



*Structural  
Grace, Inc*



Sunset Road: Silverbell Road to River Road  
PCDOT Project Number 4RTSUN

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Technical Memorandum  
Final

Sunset Road and Silverbell Road Intersection  
Conceptual Design Option Comparison  
Interim versus Ultimate Configurations

May 8, 2014  
Amended September 8, 2014

Prepared by:



*Structural  
Grace, Inc*

1430 E. Ft. Lowell Road, Suite 200  
Tucson, AZ 85719



In Coordination with:



1430 E. Ft. Lowell Road, Suite 200  
Tucson, AZ 85719  
(520) 320-0156  
Fax (520) 320-0157  
www.structuralgrace.com

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## INTRODUCTION

In May 2006, the Regional Transportation Authority (RTA) plan and sales tax were approved by the voters of Pima County. One of the 35 roadway projects included in the RTA plan is Pima County's Sunset Road: Silverbell Road to River Road (RTA #8). Sunset Road once extended from Silverbell Road to Interstate 10 (I-10), but the Sunset Road Bridge over the Santa Cruz River was washed away during the flood of 1983. Due to the growth in the northwest Tucson region, the connection of Silverbell Road to Interstate 10 and ultimately River Road is needed to improve operations, increase mobility, improve safety and reduce congestion.

The RTA plan calls for this new reach of Sunset Road as a three-lane roadway (one lane in each direction with a two-way left-turn lane in the center) with appropriate additional turn lanes at the intersections with Silverbell Road, the east-and westbound I-10 frontage roads, and River Road. The ultimate configuration of Sunset Road will pass over a lowered and expanded I-10; which is planned to be reconstructed by the Arizona Department of Transportation (ADOT) in the future. The reconstructed frontage roads and on/off ramps will rise to intersect with the elevated Sunset Road. Sunset Road will continue northeasterly from this elevated interchange with I-10 and drop down to meet River Road at its current alignment north of the Rillito River. This new Sunset Road will include bridges over the Santa Cruz River, I-10, the Union Pacific Railroad (UPRR), and the Rillito River. The Sunset Road traffic interchange bridge structure over I-10 will be constructed and funded by ADOT.

Pima County plans to develop this reach of Sunset Road in two phases. The first phase, referred to as Segment I, will construct Sunset Road from Silverbell Road easterly over a new bridge across the Santa Cruz River to connect with the eastbound I-10 frontage road at the existing grade. The second phase of the project, referred to as Segment II, will begin along Sunset Road west of I-10 (approximately 1,200 feet west of the eastbound frontage road) at the "touch down point" where the road will rise to meet the new elevated I-10 interchange (as described above), cross over the UPRR and then drop to connect at River Road with an at-grade "T" intersection.

## SUNSET ROAD / SILVERBELL INTERSECTION

Two configurations for the intersection of Sunset Road and Silverbell Road have been identified. One is an interim design option to tie the new Sunset Road into Silverbell Road at its existing vertical and horizontal alignment and adding left-and right-turn lane improvements on Silverbell Road. The other is an ultimate configuration tying the new Sunset Road to Silverbell Road that is widened to a four lane divided roadway with left and right-turn lanes<sup>1</sup> and then transitioning to its existing conditions north and south.

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<sup>1</sup> As defined by "Silverbell Road, Ina Road to Grant Road Design Concept Study – Final Report," June 2011.

This Technical Memorandum describes, evaluates and compares these two options and offers a recommendation for Pima County Department of Transportation's (PCDOT) consideration.

For both configurations, the cross section on Sunset Road will include two 11-foot wide travel lanes (one in each direction) and a 12-foot wide two-way left-turn lane. The proposed horizontal alignment of Sunset Road would tie into the Silverbell Road alignment at a 2.5 degree skew. There are no horizontal curves within the Sunset Road alignment between the bridge and Silverbell Road. The cross slope would be a normal crown.

## **Interim Alternative**

### Silverbell Road

For the Interim Alternative, the proposed improvements on Silverbell Road would involve widening the existing roadway to include a southbound left-turn lane and northbound right-turn lane. The widening would generally occur to the east of the existing roadway edge of pavement (see plans in Appendix A).

#### *Cross Section*

Silverbell Road would contain one 11-foot wide travel lane and six-foot wide paved shoulder in each direction. The roadway would be widened at Sunset Road to include a 12-foot wide southbound left-turn lane and a 12-foot wide northbound right-turn lane. The bike lane between the travel and right-turn lane would be five feet wide.

#### *Horizontal Alignment*

The existing Silverbell Road centerline alignment would be maintained. It consists of two horizontal curves with radii of 3,500 feet and 1,400 feet (see plans in Appendix A). The horizontal curves allow for the roadway cross slope to be at a normal crown based on a 50 mph design speed. The roadway widening would occur to the east of the existing roadway pavement edge.

#### *Vertical Alignment*

There would be no change to the existing vertical profile on Silverbell Road.

#### *Drainage*

There would be no change to the existing cross drainage patterns. Where ford walls exist on the east side of the roadway, new ones would be established at the new edge of pavement.

## Sunset Road

For the Interim Alternative, the proposed improvements assume that a portion of Sunset Road is reconstructed at a future date to match the horizontal and vertical alignment of Silverbell Road when it is ultimately improved.

### *Vertical Alignment*

The proximity of the west abutment for the bridge along Sunset Road over the Santa Cruz River to Silverbell Road is a critical controlling element for the Interim Alternative's vertical profile. Preliminary hydraulic modelling indicated that the abutment would need to be located very close to Silverbell Road. The necessary freeboard over the regulatory flood event in addition to the structural depth of the bridge made it impossible to connect the new Sunset Road alignment into the existing Silverbell Road.

Subsequently, consultation with PCDOT and Regional Flood Control District staff has led to the conclusion that the floodplain in this area needs to be remapped and an increase to the upstream base flood elevation of one foot would be acceptable. This will allow for a shorter structure overall, and, perhaps fewer spans.

Given this leeway in the hydraulic modelling process, the design team established a vertical profile for Sunset Road rising at a 5.4% grade that provides sufficient clearance above the current regulatory flood elevation to accommodate four feet of freeboard, and six and a half feet of structure depth. This allows for the west abutment to be placed at Station 71+25, or approximately 300 feet east of the centerline of Silverbell Road. As an Environmentally Sensitive Roadway, maximum grades can reach 10% in mountainous areas and 5% in rolling terrain, with steeper grades allowed to reduce cuts and fills. It is anticipated that the final hydraulic modelling will allow for the west abutment to be moved to the east, a shorter structure, and/or a lower elevation.

For the purposes of this technical memorandum, the vertical profile for Sunset Road between the intersection and the bridge over the Santa Cruz River contains a 40-foot long sag vertical curve at the intersection, a 113-foot long tangent section, then two crest vertical curves of 120-foot and 650-foot long. A short, 15-foot tangent section is placed between the two crest vertical curves and is anticipated to be the location of the west approach slab for the bridge. The longitudinal grade between the intersection and the 120-foot long curve is about 5.4%. The vertical alignment is based on a 40 mph design speed.

## Ultimate Alternative

### Silverbell Road

Under the Ultimate Alternative scenario, Silverbell Road is reconstructed to meet the criteria as set forth in the “Silverbell Road, Ina Road to Grant Road Design Concept Study – Final Report” in the vicinity of Sunset Road where turn lanes are required. This new section will then transition, north and south, to meet existing Silverbell Road.

#### *Cross Section*

The ultimate configuration on Silverbell Road is a four-lane divided roadway that would consist of two travel lanes (12-foot wide inside and 11-foot wide outside lanes) and a six-foot wide paved shoulder in each direction with curb and gutter and a 20-foot wide raised median. At the intersection with Sunset Road, Silverbell Road would be built out to the ultimate four-lane divided roadway including 12-foot wide northbound and southbound left-turn lanes and a 12-foot wide northbound right-turn lane. Silverbell Road would be striped to accommodate one travel lane in each direction.

#### *Horizontal Alignment*

The “Silverbell Road, Ina Road to Grant Road Design Concept Study – Final Report” has the new centerline alignment shifted approximately 30 to 40 feet east of the existing centerline and the proposed improvements occurring to the east of the existing roadway (see plans in Appendix A). This offset would be achieved through horizontal curves north and south of the Silverbell Road/Sunset Road intersection that would tie the new alignment into the existing Silverbell Road alignment at the project limits.

The horizontal alignment has two curves with radii of 5,150 feet and 1,638 feet. The first curve of 5,150 feet begins about 1,380 feet north of the intersection and ends about 380 feet north of the intersection. The second curve begins about 115 feet south of the intersection and terminates about 475 feet further south. The horizontal curves allow for the roadway cross slope to be at a normal crown based on a 50 mph design speed.

The transition from the two-lane to the four-lane roadway begins approximately 885 feet north and terminates approximately 1,160 feet south of the Silverbell Road/Sunset Road intersection.

#### *Vertical Alignment*

The vertical profile for Silverbell Road contains two vertical reverse curves, all at 300 feet in length, near the beginning and end of the alignment and a 112-foot crest vertical curve to tie into the existing roadway at the south end. The longitudinal grades range from about .18%

to about .90%. This vertical alignment satisfies the sight distance requirements of the 50 mph design speed.

## Sunset Road

Under the Ultimate Alternative, Sunset Road is constructed to connect into the ultimate alignment of Silverbell Roadway. This would avoid reconstructing Sunset Road when improvements to Silverbell Road occur in the future.

### *Vertical Alignment*

The vertical profile for Sunset Road contains a 700-foot crest vertical curve coming off of the bridge and a 40-foot sag vertical curve at the intersection. The longitudinal grade is about 2%. The vertical alignment is based on a 40 mph design speed.

## **Interim and Ultimate Alternatives – Comparisons**

### Access Control

The Interim Configuration allows for the majority of the existing access points along Silverbell Road to be maintained. With both configurations, access off of Sunset Road to properties north and south of Sunset Road on the east side of Silverbell Road will be somewhat problematic due to the elevation of Sunset Road as it rises to meet the future bridge grade. The property to the north is owned by Pima County Regional Flood Control District. The property to the south is privately held and appears to be impacted by the right-of-way and slope easements needed for Sunset Road.

### Right-of-Way

It is assumed the future 150-foot Sunset Road right-of-way will be acquired for both alternatives.

The existing right-of-way on Silverbell Road is generally 60 feet within the project limits. Both Alternatives require right-of-way on the east side of Silverbell Road. For the purposes of comparison, it will be assumed that the future right-of-way on the east as identified in the “Silverbell Road, Ina Road to Grant Road Design Concept Study – Final report” will be acquired for either Alternative.

For the Interim Alternative, no right-of-way is anticipated to be acquired on the west side of Silverbell Road, as the necessary widening is occurring to the east with the exception of some minor additions to the shoulder on the west to establish a six-foot width within the project limits.

For the Ultimate Alternative, it is assumed a combination of new right-of-way and easements will be required on the west side of Silverbell Road from various property owners. See Table 1.

