the data gaps to create complete records through December 2021 are readily available and will be collected from the following sources:

- The Santa Ana Watershed Project Authority's Basin Monitoring Program Task Force database (groundwater level and quality in Santa Ana Region GMZs for the period of 2013 through 2021).
- The Maximum Benefit SNMP Monitoring Programs (surface water discharge and surface water quality for 2013 to 2022; groundwater level and quality for 2022).
- The California Integrated Water Quality System Project (CIWQS)[4] (Beaumont and YVWD effluent discharge rates and quality through the present).

DRAFT

[4] https://www.waterboards.ca.gov/water_issues/programs/ciwqs/

**Table 1. Groundwater Monitoring Locations for the City of Beaumont AMMP**

| Well Name | Owner | Data Type (WL, WQ, or Both) | Data in West Yost Database | | | |
|---|---|---|---|---|---|---|
| | | | Water Quality | | Water Level | |
| | | | Start Date | End Date | Start Date | End Date |
| Beaumont Management Zone | | | | | | |
| Beaumont/Hiway60 | United States, Geological Survey (USGS) | Both | 7/21/1932 | 11/6/1973 | 10/10/1926 | 10/23/2008 |
| 2 | Dowling, Francis M | Both | 9/28/2006 | 11/13/2007 | 7/20/2006 | 12/30/2014 |
| NA_1004370 | Pistilli, Joe | Both | 9/28/2006 | 11/11/2021 | 11/9/1994 | 12/24/2014 |
| NA_1006182 | Almo, M.C. | Both | 9/28/2006 | 12/24/2014 | 8/21/2006 | 12/24/2014 |
| NA_1206892 | Witter George G | Both | 3/17/2011 | 11/11/2021 | 5/19/2006 | 12/22/2014 |
| A | East Valley Golf Club | Both | 1/16/2003 | 11/10/2021 | 10/25/2000 | 12/1/2014 |
| C | East Valley Golf Club | Both | 5/31/2002 | 5/31/2002 | 4/26/2000 | 12/30/2014 |
| Ranch Well | MCM Poultry | Both | 9/28/2006 | 11/9/2021 | 5/25/2006 | 12/30/2014 |
| Dowling Orchard | Dowling, Francis M | Both | 10/5/2009 | 11/10/2021 | 4/23/2009 | 12/23/2014 |
| OBMW-1 | Riverside County Waste Management Department | Both | 1/31/2005 | 12/13/2021 | 1/31/2005 | 10/2/2013 |
| OBMW-2 | Riverside County Waste Management Department | Both | 1/31/2005 | 12/13/2021 | 1/31/2005 | 10/2/2013 |
| OBMW-3 | Riverside County Waste Management Department | Both | 1/31/2005 | 12/13/2021 | 1/31/2005 | 10/2/2013 |
| OBMW-4 | Riverside County Waste Management Department | Both | 1/31/2005 | 12/13/2021 | 1/31/2005 | 10/2/2013 |
| MW1 | State of California, Department of Water Resources | WL | na | na | 11/8/2005 | 11/14/2012 |
| MW2 | State of California, Department of Water Resources | WL | na | na | 11/8/2005 | 8/12/2014 |
| MW3 | State of California, Department of Water Resources | WL | na | na | 11/8/2005 | 11/5/2014 |

DRAFT

**Table 1. Groundwater Monitoring Locations for the City of Beaumont AMMP**

| Well Name | Owner | Data Type (WL, WQ, or Both) | Data in West Yost Database | | | |
|---|---|---|---|---|---|---|
| | | | Water Quality | | Water Level | |
| | | | Start Date | End Date | Start Date | End Date |
| MW4 | State of California, Department of Water Resources | WL | na | na | 11/8/2005 | 11/5/2014 |
| MW5 | State of California, Department of Water Resources | WL | na | na | 4/6/2011 | 11/5/2014 |
| MW6 | State of California, Department of Water Resources | WL | na | na | 4/6/2011 | 11/5/2014 |
| MW7 | State of California, Department of Water Resources | WL | na | na | 4/6/2011 | 11/5/2014 |
| MW8 | State of California, Department of Water Resources | WL | na | na | 4/6/2011 | 11/5/2014 |
| MW9 | State of California, Department of Water Resources | WL | na | na | 4/6/2011 | 11/5/2014 |
| #493 Schuelke R | Unknown | WL | na | na | 11/8/1994 | 12/30/2014 |
| #569 Jurado | Unknown | WL | na | na | 5/19/2006 | 12/22/2014 |
| #608 Co. of Riv | County of Riverside | WL | na | na | 11/8/1994 | 11/3/2014 |
| 335510116581901 | United States, Geological Survey (USGS) | WL | na | na | 4/26/2000 | 12/4/2013 |
| 335552116592601 | Dowling, Francis M | WL | na | na | 11/1/1991 | 5/23/2012 |
| San Timoteo Management Zone | | | | | | |
| NA_1003048 | Hildebrand, Chester F. | Both | 3/23/1961 | 7/31/1961 | 8/21/2006 | 12/30/2014 |
| ONE | El Casco Lake Ranch | Both | 11/17/2008 | 5/10/2011 | 8/21/2006 | 12/30/2014 |
| Fishermen's Retreat 1 | Rutherford, Mark | Both | 3/23/1961 | 4/26/2021 | 11/16/2007 | 11/16/2007 |
| 1 | Schwenckert, Henry W. and Jewel | Both | 10/27/2006 | 11/9/2021 | 10/16/2006 | 12/22/2014 |
| Fishermen's Retreat 2 | Rutherford, Mark | Both | 8/24/2005 | 4/26/2021 | 11/16/2007 | 12/23/2014 |

DRAFT

**Table 1. Groundwater Monitoring Locations for the City of Beaumont AMMP**

| Well Name | Owner | Data Type (WL, WQ, or Both) | Data in West Yost Database | | | |
|---|---|---|---|---|---|---|
| | | | Water Quality | | Water Level | |
| | | | Start Date | End Date | Start Date | End Date |
| 335645117024201 | East Valley Golf Club | Both | 6/25/2001 | 6/25/2001 | 10/26/1999 | 12/30/2014 |
| Heartland Well | City of Beaumont | Both | 10/10/2006 | 5/18/2020 | 2/23/2007 | 12/30/2014 |
| BH-19 | Metropolitan Water District of Southern California | Both | 11/17/2008 | 5/26/2011 | 11/17/2008 | 5/23/2013 |
| YVWD GWMW-3 | Yucaipa Valley Water District | Both | 6/30/2010 | 10/19/2012 | 6/30/2010 | 12/1/2012 |
| YVWD GWMW-2 | Yucaipa Valley Water District | Both | 6/29/2010 | 11/8/2021 | 6/29/2010 | 12/1/2012 |
| YVWD GWMW-1 | Yucaipa Valley Water District | Both | 12/30/2009 | 11/8/2021 | 6/30/2010 | 12/1/2012 |
| YVWD GWMW-4 | Yucaipa Valley Water District | Both | 8/17/2010 | 11/9/2021 | 1/29/2010 | 12/1/2012 |
| YVWD GWMW-5A | Yucaipa Valley Water District | Both | 8/3/2010 | 11/8/2021 | 8/25/2010 | 12/1/2012 |
| YVWD GWMW-5B | Yucaipa Valley Water District | Both | 8/3/2010 | 11/8/2021 | 8/25/2010 | 12/1/2012 |
| USGS 2 | United States, Geological Survey (USGS) | WL | na | na | 4/13/1993 | 11/13/2008 |
| GL-8 | Chino Investors Ltd | WL | na | na | 6/27/2006 | 12/1/2012 |
| #427, Agri-Empire | San Gorgonio Pass Water Agency | WL | na | na | 11/8/1994 | 11/4/2014 |
| #428, Agri-Empire #2 | San Gorgonio Pass Water Agency | WL | na | na | 11/8/1994 | 11/4/2014 |
| Fishermen's Retreat 3 | Rutherford, Mark | WQ | 12/4/2003 | 12/4/2003 | na | na |
| SanTim-1 | City of Beaumont | WQ | 5/21/2010 | 11/9/2021 | na | na |
| San Tim-2B/1 | City of Beaumont | WQ | 7/28/2010 | 11/9/2021 | na | na |
| San Tim-2B/2 | City of Beaumont | WQ | 7/22/2010 | 11/9/2021 | na | na |
| YVWD GWMW-5C | Yucaipa Valley Water District | WQ | 8/2/2010 | 11/8/2021 | na | na |
| Deep Well | Martie Wells | WQ | 10/8/2009 | 5/6/2019 | na | na |
| Bunker Hill Management Zone | | | | | | |
| Redlands 38 | City of Redlands | Both | 1/24/1996 | 12/15/2021 | 12/15/1993 | 12/1/2012 |
| Bryn Mar #2/3 | Bryn Mawr Mutual Water Company | Both | 8/22/1949 | 8/22/1949 | 10/8/1935 | 12/1/2012 |

DRAFT

**Table 1. Groundwater Monitoring Locations for the City of Beaumont AMMP**

| Well Name | Owner | Data Type (WL, WQ, or Both) | Data in West Yost Database | | | |
|---|---|---|---|---|---|---|
| | | | Water Quality | | Water Level | |
| | | | Start Date | End Date | Start Date | End Date |
| Bryn Mar #1 | Bryn Mawr Mutual Water Company | Both | 8/5/1932 | 7/26/1977 | 4/25/1929 | 11/1/2012 |
| Lee Well | City of Redlands | Both | 4/24/1951 | 4/16/2009 | 6/1/1947 | 12/1/2012 |
| Redlands 39 | City of Redlands | Both | 5/1/1999 | 12/17/2021 | 1/1/2000 | 12/1/2012 |
| Bryn Mar #4 | Bryn Mawr Mutual Water Company | WL | na | na | 12/2/1997 | 12/1/2012 |

Notes:
na- no data is available within West Yost's database
TDS - total dissolved solids
WQ - water quality
WL - water level

