Statewide Stormwater & Erosion Control Study

Working Paper #1

October 2019

Prepared For:

Arizona Department of Transportation
2901 W. Durango Street
Phoenix, Arizona 85009

Prepared By:

Michael Baker International
2929 N. Central Avenue, Suite 800
Phoenix, Arizona 85012

TABLE OF CONTENTS

I. INTRODUCTION 10
A. STATEMENT OF NEED 10
B. PROJECT OBJECTIVES 10
C. STUDY AREA 11
D. STUDY PROCESS 14
II. DATA COLLECTION EFFORTS 16
A. DATA NEEDS IDENTIFICATION 16
B. MS4 BOUNDARIES AND OUTFALL LOCATIONS 16
C. ADOT DISTRICT STORMWATER NEEDS IDENTIFICATION 17
D. DEFINITIONS OF "CONSTRUCTION", "PREVENTATIVE MAINTENANCE" AND "ROUTINE MAINTENANCE" 19
Construction 19
Preventative Maintenance 20
Routine Maintenance 20
III. PROPOSED ADOT DISTRICT STORMWATER CONSTRUCTION PROJECTS 21
A. PRELIMINARY STORMWATER CONSTRUCTION PROJECTS BY DISTRICT 21
Northwest District 22
Project A- Interstate 40 @ MP 144 24
Project B- State Route 95 @ MP 165.3 – 165.4 NB and SB 27
Project C- State Route 93 @ MP 157.6 SB – Cottonwood Canyon 30
Project D- Interstate 17 @ MP 237, SE Corner of NB bridge over Moore's Gulch 33
Northcentral District 36
Project A- SR 89A @ MP 352.45 38
Project B- US 89 @ MP 506.3 & 507.3 41
Project C- US 89A @ MP 556 44
Project D- SR 98 @ MP 299 47
Project E- SR 87 @ MP 239.5 50
Project F- US 160 @ MP 322 - 325 53
Project G- US 160 @ MP 356 56
Northeast District 59
Project A- US 191 @ MP 389.3 61
Project B- US 160 @ MP 420 64
Project C- US 160 @ MP 380.7 – 383.6 67
Project D- SR 264 @ MP 447.3 70
Project E- SR 73 @ MP 313 73
Project F- US 180 @MP 415.6 - 415.7 76
Project G- US 160 @ MP 369 & 377.3 79
Project H- US 191 @ MP 472 83

Project I- SR 264 @ MP 417 86
Project J- Interstate 40 @ MP 287 EB 89
Project K- SR 377 @ MP 8, 13 and 24 92
Central District 95

Project A- SR 347 – @ SR 238 to MP 175.8 (GRIC Boundary) 98
Project B- Interstate 10 @ MP 163.9/ Queen Creek Traffic Interchange 101
Project C- SR 238 @ MP 24 to 44.24 104
Southwest District 107

Project A- US 95 @ MP 65.2, 66.5, 66.9, 69.3, 92.1, 92.5, 92.9, 110.8, & 112.5 109
Project B- US 95 @ MP 54 - 56 116
Project C- Interstate 8, MP 117.95 WB 119
Project D- Pacific Avenue @ Ave 2E Underpass, Structure # 1381 122
Project E- US 95 @ Fortuna Wash 125
Project F- US 95 @ MP 69.83 – 70.04 128
Project G- Interstate 10 @MP 31.5 – 32.5 131
Project H- SR 85 @ MP 139.81 – 141.11 134
Project I- Interstate 10 @ MP 18.89 137
Project J- Interstate 10 @ WB MP 95.8 – 97.5 140
Southcentral District 143

Project A- Interstate 10 WB frontage Rd @ MP 306 and 306.917 145
Project B- Interstate 10 WB @ MP 306.9 – San Pedro River bridge 149
Project C- SR 80 SB @ MP 306.079 152
Project D- SR 386 @ MP 4.37, 6.05, 6.58, 7.5 and 11.1 155
Project E- Interstate 10, EB and WB @ MP 289.41 – 291.70 158
Project F- Interstate 19 @ MP 8.9 – 9.1 161
Southeast District 164

Project A- US 60 @ MP 229.2 – 229.45 167
Project B- SR 288 @ MP 289 170
Project C- US 70 @ MP 380.46 173
Project D- SR 186 @ MP 343.83, 344.11, 344.60, 345.07, 345.46, 346.65, 347.87, 348.24, 348.96, 349.47 176
Project E- SR 181 @ MP 51, 55 and 60 180
Project F- SR 266 @ MP 210 183
Project G- US 60 @ MP 262 - 263 186
Project H- SR 177 @ MP 166.7 189
Project I- SR 288 @ MP 265.3 192
Project J- SR 88 @ MP 220.2 – 229.2 195
IV. NEXT STEPS 198

LIST OF FIGURES

Figure 1: Arizona's State Highway System and District Boundaries 12
Figure 2: Statewide USACE 404 Permits 13
Figure 3: Project Process 15
Figure 4: Phone Interview Questions 18
Figure 5: Northwest District & Project Locations 23
Figure 6: Northwest Project A 25
Figure 7: Westbound, Northern View 26
Figure 8: Eastbound, Rear View 26
Figure 9: Aerial 26
Figure 10: Northwest District Project B 28
Figure 11: Southbound, Western View 29
Figure 12: Southbound, Rear View 29
Figure 13: Aerial 29
Figure 14: Northwest District Project C 31
Figure 15: Downstream View (Picture Provided by ADOT) 32
Figure 16: Upstream View (Picture Provided by ADOT) 32
Figure 17: Aerial 32
Figure 18: Northwest District Project D 34
Figure 19: Northbound, Eastern View 35
Figure 20: Northbound, Rear View 35
Figure 21: Aerial 35
Figure 22: Northcentral District & Project Locations 37
Figure 23: Northcentral District Project A 39
Figure 24: Eastbound, Rear View 40
Figure 25: Eastbound, Northern View 40
Figure 26: Westbound, Southern View 40
Figure 27: Northcentral District Project B 42
Figure 28: Northbound, Eastern View 43
Figure 29: Northbound, Rear View 43
Figure 30: Aerial 43
Figure 31: Northcentral District Project C 45
Figure 32: Northside of Roadway, Western Facing (Picture Provided by ADOT) 46
Figure 33: Northside of Roadway, Southern Facing (Picture Provided by ADOT) 46
Figure 34: Northside of Roadway, Eastern Facing (Picture Provided by ADOT) 46
Figure 35: Northcentral District Project D 48
Figure 36: Westbound, Rear View 49
Figure 37: Westbound, Southern View 49
Figure 38: Westbound, Southern View 49
Figure 39: Northcentral District Project E 51
Figure 40: Hog Wash Downstream (Picture Provided by ADOT) 52
Figure 41: Hog Wash Inlet (Picture Provided by ADOT) 52

Figure 42: Hog Wash Upstream Debris (Picture Provided by ADOT) 52
Figure 43: Northcentral District Project F 54
Figure 44: Southbound View (Picture Provided by ADOT) 55
Figure 45: Eastern View, from Peshlakai Avenue (Picture Provided by ADOT) 55
Figure 46: Southbound View (Picture Provided by ADOT) 55
Figure 47: Northcentral District Project G 57
Figure 48: Box Culverts (Picture Provided by ADOT) 58
Figure 49: Northern View at Railroad Tracks (Picture Provided by ADOT) 58
Figure 50: Aerial 58
Figure 51: Northeast District & Project Locations 60
Figure 52: Northeast District Project A 62
Figure 53: US 191, MP 389.3 63
Figure 54: US 191, MP 389.3 63
Figure 55: US 191, MP 389.3 63
Figure 56: Northeast District Project B 65
Figure 57: Aerial (Picture Provided by ADOT) 66
Figure 58: Aerial (Picture Provided by ADOT) 66
Figure 59: Northeast District Project C 68
Figure 60: US 160 MP 369 69
Figure 61: US 160 MP 369 69
Figure 62: US 160 MP 369 69
Figure 63: Northeast District Project D 71
Figure 64: Eastbound, Southern View (MP 447) 72
Figure 65: Eastbound, Rear View 72
Figure 66: Westbound, Northern View 72
Figure 67: Northeast District Project E 74
Figure 68: SR 73 at MP 313 75
Figure 69: SR 73 at MP 313 75
Figure 70: Northeast District Project F 77
Figure 71: US 180 at MP 415 78
Figure 72: US 180 at MP 415 78
Figure 73: US 180 at MP 415 78
Figure 74: US 180 at MP 415 78
Figure 75: Northeast District Project G1 80
Figure 76: Northeast District Project G2 81
Figure 77: Northbound, Eastern View (MP 377) 82
Figure 78: Northbound, Rear View (MP 370) 82
Figure 79: Northbound, Eastern View (MP 369) 82
Figure 80: Northeast District Project H 84
Figure 81: US 191 MP 472 85
Figure 82: US 191 MP 472 85
Figure 83: US 191 MP 472 85
Figure 84: US 191 MP 472 85

Figure 85: Northeast District Project I 87
Figure 86: SR 264 at MP 417 88
Figure 87: SR 264 at MP 417 88
Figure 88: SR 264 at MP 417 88
Figure 89: Northeast District Project J 90
Figure 90: Westbound, Rear View (MP 287) 91
Figure 91: Westbound, Northern View 91
Figure 92: Westbound, Northern View 91
Figure 93: Northeast District Project K 93
Figure 94: SR 377 at MP 8 94
Figure 95: SR 377 at MP 8 94
Figure 96: SR 377 at MP 8 94
Figure 97: Central District & Project Locations 97
Figure 98: Central District Project A 99
Figure 99: Northbound, Eastern View 100
Figure 100: Northbound, Rear View 100
Figure 101: Southbound, Western View 100
Figure 102: Central District Project B 102
Figure 103: Northbound, Rear View 103
Figure 104: Southbound, Rear View 103
Figure 105: Northbound, Eastern View 103
Figure 106: Central District Project C 105
Figure 107: MP 43.58 Roadway Flooding and Closure 2018 (Picture Provided by ADOT) 106
Figure 108: MP 25 Box Culverts (Picture Provided by ADOT) 106
Figure 109: MP 34 Aerial (Picture Provided by ADOT) 106
Figure 110: Southwest District & Project Locations 108
Figure 111: Southwest District Project A1 110
Figure 112: Southwest District Project A2 111
Figure 113: Southwest District Project A3 112
Figure 114: Southwest District Project A4 113
Figure 115: Southwest District Project A5 114
Figure 116: US 95 at MP 65.2 115
Figure 117: US 95 at MP 92.5 115
Figure 118: US 95 at MP 69.3 115
Figure 119: US 95 at MP 92.5 115
Figure 120: Southwest District Project B 117
Figure 121: Northbound, Eastern View 118
Figure 122: Southbound, Western View 118
Figure 123: Northbound, Rear View 118
Figure 124: Southwest District Project C 120
Figure 125: San Tank Wash Near I-8 121
Figure 126: Debris in San Tank Wash 121
Figure 127: San Tank Wash 121

Figure 128: Southwest District Project D 123
Figure 129: Residential Property Backyard (Picture Provided by ADOT) 124
Figure 130: Pacific Avenue Bridge from the North (Picture Provided by ADOT) 124
Figure 131: Aerial View (Picture Provided by ADOT) 124
Figure 132: Southwest District Project E 126
Figure 133: Fortuna Wash Bank 127
Figure 134: Fortuna Wash from Roadway 127
Figure 135: Fortuna Wash 127
Figure 136: Southwest District Project F 129
Figure 137: Southbound, Western View (MP 69) 130
Figure 138: Northbound, Eastern View 130
Figure 139: Northbound, Rear View 130
Figure 140: Southwest District Project G 132
Figure 141: Westbound, Northern View (MP 32) 133
Figure 142: Eastbound, Southern View (MP31) 133
Figure 143: Eastbound, Southern View (MP32) 133
Figure 144: Southwest District Project H 135
Figure 145: Aerial View (MP 141) (Picture Provided by ADOT) 136
Figure 146: Southbound, Eastern View (Picture Provided by ADOT) 136
Figure 147: Southwest District Project I 138
Figure 148: Eastbound, Southern View (MP 18) 139
Figure 149: Eastbound, Rear View (Picture Provided by ADOT) 139
Figure 150: Southwest District Project J 141
Figure 151: Westbound, Northern View (MP 96) 142
Figure 152: Eastbound, Southern View 142
Figure 153: Eastbound, Rear View 142
Figure 154: Southcentral District & Project Locations 144
Figure 155: Southcentral District Project A 146
Figure 156: Ramsey Rd. Overflow of Sediment, Inlet Wingwall and Box Culvert 147
Figure 157: Ramsey Rd. Inlet Dike Failure, Box Culvert Too Small for Water Flow 147
Figure 158: Ramsey Rd. Outlet at Box Culvert, Annual Sediment Overflow 147
Figure 159: Pomerene Rd. Box Culvert and Dike Failure 147
Figure 160: Pomerene Rd. Box Culvert Inlet Overflow 147
Figure 161: Pomerene Rd. Grade Control Dike is Broken and Ready to Fall 148
Figure 162: Pomerene Rd. Box Culvert is Broken at Both Edges of the Inlet 148
Figure 163: Pomerene Rd. Box Culvert is Broken at Both Edges of the Inlet 148
Figure 164: Pomerene Rd. Channel Wider than Box Culvert, Outlet Overflow 148
Figure 165: Southcentral District Project B 150
Figure 166: MP 306.87 –12” Drainage Pipe 151
Figure 167: MP 306.87 Erosion. 151
Figure 168: MP 306.9 24” Drainage Pipe 151
Figure 169: MP 306.9 Erosion 151
Figure 170: Southcentral District Project C 153

Figure 171: Outlet Box Culvert Wingwall Erosion 154
Figure 172: Outlet Box Culvert Wingwall Erosion 154
Figure 173: Outlet Box Culvert Wingwall Erosion 154
Figure 174: Outlet Box Culvert Wingwall Erosion 154
Figure 175: Southcentral District Project D 156
Figure 176: Southbound, Eastern View (MP 7) 157
Figure 177: Southbound, Rear View (MP 6) 157
Figure 178: Southbound, Eastern View (MP 4) 157
Figure 179: Southcentral District Project E 159
Figure 180: Westbound, Northern View (MP 290) 160
Figure 181: Westbound, Northern View (MP 289) 160
Figure 182: Westbound, Northern View (MP 289) 160
Figure 183: Southcentral District Project F 162
Figure 184: Slope Erosion at MP 8.9-9.1 163
Figure 185: Slope Erosion 163
Figure 186: Slope Erosion 163
Figure 187: Southeast District & Project Locations 166
Figure 188: Southeast District Project A 168
Figure 189: Westbound, Northern View (MP 229) 169
Figure 190: Eastbound, Southern View 169
Figure 191: Eastbound, Rear View 169
Figure 192: Southeast District Project B 171
Figure 193: Images Pending (No ADOT imagery available) 172
Figure 194: Southeast District Project C 174
Figure 195: Northbound, Eastern View (MP 380) 175
Figure 196: Southbound, Western View 175
Figure 197: Northbound, Rear View 175
Figure 198: Southeast District Project D1 177
Figure 199: Southeast District Project D2 178
Figure 200: Northbound, Rear View (MP 343) 179
Figure 201: Southbound, Rear View (MP 343) 179
Figure 202: Northbound, Rear View (MP 358) 179
Figure 203: Southeast District Project E 181
Figure 204: Northbound, Rear View (MP 51) 182
Figure 205: Northbound, Rear View (MP 55) 182
Figure 206: Southbound, Rear View (MP 60) 182
Figure 207: Southeast District Project F 184
Figure 208: Westbound, Rear View (MP 110) 185
Figure 209: Eastbound, Rear View 185
Figure 210: Eastbound, Southern View 185
Figure 211: Southeast District Project G 187
Figure 212: Field Photo 1 (Provided by ADOT) 188
Figure 213: Field Photo 2 (Provided by ADOT) 188

Figure 214: Field Photo 3 (Provided by ADOT) 188
Figure 215: Southeast District Project H 190
Figure 216: Field Photo (Provided by ADOT) 191
Figure 217: Southbound, Western View (MP 166) 191
Figure 218: Southbound, Rear View 191
Figure 219: Southeast District Project I 193
Figure 220: Field Photo (Provided by ADOT) 194
Figure 221: Southbound, Western View (MP 265) 194
Figure 222: Northbound, Rear View 194
Figure 223: Southeast District Project J 196
Figure 224: Westbound, Rear View (MP 220) 197
Figure 225: Eastbound, Southern View 197
Figure 226: Westbound, Northern View 197

LIST OF TABLES

Table 1: Northwest District Stormwater Projects 22
Table 2: Northcentral District Stormwater Projects 36
Table 3: Northeast District Stormwater Projects 59
Table 4: Central District Stormwater Projects 95
Table 5: Southwest District Stormwater Projects 107
Table 6: Southcentral District Stormwater Projects 143
Table 7: Southeast District Stormwater Projects 164

I. INTRODUCTION

A. STATEMENT OF NEED

As expressed by ADOT, the Statewide Stormwater & Erosion Control Study has been identified as a need to:

- Conduct a planning study that identifies and prioritizes statewide stormwater management and erosion control needs delivered as a data model that operates with a defined project prioritization framework.
- Develop a model whose output will create a prioritized list of stormwater construction projects to be addressed on an annual program basis.
- Ensure that the model is quantitative, comprehensive, replicable, and systematic to inform /augment stormwater management activities and compete in the annual ADOT P2P process and programming.

B. PROJECT OBJECTIVES

The Technical Advisory Committee (TAC) for the Statewide Stormwater & Erosion Control Study has developed, reviewed and confirmed the following project objectives:

1. Develop a prioritization model with scoring criteria and weighting to analyze potential projects on an ongoing basis.
2. Stakeholder coordination to identify statewide stormwater and erosion control needs and required mitigation for roadway and right of way drainage.
3. Analysis of identified needs through the prioritization model using established scoring criteria.
4. Determine project scoping elements and develop planning level cost estimates for the top 20 prioritized projects.

Though not a formal project objective, an important work task that ADOT is hopeful this project will assist in achieving, is to further define data points of relevance to ADOT's Municipal Separate Storm Sewer System (MS4) and stormwater permit. As part of data collection efforts for prioritization model development, datasets are being collected that may aid in developing a repository of information to assist ADOT in defining statewide MS4 boundaries and outfall locations adjacent to ADOT State Highway System (SHS) facilities. Examples of data include GIS data layers shared by ADOT internal departments, ADEQ, other MS4s and other data sources as identified by the TAC.

As was acknowledged early in the process, this task will likely have mixed results due to limited data. The Arizona Department of Environmental Quality (ADEQ) for example does not require MS4s to share their MS4 maps with them unless requested to do so. Even if ADEQ had this data, state statutes limit what information can be shared with the public. The greatest chance for success is to obtain data directly from other MS4s, but only if they are willing to share this information. An initial data request by ADOT to adjacent MS4 permittees has had very limited results to date. There will be one additional follow up data request to MS4s located in urbanized areas by the consultant team.

C. STUDY AREA

The ADOT Statewide Stormwater & Erosion Control study area generally encompasses the entire state of Arizona and the seven ADOT Districts that are responsible for the entire ADOT SHS. See **Figure 1** for illustration of the ADOT SHS and the ADOT District boundaries that serve the SHS. See **Figure 2** that identifies the current locations of all statewide USACE Section 404 current permittees.

More specific to this project, the study area will focus upon specific Mile Post (MP) locations along the ADOT SHS where ADOT District employees have identified existing stormwater challenges or conflicts that adversely impact (or have the potential to adversely impact) ADOT rights-of-way (ROW). Please see **Section 0** for a detailed overview of each potential stormwater construction project by District.

Figure 1: Arizona's State Highway System and District Boundaries

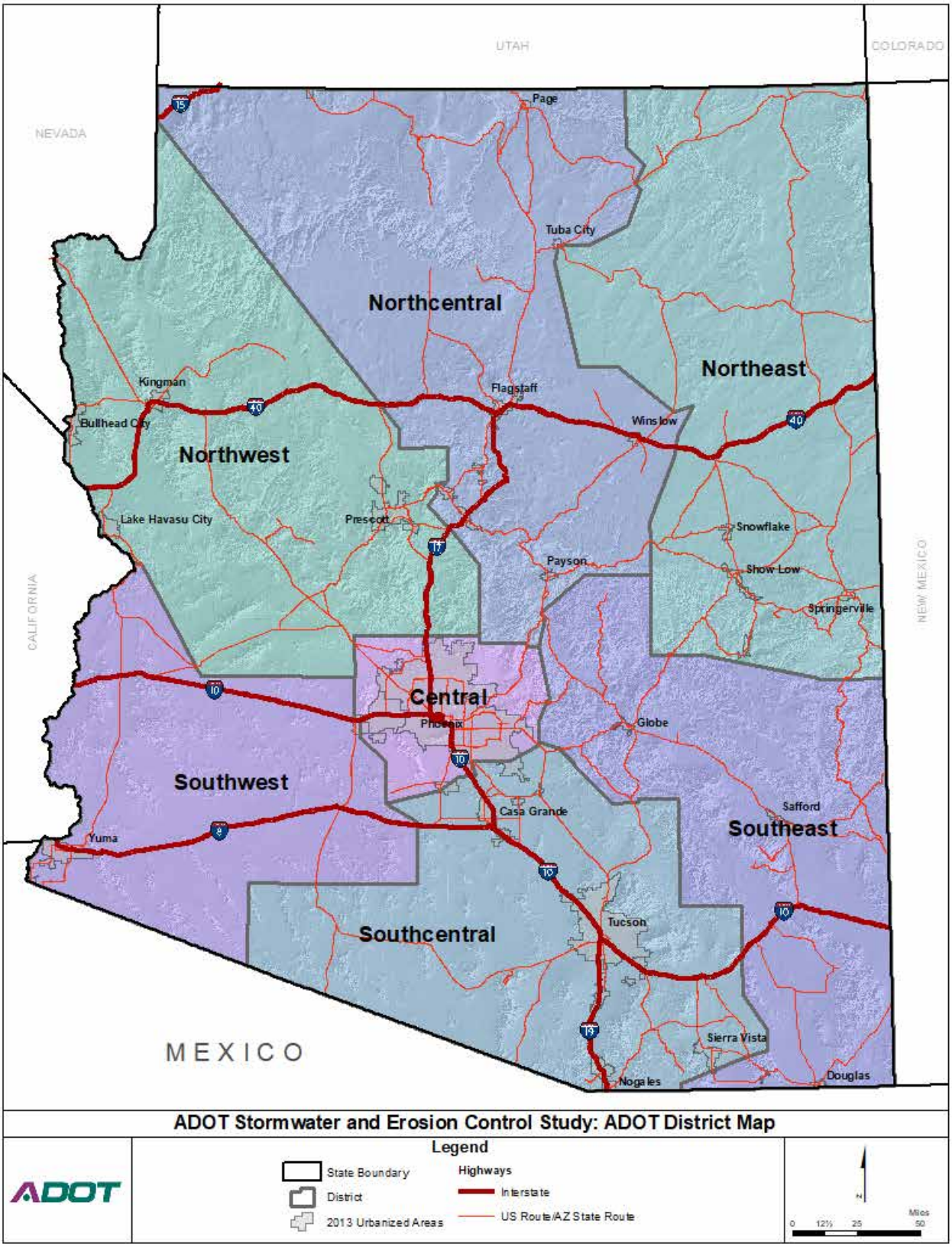
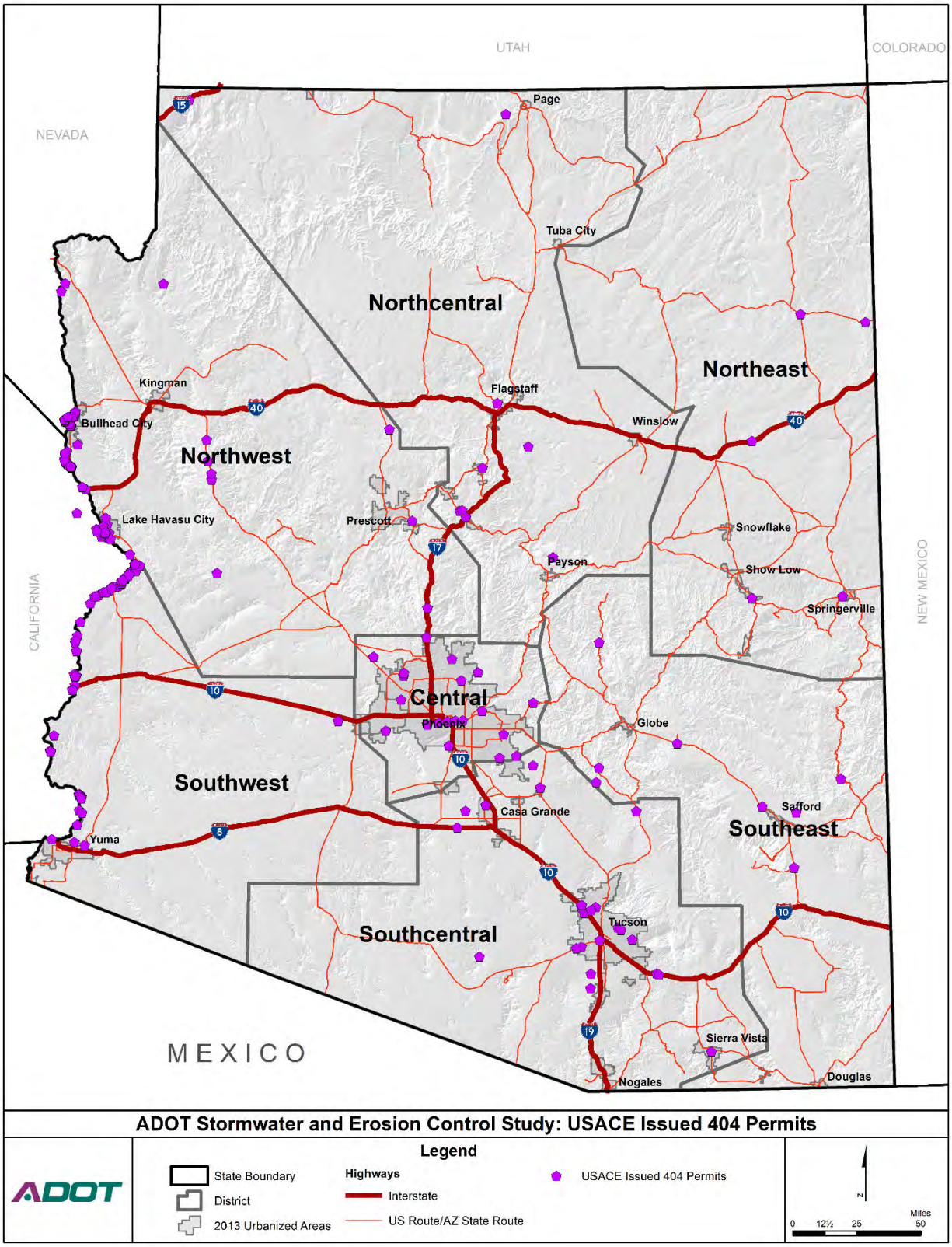


Figure 2: Statewide USACE 404 Permits



D. STUDY PROCESS

The following represents a brief description and sequence of each task included as a part of the ADOT Statewide Stormwater & Erosion Control Study.

TASK 1: Kick off Meeting

– Project team meeting to finalize work plan and budget

TASK 2: Finalize Work Plan/TAC Meeting #1

– Introduce the project work plan to the TAC; obtain their feedback on key issues, concerns and objectives

TASK 3: Develop Prioritization Model

– Data Collection – FIS, PECOS, Photolog, Interviews, list of projects by District

– Mapping MS4's – ADOT and adjacent MS4's; boundaries, overlap areas, discharge location and elevation as available, FIS environmental datasets and other info TAC desires

– Working Paper #1 – Needs Identification, Inventory and Analysis; determine project type - construction vs. maintenance, construction moves forward

– TAC Meeting #2 – TAC review and feedback of WP#1

–Evaluation Criteria/Weighting – TAC consensus driven process

TASK 4: Needs Identification/Project Scoring

– Working Paper #2 – apply model; analyze results

– TAC Meeting #3 – review and discuss model results, identify changes if needed, consensus on top 20

TASK 5: Working Paper #3 – scoping elements/cost estimates

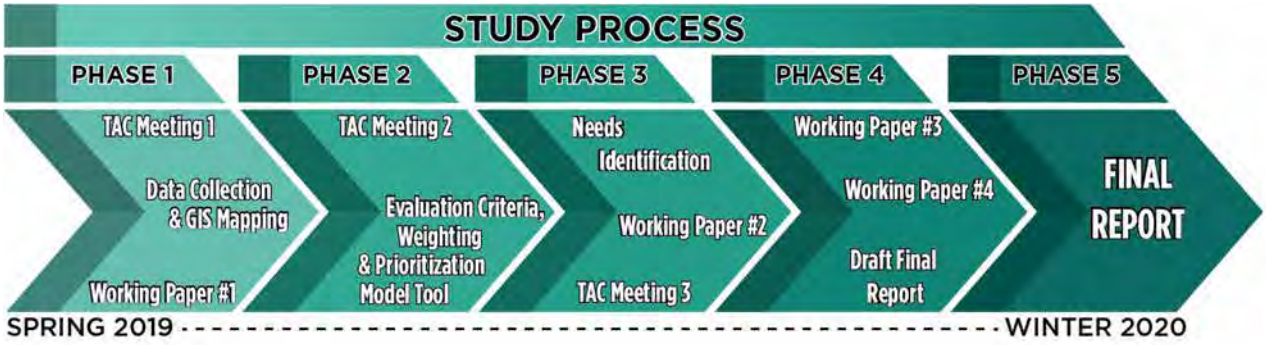
TASK 6: Working Paper #4 – TAC review of WP#4

TASK 7: Draft Final Report

TASK 8: Final Report

TASK 9: Project Closeout/GIS Files

Figure 3: Project Process



II. DATA COLLECTION EFFORTS

A. DATA NEEDS IDENTIFICATION

The consultant team, in consultation with the ADOT TAC, will identify data sources to contribute to the Prioritization Model's development. Considerations of data for model development may include data that address public safety, roadway safety, regulatory mandates, permit requirements, strategic value for the Department, environmental benefits, cost (capital improvement, maintenance and life cycle costs), District priority, ease of implementation, public support, resource impacts, reduction of flooding or hazards, and/ or increased system resiliency. Available known ADOT data sources to consider include: FIS, GIS, PECOS, ADOT Photo Log, and District interviews. Other datasets may include ADEQ, adjacent MS4s, Maricopa County Flood Control District, and County records. In addition to these datasets, ideas brought up by the diverse membership of the TAC may identify other data sources that could be factored into the Prioritization Model development.

B. MS4 BOUNDARIES AND OUTFALL LOCATIONS

A municipal separate storm sewer system (MS4) is a publicly owned means of conveyance, individually or in a system, (e.g. roads with drainage systems, streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains, etc.) for stormwater and discharges to local surface waters determined to be Waters of the United States (WOTUS) as defined by the Clean Water Act (CWA) 33 U.S.C. §1251 et seq. (1972). ADOT's MS4 Stormwater Discharge Permit only regulates non-Indian Land discharges. Indian Lands are regulated by the USEPA and Tribal Government requirements, which are not addressed in this study specifically. In the context of ADOT, the MS4 is basically the state highway system including ROW and the system's associated drainage. In Arizona, there are over 60 regulated MS4s. Since ADOT's system covers the entire state, it intersects and overlaps with the other regulated entities (typically municipalities) throughout the State of Arizona. MS4 boundaries are typically represented by municipal boundaries within the urbanized areas as defined by the 1990 United States census for ADOT.

The data collection effort will aid in refining ADOT's understanding of MS4 conveyance system's capabilities which is a regulatory requirement of the State issued stormwater discharge permit. The data will further delineate the system's potential loads, discharges, physical pathways, and interconnections with neighboring regulated entities and the surrounding terrain. The Permit requires ADOT to identify all discharge or outfall locations to which drainage is conveyed into WOTUS. These are considered priority focus areas. In the event that a serious erosion and sediment control problem occurs near an outfall, then ADOT is directed by the Permit to minimize or eliminate pollutants from entering WOTUS in these locations with increased priority.

There are some challenges in identifying outfall locations and inlets/outlets into adjacent systems. These challenges include limited data sets, large amounts of data to filter through that may have been collected for other purposes, and data sharing amongst the regulated entities is not always optimal because although entities are encouraged to share data, they are not obligated to do so. Finally, when the data was collected for this project, not all Permittees had completed mapping their systems.

Data collection will be an ongoing and iterative process over the course of this project. It is expected that over time, as more and more data is input into the model, ADOT will be able to continue to refine and improve its MS4 data repository.

For many agencies including ADOT, data collection efforts focused on drainage systems is a lengthy process. Data collection efforts will continue over project duration and we will describe what information is received and include it in ADOT's repository of data for consideration as the Prioritization Model development is refined. Please see **Section I.B** for further discussion on the data collection process and challenges relative to MS4s.

C. ADOT DISTRICT STORMWATER NEEDS IDENTIFICATION

The ADOT MPD Project Manager initially reached out to representatives from each ADOT District with a request to develop a list of potential stormwater or erosion control project needs that either; 1) represent constant or redundant maintenance concerns and/or projects that may need construction project mitigation to rectify the problem, or 2) stormwater or erosion control projects that likely represent a more resource-intensive level of mitigation which would warrant a construction level of activity.

Once the initial list of potential projects was provided by each ADOT District, the consultant conducted follow up phone interviews with representatives from each ADOT District. The phone interviews were conducted over a three-week period in July. The District phone interviews were utilized to further define and clarify the characteristics of the initial projects identified. A series of questions and talking points were used to further clarify the existing conditions of each project location, as well as to explore the characteristics of the stormwater or erosion control condition.

The resulting discussions were used to ascertain if these projects would be considered as "construction" or "maintenance". **Figure 4** represents the questions and talking points utilized for each District phone interview. The discussion points and questions utilized in the ADOT District phone interviews were used to gain a more in depth understanding of the nature of each potential stormwater/erosion control project and ascertain if the project would likely be considered "construction" or "maintenance". Only projects that were deemed "construction", and therefore eligible for Federal funding assistance, are considered for further consideration for this project. Accordingly, it is the "construction" projects that are presented and described in **Section 0**.

Figure 4: Phone Interview Questions

1. Do you have any comments, concerns or questions about the nature or objectives of this project?

2. For each stormwater related project identified in your District, we wish to explore each project in a little more detail. Also, are there any additional needs not already identified.

3. An overarching project objective is to try and make a determination if these projects should be considered a "construction" activity/project or a "maintenance" activity/project. The TAC will generally define these terms but have not done so at this time.

4. Recognizing that there often times is not a precise answer to determining what activities/ projects are considered "construction" versus what is "maintenance", we want to explore the following questions.

5. For each District project you identified, please clarify the following (as needed):

- **a.** Precise location and approximate extents of the project/activity.
- **b.** Can this project/activity readily be labeled as "construction" or "maintenance" in nature?
- **c.** How long has this project/activity been identified as an issue/problem?
- **d.** Has there been ongoing maintenance activities? If so, how long?
- **e.** If yes to **d.**, how much of your annual maintenance budget (as a percentage) does this ongoing maintenance activity consume (generally speaking)?

6. Which of the following would you say is the most applicable in describing the nature of each of the activities/projects you identified?

- **a.** Failed stabilization/erosion control
- **b.** Facility overtopping or embankment protection
- **c.** Slope washout
- **d.** Poor soil conditions
- **e.** Undersized infrastructure
- **f.** Improper construction/installation
- **g.** Additional negative impacts downstream
- **h.** Other

7. Respond to this question for each of the projects identified **(Scale 1 to 5, 5 = most)**:
If the identified project/activity were to be successfully completed, which of the following considerations would the activity/project best address?

- **a.** Public safety
- **b.** Regulatory mandate
- **c.** Environmental benefit
- **d.** Relief to District budget and/or resources
- **e.** Meets District or ADOT strategic objective
- **f.** Reduction/mitigation in flooding or hazard
- **g.** Extend facility life span

D. DEFINITIONS OF "CONSTRUCTION", "PREVENTATIVE MAINTENANCE" AND "ROUTINE MAINTENANCE"

A key objective of the ADOT Stormwater & Erosion Control Study is to identify and prioritize statewide stormwater and/or erosion control projects. As previously explained, this project is seeking to prioritize stormwater projects that can be characterized as "construction" or "preventative maintenance" in order to be eligible for Federal funding assistance under the Federal Surface Transportation Block Grant Program. Projects characterized as "routine maintenance" are not considered eligible for Federal funding and thus are not being identified for further consideration.

Utilizing guidance obtained from the Title 23 of the United States Code, Federal Highway Administration Guidance Memos, and discussions with the ADOT Federal Aid Program Manager, definitions for each term are as follows:

CONSTRUCTION

The term "construction" means the supervising, inspecting, actual building, and incurrence of all costs incidental to the construction or reconstruction of a highway or any project eligible for assistance under this title, including bond costs and other costs relating to the issuance in accordance with section 122 of bonds or other debt financing instruments and costs incurred by the State in performing Federal-Aid project related audits that directly benefit the Federal-Aid highway program. Such term includes:

A. preliminary engineering, engineering, and design-related services directly relating to the construction of a highway project, including engineering, design, project development and management, construction project management and inspection, surveying, mapping (including the establishment of temporary and permanent geodetic control in accordance with specifications of the National Oceanic and Atmospheric Administration) and architectural-related services;
B. reconstruction, resurfacing, restoration, rehabilitation and preservation;
C. acquisition of rights-of-way;
D. relocation assistance, acquisition of replacement housing sites, and acquisition and rehabilitation, relocation and construction of replacement housing;
E. elimination of hazards of railway-highway grade crossings;
F. elimination of roadside hazards;
G. improvements that directly facilitate and control traffic flow, such as grade separation of intersections, widening of lanes, channelization of traffic, traffic control systems and passenger loading and unloading areas; and
H. capital improvements that directly facilitate an effective vehicle weight enforcement program, such as scales (fixed and portable), scale pits, scale installation and scale houses.

PREVENTATIVE MAINTENANCE

Preventative maintenance is a cost-effective means of extending the useful life of the Federal-Aid highway program. In the practical application of these terms there is a bit of uncertainty if projects deemed "preventative maintenance" can include project types that may have components of their respective "construction project solutions" outside of the Federal-aid highway right-of-way. It was determined that if this project identifies prioritized projects whose mitigation measures are a "systems approach" that extend outside of the ADOT right-of-way, a more detailed evaluation with FHWA representatives will be conducted to seek their guidance on a case by case basis.

ROUTINE MAINTENANCE

Routine maintenance encompasses work that is performed in reaction to an event, season, or over all deterioration of the transportation asset. This work requires regular reoccurring attention.

III. PROPOSED ADOT DISTRICT STORMWATER CONSTRUCTION PROJECTS

A. PRELIMINARY STORMWATER CONSTRUCTION PROJECTS BY DISTRICT

As noted in **Section II.C** above, ADOT District phone interviews were used to further explore the characteristics of each identified project and help determine, at least preliminarily, if the project could be classified as "construction" or "maintenance", either routine or preventative.

For consistency, this section will introduce and describe the preliminary listing of likely construction and/or preventative maintenance stormwater and erosion projects for each ADOT District. Information presented for each District will generally be described in the following manner:

1. Table listing all stormwater and erosion control projects
2. Project overview- a description of the existing SHS stormwater problem/characteristics, map depicting existing ADOT stormwater facilities in the area, project location, area photographs, nature of the problem and perceived benefits.

NORTHWEST DISTRICT

Error! Reference source not found. identifies the initial listing of potential stormwater projects identified by representatives of the Northwest District.

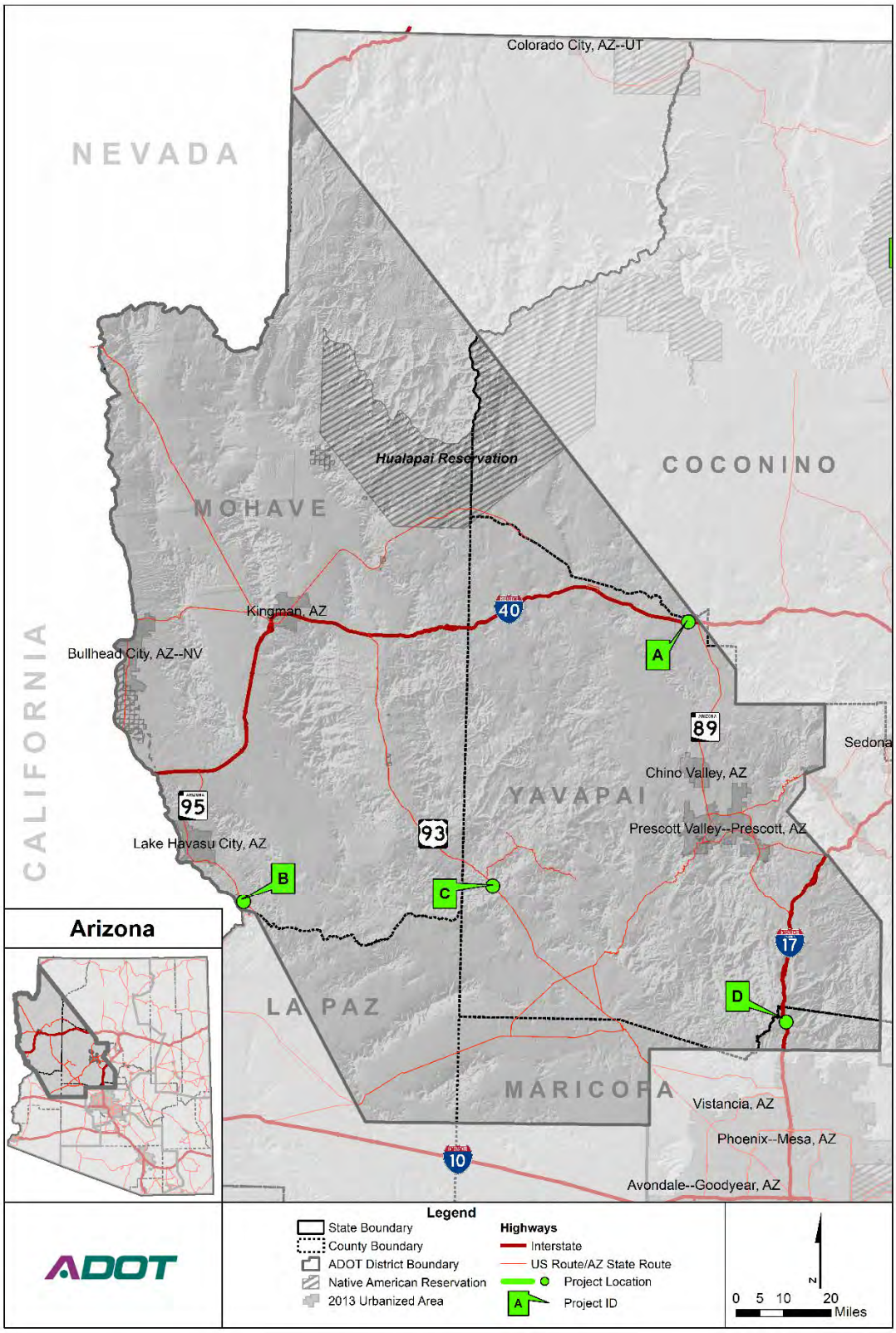
Table 1: Northwest District Stormwater Projects

Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
A	I-40	144.0 WB	Sediment clogging box culvert causing flows to overtop the roadway resulting in roadway closures and lane restrictions.	Construction
B	SR 95	165.3-.4 SB/NB	The roadway is being compromised from the clogging of two culverts and overtopping of flows.	Construction
C	SR 93	157.6 SB, Cottonwood Canyon	There is no support for slope except the strength of rock underlying fill and overhanging the scoured section.	Construction
D	I-17	237, SE corner of NB Bridge over Moore's Gulch	Scour occurring along the abutment embankment of the corner of the bridge.	Construction
–	I-17	239, Little Squaw Bridge	Severe erosion due to ditch failure.	Maintenance

1 For this column, the term "Construction" applies to both construction and preventative maintenance, therefore these projects qualify for this study. The term "Maintenance" applies to routine maintenance only, therefore these projects do not qualify for this study and no further details are provided.

