



North Bay at Lake Woodmoor

Final Drainage Report

July 2026

HR Green Project No: 2404118

Prepared For:

Lake Woodmoor Development, LLC

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EDARP File No.: SF263



Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Colleen Monahan, P.E., LEED AP

Date

State of Colorado No. 56067

For and on behalf of HR Green Development, LLC

Owner/Developer's Statement:

I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

By: _____

Authorized Signature

_____ Date

Address: Lake Woodmoor Development, LLC
9540 Federal Drive Suite 200
Colorado Springs, CO 80920

El Paso County Statement

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development code, as amended.

Joshua J. Palmer, P.E.

Date

County Engineer/ECM Administrator

Conditions:

Table of Contents

Table of Contents	2
I. General Purpose, Location and Description.....	3
a. Purpose	3
b. Location	3
c. Description of Property	3
d. Floodplain Statement	4
II. Drainage Design Criteria	4
a. Drainage Criteria	4
III. Drainage Basins and Subbasins	5
a. Major Basin Description	5
b. Existing Subbasin Description	5
c. Proposed Subbasin Description	5
IV. Drainage Facility Design.....	6
a. General Concept	6
b. Water Quality & Detention	7
c. Inspection and Maintenance	9
V. Wetlands Mitigation & Floodplain Development.....	9
a. Floodplain Development.....	9
VI. Four Step Method to Minimize Adverse Impacts of Urbanization	14
VII. Drainage and Bridge Fees.....	14
VIII. Opinion of Probable Cost	15
IX. Hydraulic Grade Line Analysis	15
X. Summary	15
XI. Drawings.....	15
XII. References	15

Appendices

- A. Vicinity Map, FEMA Map, NRCS Soil Survey
- B. Hydrologic Analysis
- C. Hydraulic Analysis
- D. Water Quality and Detention Calculations
- E. Reference Material
- F. Drainage Maps

I. General Purpose, Location and Description

a. Purpose

The purpose of this Final Drainage Report (FDR) for North Bay at Lake Woodmoor is to describe the onsite and offsite drainage patterns, size drainage infrastructure to safely capture and convey developed runoff to water quality and detention facilities, and to safely route stormwater to adequate outfalls. This FDR accompanies a Final Plat application for North Bay at Lake Woodmoor.

b. Location

North Bay at Lake Woodmoor, referred to as 'the site' herein, is a vacant property in El Paso County, Colorado near the north shoreline of Lake Woodmoor. The site lies within the southeast quarter of Section 11, Township 11 South, Range 67 West of the 6th Principal Meridian, in El Paso County, State of Colorado.

North Bay at Lake Woodmoor is located southeast of the intersection of Woodmoor Drive and Deer Creek Road. Deer Creek Road borders the northern property boundary of the site, and Lake Woodmoor borders the southern property boundary of the site. The site is bordered on the west by the Cove at Woodmoor condominiums and the east by open space owned by the Woodmoor Improvement Association and the Lake Woodmoor single-family residential neighborhood. Across Deer Creek Road to the north is the Woodmoor Oaks Subdivision. A vicinity map is presented in **Appendix A**.

c. Description of Property

The site is approximately 7.23 acres of undeveloped land consisting of native grasses and weeds, trees, floodway, and an existing gravel maintenance access to an existing sanitary sewer lift station.

The general topography of the site slopes from its northeast corner to the southern property boundary with slopes ranging from 2% to 25%. The site drains generally to the middle of the property to the FEMA floodway in its center, which drains from north to south directly into Lake Woodmoor. The site is a tributary to Lake Woodmoor, and ultimately to Dirty Woman Creek.

Per a NRCS soil survey, the western one third of the site is made up of Type B Pring Coarse Sandy Loam, and the eastern two thirds of the site Type D Alamosa Loam. Hydrologic soil groups are an estimate of soils runoff potential. Per the NRCS web soil survey, the description of hydrologic soil groups is as follows:

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

The referenced NRCS web soil survey is presented in **Appendix A**.

Lake Fork of Dirty Woman Creek is the only drainageway that traverses the site from north to south, draining through the middle of the site directly into Lake Woodmoor. There is FEMA floodway and floodplain associated with this drainageway through the middle of the site. Disturbance is proposed within the floodway and floodplain, and an application for a floodplain development permit and zero rise certification is being submitted to Pikes Peak Regional Building Department (PPRBD) as part of this project for work within the floodplain.

There are existing jurisdictional wetlands on the property at its northeast corner, and along the southern property boundary. These jurisdictional wetlands are not proposed to be disturbed as part of this project. The delineated wetlands are described in the report provided in **Appendix E**. No wetlands should be disturbed as part of this development, and if wetlands are disturbed all necessary permitting will need to be obtained. Wetlands should be staked prior to construction and verified that no disturbance is within the limits of the designated jurisdictional wetlands. Refer to the Soils & Geology report provided in El Paso County File No. SF263 for additional information on geohazards on the property.

Existing utilities include raw water, public potable water main, a fire hydrant and lateral, sanitary sewer main and services, a sanitary sewer lift station, electric line, and private storm sewer. In the Deer Creek Road right of way along the properties frontage there is public water main, public sanitary sewer main, electric lines, and telephone lines. An existing drainage map with these facilities is presented in **Appendix F**.

d. Floodplain Statement

This site is within a designated FEMA Floodplain as determined by the flood insurance rate map, community panel number 08041C0276G, effective December 07, 2018. An application for a floodplain development permit and zero rise certification is being submitted to Pikes Peak Regional Building Department (PPRBD) as part of this project for work within the floodplain.

II. Drainage Design Criteria

a. Drainage Criteria

Hydrologic data and calculations were performed using Drainage Criteria Manual Volume 1 of El Paso County (EPCDCM), with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs Drainage Criteria Manual (CCSDCM), May 2014.

Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using rainfall values from the NOAA Atlas 14 Point Precipitation Frequency Data Server. Runoff was calculated per CCSDCM Section 6.3.0 - Rational Method. Runoff Reduction calculation was completed using the latest version of Mile High Flood District's (MHFD) UD-BMP spreadsheet.

Rainfall Depths per NOAA Atlas 14		
Return Period (yr)	5	100
1-hr Rainfall Depth (in)	1.20	2.52

III. Drainage Basins and Subbasins

a. Major Basin Description

The site is located within the Dirty Woman Creek Drainage Basin. The site's drainage characteristics were previously studied in the following reports:

1. "Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study" prepared by Kiowa Engineering Corporation, last revised June 1993.

Dirty Woman Creek is approximately a 5.04 square mile watershed located in El Paso County, Colorado. This drainage basin is a right-bank tributary to Monument Creek. This project is specifically within the Lake Fork of Dirty Woman Creek. Large-lot single family residential development has occurred throughout most of the basin areas with some higher density development along Interstate 25 and within the Town of Monument.

The Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study (DBPS) did identify improvements within the site for the Lake Fork of Dirty Woman Creek. Specifically, it recommended three checks on the property, the existing floodplain to be preserved & regulated, and for the Herbaceous Wetlands at its southern property boundary to be preserved. This project proposes solutions to satisfy all requirements of the DBPS. The existing floodplain will be preserved and regulated within Tract A of the proposed subdivision, as well as the existing Herbaceous Wetlands at its southern property boundary. Tract A encompasses all areas outside of Lots 1-6 within the North Bay at Lake Woodmoor Subdivision. Flexamat Plus, which is a concrete block mat utilized for stabilized slopes and channels has been proposed as an alternative solution to El Paso County for the three checks recommended on the property in the DBPS. Flexamat Plus is provided in areas identified by a 2D HEC-RAS model with highly erosive potential, primary one location near the proposed northern private access point into the property. Results from this model have been provided in **Appendix C**. Relevant portions of the DBPS have been included in **Appendix E**.

b. Existing Subbasin Description

For the purposes of this report, one onsite basin was analyzed in existing conditions to compare the total existing and proposed runoff discharging from the site. One offsite basin was analyzed in the Deer Creek Right-Of-Way (ROW) which contains disturbed area from this project. For a more detailed description and analysis of the total flow through the floodplain in the center of the site, refer to the Floodplain Development section of this report. Existing hydrological calculations are provided in **Appendix B**.

Basin E1 is 7.23 acres of existing historic vegetation, a small portion of pavement that serves as a driveway to the Cove at Woodmoor, and existing gravel maintenance access to an existing sanitary sewer lift station at the properties southeast corner. Stormwater from this basin ($Q_5 = 3.57$ cfs $Q_{100} = 17.94$ cfs) is conveyed through the existing floodplain of the Lake Fork of Dirty Women Creek from north to south to Design Point 2. Stormwater runoff to Design Point E1 drains directly into Lake Woodmoor.

Basin ROW1 is 0.53 acres of Deer Creek Road right-of-way area with asphalt pavement, and landscaped area. Stormwater from this basin ($Q_5 = 1.58$ cfs $Q_{100} = 3.31$ cfs) is conveyed onto the site at Design Point 1. Stormwater runoff then follows drainage patterns of basin E1.

c. Proposed Subbasin Description

For the purposes of this report, one onsite basin was analyzed in proposed conditions to compare the total existing and proposed runoff discharging from the site. This basin was subdivided into four smaller subbasins that were analyzed for water quality treatment calculations of the disturbed areas. One offsite basin was

analyzed in the Deer Creek Right-Of-Way (ROW) which contains disturbed area from this project. For a more detailed description and analysis of the total flow through the floodplain in the center of the site, refer to the Floodplain Development section of this report. Proposed hydrological calculations are provided in **Appendix B**.

Basin P1 is 7.23 acres of existing historic vegetation, a small portion of pavement that serves as a driveway to the Cove at Woodmoor, an existing gravel maintenance access to an existing sanitary sewer lift station at the properties southeast corner, and the proposed improvements for the North Bay at Lake Woodmoor Subdivision. Stormwater from this basin ($Q_5 = 6.12$ cfs $Q_{100} = 21.31$ cfs) is conveyed through the existing floodplain of the Lake Fork of Dirty Women Creek from north to south to Design Point 2. Stormwater runoff to Design Point 2 drains directly into Lake Woodmoor. Disturbed area from this basin is treated by grass buffer RPAs that are provided within Tract A to provide water quality via runoff reduction. Subbasins that were used for the water quality analysis are portions of Basin P1, and further described below. Runoff from Basin P1 is detained within Lake Woodmoor, refer to the Water Quality & Detention section of this report for further description.

Subbasin P1.1 is 4.52 acres of Basin P1, consisting of existing historic vegetation, a small portion of pavement that serves as a driveway to the Cove at Woodmoor, an existing gravel maintenance access to an existing sanitary sewer lift station at the properties southeast corner, and water quality exclusion area. Refer to the proposed drainage map for exclusion details. Stormwater from this basin ($Q_5 = 2.49$ cfs $Q_{100} = 11.58$ cfs) is conveyed through the existing floodplain of the Lake Fork of Dirty Women Creek from north to south to Design Point 2. Stormwater runoff to Design Point 2 drains directly into Lake Woodmoor.

Subbasin P1.2 is 0.09 acres of Basin P1, consisting of private access drive to North Bay at Lake Woodmoor. Stormwater from this basin ($Q_5 = 0.21$ cfs $Q_{100} = 0.50$ cfs) is conveyed via sheet flow to Design Point P1.2 and into Subbasin P1.1. Stormwater runoff then follows drainage patterns of Subbasin P1.1. Disturbed area within this subbasin is treated for Water Quality via Runoff Reduction.

Subbasin P1.3 is 1.52 acres of Basin P1, consisting of private access drive to North Bay at Lake Woodmoor, and 3 lots of the subdivision. Stormwater from this basin ($Q_5 = 2.25$ cfs $Q_{100} = 5.96$ cfs) is conveyed via sheet flow to Design Point P1.3 and into Subbasin P1.1. Stormwater runoff then follows drainage patterns of Subbasin P1.1. Disturbed area within this subbasin is treated for Water Quality via Runoff Reduction.

Subbasin P1.4 is 1.10 acres of Basin P1, consisting of private access drive to North Bay at Lake Woodmoor, and 3 lots of the subdivision. Stormwater from this basin ($Q_5 = 1.77$ cfs $Q_{100} = 4.80$ cfs) is conveyed via sheet flow to Design Point P1.4 and into Subbasin P1.1. Stormwater runoff then follows drainage patterns of Subbasin P1.1. Disturbed area within this subbasin is treated for Water Quality via Runoff Reduction.

Basin ROW1 is 0.53 acres of Deer Creek Road right-of-way area with asphalt pavement, and landscaped area. Stormwater from this basin ($Q_5 = 1.64$ cfs $Q_{100} = 3.38$ cfs) is conveyed onto the site at Design Point 1. Stormwater runoff then follows drainage patterns of basin P1.1.

IV. Drainage Facility Design

a. General Concept

The proposed improvements for North Bay at Lake Woodmoor include two paved access drives to a total of 6 single-family lots, public utility mains, private utility services, and private onsite storm sewer improvements. Stormwater from the disturbed area is proposed to drain to grass buffer RPAs within Tract A for water quality treatment. All water quality features will be privately owned and maintained by the The Woodmoor

Improvement Association. Runoff generated from the site will directly into Lake Woodmoor. There is an increase in runoff discharging from the site into Lake Woodmoor, which has capacity to detain the increase in runoff from the site. A letter from the Woodmoor Water & Sanitation District No. 1 has been provided confirming that Lake Woodmoor can accept the proposed stormwater discharge from the development. A flow comparison of existing/proposed stormwater release rates offsite from the project is below:

NORTH BAY AT LAKE WOODMOOR OUTALLS				
	EXISTING		PROPOSED	
DP	Q ₅ (cfs)	Q ₁₀₀ (cfs)	Q ₅ (cfs)	Q ₁₀₀ (cfs)
2	4.73	20.37	7.35	23.85
Total:	4.73	20.37	7.35	23.85
*REFER TO FLOODPLAIN SECTION OF THIS REPORT FOR ANALYSIS OF TOTAL FLOW THROUGH LAKE FORK OF DIRTY WOMAN CREEK.				

b. Water Quality & Detention

This project proposes to meet the Runoff Reduction Standard per the El Paso County Drainage Criteria Manual I.7.1.C.3. Where the control measures are designed to infiltrate into the ground, evaporate, or evapotranspire a quantity of water equal to 60% of what the calculated WQCV would be if all impervious area for the applicable development site discharged without infiltration. The proposed grass buffers in this development provide a WQCV reduction of 86% of what the calculated WQCD would be, which meets this El Paso County Drainage Criteria. Impervious areas are routed over Grass Buffer PIAs that are within Tract A of the proposed development. A portion of the grass buffers proposed are located within the 100-year floodplain, and outside of the floodway. Grass buffers are proposed to treat the WQCV, from proposed impervious disturbed area. Treatment of the WQCV would occur prior to the total runoff volume of a 100-yr storm, therefore the 100-year floodplain is not anticipated to affect the treatment effectiveness of grass buffers. All grass buffers within the development will be owned and maintained by the The Woodmoor Improvement Association. A water quality treatment summary table has been provided below for the disturbed areas within the site.

The Woodmoor Water and Sanitation District No. 1 has provided a letter for this development certifying that Lake Woodmoor has capacity for the proposed runoff from this development. Refer to the letter provided in **Appendix E**.

ON-SITE WATER QUALITY TREATMENT SUMMARY			
NORTH BAY AT LAKE WOODMOOR			
Subbasin ID	Disturbed Area [AC]	Treatment CM	Notes:
P1.1	0.87	EXCLUSION	EXCLUSION I.7.1.B.4 - UNDERGROUND UTILITIES
P1.1	0.03	UNTREATED	DRAINS OFFSITE UNTREATED
P1.1	0.01	SPA	SPA AREA
P1.2	0.04	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.2	0.03	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.2	0.02	SPA	SPA AREA
P1.3	0.59	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.3	0.37	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.3	0.56	SPA	SPA AREA
P1.4	0.38	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.4	0.15	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.4	0.57	SPA	SPA AREA
ROW1	0.04	UNTREATED	DRAINS OFFSITE UNTREATED
ROW1	0.04	EXCLUSION	EXCLUSION I.7.1.B.4 - UNDERGROUND UTILITIES

TOTAL WATER QUALITY SUMMARY		
Treatment CM	Area [AC]	% of total
TOTAL DIST. AREA	3.70	
WQ EXCLUSION	0.91	25%
TOTAL NON-EXCLUDED AREA	2.79	
TREATED BY RPA	2.72	98%
UNTREATED	0.07	2%
TOTAL:	2.79	100%

c. Inspection and Maintenance

All private RPA areas are to be owned and maintained by the The Woodmoor Improvement Association. All RPA areas are provided within Tract A of the Subdivision with maintenance access provided from the private access drives.

V. Wetlands Mitigation & Floodplain Development

No wetlands will be disturbed as part of North Bay at Lake Woodmoor. The existing jurisdictional wetlands on site will be preserved and undisturbed within Tract A of the proposed subdivision. If jurisdictional wetlands are disturbed during development then all state requirements must be met.

a. Floodplain Development

This section documents the hydraulic analysis of the 100-year floodplain along the Lake Fork of Dirty Woman Creek, which drains into Lake Woodmoor. The hydraulic analysis was performed to evaluate the affects of the proposed development on the 100-year floodplain, perform no rise evaluation, and apply for a floodplain development permit. The details of the floodplain development hydraulic analysis are presented below.

Basin Description

The Lake Fork Basin is approximately 750 acres in size and drains into Dirty Woman Creek downstream of Lake Woodmoor. The basin drainage area is documented in the Lake Fork of Dirty Woman Creek Drainage Basin Planning Study (DBPS) Amendment Report and is shown in Figure 1. The basin topography is relatively steep with the land use comprising of majority large-lot residences, pine forests and wide natural drainageways.



A copy of the FEMA effective model for Lake Fork was acquired from El Paso County. The FEMA Effective Model is a HEC-RAS 1D steady state hydraulic model. The model includes cross-sections along the reach that passes through the project site. The model also has peak flows along the channel. The FEMA effective model is a “stick model”, which means, the Lake Fork alignment and the cross-section layouts are not georeferenced. The model is an outdated stick model (not georeferenced), therefore, it is not possible to update it. The FEMA effective 100-year water surface elevations (WSEs) through the project site from the FEMA FIS are included in Table 1. The FEMA effective floodplain through the project site is shown in Figure 2 and in Exhibit 2 in the Appendix A.

The FEMA Effective Hydrologic model was not acquired since no changes are recommended to the FEMA Effective hydrology.

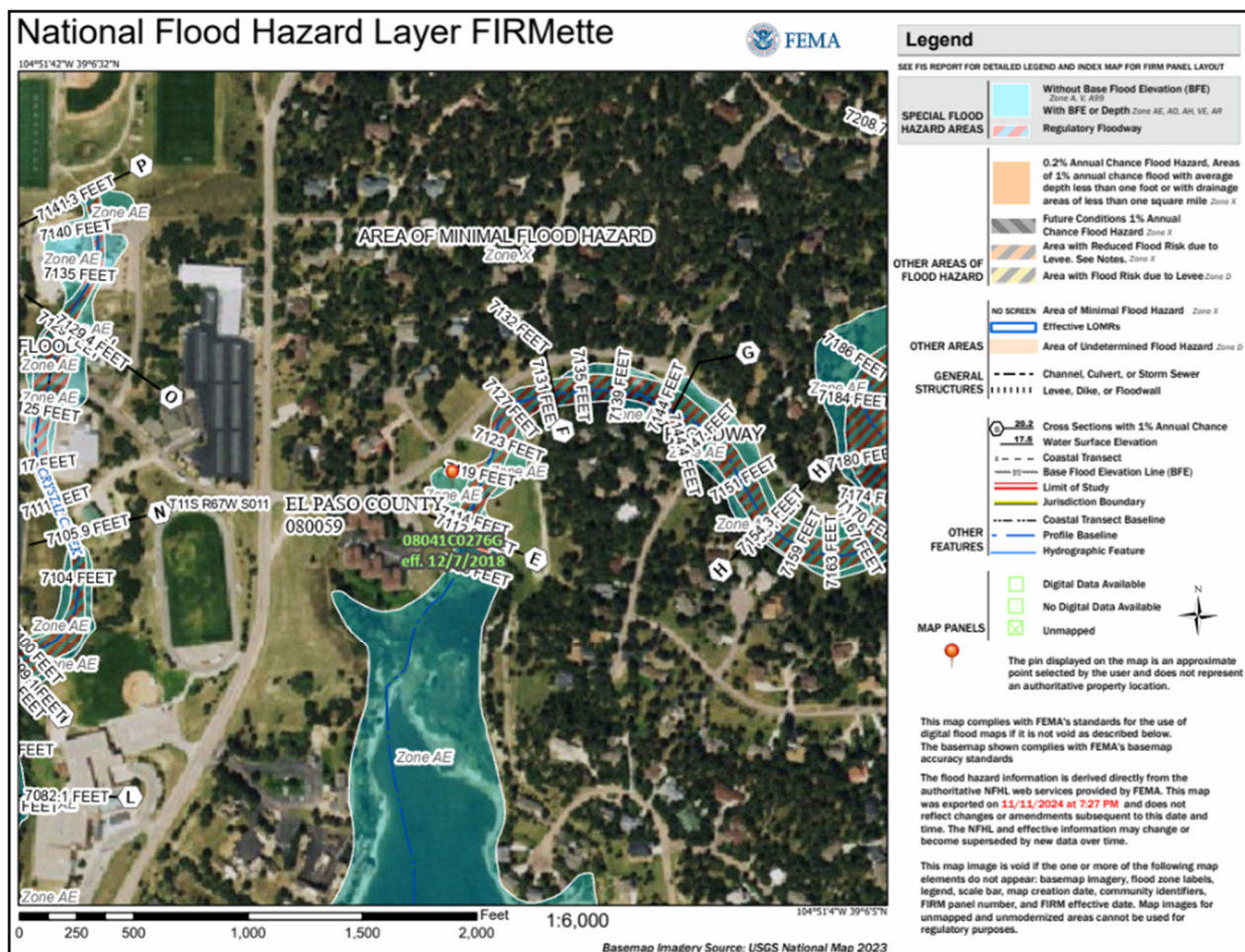


Figure 1. FEMA Effective 100-year Floodplain with FIS Cross-sections

Pre-Project Model

A georeferenced Pre-project Model was developed for the project site to evaluate the existing condition hydraulics based on topographic data as follows:

1. Cross-sections: Several cross-sections were defined along the Lake Fork reach across the channel. Cross-sections were drawn to represent FEMA cross-sections E (XS 1003) and F (XS 1021) as shown on the FEMA

FIRM to compare with the regulatory 100-year base flood elevations from the Flood Insurance Study (FIS). The cross sections are shown in Figure 3.

2. Topographic Updates: The shape of the cross-sections was defined based on topographic data to represent the latest existing conditions in the field.

3. Peak Flow Rate: The 100-year peak flow of 1,240 cfs was obtained from the FEMA FIS and was used in the model.

4. Mixed Flow Analysis: The hydraulic analysis was performed using mixed flow since the terrain is steep and the flow at most cross-sections is super critical.

The Pre-project Model peak flows and WSEs are shown in Table 1, and the Pre-project Model floodplain is compared to the FEMA effective floodplain in Exhibit 1 in Appendix A.



Figure 3. Pre-project Model Cross-sections

Post-project Model

Proposed Improvements: The proposed improvements include single-family buildings. A grass buffer along the Lake Fork banks, and minor grading and fill placement along the access road. **The single-family lots are proposed to be located entirely outside the FEMA Effective as well as the Pre-project 100-year floodplains to ensure that there is no encroachment potential for flooding of the lots.**

The Post-project model was developed by updating the Pre-project Model to include proposed improvements in the geometry. The following modifications were included in the Post-project Model geometry:

1. Private Access Drive I (Shoreditch Heights): Proposed improvements along the private access drive southwest of Burning Oak Way. This will require some cut and fill to be placed; however, this area is outside of the floodplain.
2. Private Access Drive II (Redbridge Point): The proposed improvements along the access road that crosses the floodplain northeast of Burning Oak Way. This will require placement of fill to accommodate the alignment. The access road will be asphalt lined. The placement of fill is addressed with a no-rise certificate also included with El Paso County File No. SF263.
3. Flexamat Lining: Flexamat lining will be placed at the channel bottom just downstream of Private Access Drive II for protection against erosion based on the shear force calculations presented in the following section. This does not change the grading in the channel; however, the channel roughness is changed.

The Post-project Model peak flows and WSEs are shown in Table 1. Based on the Post-project hydraulic analysis, the proposed improvements do not cause any increases in the 100-year WSE. **Therefore, the hydraulic analysis demonstrates “No Rise” in 100-year WSE due to the proposed improvements. Since there is no rise in 100-year WSE, a Letter of Map Revision (LOMR) is not anticipated for this project.**

Table 1. WSE Comparisons (FEMA, Pre-project, and Post-project Conditions)

Cross-Sections		WSE (ft)			Difference (ft)
FEMA	Pre-project/ Post-project	FEMA	Pre-project	Post-project	Post-Pre
	1024		7138.35	7138.35	0.00
	1023		7134.57	7134.57	0.00
	1022		7132.80	7132.80	0.00
F	1021	7132.00	7131.25	7131.25	0.00
	1020		7130.62	7130.62	0.00
	1019		7129.04	7129.04	0.00
	1018		7128.22	7128.21	-0.01
	1017		7127.35	7127.20	-0.15
	1016		7126.87	7126.84	-0.03
	1015		7125.13	7125.12	-0.01
	1014		7123.05	7123.05	0.00
	1013		7122.97	7122.97	0.00
	1012		7122.33	7122.33	0.00
	1011		7120.09	7120.09	0.00
	1010		7119.83	7119.83	0.00
	1009		7119.69	7119.69	0.00
	1008		7119.44	7119.44	0.00
	1007		7118.81	7118.81	0.00
	1006		7118.29	7118.29	0.00
	1005		7117.20	7117.20	0.00
	1004		7114.47	7114.47	0.00
E	1003	7112.80	7112.31	7112.31	0.00
	1002		7105.62	7105.62	0.00
	1001		7105.99	7105.99	0.00
	1000		7106.00	7106.00	0.00

Lake Fork Erosion Analysis

An evaluation was performed to determine the locations of high shear stress along the channel through the project site. A 2D HEC-RAS model was used for this analysis because it provides more precise locations of high shear stress at the peak flow. A preliminary 2D HEC-RAS model was provided to HR Green by the County, this model was reviewed and necessary updates made to provide reasonable results. The results of this 2D model are for informational purposes only. The 2D model included 100-year flows from the Lake Fork of Dirty Woman Creek Drainage Basin Planning Study (DBPS) Amendment report, prepared by Kiowa Engineering Corporation. This amendment report updates the 100-year flows presented in the original DBPS prepared in 1993. The amendment report updates the 100-year flows from the original DBPS (1,107 cfs) to 517 cfs. As per the amendment report, the original 1993 DBPS assumed majority ½-acre future residential development in the basin, whereas the actual development in the basin is primarily 1-acre residential lots with wide open spaces dedicated to natural drainage. Due to this reason, the updated 100-year flows are a lot smaller. The high shear stress locations, which are areas of Froude Number greater than or equal to 0.9 are shown in Figure 4. The Figure shows high shear stress areas just downstream of the access road. Rock rip-rap is recommended for protecting the creek in this area as shown in the proposed drainage map.



Figure 4. High Shear Stress Areas (Froude Number ≥ 0.9)

VI. Four Step Method to Minimize Adverse Impacts of Urbanization

Step 1 – Reducing Runoff Volumes: Low impact development (LID) practices are utilized to reduce runoff at the source. Impervious areas are drained over receiving pervious areas (RPAs). This practice promotes infiltration and reduces peak runoff rates prior to runoff reaching downstream drainage facilities. This project proposes to meet the Runoff Reduction Standard per the El Paso County Drainage Criteria Manual I.7.1.C.3. Refer to further description in Step 2 for Water Quality treatment.

Step 2 – Treat and slowly release the WQCV: This step utilizes full spectrum water quality and detention to capture the WQCV and slowly release runoff from the site. This project proposes to meet the Runoff Reduction Standard per the El Paso County Drainage Criteria Manual I.7.1.C.3. Where the control measures are designed to infiltrate into the ground, evaporate, or evapotranspire a quantity of water equal to 60% of what the calculated WQCV would be if all impervious area for the applicable development site discharged without infiltration. Onsite grass buffers are provided to treat the disturbed area for water quality as PIAs. The total calculated WQCV for the entire disturbed area is 1,754 CF. The grass buffers on site provide a WQCV Reduction of 1,505 CF, or 86% of the total WQCV. This site therefore exceeds the minimum reduction percentage of 60%. Runoff reduction calculations are provided in **Appendix D**.

Step 3 – Stabilize stream channels: This step establishes practices to stabilize drainageways and provide scour protection at stormwater outfalls. Stream channels are proposed to be stabilized with Flexamat Plus, which is a concrete block mat utilized for stabilized slopes and channels has been proposed as an alternative solution to El Paso County for the three checks recommended on the property. Flexamat Plus is provided in areas identified by El Paso County with highly erosive potential, primary one location near the proposed northern private access point into the property. Material specification for Flexamat Plus have been provided in Appendix C that confirm Flexamat Plus can provide the strength to stabilize these areas.

Step 4 – Consider the need for source controls: No industrial or commercial uses are proposed within this development and therefore no source controls are proposed.

VII. Drainage and Bridge Fees

The site lies within the Dirty Woman Creek Drainage Basin. The current drainage basin fee associated with the Dirty Woman Creek Drainage Basin is \$26,695 per impervious acre. The current bridge fee associated with the Dirty Woman Creek Drainage Basin is \$1,460 per impervious acre. See table below for fees due as part of this development. No DBPS improvements are proposed and no offsets to fees will apply.

Dirty Woman Creek Drainage & Bridge Fee's			
	Fee per Impervious Acre	Impervious Acres	Fee
Drainage Basin Fee:	\$26,695	1.37	\$36,572
Bridge Fee:	\$1,460	1.37	\$2,000
Total:			\$38,572

VIII. Opinion of Probable Cost

There are common area improvements as part of this project, all common area improvement proposed by this project are private. An opinion of probable cost for the common area drainage improvements proposed is provided below.

