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Charlie,

Please see the attached final design report for the Coconino County Roadway Alignment project. This document contains the project introduction, details for all design processes, and engineering scope and schedule information. The final design recommendation and construction plan set are also attached.

The final design for this project is a 1.5-mile roadway with 2 structural section alternatives provided. The roadway follows the alignment initially provided by Nate Reisner, though alternative designs are considered and presented within this report. The table below summarizes the estimated construction costs.

Engineers Opinion of Probable Cost	
Item	Total Cost
Demo	
Demo Subtotal	\$499,020
Roadway	
Roadway Subtotal Alt 1	\$5,437,529
Roadway Subtotal Alt 2	\$5,233,731
Hydraulic Structures	
Hydraulic Structures Subtotal	\$355,747
Contract	
Contract Subtotal	\$433,328
Alt. 1 Total	\$6,725,624
Alt. 2 Total	\$6,521,827

If you have any questions regarding this report feel free to reach out to sjh543@nau.edu.

Sincerely,

A handwritten signature in black ink, appearing to read "Spencer Huttenmeyer", is written over a light gray rectangular background.

Spencer Huttenmeyer
ViaNova Engineering

Coconino County Roadway Alignment Design Final Report

CENE 486 Engineering Design: Capstone Design

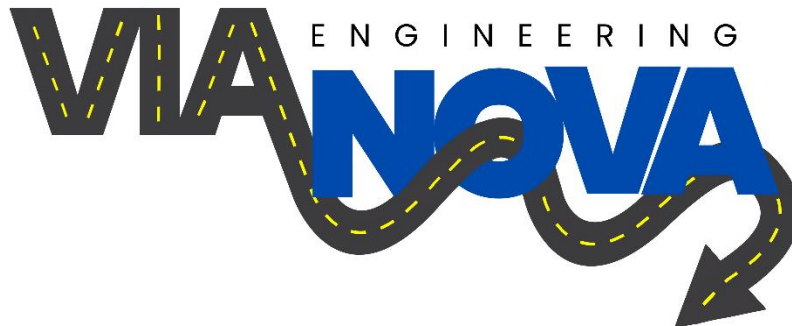
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Draft #4; Final Submittal

5/05/2026

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List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AADT	Annual Average Daily Traffic
ABC	Aggregate Base Course
ADOT	Arizona Department of Transportation
CCPW	Coconino County Public Works
CMP	Corrugated Metal Pipe
CTB	Cement-Treated Base
ENG	Project Engineer

FEMA	Federal Emergency Management Agency
IDF	Intensity Duration Frequency
NOAA	National Oceanic and Atmospheric Administration
PC	Point of Curvature
PDM	ADOT's Pavement Design Manual
PI	Point of Intersection
PT	Point of Tangency
RCBC	Reinforced Box Culvert
SENG	Senior Engineer
TCDS	Traffic Count Database System
TECH	Engineering Technician
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey

Appendices

Appendix A : Web Soil Survey Reports

Appendix A-1 : Web Soil Map

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Appendix B : Watershed Delineation

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Appendix T-1 : Original Gantt Chart

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Appendix U-1 : Original Staffing and Cost Tables

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Acknowledgments

The ViaNova Engineering team would like to thank Mark Lamer, our grading instructor, for providing the team with guidance and feedback during bi-weekly meetings. The team would also like to thank our technical advisor and client, Charlie Wilson, for helping the team with technical work and providing constructive criticism. The team would like to thank Wilbert Odem for guiding the team during hydrologic and hydraulic calculations, Corryn Smith for providing ArcGIS Pro guidance, Guillermo Cortes with Matthew Schraan for providing the team with off-site runoff values, and Ryan Mahar, Matthew Watson and Micheal Bechtel for Civil3D guidance. Lastly, the team would like to thank Nate Reisner for providing guidance with engineering decisions and interpreting results of analysis.

1.0 Project Introduction

1.1 Project Purpose

The purpose of the Coconino County Roadway Alignment project is to provide alternative access from Bellemont to prioritize resident safety, travel efficiency, and future development. This design encompasses a 1.5-mile two-lane roadway connecting Shadow Mountain Dr to Forest Service Rd 171 while traversing the Coconino National Forest. The alignment will support improved ingress and egress for daily and emergency use, while opening access to land for residential development. The project design is compliant with Coconino County standards, geometrically accounting for proper drainage and soil parameters, and will support long-term planning and funding.

1.2 Project Location

The site is located in Bellemont, Arizona—approximately 15 miles west of Flagstaff. The land is undeveloped and primarily composed of cleared, flat grasslands with patches of tall trees. A portion of the land is Forest Service property, and a part is for sale by the Forest Service. A location map of the site can be found below, in Figure 1-1, showing the project’s location in reference to Flagstaff and I-40.

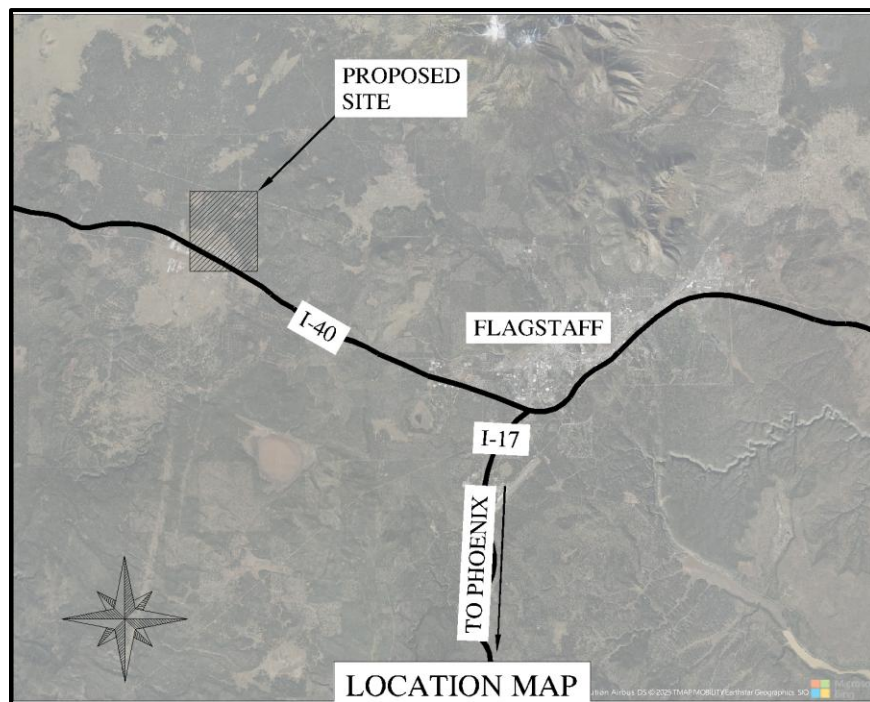


Figure 1-1: Location Map

The vicinity map, Figure 1-2, illustrates the project site's perimeter in closer proximity. As shown, the alignments to be analyzed connect Shadow Mountain Dr and Forest Service Rd 171, while providing access to developable land.

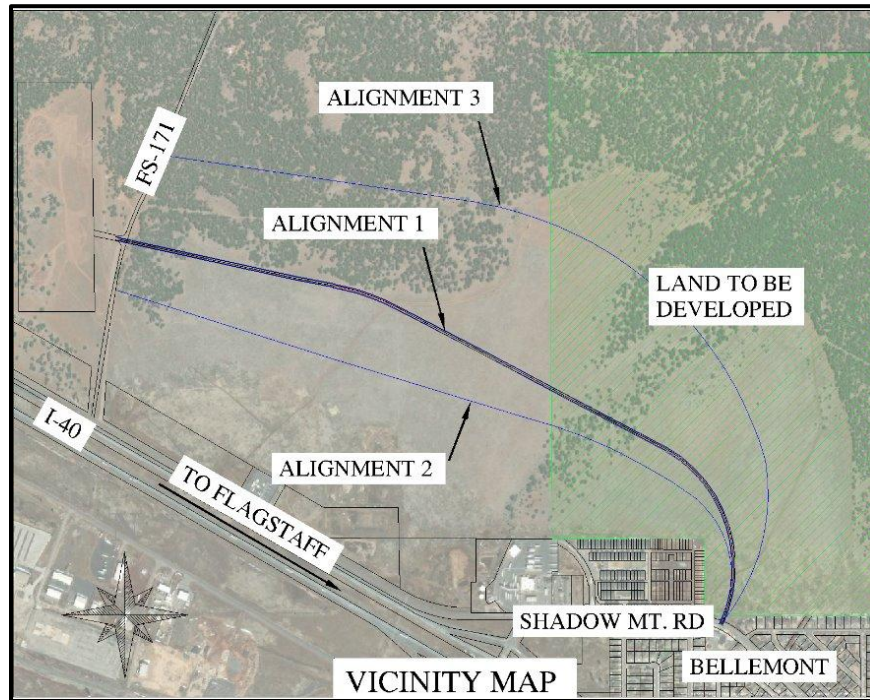


Figure 1-2: Vicinity Map

1.3 Considerations/Limitations

The team examined the following technical considerations revolving around geometric properties, drainage, and traffic. The Coconino County Design and Construction Manual guided geometric design, including design considerations for the horizontal and vertical alignment, lane widths, and sight distances [1]. The manual also contains typical structural sections for new roads, which, along with a native soil assessment, determine a structural section to meet client needs. Due to the alteration of existing stormwater drainage patterns, hydrologic and hydraulic analyses are conducted in accordance with the Coconino County Drainage Design Criteria Manual [2]. This is done to ensure proper stormwater conveyance, thereby mitigating flooding and erosion. Traffic analysis is an additional technical element that is necessary to maintain safe and efficient movement of vehicles and pedestrians throughout the proposed alignment's lifetime. The following is not within the scope of the project team: utility design, traffic impact study, safety analysis, traffic counts, or surveying. Overall, geometric design, drainage, and traffic analysis are the main technical considerations for this alignment project.

1.4 Project Objectives

The objective of this project is to develop a preliminary roadway design that supports projected 20-year traffic growth and provides access to a proposed residential neighborhood on the subject parcel. The project evaluates existing site conditions through hydrologic, hydraulic, and traffic analyses to ensure the roadway performs under both current and future conditions. Multiple roadway alignment alternatives are evaluated, including a southern, middle, and northern alignment, to compare feasibility, impacts, and performance. The overall objective is to deliver a technically sound, constructible roadway design supported by engineering analysis and documentation that reflects real-world professional practice.

2.0 Field Work and Existing Conditions

2.1 Existing Site Information

2.1.1 Topographic Data

Existing topographic data is obtained from Coconino County. This data includes two-foot contours of Bellemont, Arizona.

2.1.2 Hydrologic Data and FEMA Flood Zone

Existing hydraulic and hydrologic data is taken from the “Final Drainage Report for the Village Camp/Flagstaff” project completed by Shephard Wesnitzer, Inc [3].

2.1.3 Soil Data

Existing soil data is taken from two previous geotechnical reports in the Bellemont area. The two reports are the Shadow Mountain Road Reconstruction project by Western Technologies and the Avonlea Village project by CMT Engineering Laboratories [4] [5]. Additionally, a USDA Web Soil Survey is performed in the vicinity of the proposed roadway [6]. The results are available in Appendix A.

2.1.4 Geotechnical Analysis

Using soil data from the previous projects in Bellemont and the USDA Web Soil Survey, the primary soil in the area is identified as a gravelly clay loam. Other types of soil identified in the area include gravelly clay, clay loam, and sandy clay. Specific Web Soil Engineering properties are found in Appendix A-2. These results are corroborated by the previous geotechnical reports in the area. Overall, the soil in the area is a gravelly clay loam.

2.1.5 TCDS Data

Traffic counts on Shadow Mountain Drive are obtained from the ADOT Traffic Count Database System [7]. The average annual daily traffic at three different locations along Shadow Mountain Road is collected and shown in Table 2-1 below.

Table 2-1: Existing Traffic Counts

Location ID:	Located On:	Direction:	AADT:	EB Count:	WB Count:	Year:
CCN-141	Shadow Mountain Dr WEST OF Monarch Dr	2-WAY	1925	968	957	2024
CCN-142	Shadow Mountain Dr BETWEEN Pegasus Rd AND Roundabout	2-WAY	2872	1460	1412	2024
CCN-117	Brannigan Park Rd AT W of Transwestern Pump Rd	2-WAY	607	295	311	2024

Figure 2-1 below illustrates the position of the location IDs along Shadow Mountain Drive.



Figure 2-1: Location of Existing Traffic Counts

2.2 Site Investigation

The project site consists of a parcel proposed for future residential development. The existing roadways—Shadow Mountain Road and Forest Service Road 171—establish the primary access points and control the selection of the proposed alignment and intersection geometry. Proximity to I-40 and a large truck stop places the site within a regional transportation corridor, further influencing roadway classification and design considerations. The site location and access constraints observed during the October 2025 site visit are incorporated into the roadway layout

and geometric design to ensure functional connectivity between the proposed neighborhood and the surrounding transportation network.

3.0 Analysis

3.1 Hydrologic Analysis

Hydrologic analysis is performed at the site to determine the contribution of the surrounding watersheds. This is completed to manage the flow being obstructed by the new roadway. The process includes watershed delineation using StreamStats, with adjustments made in reference to contours and calculation of flows through various methods outlined in the Arizona Department of Transportation (ADOT) Highway Drainage Design Manual [8]. All watersheds that conflict with the proposed alignment and alternative alignments are analyzed using the Rational Method or HEC-HMS.

3.1.1 Watershed Delineation

Watersheds are primarily delineated using USGS Streamstats [9]. All watersheds that intersect with any of the three possible alignments are delineated to determine the tributary area. StreamStats delineations are used as a reference to find flow lines that intersect the roadway. The watersheds provided by StreamStats for Alternative 1 and Alternative 3 are adjusted to reflect the shape of the existing contours. The results for watershed delineation are available in Appendix B. Alternative 2 is disregarded for further analysis due to watershed four being a FEMA flood zone, resulting in large flows that would greatly increase the complexity and price of the FS 171 connection. The areas determined for each of the three alignments are shown below in Table 3-1.

Table 3-1: Watershed Area

Watershed	Area (acres)		
	Alternative 1	Alternative 2	Alternative 3
1	64.30	43.64	45.80
2	133.84	134.97	114.63
3	1477.75	1460.64	1270.80
4	98.55	23700.11	146.12
5	35.59		61.92
6			31.35

3.1.2 Rational Method

The Rational Method is conducted on all watersheds with an area of 160 acres and smaller, following the Coconino County Drainage Manual [2]. Although the Rational Method is not an adequate way of calculating flows for watersheds over 160 acres, calculations are performed as a means of comparison.

Equation 3-1 is used to determine the flow of each watershed in cubic feet per second (cfs).

Equation 3-1: Rational Method [2]

$$Q = CiA$$

Where;

$$Q = \text{Flow} \left(\frac{ft^3}{s} \right)$$

$C = \text{Runoff Coefficient}$

$$i = \text{Rainfall Intensity} \left(\frac{\text{inches}}{\text{hour}} \right)$$

$A = \text{Area (acres)}$

The runoff coefficient is determined by using Figure 2-6 from the ADOT Hydrology Manual, which is based on a mountainous ponderosa pine terrain [8]. The rainfall intensity is determined by using the National Oceanic and Atmospheric Administration (NOAA) website [10]. The coordinates of where watersheds intersect with a proposed roadway alignment are used to collect rainfall intensity data. These rainfall intensities can be found in Appendix C. An iteration process is used to calculate the correct rainfall intensity based on the time of concentration. To do this, an initial guess is made to determine the time of concentration and the corresponding rainfall intensity. With an initial rainfall intensity, Equation 3-2 is then used to calculate the new time of concentration.

Equation 3-2: Rational Method Time of Concentration [2]

$$T_c = 11.4L^{0.5}K_B^{0.52}S^{-0.31}i^{-0.38}$$

Where;

$T_c = \text{Time of Concentration (hours)}$

$K_B = \text{Watershed Resistance Coefficient}$

$$S = \text{Slope} \left(\frac{ft}{mi} \right)$$

$$i = \text{Rainfall Intensity} \left(\frac{\text{inches}}{\text{hour}} \right)$$

With a new time of concentration, a new rainfall intensity is found. This process is then repeated until the initial time of concentration guess is within one minute of the calculated time of concentration. All rational method flow calculations and iterations for time of concentration can be found in Appendix D.

The following table outlines the results of the rational method for Alternative 1 and Alternative 3 alignments.

Table 3-2: Watershed Flows using the Rational Method

Watershed	50-Year Flow (cfs)	
	Alternative 1	Alternative 3
1	63.3	48.6
2	121.3	116.8
3	945.76	831.1
4	95.0	139.7
5	32.94	65.3
6		32.5
TOTAL	1,218.4	1,234.0

3.1.3 HEC-HMS Modeling [11]

HEC-HMS is used to model any watershed larger than 160 acres per the Coconino County Drainage Manual [2]. To meet this requirement, watershed three is analyzed for Alternative 1 and Alternative 3 using HEC-HMS. To create the model, a watershed is routed to a junction, which is the point of interest where the flow would be obstructed by the new roadway. Simple models are created with a loss method of initial and constant, a transform method of the Clark Unit Hydrograph, and a routing method of lag.

The loss parameters are chosen in reference to Section 3.5 of the ADOT Hydrology Manual [8]. The constant loss rate is set to 0.05 inches per hour due to very low infiltration on the land surface. The Initial loss can be estimated using the NCRS Curve Number and Equation 3-3.

Equation 3-3: Initial Loss [8]

$$Initial\ Loss = \frac{200}{CN} - 2$$

Where;

CN = Curve Number

The Curve Number is estimated to be 71 from Figure 2-7 from the National Engineering Handbook [12, pp. 650-2.16].

The Time of Concentration is calculated using Equation 3-4.

Equation 3-4: Unit Hydrograph Time of Concentration [8]

$$T_c = 2.4A^{0.1}L^{0.25}L_{ca}^{0.25}S^{-0.2}$$

Where;

T_c = Time of Concentration (Hours)

A = Area (mi^2)

L = Length of Flow Path (mi)

L_{ca} = Length to Watershed Centroid (mi)

S = Slope ($\frac{ft}{mi}$)

The Storage Coefficient is calculated using Equation 3-5

Equation 3-5: Storage Coefficient [8]

$$R = 0.37T_c^{1.11}L^{0.8}A^{-0.57}$$

Where;

R = Storage Coefficient (Hours)

T_c = Time of Concentration

L = Length of Flow Path (mi)

A = Area (mi^2)

The values resulting from the above equations are summarized below in Table 3-3. All calculations needed to complete the hydrological analysis within HEC-HMS are provided in Appendix D.

Table 3-3: HEC-HMS Calculated Variables

	Alternative 1	Alternative 3
Initial Loss (inches)	0.82	0.82
Storage Coefficient, R (hours)	0.72	0.67
Time of Concentration, Tc (hours)	1.19	1.10

The models are run with a manual entry of data collected from NOAA. Data representing a 50-year storm with a 24-hour duration is entered in 15-minute increments. The following table displays the results for flow from both models.

Table 3-4: HEC-HMS Calculated Variables

Watershed	50-Year Flow (cfs)	
	Alternative 1	Alternative 3
3	218.2	188.0

3.2 Hydraulic Analysis

3.2.1 Determine Offsite Runoff

A full FEMA floodplain analysis is outside the scope of this project. However, a drainage report for the Village Camp development near FS 171 and Vc Dr is publicly available. The site plan for this report is available in Appendix F [3].

A screenshot of the relevant section of this model is provided below in Figure 3-1 provided by Matthew Schraan, PE from Ardurra. The blue shaded areas represent the 100-year storm flow modeled in this area. The red line indicates where Ardurra extracted the flow relevant to this project from. The runoff from the Village Camp project splits near the intersection of Vc Drive and Forest Service Road 171. This split causes part of the flow to conflict with the proposed alignment. Adurra provided the team with a flow of 315 cubic feet per second for this section during the 100-year storm event.

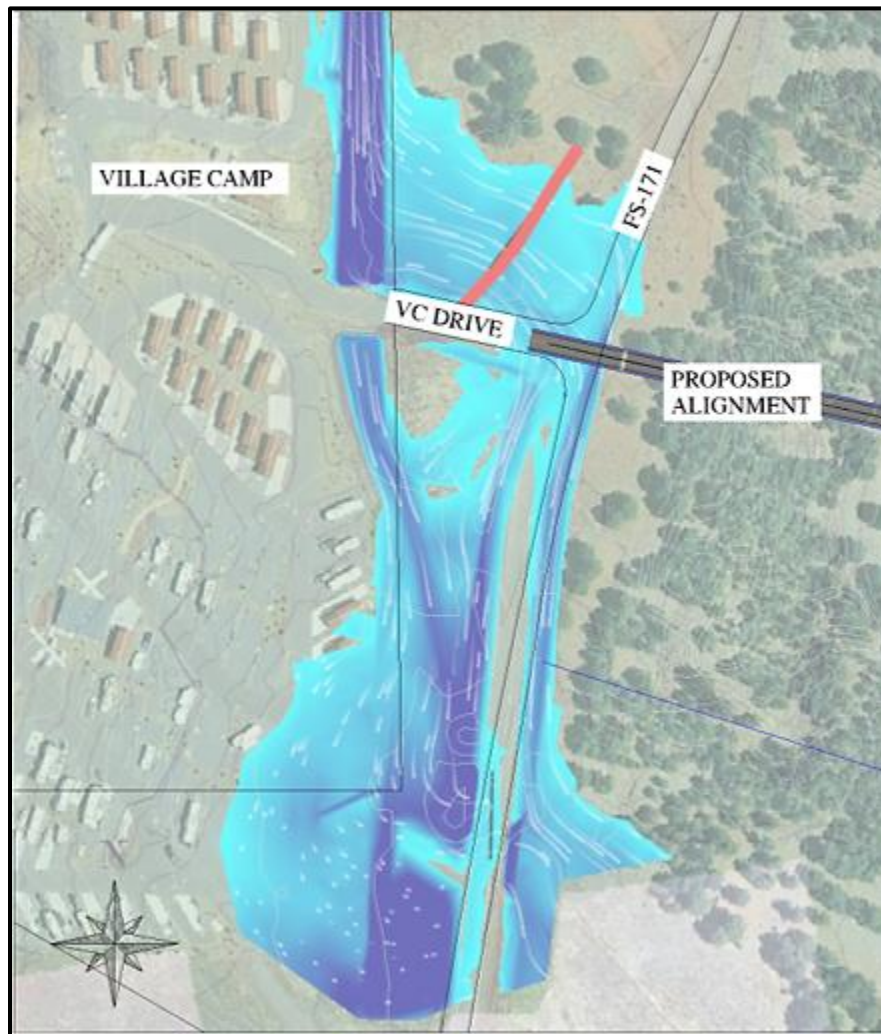


Figure 3-1: Flow Split Analysis by Ardurra

3.2.2 Analyze Potential Hydraulic Structures

Hydraulic structures are required to convey the flow previously calculated as well as the runoff produced by the proposed roadway. Refer to section 3.4.7 for calculated runoff produced by the new roadway. With respect to Alternative 1, the team identified three proposed low points where culverts will be placed to capture flow directed through graded ditches. Only Alternative 1 is considered for hydraulic analysis per the decision made in section 4.1.1 of this report. The following figure outlines the flows directed towards each culvert. These values do not include runoff flow. For total flows reference Table 3-6.

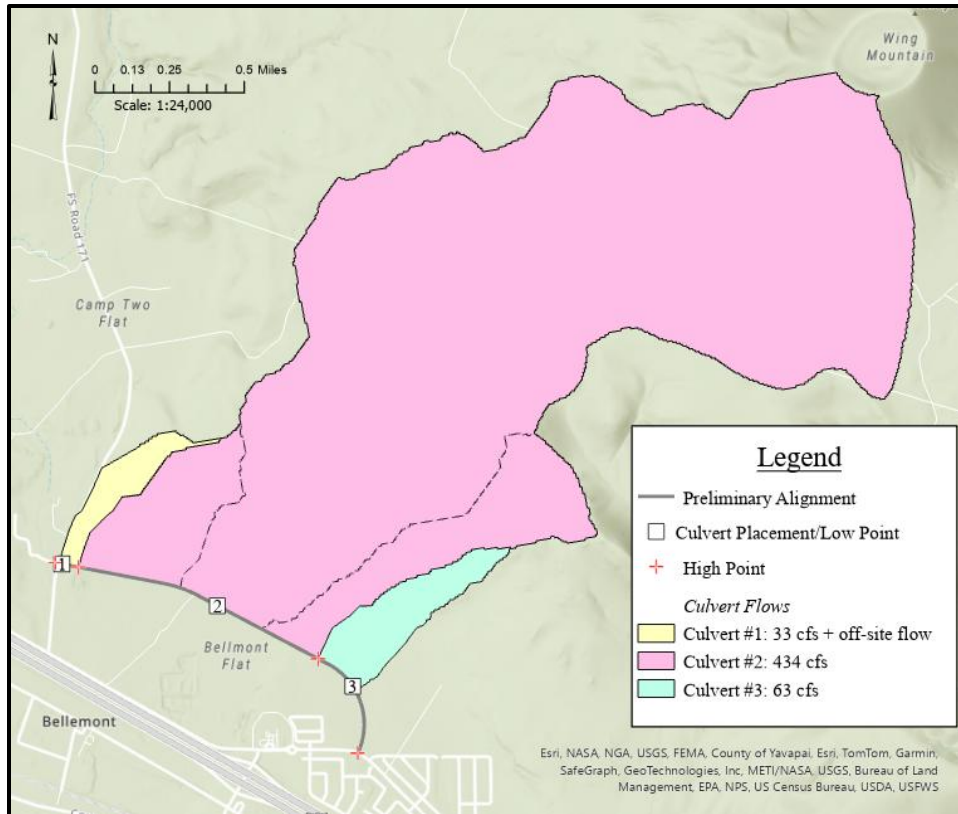


Figure 3-2: Flow per Culvert

The Coconino County requirements for culverts are outlined in Table 3-5 below.

Table 3-5: Coconino County Culvert Requirements

Coconino County Drainage Manual Culvert Requirements [2]		Manual Section
Design Frequency without Overtopping	50-year	Table 4-4
Design Frequency with 12" Overtopping	100-year	Table 4-4
Minimum Velocity	3 feet per second	4.3.5.2
Minimum Diameter	18"	4.3.5.1
Minimum Cover (18"-36" diameter)	1'	4.3.5.4
Commercial End Section Allowed? ($\leq 36"$ diameter)	Yes	4.3.5.6

Coconino County references the Drainage Design Manual for Maricopa County for additional information [2]. All culverts are designed using Figure 5.10 of the Drainage Design Manual for Maricopa County. Additionally, inlet nomographs are used to determine the headwater depth to culvert ratio based on the given flow and diameter. Corrugated metal pipes (CMP) and reinforced concrete box culverts (RCBC) are both used as hydraulic structures. Inlet controlled nomographs are used to size the culverts. Figure 5.21 from the Drainage Design Manual for Maricopa County is used to calculate headwater depth to culvert diameter ratio. Calculations for culvert sizing are shown in Appendix G. All RCBC's will have 45° wing walls, and the double CMP will have commercial flared end sections. A summary of the three hydraulic structures is shown below in Table 3-6.

Table 3-6: Proposed Hydraulic Structures

Hydraulic Structures						
Culvert ID	Type	Size/Diameter	Flow (cfs)	Velocity (ft/s)	Cover (ft)	Station
1	RCBC	(1) 4' x 10'	353.15	8.8	1.2	1+10
2	RCBC	(2) 4' x 7'	445.16	4.0	1.2	25+00
3	CMP	(2) x 30"	63.85	6.5	1	57+29

3.3 Traffic Analysis

3.3.1 Determine Future Traffic

At the request of the client, future traffic counts are obtained by extrapolating existing development density in Bellemont. Existing area measurements include streets and green areas to provide a realistic density. This density is extrapolated on to the proposed development area, which is split into two sections based upon relative developability. The parcel for development includes 221.23 acres with minimal elevation changes, which is labeled “high density”. The rest of the parcel includes 249.97 acres with greater elevation change, which is labeled “low density”. Calculations for the predicted density of the proposed development are available in Appendix H-1. The existing and predicted future density is summarized in Table 3-7 below.

Table 3-7: Future Traffic Counts

Total Units for Proposed Development	
Total Density for High-Density Development (units/sf):	1.01E-04
High-Density Area (sf):	9.64E+06
High-Density Total Units:	974
Total Density for Low-Density Development (units/sf):	5.05E-05
Low-Density Area (sf):	1.09E+07
Low-Density Total Units:	550
Total Units for Proposed Development:	1524

The existing traffic patterns within the Shadow Mountain neighborhood are expected to be similar to those of the proposed development. Therefore, and by request of the client, the existing traffic counts are extrapolated linearly to calculate the proposed traffic counts. The ratio of proposed to existing units is multiplied by the existing traffic counts to find the predicted traffic counts used for further analysis. The results of these calculations are summarized below in Table 3-8. Calculations for the predicted traffic counts for the proposed development are available in Appendix H-1.

Table 3-8: Extrapolate Existing Traffic Data to Proposed Development

Extrapolate Existing Traffic Data to Proposed Development	
Total Existing Units in Shadow Mountain:	773
Total Proposed Development Units:	1524
Ratio of Proposed Units to Existing Units:	1.972
Existing Traffic Counts for Shadow Mountain - CCN-142 (AADT):	2872
Proposed Traffic Counts for Development Using Factor (AADT):	5662

3.3.2 Determine Connections into Existing Roadway

The Alternative 1 alignment proposed by the County connects to Shadow Mountain approximately 400 feet to the west of Monarch Drive. This end of the alignment will be constrained by the surrounding developments, the Shadow Mountain Village development to the west, and the single-family residential unit to the east. There is approximately 60 feet between these development's right-of-way, so this connection remains consistent with all considered alternatives. Figure 3-3 below shows all potential connections to Shadow Mountain.



Figure 3-3: Proposed Connections for Each Alignment to Shadow Mountain

The Alternative 1 alignment connects to FS 171 at Vc Drive, opposite the Village Camp development. This connection is ideal as it would utilize typical 4-way intersection geometry, which adheres to driver expectations and increases safety. Alternative 2 connects with FS 171 approximately 800 feet south of Vc Drive. Alternative 3 connects with FS 171 approximately 350 feet north of Vc Drive. Figure 3-4 below shows all potential connections to FS 171.

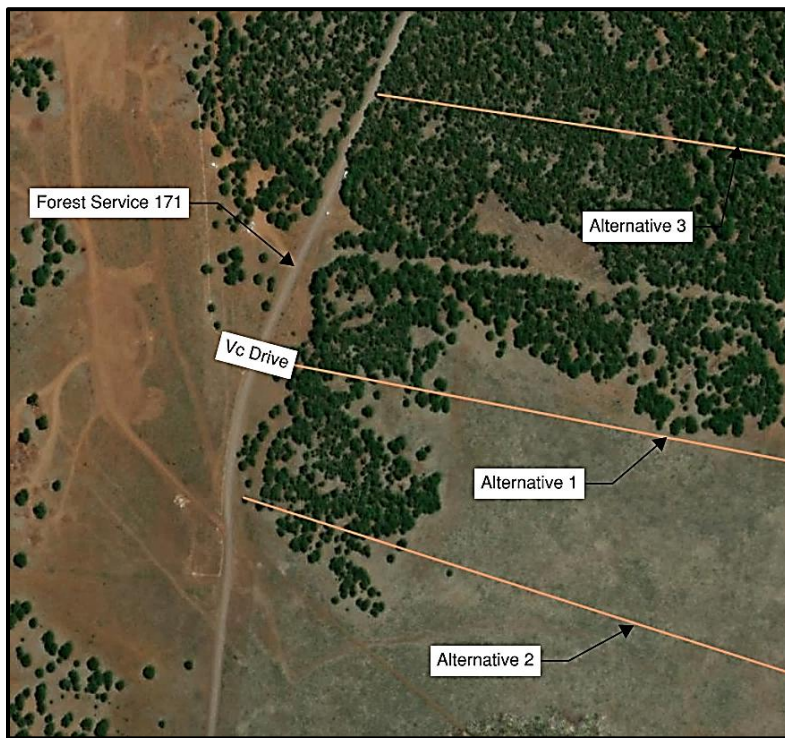


Figure 3-4: Proposed Connections for Each Alignment to Forest Service 171

3.3.3 Determine Need for Turn Lanes

Existing traffic volumes on Shadow Mountain are obtained from the Traffic Count Database System (TCDS) and are available in Table 2-1. Further details for existing traffic counts on Shadow Mountain are provided below in Table 3-9.

Table 3-9: Existing Traffic Data for Shadow Mountain Rd

Location ID:	CCN-141
Road:	Shadow Mt.
Pos Dir AADT (Eastbound):	968
Neg Dir AADT (Westbound):	957
AADT 2025:	1925
K Factor:	11%
D Factor:	55%
AADT Single Trucks:	116
AADT Combo Trucks:	39
T Factor:	6%
2043 Future AADT:	2802

To find the peak traffic volume in both directions for Shadow Mountain, Equation 3-6 is used.

Equation 3-6: Peak Traffic Volume for Both Directions

$$V = AADT \cdot K$$

Where;

AADT = Annual Average Daily Traffic

K = K Factor, percent of AADT during 30th highest hour of the year

V = Traffic Volume

To find the peak traffic volume in the positive direction (eastbound) for Shadow Mountain, Equation 3-7 is used.

Equation 3-7: Peak Traffic Volume for the Positive Direction

$$V = AADT \cdot K \cdot (1 - D)$$

Where;

AADT = Annual Average Daily Traffic

K = K Factor, percent of AADT during 30th highest hour of the year

D = D Factor, percent of traffic moving in peak travel direction during 30th highest hourly volume of the year

V = Traffic Volume

To find the peak traffic volume in the negative direction (westbound) for Shadow Mountain, Equation 3-8 is used.

Equation 3-8: Peak Traffic Volume for the Negative Direction

$$V = AADT \cdot K \cdot D$$

Where;

AADT = Annual Average Daily Traffic

K = K Factor, percent of AADT during 30th highest hour of the year

D = D Factor, percent of traffic moving in peak travel direction during 30th highest hourly volume of the year

V = Traffic Volume

The results of the analysis for the existing Shadow Mountain traffic are summarized below in Table 3-10.

Table 3-10: Existing Peak Traffic Volume Results on Shadow Mountain Rd in Positive, Negative, and Both Directions

Existing Shadow Mountain Traffic Volumes (AADT)	
Peak Traffic Volume, Both Directions:	212
Eastbound Peak Volume:	96
Westbound Peak Volume:	117

To find the peak traffic volume in both directions, in the positive direction (northbound), and in the negative direction (southbound) for the Alternative 1 alignment, Equations 3-6, 3-7, and 3-8 are used, respectively. The K Factor and D Factor are assumed to be the same as the existing Shadow Mountain factors because the proposed development traffic is expected to behave very similar to the existing traffic. Because of the rural nature of both the existing and proposed developments in Bellemont, most trips will only take place in the peak hours. This is because most trips will be to and from the city, with other necessary trips being performed within the city and without return trips home. The results of analysis for the proposed alignment are summarized below in Table 3-11.

Table 3-11: Calculated Peak Traffic Volume Results on Proposed Alignment in Positive, Negative, and Both Directions

Proposed Alignment Traffic Volumes (AADT)	
Peak Traffic Volume, Both Directions:	624
Eastbound Peak Volume:	281
Westbound Peak Volume:	343

Shadow Mountain Connection

With these results, the “ADOT Traffic Guidelines and Processes, Section 245 - Turn Lane Warrants” is used to determine the need for a turn lane [13]. This analysis results in a left turn lane required for traffic turning from Shadow Mountain. A right turn lane for traffic turning onto Shadow Mountain is not required. The results of this analysis are available in Appendix H-2.

The MUTCD is used to determine the intersection control [14]. For the connection at Shadow Mountain on the east side of the proposed alignment, Section 2B.16 “All-Way Stop Control Warrant D: 8-Hour Volume (Vehicles, Pedestrians, Bicycles)” results in an all-way stop control being warranted.

FS 171 Connection

For the FS 171 intersection on the west side of the proposed development, existing traffic counts aren’t available. Therefore, warranting a certain control based on traffic volumes will not be possible. Section 2B.07 “Determining the Minor Road for Unsignalized Intersections” of the MUTCD results in a minor-stop control being warranted [14]. The existing three-way intersection of FS 171 and Vc Dr is a minor stop control, so the proposed stop control will align with driver expectations and the existing intersection control. Because traffic counts are unavailable, this intersection may require further investigation that is outside the scope of this project.

3.3.4 Determine Signage on Roadway

Roadway signage required for the proposed alignment are determined by the MUTCD Section 2B, Table 2B-1 [14] and Table 3-1 in the AASHTO Roadside Design Guide [15]. The table below summarizes the signage characteristics that are implemented in the roadway.

Table 3-12: Roadway Signage

Sign	Designation	Size	Clear Zone Offset
Stop Sign	R1-1	30” by 30”	12’
Speed Limit	R2-1	24” by 30”	12’

*For signage where sidewalk infrastructure is not present, the minimum mounting height is five feet. For signage where sidewalk infrastructure is present, the minimum mounting height is seven feet [14].

Finally, other auxiliary signage such as bike lane, no parking, and other signs must meet the same requirements as above and meet all relevant requirements within the MUTCD and AASHTO Roadside Design Guide.

Per the ADOT Traffic Engineering Guidelines and Processes Sub-Section 311, the recommended maximum spacing for speed limit signs when the speed limit is less than 55 miles per hour is defined by Equation 3-9 below [15]. This equation yields 0.64 miles, which is 3,360 feet.

Equation 3-9: Maximum Spacing for Speed Limit Signs [14]

$$x = \frac{V}{6}$$

Where;

x = Recommended Maximum Spacing for Speed Limit Signs (miles)

V = Posted Speed Limit (miles per hour)

3.4 Roadway Design

3.4.1 Select Horizontal and Vertical Alignment

The alignment chosen for further design is Alternative Alignment 1. The reasoning for this design is available in section 4.4.1 of this report. This is the preliminary alternative provided by the County which will tie directly into Vc Drive at the east end of the alignment.

3.4.2 Determine Design Vehicle and Design Speed

The proposed roadway classification is a Minor Collector (Rural) per the Coconino County Public Works Engineering Design and Construction Manual [1]. This classification dictates the posted speed limit to 35 miles per hour and the design speed to 45 miles per hour. The recommended design vehicles per the ADOT Roadway Design Guidelines for this roadway are WB-40, SU-40, and SU-30 [15]. These vehicles are an intermediate semi-trailer with a 40-foot length, a single-unit truck with a 40-foot length, and a single-unit truck with a 30-foot length, respectively. The existing roadway network in Bellemont includes a truck route to FS 171, so the WB-40 vehicle will not be analyzed. The SU-40 vehicle will be used for future analysis as the design vehicle.

3.4.3 Determine Horizontal Alignment

The alignment selected is laid out by the client, and the project team analyzed the alignment to ensure that it meets the required specifications laid out in the AASHTO Green Book [16] and the Coconino County Engineering Design and Construction Manual [1]. There are two horizontal curves, each laid out by increasing station. The radius is found from measurement within AutoCAD. From the AASHTO Green Book, Table 3-9 is used to find the superelevation rate, Figure 3-4 is used to find the side friction factor assumed for design, Equation 3-23 is used to find the runoff length, and Equation 3-24 is used to find the runout length. The maximum superelevation rate permitted by the Coconino County Engineering Design and Construction Manual for a minor collector is 6%. The horizontal curve calculations are available in Appendix I. Table 3-13 below shows the horizontal curve data for this alignment. Included in this data are the point of curvature (PC), point of intersection (PI), and point of tangent (PT).

Table 3-13: Horizontal Curve Summary

Horizontal Curve Data	Horizontal Curve 1	Horizontal Curve 2
Radius (ft)	2303	1176
PC (station)	19+78.48	52+46.67
PI (station)	23+17.49	60+57.93
PT (station)	26+59.58	70+26.26
Superelevation rate (%)	3.6	5.2
Side-Friction Factor	0.15	0.15
Length of Runoff (ft)	86.4	124.8
Length of Runout (ft)	28.8	41.6

3.4.4 Determine Vertical Alignment

The vertical alignment is optimized to direct flow to appropriate culverts and reduce the total cut/fill required for construction. The minimum grade permitted by the Coconino County Engineering Design and Construction Manual is 0.5% for all roadways [1]. For minor collectors, the maximum grade permitted is 8%. Grade breaks are permitted for slope changes less than 1%. Each culvert is required to be a local low point to ensure the intended drainage patterns for both on-site drainage and roadway drainage.

By recommendation from our technical advisor, some watersheds are combined to reduce cut/fill. Crest vertical curve lengths are calculated using Equations 3-42 and 3-43 from the AASHTO Green Book [16]. Sag vertical curve lengths are calculated using Equations 3-49 and 3-51 from the AASHTO Green Book. The vertical curve data is available in Appendix J. The vertical curve information is available in Table 3-14 below.

Table 3-14: Vertical Curve Summary

Curve Number	Curve Description	Curve Type	Foreslope	Design Length (ft)
N/A	Start	Break	0.00%	46
1	Culvert 1	Sag	-0.75%	99
2	Watershed 1-2	Crest	0.50%	163
3	Insert	Sag	-2.18%	211
4	Culvert 2	Sag	-0.50%	79
5	Insert	Sag	0.50%	183
6	Watershed 3-4	Crest	1.82%	236
7	Culvert 3	Sag	-2.05%	162
N/A	End	Break	0.52%	32

3.4.5 Structural Section

The Coconino County Engineering Design and Construction Manual provides a standard structural section for each roadway classification in *Section 5.3.7.1, Structural Sections* [1]. For a minor collector, which this roadway is identified as, the minimum structural section is five inches of asphalt concrete over 10 inches of aggregate base course. Due to the elevation of this roadway, the required Performance Grade asphalt binder is PG 58-28.

To determine if the minimum structural section is sufficient per traffic volumes, procedures for flexible pavement design, outlined in ADOT’s Pavement Design Manual (PDM), are followed [17]. The impact of the traffic is calculated in terms of the number of 18-Kip equivalent single axle loads (ESAL’s, W_{18}). These calculations are found in Appendix K. To perform the calculations, a proper vehicle class distribution (VCD) is set based on truck traffic classifications (TTC) and the percentage of combo units. This roadway fits into TTC AZ-6 as it prioritizes the SU-40 design vehicle. PDM also classifies minor rural collectors with a cluster number of two, which provide their respective truck load factors. This information is found in Tables A-4 and A-5 of PDM. Other supplemental information needed is growth rate, percent trucks, and directional and lane distribution factors, which are taken from the design parameters found in Coconino County’s Design and Construction Manual [1]. The following table summarizes the variables used to quantify the design ESAL’s.

Table 3-15: ESAL Calculation Variables

Parameter	Value
AADT Volume	5662
Growth Rate Factor	2%
Percent Truck Traffic	6%
ADOT TTC	AZ-6
Directional Distribution Factor	50%
Lane Distribution Factor	100%

Equation 3-10 is utilized throughout the worksheet to compute the design ESAL’s.

Equation 3-10: Design ESAL’s [17]

$$Design\ ESAL's = \sum_{c=1}^{13} \{(AADT_c)(G_c)(365)(T_{LFC})\} * (D_D)(D_L)$$

Where:

$AADT_c$ = Traffic Volume for Each Vehicle Class

G_c = Growth Factor for Each Vehicle Class

T_{LFC} = Truck Load Factor for Each Vehicle Class

D_D = Directional Distribution Factor

D_L = Lane Distribution Factor

The design ESAL's are used to calculate the necessary structural number (SN) for the section, which represents the necessary capacity to accommodate the traffic loading. The standard normal deviate is based on a level of reliability of 85%, a parameter listed in Table 5-3 of Coconino County's Design Manual [1]. This table also lists the appropriate serviceability values. Values taken from PDM include the combined standard error, correlated R-value, seasonal variation, and resilient modulus (Figure 2-2 of PDM relates the resilient modulus to seasonal variation and correlated R-value). The values of these parameters are summarized below in Table 3-16.

Table 3-16: SN Calculation Variables

Parameter	Value
Standard Normal Deviate	-1.037
Combined Standard Error	0.45
Serviceability Index	1.5: Po=4.5, Pt=3.0
Resilient Modulus of Subgrade	6800
Correlated R Value	19
Seasonal Variation Factors	3.5

The following equation is used to output the SN, resulting in a value of 4.23.

Equation 3-11: Flexible Pavement Design

$$\log_{10}(W_{18}) = Z_r S_o + 9.36 \log_{10}(SN + 1) - 0.20 + \left\{ \frac{\frac{|\Delta PSI|}{4.2 - 1.5}}{0.40 + \frac{1094}{(SN + 1)^{5.19}}} \right\} + 2.32 \log_{10}(M_r) - 8.07$$

Where:

W_{18} = Predicted Number of 18 – kip Equivalent Single Axle Load Applications

Z_r = Standard Normal Deviate

S_o = Combined Standard Error of the Traffic Prediction and Performance Prediction

$\Delta PSI = P_o - P_t$

P_o = Initial Serviceability Index

P_t = Terminal Serviceability Index

M_r = Resilient Modulus (psi)

SN = Structural Number

The AASHTO pavement design excel worksheet is utilized to create a structural section with a SN value of 4.23 or greater. The following parameters, gathered from the Shadow Mountain Geotechnical Evaluation and PMD suggestions, are used for their respective materials as shown in Table 3-17.

Table 3-17: Structural Section Parameters

Material	Layer Coefficient, a_i	Drainage Coefficient, m_i
Asphaltic Concrete (AC)	0.44	1.00
Aggregate Base Coarse (ABC)	0.14	0.85
Cement Treated Base (CTB)	0.24	0.85
Subgrade	0.11	0.64

Through an iterative process, the following structural sections shown in the table below produce a sufficient design.

Table 3-18: Structural Section Alternatives

	Structural Section 1 (SN=4.25)	Structural Section 2 (SN=4.29)
AC	4.5"	4.5"
ABC	12"	2"
CTB		6"
Subgrade	12"	12"

These both meet Coconino County standards of a minimum of 5" AC on 10" ABC for rural minor collector roads. Reference Appendix L for flexible pavement design worksheets for both structural sections.

3.4.6 Typical Cross-Section

The Coconino County Engineering Design and Construction Manual [1] provides a typical cross-section for each roadway classification in *Section 5.3, Roadway Design*. For a minor collector, which this roadway is identified as, the typical cross-section is shown below in Figure 3-5. This cross-section is used for this roadway design, with minor adjustments made including superelevation for curves and roadway ditch adjustments for culverts. The roadway prism is 36 feet wide, and the overall roadway right-of-way is 100 feet. This section specifies two lanes for travel. Using the AASHTO Green Book [16], level of services is calculated to ensure that this roadway will properly support future traffic. Calculations for level of service are available in Appendix M.

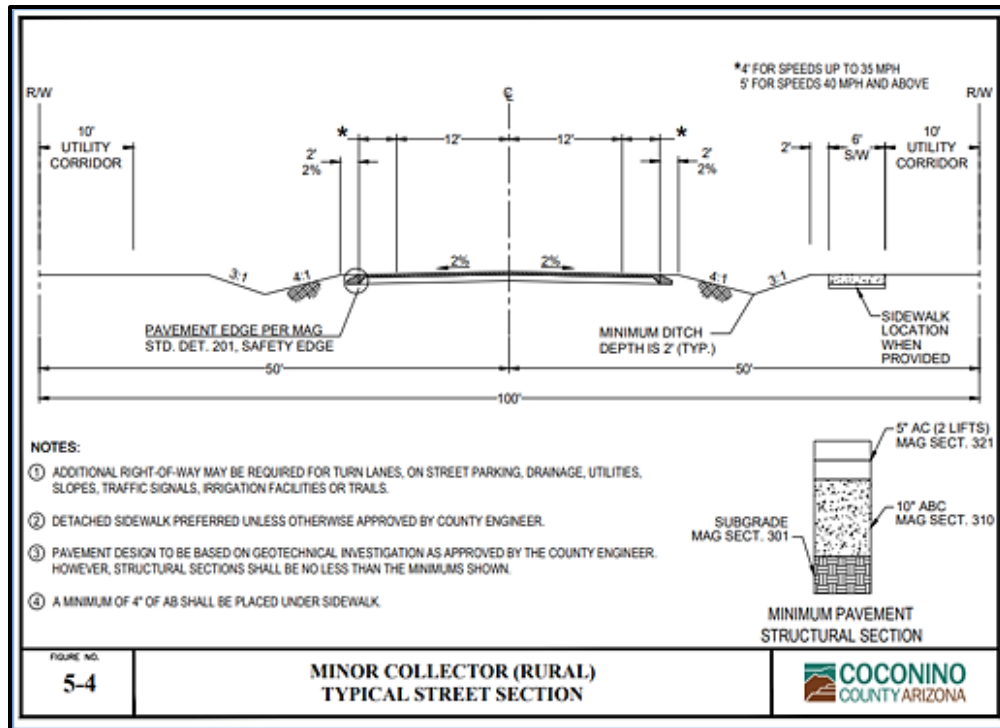


Figure 3-5: Typical Cross Section

3.4.7 Determine Roadway Drainage

To determine the runoff produced by the new roadway, the Rational Method is utilized. Due to the number of culverts, three different areas are determined. Each area would flow to the nearest culvert where it would discharge into. Due to the crown in the center of the road, the flow is split in half. The flow for each area is determined the same way as completed in task 3, hydrological analysis. Runoff coefficients are changed to account for asphalt instead of soil using Figure 2-1 in the ADOT Highway Drainage Design Manual [2]. The following table shows the runoff produced by each area of the roadway. All Rational Method calculations for each area of the roadway can be found in Appendix N.

Table 3-19: Area #1 Roadway Runoff

Runoff Coefficient, (C)	Average Rainfall Intensity, i (Inches/Hour)	Area (Acres)	Drain to Culvert	Flow (cfs)
0.95	6.20	0.14	1	0.85
0.95	6.21	1.89	2	11.16
0.95	6.23	0.87	3	5.14

After determining the flow each area would create, v-ditches are sized in accordance with the Coconino County Drainage Manual [2]. The following table illustrates the requirements for open channels.

Table 3-20: Open Channel Requirements

Description	Value	Unit
Maximum Velocity	18	ft/s
Minimum Slope	0.50	%
Freeboard	1	Ft
Minimum Depth	2	Ft
Minimum Side Slope for Earth Linings	3:1	ft/ft

To simplify the channels and improve the environmental impacts of the roadway, all channels are lined with natural earth. Manning's Equation is utilized to determine the maximum capacity of the channel using a 3:1 slope and a minimum depth of two feet.

Equation 3-12: Manning's Equation

$$Q = \left(\frac{1.49}{n}\right) A (R_h^{2/3}) S^{0.5}$$

Where:

$$Q = \text{Flow} \left(\frac{ft^3}{s}\right)$$

n = Manning's Roughness Coefficient

A = Area (ft^2)

R_h = Hydraulic Radius (ft)

$$S = \text{Slope} \left(\frac{ft}{ft}\right)$$

Using Equation 3-12, minimum slopes, and a manning's roughness coefficient of 0.025 for a lining of earth channel with grass and weeds the channel can convey a maximum flow of 48.83 cubic feet per second. To verify all channels can convey the design flow while meeting the freeboard requirement, an iterative process is used. By inputting the known variables and taking an initial depth guess, the goal seek function in Excel is used to approximate the depth of water. Excel would then find a depth which caused the flow to match up with the intended flow. In total seven different channels are designed, and Table 21 shows the characteristics for each channel.

Table 3-21: Design V-Ditches

Channel ID	Drain to Culvert	Design Flow (cfs)	Velocity (ft/s)	Slope	Depth (ft)
1	1	0.85	1.72	0.75%	2.00
2	1	0.85	1.48	0.50%	2.00
3	2	11.16	4.89	2.18%	2.00
4	2	11.16	2.81	0.50%	2.15
5	2	11.16	2.81	0.50%	2.15
6	3	5.14	3.93	2.05%	2.00
7	3	5.14	2.35	0.52%	2.00

All calculations for design channel iterative processes can be found in Appendix O.

3.4.8 Pavement Markings/Striping Layout

The striping and pavement marking layout is completed in accordance with the MUTCD and the Coconino County Roadway Construction and Design Manual [1]. The centerline of the roadway shall be a solid double yellow line, and the edge of the roadway shall be a solid white line. All striping shall be 6-inches wide at a thickness of 0.009 mills. All pavement markings are found in ADOT standard drawings and include turn arrows, 12” white stop bars, and 12” white crosswalk lines.

3.5 Site Design

3.5.1 Determine Cut/Fill

Cut and fill data is obtained from Civil3D by inserting the proposed alignment into the existing topographic surface. The volume of fill represents the amount of material needed to raise the roadway above existing grade, while the volume of cut represents the amount of material excavated from the existing grade. The cut/fill balance is optimized by modifying the vertical alignment with the aim to be close to zero to reduce the cost of importing material for construction. Table 3-22 indicates the total amount of earthwork for the proposed roadway. These results indicate that a net 14,153.45 cubic yards of fill of materials will be required for construction. These materials must meet or exceed the structural strength of the native soil. Native soil data is available in Section 2.1.3 of this report.

Table 3-22: Earthwork Volumes

Earthwork Volumes			
Cut (CY)	Fill (CY)	Net (CY)	Total (CY)
12,285.28	26,438.73	14,153.45	24,570.56

3.5.2 Determine Site Grading

Site grading aims to promote the intended drainage patterns along the alignment. This includes establishing positive drainage towards each culvert inlet to reduce standing water and encourage intended flow patterns.

Proposed site grading also ensures that downstream flow patterns are not changed. Appendix P shows existing downstream flow patterns in comparison to proposed downstream flow patterns. Culverts 1 and 3 will not alter existing flow patterns. The proposed downstream flow pattern for Culvert 2 will diverge slightly from the existing conditions but will not impact any existing infrastructure.

While not within the scope of this project, a No Impact Analysis should be performed to ensure that existing developments downstream of the proposed roadway will not be impacted by construction.

3.5.3 Utility Corridor Design

The Coconino County Engineering Design and Construction Manual [1] provides two 10-foot utility corridors on either side of the road with the standard Minor Collector (Rural) cross-section, which this alignment will be using. Further utility design, such as connections to existing utilities, is outside of the scope of this project and should be further analyzed for final design.

3.6 Plan Set

Using Civil 3D, a full conceptual plan set is produced. This includes a border, template, cover page, estimated quantities, note sheets, typical cross-sections, existing site conditions, removals, topographic data, existing landmarks, plan and profile views for proposed improvements, and plan details. The full plan set is available in Appendix Q.

4.0 Alternatives Considered

A weighted decision matrix is utilized to determine which alternative for the following selections will best serve the needs of the client, the local Bellemont community, and of this project. Each category is based on a quantitative feature. The data for each decision matrix is available in Appendix R. To compare each category, a standardized score is determined utilizing the equation below, where the higher score is the most ideal.

Equation 4-1: Normalization Based on Maximum

$$x' = \left(1 - \frac{x}{\max(X)}\right) 100$$

Where:

x = raw value

x' = standardized value

max(X) = maximum value within the set

Furthermore, the resulting standardized values (raw values) are weighted. These weights represent the relative importance of each category with respect to the goals of the project.

4.1 Roadway Alignment Selection

A map of the three alternative alignments examined in this decision matrix are available in Figure 1-2 of this report. Alternative 1 is provided by the owner. The team decided to analyze two other alternatives to ensure that the owner had a full understanding of the options for this project.

Alternative 2 is intended to reduce the overall length of the alignment and reduce the number of trees removed for construction. However, Alternative 2 intersects with the FEMA flood plain in the area, as shown in Figure 3-1, which greatly increases the cost of hydraulic infrastructure. Alternative 3 is intended to increase the overall length of the alignment, which would allow for further development of the land surrounding the roadway. However, Alternative 3 would require much greater tree removal for construction.

The hydraulic cost is analyzed with respect to the amount of flow intersecting the proposed alignment, the cut & fill work is analyzed with respect to the existing grade changes along each alignment, the environmental impact is analyzed with respect to the amount of trees removed for construction, and the alignment length is analyzed with respect to the overall length of the proposed alignment. The decision matrix below in Table 4-1 examines each alternative alignment with respect to each category discussed above. Alternative 1, with the highest score, shows to be the most ideal alignment option.

Table 4-1: Decision Matrix

	Weight	Alternative 1		Alternative 2		Alternative 3	
		Raw	Weighted	Raw	Weighted	Raw	Weighted
Hydraulic Cost	40%	93	37	0	0	93	37
Cut & Fill Work	20%	45	9	44	9	0	0
Environmental Impact	20%	73	15	80	16	0	0
Alignment Length	20%	13	3	16	3	0	0
Total Score	100%	223	63	140	28	93	37

4.2 Structural Section Selection

The two alternatives considered for the structural section are detailed below.

- Alternative 1 – 12-inches of aggregate base course on 12-inches of scarified & compacted subgrade
- Alternative 2 – 2-inches of aggregate base course on 6-inches of cement treated subgrade on 12-inches of scarified & compacted subgrade

Both alternatives will pave 4.5-inches of asphalt concrete. Using the processes in section 3.4.5 of this report, the structural number for Alternative 1 is 4.25. The structural number for Alternative 2 is 4.29. The required structural number is 4.23. This comparison is illustrated in Table 3-18 shown previously.

The construction cost is analyzed with respect to the prices of each alternative discussed in section 5.2 of this report. The structural strength is analyzed with respect to the structural numbers discussed above. The decision matrix below in Table 4-2 examines each alternative alignment with respect to each category discussed above. Alternative 2 is selected as the preferred alternative. Per our client's request, both alternatives are provided in the plan set.

Table 4-2: Structural Section Alternatives

	Weight	Alternative 1 - 12" AB & 12" Subgrade		Alternative 2 - 2" AB, 6" CTB, & 12" Subgrade	
		Raw	Weighted	Raw	Weighted
Construction Cost	50%	0	0	9	5
Structural Strength	50%	5	2	14	7
Total Score		5	2	23	12

4.3 Sidewalk Length Selection

The proposed alignment is largely surrounded by areas with few pedestrians or open space that has not yet been developed. The only area generating pedestrian traffic is the proposed development. Because of this, the length of the sidewalk may be reduced from the full alignment length to only serve the proposed development, from 7026 feet to 2883 feet.