As **Table 1** indicates, the Northwest District submitted a total of five (5) potential stormwater projects. After the District phone interview, the Northwest District feels that four (4) of the five (5) submitted projects meet the definition of a "construction" or "preventative maintenance" project. These construction projects are described below.

Figure 5: Northwest District & Project Locations



PROJECT A- INTERSTATE 40 @ MP 144

Project Description: Erosion occurring on the north slope of the fill section between BNSF Bridge and concrete box culvert to west. Erosion and sedimentation occurring at the toe of fill slope. Sedimentation occurring in box culvert. No curb on the highway to properly channel flows. During heavy rains (about once or twice a year) water flows from drainage basin north of I-40 towards the highway and overtops at this location. Flow is concentrated through a breach in a berm used to channel water to an old ranch cattle tank no longer in existence. This flow is concentrated at the concrete box to the west of MP 144. Due to the sedimentation in the box culvert, capacity has been significantly reduced. Saturation of the toe of the slope is causing the fill slope to slough into the cut ditch in the ADOT ROW which is now filled in with sediment.

How long has this been a concern? At least 5 years

Has the problem led to road closures? Yes, several times in last five years.

District Priority (if identified): #3

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. **Additional negative impacts downstream**
h. Other

Possible Mitigation/Solution: Construct asphalt berm at top of fill slope between bridge and culvert; Re-establish ROW drainage ditch; Use excavated material as a berm at the ROW or push it up and compact it at the toe of the fill slope between bridge and culvert; Excavate sediment from culvert and re-establish grade for flow. It seems all activity can occur within ROW. Temporary construction easement may be necessary.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 6: Northwest Project A

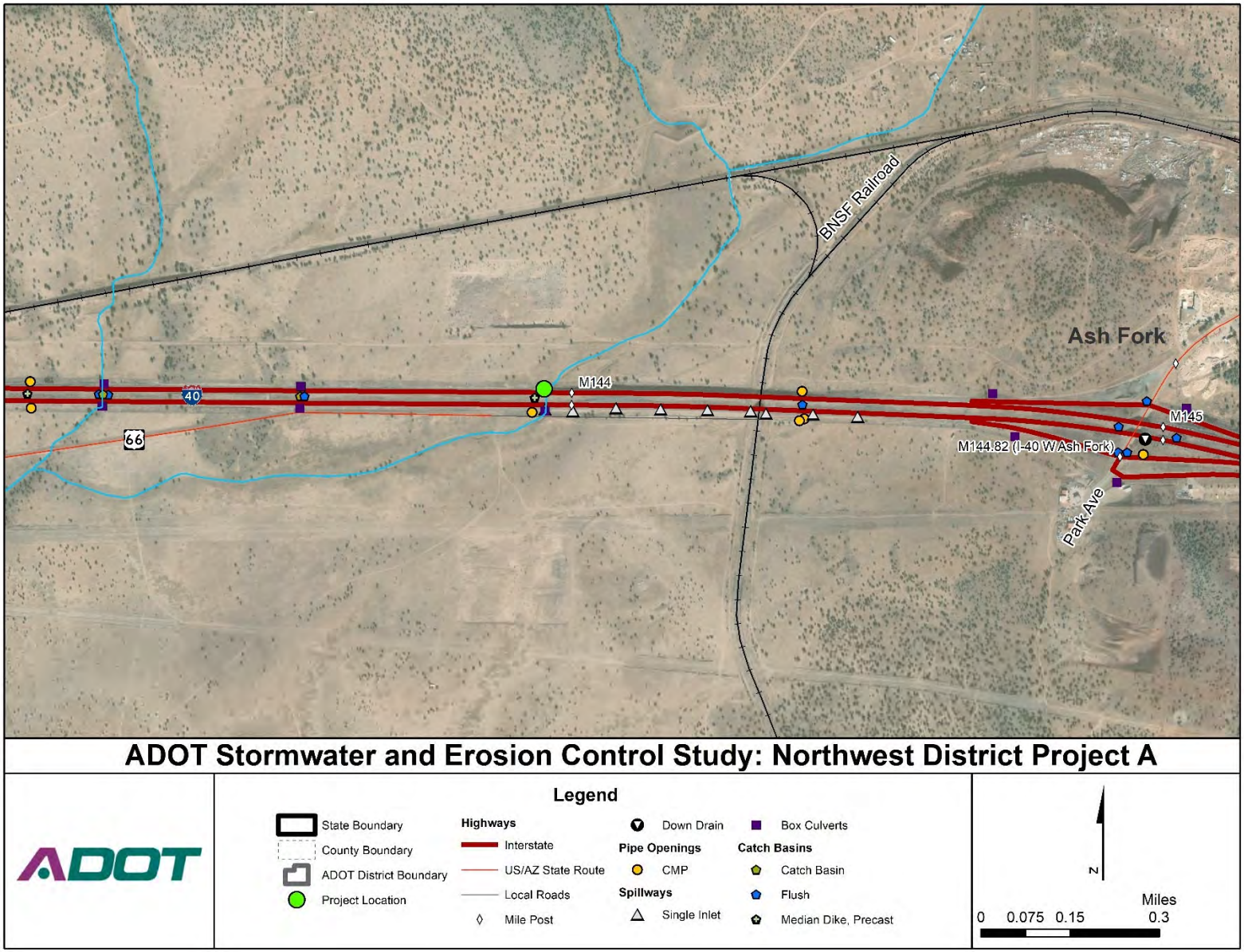


Figure 7: Westbound, Northern View

Figure 8: Eastbound, Rear View

Figure 9: Aerial

PROJECT B- STATE ROUTE 95 @ MP 165.3 – 165.4 NB AND SB

Project Description: Water draining from undeveloped RV camping spot on State Land to the east of SR 95 causing severe sedimentation of area around CMP Culverts in this location. Water pooling around culverts is saturating the roadway causing sloughing of the fill above the culverts. The roadway is being compromised from the clogging of the two culverts. Erosion caused by water flowing is undercutting roadway fill and causing sedimentation of the culvert inlets preventing stormwater from flowing through them.

How long has this been a concern? 5 + years

Has the problem led to road closures? No

District Priority (if identified): #2

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Install rock gabion baskets above and around the culvert inlets. Re-direct drainage from the road to a nearby cut ditch. Re-shape the cut ditch. Berm the drainage basin receiving stormwater from State Land RV Park and install corrugated piping at special locations within the berm. Permission from State Land will be required to complete project on their property. District is currently in discussion with State Land for easement to perform berm-building.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 10: Northwest District Project B

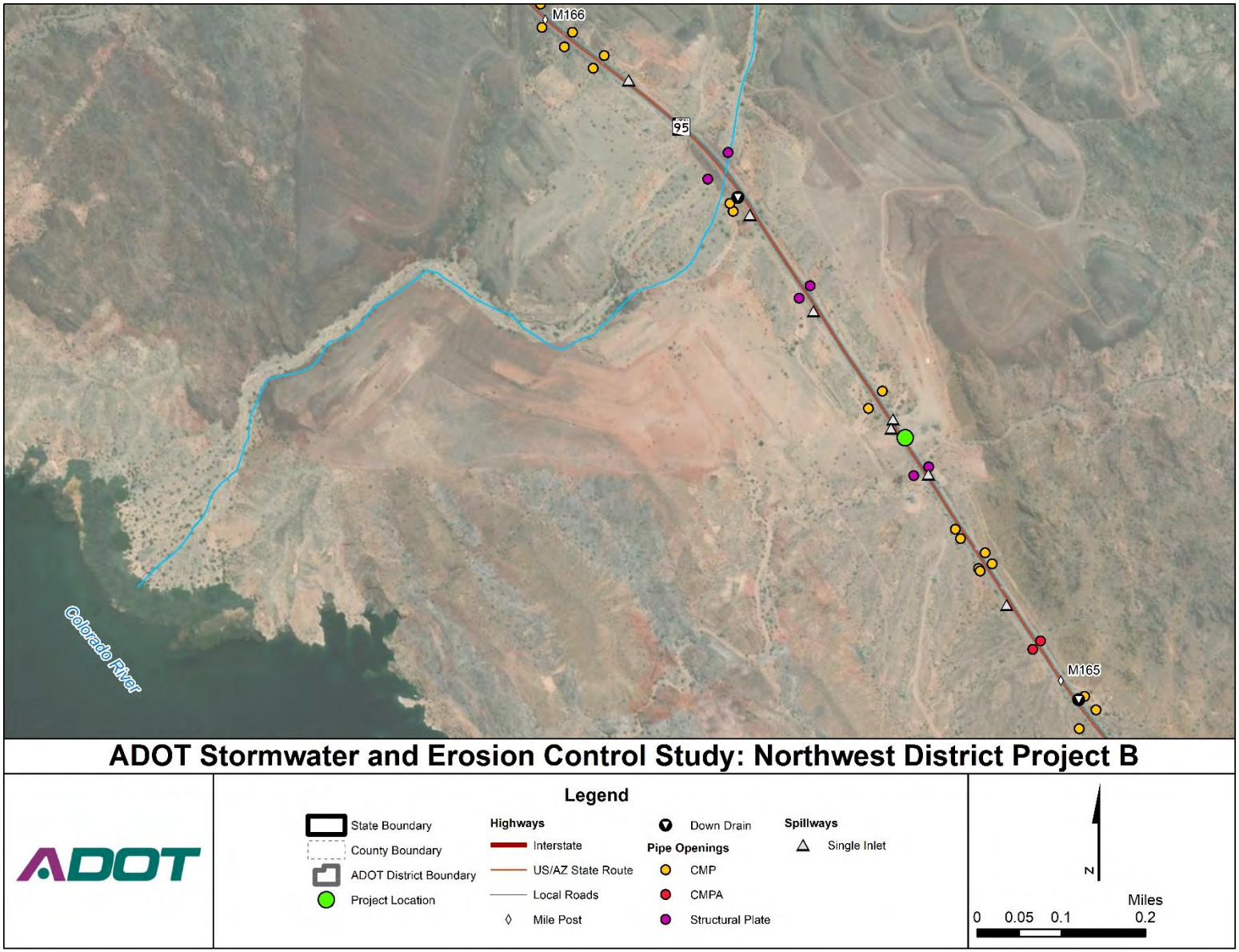


Figure 11: Southbound, Western View

Figure 12: Southbound, Rear View

Figure 13: Aerial

PROJECT C- STATE ROUTE 93 @ MP 157.6 SB – COTTONWOOD CANYON

Project Description: Cottonwood Canyon Wash is eroding the bedrock underlying fill slope supporting the southbound lane. A full-sized adult can stand under the overhang of the scoured bedrock. There is no support for the slope except the strength of rock underlying fill and overhanging the scoured section.

How long has this been a concern? 3 years +

Has the problem led to road closures? No

District Priority (if identified): #1

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Solution requires full system assessment, possible installation of a cut channel with concrete wall to reinforce redirection of flows to minimize flow surge from 5-square-mile watershed impacting this location. Need to incorporate structural support under bedrock of fill slope for south bound lane.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. Reduction/mitigation in flooding or hazard
g. **Extend facility life span**

Figure 14: Northwest District Project C

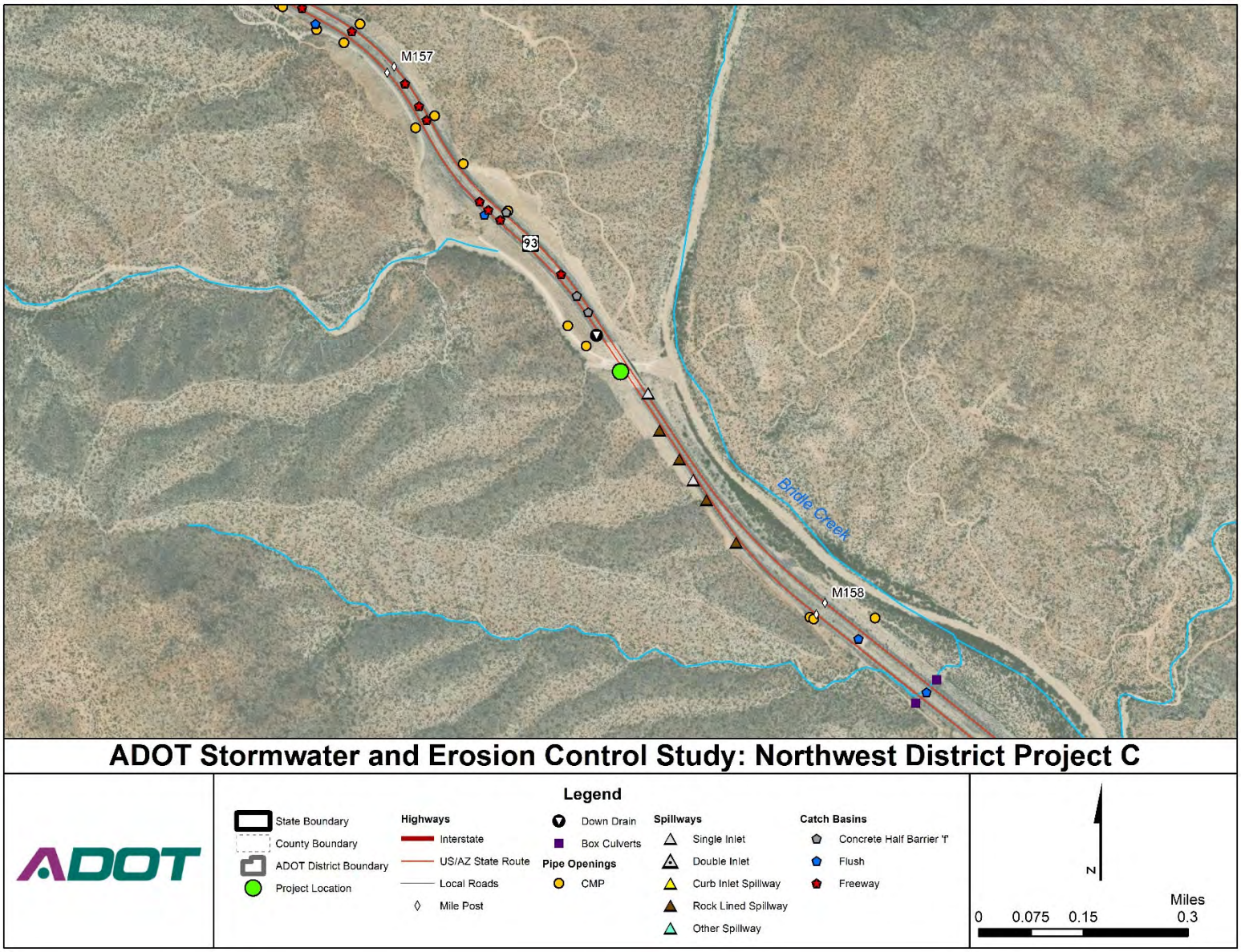


Figure 15: Downstream View (Picture Provided by ADOT)

Figure 16: Upstream View (Picture Provided by ADOT)

Figure 17: Aerial

PROJECT D- INTERSTATE 17 @ MP 237, SE CORNER OF NB BRIDGE OVER MOORE'S GULCH

Project Description: Scour occurring along the abutment embankment of the southeast corner of the northbound bridge. It appears that Moore's Gulch is continually migrating toward the bridge abutment, so there is potential for more erosion to occur over time. This location is very difficult to access. ADOT is currently working on a roadway design to widen I-17 from Anthem to Sunset Point, which includes Moore's Gulch, but there does not appear to be any consideration for this scour/erosion issue in the current design plans.

How long has this been a concern? At least 3 years +

Has the problem led to road closures? No

District Priority (if identified): #4

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Repair/construction possibly using gabion baskets to shore up the eroded embankment on the bridge abutment. Likely place gabion baskets subgrade to prevent future scouring. May need to re-grade BLM road to provide adequate access to the wash (Moore's Gulch).

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 18: Northwest District Project D

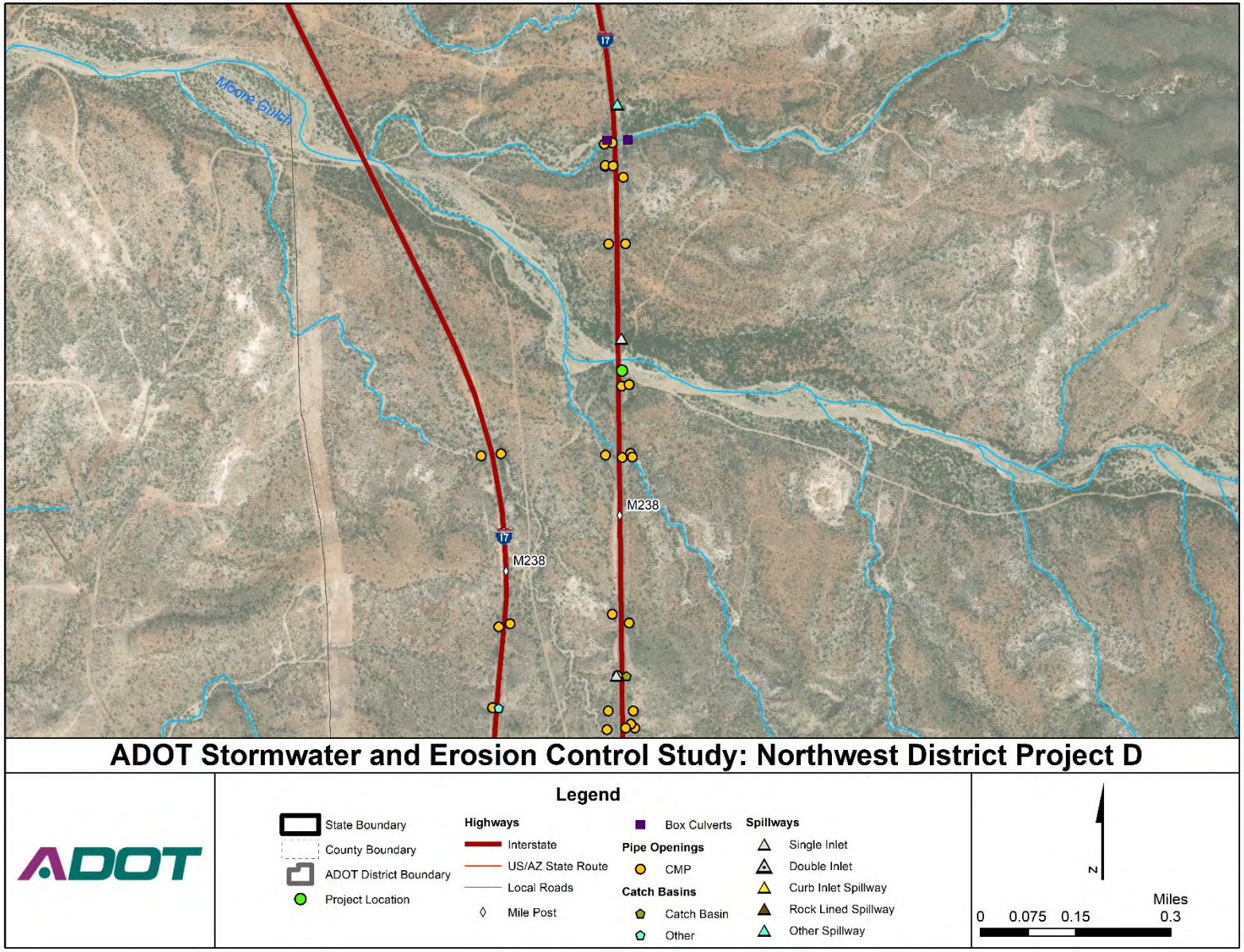


Figure 19: Northbound, Eastern View

Figure 20: Northbound, Rear View

Figure 21: Aerial

NORTHCENTRAL DISTRICT

Table 2 identifies the initial listing of potential stormwater projects identified by representatives of the Northcentral District.

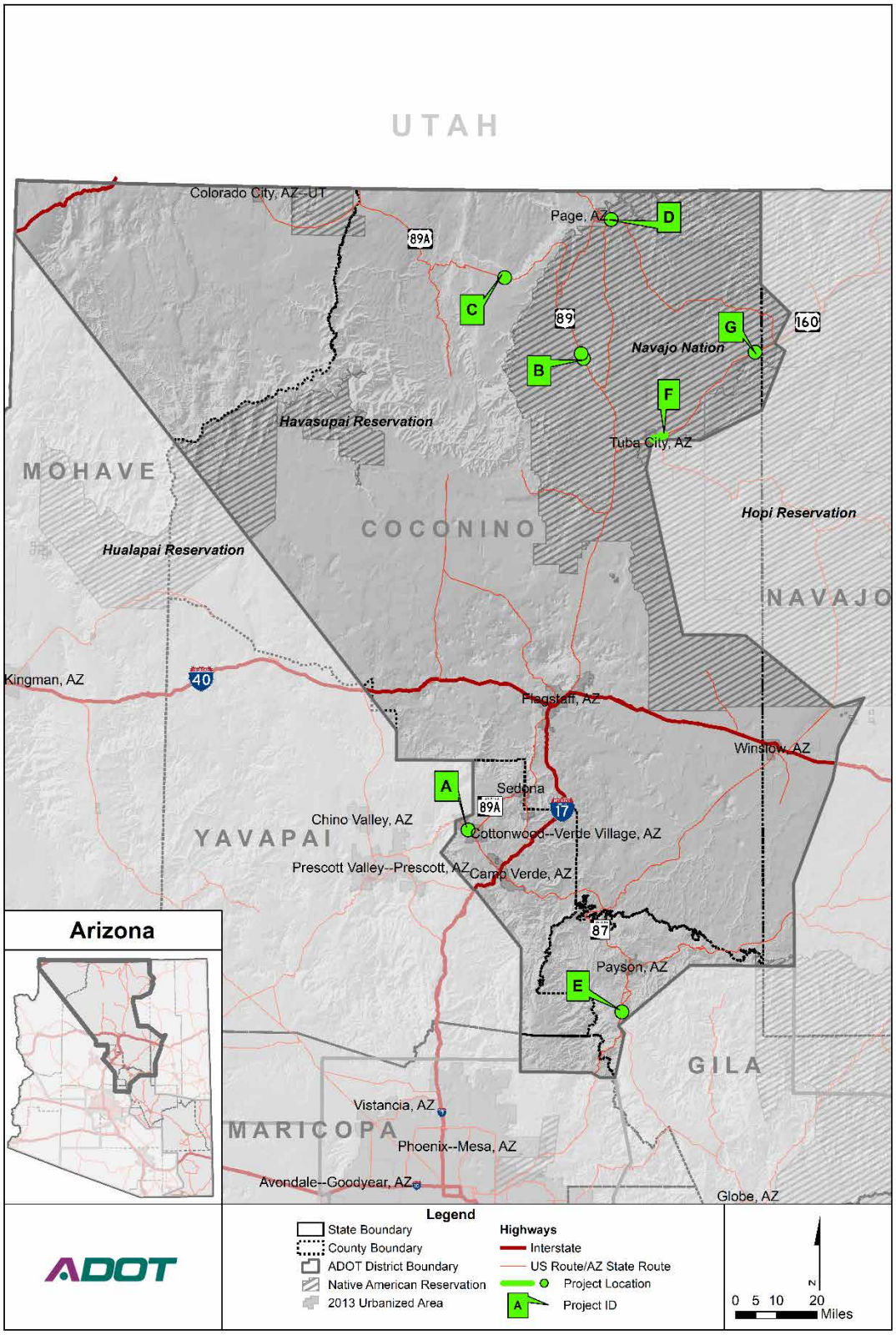
Table 2: Northcentral District Stormwater Projects

Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
A	SR 89A	352.45	Sediment upstream and downstream needs to be removed. Standard maintenance equipment will not fit in the 5-foot high box culverts.	Construction
B	US 89	506.3 & 507.3 (Tanner Wash)	Tanner Wash getting closer to US 89, potential for highway failure.	Construction
C	US 89A	556	Wash on the north side of US 89A at MP 556 is within 5-feet of highway.	Construction
D	SR 98	299	Pipes are 15 to 20-feet below grade at inlet causing highway to act as dam.	Construction
E	SR 87	239.5 (Hog Wash)	Private citizen dumps construction material upstream clogging culvert and causing sediment build up.	Construction
F	US 160	322-325 (Tuba City)	Flowing water and mud/debris overtops roadway.	Construction
G	US 160	356	Pipe issues results in culvert plugged with sediment and flows overtop roadway.	Construction

1 For this column, the term "Construction" applies to both construction and preventative maintenance, therefore these projects qualify for this study. The term "Maintenance" applies to routine maintenance only, therefore these projects do not qualify for this study and no further details are provided.

As **Table 2** indicates, the Northcentral District submitted a total of seven (7) potential stormwater projects. After the District phone interview, the Northcentral District feels that all seven (7) of the submitted projects meet the definition of a "construction" or "preventative maintenance" project. These construction projects are described below.

Figure 22: Northcentral District & Project Locations



PROJECT A- SR 89A @ MP 352.45

Project Description: Location consists of built-up sediment, limiting capacity of flow in the wash. Four of the five barrels are 80% clogged, however the box culverts are likely properly sized. The ADOT Drainage Group looked at this location and determined that sediment upstream and downstream needs to be removed to alleviate the condition. Forest vegetation has built up over the years, impacting the sediment deposition at this location. Survey shows approximately 1300 CY of material needs to be removed from upstream, downstream and in the box culvert. This effort is larger than a typical maintenance project and specialized equipment will be needed due to forest, boulders, box height and sediment. Standard maintenance equipment will not fit in the 5-foot high box culverts. 700 CY of sediment is estimated to be inside the box culvert. If not mitigated, there is concern that the box culverts will overtop, and water will flow into the businesses downstream.

How long has this been a concern? 3 to 4 years and sediment continually building up.

Has the problem led to road closures? No

District Priority (if identified): #2

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. **Facility overtopping or embankment protection**
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. **Additional negative impacts downstream**
h. **Other – increased vegetative growth is causing the flow pattern to change and increase in sediment disposition.**

Possible Mitigation/Solution: Excavation/specialized equipment to remove sediment from inside the box culvert and additional excavation at the inlet and outlet to create adequate flow.

Likely Project Benefits:

a. **Public safety**
b. **Regulatory mandate – by keeping the flow moving in the manner it should without adverse impact downstream**
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 23: Northcentral District Project A

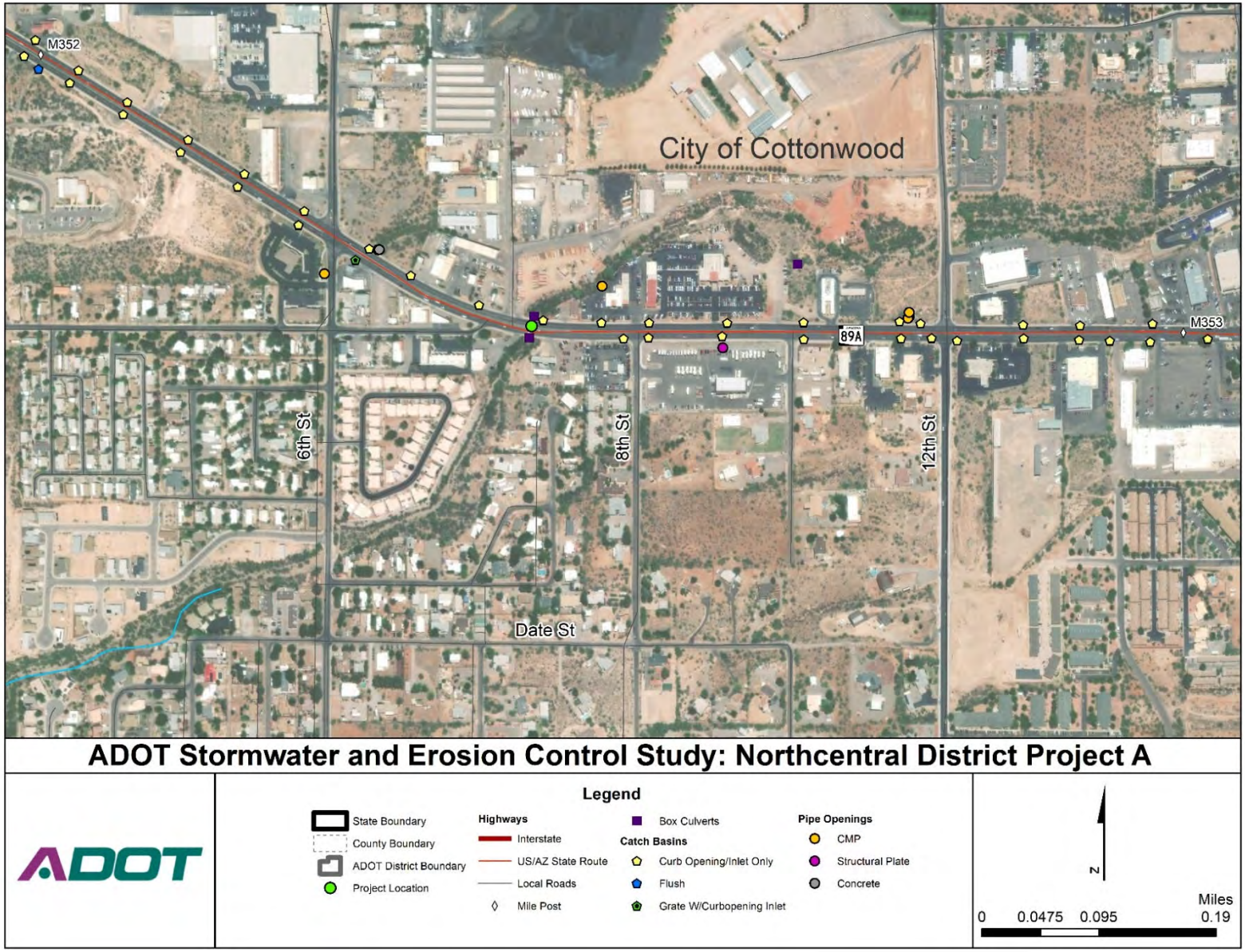


Figure 24: Eastbound, Rear View

Figure 25: Eastbound, Northern View

Figure 26: Westbound, Southern View

PROJECT B- US 89 @ MP 506.3 & 507.3

Project Description: Tanner Wash adjacent to the highway (south) is continually meandering towards the highway at two locations: MP 506.3 and MP 507.3. Historical google satellite images show the continued trend of the stream getting closer to US 89 and there is a potential for highway failure if it reaches the highway. Each year severe monsoon flows bring Tanner Wash closer to the highway. Wash exhibits large flow and high velocity characteristics. The wash migration seems to be occurring naturally and not the result of any upstream activities. The roadway embankment is continually eroding into the channel, leading to the collapse of the ADOT fence on multiple occasions. Fine sandy soil conditions exacerbate the problem. ADOT maintenance has installed weirs to mitigate, but that did not prove to be effective. ADOT successfully mitigated a similar issue upstream at MP 510-518 in conjunction with a passing lane installation project, and that seemed to be effective. Recommend emulating that solution at these two locations.

How long has this been a concern? 15 to 20 years; last 5 to 6 years of continued ADOT maintenance since the wash has migrated into ADOT ROW.

Has the problem led to road closures? No

District Priority (if identified): #1

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. Slope washout
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Consider mitigation measures to armor the bank of the wash, possibly railbank protection.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. **Extend facility life span - roadway will wash out if the problem is not properly mitigated**

Figure 27: Northcentral District Project B

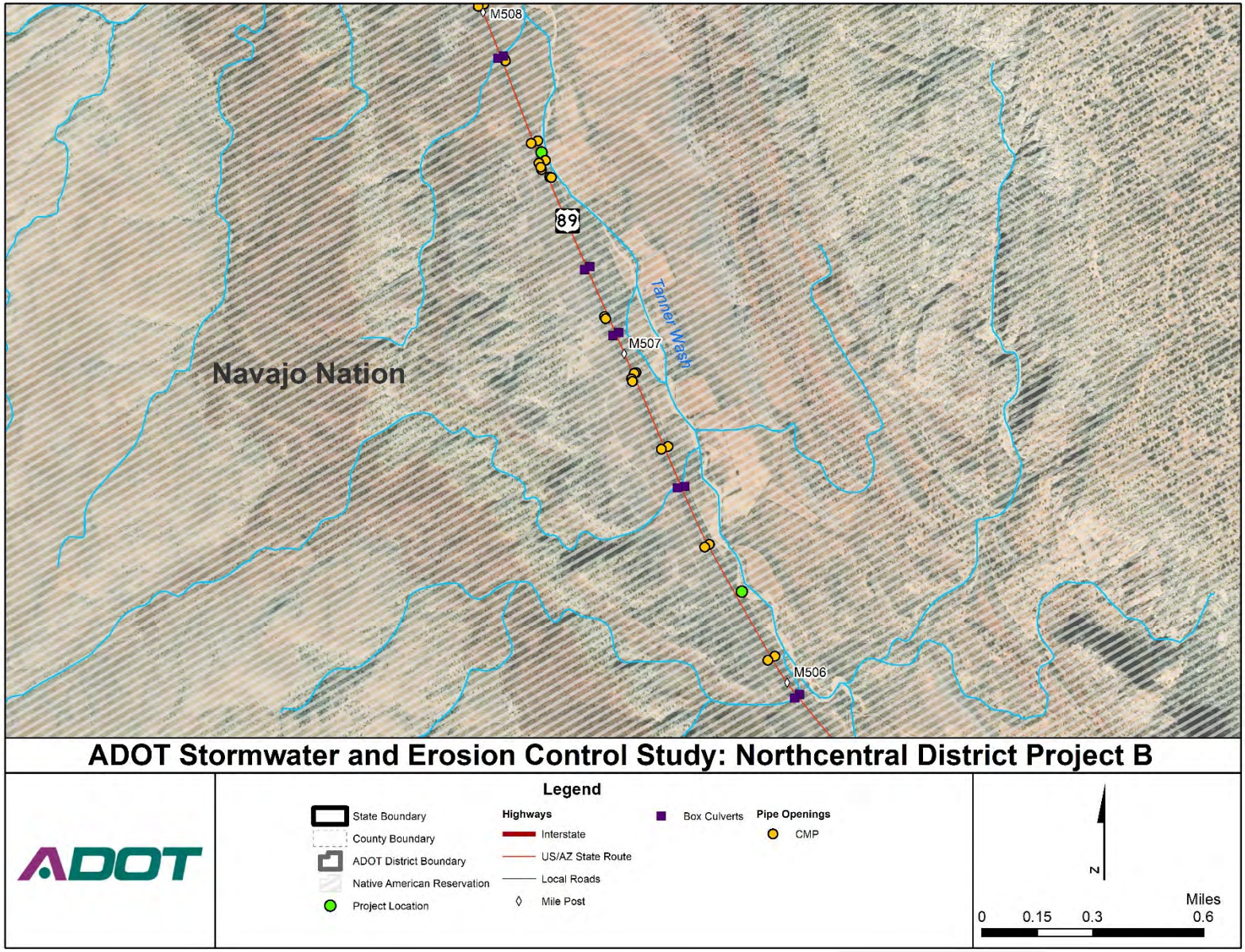


Figure 28: Northbound, Eastern View

Figure 29: Northbound, Rear View

Figure 30: Aerial

PROJECT C- US 89A @ MP 556

Project Description: Wash on the north side of US 89A at MP 556 is within 5-feet of highway. Over the years, the flow of the channel has changed (the natural channel bank breached) and now runs parallel to the highway instead of the historic perpendicular flow. Rip rap has been placed on the shoulder, but this is now being undermined. It is preferred that the channel be restored to its historical location approximately 50-yards away, but the existing channel is 5-inches to 10-inches lower than the historical channel location. Fine sandy soil conditions complicate potential mitigation measures.

How long has this been a concern? 10 years

Has the problem led to road closures? No

District Priority (if identified): #3

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. **Facility overtopping or embankment protection (natural channel bank)**
c. Slope washout
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: 1) Wash can be re-aligned into its historical channel (outside of ADOT ROW) on BLM land to create flow straight into the pipe culvert. 2) Railbank /armor shoulder and embankment for permanent stabilization to protect highway.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 31: Northcentral District Project C

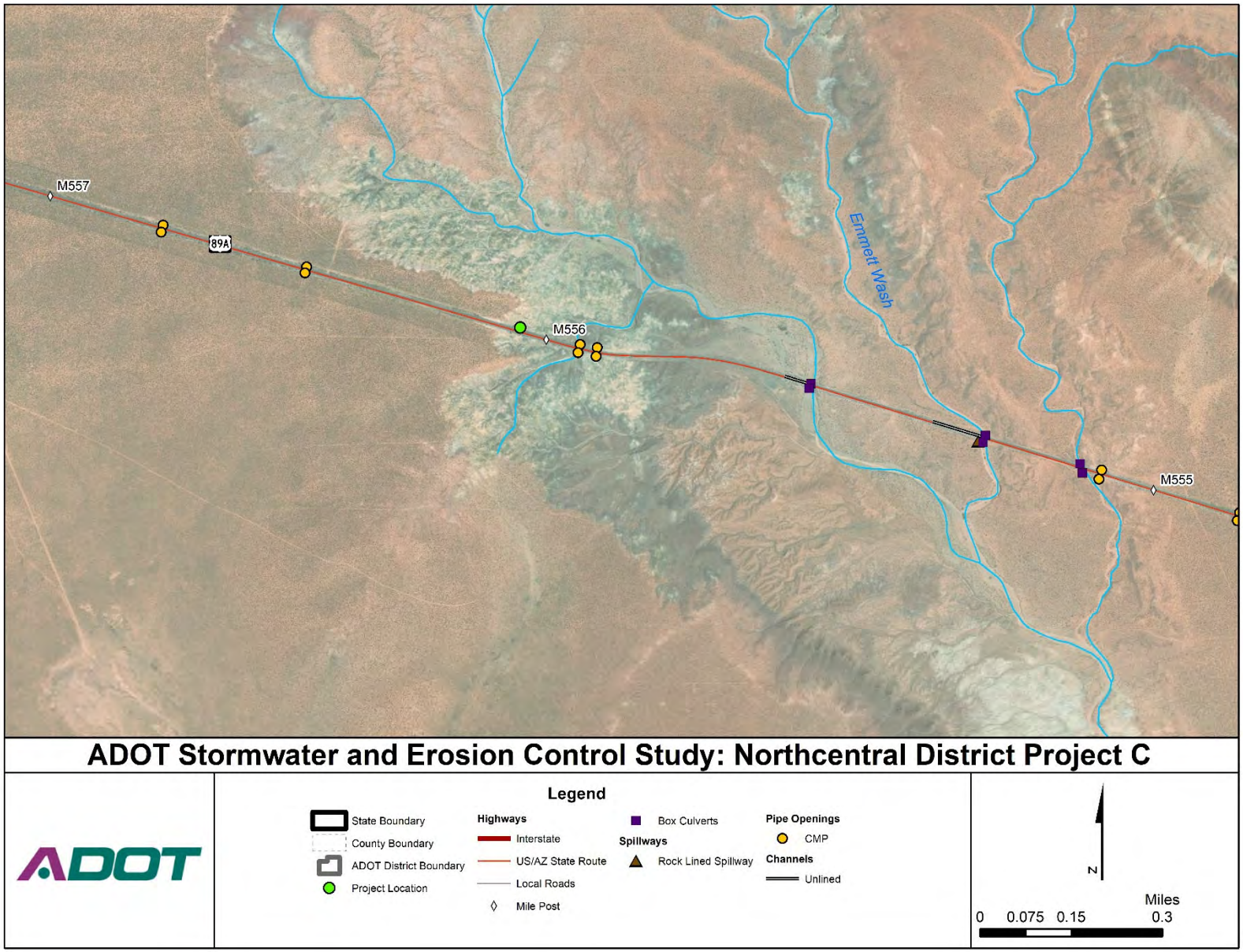


Figure 32: Northside of Roadway, Western Facing (Picture Provided by ADOT)

Figure 33: Northside of Roadway, Southern Facing (Picture Provided by ADOT)

Figure 34: Northside of Roadway, Eastern Facing (Picture Provided by ADOT)

PROJECT D- SR 98 @ MP 299

Project Description: Pipes were buried when the Lachee Waste Water Treatment Plant (WWTP) failed approximately 10 to 12 years ago. Sediment deposition as a result now has existing CMPs about 15 to 20-feet below grade at the inlet. The highway is acting as a dam, and sediment now is approximately 10-feet from the highway.

How long has this been a concern? Since the WWTP failed 10 to 12 years ago. No ADOT maintenance activities have been conducted.

Has the problem led to road closures? No

District Priority (if identified): #5

Characteristics of the Problem:

- **i. Failed stabilization/erosion control (outside of ADOT ROW)**
- j. Facility overtopping or embankment protection
- k. Slope washout
- l. Poor soil conditions
- **m. Undersized infrastructure**
- n. Improper construction/installation
- o. Additional negative impacts downstream
- p. Other

Possible Mitigation/Solution: Potential mitigation measures should either evaluate; 1) Excavate down to the original grade to allow existing culverts to function; or, 2) Install new culverts at the current grade. Perhaps one 36-inch or 48-inch culvert would suffice.