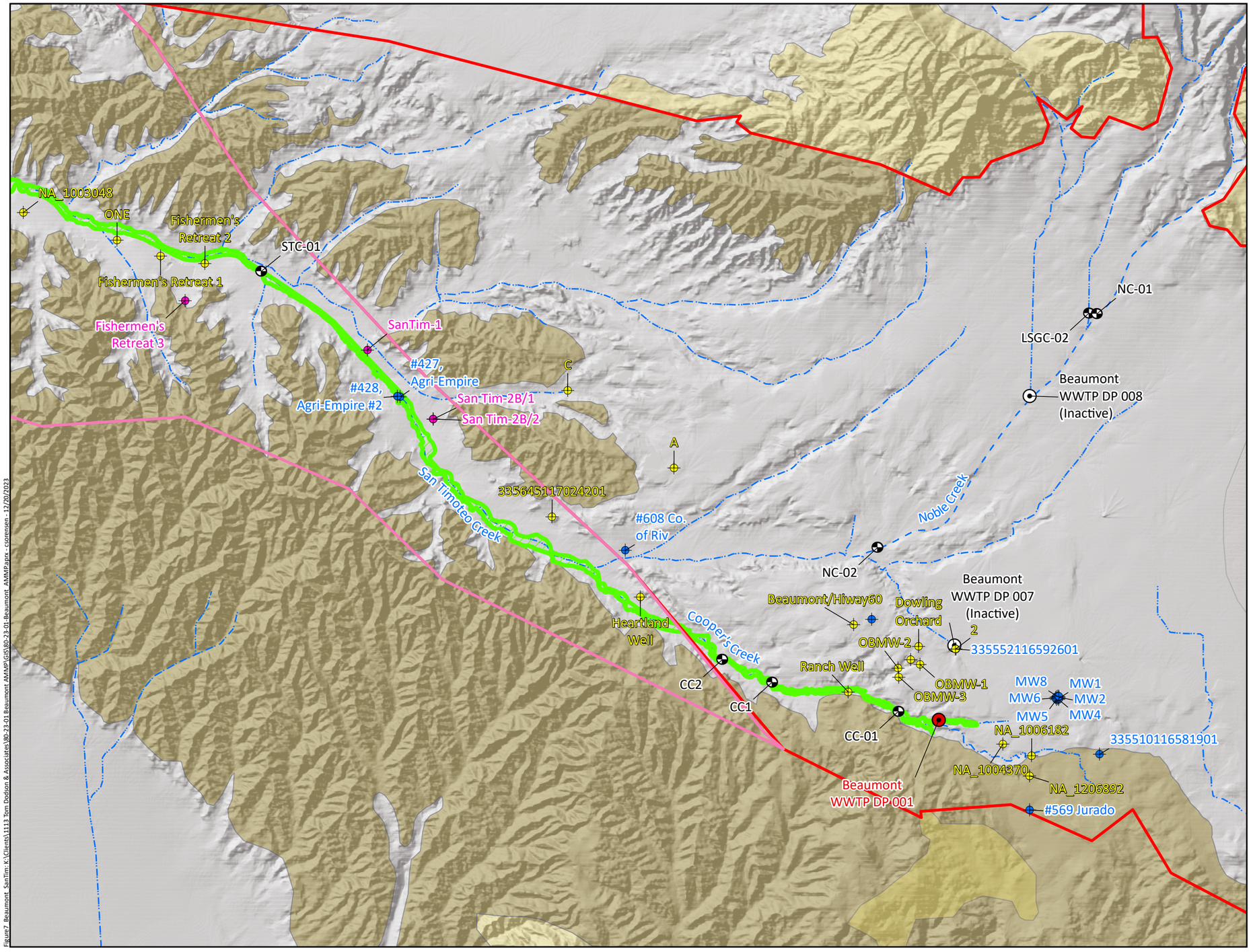
DRAFT

**Table 2. Surface Water Monitoring Locations for the City of Beaumont AMMP**

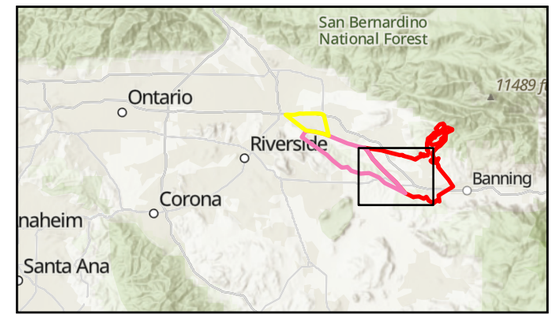
| Site Name | Facility Type | Data in West Yost Database | | | |
|---|---|---|---|---|---|
| | | Water Quality | | Flow/Effluent | |
| | | Start Date | End Date | Start Date | End Date |
| Beaumont Management Zone | | | | | |
| Beaumont WWTP DP 001 | WWTP/RWRF | 1/1/2002 | 7/9/2018 | 1/1/2006 | 7/30/2018 |
| Beaumont WWTP DP 007 | WWTP/RWRF | None | None | 3/29/2010 | 12/31/2014 |
| Beaumont WWTP DP 008 | WWTP/RWRF | None | None | None | None |
| CC-01 | Stream Monitoring Site | 10/5/2005 | 12/22/2014 | 10/21/2005 | 12/22/2014 |
| CC1 | Stream Monitoring Site | 12/12/2005 | 1/27/2006 | None | None |
| CC2 | Stream Monitoring Site | 12/12/2005 | 1/27/2006 | None | None |
| LSGC-02 | Stream Monitoring Site | 4/5/2006 | 4/5/2006 | 4/5/2006 | 12/22/2014 |
| NC-01 | Stream Monitoring Site | 3/22/2006 | 3/11/2010 | 3/22/2006 | 12/22/2014 |
| NC-02 | Stream Monitoring Site | 4/5/2006 | 4/5/2006 | 4/5/2006 | 12/22/2014 |
| Bunker Hill Management Zone | | | | | |
| YVWD-D | Stream Monitoring Site | 2/2/2005 | 12/15/2010 | 10/21/2005 | 3/21/2013 |
| YVWD-E | Stream Monitoring Site | 10/13/2005 | 12/30/2010 | 1/1/1990 | 3/31/2013 |
| YVWD-F | Stream Monitoring Site | 2/2/2005 | 12/30/2010 | 10/21/2005 | 5/3/2012 |
| San Timoteo Management Zone | | | | | |
| Henry Wochholz RWRF DP 001 | WWTP/RWRF | 1/1/2002 | 7/31/2018 | 10/1/1986 | 7/31/2018 |
| STC-01 | Stream Monitoring Site | 10/5/2005 | 12/22/2014 | 12/12/2005 | 12/22/2014 |
| YVWD-A | Stream Monitoring Site | 2/2/2005 | 12/30/2010 | 11/14/2005 | 3/12/2013 |
| YVWD-B | Stream Monitoring Site | 2/2/2005 | 12/30/2010 | 10/21/2005 | 3/21/2013 |
| YVWD-C | Stream Monitoring Site | 2/2/2005 | 12/30/2010 | 7/3/2008 | 7/6/2012 |

Notes:
HD - HydroDaVE (West Yost hydrologic database)
CIWQS - California Integrated Water Quality System Project
None – no data is available within West Yost's database

DRAFT




Notes:
1. Riparian Zone was drawn using tree line.
2. The hydrological study area is defined as the three GMZs shown
3. GW - groundwater; SW - surface water
4. GMZ - groundwater management zone
5. WWTP - wastewater treatment plant
6. WL - water level; WQ - water quality




Prepared by:

WEST YOST

N

0 2 Miles

0 2,000 4,000 Feet

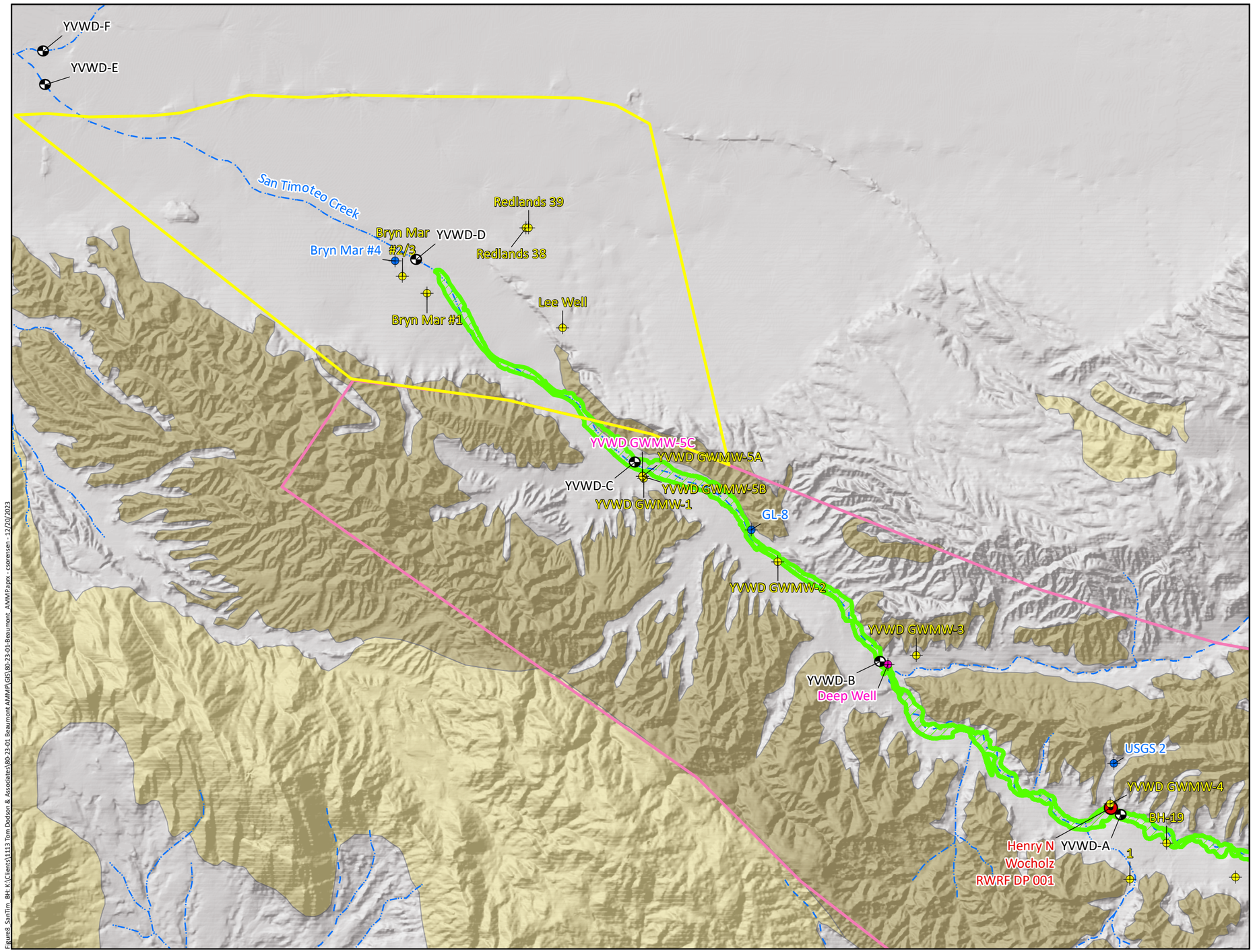
Prepared for:

**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

**Hydrogeological Monitoring Locations - Beaumont and Upper San Timoteo GMZs**
*City of Beaumont AMMP*

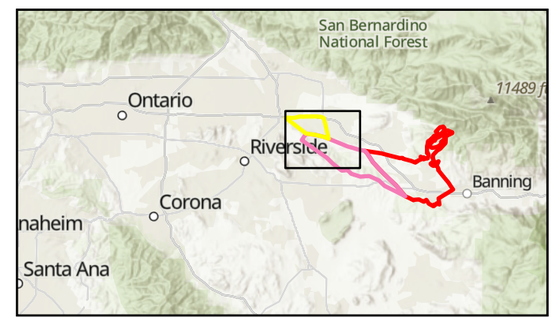
**DRAFT Figure 7**

Figure7_Beaumont_SanTim: K:\Clients\1113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01-Beaumont_AMMP.aprx - csorensen - 12/20/2023




- GW wells with WL and WQ data
- GW wells with WL data
- GW wells with WQ data
- Stream Monitoring Sites
- WWTP Discharge Point (active)
- Study Area/Riparian Zone
- Bunker Hill GMZ (portion)
- San Timoteo GMZ
- Streams

Notes:
1. Riparian Zone was drawn using tree line.
2. The hydrological study area is defined as the three GMZs shown
3. GW - groundwater; SW - surface water
4. GMZ - groundwater management zone
5. WWTP - wastewater treatment plant
6. WL - water level; WQ - water quality




Prepared by:

WEST YOST

N

0 2 Miles

0 2,000 4,000 Feet

Prepared for:

**City of Beaumont**
*Adaptive Management and Mitigation Plan (AMMP)*

BEAUMONT CALIFORNIA

**Hydrogeological Monitoring Locations - Lower San Timoteo and Bunker Hill GMZs**
*City of Beaumont AMMP*

**DRAFT Figure 8**

Figure8_SanTim_BH: K:\Client\1113 Tom Dodson & Associates\80-23-01 Beaumont AMMP\GIS\80-23-01-Beaumont_AMMP.aprx - csorensen - 12/20/2023

## Available Modeling Tools

A thorough review of available modeling and/or analytical tools will be required for Phase 1 of the AMMP. The available models will be identified and assessed to determine their potential for use in evaluating the impacts of reduced discharge to Cooper's Creek within the study area. The known models that exist are listed below, however more may be added following further research:

1. Beaumont Basin Groundwater Model. This groundwater flow model was developed by the Beaumont Basin Watermaster. The model overlies the Beaumont GMZ, and may overlie a portion of the San Timoteo GMZ. After initial review of the model documentation, the consultant team may prepare a request for information that the City can submit to the Watermaster for access to the model and/or model files.
2. Yucaipa Subbasin Groundwater Model. This groundwater flow model was prepared by the USGS for use in supporting the Yucaipa Subbasin Groundwater Sustainability Plan. The model may overlie a portion of the San Timoteo GMZ. After initial review of the model documentation, the consultant team may prepare a request for information that the City can submit to the USGS for access to the model and/or model files.
3. County of Riverside's surface water modeling and related work for the Flow Ecology investigation into Cooper's Creek or other regional surface water systems.

