

**FINAL GEOTECHNICAL REPORT**  
**SR 89A, Coyote Springs Rd - Legend Hill Rd**  
**TRACS No. 089A YV 329.8 H837701D**  
**Federal Aid No. HSIP -A89-A (209) A**

**Prepared by:**  
**Geotechnical Services**  
**Bridge Group**  
**Arizona Department of Transportation**

**May 06, 2016**



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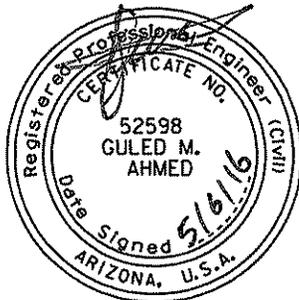
206 S. 17th Ave.  
Phoenix, AZ 85007

Subject: SR 89A, Shoulder Widening  
SR 89A, Coyote Springs Rd - Legend Hill Rd  
089A YV 329.8 H8377 01C

The following report presents the results of a geotechnical investigation and its findings of SR 89A shoulder widening between MP 324.7 to MP 326.3 and MP 329.8- MP 331.2 and fixing curve around MP 331.00 in the Arizona Department of Transportation's (ADOT) Northwest District at north east of Prescott Valley, Arizona within Yavapai County. The scope of work consists of 8 feet shoulder widening from MP 324.7 to MP 326.3 and 5 feet shoulder widening from MP 329.8 to MP 331.2. In addition, the proposed work also includes fixing a curve around MP 331 and traffic countermeasures from MP 331.2 to MP 333.0.

The geotechnical investigation field program included 10 backhoe test pits for the shoulder widening from MP 329.8 to MP 331.2. Bulk samples of the soil were taken to determine soil type, gradation, Atterberg limits, Proctor densities, pH, In-situ densities and R-values. Results of the investigation, laboratory testing and recommendations are included in this report.

Should there be any questions regarding the contents of this report or its appropriate incorporation into designs, please do not hesitate to contact us.



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EXPIRES 09/30/2014  
09/30/2017

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## 1. INTRODUCTION

This report presents the results of a geotechnical investigation and its findings of SR 89A shoulder widening between MP 324.7 to MP 326.3 and MP 329.8 to MP 331.2 and fixing curve around MP 331 in the Arizona Department of Transportation's (ADOT) Northwest District at north east of Prescott Valley, Arizona within Yavapai County. The scope of work consists of 8 feet shoulder widening from MP 324.7 to MP 326.3 and 5 feet shoulder widening from MP 329.8 to 331.2. In addition, the proposed work also includes fixing a curve around MP 331 and traffic countermeasures from MP 331.2 to MP 333.0.

## 2. GEOTECHNICAL INVESTIGATION

### 2.1. Field Investigation

The roadway field investigation included ten (10) backhoe test pits (TP1- TP10) between MP 329.8 to MP 331.2 only. During design Stage III, the project scope was extended to include 5 feet shoulder widening from MP 324.7 to MP 326.3. To avoid additional geotechnical environmental clearance that will delay this project and the fact that Geotech profile is uniform within the project limits (MP 324.7 to MP 326.3 and MP 329.8 to MP 331.2) Therefore, no additional geotechnical investigation is preformed; ADOT project team decided to use existing geotechnical data. The test pits were advanced by ADOT Geotechnical Operations Section using Caterpillar 420E Rubber Tired Backhoe. The test pits were advanced to a depth of 5 feet and were logged and sampled by ADOT personnel at selected intervals. Field moisture and in-situ density were measured at selected locations using a nuclear moisture-density gauge.

Detailed soil descriptions and test results for materials obtained from the test pits are presented in appendix A.

### 2.2. Laboratory Investigation

The soil samples obtained during the field subsurface investigation from the test pits were collected by ADOT Geotechnical Operations Section and delivered to the ADOT Central Materials Laboratory in Phoenix to perform laboratory testing. Selected samples were tested in general conformance with the procedures listed in Table 1.

**Table 1: Test Methods Applied to Representative Soil and Rock Samples**

<b>Geotechnical Test</b>	<b>Test Procedure</b>
Sieve (Grain Size) Analysis	ARIZ 201c
Atterberg Limits (Plasticity)	AASHTO T 89 and T 90
R-Value (Subgrade Support)	AASHTO T 190
Moisture Content of Soils	AASHTO T265
Maximum Density and Optimum Moisture of Soils	ARIZ 225a
pH and Minimum Resistivity of Soils	ARIZ 236b
Sulfate and Chloride in Soils	ARIZ 736a and 733a

### 3. GEOTECHNICAL CONDITIONS

#### 3.1. Subsurface Soil Conditions

The soil deposits encountered at the test pit locations (TP1-TP10) consist of high plasticity fat clay (CH) within the upper 2 feet underlain by clayey gravel (GC) with varying amounts of cobbles and boulders ranging from 6 to 18 inches.