<b>TABLE 1</b>						
<b>SILVERBELL ULTIMATE ALTERNATIVE</b>						
<b>Parcel No.</b>	<b>Total R/W Acquisition</b>		<b>Drainage Easement</b>		<b>Slope Easement</b>	
	<b>S.F.</b>	<b>Acres</b>	<b>S.F.</b>	<b>Acres</b>	<b>S.F.</b>	<b>Acres</b>
101-21-003C	3,482	0.08	1,087	0.02	-	-
101-21-003B	3,057	0.07	944	0.02	-	-
101-21-003E	3,027	0.07	-	-	-	-
101-21-009C	2,688	0.06	1,994	0.05	-	-
101-21-010F	-	-	509	0.01	-	-
101-21-010D	-	-	-	-	4,177	0.10
101-21-1250	-	-	927	0.02	-	-
<b>Total</b>	<b>12,254</b>	<b>0.28</b>	<b>5,460</b>	<b>0.13</b>	<b>4,177</b>	<b>0.10</b>

## Drainage

For Sunset Road in both alternatives, the pavement is drained to adjacent swales that slope to the west and would then connect to the existing drainage patterns crossing Silverbell Road.

For Silverbell Road, the Interim Alternative keeps the existing cross drainage patterns that convey the flow over the pavement. New ford walls along the edge of the widened pavement would be required on the east side of the roadway.

For the Ultimate Alternative, the raised vertical alignment of Silverbell Road calls for the need to install culverts both north (2-10'x5'x135' R.C.B.C) and south (4-36"x194' R.C.P. and a 5-24"x163' R.C.P) of Sunset Road<sup>2</sup>. These culverts require drainage easements on the west side to accommodate the inlet structures. It is anticipated that the outlet structures and channels are accommodated within the proposed right-of-way to be acquired on the east side of Silverbell Road, with the exception of the 2-10'x5'x135' R.C.B.C. on existing Pima County Regional Flood Control District controlled property also needing a drainage easement.

The current regulatory FEMA floodplain encompasses portions of Silverbell Road within the vicinity of the intersection with the future Sunset Road. With the construction of the Sunset Road bridge over the Santa Cruz River, this floodplain and floodway will be remapped and the floodplain limits will change. A Conditional Letter of Map Revision and Letter of Map Revision will document the revised floodplain in this vicinity. With the Interim Alternative,

<sup>2</sup> As defined by "Silverbell Road, Ina Road to Grant Road Design Concept Study – Final Report," June 2011.

the construction of the bridge will likely increase the flooding in and around the intersection location. With the Ultimate Alternative, the intersection itself would be out of the floodplain, but Silverbell Road leading to but outside of the project limits will continue to experience flooding.

### Constructability / Traffic Control / Construction Phasing

Both Alternatives can accommodate the construction of Sunset Road without significant issues associated with constructability or traffic control. For both alternatives, the construction of the bridge over the Santa Cruz River will drive the construction project schedule and duration.

For the Interim Alternative, it is conceivable that the additional pavement width on Silverbell Road can be added along with an overlay of the existing pavement section without a major detour.

For the Ultimate Alternative, a detour route would be required for Silverbell Road to allow for the additional fill to be placed and the cross drainage structures constructed. It is anticipated that the detour would be placed to the east of the existing Silverbell Road pavement section.

### Earthwork

The vertical alignment for the Interim Alternative would result in fill sections along both sides of Sunset Road as it heads to the east approaching the abutment for the bridge over the Santa Cruz River. The vertical alignment for the Ultimate Alternative would result in fill sections along both Silverbell Road and Sunset Road. The maximum fill slopes on both sides of Silverbell Road and Sunset Road would be 3H:1V outside of the clear zone to match existing ground. The 3H:1V fill slopes would be benched and hydroseeded. The Interim Alternative would require about 11,000 cubic yards (cy) of borrow. The Ultimate Alternative would require about 50,000 cy of borrow.

### Utilities

For the purposes of comparing the two alternatives, only the utilities along Silverbell Road are potentially impacted.

#### *Tucson Electric Power*

Tucson Electric Power (TEP) has overhead power lines on both sides of Silverbell Road. There is a 46kv transmission line on the west side of the road and a 13.8kv line on the east and includes CenturyLink and, possibly, Cox cable lines.

With the Interim Alternative, the poles on the west side should be able to remain in place, as the location of the southbound travel lane remains the same (although additional pavement to establish a six-foot shoulder is proposed). The widening on the east will impact the 13.8kv line.

With the Ultimate Alternative, the poles on both sides of Silverbell Road within the project limits will be impacted. TEP has indicated that the 46kv line would need to be relocated between October 14 and April 15

### *Tucson Water*

Tucson Water has a 12-inch and a 42-inch potable water line along with a 24 inch reclaimed water line within the existing Silverbell Road right-of-way. These lines should not be impacted by either alternative as the Interim Alternative would be built along existing grade and the Ultimate Alternative would be constructed on fill.

## Pavement Design

For the purposes of comparing the two alternatives, the pavement sections are roughly estimated since the geotechnical work for the pavement design has not been completed. The sections described below reflect the differences of the life spans of the two alternatives, with the Interim Alternative section reflecting a shorter one.

For Silverbell Road, the additional pavement width assumed for the Interim Alternative is 2" of Mix No. 1, over 6" of Aggregate Base (AB), with a 2" Mix No. 2 overlay within the project limits. For Sunset Road, under the Interim Alternative, the pavement is assumed to be 2" of Mix No. 2, over 2" of Mix No. 1, over 6" of AB.

Under the Ultimate Alternative for both Silverbell Road and Sunset Road, the pavement section is assumed to be 2" of mix No. 2, over 3" of mix No.1, over 8" of AB.

## Signalization

A new traffic signal and intersection lighting system would be installed for both alternatives. For the Interim Alternative, the traffic signal and intersection lighting would be temporary. The recommended system would be a span wire type system with steel poles. Under the Ultimate Alternative, the traffic signal and intersection lighting system would be a permanent installation with steel poles and mast arms. Electrical service would be coordinated with TEP to determine a permanent location for both alternatives.

## Pavement Marking and Signing

Both alternatives would require interim pavement marking and signing conforming to Pima County requirements on Silverbell Road. Although the pavement marking and signing on

Sunset Road would be consistent under both scenarios, if the Interim Alternative is constructed, about 300 feet of Sunset Road (to the approach slab of the west abutment) would need to be reconstructed in the future to match the new vertical alignment on Silverbell Road. The posted speed limit on Silverbell Road would be 45 mph and 35 mph on Sunset Road. For the Ultimate Alternative, the interim striping on Silverbell Road would need to be obliterated and restriped to accommodate four travel lanes.

## Landscaping

For the purposes of comparison between the Interim and Ultimate Alternatives, no landscaping is assumed. Appropriate sleeving for irrigation would be included for the median islands called for with the Ultimate Alternative, but its cost is assumed to be incidental.

## Social, Economic and Environmental Considerations

A comparison of the two alternatives from a social, economic and environmental consideration; which included noise, historic/cultural resources, Section 401 and 404 of the Clean Water Act, hazardous materials, visual impacts and wildlife linkages was conducted. In general, environmental considerations are not substantive issues which would guide the selection of the Interim or Ultimate connection options. Those resources or issue of note are provided below.

From a noise perspective, neither alternative will trigger noise mitigation measures. The Ultimate Alternative will raise the elevation of Silverbell Road and increase the noise level to some degree, but it is not anticipated that it will impact sensitive receptors where mitigation measures are warranted.

From Section 401 and 404 of the Clean Water Act perspectives, the new portion of Sunset Road called for in both alternatives will have similar permitting implications. Silverbell Road widening needed for the intersection would encroach on Waters of the US and be subject to Section 401/404 Nationwide Permit #14 (Linear Transportation Projects) permitting. The Interim Alternative footprint is likely less than 1/10th of an acre and would be a non-notifying action. The Ultimate Alternative impacts may exceed 1/10th of an acre and require a Pre-Construction Notice (PCN). In neither case are the Clean Water Act implications of significant concern.

For historic/cultural resources, efforts to-date does not indicate any potential issues. No known cultural resource sites are located at the intersection location. The future Historic District proposed as part of the overall Silverbell Road: Ina Road to Grant Road planning effort will not be in place prior to construction of the Sunset Road / Silverbell Road intersection and should not complicate the construction effort for either alternative.

The impacts to biological resources would be similar with either alternative. No riparian or protected plant or animal species are expected at the Silverbell Road connection. The Ultimate Alternative would remove a greater number of native plants; however, the difference is not significant.

For both alternatives, the visual impact associated with the new Sunset Road would be similar. For the Ultimate Alternative, raising Silverbell Road by up to eight to nine feet would alter the visual aesthetic resources. For the purposes of this comparison; however, no significant mitigation measures are anticipated.

The "Silverbell Road, Ina Road to Grant Road Design Concept Study – Final Report" identified a wildlife corridor in the area immediately adjacent and to the north of the planned Sunset Road and Silverbell Road intersection. The area was originally defined under the Pima County 2004 Conservation Lands System Bond Program as "Highest Priority Private" land, due to generally open space connectivity between the Tucson Mountains and Santa Cruz River at this location. The future widening of Silverbell Roadway to a 4-lane divided roadway is the primary issue associated with consideration of increased hazards to motorist and wildlife. The Ultimate Alternative would substantially widen Silverbell Road and would also include a box culvert just north of the intersection that could conceivably facilitate wildlife crossings if appropriate fencing and other measures were installed to encourage its use. The additional fencing would fall well outside of the project limits in order to make the new culvert an effective wildlife linkage across Silverbell Road. The Interim Alternative condition does not substantially widen Silverbell Road, therefore it is not substantively changing the current wildlife movement conditions. Also, the forecast Silverbell traffic volumes change minimally with the new Sunset Road connection to I-10. 2018 and 2025 volumes with or without Sunset Road are within 10% of each other. Since the interim condition is not substantially changing Silverbell Road, the current wildlife movements would not be expected to be impacted.

## Probable Costs for Construction

The probable costs for construction (see Appendix B) include 10% design, 25% construction and 1% post design services contingencies for both alternatives. For right-of-way, a \$1.50 per square foot value is assumed and a \$0.75 per square foot value is assumed for easements. Needed right-of-way and easement costs are only applied to what is needed to construct the Ultimate Alternative and does not include the overlap of right-of-way / easements with the Interim Alternative.

For the purposes of comparing the two alternatives, the portion of the respective Alternatives improvement that will be removed when rest of Silverbell Road is widened is characterized as the "throwaway." The following assumptions were used in determining the costs provided in the table:

- Interim Alternative – the “throwaway” includes the span wire signal and lighting system (minus salvage value), aggregate base and paving on Silverbell Road (widening) and about 300 feet along Sunset Road, along with the ford walls.
- Ultimate Alternative – the “throwaway” includes the transition paving and aggregate base.

<b>Alternative</b>	<b>Total Estimated Construction Costs</b>	<b>Total Estimated Cost of Throwaway</b>
Interim	\$1.25 M	\$371K
Ultimate	\$3.70 M	\$300K

## Summary

The Sunset Road: Silverbell Road to River Road project has significant regional implications. Constructing the Silverbell Road to I-10 portion (Segment I) as soon as possible will allow for a key traffic relief route for the upcoming Ina Road/I-10 and Ruthrauff Road/I-10 Traffic Interchange reconstruction projects.

The Sunset Road / Silverbell Road intersection has implications on the ability to have the Segment I project move forward with alacrity and cost effectiveness. The design features reviewed in this technical memorandum offer insight on how to best meet these overarching goals and address key concerns with respect to scope, schedule and budget.

The significant design features considered in the comparison of the two alternatives demonstrate benefits and challenges associated with their respective implementation. In the three and a half months since the design’s kick-off meeting, other project related issues have emerged that offer some insight on how to weight the differences between the two. Most notably, the hydraulics of the Santa Cruz River and its impact on the bridge location and length has caused considerable concerns.