The construction cost is analyzed with respect to the prices discussed in section 5.2 of this report. The pedestrian access is analyzed with respect to the amount of the alignment that is served by the sidewalk. The future costs are analyzed with respect to the cost to build out the rest of the length of sidewalk in the future. The decision matrix below in Table 4-3 examines each alternative alignment with respect to each category discussed above. The highest scoring alternative is the reduced sidewalk length.

Table 4-3: Sidewalk Alternatives

	Weight	Reduced Sidewalk Length		Full Sidewalk Length	
		Raw	Weighted	Raw	Weighted
Construction Cost	40%	59	24	0	0
Pedestrian Access	30%	0	0	59	18
Future Costs	30%	100	30	0	0
Total Score		159	54	59	18

5.0 Final Design Recommendation

5.1 Summary of Deliverables

This project delivers a full construction plan set, available in Appendix Q. Appendix A includes the results of analysis for existing soil. Appendices B through E include results for hydrologic analysis. Appendices E through G include results for hydraulic analysis. Appendix P includes methods and calculations for decision matrices.

Summary of project-specific deliverables, construction drawings, site plans, survey maps, analysis results tables and printouts, O&M plans, photo logs, etc.

5.2 Cost of Implementing the Final Design

Table 5-1 below summarizes the results of the Engineer’s Opinion of Probable Cost (EOPC). The full EOPC is available in Appendix S. Costs are estimated using previous ADOT bid tabulations [18] and by referencing local projects of similar scope. Costs include material and labor for the demolition, roadway construction, and hydraulic structure construction scopes of work. Contract prices are also included. Two alternative costs are provided for each alternative structural section as outlined in Section 4.2 of this report. Major cost items include the aggregate base course and paving scopes of work. The cost for Alternative 1 is approximately 6.7 million dollars. The cost for Alternative 2 is approximately 6.5 million dollars.

Table 5-1: Engineers’ Opinion of Probable Cost Summary

Engineers’ Opinion of Probable Cost	
Item	Total Cost
Alt. 1 Total	\$6,725,624.40
Alt. 2 Total	\$6,521,826.69

6.0 Project Impact

The construction of the proposed roadway will cause impacts to the public health, safety and welfare, as well as the social, environmental, and economic status of the surrounding area. These include both positive and negative changes. These impacts are analyzed in the following sections.

6.1 Public Health, Safety, and Welfare

The construction of the proposed roadway will have both positive and negative public health, safety, and welfare impacts. The purpose of the roadway is to provide alternative access in the area and increase emergency egress. This roadway will deliver both goals and allow for increased safety during emergency events by providing alternative access paralleling Shadow Mountain Dr.

However, this roadway will introduce possible safety issues. The proposed alignment has long, winding horizontal curves that do not discourage speeding. As previously stated, this issue warrants further analysis beyond this report. The County does not maintain speed bumps due to snowplow operations, but the installation of speed feedback signs or other enforcement strategies may alleviate this problem. Other safety concerns include falls from heights near the proposed box culverts, but standard railing is designed to prevent falls near this infrastructure.

6.2 Social Factors

The construction of the proposed roadway will have both positive and negative social impacts. The new roadway and proposed development will increase the population of the Bellemont area. The construction process will likely disrupt the daily lives of the existing population by way of noise, construction traffic, and restricted roadway access when modifying existing infrastructure. However, increased population may encourage further development of social infrastructure, such as parks, stores, and employment centers in the area.

6.3 Environmental Factors

The construction of the proposed roadway will have both positive and negative environmental impacts. The most substantial negative impact will be the disruption to the current landscape. The clearing of existing vegetation and removal of trees may disrupt the wildlife in the area. The removal of existing vegetation and road construction may disrupt existing drainage patterns, which may impact existing wildlife as well. Further negative impacts include the pollution generated during construction and the pollution generated over the lifespan of this roadway by the travelling public. Pollutants may run off into the surrounding area, causing negative impacts on the health of the water in this area. However, the construction of this road and associated hydraulic structures will promote proper drainage of on-site, off-site, and roadway runoff downstream of the roadway. This may reduce erosion downstream and increase the health of the water in this area.

6.4 Economic Factors

The construction of the proposed roadway will have both positive and negative economic impacts. Improved development area will increase the population of the area, encouraging further development of homes and stores in the area. This could increase the economic output of Bellemont. Improved access may reduce traffic for commuters, which may increase the value of homes in the area. However, a greater population will lead to more vehicle travel which may increase noise pollution and decrease appeal to the small size of the current exurban development, which may lower the value of homes in the area. The construction of this roadway will provide jobs to the northern Arizona region, but these jobs will not permanently stay in the area.

7.0 Summary of Engineering Work

After completing the project, the team encountered several changes in scope and schedule. Changes in scope consisted of reassessing subtasks, removing subtasks, and moving subtasks around. Changes in schedule include a significant reduction in estimated time to complete the project, regardless the project was successfully completed.

7.1 Changes in Scope

Subtask 4.1 was originally scoped to find the elevation of the FEMA floodplain that intersects with the proposed alignment on the east side near FS 171. This was intended to ensure that our roadway would not overtop during the 100-year flow event that is specified in the Coconino County Engineering Design and Construction Manual [1]. In working with our TA, the team determined that finding a relevant drainage report for the Village Camp development nearby would provide the most accurate data. The scope of this subtask is revised to include meeting with Ardurra, the author of the drainage report for the Village Camp development, to find the off-site flow rates that the hydraulic infrastructure of the roadway must convey.

Subtask 4.3 was originally scoped to model the hydraulic infrastructure within HEC-RAS and CulvertMaster software to ensure that all Coconino County Drainage Manual [2] requirements are met. With further review of the manual, full-scale modeling is not required. The scope of this subtask is revised to include sizing culverts using inlet-controlled nomographs as required by the manual.

Subtask 6.8 was originally scoped to select the best horizontal and vertical curve after all other Task 6 work. This was revised during the project to be the first subtask completed within Task 6. Because complications with the other alternatives were apparent without further design, the decision matrix is designed to analyze each alternative at a high level. Therefore, Subtask 6.8 is modified to become Subtask 6.1, and all other Task 6 subtasks are unaffected.

7.2 Changes in Schedule

The Gantt chart to show overall schedule change is available in Appendix T. The colored tasks represent the final schedule, while greyed-out tasks represent the original schedule. Overall, the schedule for this project did not change dramatically. In general, the shorter tasks took less time to complete, while the longer tasks took more time to complete. Preparing the estimated quantities and EOPC varied greatly between originally scheduled length and actual time to complete. This is because the EOPC originally did not consider the need to revise as the proposed improvements are developed. The original schedule also did not consider the time to compile other project deliverables, such as presentations and progress report updates. Despite minor schedule changes, all milestones were achieved, and the project was delivered on time in all regards.

7.3 Completed Work

The original and updated Gantt charts are available in Appendix T-1 and T-2, respectively. All scoped engineering work for this project is completed.

8.0 Summary of Engineering Costs

Due to the team completing the project ahead of schedule, removal of subtasks, and restructuring of subtasks the cost of engineering services decreased. All engineering roles saw a decrease in hours compared to the estimated hours.

8.1 Staffing and Cost

Due to the changes in scope to subtasks 4.1 and 4.3 the cost of the project decreased slightly. All staffing and cost tables can be found in Appendix U, where the original can be found in Appendix U-1 and the final can be found in Appendix U-2. Subtask 4.1 was originally intended to find the elevation of the FEMA flood zone; this was later changed to determining the off-site flow. This decreased the amount of time spent on this task which decreased the cost of the project. Subtask 4.3 was originally intended for hydraulic modeling of potential hydraulic structures; this was removed since the culverts were sufficiently designed without the need for modeling. Similarly to subtask 4.1 this decreased the total cost of the project. Additionally, the majority of tasks were either completed on time or ahead of schedule, decreasing the cost of engineering services. Table 8-1 shows the original cost for engineering services coming out to \$78,505.

Table 8-1: Original Cost of Engineering Services

1.0 Personnel	Classification	Hours	Rate, \$/hr	Cost
	SENG	105	\$162	\$17,010
	ENG	151	\$127	\$19,177
	TECH	207	\$110	\$22,770
	INT	197	\$84	\$16,548
	Total personnel			\$75,505
2.0 Software	Software	300	\$10	\$3,000
3.0 Total				\$78,505

The final cost of engineering services is shown in Table 8-2 and comes out to \$65,770. This comes out to cost savings of \$12,735 due to the reduction of hours in all engineering roles.

Table 8-2: Final Cost of Engineering Services

1.0 Personnel	Classification	Hours	Rate, \$/hr	Cost
	SENG	103	\$162	\$16,686
	ENG	104	\$127	\$13,208
	TECH	166	\$110	\$18,260
	INT	174	\$84	\$14,616
	Total personnel			\$62,770
2.0 Software	Software	300	\$10	\$3,000
3.0 Total				\$65,770

9.0 Conclusion

The final design recommendation is a 1.5-mile, 2-lane roadway connecting Forest Service 171 and Shadow Mountain Dr in the Bellemont, AZ area. This design includes reinforced concrete box culvert and corrugated metal pipe structures to properly convey the on-site, off-site, and roadway drainage flows. The design follows all relevant county, state, and federal regulations. The design will accommodate the future 20-year growth in traffic of existing and proposed developments.

The total construction cost for Alternative 1 is \$6,725,624 for a typical aggregate base course structural section. The total construction cost for Alternative 2 is \$6,521,826 for a cement treated base course structural section. The final cost of engineering services is \$65,770.

The proposed roadway will provide vital emergency access and increase developable areas in Bellemont. The design considers public health, safety, and welfare as well as social, environmental, and economic impacts. The proposed roadway includes a reduced-length sidewalk designed to serve the proposed development area with right-of-way available for future developments to install further sidewalk infrastructure. The right-of-way also includes utility corridors to allow for future developments to install utility infrastructure.

In conclusion, the proposed roadway addresses the objectives of the County to increase emergency access and developable areas in Bellemont. The project completed all scoped engineering tasks, though further consideration is warranted. A full downstream FEMA floodplain analysis should be performed to ensure FEMA requirements are met. Utility design should be considered for any future developments to ensure all county standards are met. A full traffic count on Forest Service 171 should be performed to ensure that design assumptions in Section 3.3.3 of this report are correct. A consideration of the straight nature of the horizontal alignment on speeding and safety should be performed to ensure that further speed monitoring, such as speed feedback signs, are not warranted.

10.0 References

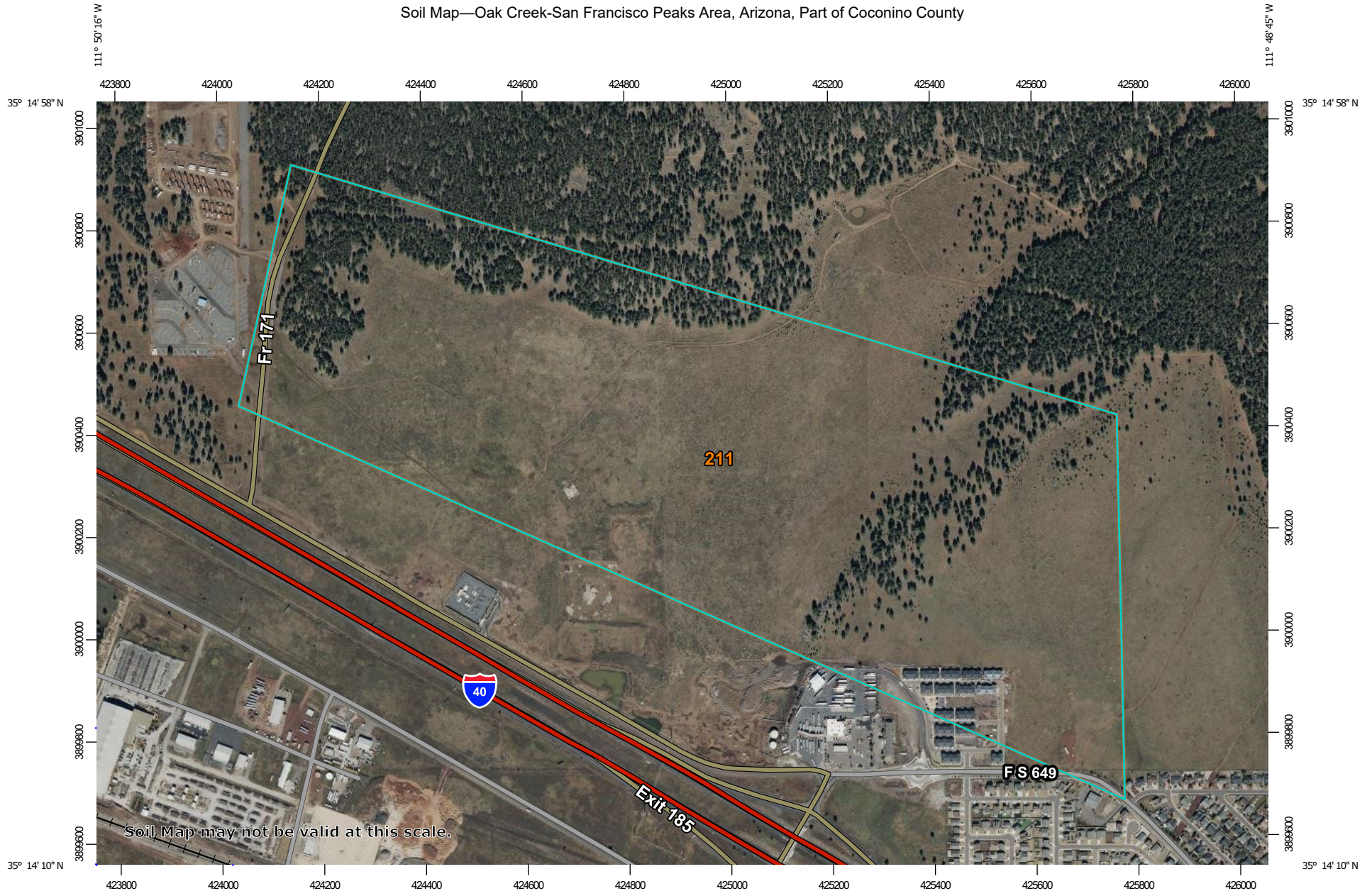
- [1] Coconino County Public Works, Coconino County Engineering Design and Construction Manual, Flagstaff: Coconino County , 2025.
- [2] Coconino County Public Works, Coconino County Drainage Design Criteria Manual, Flagstaff: Coconino County, 2025.
- [3] Shephard - Wesnitzer, Inc. , "Final Drainage Report For Village Camp/Flagstaff," Flagstaff, 2021.
- [4] Western Technologies , "Geotechnical Evaluation Shadow Mountain Road Reconstruction," Flagstaff, 2023.
- [5] CMT Engineering Laboratories, "Geotechnical Engineering Study Avonlea Village," Bellemont, 2021.
- [6] United States Department of Agriculture, "Web Soil Survey," Natural Resources Conservation Service, 21 July 2019. [Online]. Available: <https://websoilsurvey.nrcs.usda.gov/app/>.
- [7] Arizona Department of Transportation, "Traffic Count (TCDS)," Midwestern Software Solutions, 2026. [Online]. Available: <https://adot.public.ms2soft.com/tcds/tsearch.asp?loc=Adot&mod=TCDS>.
- [8] Arizona Department of Transportation, Highway Drainage Design Manual, 2014.
- [9] U.S. Geological Survey, "StreamStats," [Online]. Available: <https://streamstats.usgs.gov/ss/>.
- [10] National Oceanic and Atmospheric Administration, "Precipitation Frequency Data Server," 4 August 2025. [Online]. Available: https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=az.
- [11] U.S. Army Corps of Engineers Hydrologic Engineering Center, "HEC-HMS HYdrologic Modeling System , Version 4.13," 2025.
- [12] United States Department of Agriculture, National Engineering Handbook, 2021.
- [13] Arizona Department of Transportation, "245 Turn Lane Warrants," in *ADOT Traffic Guidelines and Processes*, IDO and TSMO, January .

- [14] U. D. o. T. F. H. Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, 2025.
- [15] Arizona Department of Transportation , Roadway Design Guidelines, 2021.
- [16] American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highway and Streets, Washington: American Association of State Highway and Transportation Officials, 2018.
- [17] Arizona Department of Transportation, "Pavement Design Manual," 2017.
- [18] Arizona Department of Transportation, "Bid Tabulations," Arizona Department of Transportation, Phoenix, 2026.
- [19] U.S. Department of Homeland Security, "Federal Emergency Management Agency," 3 September 2010. [Online]. Available: <https://msc.fema.gov/portal/images/btn-sm-dnldfirmpanel.gif>. [Accessed January 2025].
- [20] Institute of Transportation Engineers, "ITETripGen Web-based App," 2025. [Online]. Available: <https://www.itetripgen.org>.
- [21] Institute of Transportation Engineers, Trip Generation Manual (10th edition), ITE, 2017.
- [22] Arizona Department of Transportation, "311 Speed Limit Signing," in *Adot Traffic Engineering Guidelines and Processes*, 2015.

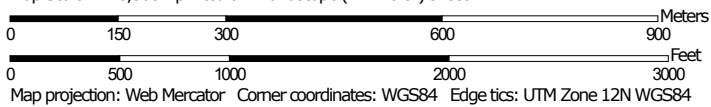
Appendix A: Web Soil Survey Reports

Appendix A-1: Web Soil Map

Soil Map—Oak Creek-San Francisco Peaks Area, Arizona, Part of Coconino County




Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.





MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Oak Creek-San Francisco Peaks Area, Arizona, Part of Coconino County

Survey Area Data: Version 15, Aug 27, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 19, 2022—Oct 31, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
211	Aridic Argiustolls, Cumulic Haplustolls, rarely flooded, and Aridic Ustifluvents, rarely flooded; cool mesic ustic hills and fans	262.5	100.0%
Totals for Area of Interest		262.5	100.0%

Appendix A-2: Web Soil Engineering Properties

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard
classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk "*" denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

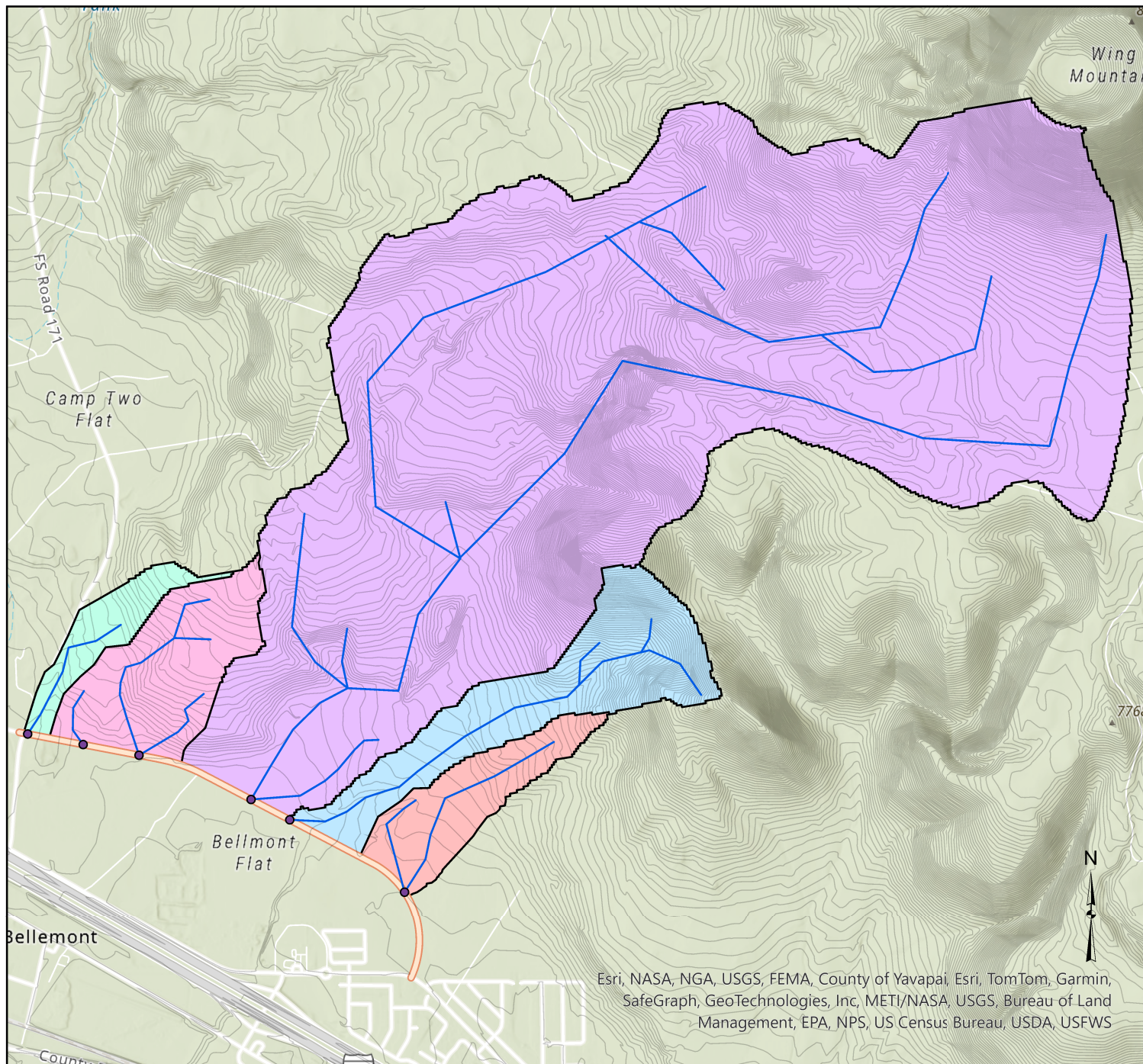
Engineering Properties—Oak Creek-San Francisco Peaks Area, Arizona, Part of Coconino County														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
211—Aridic Argiustolls, Cumulic Haplustolls, rarely flooded, and Aridic Ustifluvents, rarely flooded; cool mesic ustic hills and fans														
Aridic argiustolls	45	D	0-8	Gravelly clay loam	CH, GC	A-7-6, A-7-5	0- 0- 0	0- 8- 15	65-74-91	64-73-90	55-67-88	43-53-70	43-51-58	21-25-28
			8-36	Gravelly clay, cobbly clay	CH, GC	A-7-6	0- 0- 0	0- 7- 14	59-68-91	58-66-91	53-62-87	42-50-71	49-53-59	28-30-32
			36-46	Bedrock	—	—	—	—	—	—	—	—	—	—
Cumulic haplustolls, cool	35	C	0-14	Clay loam	CL	A-7-6	0- 0- 0	0- 0- 0	80-90-100	79-89-100	70-81-94	55-63-74	42-45-49	21-23-25
			14-60	Loam, clay loam, silt loam	CL, SC	A-7-6, A-6	0- 0- 0	0- 0- 0	81-90-100	80-90-100	64-81-95	47-61-73	32-43-49	13-21-25
Aridic ustifluvents	20	C	0-10	Fine sandy loam	SC, SC-SM	A-4, A-6, A-2-4	0- 0- 0	0- 0- 0	83-90-100	82-89-100	72-83-98	29-36-46	23-30-37	6-10-13
			10-60	Stratified loamy fine sand to fine sandy loam	SC, SM	A-1-b, A-6, A-2-6	0- 0- 0	0- 0- 0	75-87-100	74-87-100	47-66-77	18-31-37	16-28-29	2-11-12

Data Source Information

Soil Survey Area: Oak Creek-San Francisco Peaks Area, Arizona, Part of Coconino County
Survey Area Data: Version 15, Aug 27, 2025

Appendix B: Watershed Delineation

Watershed Delineation for Alternative 1



Legend

- Points of Interest
- Flow Line
- County Contours(7FT)
- Preliminary Alignment
- 1
- 2
- 3
- 4
- 5

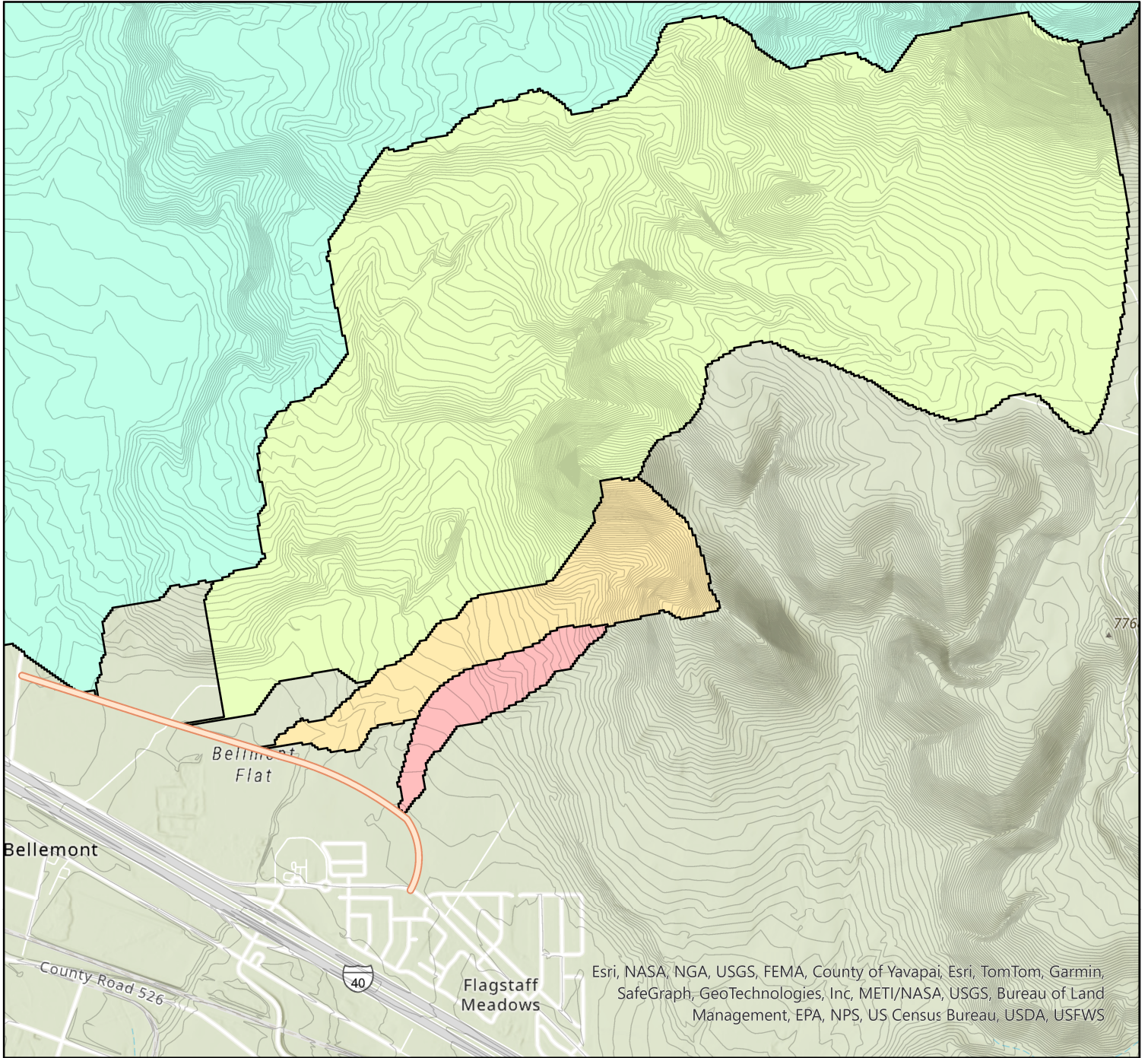
Watershed Areas

- Watershed #1: 64 acres
- Watershed #2: 134 acres
- Watershed #3: 1478 acres
- Watershed #4: 99 acres
- Watershed #5: 36 acres

0 0.13 0.25 0.5 Miles
Scale: 1:24,000



Watershed Delineation for Alternative 2 Alignment

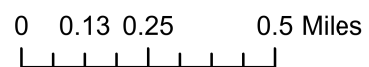


Legend

- County Contours(7FT)
- Alt. 1 Alignment
- 1
- 2
- 3
- 4

Watershed Areas

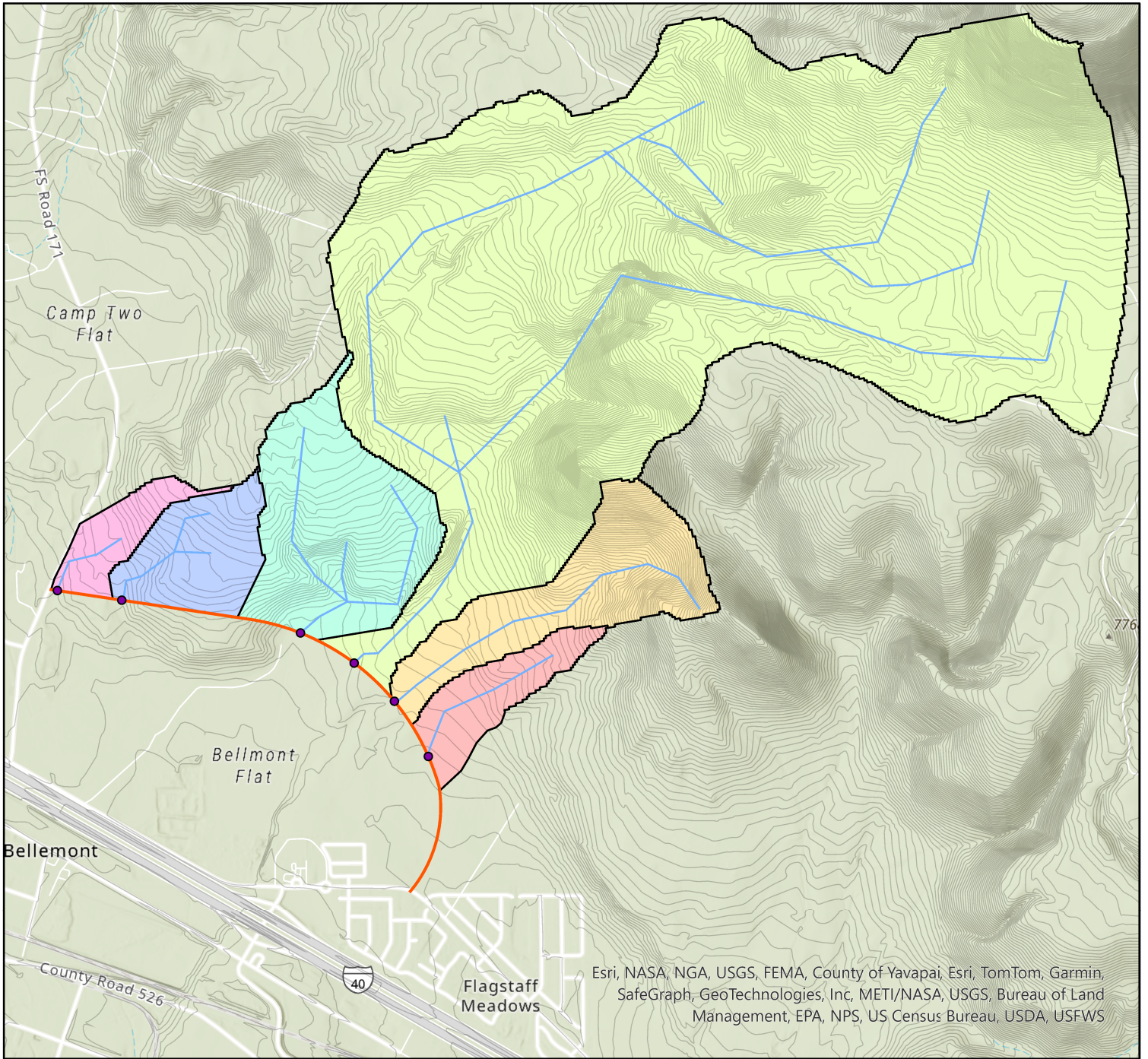
Watershed #1: 43 acres
Watershed #2: 135 acres
Watershed #3: 1461 acres
Watershed #4: 23700 acres



Scale: 1:24,000



Watershed Delineation for Alternative 3 Alignment



Esri, NASA, NGA, USGS, FEMA, County of Yavapai, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, USFWS

Legend

- County Contours(7FT)
- 6
- 1
- 2
- 3
- 4
- 5
- Flow Line
- Alt. 2 Alignment
- Points of Interest

Watershed Areas

- Watershed #1: 46 acres
- Watershed #2: 115 acres
- Watershed #3: 1271 acres
- Watershed #4: 146 acres
- Watershed #5: 62 acres
- Watershed #6: 31 acres

0 0.13 0.25 0.5 Miles

Scale: 1:24,000



Appendix C: Rainfall Intensities

Appendix C-1: Alignment 1 Rainfall Intensity



NOAA Atlas 14, Volume 1, Version 5
Location name: Belmont, Arizona, USA*
Latitude: 35.2409°, Longitude: -111.8166°
Elevation: 7146 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerials](#)

PF tabular

AMS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹									
Duration	Annual exceedance probability (1/years)								
	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/500	1/1000
5-min	3.05 (2.64-3.53)	4.45 (3.84-5.16)	5.51 (4.72-6.35)	6.96 (5.92-7.99)	8.15 (6.86-9.37)	9.47 (7.87-10.9)	10.9 (8.90-12.6)	12.9 (10.4-15.1)	14.7 (11.5-17.3)
10-min	2.32 (2.01-2.69)	3.39 (2.93-3.92)	4.19 (3.59-4.84)	5.29 (4.50-6.08)	6.20 (5.23-7.13)	7.20 (5.99-8.30)	8.27 (6.77-9.56)	9.85 (7.88-11.5)	11.2 (8.78-13.2)
15-min	1.92 (1.66-2.22)	2.80 (2.42-3.24)	3.46 (2.96-4.00)	4.37 (3.72-5.03)	5.12 (4.32-5.89)	5.95 (4.95-6.86)	6.84 (5.60-7.90)	8.14 (6.52-9.47)	9.25 (7.26-10.9)
30-min	1.29 (1.12-1.50)	1.89 (1.63-2.18)	2.33 (2.00-2.69)	2.94 (2.50-3.39)	3.45 (2.91-3.97)	4.01 (3.33-4.62)	4.61 (3.77-5.32)	5.48 (4.39-6.38)	6.23 (4.89-7.32)
60-min	0.799 (0.691-0.926)	1.17 (1.01-1.35)	1.44 (1.24-1.66)	1.82 (1.55-2.10)	2.13 (1.80-2.45)	2.48 (2.06-2.86)	2.85 (2.33-3.29)	3.39 (2.72-3.95)	3.85 (3.02-4.53)
2-hr	0.460 (0.404-0.526)	0.657 (0.577-0.751)	0.803 (0.700-0.915)	1.01 (0.872-1.15)	1.18 (1.01-1.34)	1.37 (1.15-1.56)	1.57 (1.30-1.79)	1.87 (1.52-2.15)	2.12 (1.68-2.45)
3-hr	0.338 (0.301-0.386)	0.470 (0.417-0.534)	0.568 (0.502-0.645)	0.705 (0.617-0.799)	0.817 (0.708-0.925)	0.944 (0.808-1.07)	1.08 (0.910-1.23)	1.28 (1.06-1.47)	1.45 (1.17-1.68)
6-hr	0.203 (0.183-0.228)	0.273 (0.245-0.306)	0.325 (0.291-0.364)	0.396 (0.351-0.443)	0.453 (0.398-0.507)	0.516 (0.449-0.578)	0.583 (0.499-0.655)	0.681 (0.571-0.771)	0.763 (0.629-0.870)
12-hr	0.129 (0.116-0.144)	0.171 (0.154-0.190)	0.200 (0.180-0.222)	0.237 (0.212-0.264)	0.266 (0.236-0.296)	0.297 (0.261-0.331)	0.328 (0.285-0.367)	0.374 (0.321-0.421)	0.412 (0.350-0.468)
24-hr	0.080 (0.074-0.088)	0.109 (0.099-0.119)	0.128 (0.116-0.140)	0.154 (0.139-0.168)	0.173 (0.156-0.190)	0.194 (0.174-0.213)	0.215 (0.192-0.236)	0.244 (0.215-0.268)	0.266 (0.233-0.293)
2-day	0.048 (0.044-0.053)	0.066 (0.060-0.072)	0.077 (0.071-0.085)	0.093 (0.084-0.102)	0.105 (0.095-0.115)	0.118 (0.106-0.130)	0.131 (0.117-0.144)	0.149 (0.131-0.164)	0.163 (0.143-0.180)
3-day	0.035 (0.032-0.038)	0.047 (0.043-0.052)	0.056 (0.051-0.062)	0.068 (0.062-0.074)	0.077 (0.070-0.084)	0.087 (0.078-0.095)	0.097 (0.086-0.106)	0.110 (0.097-0.122)	0.121 (0.106-0.134)
4-day	0.028 (0.026-0.031)	0.038 (0.035-0.042)	0.046 (0.042-0.050)	0.055 (0.050-0.060)	0.063 (0.057-0.069)	0.071 (0.064-0.078)	0.080 (0.071-0.087)	0.091 (0.080-0.100)	0.101 (0.088-0.111)
7-day	0.019 (0.017-0.021)	0.026 (0.024-0.028)	0.030 (0.028-0.033)	0.037 (0.033-0.040)	0.042 (0.038-0.045)	0.047 (0.042-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.065)	0.066 (0.058-0.072)
10-day	0.015 (0.014-0.016)	0.020 (0.019-0.022)	0.024 (0.022-0.026)	0.028 (0.026-0.031)	0.032 (0.029-0.035)	0.035 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.047 (0.042-0.052)
20-day	0.010 (0.009-0.011)	0.013 (0.012-0.014)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.021 (0.020-0.023)	0.023 (0.021-0.025)	0.025 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.008 (0.007-0.009)	0.010 (0.010-0.011)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.015 (0.014-0.017)	0.017 (0.015-0.018)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.006-0.007)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.005-0.006)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.011 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

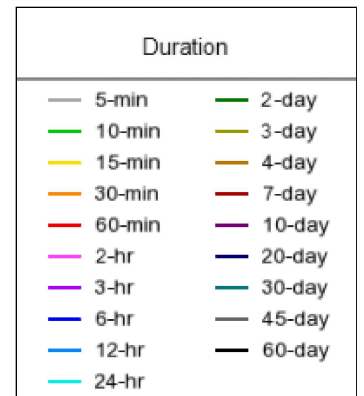
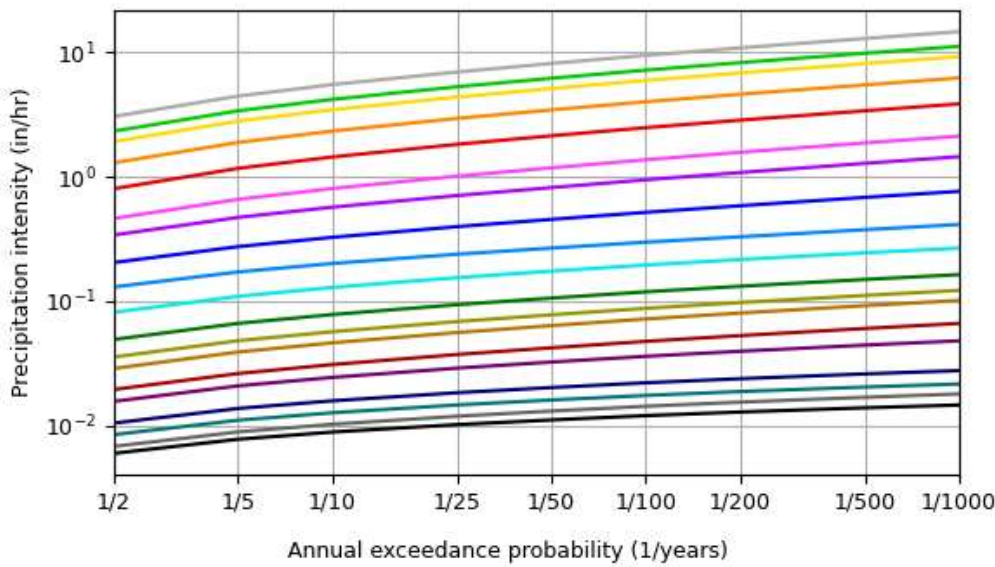
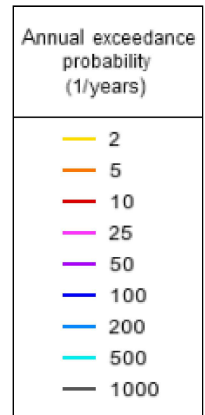
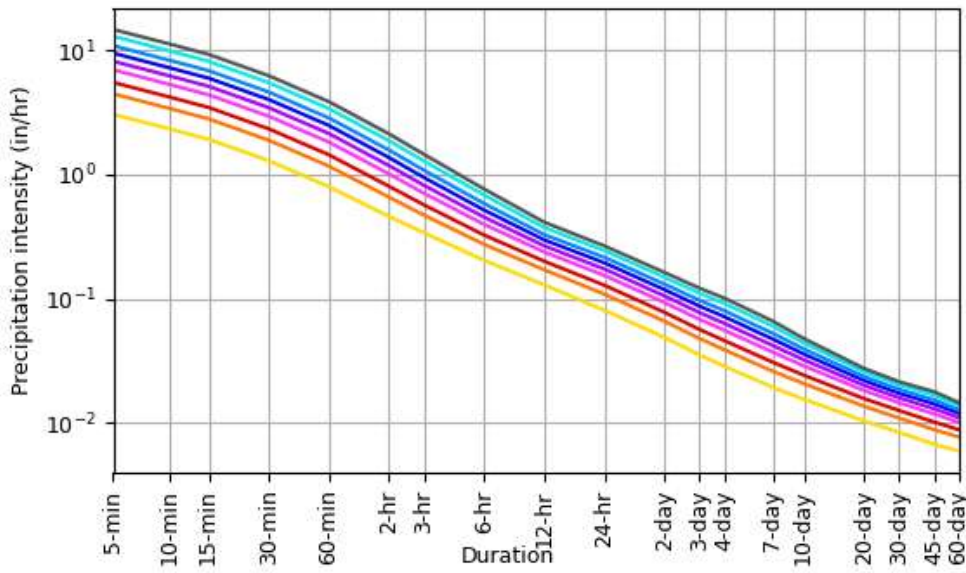
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of annual maxima series (AMS).
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and annual exceedance probability) will be greater than the upper bound (or less than the lower bound) is 5%.
 Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
 Please refer to NOAA Atlas 14 document for more information.

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PF graphical

AMS-based intensity-duration-frequency (IDF) curves

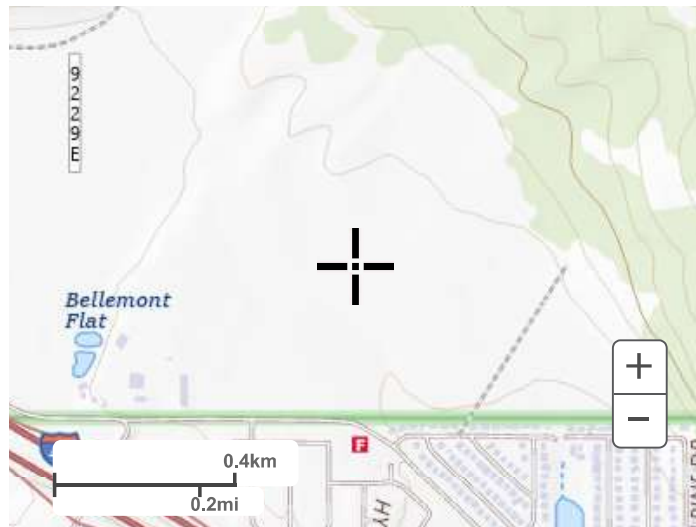
Latitude: 35.2409°, Longitude: -111.8166°



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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



NOAA Atlas 14, Volume 1, Version 5
Location name: Belmont, Arizona, USA*
Latitude: 35.2436°, Longitude: -111.8218°
Elevation: 7135 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerals](#)

PF tabular

AMS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹									
Duration	Annual exceedance probability (1/years)								
	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/500	1/1000
5-min	3.06 (2.65-3.54)	4.46 (3.86-5.17)	5.52 (4.73-6.37)	6.97 (5.93-8.02)	8.16 (6.89-9.40)	9.49 (7.90-10.9)	10.9 (8.93-12.6)	13.0 (10.4-15.1)	14.7 (11.6-17.3)
10-min	2.33 (2.02-2.69)	3.40 (2.94-3.94)	4.20 (3.60-4.85)	5.30 (4.51-6.10)	6.21 (5.24-7.15)	7.22 (6.01-8.33)	8.30 (6.79-9.59)	9.87 (7.91-11.5)	11.2 (8.81-13.2)
15-min	1.92 (1.66-2.23)	2.81 (2.43-3.25)	3.47 (2.98-4.01)	4.38 (3.73-5.04)	5.14 (4.33-5.91)	5.97 (4.97-6.88)	6.86 (5.62-7.92)	8.16 (6.54-9.50)	9.27 (7.28-10.9)
30-min	1.29 (1.12-1.50)	1.89 (1.64-2.19)	2.34 (2.00-2.70)	2.95 (2.51-3.40)	3.46 (2.92-3.98)	4.02 (3.34-4.63)	4.62 (3.78-5.33)	5.49 (4.40-6.39)	6.24 (4.90-7.34)
60-min	0.801 (0.694-0.929)	1.17 (1.01-1.36)	1.44 (1.24-1.67)	1.83 (1.55-2.10)	2.14 (1.80-2.46)	2.49 (2.07-2.87)	2.86 (2.34-3.30)	3.40 (2.72-3.96)	3.86 (3.03-4.54)
2-hr	0.461 (0.406-0.529)	0.659 (0.579-0.754)	0.806 (0.703-0.918)	1.01 (0.875-1.15)	1.18 (1.01-1.35)	1.37 (1.16-1.56)	1.58 (1.31-1.80)	1.88 (1.52-2.16)	2.13 (1.69-2.46)
3-hr	0.340 (0.302-0.387)	0.472 (0.419-0.536)	0.571 (0.504-0.647)	0.707 (0.619-0.801)	0.820 (0.710-0.928)	0.947 (0.811-1.08)	1.08 (0.913-1.24)	1.28 (1.06-1.47)	1.46 (1.18-1.68)
6-hr	0.204 (0.184-0.229)	0.275 (0.246-0.308)	0.326 (0.292-0.365)	0.398 (0.353-0.445)	0.455 (0.400-0.509)	0.519 (0.451-0.581)	0.586 (0.502-0.658)	0.684 (0.574-0.775)	0.766 (0.632-0.874)
12-hr	0.130 (0.117-0.145)	0.172 (0.154-0.191)	0.201 (0.180-0.224)	0.238 (0.213-0.266)	0.267 (0.237-0.298)	0.298 (0.262-0.333)	0.329 (0.287-0.368)	0.376 (0.322-0.424)	0.415 (0.351-0.470)
24-hr	0.081 (0.074-0.089)	0.109 (0.099-0.120)	0.129 (0.117-0.141)	0.154 (0.139-0.169)	0.174 (0.157-0.190)	0.195 (0.175-0.214)	0.216 (0.192-0.237)	0.244 (0.216-0.269)	0.267 (0.234-0.295)
2-day	0.049 (0.044-0.054)	0.066 (0.060-0.073)	0.078 (0.071-0.085)	0.093 (0.085-0.103)	0.106 (0.096-0.116)	0.119 (0.107-0.130)	0.132 (0.118-0.145)	0.149 (0.132-0.165)	0.163 (0.143-0.181)
3-day	0.035 (0.032-0.039)	0.048 (0.044-0.052)	0.056 (0.052-0.062)	0.068 (0.062-0.075)	0.077 (0.070-0.085)	0.087 (0.078-0.096)	0.097 (0.087-0.107)	0.111 (0.098-0.122)	0.122 (0.107-0.135)
4-day	0.028 (0.026-0.031)	0.039 (0.035-0.042)	0.046 (0.042-0.050)	0.056 (0.050-0.061)	0.063 (0.057-0.069)	0.072 (0.064-0.078)	0.080 (0.071-0.088)	0.092 (0.081-0.101)	0.101 (0.088-0.112)
7-day	0.019 (0.017-0.021)	0.026 (0.024-0.028)	0.030 (0.028-0.033)	0.037 (0.034-0.040)	0.042 (0.038-0.045)	0.047 (0.043-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.066)	0.066 (0.058-0.072)
10-day	0.015 (0.014-0.017)	0.020 (0.019-0.022)	0.024 (0.022-0.026)	0.028 (0.026-0.031)	0.032 (0.029-0.035)	0.036 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.048 (0.042-0.052)
20-day	0.010 (0.009-0.011)	0.013 (0.012-0.014)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.022 (0.020-0.024)	0.023 (0.021-0.025)	0.026 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.008 (0.007-0.009)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.014-0.017)	0.017 (0.015-0.019)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.006-0.007)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.016-0.019)
60-day	0.005 (0.005-0.006)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

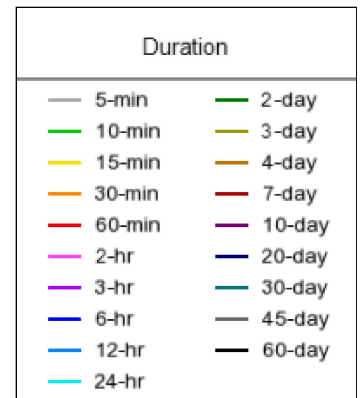
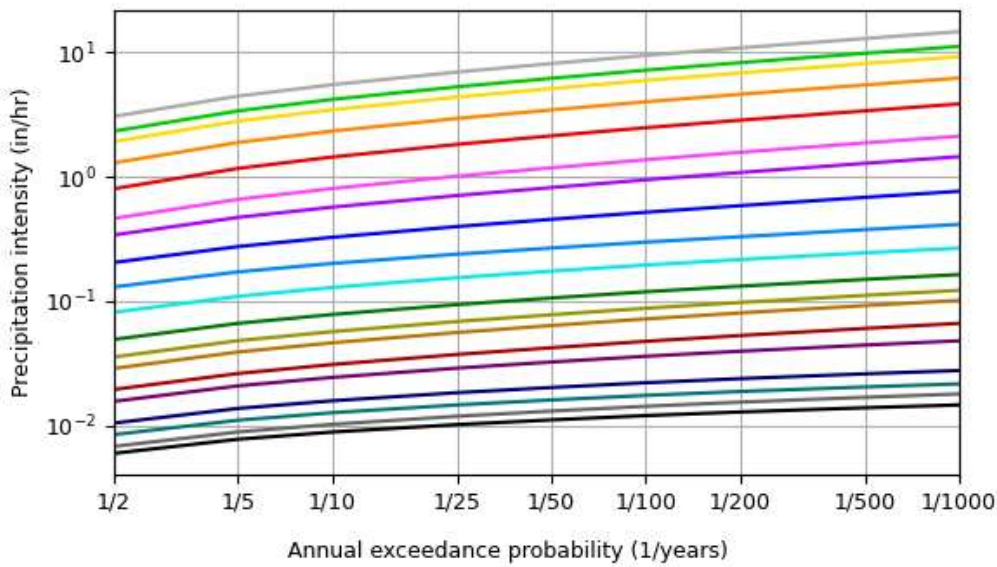
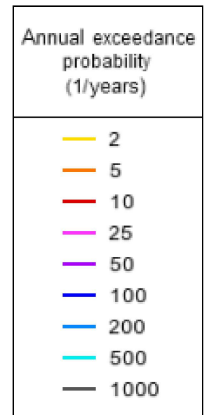
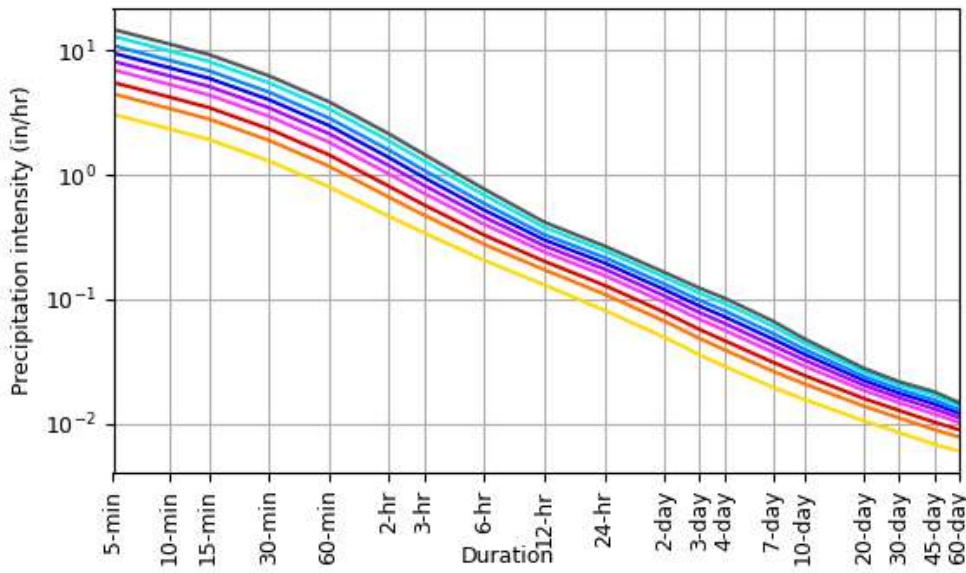
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of annual maxima series (AMS).
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and annual exceedance probability) will be greater than the upper bound (or less than the lower bound) is 5%.
 Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
 Please refer to NOAA Atlas 14 document for more information.