Detailed soil descriptions and test results for materials obtained from the test pits are presented in Appendix A.

#### 3.2. Groundwater

No free groundwater was observed in any of the test pits at the time of the field investigation. The observed moisture conditions may vary considerably with time, according to the prevailing climate, rainfall or other factors.

### 4. ROADWAY RECOMMENDATIONS

#### 4.1. Pavement Design Information

The correlated and tested R-values of the soil samples obtained within the test pits are presented in Table 2. Based on a statistical analysis using the procedure presented in Section 202.02(G) of the ADOT Preliminary Engineering and Design Manual (PE&D Manual, 1989), we recommend a Design and Construction Control R-Value of 20 for this project.

**Table 2: Tested and Correlated R-Values**

Test Pit No.	RDWY Direction	Station & Offset	Depth (ft)	PI	#200	Rc	Rt
1/1	EXIST NB	978+00,30L	0-2	11.8	75.6	8	
1/1	EXIST NB	978+00,30L	2-5	9.7	48.4	13	
2/1	EXIST NB	986+00,30R	0-2	6.5	87.3	10	
2/1	EXIST NB	986+00,30R	2-5	9.0	39.7	17	
3/1	EXIST NB	994+00,30L	0-2	4.9	77.5	7	
3/1	EXIST NB	994+00,30L	2-5	6.8	70.3	9	
4/1	EXIST NB	1002+00,30R	0-2	9.7	82	5	
4/1	EXIST NB	1002+00,30R	2-5	9.0	21.5	26	
5/1	EXIST NB	1010+00,30L	0-5	6.7	79.8	12	
6/1	EXIST NB	1018+00,30R	0-2	4.7	77.4	12	
6/1	EXIST NB	1018+00,30R	2-5	9.6	47.9	15	
7/1	EXIST NB	1026+00,30L	0-2	13.6	77	10	
7/1	EXIST NB	1026+00,30L	2-5	26.5	44.8	21	
8/1	EXIST NB	1034+00,30R	0-2	15.2	70.4	9	
8/1	EXIST NB	1034+00,30R	2-5	8.8	40.4	25	

**Table 2: Tested and Correlated R-Values (cont.)**

Test Pit No.	RDWY Direction	Station & Offset	Depth (ft)	PI	#200	Rc	Rt
9/1	EXIST NB	1042+00,30L	0-5	6.1	52.3	32	11
10/1	EXIST NB	1047+00,30R	0-5	15.4	65.5	14	

**4.2. Roadway Embankment Slopes**

**4.2.1. Excavations**

During project field review meeting, exposed / outcropped rocks were observed approximately from MP 331 to MP 334. **Thus, the contractor should anticipate bedrock below/above the ground surface for all roadway excavations including drainage structures, drilled shaft pole / sign post foundations, and any directional drilling from MP 331 to MP 334. And, it is the contractor’s responsibility to determine the type of equipment to be used for excavation.**

**4.2.2. Subgrade Treatment**

Subgrade within the limits shown on Table 3 does not meet the subgrade acceptance chart provided in Materials Pavement Design Report and shall be modified by the placement of non-woven high survivability separation geofabric (ADOT Standard Specification Section 1014-14.03 (A)) overlain with a layer of geogrid(ADOT Standard Specification Section 1014-3) on top of finished subgrade.

**Table 3: Subgrade Modification Limits**

Main Line Station	Subgrade Treatment Application
Project Limits	Geogrid & Separation Geotextile Fabric

**4.3. Slopes and Earthwork Factors**

Recommendations for maximum cut and fill slope ratios and Earthwork Factors are presented in Table 4. A Ground Compaction Factor of 0.2 feet should be used for the embankment sections outside the existing roadway prism to compensate the ground loss within project limits.

Excavation factor indicate the volumetric changes when excavated materials are used in the engineered fills. Potential bidders should asses these factors in preparing the estimates and are encouraged to review all available data and make their own conclusions regarding excavation conditions.