The findings and recommendations will be summarized in the Phase 1 Report – *Cooper's Creek Habitat Characterization and Sustainability Report* following the completion of Phase 1 activities.

## NEXT STEPS

The next steps that the Consultant Team will perform to develop the AMMP include:

- Complete collection of all missing historical data.
- Characterize the extent and health of riparian habitat using NDVI and other data.
- Characterize historical and existing hydrogeologic conditions.
- Correlate historical and existing conditions to riparian habitat extent and health.
- Identifiy the potential impacts to riparian habitat extent and health from reduced discharge to Cooper's Creek.
- Assess the available tools and identify necessary tools for analyzing surface water and groundwater impacts of reduced discharge.
- Identify data gaps and uncertainties.
- Define a baseline monitoring program.
- Prepare the Phase 1 report: *Cooper's Creek Habitat Characterization and Sustainability Report*. Appendix A includes proposed outline of the Phase 1 report.

DRAFT

## REFERENCES

Dudek, 2021. *Maximum Benefit Monitoring Program 2020 Annual Report for the Beaumont, San Timoteo and Yucaipa Groundwater Management Zones. Prepared for Yucaipa Valley Water District. April 9.*

Santa Ana Regional Water Quality Control Board (RWQCB), 2006. *Order No. R8-2006-0003, NPDES No. CA0105376 Waste Discharge Requirements for the City of Beaumont, Beaumont Wastewater Treatment Plant, Riverside County.*

Santa Ana Regional Water Quality Control Board (RWQCB), 2014. *Resolution R8-2014-0005 Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate Updates to the Salt Management Plan for the Santa Ana Region.*

Santa Ana Regional Water Quality Control Board (RWQCB), 2015. *Order No. R8-2015-0026, NPDES No. CA0105376 Waste Discharge Requirements and Master Reclamation Permit for the City of Beaumont, Beaumont Wastewater Treatment Plant, Riverside County.*

DRAFT

Appendix A

# Outline for Cooper's Creek Habitat Characterization and Sustainability Report

DRAFT

**Outline for Cooper's Creek Habitat Characterization and Sustainability Report**

**1. Introduction**

This section will include:

- The purpose of the Cooper's Creek Habitat Characterization and Sustainability Report.
- A brief overview of the need for the Report in the context of the AMMP.

**2. Background and Setting**

This section will include:

- A description and overview of the regulatory setting.
- A description of the study area(s) and its characteristics.
- The historical context of the WWTP and its discharges.
- The hydrological, geological, and hydrogeological setting.

**3. Initial Goals, Objectives, and Performance Criteria**

This section will include:

- An explanation of the updated goals and objectives as well as the performance criteria to measure success under the AMMP.
- The Task 2 TM will be updated and referred to in this section as reference and for more detail.

**4. Historical and Existing Biological Resources**

This section will include:

- Review of prior biologic resources assessment used to obtain the City's existing discharge permit, review habitat conditions in the field, and review reports and data from other relevant investigations (i.e., those completed in the downstream reaches of San Timoteo Creek through other scopes of work).
- Identification of the potential impacts to biologic resources when the City reduces its discharges to Cooper's Creek. Exhibits will be prepared to characterize the biologic resources.

**5. Historical Discharge and Surface Water Flow Hydrology Characterization**

This section will include:

- A description, review, and analysis of all available data relevant to surface water flow and wastewater discharge, including climate/precipitation, water conservation, WWTP discharges, surface water flow, groundwater levels, and water quality.
- Explanatory graphics to characterize historical surface water flow and groundwater conditions and the relationship to the factors that contribute to short term and long-term variations in the observed record.

DRAFT

**6. Historical Riparian Habitat Health (NDVI)**

This section will include:

- A review and analysis of available NDVI of the area and as it pertains to riparian vegetation health between 1982 and 2023.
- Explanatory graphics to characterize historical habitat conditions and the relationship to the factors that contribute to short term and long-term variations in the observed record.

**7. Potential Impacts to Biological Resources from Reduced Discharge to Cooper's Creek**

This section will include:

- A presentation and review of all the factors that could have supported or affected the extent/health of the biological resources over time.
- Description of the relationship of the above factors to the extent/health of the biological resources.
- A definition of preliminary metrics for habitat sustainability.
- Any identified data gaps.

**8. Assessment of Available Tools for Analyzing Surface Water and Groundwater Impacts**

This section will include:

- A review and assessment of all available surface and groundwater models or analytical tools that could potentially be used to assess hydrogeologic impacts of reduced discharge to Cooper's Creek, including a review of the County of Riverside's modeling and related work for the Flow Ecology investigation into Cooper's Creek.
- A description/articulation of the level of analysis necessary to support development of the AMMP (what is the "right size" level of work to support the City's project) and an assessment of the ability to use the existing surface and groundwater models/tools in Phase 2 to evaluate reduced discharges to Cooper's Creek.

**9. Scope for Baseline Monitoring and Data Collection**

This section will include:

- An outline of a plan for ongoing monitoring and data collection, including monitoring sites for hydrological and riparian monitoring, as necessary.
- Explanation of how this data will be used to assess riparian habitat health and sustainability, particularly as it pertains to reductions in discharges from the Beaumont WWTP Discharge Point 001.

**10. Summary and Conclusions**

This section will summarize the Report and list the conclusions in bullet form.

DRAFT

# Appendix B

## Letter, Least Bell's Vireo and Southwestern Willow Flycatcher Survey Results for the City of Beaumont, Cooper's Creek Wastewater Discharge Study, November 5, 2024

November 5, 2024

Stacey Love
U.S. Fish and Wildlife Service
2177 Salk Avenue, Suite 250
Carlsbad, California 92008

**Re: Least Bell's Vireo and Southwestern Willow Flycatcher Survey Results for the City of Beaumont, Cooper's Creek Wastewater Discharge Study**

Dear Ms. Love,

This letter report documents the results of protocol surveys for the least Bell's vireo (*Vireo bellii pusillus,* LBVI) and southwestern willow flycatcher (*Empidonax traillii extimus,* SWFL) conducted by HDR Engineering, Inc. for the City of Beaumont, Cooper's Creek Wastewater Discharge Study (Project) located in the community of Beaumont, California (Figures B-1, B-2 and B-3).

The Project is being conducted in order to help inform potential changes to wastewater discharge into Cooper's Creek. To reduce the volume of discharge, the City must file a Wastewater Change Petition (Change Petition) with the State Water Resources Control Board (SWRCB), Division of Water Rights. When the City first discussed the plan to apply for a change petition with the SWRCB, the Division of Water Rights staff advised that the city develop an Adaptive Management and Mitigation Program (AMMP) to aid in the process of approving the reduced discharge.

The SWFL and LBVI are listed as endangered by the United States Fish and Wildlife Service (USFWS) and the State of California under the jurisdiction of the California Department of Fish and Wildlife (CDFW). The USFWS and CDFW require surveys for SWFL and LBVI when suitable habitat for these species occurs within or adjacent to a project. Surveys were conducted in accordance with USFWS listed protocols for each species.

**Project Location and Riparian Bird Survey Area**

These surveys were conducted in riparian habitat in three areas southwest of the intersection of Interstate-60 and Interstate-10 in Beaumont, California. These areas are located within the El Casco and Beaumont USGS Quadrangle maps (Figures B-1, B-2 and B-3).

Surveys were conducted in potentially suitable riparian habitat along Cooper's Creek. Habitat consisted of riparian forest dominated by willow species (*Salix* sp.), Fremont cottonwood (*Populus fremontii*), California sycamore (*Platanus racemosa*), and oak (*Quercus* sp.).

**Methods**

A 15-day prior notification for surveys was provided to the USFWS on April 10, 2024 (Appendix A, attached). All survey areas are depicted in Figures B-1, B-2 and B-3. HDR biologist Adam Lockyer (Permitted Biologist, TE55135D-0) and assisting biologist Aaron Newton conducted only the first of eight protocol LBVI surveys. During the first round of LBVI surveys conducted on April 25, LBVI were detected throughout all three of the survey areas. Following the confirmation of the presence of LBVI during the first survey, subsequent surveys were canceled because the purpose of the surveys was to

determine only the presence or absence of LBVI in the survey areas. Five total protocol SWFL surveys were conducted from May 16 to July 5, 2024. After accessing survey area #1 on April 25, locks were placed on all gates with access to the survey area. No other probable access was possible and the fence precluded any future surveys of this area. Subsequent SWFL surveys were conducted in survey areas #2 and #3.

Because surveys for LBVI and SWFL did not occur on the same days, there was no need to stagger LBVI surveys following SWFL surveys. During each of the surveys, the biologist walked slowly along the edge of riparian habitat, stopping at 60-to-100-foot intervals to listen for LBVI and SWFL. During the SWFL surveys, a recording of SWFL vocalizations was played at 60-to-100-foot intervals along the survey route. The surveying biologist, with the aid of binoculars for viewing wildlife species, waited for several minutes after each playback to look and listen for SWFL. Surveys for LBVI were conducted by stopping at similar intervals along the survey route to watch and listen for LBVI. All surveys were completed between dawn and 11:00 AM for LBVI and by 10:30 AM for SWFL. No surveys were conducted during extreme weather conditions (i.e., winds exceeding 15 miles per hour, rain, or temperatures in excess of 95°F).

Tables 1, 2 and 3 present the survey dates, times, and weather conditions for the surveys.