Common Area Drainage Infrastructure Cost Estimate				
Line Item	Quantity	Unit Price		Cost
24" Reinforced Concrete Pipe	339.5	\$105	/LF	\$35,648
Storm Sewer Manhole, Box Base	1	\$16,265	EA	\$16,265
Flexamat Plus Channel Lining'	7181	\$10	SF	\$71,810
Sub-Total				\$123,723
10% Contingency				\$12,372
TOTAL:				\$136,095

IX. Hydraulic Grade Line Analysis

There was no hydraulic grade line analysis required as part of this project. In coordination with El Paso County, an existing private 24" CMP storm sewer pipe has been replaced with a proposed private 24" RCP storm sewer pipe due to maintenance concerns for the existing 24" CMP. This pipe is located through the center of the property, and drains south to Lake Woodmoor. This pipe has not been analyzed and just replaced at the direction of El Paso County. This project will not affect the tributary flow to the pipe.

X. Summary

The drainage patterns for North Bay at Lake Woodmoor Water will continue to follow existing drainage patterns. Water quality is provided on site for the proposed development using grass buffer receiving pervious areas (RPAs) within Tract A, detention is provided in Lake Woodmoor south of the site. The water quality RPAs will be owned and maintained by the The Woodmoor Improvement Association, Lake Woodmoor is owned and maintained by Woodmoor Water & Sanitation District No. 1. All drainage facilities were sized per the El Paso County Drainage Criteria Manuals.

The development of this project will not adversely affect downstream properties.

XI. Drawings

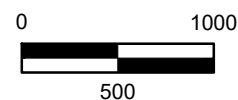
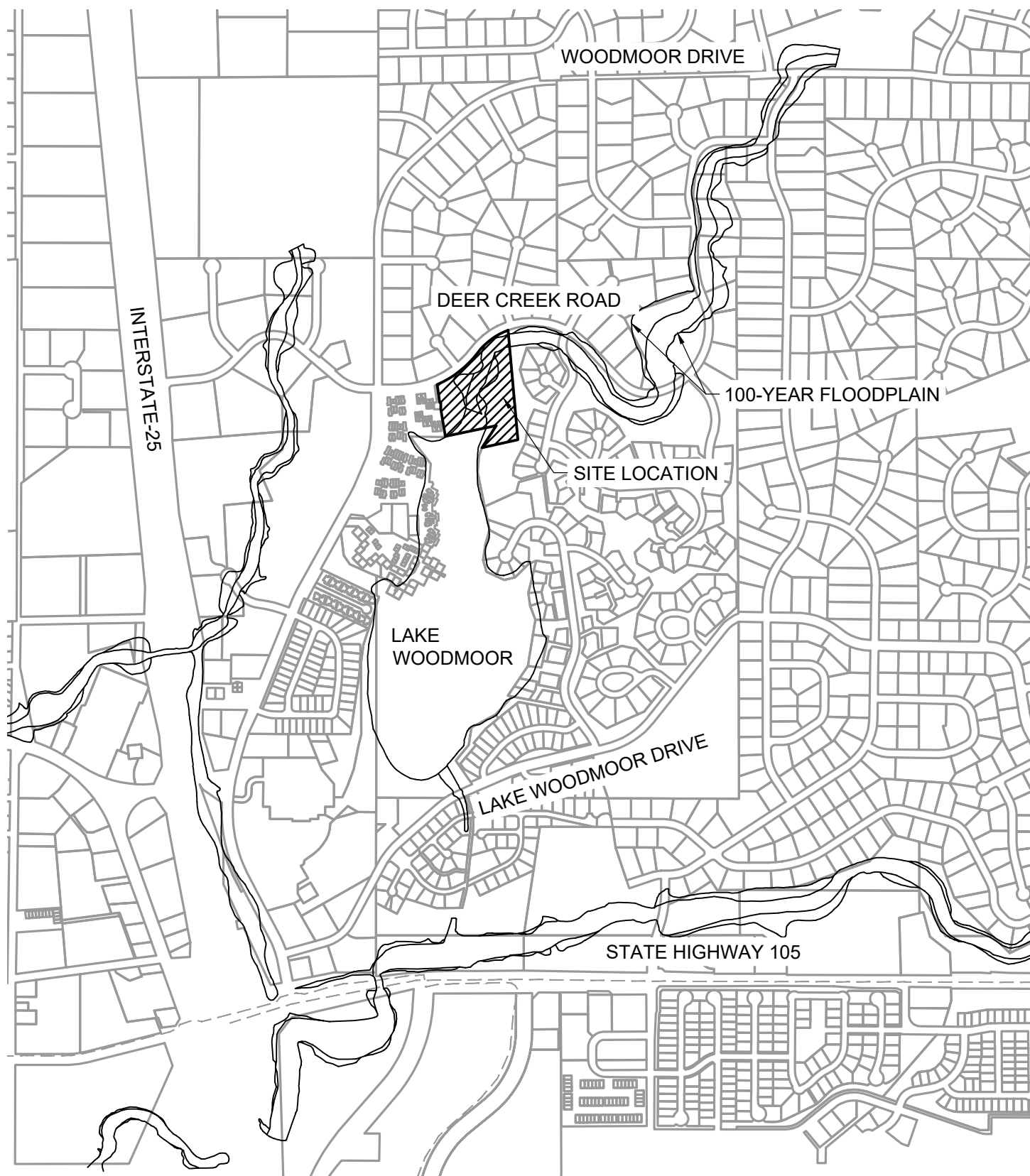
Please refer to the appendices for vicinity and drainage basin maps.

XII. References

1. City of Colorado Springs – Drainage Criteria Manual, May 2014.
2. Drainage Criteria Manual and DCM Update of El Paso, Colorado, October 2018.
3. Mile High Flood District. *Urban Storm Drainage Criteria Manual Volumes 1 and 2*, January 2016. Revised March 2024 (Volume 1).
4. Mile High Flood District. *Urban Storm Drainage Criteria Manual Volumes 3*, November 2010. Revised March 2024
5. "Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study" prepared by Kiowa Engineering Corporation, last revised June 1993.

6. "Lake Fork of Dirty Woman Creek Drainage Basin Planning Study Hydrology Amendment" prepared by Kiowa Engineering Corporation, last revised September 1, 2022.
7. "Natural Features, Wetland, Wildfire, Noxious Weeds & Wildlife Report for North Bay at Lake Woodmoor in El Paso County, Colorado" prepared by ECOS LLC, last revised June 1, 2022.

APPENDIX A – VICINITY MAP, PHOTOS, SOIL MAP, FEMA MAP





FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE)
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee See Notes Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		Cross Sections with 1% Annual Chance
		Water Surface Elevation
		Coastal Transect
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-6627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

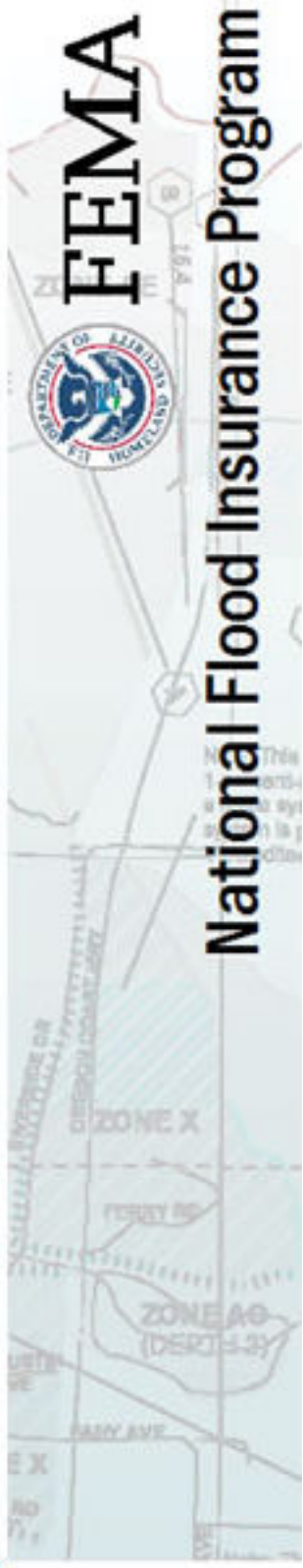
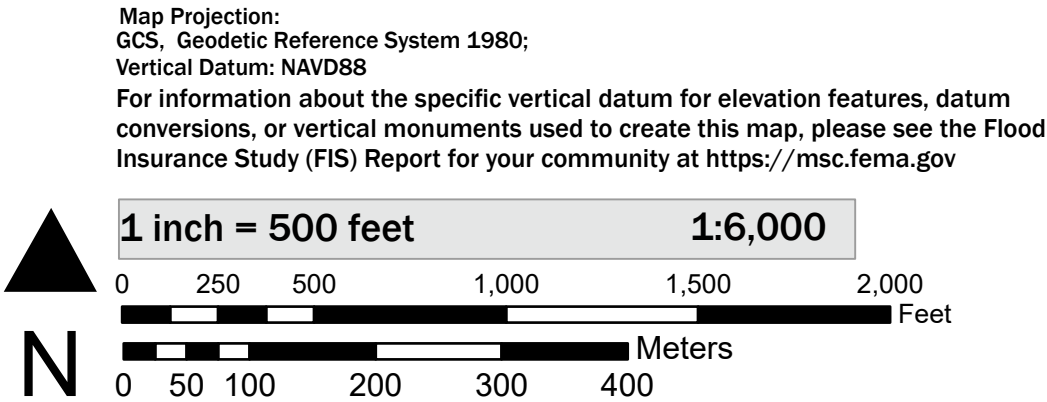
To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **10/23/2025 3:30 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at <https://www.fema.gov/media-library/assets/documents/118418>

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards. This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PANEL 276 OF 1275

Panel Contains:	080059	0276
COMMUNITY	080064	0276
EL PASO COUNTY		
TOWN OF PALMER		
LAKE		
TOWN OF MONUMENT		

Hydrologic Soil Group—El Paso County Area, Colorado



MAP LEGEND**Area of Interest (AOI)**
 Area of Interest (AOI)
Soils**Soil Rating Polygons**

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Rating Lines

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Rating Points

-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available

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: El Paso County Area, Colorado
Survey Area Data: Version 23, Aug 29, 2025

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Alamosa loam, 1 to 3 percent slopes	D	4.3	68.4%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	0.0	0.0%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	2.0	31.6%
Totals for Area of Interest			6.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B – HYDROLOGIC CALCULATIONS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

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

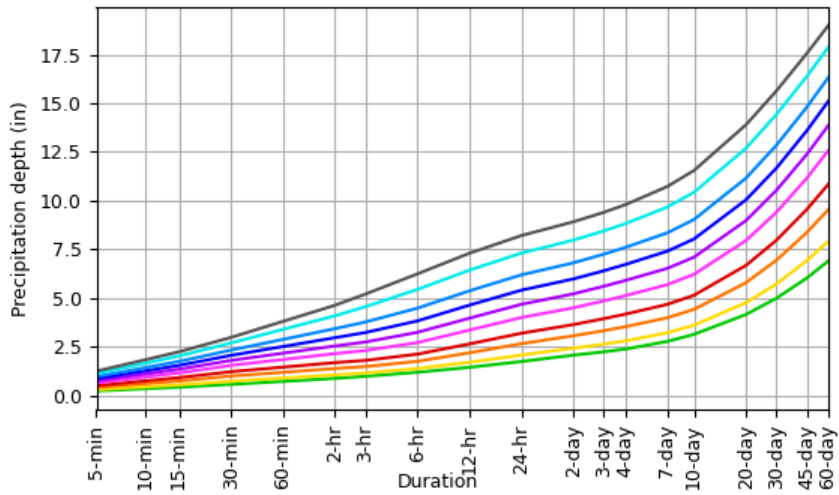
PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.244 (0.200-0.296)	0.310 (0.254-0.377)	0.422 (0.345-0.514)	0.518 (0.420-0.632)	0.653 (0.512-0.822)	0.760 (0.581-0.966)	0.870 (0.642-1.13)	0.984 (0.695-1.30)	1.14 (0.773-1.54)	1.26 (0.832-1.72)
10-min	0.357 (0.293-0.434)	0.455 (0.373-0.552)	0.618 (0.505-0.753)	0.758 (0.615-0.926)	0.956 (0.749-1.20)	1.11 (0.851-1.41)	1.27 (0.940-1.65)	1.44 (1.02-1.90)	1.67 (1.13-2.25)	1.84 (1.22-2.52)
15-min	0.435 (0.357-0.529)	0.554 (0.454-0.674)	0.754 (0.616-0.918)	0.924 (0.750-1.13)	1.16 (0.914-1.47)	1.36 (1.04-1.72)	1.55 (1.15-2.01)	1.76 (1.24-2.32)	2.03 (1.38-2.75)	2.25 (1.49-3.07)
30-min	0.579 (0.475-0.703)	0.738 (0.605-0.897)	1.00 (0.820-1.22)	1.23 (0.999-1.50)	1.55 (1.22-1.96)	1.81 (1.38-2.30)	2.07 (1.52-2.68)	2.34 (1.65-3.09)	2.70 (1.84-3.65)	2.99 (1.97-4.07)
60-min	0.732 (0.600-0.888)	0.901 (0.739-1.10)	1.20 (0.978-1.46)	1.46 (1.19-1.79)	1.86 (1.46-2.36)	2.18 (1.67-2.78)	2.52 (1.87-3.28)	2.89 (2.05-3.84)	3.40 (2.32-4.61)	3.81 (2.52-5.20)
2-hr	0.885 (0.730-1.06)	1.06 (0.878-1.28)	1.39 (1.14-1.68)	1.70 (1.38-2.05)	2.16 (1.72-2.73)	2.55 (1.98-3.25)	2.97 (2.22-3.86)	3.44 (2.46-4.55)	4.10 (2.81-5.54)	4.64 (3.08-6.28)
3-hr	0.991 (0.821-1.19)	1.16 (0.962-1.39)	1.49 (1.23-1.79)	1.81 (1.48-2.18)	2.31 (1.86-2.94)	2.75 (2.15-3.51)	3.24 (2.44-4.20)	3.78 (2.72-5.00)	4.56 (3.15-6.16)	5.21 (3.48-7.03)
6-hr	1.20 (1.00-1.43)	1.39 (1.16-1.65)	1.76 (1.46-2.10)	2.13 (1.76-2.54)	2.72 (2.21-3.44)	3.25 (2.56-4.12)	3.83 (2.91-4.95)	4.49 (3.26-5.91)	5.45 (3.79-7.31)	6.25 (4.20-8.38)
12-hr	1.45 (1.22-1.71)	1.71 (1.44-2.02)	2.20 (1.83-2.59)	2.65 (2.20-3.14)	3.36 (2.73-4.18)	3.97 (3.14-4.97)	4.64 (3.53-5.92)	5.38 (3.92-7.00)	6.43 (4.50-8.55)	7.30 (4.94-9.73)
24-hr	1.75 (1.48-2.04)	2.08 (1.75-2.43)	2.67 (2.24-3.12)	3.20 (2.67-3.76)	4.01 (3.26-4.92)	4.68 (3.71-5.79)	5.41 (4.13-6.82)	6.20 (4.53-7.98)	7.31 (5.14-9.62)	8.21 (5.59-10.9)
2-day	2.08 (1.76-2.40)	2.44 (2.07-2.82)	3.07 (2.60-3.56)	3.64 (3.06-4.24)	4.50 (3.69-5.47)	5.22 (4.16-6.39)	5.99 (4.60-7.48)	6.81 (5.01-8.70)	7.98 (5.64-10.4)	8.92 (6.11-11.7)
3-day	2.25 (1.92-2.59)	2.64 (2.25-3.04)	3.33 (2.83-3.85)	3.95 (3.33-4.58)	4.86 (3.99-5.85)	5.61 (4.48-6.82)	6.40 (4.94-7.95)	7.25 (5.36-9.21)	8.44 (5.99-11.0)	9.40 (6.47-12.3)
4-day	2.39 (2.04-2.74)	2.81 (2.40-3.22)	3.54 (3.01-4.07)	4.18 (3.54-4.83)	5.13 (4.22-6.15)	5.91 (4.73-7.15)	6.73 (5.20-8.32)	7.60 (5.62-9.62)	8.82 (6.27-11.4)	9.79 (6.76-12.8)
7-day	2.78 (2.39-3.17)	3.22 (2.77-3.67)	4.00 (3.42-4.56)	4.68 (3.98-5.36)	5.69 (4.71-6.78)	6.53 (5.26-7.85)	7.41 (5.76-9.10)	8.35 (6.22-10.5)	9.67 (6.91-12.5)	10.7 (7.44-13.9)
10-day	3.14 (2.71-3.56)	3.61 (3.11-4.10)	4.43 (3.80-5.03)	5.15 (4.39-5.88)	6.22 (5.16-7.37)	7.10 (5.74-8.51)	8.04 (6.27-9.83)	9.04 (6.75-11.3)	10.4 (7.48-13.4)	11.5 (8.04-15.0)
20-day	4.16 (3.61-4.68)	4.77 (4.13-5.36)	5.80 (5.00-6.53)	6.68 (5.74-7.56)	7.96 (6.62-9.30)	8.98 (7.29-10.6)	10.0 (7.87-12.1)	11.2 (8.38-13.8)	12.7 (9.15-16.1)	13.9 (9.74-17.9)
30-day	5.00 (4.35-5.58)	5.73 (4.98-6.40)	6.95 (6.02-7.78)	7.97 (6.87-8.97)	9.41 (7.84-10.9)	10.5 (8.56-12.4)	11.7 (9.16-14.0)	12.8 (9.66-15.8)	14.4 (10.4-18.2)	15.6 (11.0-20.0)
45-day	6.03 (5.28-6.70)	6.92 (6.05-7.70)	8.37 (7.28-9.32)	9.55 (8.26-10.7)	11.2 (9.30-12.8)	12.4 (10.1-14.4)	13.6 (10.7-16.2)	14.8 (11.2-18.1)	16.4 (11.9-20.5)	17.6 (12.4-22.4)
60-day	6.91 (6.06-7.65)	7.93 (6.94-8.78)	9.54 (8.33-10.6)	10.8 (9.41-12.1)	12.6 (10.5-14.3)	13.9 (11.3-16.0)	15.1 (11.9-17.9)	16.3 (12.3-19.8)	17.9 (13.0-22.3)	19.0 (13.5-24.2)
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.										

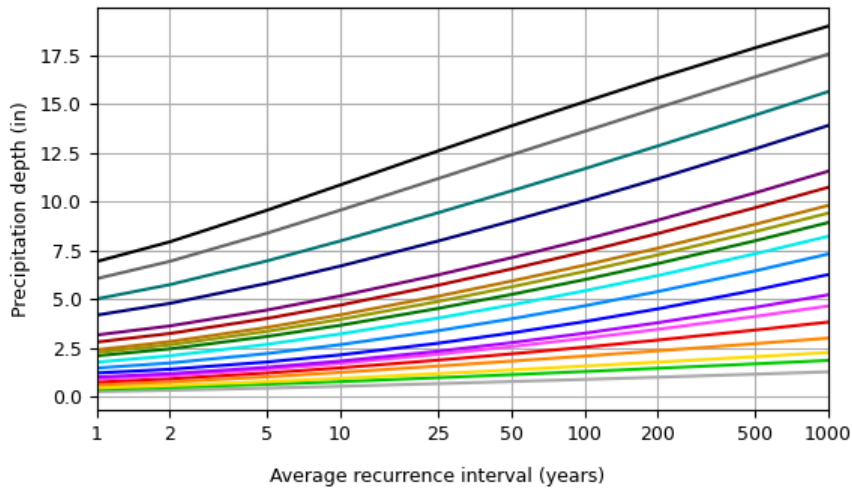
[Back to Top](#)

PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 39.1049°, Longitude: -104.8563°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



Duration
5-min
10-min
15-min
30-min
60-min
2-hr
3-hr
6-hr
12-hr
24-hr
2-day
3-day
4-day
7-day
10-day
20-day
30-day
45-day
60-day

NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Thu Oct 23 20:54:56 2025

[Back to Top](#)

Maps & aerals

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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[National Weather Service](#)
[National Water Center](#)
 1325 East West Highway
 Silver Spring, MD 20910
 Questions?: HDSC.Questions@noaa.gov

[Disclaimer](#)

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

**NORTH BAY AT LAKE WOODMOOR****EXISTING CONDITIONS****EL PASO COUNTY, CO****Calc'd by:****SPC****Checked by:****CM****Date:****7/8/2026****SUMMARY RUNOFF TABLE**

BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
E1	7.23	7	3.57	17.94
ROW1	0.53	61	1.58	3.31

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ ₅ (cfs)	ΣQ ₁₀₀ (cfs)
1	E1	1.58	3.31
2	E1, DESIGN POINT [1]	4.73	20.37



NORTH BAY AT LAKE WOODMOOR

EXISTING CONDITIONS

EL PASO COUNTY, CO

Calc'd by:

SPC

Checked by:

CM

Date:

7/8/2026

SOIL TYPE: HSG A&B

COMPOSITE 'C' FACTORS																						
BASIN	LAND USE TYPE																	TOTAL	COMPOSITE IMPERVIOUSNESS & C FACTOR			
	Paved			Drive and Walks			Roofs			Gravel			Lawns			Historic Flow Analysis-- Greenbelts,						
	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀	%I	C ₅					C ₁₀₀
	100	0.90	0.96	100	0.90	0.96	90	0.73	0.81	80	0.59	0.70	0	0.08	0.35	2	0.09					0.36
	ACRES			ACRES			ACRES			ACRES			ACRES			ACRES						ACRES
E1	0.24									0.19						6.80			7.23	7	0.13	0.39
ROW1	0.32															0.21			0.53	61	0.58	0.72
																			0.00	0		
																			0.00	0		
																			0.00	0		
																			0.00	0		
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**NORTH BAY AT LAKE WOODMOOR**

Calc'd by:

SPC

EXISTING CONDITIONS

Checked by:

CM

DESIGN STORM: 5-YEAR

Date:

7/8/2026

1433 HRGreen			NORTH BAY AT LAKE WOODMOOR										Calc'd by:		SPC								
			EXISTING CONDITIONS										Checked by:		CM								
			DESIGN STORM: 5-YEAR										Date:		7/8/2026								
			DIRECT RUNOFF					TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS	
	DESIGN POINT	BASIN ID	AREA (ac)	C _s	t _c (min)	C _s *A (ac)	I (in./ hr.)	Q (cfs)	t _c (min)	C _s *A (ac)	I (in./ hr.)	Q (cfs)	Q _{street} (cfs)	C _s *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C _s *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min)	
	1	ROW1	0.53	0.58	5.0	0.30	5.17	1.58	5.0	0.30	5.17	1.58	1.6	0.30	5.9					465	3.63	2.13	DRAINS OVERLAND FLOW TO DESIGN POINT 2
	2	E1	7.23	0.13	12.4	0.94	3.80	3.57	12.4	1.24	3.80	4.73											DRAINS OFFSITE DIRECTLY INTO LAKE WOODMOOR

1+33 HRGreen			NORTH BAY AT LAKE WOODMOOR												Calc'd by:		SPC												
			EXISTING CONDITIONS												Checked by:		CM												
			DESIGN STORM: 100-YEAR												Date:		7/8/2026												
			DIRECT RUNOFF						TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS								
	DESIGN POINT	BASIN ID	AREA (ac)	C ₁₀₀	t _c (min)	C ₁₀₀ *A (ac)	I (in./ hr.)	Q (cfs)	t _c (min)	C ₁₀₀ *A (ac)	I (in./ hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)							
	1	ROW1	0.53	0.72	5.0	0.38	8.68	3.31	5.0	0.38	8.68	3.31	3.3	0.38	5.9					465	3.63	2.13	DRAINS OVERLAND FLOW TO DESIGN POINT 2						
	2	E1	7.23	0.39	12.4	2.81	6.38	17.94	12.4	3.19	6.38	20.37												DRAINS OFFSITE DIRECTLY INTO LAKE WOODMOOR					



NORTH BAY AT LAKE WOODMOOR

PROPOSED CONDITIONS

EL PASO COUNTY, CO

Calc'd by:

SPC

Checked by:

CM

Date:

7/8/2026

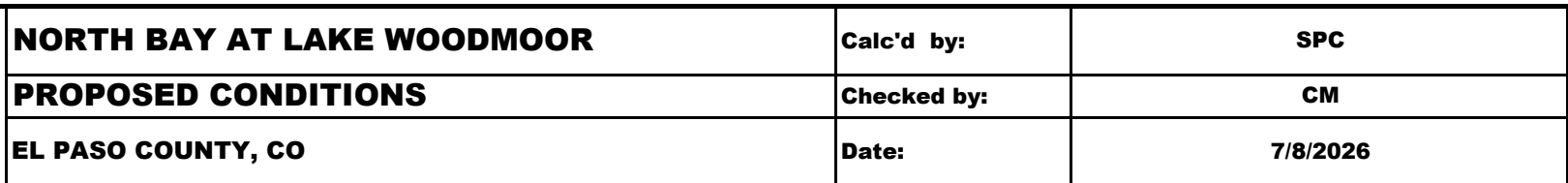
SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
P1.1	4.52	9	2.49	11.58
P1.2	0.09	47	0.21	0.50
P1.3	1.52	36	2.25	5.96
P1.4	1.10	33	1.77	4.80
P1 (OVERALL SITE)	7.23	19	6.12	21.31
ROW1	0.53	64	1.64	3.38

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ ₅ (cfs)	ΣQ ₁₀₀ (cfs)
1	ROW1	1.64	3.38
1.2	P1.2	0.21	0.50
1.3	P1.3	2.25	5.96
1.4	P1.4	1.77	4.80
2	P1 (OVERALL SITE), DESIGN POINT [1]	7.35	23.85



[illegible]
$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad V = C_v S_w^{0.5}$$

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

4118-Pr_Drainage_Calc

 HRGreen			NORTH BAY AT LAKE WOODMOOR												Calc'd by:		SPC						
			PROPOSED CONDITIONS												Checked by:		CM						
			DESIGN STORM: 5-YEAR												Date:		7/8/2026						
			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
	DESIGN POINT	BASIN ID	AREA (ac)	C _s	f _c (min)	C _s * A (ac)	f (lin./ hr.)	Q (cfs)	f _c (min)	C _s * A (ac)	f (lin./ hr.)	Q (cfs)	Q _{street} (cfs)	C _s * A (ac)	SLOPE %	Q _{PIPE} (cfs)	C _s * A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min)	
	1	ROW1	0.53	0.60	5.0	0.32	5.17	1.64	5.0	0.32	5.17	1.64	1.6	0.32	5.9					465	3.63	2.13	DRAINS OVERLAND FLOW TO DESIGN POINT 2
	1.2	P1.2	0.09	0.46	5.0	0.04	5.17	0.21	5.0	0.04	5.17	0.21											DRAINS OVERLAND FLOW TO DESIGN POINT 2
	1.3	P1.3	1.52	0.34	8.7	0.52	4.33	2.25	8.7	0.52	4.33	2.25											DRAINS OVERLAND FLOW TO DESIGN POINT 2
	1.4	P1.4	1.10	0.33	6.0	0.36	4.89	1.77	6.0	0.36	4.89	1.77											DRAINS OVERLAND FLOW TO DESIGN POINT 2
	2	P1.1 P1 (OVERALL SITE)	4.52 7.23	0.14 0.22	12.3 11.8	0.65 1.58	3.81 3.88	2.49 6.12	11.8 1.89	3.88		7.35											DRAINS OFFSITE DIRECTLY INTO LAKE WOODMOOR BASIN P1.1 INCLUDED FOR SUBBASIN FLOW ONLY, TOTAL FLOW CALCULATED WITH BASIN P1 (OVERALL SITE)

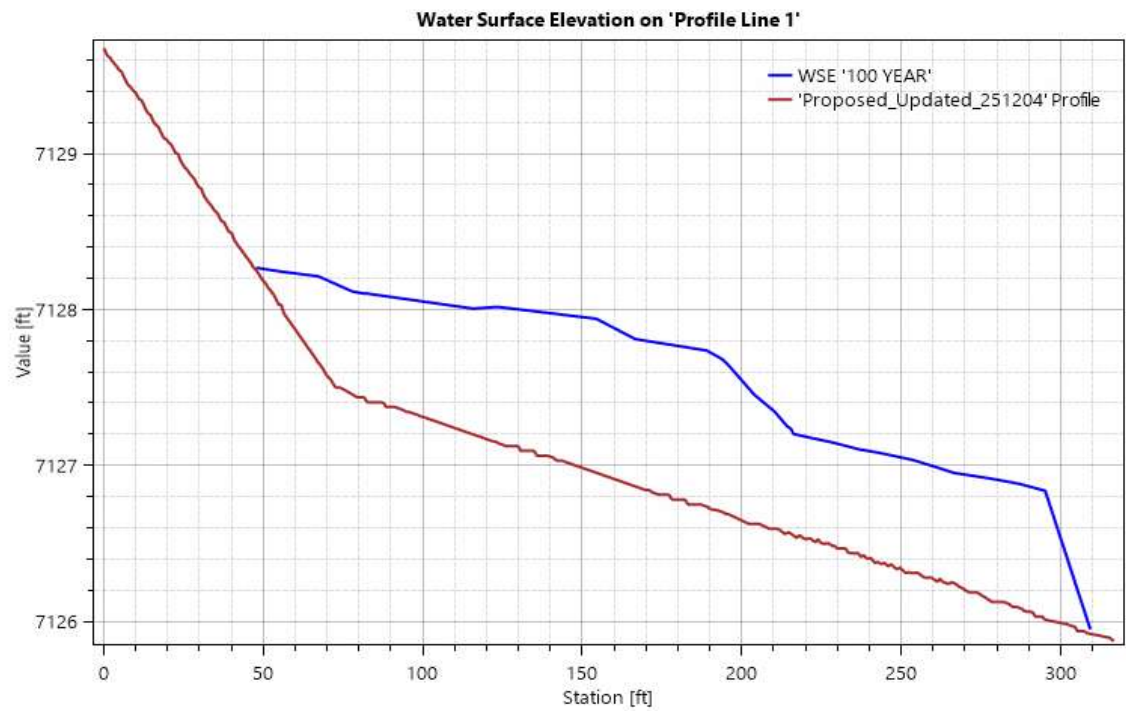
1433 HRGreen			NORTH BAY AT LAKE WOODMOOR											Calc'd by:		SPC										
			PROPOSED CONDITIONS											Checked by:		CM										
			DESIGN STORM: 100-YEAR											Date:		7/8/2026										
			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS			
	DESIGN POINT	BASIN ID	AREA (ac)	C ₁₀₀	t _e (min)	C ₁₀₀ * A (ac)	I (in./ hr.)	Q (cfs)	t _e (min)	C ₁₀₀ * A (ac)	I (in./ hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ * A (ac)	SLOPE %	Q _{pipe} (cfs)	C ₁₀₀ * A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)				
	1	ROW1	0.53	0.74	5.0	0.39	8.68	3.38	5.0	0.39	8.68	3.38	3.4	0.39	5.9					465	3.63	2.13	DRAINS OVERLAND FLOW TO DESIGN POINT 2			
	1.2	P1.2	0.09	0.63	5.0	0.06	8.68	0.50	5.0	0.06	8.68	0.50											DRAINS OVERLAND FLOW TO DESIGN POINT 2			
	1.3	P1.3	1.52	0.54	8.7	0.82	7.27	5.96	8.7	0.82	7.27	5.96											DRAINS OVERLAND FLOW TO DESIGN POINT 2			
	1.4	P1.4	1.10	0.53	6.0	0.58	8.22	4.80	6.0	0.58	8.22	4.80											DRAINS OVERLAND FLOW TO DESIGN POINT 2			
	2	P1.1 P1 (OVERALL SITE)	4.52	0.40	12.3	1.81	6.40	11.58	11.8	3.66	6.52	23.85											DRAINS OFFSITE DIRECTLY INTO LAKE WOODMOOR BASIN P1.1 INCLUDED FOR SUBBASIN FLOW ONLY, TOTAL FLOW CALCULATED WITH BASIN P1 (OVERALL SITE)			
			7.23	0.45	11.8	3.27	6.52	21.31																		

APPENDIX C – HYDRAULIC CALCULATIONS

Norhtbay - 100-yr WSE Along The Proposed Driveway

Proposed 100-year WSE along the proposed driveway centerline:

Note: The WSE varies since the drievway curves and is not always perpendicular to the direction of flow.