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PF graphical

AMS-based intensity-duration-frequency (IDF) curves

Latitude: 35.2436°, Longitude: -111.8218°



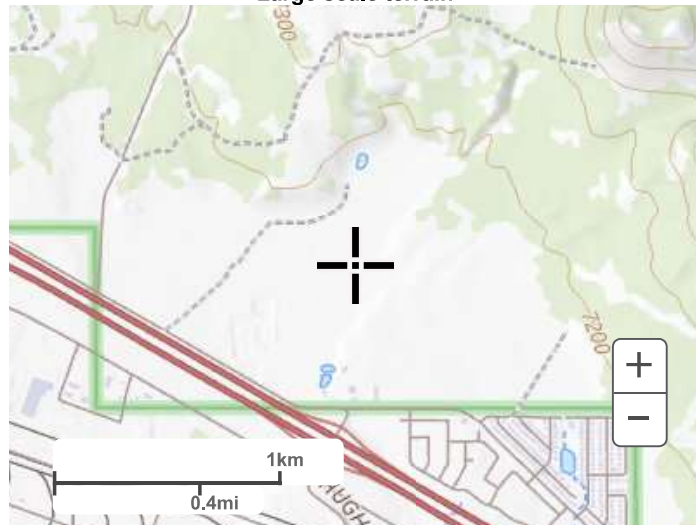
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



NOAA Atlas 14, Volume 1, Version 5
Location name: Belmont, Arizona, USA*
Latitude: 35.2444°, Longitude: -111.8237°
Elevation: 7133 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

AMS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹									
Duration	Annual exceedance probability (1/years)								
	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/500	1/1000
5-min	3.06 (2.65-3.54)	4.46 (3.86-5.17)	5.52 (4.73-6.37)	6.97 (5.93-8.02)	8.16 (6.89-9.40)	9.49 (7.90-10.9)	10.9 (8.93-12.6)	13.0 (10.4-15.1)	14.7 (11.6-17.3)
10-min	2.33 (2.02-2.69)	3.40 (2.94-3.94)	4.20 (3.60-4.85)	5.30 (4.51-6.10)	6.21 (5.24-7.15)	7.22 (6.01-8.33)	8.30 (6.79-9.59)	9.87 (7.91-11.5)	11.2 (8.81-13.2)
15-min	1.92 (1.66-2.23)	2.81 (2.43-3.25)	3.47 (2.98-4.01)	4.38 (3.73-5.04)	5.14 (4.33-5.91)	5.97 (4.97-6.88)	6.86 (5.62-7.92)	8.16 (6.54-9.50)	9.27 (7.28-10.9)
30-min	1.29 (1.12-1.50)	1.89 (1.64-2.19)	2.34 (2.00-2.70)	2.95 (2.51-3.40)	3.46 (2.92-3.98)	4.02 (3.34-4.63)	4.62 (3.78-5.33)	5.49 (4.40-6.39)	6.24 (4.90-7.34)
60-min	0.801 (0.694-0.929)	1.17 (1.01-1.36)	1.44 (1.24-1.67)	1.83 (1.55-2.10)	2.14 (1.80-2.46)	2.49 (2.07-2.87)	2.86 (2.34-3.30)	3.40 (2.72-3.96)	3.86 (3.03-4.54)
2-hr	0.461 (0.406-0.529)	0.659 (0.579-0.754)	0.806 (0.703-0.918)	1.01 (0.875-1.15)	1.18 (1.01-1.35)	1.37 (1.16-1.56)	1.58 (1.31-1.80)	1.88 (1.52-2.16)	2.13 (1.69-2.46)
3-hr	0.340 (0.302-0.387)	0.472 (0.419-0.536)	0.571 (0.504-0.647)	0.707 (0.619-0.801)	0.820 (0.710-0.928)	0.947 (0.811-1.08)	1.08 (0.913-1.24)	1.28 (1.06-1.47)	1.46 (1.18-1.68)
6-hr	0.204 (0.184-0.229)	0.275 (0.246-0.308)	0.326 (0.292-0.365)	0.398 (0.353-0.445)	0.455 (0.400-0.509)	0.519 (0.451-0.581)	0.586 (0.502-0.658)	0.684 (0.574-0.775)	0.766 (0.632-0.874)
12-hr	0.130 (0.117-0.145)	0.172 (0.154-0.191)	0.201 (0.180-0.224)	0.238 (0.213-0.266)	0.267 (0.237-0.298)	0.298 (0.262-0.333)	0.329 (0.287-0.368)	0.376 (0.322-0.424)	0.415 (0.351-0.470)
24-hr	0.081 (0.074-0.089)	0.109 (0.099-0.120)	0.129 (0.117-0.141)	0.154 (0.139-0.169)	0.174 (0.157-0.190)	0.195 (0.175-0.214)	0.216 (0.192-0.237)	0.244 (0.216-0.269)	0.267 (0.234-0.295)
2-day	0.049 (0.044-0.054)	0.066 (0.060-0.073)	0.078 (0.071-0.085)	0.093 (0.085-0.103)	0.106 (0.096-0.116)	0.119 (0.107-0.130)	0.132 (0.118-0.145)	0.149 (0.132-0.165)	0.163 (0.143-0.181)
3-day	0.035 (0.032-0.039)	0.048 (0.044-0.052)	0.056 (0.052-0.062)	0.068 (0.062-0.075)	0.077 (0.070-0.085)	0.087 (0.078-0.096)	0.097 (0.087-0.107)	0.111 (0.098-0.122)	0.122 (0.107-0.135)
4-day	0.028 (0.026-0.031)	0.039 (0.035-0.042)	0.046 (0.042-0.050)	0.056 (0.050-0.061)	0.063 (0.057-0.069)	0.072 (0.064-0.078)	0.080 (0.071-0.088)	0.092 (0.081-0.101)	0.101 (0.088-0.112)
7-day	0.019 (0.017-0.021)	0.026 (0.024-0.028)	0.030 (0.028-0.033)	0.037 (0.034-0.040)	0.042 (0.038-0.045)	0.047 (0.043-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.066)	0.066 (0.058-0.072)
10-day	0.015 (0.014-0.017)	0.020 (0.019-0.022)	0.024 (0.022-0.026)	0.028 (0.026-0.031)	0.032 (0.029-0.035)	0.036 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.048 (0.042-0.052)
20-day	0.010 (0.009-0.011)	0.013 (0.012-0.014)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.022 (0.020-0.024)	0.023 (0.021-0.025)	0.026 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.008 (0.007-0.009)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.014-0.017)	0.017 (0.015-0.019)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.006-0.007)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.016-0.019)
60-day	0.005 (0.005-0.006)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

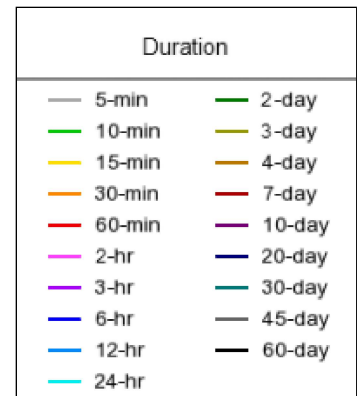
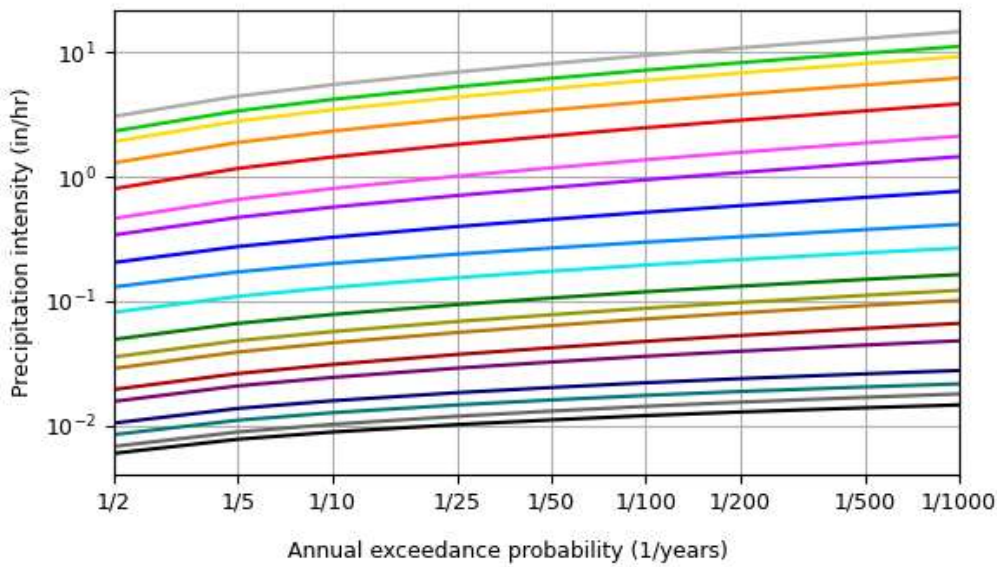
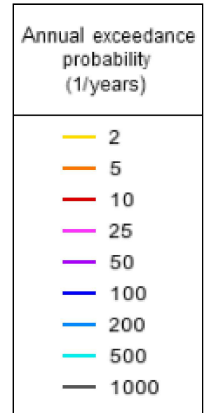
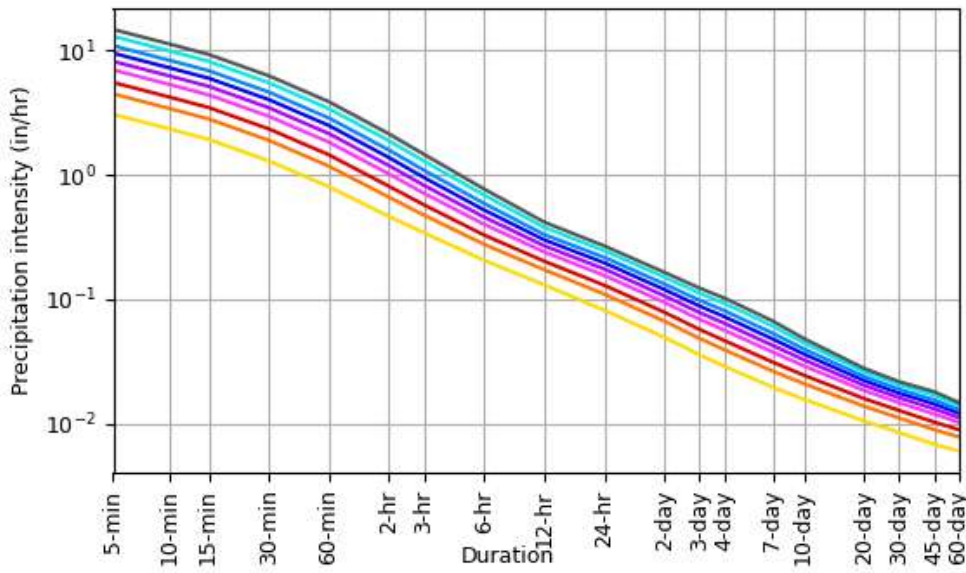
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of annual maxima series (AMS).
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and annual exceedance probability) will be greater than the upper bound (or less than the lower bound) is 5%.
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 Please refer to NOAA Atlas 14 document for more information.

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PF graphical

AMS-based intensity-duration-frequency (IDF) curves

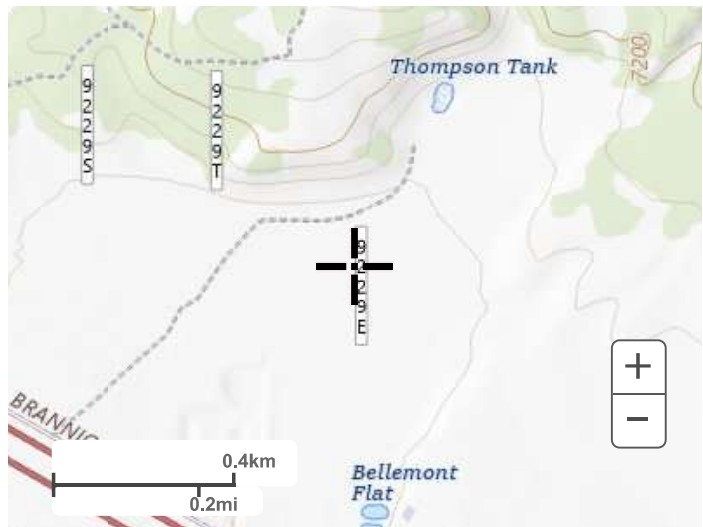
Latitude: 35.2444°, Longitude: -111.8237°



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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



NOAA Atlas 14, Volume 1, Version 5
Location name: Belmont, Arizona, USA*
Latitude: 35.2465°, Longitude: -111.8315°
Elevation: 7142 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerials](#)

PF tabular

AMS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹									
Duration	Annual exceedance probability (1/years)								
	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/500	1/1000
5-min	3.07 (2.65-3.55)	4.48 (3.88-5.18)	5.53 (4.75-6.40)	6.98 (5.95-8.05)	8.20 (6.91-9.43)	9.52 (7.92-11.0)	10.9 (8.96-12.6)	13.0 (10.4-15.2)	14.8 (11.6-17.4)
10-min	2.33 (2.02-2.71)	3.41 (2.95-3.95)	4.21 (3.61-4.86)	5.32 (4.53-6.13)	6.23 (5.26-7.18)	7.24 (6.03-8.36)	8.33 (6.82-9.62)	9.91 (7.93-11.5)	11.3 (8.84-13.2)
15-min	1.93 (1.67-2.24)	2.82 (2.44-3.26)	3.48 (2.99-4.02)	4.40 (3.74-5.06)	5.15 (4.35-5.93)	5.99 (4.98-6.91)	6.88 (5.64-7.95)	8.18 (6.56-9.53)	9.31 (7.30-10.9)
30-min	1.30 (1.12-1.51)	1.90 (1.64-2.20)	2.34 (2.01-2.71)	2.96 (2.52-3.41)	3.47 (2.93-3.99)	4.03 (3.36-4.65)	4.63 (3.79-5.35)	5.51 (4.42-6.42)	6.27 (4.92-7.37)
60-min	0.803 (0.695-0.932)	1.17 (1.02-1.36)	1.45 (1.24-1.68)	1.83 (1.56-2.11)	2.15 (1.81-2.47)	2.50 (2.08-2.88)	2.87 (2.35-3.31)	3.41 (2.73-3.97)	3.88 (3.04-4.56)
2-hr	0.463 (0.407-0.531)	0.662 (0.580-0.757)	0.809 (0.705-0.922)	1.02 (0.878-1.16)	1.19 (1.01-1.35)	1.38 (1.16-1.57)	1.58 (1.31-1.81)	1.88 (1.52-2.16)	2.14 (1.70-2.47)
3-hr	0.340 (0.303-0.388)	0.473 (0.419-0.537)	0.572 (0.505-0.649)	0.709 (0.620-0.803)	0.822 (0.711-0.931)	0.950 (0.812-1.08)	1.09 (0.915-1.24)	1.29 (1.06-1.48)	1.46 (1.18-1.69)
6-hr	0.205 (0.184-0.230)	0.275 (0.247-0.309)	0.327 (0.292-0.366)	0.399 (0.353-0.446)	0.456 (0.400-0.511)	0.520 (0.452-0.583)	0.588 (0.503-0.660)	0.686 (0.575-0.777)	0.768 (0.633-0.876)
12-hr	0.130 (0.117-0.145)	0.172 (0.155-0.192)	0.202 (0.181-0.225)	0.239 (0.213-0.267)	0.268 (0.238-0.299)	0.300 (0.263-0.334)	0.331 (0.288-0.370)	0.378 (0.323-0.426)	0.416 (0.353-0.473)
24-hr	0.081 (0.074-0.089)	0.109 (0.099-0.120)	0.129 (0.117-0.141)	0.154 (0.139-0.169)	0.174 (0.157-0.191)	0.195 (0.175-0.214)	0.216 (0.193-0.237)	0.245 (0.216-0.269)	0.267 (0.234-0.295)
2-day	0.049 (0.044-0.054)	0.066 (0.060-0.073)	0.078 (0.071-0.086)	0.093 (0.085-0.103)	0.106 (0.096-0.116)	0.119 (0.107-0.130)	0.132 (0.118-0.145)	0.149 (0.132-0.165)	0.164 (0.143-0.181)
3-day	0.035 (0.032-0.039)	0.048 (0.044-0.052)	0.056 (0.052-0.062)	0.068 (0.062-0.075)	0.077 (0.070-0.085)	0.087 (0.078-0.096)	0.097 (0.087-0.107)	0.111 (0.098-0.122)	0.122 (0.107-0.135)
4-day	0.028 (0.026-0.031)	0.039 (0.035-0.042)	0.046 (0.042-0.050)	0.056 (0.050-0.061)	0.063 (0.057-0.069)	0.072 (0.064-0.078)	0.080 (0.071-0.088)	0.092 (0.081-0.101)	0.101 (0.088-0.112)
7-day	0.019 (0.017-0.021)	0.026 (0.024-0.028)	0.030 (0.028-0.033)	0.037 (0.034-0.040)	0.042 (0.038-0.045)	0.047 (0.043-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.066)	0.066 (0.058-0.072)
10-day	0.015 (0.014-0.017)	0.020 (0.019-0.022)	0.024 (0.022-0.026)	0.028 (0.026-0.031)	0.032 (0.029-0.035)	0.036 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.048 (0.042-0.052)
20-day	0.010 (0.009-0.011)	0.013 (0.012-0.014)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.022 (0.020-0.023)	0.023 (0.021-0.025)	0.026 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.008 (0.007-0.009)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.014-0.017)	0.017 (0.015-0.019)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.006-0.007)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.005-0.006)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

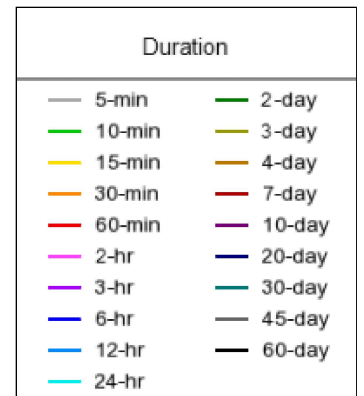
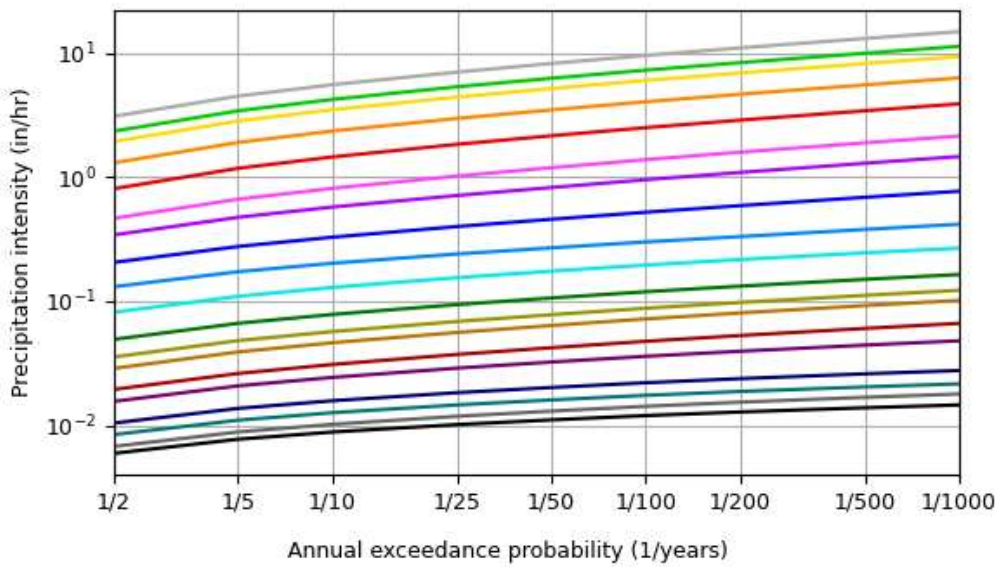
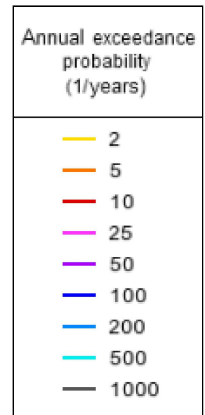
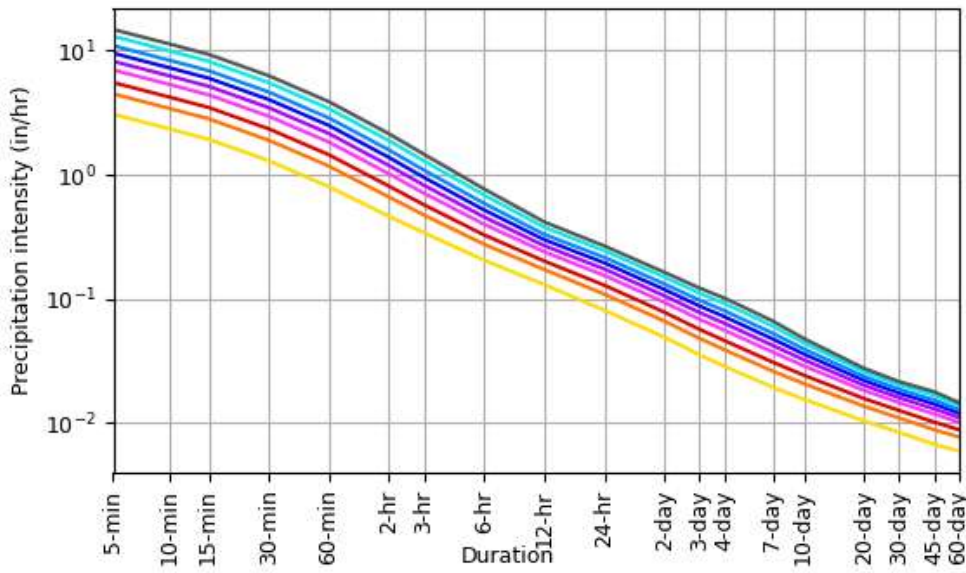
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of annual maxima series (AMS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and annual exceedance probability) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

AMS-based intensity-duration-frequency (IDF) curves

Latitude: 35.2465°, Longitude: -111.8315°



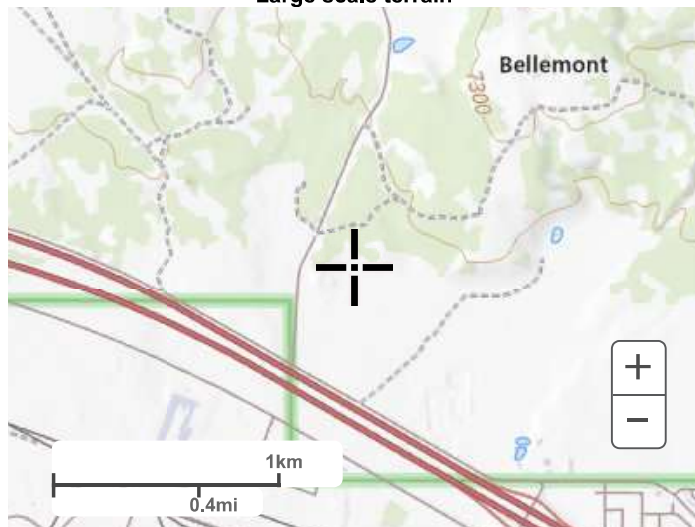
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Maps & aeriels

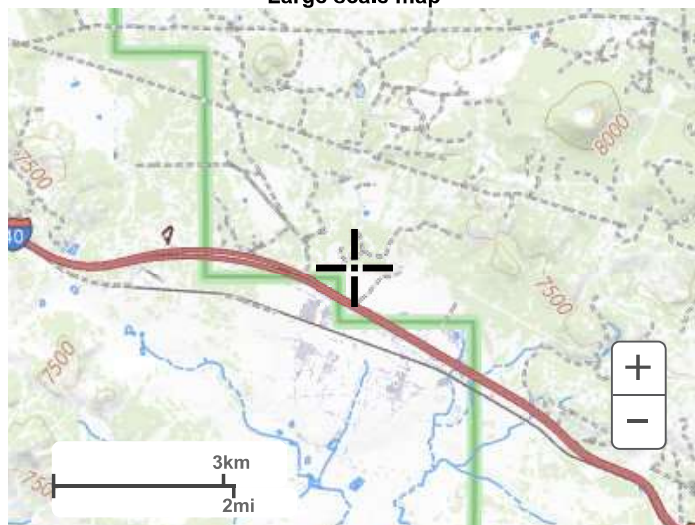
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



NOAA Atlas 14, Volume 1, Version 5
Location name: Belmont, Arizona, USA*
Latitude: 35.2469°, Longitude: -111.8341°
Elevation: 7151 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

AMS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹									
Duration	Annual exceedance probability (1/years)								
	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/500	1/1000
5-min	3.07 (2.65-3.55)	4.48 (3.88-5.18)	5.53 (4.75-6.40)	6.98 (5.95-8.05)	8.20 (6.91-9.43)	9.52 (7.92-11.0)	10.9 (8.96-12.6)	13.0 (10.4-15.2)	14.8 (11.6-17.4)
10-min	2.33 (2.02-2.71)	3.41 (2.95-3.95)	4.21 (3.61-4.86)	5.32 (4.53-6.13)	6.23 (5.26-7.18)	7.24 (6.03-8.36)	8.33 (6.82-9.62)	9.91 (7.93-11.5)	11.3 (8.84-13.2)
15-min	1.93 (1.67-2.24)	2.82 (2.44-3.26)	3.48 (2.99-4.02)	4.40 (3.74-5.06)	5.15 (4.35-5.93)	5.99 (4.98-6.91)	6.88 (5.64-7.95)	8.18 (6.56-9.53)	9.31 (7.30-10.9)
30-min	1.30 (1.12-1.51)	1.90 (1.64-2.20)	2.34 (2.01-2.71)	2.96 (2.52-3.41)	3.47 (2.93-3.99)	4.03 (3.36-4.65)	4.63 (3.79-5.35)	5.51 (4.42-6.42)	6.27 (4.92-7.37)
60-min	0.803 (0.695-0.932)	1.17 (1.02-1.36)	1.45 (1.24-1.68)	1.83 (1.56-2.11)	2.15 (1.81-2.47)	2.50 (2.08-2.88)	2.87 (2.35-3.31)	3.41 (2.73-3.97)	3.88 (3.04-4.56)
2-hr	0.463 (0.407-0.531)	0.662 (0.580-0.757)	0.809 (0.705-0.922)	1.02 (0.878-1.16)	1.19 (1.01-1.35)	1.38 (1.16-1.57)	1.58 (1.31-1.81)	1.88 (1.52-2.16)	2.14 (1.70-2.47)
3-hr	0.340 (0.303-0.388)	0.473 (0.419-0.537)	0.572 (0.505-0.649)	0.709 (0.620-0.803)	0.822 (0.711-0.931)	0.950 (0.812-1.08)	1.09 (0.915-1.24)	1.29 (1.06-1.48)	1.46 (1.18-1.69)
6-hr	0.205 (0.184-0.230)	0.275 (0.247-0.309)	0.327 (0.292-0.366)	0.399 (0.353-0.446)	0.456 (0.400-0.511)	0.520 (0.452-0.583)	0.588 (0.503-0.660)	0.686 (0.575-0.777)	0.768 (0.633-0.876)
12-hr	0.130 (0.117-0.145)	0.172 (0.155-0.192)	0.202 (0.181-0.225)	0.239 (0.213-0.267)	0.268 (0.238-0.299)	0.300 (0.263-0.334)	0.331 (0.288-0.370)	0.378 (0.323-0.426)	0.416 (0.353-0.473)
24-hr	0.081 (0.074-0.089)	0.109 (0.099-0.120)	0.129 (0.117-0.141)	0.154 (0.139-0.169)	0.174 (0.157-0.191)	0.195 (0.175-0.214)	0.216 (0.193-0.237)	0.245 (0.216-0.269)	0.267 (0.234-0.295)
2-day	0.049 (0.044-0.054)	0.066 (0.060-0.073)	0.078 (0.071-0.086)	0.093 (0.085-0.103)	0.106 (0.096-0.116)	0.119 (0.107-0.130)	0.132 (0.118-0.145)	0.149 (0.132-0.165)	0.164 (0.143-0.181)
3-day	0.035 (0.032-0.039)	0.048 (0.044-0.052)	0.056 (0.052-0.062)	0.068 (0.062-0.075)	0.077 (0.070-0.085)	0.087 (0.078-0.096)	0.097 (0.087-0.107)	0.111 (0.098-0.122)	0.122 (0.107-0.135)
4-day	0.028 (0.026-0.031)	0.039 (0.035-0.042)	0.046 (0.042-0.050)	0.056 (0.050-0.061)	0.063 (0.057-0.069)	0.072 (0.064-0.078)	0.080 (0.071-0.088)	0.092 (0.081-0.101)	0.101 (0.088-0.112)
7-day	0.019 (0.017-0.021)	0.026 (0.024-0.028)	0.030 (0.028-0.033)	0.037 (0.034-0.040)	0.042 (0.038-0.045)	0.047 (0.043-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.066)	0.066 (0.058-0.072)
10-day	0.015 (0.014-0.017)	0.020 (0.019-0.022)	0.024 (0.022-0.026)	0.028 (0.026-0.031)	0.032 (0.029-0.035)	0.036 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.048 (0.042-0.052)
20-day	0.010 (0.009-0.011)	0.013 (0.012-0.014)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.022 (0.020-0.023)	0.023 (0.021-0.025)	0.026 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.008 (0.007-0.009)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.014-0.017)	0.017 (0.015-0.019)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.006-0.007)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.005-0.006)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

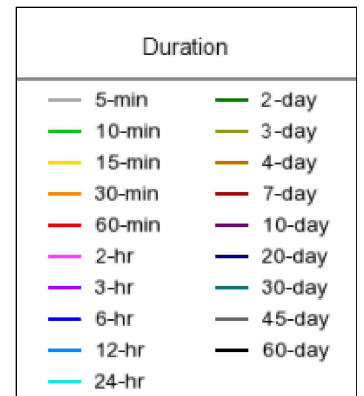
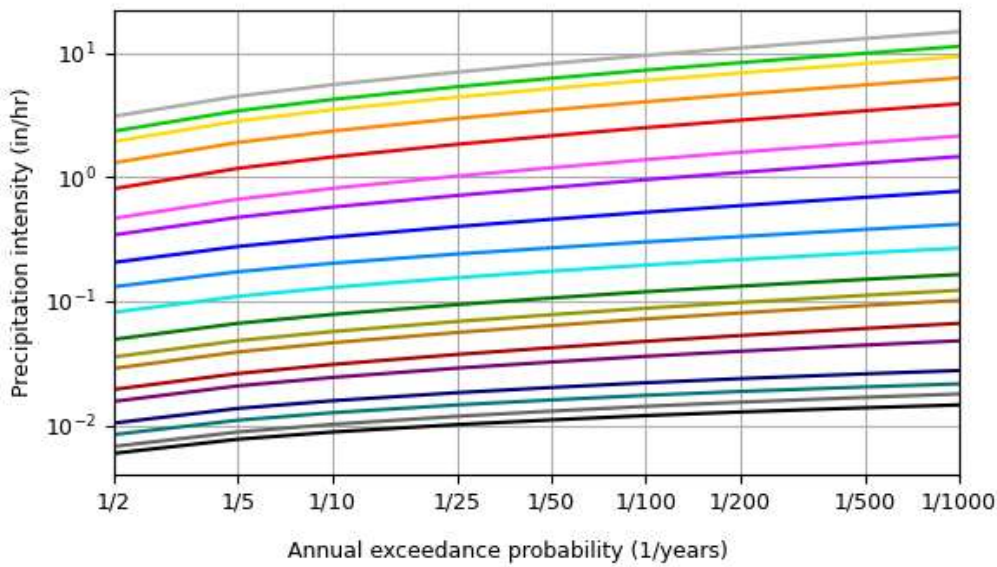
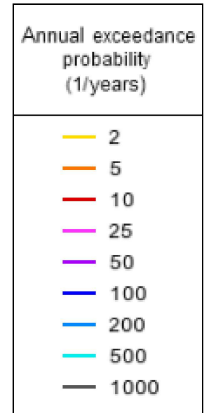
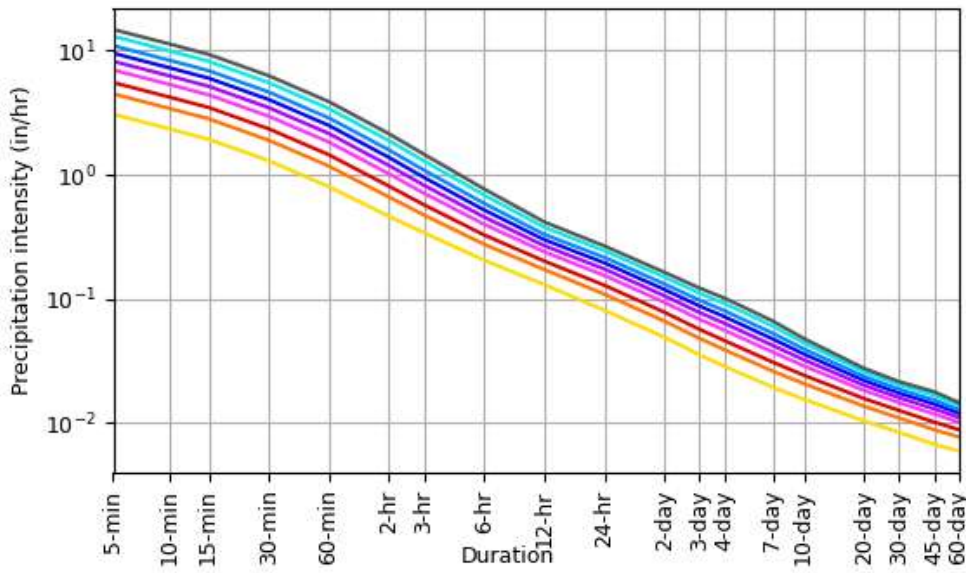
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of annual maxima series (AMS).
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and annual exceedance probability) will be greater than the upper bound (or less than the lower bound) is 5%.
 Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
 Please refer to NOAA Atlas 14 document for more information.

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PF graphical

AMS-based intensity-duration-frequency (IDF) curves

Latitude: 35.2469°, Longitude: -111.8341°



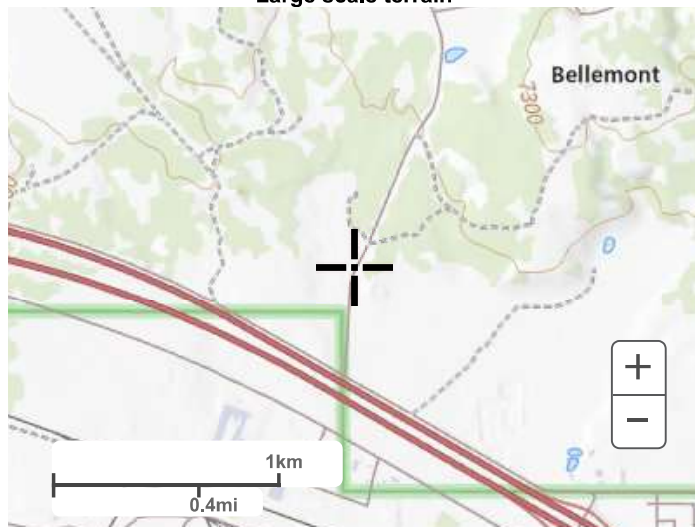
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

Appendix C-2: Alignment 3 Rainfall Intensity



NOAA Atlas 14, Volume 1, Version 5
 Location name: **Bellemont, Arizona, USA***
 Latitude: **35.2427°**, Longitude: **-111.8154°**
 Elevation: **7157 ft****
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriads](#)

PF tabular

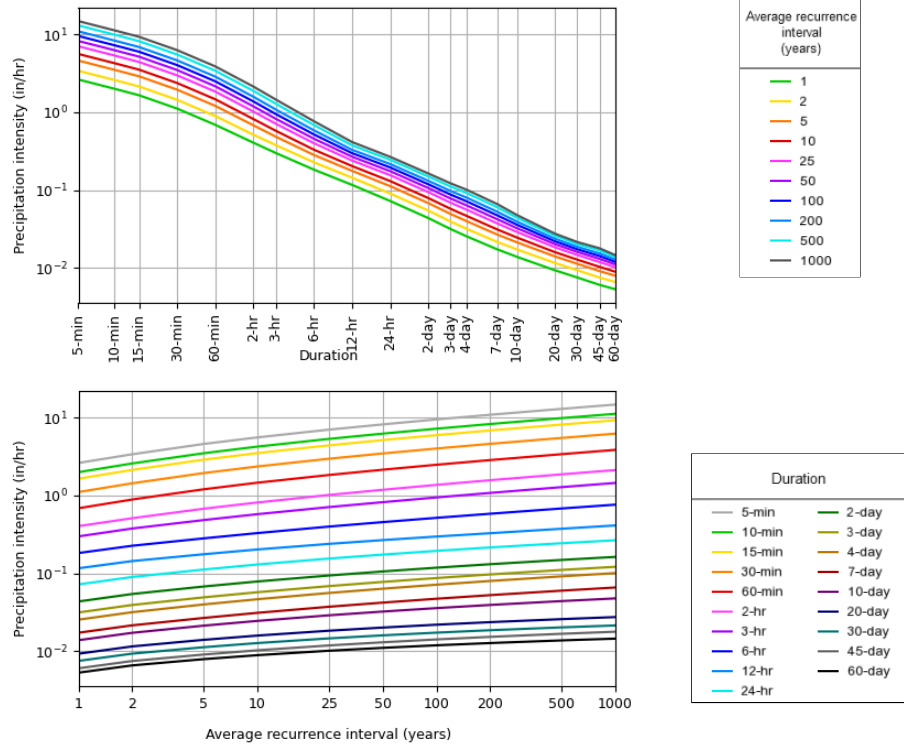
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.62 (2.27-3.04)	3.38 (2.93-3.92)	4.58 (3.95-5.30)	5.57 (4.78-6.43)	7.00 (5.95-8.04)	8.17 (6.89-9.41)	9.47 (7.87-10.9)	10.9 (8.90-12.6)	12.9 (10.4-15.1)	14.7 (11.5-17.3)
10-min	1.99 (1.72-2.32)	2.58 (2.23-2.99)	3.49 (3.01-4.04)	4.24 (3.64-4.90)	5.32 (4.53-6.12)	6.22 (5.24-7.16)	7.20 (5.99-8.30)	8.27 (6.77-9.56)	9.85 (7.88-11.5)	11.2 (8.78-13.2)
15-min	1.64 (1.42-1.91)	2.13 (1.85-2.47)	2.88 (2.49-3.34)	3.50 (3.00-4.04)	4.40 (3.74-5.06)	5.14 (4.33-5.91)	5.95 (4.95-6.86)	6.84 (5.60-7.90)	8.14 (6.52-9.47)	9.25 (7.26-10.9)
30-min	1.11 (0.960-1.29)	1.44 (1.24-1.66)	1.94 (1.68-2.25)	2.36 (2.02-2.72)	2.96 (2.52-3.41)	3.46 (2.92-3.96)	4.01 (3.33-4.62)	4.61 (3.77-5.32)	5.48 (4.39-6.38)	6.23 (4.89-7.32)
60-min	0.686 (0.594-0.798)	0.889 (0.769-1.03)	1.20 (1.04-1.39)	1.46 (1.25-1.69)	1.83 (1.56-2.11)	2.14 (1.81-2.46)	2.48 (2.06-2.86)	2.85 (2.33-3.29)	3.39 (2.72-3.95)	3.85 (3.02-4.53)
2-hr	0.404 (0.356-0.463)	0.511 (0.450-0.586)	0.676 (0.593-0.773)	0.813 (0.709-0.927)	1.02 (0.877-1.16)	1.18 (1.01-1.35)	1.37 (1.15-1.56)	1.57 (1.30-1.79)	1.87 (1.52-2.15)	2.12 (1.68-2.45)
3-hr	0.298 (0.265-0.340)	0.377 (0.335-0.429)	0.483 (0.429-0.549)	0.576 (0.508-0.653)	0.709 (0.621-0.803)	0.820 (0.711-0.929)	0.944 (0.808-1.07)	1.08 (0.910-1.23)	1.28 (1.06-1.47)	1.45 (1.17-1.68)
6-hr	0.182 (0.164-0.204)	0.226 (0.204-0.254)	0.281 (0.252-0.315)	0.329 (0.294-0.368)	0.398 (0.353-0.446)	0.455 (0.399-0.509)	0.516 (0.449-0.578)	0.583 (0.499-0.655)	0.681 (0.571-0.771)	0.763 (0.629-0.870)
12-hr	0.116 (0.105-0.129)	0.144 (0.130-0.160)	0.176 (0.158-0.196)	0.203 (0.182-0.225)	0.239 (0.213-0.266)	0.267 (0.237-0.297)	0.297 (0.261-0.331)	0.328 (0.285-0.367)	0.374 (0.321-0.421)	0.412 (0.350-0.468)
24-hr	0.072 (0.066-0.079)	0.090 (0.082-0.098)	0.112 (0.102-0.123)	0.130 (0.118-0.142)	0.155 (0.140-0.169)	0.174 (0.157-0.190)	0.194 (0.174-0.213)	0.215 (0.192-0.236)	0.244 (0.215-0.268)	0.266 (0.233-0.293)
2-day	0.043 (0.040-0.047)	0.054 (0.049-0.060)	0.067 (0.062-0.074)	0.078 (0.072-0.086)	0.093 (0.085-0.103)	0.106 (0.096-0.116)	0.118 (0.106-0.130)	0.131 (0.117-0.144)	0.149 (0.131-0.164)	0.163 (0.143-0.180)
3-day	0.031 (0.028-0.034)	0.039 (0.036-0.043)	0.049 (0.045-0.054)	0.057 (0.052-0.062)	0.068 (0.062-0.075)	0.077 (0.070-0.085)	0.087 (0.078-0.095)	0.097 (0.086-0.106)	0.110 (0.097-0.122)	0.121 (0.106-0.134)
4-day	0.025 (0.023-0.027)	0.031 (0.029-0.034)	0.039 (0.036-0.043)	0.046 (0.042-0.051)	0.056 (0.051-0.061)	0.063 (0.057-0.069)	0.071 (0.064-0.078)	0.080 (0.071-0.087)	0.091 (0.080-0.100)	0.101 (0.088-0.111)
7-day	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.026 (0.024-0.029)	0.031 (0.028-0.033)	0.037 (0.034-0.040)	0.042 (0.038-0.045)	0.047 (0.042-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.065)	0.066 (0.058-0.072)
10-day	0.013 (0.012-0.015)	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.024 (0.022-0.026)	0.029 (0.026-0.031)	0.032 (0.029-0.035)	0.035 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.047 (0.042-0.052)
20-day	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.014 (0.012-0.015)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.021 (0.020-0.023)	0.023 (0.021-0.025)	0.025 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.014-0.017)	0.017 (0.015-0.018)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.004-0.005)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.011 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 35.2427°, Longitude: -111.8154°



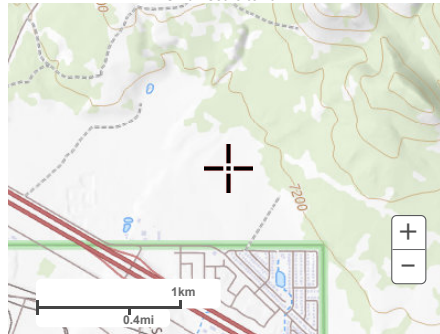
NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Wed Jan 28 23:47:14 2026

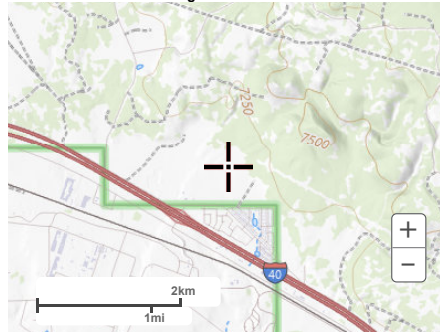
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



NOAA Atlas 14, Volume 1, Version 5
 Location name: Bellemont, Arizona, USA*
 Latitude: 35.2448°, Longitude: -111.8171°
 Elevation: 7165 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

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PF tabular

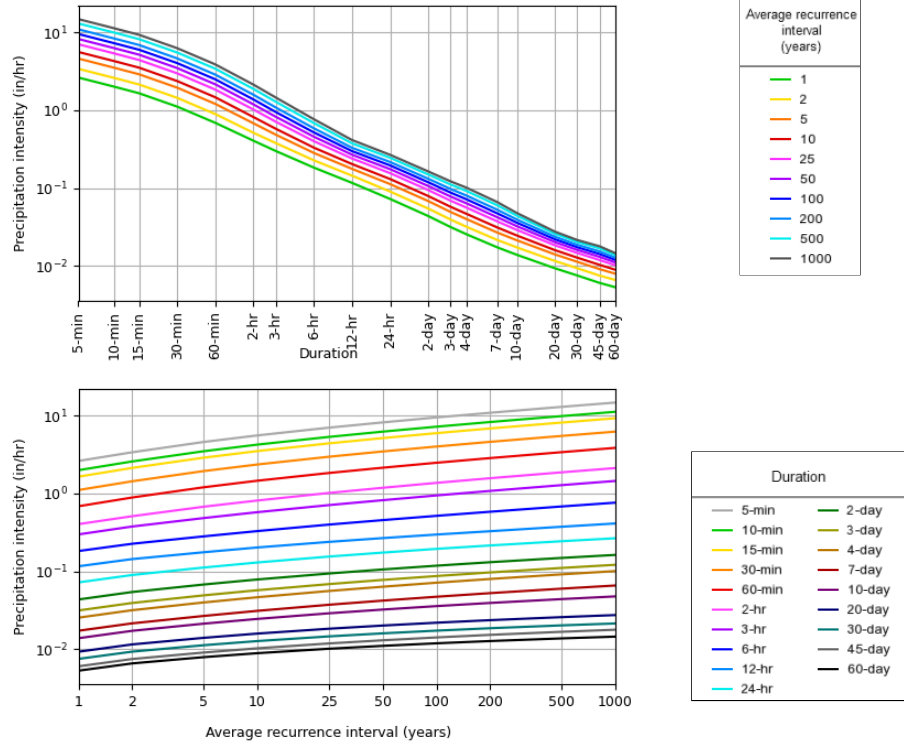
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.62 (2.27-3.04)	3.38 (2.93-3.92)	4.58 (3.95-5.30)	5.57 (4.78-6.43)	7.00 (5.95-8.04)	8.17 (6.89-9.41)	9.47 (7.87-10.9)	10.9 (8.90-12.6)	12.9 (10.4-15.1)	14.7 (11.5-17.3)
10-min	1.99 (1.72-2.32)	2.58 (2.23-2.99)	3.49 (3.01-4.04)	4.24 (3.64-4.90)	5.32 (4.53-6.12)	6.22 (5.24-7.16)	7.20 (5.99-8.30)	8.27 (6.77-9.56)	9.85 (7.88-11.5)	11.2 (8.78-13.2)
15-min	1.64 (1.42-1.91)	2.13 (1.85-2.47)	2.88 (2.49-3.34)	3.50 (3.00-4.04)	4.40 (3.74-5.06)	5.14 (4.33-5.91)	5.95 (4.95-6.86)	6.84 (5.60-7.90)	8.14 (6.52-9.47)	9.25 (7.26-10.9)
30-min	1.11 (0.960-1.29)	1.44 (1.24-1.66)	1.94 (1.68-2.25)	2.36 (2.02-2.72)	2.96 (2.52-3.41)	3.46 (2.92-3.96)	4.01 (3.33-4.62)	4.61 (3.77-5.32)	5.48 (4.39-6.38)	6.23 (4.89-7.32)
60-min	0.686 (0.594-0.798)	0.889 (0.769-1.03)	1.20 (1.04-1.39)	1.46 (1.25-1.69)	1.83 (1.56-2.11)	2.14 (1.81-2.46)	2.48 (2.06-2.86)	2.85 (2.33-3.29)	3.39 (2.72-3.95)	3.85 (3.02-4.53)
2-hr	0.404 (0.356-0.463)	0.511 (0.450-0.586)	0.676 (0.593-0.773)	0.813 (0.709-0.927)	1.02 (0.877-1.16)	1.18 (1.01-1.35)	1.37 (1.15-1.56)	1.57 (1.30-1.79)	1.87 (1.52-2.15)	2.12 (1.68-2.45)
3-hr	0.298 (0.265-0.340)	0.377 (0.335-0.429)	0.483 (0.429-0.549)	0.576 (0.508-0.653)	0.709 (0.621-0.803)	0.820 (0.711-0.929)	0.944 (0.808-1.07)	1.08 (0.910-1.23)	1.28 (1.06-1.47)	1.45 (1.17-1.68)
6-hr	0.182 (0.164-0.204)	0.226 (0.204-0.254)	0.281 (0.252-0.315)	0.329 (0.294-0.368)	0.398 (0.353-0.446)	0.455 (0.399-0.509)	0.516 (0.449-0.578)	0.583 (0.499-0.655)	0.681 (0.571-0.771)	0.763 (0.629-0.870)
12-hr	0.116 (0.105-0.129)	0.144 (0.130-0.160)	0.176 (0.158-0.196)	0.203 (0.182-0.225)	0.239 (0.213-0.266)	0.267 (0.237-0.297)	0.297 (0.261-0.331)	0.328 (0.285-0.367)	0.374 (0.321-0.421)	0.412 (0.350-0.468)
24-hr	0.072 (0.066-0.079)	0.090 (0.082-0.098)	0.112 (0.102-0.123)	0.130 (0.118-0.142)	0.155 (0.140-0.169)	0.174 (0.157-0.190)	0.194 (0.174-0.213)	0.215 (0.192-0.236)	0.244 (0.215-0.268)	0.266 (0.233-0.293)
2-day	0.043 (0.040-0.047)	0.054 (0.049-0.060)	0.067 (0.062-0.074)	0.078 (0.072-0.086)	0.093 (0.085-0.103)	0.106 (0.096-0.116)	0.118 (0.106-0.130)	0.131 (0.117-0.144)	0.149 (0.131-0.164)	0.163 (0.143-0.180)
3-day	0.031 (0.028-0.034)	0.039 (0.036-0.043)	0.049 (0.045-0.054)	0.057 (0.052-0.062)	0.068 (0.062-0.075)	0.077 (0.070-0.085)	0.087 (0.078-0.095)	0.097 (0.086-0.106)	0.110 (0.097-0.122)	0.121 (0.106-0.134)
4-day	0.025 (0.023-0.027)	0.031 (0.029-0.034)	0.039 (0.036-0.043)	0.046 (0.042-0.051)	0.056 (0.051-0.061)	0.063 (0.057-0.069)	0.071 (0.064-0.078)	0.080 (0.071-0.087)	0.091 (0.080-0.100)	0.101 (0.088-0.111)
7-day	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.026 (0.024-0.029)	0.031 (0.028-0.033)	0.037 (0.034-0.040)	0.042 (0.038-0.045)	0.047 (0.042-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.065)	0.066 (0.058-0.072)
10-day	0.013 (0.012-0.015)	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.024 (0.022-0.026)	0.029 (0.026-0.031)	0.032 (0.029-0.035)	0.035 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.047 (0.042-0.052)
20-day	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.014 (0.012-0.015)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.021 (0.020-0.023)	0.023 (0.021-0.025)	0.025 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.014-0.017)	0.017 (0.015-0.018)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.004-0.005)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.011 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
 Latitude: 35.2448°, Longitude: -111.8171°



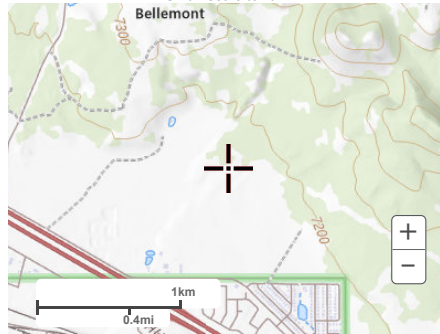
NOAA Atlas 14, Volume 1, Version 5

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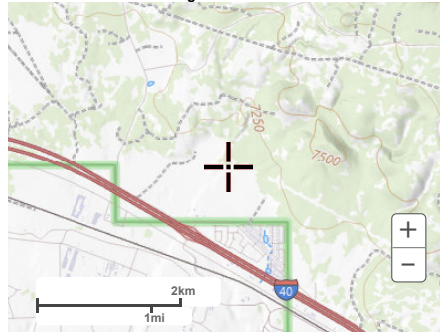
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



NOAA Atlas 14, Volume 1, Version 5
 Location name: Bellemont, Arizona, USA*
 Latitude: 35.2471°, Longitude: -111.8207°
 Elevation: 7149 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

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PF tabular

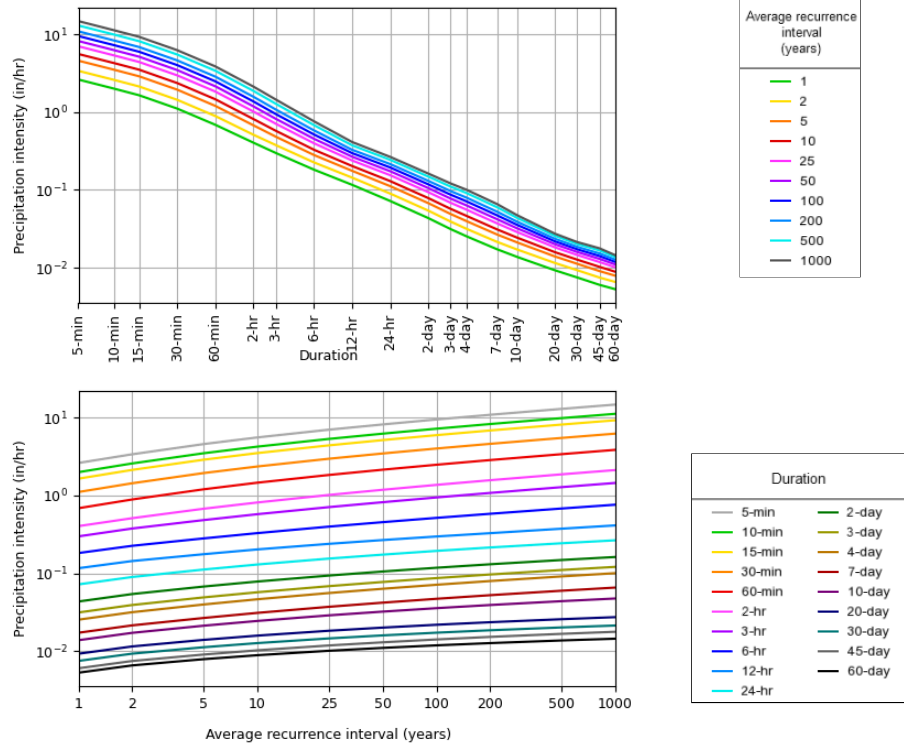
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.62 (2.27-3.04)	3.38 (2.93-3.94)	4.57 (3.96-5.30)	5.57 (4.78-6.43)	7.00 (5.95-8.05)	8.17 (6.90-9.41)	9.47 (7.87-10.9)	10.9 (8.90-12.6)	12.9 (10.4-15.1)	14.7 (11.6-17.3)
10-min	1.99 (1.72-2.32)	2.58 (2.23-2.99)	3.49 (3.01-4.04)	4.24 (3.64-4.90)	5.32 (4.53-6.13)	6.22 (5.25-7.16)	7.21 (5.99-8.31)	8.28 (6.78-9.57)	9.85 (7.89-11.5)	11.2 (8.79-13.2)
15-min	1.64 (1.42-1.91)	2.13 (1.85-2.47)	2.88 (2.49-3.34)	3.50 (3.00-4.05)	4.40 (3.74-5.06)	5.14 (4.34-5.92)	5.96 (4.96-6.87)	6.84 (5.60-7.91)	8.14 (6.52-9.48)	9.26 (7.26-10.9)
30-min	1.11 (0.960-1.29)	1.44 (1.24-1.67)	1.94 (1.68-2.25)	2.36 (2.02-2.73)	2.96 (2.52-3.41)	3.46 (2.92-3.96)	4.01 (3.34-4.63)	4.61 (3.77-5.33)	5.48 (4.39-6.38)	6.23 (4.89-7.33)
60-min	0.686 (0.594-0.798)	0.889 (0.769-1.03)	1.20 (1.04-1.39)	1.46 (1.25-1.69)	1.83 (1.56-2.11)	2.14 (1.81-2.46)	2.48 (2.06-2.86)	2.85 (2.34-3.30)	3.39 (2.72-3.95)	3.86 (3.03-4.54)
2-hr	0.404 (0.356-0.462)	0.511 (0.450-0.585)	0.675 (0.592-0.772)	0.813 (0.709-0.926)	1.02 (0.876-1.15)	1.18 (1.01-1.35)	1.37 (1.15-1.56)	1.57 (1.30-1.79)	1.87 (1.51-2.15)	2.12 (1.68-2.45)
3-hr	0.298 (0.265-0.339)	0.376 (0.334-0.428)	0.482 (0.429-0.548)	0.575 (0.508-0.652)	0.708 (0.620-0.802)	0.819 (0.709-0.927)	0.943 (0.807-1.07)	1.08 (0.908-1.23)	1.28 (1.06-1.47)	1.45 (1.17-1.68)
6-hr	0.182 (0.163-0.204)	0.225 (0.203-0.253)	0.280 (0.252-0.314)	0.328 (0.293-0.367)	0.397 (0.352-0.444)	0.454 (0.398-0.508)	0.515 (0.448-0.577)	0.582 (0.498-0.654)	0.680 (0.570-0.770)	0.761 (0.627-0.868)
12-hr	0.116 (0.105-0.129)	0.143 (0.129-0.160)	0.176 (0.158-0.196)	0.202 (0.182-0.225)	0.239 (0.213-0.266)	0.267 (0.237-0.297)	0.297 (0.261-0.331)	0.328 (0.285-0.367)	0.374 (0.321-0.422)	0.412 (0.350-0.468)
24-hr	0.072 (0.065-0.078)	0.089 (0.082-0.098)	0.111 (0.102-0.122)	0.129 (0.118-0.142)	0.154 (0.140-0.169)	0.173 (0.157-0.190)	0.194 (0.174-0.212)	0.214 (0.191-0.235)	0.243 (0.215-0.267)	0.265 (0.232-0.292)
2-day	0.043 (0.039-0.047)	0.054 (0.049-0.059)	0.067 (0.061-0.074)	0.078 (0.071-0.086)	0.093 (0.085-0.102)	0.105 (0.095-0.115)	0.117 (0.106-0.129)	0.130 (0.116-0.143)	0.148 (0.131-0.163)	0.162 (0.142-0.179)
3-day	0.031 (0.028-0.034)	0.039 (0.035-0.043)	0.049 (0.044-0.053)	0.057 (0.052-0.062)	0.068 (0.062-0.074)	0.077 (0.070-0.084)	0.086 (0.078-0.095)	0.096 (0.086-0.106)	0.110 (0.097-0.121)	0.121 (0.106-0.133)
4-day	0.025 (0.023-0.027)	0.031 (0.029-0.034)	0.039 (0.036-0.043)	0.046 (0.042-0.050)	0.055 (0.050-0.060)	0.063 (0.057-0.069)	0.071 (0.064-0.078)	0.079 (0.071-0.087)	0.091 (0.080-0.100)	0.100 (0.087-0.111)
7-day	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.026 (0.024-0.028)	0.031 (0.028-0.033)	0.037 (0.034-0.040)	0.041 (0.038-0.045)	0.047 (0.042-0.051)	0.052 (0.047-0.057)	0.059 (0.053-0.065)	0.065 (0.058-0.072)
10-day	0.013 (0.012-0.015)	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.024 (0.022-0.026)	0.028 (0.026-0.031)	0.032 (0.029-0.035)	0.035 (0.032-0.038)	0.039 (0.035-0.042)	0.043 (0.039-0.048)	0.047 (0.042-0.052)
20-day	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.013 (0.012-0.015)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.021 (0.019-0.023)	0.023 (0.021-0.025)	0.025 (0.023-0.028)	0.027 (0.024-0.029)
30-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.015 (0.014-0.017)	0.017 (0.015-0.018)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.014-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.004-0.005)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.011 (0.010-0.013)	0.012 (0.011-0.013)	0.013 (0.012-0.015)	0.014 (0.013-0.015)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 35.2471°, Longitude: -111.8207°



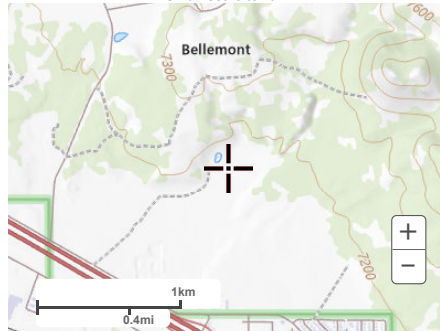
NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Wed Jan 28 23:52:11 2026

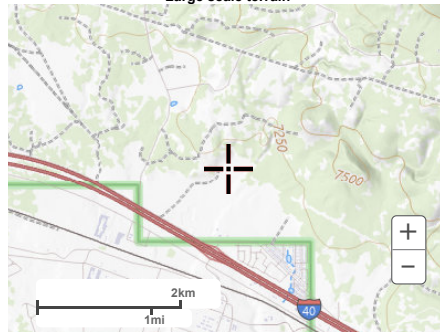
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



NOAA Atlas 14, Volume 1, Version 5
 Location name: Bellemont, Arizona, USA*
 Latitude: 35.2471°, Longitude: -111.8208°
 Elevation: 7148 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchon

