

Roadway Engineering Group

Infrastructure Delivery and Operations Division

*Designing, Supporting & Delivering
ADOT's Roadway Projects*

*Michael DenBleyker, P.E.
Roadway Group Manager
State Roadway Engineer*



Roadway Design – What is Needed?

What is the Project Need & Objective?

What are the Existing Conditions?

Environmental

Utilities

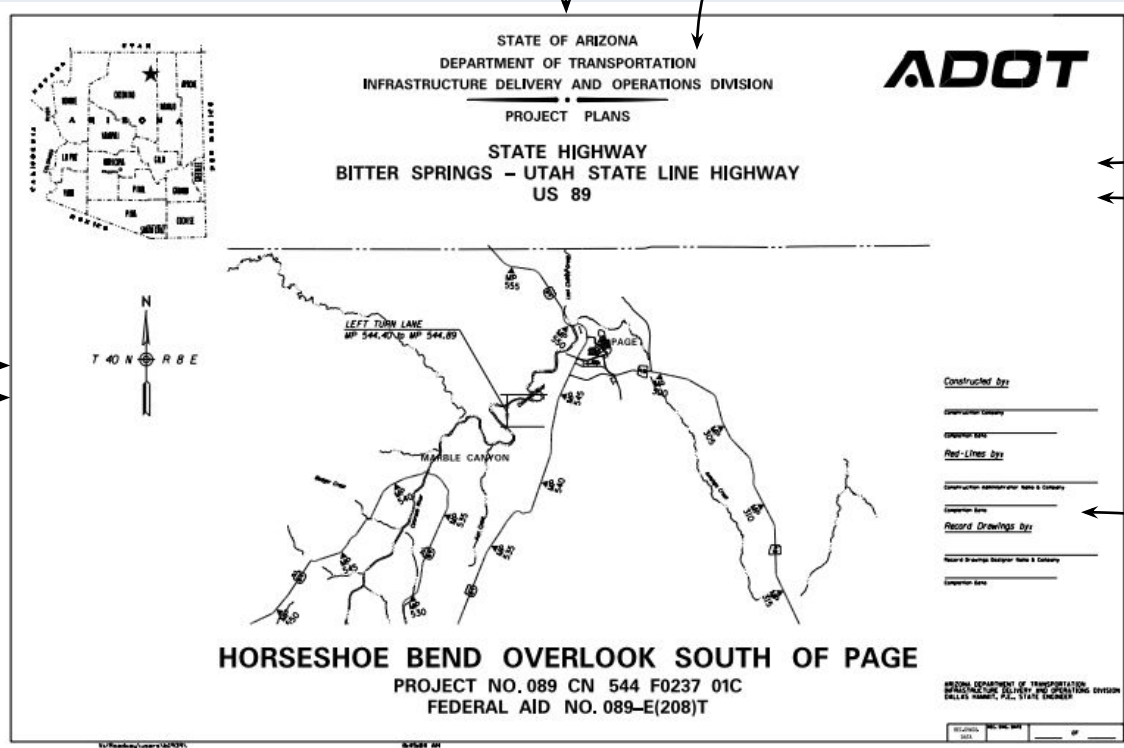
Are there Safety Considerations?

What Project Risk Factors Exist?

Structures/Bridges

What is the Budget?

Construction



What Design Parameters & Standards/Criteria Exist?

What is the Schedule?

Drainage

Erosion Control/Landscape

Traffic

Right-of-Way



Who We Are and What Do We Do?



Roadway Survey

Section Manager: Virgil Coxon
Location Chief Surveyor: Mark Luond
Construction Chief Surveyor: Clifton Clark

Services/ Responsibilities

- *Design/ Location Survey
- *Construction Survey
- *Survey Support

Roadway Standards

Section Manager: Hiren Shah
Team Lead: Chris Cooper

Services/ Responsibilities

- *Roadway Design Guidelines
- *AASHTO Standards & Criteria
- *MASH Standards
- *Roadway Construction Details
- *Design Support

Roadway Design

Section Manager: Doug Smith
Team Leads: Jordan Kurlin
Hassan Eghbali
Vacant

Services/ Responsibilities

- *Roadway Design Documentation
- *Earthwork/ Drainage Calculations
- *Construction/ Maintenance Details
- *Design Management and Coordination

Roadway Pavement Design

Section Manager: Vacant
Team Leads: Ali Zareh
Ashek Rana

Services/ Responsibilities

- *Pavement Testing/ Cores/ Evaluation
- *Material/Pavement Design Reports

Roadside Development

Section Manager: LeRoy Brady
Team Lead: John Hucko

Services/ Responsibilities

- *Aesthetic Enhancements
- *Seeding & Revegetation
- *Landscape & Irrigation Design
- *Stormwater Quality & Erosion/ Sedimentation Control Plans

Roadway Drainage

Section Manager: Syed Alam

Services/ Responsibilities

- *Hydraulic/Hydrology Design & Standards
- *Drainage Permits
- *Scour/ Erosion Protection Design

Roadway Pre-Design

Section Manager: Hiren Shah
Team Lead: Shahid Bhuiyan

Services/ Responsibilities

- *Project Scoping Documentation
- *Design Exceptions/ Variances
- *AASHTO Controlling Criteria
- *Change of Access Reports

Contact Information

Manager: **Michael DenBleyker**
mdenbleyker@azdot.gov
602.712.7808

Survey: **Virgil Coxon**
vcxon@azdot.gov
602.712.8580

Pre-Design, Standards: **Hiren Shah**
dhenry@azdot.gov
602.712.779

Pavement: **Vacant**
@azdot.gov
602.712.8131

Drainage: **Syed Alam**
gaouad@azdot.gov
602.712.87011

Roadside Development: **LeRoy Brady**
lbrady@azdot.gov
602.712.4261

Design: **Doug Smith**
dsmith2@azdot.gov
602.712.8482

ROADWAY ENGINEERING GROUP

Manager: Michael DenBleyker
Assistant State Engineer

Roadway - Who We are and What We Do?