**Table 4: Slopes and Earthwork Factors**

Station	Excavation Factor	Allowable Maximum Slopes	Ground Compaction Factor
	Shrink	Cut / Fill	0.2 feet
Project Limits	10 %	2:1	

#### 4.4. Pipe Design Information

The following tabulation presents a summary of pH, sulfate, chloride, and Resistivity test results on soils sampled at drainage / box culverts potential locations. The selection of coating and type of pipe should be based on ADOT Pipe Selection Guidelines and Procedures (1996). Due to moderate sulfate exposure, it is recommended the use of Type II Portland cement for this project if concrete pipe purposed or existing box culvert will be extended.

**Table 5: Soil pH and Resistivity Results**

TEST HOLE	STA & OFFSET	DEPTH (feet)	pH	Sulfate ppm	Chloride ppm	Resistivity (ohm-cm)
2/1	986+00,30R	2-5	7.70	130	100	2,281
4/1	1002+00,30R	2-5	7.80	370	230	671
6/1	1018+00,30R	2-5	7.60	200	280	497

#### 4.5. Water Requirements

Approximately 60 gallons of water per cubic yard may be estimated for compaction of base and subgrade materials. This is considerably higher than the amount calculated based on the difference between in-situ and Optimum Moisture Content and includes a conservative overrun for losses due to seepage, evaporation, inadequate mixing, spillage, etc. Precipitation before and/or during construction may also reduce the required amount of water significantly.

#### 4.6. Aggregate Availability, Weight and Hauls

No source of aggregate material will be designated. A Materials Pavement Design Report will be prepared under separate cover for this project that contains estimated haul distances, unit weights and asphalt content for asphaltic concrete materials that can be used for estimating purposes.

### 5. TEST PIT LOG LIMITATIONS

1. General soil and rock (where encountered) strata descriptions and indicated boundaries are based on engineering interpretation of available subsurface information by the geotechnical engineer and may not reflect actual variation in subsurface conditions between borings/test pits and samples. The locations of contacts between strata shown on the logs are generally approximate, and changes between material types may be gradual rather than abrupt. Classification of soil materials is in general accordance with ASTM D2488 and is based on field observation unless accompanied by mechanical analysis.

2. The observed water levels and/or moisture conditions indicated on the logs are as recorded at the time of exploration. These water levels and/or moisture conditions may vary considerably, with time, according to the prevailing climate, rainfall or other factors and are otherwise dependent upon the duration of and methods used in the exploration program.

3. Sound engineering judgment was exercised in preparing the subsurface information presented on the boring and subgrade logs. This information was prepared and is

intended for design and preliminary quantity estimate purposes. Its presentation on the plans or elsewhere is for the purpose of providing intended users with access to the same information as the State and its designers. This subsurface information interpretation is presented in good faith and is not intended as a substitute for personal investigation, independent interpretations or judgment of the contractor or other users of this report.

## 6.0 REFERENCES

Arizona Department of Transportation (ADOT), 2011, Materials Testing Manual, Sampling and Testing Procedures. Phoenix, AZ.

[http://www.azdot.gov/Highways/Materials/QA/QA\\_Manuals/index.asp](http://www.azdot.gov/Highways/Materials/QA/QA_Manuals/index.asp)

Arizona Department of Transportation (ADOT), 2008, Standard Specifications for Road and Bridge Construction. Phoenix, AZ.

Arizona Department of Transportation (ADOT), 1989, Materials Testing Manual, Preliminary Engineering and Design Manual. Phoenix, AZ.

[http://www.azdot.gov/Highways/Materials/QA/QA\\_Manuals/index.asp](http://www.azdot.gov/Highways/Materials/QA/QA_Manuals/index.asp)