As noted earlier in this memorandum, the preliminary hydraulic modelling placed the western Santa Cruz Bridge abutment so close to Silverbell Road that it precluded the consideration of the Interim Alternative due to the differences in grade. With the new approach to the hydraulic modelling, the abutment has been set at a location where the vertical geometry is manageable and the Interim Alternative is still a viable option.

Early indications of the hydraulic modelling effort under the new approach reflect flow conditions that will increase the length of the Santa Cruz River Bridge over the one used in establishing the budget and scope as included in the original Solicitation for Qualifications. As such, the cost of the overall project could become a key concern and cost saving measures are, likewise, carrying greater weight.

Reviewing the alternatives with respect to the design features described above, the Ultimate Alternative has three key advantages:

- Drainage across a portion of Silverbell Road will be improved
- The traffic signal will not need to be rebuilt
- The cost of the improvements that must be rebuilt (the “throw away” portion is less.

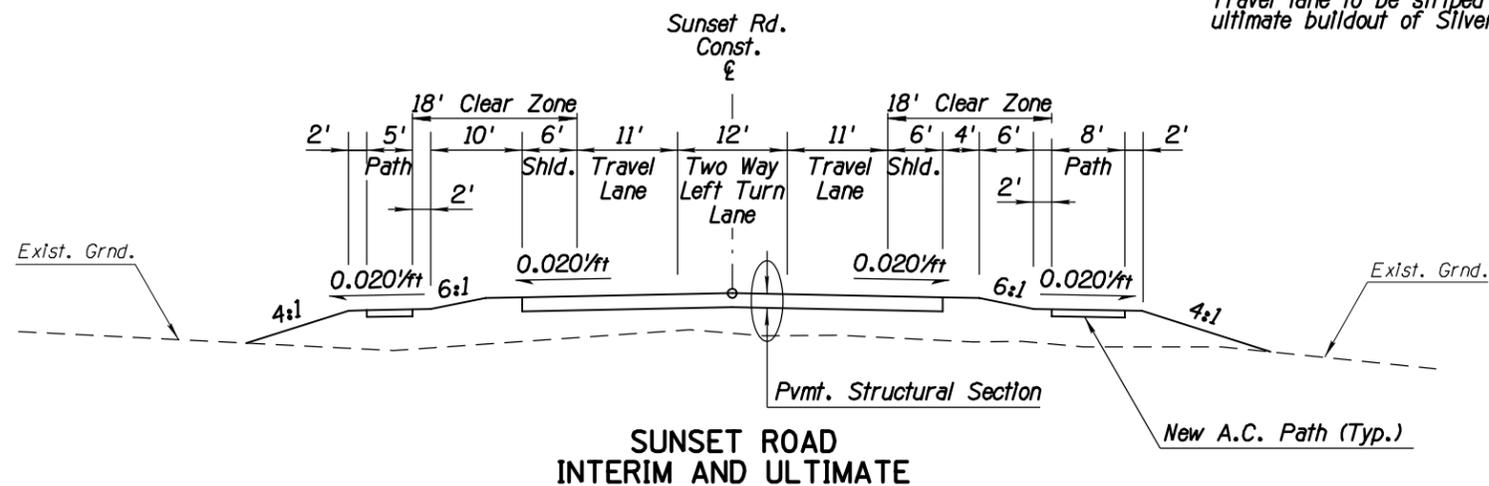
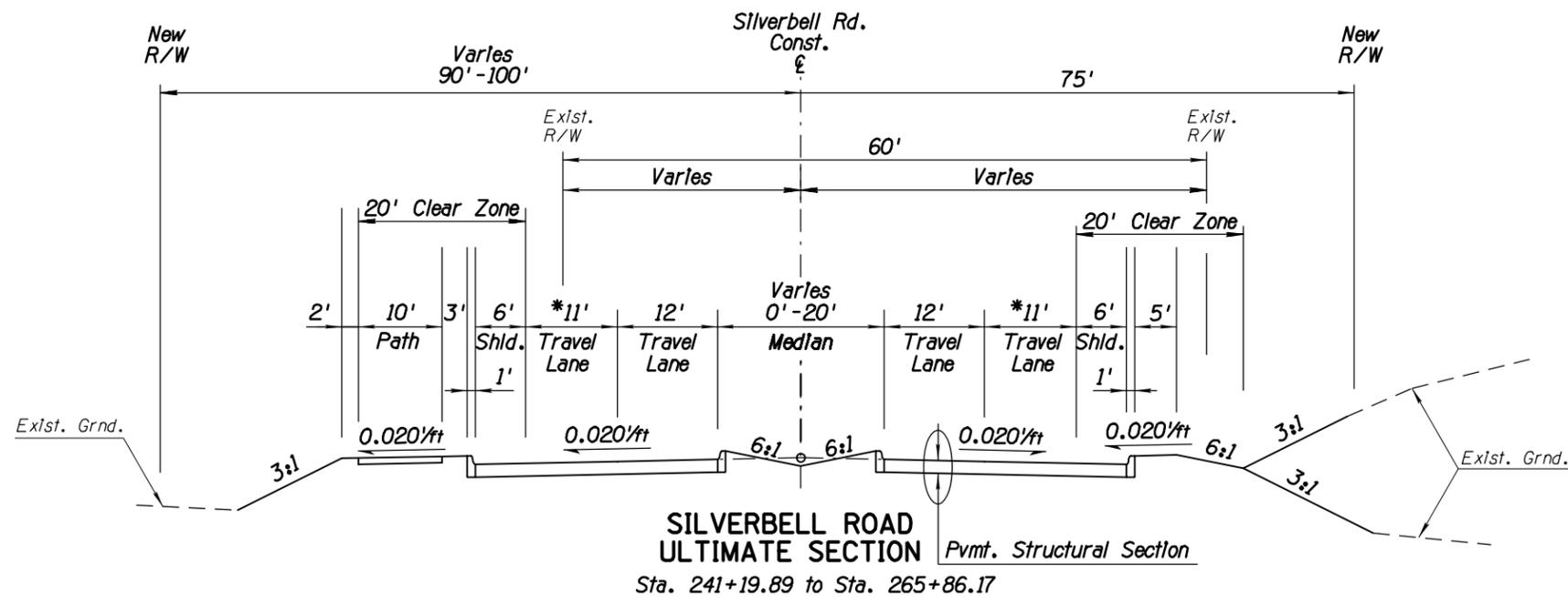
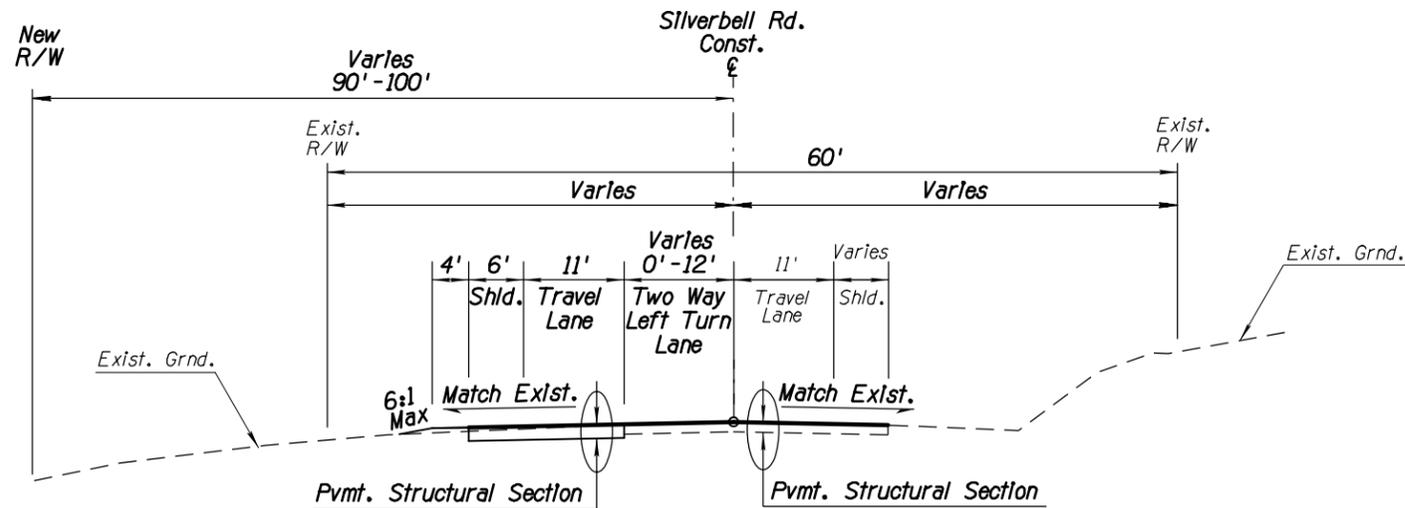
Focusing on the design feature where there are notable differences, the Interim Alternative offers advantages over the Ultimate in terms of the following:

- Access to adjacent properties along Silverbell is not as severely impacted
- Right-of-way requirements are less
- Earthwork is reduced
- Constructability / Traffic Control/ Construction Phasing is easier to accommodate
- Utilities, most notably Tucson Electric Power are less impacted
- Noise impacts are lower
- Visual impacts are less
- The construction cost is lower

## **Recommendation**

Recognizing the fiscal constraints that are beginning to emerge with respect to the project’s cost as well as the advantages associated with some of the key design features, the Interim Alternative is the approach recommended at this time. Should assumptions change, other design factors emerge, or other issues surface, this recommendation is subject to change.

## Appendix A – Preliminary Plans

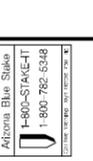


Priscilla S. Cornello, P.E., Director

Date	05/14
Designed	MPK
Drawn	RM
Checked	CLR
Proj. Engr.	MPK

No.	Revision Description	Engineer	Date

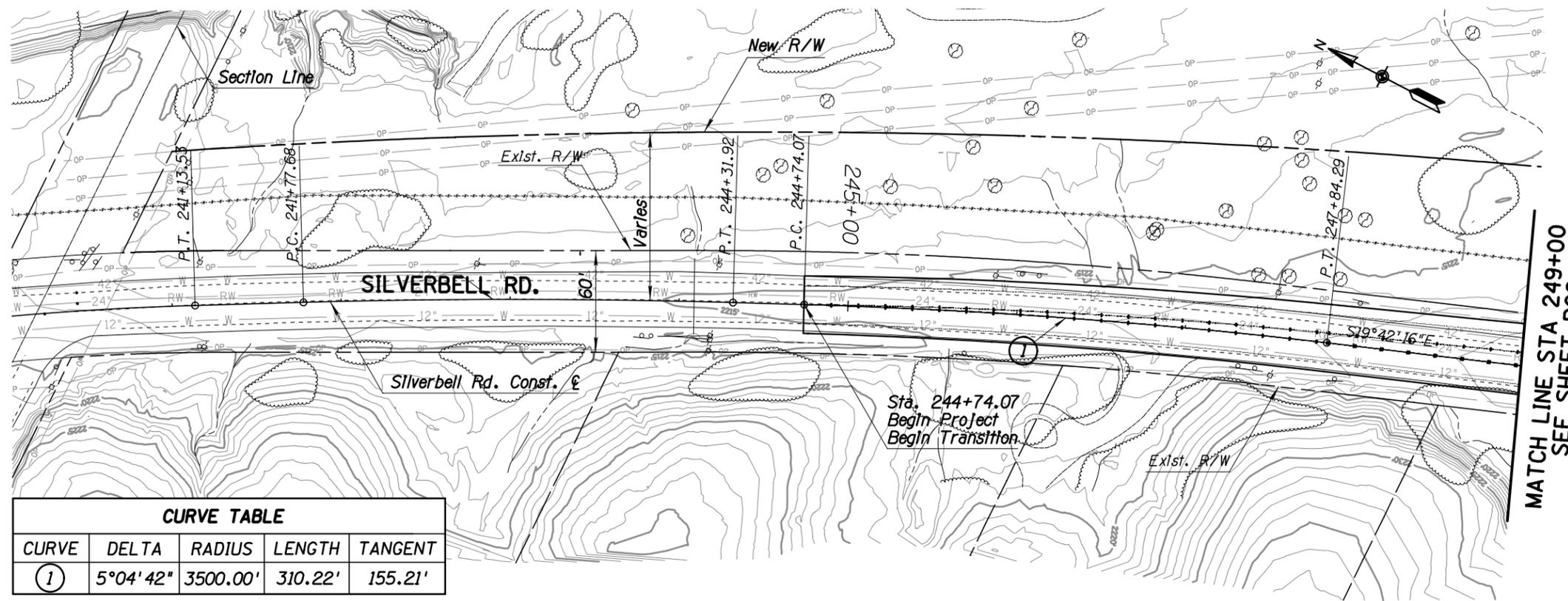
PRELIMINARY NOT FOR CONSTRUCTION STAGE 1