Likely Project Benefits:

- **h. Public safety**
- i. Regulatory mandate
- **j. Environmental benefit (concern/question about WWTP sludge mixed with sediment disposition)**
- k. Relief to District budget and/or resources
- l. Meets District or ADOT strategic objective
- **m. Reduction/mitigation in flooding or hazard**
- **n. Extend facility life span**

Figure 35: Northcentral District Project D

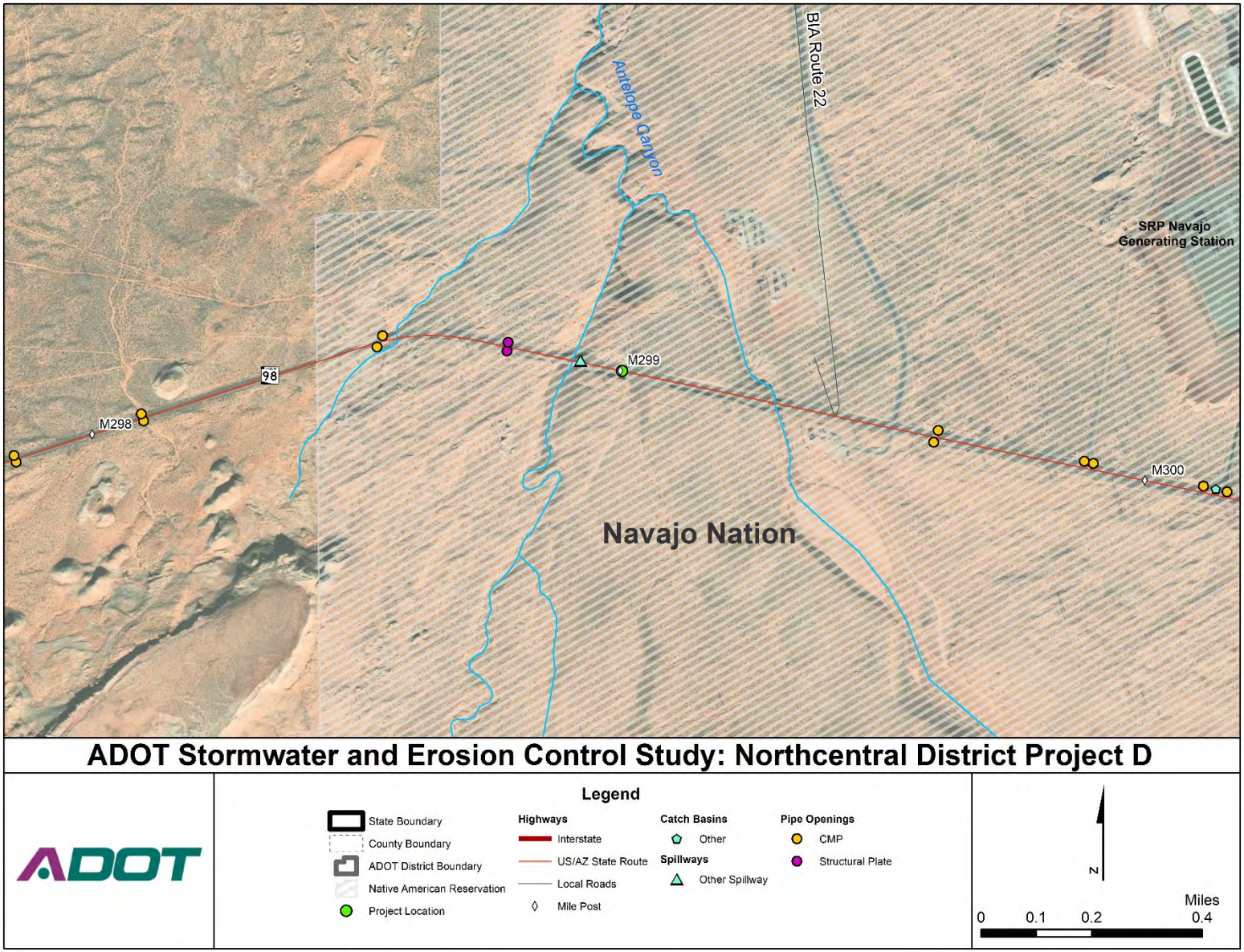


Figure 36: Westbound, Rear View

Figure 37: Westbound, Southern View

Figure 38: Westbound, Southern View

PROJECT E- SR 87 @ MP 239.5

Project Description: A private citizen is dumping construction material (wood, concrete) in Hog Wash upstream, causing the channel to redirect its flows towards the roadway (and box culverts) instead of its historical flow pattern that is perpendicular to the roadway. The material is causing congestion in three of the five existing barrels of the box culvert. The dumping of sediment is pushing the flow away from our inlet and is cutting into the bank and around the current rip rap blankets.

How long has this been a concern? One year or less due to sudden upstream dumping of materials.

Has the problem led to road closures? No

District Priority (if identified): #4

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other – Channel redirection causing sediment buildup, potential for overtopping.

Possible Mitigation/Solution: Large excavation effort needed; beyond that of what ADOT maintenance can accommodate. Excavate approximately 1000 CY of sediment in culvert and downstream to create better flow and extend gabion baskets or grouted rip rap blanket on the inlet side of culvert.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 39: Northcentral District Project E

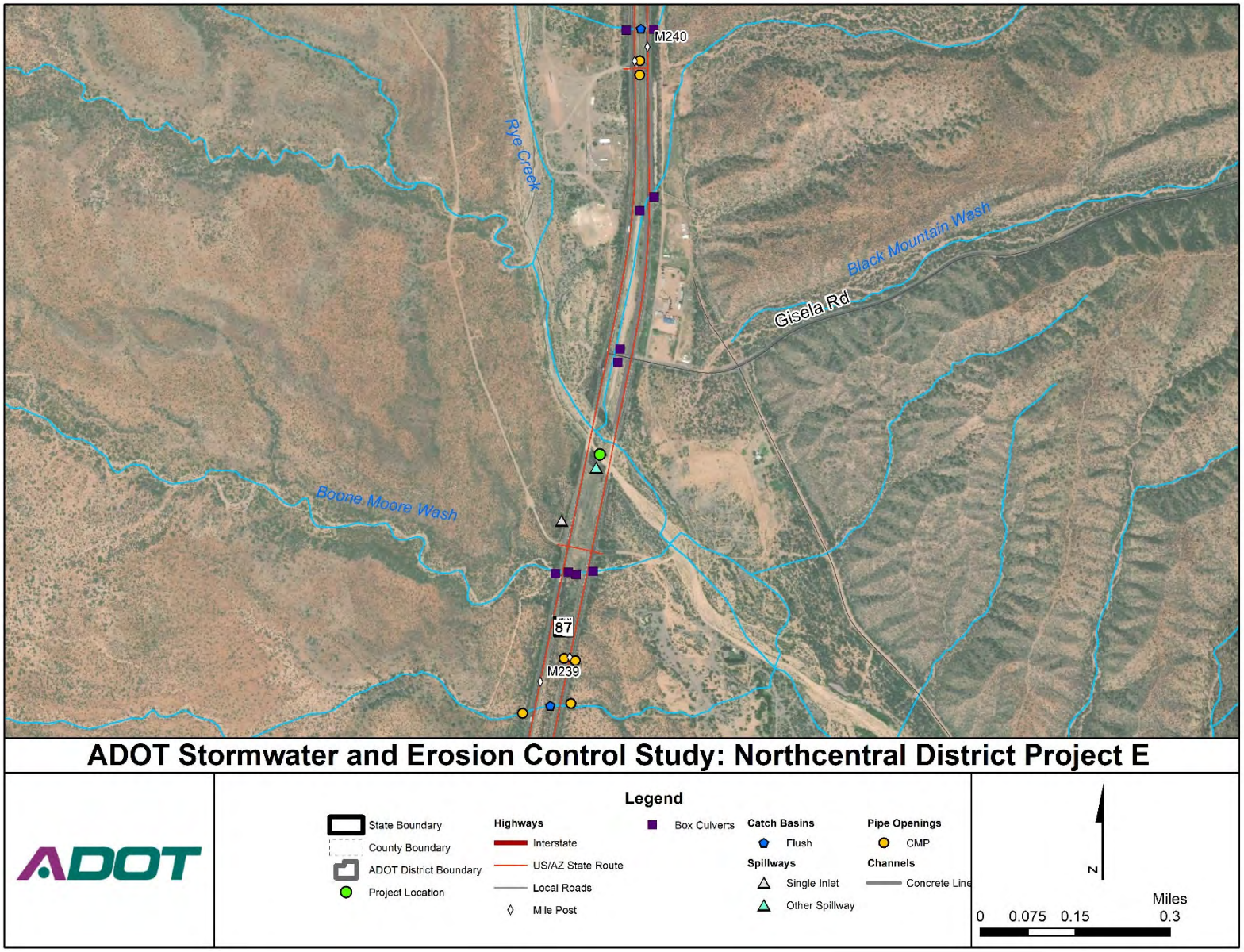


Figure 40: Hog Wash Downstream (Picture Provided by ADOT)

Figure 41: Hog Wash Inlet (Picture Provided by ADOT)

Figure 42: Hog Wash Upstream Debris (Picture Provided by ADOT)

PROJECT F- US 160 @ MP 322 - 325

Project Description: During monsoon rains, water runs off the city streets on the north side of US 160 and flows over the highway leaving sediment deposits. There are no existing culverts in the ADOT ROW. Flowing water and mud/debris are common for this five-lane highway through Tuba City. It appears that city drop down drains are not functioning properly, causing water to bypass the city infrastructure and thereby discharging into the ADOT ROW overtopping US 160.

How long has this been a concern? 5 years +

Has the problem led to road closures? Yes

District Priority (if identified): #6

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure (city infrastructure)
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Tuba City infrastructure needs to be evaluated for needed enhancements adjacent to the highway and larger culverts are needed crossing the highway.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 43: Northcentral District Project F

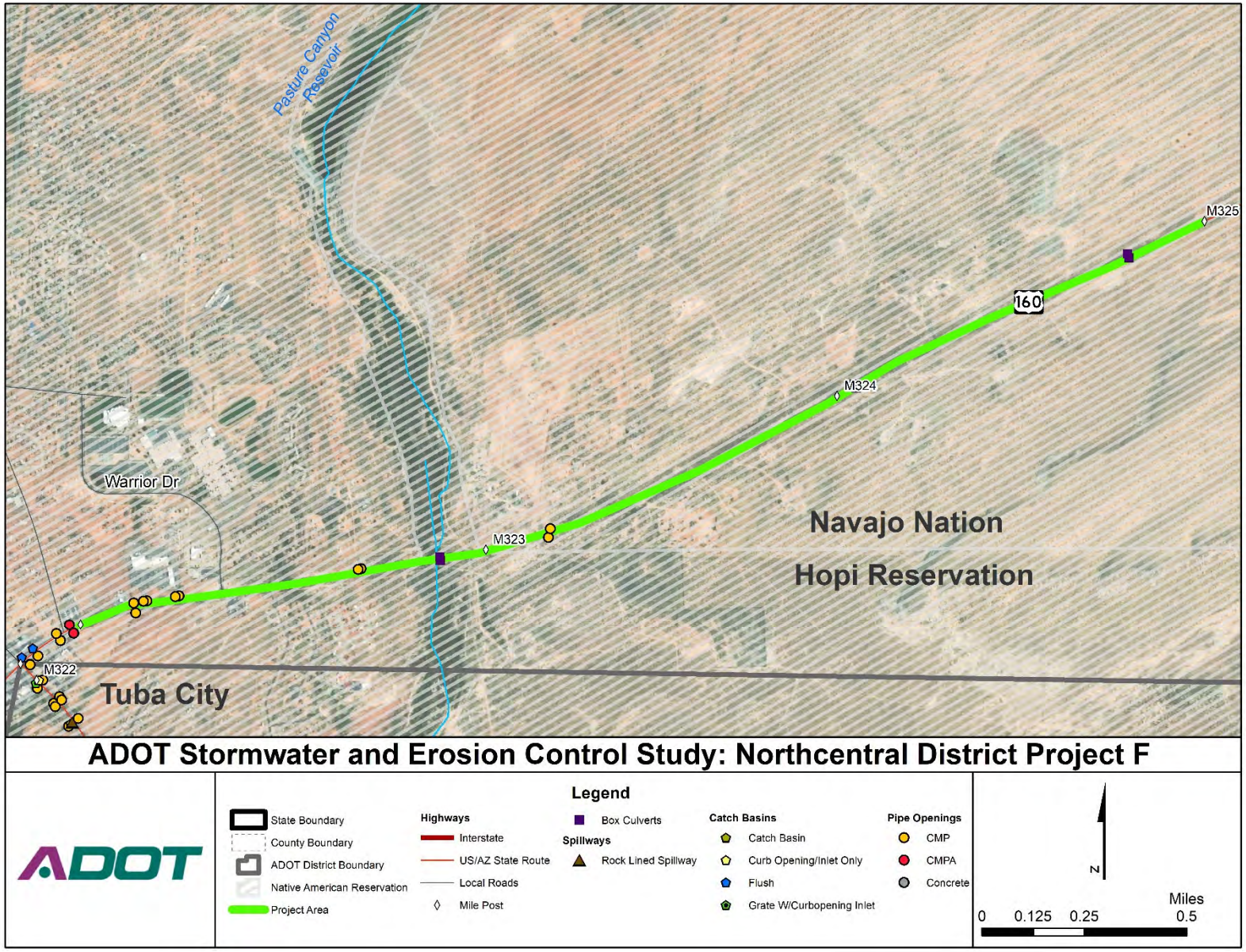


Figure 44: Southbound View (Picture Provided by ADOT)

Figure 45: Eastern View, from Peshlakai Avenue (Picture Provided by ADOT)

Figure 46: Southbound View (Picture Provided by ADOT)

PROJECT G- US 160 @ MP 356

Project Description: The wash flows south to north under the highway and bends west, running approximately 200-yards within the ADOT ROW, then takes a 90 degree turn. The pipe under the railroad tracks downstream is at a higher grade than the culvert under the highway. This backs up water onto the roadway and plugs the culvert with sediment. Overtopping of the highway has occurred at this location.

How long has this been a concern? 5 years +

Has the problem led to road closures? Yes

District Priority (if identified): #7

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation (in the railroad ROW)
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Either the roadway profile and box culverts need to be raised or the railroad needs to lower their culvert.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 47: Northcentral District Project G

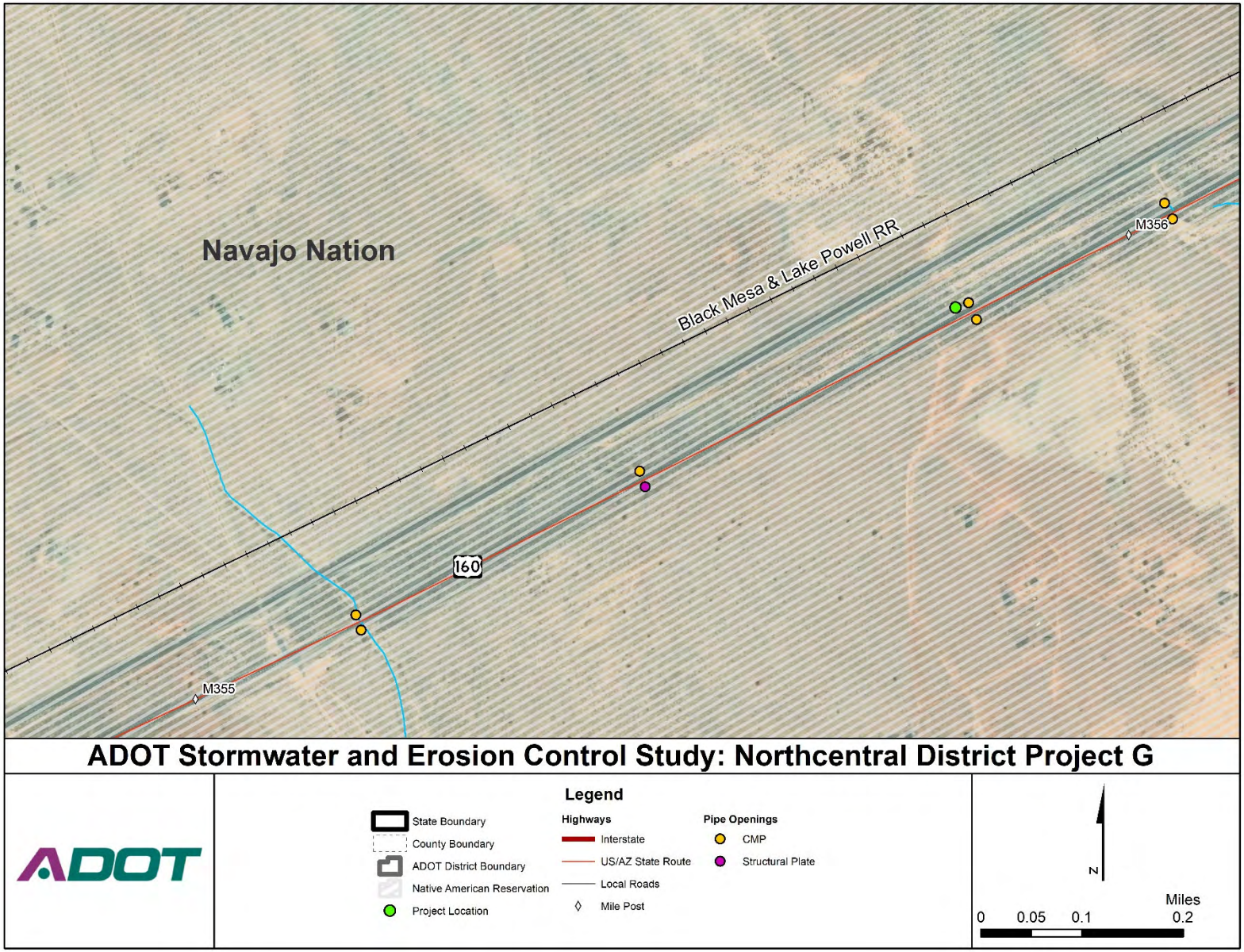


Figure 48: Box Culverts (Picture Provided by ADOT)

Figure 49: Northern View at Railroad Tracks (Picture Provided by ADOT)

Figure 50: Aerial

NORTHEAST DISTRICT

Table 3 identifies the initial listing of potential stormwater projects identified by representatives of the Northeast District.

Table 3: Northeast District Stormwater Projects

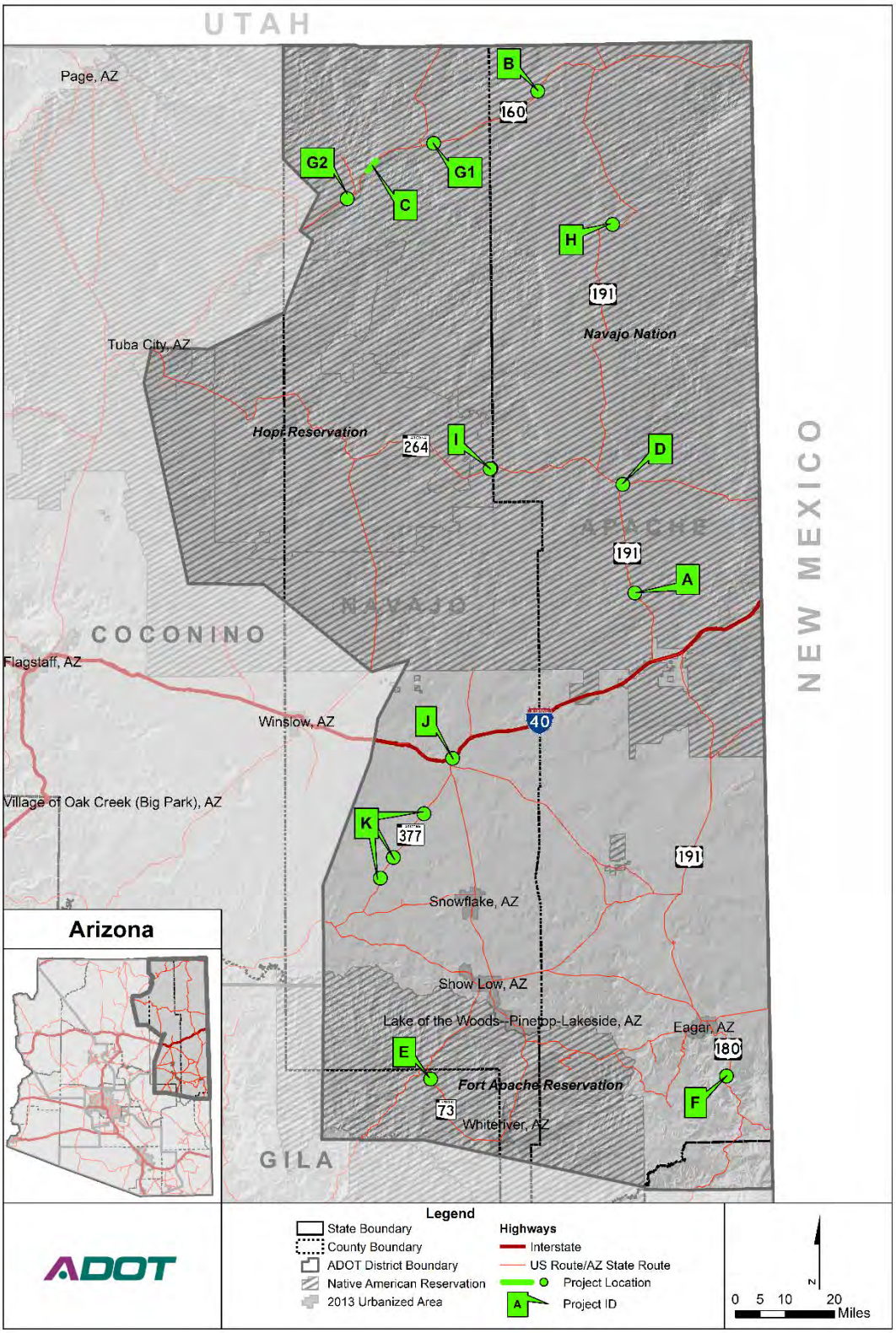
Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
A	US 191	389.3	Area floods regularly and completely fills drainage.	Construction
B	US 160	420	Erosion threatening roadway.	Construction
C	US 160	380.7-363.6	PA for pipe erosion.	Construction
D	SR 264	447.3	Flooding issues of a local school track and field.	Construction
E	SR 73	313	Slope erosion.	Construction
F	US 180	415.6-415.7	Stormwater erosion and roadway scour issues.	Construction
G	US 160	373.3, 396	Severe deposition of material after each storm.	Construction
H	US191	472	Significant down-cutting in ditch.	Construction
I	SR 264	417+/-	Severe erosion in cut ditches.	Construction
J	I-40	287 EB	Slow lane and onramp shoulders wash out.	Construction
K	SR 377	8,13,24	During large rain storms the water overtops the road requiring a traffic detour.	Construction

1 For this column, the term "Construction" applies to both construction and preventative maintenance, therefore these projects qualify for this study. The term "Maintenance" applies to routine maintenance only, therefore these projects do not qualify for this study and no further details are provided.

As **Table 3** indicates, the Northeast District submitted a total of eleven (11) potential stormwater projects. After the District phone interview, the Northeast District feels that all eleven (11) of the submitted projects meet the definition of a "construction" or "preventative maintenance" project. These construction projects are described below.

Overall District Footnote: The Northeast District feels that erosion issues take higher priority than road closures.

Figure 51: Northeast District & Project Locations



PROJECT A- US 191 @ MP 389.3

Project Description: Existing 24-inch CMP is too small to handle existing flows. Large drainage area outside ADOT ROW drains into this undersized ADOT CMP, causing sediment to fill in and around the CMP and overtopping the roadway at times. Area floods regularly and completely fills drainage at this location. There is approximately 10-feet of sediment at pipe opening.

How long has this been a concern? 10 years +, Continued hydrovac maintenance is not effective.

Has the problem led to road closures? Yes, approximately once per year during monsoon season.

District Priority (if identified): #2

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. **Facility overtopping or embankment protection**
c. Slope washout
d. **Poor soil conditions**
e. **Undersized infrastructure – biggest problem**
f. **Improper construction/installation - maybe**
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Need to enlarge the drainage structure, perhaps with a box culvert.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 52: Northeast District Project A

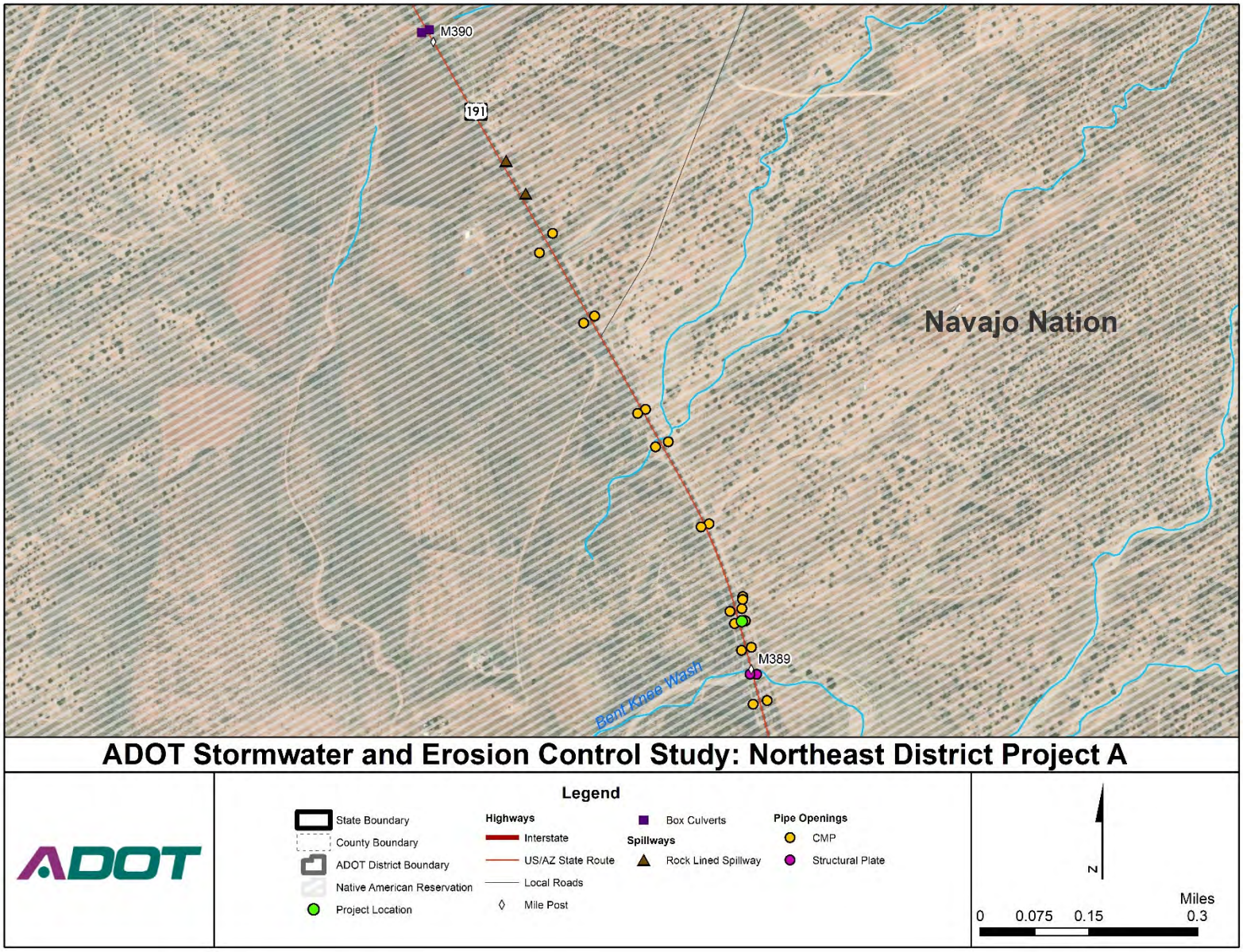


Figure 53: US 191, MP 389.3

Figure 54: US 191, MP 389.3

Figure 55: US 191, MP 389.3

PROJECT B- US 160 @ MP 420

Project Description: Erosion is threatening the roadway. Maintenance cannot perform work to counteract it because it is out of the ROW. Major event runoff measurably erodes ox-bow, while minor events continue to erode ox-bow. At some point a full earthwork re-channelization would be triggered. Unfortunately, there is also an arch site between the ox-bow and the newly graded overbank. A re-channelization would trigger an arch recovery and a costlier Army Corp of Engineers Individual Permit.

How long has this been a concern? 7-8 years

Has the problem led to road closures? Not to date. When the time comes that it does close the roadway it will not be a short closure. It will require re-channelizing to the bottom of the wash likely 30-feet below and will be beyond what maintenance forces can be expected to accomplish.

District Priority (if identified): #1

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Remediate now with Tribal ROW/RGP. Cost-effective wash control structures could be implemented heading off the costlier earthwork channelization, arch recovery, and the Army Corp of Engineers Individual Permit.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 56: Northeast District Project B

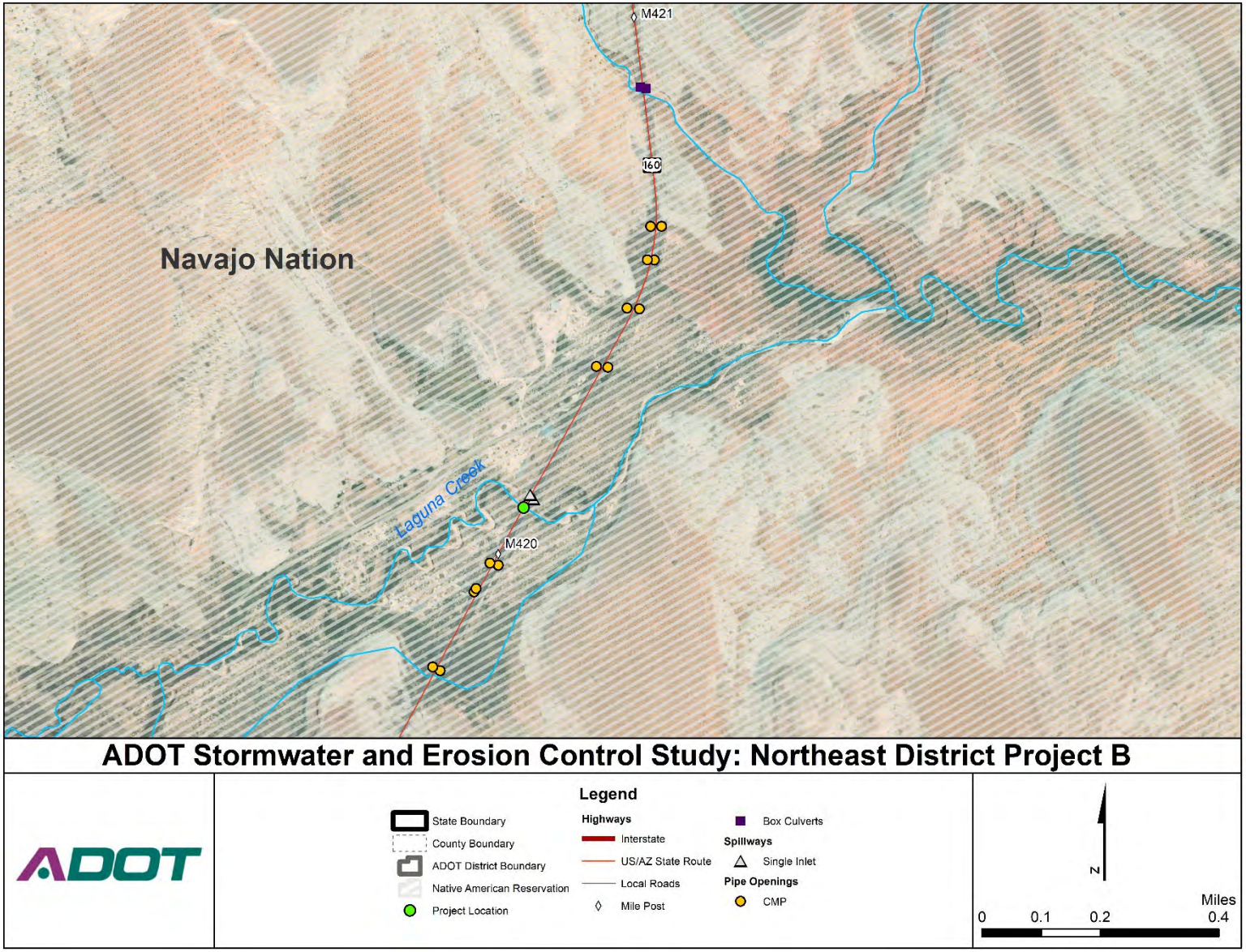


Figure 57: Aerial (Picture Provided by ADOT)

Figure 58: Aerial (Picture Provided by ADOT)

PROJECT C- US 160 @ MP 380.7 – 383.6

Project Description: There are three (3), 48-inch, 96-foot long CMPS that are experiencing significant scour and erosion on the downstream side. Poor soil conditions in the area (sandy) make it difficult to stabilize the embankment. This condition is not threatening to the roadway. This project had a Project Assessment (PA) prepared in 2007 (H-69101C) which estimated $1.5 million in new construction to mitigate the existing condition. Please refer to PA for additional details.

How long has this been a concern? 12 years +

Has the problem led to road closures? No

District Priority (if identified): #3

Characteristics of the Problem:

a. **Failed stabilization/erosion control – primary issue**
b. Facility overtopping or embankment protection
c. Slope washout
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Stair step gabion baskets, armor embankment, add energy dissipater to reduce the flow velocity. Refer to PA for more details.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 59: Northeast District Project C

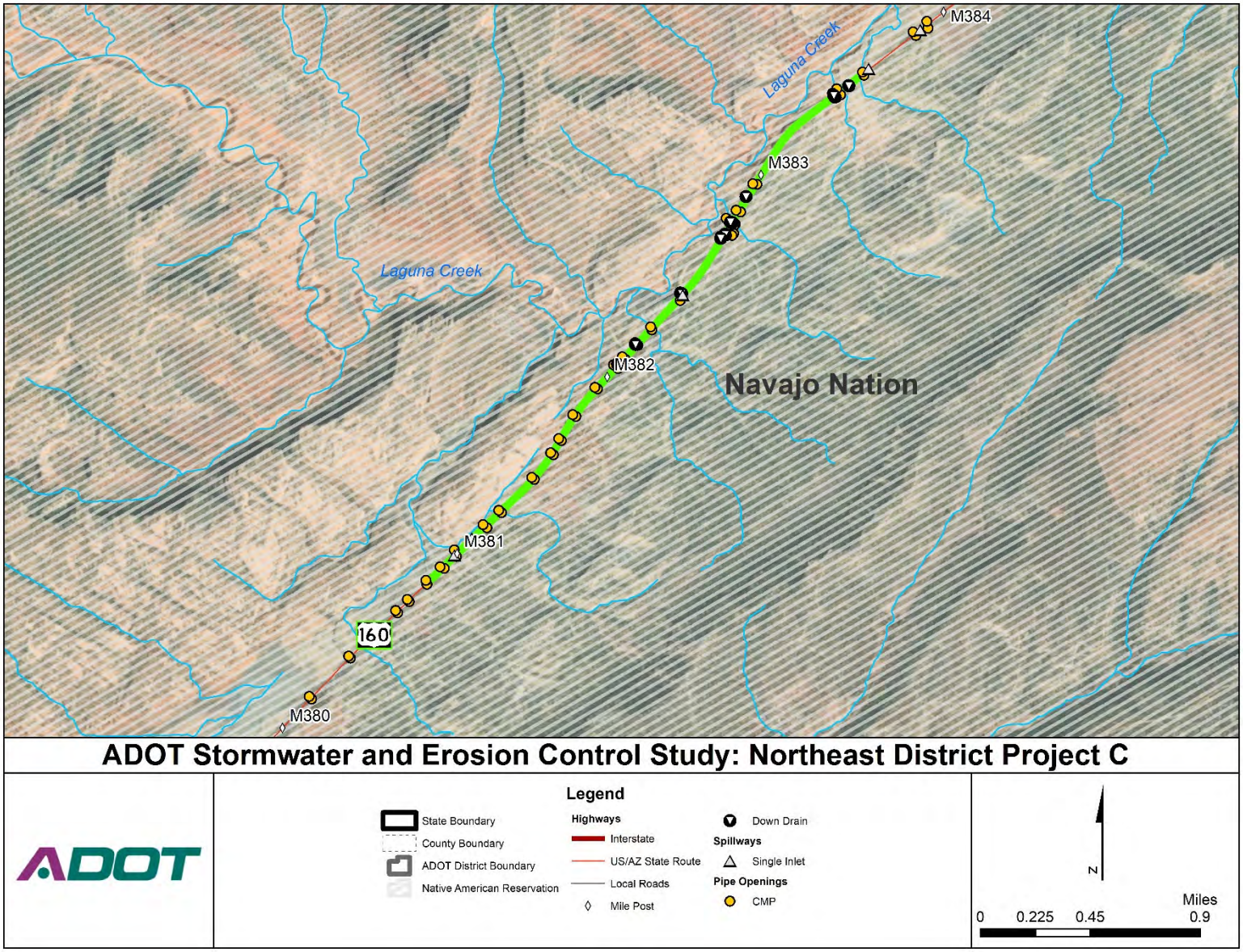


Figure 60: US 160 MP 369

Figure 61: US 160 MP 369

Figure 62: US 160 MP 369

PROJECT D- SR 264 @ MP 447.3

Project Description: Since a recent ADOT construction project approximately two years ago, erosion from the ADOT ROW is causing flooding and sediment disposition issues downstream at the Ganado Middle School track and field facility at least once or twice a year. A microburst storm event during construction activities complicated the situation. A ditch was regraded that perhaps should not be there. This problem did not exist prior to the construction project being completed.

How long has this been a concern? Approximately 2 years, since the construction project was completed.

Has the problem led to road closures? No

District Priority (if identified): #4

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. Slope washout
d. **Poor soil conditions**
e. Undersized infrastructure
f. **Improper construction/installation**
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Evaluate and recommend a location where the drainage should be discharged from the ADOT ROW and develop a new design to discharge the flows downstream.

Likely Project Benefits:

a. **Public safety – school facility, not roadway**
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard – to middle school**
g. Extend facility life span

Figure 63: Northeast District Project D

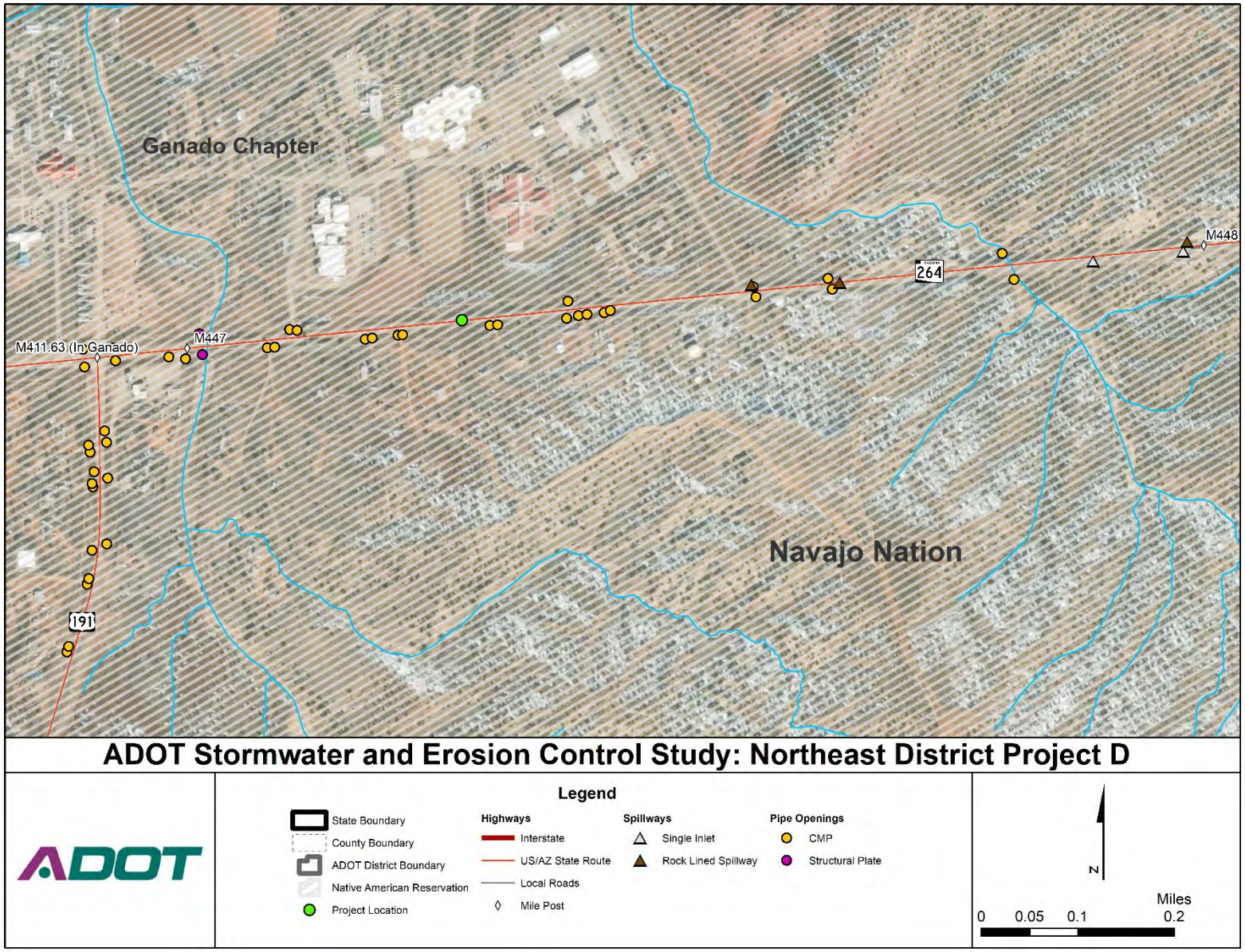


Figure 64: Eastbound, Southern View (MP 447)

Figure 65: Eastbound, Rear View

Figure 66: Westbound, Northern View

PROJECT E- SR 73 @ MP 313

Project Description: Roadway embankment is not stabilized and has been continually eroding. Sediment from the slope erosion is filling in ditch along the top of slope, burying the ADOT fence at the bottom. Slope erosion is not compromising the integrity of the roadway. Sandy soil type increasing difficulty for stabilization of the slope.

How long has this been a concern? 10 years +

Has the problem led to road closures? No

District Priority (if identified): #5

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. Slope washout
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Stabilize and armor the embankment. Cleanup slope and ditch. Reseed area. Possibly add a crown ditch.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 67: Northeast District Project E

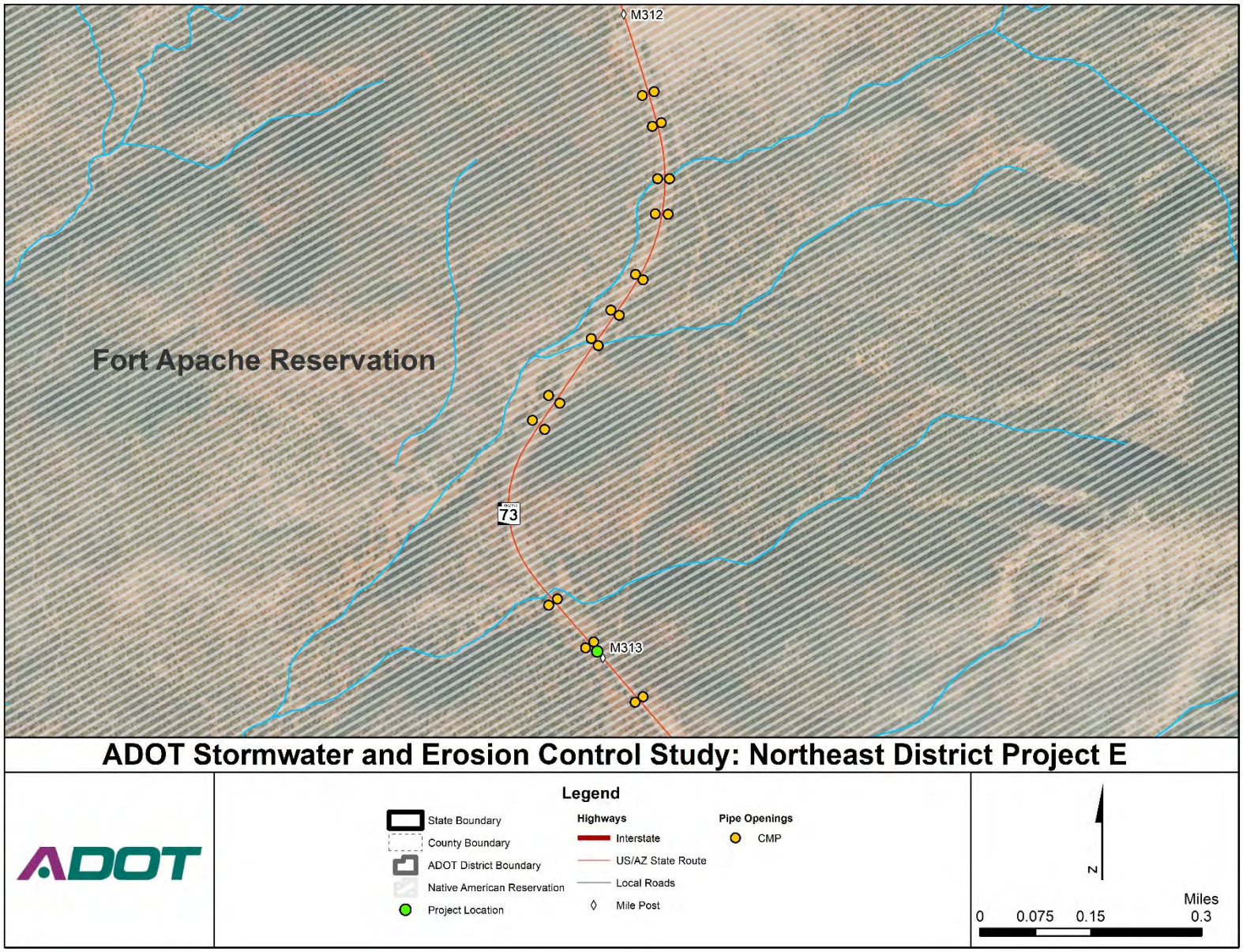


Figure 68: SR 73 at MP 313

Figure 69: SR 73 at MP 313

PROJECT F- US 180 @MP 415.6 - 415.7

Project Description: Increased flow via Wallow Fire scars has led to stormwater, erosion and roadway scour issues, where an existing culvert can no longer handle the increased flows and sediment disposition. Even with a structure built upstream designed to catch debris, outside ADOT ROW sediment clogs the pipe and fills up roadway ditch, sometimes causing overtopping of the roadway. The impacted ditch measures 472feet. Existing pipe is 24-inches by 75-feet long.