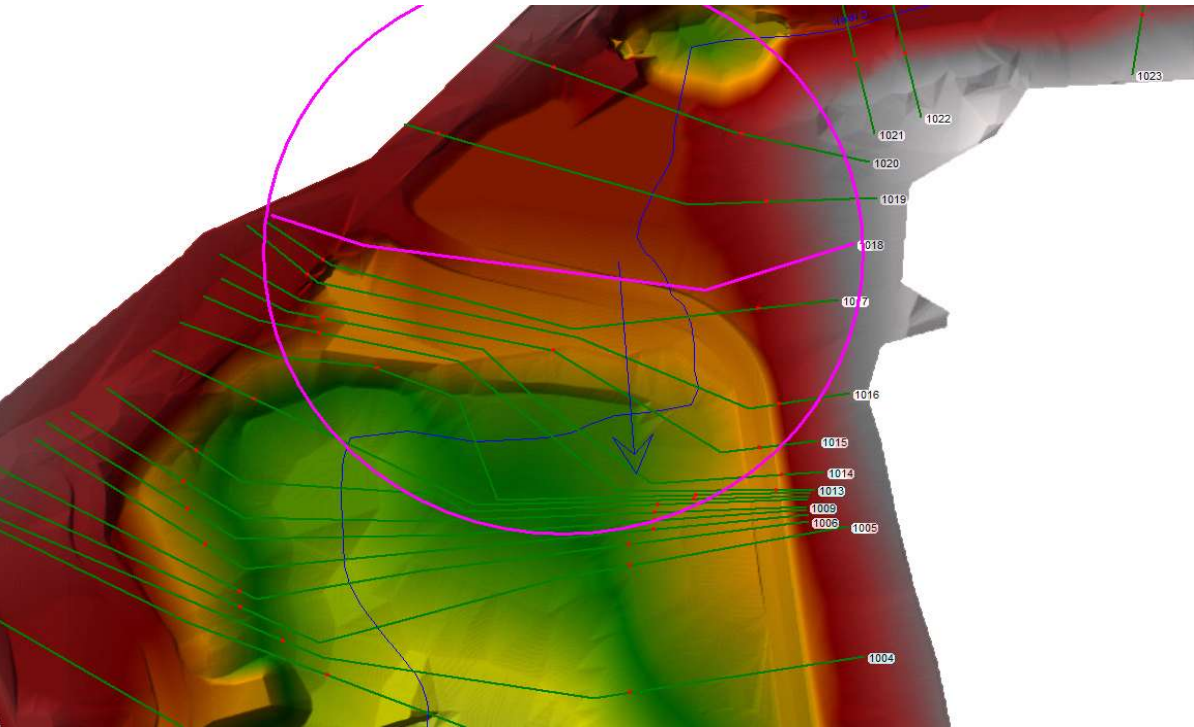


Proposed 100-year WSE along the proposed driveway centerline (Table):

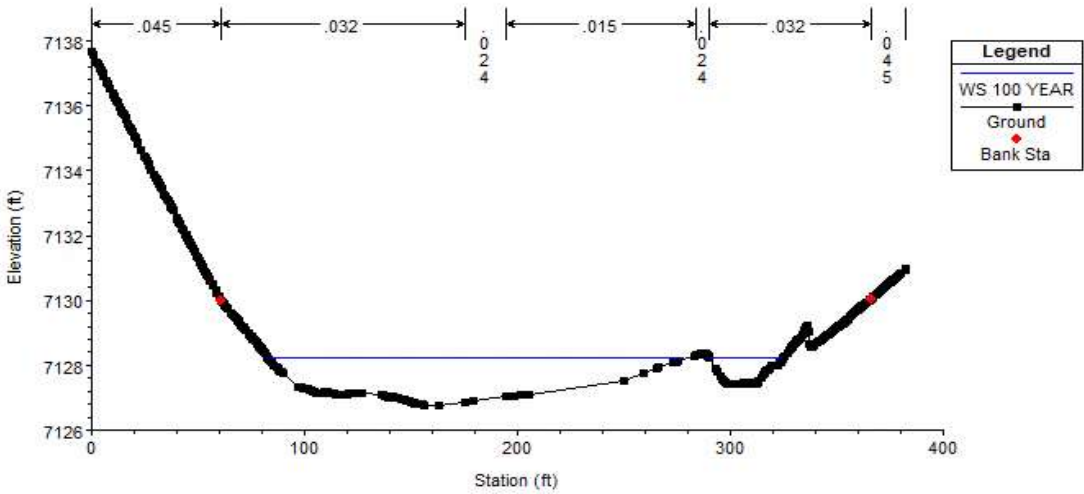
Roadway Station (ft)	Prop. 100-yr WSE (ft)	Prop. Driveway CL (ft)
0.0	0.00	7129.68
10.2	0.00	7129.38
18.9	0.00	7129.10
29.7	0.00	7128.79
39.8	0.00	7128.49
49.2	7128.26	7128.21
59.3	7128.23	7127.89
79.4	7128.11	7127.44
91.7	7128.08	7127.37
103.1	7128.04	7127.29
144.1	7127.97	7127.03
153.4	7127.94	7126.96
163.2	7127.85	7126.89
173.1	7127.79	7126.82
195.5	7127.65	7126.69
203.1	7127.47	7126.63
212.8	7127.29	7126.57
221.7	7127.18	7126.53
229.9	7127.14	7126.47
239.1	7127.10	7126.41
248.0	7127.06	7126.34
283.2	7126.90	7126.12
292.1	7126.86	7126.03
303.5	7126.32	7125.97
314.3	0.00	7125.90

Proposed 100-yr WSE along cross-section 1018, which is closest to the proposed driveway:

Note: Since this cross-section is perpendicular to the flow, the WSE is flat. The proposed 100-yr WSE = 7128.21



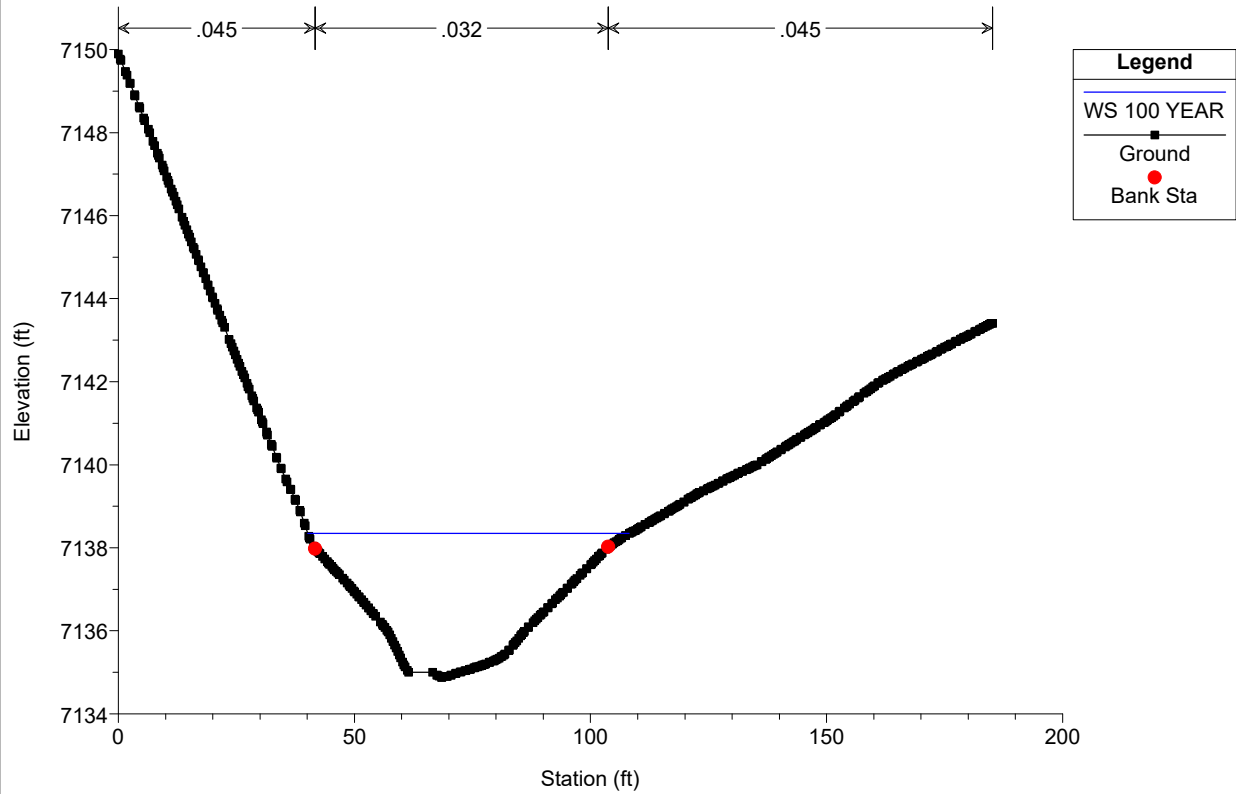
Northbay at Woodmoor Plan: Proposed 1/26/2026



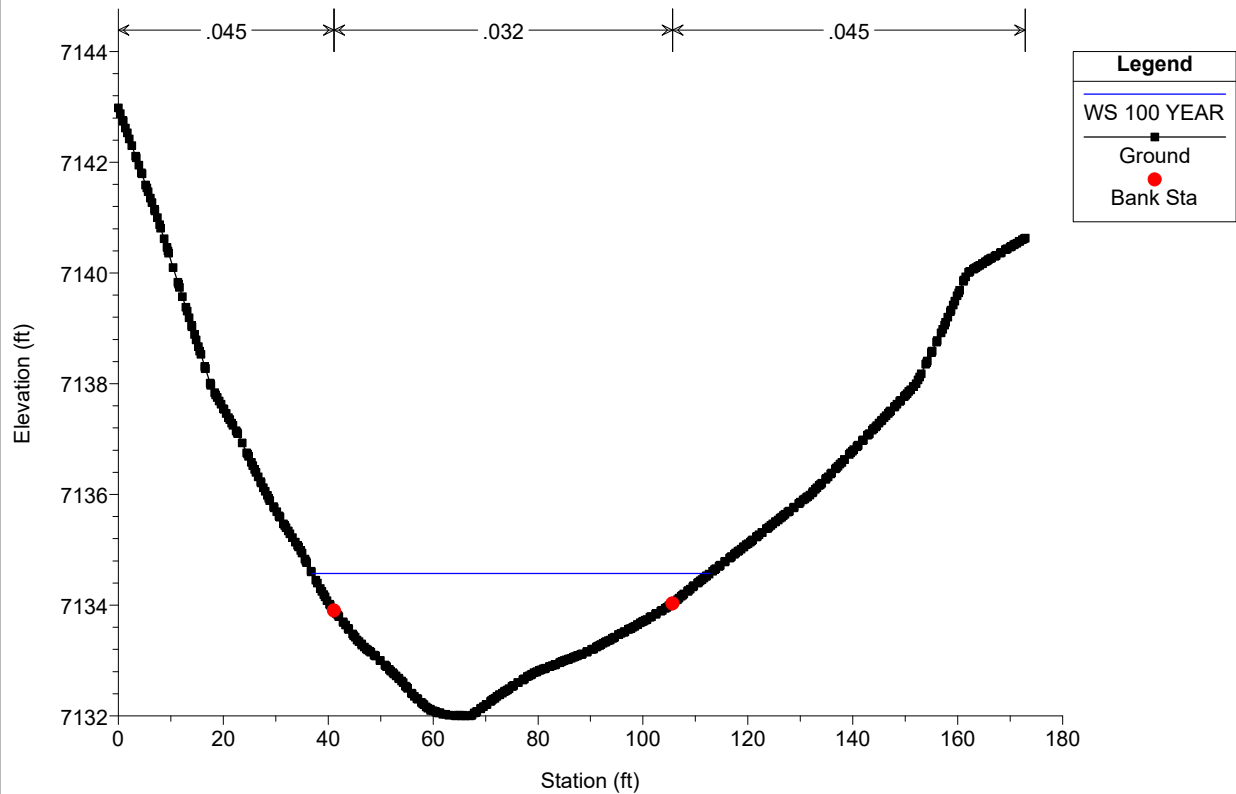
HEC-RAS Plan: Proposed River: Creek Reach: Creek Profile: 100 YEAR

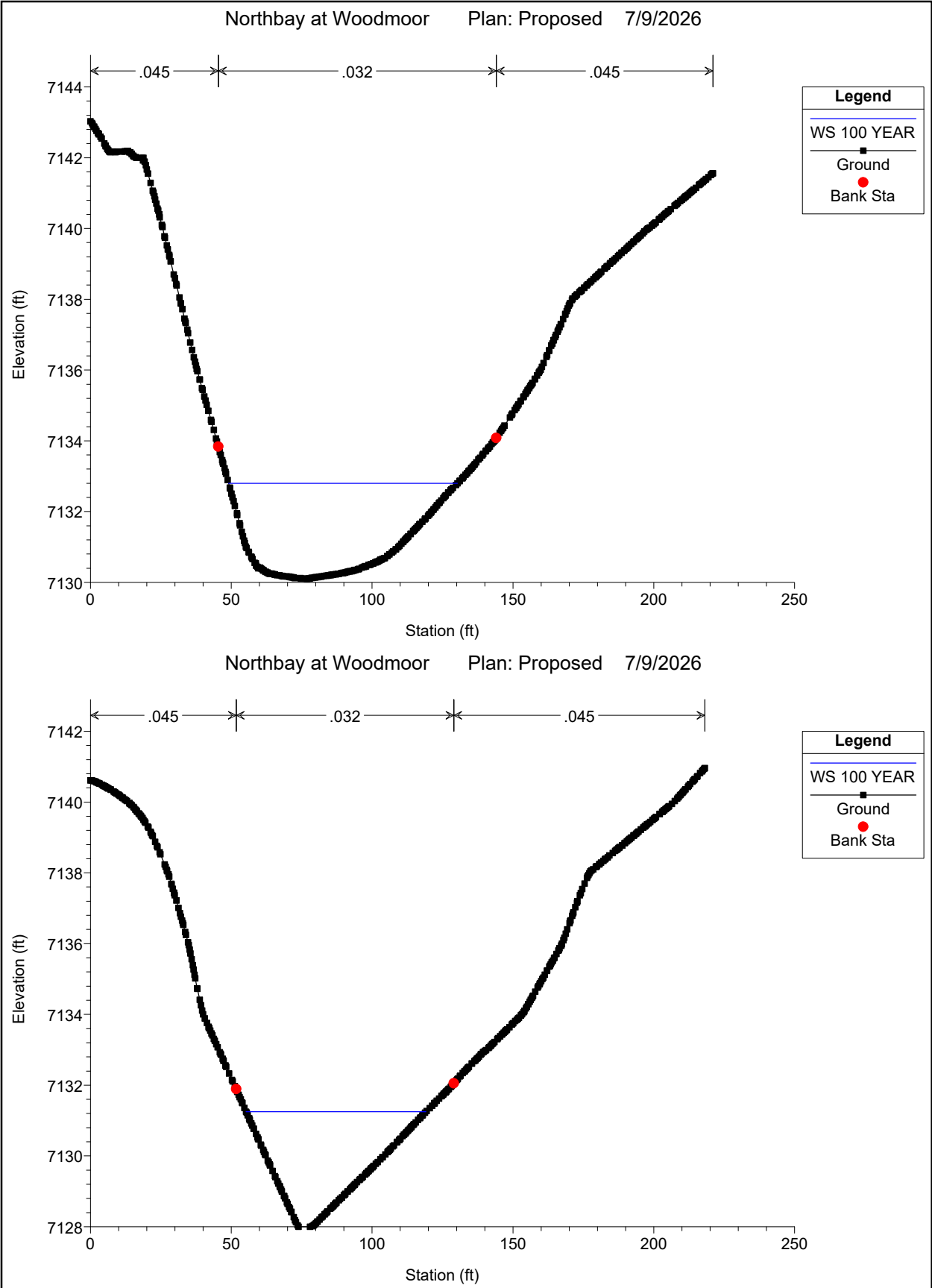
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Creek	1024	100 YEAR	1240.00	7134.88	7138.35	7138.50	7139.66	0.014086	9.19	135.74	68.06	1.10
Creek	1023	100 YEAR	1240.00	7132.00	7134.57	7135.18	7136.58	0.030507	11.41	111.31	75.89	1.56
Creek	1022	100 YEAR	1240.00	7130.10	7132.80	7132.80	7133.78	0.012268	7.93	156.39	81.27	1.01
Creek	1021	100 YEAR	1240.00	7128.00	7131.25	7131.81	7133.13	0.026417	10.99	112.87	63.84	1.46
Creek	1020	100 YEAR	1240.00	7128.00	7130.62	7130.63	7131.38	0.013464	6.99	177.31	119.70	1.01
Creek	1019	100 YEAR	1240.00	7128.00	7129.04	7129.36	7130.12	0.035597	8.35	148.48	159.44	1.53
Creek	1018	100 YEAR	1240.00	7126.75	7128.21	7128.29	7128.77	0.009977	6.00	206.64	230.22	1.12
Creek	1017	100 YEAR	1240.00	7126.28	7127.20	7127.51	7128.26	0.043330	8.25	150.34	255.75	1.90
Creek	1016	100 YEAR	1240.00	7124.94	7126.84	7126.84	7127.26	0.014382	5.21	238.11	291.26	1.02
Creek	1015	100 YEAR	1240.00	7123.15	7125.12	7125.49	7126.40	0.032080	9.08	136.61	119.71	1.50
Creek	1014	100 YEAR	1240.00	7121.62	7123.05	7123.51	7124.55	0.040324	9.85	125.94	115.94	1.67
Creek	1013	100 YEAR	1240.00	7121.35	7122.97	7123.15	7123.87	0.021231	7.60	163.23	137.08	1.23
Creek	1012	100 YEAR	1240.00	7120.46	7122.33	7122.33	7122.92	0.014576	6.19	200.43	172.81	1.01
Creek	1011	100 YEAR	1240.00	7118.00	7120.09	7120.52	7121.25	0.025628	8.66	143.12	113.64	1.36
Creek	1010	100 YEAR	1240.00	7117.86	7119.83	7119.91	7120.65	0.015641	7.22	171.75	123.78	1.08
Creek	1009	100 YEAR	1240.00	7117.33	7119.69	7119.61	7120.34	0.011555	6.46	191.85	130.06	0.94
Creek	1008	100 YEAR	1240.00	7117.01	7119.44	7119.44	7120.17	0.013562	6.86	180.70	126.27	1.01
Creek	1007	100 YEAR	1240.00	7116.20	7118.81	7119.06	7119.89	0.021054	8.34	148.67	107.78	1.25
Creek	1006	100 YEAR	1240.00	7116.00	7118.29	7118.62	7119.49	0.025124	8.76	141.56	108.89	1.35
Creek	1005	100 YEAR	1240.00	7115.19	7117.20	7117.58	7118.52	0.028765	9.23	134.36	105.81	1.44
Creek	1004	100 YEAR	1240.00	7113.28	7114.47	7115.12	7116.72	0.081924	12.02	103.13	119.81	2.28
Creek	1003	100 YEAR	1240.00	7110.52	7112.31	7113.00	7114.56	0.060056	12.03	103.06	94.60	2.03
Creek	1002	100 YEAR	1240.00	7104.00	7105.62	7106.38	7108.37	0.091505	13.31	93.20	100.63	2.44
Creek	1001	100 YEAR	1240.00	7099.92	7105.99	7102.96	7106.03	0.000196	1.61	771.03	196.40	0.14
Creek	1000	100 YEAR	1240.00	7098.01	7106.00	7100.29	7106.02	0.000043	1.01	1227.94	201.88	0.07

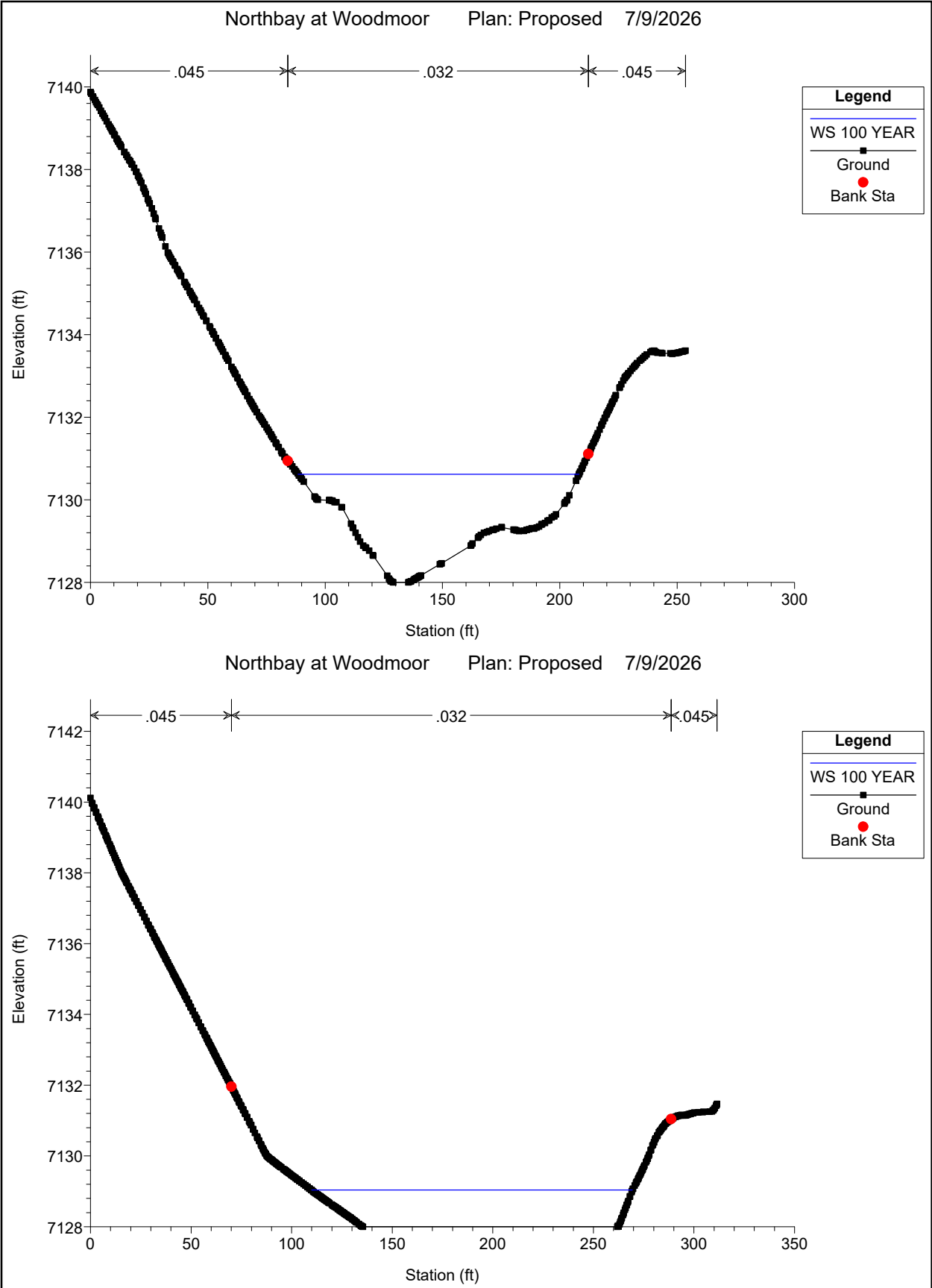
Northbay at Woodmoor Plan: Proposed 7/9/2026