| Pre-Design (Scoping) | Survey | Pavement Design | Roadway Design | Drainage | Roadside Development | Standards |
|---|---|--|--|--|---|--|
| <i>Define the Scope, Schedule and Budget</i> | <i>Aerial Photography and Engineering & Topographic Surveys</i> | <i>Design of New Pavement and Recommendations for Pavement Rehabilitation Treatments</i> | <i>Prepare Roadway Technical Design and Construction Documents</i> | <i>Hydrology, Hydraulics and Water Resources Expertise and Design for Projects</i> | <i>Design of Landscape Architecture, Aesthetics and Environmental Design for Projects</i> | <i>Provide Technical Guidance & Expertise in Roadway Design Criteria</i> |
| Field Research | Construction Survey | Field Reviews & Testing | Records Review | Field & Records Research | Field Reviews | Roadway Design Guidelines |
| Records Review | Field Survey | Records Review | Gather/Calculate Design Data | Roadway Drainage Calculations | Erosion/Sedimentation Control Plans & Specification | AASHTO Standards & Criteria |
| Standards Research – ADOT & AASHTO Controlling Design Criteria | CADD Processing of data | Standards Research | Develop Roadway Sections, Alignments & Profiles | Hydraulic/Hydrology Design & Modeling | Vegetation Inventory | MASH Standards |
| Coordination with Safety Studies | Aerial Drone Surveys & Mapping | Calculations & Pavement Design | Develop Roadway Design Plan Sheets | Modeling & Analysis of Washes, Floodplain & Floodway | Roadside and Structure Aesthetics Design | Roadway Construction Details |
| Documentation of Project Scope, Schedule and Budget | | Report Preparation & Documentation | Evaluate Guardrail Length of Need | Bridge Hydraulics and Scour Protection Analysis & Design | Seeding & Re-vegetation Design | Design Support |
| Design Exceptions & Variances | | Existing Conditions Analysis | Construction Details | Report Preparation & Documentation | Landscape and Irrigation Design | |
| Change of Access Reports | | | Calculations: Superelevation, Alignment, Drainage | Drainage Permits | | |
| | | | Design Management & Coordination | | | |
| | | | Model and Calculate Earthwork Quantities | | | |
| | | | Prepare Cost Estimates | | | |

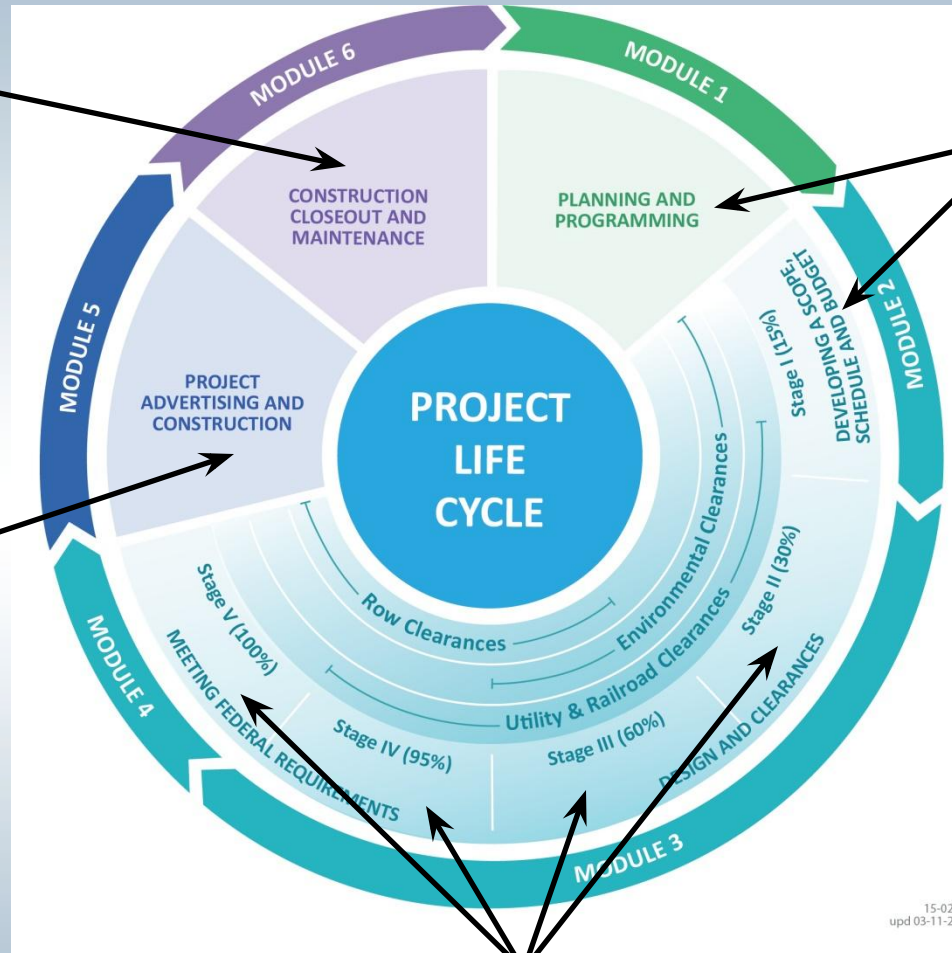
Where Do We Fit In?



Roadway Design Teams Assist in Addressing Construction Questions and Providing Technical Guidance for Construction Related Matters

Roadway Design Teams Provide Critical Input into Development of a Project's Scope, Schedule and Budget

Roadway Design Teams Assist in the Preparation of Bid Documents and Address Bid RFIs



Roadway Design Teams Coordinate to Deliver Technical Designs and Construction Documentation

What Do We Use?



AMERICAN ASSOCIATION
OF STATE HIGHWAY AND
TRANSPORTATION ENGINEERS
AASHTO

A Policy on **Geometric Design of Highways and Streets**

2018
7th Edition
2nd Printing



THE GREEN BOOK

ARIZONA DEPARTMENT OF TRANSPORTATION

ROADWAY ENGINEERING GROUP

ROADWAY DESIGN GUIDELINES



JANUARY 2021

Visit the ADOT Roadway Engineering webpage for future updates

What Do We Use?



ARIZONA DEPARTMENT OF TRANSPORTATION



PAVEMENT DESIGN MANUAL

September 29, 2017

ROADWAY ENGINEERING GROUP
PAVEMENT DESIGN SECTION

ADOT
Arizona Department of Transportation

Erosion and Pollution Control Manual *For Highway Design and Construction*



ARIZONA DEPARTMENT OF TRANSPORTATION



HIGHWAY DRAINAGE DESIGN MANUAL HYDRAULICS

Final Report

January, 2007

Arizona Department of Transportation
206 South 17th Avenue
Phoenix, Arizona 85007

What Do We Use?



An Arizona Management System Agency

Douglas A. Ducey, Governor
John S. Hallikowski, Director
Dallas Hammit, State Engineer
Steve Boschen, Division Director

Arizona Department of Transportation

Guiding Principles for Performance-Based Practical Design

Date: March 14, 2019

Introduction & Overview

This document has been prepared to provide guidance on using Performance-Based Practical Design (PBPD) in the development of Arizona Department of Transportation (ADOT) projects. **PBPD** is not intended to replace existing design standards or project development processes, but provides flexibility and encourages project development professionals to diligently evaluate design decisions and alternatives. Utilizing the PBPD approach will help ensure that designs meet the project's objective and need, resulting in the most optimized performance of the roadway system.

The Federal Highway Administration (FHWA) has defined **PBPD** as a decision-making approach that relies on quantitative analyses to guide decision-making throughout the project development process resulting in a better system performance. The **PBPD** approach combines the Practical Design philosophy of designing roadway facilities that makes the best use of financial resources to optimize performance, with the Performance-Based Design philosophy of evaluating the effects the roadway features have on its actual performance. By focusing on the overall system performance, **PBPD** helps agencies better manage their transportation investment and serve system-level needs and performance priorities with the limited resources it has.