SUNSET ROAD - SEGMENT 1  
SILVERBELL RD. TO I-10  
PROJECT NO. 4RTSUN

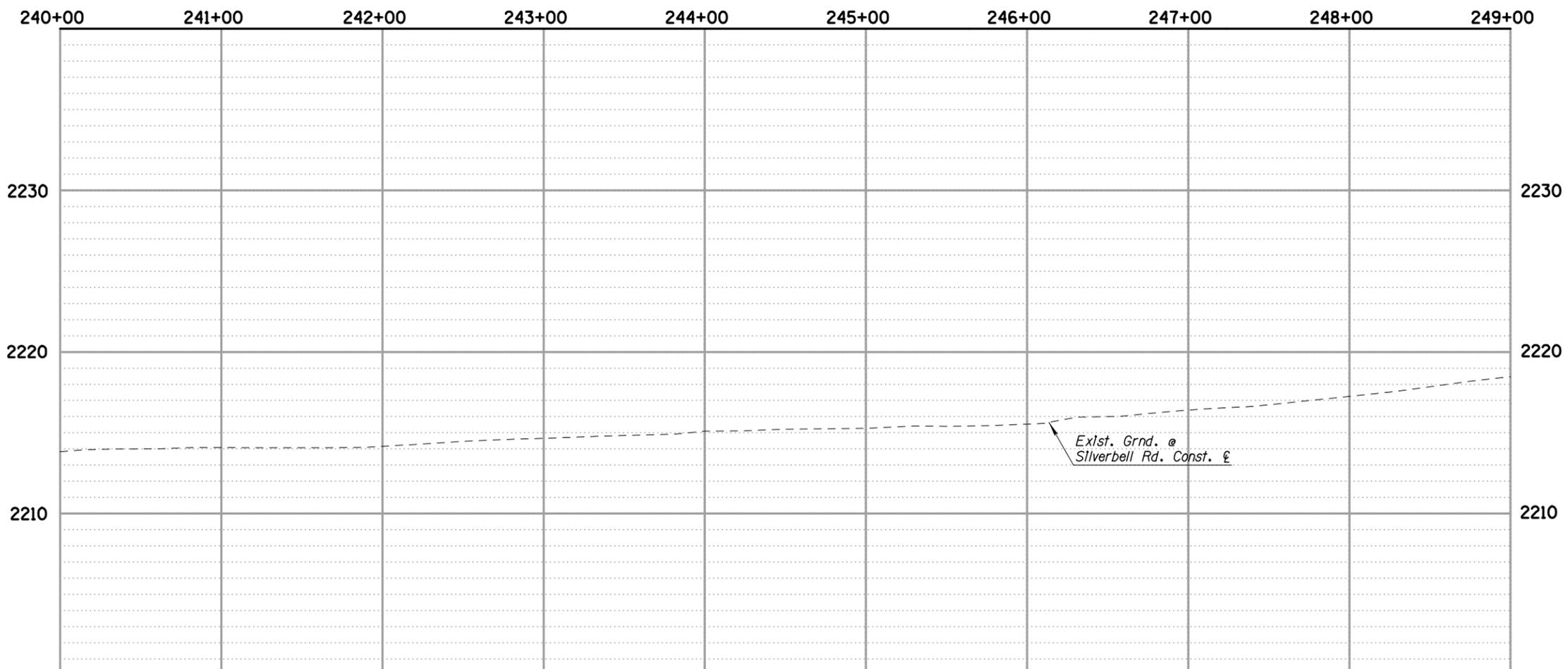
SUNSET ROAD - SILVERBELL ROAD TO I-10 - PROJECT NO. 4RTSUN

Pima County Department of Transportation



MATCH LINE STA 249+00  
SEE SHEET P02

CURVE TABLE				
CURVE	DELTA	RADIUS	LENGTH	TANGENT
1	5°04'42"	3500.00'	310.22'	155.21'



Priscilla S. Cornello, P.E., Director

Date	Designated
03/14	J.L.C.
03/14	J.L.C.
03/14	M.P.K.
03/14	C.R.

No.	Revision Description	Engineer	Date

Silverbell Rd./Sunset Rd. Technical Memo



ROADWAY PLAN & PROFILE SHEET  
SUNSET ROAD  
PROJECT NO. 4RTSUN

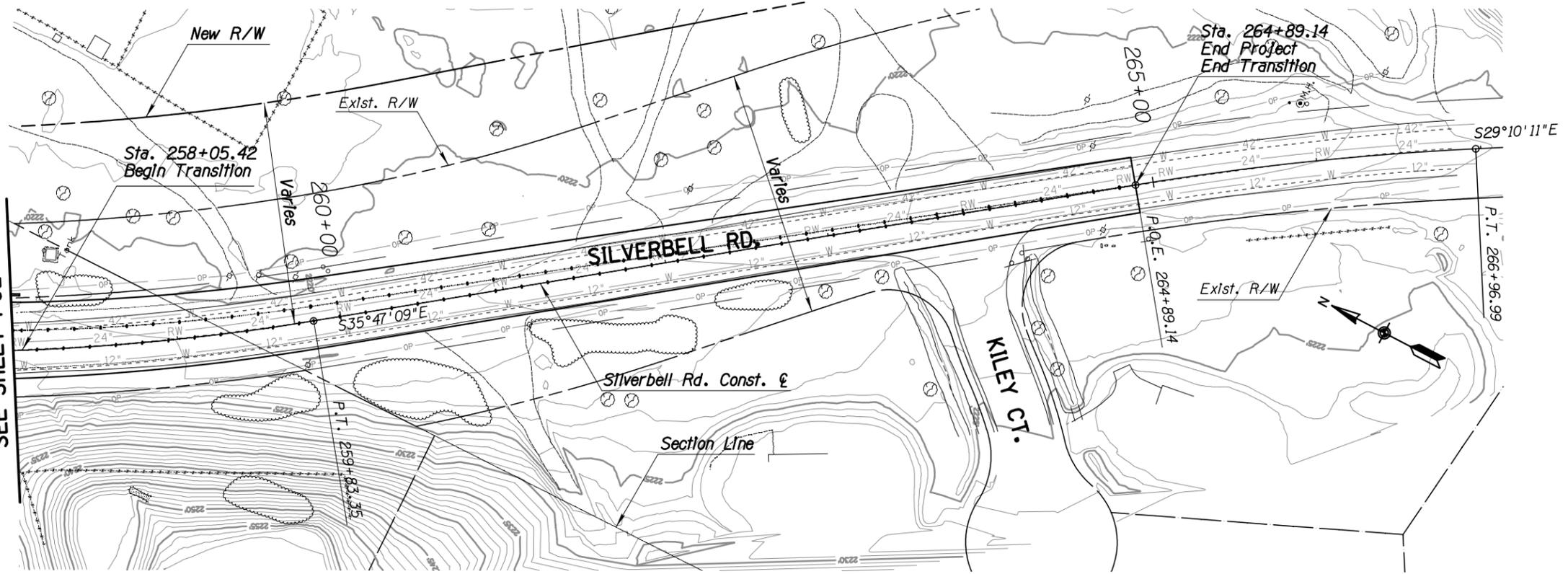
Plima County Department of Transportation

SUNSET ROAD - SILVERBELL ROAD TO I-10 - PROJECT NO. 4RTSUN

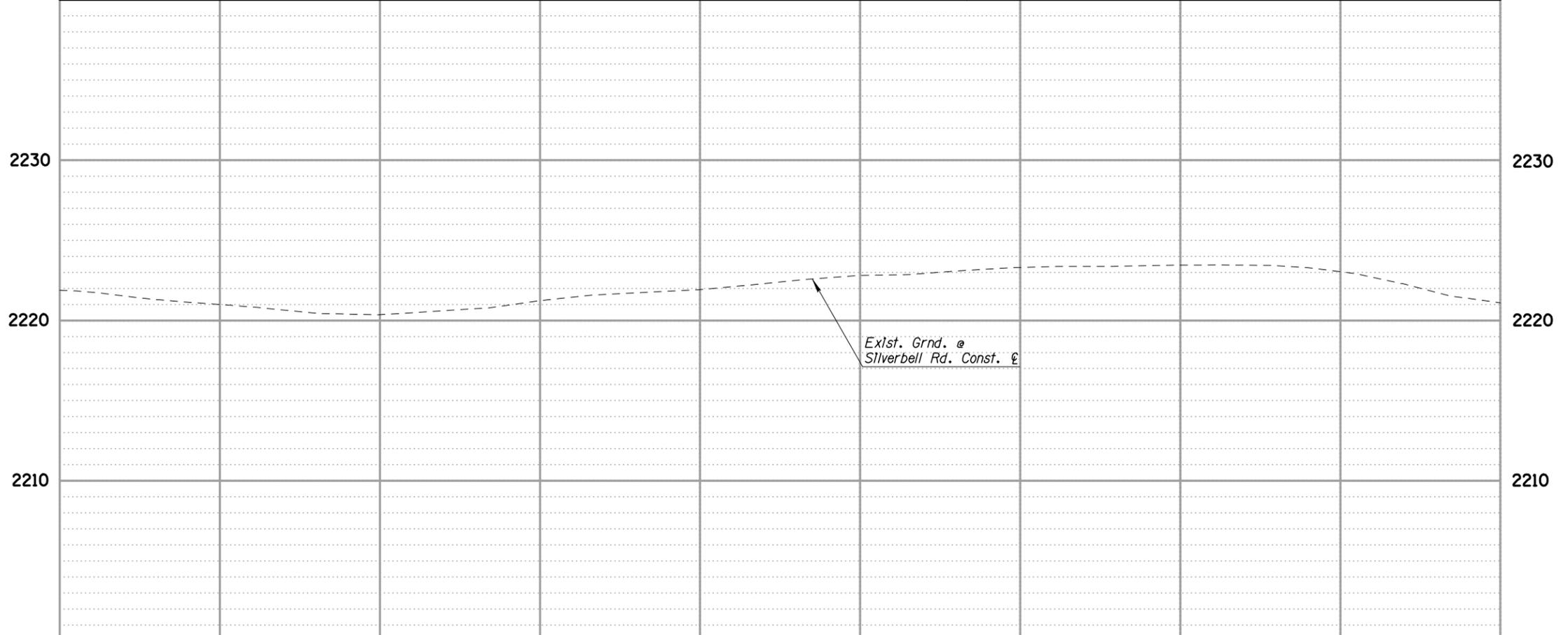
TECHNICAL MEMO  
INTERIM SILVERBELL OPTION



MATCH LINE STA 258+00  
SEE SHEET P02



258+00      259+00      260+00      261+00      262+00      263+00      264+00      265+00      266+00      267+00



Scale: 1"=40'      Sheet P03 of P04      Page 4 of 9

Priscilla S. Cornello, P.E., Director

Designed	J.C.	Date	03/14
Drawn	J.C.	Checked	MPK
Checked	MPK	Proj. Engr.	C.R.
Proj. Engr.	C.R.		