NOAA, National Weather Service, Silver Spring, Maryland

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PF tabular

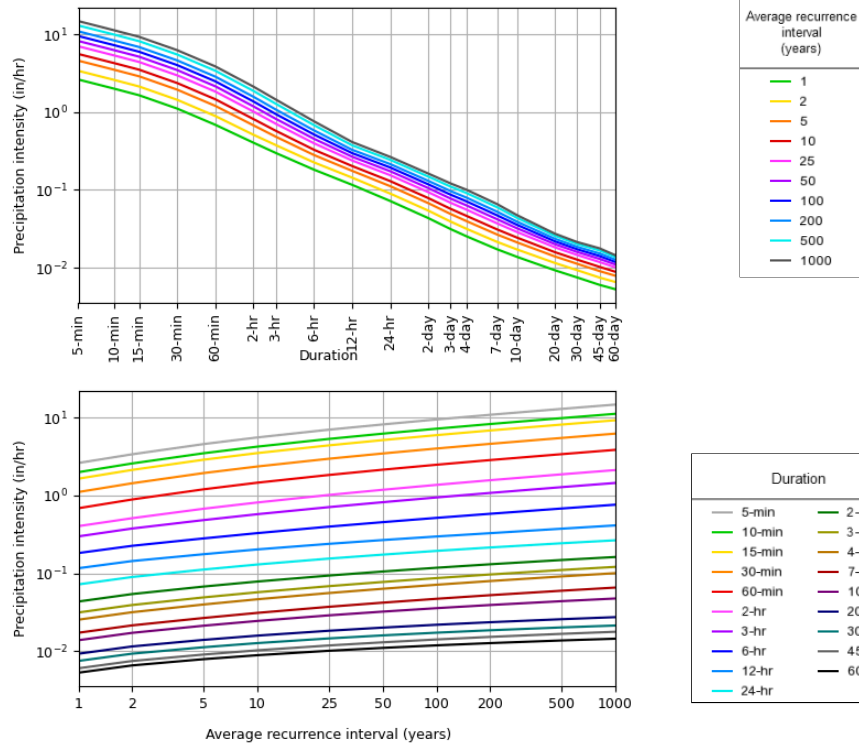
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.62 (2.27-3.04)	3.38 (2.93-3.94)	4.57 (3.96-5.30)	5.57 (4.78-6.43)	7.00 (5.95-8.05)	8.17 (6.90-9.41)	9.47 (7.87-10.9)	10.9 (8.90-12.6)	12.9 (10.4-15.1)	14.7 (11.6-17.3)
10-min	1.99 (1.72-2.32)	2.58 (2.23-2.99)	3.49 (3.01-4.04)	4.24 (3.64-4.90)	5.32 (4.53-6.13)	6.22 (5.25-7.16)	7.21 (5.99-8.31)	8.28 (6.78-9.57)	9.85 (7.89-11.5)	11.2 (8.79-13.2)
15-min	1.64 (1.42-1.91)	2.13 (1.85-2.47)	2.88 (2.49-3.34)	3.50 (3.00-4.05)	4.40 (3.74-5.06)	5.14 (4.34-5.92)	5.96 (4.96-6.87)	6.84 (5.60-7.91)	8.14 (6.52-9.48)	9.26 (7.26-10.9)
30-min	1.11 (0.960-1.29)	1.44 (1.24-1.67)	1.94 (1.68-2.25)	2.36 (2.02-2.73)	2.96 (2.52-3.41)	3.46 (2.92-3.96)	4.01 (3.34-4.63)	4.61 (3.77-5.33)	5.48 (4.39-6.38)	6.23 (4.89-7.33)
60-min	0.686 (0.594-0.798)	0.889 (0.769-1.03)	1.20 (1.04-1.39)	1.46 (1.25-1.69)	1.83 (1.56-2.11)	2.14 (1.81-2.46)	2.48 (2.06-2.86)	2.85 (2.34-3.30)	3.39 (2.72-3.95)	3.86 (3.03-4.54)
2-hr	0.404 (0.356-0.462)	0.511 (0.450-0.585)	0.675 (0.592-0.772)	0.813 (0.709-0.926)	1.02 (0.876-1.15)	1.18 (1.01-1.35)	1.37 (1.15-1.56)	1.57 (1.30-1.79)	1.87 (1.51-2.15)	2.12 (1.68-2.45)
3-hr	0.298 (0.265-0.339)	0.376 (0.334-0.428)	0.482 (0.429-0.548)	0.575 (0.508-0.652)	0.708 (0.620-0.802)	0.819 (0.709-0.927)	0.943 (0.807-1.07)	1.08 (0.908-1.23)	1.28 (1.06-1.47)	1.45 (1.17-1.68)
6-hr	0.182 (0.163-0.204)	0.225 (0.203-0.253)	0.280 (0.252-0.314)	0.328 (0.293-0.367)	0.397 (0.352-0.444)	0.454 (0.398-0.508)	0.515 (0.448-0.577)	0.582 (0.498-0.654)	0.680 (0.570-0.770)	0.761 (0.627-0.868)
12-hr	0.116 (0.105-0.129)	0.143 (0.129-0.160)	0.176 (0.158-0.196)	0.202 (0.182-0.225)	0.239 (0.213-0.266)	0.267 (0.237-0.297)	0.297 (0.261-0.331)	0.328 (0.285-0.367)	0.374 (0.321-0.422)	0.412 (0.350-0.468)
24-hr	0.072 (0.065-0.078)	0.089 (0.082-0.098)	0.111 (0.102-0.122)	0.129 (0.118-0.142)	0.154 (0.140-0.169)	0.173 (0.157-0.190)	0.194 (0.174-0.212)	0.214 (0.191-0.235)	0.243 (0.215-0.267)	0.265 (0.232-0.292)
2-day	0.043 (0.039-0.047)	0.054 (0.049-0.059)	0.067 (0.061-0.074)	0.078 (0.071-0.086)	0.093 (0.085-0.102)	0.105 (0.095-0.115)	0.117 (0.106-0.129)	0.130 (0.116-0.143)	0.148 (0.131-0.163)	0.162 (0.142-0.179)
3-day	0.031 (0.028-0.034)	0.039 (0.035-0.043)	0.049 (0.044-0.053)	0.057 (0.052-0.062)	0.068 (0.062-0.074)	0.077 (0.070-0.084)	0.086 (0.078-0.095)	0.096 (0.086-0.106)	0.110 (0.097-0.121)	0.121 (0.106-0.133)
4-day	0.025 (0.023-0.027)	0.031 (0.029-0.034)	0.039 (0.036-0.043)	0.046 (0.042-0.050)	0.055 (0.050-0.060)	0.063 (0.057-0.069)	0.071 (0.064-0.078)	0.079 (0.071-0.087)	0.091 (0.080-0.100)	0.100 (0.087-0.111)
7-day	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.026 (0.024-0.028)	0.031 (0.028-0.033)	0.037 (0.034-0.040)	0.041 (0.038-0.045)	0.047 (0.042-0.051)	0.052 (0.047-0.057)	0.059 (0.053-0.065)	0.065 (0.058-0.072)
10-day	0.013 (0.012-0.015)	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.024 (0.022-0.026)	0.028 (0.026-0.031)	0.032 (0.029-0.035)	0.035 (0.032-0.038)	0.039 (0.035-0.042)	0.043 (0.039-0.048)	0.047 (0.042-0.052)
20-day	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.013 (0.012-0.015)	0.015 (0.014-0.017)	0.018 (0.016-0.019)	0.020 (0.018-0.021)	0.021 (0.019-0.023)	0.023 (0.021-0.025)	0.025 (0.023-0.028)	0.027 (0.024-0.029)
30-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.015 (0.014-0.017)	0.017 (0.015-0.018)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.014-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.004-0.005)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.011 (0.010-0.013)	0.012 (0.011-0.013)	0.013 (0.012-0.015)	0.014 (0.013-0.015)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
 Latitude: 35.2471°, Longitude: -111.8208°



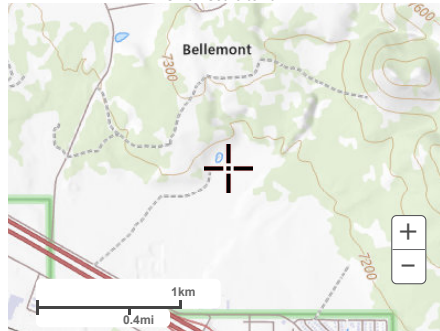
NOAA Atlas 14, Volume 1, Version 5

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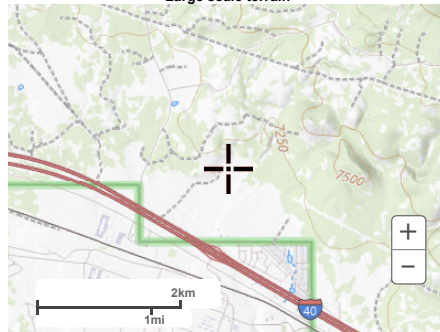
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



NOAA Atlas 14, Volume 1, Version 5
 Location name: Bellemont, Arizona, USA*
 Latitude: 35.2487°, Longitude: -111.8299°
 Elevation: 7177 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

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PF tabular

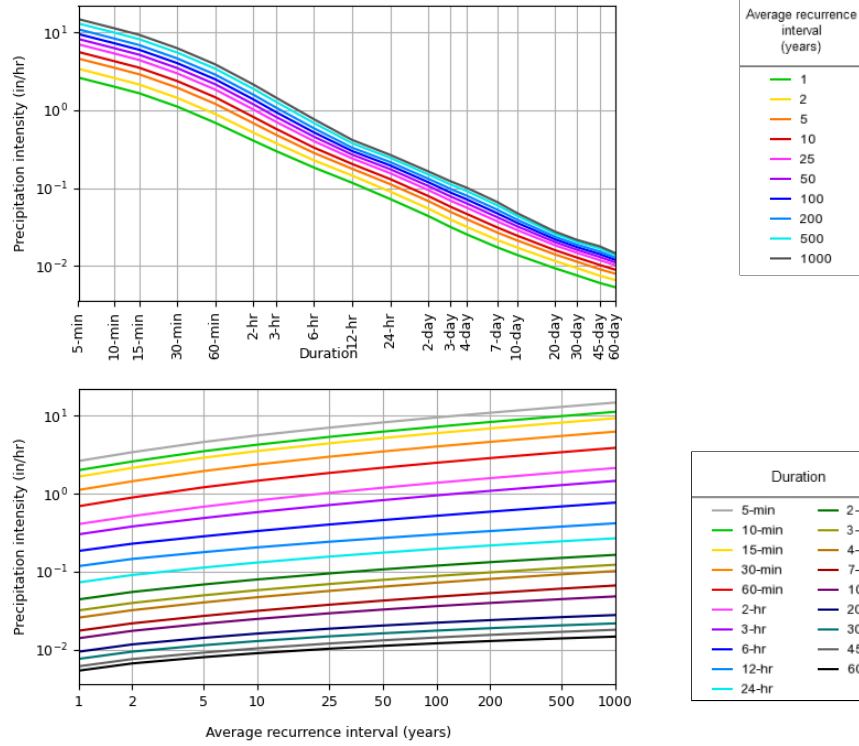
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.63 (2.28-3.06)	3.41 (2.95-3.96)	4.61 (3.98-5.34)	5.60 (4.81-6.47)	7.03 (5.99-8.10)	8.22 (6.94-9.47)	9.52 (7.92-11.0)	10.9 (8.96-12.6)	13.0 (10.4-15.2)	14.8 (11.6-17.4)
10-min	2.00 (1.73-2.33)	2.59 (2.24-3.01)	3.51 (3.03-4.06)	4.26 (3.66-4.93)	5.35 (4.55-6.16)	6.26 (5.28-7.20)	7.24 (6.03-8.36)	8.33 (6.82-9.62)	9.91 (7.93-11.5)	11.3 (8.84-13.2)
15-min	1.66 (1.44-1.93)	2.14 (1.86-2.49)	2.90 (2.51-3.36)	3.52 (3.02-4.07)	4.42 (3.76-5.09)	5.17 (4.36-5.95)	5.99 (4.98-6.91)	6.88 (5.64-7.95)	8.18 (6.56-9.53)	9.31 (7.30-10.9)
30-min	1.12 (0.966-1.30)	1.44 (1.25-1.68)	1.95 (1.69-2.26)	2.37 (2.04-2.74)	2.98 (2.53-3.43)	3.48 (2.94-4.01)	4.03 (3.36-4.65)	4.63 (3.79-5.35)	5.51 (4.42-6.42)	6.27 (4.92-7.37)
60-min	0.690 (0.598-0.803)	0.893 (0.774-1.04)	1.21 (1.04-1.40)	1.47 (1.26-1.70)	1.84 (1.57-2.12)	2.16 (1.82-2.48)	2.50 (2.08-2.88)	2.87 (2.35-3.31)	3.41 (2.73-3.97)	3.88 (3.04-4.56)
2-hr	0.407 (0.358-0.466)	0.515 (0.453-0.591)	0.681 (0.597-0.779)	0.819 (0.714-0.934)	1.02 (0.883-1.16)	1.19 (1.02-1.36)	1.38 (1.16-1.57)	1.58 (1.31-1.81)	1.88 (1.52-2.16)	2.14 (1.70-2.47)
3-hr	0.300 (0.267-0.342)	0.379 (0.337-0.432)	0.487 (0.432-0.553)	0.580 (0.511-0.657)	0.713 (0.624-0.808)	0.825 (0.714-0.934)	0.950 (0.812-1.08)	1.09 (0.915-1.24)	1.29 (1.06-1.48)	1.46 (1.18-1.69)
6-hr	0.184 (0.165-0.206)	0.228 (0.205-0.256)	0.283 (0.254-0.318)	0.331 (0.296-0.371)	0.401 (0.355-0.449)	0.458 (0.402-0.513)	0.520 (0.452-0.583)	0.588 (0.503-0.660)	0.686 (0.575-0.777)	0.768 (0.633-0.876)
12-hr	0.117 (0.105-0.131)	0.145 (0.131-0.162)	0.177 (0.160-0.198)	0.204 (0.183-0.228)	0.241 (0.215-0.268)	0.269 (0.239-0.300)	0.300 (0.263-0.334)	0.331 (0.288-0.370)	0.378 (0.323-0.426)	0.416 (0.353-0.473)
24-hr	0.072 (0.066-0.079)	0.090 (0.082-0.099)	0.112 (0.102-0.123)	0.130 (0.118-0.143)	0.155 (0.140-0.170)	0.175 (0.157-0.191)	0.195 (0.175-0.214)	0.216 (0.193-0.237)	0.245 (0.216-0.269)	0.267 (0.234-0.295)
2-day	0.043 (0.040-0.048)	0.054 (0.050-0.060)	0.068 (0.062-0.075)	0.079 (0.072-0.087)	0.094 (0.085-0.103)	0.106 (0.096-0.117)	0.119 (0.107-0.130)	0.132 (0.118-0.145)	0.149 (0.132-0.165)	0.164 (0.143-0.181)
3-day	0.031 (0.029-0.034)	0.039 (0.036-0.043)	0.049 (0.045-0.054)	0.057 (0.052-0.063)	0.069 (0.062-0.075)	0.078 (0.070-0.085)	0.087 (0.078-0.096)	0.097 (0.087-0.107)	0.111 (0.098-0.122)	0.122 (0.107-0.135)
4-day	0.025 (0.023-0.028)	0.031 (0.029-0.035)	0.040 (0.036-0.044)	0.046 (0.042-0.051)	0.056 (0.051-0.061)	0.063 (0.057-0.070)	0.072 (0.064-0.078)	0.080 (0.071-0.088)	0.092 (0.081-0.101)	0.101 (0.088-0.112)
7-day	0.017 (0.016-0.018)	0.021 (0.019-0.023)	0.026 (0.024-0.029)	0.031 (0.028-0.034)	0.037 (0.034-0.040)	0.042 (0.038-0.046)	0.047 (0.043-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.066)	0.066 (0.058-0.072)
10-day	0.013 (0.012-0.015)	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.024 (0.022-0.026)	0.029 (0.026-0.031)	0.032 (0.029-0.035)	0.036 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.048 (0.042-0.052)
20-day	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.014 (0.013-0.015)	0.016 (0.014-0.017)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.022 (0.020-0.023)	0.023 (0.021-0.025)	0.026 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.014)	0.014 (0.013-0.016)	0.016 (0.014-0.017)	0.017 (0.015-0.019)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.004-0.005)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
 Latitude: 35.2487°, Longitude: -111.8299°



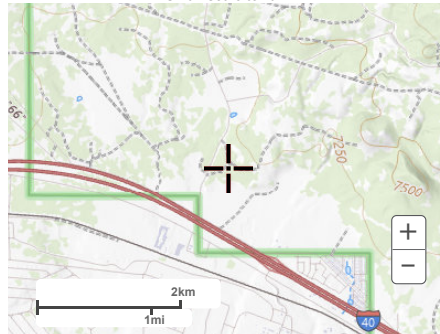
NOAA Atlas 14, Volume 1, Version 5

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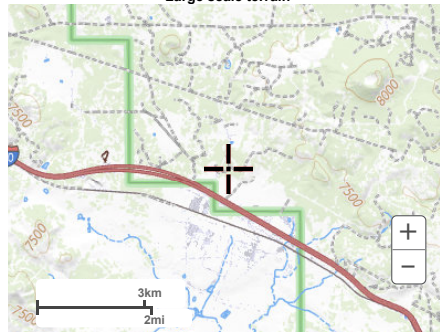
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



NOAA Atlas 14, Volume 1, Version 5
 Location name: Flagstaff, Arizona, USA*
 Latitude: 35.249°, Longitude: -111.8325°
 Elevation: 7163 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchon

NOAA, National Weather Service, Silver Spring, Maryland

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PF tabular

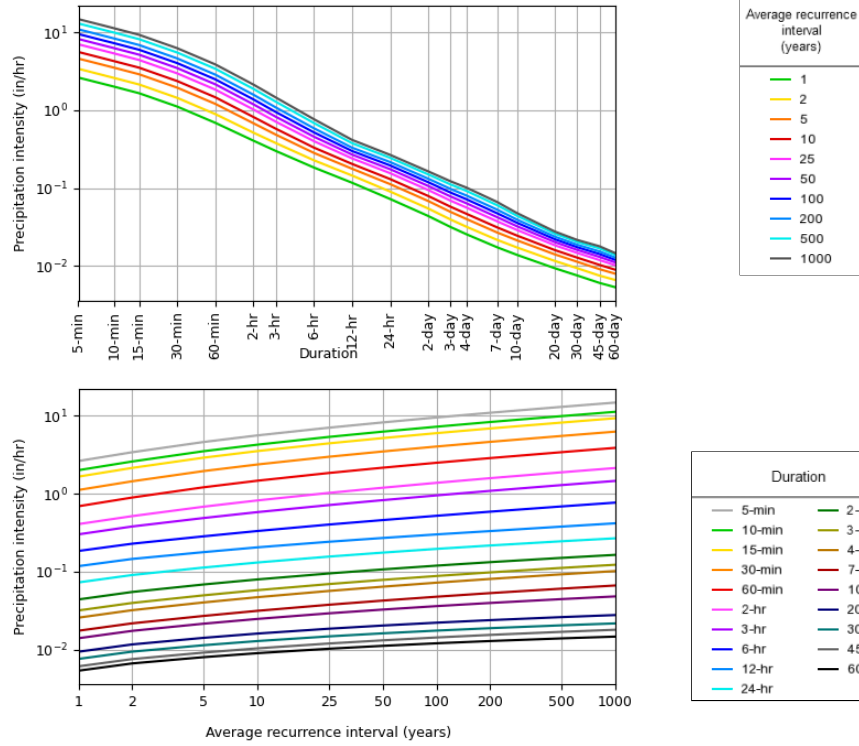
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.63 (2.28-3.06)	3.41 (2.95-3.96)	4.61 (3.98-5.34)	5.60 (4.81-6.47)	7.03 (5.99-8.10)	8.22 (6.94-9.47)	9.52 (7.92-11.0)	10.9 (8.96-12.6)	13.0 (10.4-15.2)	14.8 (11.6-17.4)
10-min	2.00 (1.73-2.33)	2.59 (2.24-3.01)	3.51 (3.03-4.06)	4.26 (3.66-4.93)	5.35 (4.55-6.16)	6.26 (5.28-7.20)	7.24 (6.03-8.36)	8.33 (6.82-9.62)	9.91 (7.93-11.5)	11.3 (8.84-13.2)
15-min	1.66 (1.44-1.93)	2.14 (1.86-2.49)	2.90 (2.51-3.36)	3.52 (3.02-4.07)	4.42 (3.76-5.09)	5.17 (4.36-5.95)	5.99 (4.98-6.91)	6.88 (5.64-7.95)	8.18 (6.56-9.53)	9.31 (7.30-10.9)
30-min	1.12 (0.966-1.30)	1.44 (1.25-1.68)	1.95 (1.69-2.26)	2.37 (2.04-2.74)	2.98 (2.53-3.43)	3.48 (2.94-4.01)	4.03 (3.36-4.65)	4.63 (3.79-5.35)	5.51 (4.42-6.42)	6.27 (4.92-7.37)
60-min	0.690 (0.598-0.803)	0.893 (0.774-1.04)	1.21 (1.04-1.40)	1.47 (1.26-1.70)	1.84 (1.57-2.12)	2.16 (1.82-2.48)	2.50 (2.08-2.88)	2.87 (2.35-3.31)	3.41 (2.73-3.97)	3.88 (3.04-4.56)
2-hr	0.407 (0.358-0.466)	0.515 (0.453-0.591)	0.681 (0.597-0.779)	0.819 (0.714-0.934)	1.02 (0.883-1.16)	1.19 (1.02-1.36)	1.38 (1.16-1.57)	1.58 (1.31-1.81)	1.88 (1.52-2.16)	2.14 (1.70-2.47)
3-hr	0.300 (0.267-0.342)	0.379 (0.337-0.432)	0.487 (0.432-0.553)	0.580 (0.511-0.657)	0.713 (0.624-0.808)	0.825 (0.714-0.934)	0.950 (0.812-1.08)	1.09 (0.915-1.24)	1.29 (1.06-1.48)	1.46 (1.18-1.69)
6-hr	0.184 (0.165-0.206)	0.228 (0.205-0.256)	0.283 (0.254-0.318)	0.331 (0.296-0.371)	0.401 (0.355-0.449)	0.458 (0.402-0.513)	0.520 (0.452-0.583)	0.588 (0.503-0.660)	0.686 (0.575-0.777)	0.768 (0.633-0.876)
12-hr	0.117 (0.105-0.131)	0.145 (0.131-0.162)	0.177 (0.160-0.198)	0.204 (0.183-0.228)	0.241 (0.215-0.268)	0.269 (0.239-0.300)	0.300 (0.263-0.334)	0.331 (0.288-0.370)	0.378 (0.323-0.426)	0.416 (0.353-0.473)
24-hr	0.072 (0.066-0.079)	0.090 (0.082-0.099)	0.112 (0.102-0.123)	0.130 (0.118-0.143)	0.155 (0.140-0.170)	0.175 (0.157-0.191)	0.195 (0.175-0.214)	0.216 (0.193-0.237)	0.245 (0.216-0.269)	0.267 (0.234-0.295)
2-day	0.043 (0.040-0.048)	0.054 (0.050-0.060)	0.068 (0.062-0.075)	0.079 (0.072-0.087)	0.094 (0.085-0.103)	0.106 (0.096-0.117)	0.119 (0.107-0.130)	0.132 (0.118-0.145)	0.149 (0.132-0.165)	0.164 (0.143-0.181)
3-day	0.031 (0.029-0.034)	0.039 (0.036-0.043)	0.049 (0.045-0.054)	0.057 (0.052-0.063)	0.069 (0.062-0.075)	0.078 (0.070-0.085)	0.087 (0.078-0.096)	0.097 (0.087-0.107)	0.111 (0.098-0.122)	0.122 (0.107-0.135)
4-day	0.025 (0.023-0.028)	0.031 (0.029-0.035)	0.040 (0.036-0.044)	0.046 (0.042-0.051)	0.056 (0.051-0.061)	0.063 (0.057-0.070)	0.072 (0.064-0.078)	0.080 (0.071-0.088)	0.092 (0.081-0.101)	0.101 (0.088-0.112)
7-day	0.017 (0.016-0.018)	0.021 (0.019-0.023)	0.026 (0.024-0.029)	0.031 (0.028-0.034)	0.037 (0.034-0.040)	0.042 (0.038-0.046)	0.047 (0.043-0.051)	0.052 (0.047-0.057)	0.060 (0.053-0.066)	0.066 (0.058-0.072)
10-day	0.013 (0.012-0.015)	0.017 (0.015-0.018)	0.021 (0.019-0.023)	0.024 (0.022-0.026)	0.029 (0.026-0.031)	0.032 (0.029-0.035)	0.036 (0.032-0.039)	0.039 (0.035-0.043)	0.044 (0.039-0.048)	0.048 (0.042-0.052)
20-day	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.014 (0.013-0.015)	0.016 (0.014-0.017)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.022 (0.020-0.023)	0.023 (0.021-0.025)	0.026 (0.023-0.028)	0.027 (0.024-0.030)
30-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.014)	0.014 (0.013-0.016)	0.016 (0.014-0.017)	0.017 (0.015-0.019)	0.018 (0.016-0.020)	0.020 (0.018-0.022)	0.021 (0.019-0.023)
45-day	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.015-0.018)	0.017 (0.015-0.019)
60-day	0.005 (0.004-0.005)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.010-0.013)	0.012 (0.011-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.016)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 35.2490°, Longitude: -111.8325°



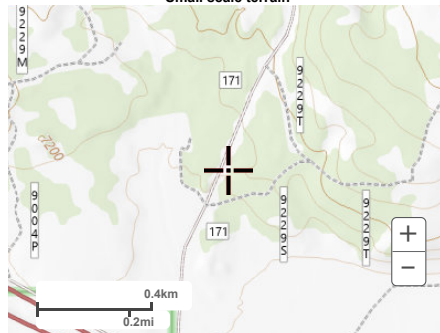
NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Mon Feb 2 19:42:46 2026

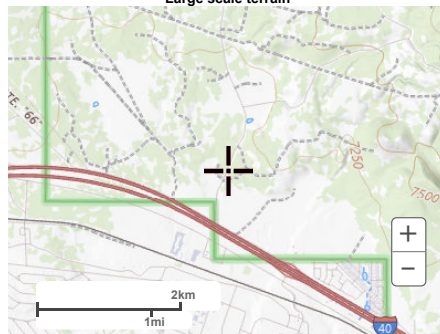
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map

Appendix D: Rational Method Calculations

Primary Alignment Rational Method						
Variable	Units	Watershed 1	Watershed 2	Watershed 3	Watershed 4	Watershed 5
Area, (A)	Acres	42.68	133.34	1446.80	82.36	53.49
Time of Concentration, (Tc)	Minutes	16.77	20.48	35.84	17.97	19.66
Average Rainfall Intensity, (i)	Inches/Hour	4.92	4.53	3.20	4.82	4.63
Hydraulic Soil Group	N/A	D	D	D	D	D
Terrian	N/A	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)
Vegetation Cover	%	70	95	95	95	95
Runoff Coefficient, (C)	N/A	0.2	0.2	0.2	0.2	0.2
Flow, (Q)	cfs	42.02	120.71	926.83	79.35	49.51

Primary Alignment Time of Concentration						
Variable	Units	Watershed 1	Watershed 2	Watershed 3	Watershed 4	Watershed 5
Length of Longest Flow Path, (L)	Miles	0.74	1.28	3.2	0.75	0.8
Watershed Resistance Coefficient, (K _b)	N/A	0.1	0.1	0.1	0.1	0.1
Elevation #1	ft	7354	7646	8540	7328	7315
Elevation #2	ft	7146	7136	7134	7152	7150
Slope of Longest Flow Path, (S)	ft/mile	281.08	398.44	439.38	234.67	206.25
Initial Time of Concentration, (Tc')	Minutes	16	20	35	17	19
Initial Rainfall Intensity, (i')	Inches/Hour	5.01	4.58	3.24	4.93	4.70
Final Time of Concentration, (Tc)	Minutes	16.77	20.48	35.84	17.97	19.66
Final Rainfall Intensity, (i)	Inches/Hour	4.92	4.53	3.20	4.82	4.63

Alternative 2 Alignment Rational Method

Variable	Units	Watershed 1	Watershed 2	Watershed 3	Watershed 4	Watershed 5	Watershed 6
Area, (A)	Acres	45.80	114.63	1270.80	146.12	61.92	31.35
Time of Concentration, (Tc)	Minutes	14.23	15.42	34.32	18.21	14.52	14.94
Average Rainfall Intensity, (i)	Inches/Hour	5.31	5.09	3.27	4.78	5.27	5.18
Hydraulic Soil Group	N/A	D	D	D	D	D	D
Terrian	N/A	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)	Mountain (Ponderosa Pine)
Vegetation Cover	%	80	99	90	95	100	95
Runoff Coefficient, (C)	N/A	0.2	0.2	0.2	0.2	0.2	0.2
Flow, (Q)	cfs	48.61	116.76	831.08	139.70	65.32	32.47

Alternative 2 Alignment Time of Concentration

Variable	Units	Watershed 1	Watershed 2	Watershed 3	Watershed 4	Watershed 5	Watershed 6
Length of Longest Flow Path, (L)	Miles	0.6	0.95	3.02	0.84	0.54	0.57
Watershed Resistance Coefficient, (K _b)	N/A	0.1	0.1	0.1	0.1	0.1	0.1
Elevation #1	ft	7354	7672	8540	7382	7329	7315
Elevation #2	ft	7156	7164	7150	7148	7189	7168
Slope of Longest Flow Path, (S)	ft/mile	330.00	534.74	460.26	278.57	259.26	257.90
Initial Time of Concentration, (T _c)	Minutes	15	15	35	18	15	15
Initial Rainfall Intensity, (i')	Inches/Hour	5.14	5.14	3.24	4.804	5.17	5.17
Final Time of Concentration, (T _c)	Minutes	14.23	15.42	34.32	18.21	14.52	14.94
Final Rainfall Intensity, (i)	Inches/Hour	5.31	5.09	3.27	4.78	5.27	5.18

Appendix E: HEC-HMS Calculations

HEC-HMS Calculations

Alternative #1 Alignment:

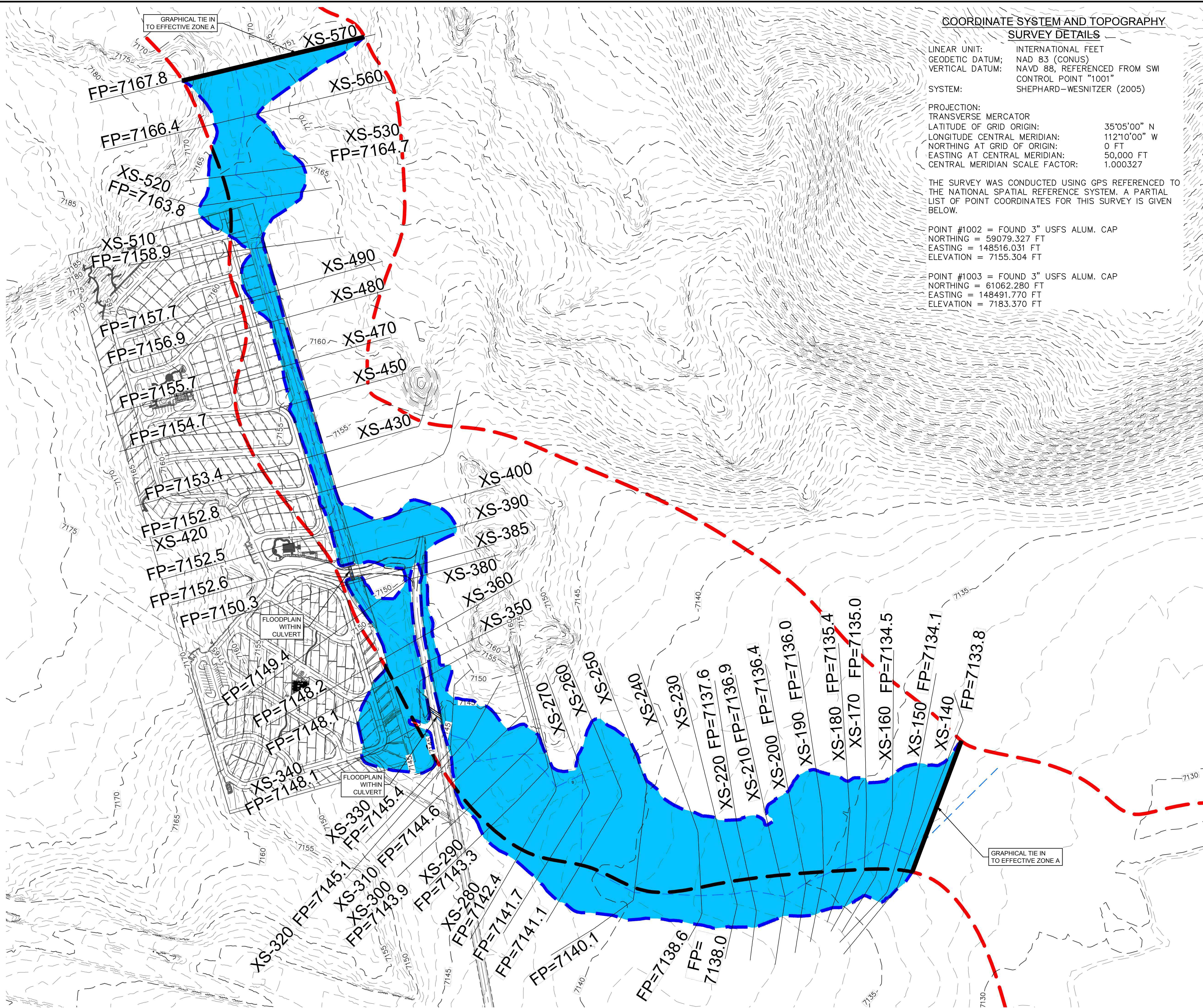
Unit Hydrograph Time of Concentration		
Variable	Value	Units
Area, (A)	2.26	mi ²
Length of Flow Path, (L)	3.2	Miles
Length to Watershed Centroid, (Lca)	1.8	Miles
Slope of Longest Flow Path, (S)	439.38	ft/mile
Time of Concentration, (Tc)	1.19	Hours
Unit Hydrograph Storage Coefficient		
Time of Concentration, (Tc)	1.19	Hours
Length of Flow Path, (L)	3.2	Miles
Area, (A)	2.26	mi ²
Storage Coefficient, (R)	0.72	Hours
HEC-HMS Input Values		
Curve Number	71	N/A
Initial Loss	0.82	Inches
Storage Coefficient, (R)	0.72	Hours
Time of Concentration, (Tc)	1.19	Hours
Constant Rate	0.05	Inches/Hour
Lag Value	60	Minutes
Manual Input Data: 24 hours duration, 50-year reoccurrence, 15 min intervals	0.044	Incremental Inches

Alternative #3 Alignment:

Unit Hydrograph Time of Concentration		
Variable	Value	Units
Area, (A)	1.99	mi ²
Length of Flow Path, (L)	3.0	Miles
Length to Watershed Centroid, (Lca)	1.5	Miles
Slope of Longest Flow Path, (S)	460.26	ft/mile
Time of Concentration, (Tc)	1.10	Hours
Unit Hydrograph Storage Coefficient		
Time of Concentration, (Tc)	1.10	Hours
Length of Flow Path, (L)	3.0	Miles
Area, (A)	1.99	mi ²
Storage Coefficient, (R)	0.67	Hours
HEC-HMS Input Values		
Curve Number	71	N/A
Initial Loss	0.82	Inches
Storage Coefficient, (R)	0.67	Hours
Time of Concentration, (Tc)	1.10	Hours
Constant Rate	0.05	Inches/Hour
Lag Value	60	Minutes
Manual Input Data: 24 hours duration, 50-year reoccurrence, 15 min intervals	0.044	Incremental Inches

Appendix F: Village Camp Site Plan

DATE: Feb 20, 2025, FILE: R:\Projects\2025\081 Projects_Village Camp\Map\Map_Village Camp_V1100 - REVISED FP WORKMAP_25-0213.dwg



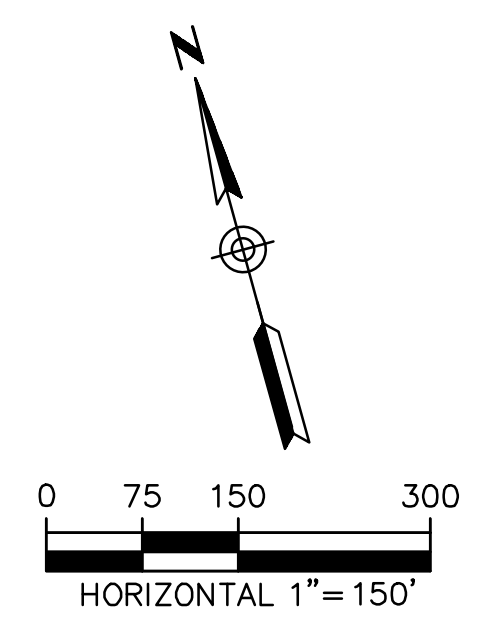
COORDINATE SYSTEM AND TOPOGRAPHY
SURVEY DETAILS
 LINEAR UNIT: INTERNATIONAL FEET
 GEODETIC DATUM: NAD 83 (CONUS)
 VERTICAL DATUM: NAVD 88, REFERENCED FROM SWI CONTROL POINT "1001"
 SYSTEM: SHEPHARD-WESNITZER (2005)
 PROJECTION: TRANSVERSE MERCATOR
 LATITUDE OF GRID ORIGIN: 35°05'00" N
 LONGITUDE CENTRAL MERIDIAN: 112°10'00" W
 NORTHING AT GRID OF ORIGIN: 0 FT
 EASTING AT CENTRAL MERIDIAN: 50,000 FT
 CENTRAL MERIDIAN SCALE FACTOR: 1.000327

THE SURVEY WAS CONDUCTED USING GPS REFERENCED TO THE NATIONAL SPATIAL REFERENCE SYSTEM. A PARTIAL LIST OF POINT COORDINATES FOR THIS SURVEY IS GIVEN BELOW.
 POINT #1002 = FOUND 3" USFS ALUM. CAP
 NORTHING = 59079.327 FT
 EASTING = 148516.031 FT
 ELEVATION = 7155.304 FT
 POINT #1003 = FOUND 3" USFS ALUM. CAP
 NORTHING = 61062.280 FT
 EASTING = 148491.770 FT
 ELEVATION = 7183.370 FT

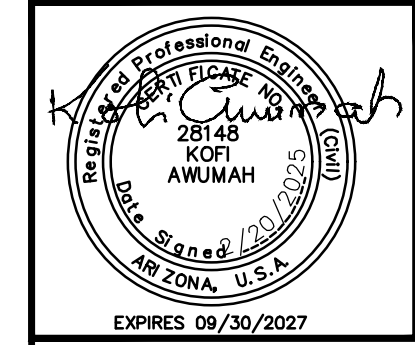
LEGEND

- LEGEND**
- EFFECTIVE 100-YR FLOODPLAIN LIMITS
 - REVISED 100-YR FLOODPLAIN LIMITS
 - FLOODPLAIN
 - RIVER CENTER LINE
 - HEC-RAS SECTION AND #

GENERAL NOTES



RFC NO.	DATE	DESCRIPTION	BY



ARDURRA
 COLLABORATE. INNOVATE. CREATE.
 O: 602.263.1177
 1001 N. CENTRAL AVE
 SUITE 900
 PHOENIX, AZ 85004
 www.ardurra.com

CITY OF FLAGSTAFF, ARIZONA

**LOMR FOR VILLAGE CAMP
 (VOLUNTEER WASH)
 FLOODPLAIN WORKMAP
 REVISED CONDITION**

DRAWN:	DESIGN:	CHECK:	SHEET NO.	TOTAL SHEETS
MS	KA	RS	1	1
DATE: 2/25	DATE: 2/25	DATE: 2/25	SCALE: 1" = 150' HORIZONTAL	

Appendix G: Culvert Sizing Calculations

Appendix G-1: Box Culvert Nomographs

FIGURE 5.26
INLET CONTROL HEADWATER DEPTH FOR BOX CULVERTS
 (USDOT, FHWA, HDS-5, 1985)



RCBC #1 = (2) 4' x 6'
 Flow Per Barrel = 217 cfs
 $Q/B = 217/6 = 36.2$
 $HW/D = 1.46$

RCBC #2 = (1) 4' x 10'
 Flow Per Barrel = 348 cfs
 $Q/B = 348/10 = 34.8$
 $HW/D = 1.40$

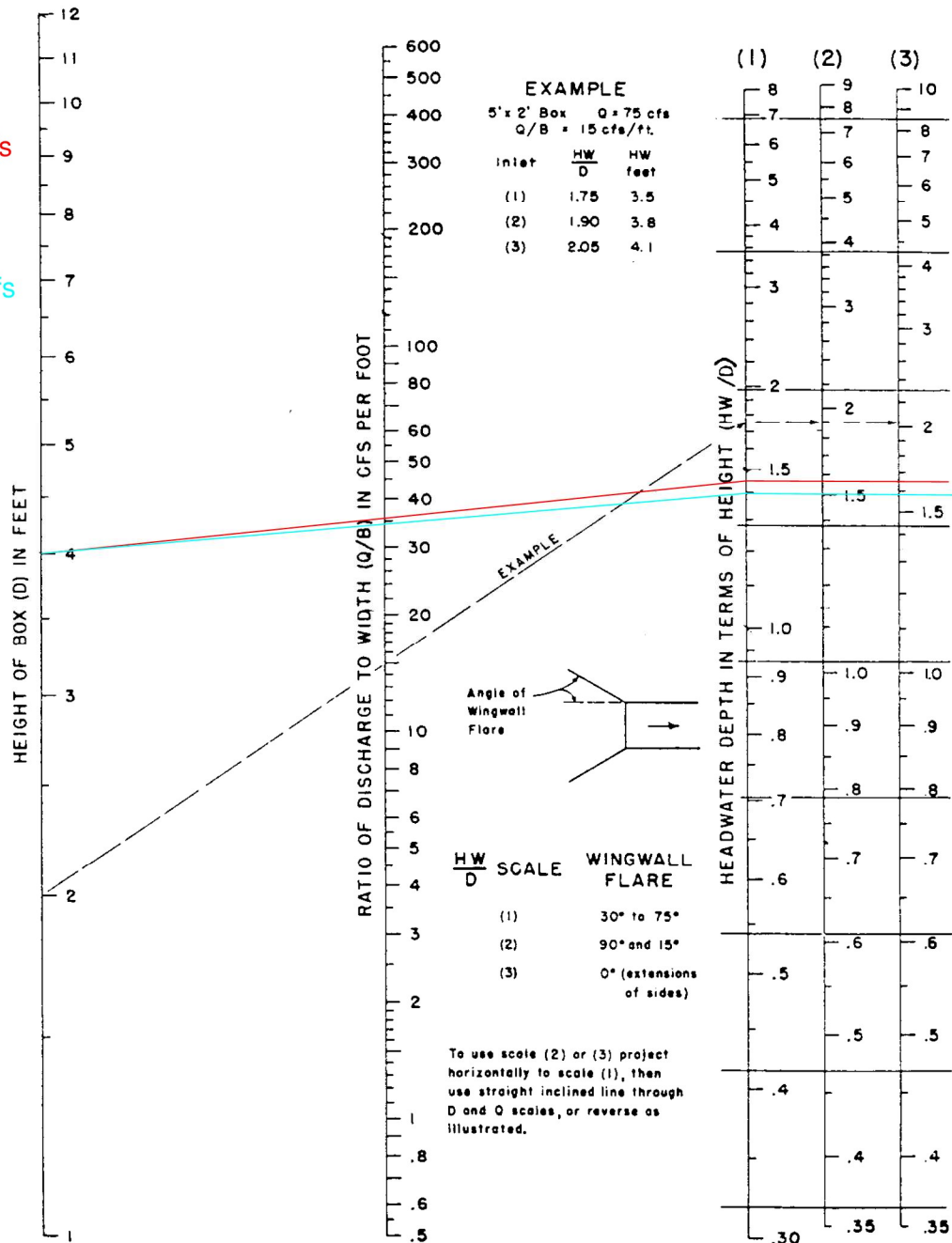


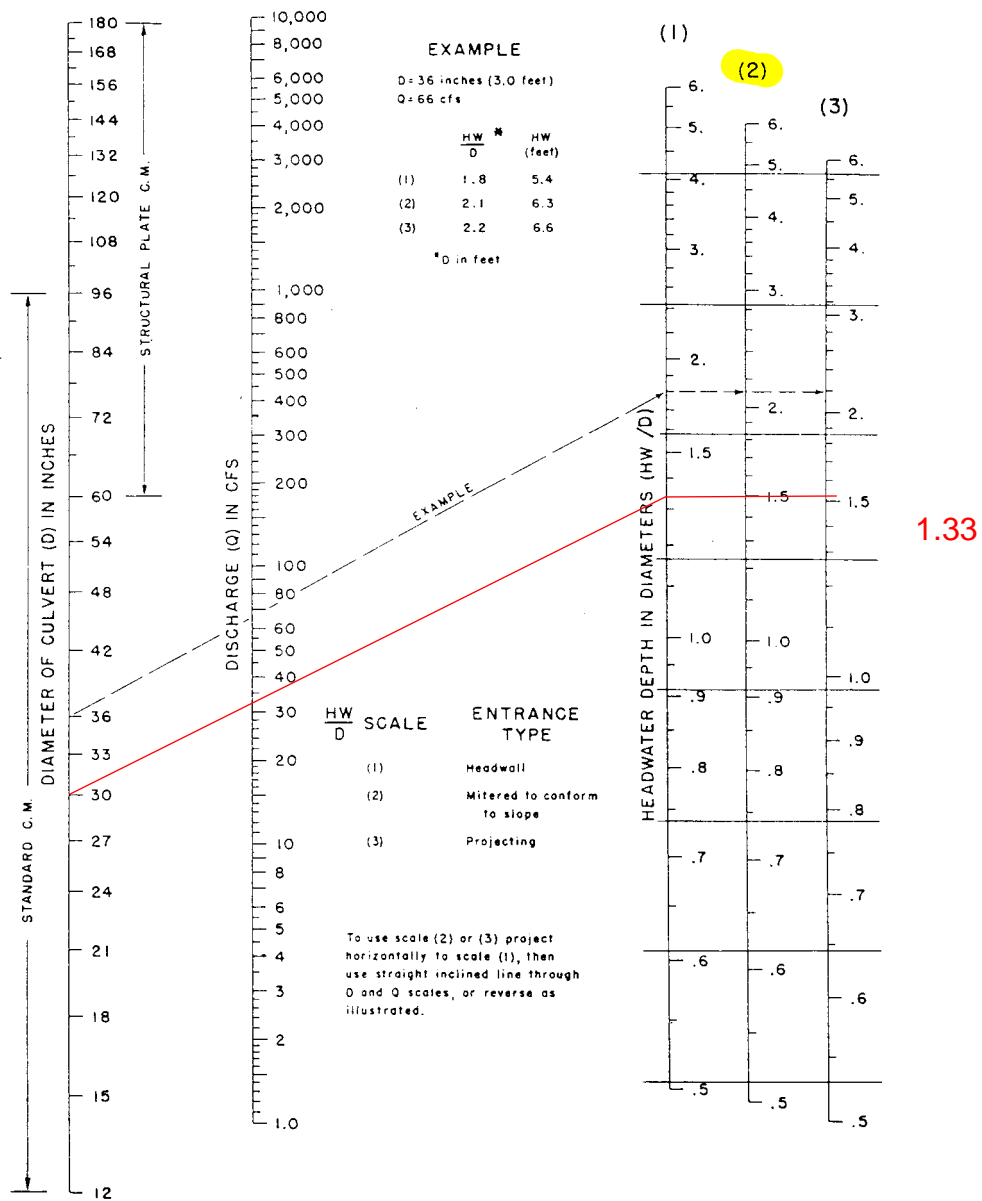
TABLE 5.1
ENTRANCE LOSS COEFFICIENTS
 OUTLET CONTROL, FULL OR PARTLY FULL ENTRANCE HEAD LOSS
 (USDOT, FHWA, HDS-5, 1985)

Type of Structure and Design of Entrance	Coefficient, K_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, square cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = $1/12 D$)	0.2
Mitered to conform to fill slope	0.7
End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side- or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side- or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of $1/12$ barrel dimension, or beveled on sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of $1/12$ barrel dimension, or beveled top edge	0.2
Wingwalls at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side- or slope-tapered inlet	0.2

Appendix G-2: CMP Culvert Nomographs

FIGURE 5.21
INLET CONTROL HEADWATER DEPTH FOR C.M. PIPE
 (USDOT, FHWA, HDS-5, 1985)

Red = Primary #1



Appendix H: Traffic Calculations

Appendix H-1: Future Traffic Calculations

Total Shadow Mountain Density		
Area (sf)	Units	Density (units/sf)
7251031.71	733	0.0001011

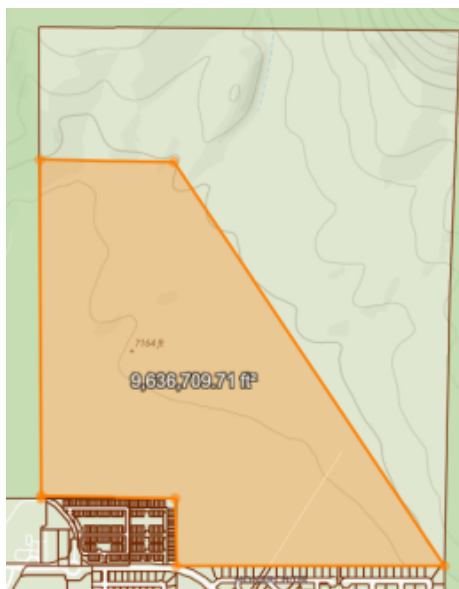
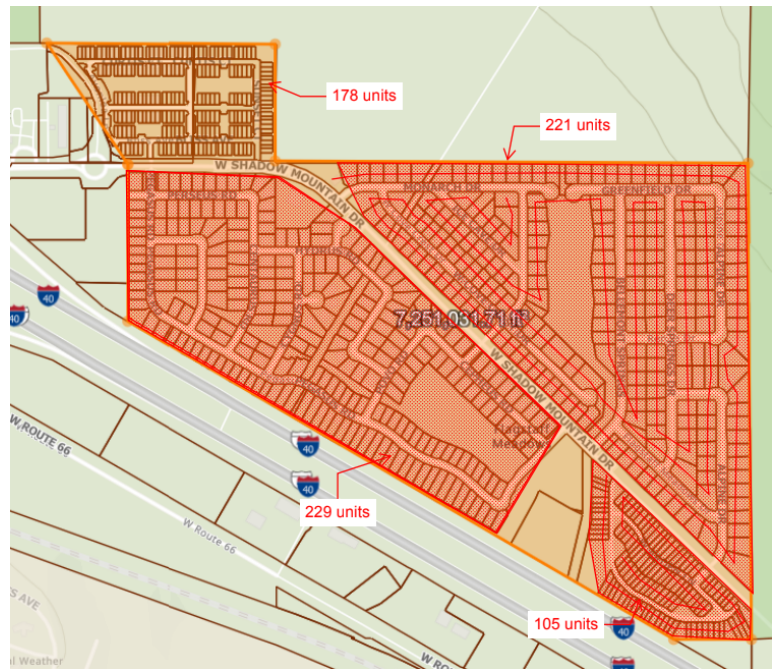
Shadow Mountain Townhome Density (North of Shadow Mtn/Pegasus)		
Area (sf)	Units	Density (units/sf)
651279.69	178	0.0002733

Shadow Mountain Single Family Density (South of Shadow Mtn, between Pegasus & Athena)		
Area (sf)	Units	Density (units/sf)
2415711.44	229	0.0000948

Shadow Mountain Single Family Density (North of Shadow Mtn, between Monarch & Alpine)		
Area (sf)	Units	Density (units/sf)
2919276.74	221	0.0000757

Shadow Mountain Dense Single Family Density (South of Shadow Mtn, Slate Mountain)		
Area (sf)	Units	Density (units/sf)
432604.4	105	0.0002427

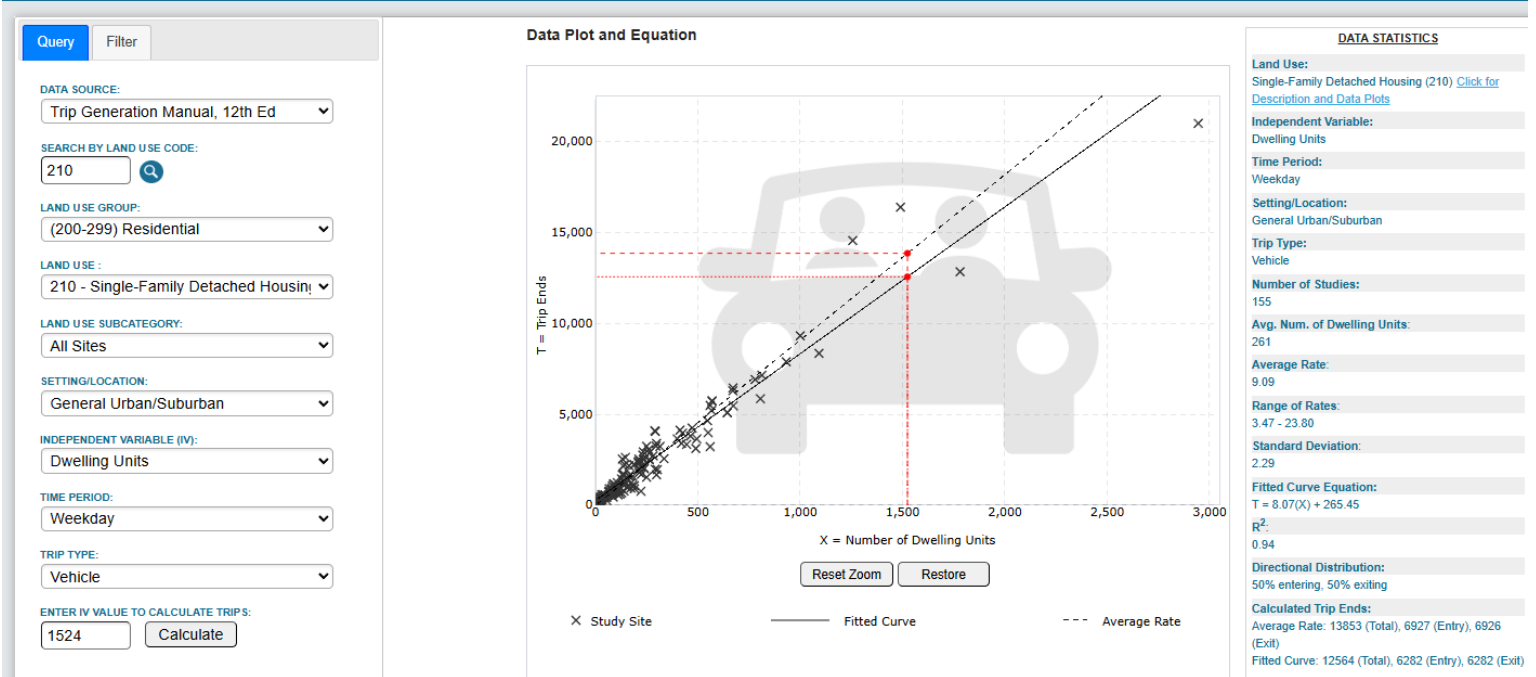
Area of Parcel for Development	Area (sf)
Total:	20525608.29
High-Density Development:	9636709.71
Low-Density Development:	10888898.58



Total Units for Proposed Development	
Total Density for High-Density Development (units/sf):	0.000101
High-Density Area (sf):	9636709.71
High-Density Total Units:	974.17
Total Density for Low-Density Development (units/sf):	0.0000505
Low-Density Area (sf):	10888898.58
Low-Density Total Units:	550.37
Total Units for Proposed Development:	1524.54

ITETripGen Web-based App

Graph Look Up



Extrapolate Existing Traffic Data to Proposed Development	
Total Existing Units in Shadow Mountain:	773
Total Proposed Development Units:	1524
Ratio of Proposed Units to Existing Units:	1.972
Existing Traffic Counts for Shadow Mountain - CCN-142 (AADT):	2872
Proposed Traffic Counts for Development Using Factor (AADT):	5662

Appendix H-2: Turn Lane Warrants

Trip Generation Calculations

Date: 1/31/2026
By: LHT

Resource Edition Used: Institute of Transportation Engineers Trip Generation Manual, 10th Edition

Land Use: 210 Single-Family Detached Housing

Average Vehicle Trip Ends

Equation per 210: $\ln(T)=0.92\ln(X)+2.71$
Factors per Land Use (A), (B) 0.92 2.71
Occupied Units (X) 708
Trips Generated (T) 6294.61
Trips Generated (T) Rounded 6295

T=Trips Generated
A,B=Factors per individual Land Use
X=Occupied Units per Land Use

Average Vehicle Trip Ends A.M. Peak Hour Generator

Equation per Land Use $\ln(T)=0.91\ln(X)+0.2$
Factors per Land Use (A), (B) 0.91 0.2
Occupied Units (X) 708
Trips Generated (T) 479.059173
Trips Generated (T) Rounded 480

Average Vehicle Trip Ends P.M. Peak Hour Generator

Equation per 416 Use Page: $\ln(T)=0.94\ln(X)+0.34$
Factors per Land Use (A), (B) 0.94 0.34
Occupied Units (X) 708
Trips Generated (T) 670.951898
Trips Generated (T) Rounded 671

Total Trips Generated

Total A.M. Peak Hour Trips Generated 480
Total P.M. Peak Hour Trips Generated 671

Existing Traffic along Shadow Mountain Dr

Date: 1/31/2026
By: LHT

Shadow Mountain Dr WEST OF Monarch Dr

ADOT Average Annual Daily Traffic Reports, TCDS

Reference #		K Factor %	11%
Location ID	CCN-141	D Factor %	55%

Road	Shadow Mt.	AADT Single Trucks	116
Pos Dir AADT (Eastbound)	968	AADT Combo Trucks	39
Neg Dir AADT (Westbound)	957	T Factor %	6%
AADT 2025	1925	2043 Future AADT	2802

Turn Lane Warrant Analysis

Date: 1/31/2026
 By: LHT

AADT	1925	
Pos Dir AADT (Eastbound)	968	
Neg Dir AADT (Westbound)	957	Peak Travel Direction
K Factor	11%	Percent of AADT during 30th highest hour of the year
D Factor	55%	Percent of traffic moving in peak travel direction during 30th highest hourly volume of the year

Existing Volumes

Peak Traffic Volume, Both Directions	211.75	Use:	212	=AADT*K
Northbound Peak Volume	95.4	Use:	96	=AADT*K*(1-D)
Southbound Peak Volume	116.6	Use:	117	=AADT*K*D

Proposed Development Trip Generation

Total A.M. Peak Hour Trips Generated	480
Total P.M. Peak Hour Trips Generated	671

A.M. Peak Hour Trips Generated	NB	216	Use:	216
P.M. Peak Hour Trips Generated	NB	301.95	Use:	302
A.M. Peak Hour Trips Generated	SB	264	Use:	264
P.M. Peak Hour Trips Generated	SB	369.05	Use:	370

ADOT Traffic Guidelines and Processes, January 2019, Section 245 - Turn Lane Warrants

Posted Speed Limit	35	mph
Number of Lanes each way	1	
Right Turn Lane Minimum	27	
Left Turn Lane Minimum	12	

Lane to receive right turn lane	SB	Trips Gen 370	>	27
Lane to receive left turn lane:	NB	Trips Gen 302	>	12