It is expected that all ADOT project development professionals and consultants will apply the **PBPD** approach on every project by incorporating:

- Clear project objective and need statements that document the Department's performance objectives for the project.
- Performance-based, data-driven decision making.
- Practical Design methodology that results in the most cost effective (efficient) design solution that meets the project objective and optimizes system performance.
- Consideration of design alternatives that address and support the documented project objectives and need, while maximizing system improvements. Evaluation of more than one design option is inherent in the performance-based approach.

Performance Based Practical Design (PBPD):

ADOT's Goal is to deliver projects that:

1. Maintain or improve the operational performance of the roadway system.
 2. Are the most cost effective solution to meeting the Project Objective and Need.
- **PBPD** is a decision-making approach that relies on quantitative analysis to guide decision-making throughout the project development process resulting in a better system performance.
 - **PBPD** combines "Practical Design" philosophy of designing roadway facilities that makes the best use of the financial resources to optimize performance, with the "Performance-Based Design" philosophy of evaluating the effects the roadway features have on its actual performance.
 - **PBPD** helps agencies better manage their transportation investment and serve system-level needs and performance priorities with the limited resources it has.
 - **PBPD** is not intended to replace existing design standards or project development processes. **PBPD** provides flexibility and encourages professionals to diligently evaluate design decisions and alternatives.

What We Do?

Scoping & Pavement Design



089 CN 544 F0237 01C
NHPP-089-E(208)T
HORSESHOE BEND OVERLOOK SOUTH OF PAGE
BITTER SPRINGS – UTAH STATE LINE HIGHWAY
US 89



Project No. 089 CN 544 F0237 01C

ATTACHMENT 1 – VERTICAL CURVE INVENTORY

PROJECT NAME: HORSESHOE BEND OVERLOOK SOUTH OF PAGE
PROJECT NO: 089 CN 544 F0237 01C
ROADWAY TYPE: UNDIVIDED ROADWAY (BI-DIRECTIONAL)

| VPI STATION (FT) | MILEPOST | | GRADE (%) | | CURVE LENGTH (FT) | CURVE TYPE | STOPPING SIGHT DISTANCE (FT) | | SPEED (MPH) | |
|---------------------|----------|--------|-----------|-----------|----------------------|---------------|------------------------------|----------|-------------|--------|
| | BEGIN | END | APPROACH | DEPARTURE | | | EXISTING | REQUIRED | EXISTING | POSTED |
| 1215+00.00 | 544.00 | 544.11 | -1.4000 | -2.5000 | 600.00 | Crest | 1281 | 675 | 95 | 65 |
| 1225+00.00 | 544.19 | 544.30 | -2.5000 | -1.1430 | 600.00 | Sag | +9999 | 675 | +100 | 65 |
| 1232+00.00 | 544.32 | 544.43 | -1.1430 | -2.2500 | 600.00 | Crest | 1275 | 672 | 95 | 65 |
| 1240+00.00 | 544.47 | 544.58 | -2.2500 | -1.2000 | 600.00 | Sag | +9999 | 672 | +100 | 65 |
| 1250+00.00 | 544.66 | 544.77 | -1.2000 | -2.5860 | 600.00 | Crest | 1078 | 676 | 86 | 65 |

| VPI STATION (FT) | MILEPOST | | GRADE (%) | | CURVE LENGTH (FT) | CURVE TYPE | STOPPING SIGHT DISTANCE (FT) | | SPEED (MPH) | |
|---------------------|----------|--------|-----------|-----------|----------------------|---------------|------------------------------|----------|-------------|--------|
| | BEGIN | END | APPROACH | DEPARTURE | | | EXISTING | REQUIRED | NEW | DESIGN |
| 1215+00.00 | 544.00 | 544.11 | -1.4000 | -2.5000 | 600.00 | Crest | 1281 | 592 | 95 | 60 |
| 1225+00.00 | 544.19 | 544.30 | -2.5000 | -1.1430 | 600.00 | Sag | +9999 | 592 | +100 | 60 |
| 1232+00.00 | 544.32 | 544.43 | -1.1430 | -2.2500 | 600.00 | Crest | 1275 | 589 | 95 | 60 |
| 1240+00.00 | 544.47 | 544.58 | -2.2500 | -1.2000 | 600.00 | Sag | +9999 | 589 | +100 | 60 |
| 1250+00.00 | 544.66 | 544.77 | -1.2000 | -2.5860 | 600.00 | Crest | 1078 | 593 | 86 | 60 |

| VPI STATION (FT) | MILEPOST | | GRADE (%) | | CURVE LENGTH (FT) | CURVE TYPE | STOPPING SIGHT DISTANCE (FT) | | SPEED (MPH) | |
|---------------------|----------|--------|-----------|-----------|----------------------|---------------|------------------------------|----------|-------------|--------|
| | BEGIN | END | APPROACH | DEPARTURE | | | EXISTING | REQUIRED | NEW | POSTED |
| 1215+00.00 | 544.00 | 544.11 | -1.4000 | -2.5000 | 600.00 | Crest | 1281 | 514 | 95 | 55 |
| 1225+00.00 | 544.19 | 544.30 | -2.5000 | -1.1430 | 600.00 | Sag | +9999 | 514 | +100 | 55 |
| 1232+00.00 | 544.32 | 544.43 | -1.1430 | -2.2500 | 600.00 | Crest | 1275 | 512 | 95 | 55 |
| 1240+00.00 | 544.47 | 544.58 | -2.2500 | -1.2000 | 600.00 | Sag | +9999 | 512 | +100 | 55 |
| 1250+00.00 | 544.66 | 544.77 | -1.2000 | -2.5860 | 600.00 | Crest | 1078 | 515 | 86 | 55 |

Meaning of Symbols:
GB = Grade Break – Stopping Sight Distance and Speed not calculated
+ = Existing Stopping Sight Distance less than AASHTO required value
Note:
Input grade
Project Limit

Data Collection & Field Analysis/Research

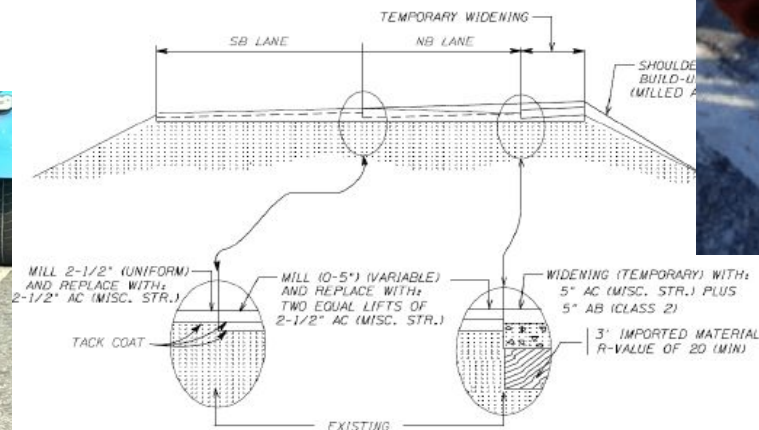


AASHTO CONTROLLING DESIGN CRITERIA REPORT
MAY 26, 2020



PREPARED BY
KATHRYN HAMMOND
ROADWAY PREDESIGN SECTION
ROADWAY ENGINEERING GROUP
ADOT
Infrastructure Delivery and Operations

TYPICAL SECTION 191 AP 323 F015001C / STBG-191-D(202)T CARRIZO WASH



US 191
CARRIZO WASH CBC
(AT CBC APPROACHES)^{1, 2}



What We Do?