Stacey Love
U.S. Fish and Wildlife Service
November 5, 2024

**Table 1. Summary of Least Bell's Vireo Survey Dates, Times, and Weather Conditions for Survey Area #1.**

| Survey | Date | Surveyor | Time (start/end) | Weather | Temp. Range (°F) | LBV/WIFL Detected |
|---|---|---|---|---|---|---|
| LBVI 1 | 4/25/24 | AL/AN | 0810-0920 | Start: 0 mph, overcast; End: 0 mph, overcast | 60 | 1 |

*Notes:*
*Due to access issues, no other surveys past April 25 were possible for survey area #1*
*AL: Adam Lockyer – Permitted Biologist (*TE55135D-0*), AN: Aaron Newton*
*°F = degrees Fahrenheit*
*mph = miles per hour*
*LBVI = least Bell's vireo*

**Table 2. Summary of Least Bell's Vireo and Southwestern Willow Flycatcher Survey Dates, Times, and Weather Conditions for Survey Area #2.**

| Survey | Date | Surveyor | Time (start/end) | Weather | Temp. Range (°F) | LBV/WIFL Detected |
|---|---|---|---|---|---|---|
| LBVI 1 | 4/25/24 | AL/AN | 0955-1040 | Start: 0 mph, overcast; End: 3 mph, partly cloudy | 60-65 | 1(LBVI) |
| SWFL 1 | 5/16/24 | AL | 0840-0920 | Start: 3 mph, overcast; End: 3 mph, overcast | 55-60 | 0 |
| SWFL 2 | 6/4/24 | AL | 0925-1015 | Start: 0 mph, partly cloudy; End: 0 mph, partly cloudy | 72-75 | 1(WIFL) |
| SWFL 3 | 6/14/24 | AL/AN | 0845-0950 | Start: 0 mph, clear; End: 0 mph, clear | 71-75 | 0 |
| SWFL 4 | 6/25/24 | AL | 0842-1002 | Start: 5 mph, partly cloudy; End: 0 mph, partly cloudy | 77-80 | 0 |
| SWFL 5 | 7/10/24 | AL | 0903-1015 | Start: 0 mph, clear; End: 0 mph, clear | 75-85 | 0 |

*Notes:*
*AL: Adam Lockyer, AN: Aaron Newton*
*°F = degrees Fahrenheit*
*LBVI = least Bell's vireo*
*SWFL = southwestern willow flycatcher*
*mph = miles per hour*

**Table 3. Summary of Least Bell's Vireo and Southwestern Willow Flycatcher Survey Dates, Times, and Weather Conditions for Survey Area #3.**

| Survey | Date | Surveyor | Time (start/end) | Weather | Temp. Range (°F) | LBV/WIFL Detected |
|---|---|---|---|---|---|---|
| LBVI 1 | 4/25/24 | AL/AN | 0700-0745 | Start: 0 mph, light drizzle; End: 0 mph, light drizzle | 47-60 | 2 |
| SWFL 1 | 5/16/24 | AL | 0720-0815 | Start: 0 mph, overcast; End: 0 mph, overcast | 58-58 | 0 |
| SWFL 2 | 6/4/24 | AL | 0705-0900 | Start: 0 mph, partly cloudy; End: 0 mph, partly cloudy | 65-72 | 0 |
| SWFL 3 | 6/14/24 | AL/AN | 0710-0831 | Start: 0 mph, partly cloudy; End: 0 mph, partly cloudy | 72-76 | 0 |
| SWFL 4 | 6/25/24 | AL | 0815-0905 | Start: 5 mph, partly cloudy; End: 0 mph, partly cloudy | 68-72 | 0 |
| SWFL 5 | 7/10/24 | AL | 0620-0830 | Start: 0 mph, clear; End: 0 mph, clear | 70-75 | 0 |

*Notes:*
*AL: Adam Lockyer, AN: Aaron Newton*
*°F = degrees Fahrenheit*
*LBVI = least Bell's vireo*
*SWFL = southwestern willow flycatcher*
*mph = miles per hour*

## Results

LBVI surveys were halted following the first round of surveys over all three survey areas because there were multiple detections in all areas and this satisfied the purpose of the survey effort (it is understood that this does not constitute a full protocol LBVI survey). Although there were no more LBVI protocol surveys, LBVI were noted when detected in all survey areas during SWFL protocol surveys.

One willow flycatcher was detected in survey area #2 on June 4. No other detections of willow flycatchers were made during other survey events and no nesting was observed. Because this individual was not detected during subsequent visits during the nesting survey windows, this one observation of a willow flycatcher is not considered to be the southwester willow flycatcher subspecies. All observations of WIFL and LBVI along with the dates of observations are included in Figures B-1, B-2 and B-3.

One brown-headed cowbird was detected just outside survey area #2 on April 25.

A complete list of birds and other wildlife observed on-site during surveys is included as Appendix B. A completed Willow Flycatcher Survey and Detection Form is included as Appendix C.

If you have any questions regarding this survey report, please contact me at (702) 283-9429.

Stacey Love
U.S. Fish and Wildlife Service
November 5, 2024

***I certify that the information in this survey report and attached exhibits fully and accurately depict my work.***

Sincerely,
HDR Engineering, Inc.

Adam Lockyer, TE55135D-0
*Biologist*

**Attachments**

Figure B-1. Beaumont Survey Area #1
Figure B-2: Beaumont Survey Area #2
Figure B-3. Beaumont Survey Area #3
Appendix A: USFWS 15-Day Notification (April 10, 2024)
Appendix B: Inventory of Wildlife Species Observed During 2024 Protocol Surveys
Appendix C: Willow Flycatcher Survey and Detection Form

**Figure B-1. Beaumont LBVI/SWFL Survey Area #1**

Beaumont Survey Area Site 1

Sensitive Wildlife Point

Least Bell's Vireo

0 350 Feet

**Figure B-2. Beaumont Survey Area #2**

Beaumont Survey Area Site 2

Sensitive Wildlife Point

Brown Headed Cowbird

Least Bell's Vireo

Willow Fly Catcher

0 250 Feet

**Figure B-3. Beaumont Survey Area #3**

Beaumont Survey Area Site 3

Sensitive Wildlife Point

Least Bell's Vireo

0 250 Feet

# Appendix A: USFWS 15-Day Notification

**From:** Love, Stacey
**To:** Lockyer, Adam T
**Cc:** Patterson, Lisa; Keller, Andrew
**Subject:** Re: [EXTERNAL] RE: Returned: SWFL/LBVI Survey Notification; Permit # TE55135D-0
**Date:** Thursday, April 11, 2024 10:03:49 AM
**Attachments:** image003.png

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Adam, thank you for the revised notification, which has been forwarded to my colleagues for review.

---

**From:** Lockyer, Adam T <Adam.Lockyer@hdrinc.com>
**Sent:** Wednesday, April 10, 2024 7:18 PM
**To:** Love, Stacey <stacey_love@fws.gov>
**Cc:** Patterson, Lisa <Lisa.Patterson@hdrinc.com>; Keller, Andrew <Andrew.Keller@hdrinc.com>
**Subject:** [EXTERNAL] RE: Returned: SWFL/LBVI Survey Notification; Permit # TE55135D-0

**This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.**

Hi Stacey,

Thank you for the comments and guidance. Below is my updated notification.

This is my 15-day notification to conduct southwestern willow flycatcher (SWFL) surveys along with least Bell's vireo (LBVI) surveys in suitable habitat in the survey areas depicted in the attached maps. These surveys will be conducted in riparian habitat southwest of the intersection of Interstate-60 and Interstate-10 in Beaumont, California. These areas are located within the El Casco and Beaumont USGS Quadrangle maps. Also attached is my federal permit for SWFL surveys. Scheduled dates for those surveys are below. For survey events when both SWFL and LBVI surveys are scheduled for the same day, surveys will not be done concurrently. Surveys for SWFL will be conducted first thing in the morning followed by LBVI surveys.

Please let me know if you need any further information.

| Survey Dates | SWFL Survey # | LBVI Survey # |
|---|---|---|
| | 5 days apart | 10 days apart |
| | 1: May 15 - 31 - 1 visit | April 10 - July 31 |
| | 2: June 1 - 24 - 2 visits | 8 surveys |
| | 3: June 25 - July 17 - 2 visits | |
| Thur 25-Apr | | 1 |
| Mon 6-May | | 2 |
| Thur 16-May | 1 | 3 |
| Tue 4-Jun | 2 | 4 |
| Fri 14-Jun | 3 | 5 |
| Tue 25-Jun | 4 | 6 |
| Fri 5-Jul | 5 | 7 |
| Fri 19-Jul | | 8 |

Thank You,

**Adam Lockyer**
*Biologist*

**HDR**
591 Camino de la Reina, Suite 300
San Diego, CA 92108
M 702-283-9429
Adam.Lockyer@hdrinc.com

hdrinc.com/follow-us

---

**From:** Love, Stacey <stacey_love@fws.gov>
**Sent:** Tuesday, April 9, 2024 4:23 PM
**To:** Lockyer, Adam T <Adam.Lockyer@hdrinc.com>
**Cc:** Patterson, Lisa <Lisa.Patterson@hdrinc.com>; Keller, Andrew <Andrew.Keller@hdrinc.com>
**Subject:** Returned: SWFL/LBVI Survey Notification; Permit # TE55135D-0

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello Adam,

Thank you for the notification. I am returning it to you with the following comments:

Comment 1

Regarding your statement "For survey events when both SWFL and LBVI surveys are scheduled for the same day, surveys will not be done concurrently. Surveys for SWFL will be conducted upon entry to the survey area and LBVI surveys will be conducted on return or visa versa." Thank you for not conducting the surveys concurrently, however, I am concerned about the statement "vice versa." The SWFL surveys should be conducted first, early in the morning, in accordance with the protocol. Surveys early in the morning increases the detectability of SWFL whereas vireos are vocal throughout the day. For your reference, here is an excerpt of our current permit conditions for SWFL permits, which were revised since your last permit was issued: "If protocol surveys are conducted on the same day, we recommend that surveys be conducted sequentially, with surveys for the flycatcher first (*i.e.*, first thing in the morning) and surveys for the vireo conducted afterwards."

Comment 2

A 1:24,000 scale U.S. Geological Survey (USGS) topographical map is required.

Please see permit condition 5. Maps should not be created at more or less than 1:24,000 scale (i.e., zoomed out or in). Please clip to the area of interest and do not exceed page sizes of 11 x 17. Multiple maps may need to be prepared to accurately depict all locations. (Please attach the map(s) to the email rather than inserting as images in the email).

If you are using ArcGIS, the correct basemap to use is "USA Topo Maps", not "USGS National Map." If you are *not* using ArcGIS, we have prepared guidance (attached) regarding using the free software (confusingly) called National Map. Please identify the quadrangle map name(s).

Finally, I would like to clarify regarding other maps, which was received here. At stated above, we require maps of the survey area on a USGS topographic map at minimum. However, we accept and appreciate *additional* maps with other base data, as they can provide additional information. As you already created this other map, please resend the notification with all maps included.

Thank you,

**Stacey Love** (she/her)
Recovery Permit Coordinator
Carlsbad (incl. Palm Springs) field office
(click here for jurisdiction map)

U.S. Fish and Wildlife Service
2177 Salk Avenue, Ste. 250
Carlsbad, CA 92008
(760) 431-9440 x 263
stacey_love@fws.gov

Useful links:
Pacific Southwest Region Recovery Permits web page
General Recovery Permits web page
[Video] How to Submit a Renewal Application in ePermits
Technical problems with an ePermits account? Contact Support

Permittees: Please include your permit number in all correspondence and reporting, thank you.

***Check out our annual report***

---

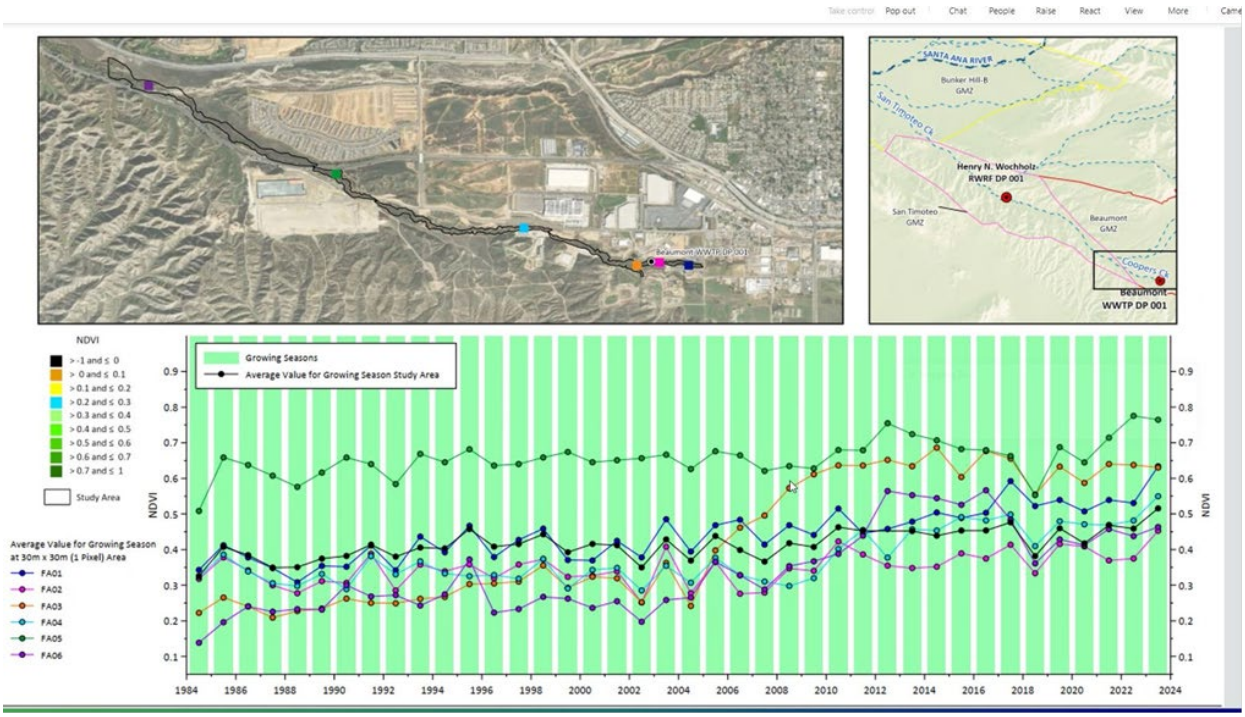
**From:** Lockyer, Adam T <Adam.Lockyer@hdrinc.com>
**Sent:** Tuesday, April 9, 2024 3:56 PM
**To:** Love, Stacey <stacey_love@fws.gov>
**Cc:** Patterson, Lisa <Lisa.Patterson@hdrinc.com>; Keller, Andrew <Andrew.Keller@hdrinc.com>
**Subject:** [EXTERNAL] SWFL/LBVI Survey Notification; Permit # TE55135D-0