How long has this been a concern? Since Wallow Fire in 2011, ADOT maintenance performs maintenance activities at least 3-4 times each year.

Has the problem led to road closures? Yes, about once per year.

District Priority (if identified): #6

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. **Poor soil conditions**
e. **Undersized infrastructure**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Enlarge drainage pipe/structure and line approximately 400-feet of existing ditch with concrete to the inlet so that it can be easily maintained.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 70: Northeast District Project F

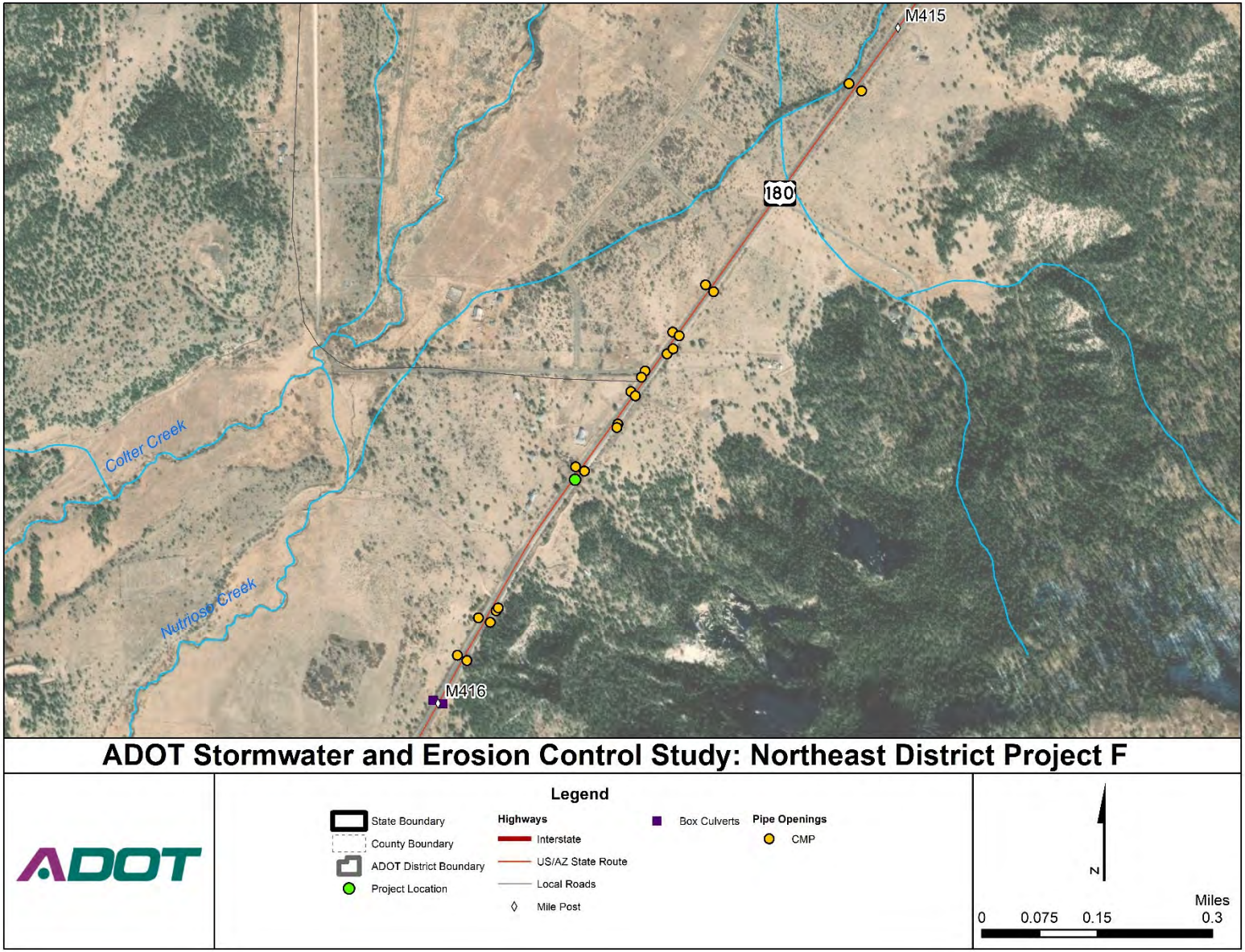


Figure 71: US 180 at MP 415

Figure 72: US 180 at MP 415

Figure 73: US 180 at MP 415

Figure 74: US 180 at MP 415

PROJECT G- US 160 @ MP 369 & 377.3

Project Description: Fine grain sandy soil blows along with severe sediment disposition from outside of ADOT ROW is occurring for most rain events, small to large. Sediment overtops CMP inlets. Culvert size is likely too small. The problem is compounded by the adjacent railroad facility. This extent of this project is depicted in **Figure 75** and **Figure 76**.

How long has this been a concern? 10 years +

Has the problem led to road closures? Yes, 3-4 times per year. ADOT needs to use a front loader to remove the debris that accumulates on roadway.

District Priority (if identified): #7

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. Slope washout
d. **Poor soil conditions**
e. **Undersized infrastructure**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Consider an increase in the sizing of the drainage structure (CMP or box culvert) and/or raise the profile of the roadway.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 75: Northeast District Project G1

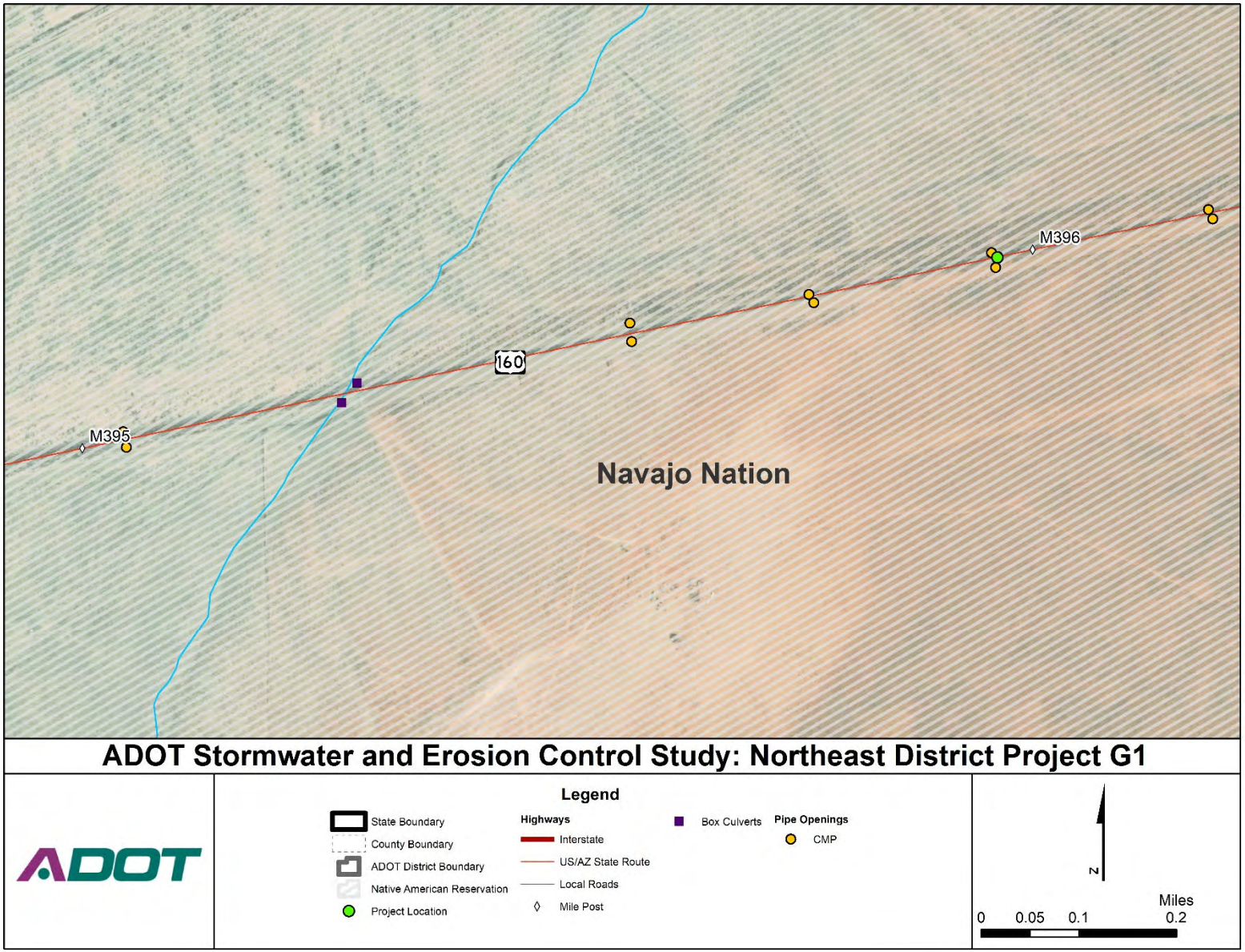


Figure 76: Northeast District Project G2

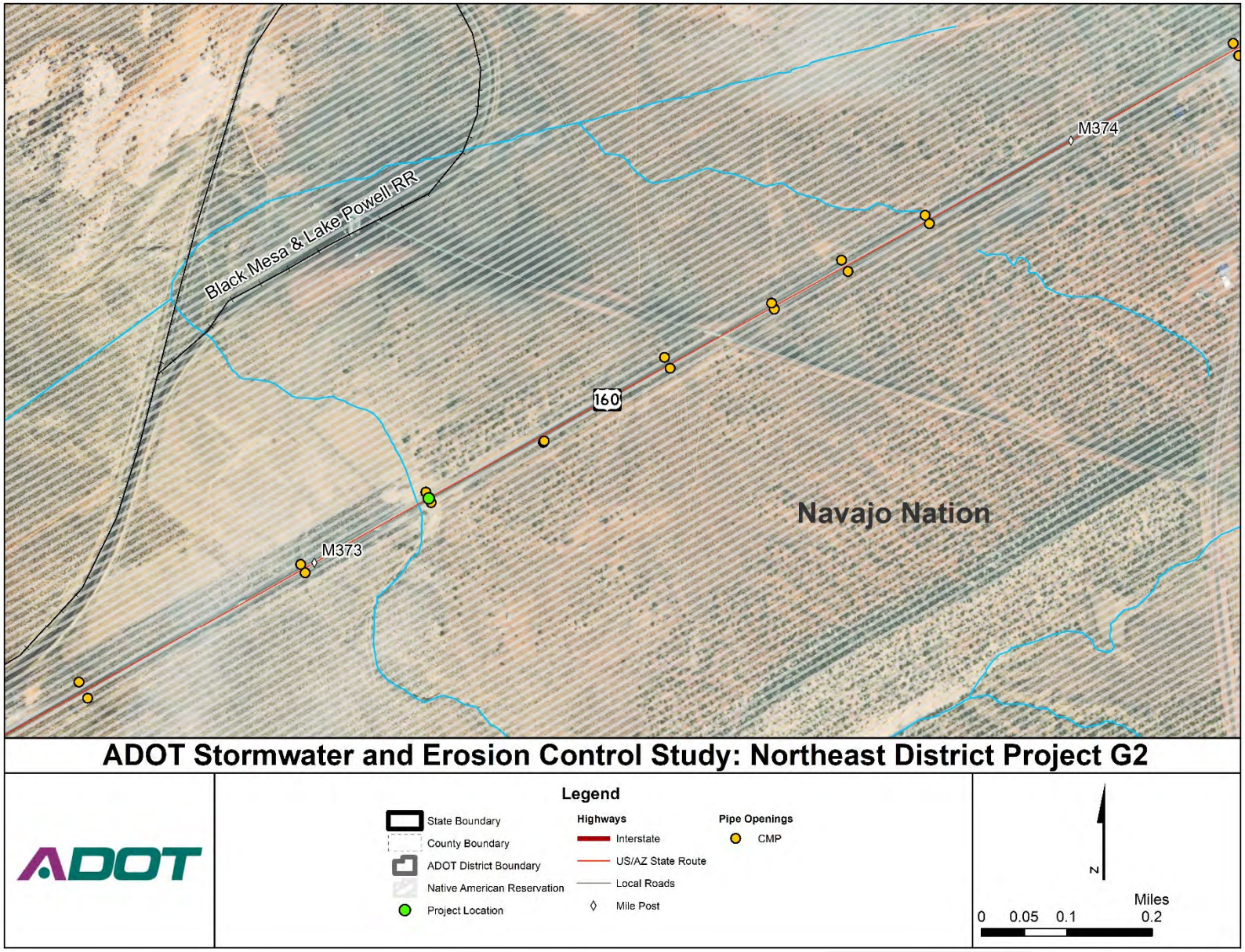


Figure 77: Northbound, Eastern View (MP 377)

Figure 78: Northbound, Rear View (MP 370)

Figure 79: Northbound, Eastern View (MP 369)

PROJECT H- US 191 @ MP 472

Project Description: Located along a segment of roadway with a 6% grade uphill, the northbound roadside ditch is steep and is experiencing significant down-cutting. Slope has down-cut to the point where it is like a crevasse. Sediment from slope is depositing into the ditch that is more than 30-feet below the roadway. Sediment is building in the ditch, impacting the ADOT fence at this location. Erosion is not impacting the side slope of the roadway itself. Past efforts to remedy with check dams has failed.

How long has this been a concern? 10 years +. Limited ADOT maintenance at this location due to other priorities, not impacting roadway itself and difficulty of access.

Has the problem led to road closures? No

District Priority (if identified): #8

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Armor the slope to minimize erosion, remove the sediment buildup in ditch and repair the ditch.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 80: Northeast District Project H

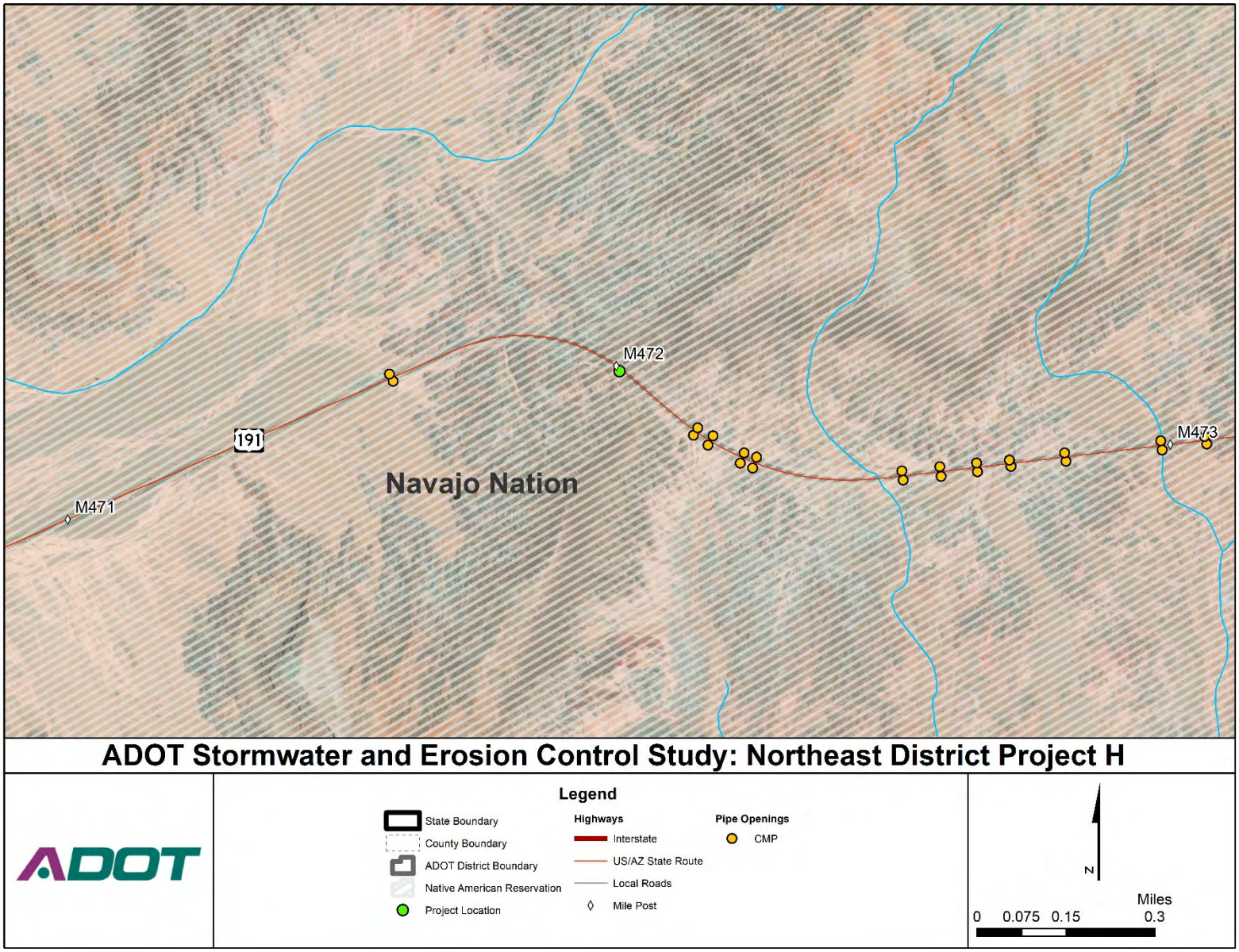


Figure 81: US 191 MP 472

Figure 82: US 191 MP 472

Figure 83: US 191 MP 472

Figure 84: US 191 MP 472

PROJECT I- SR 264 @ MP 417

Project Description: For approximately 500-foot length along each side of the roadway, the roadway embankment has a steep slope. This area has sandy soil characteristics and is experiencing significant erosion between the cut and fill slopes, some of which is behind the guardrail causing safety concerns. Sediment from slope is depositing into the ditch that is 15 to 20-feet below the roadway.

How long has this been a concern? 4-5 years

Has the problem led to road closures? No

District Priority (if identified): #9

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. Slope washout
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Armor the slope to minimize erosion, remove the sediment buildup in ditch and repair the ditch. Perhaps add grouted rip rap for energy dissipater of flow velocities.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 85: Northeast District Project I

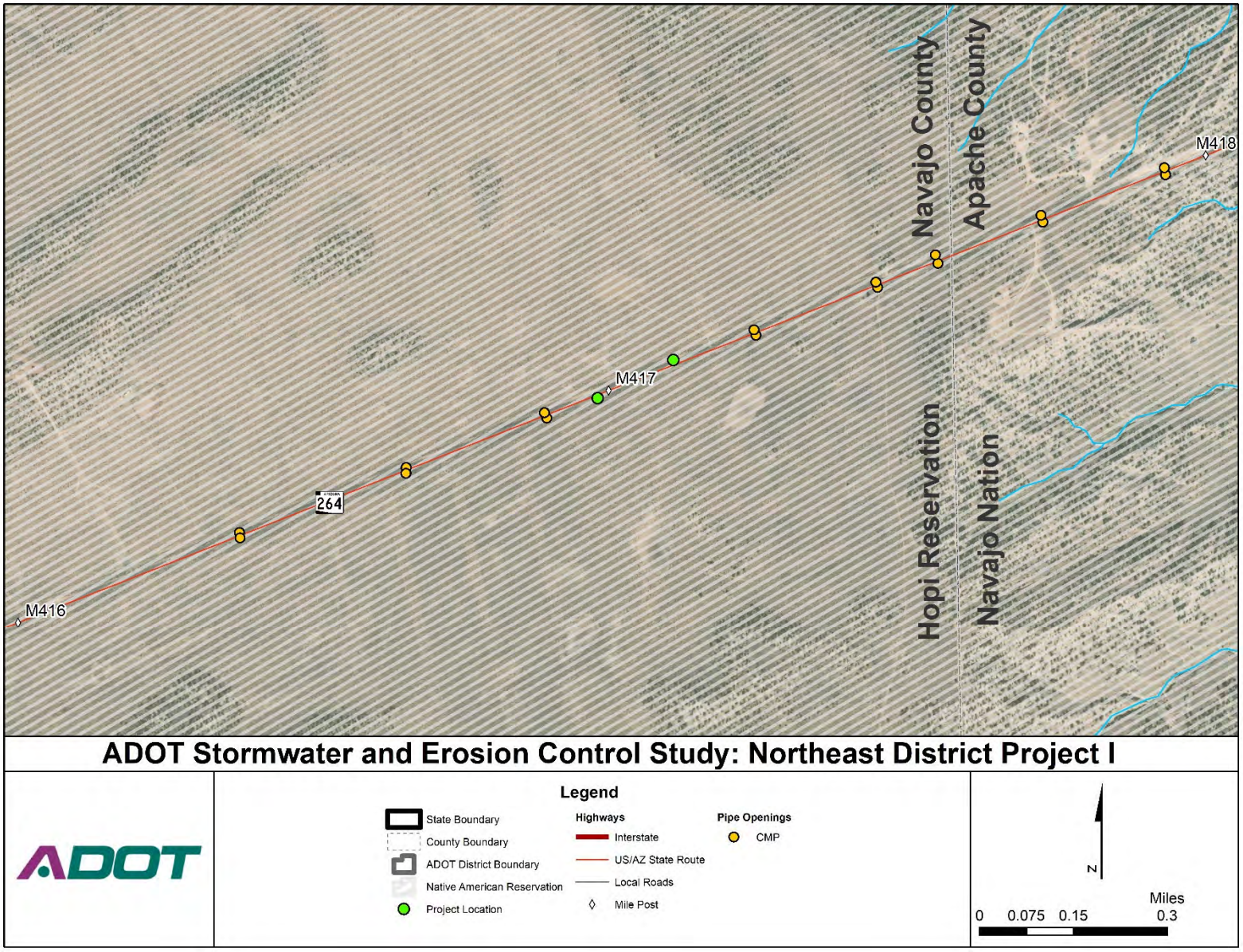


Figure 86: SR 264 at MP 417

Figure 87: SR 264 at MP 417

Figure 88: SR 264 at MP 417

PROJECT J- INTERSTATE 40 @ MP 287 EB

Project Description: Slow lane and on-ramp shoulders wash out. The down drains are clogged with sediment, which backs up debris and water, causing overtopping of Business I-40 and then discharging into the City of Holbrook. Area has been a maintenance problem for years with a lot of man hours to keep drains open to move water after large rain storms.

How long has this been a concern? 25 years + since the freeway was constructed.

Has the problem led to road closures? Yes, 1 time per year on average. Usually during a monsoon storm event.

District Priority (if identified): #10

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. Slope washout
d. **Poor soil conditions – sandy soils**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Armor the roadway shoulder embankment with gabion baskets or similar reinforcement of slope and ditch. Consider additional check dams and increase the number of inlets into the catch basins.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 89: Northeast District Project J

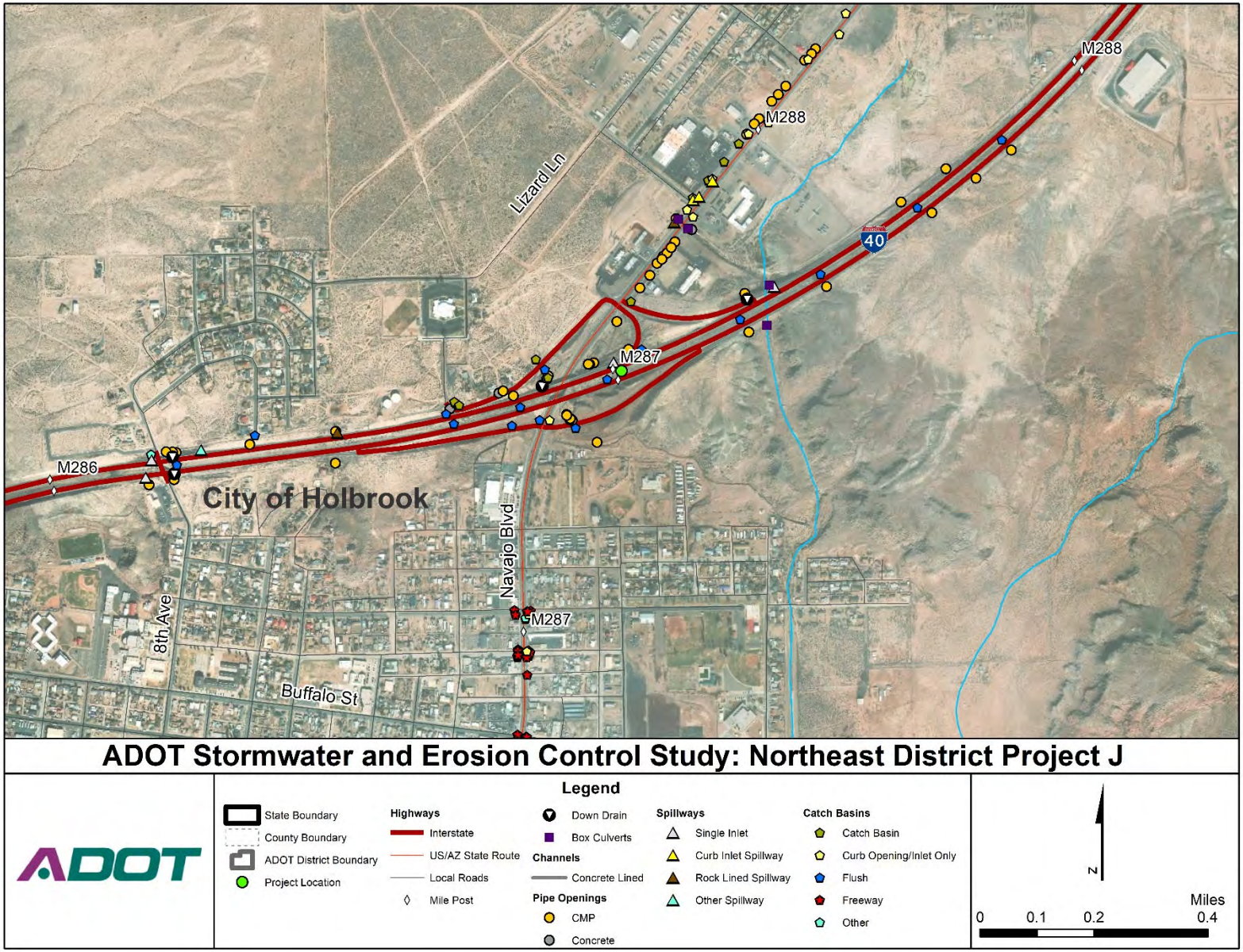


Figure 90: Westbound, Rear View (MP 287)

Figure 91: Westbound, Northern View

Figure 92: Westbound, Northern View

PROJECT K- SR 377 @ MP 8, 13 AND 24

Project Description: During large rain storms the water overtops the roadway (one to 1.5-feet) and a traffic detour is required around the area. At MP 8 and 13, four (4) existing 36-inch CMP's cannot handle the volume of water hitting these locations (being impacted by the same wash). At MP 24, two 24-inch CMP's cannot handle the water volume causing roadway overtopping. Infrastructure is undersized at all three locations. MP 24 could also be experiencing an alignment issue. There is not much sediment overtopping, only water. There is significant vegetation in the area and there is little to no scour nor erosion being experienced. Structurally, the CMPs are sound and not jeopardized.

How long has this been a concern? 20-30 years

Has the problem led to road closures? Yes, 2-4 times a year for a duration of approximately 2 hours each. Lower priority because this maintenance requires fewer man hours.

District Priority (if identified): #11

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Evaluate existing infrastructure sizing for likely need to upsize the existing CMPs to accommodate volume of flows at this location.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 93: Northeast District Project K

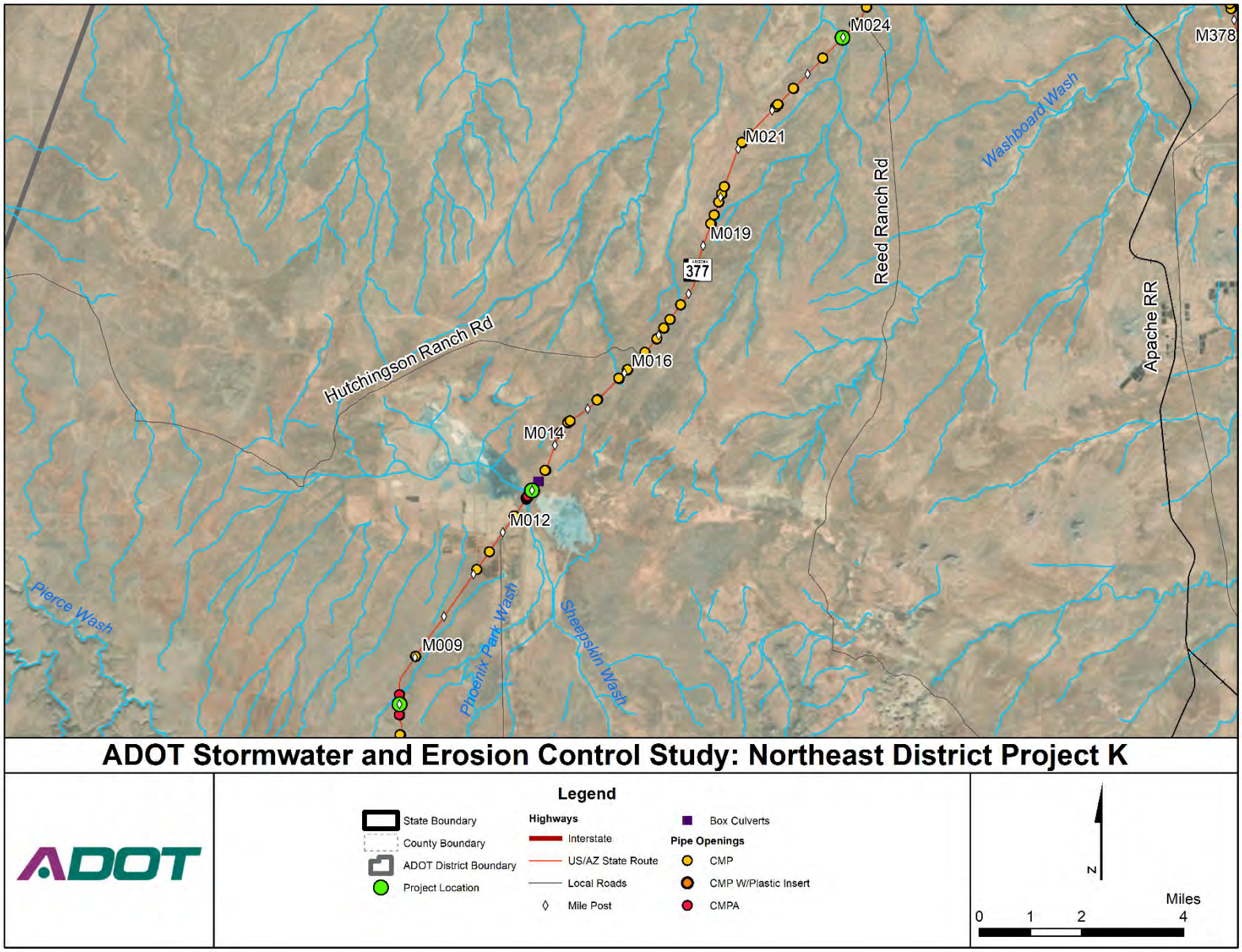


Figure 94: SR 377 at MP 8

Figure 95: SR 377 at MP 8

Figure 96: SR 377 at MP 8

CENTRAL DISTRICT

Error! Reference source not found. identifies the initial listing of potential stormwater projects identified by representatives of the Central District.

Table 4: Central District Stormwater Projects

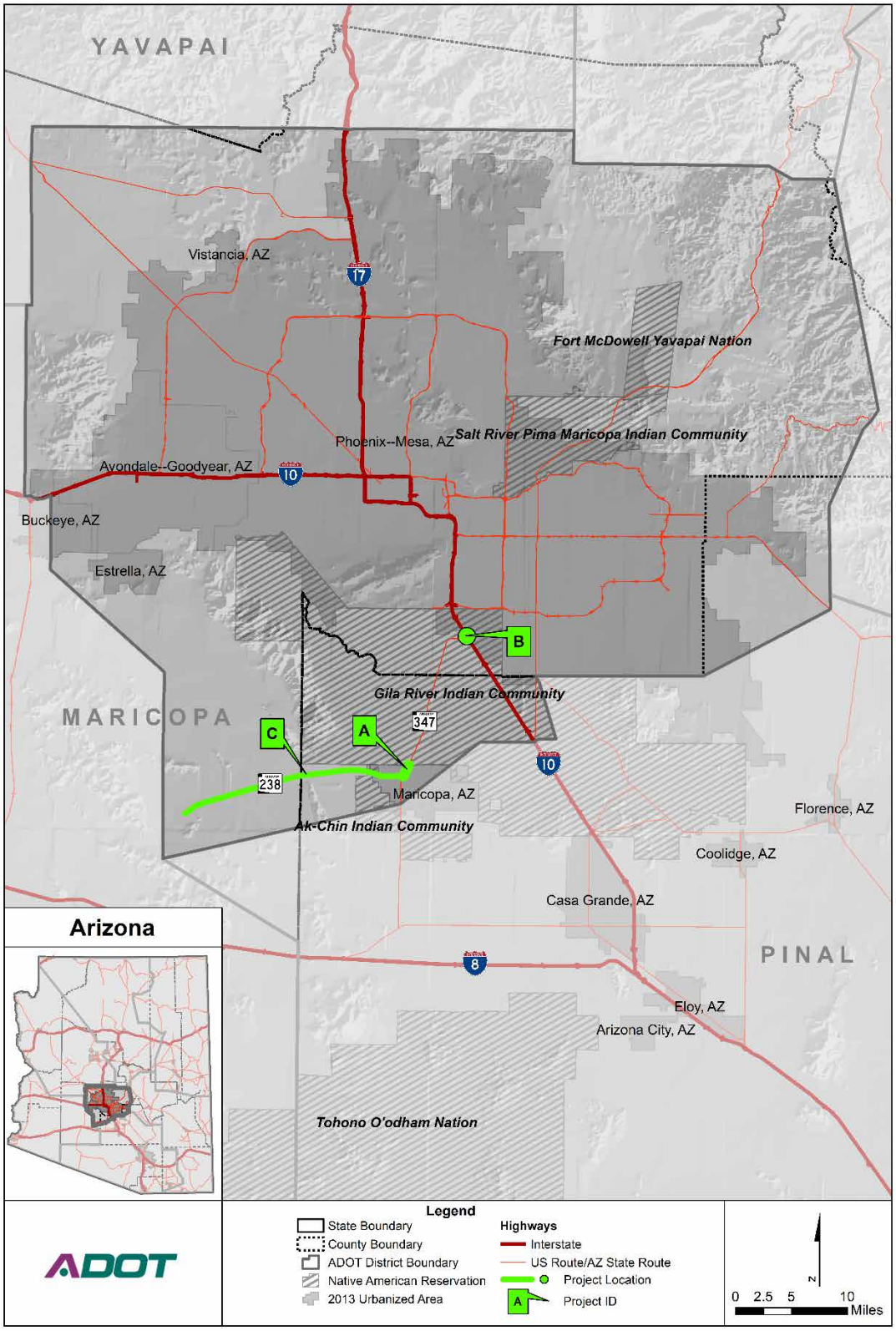
Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
A	SR 347	SR 238 to GRIC boundary	Erosion, bank protection and/or curb and gutter needed.	Construction
B	I-10	163.9 - Queen Creek TI	Unstable slopes, extreme rutting and pole foundations exposed.	Construction
C	SR 238	24.00 – 44.24	Highway experiences frequent flooding at low points, often causing roadway closures.	Construction
–	SR 101 AF	McDowell to Bethany Home	Numerous tons of agricultural sediment removed every year.	Maintenance
–	SR 303	Camelback and Northern	Offsite agricultural tail water erodes ADOT roadsides.	Maintenance
–	US 60	North side of US 60, NB Meridian Rd and channel on east side	Floods and scours slopes just north of and in recent project area.	Maintenance
–	US 60	South side at end of project area on NB Meridian east side	Erosion from bridge washes out slope.	Maintenance
–	I-10	EB to SR 202 WB Ramp, East side of 48th St. Slope	Rill and Gulley failure.	Maintenance
–	SR 101 AF	I-10 and McDowell	Various erosion around bridges and drain inlets (as noted).	Maintenance
–		Flyover abutments for I-10 W to L 101 N and L 101 S to I-10 W	Erosion features failing.	Maintenance
–		McDowell on-ramp to L 101 N	Excessive stormwater runoff causing erosion.	Maintenance
–	SR 101 AF	Northern off ramp gore point	Excessive stormwater runoff causing erosion.	Maintenance

Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
_	SR202	RM Spook Hill Levee	Erosion of the levee.	Maintenance
_	SR303	Beardsley Canal	Offsite flows erode westside slopes above channel.	Maintenance
_	SR303	SR303 at Lake Pleasant Parkway, northside	Offsite flows erode northside slopes.	Maintenance

1 For this column, the term "Construction" applies to both construction and preventative maintenance, therefore these projects qualify for this study. The term "Maintenance" applies to routine maintenance only, therefore these projects do not qualify for this study and no further details are provided.

As **Table 4** indicates, the Central District submitted a total of fifteen (15) potential stormwater projects. After the District phone interview, the Central District feels that three (3) of the submitted projects meet the definition of a "construction" or "preventative maintenance" project. These construction projects are described below.

Figure 97: Central District & Project Locations



PROJECT A- SR 347 – @ SR 238 TO MP 175.8 (GRIC BOUNDARY)

Project Description: Existing slopes lacking stabilization with riling/rutting up to 24-inch deep. Decomposed granite is discharged into channel. Water from roadway is not channeled into scuppers on the edge of the roadway, but rather sheet flow draining of edges in between scupper causing erosion along the bank. The roadway itself is not degrading, but access control fence poles are exposed as sediment leaves the site to the north eventually entering the Gila River drainage area. The southbound side of the road was improved by the City of Maricopa and their developers implementing drainage improvements as part of their development. The northbound side is not improved where erosion stormwater problem exists.

How long has this been a concern? Not sure, Central District inherited this condition when ADOT reconfigured Districts in 2015.

Has the problem led to road closures? Yes, at least three times recalled.

*District Priority (if identified): #*2

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. **Poor soil conditions**
e. Undersized infrastructure
f. **Improper construction/installation**
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Stabilize bank with liner and add curb and gutter to direct flows to scupper locations.

Likely Project Benefits:

a. **Public safety**
b. **Regulatory mandate**
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. **Meets District or ADOT strategic objective**
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 98: Central District Project A

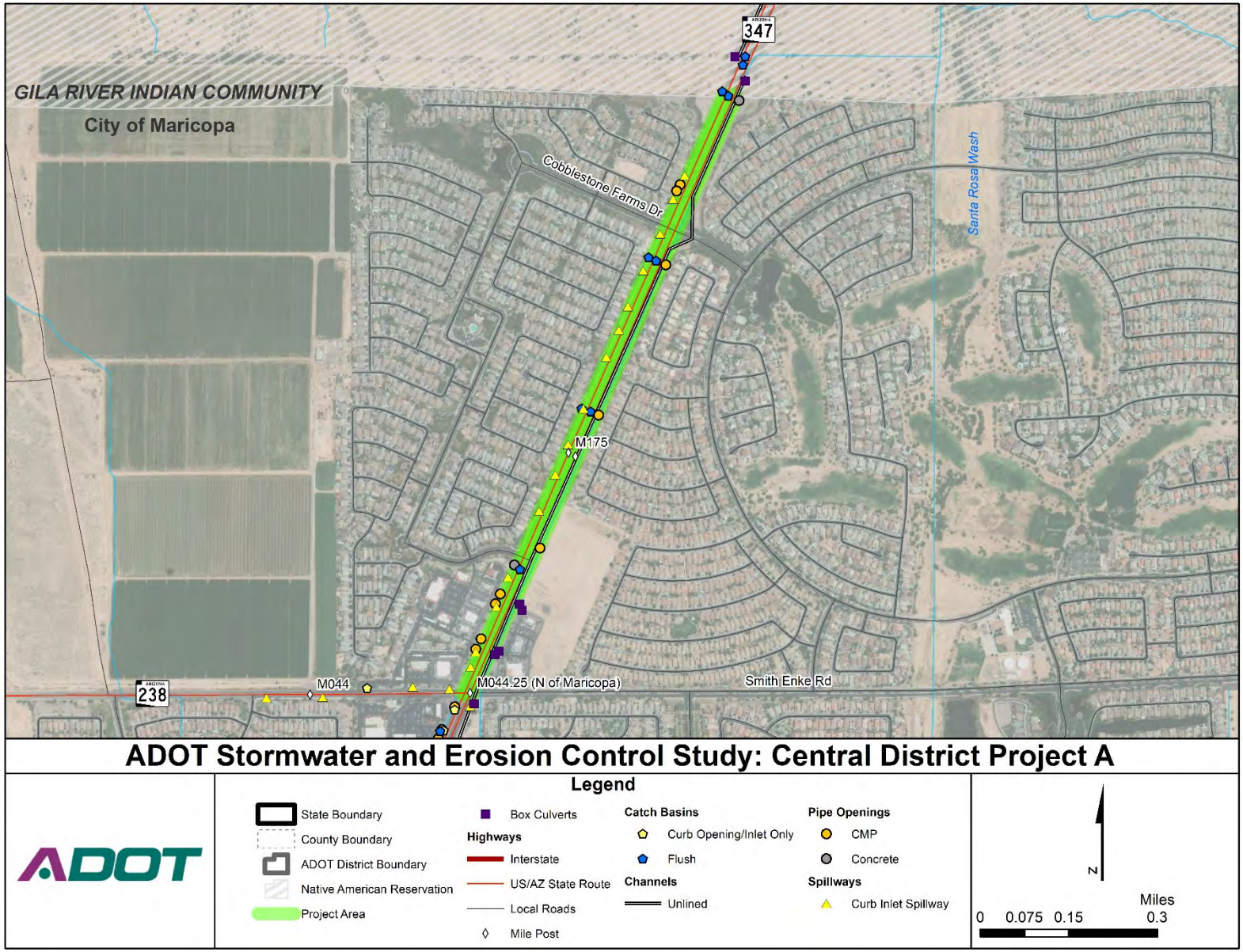


Figure 99: Northbound, Eastern View

Figure 100: Northbound, Rear View

Figure 101: Southbound, Western View

PROJECT B- INTERSTATE 10 @ MP 163.9/ QUEEN CREEK TRAFFIC INTERCHANGE

Project Description: Significant erosion occurring on the slopes of the traffic interchange. This lack of slope stabilization has also led to sediment collecting in the retention/detention basin below. Continuous runoff from roadway has led to extreme rutting causing pole foundations of the ADOT access control fence, and light pole foundations, to become exposed.