Scoping & Pavement Design



**Project 101L MA 001 F0203 01C
Federal ID Number – 888-A(234)T
Agua Fria Freeway
Interstate 10 (I-10) to Interstate 17 (I-17)
State Route 101 Loop (SR 101L)**

FINAL SCOPING LETTER

November 1, 2019

Revised February 25, 2020

Prepared For:



**ARIZONA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION TECHNOLOGY GROUP**

ARIZONA DEPARTMENT OF TRANSPORTATION * ROADWAY ENGINEERING GROUP
205 SOUTH 17TH AVENUE * PHOENIX, AZ 85007 * PHONE: 602.712.7360

May 28, 2020

MATERIALS DESIGN REPORT

Report Type: Revised Final (Rev. 1) Report # 19-12-RF1

| |
|--|
| HIGHWAY NAME: ST JOHNS-SANDERS HWY (US 191) |
| PROJECT NAME: CARRIZO WASH |
| PROJECT NUMBER: 191 AP 323 F015001C / STBG-191-D(202)T |
| PROJECT SCOPE: DRAINAGE IMPROVEMENT |
| MILE POST LIMITS: MP 323.53 AND MP 324.03 |

Prepared by:
Pavement Design Section
Roadway Engineering Group
Arizona Department of Transportation

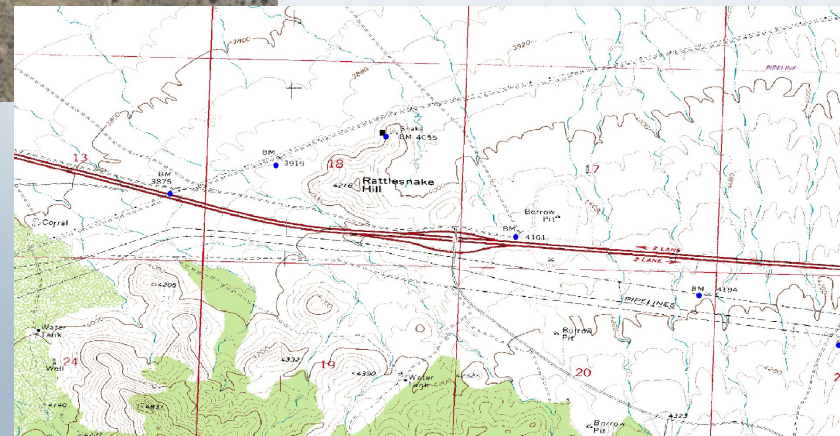
Design Reports & Documentation

What We Do?

Survey



Mapping and Research

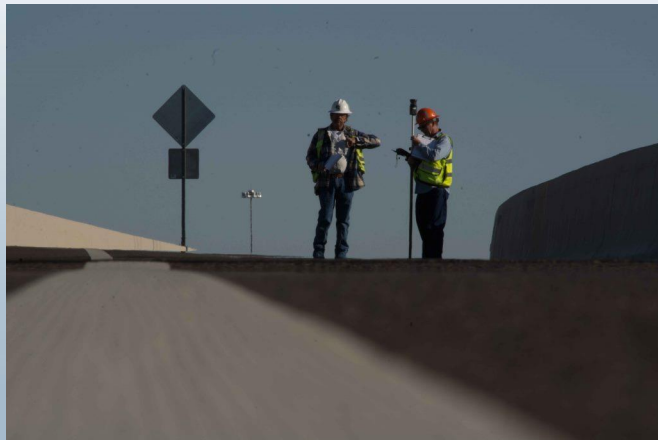


What We Do?

Survey



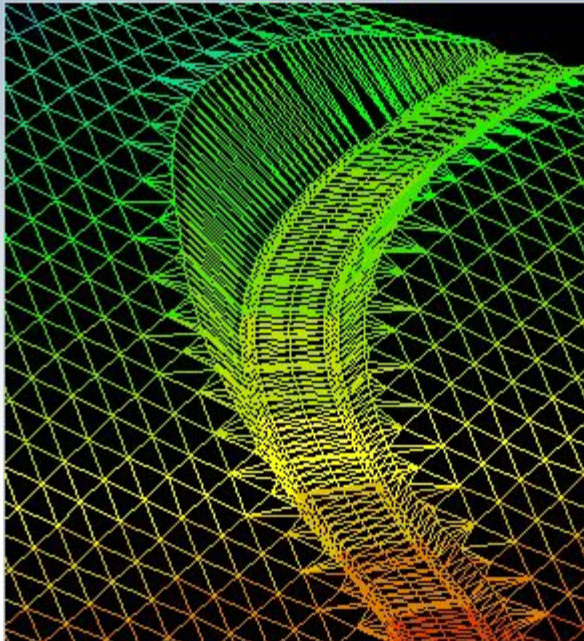
Field Data Collection



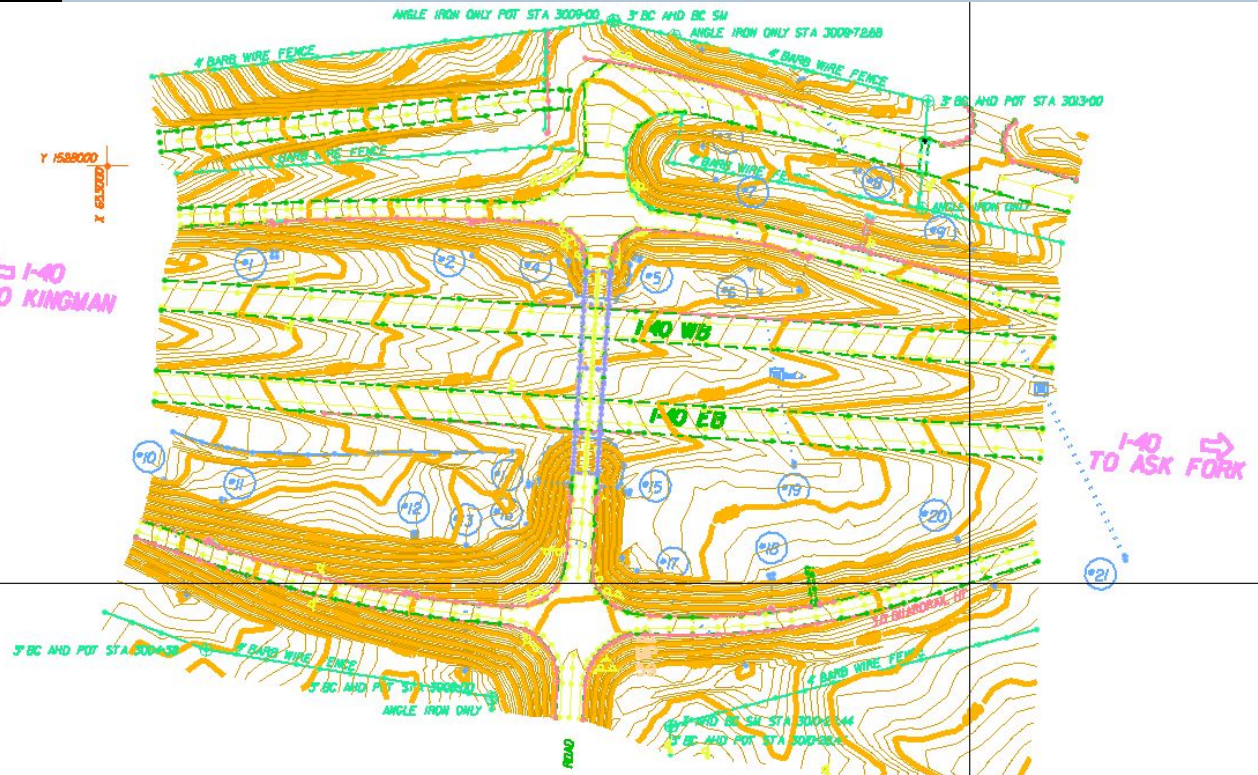
What We Do?