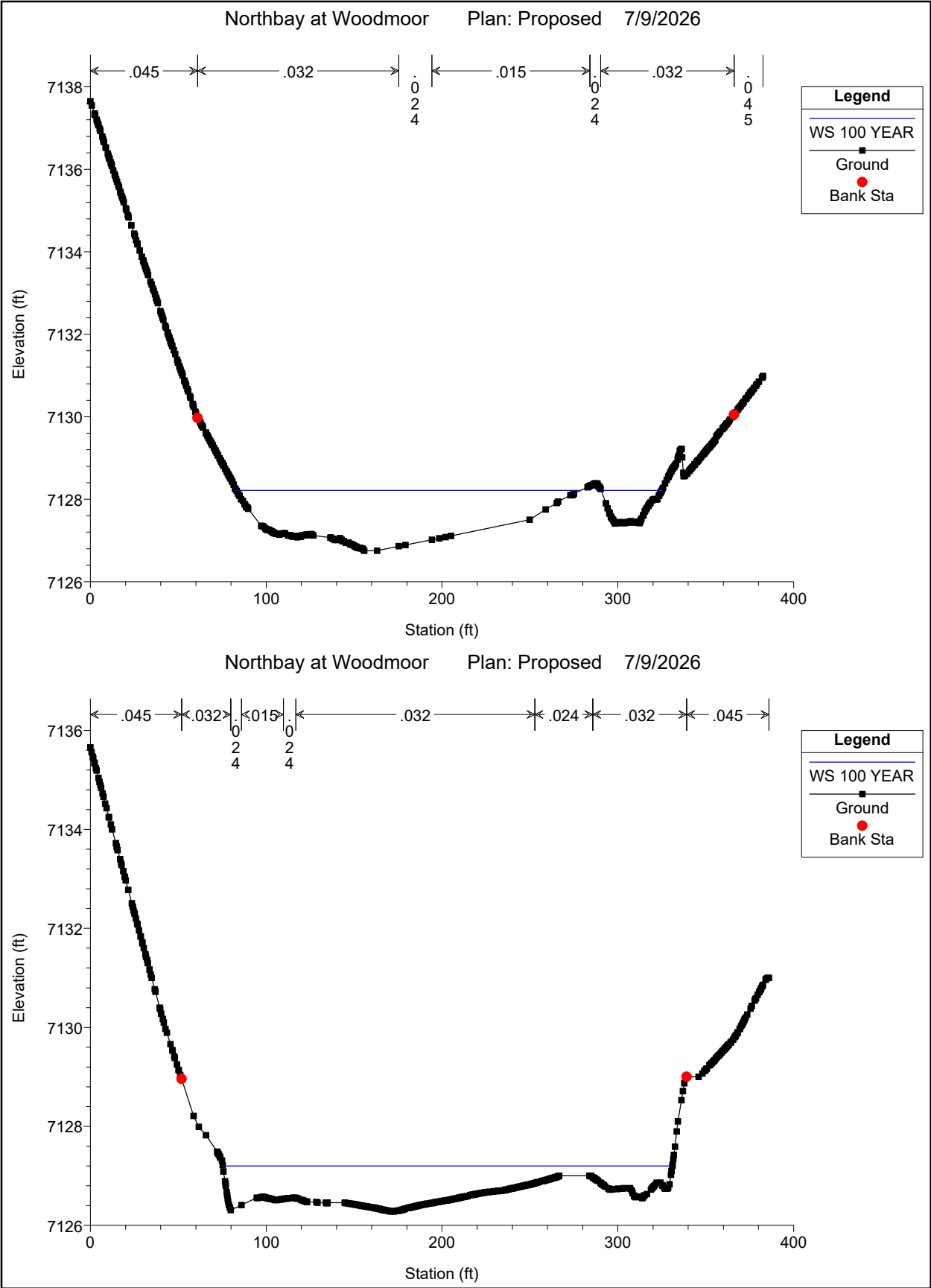


Northbay at Woodmoor Plan: Proposed 7/9/2026

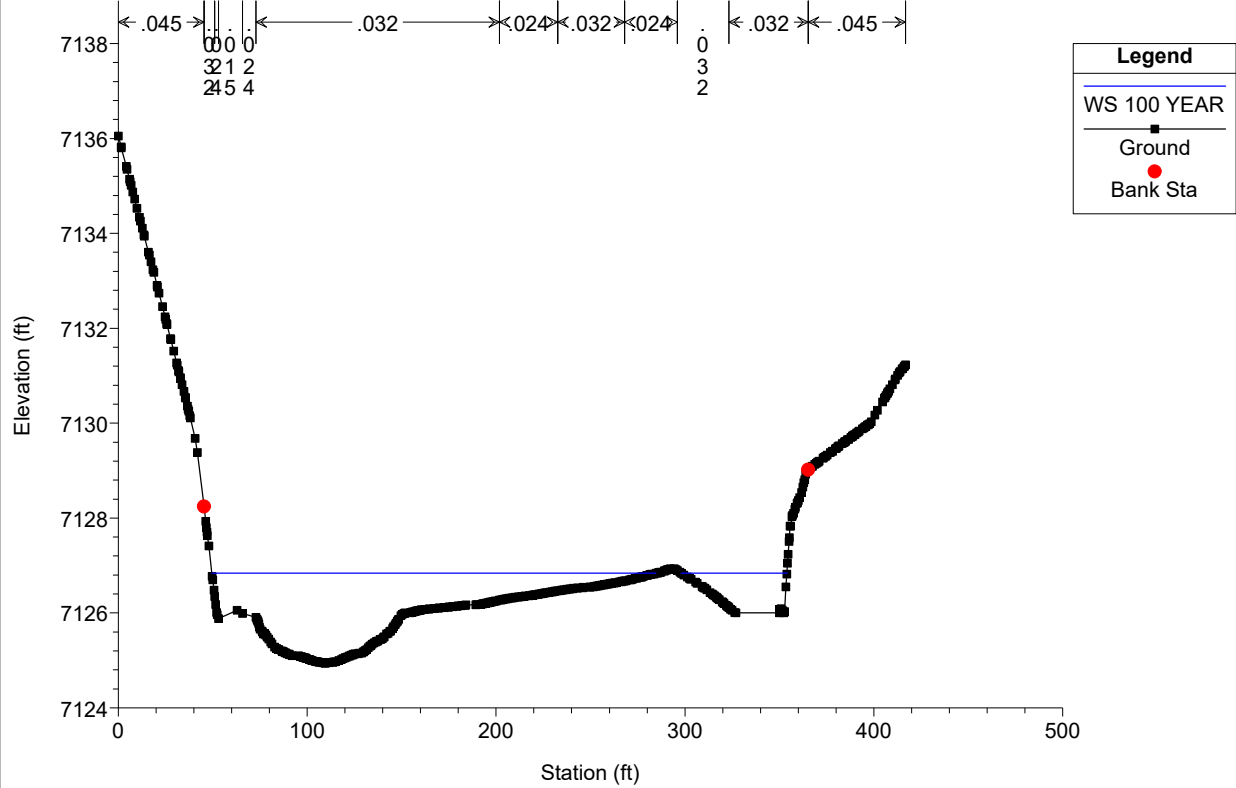




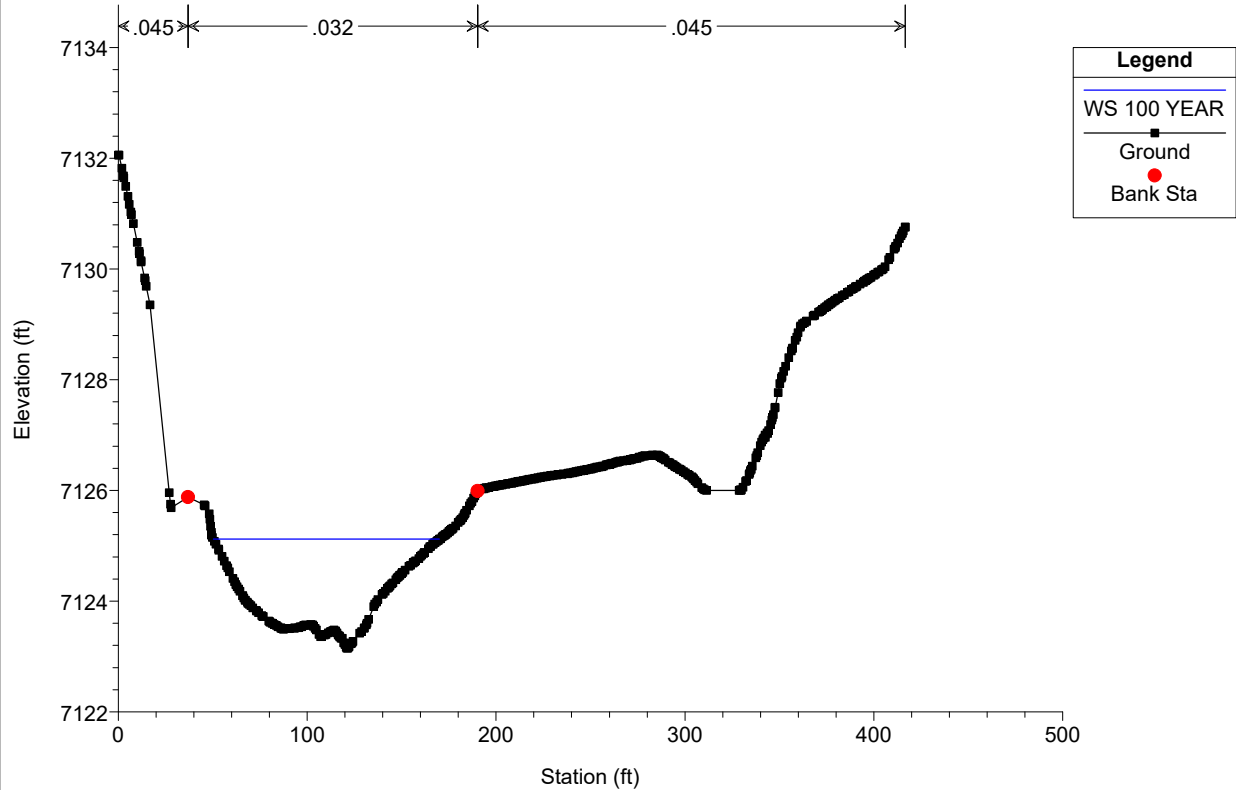




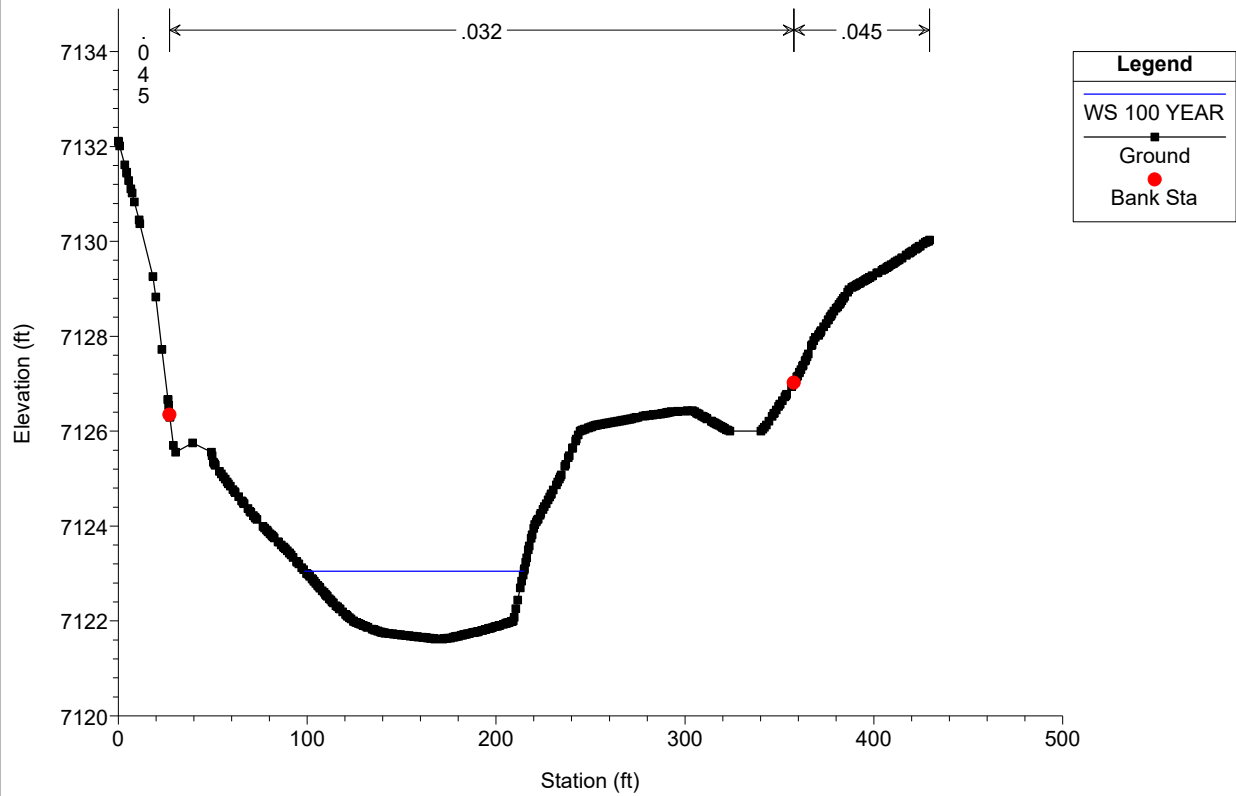
Northbay at Woodmoor Plan: Proposed 7/9/2026



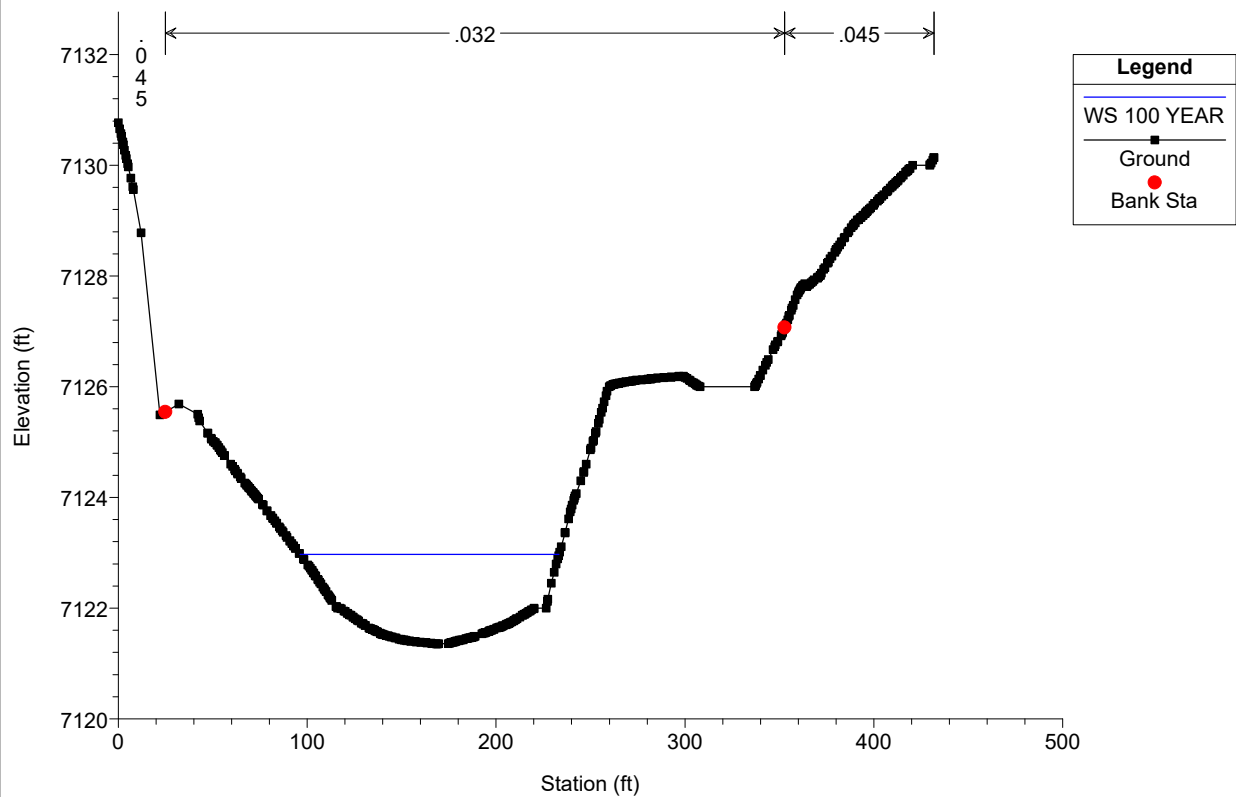
Northbay at Woodmoor Plan: Proposed 7/9/2026



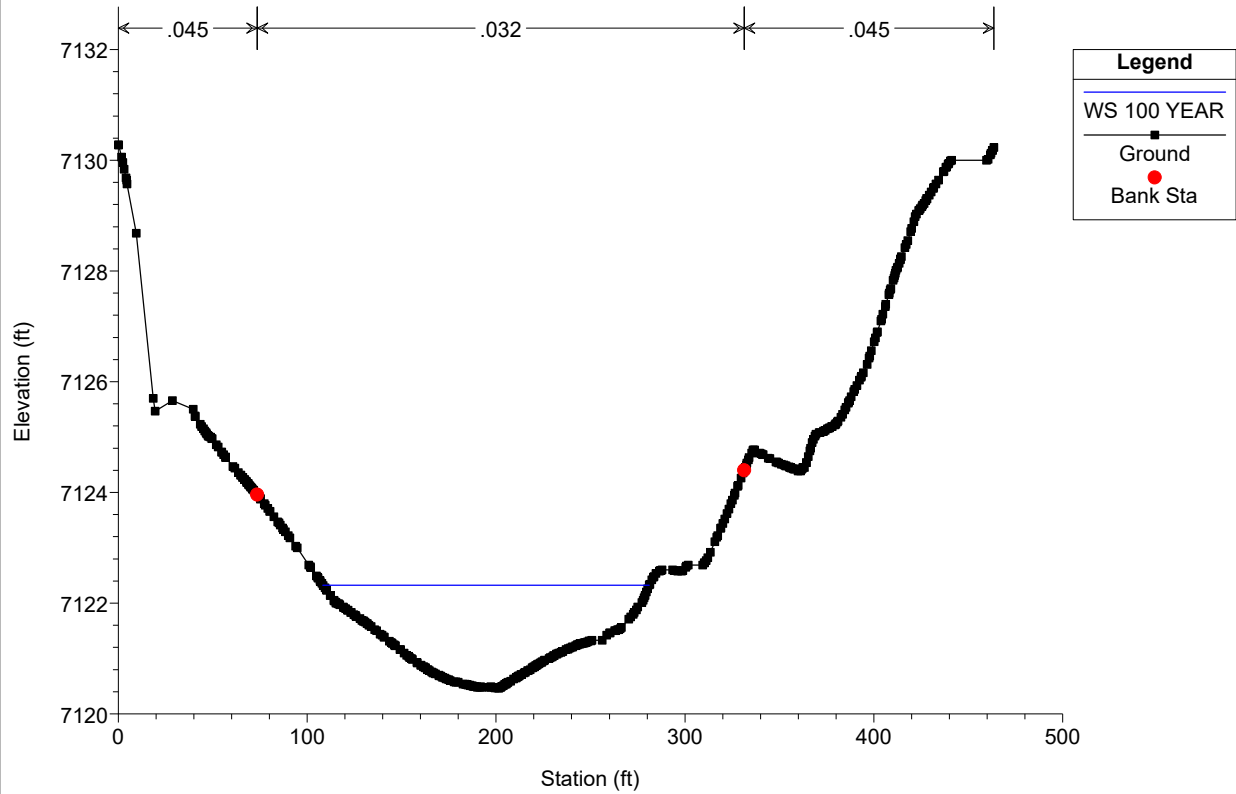
Northbay at Woodmoor Plan: Proposed 7/9/2026



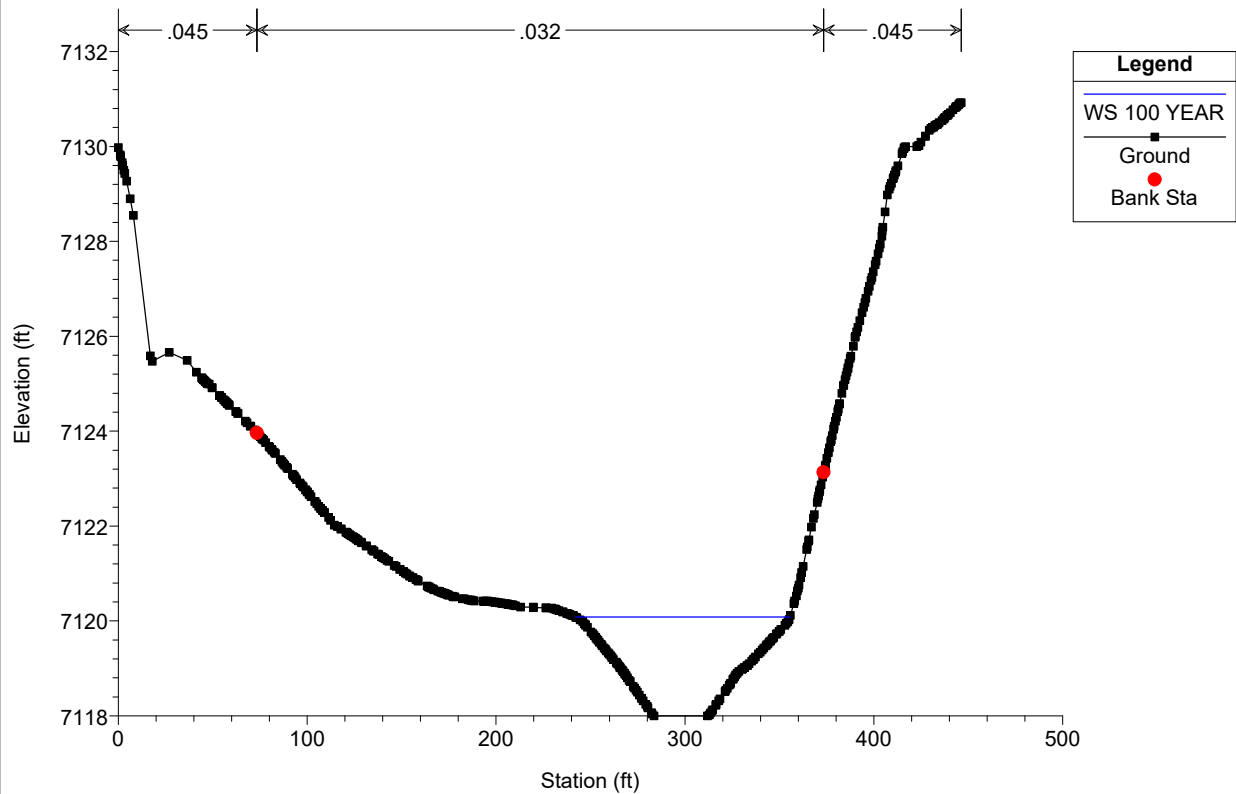
Northbay at Woodmoor Plan: Proposed 7/9/2026



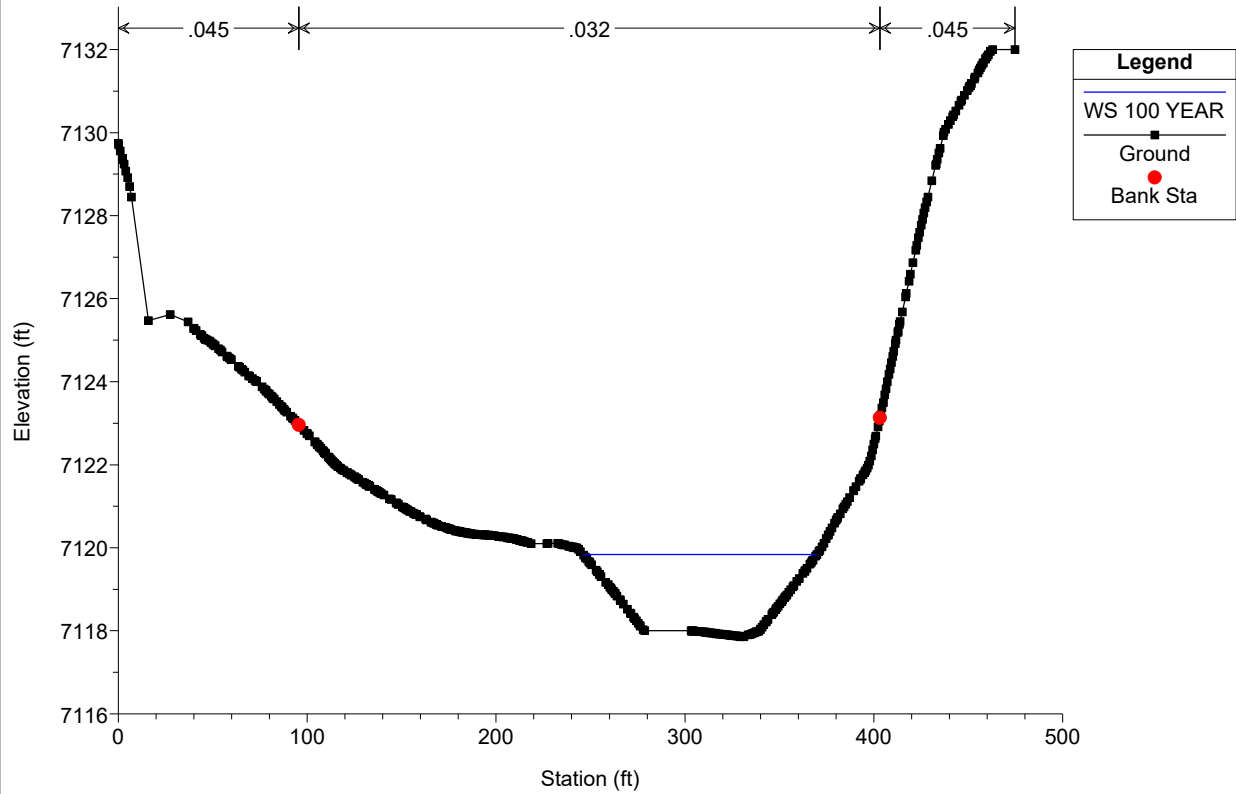
Northbay at Woodmoor Plan: Proposed 7/9/2026



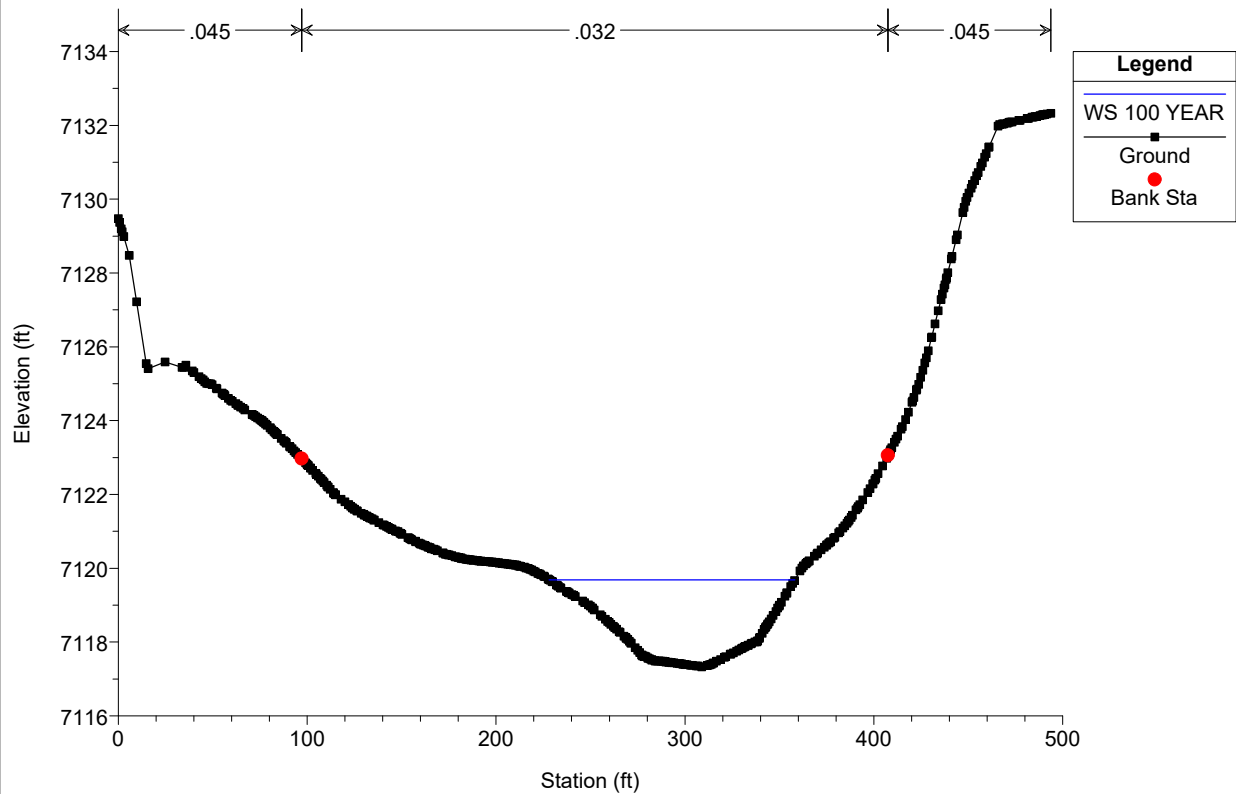
Northbay at Woodmoor Plan: Proposed 7/9/2026



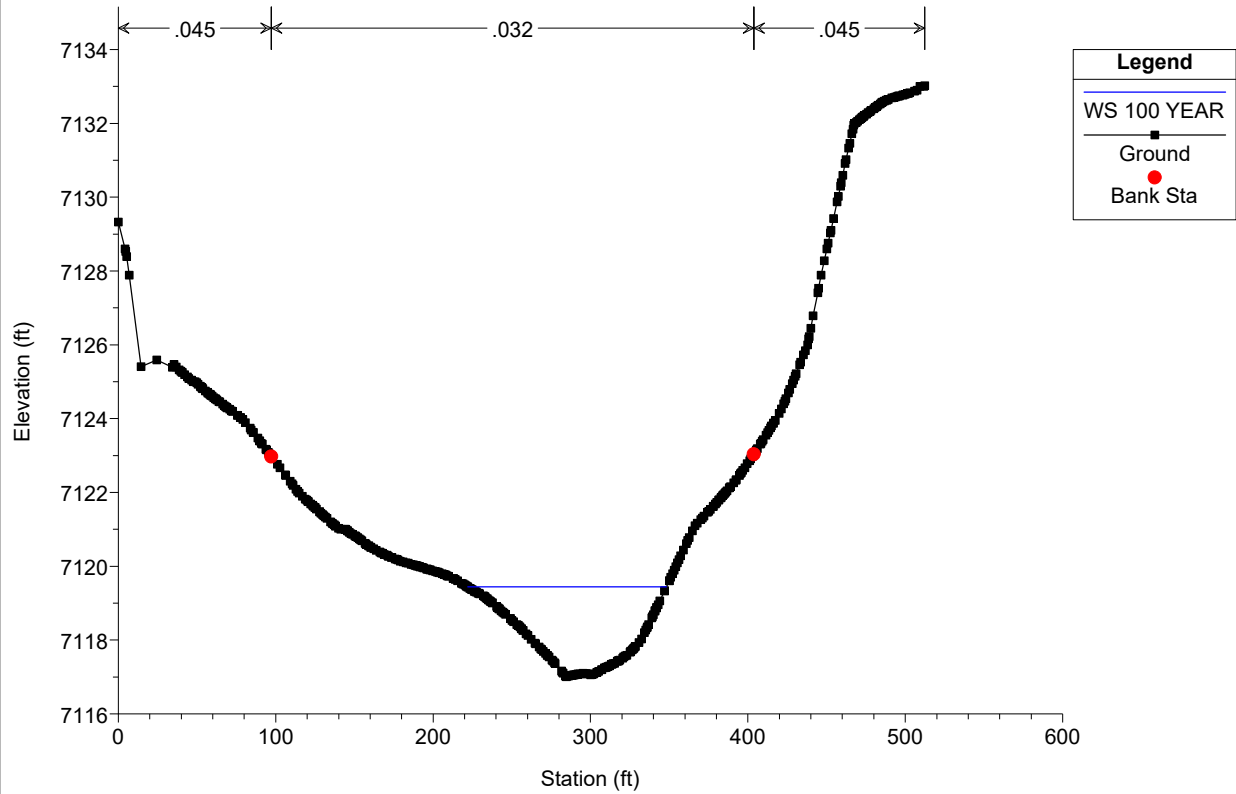
Northbay at Woodmoor Plan: Proposed 7/9/2026