**This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.**

Hi Stacey,

This is my 15-day notification to conduct southwestern willow flycatcher (SWFL) surveys along with least Bell's vireo (LBVI) surveys in suitable habitat in the areas depicted in purple, green and orange on the map below. These surveys will be conducted in riparian habitat southwest of the intersection of Interstate-60 and Interstate-10 in Beaumont, California. Also attached is my federal permit for SWFL surveys. Scheduled dates for those surveys are below. For survey events when both SWFL and LBVI surveys are scheduled for the same day, surveys will not be done concurrently. Surveys for SWFL will be conducted upon entry to the survey area and LBVI surveys will be conducted on return or visa versa.

Please let me know if you need any further information.




| Survey Dates | SWFL Survey # | LBVI Survey # |
|---|---|---|
| | 5 days apart | 10 days apart |
| | 1: May 15 - 31 - 1 visit | April 10 - July 31 |
| | 2: June 1 - 24 - 2 visits | 8 surveys |
| | 3: June 25 - July 17 - 2 visits | |
| Thur 25-Apr | | 1 |
| Mon 6-May | | 2 |
| Thur 16-May | 1 | 3 |
| Tue 4-Jun | 2 | 4 |
| Fri 14-Jun | 3 | 5 |
| Tue 25-Jun | 4 | 6 |
| Fri 5-Jul | 5 | 7 |
| Fri 19-Jul | | 8 |

Thank You,

**Adam Lockyer**
*Biologist*

**HDR**
591 Camino de la Reina, Suite 300
San Diego, CA 92108
M 702-283-9429
Adam.Lockyer@hdrinc.com

hdrinc.com/follow-us

# Appendix B: Inventory of Wildlife Species Observed During 2024 Protocol Surveys

| Scientific Name | Common Name | Special Status |
|---|---|---|
| **BIRDS** | | |
| **ACCIPITRIDAE - HAWK FAMILY** | | |
| *Buteo jamaicensis* | Red-tailed hawk | |
| **ANATIDAE - SWAN, GOOSE, AND DUCK FAMILY** | | |
| *Anas platyrhynchos* | Mallard | |
| **FALCONIDAE - FALCON FAMILY** | | |
| *Falco sparverius* | American kestrel | |
| **ODONTOPHORIDAE - NEW WORLD QUAIL FAMILY** | | |
| *Callipepla californica* | California quail | |
| **RALLIDAE - RAIL AND COOT FAMILY** | | |
| *Fulica americana* | American coot | |
| **CHARADRIIDAE - PLOVER FAMILY** | | |
| *Charadrius vociferus* | Killdeer | |
| **COLUMBIDAE - PIGEON AND DOVE FAMILY** | | |
| *Zenaida macroura* | Mourning dove | |
| *Columba livia** | Rock pigeon | |
| **PICIDAE - WOODPECKER FAMILY** | | |
| *Picoides nuttallii* | Nuttall's woodpecker | |
| **TYRANNIDAE - TYRANT FLYCATCHER FAMILY** | | |
| *Empidonax traillii* | Willow flycatcher | SE |
| *Sayornis nigricans* | Black phoebe | |
| **VIREONIDAE - VIREO FAMILY** | | |
| *Vireo bellii pusillus* | Least bell's vireo | FE, SE |
| **CORVIDAE - JAY AND CROW FAMILY** | | |
| *Aphelocoma californica* | Western scrub-jay | |
| *Corvus corax* | Common raven | |
| **AEGITHALIDAE - BUSHTIT FAMILY** | | |
| *Psaltriparus minimus* | Bushtit | |
| **TROGLODYTIDAE - WREN FAMILY** | | |
| *Thryomanes bewickii* | Bewick's wren | |

| Scientific Name | Common Name | Special Status |
|---|---|---|
| **SYLVIIDAE - SILVIID WARBLERS FAMILY** | | |
| *Chamaea fasciata* | Wrentit | |
| **MIMIDAE - MOCKINGBIRD AND THRASHER FAMILY** | | |
| *Toxostoma redivivum* | California thrasher | |
| **STURNIDAE - STARLING FAMILY** | | |
| *Sturnus vulgaris** | European starling* | |
| **PARULIDAE - WOOD-WARBLER FAMILY** | | |
| *Geothlypis trichas* | Common yellowthroat | |
| **EMBERIZIDAE - NEW WORLD SPARROW FAMILY** | | |
| *Melospiza melodia* | Song sparrow | |
| *Zonotrichia leucophrys* | White-crowned sparrow | |
| *Pipilo maculatus* | Spotted towhee | |
| *Melozone crissalis* | California towhee | |
| **ICTERIDAE - BLACKBIRD AND ORIOLE FAMILY** | | |
| *Icterus bullockii* | Bullock’s oriole | |
| *Molothrus ater* | Brown-headed cowbird | |
| **FRINGILLIDAE - FINCH FAMILY** | | |
| *Spinus tristis* | American goldfinch | |
| *Spinus psaltria* | Lesser goldfinch | |
| *Haemorhous mexicanus* | House finch | |

# Appendix C: Willow Flycatcher Survey and Detection Form

# Willow Flycatcher (WIFL) Survey and Detection Form (revised April, 2010)

Site Name: **Beaumont SWFL Survey - Area #2** State: **California** County: **San Bernardino**

USGS Quad Name: **El Casco** Elevation: **725** (meters)

Creek, River, or Lake Name: **Cooper's Creek**

***Is copy of USGS map marked with survey area and WIFL sightings attached (as required)?*** ***Yes*** **X** ***No*** ____

Survey Coordinates: Start: E **497,519** N **3,754,659** UTM Datum: **NAD27** (See instructions)

Stop: E **497,789** N **3,754,585** UTM Zone: **11S**

If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.

*****Fill in additional site information on back of this page*****

| Survey # Observer(s) (Full Name) | Date (m/d/y) Survey Time | Number of Adult WIFLs | Estimated Number of Pairs | Estimated Number of Territories | Nest(s) Found? Y or N<br>If Yes, number of nests | Comments (e.g., bird behavior; evidence of pairs or breeding;-potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator. | GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | # Birds | Sex | UTM E | UTM N |
| **Survey # 1** | Date: 5/16/2024 | 0 | 0 | NA | No | | | | | |
| Observer(s): A. Lockyer | Start: 8:40 | | | | | | | | | |
| | Stop: 9:20 | | | | | | | | | |
| | Total hrs: 0.7 | | | | | | | | | |
| **Survey # 2** | Date: 6/4/2023 | 1 | 0 | NA | No | Single adult heard during call-backs. No nest located, only one individual heard. | 1 | unk | 497,638 | 3,754,623 |
| Observer(s): A. Lockyer | Start: 9:25 | | | | | | | | | |
| | Stop: 0:15 | | | | | | | | | |
| | Total hrs: 0.8 | | | | | | | | | |
| **Survey # 3** | Date: 6/14/2024 | 0 | 0 | NA | No | | | | | |
| Observer(s): A. Lockyer, A. Newton | Start: 8:45 | | | | | | | | | |
| | Stop: 9:50 | | | | | | | | | |
| | Total hrs: 1 | | | | | | | | | |
| **Survey # 4** | Date: 6/25/2024 | 0 | 0 | NA | No | | | | | |
| Observer(s): A. Lockyer | Start: 8:42 | | | | | | | | | |
| | Stop: 10:02 | | | | | | | | | |
| | Total hrs: 1.3 | | | | | | | | | |
| **Survey # 5** | Date: 7/10/2024 | 0 | 0 | NA | No | | | | | |
| Observer(s): A. Lockyer | Start: 9:03 | | | | | | | | | |
| | Stop: 10:15 | | | | | | | | | |
| | Total hrs: 1.1 | | | | | | | | | |
| Overall Site Summary<br>Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings.<br>Be careful not to double count individuals.<br>Total survey hrs: 4.9 | | Total Adult Residents: 0 | Total Pairs: 0 | Total Territories: 0 | Total Nests: 0 | Were any WIFLs color-banded? Yes ____ No ____<br>If yes, report color combination(s) in the comments section on back of form and report to USFWS. | | | | |

Reporting Individual: **Adam Lockyer** Date Report Completed: **7/26/2024**

US Fish & Wildlife Service Permit #: **TE55135D-0** State Wildlife Agency Permit #: ____

***Submit form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.***

***Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.***

Reporting Individual **Adam Lockyer** Phone # **702-283-9429**

Affiliation **HDR Engineering, Inc.** E-mail Adam.Lockyer@hdrinc.com

Site Name **Beaumont, Cooper's Creek, Area #2** Date report Completed **7/26/2024**

Was this site surveyed in a previous year? Yes____ No___ Unknown__X__

Did you verify that this site name is consistent with that used in previous yrs? Yes ____ No **X** Not Applicable **X**

If name is different, what name(s) was used in the past? ____

If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.

Did you survey the same general area during each visit to this site this year? Yes ____ No ____ If no, summarize below.

Management Authority for Survey Area: Federal ____ Municipal/County **X** State ____ Tribal ____ Private ____

Name of Management Entity or Owner (e.g., Tonto National Forest) ____

Length of area surveyed: **Approximately 0.3** (km)

Vegetation Characteristics: Check (only one) category that best describes the predominant tree/shrub foliar layer at this site:

____ Native broadleaf plants (entirely or almost entirely, > 90% native)

**X** Mixed native and exotic plants (mostly native, 50 - 90% native)

____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

____ Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific name.

*Salix* sp, *Quercus* sp, *Populus fremontii*

Average height of canopy (Do not include a range): **7** (meters)

Attach the following: 1) copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections;
2) sketch or aerial photo showing site location, patch shape, survey route, location of any detected WIFLs or their nests;
3) photos of the interior of the patch, exterior of the patch, and overall site. Describe any unique habitat features in Comments.

Comments (such as start and end coordinates of survey area if changed among surveys, supplemental visits to sites, unique habitat features. Attach additional sheets if necessary.