Survey

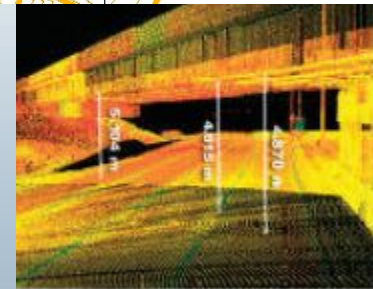


I-40
TO KINGMAN



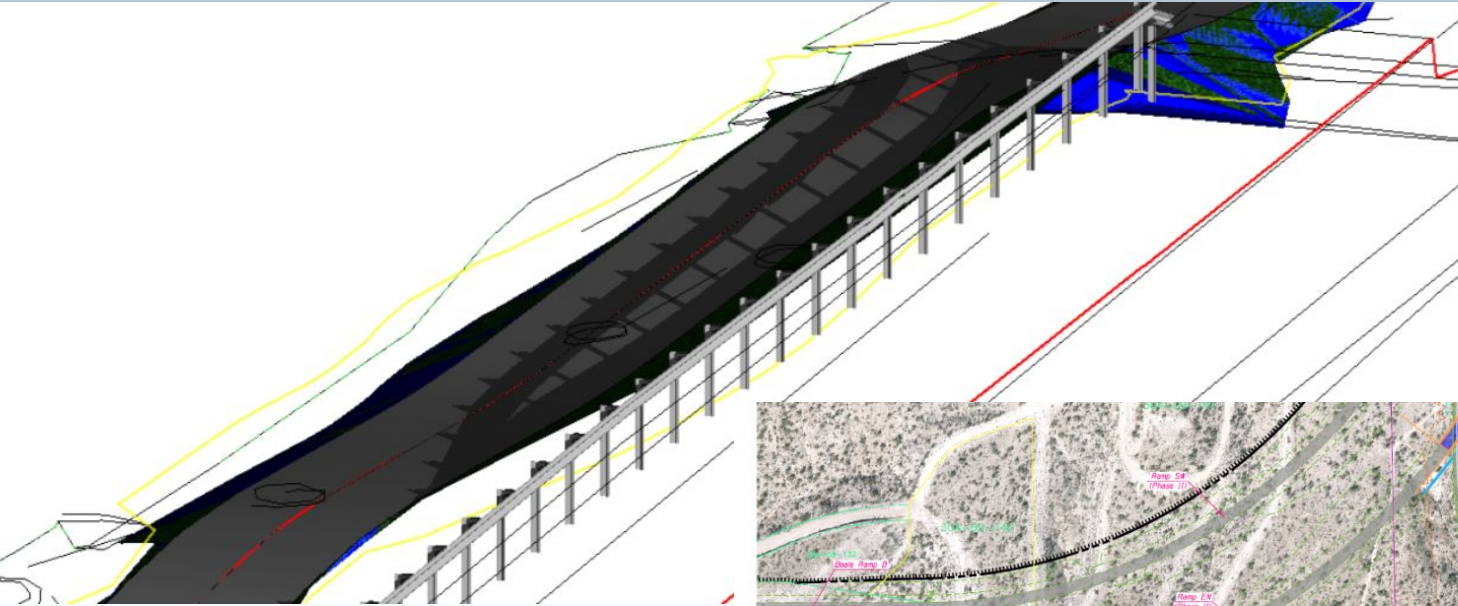
| | A | B | C | D | E | F | G |
|----|--|--------------|--------------|----------|---------------------------|---|---|
| 1 | FINAL GROUND COORDINATES WESTERN ZONE | | | | | | |
| 2 | I-40 @ DW RANCH RD T.J. MP 59.71 | | | | | | |
| 3 | JOB LS1226, TRACS H879901D | | | | | | |
| 4 | DTM | | | | | | |
| 5 | VALUES OBTAINED BY STATIC GPS | | | | | | |
| 6 | DATA COLLECTED BY McWHORTER CREW | | | | | | |
| 7 | INTERNATIONAL FEET | | | | | | |
| 8 | NAD83/92 HORIZONTAL & NAVD88 VERTICAL (GEOID 09AZ) | | | | | | |
| 9 | GROUND ADJUSTMENT FACTOR = 1.00025 | | | | | | |
| 10 | | | | | | | |
| 11 | PT. NO. | GROUND (N) | GROUND (E) | ELEV. | DESC. | | |
| 12 | 1001 | 1527305.252 | 653582.303 | 4111.218 | CLS ST | | |
| 13 | 1002 | 1527306.428 | 653564.973 | 4111.014 | EP ST | | |
| 14 | 1003 | 1527306.290 | 653564.273 | 4111.275 | GR ST * 2.9FT ON 6IN CURB | | |
| 15 | 1004 | 1527306.216 | 653564.278 | 4111.108 | GB ST | | |
| 16 | 1005 | 1527305.650 | 653570.288 | 4111.171 | DS ST * 6INCH | | |
| 17 | 1006 | 1527347.914 | 653584.892 | 4111.271 | CLS | | |
| 18 | 1007 | 1527350.601 | 653567.816 | 4111.045 | EP | | |
| 19 | 1008 | 1527350.563 | 653566.903 | 4111.307 | GR | | |
| 20 | 1009 | 1527350.589 | 653566.857 | 4111.040 | GB | | |
| 21 | 1010 | 1527350.098 | 653572.700 | 4111.155 | DS | | |
| 22 | 1011 | 1527368.388 | 653573.414 | 4111.045 | DS | | |
| 23 | 1012 | 1527367.877 | 653586.077 | 4111.198 | CLS | | |
| 24 | 1013 | 1527384.167 | 653587.165 | 4111.128 | CLS | | |
| 25 | 1014 | 1527383.104 | 653567.664 | 4110.771 | DS | | |