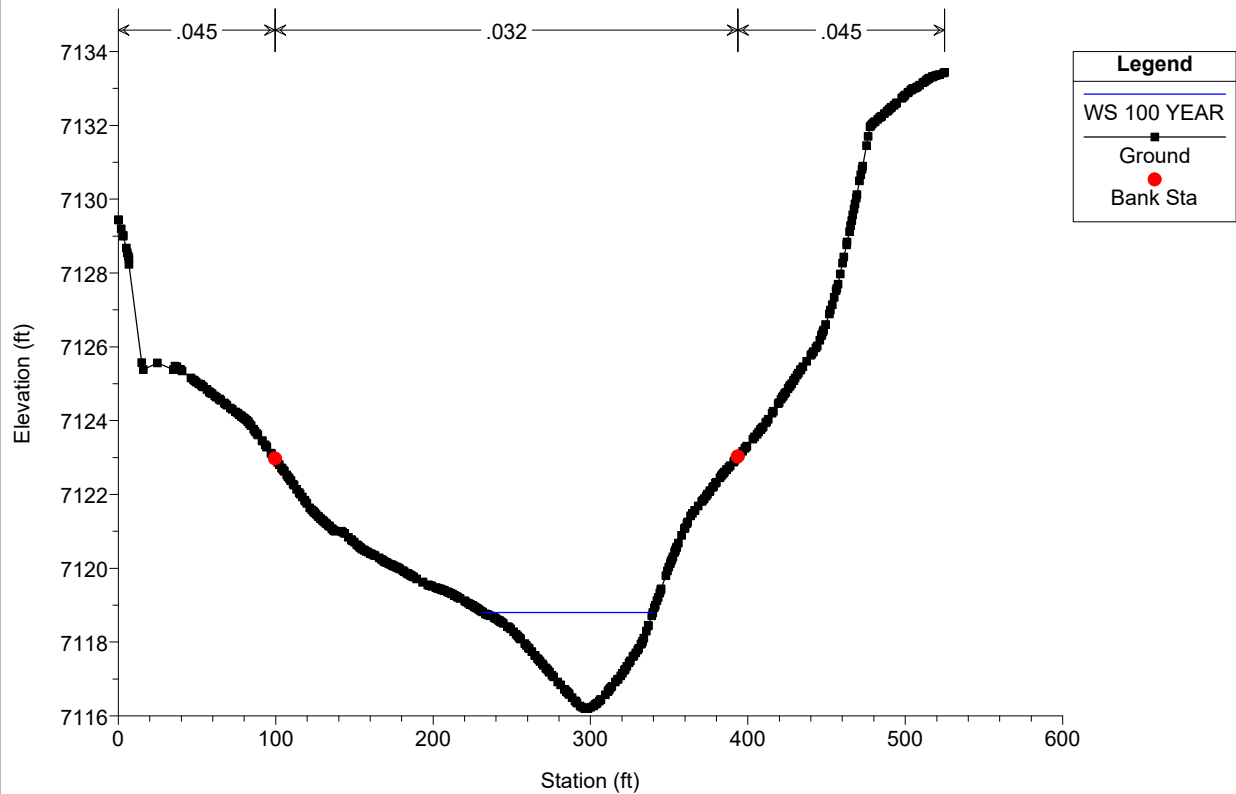
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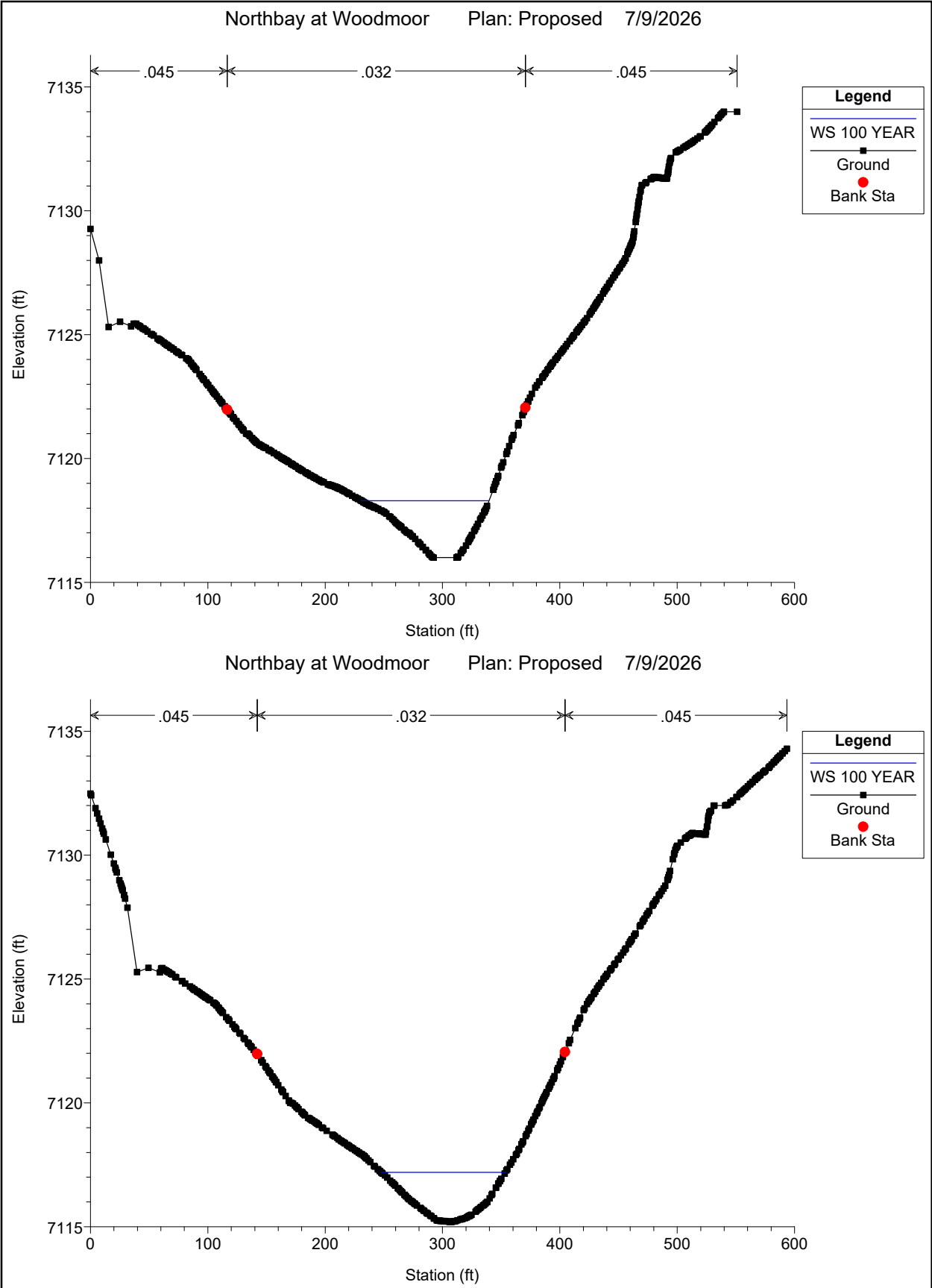


Northbay at Woodmoor Plan: Proposed 7/9/2026

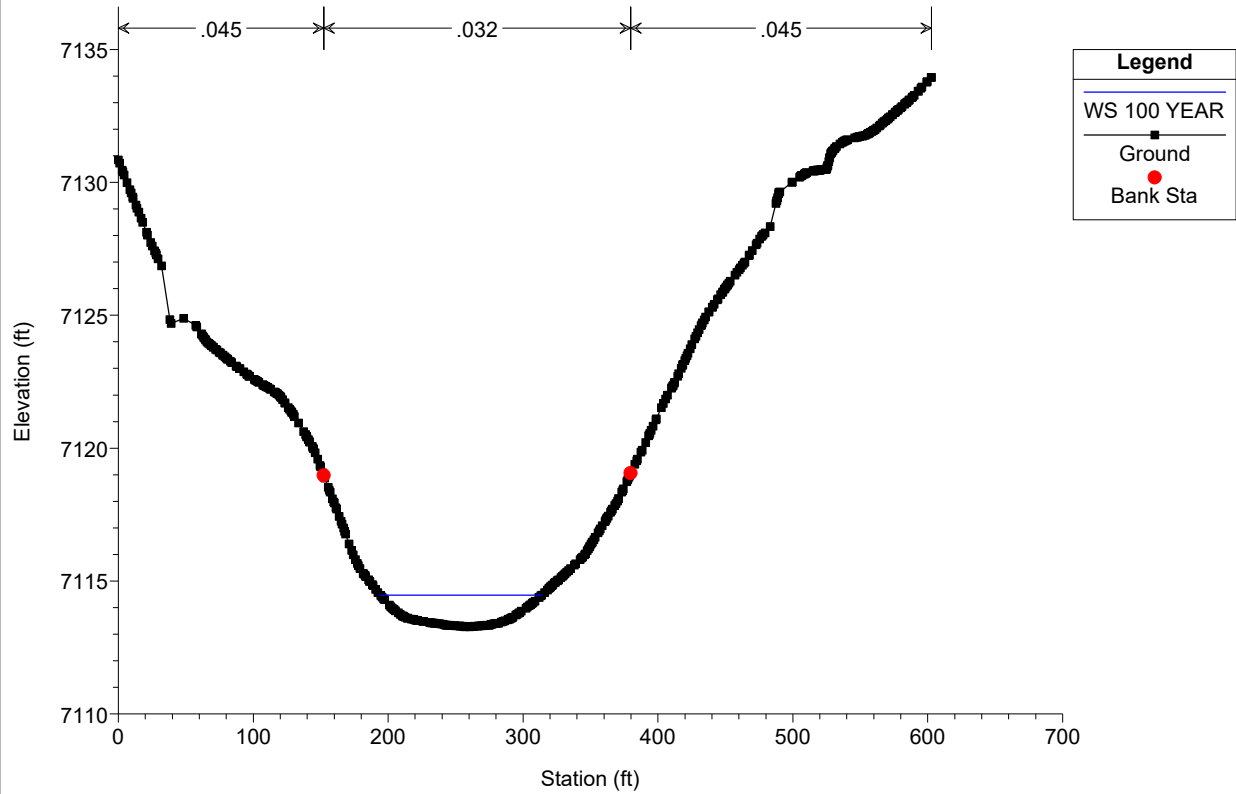


Northbay at Woodmoor Plan: Proposed 7/9/2026

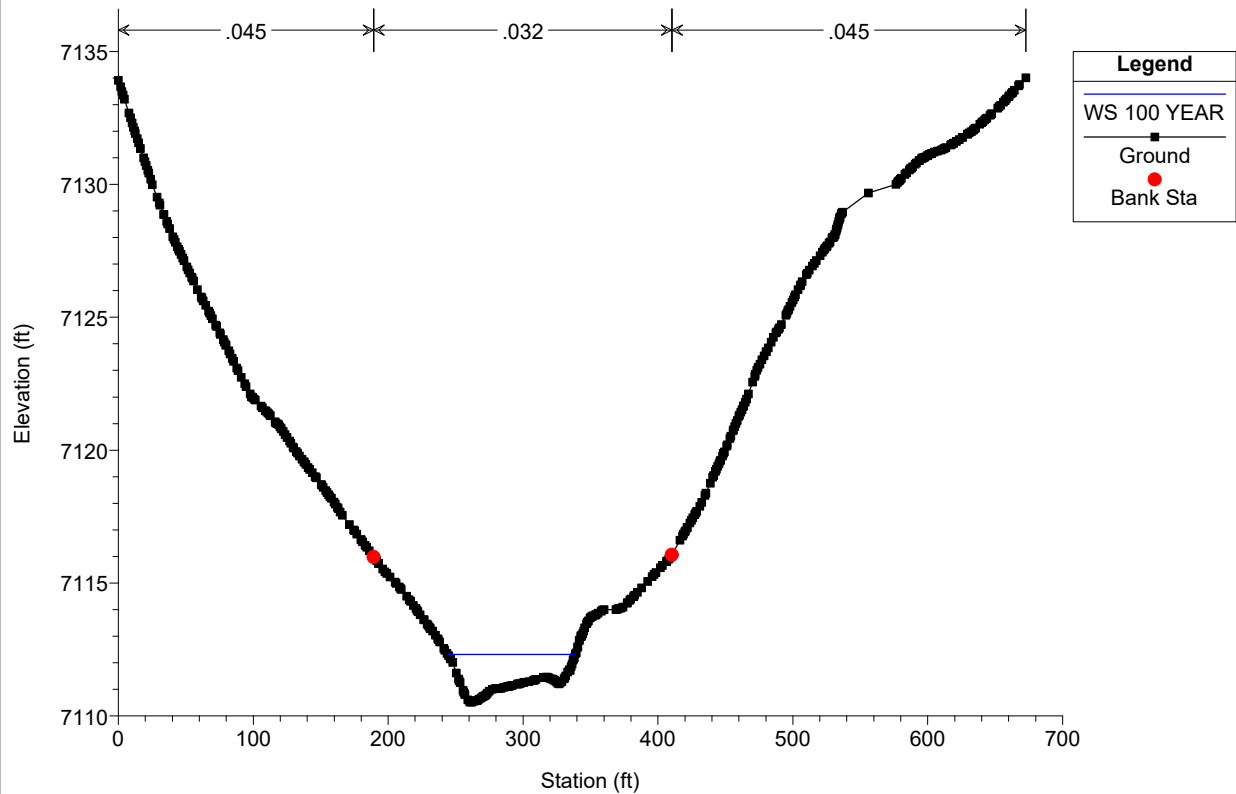


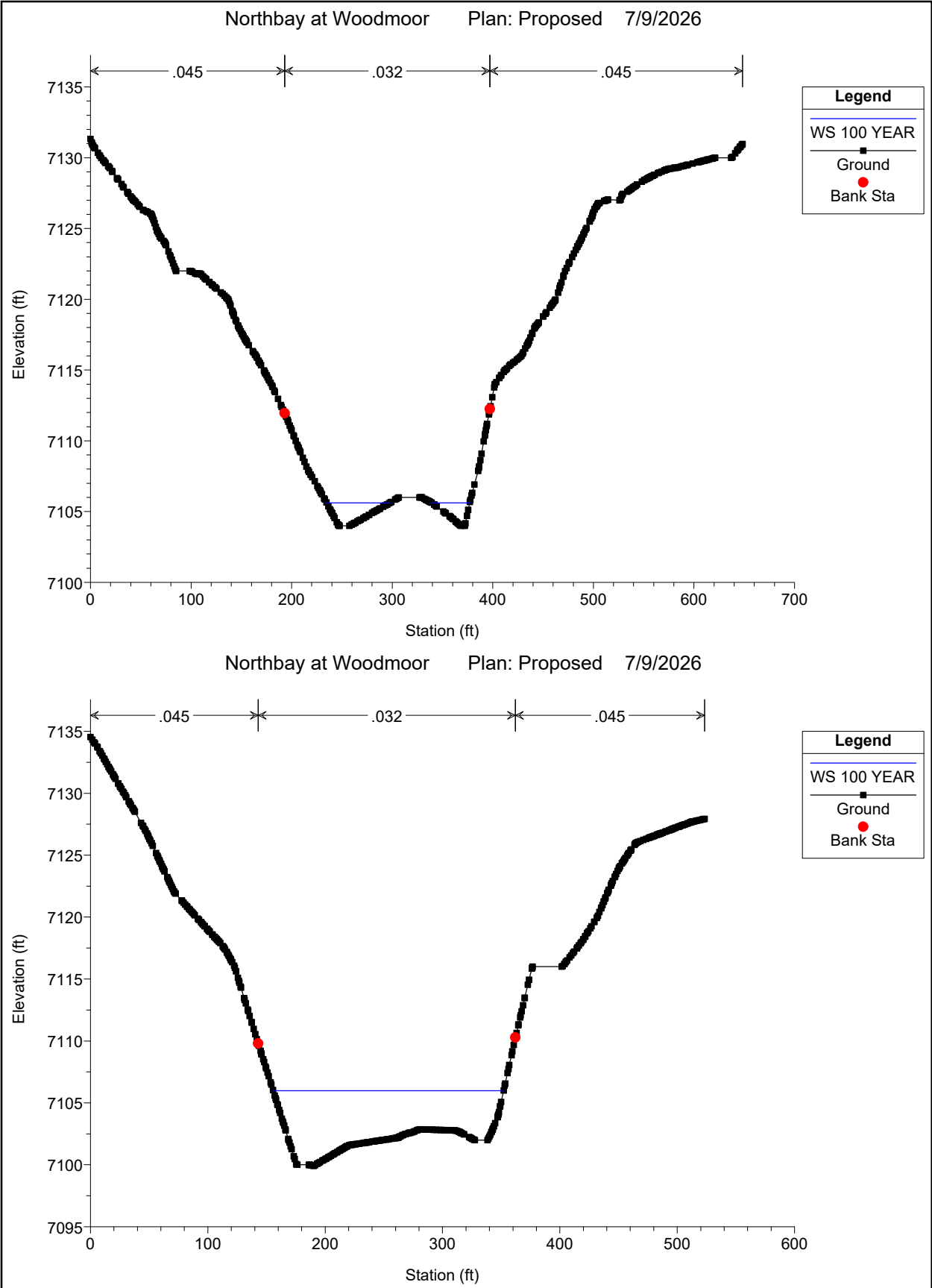


Northbay at Woodmoor Plan: Proposed 7/9/2026

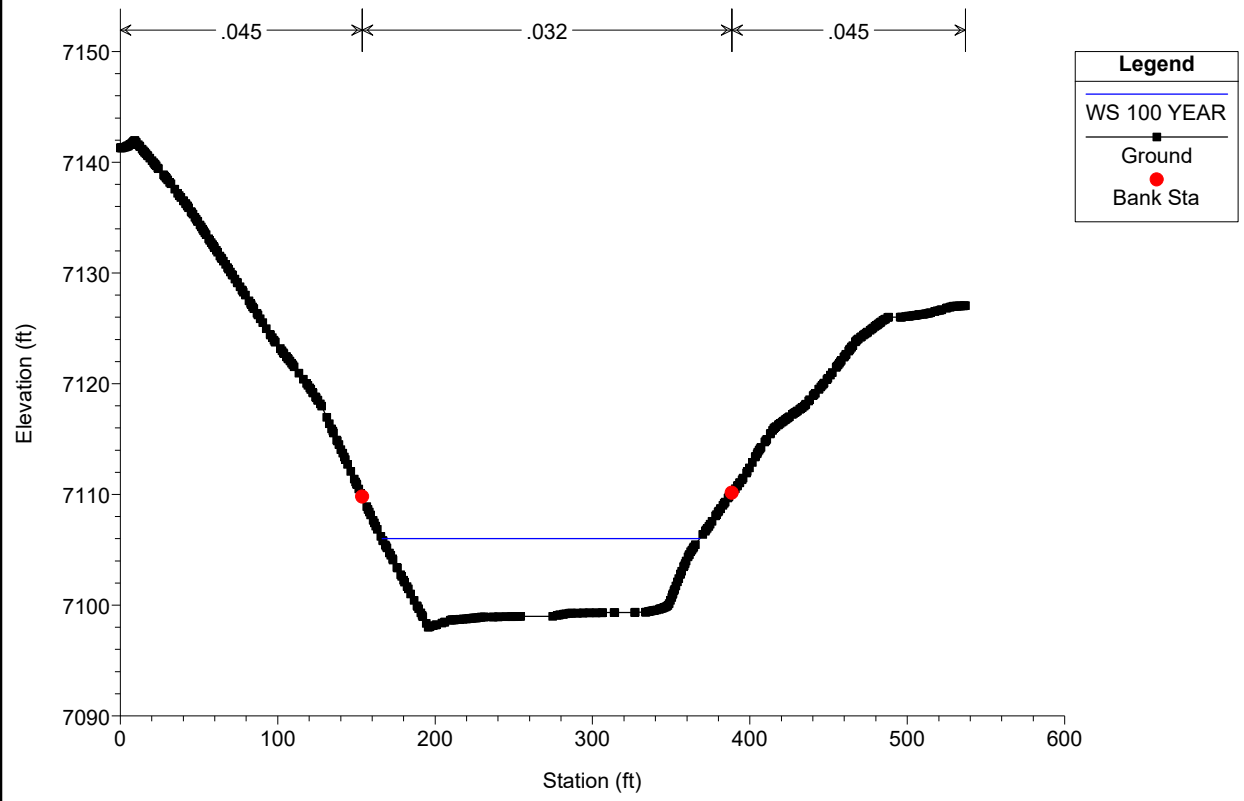


Northbay at Woodmoor Plan: Proposed 7/9/2026



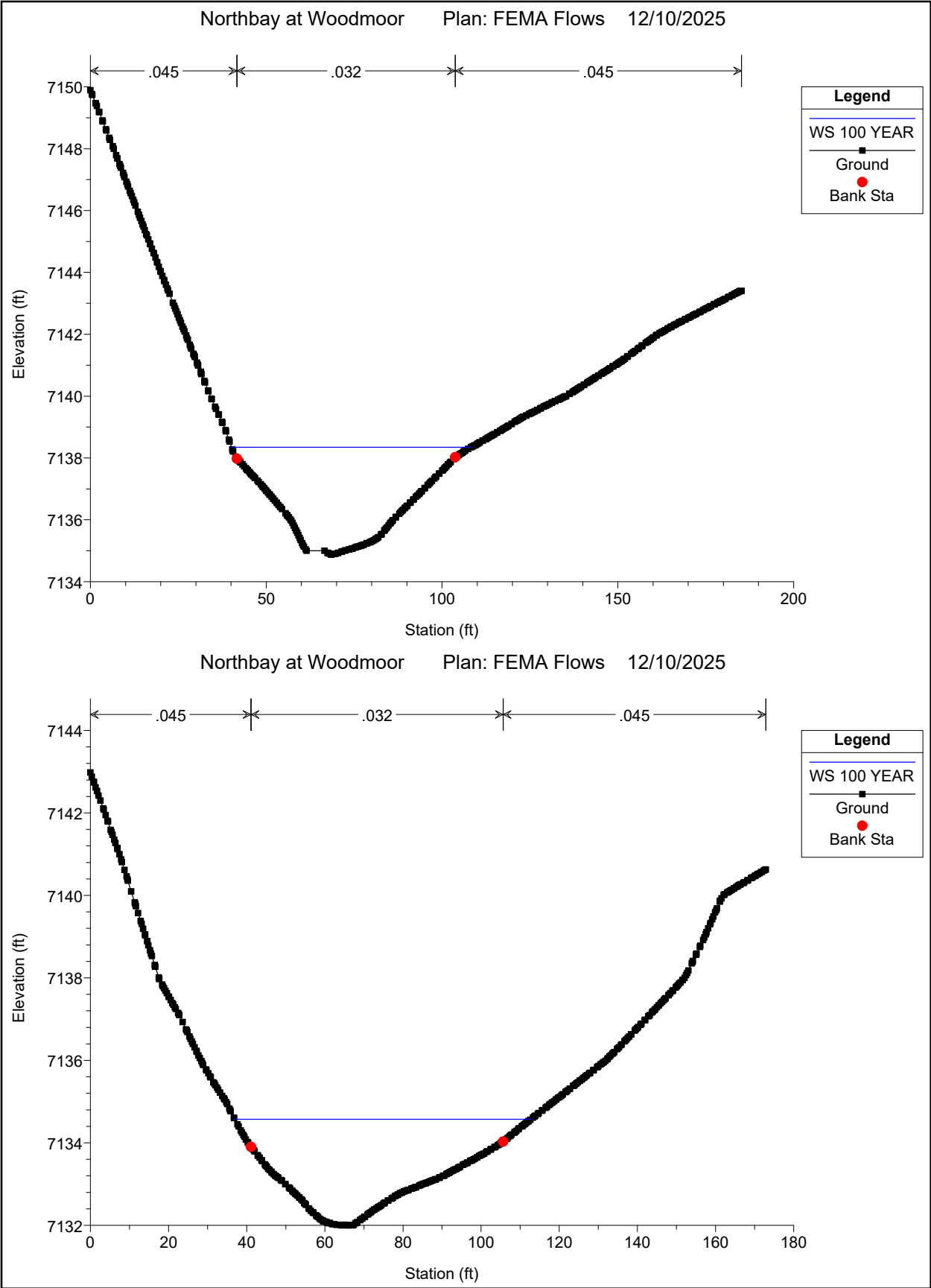


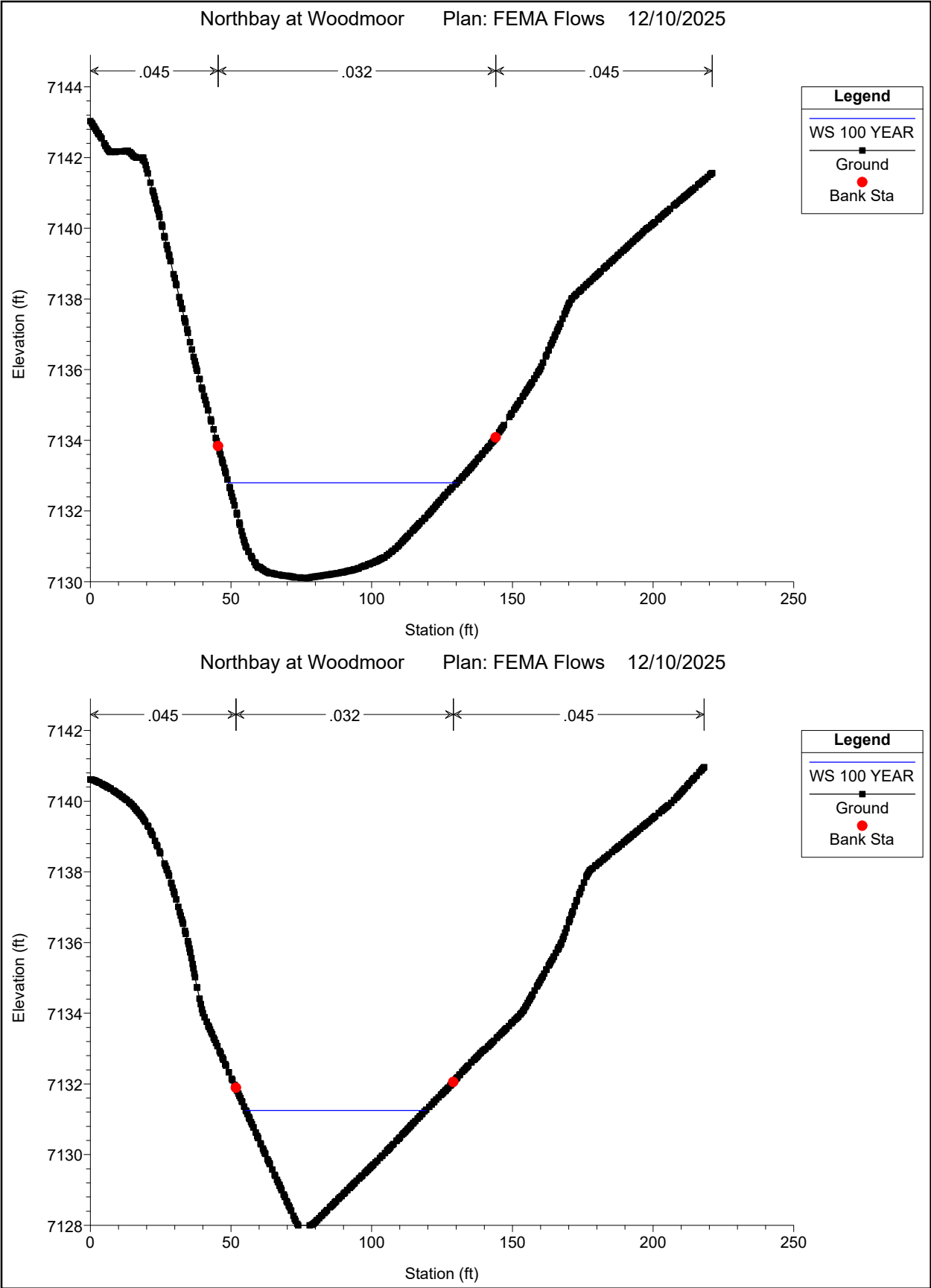
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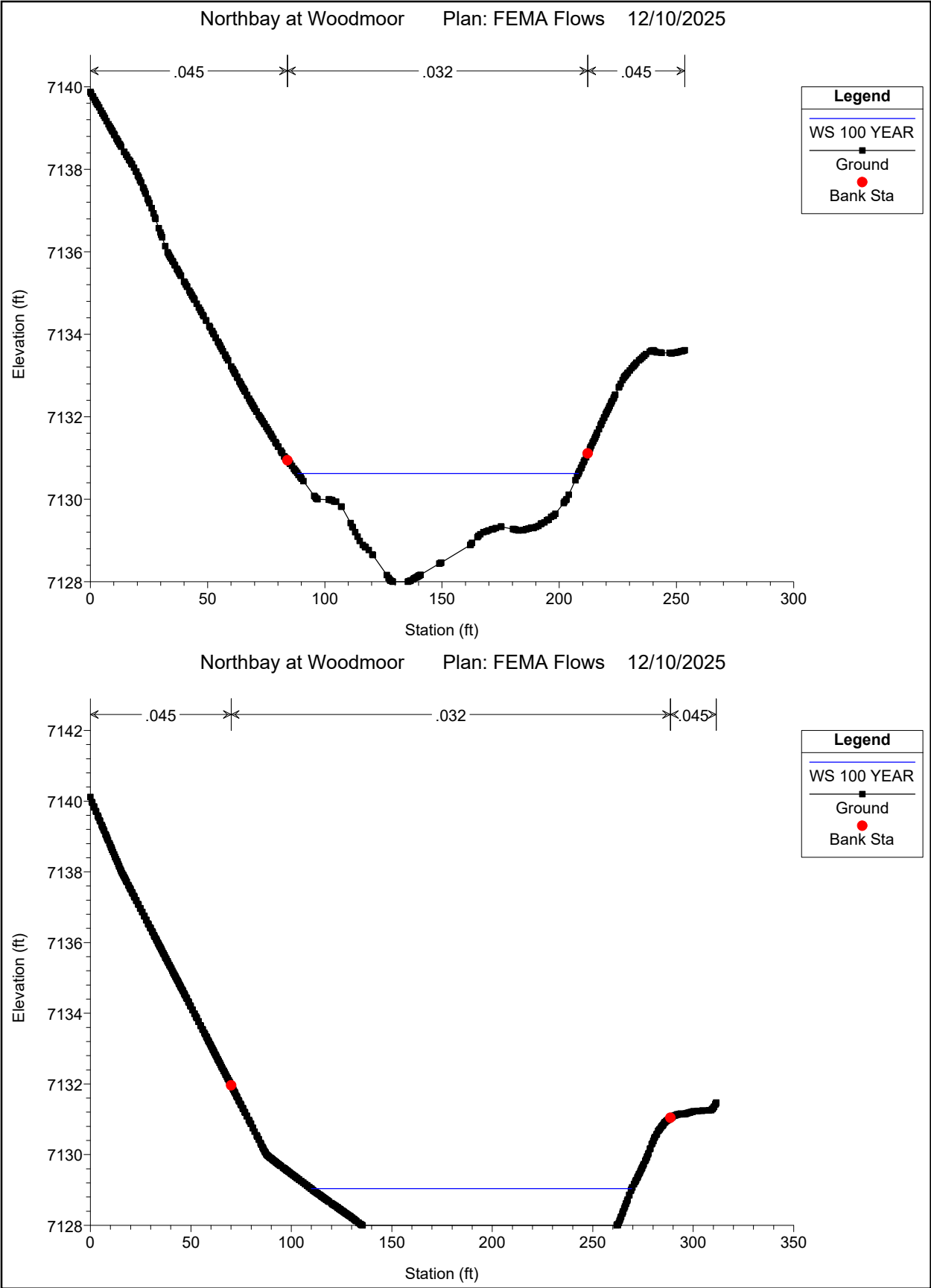