No.	Revision Description	Engineer	Date

Silverbell Rd./  
Sunset Rd.  
Technical Memo

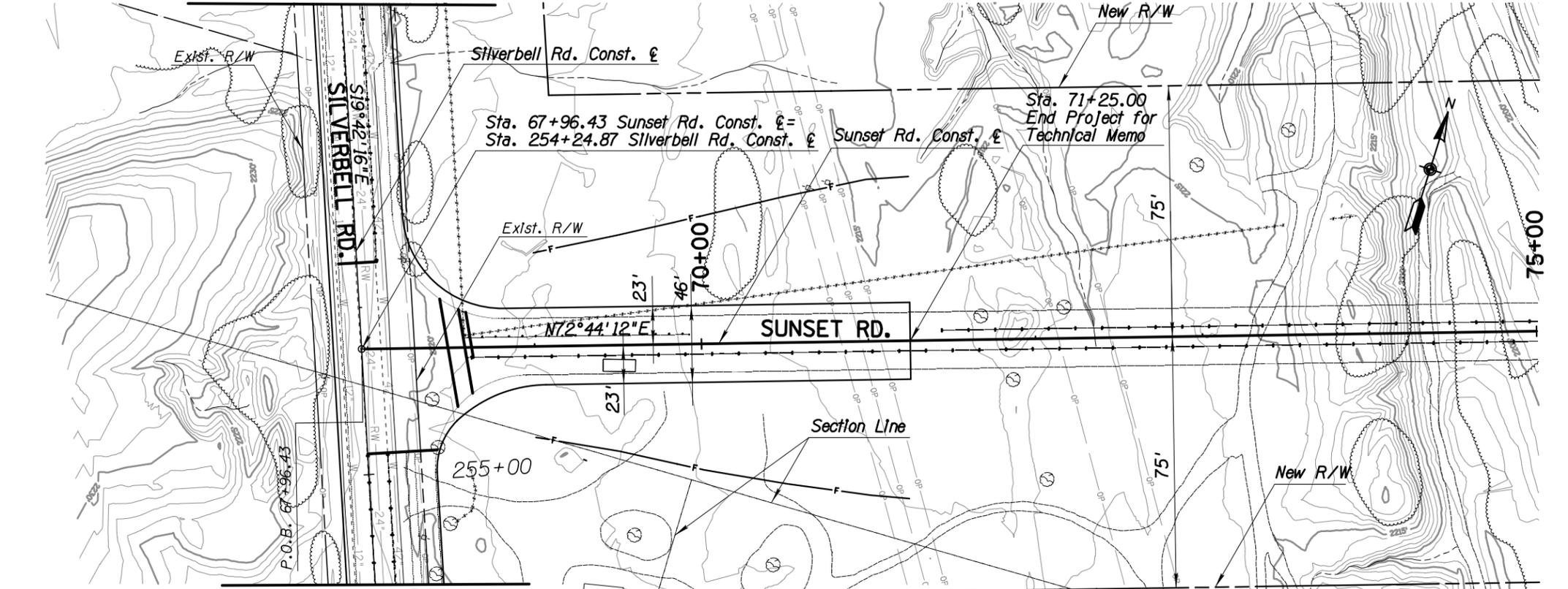


ROADWAY PLAN & PROFILE SHEET  
SUNSET ROAD  
PROJECT NO. 4RTSUN

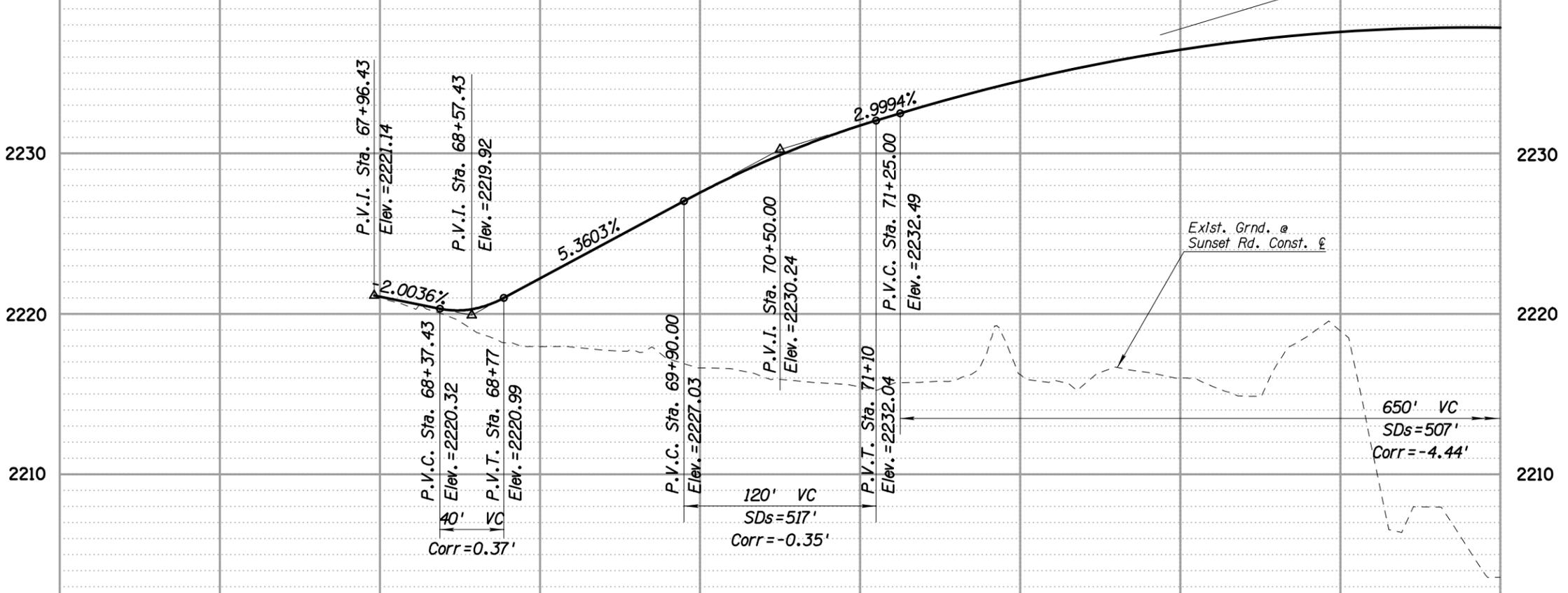
Plima County Department of Transportation