- Digital Terrain Models
- 3D Scans
- Topographic Maps

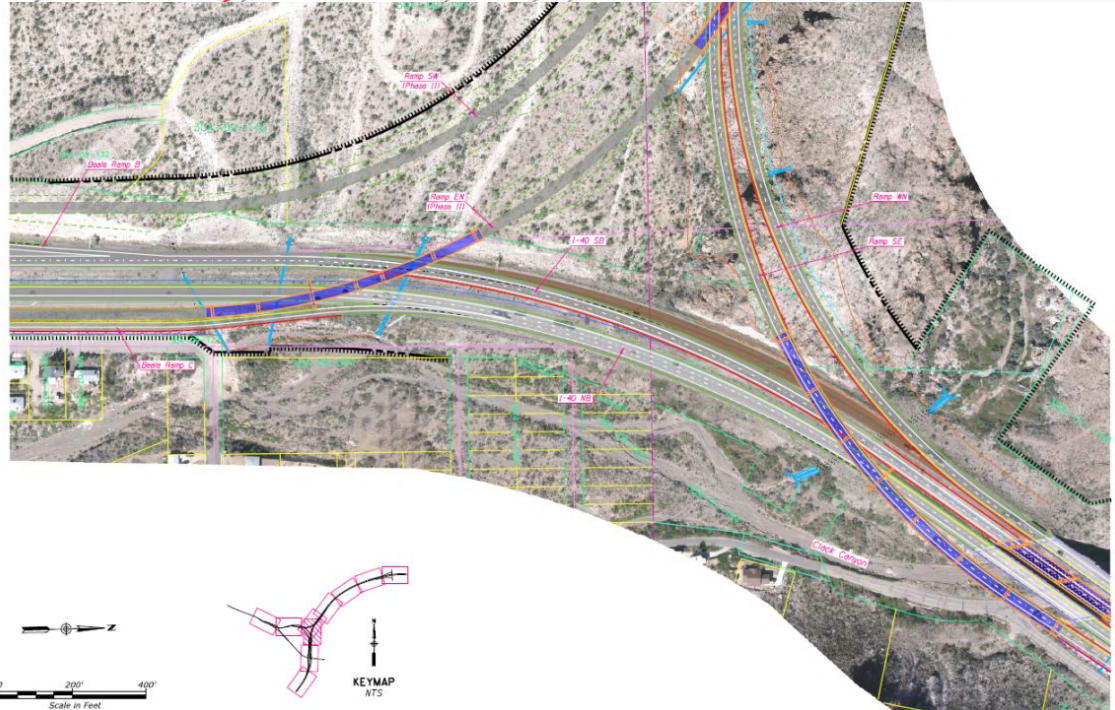


What We Do?

Roadway Design

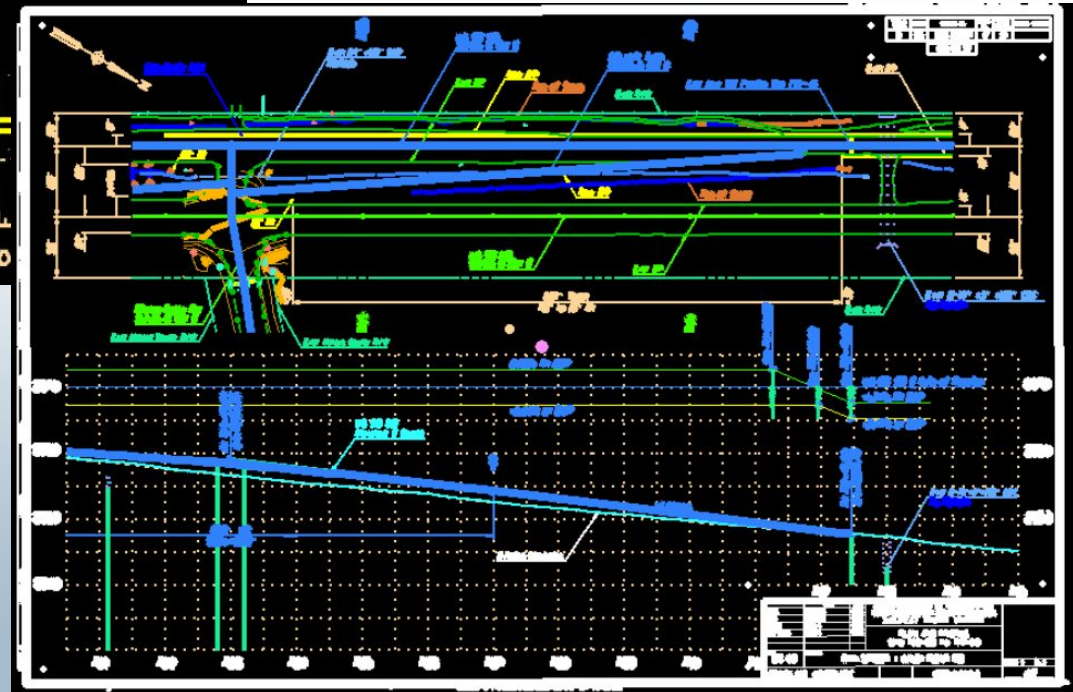
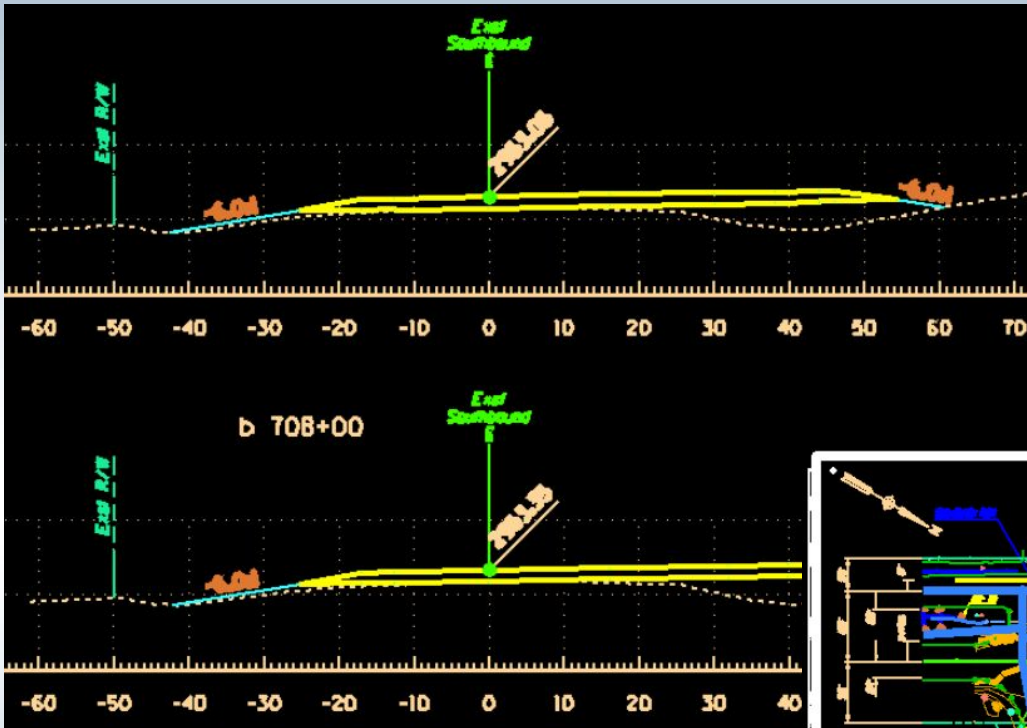


*CADD Based
Modeling and Geometrics*



What We Do?