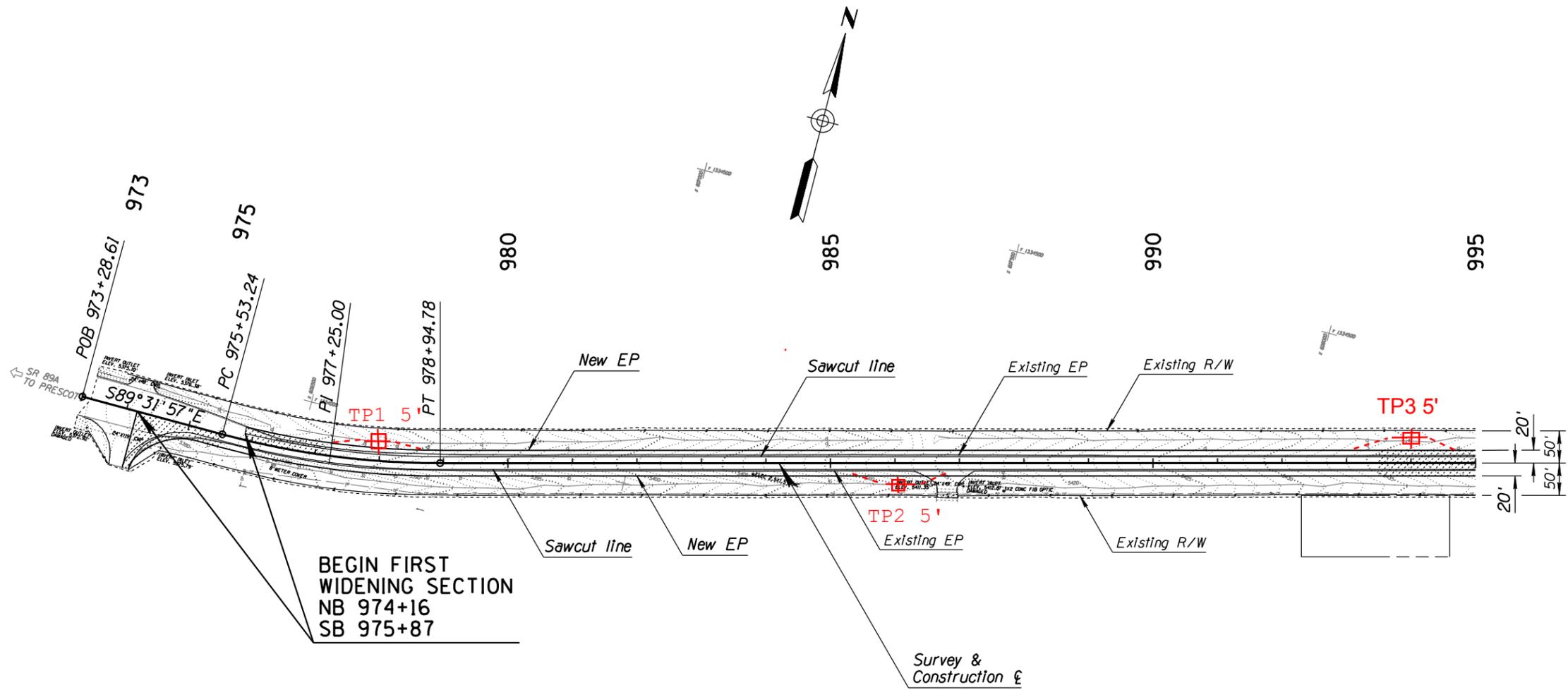
Arizona Department of Transportation (ADOT), 2003, Final Project Assessment, SR 89A Prescott Valley MP 324.8 to MP 333.33.

Arizona Department of Transportation (ADOT), 2004, Geotechnical Report Coyote Springs – Forest Boundary 89A YV 324 H614801c; STP-HES-A89-A (004).

**APPENDIX A**  
**Field Investigation**

Proposed Locations and Depths of Test Pits		
Test Pit ID	Location by Sta.	Proposed Depth of Investigation Depth (feet)
TP1	977+00, 30'L	5-10
TP2	986+00, 30'R	5-10
TP3	994+00, 30'L	5-10
TP4	1002+00, 30'R	5-10
TP5	1010+00, 30'L	5-10
TP6	1018+00, 30'R	5-10
TP7	1026+00, 30'L	5-10
TP8	1034+00, 30'R	5-10
TP9	1042+00, 30'L	5-10
TP10	1047+00, 30'R	5-10

DATE- LOCATION- REVISIONS- FINISHED PLANS- SURVEY NO. DATE- LOCATION- REVISIONS- FINISHED PLANS- SURVEY NO.