How long has this been a concern? More than 10 years.

Has the problem led to road closures? No

District Priority (if identified): #3

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Bank stabilization with either temporary fix of hydroseeding or long-term fix with filter matting. Repair of fence, and removal of sediment in catch basin are all necessary. Adding a combination of 1-inch to 3-inch (gradation C) fractured rock mulch on the slopes and possibly adding Reno Mattressing product or equivalent is the desired alternative to filter matting. There is some uncertainty if the possible construction fix could already be identified/included in an upcoming I-10 corridor project beginning at I-10 & WHP and ending at Casa Grande.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 102: Central District Project B

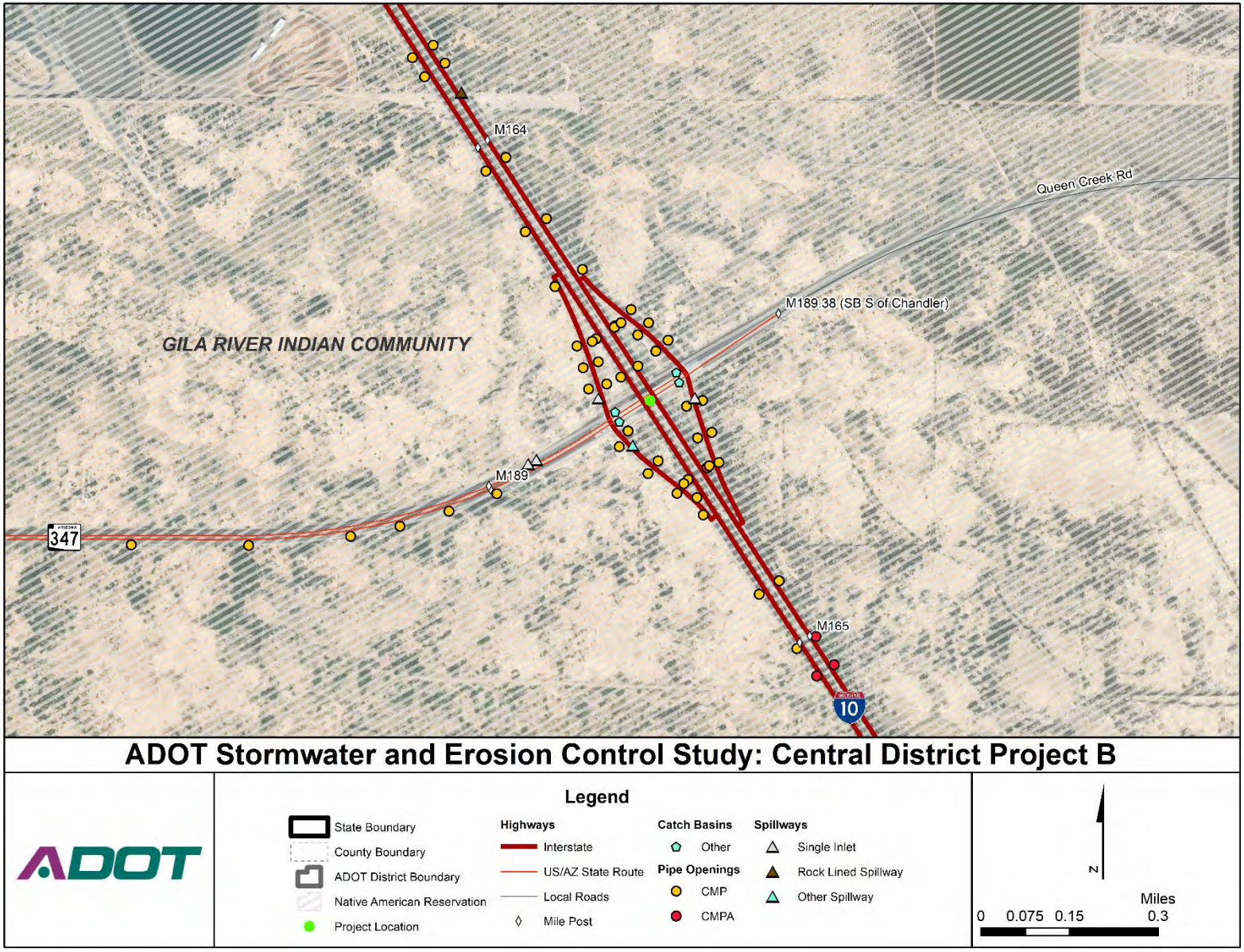


Figure 103: Northbound, Rear View

Figure 104: Southbound, Rear View

Figure 105: Northbound, Eastern View

PROJECT C- SR 238 @ MP 24 TO 44.24

Project Description: SR 238 along this 20-mile segment of roadway experiences flooding during heavy rain events, frequently causing roadway closures and restrictions, resulting in detours of local traffic. Water and debris frequently overtop the roadway at multiple dip section locations during larger rain events, triggering ADOT maintenance crews to conduct removal. The study area is parallel to an existing Union Pacific Railroad (UPRR) alignment located to the south of SR 238. The Railroad has constructed ditches and berms to direct water through drainage structures at various locations. Water discharged from these locations often overtops the roadway. ADOT has completed a Draft Initial Project Assessment for this project (Project 238 MA 24 P130309P) in June 2019 and has identified a preliminary construction budget of $15,832,000 for this project.

How long has this been a concern? Over ten years.

Has the problem led to road closures? Yes, seven times annually.

District Priority (if identified): #1

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: The vast majority of the proposed improvements found within the Draft Initial Project Assessment consist of raising the roadway profile and adding culverts to the multiple dip section locations.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 106: Central District Project C

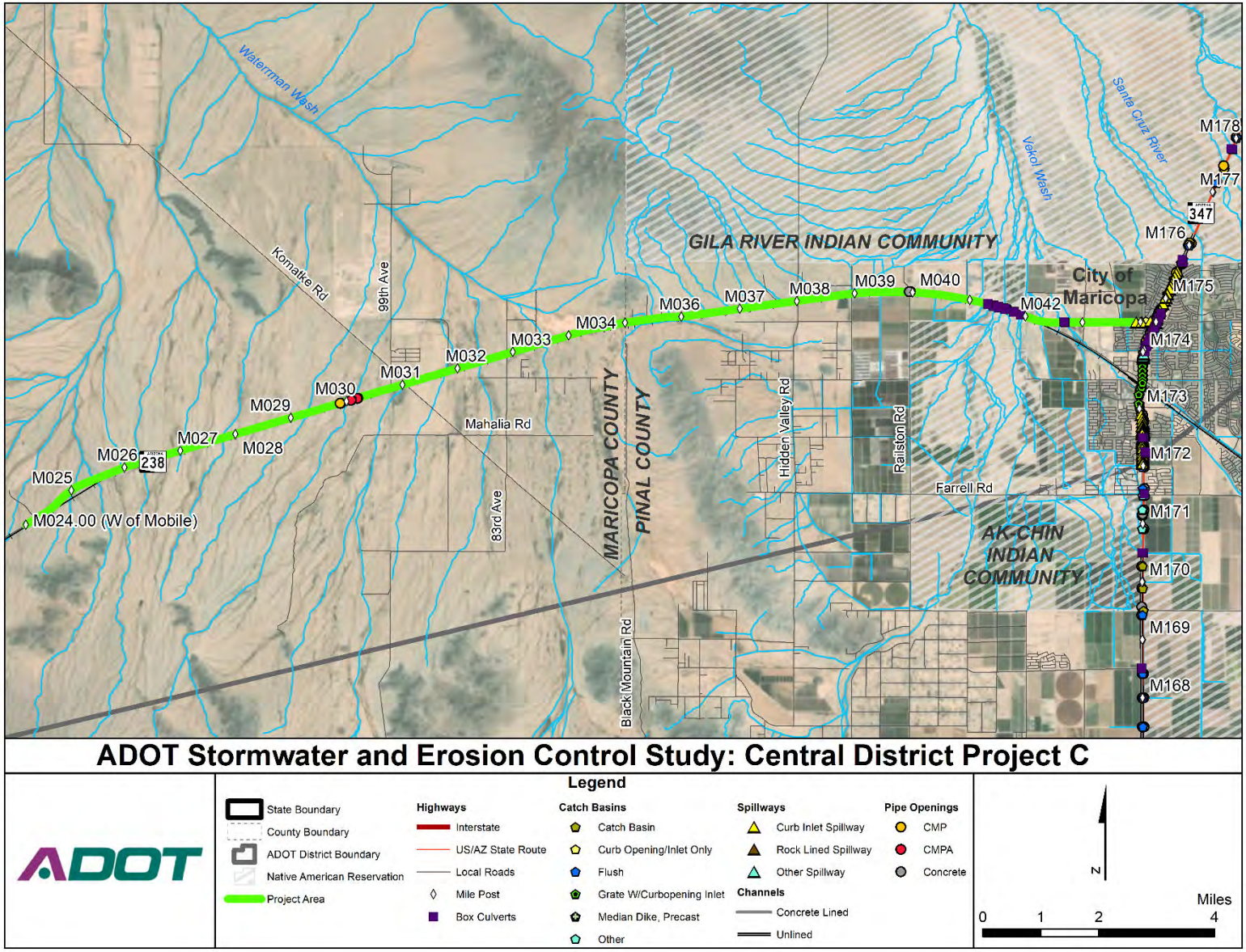


Figure 107: MP 43.58 Roadway Flooding and Closure 2018 (Picture Provided by ADOT)

Figure 108: MP 25 Box Culverts (Picture Provided by ADOT)

Figure 109: MP 34 Aerial (Picture Provided by ADOT)

SOUTHWEST DISTRICT

Table 5 identifies the initial listing of potential stormwater projects identified by representatives of the Southwest District.

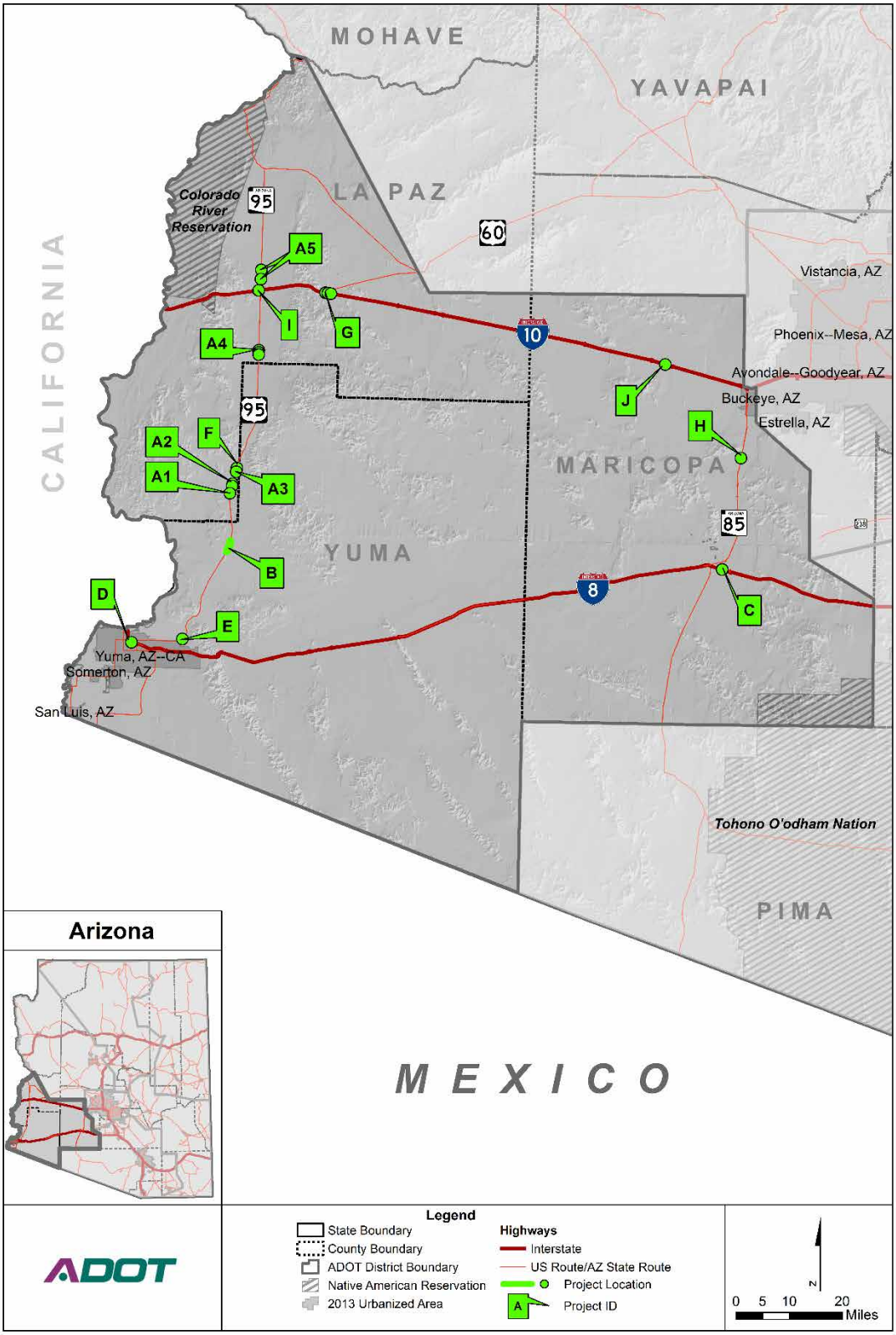
Table 5: Southwest District Stormwater Projects

Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
A	US 95	65.2, 66.5, 66.9, 69.3, 92.1, 92.5, 92.9, 110.8, & 112.5	Nine low water crossings causing pavement erosion.	Construction
B	US 95	54-56	Stormwater run-off eroding shoulders.	Construction
C	I-8	WB 117.95	Flowing through box culvert flooding residential property.	Construction
D	Pacific Ave	Ave 2E Underpass Structure #1381	Stormwater flows damaging residential subdivision.	Construction
E	US 95	Fortuna Wash	Stormwater flows erosion threatening flooding of adjacent properties.	Construction
F	US 95	69.83-70.04	Wash cutting into roadway during storm events causing pavement undermining.	Construction
G	I-10	31.5-32.5	Roadway overtopping occurs during large storm events.	Construction
H	SR 85	139.81-141.11	Water overtopping bank of the wash into the median eroding the roadway shoulders.	Construction
I	I-10	18.89	Flooding occurs in southeast quadrant of structure threatening mobile businesses.	Construction
J	I-10	WB 95.8-97.5	Agricultural run-off compromising pavement section.	Construction

1 For this column, the term "Construction" applies to both construction and preventative maintenance, therefore these projects qualify for this study. The term "Maintenance" applies to routine maintenance only, therefore these projects do not qualify for this study and no further details are provided.

As **Table 5** indicates, the Southwest District submitted a total of ten (10) potential stormwater projects. After the District phone interview, the Southwest District feels that all ten (10) of the submitted projects meet the definition of a "construction" or "preventative maintenance" project. These construction projects are described below.

Figure 110: Southwest District & Project Locations



PROJECT A- US 95 @ MP 65.2, 66.5, 66.9, 69.3, 92.1, 92.5, 92.9, 110.8, & 112.5

Project Description: There are nine (9) low water crossings on US 95 where erosion occurs, typically after monsoon storm events. Water flows undercut the material along the edge of pavement causing drop-offs and undermining the highway pavement structural section. The nine locations are included as one project since the likely mitigation measures for erosion at low water crossings would likely be similar in application along US 95. These locations have been persistent and continuous maintenance activities that have consumed a considerable portion of the District maintenance budget. As a persistent maintenance problem, a new construction project(s) is needed to resolve this condition. A District project request for construction mitigation was submitted in 2018. The extent of this project is depicted in **Figure 111**, **Figure 112**, **Figure 113**, **Figure 114**, and **Figure 115**.

How long has this been a concern? 14 years +

Has the problem led to road closures? Yes, once annually during monsoon season.

District Priority (if identified): #1

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. **Undersized infrastructure**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Each location will likely need some combination of installation of concrete or rock ford walls, gabion baskets and/or grouted rip rap to successfully mitigate erosion of roadway subgrade.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 111: Southwest District Project A1

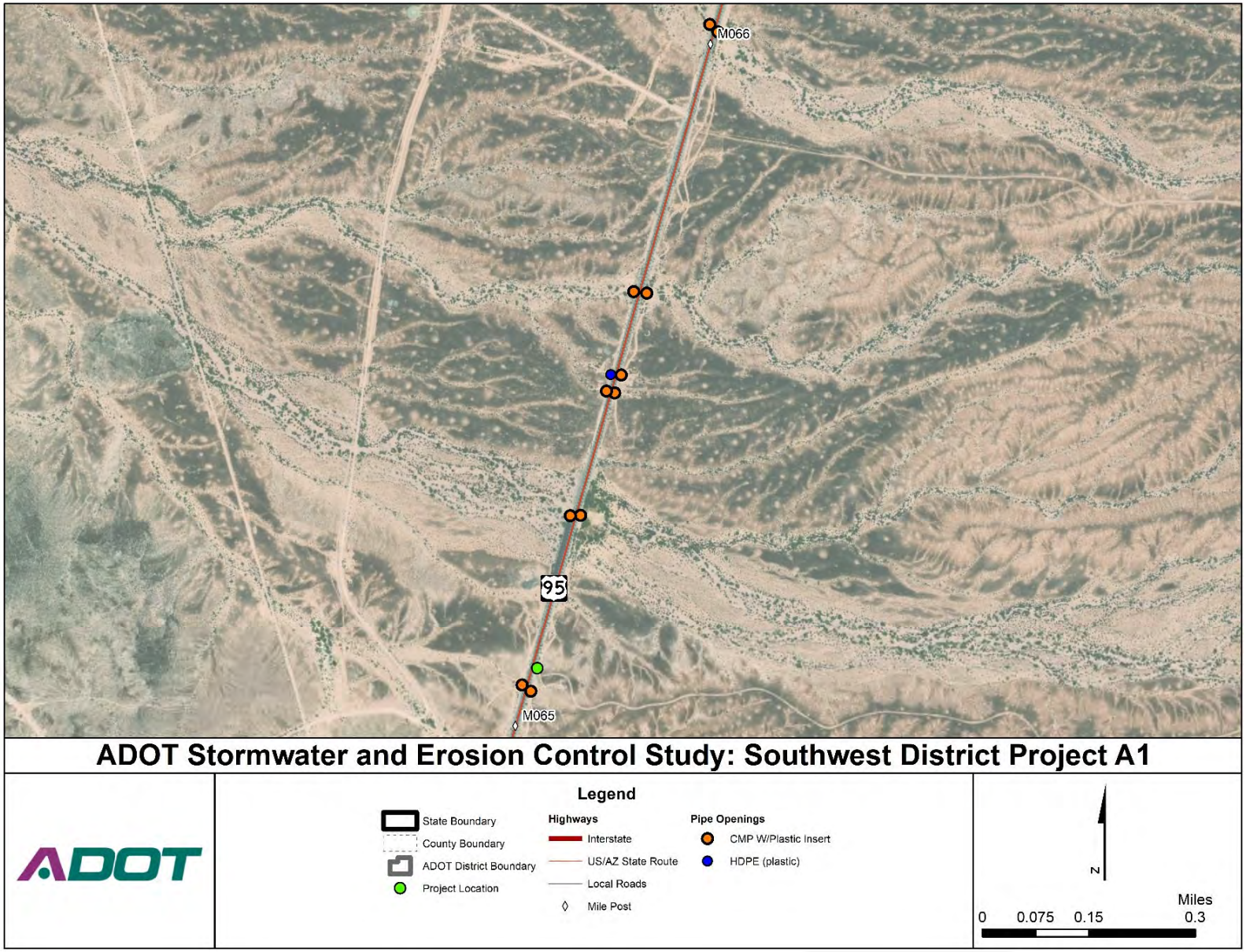


Figure 112: Southwest District Project A2

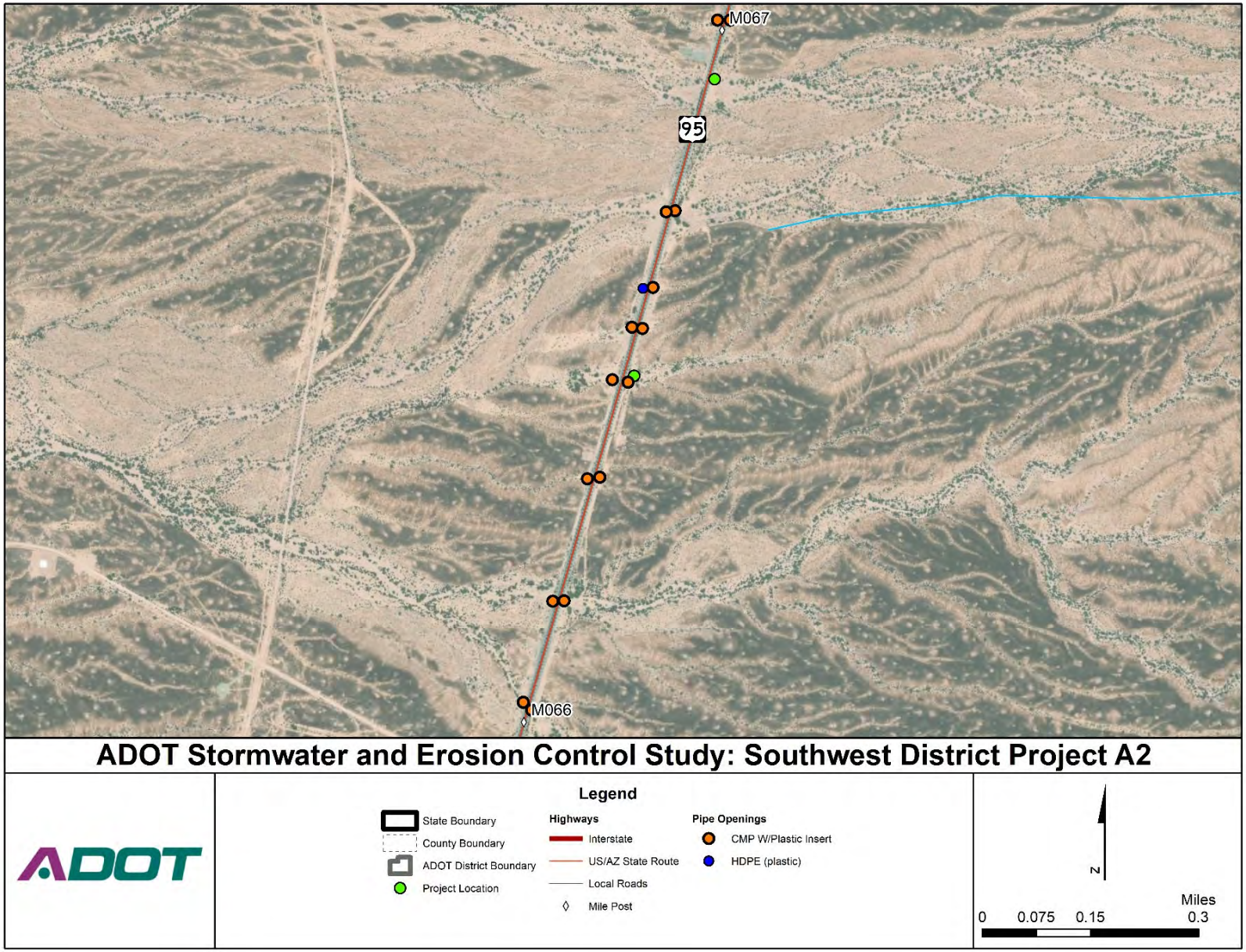


Figure 113: Southwest District Project A3

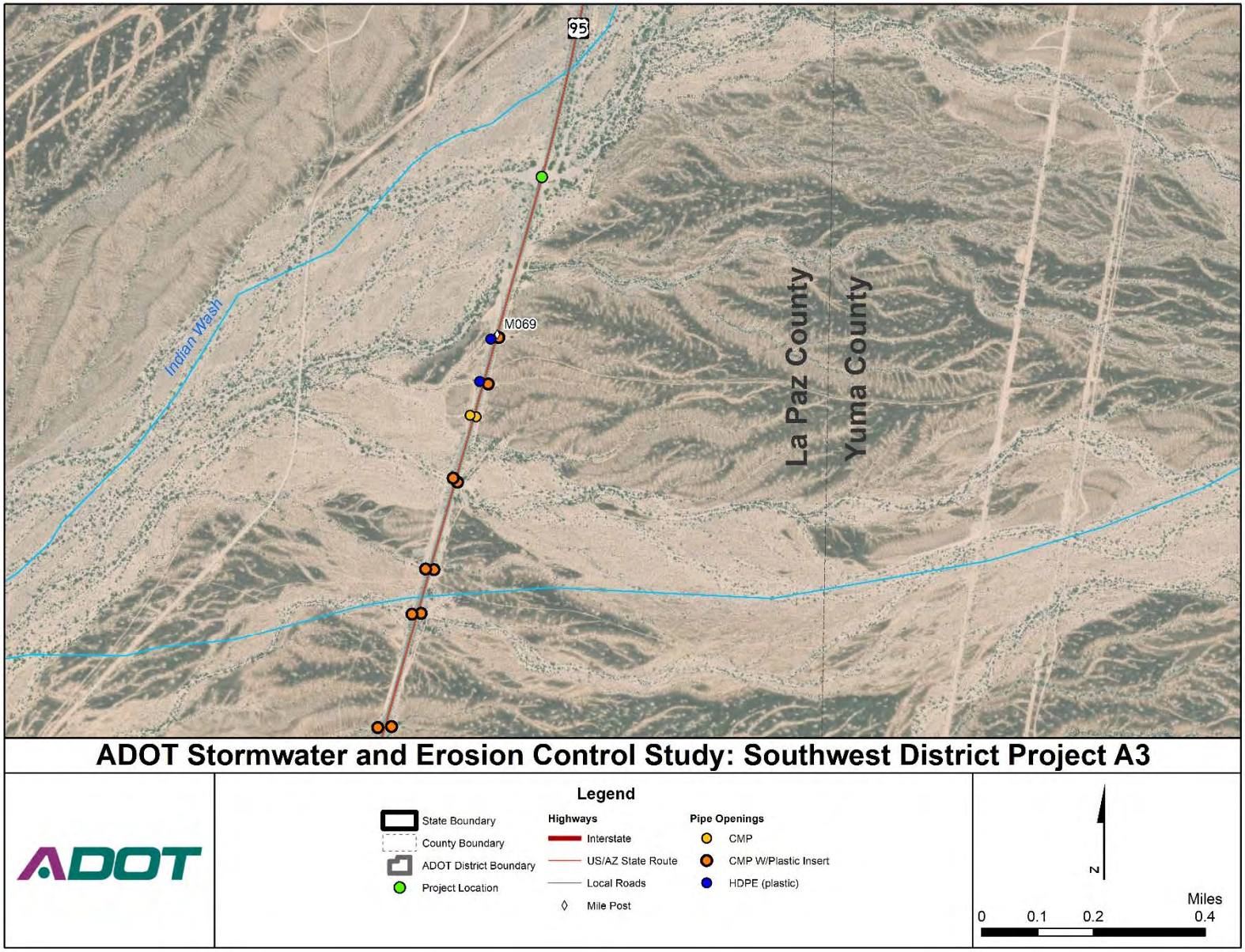


Figure 114: Southwest District Project A4

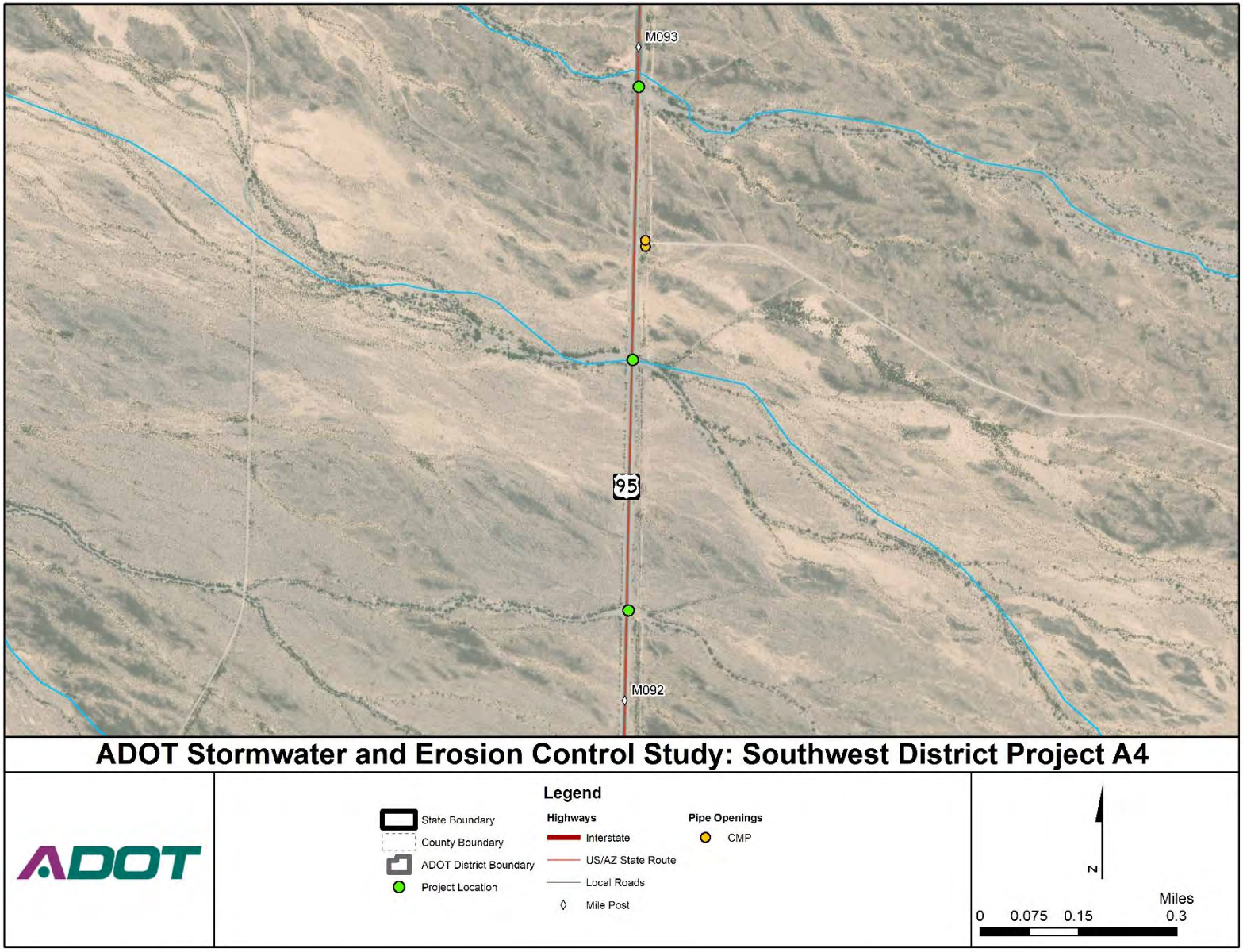


Figure 115: Southwest District Project A5

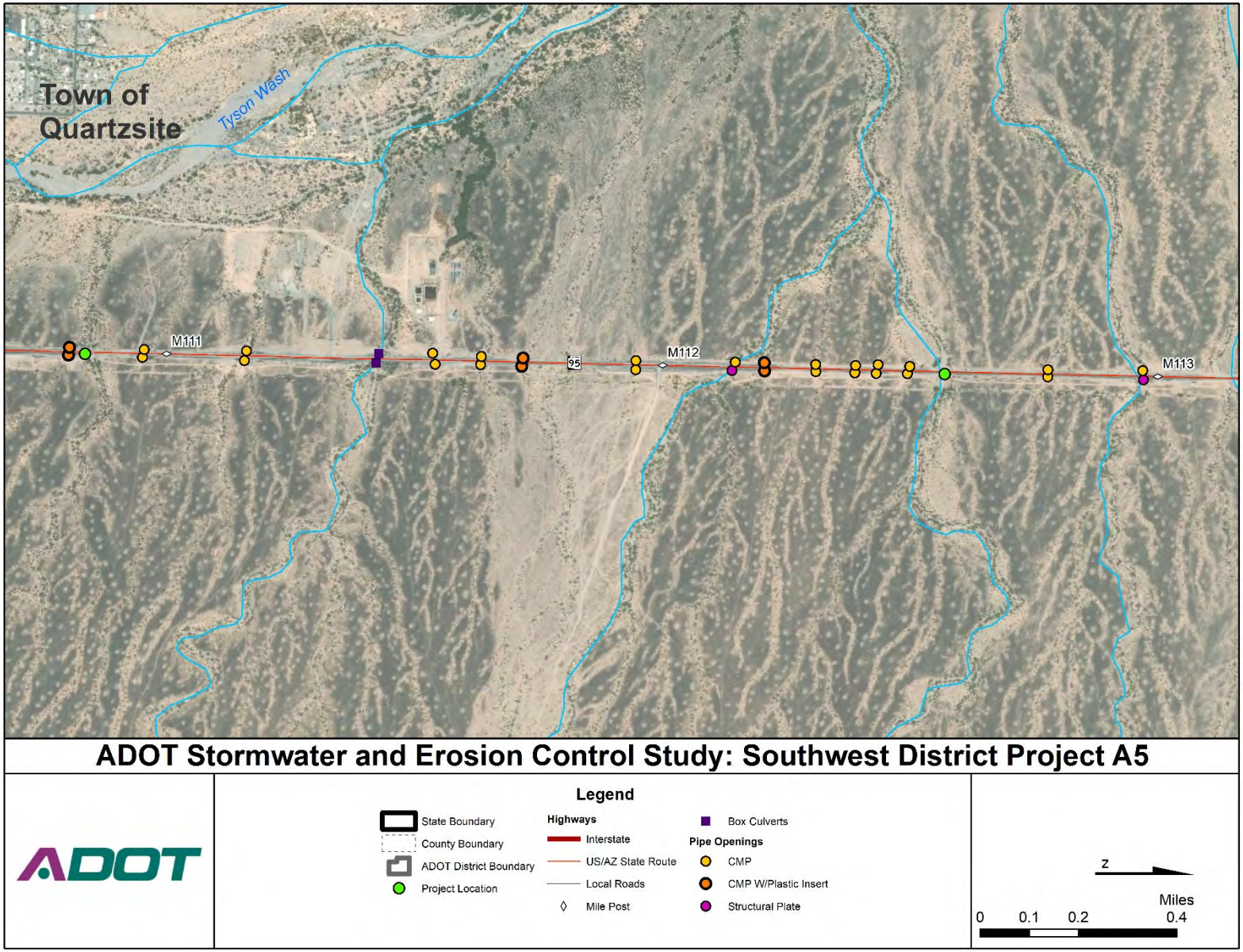


Figure 116: US 95 at MP 65.2

Figure 117: US 95 at MP 92.5

Figure 118: US 95 at MP 69.3

Figure 119: US 95 at MP 92.5

PROJECT B- US 95 @ MP 54 - 56

Project Description: Stormwater run-off running parallel to the roadway washes out the shoulders along US 95 within these limits. The existing CMPs under the roadway get blocked, reducing the capacity of the pipes, and eroding the shoulders at the edge of roadway pavement. Maintenance has fixed this area multiple times, however this results in up to 7-foot drop-offs from the roadway edge in places. The entrance to the General Motors test track has been washed out, rendering the facility inaccessible. Fill materials must be imported to address the problem. The maintenance activities take 3-4 weeks each year and the problem has yet to be resolved.

How long has this been a concern? Ongoing maintenance activities for 7 years +

Has the problem led to road closures? Yes, at least once annually during monsoon season.

District Priority (if identified): #2

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. **Poor soil conditions**
e. **Undersized infrastructure**
f. Improper construction/installation
g. **Additional negative impacts downstream**
h. Other

Possible Mitigation/Solution: Needs further examination, but embankment protection possibilities include soil cement along shoulders, gabion baskets, grouted rip rap, channel cutting, concrete and/or rock ford walls.

Likely Project Benefits:

a. **Public safety**
b. **Regulatory mandate**
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 120: Southwest District Project B

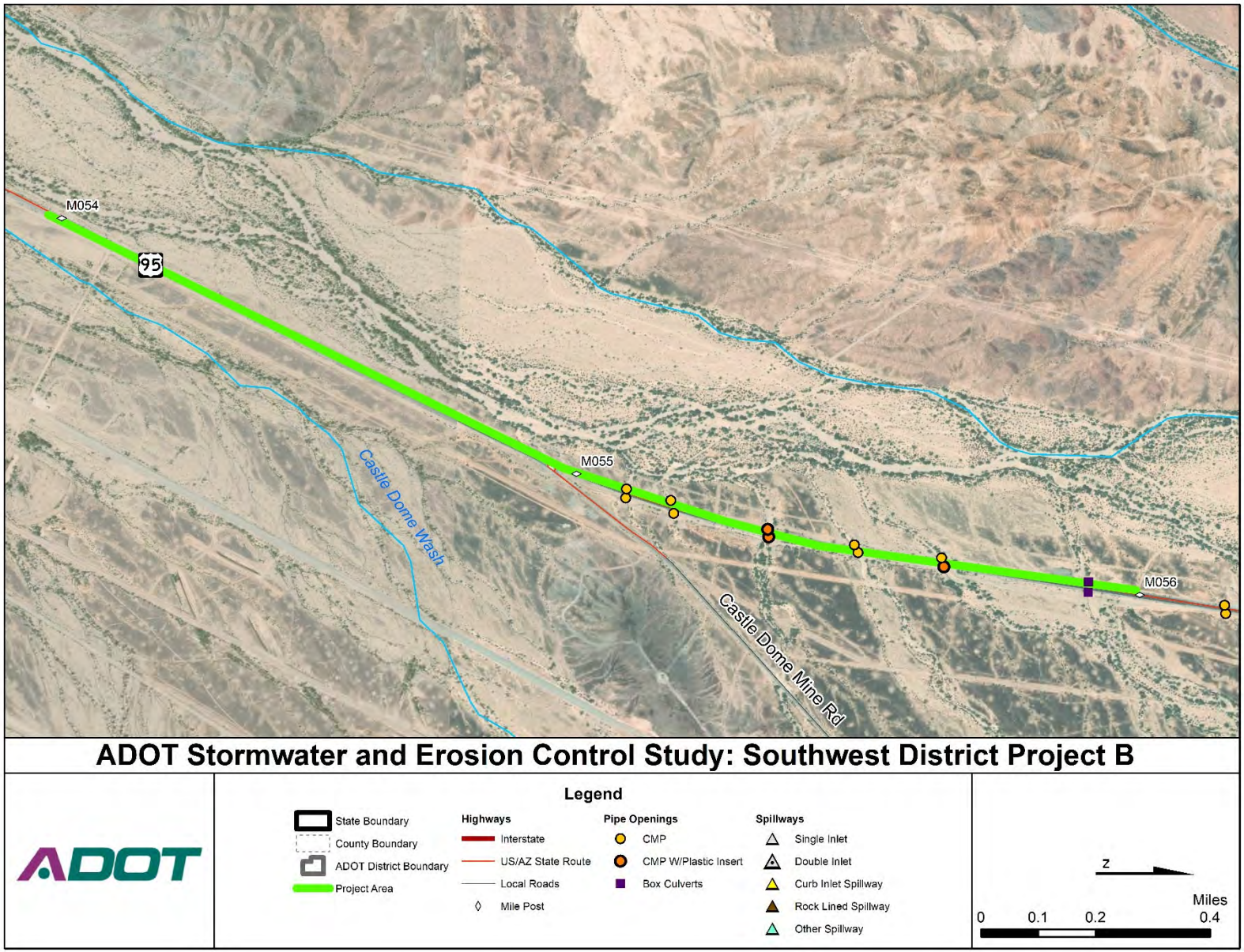


Figure 121: Northbound, Eastern View

Figure 122: Southbound, Western View

Figure 123: Northbound, Rear View

PROJECT C- INTERSTATE 8, MP 117.95 WB

Project Description: Two washes in this area converge, diverting north to a bend, but water travels straight onto private property. Flows typically are high volume and high velocity. The water flowing through the box culvert is overtopping at this location, eroding the earthen banks/slopes within the wash causing flooding onto a residential property located adjacent to the wash. Box culverts seem to be sized properly, but the velocity of the water is too fast. Maintenance has repaired the banks multiple times. Private property owner has escalated this issue to the Director.

How long has this been a concern? 9 years +

Has the problem led to road closures? None to date.