SUNSET ROAD - SILVERBELL ROAD TO I-10 - PROJECT NO. 4RTSUN

SEE SHEET P02



66+00 67+00 68+00 69+00 70+00 71+00 72+00 73+00 74+00 75+00



TECHNICAL MEMO  
INTERIM SILVERBELL OPTION

Priscilla S. Cornello, P.E., Director

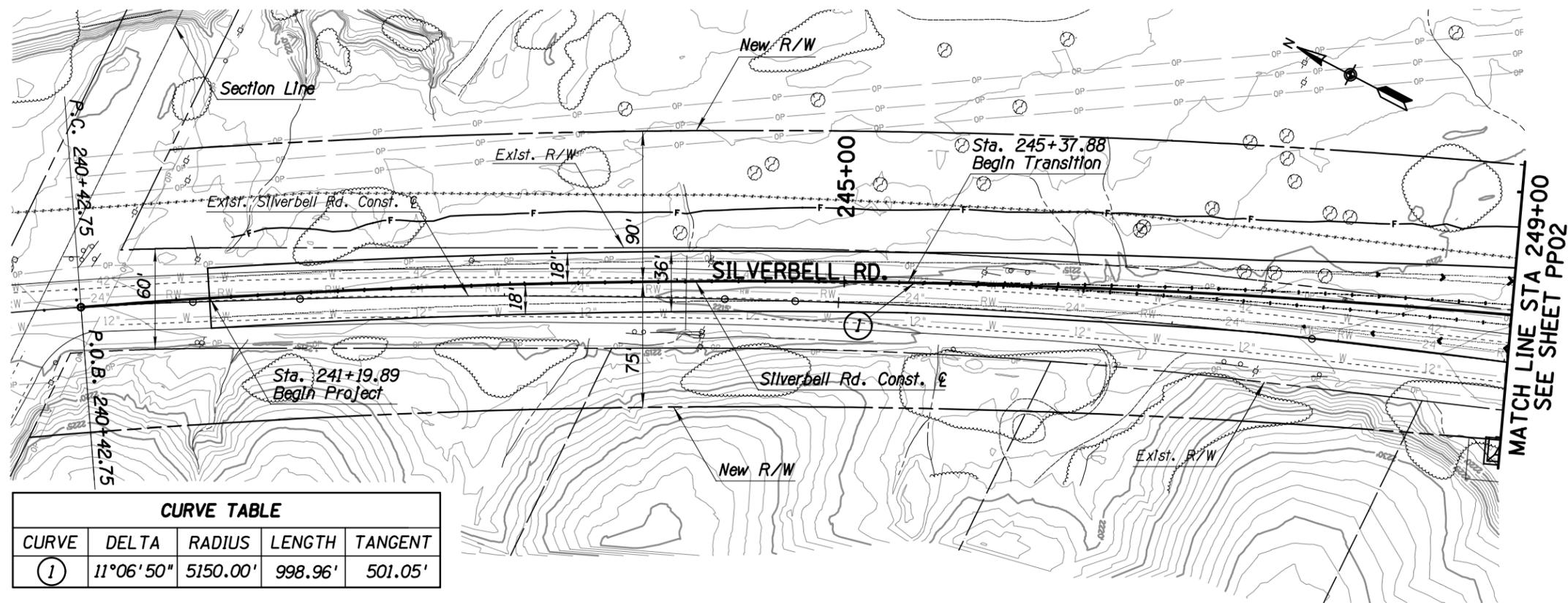
No.	Revision Description	Engineer	Date

Silverbell Rd./  
Sunset Rd.  
Technical Memo

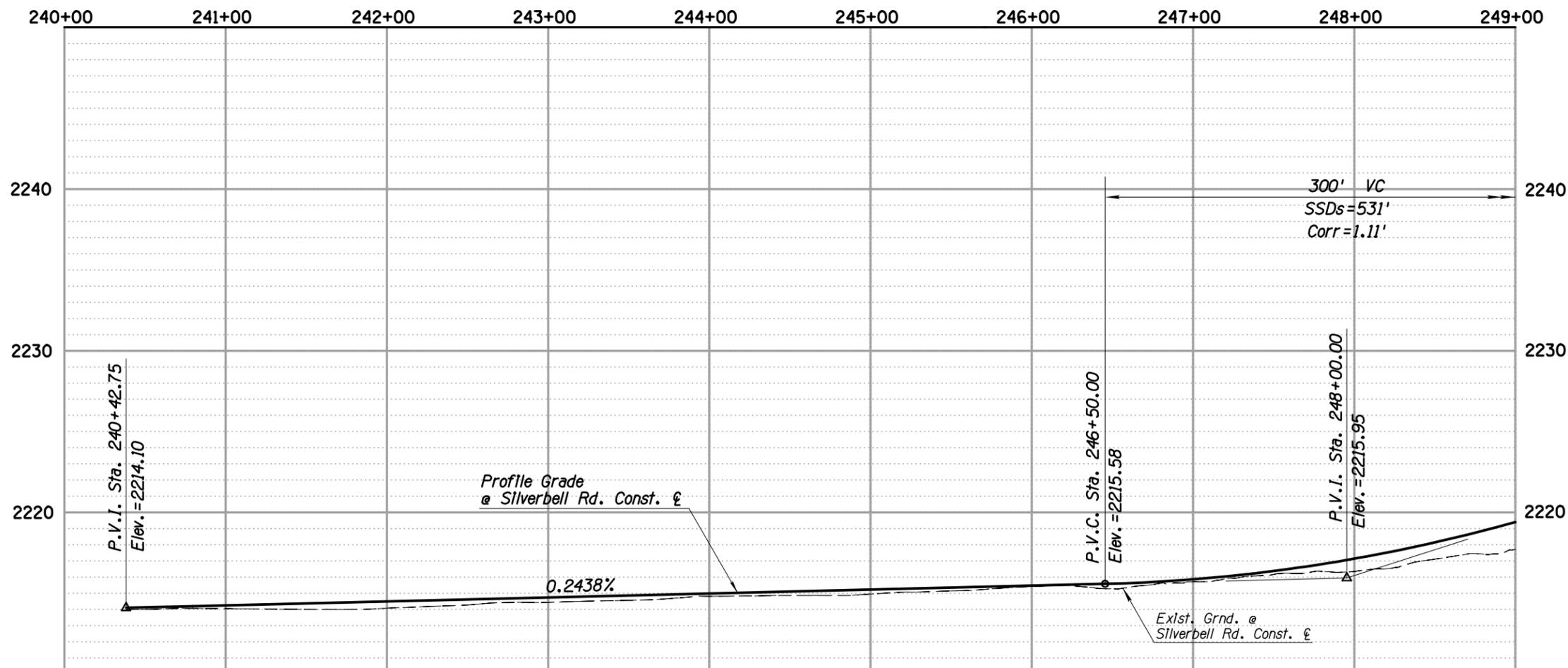
TRANSPORTATION  
 AECOM  
 1400 STAKE-IT  
 1-800-782-6348  
 10000 N. CENTRAL EXPRESSWAY, SUITE 100  
 DALLAS, TEXAS 75243-9777

Arizona Blue Stakes  
 1-800-STAKE-IT  
 1-800-782-6348  
 10000 N. CENTRAL EXPRESSWAY, SUITE 100  
 DALLAS, TEXAS 75243-9777

Pima County Department of Transportation  
 ROADWAY PLAN & PROFILE SHEET  
 SUNSET ROAD  
 PROJECT NO. 4RTSUN



CURVE TABLE				
CURVE	DELTA	RADIUS	LENGTH	TANGENT
①	11°06'50"	5150.00'	998.96'	501.05'



TECHNICAL MEMO  
ULTIMATE SILVERBELL OPTION

Priscilla S. Cornello, P.E., Director

No.	Revision Description	Engineer	Date

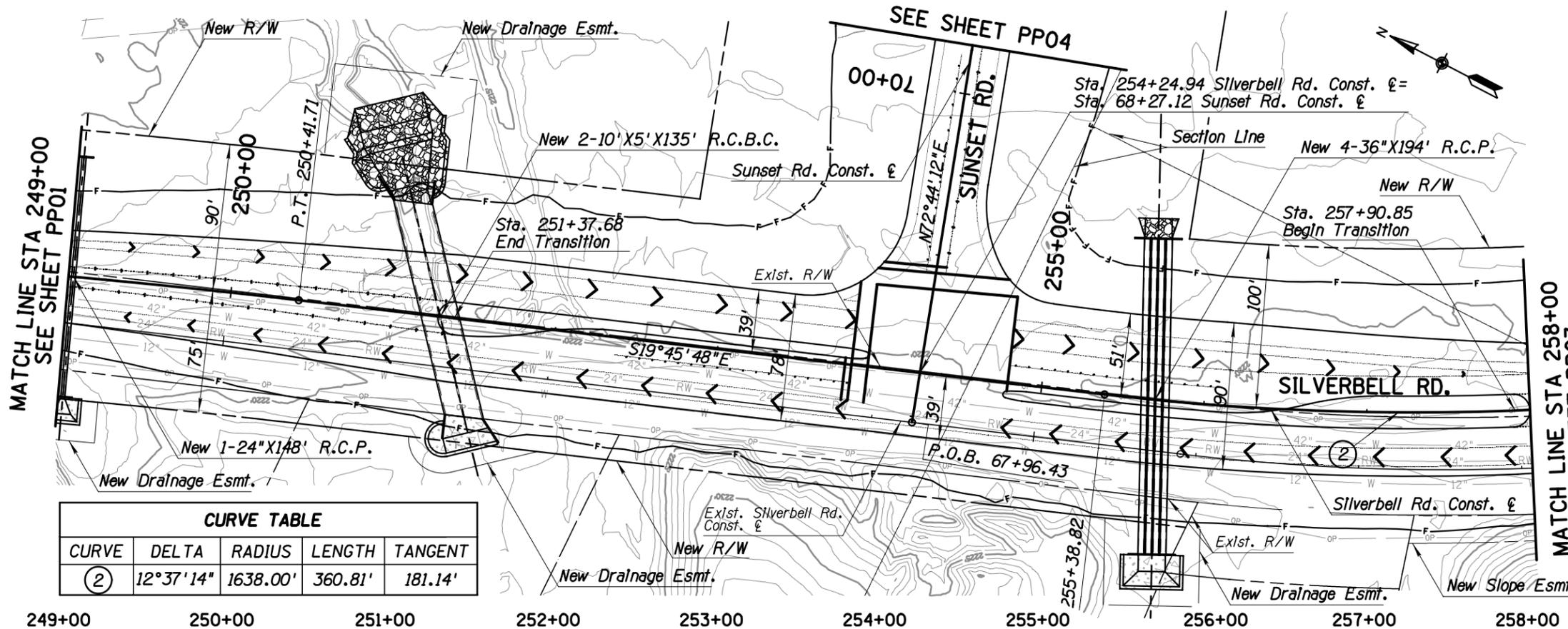
Designed: J.L.C. 03/14  
 Drawn: J.L.C. 03/14  
 Checked: M.P.K. 03/14  
 Proj. Engr.: C.R. 03/14

Silverbell Rd./Sunset Rd. Technical Memo  
 AECOM  
 TRANSPORTATION  
 AECOM USA, INC. SUITE 125  
 1400 N. 17TH AVENUE, SUITE 125  
 DENVER, CO 80202

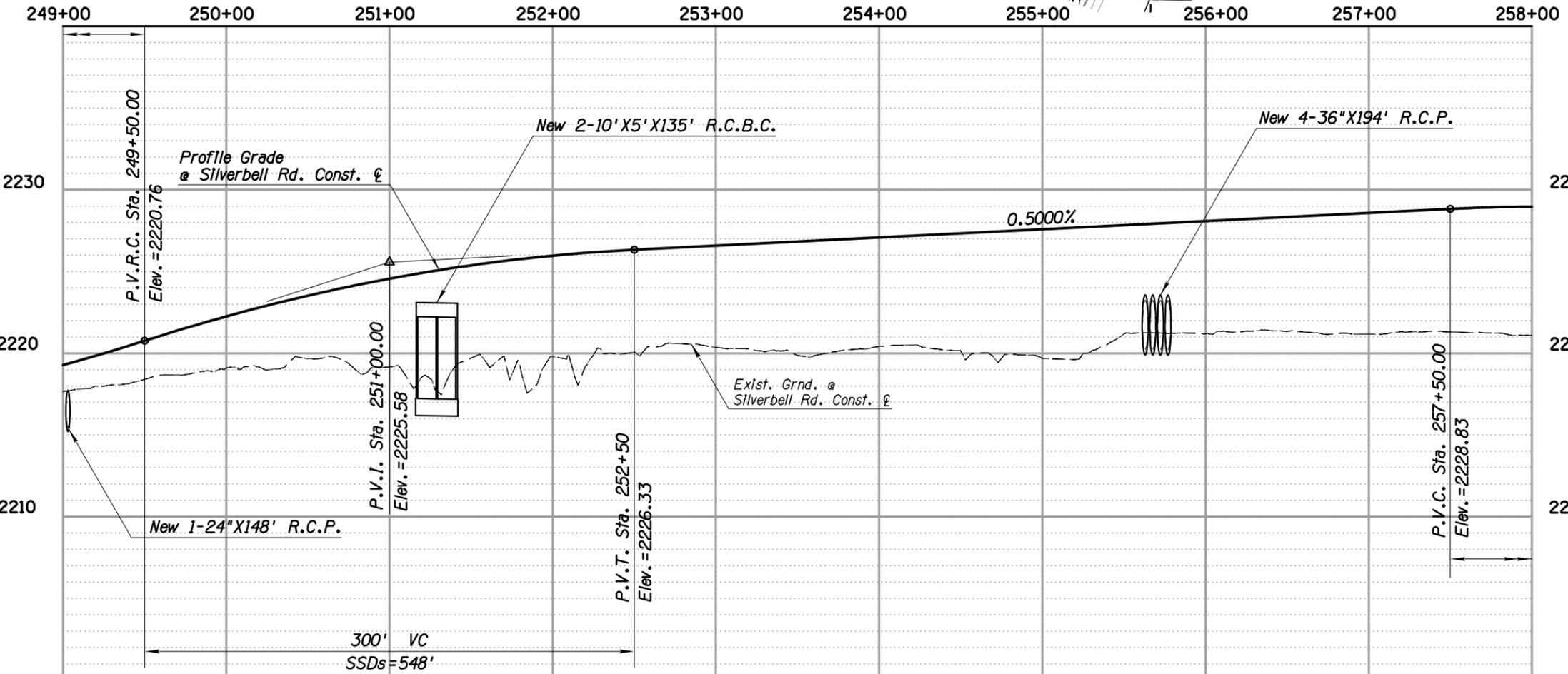
Arizona Blue Stakes  
 1-800-STAKE-IT  
 1-800-782-5348  
 1575 N. 17TH AVENUE, SUITE 100  
 DENVER, CO 80202

ROADWAY PLAN & PROFILE SHEET  
 SUNSET ROAD  
 PROJECT NO. 4RTSUN

Plima County Department of Transportation



CURVE TABLE				
CURVE	DELTA	RADIUS	LENGTH	TANGENT
②	12°37'14"	1638.00'	360.81'	181.14'



Priscilla S. Cornello, P.E., Director

Date	Designated
03/14	J.L.C.
03/14	J.L.C.
03/14	M.P.K.
03/14	C.R.