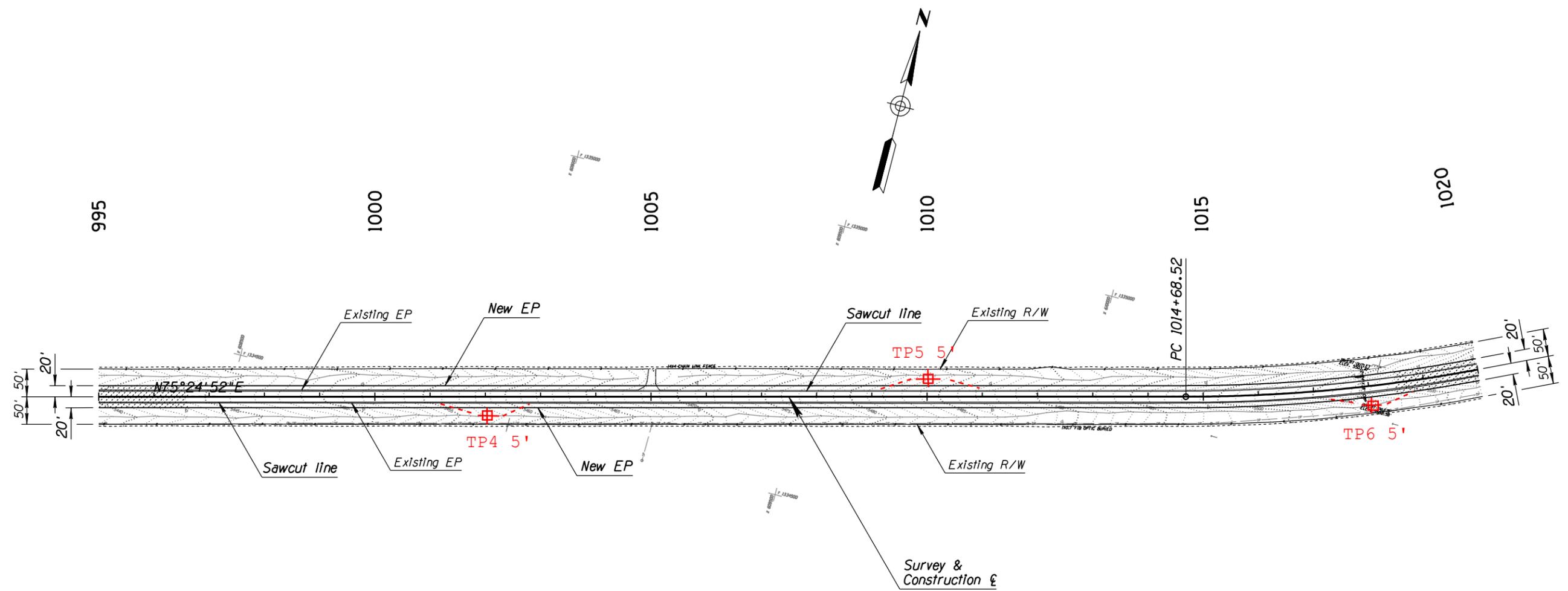


**LEGEND**

-  Proposed ADOT Test Pit Location and Depth (feet)
-  Proposed Access Route

DESIGN		P Garza	08-12	Figure A-1	PRELIMINARY <b>STAGE II</b> Review
DRAWN		P Garza	08-12		
CHECKED		C Labye	08-12		
TEAM LEADER		P Garza	08-12		
ROUTE SR 89A				SR 89A MP 329.8 to MP 333.0	PLAN SHEET Sta 974+18.48 to Sta 995+00
TRACS NO. H8377 01 C				A89-A(209)A	NOT FOR CONSTRUCTION OR RECORDING SHEET 1 OF 8
					OF

SURVEY NO. DATE FINISHED PLANS REVISIONS LOCATION DATE FINISHED PLANS REVISIONS LOCATION DATE FINISHED PLANS REVISIONS LOCATION DATE