District Priority (if identified): #3

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. **Additional negative impacts downstream**
h. Other

Possible Mitigation/Solution: Armoring the banks with soil cement, gabion baskets, grouted rip rap and consider an energy dissipator structure at the outlet of the box culverts.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 124: Southwest District Project C

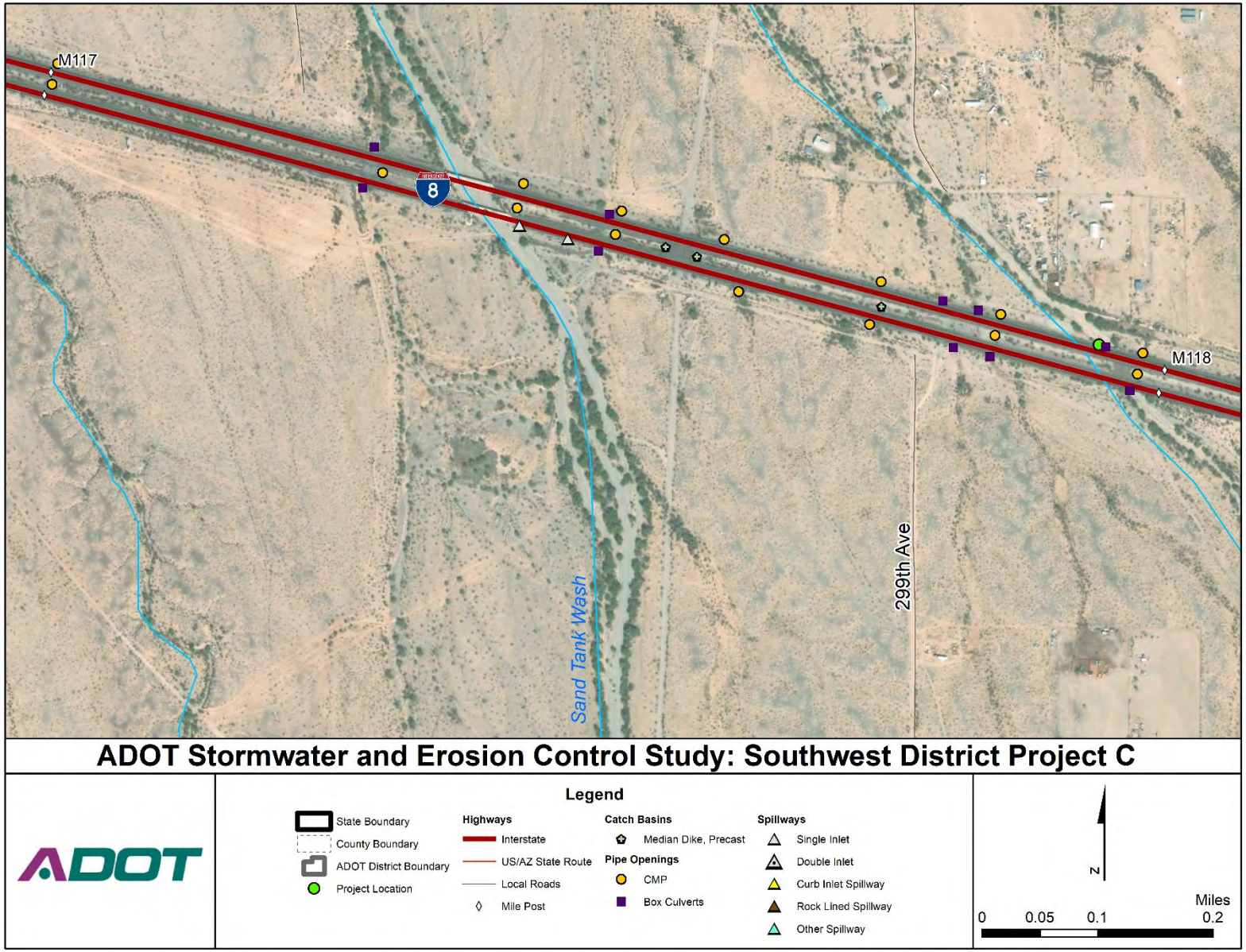


Figure 125: San Tank Wash Near I-8

Figure 126: Debris in San Tank Wash

Figure 127: San Tank Wash

PROJECT D- PACIFIC AVENUE @ AVE 2E UNDERPASS, STRUCTURE # 1381

Project Description: Stormwater flows being conveyed from east to west along the toe of slope of the I-8 north embankment, flooding into a residential subdivision below. Slopes are sufficient, but water travels at high velocity. Water overtops the 90-dgree bend in the wash in multiple locations, permeating the CMU subdivision wall, and impacting the back yards of residential properties (approximately 10 properties).

How long has this been a concern? At least 3 years or more.

Has the problem led to road closures? None to date.

District Priority (if identified): #4

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. **Facility overtopping or embankment protection**
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Possible re-cutting of the v-ditch and armoring with rip rap or similar.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 128: Southwest District Project D

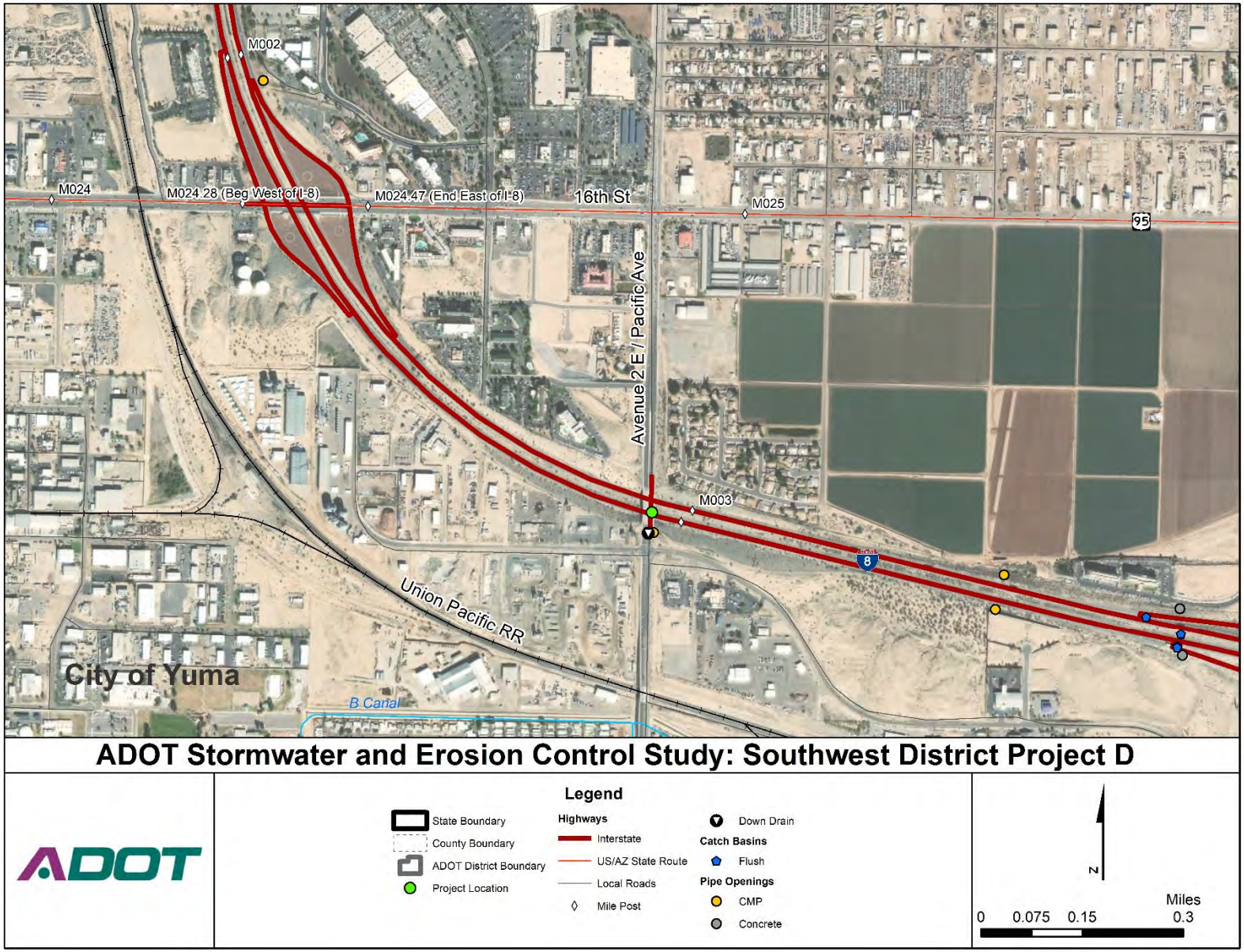


Figure 129: Residential Property Backyard (Picture Provided by ADOT)

Figure 130: Pacific Avenue Bridge from the North (Picture Provided by ADOT)

Figure 131: Aerial View (Picture Provided by ADOT)

PROJECT E- US 95 @ FORTUNA WASH

Project Description: This location was converted from a previous low water crossing to a newer bridge structure. There is a drop structure on the north side to slow the water velocity, then the wash veers to the right, but some of the flows continue straight, flooding adjacent ASLD property. Storm water flowing on the southside of the Fortuna Wash Bridge is eroding the earthen banks. The Fortuna Wash Bridge structure was recently constructed and could have possibly changed the water flow thereby negatively affecting (eroding) a slope/bank on the ASLD property, which did not seem to occur prior to the bridge construction.

How long has this been a concern? Since the new bridge was built, approximately 2 years.

Has the problem led to road closures? None to date.

District Priority (if identified): #5

Characteristics of the Problem:

- **a. Failed stabilization/erosion control**
- b. Facility overtopping or embankment protection
- c. Slope washout
- d. Poor soil conditions
- e. Undersized infrastructure
- f. Improper construction/installation
- **g. Additional negative impacts downstream**
- h. Other

Possible Mitigation/Solution: Consider armoring of the banks with soil cement or rip rap.

Likely Project Benefits:

- **a. Public safety**
- b. Regulatory mandate
- c. Environmental benefit
- d. Relief to District budget and/or resources
- e. Meets District or ADOT strategic objective
- **f. Reduction/mitigation in flooding or hazard**
- g. Extend facility life span

Figure 132: Southwest District Project E

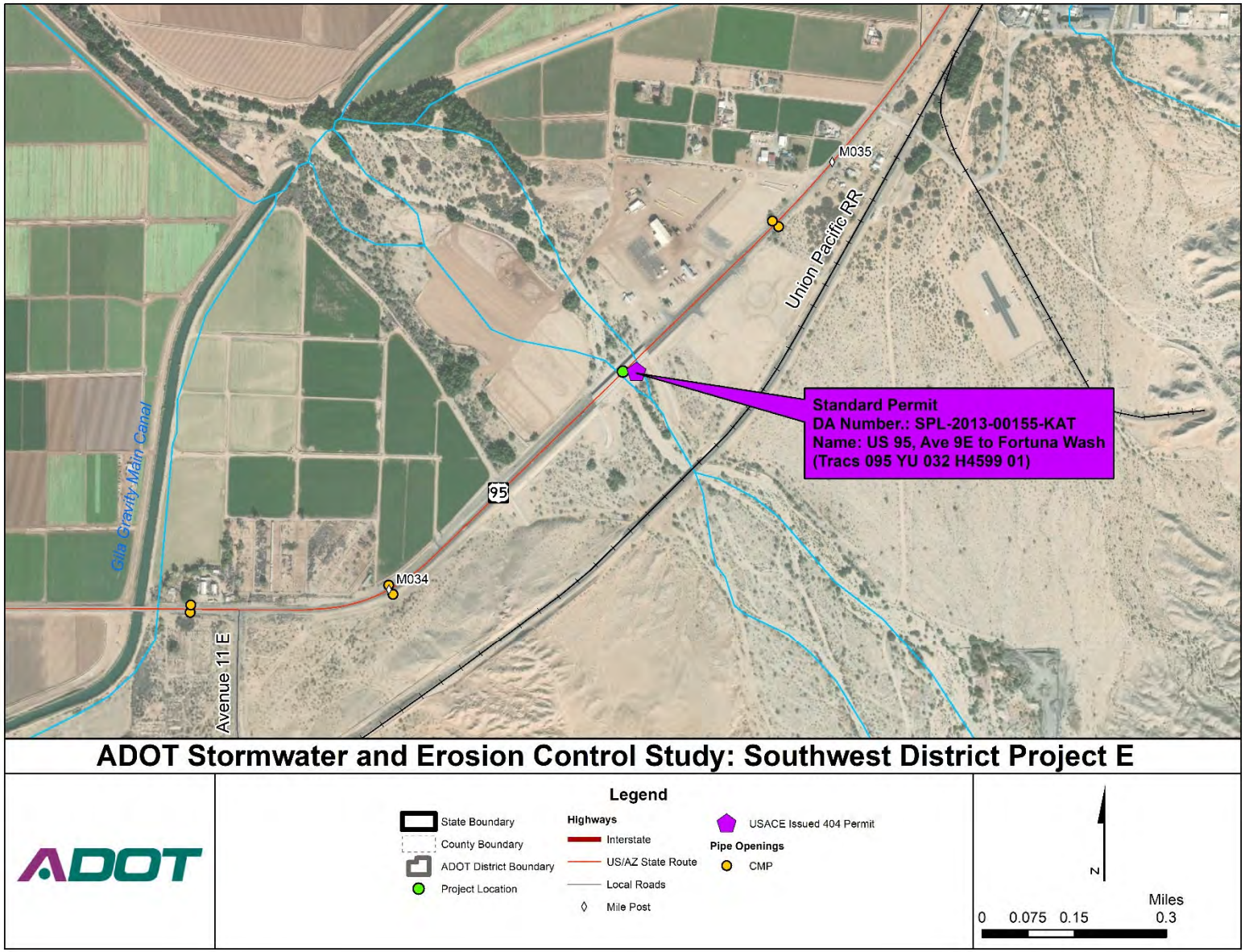


Figure 133: Fortuna Wash Bank

Figure 134: Fortuna Wash from Roadway

Figure 135: Fortuna Wash

PROJECT F- US 95 @ MP 69.83 – 70.04

Project Description: Stormwater run-off running in wash parallel to the roadway washes out the shoulders along US 95 within these limits. Causes steep drop-off's and pavement undermining. The existing CMPs under the roadway get blocked, reducing the capacity of the pipes and eroding the shoulders at the edge of roadway pavement. Maintenance has fixed this area multiple times. Fill materials must be imported, and the maintenance activities are time consuming and ultimately ineffective.

How long has this been a concern? 9 years +

Has the problem led to road closures? Yes, at least once annually during monsoon season.

District Priority (if identified): #6

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. **Poor soil conditions**
e. **Undersized infrastructure**
f. Improper construction/installation
g. **Additional negative impacts downstream**
h. Other

Possible Mitigation/Solution: Realign the wash and or recontour banks and armor the bank walls.

Likely Project Benefits:

a. **Public safety**
b. **Regulatory mandate**
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 136: Southwest District Project F

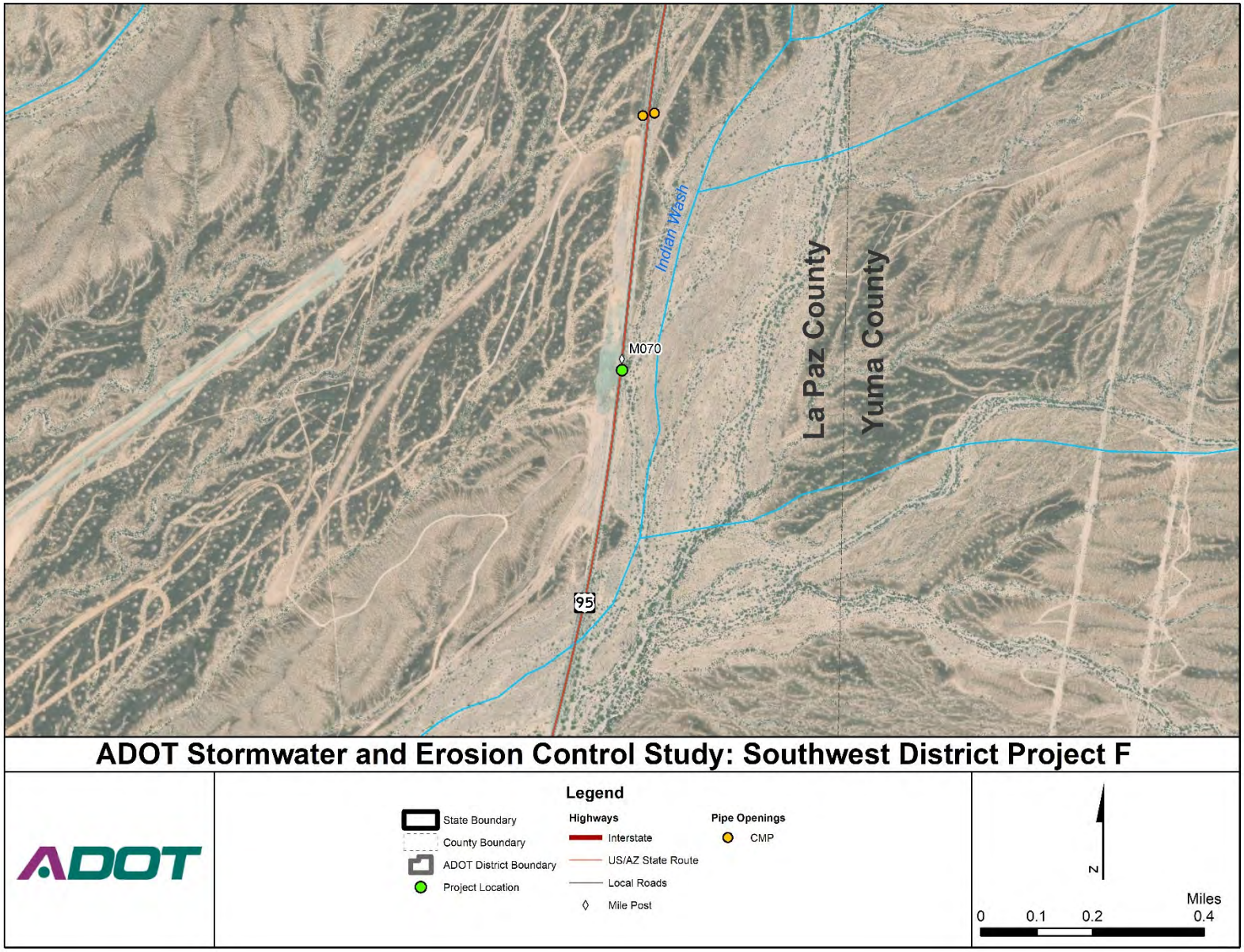


Figure 137: Southbound, Western View (MP 69)

Figure 138: Northbound, Eastern View

Figure 139: Northbound, Rear View

PROJECT G- INTERSTATE 10 @MP 31.5 – 32.5

Project Description: Roadway overtopping occurs within these milepost limits during large storm events, usually during monsoon season. Significant scour is occurring at MP 32.5 culvert outlets. There has been a previous drainage study prepared in 2004 to describe the existing condition and recommend a design concept to mitigate the existing condition.

How long has this been a concern? At least 15 years

Has the problem led to road closures? No

District Priority (if identified): #7

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. **Facility overtopping or embankment protection**
c. Slope washout
d. Poor soil conditions
e. **Undersized infrastructure (upstream and outside of ADOT ROW)**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Reduce the scour condition by possible use of grouted rip rap and evaluate energy dissipater to slow the velocity of the water.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 140: Southwest District Project G

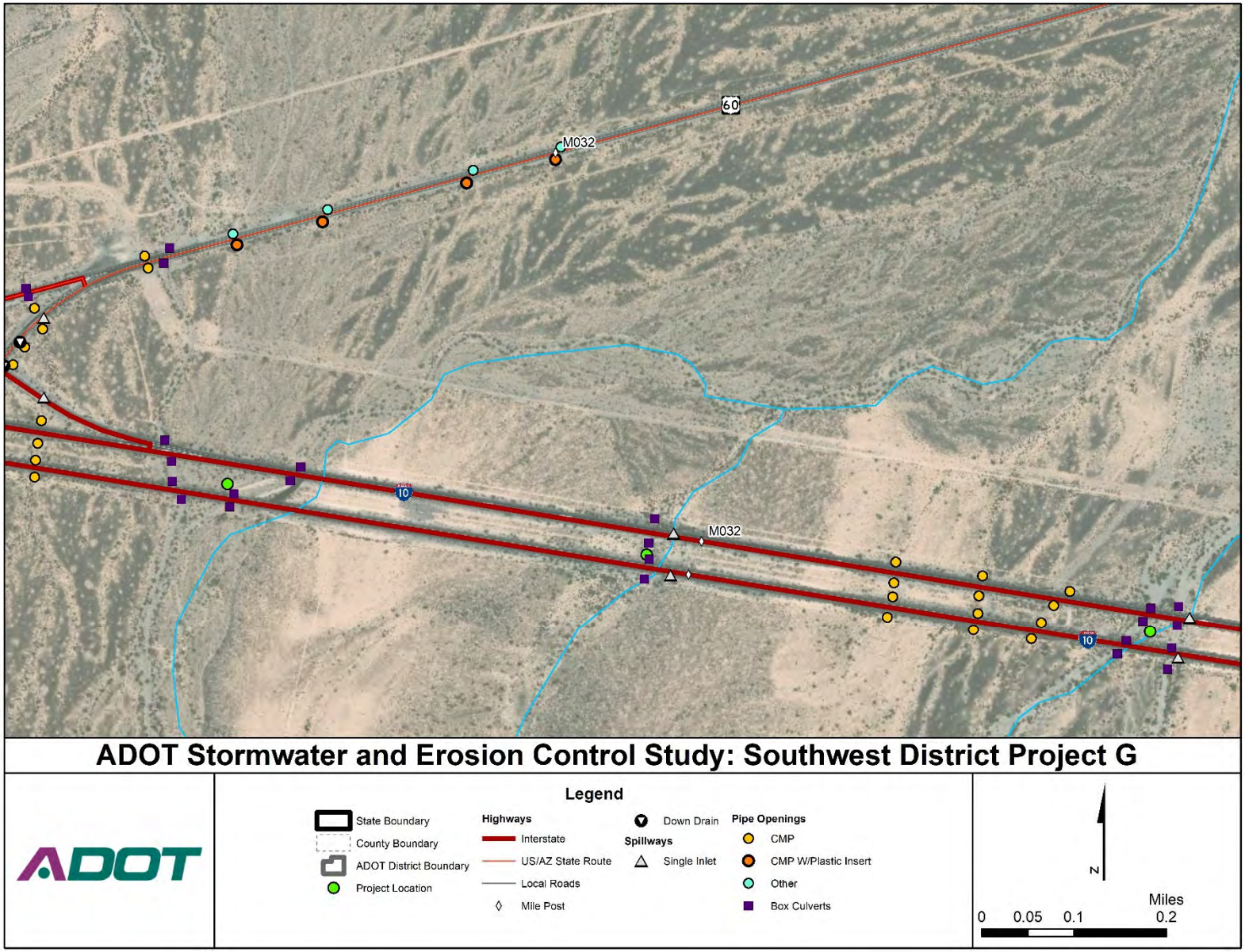


Figure 141: Westbound, Northern View (MP 32)

Figure 142: Eastbound, Southern View (MP31)

Figure 143: Eastbound, Southern View (MP32)

PROJECT H- SR 85 @ MP 139.81 – 141.11

Project Description: Water flowing over the banks of Rainbow Wash (MP 141.08) breaching onto SR 85 causing water over topping and shoulder erosion during rain events. Roadway was reconstructed into a divided highway with a large, at-grade median. An embankment between the two bridges, water runs down the median area and erodes the slope.

How long has this been a concern? Since the road was reconstructed approximately 10 to 12 years ago.

Has the problem led to road closures? None to date, potential for future road closures.

District Priority (if identified): #8

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Perhaps the wash embankment is too shallow; consider lowering the profile of the wash, realign the wash embankment and armor the banks.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 144: Southwest District Project H

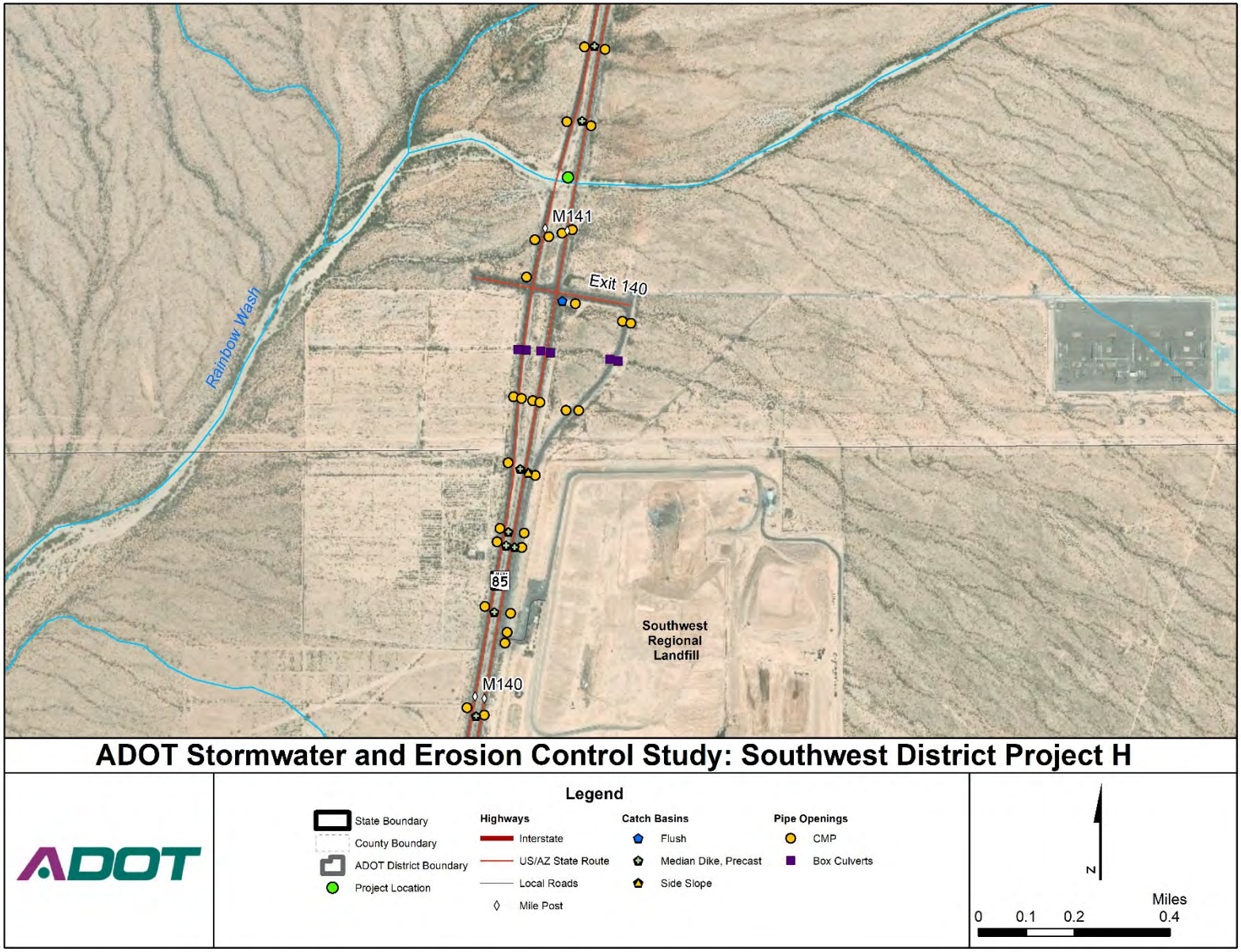


Figure 145: Aerial View (MP 141) (Picture Provided by ADOT)

Figure 146: Southbound, Eastern View (Picture Provided by ADOT)

PROJECT I- INTERSTATE 10 @ MP 18.89

Project Description: Water draining from three different sources (I-10, US 95 and tailwater ditch from adjacent farms) converge at the SEC and divert under US 95 through a box culvert eroding the shoulder slopes and compromising the pavement structural section. The wash makes a number of turns and gets blocked, likely due to a capacity issue.

How long has this been a concern? 5 years +

Has the problem led to road closures? Roadway has overtopped, not closed, but potential is there.

District Priority (if identified): #9

Characteristics of the Problem:

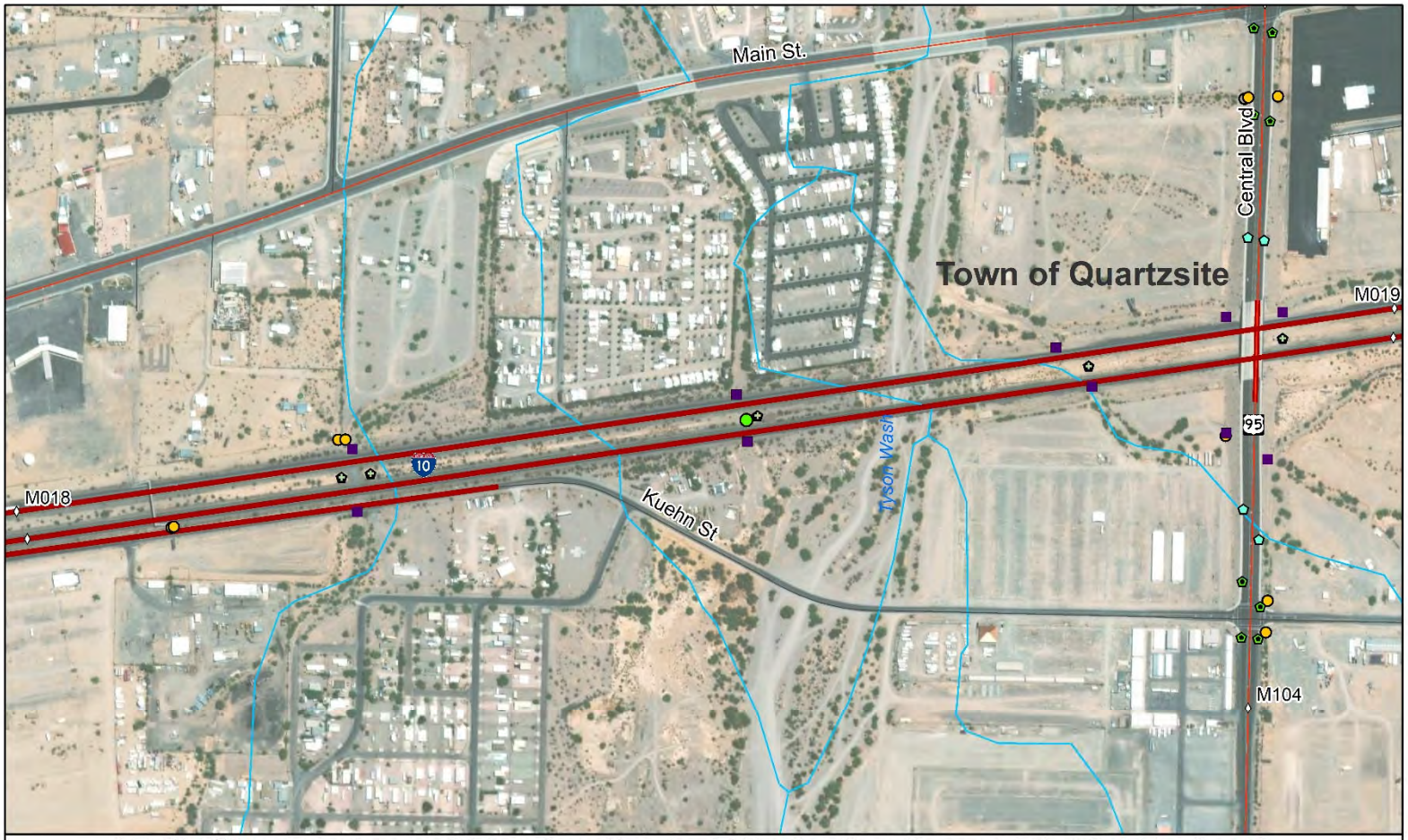
a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Evaluate the existing box culvert and possibly construct another box culvert to capture flows from I-10.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 147: Southwest District Project I



ADOT Stormwater and Erosion Control Study: Southwest District Project I

Legend

- State Boundary
- County Boundary
- ADOT District Boundary
- Project Location

Highways
- Interstate
- US/AZ State Route
- Local Roads
- Mile Post

Catch Basins
- Grate W/Curbopening Inlet
- Median Dike, Precast
- Other

Pipe Openings
- CMP
- Concrete
- Box Culverts

N

0 0.0475 0.095 0.19 Miles

Figure 148: Eastbound, Southern View (MP 18)

Figure 149: Eastbound, Rear View (Picture Provided by ADOT)

PROJECT J- INTERSTATE 10 @ WB MP 95.8 – 97.5

Project Description: Agricultural tailwater is draining from adjacent farm fields north of I-10. The water tends to converge and stagnate around a box culvert eroding the shoulder slopes by saturating the sub-structure thereby compromising the pavement structural section.

How long has this been a concern? 1 year +

Has the problem led to road closures? None to date.

District Priority (if identified): #10

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other - upstream activities outside of ADOT ROW negatively impacting ADOT facilities. Extensive vegetation growth.

Possible Mitigation/Solution: Possibly consider cut ditch to divert water from road structure and armor the slopes to protect roadway shoulder.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 150: Southwest District Project J

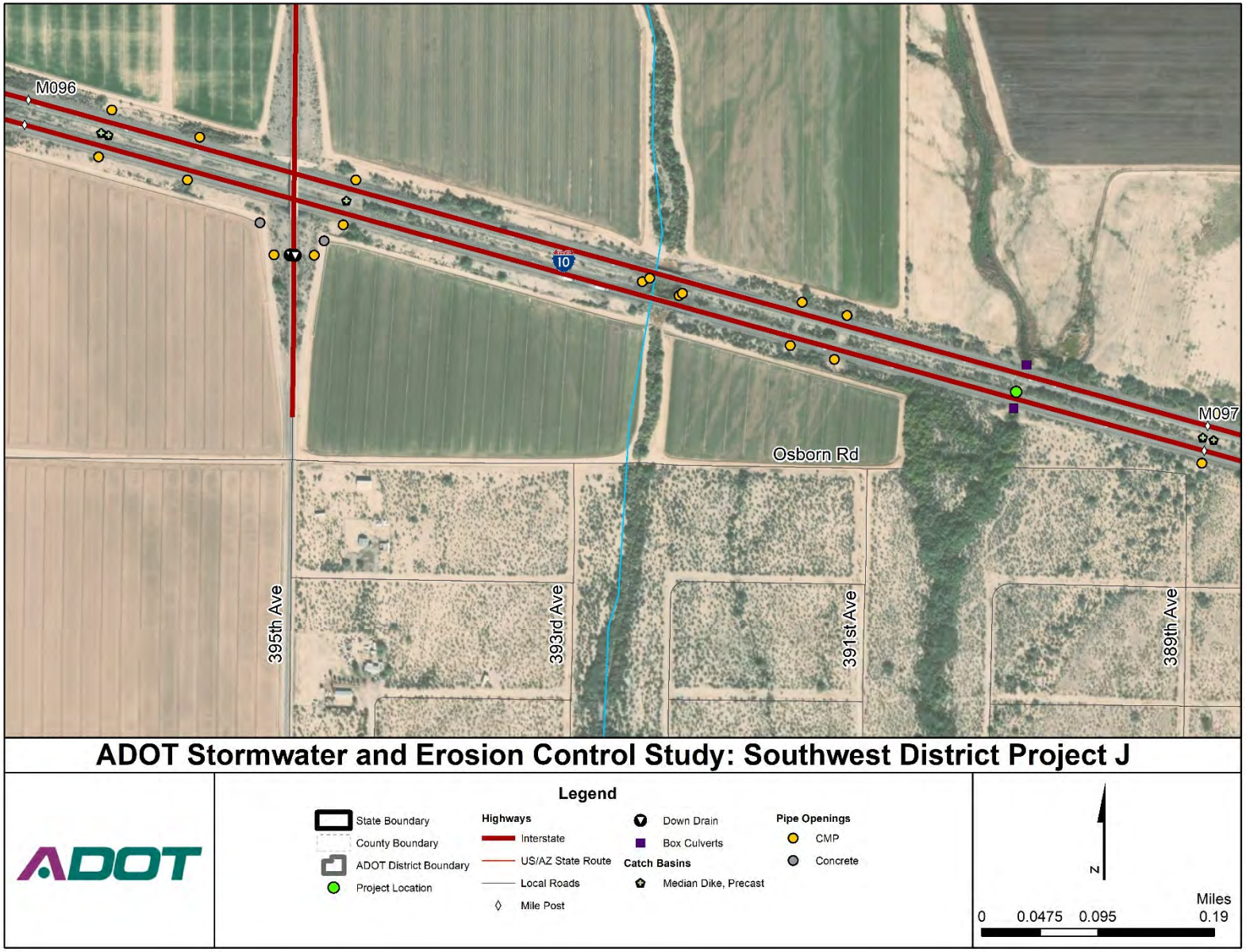


Figure 151: Westbound, Northern View (MP 96)

Figure 152: Eastbound, Southern View

Figure 153: Eastbound, Rear View

SOUTHCENTRAL DISTRICT

Table 6 identifies the initial listing of potential stormwater projects identified by representatives of the Southcentral District.

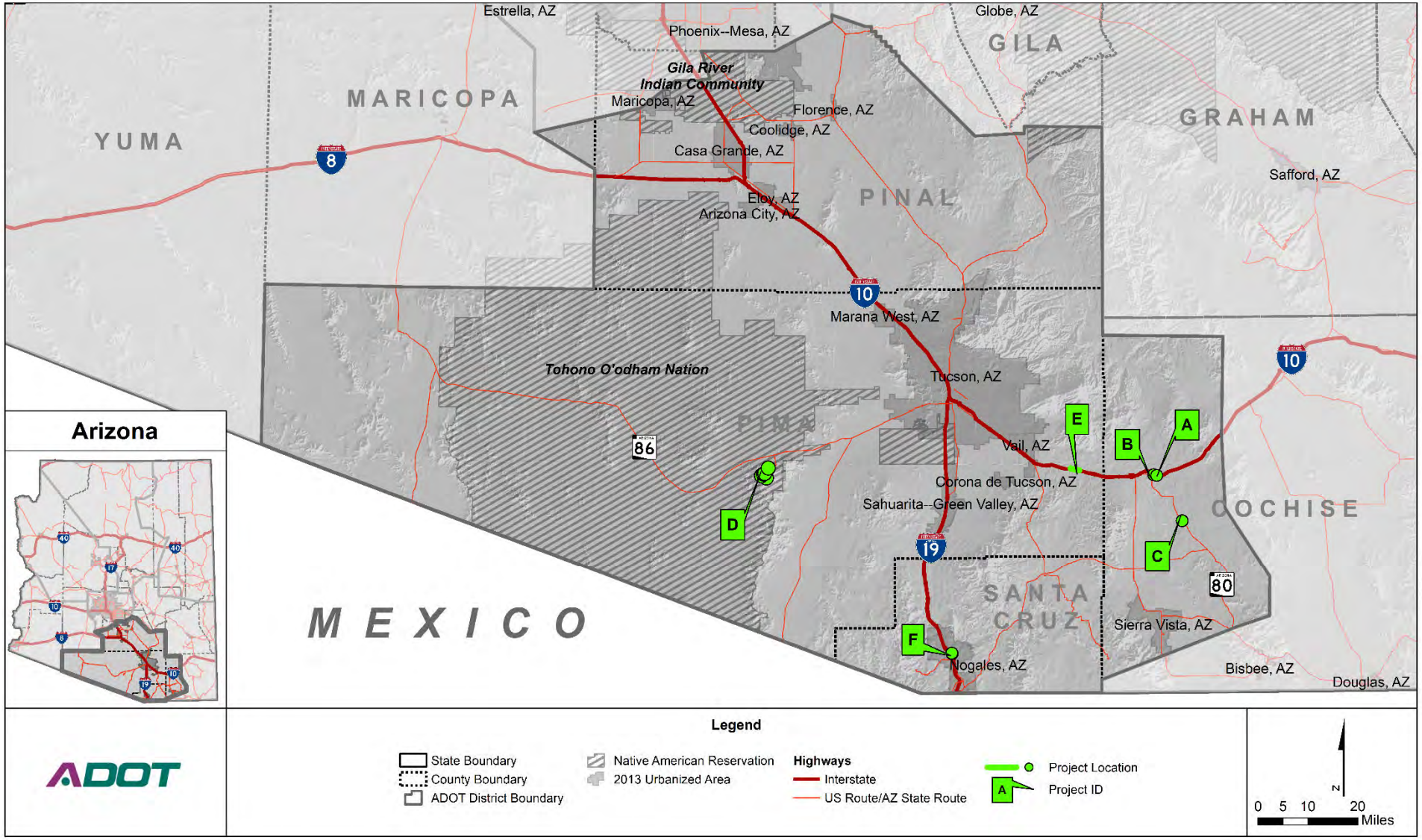
Table 6: Southcentral District Stormwater Projects

Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
A	WB I-10-Frontage Rd. (Pomerene Rd & Ramsey Rd)	306 & 306.917 (Benson)	Flows overtopping box culverts resulting in erosion.	Construction
B	WB I-10	306.9 (Benson-San Pedro River Bridge)	Drainage pipe exposed, sandy soil/scour protection needed.	Construction
C	SB SR 80	306.079 (St David)	Erosion near box culvert and wingwalls.	Construction
D	SR 386	4.37, 6.05, 6.58, 7.5, 11.1 - Three Points	Flows overtopping the road eroding shoulders. Pipe and outlets require protection.	Construction
E	EB/WB I-10, Marsh Station Rd., UPRR, Ramps	289.41-291.70 (Marsh Station)	Scour slopes eroding.	Construction
F	I-19	8.9-9.1 (Nogales)	Scour slopes eroding.	Construction
–	NB SR 79	134.53 - 134.63 (Florence)	Erosion on shoulder threatening private property.	Maintenance
–	SR 286	0-12.6	Low water crossings.	Maintenance
–	SR 289	3.32, 4.03, 10.27, 10.58	Low water crossings.	Maintenance

1 For this column, the term "Construction" applies to both construction and preventative maintenance, therefore these projects qualify for this study. The term "Maintenance" applies to routine maintenance only, therefore these projects do not qualify for this study and no further details are provided.

As **Table 6** indicates, the Southcentral District submitted a total of nine (9) potential stormwater projects. After the District phone interviews, the Southcentral District feels that six (6) of the nine (9) submitted projects meet the definition of a "construction" project. These construction projects are described below.

Figure 154: Southcentral District & Project Locations



PROJECT A- INTERSTATE 10 WB FRONTAGE RD @ MP 306 AND 306.917

Project Description: High velocity water flows are being conveyed from a wash running along the ADOT ROW resulting in erosion. A concrete, grade control dike into box culvert has failed resulting in water overtopping the aged box culvert. At MP 306.917 - Pomerene Rd. and Frontage Rd. the box culvert is overtopping when it rains (FIS Asset ID – 2081271).

How long has this been a concern? At least five years. Problem worsens during monsoon rains.