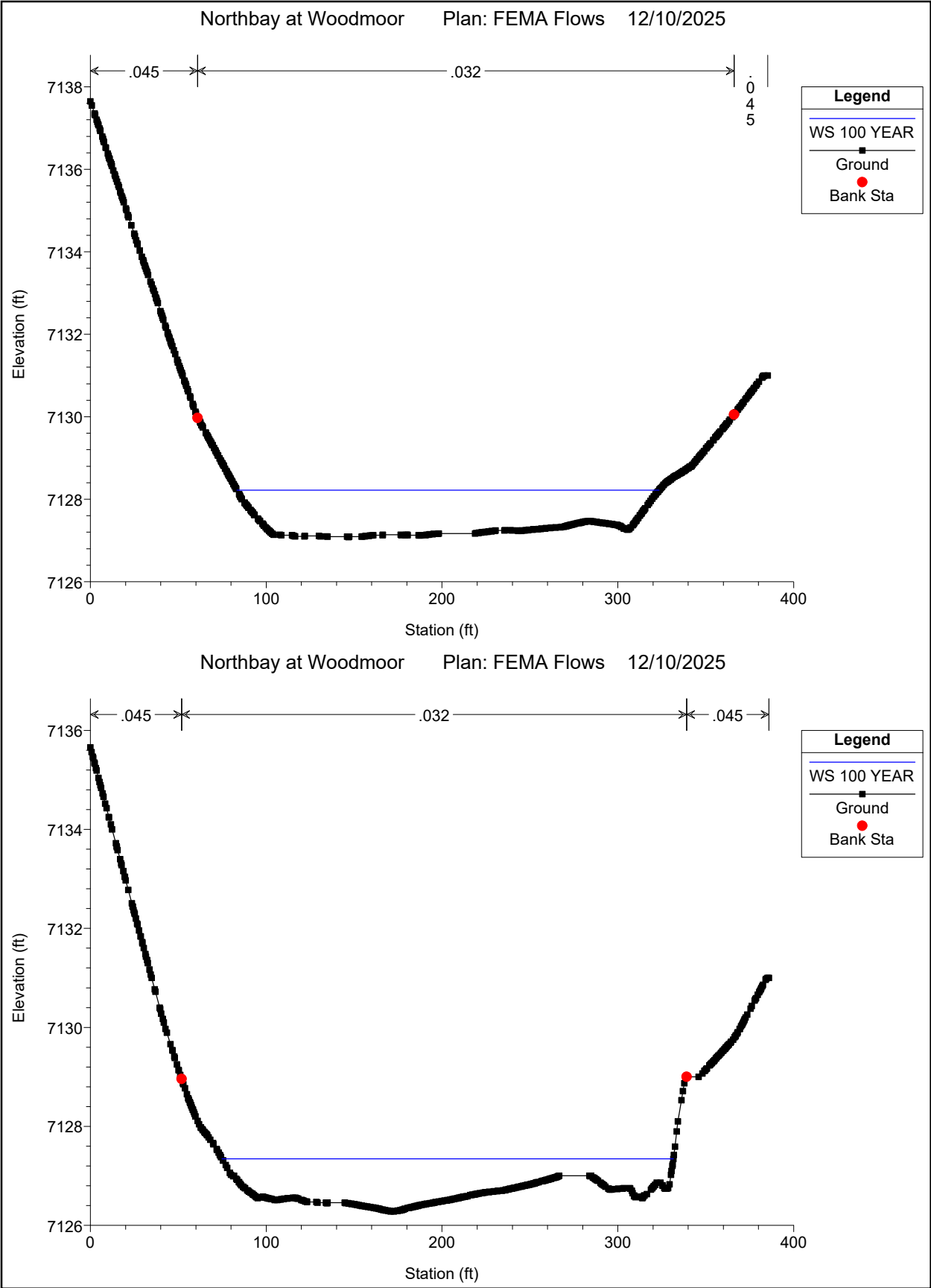
HEC-RAS Plan: FEMA River: Creek Reach: Creek Profile: 100 YEAR

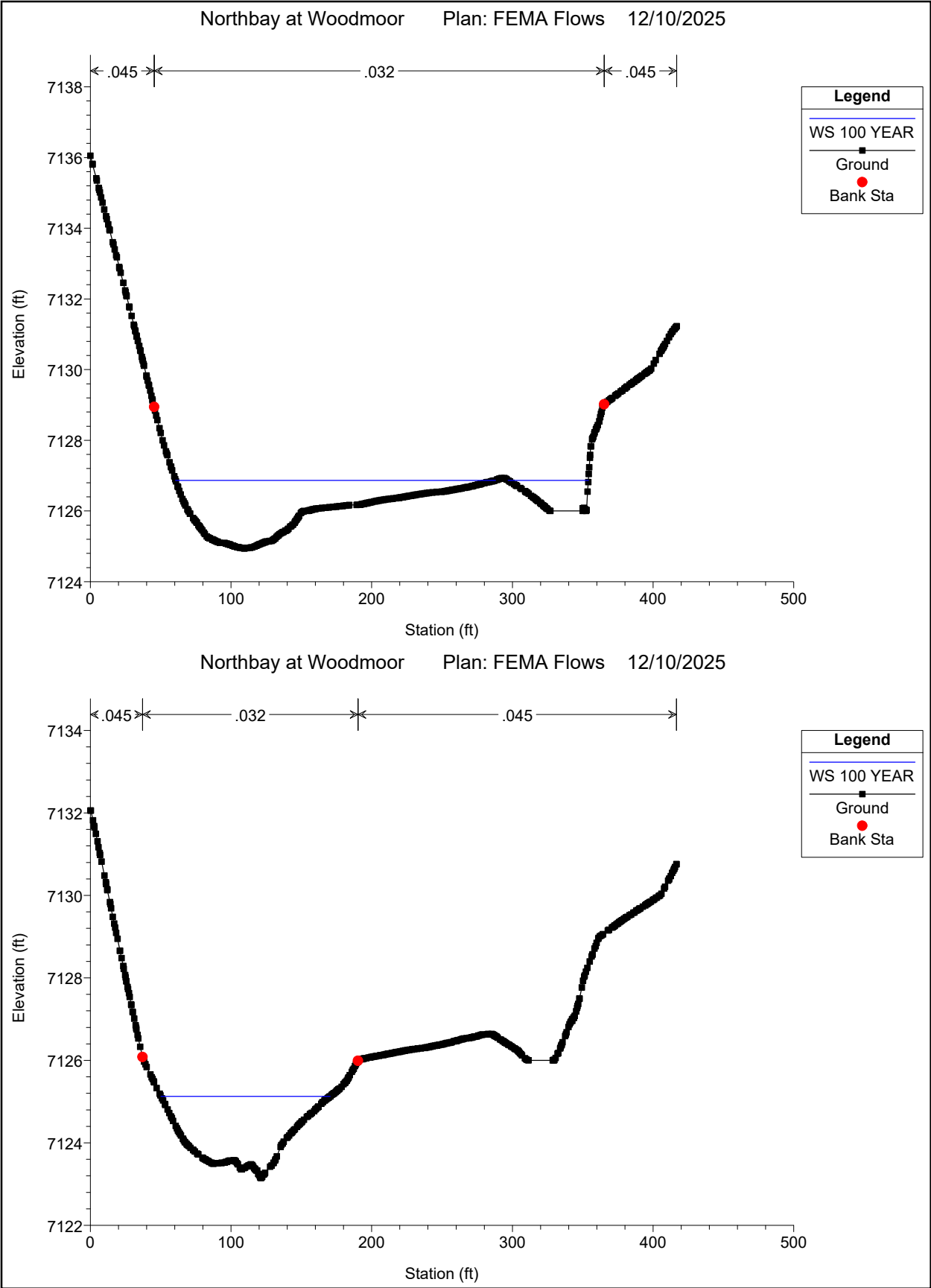
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Creek	1024	100 YEAR	1240.00	7134.88	7138.35	7138.50	7139.66	0.014086	9.19	135.74	68.06	1.10
Creek	1023	100 YEAR	1240.00	7132.00	7134.57	7135.18	7136.58	0.030507	11.41	111.31	75.89	1.56
Creek	1022	100 YEAR	1240.00	7130.10	7132.80	7132.80	7133.78	0.012268	7.93	156.39	81.27	1.01
Creek	1021	100 YEAR	1240.00	7128.00	7131.25	7131.81	7133.13	0.026417	10.99	112.87	63.84	1.46
Creek	1020	100 YEAR	1240.00	7128.00	7130.62	7130.63	7131.38	0.013397	6.98	177.60	119.75	1.01
Creek	1019	100 YEAR	1240.00	7128.00	7129.04	7129.36	7130.12	0.035597	8.35	148.48	159.44	1.53
Creek	1018	100 YEAR	1240.00	7127.08	7128.22	7128.22	7128.69	0.015353	5.51	225.05	240.07	1.00
Creek	1017	100 YEAR	1240.00	7126.28	7127.35	7127.54	7128.09	0.035662	6.91	179.54	256.73	1.46
Creek	1016	100 YEAR	1240.00	7124.94	7126.87	7126.87	7127.30	0.016767	5.28	234.72	284.60	1.03
Creek	1015	100 YEAR	1240.00	7123.15	7125.13	7125.50	7126.39	0.031426	9.00	137.78	120.42	1.48
Creek	1014	100 YEAR	1240.00	7121.62	7123.05	7123.51	7124.56	0.040489	9.86	125.77	115.91	1.67
Creek	1013	100 YEAR	1240.00	7121.35	7122.97	7123.15	7123.87	0.021310	7.61	163.03	137.04	1.23
Creek	1012	100 YEAR	1240.00	7120.46	7122.33	7122.33	7122.92	0.014576	6.19	200.43	172.81	1.01
Creek	1011	100 YEAR	1240.00	7118.00	7120.09	7120.52	7121.25	0.025628	8.66	143.12	113.64	1.36
Creek	1010	100 YEAR	1240.00	7117.86	7119.83	7119.91	7120.65	0.015641	7.22	171.75	123.78	1.08
Creek	1009	100 YEAR	1240.00	7117.33	7119.69	7119.61	7120.34	0.011555	6.46	191.85	130.06	0.94
Creek	1008	100 YEAR	1240.00	7117.01	7119.44	7119.44	7120.17	0.013562	6.86	180.70	126.27	1.01
Creek	1007	100 YEAR	1240.00	7116.20	7118.81	7119.06	7119.89	0.021054	8.34	148.67	107.78	1.25
Creek	1006	100 YEAR	1240.00	7116.00	7118.29	7118.62	7119.49	0.025124	8.76	141.56	108.89	1.35
Creek	1005	100 YEAR	1240.00	7115.19	7117.20	7117.58	7118.52	0.028765	9.23	134.36	105.81	1.44
Creek	1004	100 YEAR	1240.00	7113.28	7114.47	7115.12	7116.72	0.081924	12.02	103.13	119.81	2.28
Creek	1003	100 YEAR	1240.00	7110.52	7112.31	7113.00	7114.56	0.060056	12.03	103.06	94.60	2.03
Creek	1002	100 YEAR	1240.00	7104.00	7105.62	7106.38	7108.37	0.091505	13.31	93.20	100.63	2.44
Creek	1001	100 YEAR	1240.00	7099.92	7105.99	7102.96	7106.03	0.000196	1.61	771.03	196.40	0.14
Creek	1000	100 YEAR	1240.00	7098.01	7106.00	7100.29	7106.02	0.000043	1.01	1227.94	201.88	0.07



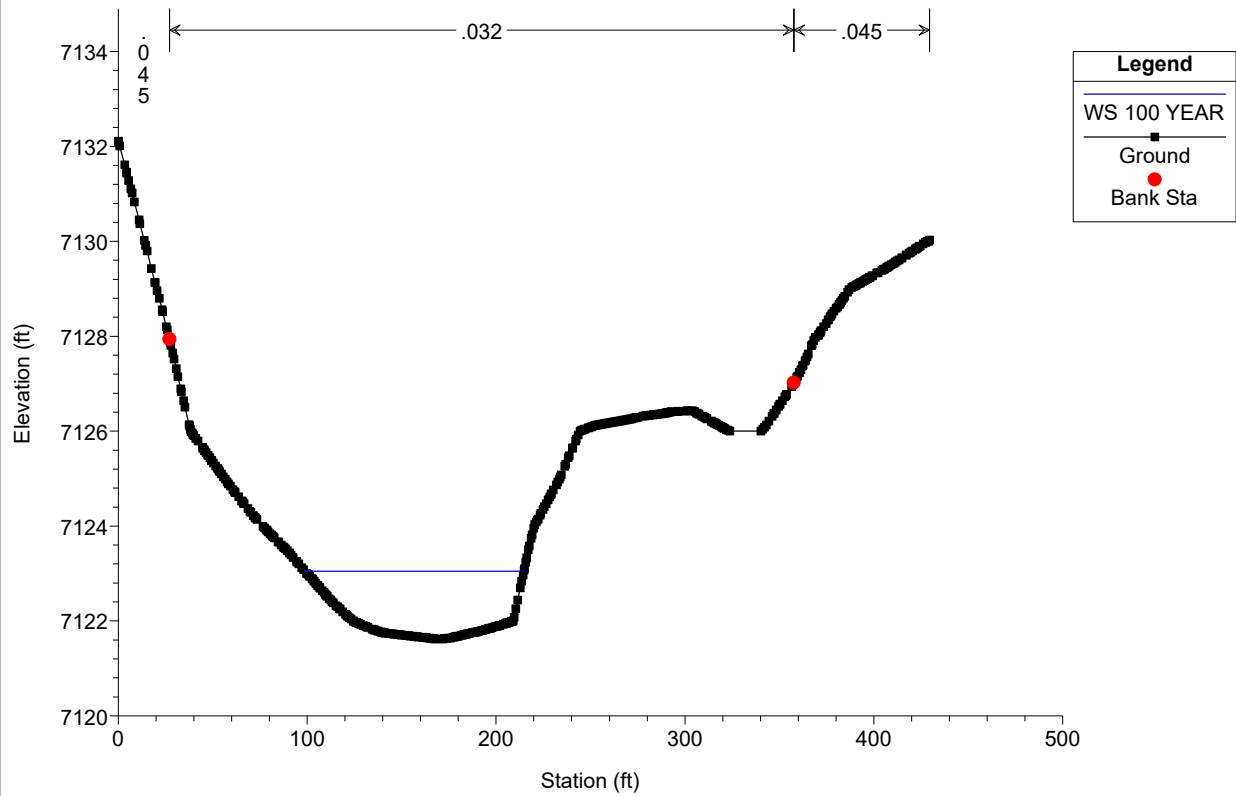




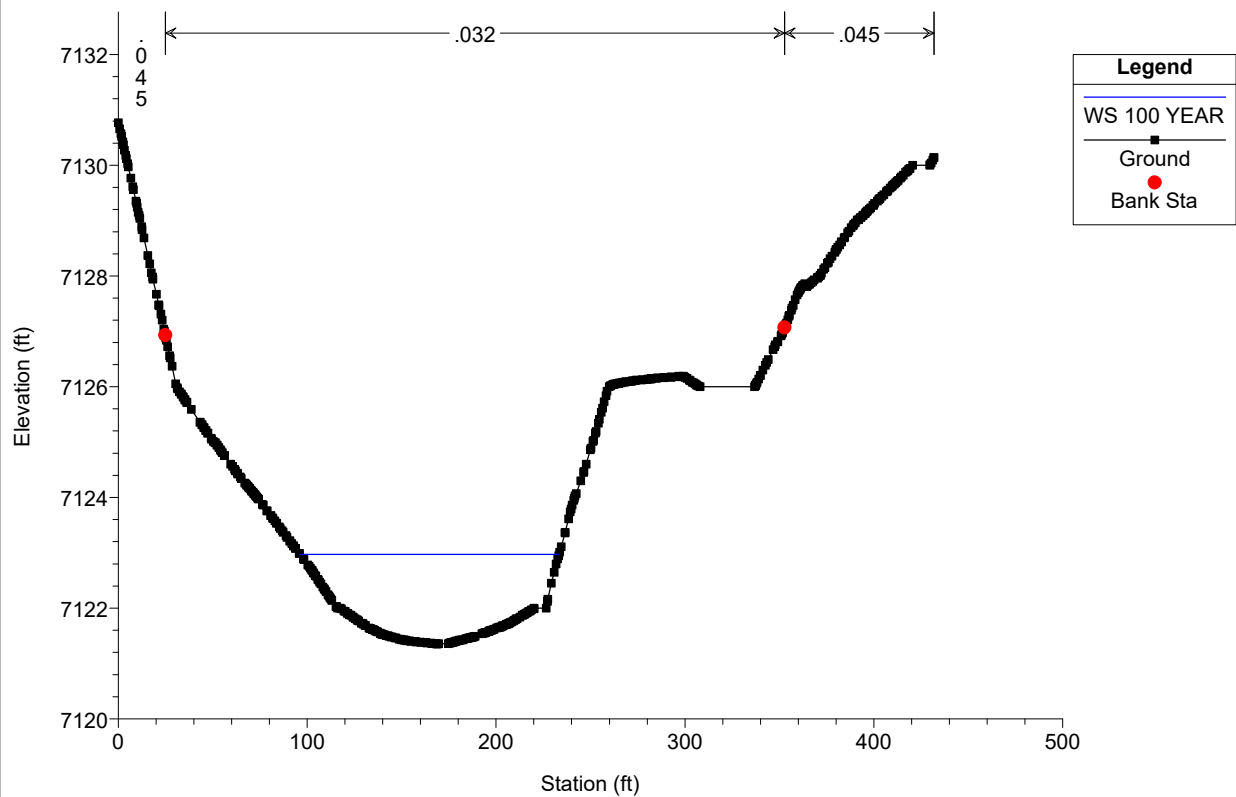


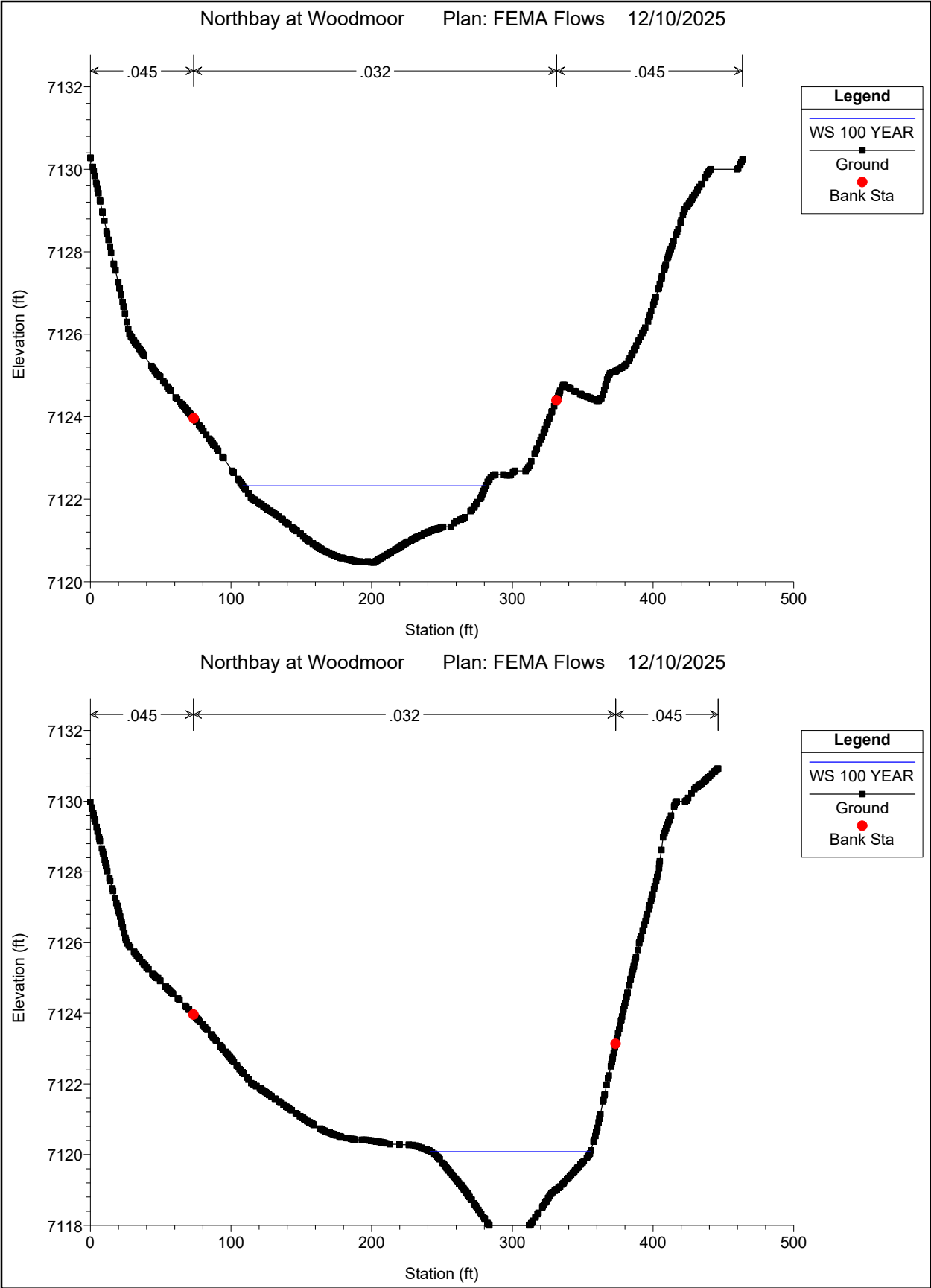


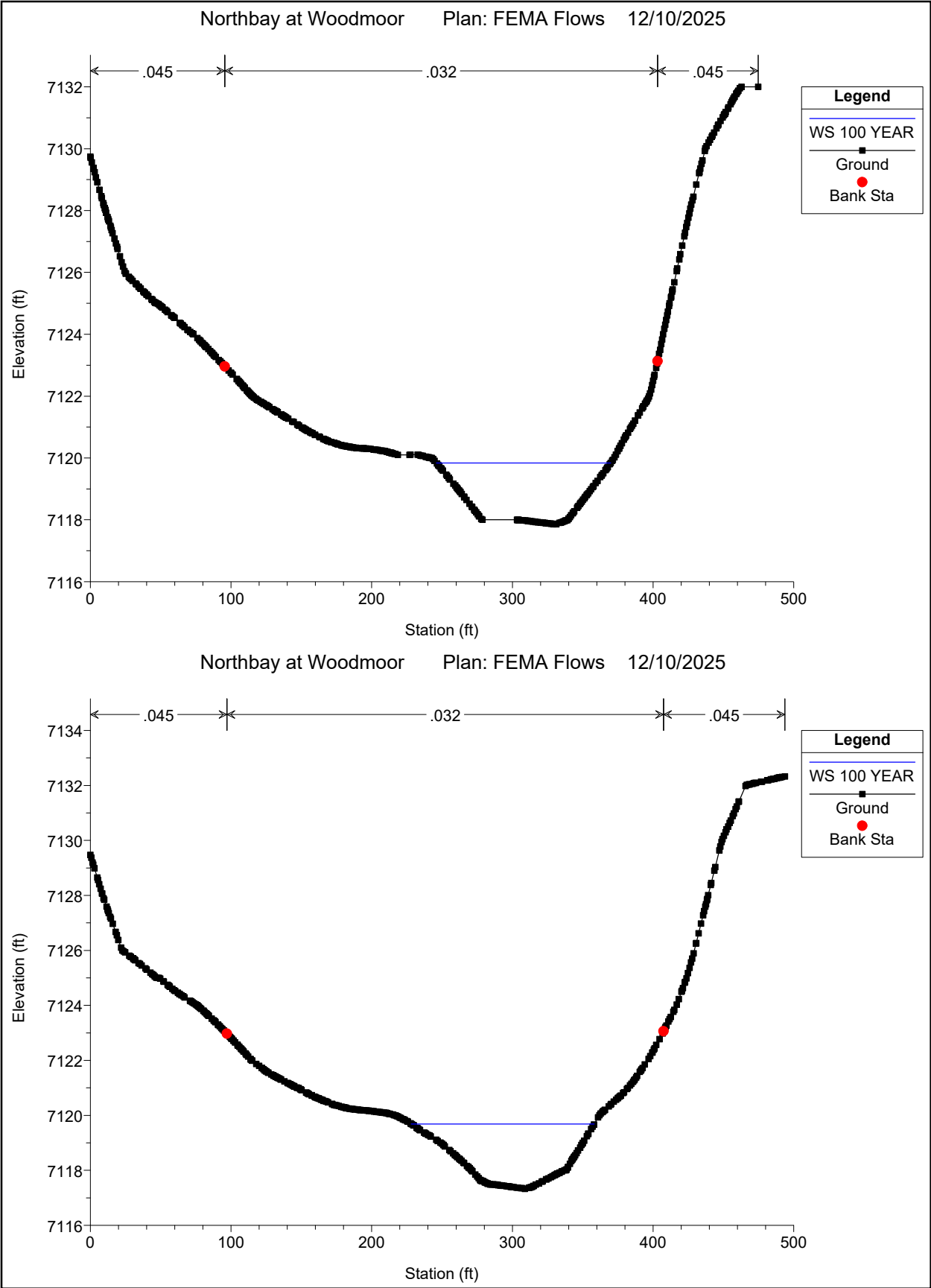
Northbay at Woodmoor Plan: FEMA Flows 12/10/2025

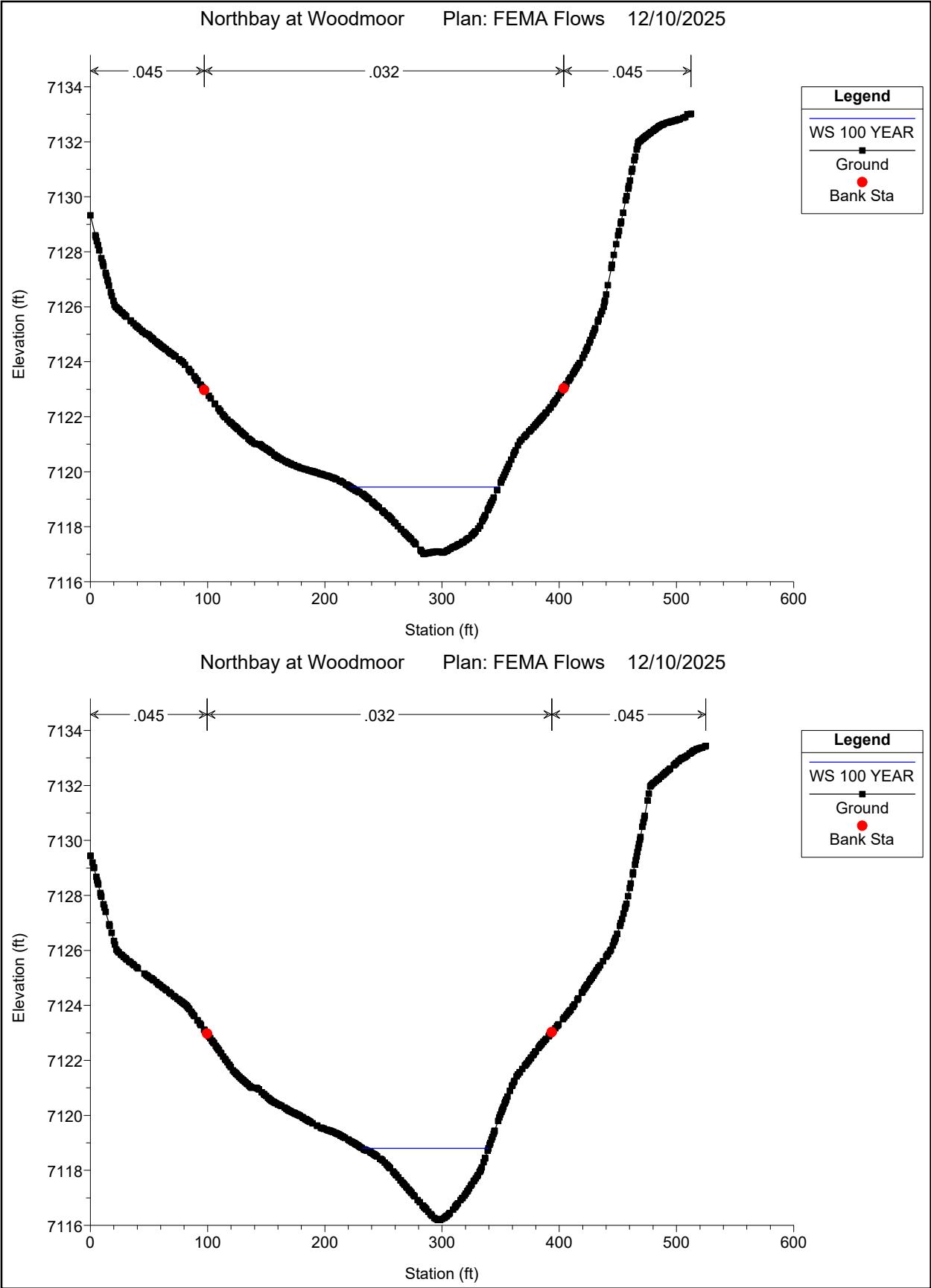


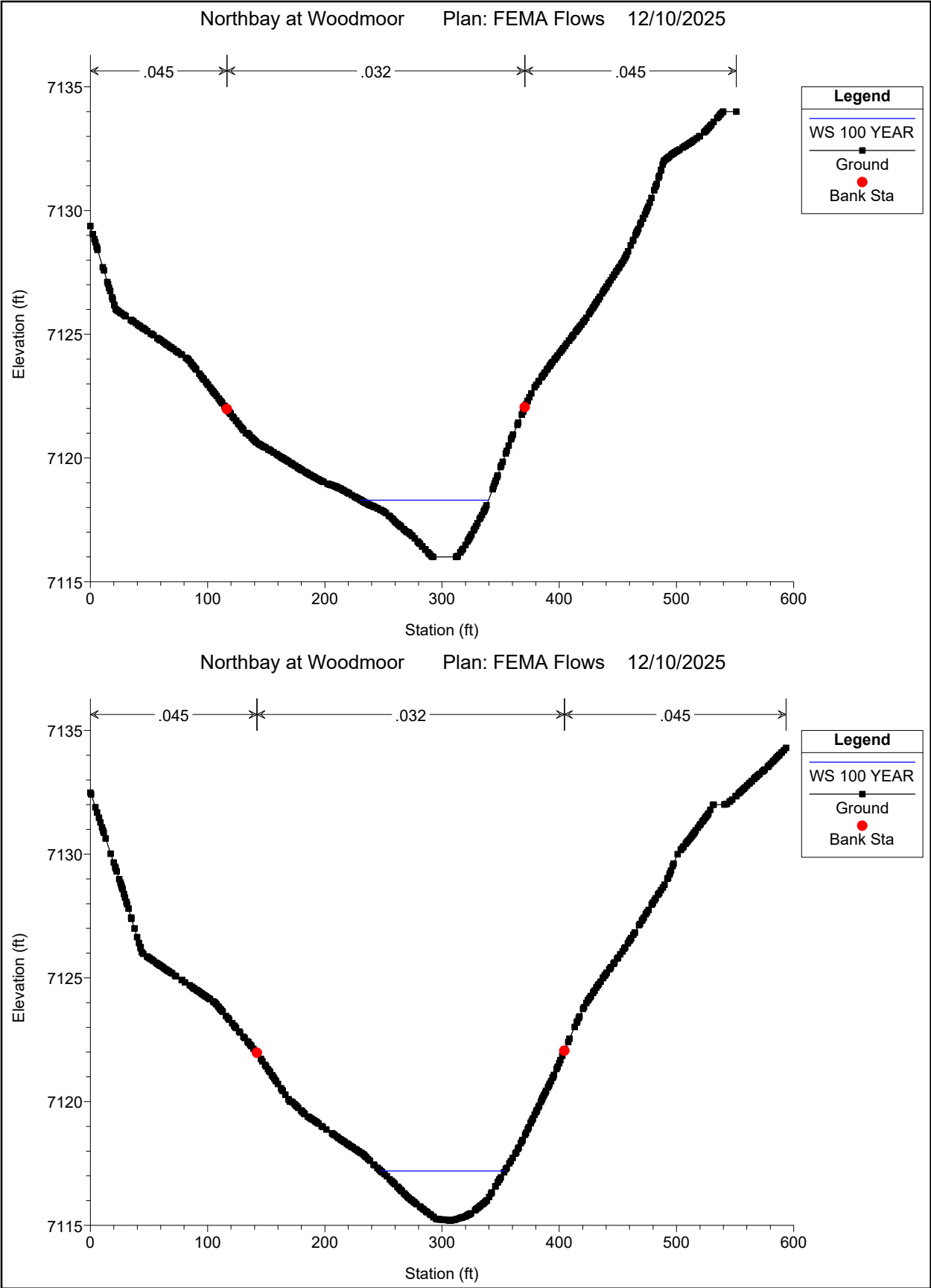
Northbay at Woodmoor Plan: FEMA Flows 12/10/2025