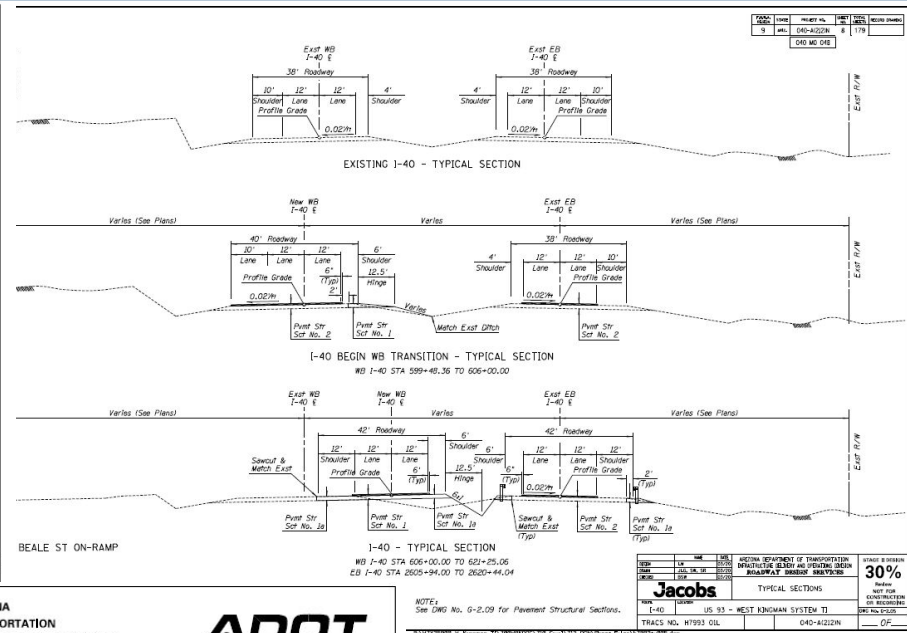
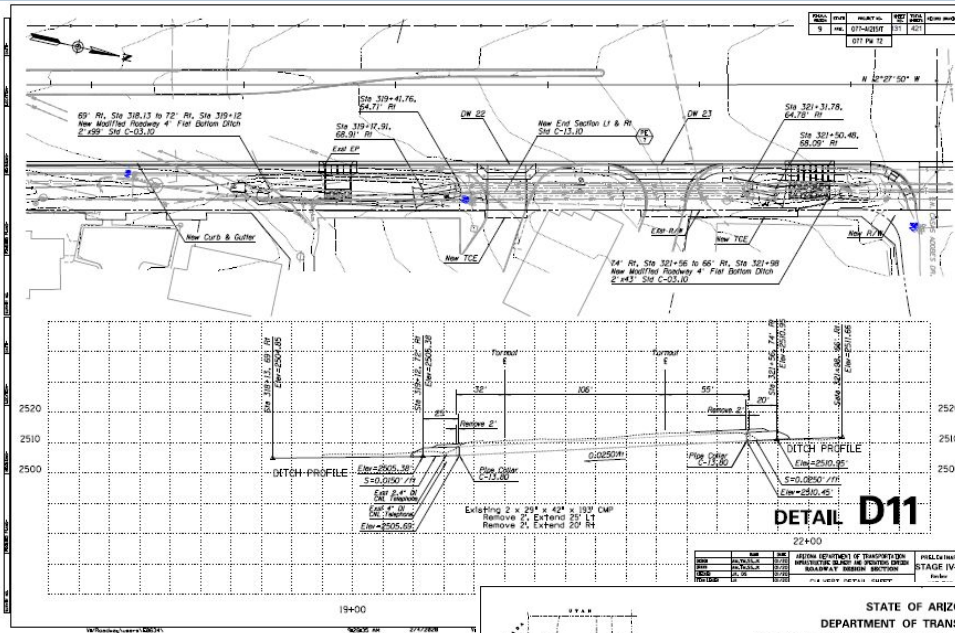
Roadway Design



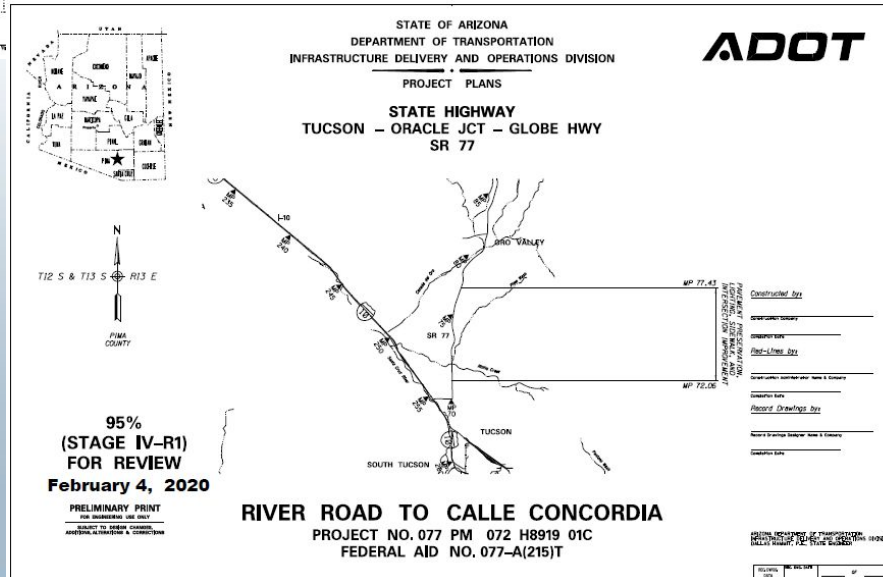
Design & Drafting

What We Do?