Has the problem led to road closures? No

District Priority (if identified): #2

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. Slope washout
d. Poor soil conditions
e. **Undersized infrastructure**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Replace aged box culvert and grade control dike. At MP 306.917, consider removing the box as it seems to serve as an obstruction.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 155: Southcentral District Project A

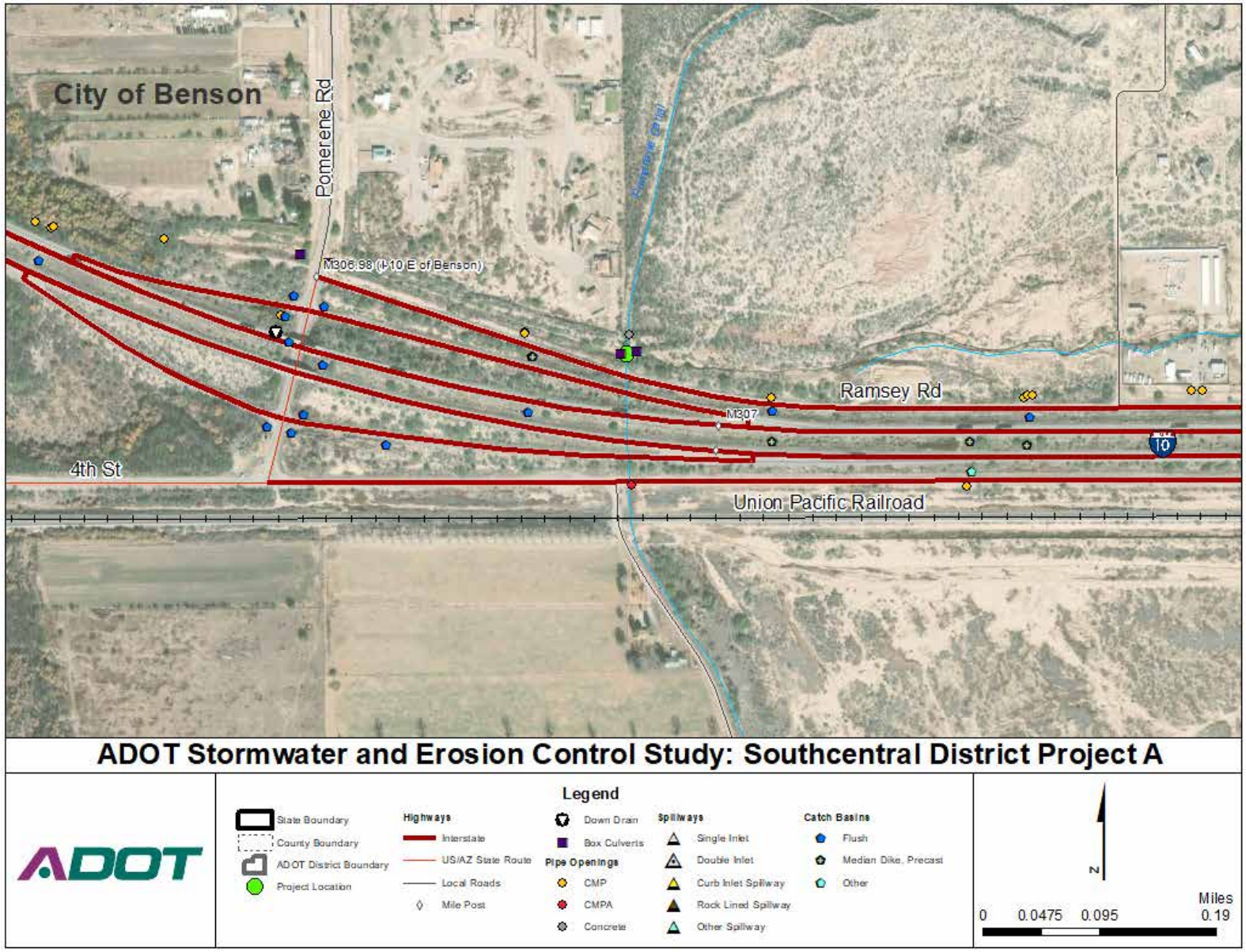


Figure 156: Ramsey Rd. Overflow of Sediment, Inlet Wingwall and Box Culvert

Figure 157: Ramsey Rd. Inlet Dike Failure, Box Culvert Too Small for Water Flow

Figure 158: Ramsey Rd. Outlet at Box Culvert, Annual Sediment Overflow

Figure 159: Pomerene Rd. Box Culvert and Dike Failure

Figure 160: Pomerene Rd. Box Culvert Inlet Overflow

Figure 161: Pomerene Rd. Grade Control Dike is Broken and Ready to Fall

Figure 162: Pomerene Rd. Box Culvert is Broken at Both Edges of the Inlet

Figure 163: Pomerene Rd. Box Culvert is Broken at Both Edges of the Inlet

Figure 164: Pomerene Rd. Channel Wider than Box Culvert, Outlet Overflow

PROJECT B- INTERSTATE 10 WB @ MP 306.9 – SAN PEDRO RIVER BRIDGE

Project Description: Water flows running off from the median to the shoulder on a steep embankment slope where a 24-inch CMP drainage pipe is exposed and is suspended in air. There is an opportunity to combine this project with Project A.

How long has this been a concern? At least five years.

Has the problem led to road closures? No

District Priority (if identified): #2

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. Slope washout
d. Poor soil conditions
e. **Undersized infrastructure**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Sandy soil/scour protection and embankment scour protection/outlet protection are needed, and the 24-inch CMP needs to be replaced with 36-inch CMP.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 165: Southcentral District Project B

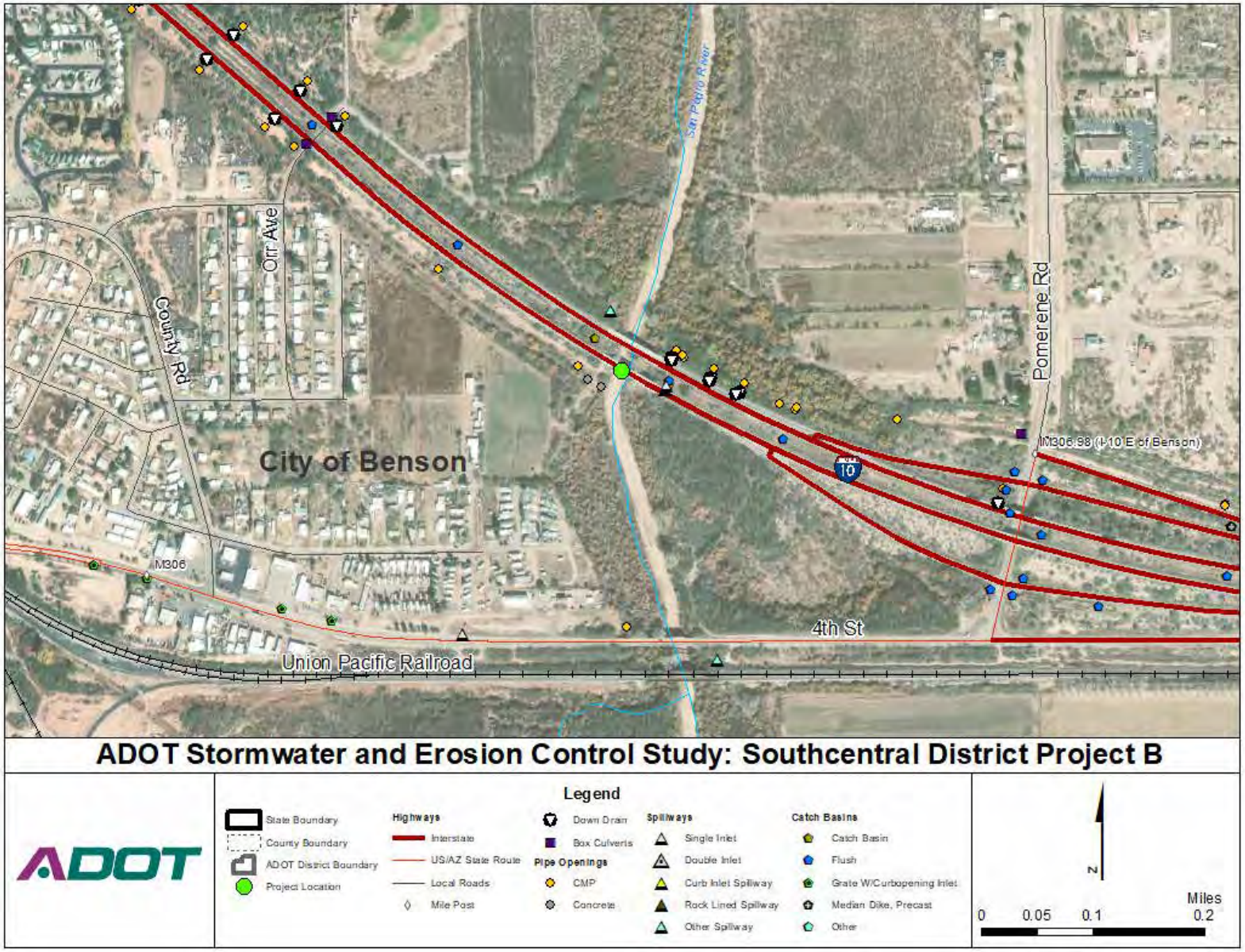


Figure 166: MP 306.87 –12" Drainage Pipe

Figure 167: MP 306.87 Erosion.

Figure 168: MP 306.9 24" Drainage Pipe

Figure 169: MP 306.9 Erosion

PROJECT C- SR 80 SB @ MP 306.079

Project Description: Erosion behind wingwall at box culvert left side wingwall at outlet is detaching. At inlet of box culvert there is erosion at slopes prior to wingwall. Issue is somewhat severe but has not caused water or debris to be on roadway (FIS Asset ID – 1560729).

How long has this been a concern? At least five years.

Has the problem led to road closures? No

District Priority (if identified): #1

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. Slope washout
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Replace wingwall and regrade erosion. Add grouted rip rap at inlet and outlet side of box culvert. Consider adding gabions on inlet side of box culvert.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. Extend facility life span

Figure 170: Southcentral District Project C

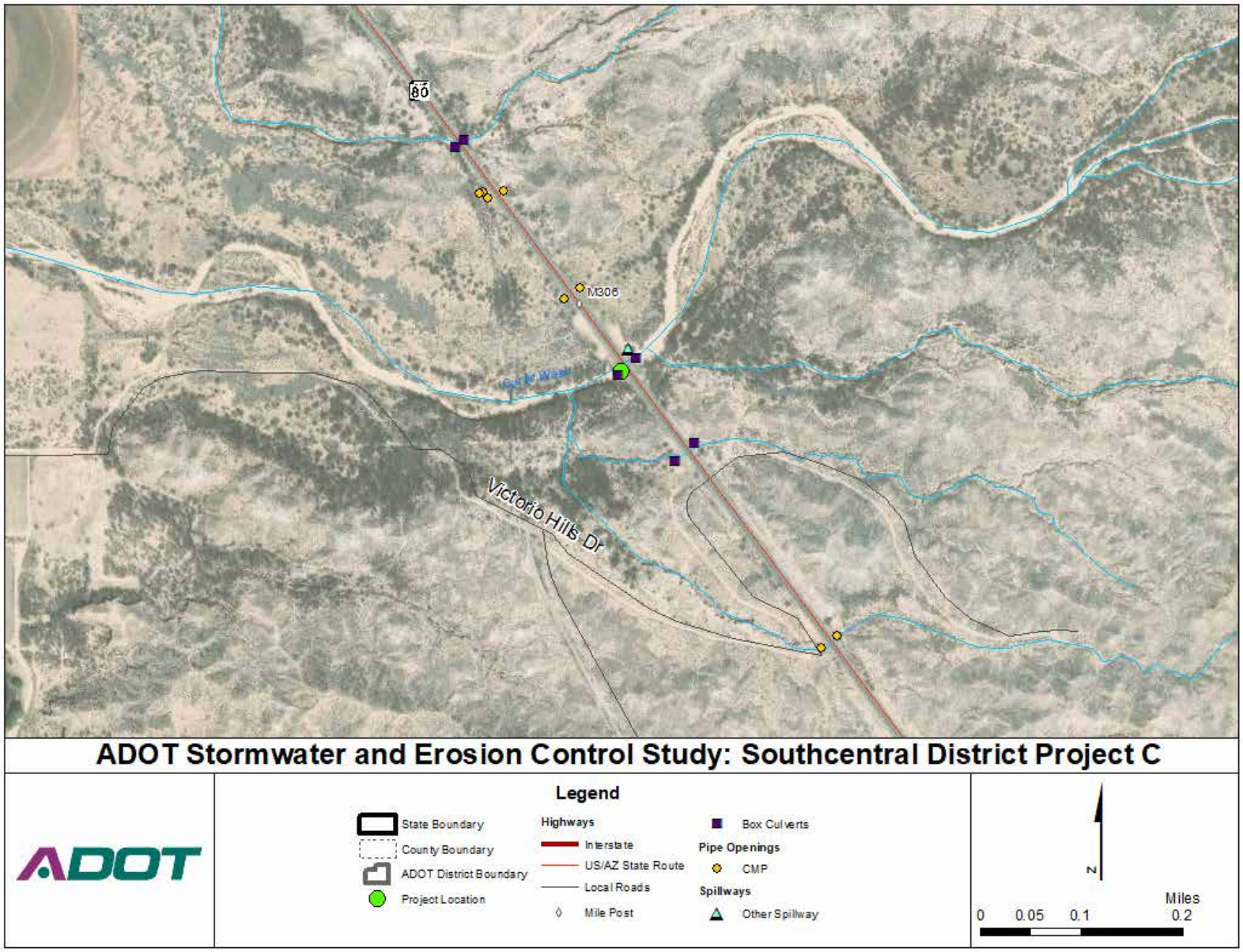


Figure 171: Outlet Box Culvert Wingwall Erosion

Figure 172: Outlet Box Culvert Wingwall Erosion

Figure 173: Outlet Box Culvert Wingwall Erosion

Figure 174: Outlet Box Culvert Wingwall Erosion

PROJECT D- SR 386 @ MP 4.37, 6.05, 6.58, 7.5 AND 11.1

Project Description: All locations can essentially be described as having catch basins plugged with debris and sediment and/or undersized pipes. Some locations are subject to falling rocks contribute to the problem. More specifically, at MP 7.5 the catchment has plugged in the past and overtopped the road eroding the opposite shoulder, at MP 11.1 the catchment has plugged in the past and overtopped the road eroding the opposite shoulder, at MP 4.37, 6.05, 6.58 the outlet is undiscoverable, possibly buried, at MP 6.05 the pipe requires hydrovacing. These stormwater issues were identified in the ADOT Low Volume Route Study in 2017.

How long has this been a concern? Not sure due to new maintenance staff not having a complete historical understanding of the problem.

Has the problem led to road closures? Yes, but unsure of frequency.

District Priority (if identified): #4

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. Facility overtopping or embankment protection
c. Slope washout
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: CMP's at all locations are undersized and need to be replaced with larger CMP's or box culverts. Persistent hydrovacing of the pipes does not improve the condition and a series of construction projects that include reconstruction with larger pipes is recommended. The inlets and outlets of the pipes need protection, perhaps with routed rip rap or gabions.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. Environmental benefit
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. Extend facility life span

Figure 175: Southcentral District Project D

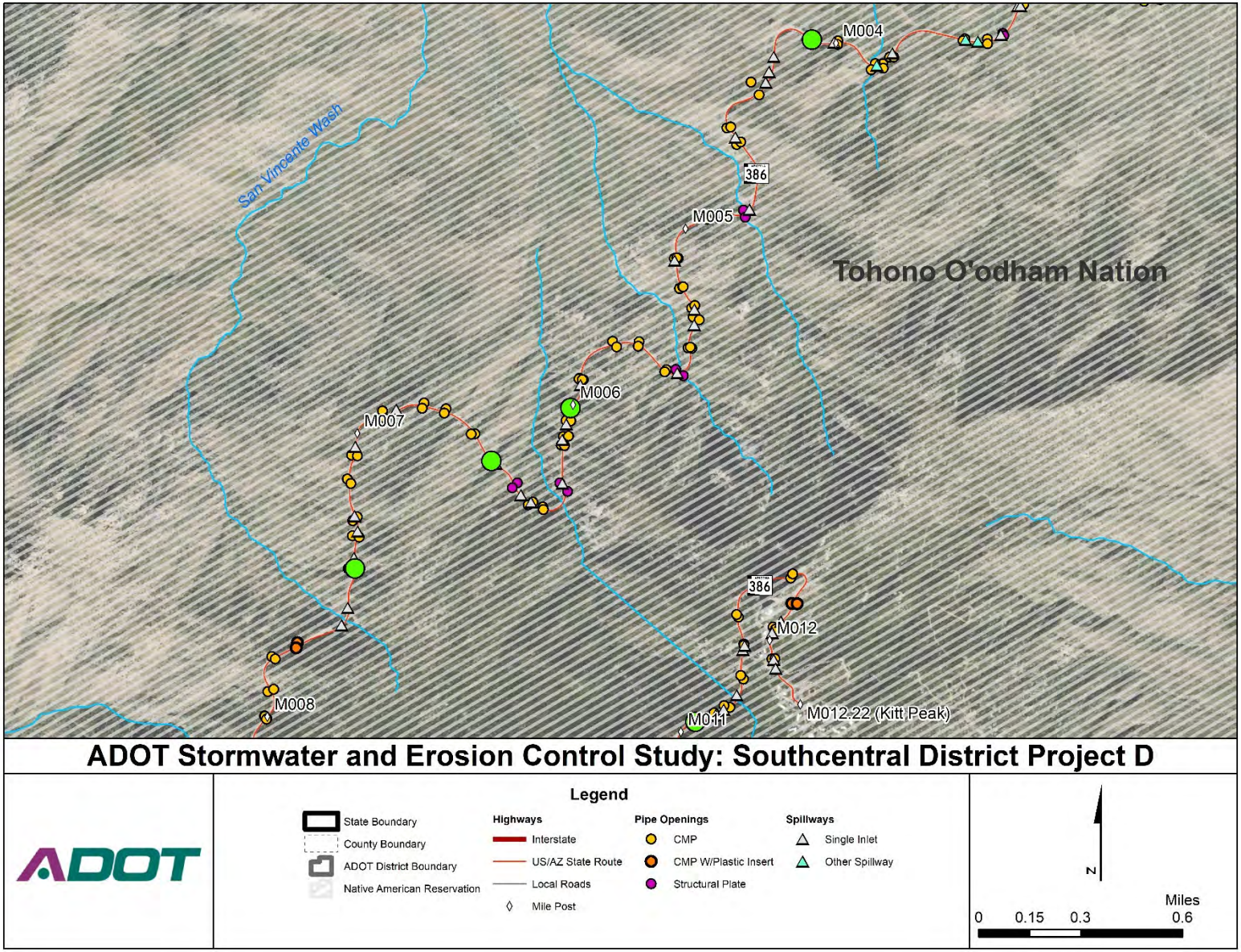


Figure 176: Southbound, Eastern View (MP 7)

Figure 177: Southbound, Rear View (MP 6)

Figure 178: Southbound, Eastern View (MP 4)

PROJECT E- INTERSTATE 10, EB AND WB @ MP 289.41 – 291.70

Project Description: Located at Marsh Station Rd. in proximity to an existing UPRR bridge, where the embankments of Marsh Station Rd. and the UPRR experience scour and erosion. There is significant erosion concern on the embankment slopes, but not at the piers of the bridge. Over $1 million was spent on a project completed in 2012 under H23901C, but now likely needs a second phase to address erosion problems on slopes for the ramps, Marsh Station Rd. and UPRR slopes.

How long has this been a concern? 7 years +

Has the problem led to road closures? No, but water has been found on the roadway and has the potential to worsen without proper mitigation.

District Priority (if identified): #5

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: The slope needs to be stabilized. Evaluate the potential use of adding riprap, regrade slope, mini bench, and or wattles.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 179: Southcentral District Project E

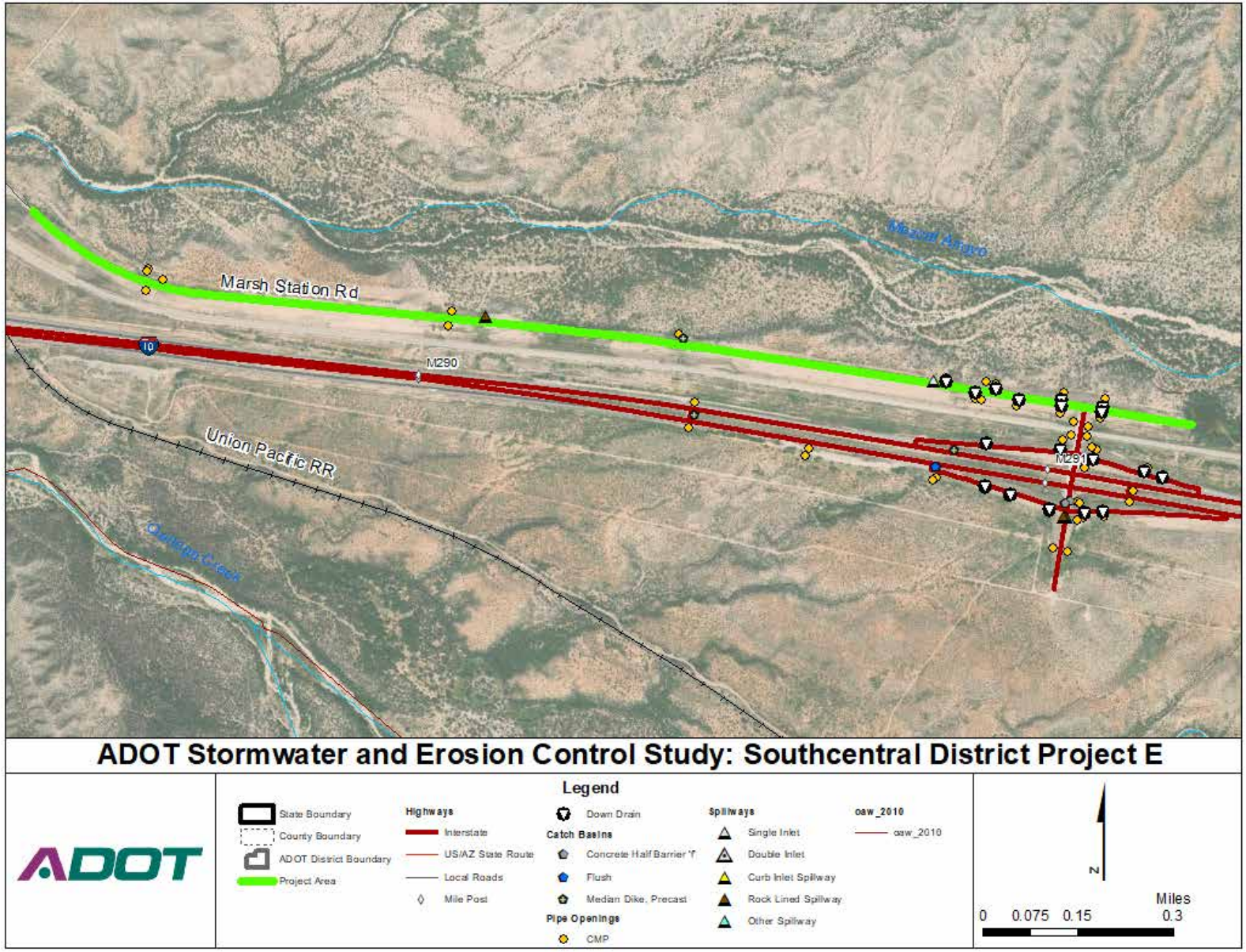


Figure 180: Westbound, Northern View (MP 290)

Figure 181: Westbound, Northern View (MP 289)

Figure 182: Westbound, Northern View (MP 289)

PROJECT F- INTERSTATE 19 @ MP 8.9 – 9.1

Project Description: There is erosion and scour on the slopes of both sides of I-19 and frontage road roadway embankment. These are steep slopes, and the erosion is severe enough that the guardrail and right-of-way fence is suspended in air.

How long has this been a concern? 10 to 15 years

Has the problem led to road closures? No

District Priority (if identified): #3

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. **Poor soil conditions**
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Potential mitigation to consider should include re-grading the slope, adding embankment curb to direct water to an added spillway and use grouted riprap for inlet and outlet support.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. Environmental benefit
d. **Relief to District budget and/or resources**
e. Meets District or ADOT strategic objective
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 183: Southcentral District Project F

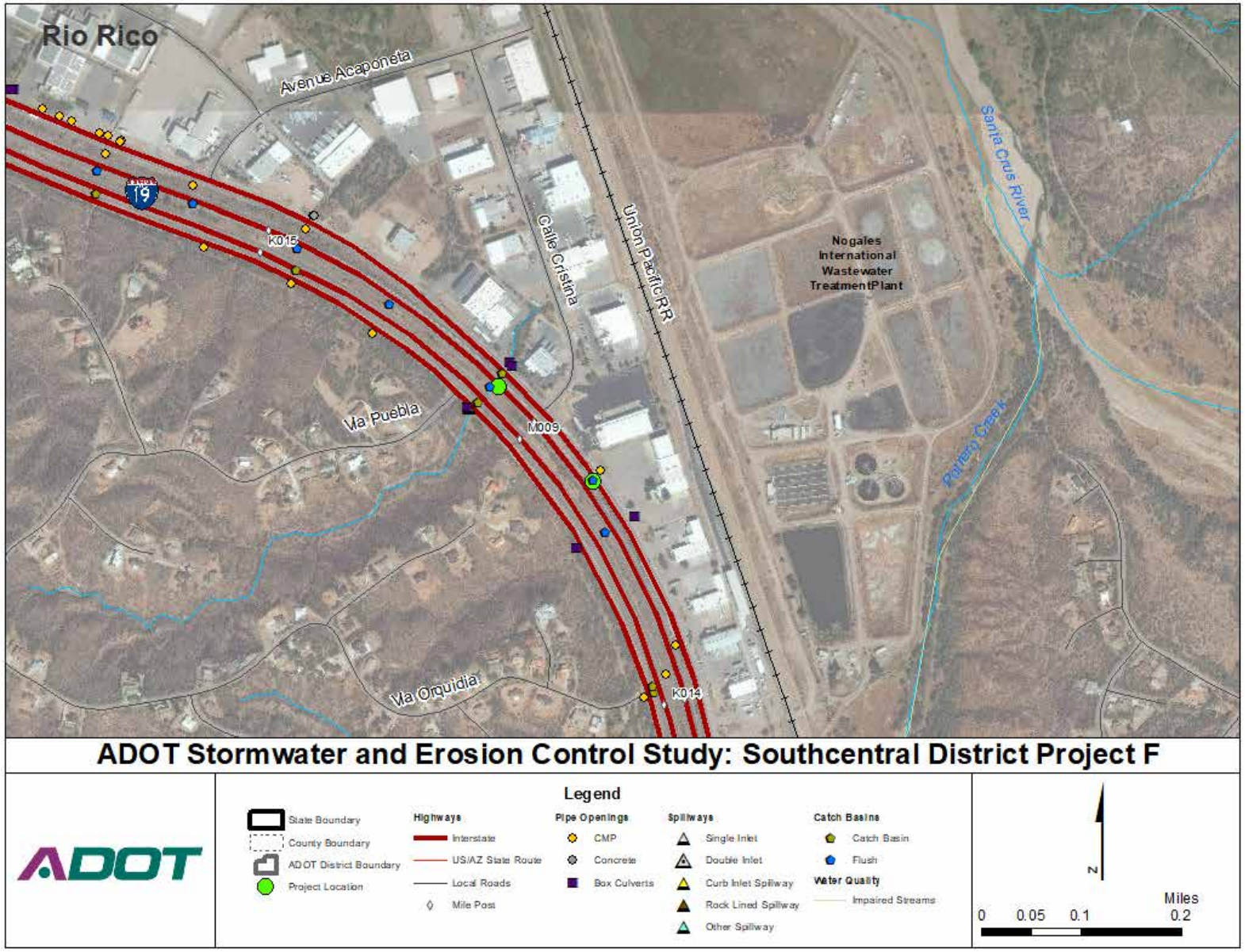


Figure 184: Slope Erosion at MP 8.9-9.1

Figure 185: Slope Erosion

Figure 186: Slope Erosion

SOUTHEAST DISTRICT

Table 7 identifies the initial listing of potential stormwater projects identified by representatives of the Southeast District.

Table 7: Southeast District Stormwater Projects

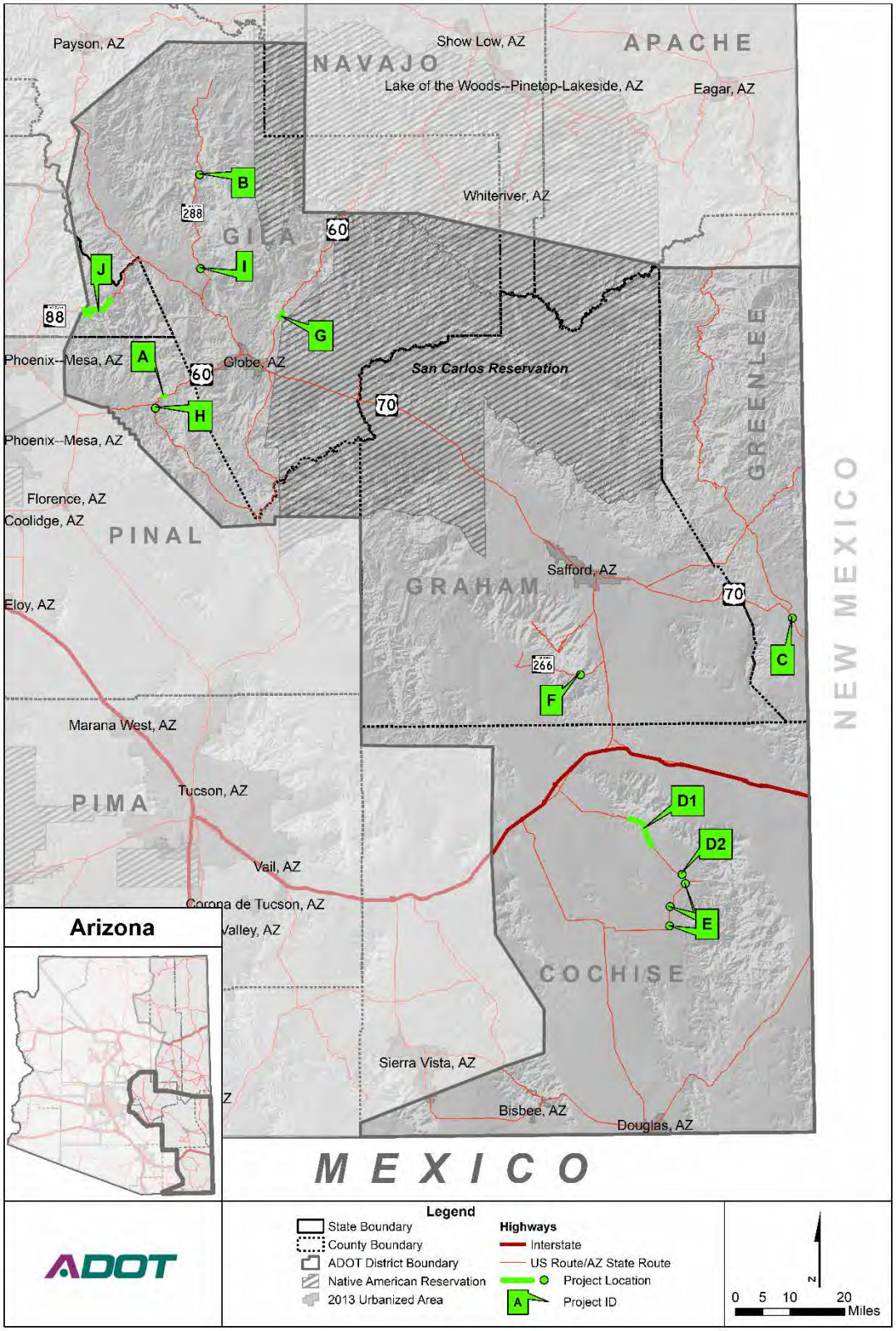
Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
A	US 60	229.2 to 229.45	Stormwater will not drain at bridge and overtops roadway resulting in erosion.	Construction
B	SR 288	289	Stormwater overtops roadway resulting in erosion.	Construction
C	US 70	380.46	Channel sedimentation, overtopping by railroad.	Construction
D	SR 186	343-350 & 358, Wilcox to Kansas Settlement	Low water crossings.	Construction
E	SR 181	51, 55 & 60	Low water crossings.	Construction
F	SR 266	210, Gillespie Wash	Outlet scour protection.	Construction
G	US 60	262-263	Embankment flumes scoured out needing reconstruction.	Construction
H	SR 177	166.7	Significant erosion on outlet side of 48-inch CMP.	Construction
I	SR 288	265.3	Culvert restoration of undersized aged structure.	Construction
J	SR 88	220.2 - 229.2	Culvert restoration.	Construction
_	I-10B	355 TI SE quadrant frontage & Page Ranch Road	Flooding and erosion.	Maintenance
_	SR 366	Above Shannon	Perennial overtopping and embankment scour.	Maintenance
_	US 60	Oak Flat to Truck Escape Ramp	Embankment scour protection, additional culverts and/or inlet/outlet protection.	Maintenance

Project Identifier	Route	MP	Issue	Construction/ Maintenance[1]
–	US 191	Cochise and Sunsites Areas	Overtopping.	Maintenance
–	SR 280	Washington Ave Intersection	Overtopping.	Maintenance

1 For this column, the term "Construction" applies to both construction and preventative maintenance, therefore these projects qualify for this study. The term "Maintenance" applies to routine maintenance only, therefore these projects do not qualify for this study and no further details are provided.

As **Table 7** indicates, the Southeast District submitted a total of fifteen (15) potential stormwater projects. After the District phone interviews, the Southeast District feels that ten (10) of the submitted projects meet the definition of a "construction" or "preventative maintenance" project. These construction projects are described below.

Figure 187: Southeast District & Project Locations



PROJECT A- US 60 @ MP 229.2 – 229.45

Project Description: During and after rain events the water runs to the west, the water will not drain into Waterfall Canyon at Waterfall Canyon Bridge on the northeast corner of the bridge. The rock slope is butted up next to the barrier wall (no channel to drain the flows) therefore the water runs across the bridge and back into the cut ditch instead of into the canyon under the bridge. At approximately MP 229.2 the water runs back across the road from north to south due to a super elevation in the road. As a result, the guard rail, edge of pavement and the slope along the south side of road wash out during heavier rain events.

How long has this been a concern? 5 years +; since the Waterfall Bridge was built.

Has the problem led to road closures? Yes, several times during the year, but mostly during large storm events. ADOT clears water and rocks off the roadway.

District Priority (if identified): #1

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. **Improper construction/installation – bridge with no channel into canyon below. Plan to replace bridge is in ADOT 5-year plan; no TRACS number identified yet.**
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: The rock slope needs to be recessed or altered so that the water can drain into the canyon and under the bridge.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 188: Southeast District Project A

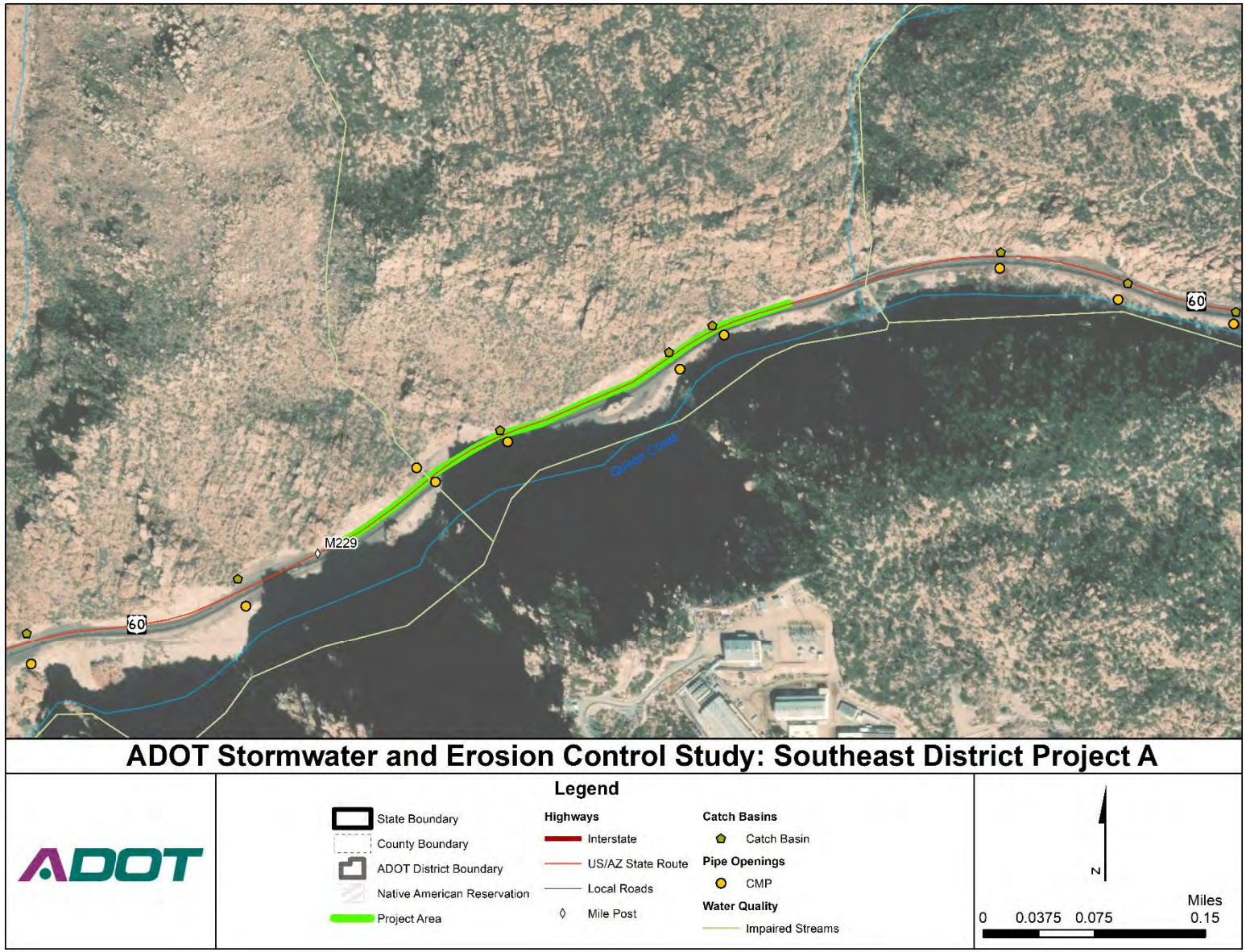


Figure 189: Westbound, Northern View (MP 229)

Figure 190: Eastbound, Southern View

Figure 191: Eastbound, Rear View

PROJECT B- SR 288 @ MP 289

Project Description: Experiencing severe head-cutting and erosion in this downhill grade, windy roadway area. It is suspected that additional stormwater flows are caused from an upgradient rock mitigation project in 2015 (laid the slope back, widened road, increased ditch size) that resulted in an increased impermeable catchment area (slope is made of rock). The additional stormwater volume has repeatedly overwhelmed the carrying capacity of the 3,000 linear feet of cut ditch leading to culvert that repeatably overtops and head cuts across road eroding fill slope of the cut ditch by approximately 20-feet (the invert of the culvert is higher than the cut ditch draining to it). ADOT has recently replaced the 24-inch culvert with a 36-inch culvert and is awaiting to see if that solution helps mitigate the problem. However, there are no headwalls to channel the water to the culvert and erosion is increasing the depth of the cut ditch.

How long has this been a concern? 4 to 5 years since the previous construction project. Exposed rock slope does not dissipate water and no percolation is occurring. Volume and velocity are increasing.

Has the problem led to road closures? No

District Priority (if identified): #5

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. Poor soil conditions
e. **Undersized infrastructure**
f. **Improper construction/installation – Not entirely, but "old facilities don't match new construction".**
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Test depth to bedrock and strength to determine final location of inlet catch basin (needs to be hammered out): May need to install a squash CMP from head wall to 20' section in order to reduce bedrock excavation for adequate burial depth: Install two-24-inch CMPs (squashed) in two-20-foot sections: Build head wall apron with rock debris grate and install outfall scour protection grouted boulder apron to the toe of the fill slope.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 192: Southeast District Project B

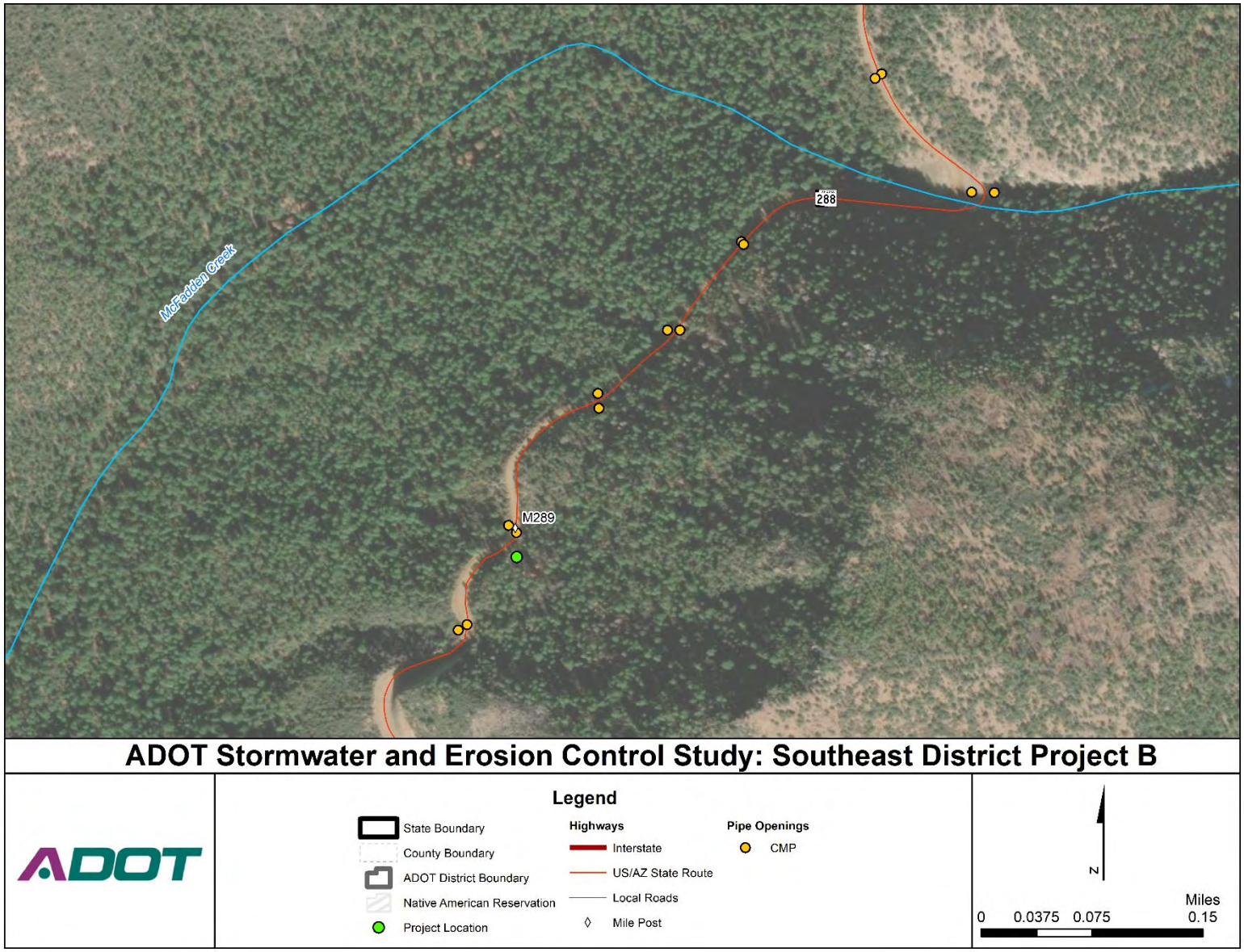
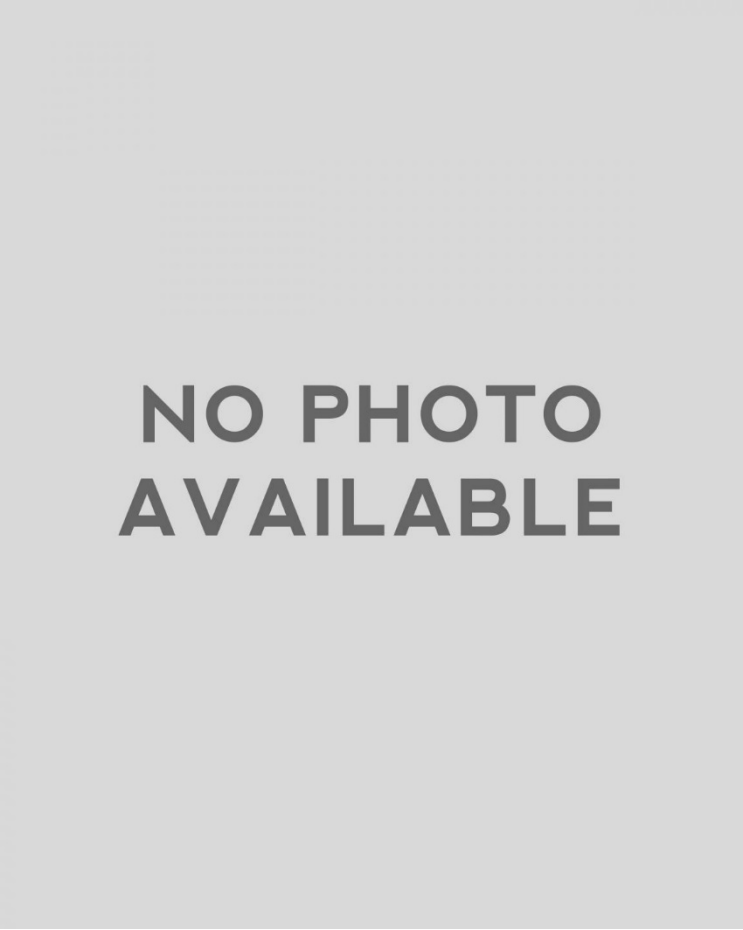


Figure 193: Images Pending (No ADOT imagery available)



PROJECT C- US 70 @ MP 380.46

Project Description: Existing box culverts are not sized to handle the volume of water that flows through this area. There is very limited space (perhaps only 2-feet) for water to get through the box culvert, as well as sedimentation of the existing channel. Approximately ¼-mile to the west, there is an above grade railroad crossing where the water is overtopping US 70, and nearby houses will flood at times.