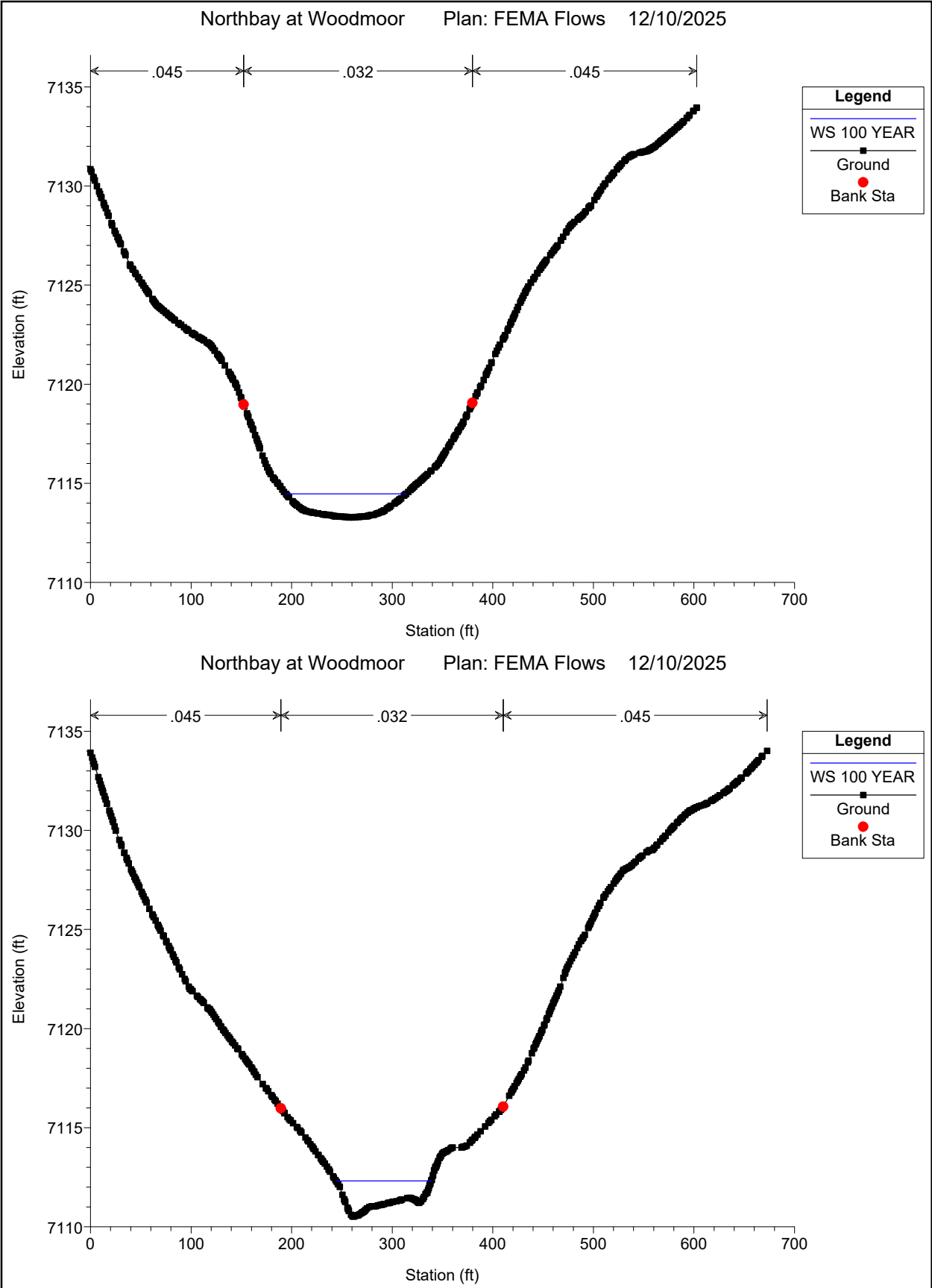


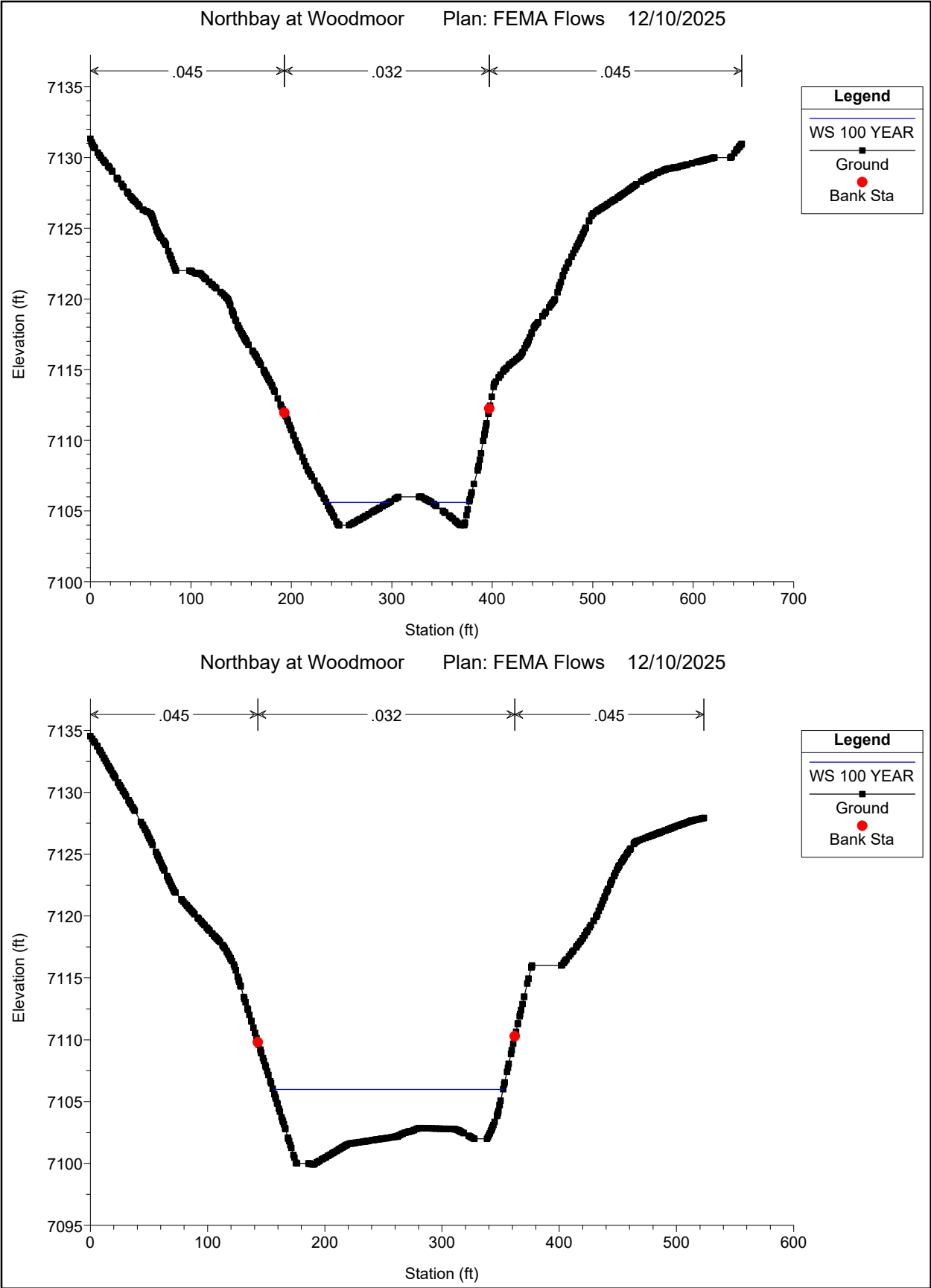




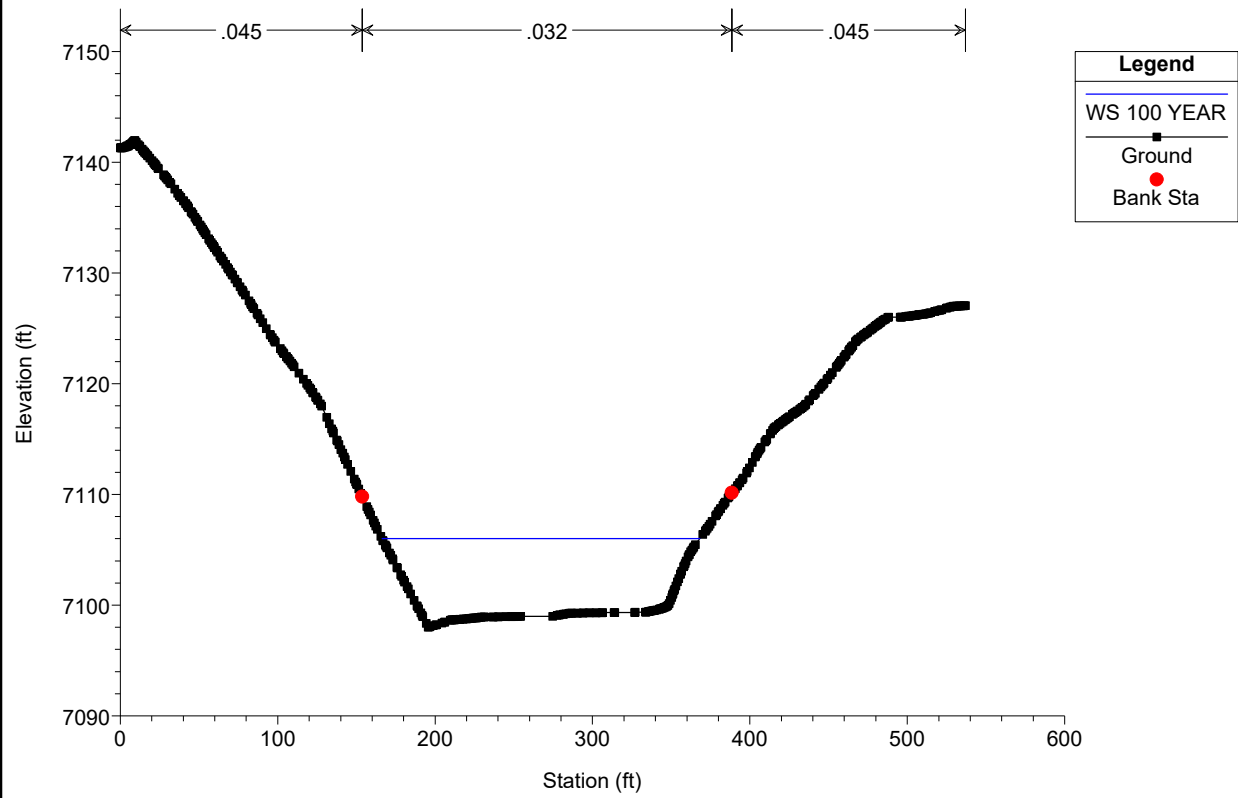








Northbay at Woodmoor Plan: FEMA Flows 12/10/2025





NORTH BAY AT LAKE WOODMOOR

Calc'd by:

SPC

2404118

Checked by:

CM

REDBRIDGE POINT ARMORING

Date:

7/14/2026

For use when longitudinal slopes are less than 2%

Input Parameters	
Mean Channel Velocity (V)	8.25 ft/s
Longitudinal Channel Slope (S)	0.02 ft/ft
Specific Gravity of Stone (G _s)	2.60

Calculated Parameters	
D ₅₀ =	5.74 in
UDFCD Riprap Type =	Type VL
Factor of Safety	2
Design D ₅₀ =	12 in
Design UDFCD Riprap Type =	Type M

Calculated D₅₀ for riprap was calculated using Equation 8-11 in the MHFD Criteria Manual Vol. 1

$$d_{50} \geq \left[\frac{VS^{0.17}}{4.5(G_s - 1)^{0.66}} \right]^2$$

Where:

V = mean channel velocity (ft/sec)

S = longitudinal channel slope (ft/ft)

d₅₀ = mean rock size (ft)

G_s = specific gravity of stone (minimum = 2.50, typically 2.5 to 2.7), Note: In this equation (G_s - 1) considers the buoyancy of the water, in that the specific gravity of water is subtracted from the specific gravity of the rock.

Note:

¹Specific gravity of stone is typically 2.5 to 2.7.

²No increased rock size is required due to channel side slopes however, side slopes steeper than 2.5:1 are not recommended by UDFCD.

³The mean channel velocity (V) is taken from the 1D HEC-RAS model for the cross section nearest to the Redbridge Point driveway, and the section with the largest velocity, which is section 1017.

⁴A Factor of safety of 2 has been applied to the design D50.

Flexamat Plus Specification

1. DESCRIPTION

A Tied Concrete Block Mat with Triple Layered Underlayment. This work shall consist of furnishing and placing the system in accordance with this specification and conforming with the lines, grades, design, and dimensions shown on the plans.

2. MATERIALS

Flexamat Plus is manufactured from individual concrete blocks tied together with high strength knitted polypropylene bi-axial geogrid. Each block is tapered, beveled and interlocked and includes connections that prevent lateral displacement of the blocks within the mats when they are lifted for placement.

Tied Concrete Block Mats with Triple Underlayment shall be Flexamat Plus, manufactured by Motz Enterprises, Inc.

- 2.1. **Blocks.** Furnish blocks manufactured with concrete conforming to the cement requirements of ASTM C150 and to the aggregate requirements of ASTM C33. Blocks shall have a minimum weight of 3 lb. per block and placed no further than 2 in. apart. Material weight per square foot shall not exceed 10 lbs. Blocks shall have a 2.25" profile, a flat-top pyramid shape, and a coarse finish without protrusions. Concrete shall have a minimum compressive strength requirement of Table1 and certified by a third party.

Table 1
Concrete Compressive Strength Requirements

Age	Required Compressive Strength psi
28 - Day	5000 psi

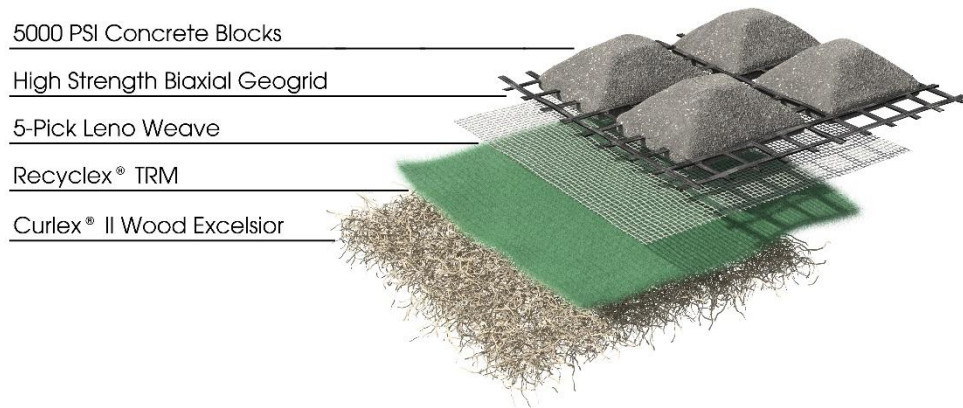
- 2.2. **Polypropylene Bi-Axial Geogrid.** The interlocking geogrid shall be an open knitted fabric composed of high tenacity, multifilament polypropylene yarns knitted and coated in tension with an acrylic based coating which is designed to resist degradation in environments with exposure to water and low pH (.4 pH) and high pH (>9 pH). Carbon black UV inhibitor shall be blended into the extruded yarns at a rate no less than 0.8% by weight. When combined with the revetment mat, this will yield a high tenacity, low elongating, and continuous filament polypropylene geogrid that is embedded within the base of the concrete blocks. Ensure the geogrid meets the requirements of Table 2.

Table 2
Polypropylene Bi-Axial Geogrid

Property	Unit	Test	Requirement
Mass/Unit Area	oz/yd ²	ASTM D5261	6.5 oz/yd ²
Aperture Size	English units	Measured	1.4x 1.4 inch
Ultimate Wide Width Tensile Strength (MD x CMD)	lb/ft	ASTM D6637	2,055 lb/ft
Elongation at Ultimate Tensile Strength (MD x CMD)	%	ASTM D6637	6%
Wide Width Tensile Strength @ 2% (MD x CMD)	lb/ft	ASTM D6637	822 lb/ft
Wide Width Tensile Strength @ 5% (MD x CMD)	lb/ft	ASTM D6637	1,640 lb/ft
Tensile Modulus @ 2% (MD x CMD)	lb/ft	ASTM D6637	41,100 lb/ft
Tensile Modulus @ 5% (MD x CMD)	lb/ft	ASTM D6637	32,800 lb/ft

2.3.

Underlayment Materials. A four-layered system includes, in order from top to bottom, 1) Concrete block mat 2) 5-Pick Leno Weave 3) Recyclex TRM-V and 4) Curlex® II. The underlayment materials shall be packaged within the roll of the Flexamat Plus.



Five-Pick Leno Weave:

This Five-Pick Weave provides added strength and support to the underlayments.

<u>Index Property</u>	<u>Units</u>	<u>Value</u>
GSM	g/m ²	118 (-3 ~ +3)
Density	Picks/10cm	62 x 24 (+/- 2)
Warp Strength	N/5cm	≥ 350
Warp Elongation	%	20 - 50
Weft Strength	N/5cm	≥ 280
Weft Elongation	%	20 - 50
Warp Shrinkage	%	≤ 7
Weft Shrinkage	%	≤ 9

Recyclex® TRM:

Recyclex TRM – V is a permanent non-degradable Turf Reinforcement Mat (TRM), consists of 100% post-consumer recycled polyester (green or brown bottles) with 80% five-inch fibers or greater fiber length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the TRM. The top and bottom of each TRM is covered with heavy duty polypropylene net. Fibers are tightly crimped and curled to allow fiber interlock, and to

retain 95% memory of the original shape after loading by hydraulic events. Fibers have a specific gravity greater than 1.0; therefore, the blanket will not float during hydraulic events. Recyclex TRM – V meets Federal Government Executive Order initiatives for use of products made from, or incorporating, recycled materials. Recyclex TRM – V shall be manufactured in the U.S.A. and the fibers shall be made from 100% recycled post-consumer goods.

Index Property	Test Method	Value
Thickness	ASTM D 6525	0.294 in (7.47 mm)
Light Penetration	ASTM D 6567	57%
Resiliency	ASTM D 6524	86%
Mass per Unit Area	ASTM D 6566	0.50 lb/yd ² (271 g/m ²)
MD-Tensile Strength Max.	ASTM D 6818	295.2 lb/ft (4.32 kN/m)
TD-Tensile Strength Max.	ASTM D 6818	194.4 lb/ft (2.85 kN/m)
MD-Elongation	ASTM D 6818	32.2%
TD-Elongation	ASTM D 6818	40.8%
Swell	ECTC Procedure	8%
Water Absorption	ASTM D 1117/ECTC	33.8%
Specific Gravity	ASTM D 792	1.21
UV Stability	ASTM D 4355 (1,000 hr)	80% minimum
Porosity	Calculated	97.5%
Bench-Scale Rain Splash	ECTC Method 2	SLR = 5.86 @ 2 in/hr ^{1,2}
Bench-Scale Rain Splash	ECTC Method 2	SLR = 5.00 @ 4 in/hr ^{1,2}
Bench-Scale Rain Splash	ECTC Method 2	SLR = 6.33 @ 6 in/hr ^{1,2}
Bench-Scale Shear	ECTC Method 3	2.41 lb/ft ² @ 0.5 in soil loss ²
Germination Improvement	ECTC Method 4	432%

¹ SLR is the Soil Loss Ratio, as reported by NTPEP/AASHTO. ² Bench-scale index values should not be used for design purposes

Curlex® II:

Curlex II erosion control blanket (ECB) consists of a specific cut of naturally seed free Great Lakes Aspen curled wood excelsior with 80% six-inch fibers or greater fiber length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the blanket. The top and bottom of each blanket is covered with degradable polypropylene netting.

Index Property	Test Method	Value
Thickness	ASTM D 6525	0.418 in (10.62 mm)
Light Penetration	ASTM D 6567	34.6%
Resiliency	ASTM D 6524	64%
Mass per Unit Area	ASTM D 6475	0.57 lb/yd ² (309 g/m ²)
MD-Tensile Strength Max.	ASTM D 6818	127.0 lb/ft (1.9 kN/m)
TD-Tensile Strength Max.	ASTM D 6818	50.9 lb/ft (0.7 kN/m)
MD-Elongation	ASTM D 6818	28.64%
TD-Elongation	ASTM D 6818	29.84%
Swell	ECTC Procedure	89%
Water Absorption	ASTM D 1117/ECTC	199%
Bench-Scale Rain Splash	ECTC Method 2	SLR = 6.84 @ 2 in/hr ^{2,3}
Bench-Scale Rain Splash	ECTC Method 2	SLR = 7.19 @ 4 in/hr ^{2,3}
Bench-Scale Rain Splash	ECTC Method 2	SLR = 7.56 @ 6 in/hr ^{2,3}
Bench-Scale Shear	ECTC Method 3	2.6 lb/ft ² @ 0.5 in soil loss ³
Germination Improvement	ECTC Method 4	645%

¹ Weight is based on a dry fiber weight basis at time of manufacture. Baseline moisture content of Great Lakes Aspen excelsior is 22%.

² SLR is the Soil Loss Ratio, as reported by NTPEP/AASHTO. ³ Bench-scale index values should not be used for design purposes.

- 2.4. Mats will be rolled for shipment. Upon delivery, rolls may be left exposed for up to 30 days. If exposure will exceed 30 days, cover or tarp the rolls to minimize UV exposure.

Chipping or missing concrete resulting in a weight loss exceeding 15% of the average weight of a concrete unit is grounds for rejection by the engineer. Replace, repair or patch the damaged areas per the manufacturer's recommendations.

3. PERFORMANCE

Full-Scale laboratory testing performed by an independent 3rd party testing facility with associated engineered calculations certifying the hydraulic capacity of the proposed Tied-Concrete Block Erosion Control Mat meets the following requirements:

Test	Tested Value	Bed Slope	Soil Classification	Limiting Value
ASTM 6460	Shear Stress	30%	Sandy Loam (USDA)	24lb./ft ²
ASTM 6460	Velocity	20%	Loam (USDA)	30 ft./sec

4. ALTERNATIVE PRODUCTS

Such products must be pre-approved in writing by the Engineer prior to bid date. Alternative product packages must be submitted to the Engineer a minimum of fifteen (45) days prior to bid date. Submittal packages for alternate products must include, as a minimum, the following:

- 4.1. Alternative Product Properties – Product must be comprised of materials as detailed in Section 2, including both in composition, underlayment layers and performance requirements.
- 4.2. Full-Scale laboratory testing performed by an independent 3rd party testing facility with associated engineered calculations certifying the hydraulic capacity of the proposed Tied-Concrete Block Erosion Control Mat meets the performance requirements listed in Section 3 of this specification.
- 4.3. A list of 15 comparable projects in terms of project size, application and material dimensions in the United States, where the results of the specific alternative material's use can be verified and reviewed for system integrity and sustained after a minimum of 10 years of service life.

5. EQUIPMENT

Provide the proper equipment to place the mat that will not damage the mat material or disturb the topsoil subgrade and seed bed.

6. CONSTRUCTION

Prior to installing Flexamat Plus, prepare the subgrade as detailed in the plans. All subgrade surfaces to be smooth and free of rocks, roots, debris, or other protrusions that would prevent intimate contact between the block and the subgrade. When seeding is shown on the plans, provide subgrade material that can sustain growth.

Ensure the prepared subgrade provides a smooth, firm, and unyielding foundation for the mats. The subgrade shall be graded into a parabolic or trapezoidal shape to concentrate flow to middle of mat or mats.

When vegetation is required, distribute seed on the prepared topsoil subgrade before installation of the concrete mats in accordance with the specifications.

Install mats to the line and grade shown on the plans and per the manufacturer's guidelines. The manufacturer or authorized representative will provide technical assistance during preparation and installation of the concrete block mats as needed.

Provide a minimum 18 in. deep concrete mat embedment toe trench at all edges exposed to concentrated flows. Recess exterior edges subject to sheet flow a minimum of 6 in.

Provide fastening or anchoring as recommended by the manufacturer or engineer for the site conditions.

7. MEASUREMENT

This Item will be measured by the square foot as shown on the plans, complete in place.

8. PAYMENT

The work performed, and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Flexamat Plus". This price is full compensation for loading and transporting, placing concrete block mats; excavation and disposal; furnishing topsoil and bedding; and equipment, labor, materials, tools, and incidentals.

APPENDIX D – WATER QUALITY & DETENTION

Site Assessment

SCM Design, Version 4.02 (June 2025)

Designer: SPC

Company: HR GREEN

Date: July 8, 2026

Project: NORTH BAY AT LAKE WOODMOOR

Location: EL PASO COUNTY

1. Physical Site Characteristics

A) Total Site Area

Area = 2.79 acres 121,532 ft²

B) Describe any upstream offsite areas that drain onto site and downstream conveyance systems or overland flow paths.

This development is within the Dirty Woman Creek watershed located in El Paso County Colorado. This project specifically is within the Lake Fork of Dirty Woman Creek. This project is at the downstream end of the Lake Fork, which drains through the center of the site directly into Lake Woodmoor.

C) Describe any floodplain/floodway mapping, fluvial hazard zones, or geomorphic/geotechnical instabilities that may impact the site.

The site is within a designated FEMA Floodplain as determined by the flood insurance rate map, community panel number 08041C0276G effective December 07, 2018.

D) Is the watershed anticipated to be in a phased development state for a number of years moving forward or are highly erosive soils present? Explain.

NO

Areas identified with highly erosive soils are stabilized with Flexamat Plus mat. Refer to floodplain development section of this report.

E) List any vegetation assessments that have been conducted including wetland and aquatic resources delineations.

Refer to the "Natural features, wetland, wildfire, noxious weeds & wildlife report for North Bay at Lake Woodmoor in El Paso County, Colorado" revised June 1, 2022 provided with this submittal. There are wetlands identified at the south and north ends of the property.

F) List any assessments of habitat for threatened or endangered species and other regulated species.

Refer to the "Natural features, wetland, wildfire, noxious weeds & wildlife report for North Bay at Lake Woodmoor in El Paso County, Colorado" revised June 1, 2022 provided with this submittal. There are no threatened or endangered species on the property.

G) Describe any existing and/or proposed utility mapping for subsurface and/or above-ground utilities that may impact SCMs.

There are existing/proposed utilities on the property. These utilities are not anticipated to impact the effectiveness of proposed SCMs due to sufficient bury depth in pervious areas.

H) Are there receiving water quality concerns such as TMDLs, 303(d) listings, or other pollutant reduction targets? Explain.

NO

There are no known TMDLs, 303(d) listings, or other pollutant reduction targets on the property. This development will provide sufficient water quality treatment via runoff reduction methods to meet El Paso County standards.

I) Describe how community values including context, scale, materials, and user experience will be incorporated on site. See Chapter 4 for additional guidance.

Community values include this development maintaining natural features in the area. This development is consistent with surrounding developments, and has minimized its impact on the natural features of the property.

J) Will attenuation of the EURV and/or flood storage (e.g. FSD) be provided onsite?

NO

Flood storage is provided in Lake Woodmoor which is owned and maintained by the Woodmoor Water & Sanitation District No. 1. Approval has been provided by the District for this development to drain directly into Lake Woodmoor with adequate WQ treatment measures provided.

Site Assessment

SCM Design, Version 4.02 (June 2025)

Designer: SPC
Company: HR GREEN
Date: July 8, 2026
Project: NORTH BAY AT LAKE WOODMOOR
Location: EL PASO COUNTY

2. Opportunities for Step 1: Runoff Reduction

A) Describe opportunities for runoff reduction measures that can be used on this site to potentially reduce WQCV requirements?

Conserve Existing Amenities: Identify portions of site that should be protected including mature trees, stream corridors, wetlands, and Type A/B soils with high infiltration potential.

Minimize Impacts: Creative site layout and constructing to minimum widths can reduce the extent of paved areas. Concentrate new impervious areas over Type C/D soils. Maintain natural drainage patterns and promote sheet flow.

Minimize Directly Connected Impervious Areas (MDCIA): Allow runoff from impervious areas to sheet flow through vegetation which slows runoff, promotes infiltration, reduces pollutant loads and helps mimic predevelopment hydrology.

Runoff reduction is the stand-alone treatment for the WQCV using RPAs.

Existing amenities are conserved and protected by this development by limiting the disturbance on the property. Tree's, stream corridors, are protected through out the property. Wetlands are not to be disturbed by this development.