Territory Summary Table. Provide the following information for each verified territory at your site.

| Territory Number | All Dates Detected | UTM E | UTM N | Pair Confirmed? Y or N | Nest Found? Y or N | Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Attach additional sheets if necessary

## Territory Summary Table, continued

Reporting Individual _____ Phone # _____

Affiliation _____ E-mail _____

Site Name _____ Date report Completed _____

| Territory Number | All Dates Detected | UTM E | UTM N | Pair Confirmed? Y or N | Nest Found? Y or N | Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, renesting attemps, behavior) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Comments

# Willow Flycatcher (WIFL) Survey and Detection Form (revised April, 2010)

Site Name: **Beaumont SWFL Survey - Area #3** State: **California** County: **San Bernardino**

USGS Quad Name: **Beaumont** Elevation: **762** (meters)

Creek, River, or Lake Name: **Cooper's Creek**

***Is copy of USGS map marked with survey area and WIFL sightings attached (as required)?*** ***Yes*** **X** ***No*** ____

Survey Coordinates: Start: E **500,415** N **3,753,577** UTM Datum: **NAD27** (See instructions)

Stop: E **500,120** N **3,753,713** UTM Zone: **11S**

If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.

*****Fill in additional site information on back of this page*****

| Survey # Observer(s) (Full Name) | Date (m/d/y) Survey Time | Number of Adult WIFLs | Estimated Number of Pairs | Estimated Number of Territories | Nest(s) Found? Y or N If Yes, number of nests | Comments (e.g., bird behavior; evidence of pairs or breeding;-potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator. | GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | # Birds | Sex | UTM E | UTM N |
| **Survey # 1** | Date: 5/16/2024 | 0 | 0 | NA | No | | | | | |
| Observer(s): A. Lockyer | Start: 7:20 | | | | | | | | | |
| | Stop: 8:15 | | | | | | | | | |
| | Total hrs: 0.9 | | | | | | | | | |
| **Survey # 2** | Date: 6/4/2024 | 0 | 0 | NA | No | | # Birds | Sex | UTM E | UTM N |
| Observer(s): A. Lockyer | Start: 7:05 | | | | | | | | | |
| | Stop: 9:00 | | | | | | | | | |
| | Total hrs: 2 | | | | | | | | | |
| **Survey # 3** | Date: 6/14/2024 | 0 | 0 | NA | No | | # Birds | Sex | UTM E | UTM N |
| Observer(s): A. Lockyer, A. Newton | Start: 7:10 | | | | | | | | | |
| | Stop: 8:31 | | | | | | | | | |
| | Total hrs: 1.3 | | | | | | | | | |
| **Survey # 4** | Date: 6/25/2024 | 0 | 0 | NA | No | | # Birds | Sex | UTM E | UTM N |
| Observer(s): A. Lockyer | Start: 8:15 | | | | | | | | | |
| | Stop: 9:05 | | | | | | | | | |
| | Total hrs: 0.8 | | | | | | | | | |
| **Survey # 5** | Date: 7/10/2024 | 0 | 0 | NA | No | | # Birds | Sex | UTM E | UTM N |
| Observer(s): A. Lockyer | Start: 6:20 | | | | | | | | | |
| | Stop: 8:30 | | | | | | | | | |
| | Total hrs: 2.2 | | | | | | | | | |
| Overall Site Summary. Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total survey hrs: 7.2 | | Total Adult Residents: 0 | Total Pairs: 0 | Total Territories: 0 | Total Nests: 0 | Were any WIFLs color-banded? Yes ____ No ____ If yes, report color combination(s) in the comments section on back of form and report to USFWS. | | | | |

Reporting Individual: **Adam Lockyer** Date Report Completed: **7/26/2024**

US Fish & Wildlife Service Permit #: **TE55135D-0** State Wildlife Agency Permit #: ____

***<u>Submit</u> form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.***

***Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.***

Reporting Individual **Adam Lockyer** Phone # **702-283-9429**

Affiliation **HDR Engineering, Inc.** E-mail Adam.Lockyer@hdrinc.com

Site Name **Beaumont, Cooper's Creek, Area #3** Date report Completed **7/26/2024**

Was this site surveyed in a previous year? Yes____ No___ Unknown__X__

Did you verify that this site name is consistent with that used in previous yrs? Yes ____ No **X** Not Applicable **X**

If name is different, what name(s) was used in the past? ____

If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.

Did you survey the same general area during each visit to this site this year? Yes ____ No ____ If no, summarize below.

Management Authority for Survey Area: Federal ____ Municipal/County **X** State ____ Tribal ____ Private ____

Name of Management Entity or Owner (e.g., Tonto National Forest) ____

Length of area surveyed: **Approximately 0.3** (km)

Vegetation Characteristics: Check (only one) category that best describes the predominant tree/shrub foliar layer at this site:

____ Native broadleaf plants (entirely or almost entirely, > 90% native)

**X** Mixed native and exotic plants (mostly native, 50 - 90% native)

____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

____ Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific name.

*Salix* sp, *Quercus* sp, *Populus fremontii*

Average height of canopy (Do not include a range): **7** (meters)

Attach the following: 1) copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections;
2) sketch or aerial photo showing site location, patch shape, survey route, location of any detected WIFLs or their nests;
3) photos of the interior of the patch, exterior of the patch, and overall site. Describe any unique habitat features in Comments.

Comments (such as start and end coordinates of survey area if changed among surveys, supplemental visits to sites, unique habitat features. Attach additional sheets if necessary.

Territory Summary Table. Provide the following information for each verified territory at your site.

| Territory Number | All Dates Detected | UTM E | UTM N | Pair Confirmed? Y or N | Nest Found? Y or N | Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Attach additional sheets if necessary

## Territory Summary Table, continued

Reporting Individual _____ Phone # _____

Affiliation _____ E-mail _____

Site Name _____ Date report Completed _____

| Territory Number | All Dates Detected | UTM E | UTM N | Pair Confirmed? Y or N | Nest Found? Y or N | Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, renesting attemps, behavior) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Comments

# Appendix C

## Normalized Differences Vegetation Index (NDVI)

## C.1 BACKGROUND

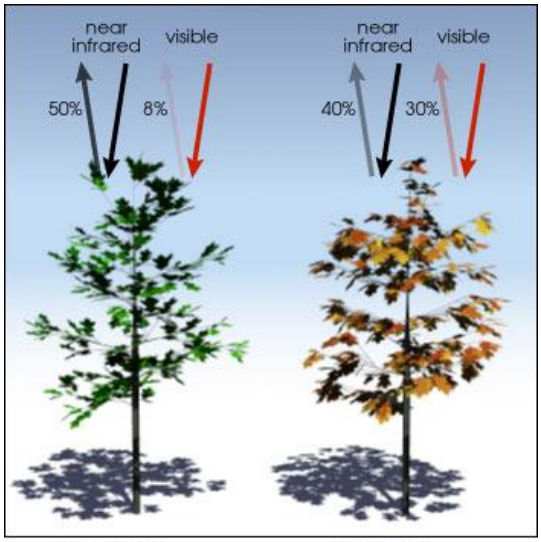
Multi-spectral remote-sensing measurements of the Earth's surface from satellites are a verifiable means of deriving complete spatial coverage of environmental information. Remote-sensing measurements have been collected in a consistent manner over time. They are updated regularly and can be analyzed retrospectively, which has made these measurements useful in various types of ecological and environmental monitoring, including vegetation monitoring (USDA, 1996; Schidt and Karnieli, 2000; Campbell, 2007; Lillesand et al., 2008; Xie et al., 2008; Jones and Vaughnan, 2010).

Remote sensing-based methods of vegetation monitoring commonly use vegetation indices that can be calculated from the wavelengths of light absorbed and reflected by vegetation (Jensen, 2007). Normalized Difference Vegetation Index (NDVI) is a widely used numerical indicator of vegetation extent and quality that is calculated from remote-sensing measurements (Ke et al., 2015; Xue, J and Su, B., 2017). Moreover, NDVI is an index of greenness correlated with photosynthesis and can be used to assess temporal and spatial changes in the distribution, productivity, and dynamics of vegetation (Pettorelli, 2013). NDVI is calculated from visible and near-infrared radiation reflected by vegetation using the following formula:

$$NDVI = \frac{(NIR - VIS)}{NIR + VIS}$$

Where: **NIR** = the spectral reflectance of near infrared radiation
**VIS** = the spectral reflectance of visible (red) radiation

During photosynthesis, healthy vegetation absorbs incoming visible light and reflects a large portion of near-infrared radiation. Unhealthy or dormant vegetation absorbs less visible light and reflects less near-infrared radiation. The figure[1] below illustrates NDVI:




[1] Nasa.gov

Near-infrared radiation and visible light spectral reflectance are both expressed as ratios of the reflected radiation over the incoming radiation (values between 0 and 1); therefore, NDVI estimates range between -1.0 and 1.0. Negative NDVI estimates correspond to standing water, and low positive values (0 to 0.1) correspond to non-vegetated areas, such as barren rock and sand, snow, and water. NDVI estimates ranging from 0.1 to 1.0 correspond to vegetated areas, with very low-end estimates indicating sparse, unhealthy, or dormant vegetation, and increasing estimates towards 0.9 indicating higher amounts of dense, healthy green vegetation.

## Advantages and Limitations

NDVI was chosen as a method for characterizing and monitoring the riparian habitat for the City of Beaumont's Adaptive Management and Mitigation Plan (AMMP) (physical setting referred to as the Study Area) for the following reasons:

- Changes in wastewater treatment plant (WWTP) discharges could cause regional changes in surface water flows or groundwater levels, which potentially could result in regional impacts to the riparian habitat that is dependent on shallow groundwater. The regional scale of NDVI makes it an appropriate "first indicator" of regional changes in the extent and quality of riparian vegetation. And, it has been widely used in the past to support similar environmental monitoring and management programs (Peters et al., 2002; Pinzon et al., 2004; Wang et al., 2004; Weiss et al., 2004; Intera, 2014; Verbesselt et al, 2010; Gandhi et al., 2015).
- There is a long time-series of historical NDVI (early 1980s to present) that spatially covers the entire Study Area. These datasets can be used to characterize the history of the spatial extent and quality of the riparian vegetation prior to and after the increased discharges at Beaumont WWTP (2004).
- In the future, it is likely that multi-spectral remote sensing will continue to collect the commonly measured spectral bands that are used to calculate NDVI (red and near-infrared) and that these data will be available for use as part of the AMMP at a low cost.

Like most monitoring tools, NDVI has its limitations, which can reduce its reliability and usefulness. Important examples include:

- Cloud cover, water vapor, and atmospheric contaminants can lead to false decreases in NDVI estimates compared to clear days (Tanre et al., 1992; Achard and Estreguil, 1995; Chen et al., 2004; Hird and McDermid, 2009).
- Satellite degradation, sensor errors, and data transmission errors can lead to false increases in NDVI estimates (James and Kalluri, 1994).
- Changes in soil moisture can lead to changes in NDVI estimates that are not necessarily related to changes in vegetation (Pettorelli, 2013).

- NDVI is a composite view of plant species diversity, form, structure, density, and vigor. As such, changes in NDVI may be caused by various changes in riparian habitat (Markon et al., 1995; Markon and Peterson, 2002). In other words, NDVI does not provide a complete picture of how and why vegetative changes are occurring; it simply indicates a change in vegetation.
- In densely vegetated areas, NDVI estimates have been shown to plateau during the growing season, indicating that NDVI can underestimate the green biomass in densely vegetated areas (Tucker et al., 1986).

These limitations demand that NDVI data be screened and filtered to identify or remove errors and noise. To reduce or eliminate noise, processing algorithms can be applied to "smooth" the time-series data and reveal patterns of change over time. For example, a smoothing technique applied in this report was the averaging of all NDVI from the growing season months. The average values are then plotted on time-series charts to display long-term trends in growing season vegetation quality.

The limitations also demand that NDVI not be interpreted in isolation. Interpretations of NDVI (vegetative changes) should be (i) verified with other georeferenced datasets, such as air photos and field vegetation surveys, and (ii) explained by comparison to datasets of causal factors of vegetative changes, such as water availability.