No.	Revision Description	Engineer	Date

Silverbell Rd./ Sunset Rd. Technical Memo



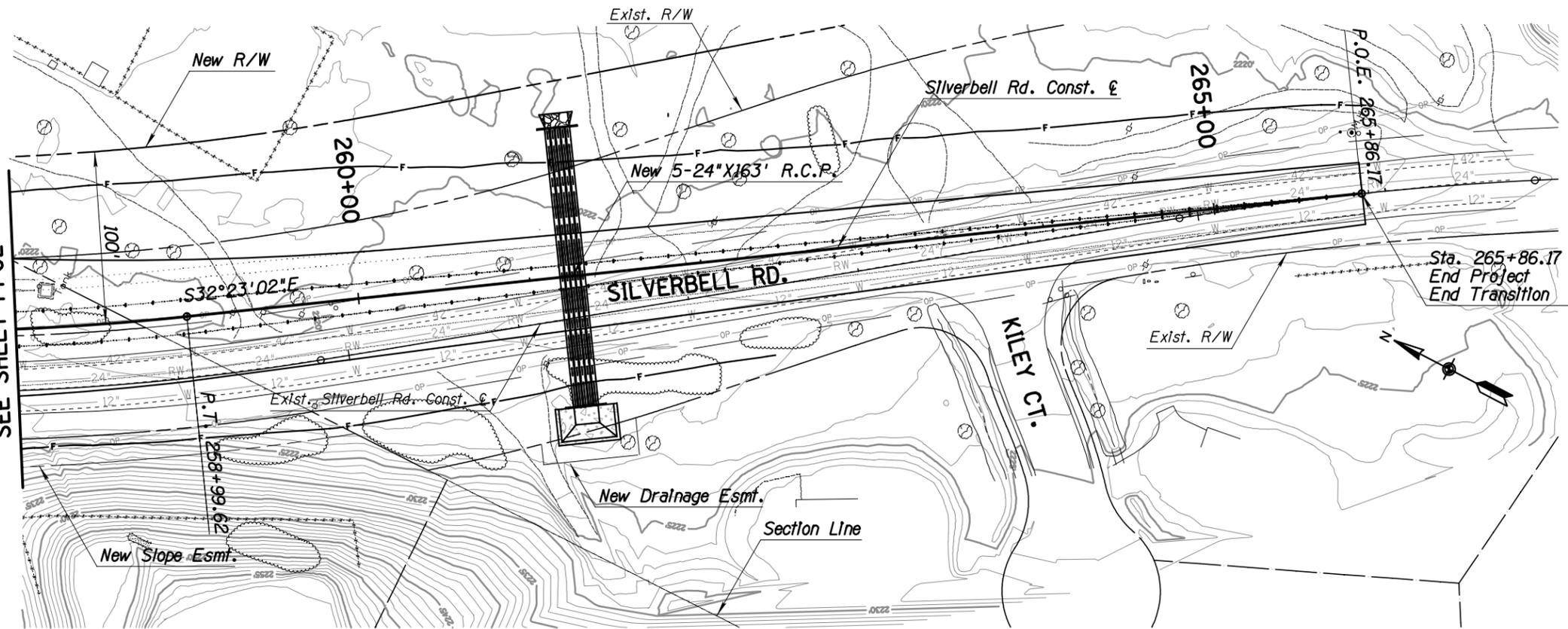
ROADWAY PLAN & PROFILE SHEET  
SUNSET ROAD  
PROJECT NO. ARTSUN

Plima County Department of Transportation

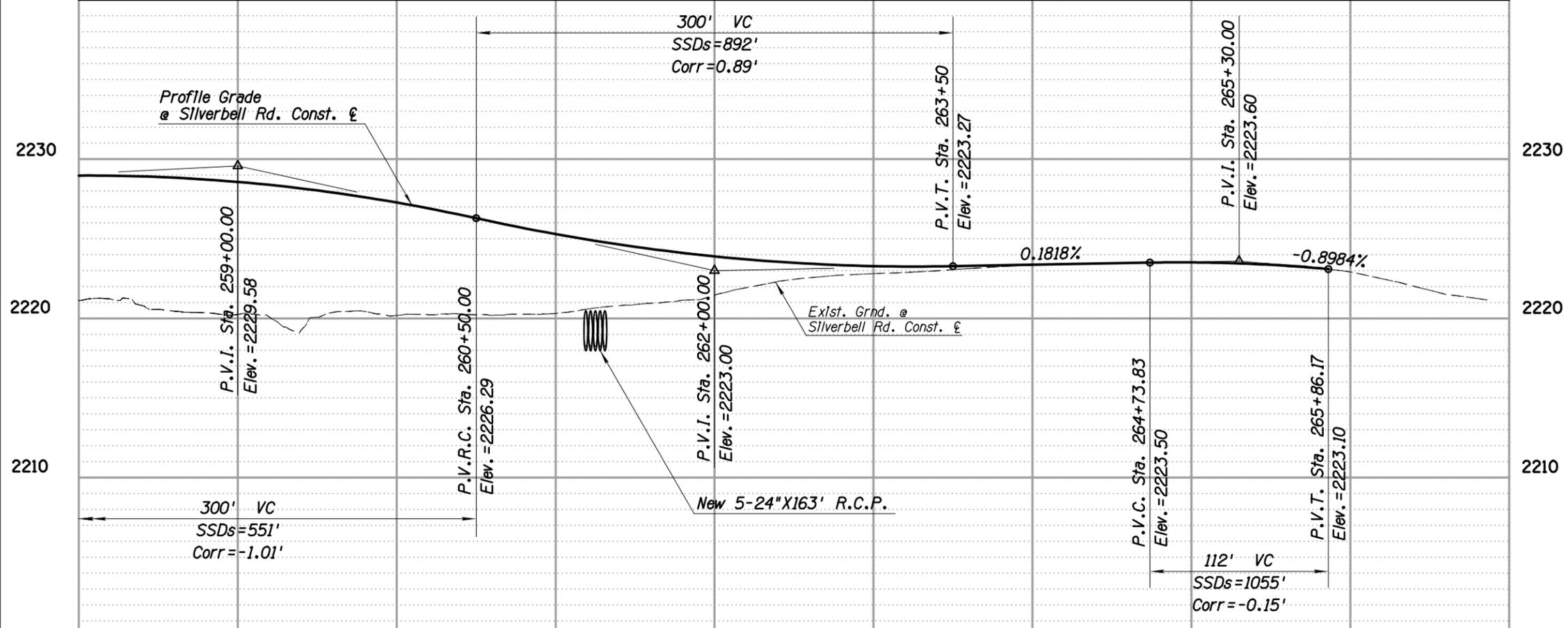
SUNSET ROAD - SILVERBELL ROAD TO I-10 - PROJECT NO. ARTSUN

TECHNICAL MEMO  
ULTIMATE SILVERBELL OPTION

MATCH LINE STA 258+00  
SEE SHEET PP02



258+00    259+00    260+00    261+00    262+00    263+00    264+00    265+00    266+00    267+00



TECHNICAL MEMO  
ULTIMATE SILVERBELL OPTION

Scale: 1"=40'    Sheet PP03 of PP04    Page 8 of 9

Priscilla S. Cornello, P.E., Director

No.	Revision Description	Engineer	Date

Silverbell Rd./ Sunset Rd. Technical Memo

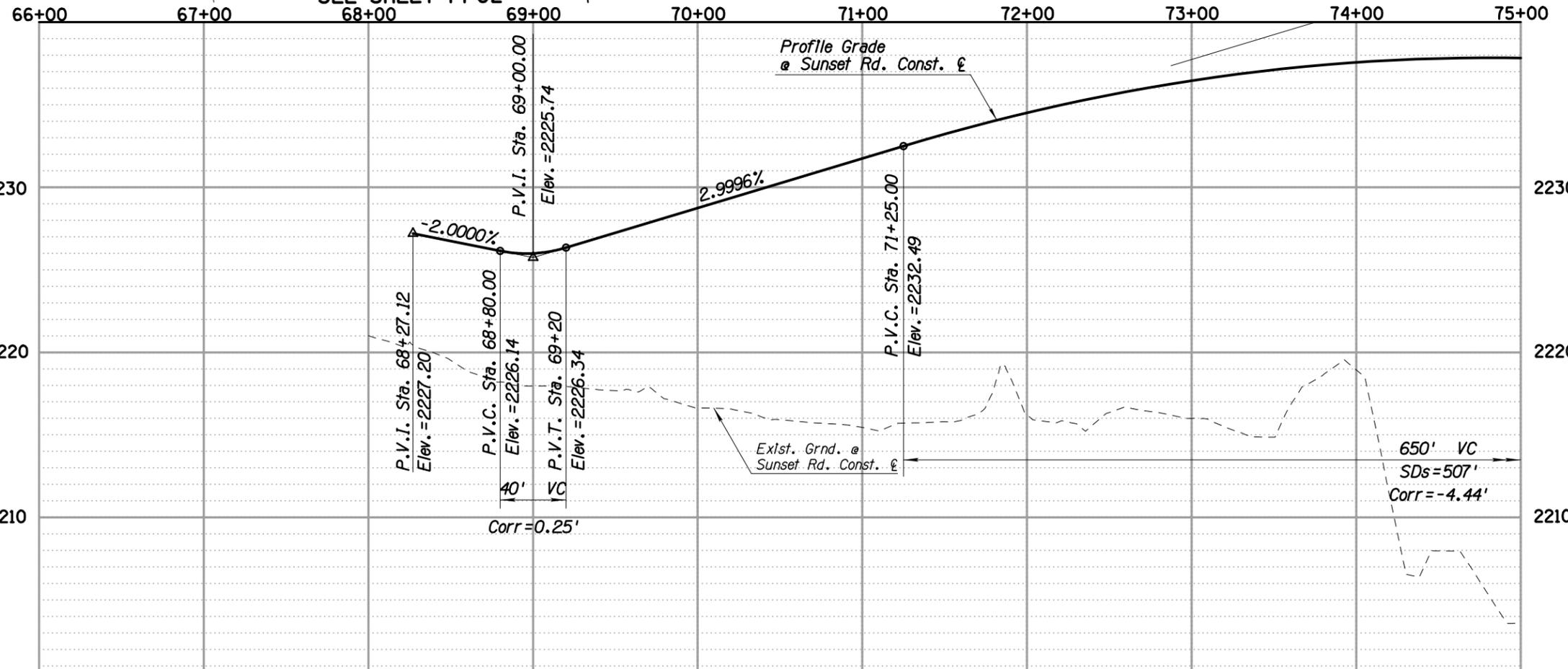
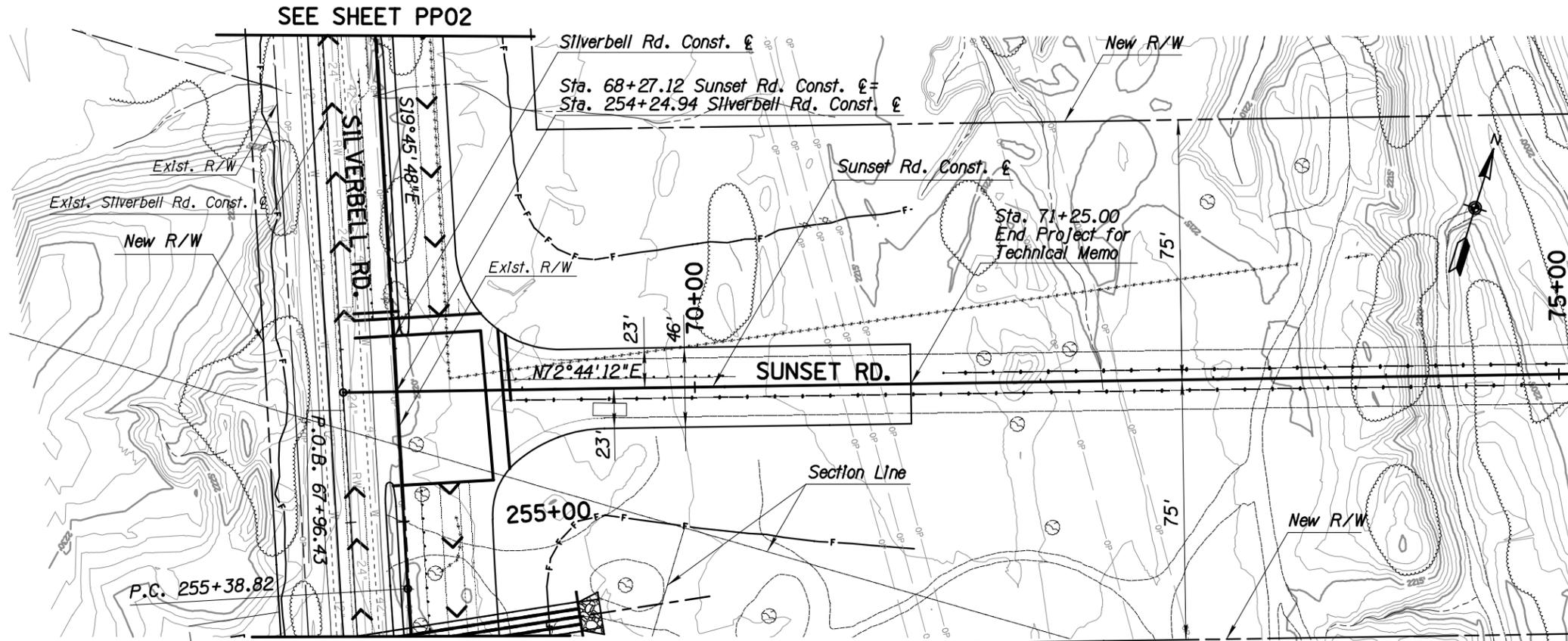
AECOM