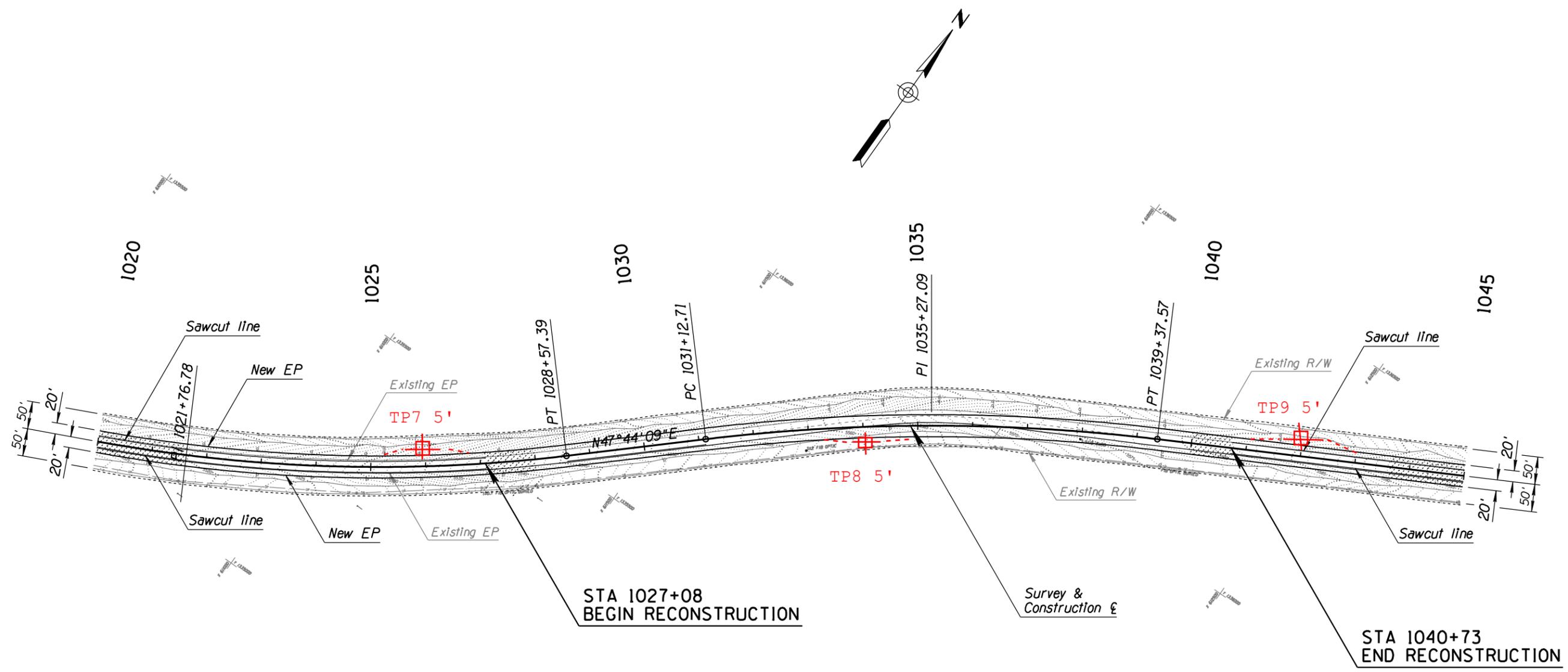


**LEGEND**

- Proposed ADOT Test Pit Location and Depth (feet)
- Survey & Construction E
- Proposed Access Route

	<b>NAME</b>	<b>DATE</b>	Figure A-2	PRELIMINARY
DESIGN	P Garza	08-12	PLAN SHEET Sta 995+00 to Sta 1020+00	<b>STAGE II</b>
DRAWN	P Garza	08-12		Review
CHECKED	C Labye	08-12		NOT FOR
TEAM LEADER	P Garza	08-12		CONSTRUCTION
ROUTE	SR 89A	LOCATION	SR 89A MP 329.8 to MP 333.0	OR RECORDING
			TRACS NO. H8377 01 C	SHEET 2 OF 8
			A89-A(209)A	___ OF ___

SURVEY NO. FINISHED PLANS DATE REVISIONS LOCATION DATE FINISHED PLANS DATE REVISIONS LOCATION DATE FINISHED PLANS DATE SURVEY NO.