## C.2 LANDSAT PROGRAM AND NDVI

The USGS and the National Aeronautics and Space Administration (NASA) jointly manage the Landsat Program[2], a series of Earth-observing satellite missions that began in 1972 with sensors that observe the Earth's surface and transmit information to ground stations that receive and process multi-spectral, remote-sensing data. Landsat satellites use technology that collects scenes of remote sensing measurements at the same time and location on the Earth's surface at a temporal frequency of about every two weeks. Landsat remote sensing measurements (Landsat imagery) is acquired in scenes that are approximately 106 by 115 miles. Landsat imagery is the only data source with more than thirty-years of continuous records of global land surface conditions at a spatial resolution of tens of meters (Tuck et al., 2004). Landsat imagery is among the most widely used satellite imagery in ecology and conservation studies (Pettorelli, 2013), and the data have been available for no cost since about 2010.

The United States Geological Survey (USGS), in compliance with the Global Climate Observing System[3], produces spectral indices products from Landsat imagery to support land surface change studies, which includes NDVI from 1982 to present (USGS, 2016). The USGS uses remote sensing imagery from the Landsat satellites—*Landsat 4, Landsat 5, Landsat 7, Landsat 8, and Landsat 9* (*Landsat 4, 5, 7, 8, and 9*)—to generate NDVI estimates of the Earth's surface at a 30 x 30-meter pixel resolution. To apply the necessary atmospheric corrections and generate a surface reflectance product, the USGS uses a specialized software called Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) to post-process the Landsat imagery (USGS 2015; 2017a). This surface reflectance product is then used to

[2] Nasa.gov

[3] Global Climate Observing System Link

determine NDVI, among the other spectral indices. The spectral indices products are available for the USGS Landsat Collection 2 Level-2.[4]

## C.3 COLLECTION, REVIEW, AND ANALYSIS OF NDVI FOR THE PBHSP

### Collection

NDVI from the Landsat imagery for the period 1982 to 2023 were collected from the USGS, using the Earth Resources Observation and Science (EROS) Center Science Processing Architecture (ESPA) On Demand Interface[5] (USGS 2017b). The interface requires a bulk request in the form of a text file list of specific Landsat scenes using the Landsat scene identifier ID.[6] To obtain complete spatial coverage of the Study Area, NDVI was requested for all Landsat scenes for Path 040, Rows 036 and 037.[7] Table 1 below summarizes the Landsat satellites and periods for which NDVI was obtained to produce a near-continuous NDVI record.

**Table C-1. Landsat Satellites**

| Satellite | Instrument | Launched | Ended | Period of NDVI Data Obtained from USGS |
|---|---|---|---|---|
| Landsat 4 | Thematic Mapper | July 16, 1982 | December 14, 1993 | 1982 - 1983 |
| Landsat 5 | Thematic Mapper | March 1, 1984 | June 5, 2013 | 1984 - 2011 |
| Landsat 7 | Enhanced Thematic Mapper | April 15, 1999 | Still active | 1999 - 2016 |
| Landsat 8 | Operational Land Imager | February 11, 2013 | Still active | 2013 - 2023 |
| Landsat 9 | Operational Land Imager 2 and Thermal Infrared Sensor 2 | September 27, 2021 | Still active | 2021 - 2023 |

[4] NDVI from the entire period of record from 1984 to 2023 was obtained and uploaded to the project database to have a consistent record of NDVI from the same collection so that there are no changes in the NDVI analyzed in time series that were attributable to the difference in the spectral indices products from different Landsat Collections over time.

[5] USGS Link

[6] Landsat imagery is captured in scenes that are about 106 by 114 miles. Each Landsat scene has a unique scene ID based on the specific Landsat satellite, Landsat path number, Landsat row number, and date the image was collected.

[7] The Study Area is in an area of the Landsat path 040 that straddles Rows 036 and 037. Landsat scenes from Path 040 Row 036 and Path 040 Row 037 overlap each other throughout most of the Study Area, but both are required to obtain complete spatial coverage of the Study Area.

NDVI from scenes produced from the *Landsat 4, 5, 7, 8, and 9* satellites were obtained from the USGS for the period 1982 through 2023. The source and frequency of availability of NDVI from the USGS varies over the period of record:

- From 1982 to 1989, NDVI is from Landsat 4 and 5 and is patchy, ranging from a frequency of once every eight days to one year.
- From 1990 to 1999, NDVI is from Landsat 5 at a frequency of about once every 16 days.
- From 1999 to 2011, NDVI is from Landsat 5 and 7 at a frequency of once every seven to eight days.
- In 2012, NDVI is from Landsat 7 at a frequency of once every 14 to 16 days.
- From 2013 to 2023, NDVI is from Landsat 7 and 8 at a frequency of once every seven to eight days.
- Since November 2021, NDVI is from Landsat 7, 8, and 9 at a frequency of once every one to eight days.

NDVI were cataloged, processed, and uploaded into HydroDaVE[SM], a database management software that manages gridded datasets and features tools for viewing and extracting data.[8] There is some overlap of NVDI data in areas where there is NVDI from Landsat scenes from Rows 036 and 037. HydroDaVE has the ability to compute a stacked average for Landsat scenes from Rows 036 and 037 for each NDVI pixel they overlay[9] when viewing and extracting NDVI data.

## Review

Spatial NDVI were reviewed for disormalized Difference Vegetation Indeturbances that can be caused by cloud cover, unfavorable atmospheric conditions, or satellite equipment malfunction. In HydroDaVE[SM], maps were prepared of spatial NDVI for the entire Study Area for each date. The maps were reviewed and documented to identify specific dates for exclusion due to cloud cover or other disturbances. Erroneous NDVI estimates were discernable because NDVI patterns of permanent landscape features were distorted and/or NDVI estimates were clearly not consistent with estimates typically observed for a particular area both seasonally and over time. On average, about 31 percent of the NDVI were identified as erroneous and excluded from the analysis. Most of which were rejected because of cloud coverage, which was further verified by referencing and viewing the specific Landsat scene on the USGS *EarthExplorer* website.[10]

After excluding erroneous NDVI estimates, the time-series data discussed throughout Section 5 of the report include NDVI estimates for 1984 to 2023.

[8] Hydrodave Link

[9] Not all dates will have Landsat scenes for both Rows 036 and 037 if cloud cover was greater than 20 percent in one of them; Landsat scenes with a percent cloud cover greater than 20 percent were not obtained from the USGS for this study.

[10] Earthexplorer Link

NDVI estimates derived from *Landsat 7* satellite imagery since mid-2003 have to be further reviewed date-by-date for the occurrence of spatial data gaps, resulting from the failure of the Scan Line Corrector (SLC) on the *Landsat 7* satellite, which accounts for the satellite's forward motion. SLC failure results in data gaps along scan line paths of variable widths and occurrences. An estimated 22 percent of any given *Landsat 7* scene is lost because of SLC failure; however, the imagery acquired between these gaps is valid and useable for analysis.[11] All NDVI estimates derived from *Landsat 7* satellite imagery since 2003 were evaluated spatially date-by-date to determine if the valid portion of the data covers the defined areas of interest used for the temporal analysis of NDVI in the time series discussed in Section 5 of this report. Date-by-date analysis is necessary because the spatial position and size of the data gaps from the *Landsat-7* satellite vary for each date. Generally, areas of interest for NDVI analysis that are larger than about 400 square meters cannot use any NDVI determined from *Landsat 7* satellite imagery because it would include data gaps within the area; while areas of interest less than 400 square meters can use NDVI determined from the *Landsat 7* satellite imagery if the data gap area is not within the area of interest. During 2012, the *Landsat 7* satellite was the only Landsat satellite collecting data. Therefore, there are no data for the areas of interest larger than 400 square meters during 2012. After the launch of the *Landsat-9* satellite in 2022, there were several dates without spatial data gaps from the *Landsat 7* satellite.

## Analyses of Time-series Data

HydroDaVE[SM] contains features to calculate and extract a spatial average NDVI for a designated area and time period. The NDVI spatial average for each available date is plotted in time-series charts to analyze seasonal and temporal changes for a defined area. Time-series charts of NDVI for various areas in the Study Area are first introduced in Section 5.1 of this report.

When viewing time-series charts of NDVI for the period of record, it should be noted that a methodological factor that can affect observed NDVI trends is the difference between the technology of the *Landsat 4, 5, and 7* satellites, and the *Landsat 8 and 9* satellites. The *Landsat 4, 5, and 7* satellites use thematic mapper technology to scan the land surface, whereas *Landsat 8* and *Landsat 9* use operational land imager sensors. It has been well documented that the NDVI estimates obtained from the operational land imager sensors used on the *Landsat 8 and 9* satellites generate slightly higher index values for vegetated land cover (Xu and Guo 2014; She et al., 2015). In order to analyze the time-series of NDVI derived across all Landsat satellites for the period of record, a bias-correction factor of -0.05, derived from literature review (Li et al., 2014; Flood, 2014: and Ke et al., 2015), was used to transform all Landsat 8 and 9 NDVI estimates such that all historical NDVI estimates could be analyzed collectively (Roy et al., 2016). The *Landsat 9* satellite was launched into orbit in 2022, and since then, NDVI has been available from *Landsat 7, 8, and 9* satellites. During 2023, data was collected from both the *Landsat 8 and 9* satellites on some of the same dates. On these dates, only NDVI from the *Landsat 9* satellite was used.

[11] Landsat Link

## C.4 REFERENCES

Achard F., and Estreguil, C. 1995. *Forest Classification of Southeast Asia Using NOAA AVHRR data*. Remote Sensing of the Environment v. 56, pg. 198-208.

Campbell, 2007. *Introduction to Remote Sensing. Fourth edition*. Published 2007 Guilford Press.

Chen, J., Jonsson, P., Tamura, M, Gu, Z., Matsushita, B., and Eklundh, L. 2004. *A Simple Method For Reconstructing A High-Quality NDVI Time-Series Data Set Based On The Savitzky-Golay Filter.* Remote Sensing Of Environment V. 91, Pg. 332-344.

Gandhi, M., Parthiban, S., Thummalu, N., and A., C. 2015. *Ndvi: Vegetation Changes Detection Using Remote Sensing And Gis – A Case Study Of Vellore District.* Procedia Computer Science v. 57, pg. 1199-1210.

Hird, J., and McDermid, G. 2009. *Noise reduction of NDVI time series: An Empirical Comparison of Selected Techniques.* Remote Sensing of Environment V. 113, Pg. 248-258.

Intera Inc. 2015. *Memorandum Remote-Sensing Based Evaluation of Temporal Changes in Riparian Vegetation Health Along Temescal Creek, Prado Reservoir, Corona, California*. Prepared for Orange County Water District. January 30, 2015.

James, M., and Kalluri, S. 1994. *The Pathfinder AVHARR Land Data Set; An Improved Coarse Resolution Data Set for Terrestrial Monitoring*. International Journal Of Remote Sensing V. 15, Pg. 3347-3363.

Jenson, J. 2007. *Remote Sensing of the Environment: An Earth Resource Perspective, Second Edition*.Jones, H., and Vaughan, R. 2010. *Remote Sensing of Vegetation: Principles, Techniques and Applications*. Oxford University Press, Oxford.

Ke, Y., Im, J., Lee, J., Gong, H., and Ryu, Y. 2015. *Characteristics of Landsat 8 OLI-derived NDVI by Comparison with Multiple Sensors and In-Situ Observations.* Remote Sensing of Environment v. 164, pg. 298-313.

Lillesand,T, Kiefer, R, and Chipman, J. 2008. *Remote Sensing and Image Interpretation*, *Sixth Edition*. Published in 2008 by John Wiley & Sons, New York.

Markon, C., and Peterson, K. 2002. *The Utility Of Estimating Net Primary Productivity Over Alaska Using Baseline AVHRR Data.* International Journal of Remote Sensing, v.23, pg. 4571-4596

Markon, C., Fleming, M., and Binnian, E. 1995. *Characteristics of Vegetation Phenology Over Alaskan Landscape Using AVHRR Time-Series Data*. Polar Records v. 31, pg.179-190.