TRANSPORTATION  
AECOM USA, INC. 3000 N. CENTRAL EXPRESSWAY, SUITE 125  
TULSA, OKLAHOMA 74103-2000

Arizona Blue Stakes  
1-800-STAKE-IT  
1-800-782-6348  
1000 N. CENTRAL EXPRESSWAY, SUITE 125  
TULSA, OKLAHOMA 74103-2000

Plima County Department of Transportation

ROADWAY PLAN & PROFILE SHEET  
SUNSET ROAD  
PROJECT NO. 4RTSUN



TECHNICAL MEMO  
ULTIMATE SILVERBELL OPTION

Priscilla S. Cornello, P.E., Director

No.	Revision Description	Engineer	Date

Plima County Department of Transportation

ROADWAY PLAN & PROFILE SHEET  
SUNSET ROAD  
PROJECT NO. 4RTSUN

AECOM  
TRANSPORTATION  
14800-STAKE-IT  
14800-782-5348  
7000 N. 19TH AVENUE, SUITE 100  
DENVER, CO 80202

Silverbell Rd./  
Sunset Rd.  
Technical Memo

Date	
03/14	Designed
03/14	Drawn
03/14	Checked
03/14	Proj. Engr.

## Appendix B – Preliminary Cost Estimates

### Interim Alternative Probable Cost

	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	2010001	CLEARING AND GRUBBING	L.S.	1	\$10,000.00	\$10,000.00
2	2010010	CLEARING AND GRUBBING (NOXIOUS AND INVASIVE SPECIES CONTROL ALLOWANCE)	USD	5,000	\$1.00	\$5,000.00
3	2020001	REMOVAL OF STRUCTURES & OBSTRUCTIONS	L.S.	1	\$10,000.00	\$10,000.00
4	2020030	REMOVAL OF BITUMINOUS PAVEMENT BY MILLING	S.Y.	6,700	\$2.00	\$13,400.00
5	2030901	BORROW	C.Y.	11,000	\$12.00	\$132,000.00
6	3030003	AGGREGATE BASE	C.Y.	834	\$40.00	\$33,360.00
7	4060001	ASPHALTIC CONCRETE (NO. 1)	TON	544	\$85.00	\$46,240.00
8	4060002	ASPHALTIC CONCRETE (NO. 2)	TON	1,275	\$85.00	\$108,375.00
9	7010001	MAINTENANCE AND PROTECTION OF TRAFFIC	L.S.	1	\$50,000.00	\$50,000.00
10	7010007	CONSTRUCTION AREA ELEMENTS (PREDETERMINED REIMBURSEMENT RATE ALLOWANCE)	USD	25,000	\$1.00	\$25,000.00
11	9010001	MOBILIZATION	L.S.	1	\$100,000.00	\$100,000.00
12	9080504	CONCRETE FORD WALL (1'x4')	L.F.	800	\$75.00	\$60,000.00
13	9250001	CONSTRUCTION SURVEYING AND LAYOUT	L.S.	1	\$15,000.00	\$15,000.00
14	9300100	INCIDENTAL ITEMS ALLOWANCE	USD	20,000	\$1.00	\$20,000.00
15		TRAFFIC SIGNAL	EACH	1	\$150,000.00	\$150,000.00
16		PAVEMENT MARKINGS	L.S.	1	\$10,000.00	\$10,000.00
17		SIGNING	L.S.	1	\$25,000.00	\$25,000.00
18		LANDSCAPE & IRRIGATION	L.S.	1	\$0.00	\$0.00
19		EROSION CONTROL	L.S.	1	\$15,000.00	\$15,000.00
		<b>ROADWAY TOTAL</b>				<b>\$828,375.00</b>
		ENGINEERING DESIGN (10%)				\$82,838.00
		CONTINGENCIES (25%)				\$207,094.00
		RIGHT OF WAY				\$0.00
		POST DESIGN SERVICES (1%)				\$8,284.00
		CONSTRUCTION ADMINISTRATION (15%)				\$124,256.00
		<b>INTERIM ALTERNATIVE TOTAL PROJECT COST</b>				<b>\$1,250,847.00</b>

## Interim Alternative Probable Cost of Throwaway

	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	3030003	AGGREGATE BASE	C.Y.	834	\$40.00	\$33,360.00
2	4060001	ASPHALTIC CONCRETE (NO. 1)	TON	544	\$85.00	\$46,240.00
3	4060002	ASPHALTIC CONCRETE (NO. 2)	TON	1,275	\$85.00	\$108,375.00
4	9080504	CONCRETE FORD WALL (1'X4')	L.F.	800	\$75.00	\$60,000.00
5		TRAFFIC SIGNAL	EACH	1	\$100,000.00	\$100,000.00
6		PAVEMENT MARKINGS	L.S.	1	\$6,500.00	\$6,500.00
7		SIGNING	L.S.	1	\$16,250.00	\$16,250.00
		<b>INTERIM ALTERNATIVE ROADWAY THROWAWAY TOTAL</b>				<b>\$370,725.00</b>

## Ultimate Alternative Probable Cost

	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	2010001	CLEARING AND GRUBBING	L.S.	1	\$25,000.00	\$25,000.00
2	2010010	CLEARING AND GRUBBING (NOXIOUS AND INVASIVE SPECIES CONTROL ALLOWANCE)	USD	10,000	\$1.00	\$10,000.00
3	2020001	REMOVAL OF STRUCTURES & OBSTRUCTIONS	L.S.	1	\$25,000.00	\$25,000.00
4	2020029	REMOVAL OF BITUMINOUS PAVEMENT	S.Y.	9,000	\$3.00	\$27,000.00
5	2030901	BORROW	C.Y.	50,000	\$12.00	\$600,000.00
6	3030003	AGGREGATE BASE	C.Y.	3,181	\$40.00	\$127,256.00
7	4060001	ASPHALTIC CONCRETE (NO. 1)	TON	2,183	\$85.00	\$185,555.00
8	4060002	ASPHALTIC CONCRETE (NO. 2)	TON	1,862	\$85.00	\$158,270.00
9	5011024	PIPE, REINFORCED CONCRETE, CLASS IV, 24"	L.F.	963	\$95.00	\$91,485.00
10	5011044	PIPE, REINFORCED CONCRETE, CLASS IV, 36"	L.F.	776	\$145.00	\$112,520.00
11	6010101	BOX CULVERT 1 (2-10'X5' RCBC)	L.F.	135	\$1,675.00	\$226,125.00
12	7010001	MAINTENANCE AND PROTECTION OF TRAFFIC	L.S.	1	\$120,000.00	\$120,000.00
13	7010007	CONSTRUCTION AREA ELEMENTS (PREDETERMINED REIMBURSEMENT RATE ALLOWANCE)	USD	50,000	\$1.00	\$50,000.00
14	9010001	MOBILIZATION	L.S.	1	\$250,000.00	\$250,000.00
15	9080001	CONCRETE CURB (STD. DTL. 209) (TYPE 1)	L.F.	2,240	\$18.00	\$40,320.00
16	9080286	MEDIAN REFUGE AREA (TYPE 2)	EACH	1	\$1,200.00	\$1,200.00
17	9250001	CONSTRUCTION SURVEYING AND LAYOUT	L.S.	1	\$35,000.00	\$35,000.00
18	9300100	INCIDENTAL ITEMS ALLOWANCE	USD	35,000	\$1.00	\$35,000.00
19		STORM DRAIN	L.S.	1	\$50,000.00	\$50,000.00
20		TRAFFIC SIGNAL	L.S.	1	\$200,000.00	\$200,000.00
21		PAVEMENT MARKINGS	L.S.	1	\$25,000.00	\$25,000.00
22		SIGNING	L.S.	1	\$50,000.00	\$50,000.00
23		LANDSCAPE & IRRIGATION	L.S.	1	\$0.00	\$0.00
24		EROSION CONTROL	L.S.	1	\$35,000.00	\$35,000.00
		<b>ROADWAY TOTAL</b>				<b>\$2,479,731.00</b>
		ENGINEERING DESIGN (10%)				\$247,973.00
		CONTINGENCIES (25%)				\$619,933.00
		RIGHT OF WAY	S.F.	12,235	\$1.50	\$18,353.00
		EASEMENTS	S.F.	9,638	\$0.75	\$7,228.00
		POST DESIGN SERVICES (1%)				\$24,797.00
		CONSTRUCTION ADMINISTRATION (15%)				\$371,960.00
		<b>ULTIMATE ALTERNATIVE TOTAL CONSTRUCTION COST:</b>				<b>\$3,769,975.00</b>

## Ultimate Alternative Probable Cost of Throwaway

	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	3030003	AGGREGATE BASE	C.Y.	1,873	\$40.00	\$74,927.00
2	4060001	ASPHALTIC CONCRETE (NO. 1)	TON	1,222	\$85.00	\$103,891.00
3	4060002	ASPHALTIC CONCRETE (NO. 2)	TON	1,222	\$85.00	\$103,891.00
4		PAVEMENT MARKINGS	L.S.	1	\$5,000.00	\$5,000.00
5		SIGNING	L.S.	1	\$12,500.00	\$12,500.00
		<b>ULTIMATE ALTERNATIVE ROADWAY THROWAWAY TOTAL</b>				<b>\$300,209.00</b>