Right Turn Lane Warranted
Left Turn Lane Warranted

Appendix I: Horizontal Curve Calculations

Runoff Length Table

Table 3-16a. Superelevation Runoff L_r (ft) for Horizontal Curves

U.S. Customary																													
e (%)	$V_d = 15$ mph		$V_d = 20$ mph		$V_d = 25$ mph		$V_d = 30$ mph		$V_d = 35$ mph		$V_d = 40$ mph		$V_d = 45$ mph		$V_d = 50$ mph		$V_d = 55$ mph		$V_d = 60$ mph		$V_d = 65$ mph		$V_d = 70$ mph		$V_d = 75$ mph		$V_d = 80$ mph		
	Number of Lanes Rotated. Note that 1 lane rotated is typical for a 2-lane highway, 2 lanes rotated is typical for a 4-lane highway, etc. (See Table 3-15.)																												
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)
1.5	23	35	24	37	26	39	27	41	29	44	31	47	33	50	36	54	38	58	40	60	42	63	45	68	47	71	52	77	
2.0	31	46	32	49	34	51	36	55	39	58	41	62	44	67	48	72	51	77	53	80	56	84	60	90	63	95	69	103	
2.2	34	51	36	54	38	57	40	60	43	64	46	68	49	73	53	79	56	84	59	88	61	92	66	99	69	104	75	113	
2.4	37	55	39	58	41	62	44	65	46	70	50	74	53	80	58	86	61	92	64	96	67	100	72	108	76	114	82	123	
2.6	40	60	42	63	45	67	47	71	50	75	54	81	58	87	62	94	66	100	69	104	73	109	78	117	82	123	89	134	
2.8	43	65	45	68	48	72	51	76	54	81	58	87	62	93	67	101	71	107	75	112	78	117	84	126	88	133	96	144	
3.0	46	69	49	73	51	77	55	82	58	87	62	93	67	100	72	108	77	115	80	120	84	126	90	135	95	142	103	154	
3.2	49	74	52	78	55	82	58	87	62	93	66	99	71	107	77	115	82	123	85	128	89	134	96	144	101	152	110	165	
3.4	52	78	55	83	58	87	62	93	66	99	70	106	76	113	82	122	87	130	91	136	95	142	102	153	107	161	117	175	
3.6	55	83	58	88	62	93	65	98	70	105	74	112	80	120	86	130	92	138	96	144	100	151	108	162	114	171	123	185	
3.8	58	88	62	92	65	98	69	104	74	110	79	118	84	127	91	137	97	146	101	152	106	159	114	171	120	180	130	195	
4.0	62	92	65	97	69	103	73	109	77	116	83	124	89	133	96	144	102	153	107	160	112	167	120	180	126	189	137	206	
4.2	65	97	68	102	72	108	76	115	81	122	87	130	93	140	101	151	107	161	112	168	117	176	126	189	133	199	144	216	
4.4	68	102	71	107	75	113	80	120	85	128	91	137	98	147	106	158	112	169	117	176	123	184	132	198	139	208	151	226	
4.6	71	106	75	112	79	118	84	125	89	134	95	143	102	153	110	166	117	176	123	184	128	193	138	207	145	218	158	237	
4.8	74	111	78	117	82	123	87	131	93	139	99	149	107	160	115	173	123	184	128	192	134	201	144	216	152	227	165	247	
5.0	77	115	81	122	86	129	91	136	97	145	103	155	111	167	120	180	128	191	133	200	140	209	150	225	158	237	171	257	
5.2	80	120	84	126	89	134	95	142	101	151	108	161	116	173	125	187	133	199	139	208	145	218	156	234	164	246	178	267	
5.4	83	125	88	131	93	139	98	147	105	157	112	168	120	180	130	194	138	207	144	216	151	226	162	243	171	256	185	278	
5.6	86	129	91	136	96	144	102	153	108	163	116	174	124	187	134	202	143	214	149	224	156	234	168	252	177	265	192	288	
5.8	89	134	94	141	99	149	105	158	112	168	120	180	129	193	139	209	148	222	155	232	162	243	174	261	183	275	199	298	
6.0	92	138	97	146	103	154	109	164	116	174	124	186	133	200	144	216	153	230	160	240	167	251	180	270	189	284	206	309	
6.2	95	143	101	151	106	159	113	169	120	180	128	192	138	207	149	223	158	237	165	248	173	260	186	279	196	294	213	319	
6.4	98	148	104	156	110	165	116	175	124	186	132	199	142	213	154	230	163	245	171	256	179	268	192	288	202	303	219	329	
6.6	102	152	107	161	113	170	120	180	128	192	137	205	147	220	158	238	169	253	176	264	184	276	198	297	208	313	226	339	
6.8	105	157	110	165	117	175	124	185	132	197	141	211	151	227	163	245	174	260	181	272	190	285	204	306	215	322	233	350	

Runout Length Calculations

Horiz Curve 1 Horiz Curve 2

eNC	2	2
ed	6	6
Lr	86.4	124.8
Lt	28.8	41.6

U.S. Customary	Metric
$L_t = \frac{e_{NC}}{e_d} L_r$	$L_t = \frac{e_{NC}}{e_d} L_r$
where:	where:
L_t = minimum length of tangent runout, ft	L_t = minimum length of tangent runout, m
e_{NC} = normal cross slope rate, percent	e_{NC} = normal cross slope rate, percent
e_d = design superelevation rate, percent	e_d = design superelevation rate, percent
L_r = minimum length of superelevation runoff, ft	L_r = minimum length of superelevation runoff, m

(3-24)

Percent Complete 100%

Task #	Task Name	Spencer Huttenmeyer				Janelle Sanchez				Orlando Santoyo				Lauren Townner				Total				
		Sr Engr.	Engr.	Tech	Intern	Sr Engr.	Engr.	Tech	Intern	Sr Engr.	Engr.	Tech	Intern	Sr Engr.	Engr.	Tech	Intern	Sr Engr.	Engr.	Tech	Intern	
1.0	Acquire Existing Site Information																					
1.1	Lidar Data	0.5						1										3	0.5	0	7	2
1.2	FEMA Flood Zone	0.5						1										0.5	0	0	0	2
1.3	Geotechnical Reports from Similar/Relevant Projects				3					2	0.5			1				0.5	0	0	0	13
1.4	Geotechnical Analysis	0.5				0.5						4	8					1	0	0	4	0
1.5	TCDS Data							1	0.5									0.5	0	0	0	6
2.0	Site Investigation																	8	4	8	4	4
2.1	Site Investigation Planning	2			1	2		2		2	2	2					1	6	2	2	4	2
2.2	Conduct Site Investigation				1	2		2		2	2						1	2	2	2	4	2
3.0	Hydrologic Analysis																	5.5	4	22	6	23
3.1	Delineate Watershed	1				0.5			18	1			5					2.5	0	0	0	23
3.2	Determine Rainfall Intensity					0.5		4		0.5		6						1	0	0	10	0
3.3	Determine Peak Flow					0.5	2	2		0.5	2	4						0.5	2	6	6	0
3.4	Model Within HEC-HMS							6		1.5	2	4						1.5	2	6	6	0
4.0	Hydraulic Analysis																	1	6	9	9	9
4.1	Determine Off-Site Drainage	0.5	1				1				1				1			0.5	4	0	0	0
4.2	Analyze Potential Hydraulic Structures	0.5					2					9	9					0.5	2	9	9	9
4.3	Model Hydraulic Structure																	0	0	0	0	0
5.0	Traffic Analysis																	2	14	16	5	10
5.1	Determine Future Traffic		2	2	8										1	3		0	3	5	8	0
5.2	Determine Connections Into Existing Roadway		3	3										0.5	1	1		0.5	4	4	4	0
5.3	Determine Need for Turn Lanes		3	4										0.5	2	1		0.5	5	5	5	0
5.4	Determine Signage on Roadway		1	2	2									1	1			1	2	2	2	2
6.0	Roadway Design																	12.5	18	21	1	35
6.1	Determine Design Vehicle and Design Speed			1	2	0.5												0.5	0	1	1	2
6.2	Determine Horizontal Alignment		8	6	8	1				1			1					3	8	6	6	6
6.3	Determine Vertical Alignment		5	7	6	1				1			1					3	5	7	7	6
6.4	Structural Section	1						14		1								2	0	0	0	14
6.5	Typical Cross-Section			1				1			1				1			0	0	0	4	0
6.6	Determine Roadway Drainage					0.5					1	1	2					0.5	1	1	1	2
6.7	Pavement Marking/Striping Layout	0.5	1							1	1	2						0.5	2	2	2	0
6.8	Select Horizontal and Vertical Alignment	1	2				1	3		1	1	2		1				3	3	2	1	3
7.0	Site Design																	3	5	8	10	10
7.1	Determine Cut/Fill		2			1				1				1	4	4		2	3	4	4	4
7.2	Determine Site Grading	0.5				1					1				4	4		4	4	4	4	4
7.3	Utility Corridor Design					0.5									2			0.5	0	0	0	2
8.0	Create a Plan Set																	8	14	45	2	34
8.1	Plan Set Border/Template									0.5				2	2			0.5	2	2	2	0
8.2	Cover Page														2	2		0	0	1	2	0
8.3	Estimated Quantities/EOPC		1	1						0.5								0.5	1	1	1	0
8.4	Note Sheet					0.5									3	2		0.5	0	3	2	0
8.5	Proposed Cross-Section/Typical Cross-Section						2			0.5								0.5	0	2	0	0
8.6	Existing Site Conditions and Removals	0.5												1	1			0.5	1	1	1	0
8.6.1	Topographic Data					0.5									3			0.5	0	3	0	0
8.6.2	Existing Landmarks from Aerial Imagery									0.5	2				1	4		0.5	0	1	4	4
8.7	Proposed Improvements (Plan and Profile)	2	2			1	2			1	2			4	24	16		4	10	24	16	16
8.8	Plan Details			2	2		4	4		0.5			4					0.5	0	6	0	10
9.0	Impact Analysis	4	4									5						4	4	5	0	0
10.0	Project Management																	24	15	9	3	6
10.1	Meetings	4				2				1	3	2	1	1	2	1	1	8	5	3	2	2
10.2	Schedule Management	8	2				3	1	1		1	1	1					8	5	3	2	2
10.3	Resource Management	4				2	2			1	2	2	1	1	1	1	1	8	5	3	2	2
11.0	Deliverables																	32	20	16	16	16
11.1	30% Deliverables	2				5	1	2	1		2	1	2	1	1	1	1	8	4	4	4	4
11.2	60% Deliverables	1		2	1	6	2	1	2	1	2	2	1					8	4	4	4	4
11.3	90% Deliverables	2			1	3	4	1	2	2	3	2	1	1	1	1	1	8	8	4	4	4
11.4	Final Deliverables	2				2	4	1	2	2	4	2	4	4	2	4	4	8	4	4	4	4
Total		38	37	31	35	32.5	24	29	49	19.5	24	48	39	13	19	58	51	103	104	166	174	174

Spencer = 141

Janelle = 134.5

Orlando = 130.5

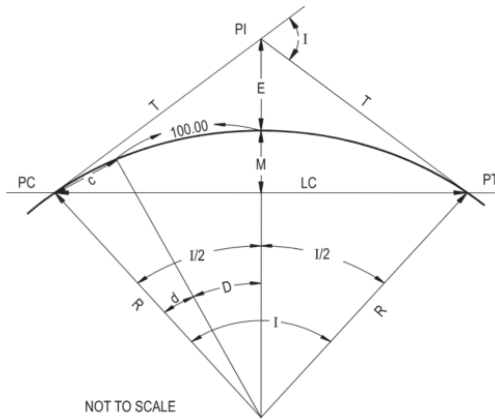
Lauren = 141

Task #	Task Name	Sr Engr.	Engr.	Tech	Intern	Subtotal
1.0	Acquire Existing Site Information	3	0	7	27	37
2.0	Site Investigation	8	4	8	4	24
3.0	Hydrologic Analysis	5.5	4	22	23	54.5
4.0	Hydraulic Analysis	1	6	9	9	25
5.0	Traffic Analysis	2	14	16	30	42
6.0	Roadway Design	12.5	18	21	35	86.5
7.0	Site Design	3	5	8	30	26
8.0	Create a Plan Set	8	14	45	34	101
9.0	Impact Analysis	4	4	5	0	13
10.0	Project Management	24	15	9	6	54
11.0	Deliverables	32	20	16	16	84
Total Project Hours		103	104	166	174	547

L0 Personnel	Classification	Hours	Rate, \$/hr	Cost
	SENG	107	\$162	\$16,648
	ENG	104	\$127	\$13,208
	TECH	166	\$100	\$16,600
	INT	174	\$84	\$14,596
	Total personnel			\$60,052
L0 Software	Software	300	\$10	\$3,000
L0 Total				\$66,648

Horizontal Curve Calculations

	Horiz Curve 1	Horiz Curve 2
LC	678.01	1622.52
I (degree)	16.93	87.27
I (radian)	0.30	1.52
PC	1978.48	5246.67
PT	2659.58	7026.26
R	2303.02	1175.65
e min (%)	3.60	5.20
f for 45mph	0.15	
D	2.49	4.87
Lr	86.40	124.80
Lt	28.80	41.60
PI	2317.49	6057.93



$$R = \frac{5729.58}{D}$$

$$R = \frac{LC}{2 \sin(I/2)}$$

$$T = R \tan(I/2) = \frac{LC}{2 \cos(I/2)}$$

$$L = RI \frac{\pi}{180} = \frac{I}{D} 100$$

$$M = R[1 - \cos(I/2)]$$

$$\frac{R}{E + R} = \cos(I/2)$$

$$\frac{R - M}{R} = \cos(I/2)$$

$$c = 2R \sin(d/2)$$

$$l = Rd \left(\frac{\pi}{180} \right)$$

$$E = R \left[\frac{1}{\cos(I/2)} - 1 \right]$$

Minimum Radius

Rmin

643

Table 3-7. Minimum Radius Using Limiting Value

U.S. Customary					
Design Speed (mph)	Maximum e (%)	Maximum f	Total (e/100 + f)	Calculated Radius (ft)	Rounded Radius (ft)
10	4.0	0.38	0.42	15.9	16
15	4.0	0.32	0.36	41.7	42
20	4.0	0.27	0.31	86.0	86
25	4.0	0.23	0.27	154.3	154
30	4.0	0.20	0.24	250.0	250
35	4.0	0.18	0.22	371.2	371
40	4.0	0.16	0.20	533.3	533
45	4.0	0.15	0.19	710.5	711
50	4.0	0.14	0.18	925.9	926
55	4.0	0.13	0.17	1186.3	1190
60	4.0	0.12	0.16	1500.0	1500
10	6.0	0.38	0.44	15.2	15
15	6.0	0.32	0.38	39.5	39
20	6.0	0.27	0.33	80.8	81
25	6.0	0.23	0.29	143.7	144
30	6.0	0.20	0.26	230.8	231
35	6.0	0.18	0.24	340.3	340
40	6.0	0.16	0.22	484.8	485
45	6.0	0.15	0.21	642.9	643
50	6.0	0.14	0.20	833.3	833
55	6.0	0.13	0.19	1061.4	1060
60	6.0	0.12	0.18	1333.3	1330
65	6.0	0.11	0.17	1656.9	1660
70	6.0	0.10	0.16	2041.7	2040
75	6.0	0.09	0.15	2500.0	2500
80	6.0	0.08	0.14	3047.6	3050

Appendix J: Vertical Curve Calculations

Vertical Curve Calculations

Curve Number	Ex Grade	Station	Elevation	Point Type	Elev High Point with min grade 0.5%	Slope (foreslope)	Max Slope? (10%)	Min Slope? (0.5%)	cut/fill	Curve	A	L (sag)	L (crest, S<L)	L (crest, S>L)	Min L (K*A)	Design L
	7150.83	0.00	7150.83	Start		0.00			0.00	Break	0.01		45.31	-2157.33	46.03	46.00
1.00	7150.85	110.00	7150.00	Culvert 1		-0.01	GOOD	GOOD	-0.85	Sag	0.01	54.63			99.11	99.00
2.00	7160.00	349.58	7151.20	Watershed 1-2	7151.20	0.01	GOOD	GOOD	-8.80	Crest	0.03		160.68	-85.22	163.21	163.00
3.00	7146.08	600.00	7145.75	Insert		-0.02	GOOD	GOOD	-0.33	Sag	0.03	116.52			211.37	211.00
4.00	7134.02	2500.00	7136.25	Culvert 2	7136.25	-0.01	GOOD	GOOD	2.23	Sag	0.01	43.55			79.00	79.00
5.00	7145.54	4500.00	7146.25	Insert	7146.25	0.01	GOOD	GOOD	0.71	Sag	0.02	101.00			183.22	183.00
6.00	7154.00	4926.00	7154.00	Watershed 3-4		0.02	GOOD	GOOD	0.00	Crest	0.04		232.66	162.38	236.32	236.00
	7146.00	5729.00	7137.50	Culvert 3	7149.99	-0.02	GOOD	GOOD		Sag	0.02	89.48			162.33	162.00
7.00	7146.00	5729.00	7137.50	Watershed 4-5	7137.50	0.00			-8.50	Sag	0.01	22.80			41.36	41.00
	7144.29	7026.00	7144.29	End		0.01	GOOD	GOOD	0.00	Break	0.01		31.44	-3430.00	31.93	32.00

Vertical Curves

$$y = ax^2$$

$$A = |g_2 - g_1| \times 100$$

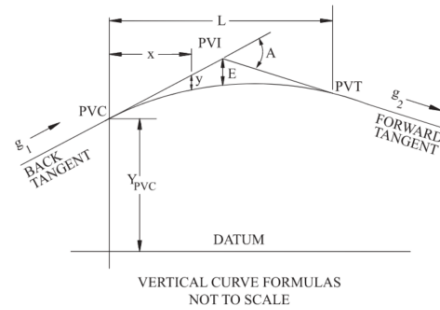
$$a = \frac{g_2 - g_1}{2L}$$

$$E = a \left(\frac{L}{2}\right)^2$$

$$r = \frac{g_2 - g_1}{L}$$

$$K = \frac{L}{A}$$

$$x_m = -\frac{g_1}{2a} = \frac{g_1 L}{g_1 - g_2}$$



Source: Compiled from AASHTO, *A Policy on Geometric Design of Highways and Streets*, 6th ed., 2011.

$$\text{Tangent elevation} = Y_{PVC} + g_1 x = Y_{PVI} + g_2 (x - L/2)$$

$$\text{Curve elevation} = Y_{PVC} + g_1 x + ax^2 = Y_{PVC} + g_1 x + [(g_2 - g_1)/(2L)]x^2$$

$$elev_{PVC} = elev_{PVI} - G_1 \left(\frac{L}{2}\right)$$

Elevations of PVC/PVT for crest curves (G in decimal form)

$$elev_{PVT} = elev_{PVI} + G_2 \left(\frac{L}{2}\right)$$

Crest Curve Length Formulas

U.S. Customary	Metric
When S is less than L , $L = \frac{AS^2}{2158}$	When S is less than L , $L = \frac{AS^2}{658}$ (3-44)
When S is greater than L , $L = 2S - \frac{2158}{A}$	When S is greater than L , $L = 2S - \frac{658}{A}$ (3-45)

Table 3-35. Design Controls for Crest Vertical C

U.S. Customary			
Design Speed (mph)	Stopping Sight Distance (ft)	Rate of Vertical Curvature, K_a	
		Calculated	Design
15	80	3.0	3
20	115	6.1	7
25	155	11.1	12
30	200	18.5	19
35	250	29.0	29
40	305	43.1	44
45	360	60.1	61
50	425	83.7	84
55	495	113.5	114
60	570	150.6	151
65	645	192.8	193
70	730	246.9	247
75	820	311.6	312
80	910	383.7	384

Sag Curve Length Formulas

U.S. Customary	Metric
$L = \frac{AV^2}{46.5}$	$L = \frac{AV^2}{395}$ (3-52)
where: L = length of sag vertical curve, ft A = algebraic difference in grades, percent V = design speed, mph	where: L = length of sag vertical curve, m A = algebraic difference in grades, percent V = design speed, km/h

Table 3-37. Design Controls for Sag Vertical Cur

U.S. Customary			
Design Speed (mph)	Stopping Sight Distance (ft)	Rate of Vertical Curvature, K^s	
		Calculated	Design
15	80	9.4	10
20	115	16.5	17
25	155	25.5	26
30	200	36.4	37
35	250	49.0	49
40	305	63.4	64
45	360	78.1	79
50	425	95.7	96
55	495	114.9	115
60	570	135.7	136
65	645	156.5	157
70	730	180.3	181
75	820	205.6	206
80	910	231.0	231

Appendix K: ESAL's Calculations

Design ESAL Calculation Worksheet

TRACS: -		Project No.: 1				Project Name: Belmont Alignment ViaNova		
Route: Primary		BMP: -		Design Life (years): 40.0		Functional Class: Rural Minor Collector		
		EMP: -		Growth Rate (%): 2.0		Pavement Type: Flexible	Cluster Number: 2	

				Truck Volumes		Percent Trucks				TTC
AA DT	2025	5,662	Data Year	Singles	Combos	(% of total AADT)		(% of total AADTT)		
AA DT	2025	5,662	Build Year	200	154	Singles	Combos	Singles	Combos	AZ-6
						3.53%	2.72%	56%	44%	
						Select appropriate TTC from Table A-1 using % Combos above				

Vehicle Class	1 - 3	4	5	6	7	8	9	10	11	12	13		Total
Distribution (%)	N/A	7.8	65.8	4.4	0.2	11.7	9.1	0.7	0.2	0	0.1		100
Class Volume (daily)	5,308	28	233	16	1	41	32	2	1	0	0		5,662
Growth Factor (G)	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4		
Class Volume (total)	117,024,010	608,754	5,135,387	343,400	15,609	913,131	710,213	54,632	15,609	0	7,805		
Truck Load Factor (TLF)	0.0008	1.26	0.36	1.31	0.85	1	1.96	2.46	1.9	1.19	5.74		
Class ESAL's	93,619	767,030	1,848,739	449,854	13,268	913,131	1,392,018	134,394	29,657	0	44,798		5,686,509
												Total Number of Trucks	7,804,540
												Directional Distribution Factor (D _a)	0.5
												Lane Distribution Factor (D _l)	1
												Design ESAL's	2,843,254

AZ-4	N/A	5.3	38.6	6.2	0.2	9	36.9	1.8	1.3	0.3	0.4		
AZ-5		5.3	46.3	5.7	0.7	16.1	24.1	1.1	0.3	0.1	0.3		
AZ-6		7.8	65.8	4.4	0.2	11.7	9.1	0.7	0.2	0	0.1		

Appendix L: Structural Number Calculations

Appendix L-1: Alternative #1 Structural Section

AASHTO FLEXIBLE PAVEMENT DESIGN
Layer Thickness Determination Using Trial and Error

	Layer No.	Description	Layer Coefficient, ai	Drainage Coefficient, mi	Layer Thickness, in	SN
(topmost)	Layer 1	AC	0.44	1.00	4.50	1.98
	Layer 2	ABC	0.14	0.85	12.00	1.43
	Layer 3	Subgrade	0.11	0.64	12.00	0.84
	Layer 4					0.00
	Layer 5					0.00
	Layer 6					0.00
	Layer 7					0.00
(bottommost)	Layer 8					0.00
	Subgrade	Subgrade	N/A	N/A	N/A	N/A

Trial SN	4.25
----------	------

Design SN to Match 4.23

Design is sufficient

Appendix L-2: Alternative #2 Structural Section

AASHTO FLEXIBLE PAVEMENT DESIGN
Layer Thickness Determination Using Trial and Error

	Layer No.	Description	Layer Coefficient, ai	Drainage Coefficient, mi	Layer Thickness, in	SN
(topmost)	Layer 1	AC	0.44	1.00	4.50	1.98
	Layer 2	ABC	0.14	0.85	2.00	0.24
	Layer 3	CTB	0.24	0.85	6.00	1.22
	Layer 4	Subgrade	0.11	0.64	12.00	0.84
	Layer 5					0.00
	Layer 6					0.00
	Layer 7					0.00
(bottommost)	Layer 8					0.00
	Subgrade	Subgrade	N/A	N/A	N/A	N/A

Trial SN	4.29
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Design SN to Match 4.23

Design is sufficient

Appendix M: Level of Service Calculations

Northbound Peak LOS (Afternoon)		Southbound Peak LOS (Morning)	
V	281	V	343
PHF	0.85	PHF	0.85
N	1	N	1
Vp	350.424	Vp	427.74
S	45	S	45
D	7.79	D	9.51
LOS	A	LOS	B

Heavy Vehicle Factor	
Pt	0.06
Et	2
fHV	0.94

Level of Service (LOS)	Density (pc/mi/ln)
A	≤11
B	>11 – 18
C	>18 – 26
D	>26 – 35
E	>35 – 45
F	Demand exceeds capacity >45

Appendix N: Roadway Rational Method Calculations

Culvert	Rational Method		
	Variable	Value	Units
Culvert 1	Area, (A)	0.14	Acres
	Time of Concentration, (Tc)	10.00	Minutes
	Average Rainfall Intensity, (i)	6.20	Inches/Hour
	Runoff Coefficient, (C)	0.95	N/A
	Flow, (Q)	0.85	ft ³ /s

Culvert	Time of Concentration Iteration		
	Variable	Value	Units
Culvert 1+10	Length of Longest Flow Path, (L)	0.045	Miles
	Watershed Resistance Coefficient, (Kb)	0.02	N/A
	Elevation #1	7151.2	ft
	Elevation #2	7150	ft
	Slope of Longest Flow Path, (S)	26.45	ft/mile
	Initial Time of Concentration, (Tc')	3	Minutes
	Initial Rainfall Intensity, (i')	11.41	Inches/Hour
	Final Time of Concentration, (Tc)	2.74	Minutes
	Final Rainfall Intensity, (i)	12.62	Inches/Hour

Default to a time of concentration of 10 minutes since the final time of concentration is less than 10 minutes

Culvert	Rational Method		
	Variable	Value	Units
Culvert 2	Area, (A)	1.89	Acres
	Time of Concentration, (Tc)	10.00	Minutes
	Average Rainfall Intensity, (i)	6.21	Inches/Hour
	Runoff Coefficient, (C)	0.95	N/A
	Flow, (Q)	11.16	ft ³ /s

Culvert	Time of Concentration Iteration		
	Variable	Value	Units
Culvert 25+00	Length of Longest Flow Path, (L)	0.459	Miles
	Watershed Resistance Coefficient, (Kb)	0.02	N/A
	Elevation #1	7154	ft
	Elevation #2	7136.25	ft
	Slope of Longest Flow Path, (S)	38.63	ft/mile
	Initial Time of Concentration, (Tc')	10	Minutes
	Initial Rainfall Intensity, (i')	6.21	Inches/Hour
	Final Time of Concentration, (Tc)	9.76	Minutes
	Final Rainfall Intensity, (i)	6.30	Inches/Hour

Default to a time of concentration of 10 minutes since the final time of concentration is less than 10 minutes

Culvert	Rational Method		
	Variable	Value	Units
Culvert 3	Area, (A)	0.87	Acres
	Time of Concentration, (Tc)	10.00	Minutes
	Average Rainfall Intensity, (i)	6.23	Inches/Hour
	Runoff Coefficient, (C)	0.95	N/A
	Flow, (Q)	5.14	ft ³ /s

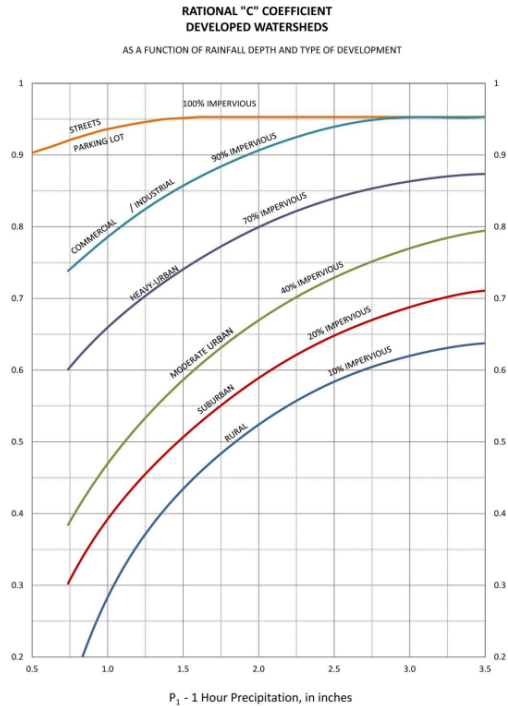
Culvert	Time of Concentration Iteration		
	Variable	Value	Units
Culvert 1+10	Length of Longest Flow Path, (L)	0.246	Miles
	Watershed Resistance Coefficient, (Kb)	0.02	N/A
	Elevation #1	7144.29	ft
	Elevation #2	7137.5	ft
	Slope of Longest Flow Path, (S)	27.64	ft/mile
	Initial Time of Concentration, (Tc')	8	Minutes
	Initial Rainfall Intensity, (i')	7.02	Inches/Hour
	Final Time of Concentration, (Tc)	7.56	Minutes
	Final Rainfall Intensity, (i)	7.19	Inches/Hour

Default to a time of concentration of 10 minutes since the final time of concentration is less than 10 minutes

Table 2-1 Resistance Coefficient (K_b) For Use With The Rational Method T_c Equation

Description of Landform	K _b	
	Defined Drainage Network	Overland Flow Only
Mountain, with forest and dense ground cover (average slopes – 50% or greater)	0.15	0.30
Mountain, with rough rock and boulder cover (average slopes – 50% or greater)	0.12	0.25
Foothills (average slopes – 10% to 50%)	0.10	0.20
Alluvial fans, Pediments and Rangelands (average slopes – 10% or less)	0.05	0.10
Irrigation Pastures ^a	-	0.20
Tilled Agricultural Fields ^a	-	0.08
URBAN		
Residential, L is less than 1,000 ft ^b	0.04	
Residential, L is greater than 1,000 ft ^b	0.025	
Grass; parks, cemeteries, etc. ^a	-	0.20
Bare ground; playgrounds, etc. ^a	-	0.08
Paved; parking lots, etc. ^a	-	0.02

Notes: a – No defined drainage network.
b – L is length in T_c equation. Streets serve as drainage network.



Appendix O: V-Ditch Calculations

Channel #1	
Actual Flow	0.85 ft ³ /s
Manning's N Value	0.025 Earth Channel w Grass/Weeds
Slope	0.75% ft/ft
Side Slope	3.00 ft
Initial Depth Guess	0.41 ft
Area	0.49 ft ²
Wetted Perimeter	2.57 ft
Hydraulic Radius	0.19 ft
Manning Flow	0.85 ft ³ /s
Freeboard (1' Min)	1.59 ft
Actual Velocity	1.72 ft/s

Channel #2	
Actual Flow	0.85 ft ³ /s
Manning's N Value	0.025 Earth Channel w Grass/Weeds
Slope	0.50% ft/ft
Side Slope	3.00 ft
Initial Depth Guess	0.44 ft
Area	0.57 ft ²
Wetted Perimeter	2.77 ft
Hydraulic Radius	0.21 ft
Manning Flow	0.85 ft ³ /s
Freeboard (1' Min)	1.56 ft
Actual Velocity	1.48 ft/s

Channel #3	
Actual Flow	11.16 ft ³ /s
Manning's N Value	0.025 Earth Channel w Grass/Weeds
Slope	2.18% ft/ft
Side Slope	3.00 ft
Initial Depth Guess	0.87 ft
Area	2.28 ft ²
Wetted Perimeter	5.52 ft
Hydraulic Radius	0.414 ft
Manning Flow	11.16 ft ³ /s
Freeboard (1' Min)	1.13 ft
Actual Velocity	4.89 ft/s

Channel #4	
Actual Flow	11.16 ft ³ /s
Manning's N Value	0.025 Earth Channel w Grass/Weeds
Slope	0.50% ft/ft
Side Slope	3.00 ft
Initial Depth Guess	1.15 ft
Area	3.97 ft ²
Wetted Perimeter	7.27 ft
Hydraulic Radius	0.545 ft
Manning Flow	11.16 ft ³ /s
Freeboard (1' Min)	1.00 ft
Actual Velocity	2.81 ft/s

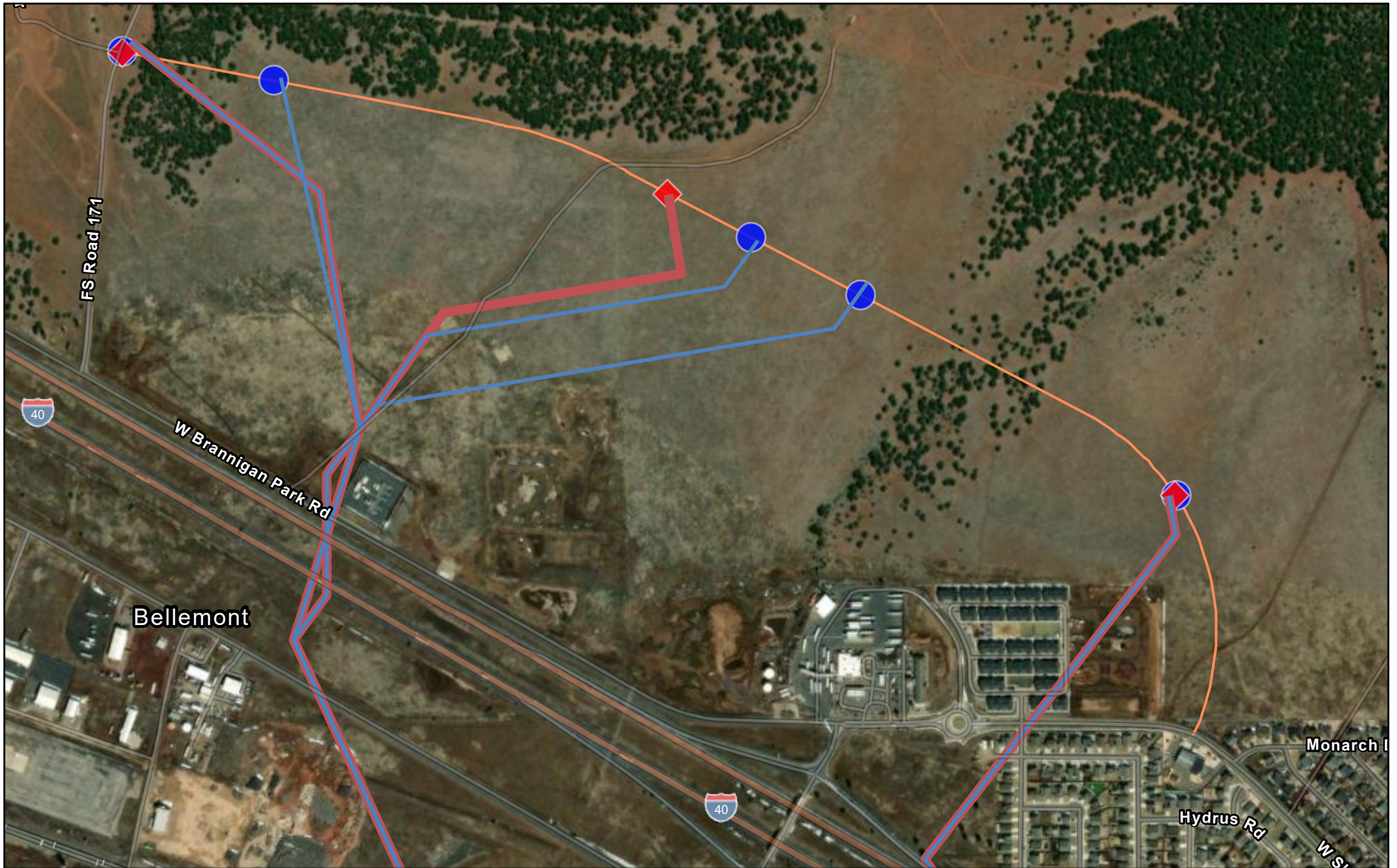
Channel #5	
Actual Flow	11.16 ft ³ /s
Manning's N Value	0.025 Earth Channel w Grass/Weeds
Slope	0.50% ft/ft
Side Slope	3.00 ft
Initial Depth Guess	1.15 ft
Area	3.97 ft ²
Wetted Perimeter	7.27 ft
Hydraulic Radius	0.545 ft
Manning Flow	11.16 ft ³ /s
Freeboard (1' Min)	1.00 ft
Actual Velocity	2.81 ft/s

Channel #6	
Actual Flow	5.14 ft ³ /s
Manning's N Value	0.025 Earth Channel w Grass/Weeds
Slope	2.05% ft/ft
Side Slope	3.00 ft
Initial Depth Guess	0.66 ft
Area	1.31 ft ²
Wetted Perimeter	4.17 ft
Hydraulic Radius	0.313 ft
Manning Flow	5.14 ft ³ /s
Freeboard (1' Min)	1.34 ft
Actual Velocity	3.93 ft/s

Channel #7	
Actual Flow	5.14 ft ³ /s
Manning's N Value	0.025 Earth Channel w Grass/Weeds
Slope	0.52% ft/ft
Side Slope	3.00 ft
Initial Depth Guess	0.85 ft
Area	2.19 ft ²
Wetted Perimeter	5.40 ft
Hydraulic Radius	0.405 ft
Manning Flow	5.14 ft ³ /s
Freeboard (1' Min)	1.15 ft
Actual Velocity	2.35 ft/s

Appendix P: Downstream Flow Comparison

Existing and Proposed Downstream Flow



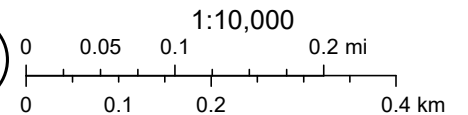
3/23/2026

- Existing Flow Crossing DS Flow
- Proposed Culvert DS Flow
- Existing Flow Crossing Points
- ◆ Proposed Culvert Locations

Low Resolution 15m Imagery

High Resolution 60cm Imagery
High Resolution 30cm Imagery

Citations
2.4m Resolution Metadata



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community, Vantor

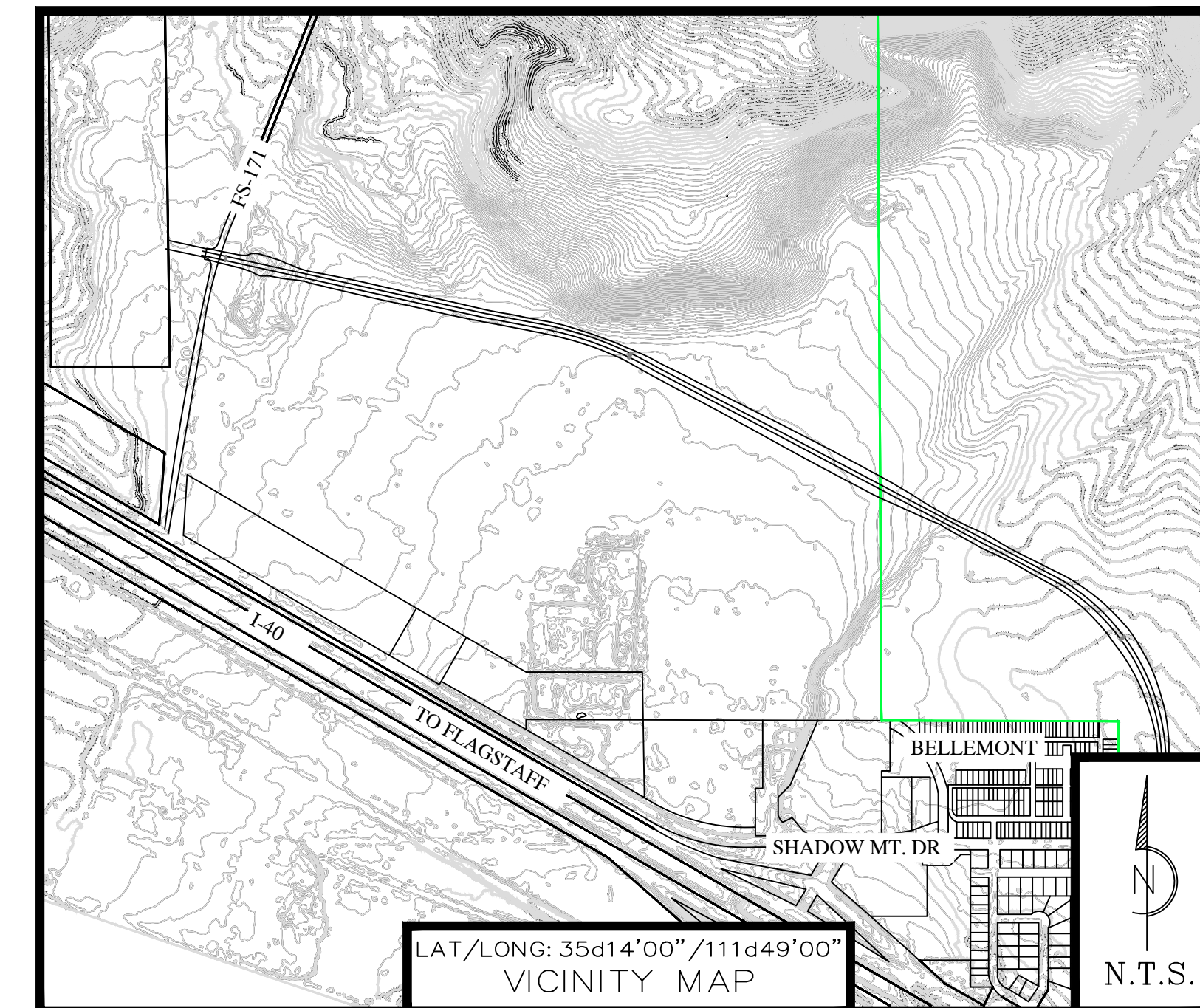
Spencer Huttenmeyer

Appendix Q: Plan Set

ROADWAY PLAN
BELLEFONT ALIGNMENT
APN 203-47-005
FLAGSTAFF, ARIZONA 86001

PROJECT INFORMATION

DEVELOPMENT NAME: BELLEFONT ALIGNMENT
 SITE ADDRESS: FLAGSTAFF, AZ 86001
 PROPERTY OWNER'S INFORMATION: UNITED STATES OF AMERICA
 333 BROADWAY BLVD SE
 ALBUQUERQUE, NM 87102
 DEVELOPER'S CONTACT INFORMATION: SAME AS PROPERTY OWNER
 PREPARER'S CONTACT INFORMATION: VIANOVA ENGINEERING
 LAUREN TOWNER
 2122 S HUFFER LN
 FLAGSTAFF, AZ 86001
 DATE PREPARED: APRIL 12TH, 2026



SURVEY PROVIDED BY:
 COCONINO COUNTY LIDAR DATA: 2019
 110 E CHERRY LN,
 FLAGSTAFF, AZ, 86001
 PHN: (928) 679-7962

SHEET INDEX

- C1 COVER SHEET & GENERAL NOTES
- C2 SITE PLAN & PROFILE
- C3 PLAN & PROFILE
- C4 PLAN & PROFILE
- C5 PLAN & PROFILE
- C6 PLAN & PROFILE
- C7 PLAN & PROFILE
- C8 PLAN & PROFILE
- C9 PLAN & PROFILE
- C10 PLAN & PROFILE
- C11 INTERSECTION DESIGN
- C12 STANDARD DETAILS
- C13 CONTROL POINT

UTILITY ACKNOWLEDGMENTS

ARIZONA PUBLIC SERVICE	APPROVED BY XXXXXX	XX/XX/202X
UNISOURCE GAS	APPROVED BY XXXXXX	XX/XX/202X
CENTURY LINK	APPROVED BY XXXXXX	XX/XX/202X
SUDDENLINK	APPROVED BY XXXXXX	XX/XX/202X

COCONINO COUNTY APPROVAL

CONCEPT APPROVAL
 THE COUNTY APPROVES THESE PLANS FOR CONCEPT ONLY. ALL LIABILITY RESULTING FROM ERRORS OR OMISSIONS IS THE RESPONSIBILITY OF THE PERMITTEE AND/OR HIS CONSULTANTS AND EMPLOYEES. COCONINO COUNTY DOES NOT VERIFY OR GUARANTEE THE MEASUREMENTS, CALCULATIONS, OWNERSHIP OR CONCLUSIONS INDICATED BY THE CREATOR OF THESE PLANS

COCONINO COUNTY COMMUNITY DEVELOPMENT

ENGINEERING SUPERVISOR _____ DATE _____

COCONINO COUNTY PUBLIC WORKS

COUNTY ENGINEER _____ DATE _____

BELLEFONT DEPARTMENT

FIRE CHIEF _____ DATE _____

COCONINO COUNTY GENERAL NOTES

1. APPROVAL OF THESE PLANS BY THE COUNTY ENGINEER IS FOR A ONE-YEAR PERIOD, SUBSEQUENT TO THE DATE OF APPROVAL. IF CONSTRUCTION WORK IS NOT STARTED WITHIN THE ONE-YEAR PERIOD, OR HAS BEEN DISCONTINUED FOR ANY REASON FOR LONGER THAN ONE YEAR, THE PLANS SHALL BE RESUBMITTED FOR REVIEW AND RE-APPROVAL.
2. PLAN REVIEW BY THE COUNTY DOES NOT EXTEND TO MATERIAL SPECIFICATIONS SHOWN ON THE PLANS.
3. AN ENCROACHMENT PERMIT, ISSUED BY THE COMMUNITY DEVELOPMENT DEPARTMENT IS REQUIRED FOR ALL WORK IN COUNTY RIGHTS-OF-WAY OR EASEMENTS. FOR CONSTRUCTION OF ANY IMPROVEMENTS A GRADING PERMIT WILL BE REQUIRED.
4. THE COUNTY SHALL BE NOTIFIED FORTY-EIGHT (48) HOURS PRIOR TO BEGINNING DIFFERENT PHASES OF CONSTRUCTION SO THAT COUNTY INSPECTORS MAY BE SCHEDULED.
5. FOR CONSTRUCTION PURPOSES, THE FOLLOWING PRECEDENCE OF STANDARDS WILL PREVAIL: CURRENT COCONINO COUNTY PUBLIC WORKS ENGINEERING DEPARTMENT STANDARDS; CURRENT INTERNATIONAL BUILDING CODE (IBC); PROJECT SPECIFIC PLANS AND SPECIFICATIONS; ADOT STANDARDS; AND MAG STANDARDS — OR OTHER SPECIFICATIONS APPROVED BY THE COUNTY ENGINEER AND WITH GENERALLY ACCEPTED GOOD CONSTRUCTION PRACTICE. ALL WORK AND MATERIALS WHICH DO NOT CONFORM TO THE STANDARDS AND SPECIFICATIONS ARE SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.
6. ANY WORK PERFORMED WITHOUT THE KNOWLEDGE AND APPROVAL OF THE COUNTY ENGINEER OR HIS AUTHORIZED REPRESENTATIVE, IS SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.
7. THE COUNTY ENGINEER OR AUTHORIZED REPRESENTATIVE MAY SUSPEND THE WORK BY WRITTEN NOTICE WHEN, IN THEIR JUDGMENT, PROGRESS IS UNSATISFACTORY, WORK BEING DONE IS UNAUTHORIZED OR DEFECTIVE, WEATHER CONDITIONS ARE UNSUITABLE, OR THERE IS DANGER TO THE PUBLIC HEALTH OR SAFETY.
8. THE COUNTY ENGINEER MAY ORDER ANY OR ALL MATERIALS USED IN THE WORK TO BE TESTED ACCORDING TO THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) AND THE AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS. THE CONTRACTOR SHALL, AT THEIR EXPENSE, HIRE A QUALIFIED TESTING LABORATORY TO PERFORM QUALITY CONTROL (QC) DURING ALL PHASES OF CONSTRUCTION, AS STATED IN COCONINO COUNTY STANDARDS, OR AS DIRECTED IN THE SPECIAL PROVISIONS.
9. LOCAL FIRE DEPARTMENT, COUNTY ENGINEERING DIVISION AND OTHER EMERGENCY RESPONDER'S APPROVAL IS REQUIRED FOR OBSTRUCTION OF ACCESS OR WATER SYSTEM SHUTDOWN - SUBMISSION OF TRAFFIC CONTROL PLANS ARE REQUIRED.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTENANCE OF THE STREETS AND OF PARTIALLY COMPLETED PORTIONS OF THE WORK UNTIL FINAL ACCEPTANCE OF THE WORK. ANY ROADS REQUIRED TO BE CLOSED FOR THE CONSTRUCTION ACTIVITY SHALL BE REOPENED WITHIN A REASONABLE TIME OR UPON ORDER OF COUNTY ENGINEER. THE REGULATION AND CONTROL OF THIS TRAFFIC SHALL BE AS DIRECTED BY THE COUNTY ENGINEER OR HIS AUTHORIZED REPRESENTATIVE.
11. APPROVAL OF A PORTION OF THE WORK IN PROGRESS DOES NOT GUARANTEE ITS FINAL ACCEPTANCE. TESTING AND EVALUATION MAY CONTINUE UNTIL WRITTEN FINAL ACCEPTANCE OF A COMPLETE WORKABLE UNIT. ANY DEFECTS WHICH APPEAR IN THE WORK WITHIN ONE YEAR FROM THE DATE OF ACCEPTANCE AND WHICH ARE DUE TO IMPROPER WORKMANSHIP OR INFERIOR MATERIALS SUPPLIED SHALL BE CORRECTED BY OR AT THE EXPENSE OF THE OWNER/DEVELOPER OR THE CONTRACTOR.
12. ACCEPTANCE OF COMPLETED PUBLIC IMPROVEMENTS WILL NOT BE GIVEN UNTIL DEFECTIVE OR UNAUTHORIZED WORK IS REMOVED, AND FINAL CLEAN-UP IS COMPLETE.
13. LOCATION OF UNDERGROUND UTILITIES BEFORE WORK IS BEGUN IS TO BE ACCOMPLISHED IN ACCORDANCE WITH ARS 40-361-22.
14. IF WORK IS DONE ON PRIVATE PROPERTY IN RELATION TO A PROJECT CONSTRUCTED UNDER THESE STANDARDS, THE CONTRACTOR WILL PROVIDE THE COUNTY WITH WRITTEN AUTHORIZATION FROM THE PROPERTY OWNER TO DO SO.
15. THE ESTABLISHMENT AND USE OF TEMPORARY CONSTRUCTION YARDS SHALL REQUIRE WRITTEN AUTHORIZATION FROM THE COUNTY PUBLIC WORKS DEPARTMENT.
16. COUNTY APPROVAL OF THESE PLANS IS FOR CONCEPT ONLY. ALL LIABILITY RESULTING FROM ERRORS OR OMISSIONS IS THE RESPONSIBILITY OF THE PERMITTEE AND/OR HIS CONSULTANTS AND EMPLOYEES. COCONINO COUNTY DOES NOT VERIFY OR GUARANTEE THE MEASUREMENTS, CALCULATIONS, OWNERSHIP, OR CONCLUSIONS INDICATED BY THE CREATOR OF THESE PLANS

COCONINO COUNTY PAVING NOTES

- ALL PAVING SHALL BE PERFORMED IN ACCORDANCE WITH COCONINO COUNTY PW ENGINEERING DEPARTMENT PAVING STANDARDS
1. EXACT POINT OF MATCHING TERMINATION AND OVERLAY, IF NECESSARY, SHALL BE DETERMINED IN THE FIELD BY THE COUNTY ENGINEER OR HIS AUTHORIZED REPRESENTATIVE.
 2. NO JOB WILL BE CONSIDERED COMPLETE UNTIL:
 - 2.1. ALL CURBS, PAVEMENTS, SIDEWALKS, DITCHES, AND MANHOLES HAVE BEEN CLEANED OF ALL DIRT AND DEBRIS.
 - 2.2. SURVEY MONUMENTS ARE INSTALLED AND STAMPED.
 - 2.3. ALL FRAMES, COVERS, AND VALVE BOXES ARE ADJUSTED TO GRADE.
 3. NO PAVING CONSTRUCTION SHALL BE STARTED UNTIL ALL UTILITY LINES UNDER PROPOSED PAVED AREA ARE COMPLETED AND APPROVED.
 4. ASPHALT SHALL NOT BE PLACED BEFORE BASE COURSE HAS BEEN APPROVED AND BASE COURSE WILL NOT BE PLACED UNTIL SUBGRADE HAS BEEN APPROVED BY THE COUNTY ENGINEER OR HIS AUTHORIZED REPRESENTATIVE.
 5. THE LOCATION OF ALL WATER VALVES, FIRE HYDRANTS, AND MANHOLES MUST AT ALL TIMES DURING CONSTRUCTION BE REFERENCED AND MADE ACCESSIBLE TO THE COUNTY.
 6. UTILITY FACILITIES IN CONFLICT WITH THIS WORK WILL BE RELOCATED BY THE PERMITTEE OR THE UTILITY OWNER. THIS ACTIVITY SHALL BE COORDINATED WITH THE OWNER OF THE UTILITY TO PREVENT ANY UNNECESSARY INTERRUPTION OF SERVICE TO EXISTING CUSTOMERS.
 7. EXISTING STREET AND TRAFFIC SIGNS WILL BE MAINTAINED DURING CONSTRUCTION AND RELOCATED BY THE PERMITTEE AS DIRECTED BY THE COUNTY ENGINEER OR HIS AUTHORIZED REPRESENTATIVE.

VIANOVA INC. GENERAL NOTES

WORK SHALL BE DONE IN ACCORDANCE WITH THE MOST CURRENT EDITION(S) OF THE FOLLOWING SPECIFICATIONS AND THESE PLANS. MAG UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, MAG UNIFORM STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION, CITY OF FLAGSTAFF ENGINEERING DESIGN AND CONSTRUCTION STANDARDS WITH MAG ADDENDUM AS APPROPRIATE, ADEQ ENGINEERING BULLETINS NO. 8, 10, 11 AND 12, A.W.M.A. STANDARDS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (M.U.T.C.D.), A.D.O.T. STANDARD SPECIFICATIONS AND DRAWINGS.

IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN COPIES OF THE ABOVE STANDARDS, SPECIFICATIONS AND DETAILS, AS WELL AS ALL OTHER STANDARDS AND SPECIFICATIONS WHICH MAY BE NECESSARY TO COMPLETELY AND ACCURATELY INTERPRET THESE PLANS.

IN THE EVENT OF A CONFLICT BETWEEN CITY OF FLAGSTAFF ENGINEERING DESIGN AND CONSTRUCTION STANDARDS, MAG UNIFORM STANDARDS AND SPECIFICATIONS, AND ADEQ DESIGN STANDARDS, CITY OF FLAGSTAFF ENGINEERING DESIGN AND CONSTRUCTION STANDARDS SHALL GOVERN.

IN THE EVENT OF A CONFLICT BETWEEN CITY OF FLAGSTAFF DESIGN AND CONSTRUCTION STANDARDS AND THE CONSTRUCTION DOCUMENTS, CITY OF FLAGSTAFF DESIGN AND CONSTRUCTION STANDARDS SHALL GOVERN.

ALL QUANTITIES SHOWN ARE APPROXIMATE AND ARE FURNISHED SOLELY FOR THE CONTRACTOR'S CONVENIENCE. THEY DO NOT NECESSARILY CORRESPOND TO BID SCHEDULE ITEMS. PAYMENT WILL BE BASED ON BID SCHEDULE ITEMS THE CONTRACTOR SHALL NOT BE RELIEVED OF RESPONSIBILITY FOR INDEPENDENTLY ESTIMATED QUANTITIES PRIOR TO BIDDING.

THE LOCATION OF EXISTING FEATURES INDICATED ON THE PLANS ARE APPROXIMATE ONLY. THE CONTRACTOR SHALL NOT BE RELIEVED OF RESPONSIBILITY FOR MAKING COMPLETE AND ACCURATE ON-SITE DETERMINATIONS OF THE LOCATIONS OF ALL UTILITIES, STRUCTURES AND FIELD CONDITIONS, WHICH MAY AFFECT THE PROGRESS OF THE WORK.

THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING WHAT PERMITS WILL BE REQUIRED FOR THE WORK AND OBTAINING AT HIS OWN EXPENSE ALL PERMITS REQUIRED UNLESS STATED OTHERWISE IN THE CONTRACT.

UTILITY NOTES (VIANOVA NOTES)

UNDERGROUND UTILITY LOCATIONS SHOWN ON THESE PLANS WERE DETERMINED FROM FIELD MEASUREMENTS, CONSTRUCTION PLANS, RECORD PLANS, OR UTILITY MAPS FURNISHED BY OTHERS. LOCATIONS OF UNDERGROUND UTILITIES ARE TO BE REGARDED AS APPROXIMATE ONLY.

IT IS THE CONTRACTOR'S RESPONSIBILITY TO ESTABLISH IN THE FIELD THE ACTUAL LOCATIONS OF ALL UNDERGROUND LINES WHICH MAY IN ANY WAY AFFECT THE WORK.

IT IS NOT WITHIN THE SCOPE OF THE PLANS FOR THE ENGINEER TO LOCATE, IDENTIFY OR FORESEE EVERY UTILITY CONFLICT WHICH MAY ARISE DURING THE CONSTRUCTION PHASE OF THE PROJECT, BUT IT IS THE INTENT OF THE OWNER TO REASONABLY COMPENSATE THE CONTRACTOR FOR WORK REQUIRED TO RELOCATE OR ADJUST UTILITIES CONFLICTING WITH THE CONSTRUCTION OF THE PROJECT. TO THAT END, UTILITIES (AS DEFINED IN MAG 101.2) WHICH ARE ENCOUNTERED WILL BE ADDRESSED AS FOLLOWS:

COMPENSATION FOR UTILITY RELOCATIONS AND ADJUSTMENTS SHALL NOT INCLUDE COSTS FOR REPAIR TO THE UTILITY DAMAGED BY THE CONTRACTOR OR HIS SUBCONTRACTOR(S). THE CONTRACTOR IS NOT RELIEVED OF THE RESPONSIBILITY FOR DETERMINING THE LOCATION OF ALL UTILITIES AFFECTING THE WORK. FRANCHISE UTILITY COMPANIES SHALL BEAR THE COST OF REQUIRED RELOCATIONS WITHIN THE C.O.F. R.O.W.

THE APPROPRIATE UTILITY COMPANIES SHALL BE NOTIFIED BY THE CONTRACTOR PRIOR TO ANY CONSTRUCTION. "BLUE STAKE" NUMBER IS, "B11". THE CONTRACTOR SHALL ALLOW TWO WORKING DAYS AFTER "BLUE STAKE" IS NOTIFIED, BEFORE COMMENCING ANY EXCAVATION WORK IN THE PROXIMITY OF BURIED UTILITIES.

AT LEAST 48 HOURS PRIOR NOTICE IS REQUIRED BEFORE DISRUPTING EXISTING UTILITY SERVICE TO MAKE CONNECTIONS OR DISCONNECTIONS. THE NOTICE MUST INCLUDE THE EXACT TIME OF THE DISRUPTION OF SERVICE AND THE EXPECTED DURATION OF THE LOSS OF SERVICE.