Peters, A., Walter-Shea, E., Ji, L, Vina, A., Hayes, M., and Svoboda, M.D. 2002. *Drought Monitoring with NDVI-Based Standardized Vegetation Index.* Photogrammetric Engineering & Remote Sensing v. 68, no. 1, pg. 71-75.

Pettorelli, N. 2013. *The Normalized Difference Vegetation Index.* First edition. Published 2013 by Oxford University Press.

Pinzon, J., Brown, M., and Tucker, C. 2004. *Monitoring Seasonal and International Variations in Land-surface Vegetation from 1981-2003 Using GIMMS NDVI* . Landval Link

Published 2007 by Prentice-Hall, Upper Saddle River, N.J.

Schimdt, H. and Karnieli, A. 2000. *Remote Sensing of Seasonal Variability of Vegetation In A Semi-Arid Environment.* Journal of Arid Environments v.45, pg. 43-59.

She, X., Zhang L., Cen, Y., Wu, T., Changping, H., and Ali Baig, H. 2015. *Comparison of the Continuity of Vegetation Indices Derived from Landsat * OLI and Landsat 7 ETM+ Data Among Different Vegetation Types*. Remote Sensing v.7, pg. 13485-13506. October 16, 2015. pg. 13485-13506. October 16, 2015.

Tucker C., Grant, D., and Dykstra, J.D. 2004. *NASA's Global Orthorectified Landsat Data Set. Photogrammetric Engineering & Remote Sensing,* v. 70, pg. 313-322.

Tucker C., Justice, C., and Prince, S. 1986. *Monitoring the Grasslands of Sahel 1984-1985. International Journal of Remote Sensing*, v. 71, pg. 1571-1581.

United State Geological Survey. 2013. *Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) Algorithm Description.* Open-File Report 2013-1057. 2013.

United State Geological Survey. 2016. *Product Guide – Landsat Surface Reflectance-Derived Spectral Indices. Version 3.3.* December 2016.

United State Geological Survey. 2017a. *Product Guide – Landsat 4-7 Climate Data Record (CDR) Surface Reflectance. Version 7.2.* January 2017.

United State Geological Survey. *2017b. User Guide – Earth Resources Observation and Science (EROS) Center Science Processing Architecture (ESPA) On Demand Interface. Version 3.7.* January 2017.

United States Department of Agriculture. 1996. *Using NDVI to Assess Departure From Average Greenness and its Relation to Fire Business. Burgan, R.E., Hartford, R.A, and Eidenshink, J.C. General Technical Report INT-GTR-333.* April 1996.

Verbesselt, J., Hyndman, R., Newnham, G., and Culvenor, D. 2010. *Detecting Trend and Seasonal Changes In Satellite Image Time-Series.* Remote Sensing of Environmental, v. 17, pg. 231-235.

Wang, J., Rich, P., Price, K., and Kettle, W. 2004. *Relations between NDVI and Tree Productivity in The Central Great Plains.* International Journal or Remote Sensing, v. 25, pg. 3127-3138.

Weiss, J., Gutzler, D., Allred Coonrod, J., and Dahm, C. 2004. *Long-Term Vegetation Monitoring with NDVI In A Diverse Semi-Arid Setting Central New Mexico, USA*. Journal of Arid Environments v. 58, pg. 249-272.

Xie, Y., Sha, Z., and Yu, M. 2008. *Remote Sensing Imagery In Vegetation Mapping: A Review.* Journal of Plant Ecology. V. 1, no.1, pg 9-23.

Xue, J. and Su, B. 2017. *Significant Remote Sensing Vegetation Indices a Review of Development and Applications*. Journal of Sensors V. 2017, Article ID 1353691 17 pages.

# Appendix D

## Mann-Kendall Analysis of NDVI

## D.1 INTRODUCTION

The Mann-Kendall statistical trend test (Mann-Kendall test) was performed on the average growing-season Normalized Difference Vegetation Index (NDVI) metrics for the period of 1984 to 2023 for all 13 areas where NDVI are analyzed for the *Cooper's Creek and San Timoteo Habitat Characterization and Sustainability Report.* The Mann-Kendall test was utilized to evaluate whether the average growing-season NDVI increased, decreased, or remained stable over time.

## D.2 METHODS

The Mann-Kendall test is a non-parametric statistical trend test. It is analogous to parametric trend testing such as regression (linear regression) except the data do not need to have a particular probability distribution (normal) and be accurately described by a particular measure of centrally tendency (mean, standard deviation, etc.) (Helsel and Hirsch, 2002).

To perform the test, the NDVI values are ordered chronologically and the signs (+/-) are recorded for all of the possible differences between a given NDVI value and every NDVI value that preceded it in the time series. The Mann-Kendall test statistic **S** is defined as the number of positive differences (+) minus the number of negative differences (-). From **S** and the number of NDVI values, **n**, the **τ** coefficient (analogous to the **r** correlation coefficient in linear associations) is then calculated. The **τ** coefficient represents the strength of the monotonic relationship between time and NVDI values with a possible range of -1 to 1. A perfect positive trend would yield a **τ** coefficient equal to 1, and a perfect negative trend would yield a **τ** coefficient equal to -1.

The Mann-Kendall test utilizes the null hypothesis that there is no trend. If the **S** test statistic and **τ** coefficient are significantly different than zero, the null hypothesis is rejected, and a trend exists. The level of statistical significance is expressed as a p-value between 0 and 1. The smaller the p-value the stronger the evidence that the null hypothesis should be rejected. In this study, a p-value of less than or equal to 0.05 was used to determine if a trend existed. In summary, the three possible outcomes of the test are

- Increasing trend (p-value ≤ 0.05, $\tau > 0$)
- No trend (p-value > 0.05)
- Decreasing trend (p-value ≤ 0.05, $\tau < 0$)

## D.3 DATA ANALYSIS AND RESULTS

The Mann-Kendall **S** test statistic, **τ** coefficient and p-value were computed for average-growing season NDVI from 1984 to 2023 for the 13 areas in the Study Area, using the python package *pyMann-Kendall* (Hussain, 2019). Tables D-1 through D-3 list the results of the Mann-Kendall test for the three time periods of interest: 1984 through 2023 (entire period of record); 1984 through 2003 (pre-Beaumont WWTP discharge increase); and 2004 through 2023 (post-Beaumont WWTP discharge increase).

| Table D-1. 1984 through 2023 | | | | | |
|---|---|---|---|---|---|
| Area | n (number of NDVI values) | S Test Statistic | τ coefficient | p-value | Trend |
| Cooper's Creek 1 Segment | 38 | 371 | 0.53 | 3.29E-06 | Increasing |
| San Timoteo 1 Segment | 39 | 459 | 0.62 | 3.02E-08 | Increasing |
| San Timoteo 2 Segment | 39 | 161 | 0.22 | 5.29E-02 | No Trend |
| FA01 | 40 | 570 | 0.73 | 3.37E-11 | Increasing |
| FA02 | 40 | 308 | 0.39 | 3.48E-04 | Increasing |
| FA03 | 40 | 582 | 0.75 | 1.29E-11 | Increasing |
| FA04 | 40 | 378 | 0.48 | 1.12E-05 | Increasing |
| FA05 | 40 | 358 | 0.46 | 3.19E-05 | Increasing |
| FA06 | 40 | 484 | 0.62 | 1.83E-08 | Increasing |
| FA07 | 40 | 364 | 0.47 | 2.34E-05 | Increasing |
| FA08 | 40 | 516 | 0.66 | 1.97E-09 | Increasing |
| FA09 | 40 | 252 | 0.32 | 3.45E-03 | Increasing |
| FA10 | 40 | 270 | 0.35 | 1.72E-03 | Increasing |

| Table D-2. 1984 through 2003 | | | | | |
|---|---|---|---|---|---|
| Area | n (number of NDVI values) | S Test Statistic | τ coefficient | p-value | Trend |
| Cooper's Creek 1 Segment | 20 | 90 | 0.47 | 3.88E-03 | Increasing |
| San Timoteo 1 Segment | 20 | 60 | 0.32 | 5.56E-02 | No Trend |
| San Timoteo 2 Segment | 20 | -46 | -0.24 | 1.44E-01 | No Trend |
| FA01 | 20 | 70 | 0.37 | 2.52E-02 | Increasing |
| FA02 | 20 | 28 | 0.15 | 3.81E-01 | No Trend |
| FA03 | 20 | 122 | 0.64 | 8.65E-05 | Increasing |
| FA04 | 20 | 0 | 0.00 | 1.00E+00 | No Trend |
| FA05 | 20 | 60 | 0.32 | 5.56E-02 | No Trend |
| FA06 | 20 | 30 | 0.16 | 3.47E-01 | No Trend |
| FA07 | 20 | 40 | 0.21 | 2.06E-01 | No Trend |
| FA08 | 20 | 82 | 0.43 | 8.59E-03 | Increasing |
| FA09 | 20 | -106 | -0.56 | 6.58E-04 | Decreasing |
| FA10 | 20 | 78 | 0.41 | 1.25E-02 | Increasing |

| Table D-3. 2004 through 2023 | | | | | |
|---|---|---|---|---|---|
| Area | n (number of NDVI values) | S Test Statistic | τ coefficient | p-value | Trend |
| Cooper's Creek 1 Segment | 18 | 67 | 0.44 | 1.24E-02 | Increasing |
| San Timoteo 1 Segment | 19 | 99 | 0.58 | 6.07E-04 | Increasing |
| San Timoteo 2 Segment | 19 | 63 | 0.37 | 3.01E-02 | Increasing |
| FA01 | 20 | 144 | 0.76 | 3.49E-06 | Increasing |
| FA02 | 20 | 112 | 0.59 | 3.17E-04 | Increasing |
| FA03 | 20 | 90 | 0.47 | 3.88E-03 | Increasing |
| FA04 | 20 | 124 | 0.65 | 6.59E-05 | Increasing |
| FA05 | 20 | 84 | 0.44 | 7.08E-03 | Increasing |
| FA06 | 20 | 78 | 0.41 | 1.25E-02 | Increasing |
| FA07 | 20 | 96 | 0.51 | 2.05E-03 | Increasing |
| FA08 | 20 | 56 | 0.29 | 7.44E-02 | No Trend |
| FA09 | 20 | 88 | 0.46 | 4.76E-03 | Increasing |
| FA10 | 20 | 26 | 0.14 | 4.17E-01 | No Trend |

## D.4 REFERENCES

Helsel, D.R., and Hirsch R.M. 2002. *Statistical Methods in Water Resources*. Techniques of Water Resource Investigations of the United States Geological Survey, Book, 4 Hydrological Analysis and Interpretation. September 2002.

Hussain et al. 2019. *Journal of Open Source Software*. pyMannKendall: a python package for non-parametric Mann Kendall family of trend tests. 4(39), 1556, https://doi.org/10.21105/joss.01556

## Concord

1001 Galaxy Way, Suite 310
Concord CA 95420
925-949-5800

## Davis

2020 Research Park Drive, Suite 100
Davis CA 95618
530-756-5905

## Irvine

25 Edelman, Suite 120
Irvine, CA 92618
949-420-3030

## Lake Oswego

5 Centerpointe Drive, Suite 130
Lake Oswego OR 97035
503-451-4500

## Oceanside

804 Pier View Way, Suite 100
Oceanside CA 92054
760-795-0365

## Phoenix

4505 E Chandler Boulevard, Suite 265
Phoenix AZ 85048
602-337-6110

## Pleasanton

6800 Koll Center Parkway, Suite 150
Pleasanton CA 94566
925-426-2580

## Sacramento

100 Howe Avenue
Suite 110S
Sacramento CA 95825

## San Diego

11545 West Bernardo Court, Suite 209
San Diego CA 92127
858-505-0075

## Santa Rosa

2235 Mercury Way, Suite 105
Santa Rosa CA 95407
707-543-8506