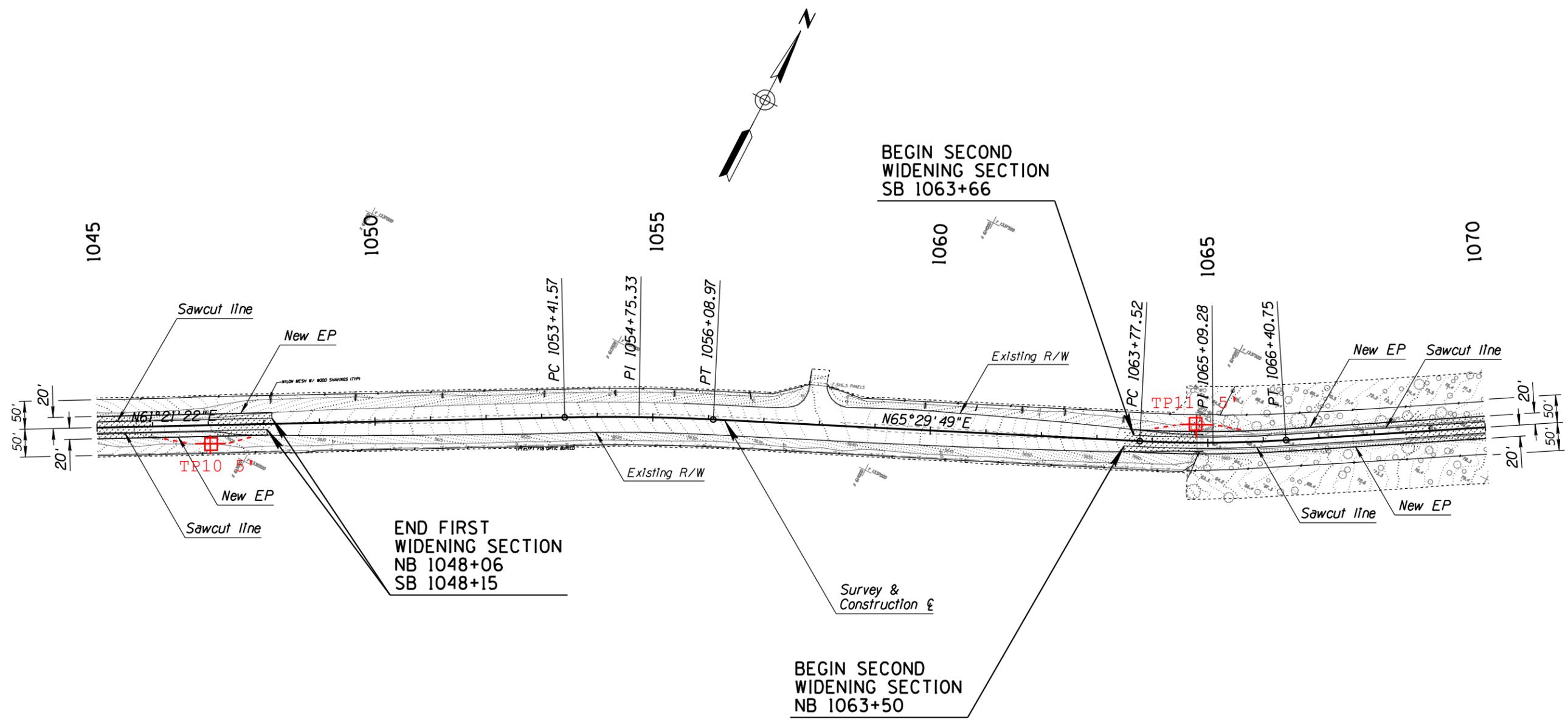


**LEGEND**

- Proposed ADOT Test Pit Location and Depth (feet)
- Proposed Access Route

DESIGN		P Garza	08-12	Figure A-3  PLAN SHEET Sta 1020+00 to Sta 1045+00	PRELIMINARY <b>STAGE II</b> Review NOT FOR CONSTRUCTION OR RECORDING
DRAWN		P Garza	08-12		
CHECKED		C Labye	08-12		
TEAM LEADER		P Garza	08-12		
ROUTE	LOCATION	SR 89A MP 329.8 to MP 333.0		SHEET 3 OF 8	
TRACS NO. H8377 01 C			A89-A(209)A		

DATE- LOCATION- REVISIONS- FINISHED PLANS- SURVEY NO. DATE- LOCATION- REVISIONS- FINISHED PLANS- SURVEY NO.



**LEGEND**

- Proposed ADOT Test Pit Location and Depth (feet)
- ⊕
- Proposed Access Route

DESIGN	P Garza	08-12	Figure A-4  PLAN SHEET Sta 1045+00 to Sta 1070+00	PRELIMINARY <b>STAGE II</b> Review NOT FOR CONSTRUCTION OR RECORDING
DRAWN	P Garza	08-12		
CHECKED	C Labye	08-12		
TEAM LEADER	P Garza	08-12		
ROUTE	SR 89A	LOCATION	SR 89A MP 329.8 to MP 333.0	SHEET 4 OF 8
TRACS NO. H8377 01 C			A89-A(209)A	OF



Test Hole No.	Roadway Direction	STATION & OFFSETS	DEPTH From -To (ft)	Date Sampled	Material Description
7/1	EXIST-NB	1026+00,30L	2-5	03/08/2016	Clay sand with gravel (SC), redish brown, observed presence of small cobbles and boulders of size 1.5 to 2 ft.
8/1	EXIST-NB	1034+00,30R	0-2	03/08/2016	Sandy Fat Clay (CH), Some Gravel, Some Cobbles, Non-Cemented, Medium Dense, Moist, High Plasticity, Dark Brownish Brown.
8/1	EXIST-NB	1034+00,30R	2-5	03/08/2016	Sandy fat clay (CH), saturated, dark brown, observed backhoe refusal on basalt.
9/1	EXIST-NB	1042+00,30L	0-5	03/08/2016	Sandy lean clay with gravel fat clay (CL),Some Gravel, Some Cobbles, Non-Cemented, Medium Dense, Damp, High Plasticity, Dark Brownish Brown.
10/1	EXIST-NB	1047+00,30R	0-5	03/08/2016	Sandy Fat Clay (CH), Some Gravel, Some Cobbles, Non-Cemented, Medium Dense, Moist, High Plasticity, Dark Brownish Brown.