CERTAIN UTILITIES ARE TO REMAIN IN SERVICE DURING THE CONSTRUCTION OF THE FILL AND UPON COMPLETION OF THIS CONTRACT, THESE UTILITIES SHALL BE PROTECTED DURING THE CONSTRUCTION AND CUT OR FILL PLACEMENT SHALL NOT PROHIBIT MAINTENANCE ACCESS TO THESE UTILITIES.

DRAINAGE MAINTENANCE DURING CONSTRUCTION (VIANOVA NOTES)

ADEQUATE DRAINAGE OF THE CONSTRUCTION AREA SHALL BE PROVIDED AT ALL TIMES. CONSTRUCTION DRAINS SHALL BE PROVIDED AS NEEDED TO ENABLE WATER TO DRAIN FROM THE CONSTRUCTION AREA RAPIDLY AND WITHOUT DAMAGING OF THE WORK IN PROGRESS. TO FURTHER PROMOTE GOOD DRAINAGE OF THE SITE, DRAINAGE CHANNELS, CULVERTS, AND STRUCTURES SHALL BE CONSTRUCTION FROM DOWN STREAM TO UPSTREAM IS SUCH A WAY THAT DURING CONSTRUCTION THEY DO NOT IMPEDE THE FLOW OF WATER FROM THE CONSTRUCTION AREA.

DAMAGE TO ADJACENT PROPERTIES OR TO ANY PORTION OF THE WORK CAUSED BY THE CONTRACTORS FAILURE TO PROVIDE ADEQUATE DRAINAGE OF THE CONSTRUCTION AREA OR TO ORDER THE WORK SO AS TO MINIMIZE THE POSSIBLE EXTENT OF SUCH DAMAGE SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE. NO EXTENSION OF TIME SHALL BE GRANTED ON ACCOUNT OF THE TIME REQUIRED TO MAKE SUCH REPAIRS.

GRADING AND DRAINAGE STATEMENT (VIANOVA NOTES)
 ADEQUATE DRAINAGE, EROSION AND SEDIMENT CONTROL MEASURES, BEST MANAGEMENT PRACTICES, AND/OR OTHER STORMWATER MANAGEMENT FACILITIES SHALL BE PROVIDED AND MAINTAINED AT ALL TIMES DURING CONSTRUCTION. DAMAGES TO ADJACENT PROPERTY AND/OR THE CONSTRUCTION SITE CAUSED BY THE CONTRACTOR'S OR PROPERTY OWNER'S FAILURE TO PROVIDE AND MAINTAIN ADEQUATE DRAINAGE AND EROSION/SEDIMENT CONTROL FROM THE CONSTRUCTION AREA SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND/OR PROPERTY OWNER.

EXISTING SOIL CONDITIONS AND DESIGN GUIDELINES (VIANOVA NOTES)

PLEASE SEE GEOTECHNICAL EVALUATION PREPARED BY WESTERN TECHNOLOGIES, INC., TITLED: "GEOTECHNICAL EVALUATION REPORT, COF PAVEMENT EVALUATION" WESTERN TECHNOLOGIES, INC. PROJECT NO. 2529JB056, JULY 10, 2019.

RIGHT-OF-WAY AND TRAFFIC CONTROL (VIANOVA NOTES)
 THE CONTRACTOR SHALL PROVIDE ANY NECESSARY TRAFFIC CONTROL DEVICES REQUIRED FOR THE CONTROL OF VEHICLE AND PEDESTRIAN TRAFFIC AFFECTED BY THE CONSTRUCTION. ALL TRAFFIC CONTROL PLANS MUST BE APPROVED BY THE OWNER OR HIS REPRESENTATIVE PRIOR TO IMPLEMENTATION.

CONSTRUCTION STAKES, LINES AND GRADES (VIANOVA NOTES)
 THE CONTRACTOR SHALL BE RESPONSIBLE FOR RETAINING A REGISTERED LAND SURVEYOR, LICENSED TO PRACTICE IN ARIZONA, WHO SHALL BE RESPONSIBLE FOR PROVIDING ALL STAKES NECESSARY TO ESTABLISH CONSTRUCTION LINES AND GRADES. STAKES PROVIDED SHALL BE OF SUFFICIENT NUMBERS TO SATISFY THE ENGINEER THAT THE WORK MAY BE CONSTRUCTED IN ACCORDANCE WITH THE PLANS.

ALL COSTS ASSOCIATED WITH STAKING ARE TO BORNE BY THE CONTRACTOR. NO ADDITIONAL PAYMENT TO THE CONTRACTOR FOR EXTRA STAKES OR FOR RE-STAKING WILL BE ALLOWED.

GENERAL STRIPING (VIANOVA NOTES)

ALL PAVEMENT STRIPING SHALL BE IN CONFORMANCE WITH THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES", LATEST EDITION.

GEOTECHNICAL INFORMATION (VIANOVA NOTES)
 SITE PREPARATION, EXCAVATION, AND PLACEMENT SHALL BE IN ACCORDANCE WITH THE GEOTECHNICAL REPORT, AND/OR U.B.C. APPENDIX CHAPTER 33 AND COF ADDENDUM TO CHAPTER 33.

MISCELLANEOUS REMOVALS AND OTHER WORK (VIANOVA NOTES)

REMOVALS NECESSITATED BY THE WORK AS IT PROGRESSES AND NOT SPECIFICALLY CALLED OUT ON THE PLANS WILL BE CONSIDERED INCIDENTAL WORK.

WATER SUPPLY (VIANOVA NOTES)

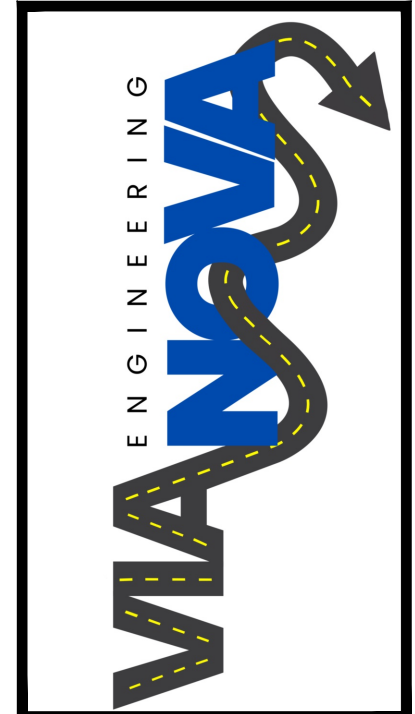
THE CONTRACTOR SHALL MAKE ARRANGEMENTS FOR AND PROVIDE ALL NECESSARY WATER FOR HIS CONSTRUCTION OPERATION AT HIS OWN EXPENSE.

FEMA INFORMATION (VIANOVA NOTES)

THIS PARCEL HAS A ZONE 'A' CLASSIFICATION, (AN AREA SUBJECT TO INUNDATION BY THE 1-PERCENT-ANNUAL-CHANCE FLOOD EVENT GENERALLY DETERMINED USING APPROXIMATE METHODOLOGIES, BECAUSE DETAILED HYDRAULIC ANALYSES HAVEN'T BEEN PERFORMED. NO BASE FLOOD ELEVATIONS (BFES) OR FLOOD DEPTHS ARE AVAILABLE) PER FEMA FIRM PANEL 04005C6834G.

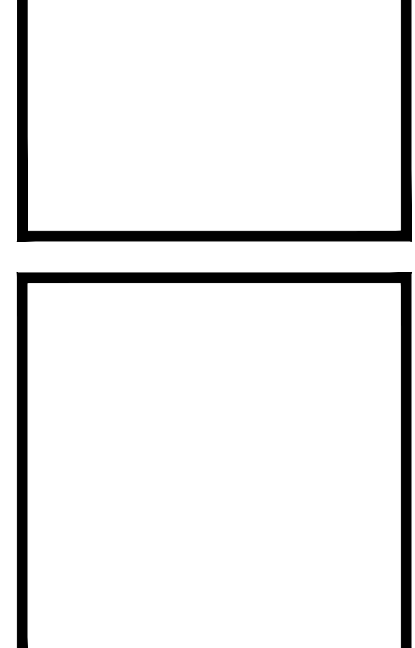
CLEANUP AND DUST CONTROL (VIANOVA NOTES)

THROUGHOUT ALL PHASES OF THE CONSTRUCTION THE CONTRACTOR SHALL KEEP THE WORK AREA, ADJACENT PROPERTIES AND STREETS CLEAN AND FREE FROM RUBBISH, EXCESS MATERIALS, DUST AND DEBRIS GENERATED BY THE CONSTRUCTION ACTIVITY.



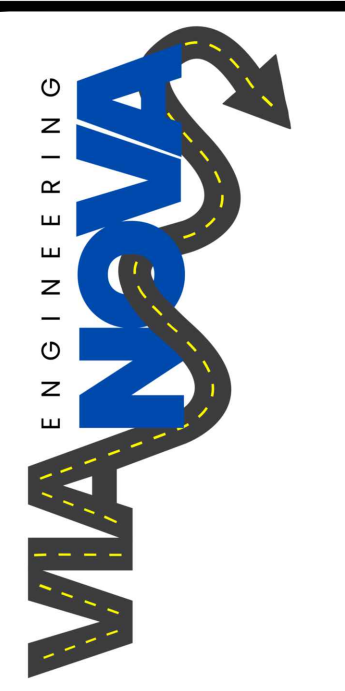
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COVER SHEET & GENERAL NOTES
 BELLEFONT ALIGNMENT
 APN 203-47-005
 BELLEFONT
 ARIZONA, 86005



project:
 proj #:
 drawing name:
 VIANOVA 486 PLANSET
 drawn by: LHT
 reviewed by: SH,JS,OS
 date: 04/12/2026
 review #:

revisions:



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SITE PLAN AND PROFILE
BELLEMONT ALIGNMENT
APN 203-47-005
BELLEMONT
ARIZONA, 86005



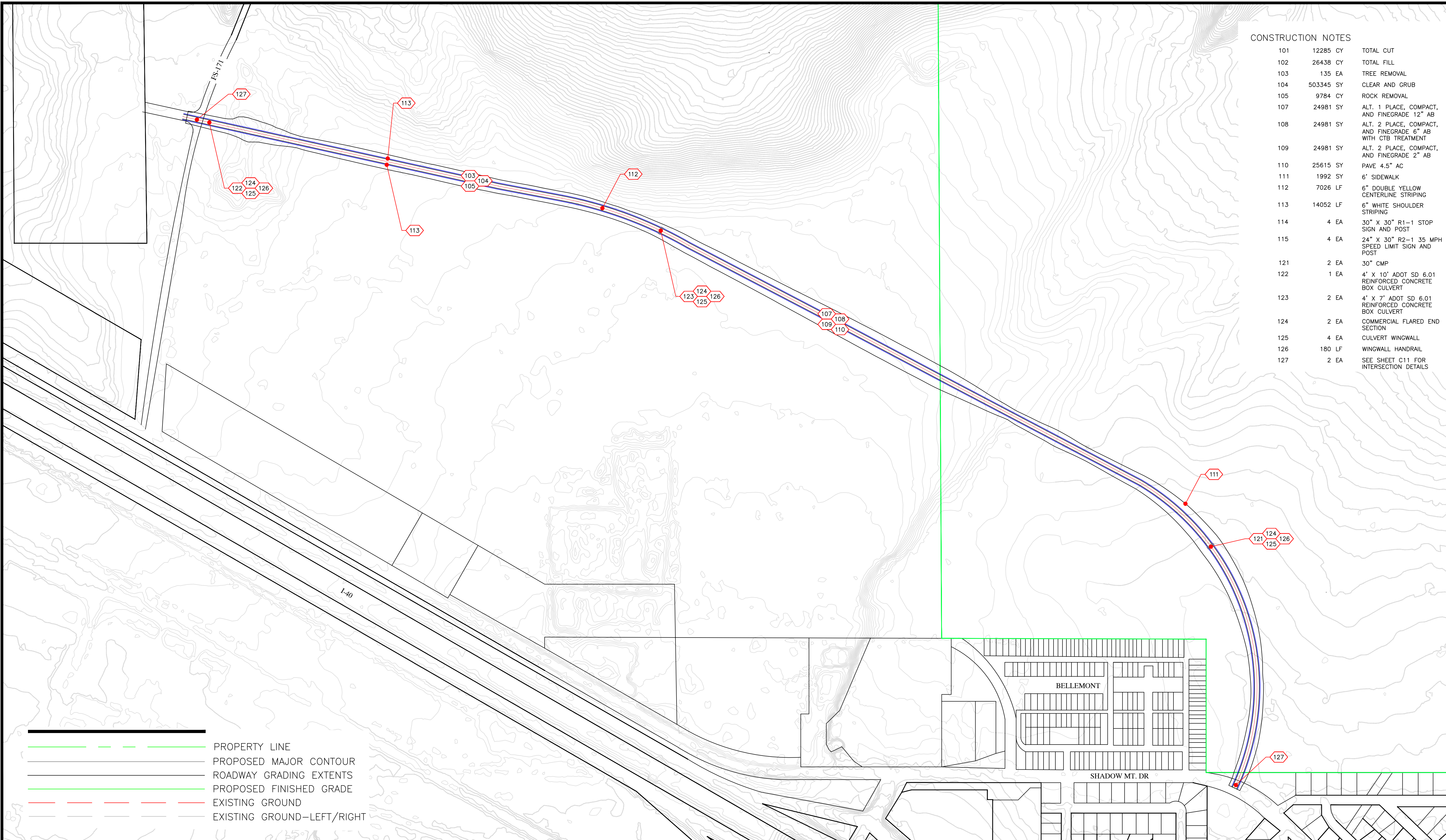
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VANOVA 486 PLANSET
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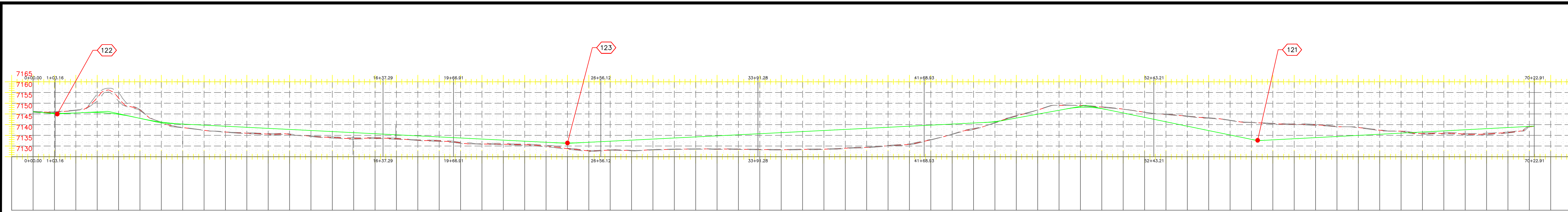
revisions:

CONSTRUCTION NOTES

101	12285 CY	TOTAL CUT
102	26438 CY	TOTAL FILL
103	135 EA	TREE REMOVAL
104	503345 SY	CLEAR AND GRUB
105	9784 CY	ROCK REMOVAL
107	24981 SY	ALT. 1 PLACE, COMPACT, AND FINEGRADE 12" AB
108	24981 SY	ALT. 2 PLACE, COMPACT, AND FINEGRADE 6" AB WITH CTB TREATMENT
109	24981 SY	ALT. 2 PLACE, COMPACT, AND FINEGRADE 2" AB
110	25615 SY	PAVE 4.5" AC
111	1992 SY	6' SIDEWALK
112	7026 LF	6" DOUBLE YELLOW CENTERLINE STRIPING
113	14052 LF	6" WHITE SHOULDER STRIPING
114	4 EA	30" X 30" R1-1 STOP SIGN AND POST
115	4 EA	24" X 30" R2-1 35 MPH SPEED LIMIT SIGN AND POST
121	2 EA	30" CMP
122	1 EA	4' X 10' ADOT SD 6.01 REINFORCED CONCRETE BOX CULVERT
123	2 EA	4' X 7' ADOT SD 6.01 REINFORCED CONCRETE BOX CULVERT
124	2 EA	COMMERCIAL FLARED END SECTION
125	4 EA	CULVERT WINGWALL
126	180 LF	WINGWALL HANDRAIL
127	2 EA	SEE SHEET C11 FOR INTERSECTION DETAILS

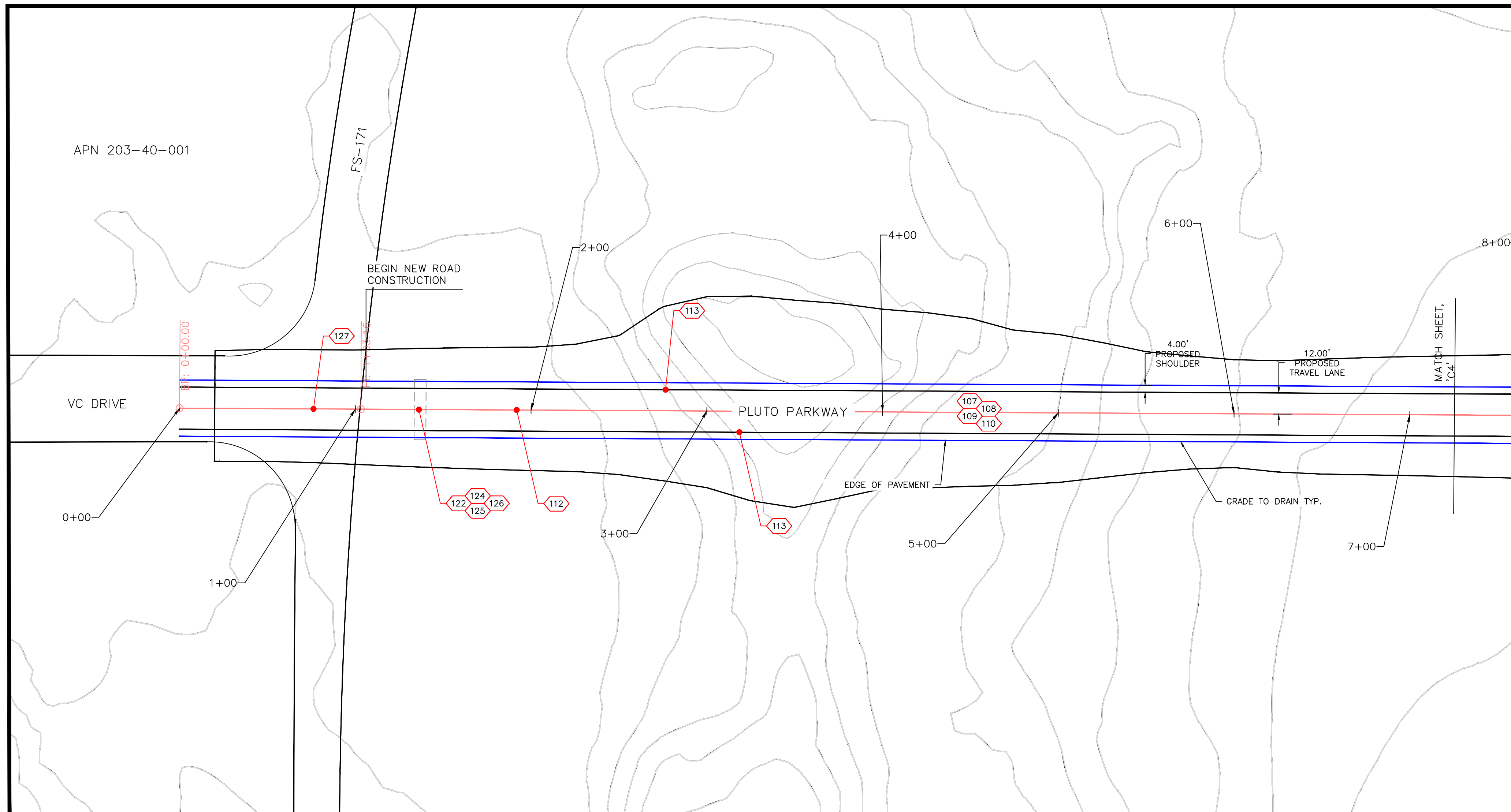


- PROPERTY LINE
- PROPOSED MAJOR CONTOUR
- ROADWAY GRADING EXTENTS
- PROPOSED FINISHED GRADE
- EXISTING GROUND
- EXISTING GROUND-LEFT/RIGHT



ALIGNMENT-PLUTO CL PROFILE

PLAN VIEW - BEGIN - STA. 0+00

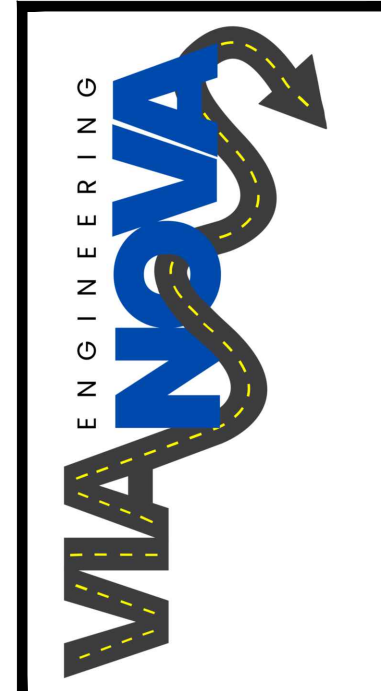
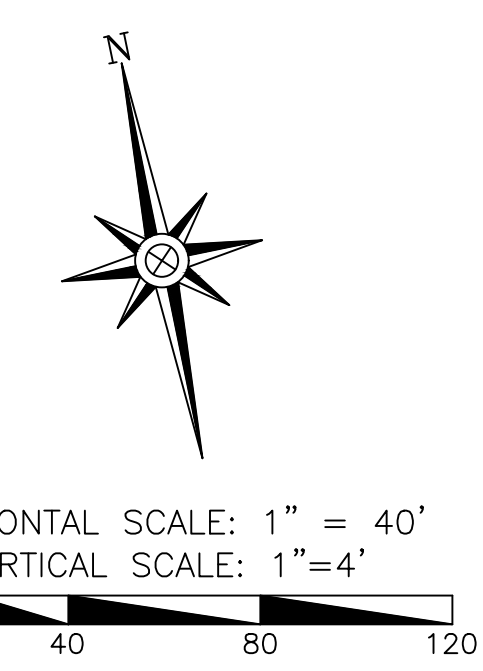
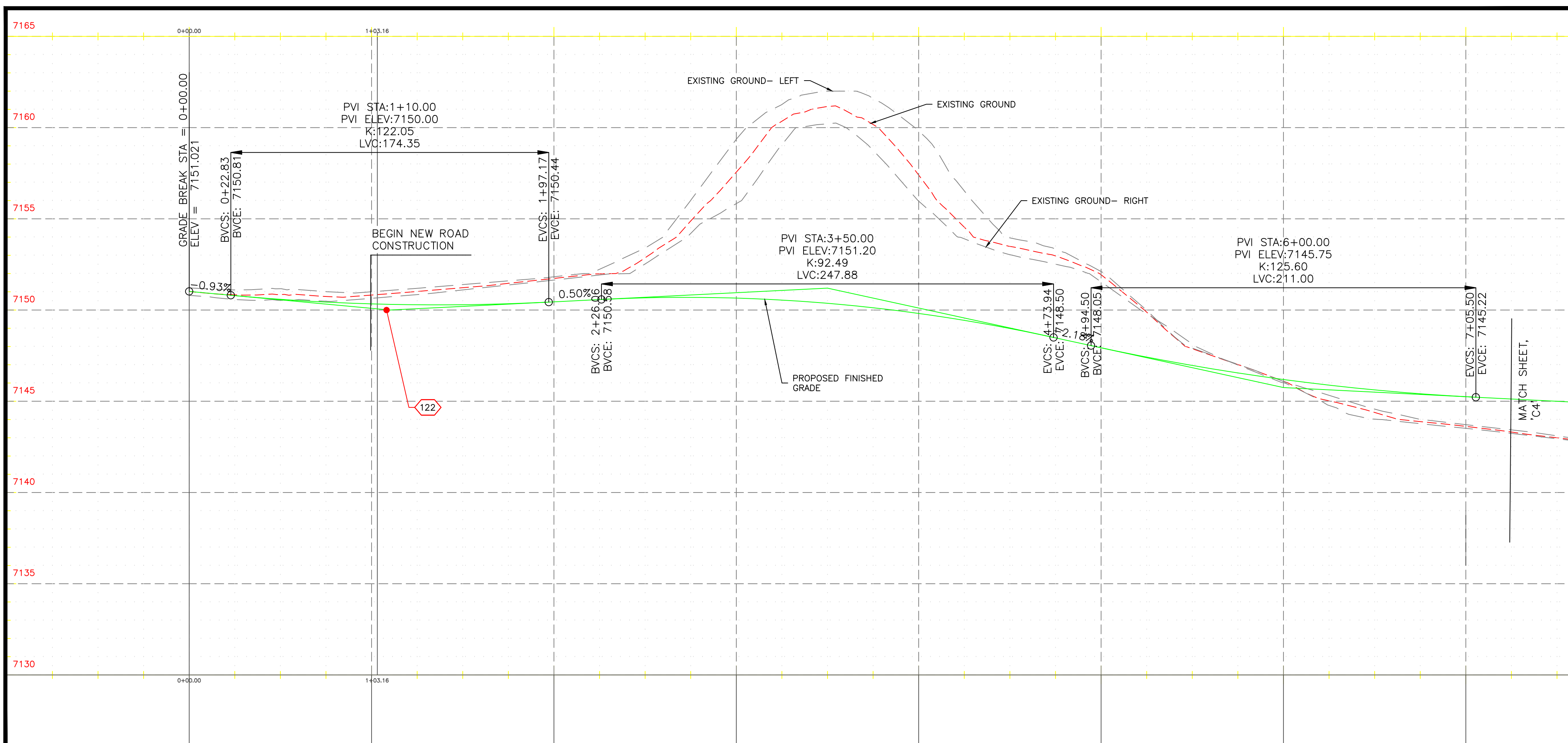


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CONSTRUCTION NOTES

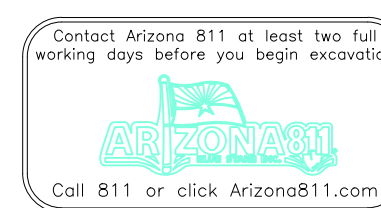
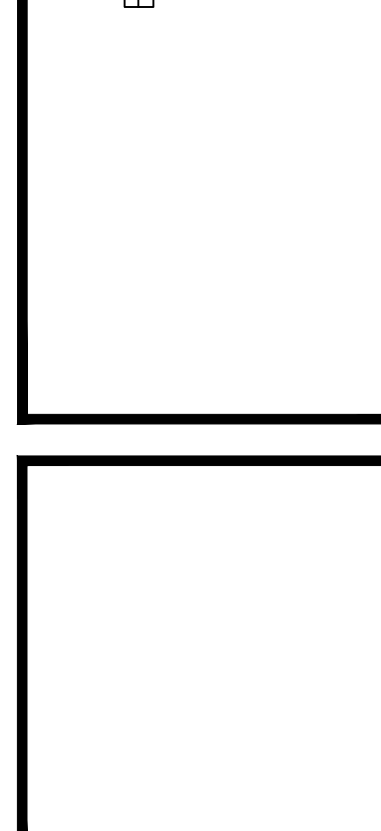
- 107 ALT. 1 PLACE, COMPACT, AND FINEGRADE 12" AB
- 108 ALT. 2 PLACE, COMPACT, AND FINEGRADE 6" AB WITH C13 TREATMENT
- 109 ALT. 2 PLACE, COMPACT, AND FINEGRADE 2" AB
- 110 PAVE 4.5" AC
- 112 6" DOUBLE YELLOW CENTERLINE STRIPING
- 113 6" WHITE SHOULDER STRIPING
- 122 4' X 10' ADOT SD 6.01 REINFORCED CONCRETE BOX CULVERT
- 124 COMMERCIAL FLARED END SECTION
- 125 CULVERT WINGWALL
- 126 WINGWALL HANDRAIL
- 127 SEE SHEET C11 FOR INTERSECTION DETAILS

PROFILE VIEW - BEGIN - STA. 0+00



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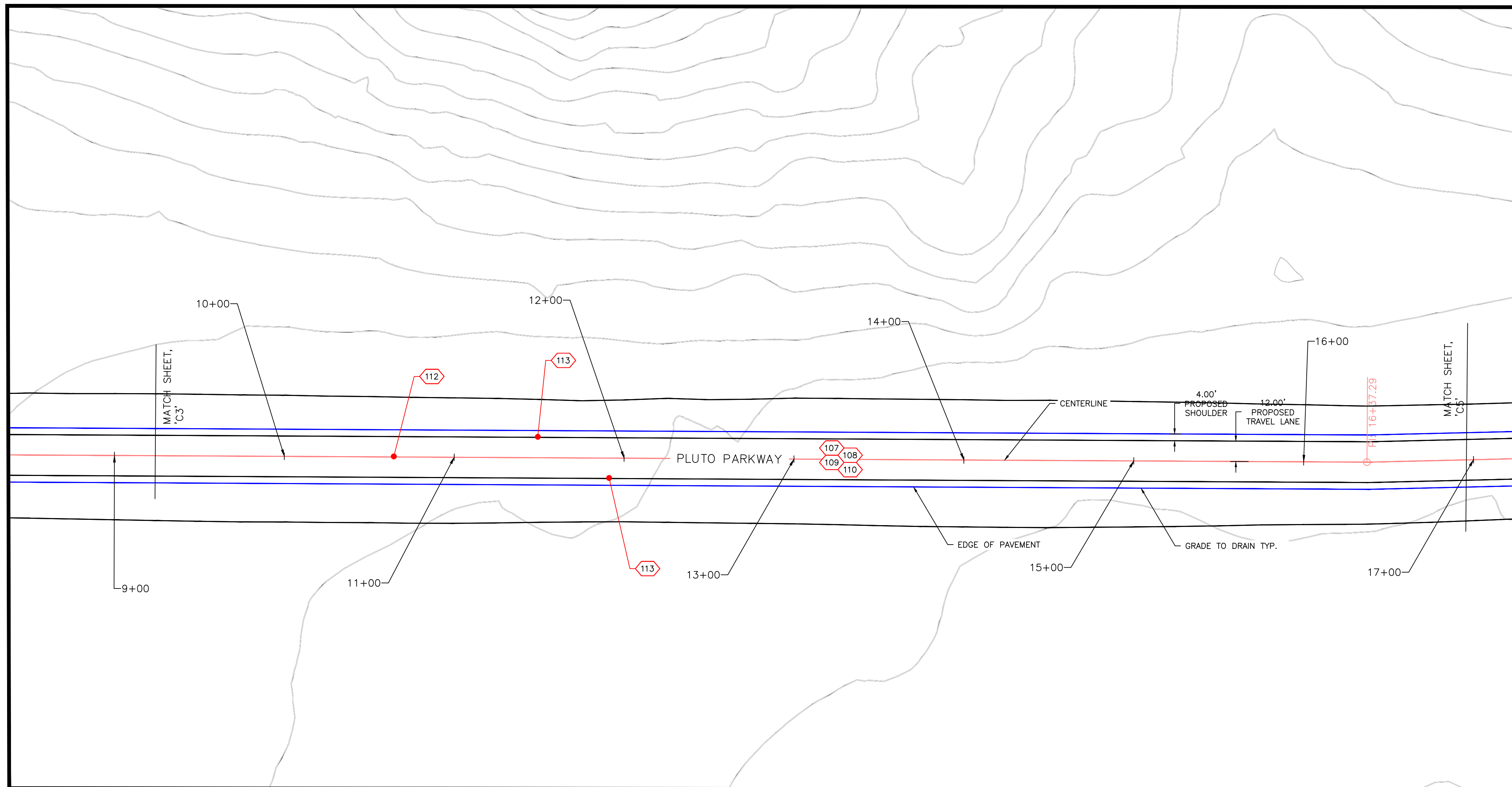
PLAN AND PROFILE
BELLEMONT ALIGNMENT
APN 203-47-005
BELLEMONT
ARIZONA, 86005



project:
proj #:
drawing name:
drawn by: LHT
reviewed by: SH,JS,OS
date: 04/12/2026
review #:

revisions:

PLAN VIEW - BEGIN - STA. 9+25

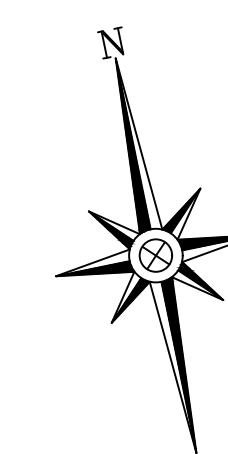
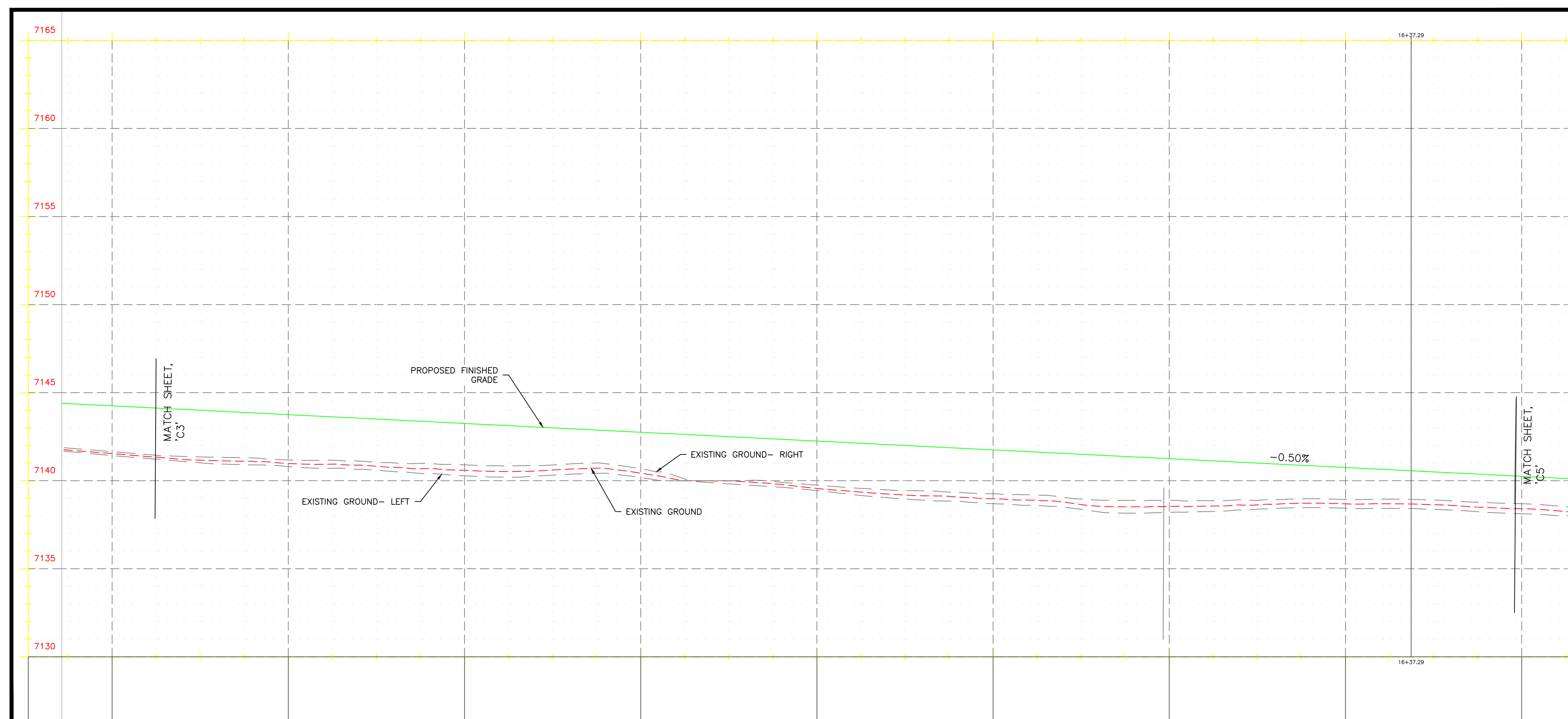


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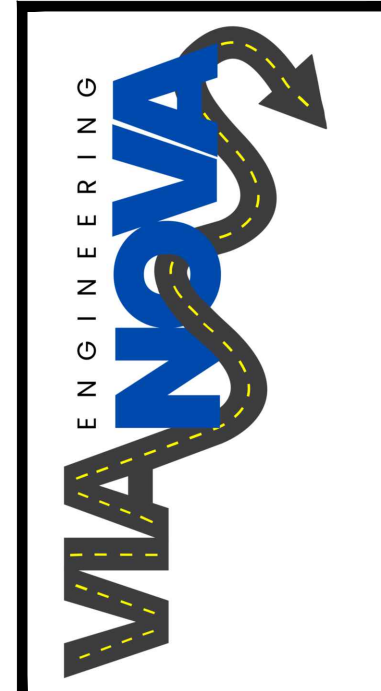
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PROFILE VIEW - BEGIN - STA. 9+25

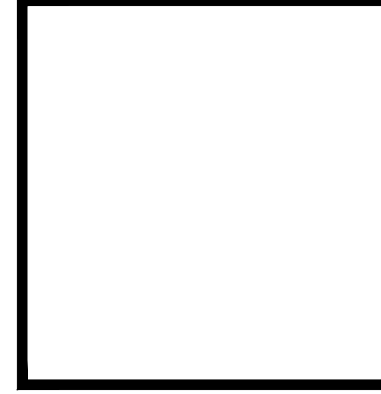


HORIZONTAL SCALE: 1" = 40'
 VERTICAL SCALE: 1" = 4'



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PLAN AND PROFILE
 BELLEMONT ALIGNMENT
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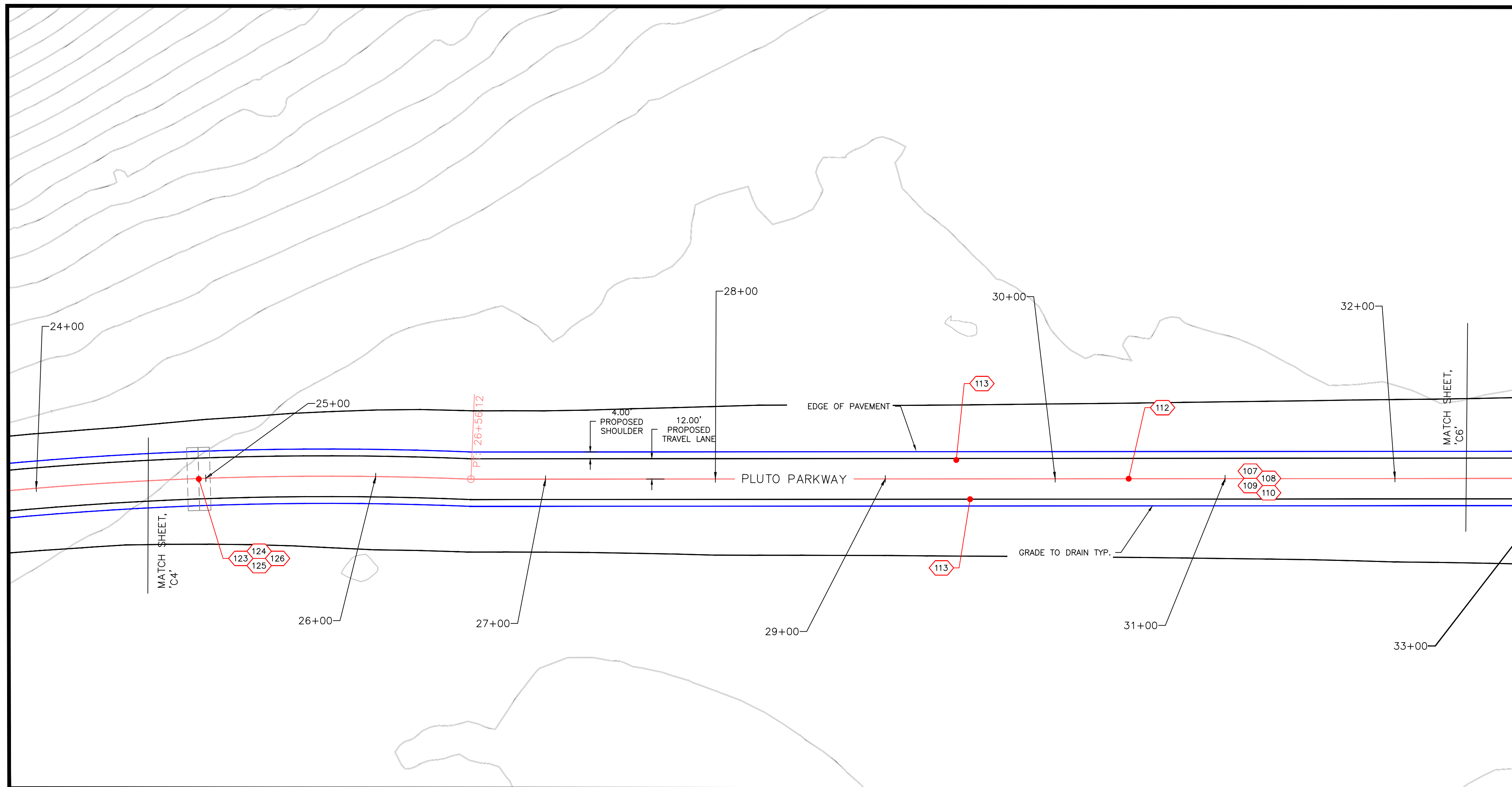


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 VANOVA 486 PLANSET
 drawn by: LHT
 reviewed by: SH,JS,OS
 date: 04/12/2026
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revisions:

PLAN VIEW - BEGIN - STA. 24+68

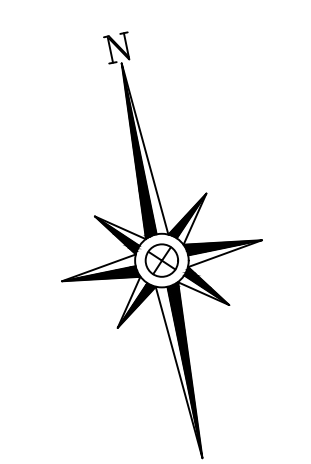
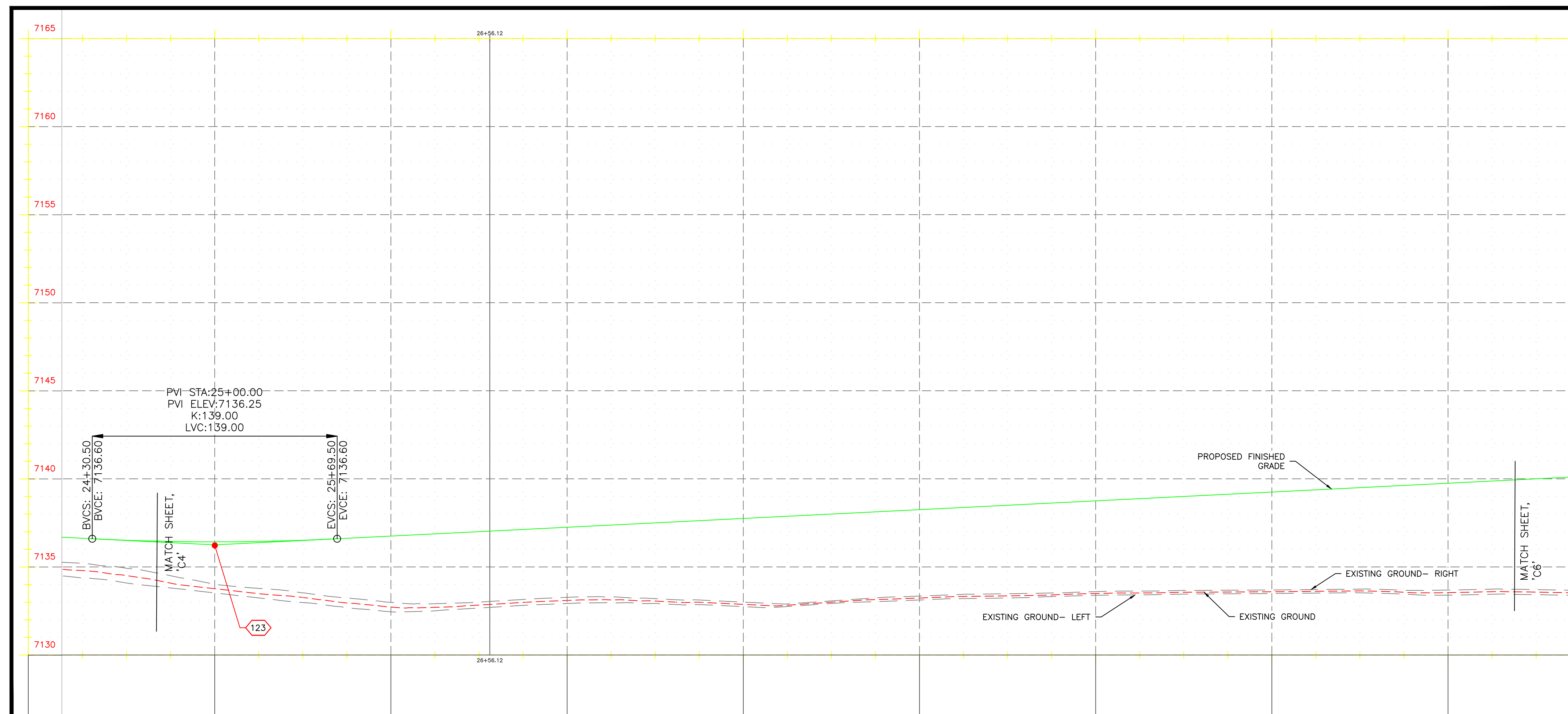


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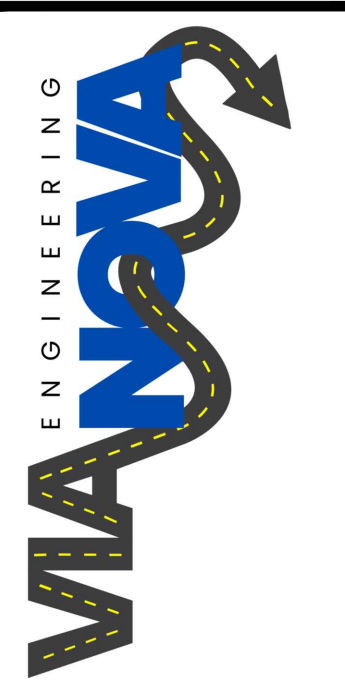
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- 126 WINGWALL HANDRAIL

PROFILE VIEW - BEGIN - STA. 24+68

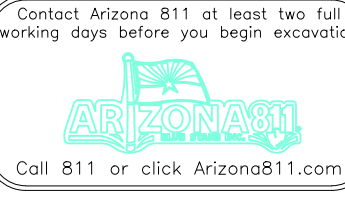
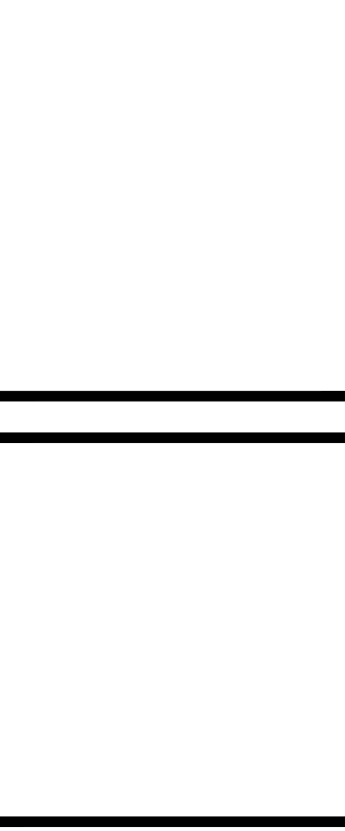


HORIZONTAL SCALE: 1" = 40'
 VERTICAL SCALE: 1" = 4'



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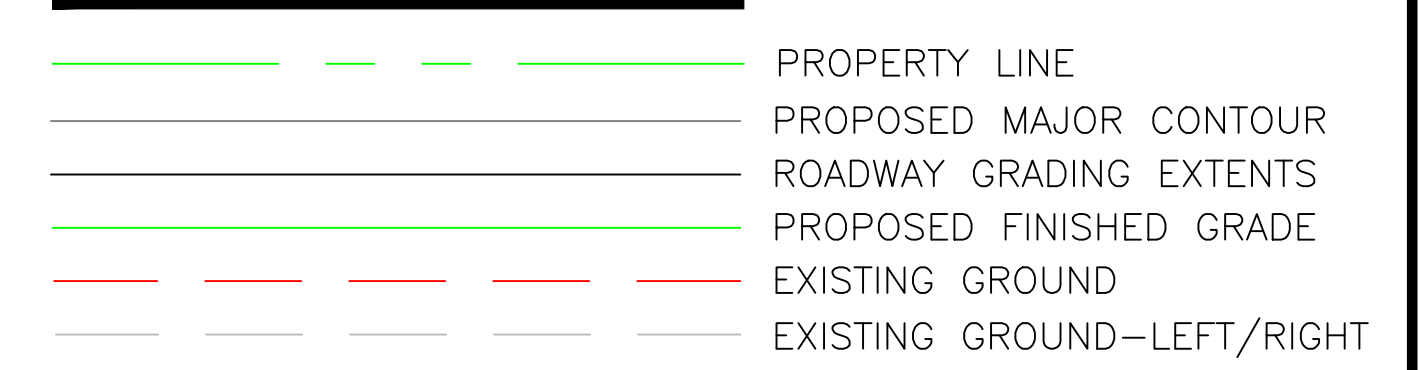
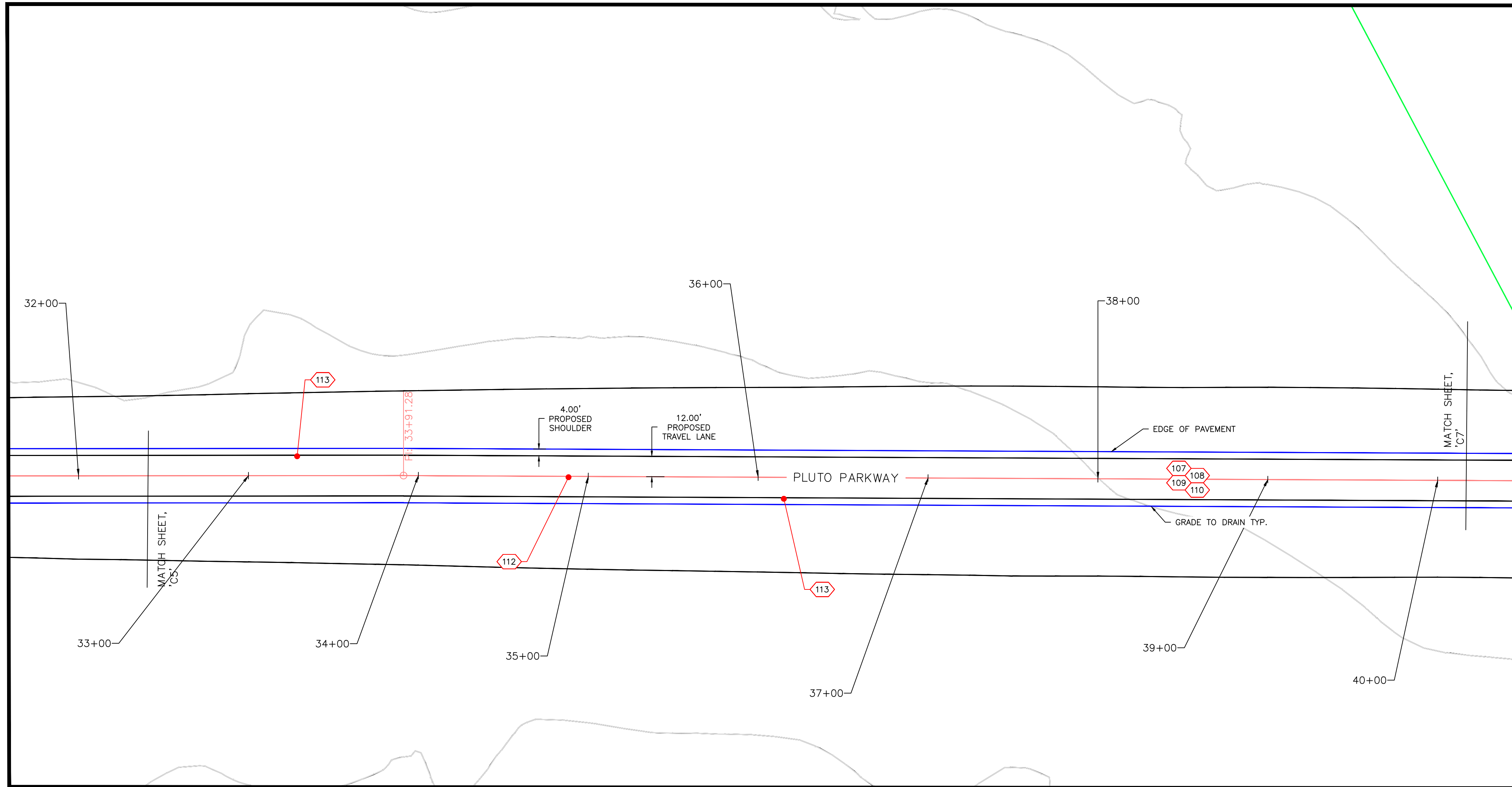
PLAN AND PROFILE
 BELLEMONT ALIGNMENT
 APN 203-47-005
 BELLEMONT
 ARIZONA, 86005



project:	
proj. #:	
drawing name:	VANOVA 486 PLANSET
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reviewed by:	SH,JS,OS
date:	04/12/2026
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revisions:	

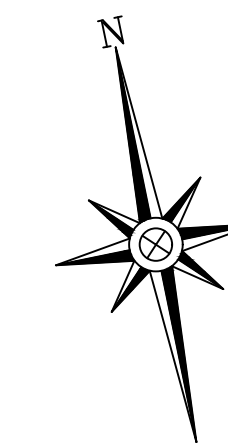
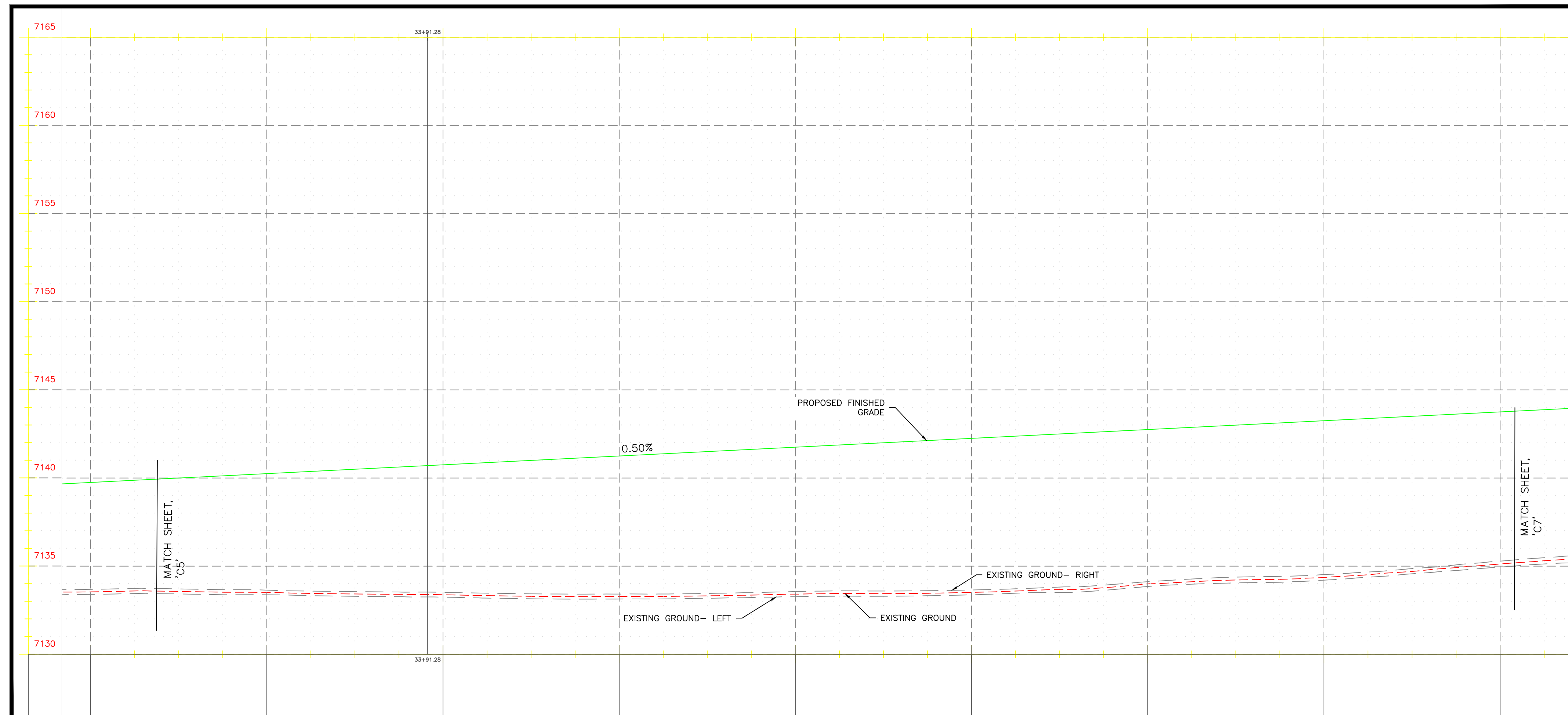
PLAN VIEW - BEGIN - STA. 32+38



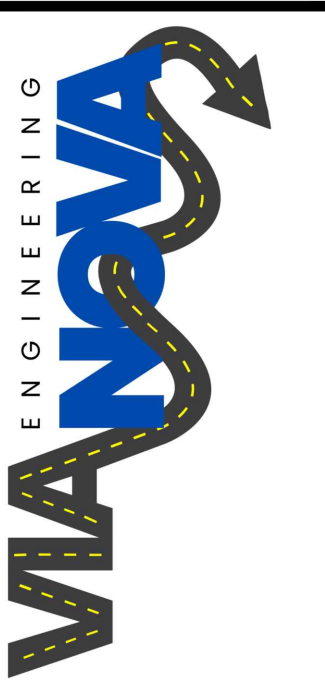
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PROFILE VIEW - BEGIN - STA. 32+38