How long has this been a concern? 20-30 years

Has the problem led to road closures? Yes, multiple times, but not recently.

District Priority (if identified): #4

Characteristics of the Problem:

a. Failed stabilization/erosion control
b. **Facility overtopping or embankment protection**
c. Slope washout
d. Poor soil conditions
e. **Undersized infrastructure**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Considerations include raising the roadway embankment, constructing a taller box culvert, and/or raising the road profile.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 194: Southeast District Project C

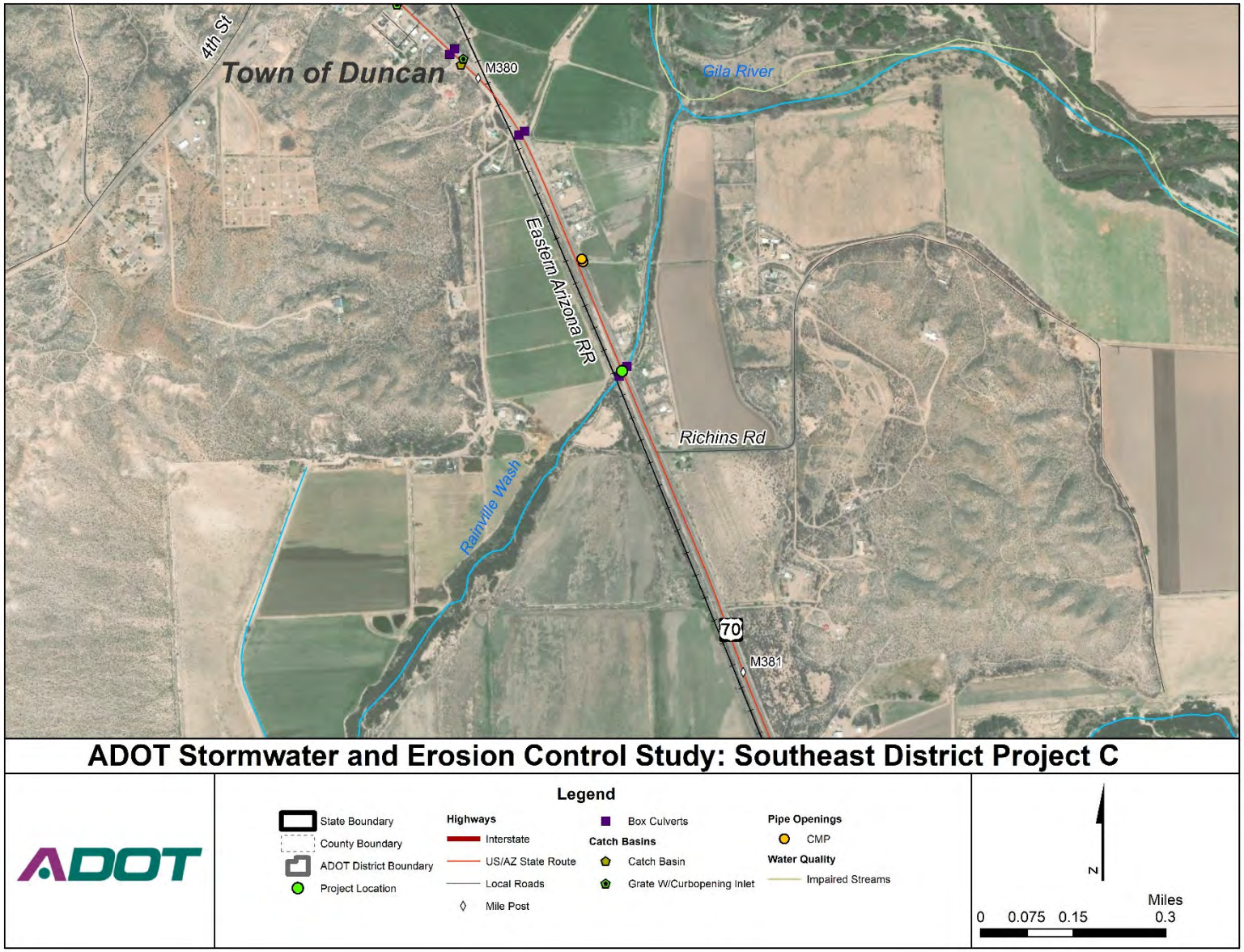


Figure 195: Northbound, Eastern View (MP 380)

Figure 196: Southbound, Western View

Figure 197: Northbound, Rear View

PROJECT D- SR 186 @ MP 343.83, 344.11, 344.60, 345.07, 345.46, 346.65, 347.87, 348.24, 348.96, 349.47

Project Description: This project consists of 10 low water crossings along SR 186 between Wilcox and Kansas Settlement. Each of these locations can be characterized as dip sections in the roadway where stormwater flows are designed to overtop the roadway and discharge to its natural drainage pattern. Each location is experiencing erosion and scour of the roadway embankment and structural degradation of the roadway shoulder, pavement and pavement edge, particularly on the outlet side of the roadway. This extent of this project is depicted in **Figure 198** and **Figure 199**.

How long has this been a concern? 30 years +, since the road was constructed.

Has the problem led to road closures? Yes, closures are common during heavy events during monsoon season.

District Priority (if identified): #8

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Embankment protection needed to mitigate erosion. Mitigation measures to consider include; replace asphalt low water crossing with concrete for enhanced resiliency, use grouted rip rap on the outlet side of roadway, alter the road profile and add culverts at crossing locations.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 198: Southeast District Project D1

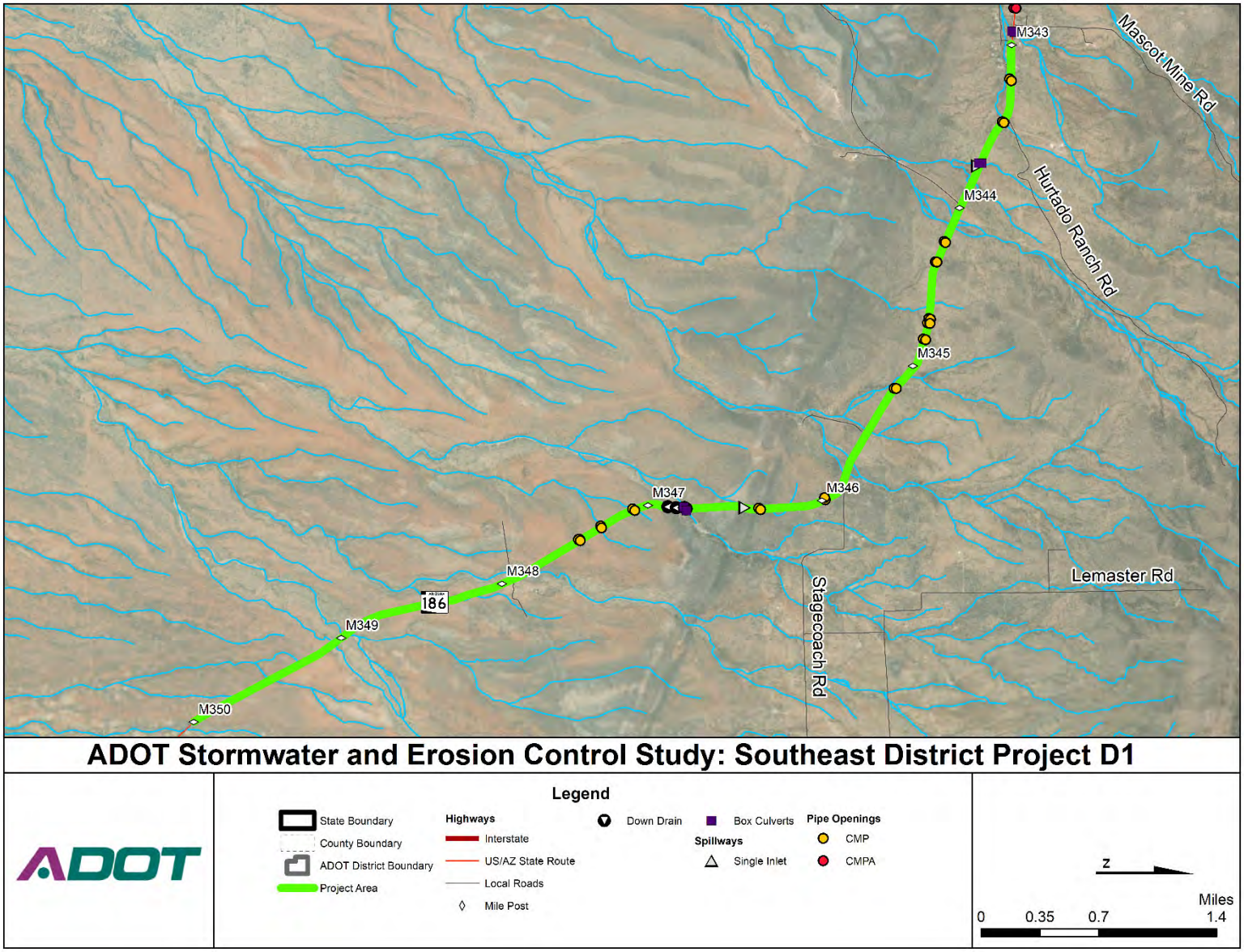


Figure 199: Southeast District Project D2

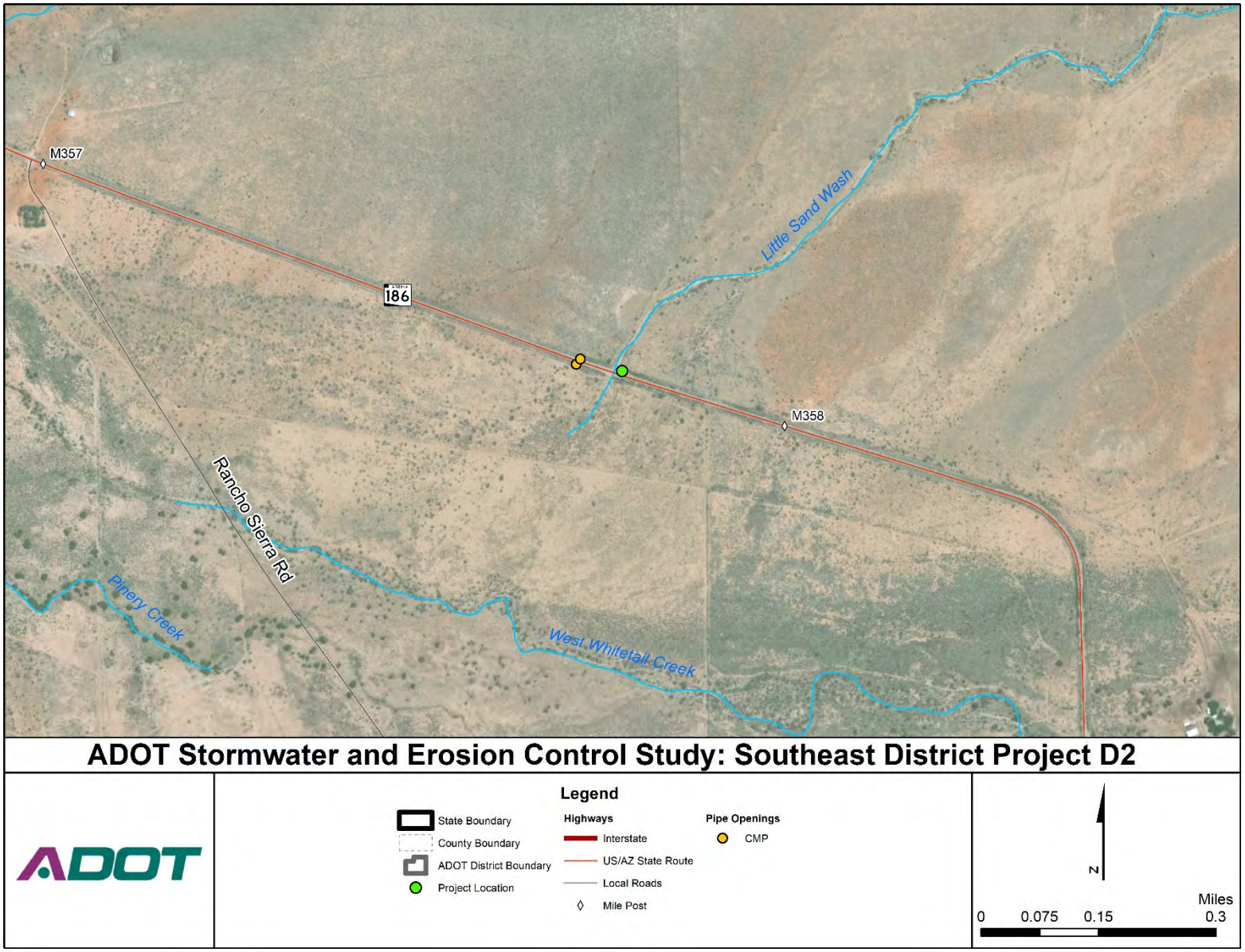


Figure 200: Northbound, Rear View (MP 343)

Figure 201: Southbound, Rear View (MP 343)

Figure 202: Northbound, Rear View (MP 358)

PROJECT E- SR 181 @ MP 51, 55 AND 60

Project Description: This project consists of 3 low water crossings along SR 181 where each of these locations has a dip section in the roadway where stormwater flows are designed to overtop the roadway and discharge to its natural drainage pattern. Each location is experiencing erosion and scour of the roadway embankment and structural degradation of the roadway shoulder, pavement and pavement edge, particularly on the outlet side of the roadway.

How long has this been a concern? 10 years +

Has the problem led to road closures? No

District Priority (if identified): #9

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Embankment protection is needed to mitigate erosion. Mitigation measures to consider include; replace asphalt low water crossing with concrete for enhanced resiliency, use grouted rip rap on the outlet side of roadway, alter the road profile and add culverts at crossing locations.

Likely Project Benefits:

a. **Public safety**
b. Regulatory mandate
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 203: Southeast District Project E

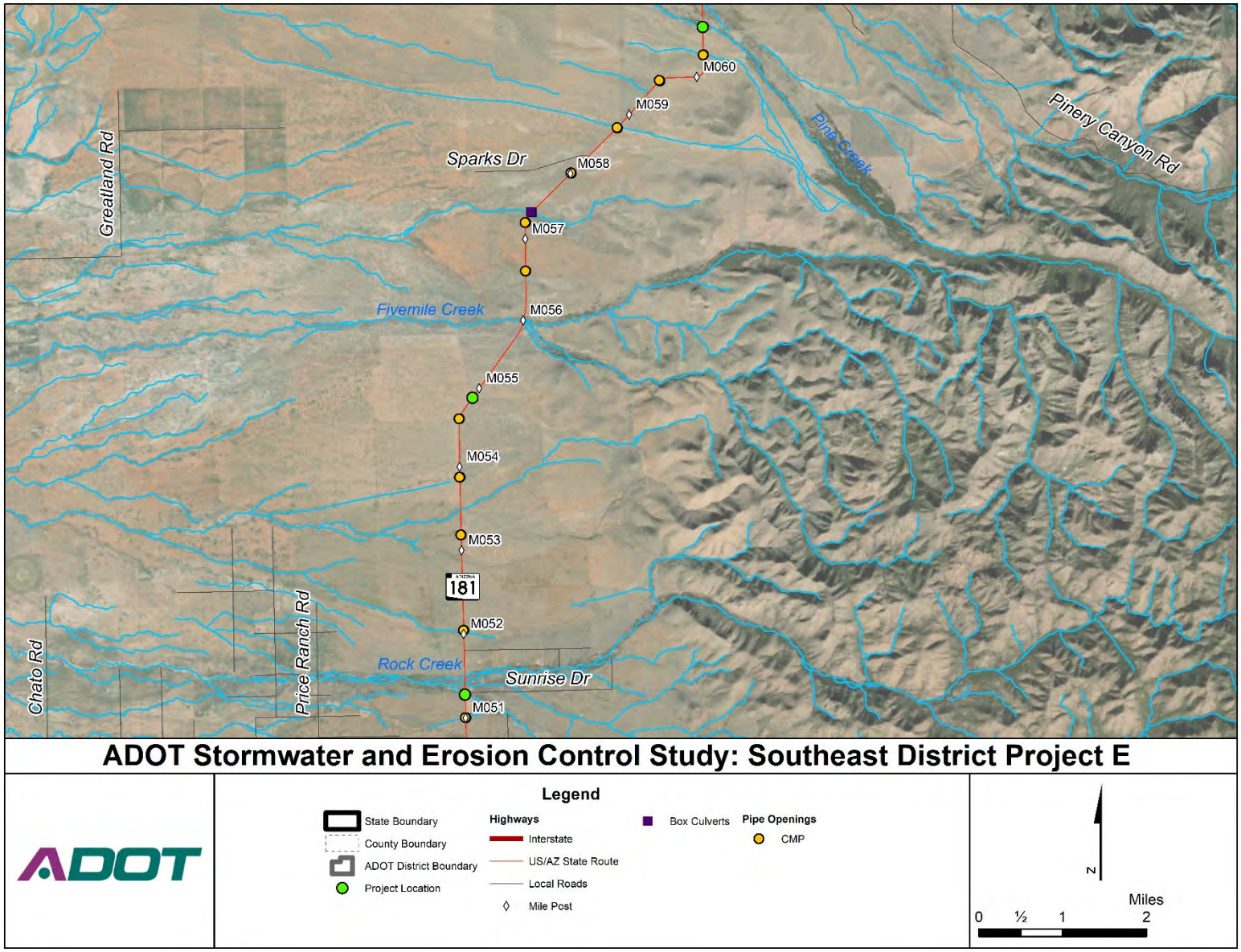


Figure 204: Northbound, Rear View (MP 51)

Figure 205: Northbound, Rear View (MP 55)

Figure 206: Southbound, Rear View (MP 60)

PROJECT F- SR 266 @ MP 210

Project Description: The existing 4 to 5 box culverts at this Gillespie Wash location have scour and erosion of the roadway embankment at the outlet side of the box culverts. The capacity of the box culverts appears to be sufficient as there is no overtopping or effects of scour at the inlet side of the box culverts. The velocity of the flows at the outlet side is causing a cutting/erosion effect on the west side (outlet side) of the roadway embankment.

How long has this been a concern? At least 3 years, but likely longer. Issue also identified in the ADOT Low Volume Route Study in 2016.

Has the problem led to road closures? No

District Priority (if identified): #10

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Bank and scour protection on outlet side of the box culverts. Consider application of rail bank protection and/or grouted rip rap at culvert outlet.

Likely Project Benefits:

a. Public safety
b. Regulatory mandate
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. Meets District or ADOT strategic objective
f. Reduction/mitigation in flooding or hazard
g. **Extend facility life span**

Figure 207: Southeast District Project F

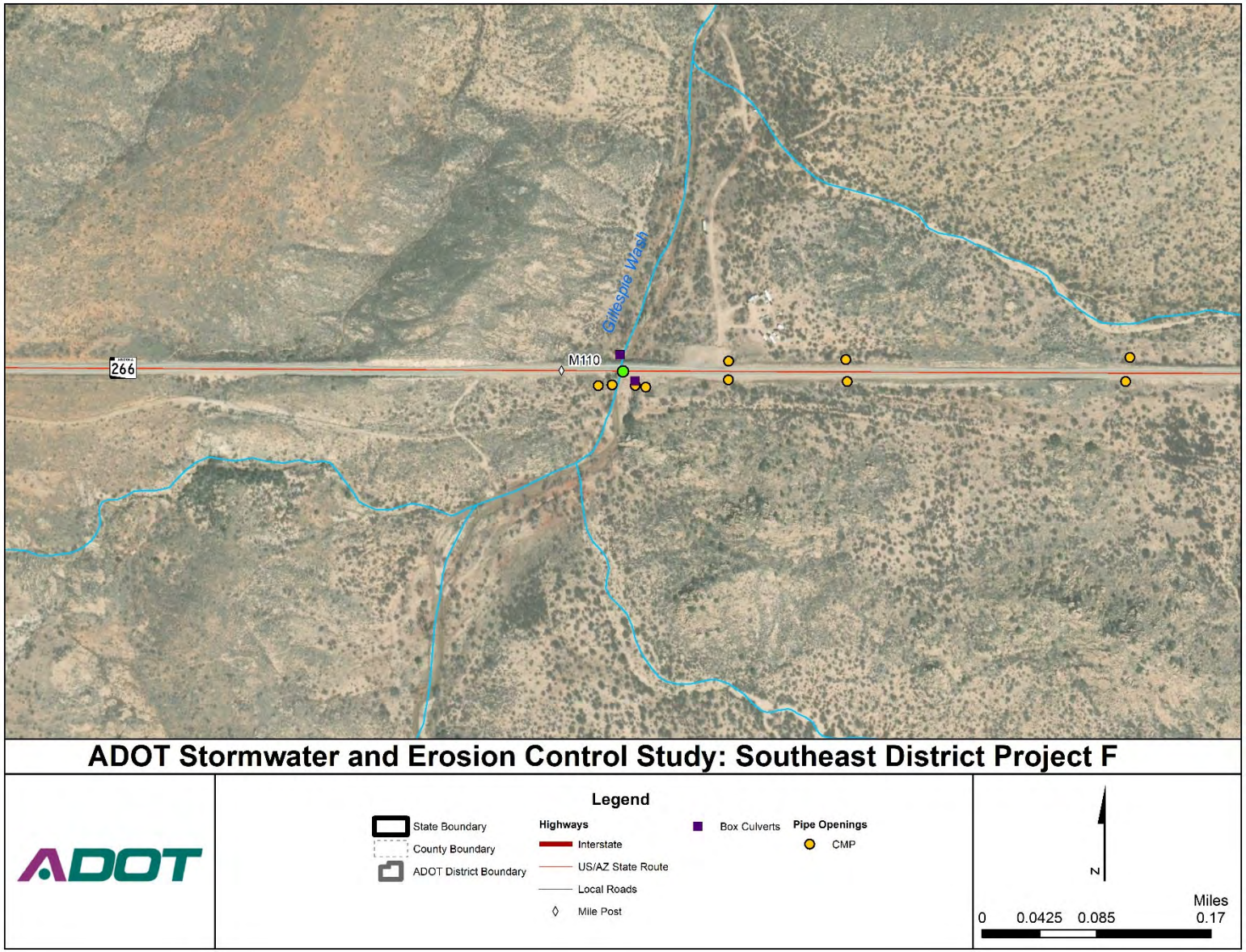


Figure 208: Westbound, Rear View (MP 110)

Figure 209: Eastbound, Rear View

Figure 210: Eastbound, Southern View

PROJECT G- US 60 @ MP 262 - 263

Project Description: This roadway segment contains a considerable fill area. There are a series of inlets, down drains and outlets at 4 to 5 locations in this mile-long road segment that are not functioning properly causing slope rutting/erosion of the roadway embankment. It appears that the inlets are either broken or eroded (or not constructed properly) causing water to not properly go to the down drains, spilling over onto the embankment where the erosion/rutting is occurring.

How long has this been a concern? 10 years +

Has the problem led to road closures? No

District Priority (if identified): #3

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. **Improper construction/installation**
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Inlets need to be rebuilt and install grouted rip rap at outlets.

Likely Project Benefits:

a. Public safety
b. **Regulatory mandate**
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 211: Southeast District Project G

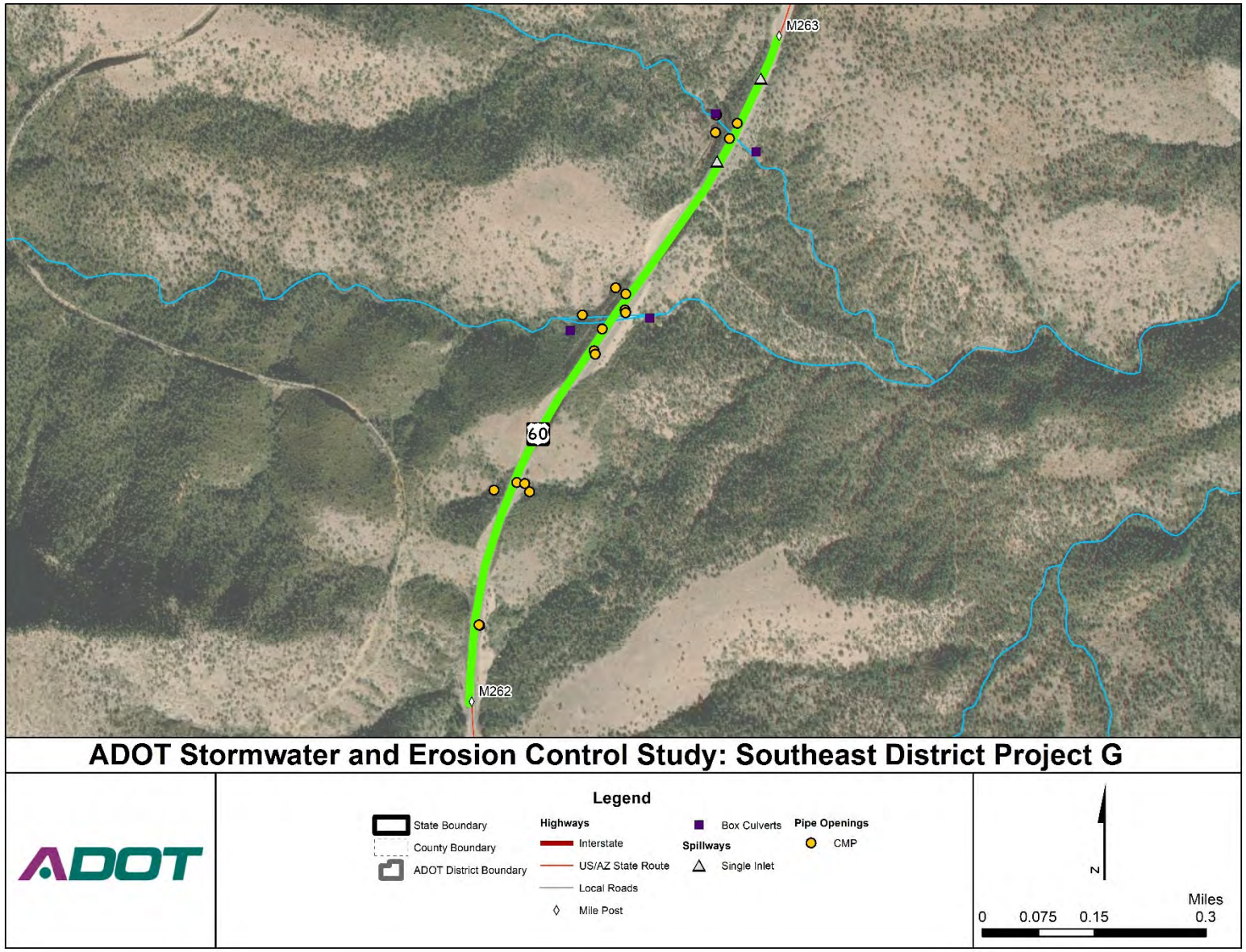


Figure 212: Field Photo 1 (Provided by ADOT)

Figure 213: Field Photo 2 (Provided by ADOT)

Figure 214: Field Photo 3 (Provided by ADOT)

PROJECT H- SR 177 @ MP 166.7

Project Description: This location has a 48-inch CMP that is experiencing significant erosion of the roadway embankment on the outlet side. There is no protection on the outlet side. The inlet side is difficult to access and is covered with dense vegetation.

How long has this been a concern? 10 years +

Has the problem led to road closures? No

District Priority (if identified): #6

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. Facility overtopping or embankment protection
c. **Slope washout**
d. Poor soil conditions
e. Undersized infrastructure
f. **Improper construction/installation**
g. **Additional negative impacts downstream**
h. Other

Possible Mitigation/Solution: Protect culvert and reduce erosion by installing an end section that could include grouted rip rap. Also consider an energy dissipater to reduce outlet velocities that could cause additional scour/erosion of the roadway embankment.

Likely Project Benefits:

a. Public safety
b. **Regulatory mandate**
c. **Environmental benefit**
d. Relief to District budget and/or resources
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 215: Southeast District Project H

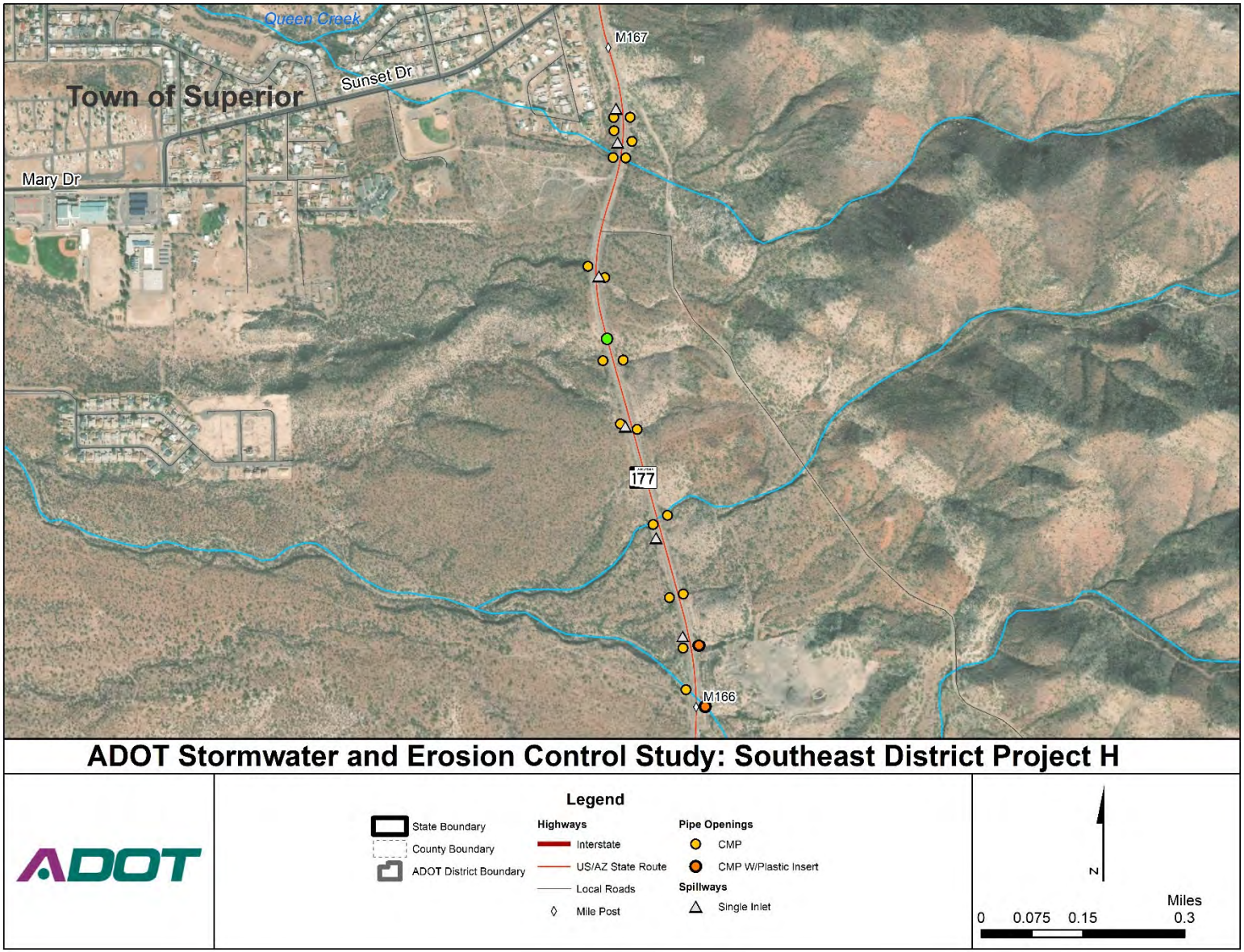


Figure 216: Field Photo (Provided by ADOT)

Figure 217: Southbound, Western View (MP 166)

Figure 218: Southbound, Rear View

PROJECT I- SR 288 @ MP 265.3

Project Description: The existing culvert at this location is undersized for receiving flows, causing the roadway to be overtopped and erosion of the roadway embankment.

How long has this been a concern? 10 years +

Has the problem led to road closures? Yes, but not recently.

District Priority (if identified): #7

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. Poor soil conditions
e. **Undersized infrastructure**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Evaluate proper culvert sizing, install a larger culvert(s) and reinforce stability with grouted rip rap on inlet and outlet sides of the box culvert.

Likely Project Benefits:

a. **Public safety**
b. **Regulatory mandate**
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 219: Southeast District Project I

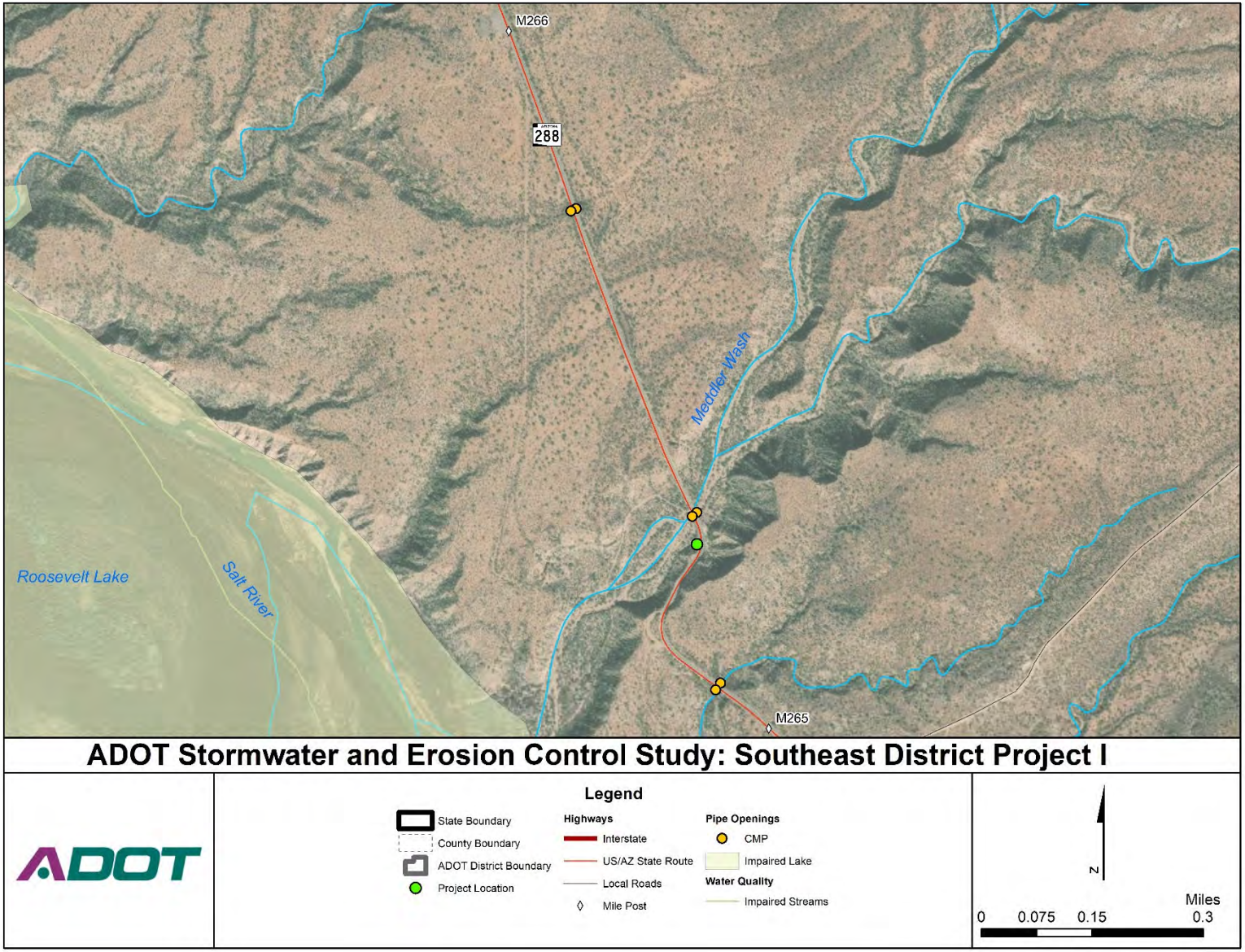


Figure 220: Field Photo (Provided by ADOT)

Figure 221: Southbound, Western View (MP 265)

Figure 222: Northbound, Rear View

PROJECT J- SR 88 @ MP 220.2 – 229.2

Project Description: Within this 9-mile segment of roadway, there are multiple culvert locations that are aged and undersized. These existing culverts cannot handle the volume and velocities of flows, thus causing overtopping of the roadway and embankment erosion/washout at multiple locations. This urgency of this historical condition is now exacerbated by the recent wildfire in the area and the anticipated flooding that will occur as a result. ADOT has this entire section of roadway currently closed due to critical safety concerns.

How long has this been a concern? 10 years +; ADOT maintenance staff historically uses a considerable amount of their resources at this location(s).

Has the problem led to road closures? Historically yes, many occasions. Road now closed to public due to anticipated flooding resulting from wildfire runoff.

District Priority (if identified): #2

Characteristics of the Problem:

a. **Failed stabilization/erosion control**
b. **Facility overtopping or embankment protection**
c. **Slope washout**
d. Poor soil conditions
e. **Undersized infrastructure**
f. Improper construction/installation
g. Additional negative impacts downstream
h. Other

Possible Mitigation/Solution: Evaluate proper culvert sizing, enlarge culvert sizing at all locations, install headwalls and grouted rip rap on outlet side of the culverts.

Likely Project Benefits:

a. **Public safety**
b. **Regulatory mandate**
c. **Environmental benefit**
d. **Relief to District budget and/or resources**
e. **Meets District or ADOT strategic objective**
f. **Reduction/mitigation in flooding or hazard**
g. **Extend facility life span**

Figure 223: Southeast District Project J

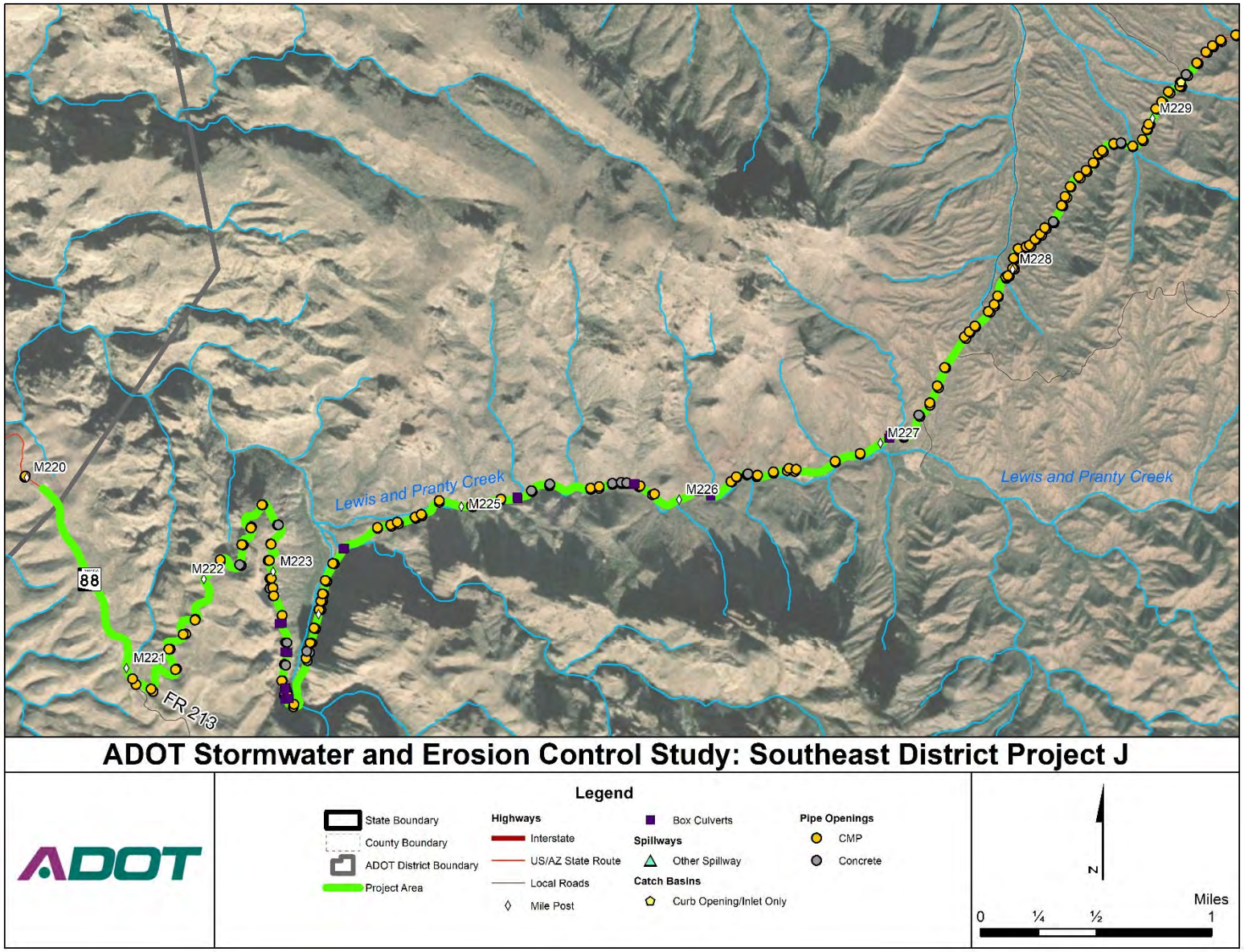


Figure 224: Westbound, Rear View (MP 220)

Figure 225: Eastbound, Southern View

Figure 226: Westbound, Northern View

IV. NEXT STEPS

The next steps in the ADOT Stormwater & Erosion Control Study include the following:

1. Continued data collection of existing MS4s with adjacency to ADOT facilities in urbanized areas.
2. Conduct TAC meeting #2 to review the contents of Working Paper #1. This meeting is scheduled for Tuesday, September 10th.
3. Develop draft evaluation criteria, weighting and model tool.