Roadway Design

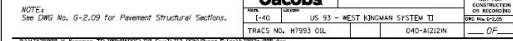


Construction Plan
Production
& Delivery

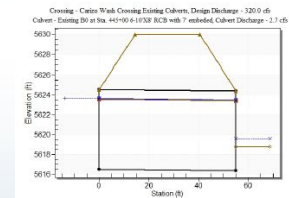
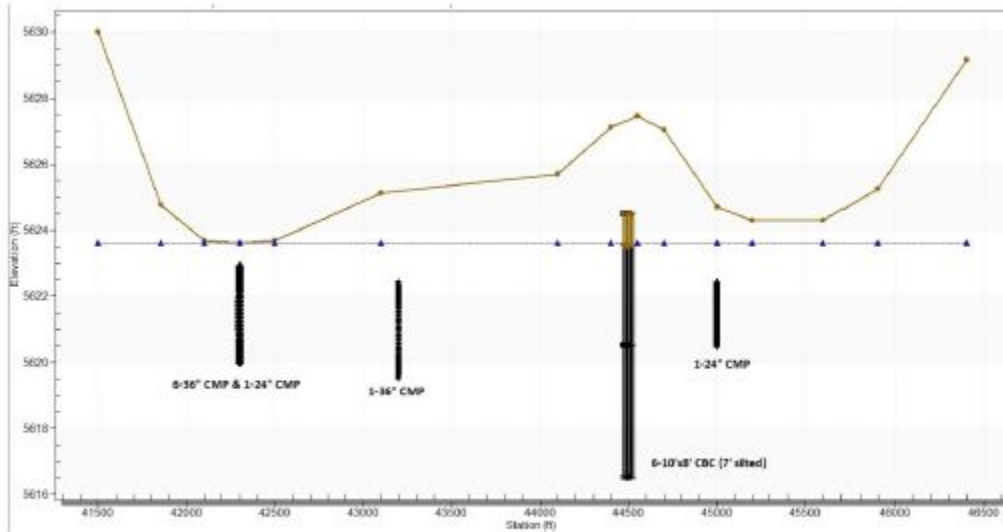


95%
(STAGE IV-R1)
FOR REVIEW
February 4, 2020

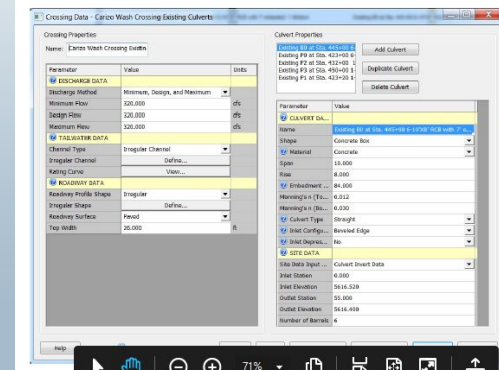
RIVER ROAD TO CALLE CONCORDIA
PROJECT NO. 077 PM 072 H8919 01C
FEDERAL AID NO. 077-A(215)T



Drainage



- Data Collection
- Field Analysis
- Calculations & Modeling



What We Do?

Drainage



US 191 – Carrizo wash

Revised Final Drainage Report

TRACS NO. F015001D

Prepared for:
Arizona Department of Transportation



November 2019

Prepared by
Arizona Department of Transportation

Khandaker Haque, PE

Abu S Mohsenin

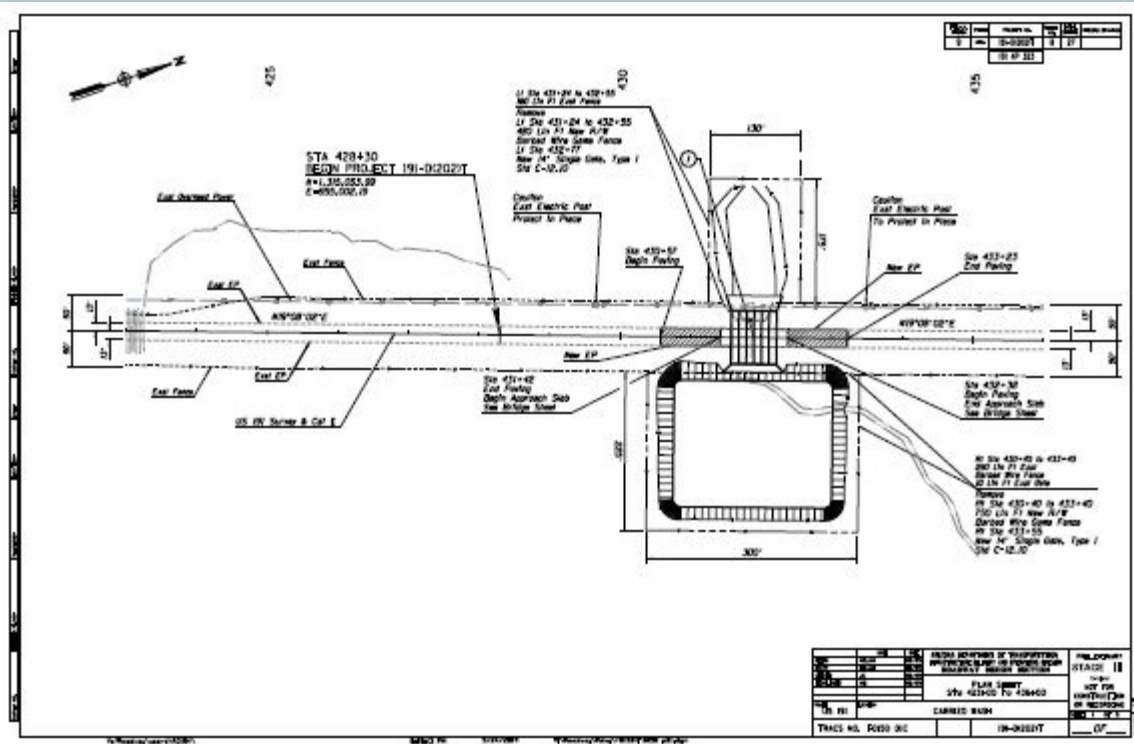


Figure 5: FEMA Flood Zone

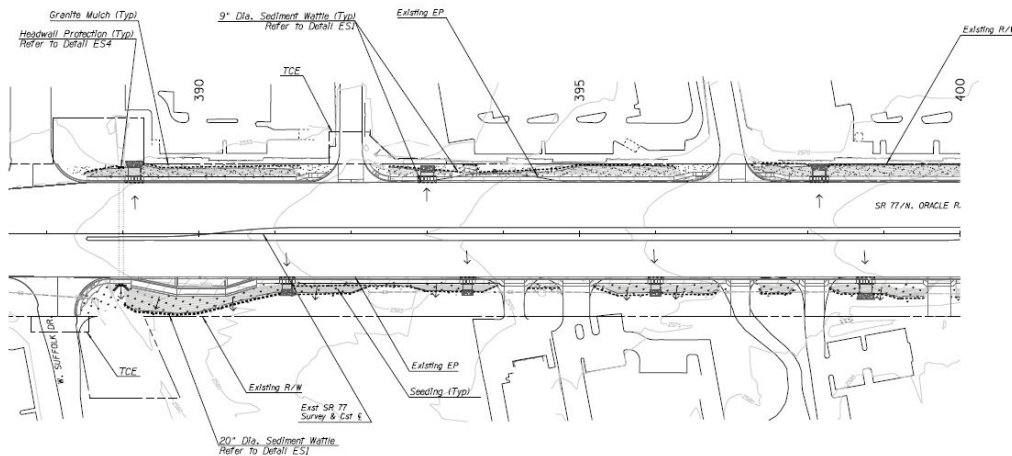
- Design Reports & Documentation
- Construction Details & Plans
- Floodplain Modeling

What We Do?

Roadside Development



Roadway Group Roadside Development Section



- Erosion Control
- Landscape Design
- Aesthetics

Questions