HORIZONTAL SCALE: 1" = 40'
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PLAN AND PROFILE
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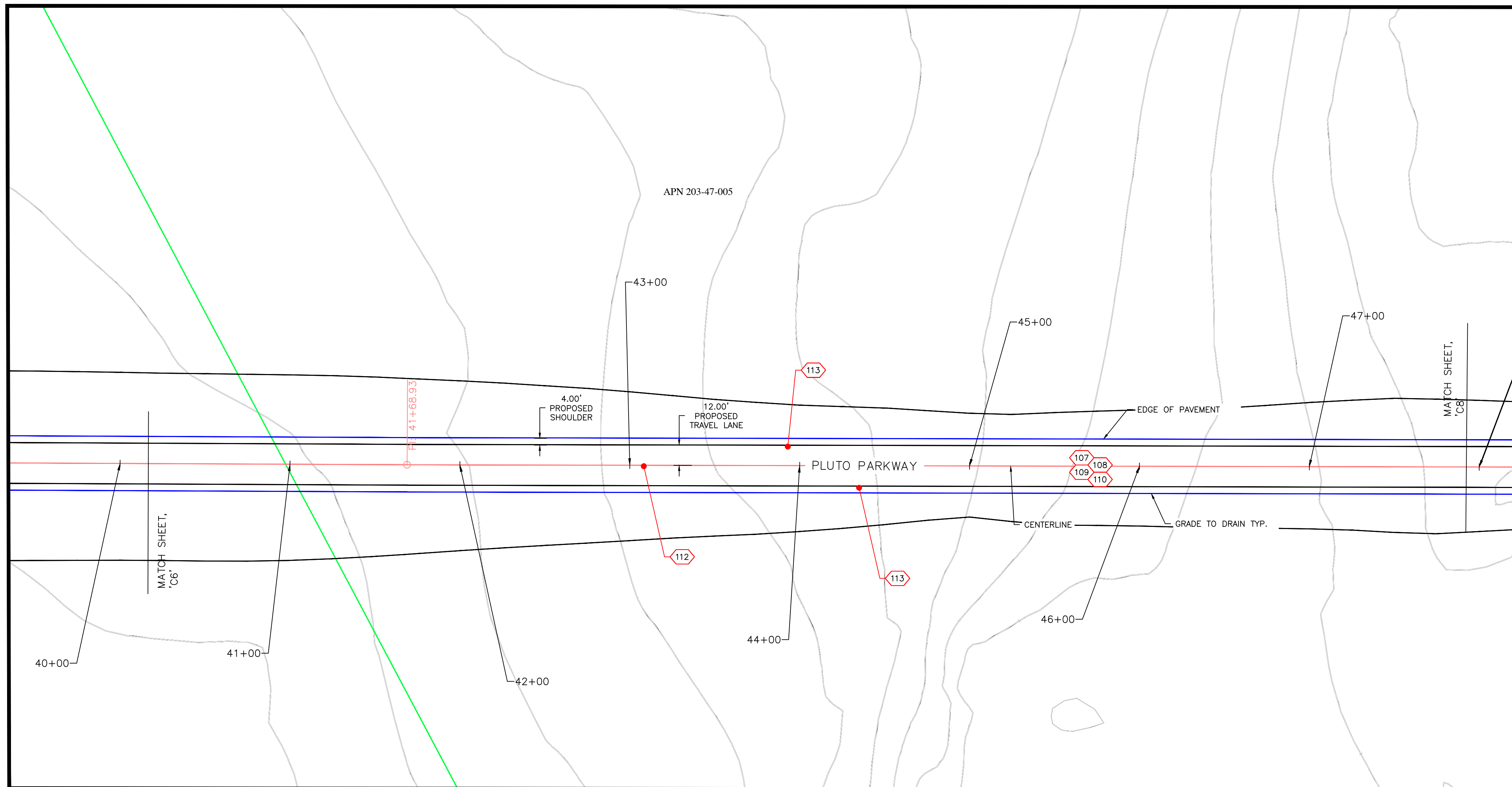


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PLAN VIEW - BEGIN - STA. 40+20

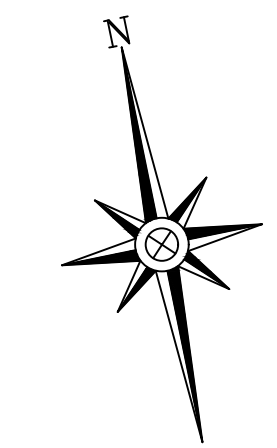
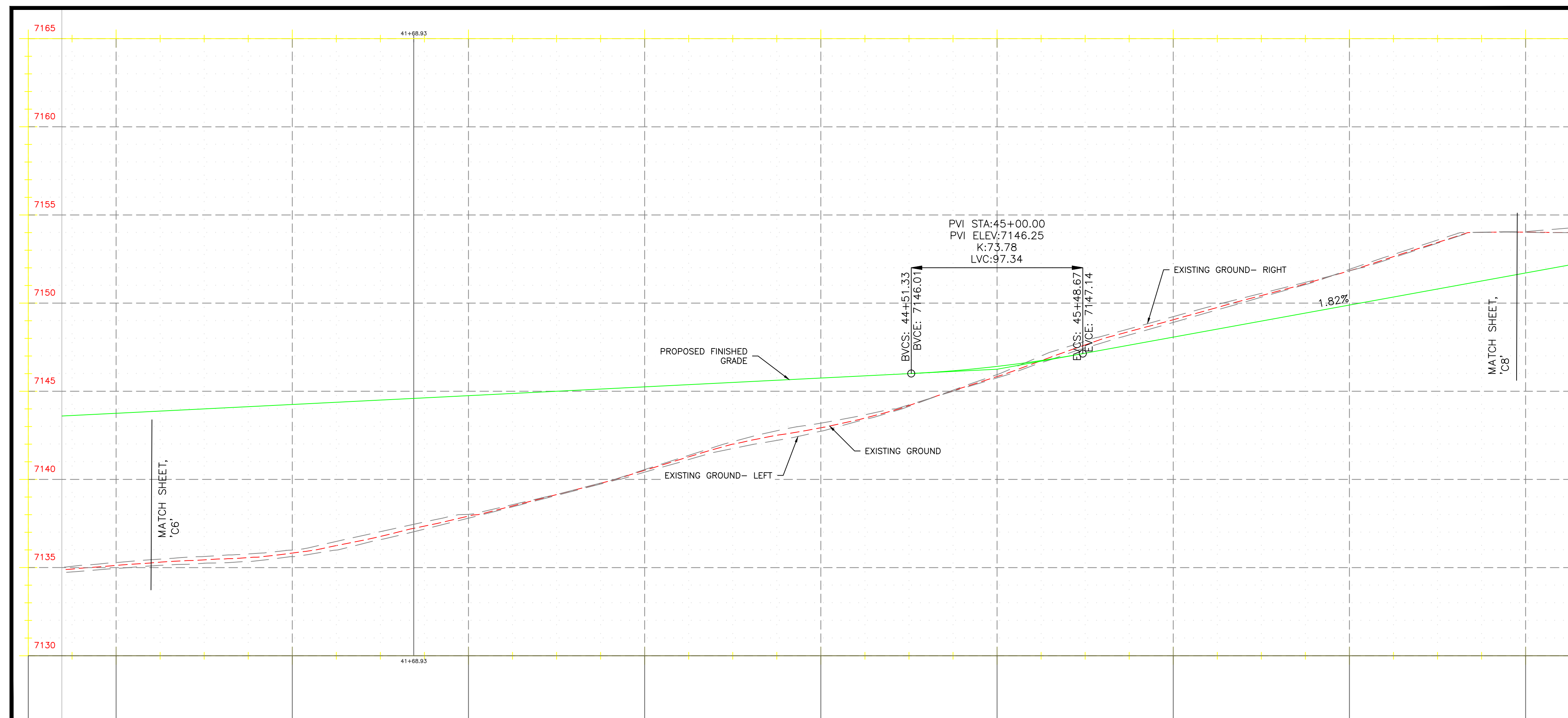


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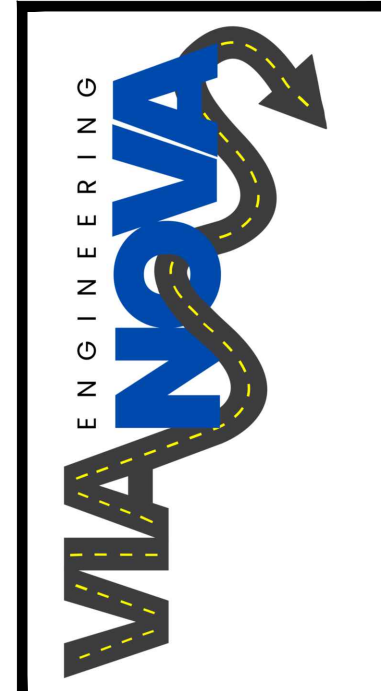
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PROFILE VIEW - BEGIN - STA. 40+20

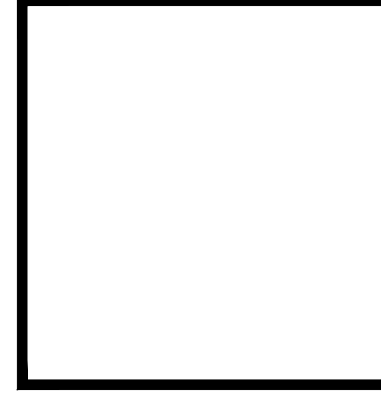


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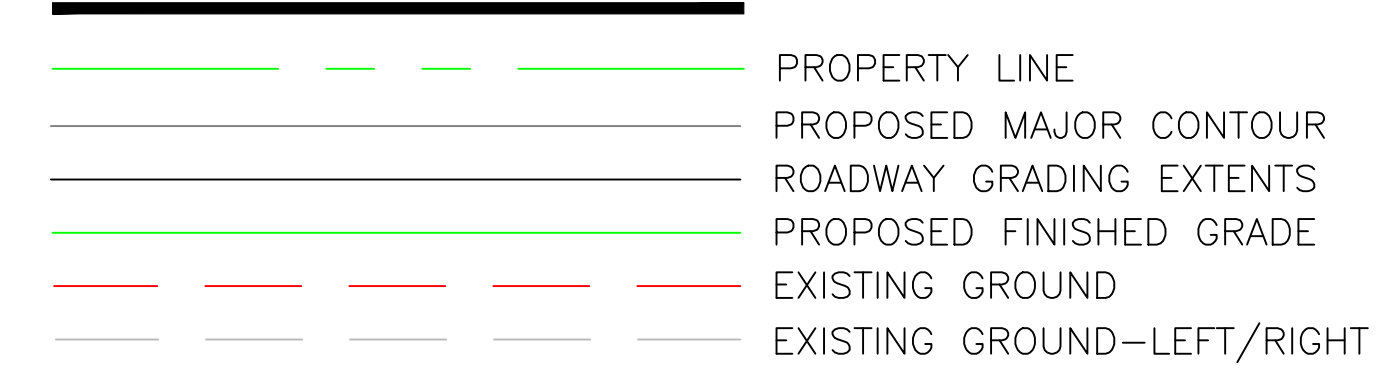
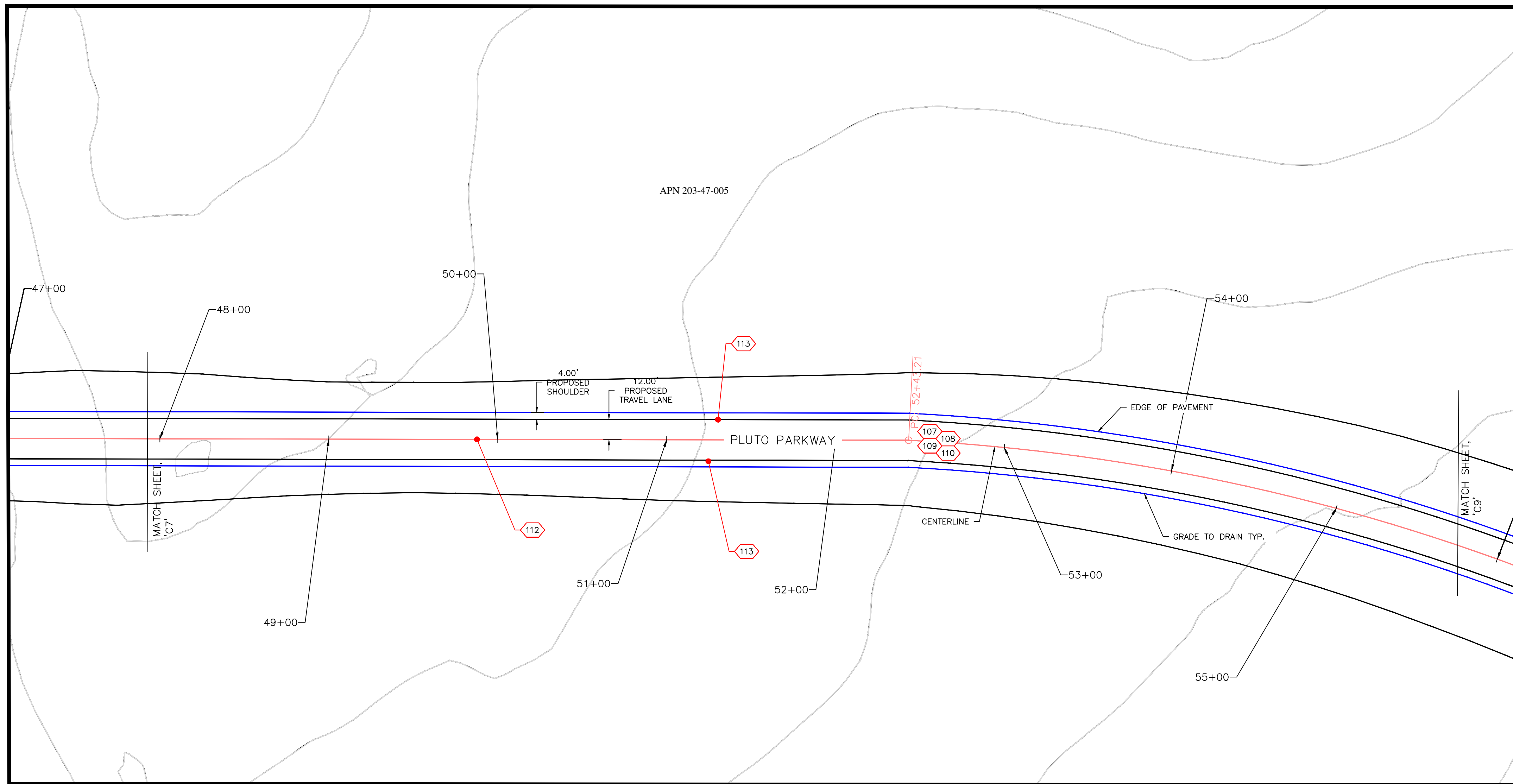
PLAN AND PROFILE
 BELLEMONT ALIGNMENT
 APN 203-47-005
 BELLEMONT
 ARIZONA, 86005



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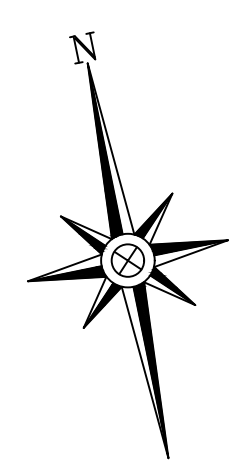
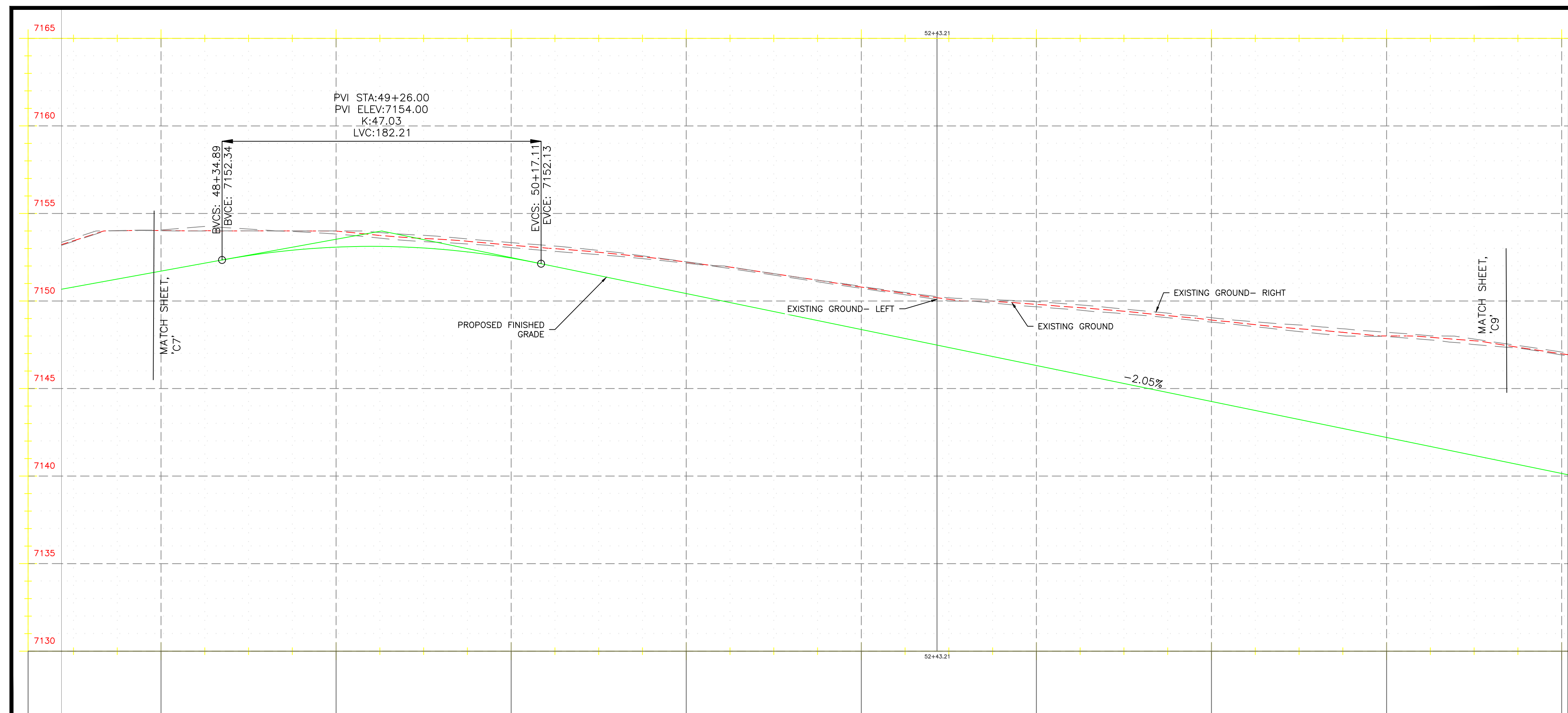
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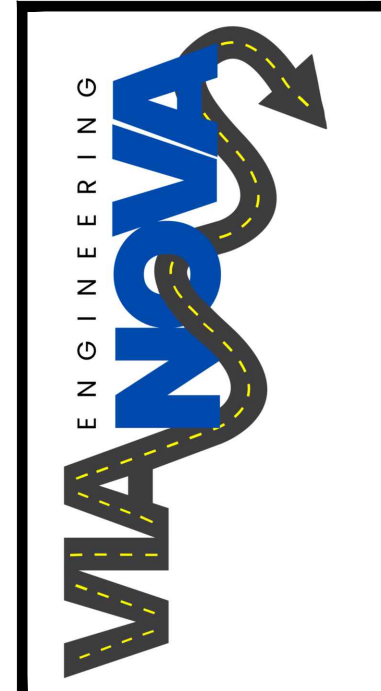


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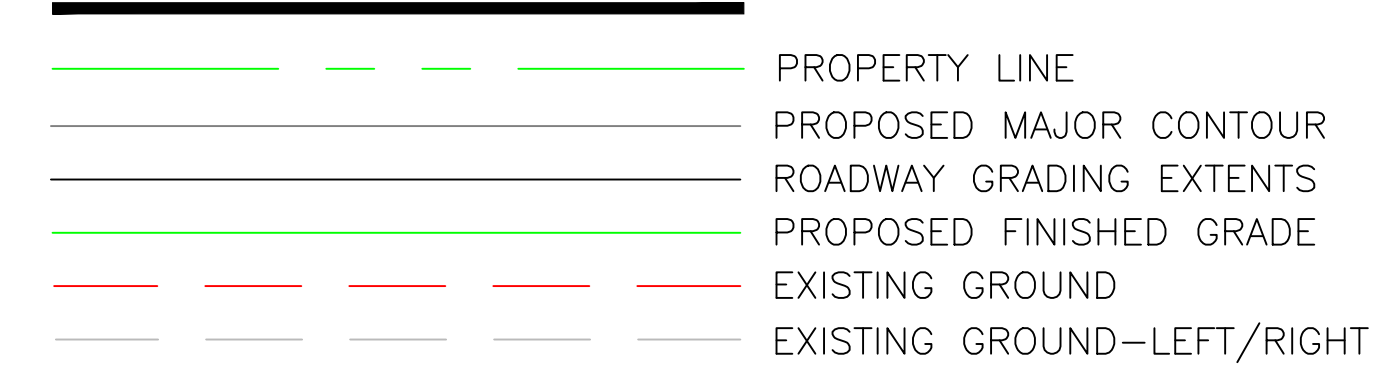
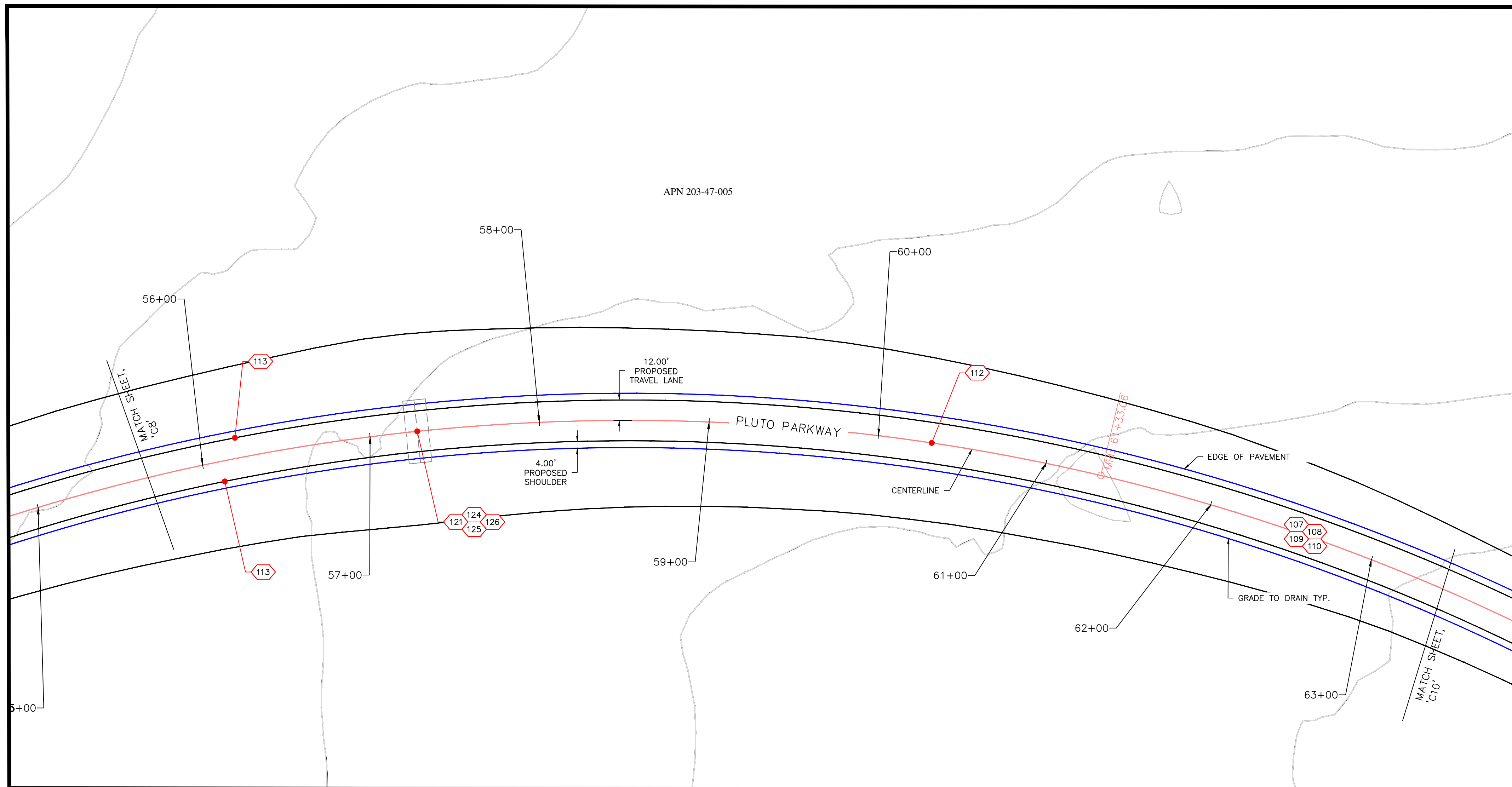


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 Call 811 or click Arizona811.com

project:
 proj #:
 drawing name:
 VANOVA 486 PLANSET
 drawn by: LHT
 reviewed by: SH,JS,OS
 date: 04/12/2026
 review #:

revisions:

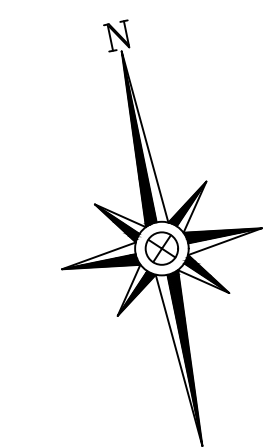
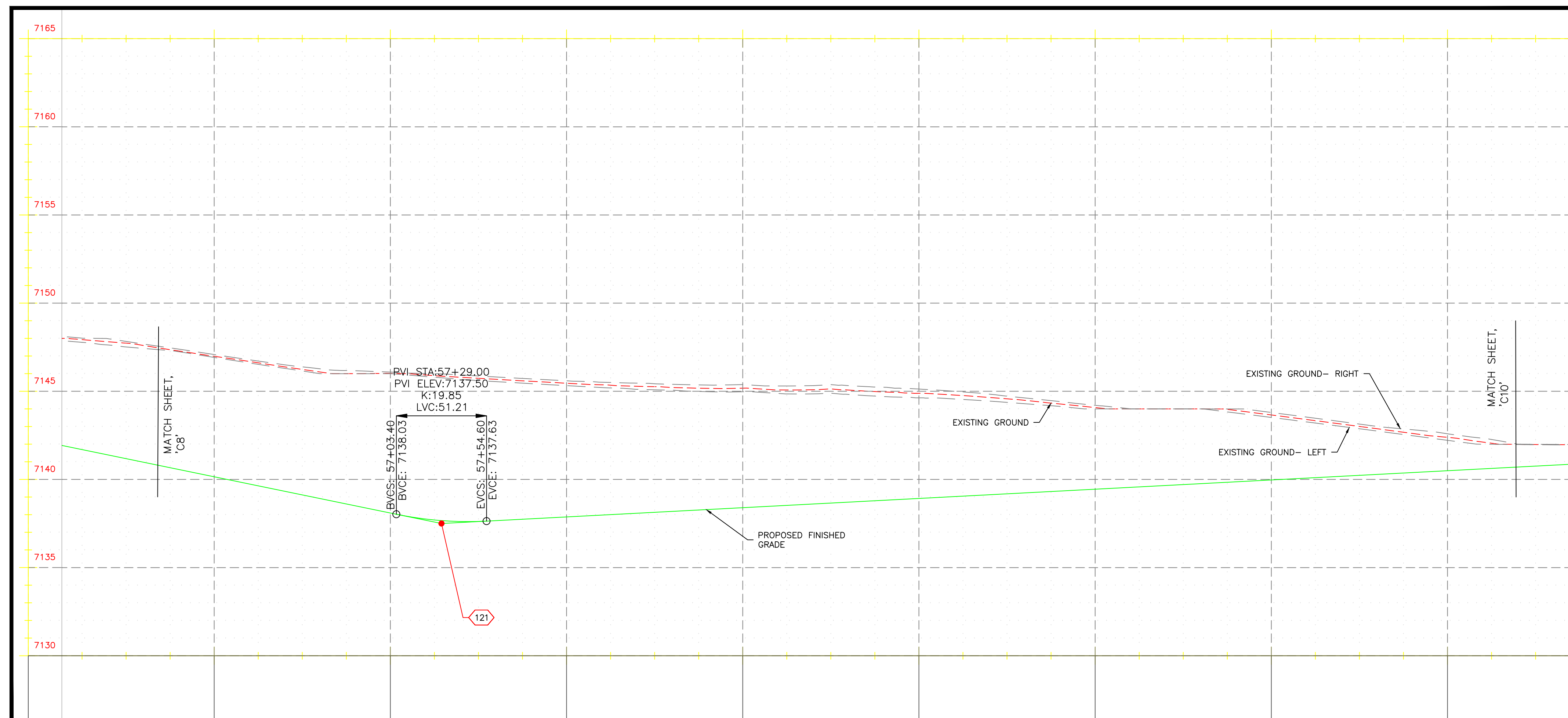
PLAN VIEW - BEGIN - STA. 55+60



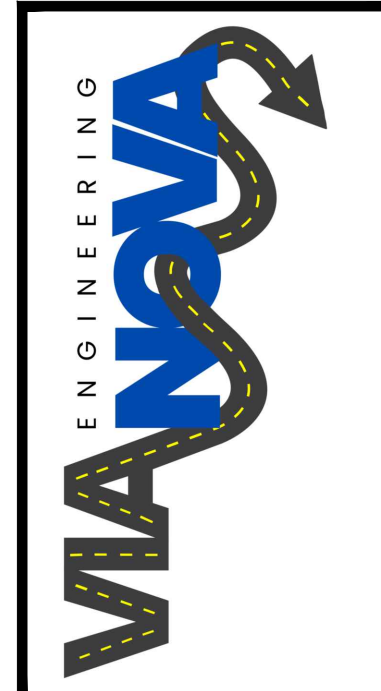
CONSTRUCTION NOTES

- 107 ALT. 1 PLACE, COMPACT, AND FINEGRADE 12" AB
- 108 ALT. 2 PLACE, COMPACT, AND FINEGRADE 6" AB WITH CTB TREATMENT
- 109 ALT. 2 PLACE, COMPACT, AND FINEGRADE 2" AB
- 110 PAVE 4.5" AC
- 112 6" DOUBLE YELLOW CENTERLINE STRIPING
- 113 6" WHITE SHOULDER STRIPING
- 121 30" CMP
- 124 COMMERCIAL FLARED END SECTION
- 125 CULVERT WINGWALL
- 126 WINGWALL HANDRAIL

PROFILE VIEW - BEGIN - STA. 55+60



HORIZONTAL SCALE: 1" = 40'
 VERTICAL SCALE: 1" = 4'



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PLAN AND PROFILE
 BELLEMONT ALIGNMENT
 APN 203-47-005
 BELLEMONT
 ARIZONA, 86005

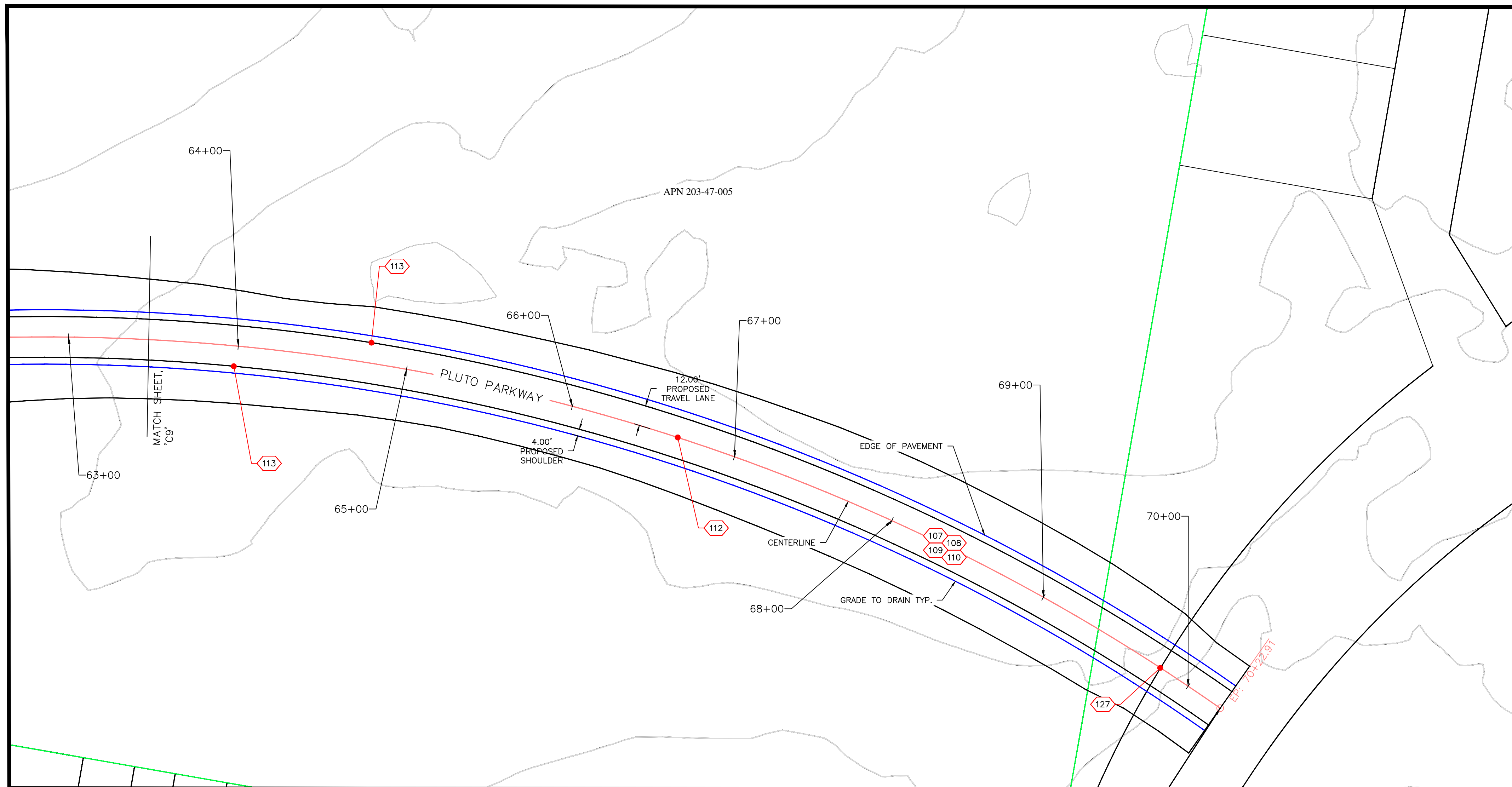


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project:
 proj #:
 drawing name:
 VANOVA 486 PLANSET
 drawn by: LHT
 reviewed by: SH,JS,OS
 date: 04/12/2026
 review #:

revisions:

PLAN VIEW - BEGIN - STA. 63+39

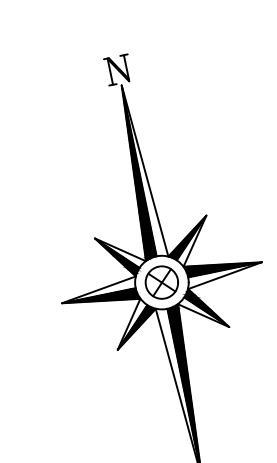
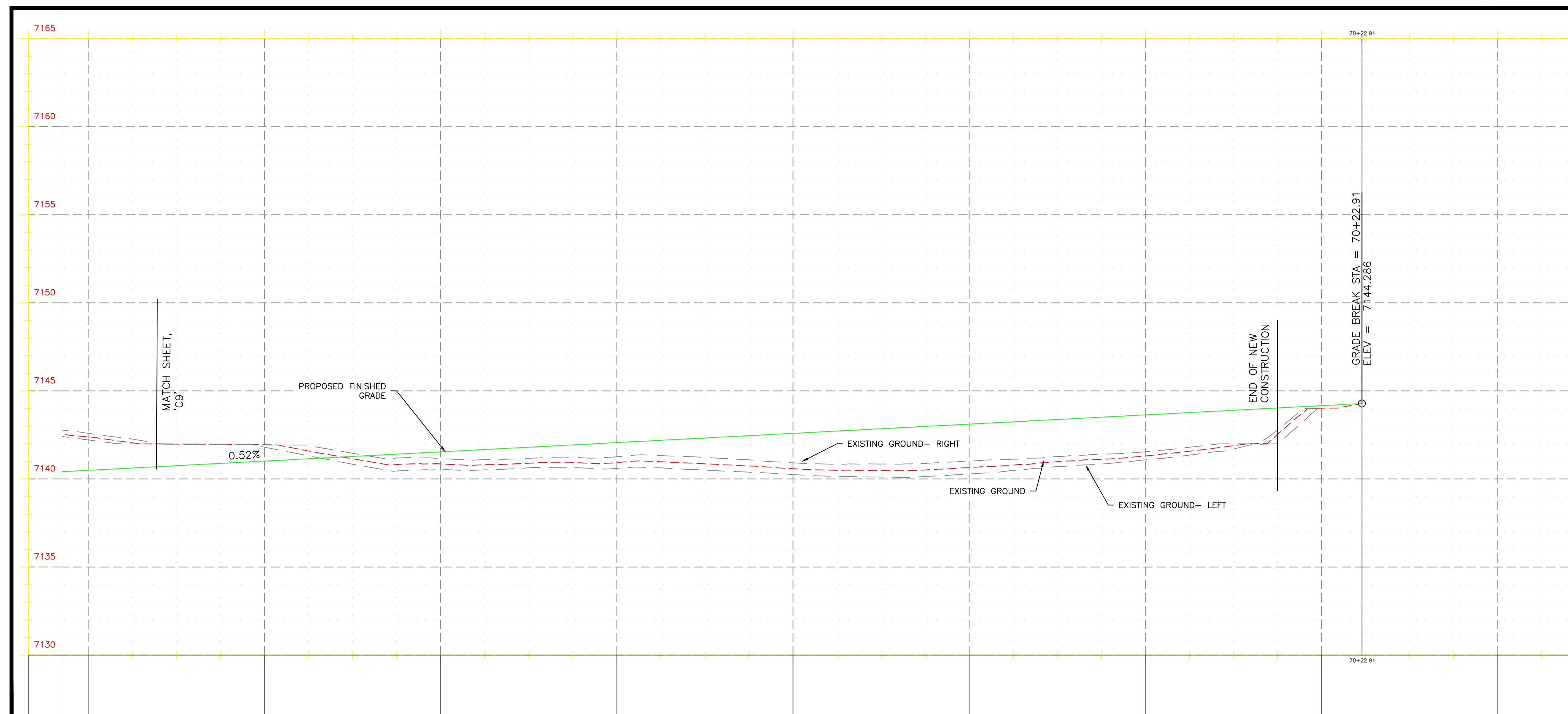


- PROPERTY LINE
- PROPOSED MAJOR CONTOUR
- ROADWAY GRADING EXTENTS
- PROPOSED FINISHED GRADE
- EXISTING GROUND
- EXISTING GROUND-LEFT/RIGHT

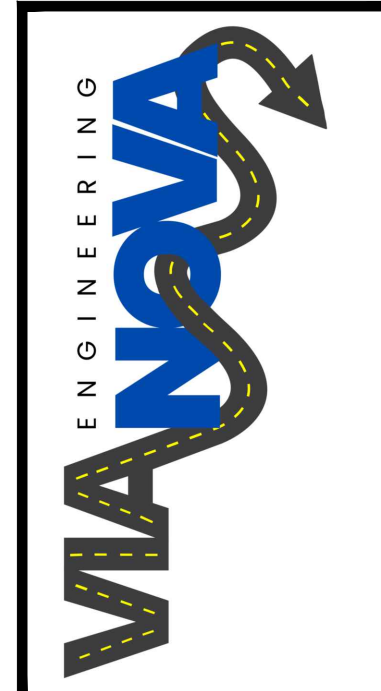
CONSTRUCTION NOTES

- 107 ALT. 1 PLACE, COMPACT, AND FINEGRADE 12" AB
- 108 ALT. 2 PLACE, COMPACT, AND FINEGRADE 6" AB WITH CTB TREATMENT
- 109 ALT. 2 PLACE, COMPACT, AND FINEGRADE 2" AB
- 110 PAVE 4.5" AC
- 112 6" DOUBLE YELLOW CENTERLINE STRIPING
- 113 6" WHITE SHOULDER STRIPING
- 127 SEE SHEET C11 FOR INTERSECTION DETAILS

PROFILE VIEW - BEGIN - STA. 63+39



HORIZONTAL SCALE: 1" = 40'
 VERTICAL SCALE: 1" = 4'



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PLAN AND PROFILE
 BELLEMONT ALIGNMENT
 APN 203-47-005
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 ARIZONA, 86005

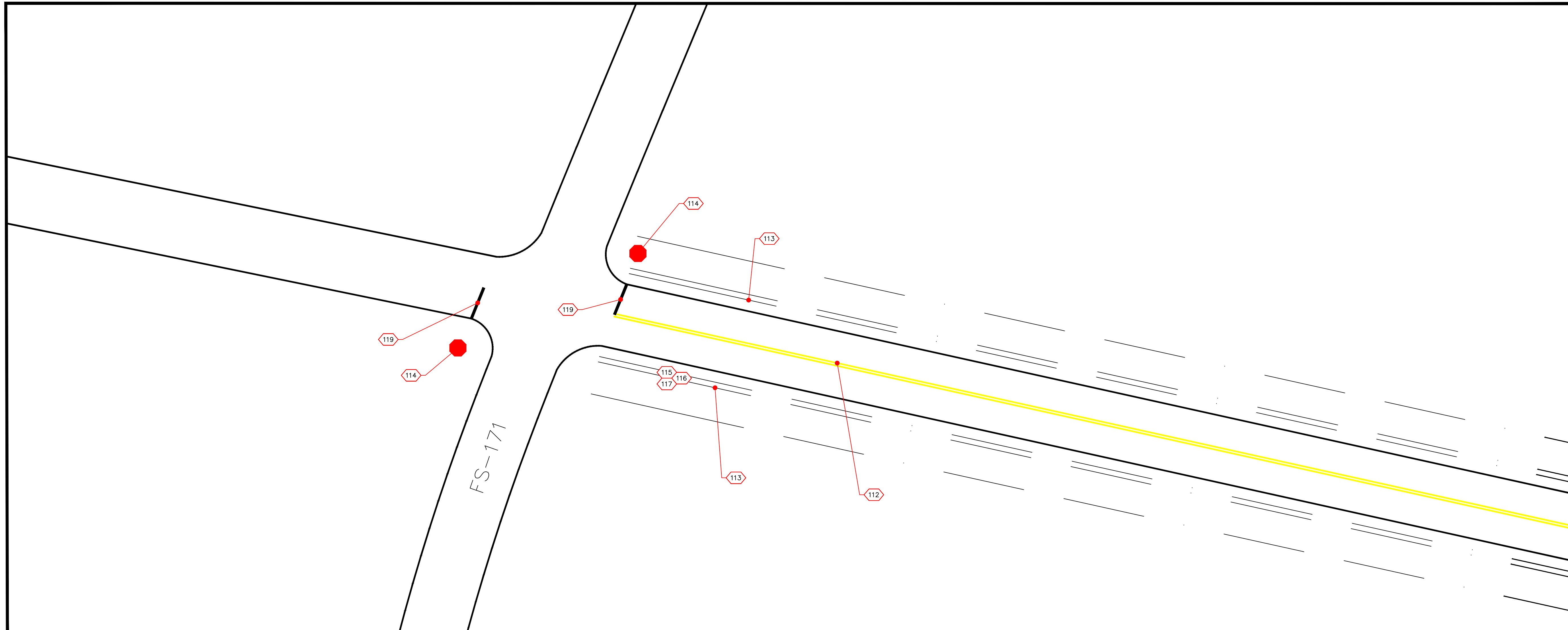


Contact Arizona 811 at least two full working days before you begin excavation.
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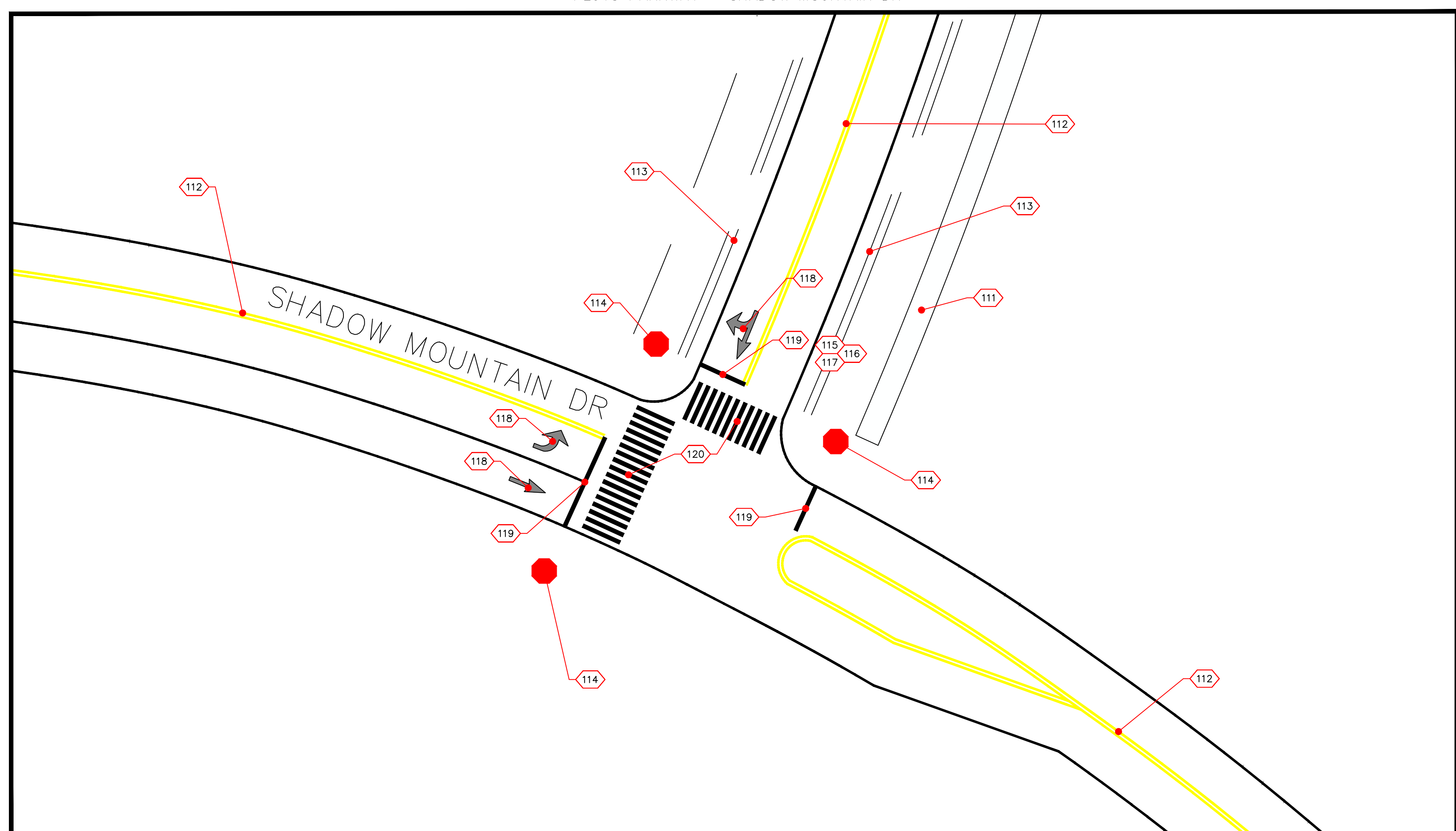
project:	
proj #:	
drawing name:	VANOVA 486 PLANSET
drawn by:	LHT
reviewed by:	SH,JS,OS
date:	04/12/2026
review #:	

revisions:	

INTERSECTION
PLUTO PARKWAY – FS RD 171

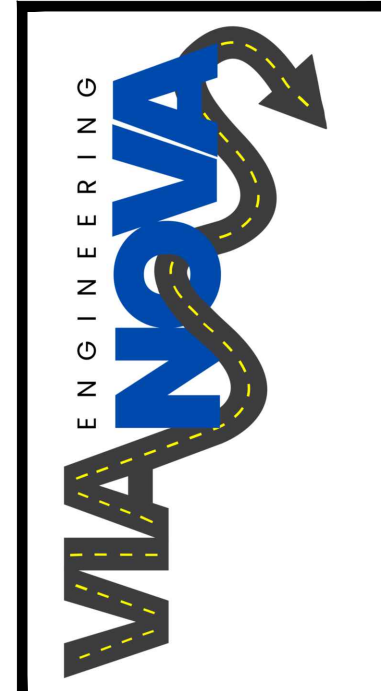
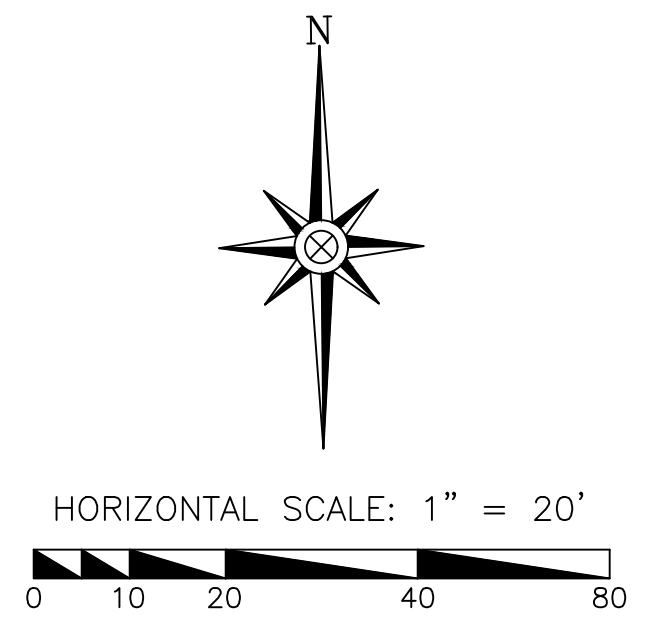


INTERSECTION
PLUTO PARKWAY – SHADOW MOUNTAIN DR



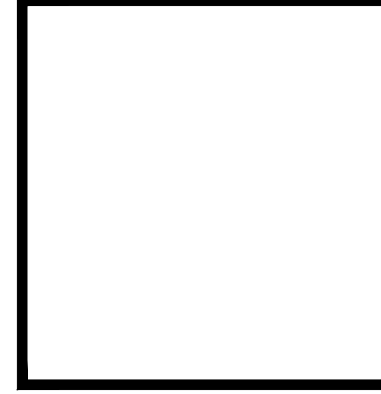
CONSTRUCTION NOTES

- 111 6' SIDEWALK
- 112 6" DOUBLE YELLOW CENTERLINE STRIPING
- 113 6" WHITE SHOULDER STRIPING
- 114 30" X 30" R1-1 STOP SIGN AND POST
- 115 24" X 30" R2-1 35 MPH SPEED LIMIT SIGN AND POST
- 116 24" X 30" R4-1 DO NOT PASS SIGN AND POST
- 117 24" X 30" R3-17 BIKE LANE SIGN AND POST
- 118 ADDOT M-10 TURN LANE ARROWS THERMO
- 119 12" WHITE STOP BAR THERMO
- 120 12" WHITE CROSSWALK LINE THERMO



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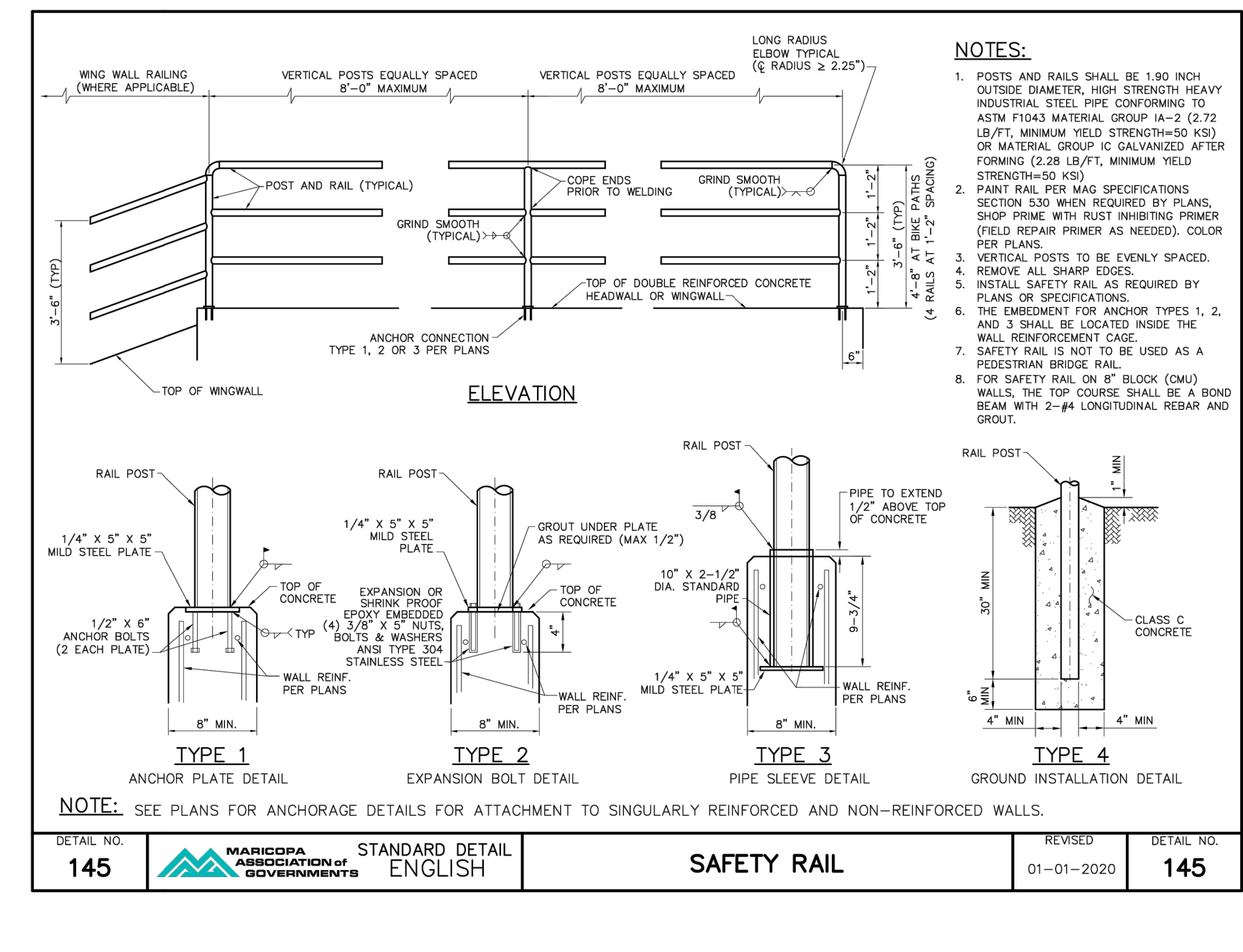
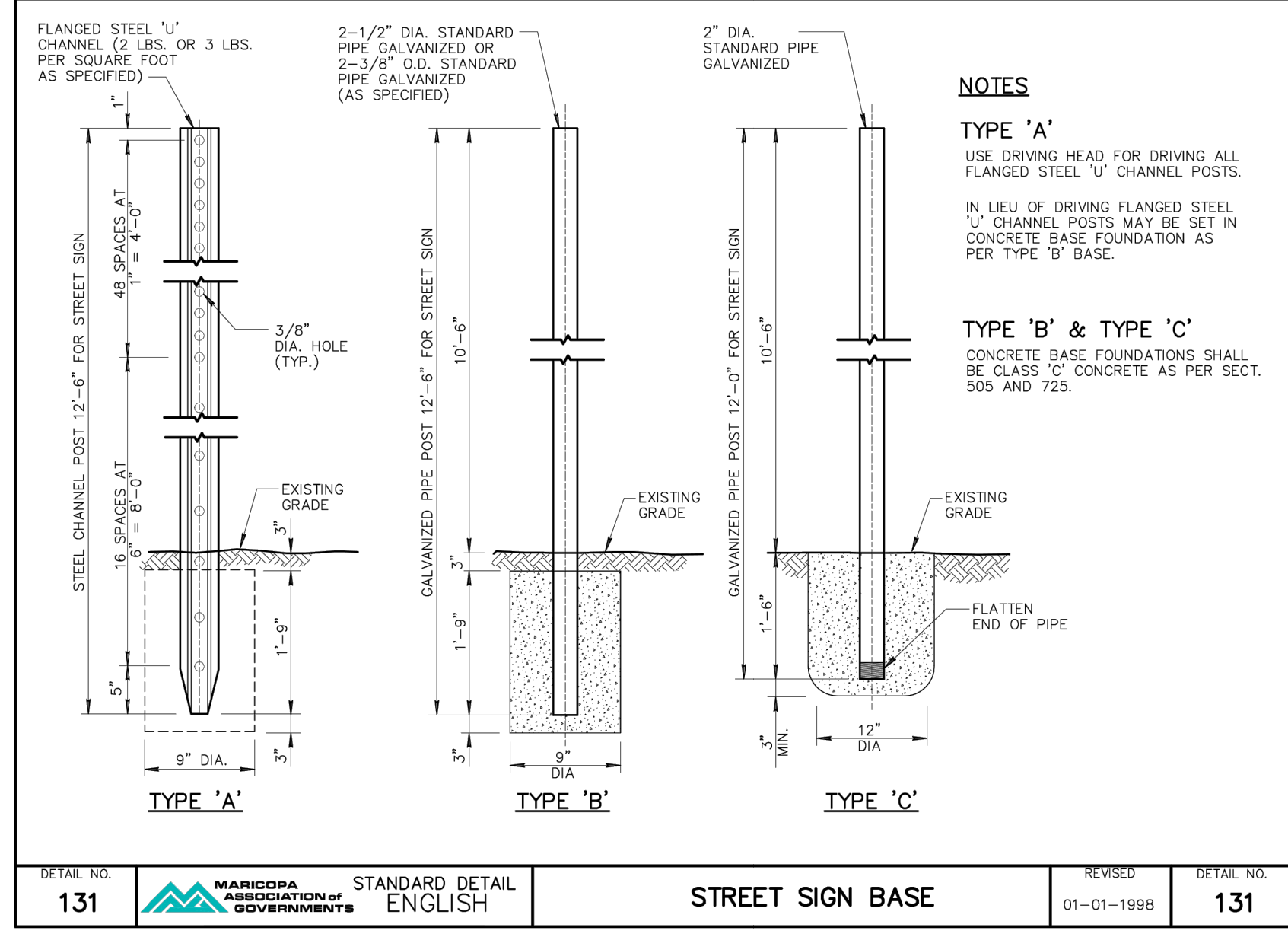
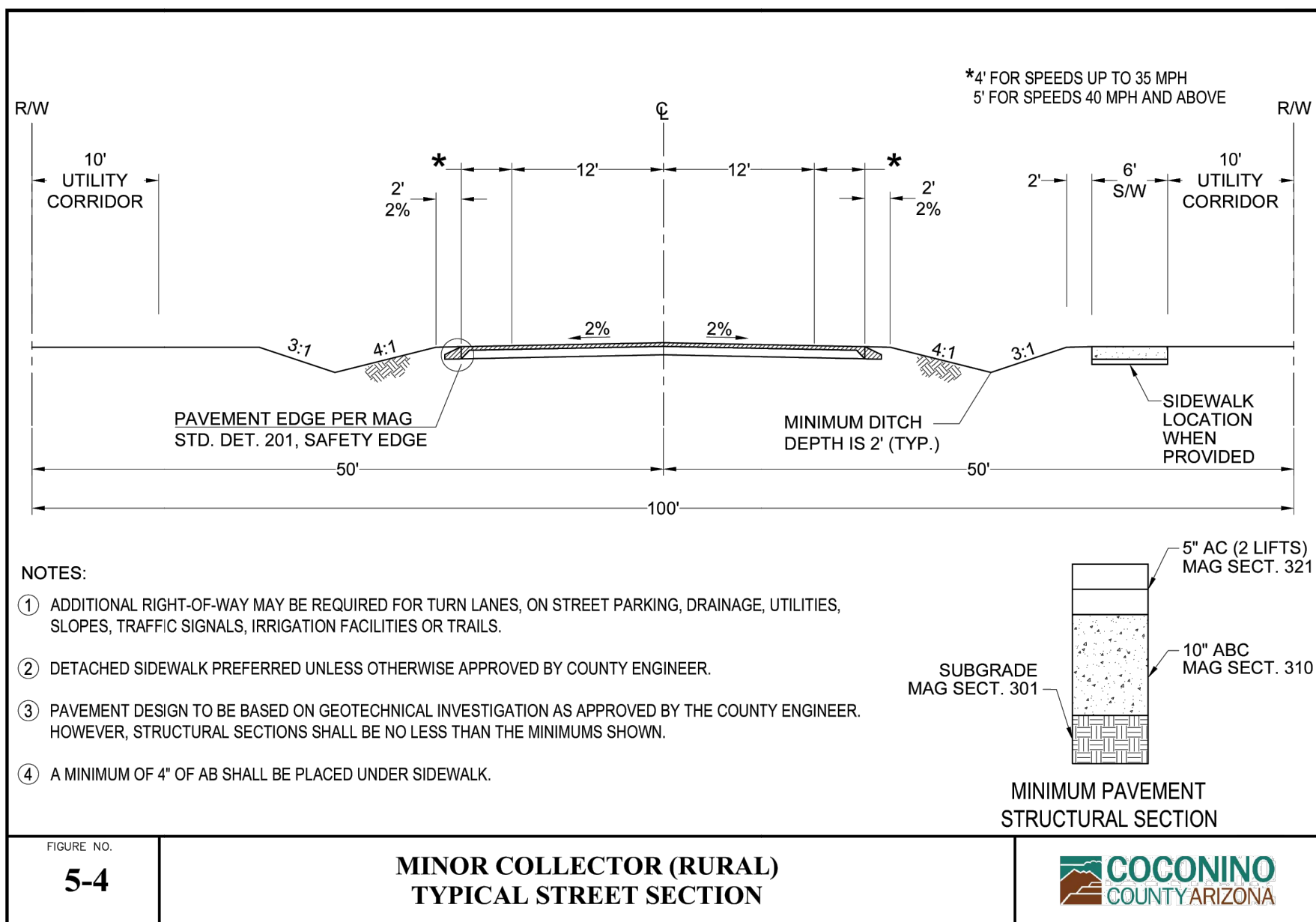
INTERSECTION DESIGN
BELLEMONT ALIGNMENT
APN 203-47-005
BELLEMONT
ARIZONA, 86005



project:
proj #:
drawing name:
drawn by: LHT
reviewed by: SH,JS,OS
date: 04/12/2026
review #:

revisions:

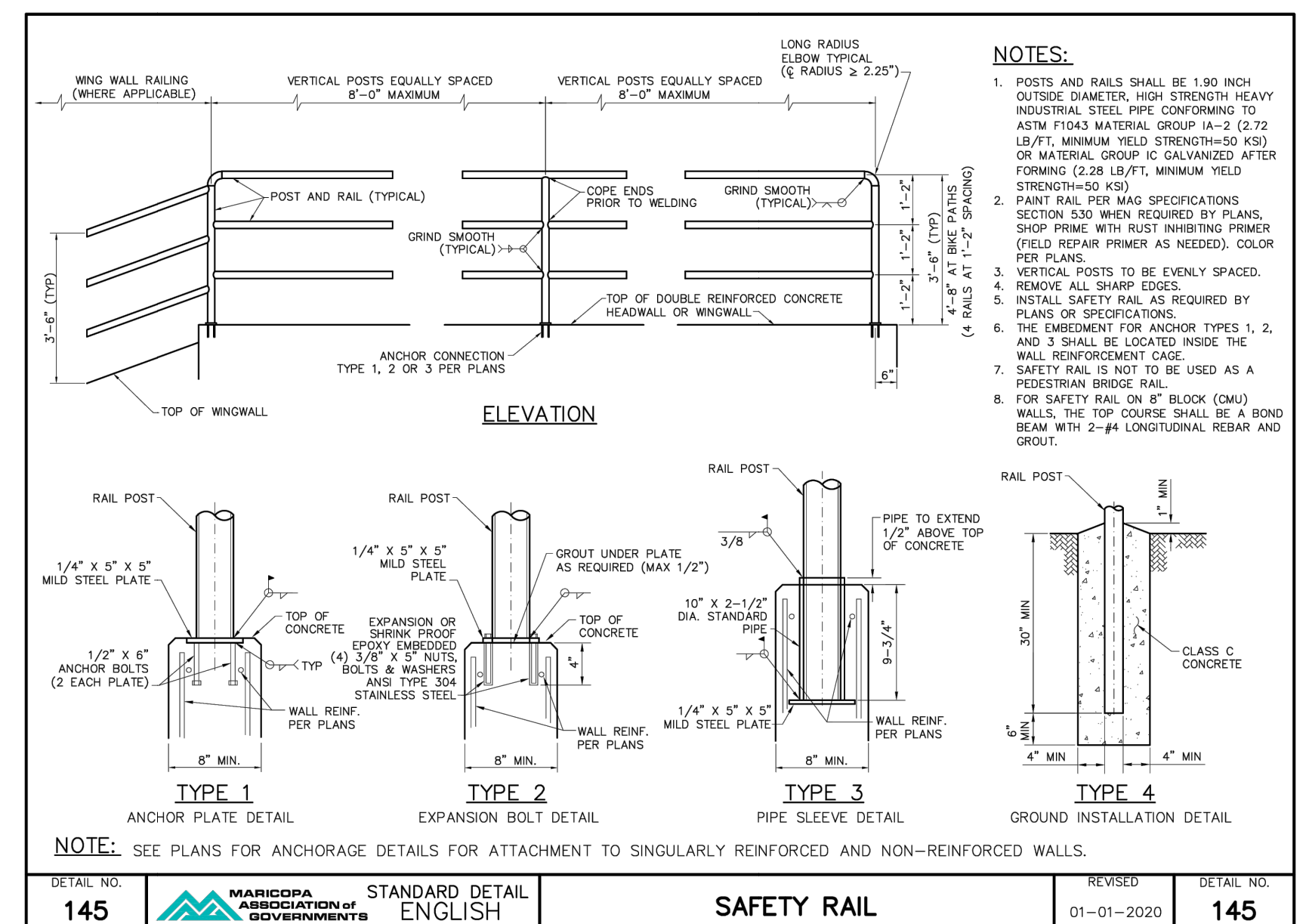
sheet C11 of C13



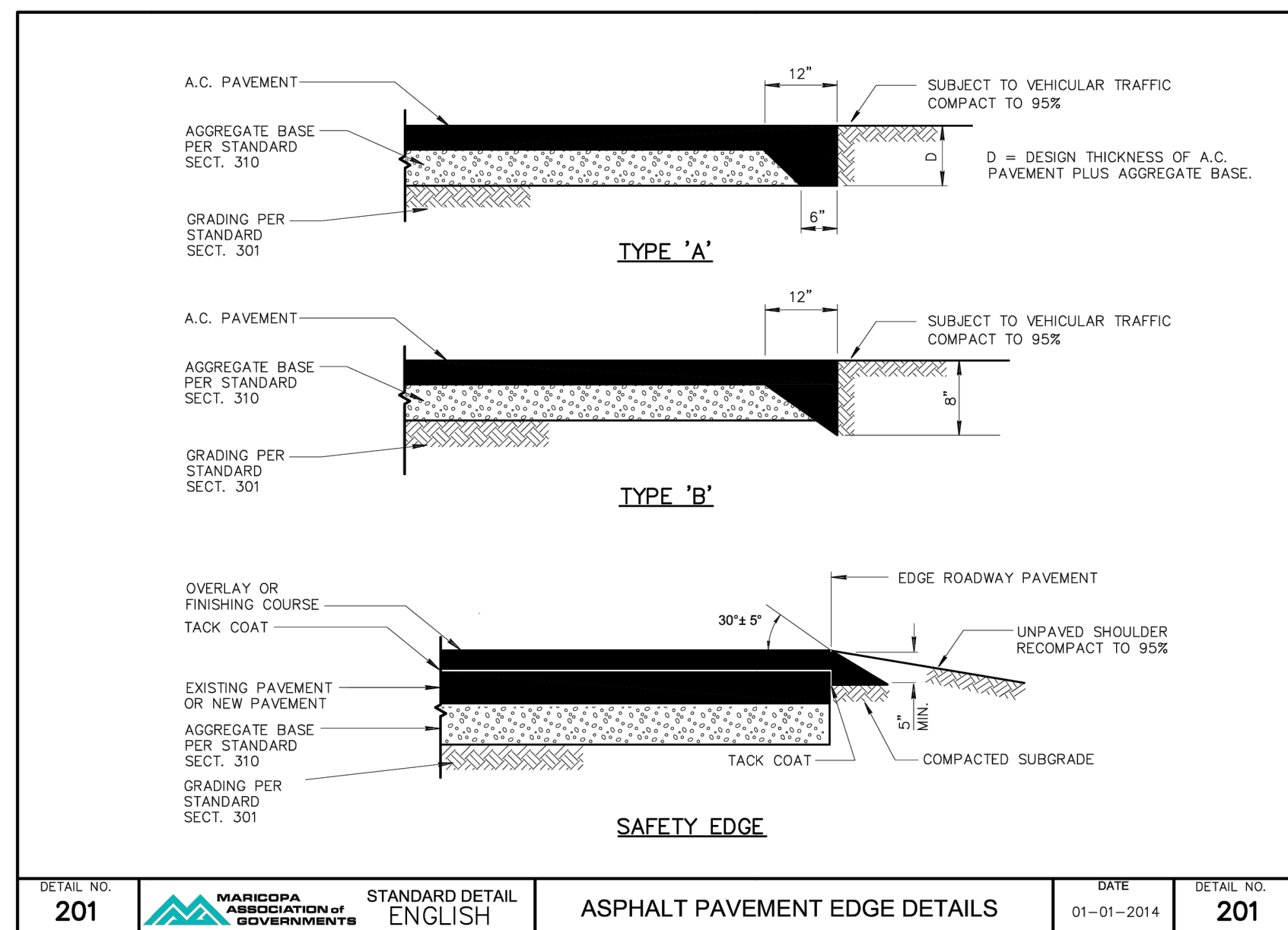
A MINOR COLLECTOR (RURAL) TYPICAL STREET SECTION
NOT TO SCALE

B STREET SIGN BASE
NOT TO SCALE

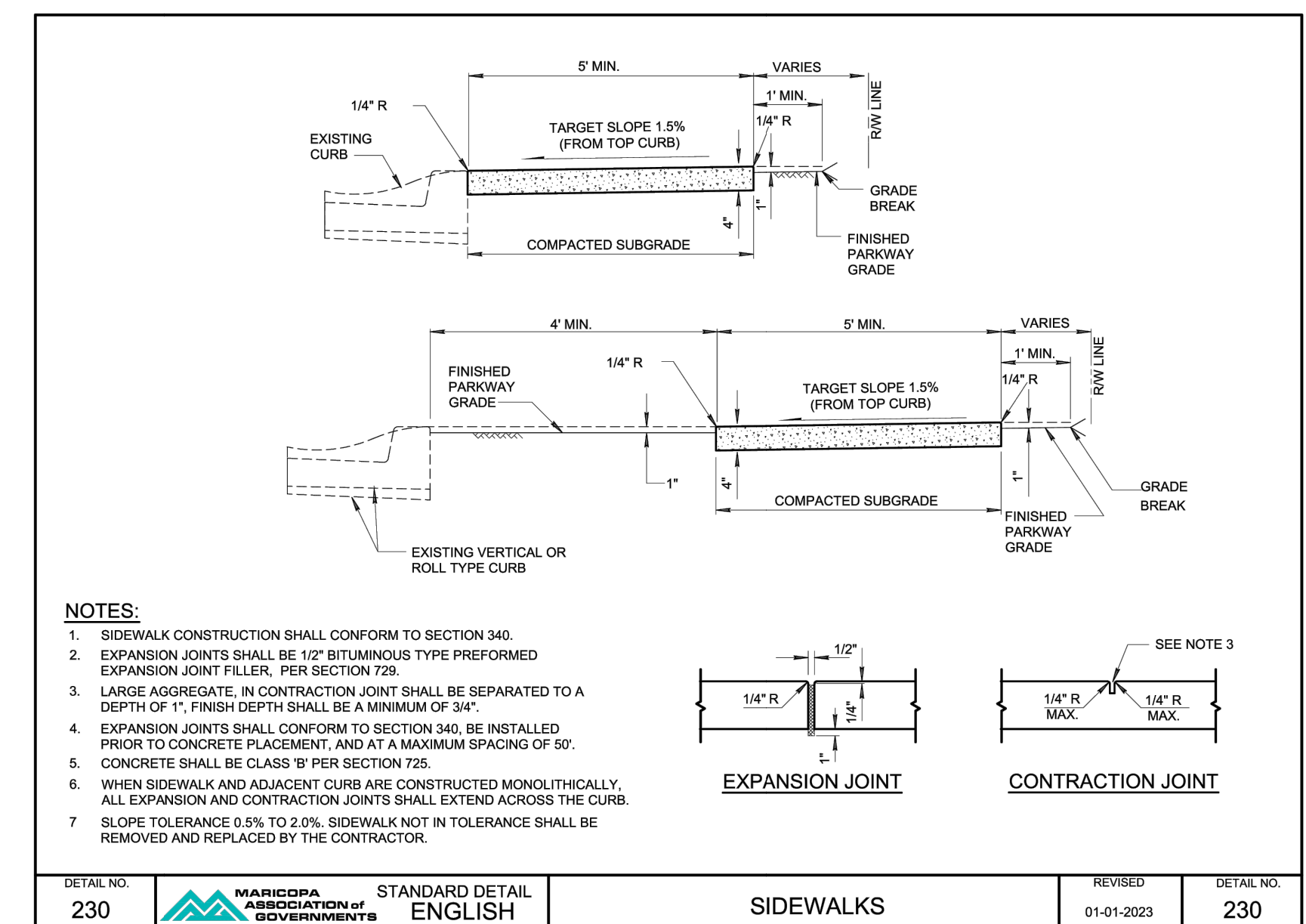
C SAFETY RAIL
NOT TO SCALE



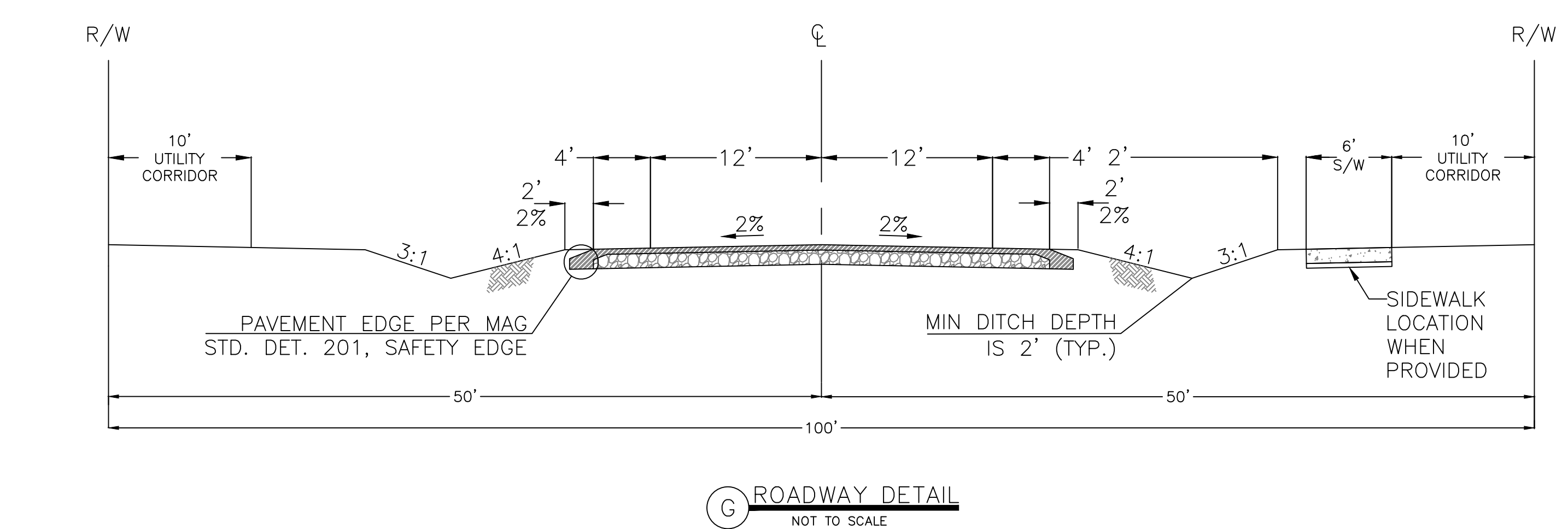
D SAFETY RAIL
NOT TO SCALE



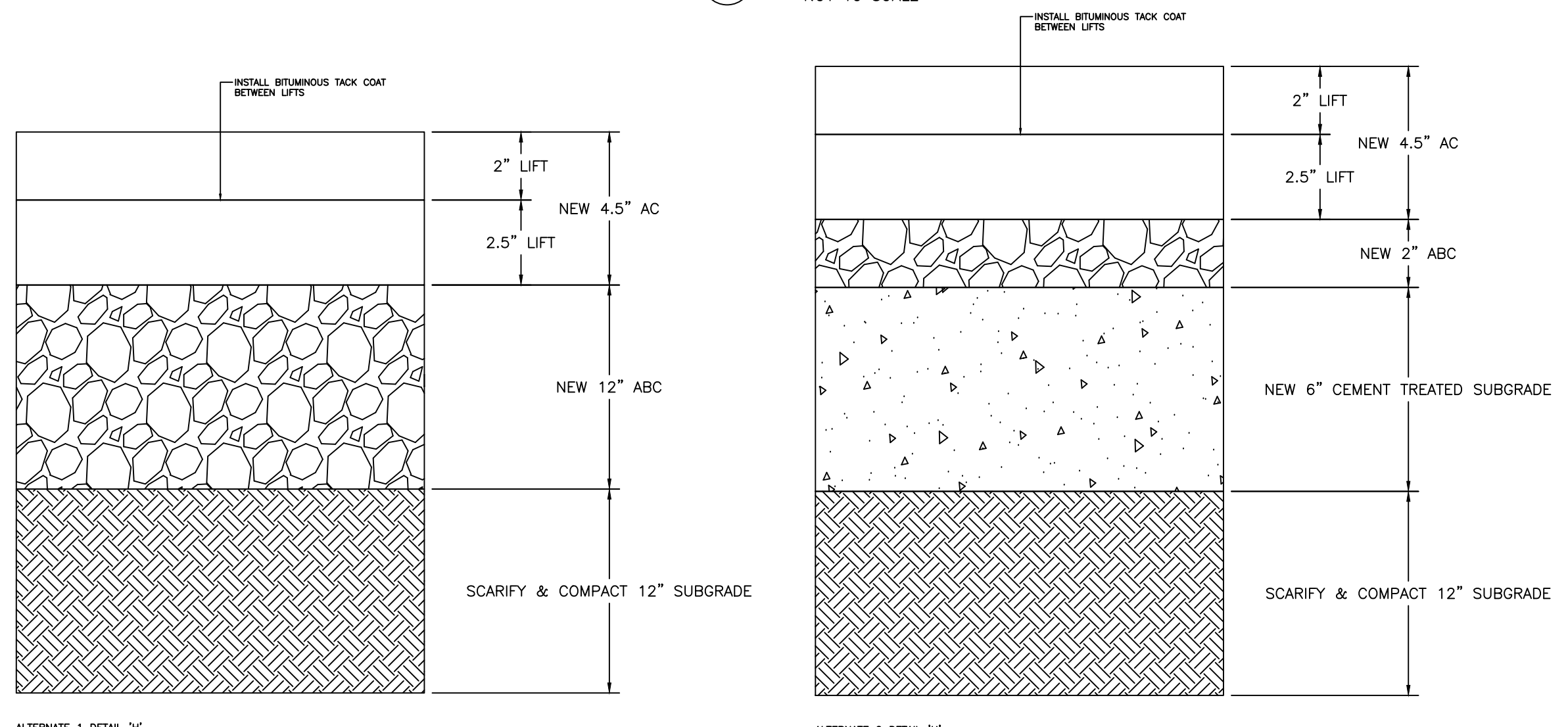
E ASPHALT PAVEMENT EDGE DETAILS
NOT TO SCALE



F SIDEWALKS
NOT TO SCALE



G ROADWAY DETAIL
NOT TO SCALE



H PAVEMENT DETAIL
NOT TO SCALE

VERTICAL CURVE

Curve Number	Curve Type	PVC Station	PVC Elev	PVI Station	PVI Elev	PVT Station	PVT Elev
Curve 1	Sag	60.50	7150.37	110.00	7150	159.50	7150.25
Curve 2	Crest	268.08	7150.79	349.58	7,151.20	431.08	7149.42
Curve 3	Sag	494.50	7148.05	600.00	7145.75	705.50	7145.22
Curve 4	Sag	2460.50	7136.45	2500.00	7,136.25	2539.50	7136.45
Curve 5	Sag	4408.50	7145.79	4500.00	7,146.25	4591.50	7147.91
Curve 6	Crest	4808.00	7151.85	4926.00	7154	5044.00	7151.58
Curve 7	Sag	5708.50	7137.50	5729.00	7137.5	5749.50	7137.61

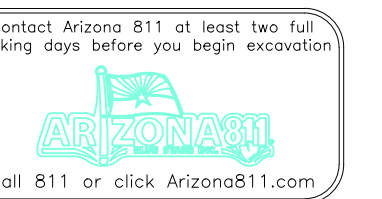
HORIZONTAL CURVE

Horizontal Curve Data	Horizontal Curve 1	Horizontal Curve 2
Radius (ft)	2303	1176
PC (station)	19+78.48	52+46.67
PI (station)	23+17.49	60+57.93
PT (station)	26+59.58	70+26.26
Superelevation rate (%)	3.6	5.2
Side-Friction Factor	0.15	0.15
Length of Runoff (ft)	86.4	124.8
Length of Runout (ft)	28.8	41.6



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CONTROL POINT
BELLEMONT ALIGNMENT
APN 203-47-005
BELLEMONT
ARIZONA, 86005



project:
pro. #:
drawing name:
VANOVA 486 PLANSET
drawn by: LHT
reviewed by: SH,JS,OS
date: 04/12/2026
review #:

revisions:

Appendix R: Decision Matrix Calculations

Decision Matrix Calculations

Table 1: Quantitative Data

	Alternative 1	Alternative 2	Alternative 3
Watershed Total Acreage	1759	25339	1671
Earthwork (CY)	36062	36722	65633
Tree Removal (SF)	162818	119030	59699
Alignment Length (ft)	6881	6610	7876

Max Normalization (Highest Score = Ideal Alternative)

$$x' = 1 - \frac{x}{\max(X)}$$

Where:

x = raw value

x' = standardized value

$\max(X)$ = maximum value within the set

Table 2: Standardized Data

	Alternative 1	Alternative 2	Alternative 3
Hydraulic Cost	.93	0	.93
Cut & Fill Work	.45	.44	0
Environmental Impact	.73	.80	0
Alignment Length	.13	.16	0
Total Score	2.23	1.40	.93

Table 3: Weighted Matrix

	Weight	Alternative 1	Alternative 2	Alternative 3
Hydraulic Cost	40%	37	0	37
Cut & Fill Work	20%	9	9	0
Environmental Impact	20%	15	16	0
Alignment Length	20%	3	3	0
Total Score	100%	63	28	37

Structural Section

Table 4: Raw Structural Section Values

	subgrade	ctb
cost	2190962.86	1987165.14
strength	4.25	4.29

Table 5: Weighted Structural Section Values

		subgrade	ctb
cost	Weighted by Max	0	.093
strength	Weighted Relative to SN=4.23	.047	.142

Sidewalk Length

Table 6: Raw Sidewalk Length Values

raw	reduced	full
cost	25852.16	62999.81
access	0.41	1
future	37147.65	0

Table 7: Weighted by Maximum Sidewalk Length Values

	reduced	full
cost	0.59	0
access	0	0.59
future	1	0

Appendix S: Engineer's Opinion of Probable Cost

Engineers Opinion of Probable Cost				
Item	Quantity	Unit of Measure	Unit Price	Total Cost
Demo				
Tree Removal	135	EA	\$225.96	\$30,503.99
Clear and Grub	503345	SY	\$0.85	\$428,346.21
Rock Removal	9784	CY	\$4.11	\$40,170.18
Demo Subtotal				\$499,020.39
Roadway				
Earthwork (Cut & Fill)	38723	CY	\$21.80	\$844,316.29
Scarify, Recompact, and Finegrade 12" Subgrade	24981	SY	\$8.72	\$217,837.23
Alt. 1 Place, Compact, and Finegrade 12" AB	24981	SY	\$78.98	\$1,973,125.63
Alt. 2 Place, Compact, and Finegrade 6" AB with CTB Treatment	24981	SY	\$57.66	\$1,440,473.64
Alt. 2 Place, Compact, and Finegrade 2" AB	24981	SY	\$13.16	\$328,854.27
Pave 4.5" AC	25615	SY	\$92.07	\$2,358,366.91
6' Sidewalk	1922	SY	\$13.45	\$25,852.16
6" Double Yellow Centerline Striping	7026	LF	\$0.49	\$3,442.74
6" White Shoulder Striping	14052	LF	\$0.25	\$3,513.00
30" x 30" R1-1 Stop Sign and Post	4	EA	\$547.22	\$2,188.88
24" x 30" R2-1 35 MPH Speed Limit Sign and Post	4	EA	\$547.22	\$2,188.88
24" x 30" R4-1 Do Not Pass Sign and Post	2	EA	\$547.22	\$1,094.44
24" x 30" R3-17 Bike Lane Sign and Post	4	EA	\$547.22	\$2,188.88
ADOT M-10 Turn Lane Arrows Thermo	3	EA	\$557.50	\$1,672.50
12" White Stop Bar Thermo	50	LF	\$6.03	\$301.50
12" White Crosswalk Line Thermo	250	LF	\$5.76	\$1,440.00
Roadway Subtotal Alt 1				\$5,437,529.04
Roadway Subtotal Alt 2				\$5,233,731.32
Hydraulic Structures				
30" CMP	2	EA	\$25,194.40	\$50,388.80
4' x 10' ADOT SD 6.01 Reinforced Concrete Box Culvert	1	EA	\$94,112.78	\$94,112.78
4' x 7' ADOT SD 6.01 Reinforced Concrete Box Culvert	2	EA	\$65,878.94	\$131,757.88
Commercial Flared End Section	2	EA	\$545.42	\$1,090.84
Culvert Wingwall	4	EA	\$14,068.26	\$56,273.04
Wingwall Handrail	180	LF	\$122.91	\$22,123.80
Hydraulic Structures Subtotal				\$355,747.14
Contract				
Mobilization/Demobilization	1	LS	\$185,711.93	\$185,711.93
SWPPP/BMP Installation	1	LS	\$30,951.99	\$30,951.99
Survey/Staking	1	LS	\$30,951.99	\$30,951.99
Traffic Control	1	LS	\$61,903.98	\$61,903.98
Quality Control	1	LS	\$123,807.95	\$123,807.95
Contract Subtotal				\$433,327.84
Alt. 1 Total				\$6,725,624.40
Alt. 2 Total				\$6,521,826.69

Notes

west side - 33767sf @ .00270 tree/sf = 90.45, east side - 40 tree, includes trucking
quant from c3d, includes trucking
100' ROW x ASSUME 2641.81sf xc of rock, includes trucking

quant from c3d, includes trucking
32' roadway width x 7026' length, assumes native subgrade
32' roadway width x 7026' length
32' roadway width x 7026' length, 21.80/CY, assumes import AB
32' roadway width x 7026' length
add safety edge (5x8.66"x4.5"=.135 sf x 2= .27 sf / lf * 7026 lf = 70.40 CY)
ONLY from end STA 6954.96 to edge of new development STA 4071.82 - 4" class b concrete on 4" AI 2883.14
includes mob
includes mob
includes mob
includes mob, offset 500' from each intersection, 6026lf @ 1 sign/3360' = 2 more
includes mob
includes mob
includes mob
half road @ 25', two of them
50' length, 10' width, 6 lines/12', 25 lines @ 10'

Buy 2x60', 16ga @ 43.02/lf, bedding @ 50'x4'x6'=44CY @ 455/CY = 20032 EA
CIP 50 LF
CIP 50 LF
purchase + install
mats + install
assume 45 LF per wingwall, need to add some for CMP?

average of each alt total \$6,190,397.71
3%
0.5%
0.5%
1%
2%

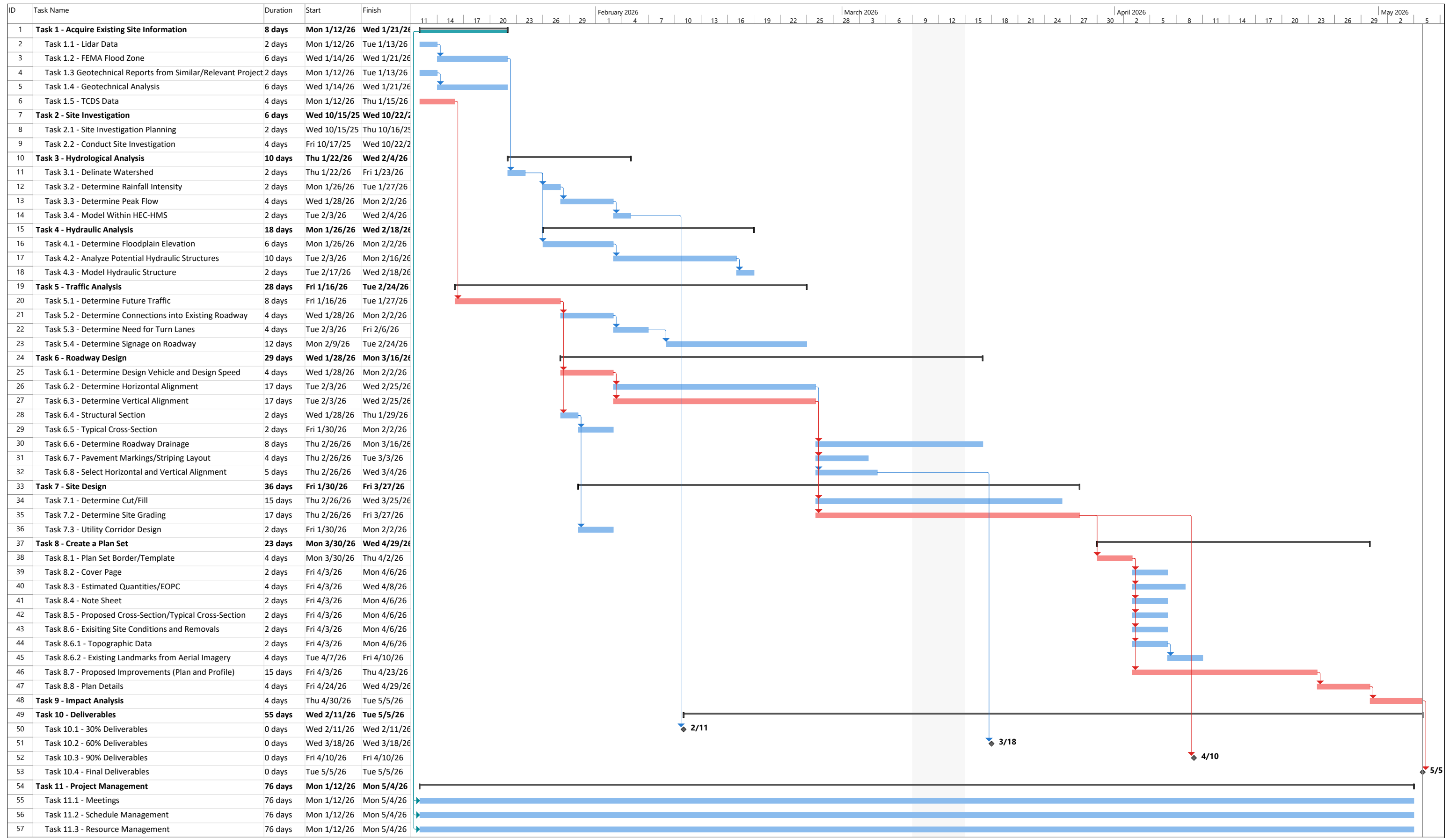
Engineers Opinion of Probable Cost	
Item	Total Cost
Demo	
Demo Subtotal	\$499,020.39
Roadway	
Roadway Subtotal Alt 1	\$5,437,529.04
Roadway Subtotal Alt 2	\$5,233,731.32
Hydraulic Structures	
Hydraulic Structures Subtotal	\$355,747.14
Contract	
Contract Subtotal	\$433,327.84
Alt. 1 Total	\$6,725,624.40
Alt. 2 Total	\$6,521,826.69

diff -\$203,797.72

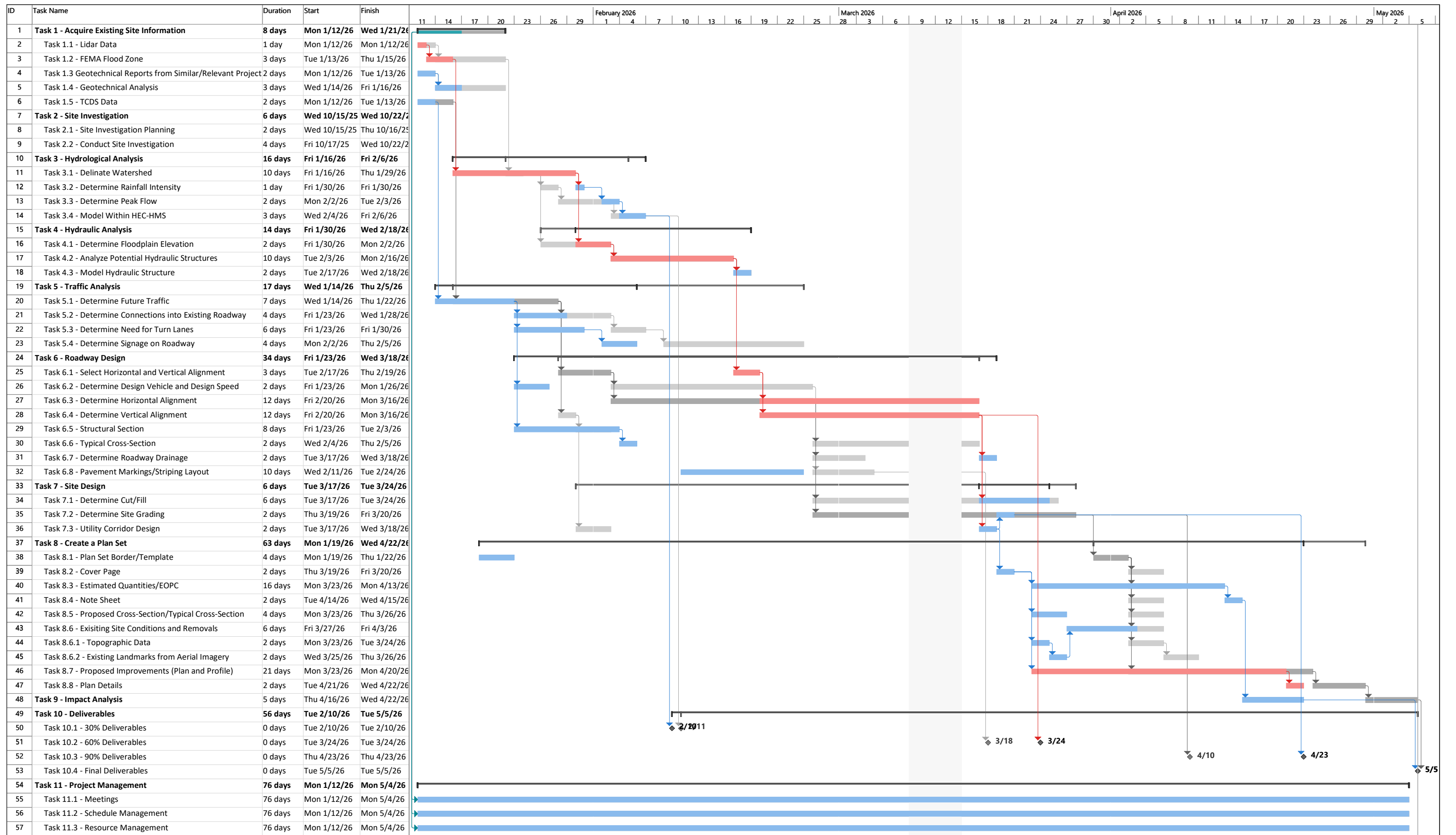
alt 1 before contract \$6,292,296.57
alt 2 before contract \$6,088,498.85

Appendix T: Project Gantt Chart

Appendix T-1: Original Gantt Chart

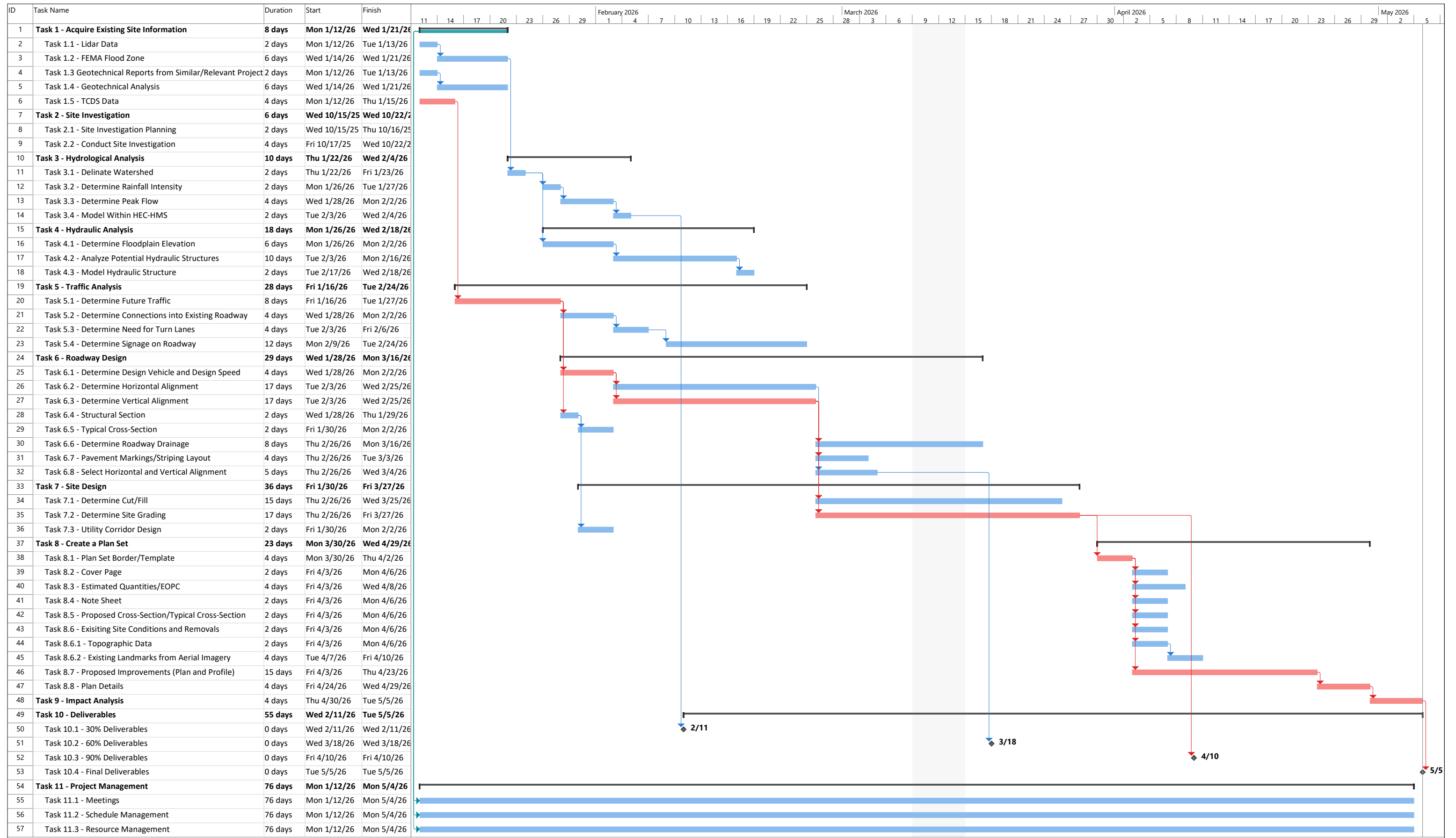


Project: Capstone Schedule Rev Date: Tue 12/9/25	Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Critical Split
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	Progress	
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Critical	Manual Progress	

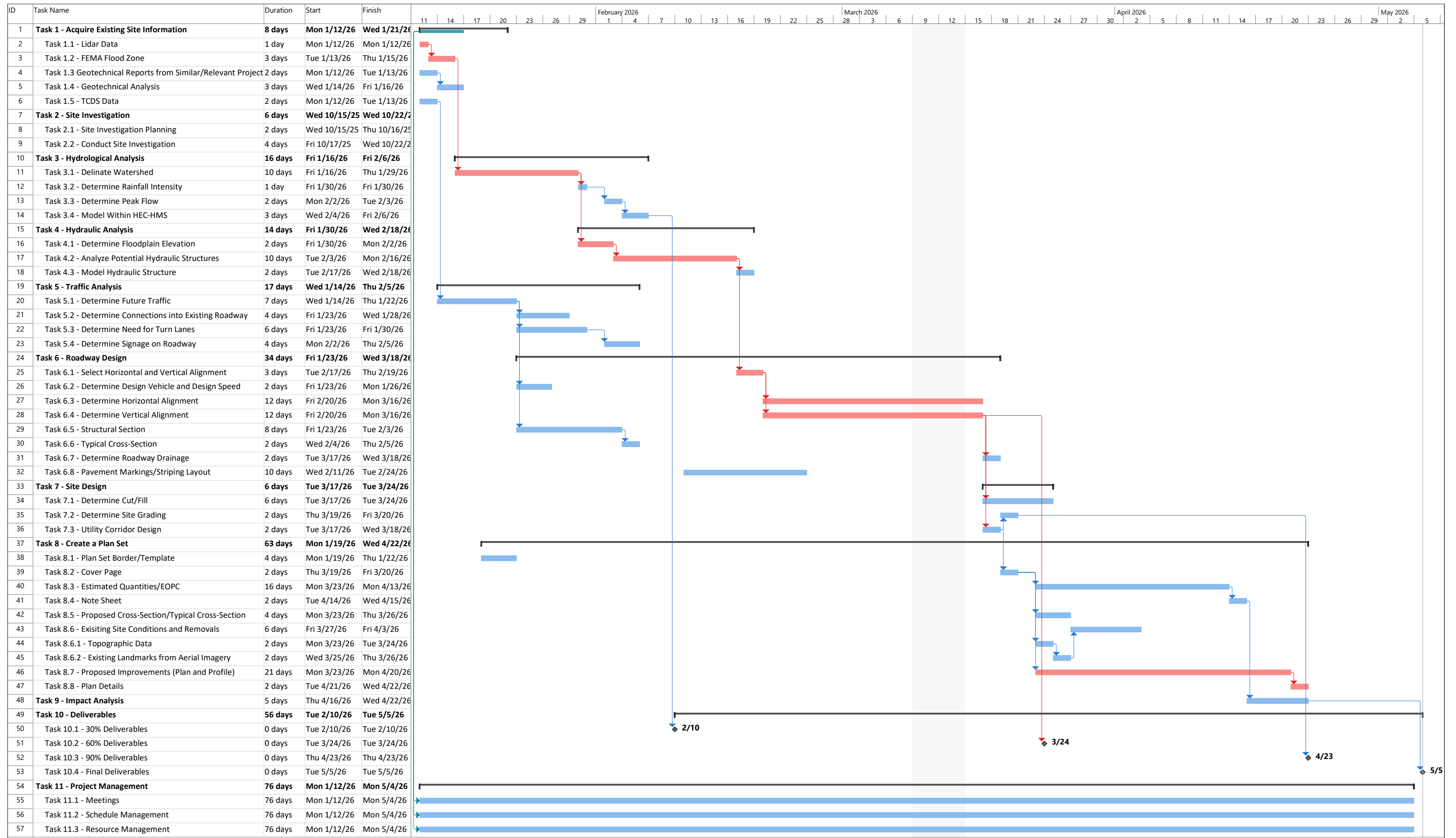


Project: Capstone Schedule	Task		Summary		Inactive Milestone		Duration-only		Start-only		External Milestone		Critical Split	
	Split		Project Summary		Inactive Summary		Manual Summary Rollup		Finish-only		Deadline		Progress	
	Milestone		Inactive Task		Manual Task		Manual Summary		External Tasks		Critical		Manual Progress	

Appendix T-2: Final Gantt Chart



Project: Capstone Schedule Rev Date: Tue 12/9/25	Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Critical Split
	Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	Progress
	Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Critical	Manual Progress



Project: Capstone Schedule Rev
Date: Thu 4/16/26

Task		Summary		Inactive Milestone		Duration-only		Start-only		External Milestone		Critical Split	
Split		Project Summary		Inactive Summary		Manual Summary Rollup		Finish-only		Deadline		Progress	
Milestone		Inactive Task		Manual Task		Manual Summary		External Tasks		Critical		Manual Progress	

Appendix U: Project Staffing and Cost Tables

Appendix U-1: Original Staffing and Cost Tables



Task #	Task Name	Sr Engr.	Engr.	Tech	Intern	Subtotal
1.0	Aquire Existing Site Information	4	0	12	40	56
1.1	Lidar Data	0.5		4	12	16.5
1.2	FEMA Flood Zone	0.5			4	4.5
1.3	Geotechnical Reports from Simlar/Relavent Projects	0.5			12	12.5
1.4	Geotechnical Analysis	2		8		10
1.5	TCDS Data	0.5			12	12.5
2.0	Site Investegation	8	4	8	4	24
2.1	Site Investigation Planning	4	2	4	2	12
2.2	Conduct Site Investigation	4	2	4	2	12
3.0	Hydrologic Analysis	3	5	22	8	38
3.1	Delinate Watershed	0.5			8	8.5
3.2	Determine Rainfall Intensity	0.5		6		6.5
3.3	Determine Peak Flow	1	5	10		16
3.4	Model Within HEC-HMS	1		6		7
4.0	Hydraulic Analysis	3	14	12	8	37
4.1	Determine Floodplain Elevation	2	10			12
4.2	Analyze Potential Hydraulic Structures	0.5	4	8	8	20.5
4.3	Model Hydraulic Structure	0.5		4		4.5
5.0	Traffic Analysis	3	18	22	14	57
5.1	Determine Future Traffic		2	6	8	16
5.2	Determine Connections Into Existing Roadway	0.5	4	4		8.5
5.3	Determine Need for Turn Lanes	0.5	4	4		8.5
5.4	Determine Signage on Roadway	2	8	8	6	24
6.0	Roadway Design	14	30	36	38	118
6.1	Determine Design Vehicle and Design Speed	0.5		2	2	4.5
6.2	Determine Horizontal Alignment	4	10	10	10	34
6.3	Determine Vertical Alignment	4	10	10	10	34
6.4	Structural Section	0.5			4	4.5
6.5	Typical Cross-Section			4		4
6.6	Determine Roadway Drainage	0.5	4	4	8	16.5
6.7	Pavement Marking/Striping Layout	0.5	4	4		8.5
6.8	Select Horizontal/Vertical Alignment	4	2	2	4	12
7.0	Site Design	3	20	22	34	79
7.1	Determine Cut/Fill	2	8	10	10	30
7.2	Determine Site Grading	0.5	12	12	20	44.5
7.3	Utility Corridor Design	0.5			4	4.5
8.0	Create a Plan Set	7	17	44	29	97
8.1	Plan Set Border/Template	0.5	2	2		4.5
8.2	Cover Page			2	2	4
8.3	Estimated Quantities/EOPC	0.5	4	4		8.5
8.4	Note Sheet	0.5		2	2	4.5
8.5	Proposed Cross-Section/Typical Cross-Section	1		3		4
8.6	Existing Site Conditions and Removals	1	3	1		5
8.6.1	Topographic Data	0.5		4		4.5
8.6.2	Existing Landmarks from Aerial Imagery	0.5		2	6	8.5
8.7	Proposed Improvements (Plan and Profile)	2	8	20	15	45
8.8	Plan Details	0.5		4	4	8.5
9.0	Impact Analysis	4	4	4		12
10.0	Project Management	24	15	9	6	54
10.1	Meetings	8	5	3	2	18
10.2	Schedule Management	8	5	3	2	18
10.3	Rescource Management	8	5	3	2	18
11.0	Deliverables	32	24	16	16	88
11.1	30% Deliverables	8	4	4	4	20
11.2	60% Deliverables	8	4	4	4	20
11.3	90% Deliverables	8	8	4	4	24
11.4	Final Deliverables	8	8	4	4	24
Total Project Hours		105	151	207	197	660

Total 660 hours

Task #	Task Name	Sr Engr.	Engr.	Tech	Intern	Subtotal
1.0	Aquire Existing Site Information	4	0	12	40	56
2.0	Site Investegation	8	4	8	4	24
3.0	Hydrologic Analysis	3	5	22	8	38
4.0	Hydraulic Analysis	3	14	12	8	37
5.0	Traffic Analysis	3	18	22	14	57
6.0	Roadway Design	14	30	36	38	118
7.0	Site Design	3	20	22	34	79
8.0	Create a Plan Set	7	17	44	29	97
9.0	Impact Analysis	4	4	4		12
10.0	Project Management	24	15	9	6	54
11.0	Deliverables	32	24	16	16	88
Total Project Hours		105	151	207	197	660

1.0 Personnel	Classification	Hours	Rate, \$/hr	Cost
	SENG	105	\$162	17,010
	ENG	151	\$127	19,177
	TECH	207	\$110	22,770
	INT	197	\$84	16,548
	Total personnel			75,505
2.0 Software	Software	300	\$10	3,000
3.0 Total				78,505

Appendix U-2: Final Staffing and Cost Tables

Percent Complete 100%

Task #	Task Name	Spencer Huttenmeyer				Janelle Sanchez				Orlando Santoyo				Lauren Towner				Total				
		Sr Engr.	Engr.	Tech	Intern	Sr Engr.	Engr.	Tech	Intern	Sr Engr.	Engr.	Tech	Intern	Sr Engr.	Engr.	Tech	Intern	Sr Engr.	Engr.	Tech	Intern	
1.0	Acquire Existing Site Information																					
1.1	Lidar Data	0.5																3	0.5	0	7	2
1.2	FEMA Flood Zone	0.5						1										1	0.5	0	0	2
1.3	Geotechnical Reports from Similar/Relevant Projects					3				2	0.5							8	0.5	0	0	13
1.4	Geotechnical Analysis	0.5					0.5					4							1	0	0	4
1.5	TCDS Data									1	0.5								0.5	0	0	6
2.0	Site Investigation																					
2.1	Site Investigation Planning	2				1		2		2	2	2							1	6	4	4
2.2	Conduct Site Investigation					1		2		2	2	2							1	2	2	2
3.0	Hydrologic Analysis																					
3.1	Delinate Watershed	1					0.5			18	1			5					5.5	4	22	23
3.2	Determine Rainfall Intensity						0.5			4	0.5			6					1	0	10	0
3.3	Determine Peak Flow						0.5	2		2	0.5			4					0.5	2	6	0
3.4	Model Within HEC-HMS							6			1.5	2		4					1.5	2	6	0
4.0	Hydraulic Analysis																					
4.1	Determine Off-Site Drainage	0.5	1				1				1								1	6	9	9
4.2	Analyze Potential Hydraulic Structures	0.5					2					9	9						0.5	2	9	9
4.3	Model Hydraulic Structure																		0	0	0	0
5.0	Traffic Analysis																					
5.1	Determine Future Traffic			2	8														2	14	16	10
5.2	Determine Connections Into Existing Roadway		3	3											0.5	1	1		0.5	4	4	8
5.3	Determine Need for Turn Lanes		3	4											0.5	2	1		0.5	5	5	0
5.4	Determine Signage on Roadway		1	2	2										1	1			1	2	2	2
6.0	Roadway Design																					
6.1	Determine Design Vehicle and Design Speed			1	2		0.5												12.5	18	21	35
6.2	Determine Horizontal Alignment		8	6	8		1				1			1					0.5	0	1	2
6.3	Determine Vertical Alignment		5	7	6		1				1			1					3	5	7	6
6.4	Structural Section	1								14	1								2	0	0	14
6.5	Typical Cross-Section			1						1		1							0	0	4	0
6.6	Determine Roadway Drainage						0.5				1	1	2						0.5	1	1	2
6.7	Pavement Marking/Striping Layout	0.5	1								1	1	2						0.5	2	2	0
6.8	Select Horizontal and Vertical Alignment	1	2					1	3	1	1	2		1					3	3	2	3
7.0	Site Design																					
7.1	Determine Cut/Fill		2				1				1				1	4	4		2	3	4	4
7.2	Determine Site Grading	0.5					1				1					4	4		4	5	2	4
7.3	Utility Corridor Design						0.5									2	0.5	0	0	0	0	2
8.0	Create a Plan Set																					
8.1	Plan Set Border/Template										0.5				2	2			8	14	45	34
8.2	Cover Page															2	2		0	2	2	0
8.3	Estimated Quantities/EOPC		1	1							0.5								0.5	1	1	0
8.4	Note Sheet						0.5								3	2			0.5	0	3	2
8.5	Proposed Cross-Section/Typical Cross-Section						2				0.5								0.5	0	2	0
8.6	Existing Site Conditions and Removals	0.5												1	1				0.5	1	1	0
8.6.1	Topographic Data						0.5									3			0.5	0	3	0
8.6.2	Existing Landmarks from Aerial Imagery										0.5					1	4		0.5	0	1	4
8.7	Proposed Improvements (Plan and Profile)	2	2				1	2			1	2			4	24	16		4	10	24	16
8.8	Plan Details			2	2			4	4		0.5								0.5	0	6	10
9.0	Impact Analysis		4	4								5							4	4	5	6
10.0	Project Management																					
10.1	Meetings	4					2				1	3	2	1	1	2	1	1	8	5	3	2
10.2	Schedule Management	8	2				3	1	1		1	1	1		1	1			8	5	3	2
10.3	Resource Management	4					2	2	2		1	2	2	1	1	1	1		8	5	3	2
11.0	Deliverables																					
11.1	30% Deliverables	2					5	1	2	1		2	1	2	1	1	1	1	32	20	16	16
11.2	60% Deliverables	1			2	1	6	2		2	1	2	2	1					8	4	4	4
11.3	90% Deliverables	2			1		3	4	1	2	2	3	2		1	1	1		8	8	4	4
11.4	Final Deliverables	2					2	4		2	2	4	4		2	4			8	4	4	4
Total		38	37	31	35		32.5	24	29	49	19.5	24	48	39	13	19	58	51	103	104	166	174

Spencer = 141

Janelle = 134.5

Orlando = 130.5

Lauren = 141

Task #	Task Name	Sr Engr.	Engr.	Tech	Intern	Subtotal
1.0	Acquire Existing Site Information	3	0	7	27	37
2.0	Site Investigation	8	4	8	4	24
3.0	Hydrologic Analysis	5.5	4	22	23	54.5
4.0	Hydraulic Analysis	1	6	9	9	25
5.0	Traffic Analysis	2	14	16	10	42
6.0	Roadway Design	12.5	18	21	35	86.5
7.0	Site Design	3	5	8	10	26
8.0	Create a Plan Set	8	14	45	34	101
9.0	Impact Analysis	4	4	5	0	13
10.0	Project Management	24	15	9	6	54
11.0	Deliverables	23	20	16	16	84
	Total Project Hours	103	104	166	174	547

1.0 Personnel	Classification	Hours	Rate, \$/hr	Cost
	SENG	103	\$162	\$16,686
	ENG	104	\$127	\$13,208
	TECH	166	\$110	\$18,260
	INT	174	\$84	\$14,616
	Total personnel			\$62,770
2.0 Software	Software	300	\$10	\$3,000
1.0 Total				\$66,770