**APPENDIX B**  
**Laboratory Test Results**

Report Number: 604

Arizona Department of Transportation  
 MATERIALS GROUP  
 LABORATORY TEST RESULTS  
 MECHANICAL PROPERTIES

4/26/2016

TRACS NO.: H837701G PROJECT NO.: SA089-YV-329

PROJECT NAME: SR 89A, MP 329.80 - 333.00 PRESCOTT VALLEY

HOLE/ PHASE	RDWY	STATION & OFFSET	MP	DEPTH From / To (feet)	PERCENT PASSING							PI	LL	UNIFIED SOIL CLASS	RV-C	RV-T	Max Dry Density (PCF)	Opt Moist Cont (%)	In Situ Moist (%)	In Situ Density (PCF)	OTHER TESTS
					3"	1-1/2"	3/4"	#4	#8	#40	#200										
1/1	EXIST NB	978+00,30L		0.0 - 2.0	100	99	98	94	92	86	75.6	37	64	CH	8		94.3	23.5	17.4	102.9	
1/1	EXIST NB	978+00,30L		2.0 - 5.0	100	98	95	79	72	58	48.4	35	58	SC	13						
2/1	EXIST NB	986+00,30R		0.0 - 2.0	100	100	100	99	98	92	87.3	28	54	CH	10						
2/1	EXIST NB	986+00,30R		2.0 - 5.0	94	86	82	67	61	51	39.7	32	56	GC	17						pH: 7.7 Min Res: 2281.0
3/1	EXIST NB	994+00,30L		0.0 - 4.0	100	99	97	95	93	87	77.5	40	68	CH	7						
3/1	EXIST NB	994+00,30L		4.0 - 5.0	100	100	99	93	90	82	70.3	36	60	CH	9						
4/1	EXIST NB	1002+00,30R		0.0 - 2.0	100	100	99	95	92	88	82.0	46	74	CH	5						
4/1	EXIST NB	1002+00,30R		2.0 - 5.0	100	98	81	53	43	27	21.5	27	52	GC	26						pH: 7.8 Min Res: 671.0
5/1	EXIST NB	1010+00,30L		0.0 - 5.0	100	100	99	95	93	89	79.8	27	55	CH	12		90.1	23.4	20.7	84.9	
6/1	EXIST NB	1018+00,30R		0.0 - 2.0	100	100	98	94	91	85	77.4	26	62	MH	12						
6/1	EXIST NB	1018+00,30R		2.0 - 5.0	100	100	94	83	77	63	47.9	31	58	SC	15						pH: 7.6 Min Res: 497.0
7/1	EXIST NB	1026+00,30L		0.0 - 3.0	100	100	99	97	94	87	77.0	32	55	CH	10						

Report Number: 604

Arizona Department of Transportation  
 MATERIALS GROUP  
 LABORATORY TEST RESULTS  
 MECHANICAL PROPERTIES

4/26/2016

TRACS NO.: H837701G PROJECT NO.: SA089-YV-329

PROJECT NAME: SR 89A, MP 329.80 - 333.00 PRESCOTT VALLEY

HOLE/ PHASE	RDWY	STATION & OFFSET	MP	DEPTH From / To (feet)	PERCENT PASSING							PI	LL	UNIFIED SOIL CLASS	RV-C	RV-T	Max Dry Density (PCF)	Opt Moist Cont (%)	In Situ Moist (%)	In Situ Density (PCF)	OTHER TESTS
					3"	1-1/2"	3/4"	#4	#8	#40	#200										
7/1	EXIST NB	1026+00,30L		3.0 - 5.0	100	98	96	93	87	65	44.8	24	45	SC	21						
8/1	EXIST NB	1034+00,30R		0.0 - 2.0	100	93	90	87	85	79	70.4	36	61	CH	9						
8/1	EXIST NB	1034+00,30R		2.0 - 5.0	100	93	85	68	63	52	40.4	21	45	GC	25						
9/1	EXIST NB	1042+00,30L		0.0 - 5.0	100	95	87	77	71	60	52.3	11	30	CL	32	11					
10/1	EXIST NB	1047+00,30R		0.0 - 5.0	100	99	98	90	86	78	65.5	28	50	CH	14		100.7	18.0	13.5	107.2	