This development's layout minimizes the impact of development by using minimum widths, and maintains natural drainage patterns and promotes sheet flow.

This development minimizes DCIA by providing RPAs for most impervious surfaces through out the property.

3. Suitability for Infiltration-Based SCMs

A) What are the dominant Hydrologic Soil Groups (HSG) for the site?

B) Provide a description of topsoil texture, agronomic properties, and geotechnical soil characterizations.

C) Identify Site Constraints

- i) Is subgrade depth to bedrock < 3 feet?
- ii) Is subgrade depth to seasonal high groundwater table < 3 feet?

D) Identify Site Risks

- i) Are expansive/collapsible soils present?
- ii) Are highly concentrated pollutant sources present (hotspot)?
- iii) Is site located above contaminated soils or groundwater?
- iv) Are steep slopes present in proposed SCM locations? (> 3H:1V)
- v) Are there other concerns that indicate high risk for infiltration?

E) Describe Exploratory Borings/Pits and Laboratory Tests (Sec. 4.2)

- i) How many borings/pits were drilled/excavated?
- ii) Depth of borings/pits below SCM (or proposed grade) surface?

iii) Describe laboratory tests performed on soil samples:

F) Preliminary Infiltration System Recommendation

This is a preliminary recommendation. Consult with a qualified geotechnical engineer when planning an infiltration-based SCM.

Type A and B Soils

Soils suitable for full infiltration

Native vegetation and trees are present through out the property.

Hydrologic soil groups on site consist of type B and D, identified as "Alamosa Loam" and "Pring Coarse Sandy Loam".

NO

NO

NO

NO

NO

NO

N_{Borings/Pits} = 4
D_{Borings/Pits} = 30.00 ft

Refer to "Geologic Hazards Evaluation and Preliminary Geotechnical Investigation Update - North Bay at Woodmoor" by CTL Thompson dated March 11, 2026.

Full Infiltration

Suitable Soils and Low Risk, must verify adequate subgrade infiltration rates.

Site Layout

SCM Design, Version 4.02 (June 2025)

Designer: **SPC**

Company: **HR GREEN**

Date: **July 8, 2026**

Project: **NORTH BAY AT LAKE WOODMOOR**

Location: **EL PASO COUNTY**

SITE LAYOUT INFO (User Input in Blue Cells)

Water Quality Event (WQE) inches

Outfall ID	1.2	1.3	1.4	2	1							
Total Tributary Area (ft ²)	3,920	66,211	47,916	1,742	1,742							
Total Tributary Area (ac)	0.09	1.52	1.10	0.04	0.04							
Imperviousness (%)	47.0%	36.0%	33.0%	75.0%	100.0%							
MS4 Design Standard	Runoff	Runoff	Runoff	None	None							
SCM Type	RPA	RPA	RPA	None	None							

Notes:

OUTFALL RESULTS

SCM Worksheet Name	RPA_1.2	RPA_1.3	RPA_1.4	--	--							
Untreated Area (ft ³)	0	0	0	1,742	1,742							
Default WQCV (ft ³)	65	933	641	43	73							
Optional Override WQCV (ft ³)												
WQCV Reduction (ft ³)	65	869	571	0	0							
Remaining WQCV (ft ³)	0	64	70	43	73							
WQCV Reduction (%)	100%	93%	89%	0%	0%							
Design WQCV of SCM (ft ³)	0	0	0	0	0							
Pollutant Removal (ft ³)	0	0	0	0	0							
Untreated WQCV (ft ³)	0	64	70	43	73							

TOTAL SITE RESULTS (Sums results from all Outfalls)

Total Site Area	121,531	ft ²	2.79	acres
Treated Area	118,047	ft ²	2.71	acres
Untreated Area	3,484	ft ²	0.08	acres
Total Site Imperviousness	36.6%	%		
Default (or Override) WQCV	1,754	ft ³	0.040	acre-feet
Remaining WQCV	249	ft ³	0.006	acre-feet
WQCV Reduction	86%	%		
Design WQCV	0	ft ³	0.000	acre-feet
Untreated WQCV	249	ft ³	0.006	acre-feet

Confirm with local jurisdiction whether design meets Runoff Reduction Standard

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.02 (June 2025)

Designer: SPC
Company: HR GREEN
Date: July 8, 2026
Project: NORTH BAY AT LAKE WOODMOOR
Location: EL PASO COUNTY
Outfall ID: 1.2

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	1.2	UIA-1.2	RPA-1.2	SPA-1.2						
Area Type	RPA	UIA	RPA_Buffer	SPA						
Downstream Design Point ID	--	RPA-1.2	1.2	1.2						
DCIA (ft ²)	--	--	--	--						
UIA (ft ²)	--	1,790	--	--						
RPA (ft ²)	--	--	1,457	--						
SPA (ft ²)	--	--	--	673						

2. Protect the RPA from Traffic

RPA Protection Type	--	--	Fencing	--						
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3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	0.0%	--						
HSG B (%)	--	--	0.0%	--						
HSG C/D (%)	--	--	100.0%	--						

4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	Other	--						
Irrigation Type	--	--	None	--						

Notes: RPA Vegetation Type is natural vegetation, existing vegetation is established and irrigated by natural drainage.

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	Curbless	--						
Is Concrete Edger used?	--	--	YES	--						
Spacing between slots (ft)	--	--	--	--						
Slot Opening Length (in)	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Total Area of UIA:RPA (ft ²)	--	--	3,247	--						
UIA:RPA Ratio	--	--	1.2	--						
UIA:RPA Interface Width (ft)	--	--	92	--						
L / W Ratio of UIA:RPA	--	--	0.38	--						

2. Buffer Length

Average Buffer Length (ft)	--	--	16	--						
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3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	0.020	--						
Effective Distance (ft)	--	--	50	--						
Number of Level Spreaders	--	--	1	--						

4. Provide a Vertical Drop

Vertical Drop (in)	--	--	0.00	--						
Mowing Strip Provided?	--	--	YES	--						

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	55.1%	--						
UIA:RPA Runoff (in)	--	--	0.01	--						
UIA:RPA Runoff (ft ³)	--	--	3	--						

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	--	75	--						
Runoff Reduction (ft ³)	--	--	72	--						
Runoff Reduction (%)	--	--	96.2%	--						

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)
1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--							
Imperviousness (%)	--	--	--	--							

2. Swale Inflows

Concentrated Flow Type	--	--	--	--							
Blind Swale Type	--	--	--	--							
Spreader Energy Dissipation	--	--	--	--							
Vertical Drop (in)	--	--	--	--							
Gutter Depression (in)	--	--	--	--							
Curb Opening Length (ft)	--	--	--	--							
Concrete Sediment Pad	--	--	--	--							
Min. Forebay Volume (ft ³)	--	--	--	--							
Design Forebay Volume (ft ³)	--	--	--	--							
Max. Forebay Depth (in)	--	--	--	--							
Design Forebay Depth (in)	--	--	--	--							
Calculated Notch Width (in)	--	--	--	--							
Design Notch Width (in)	--	--	--	--							
Drain Time (minutes)	--	--	--	--							
Energy Dissipation Type	--	--	--	--							

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--							
Bottom Width (ft)	--	--	--	--							
Bottom Area (ft ²)	--	--	--	--							
Side Slopes (horiz/vert)	--	--	--	--							

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--							
Design Slope (ft/ft)	--	--	--	--							
Total Drop Height (ft)	--	--	--	--							
Underdrains Provided?	--	--	--	--							

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--							
Reduced Trib. Runoff (ft ³)	--	--	--	--							

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--							
Swale Discharge (ft ³)	--	--	--	--							
Runoff Reduction (%)	--	--	--	--							

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--							
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8. Design Velocity

Vegetal Retardance Curve	--	--	--	--							
Velocity, V2 (fps)	--	--	--	--							

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--							
Flow Area, A (ft ²)	--	--	--	--							
Wetted Perimeter, P (ft)	--	--	--	--							
Top Width, T (ft)	--	--	--	--							
Hydraulic Radius, Rh (ft)	--	--	--	--							
VR Product (ft ² /sec)	--	--	--	--							
Manning's n value	--	--	--	--							
Hydraulic Depth, Dh (ft)	--	--	--	--							
Froude Number	--	--	--	--							

10. Swale Outflows

Outflows Considered?	--	--	--	--							
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Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	1.2	UIA-1.2	RPA-1.2	SPA-1.2							
Area Type	RPA	UIA	RPA Buffer	SPA							
Total Area (ft ²)	3,920	1,790	3,247	673							
Imperviousness (%)		100.0%	55.1%	0.0%							
Tributary Runoff (ft ³)		75	75	0							
Runoff Reduction (ft ³)	72	0	72	0							
Runoff Remaining (ft ³)	3	75	3	0							

Total Tributary Area entered on Site Layout Worksheet is: 3,920 square feet

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.02 (June 2025)

Designer: SPC
Company: HR GREEN
Date: July 8, 2026
Project: NORTH BAY AT LAKE WOODMOOR
Location: EL PASO COUNTY
Outfall ID: 1.3

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	1.3	UIA-1.3	RPA-1.3	SPA-1.3						
Area Type	RPA	UIA	RPA_Buffer	SPA						
Downstream Design Point ID	--	RPA-1.3	1.3	1.3						
DCIA (ft ²)	--	--	--	--						
UIA (ft ²)	--	25,700	--	--						
RPA (ft ²)	--	--	16,200	--						
SPA (ft ²)	--	--	--	24,311						

2. Protect the RPA from Traffic

RPA Protection Type	--	--	Fencing	--						
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3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	0.0%	--						
HSG B (%)	--	--	0.0%	--						
HSG C/D (%)	--	--	100.0%	--						

4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	Other	--						
Irrigation Type	--	--	None	--						

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	Curbless	--						
Is Concrete Edger used?	--	--		--						
Spacing between slots (ft)	--	--	--	--						
Slot Opening Length (in)	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Total Area of UIA:RPA (ft ²)	--	--	41,900	--						
UIA:RPA Ratio	--	--	1.6	--						
UIA:RPA Interface Width (ft)	--	--	500	--						
L / W Ratio of UIA:RPA	--	--	0.17	--						

2. Buffer Length

Average Buffer Length (ft)	--	--	32	--						
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3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	0.050	--						
Effective Distance (ft)	--	--	50	--						
Number of Level Spreaders	--	--	1	--						

4. Provide a Vertical Drop

Vertical Drop (in)	--	--	0.00	--						
Mowing Strip Provided?	--	--	YES	--						

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	61.3%	--						
UIA:RPA Runoff (in)	--	--	0.06	--						
UIA:RPA Runoff (ft ³)	--	--	202	--						

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	--	1,071	--						
Runoff Reduction (ft ³)	--	--	869	--						
Runoff Reduction (%)	--	--	81.2%	--						

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)
1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--							
Imperviousness (%)	--	--	--	--							

2. Swale Inflows

Concentrated Flow Type	--	--	--	--							
Blind Swale Type	--	--	--	--							
Spreader Energy Dissipation	--	--	--	--							
Vertical Drop (in)	--	--	--	--							
Gutter Depression (in)	--	--	--	--							
Curb Opening Length (ft)	--	--	--	--							
Concrete Sediment Pad	--	--	--	--							
Min. Forebay Volume (ft ³)	--	--	--	--							
Design Forebay Volume (ft ³)	--	--	--	--							
Max. Forebay Depth (in)	--	--	--	--							
Design Forebay Depth (in)	--	--	--	--							
Calculated Notch Width (in)	--	--	--	--							
Design Notch Width (in)	--	--	--	--							
Drain Time (minutes)	--	--	--	--							
Energy Dissipation Type	--	--	--	--							

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--							
Bottom Width (ft)	--	--	--	--							
Bottom Area (ft ²)	--	--	--	--							
Side Slopes (horiz/vert)	--	--	--	--							

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--							
Design Slope (ft/ft)	--	--	--	--							
Total Drop Height (ft)	--	--	--	--							
Underdrains Provided?	--	--	--	--							

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--							
Reduced Trib. Runoff (ft ³)	--	--	--	--							

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--							
Swale Discharge (ft ³)	--	--	--	--							
Runoff Reduction (%)	--	--	--	--							

7. Design Discharge

2-year Discharge, Q ₂ (cfs)	--	--	--	--							
--	----	----	----	----	--	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--							
Velocity, V ₂ (fps)	--	--	--	--							

9. Design Flow Depth

Flow Depth, D ₂ (ft)	--	--	--	--							
Flow Area, A (ft ²)	--	--	--	--							
Wetted Perimeter, P (ft)	--	--	--	--							
Top Width, T (ft)	--	--	--	--							
Hydraulic Radius, R _h (ft)	--	--	--	--							
VR Product (ft ² /sec)	--	--	--	--							
Manning's n value	--	--	--	--							
Hydraulic Depth, D _h (ft)	--	--	--	--							
Froude Number	--	--	--	--							

10. Swale Outflows

Outflows Considered?	--	--	--	--							
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Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	1.3	UIA-1.3	RPA-1.3	SPA-1.3							
Area Type	RPA	UIA	RPA Buffer	SPA							
Total Area (ft ²)	66,211	25,700	41,900	24,311							
Imperviousness (%)		100.0%	61.3%	0.0%							
Tributary Runoff (ft ³)		1,071	1,071	0							
Runoff Reduction (ft ³)	869	0	869	0							
Runoff Remaining (ft ³)	202	1,071	202	0							

Total Tributary Area entered on Site Layout Worksheet is: 66,211 square feet

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.02 (June 2025)

Designer: SPC
Company: HR GREEN
Date: July 8, 2026
Project: NORTH BAY AT LAKE WOODMOOR
Location: EL PASO COUNTY
Outfall ID: 1.4

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	1.4	UIA-1.4	RPA-1.4	SPA-1.4						
Area Type	RPA	UIA	RPA_Buffer	SPA						
Downstream Design Point ID	--	RPA-1.4	1.4	1.4						
DCIA (ft ²)	--	--	--	--						
UIA (ft ²)	--	16,553	--	--						
RPA (ft ²)	--	--	6,570	--						
SPA (ft ²)	--	--	--	24,793						

2. Protect the RPA from Traffic

RPA Protection Type	--	--	Fencing	--						
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3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	0.0%	--						
HSG B (%)	--	--	100.0%	--						
HSG C/D (%)	--	--	0.0%	--						

4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	Other	--						
Irrigation Type	--	--	None	--						

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	Curbless	--						
Is Concrete Edger used?	--	--		--						
Spacing between slots (ft)	--	--	--	--						
Slot Opening Length (in)	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Total Area of UIA:RPA (ft ²)	--	--	23,123	--						
UIA:RPA Ratio	--	--	2.5	--						
UIA:RPA Interface Width (ft)	--	--	486	--						
L / W Ratio of UIA:RPA	--	--	0.10	--						

2. Buffer Length

Average Buffer Length (ft)	--	--	14	--						
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3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	0.100	--						
Effective Distance (ft)	--	--	25	--						
Number of Level Spreaders	--	--	1	--						

4. Provide a Vertical Drop

Vertical Drop (in)	--	--	0.00	--						
Mowing Strip Provided?	--	--	YES	--						

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	71.6%	--						
UIA:RPA Runoff (in)	--	--	0.06	--						
UIA:RPA Runoff (ft ³)	--	--	119	--						

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	--	690	--						
Runoff Reduction (ft ³)	--	--	571	--						
Runoff Reduction (%)	--	--	82.8%	--						

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--							
Imperviousness (%)	--	--	--	--							

2. Swale Inflows

Concentrated Flow Type	--	--	--	--							
Blind Swale Type	--	--	--	--							
Spreader Energy Dissipation	--	--	--	--							
Vertical Drop (in)	--	--	--	--							
Gutter Depression (in)	--	--	--	--							
Curb Opening Length (ft)	--	--	--	--							
Concrete Sediment Pad	--	--	--	--							
Min. Forebay Volume (ft ³)	--	--	--	--							
Design Forebay Volume (ft ³)	--	--	--	--							
Max. Forebay Depth (in)	--	--	--	--							
Design Forebay Depth (in)	--	--	--	--							
Calculated Notch Width (in)	--	--	--	--							
Design Notch Width (in)	--	--	--	--							
Drain Time (minutes)	--	--	--	--							
Energy Dissipation Type	--	--	--	--							

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--							
Bottom Width (ft)	--	--	--	--							
Bottom Area (ft ²)	--	--	--	--							
Side Slopes (horiz/vert)	--	--	--	--							

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--							
Design Slope (ft/ft)	--	--	--	--							
Total Drop Height (ft)	--	--	--	--							
Underdrains Provided?	--	--	--	--							

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--							
Reduced Trib. Runoff (ft ³)	--	--	--	--							

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--							
Swale Discharge (ft ³)	--	--	--	--							
Runoff Reduction (%)	--	--	--	--							

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--							
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8. Design Velocity

Vegetal Retardance Curve	--	--	--	--							
Velocity, V2 (fps)	--	--	--	--							

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--							
Flow Area, A (ft ²)	--	--	--	--							
Wetted Perimeter, P (ft)	--	--	--	--							
Top Width, T (ft)	--	--	--	--							
Hydraulic Radius, Rh (ft)	--	--	--	--							
VR Product (ft ² /sec)	--	--	--	--							
Manning's n value	--	--	--	--							
Hydraulic Depth, Dh (ft)	--	--	--	--							
Froude Number	--	--	--	--							

10. Swale Outflows

Outflows Considered?	--	--	--	--							
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Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	1.4	UIA-1.4	RPA-1.4	SPA-1.4							
Area Type	RPA	UIA	RPA Buffer	SPA							
Total Area (ft ²)	47,916	16,553	23,123	24,793							
Imperviousness (%)		100.0%	71.6%	0.0%							
Tributary Runoff (ft ³)		690	690	0							
Runoff Reduction (ft ³)	571	0	571	0							
Runoff Remaining (ft ³)	119	690	119	0							

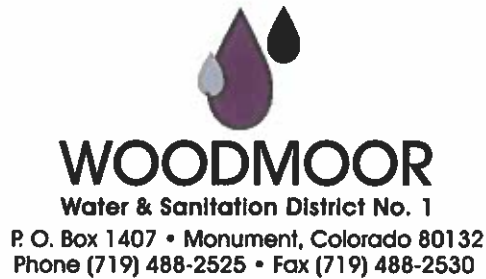
Total Tributary Area entered on Site Layout Worksheet is: 47,916 square feet

ON-SITE WATER QUALITY TREATMENT SUMMARY			
NORTH BAY AT LAKE WOODMOOR			
Subbasin ID	Disturbed Area [AC]	Treatment CM	Notes:
P1.1	0.87	EXCLUSION	EXCLUSION I.7.1.B.4 - UNDERGROUND UTILITIES
P1.1	0.03	UNTREATED	DRAINS OFFSITE UNTREATED
P1.1	0.01	SPA	SPA AREA
P1.2	0.04	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.2	0.03	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.2	0.02	SPA	SPA AREA
P1.3	0.59	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.3	0.37	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.3	0.56	SPA	SPA AREA
P1.4	0.38	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.4	0.15	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.4	0.57	SPA	SPA AREA
ROW1	0.04	UNTREATED	DRAINS OFFSITE UNTREATED
ROW1	0.04	EXCLUSION	EXCLUSION I.7.1.B.4 - UNDERGROUND UTILITIES

TOTAL WATER QUALITY SUMMARY		
Treatment CM	Area [AC]	% of total
TOTAL DIST. AREA	3.70	
WQ EXCLUSION	0.91	25%
TOTAL NON-EXCLUDED AREA	2.79	
TREATED BY RPA	2.72	98%
UNTREATED	0.07	2%
TOTAL:	2.79	100%

Min Required Area to Receive WQ	Total Disturbed Area	Total Proposed Treated Area	Total Proposed Disturbed Area Excluded from WQ	Total Treated %
2.79	3.70	2.72	0.91	98%

APPENDIX E – REFERENCE MATERIAL



May 31, 2022

To: La Plata Communities, Inc
Attn: Beth Diana
La Plata Communities, Inc
9540 Federal Drive, Suite 200
Colorado Springs, CO 80921

RE: Proposed Stormwater Drainage – North Bay at Lake Woodmoor

Dear Ms. Diana:

Woodmoor Water and Sanitation District (“the District”) has reviewed the “Final Drainage Report for North Bay at Woodmoor” as prepared by Kiowa Engineering, dated September 23, 2016. The report proposes to utilize Lake Woodmoor for meeting both water quality and water quantity storm water detention pursuant to current El Paso County Drainage Criteria by allowing storm water runoff from the development to flow directly into Lake Woodmoor without any onsite permanent storm water controls. It is our understanding that current drainage criteria typically requires both storm water quantity as well as storm water quality detention facilities.

The quantity of storm water entering Lake Woodmoor from the development does not cause the District concern. However, Lake Woodmoor is a primary drinking water supply for Woodmoor residents and therefore storm water quality is of concern. The District requests that permanent storm water quality BMPs be installed within the development that channels all developed flows through the BMPs in accordance with the current El Paso County Drainage Criteria. In addition, the District requests the usage of sand filters to other forms of permanent storm water quality BMPs.

Sincerely,

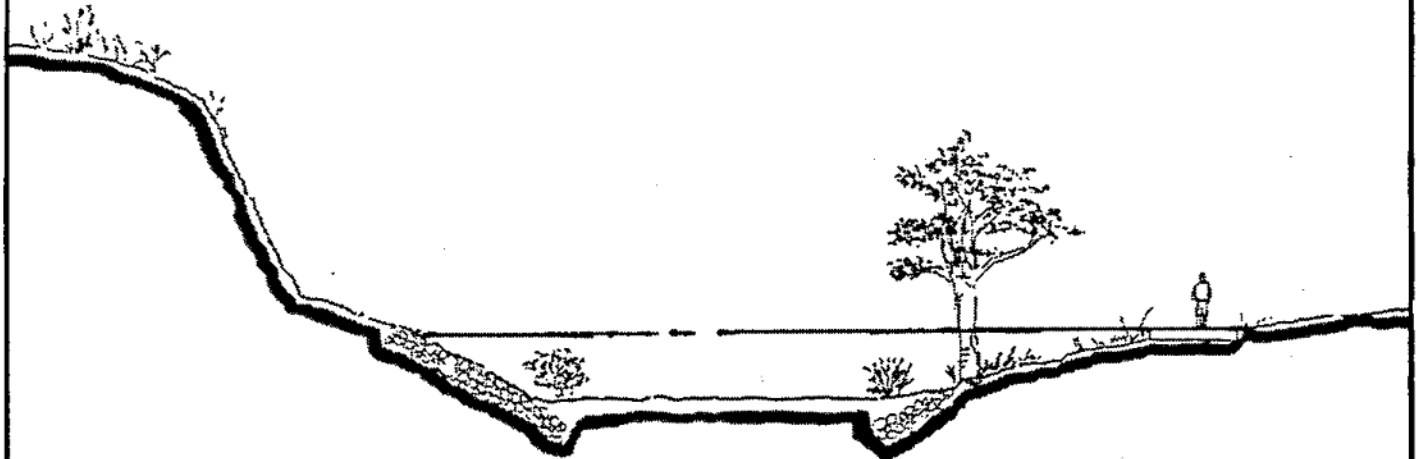
A handwritten signature in blue ink that reads "Jessie J. Shaffer". The signature is fluid and cursive, with the first name "Jessie" and last name "Shaffer" clearly legible.

Jessie J. Shaffer
District Manager

Cc: Ariel Hacker – District Engineer
Dan LaFontaine – Operations Superintendent

Drainage Basin Planning Study

Dirty Woman Creek and Crystal Creek El Paso County, Colorado



Prepared for:

El Paso County Department of Public Works
3105 North Stone
Colorado Springs, Colorado 80907

Prepared by:

Kiowa Engineering Corporation
419 West Bijou
Colorado Springs, Colorado 80905

September, 1993

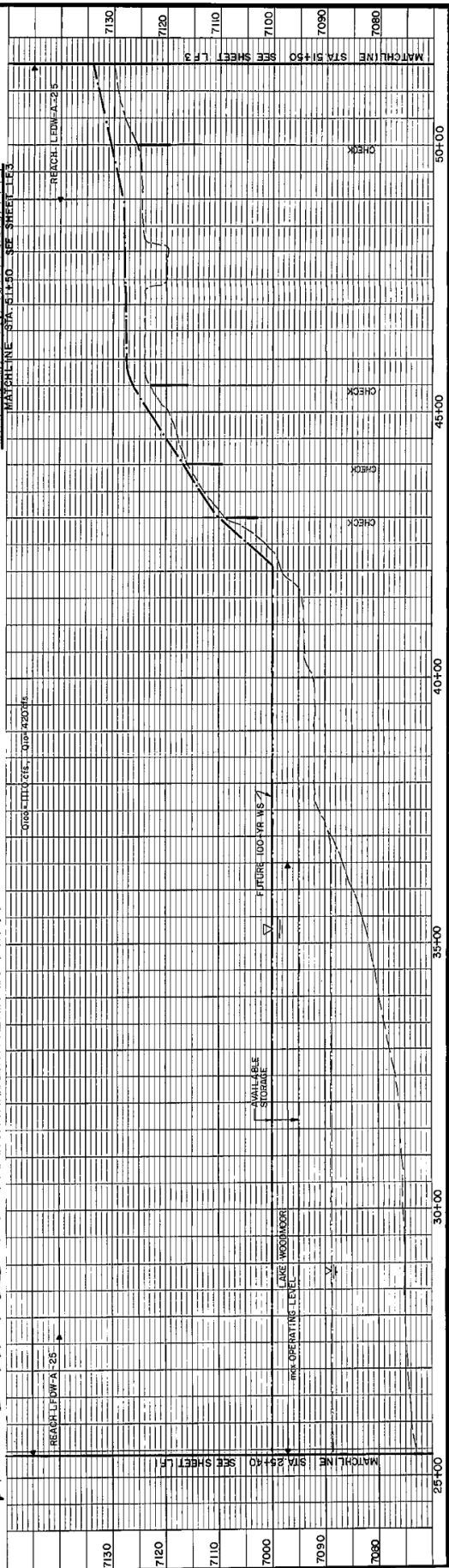
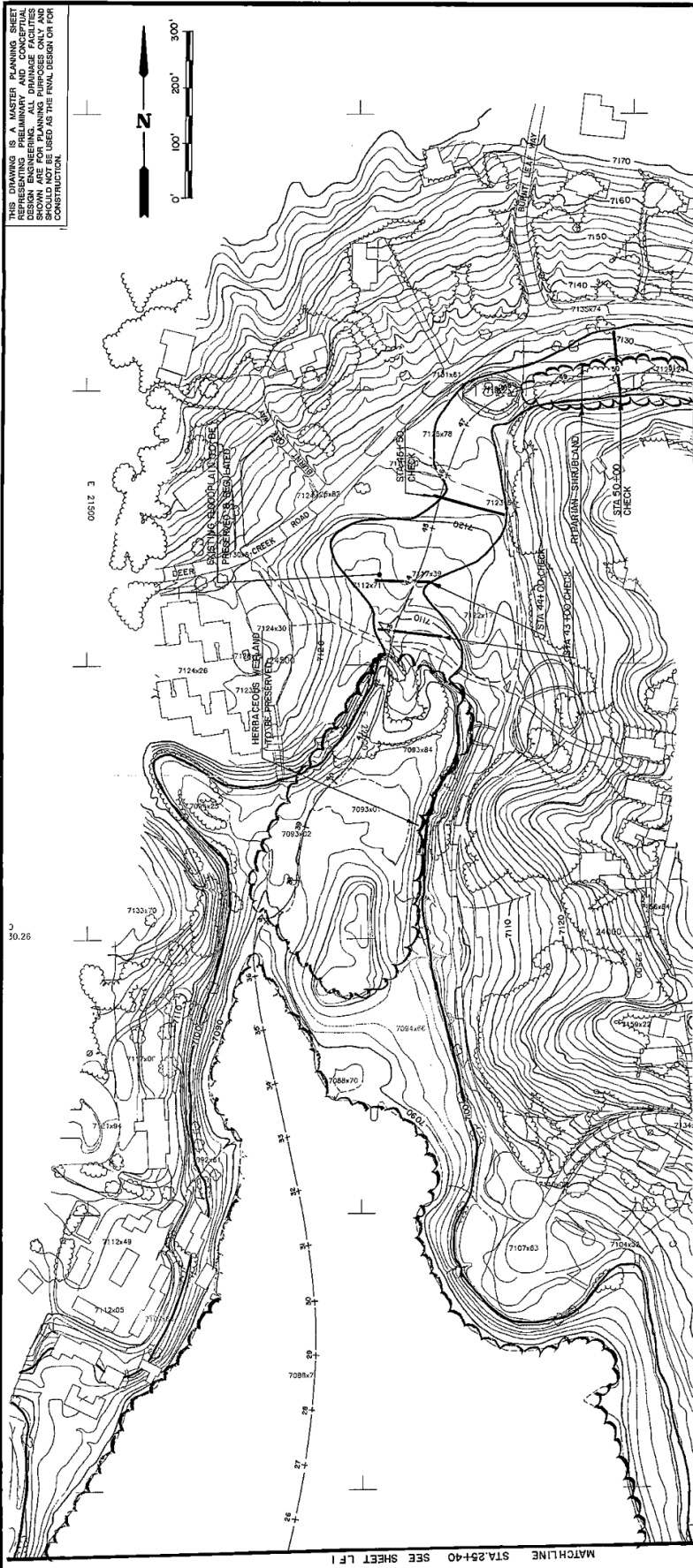
LF2

Project No. 91-0717
Date: 1/93
Design: AWWC
Drawn: EAK
Checked: RNW
Revisions:

Dirty Woman and Crystal Creeks
Drainage Basin Planning Study
PRELIMINARY DESIGN
Lake Fork Dirty Woman Creek
Sta. 25+40 to Sta. 51+50
El Paso County Department of Public Works Stormwater Management Division

Kiowa Engineering Corporation
419 West Bijou Street
Colorado Springs, Colorado
80905-1308

THIS DRAWING IS A MASTER PLANNING SHEET
REPRESENTING PRELIMINARY AND CONCEPTUAL
DESIGN ENGINEERING. ALL DRAINAGE FACILITIES
SHOWN ARE FOR INFORMATION ONLY AND
SHOULD NOT BE USED AS THE FINAL DESIGN OR FOR
CONSTRUCTION.



**Lake Fork of Dirty Woman Creek
Drainage Basin Planning Study
Hydrology Amendment
El Paso County, Colorado**

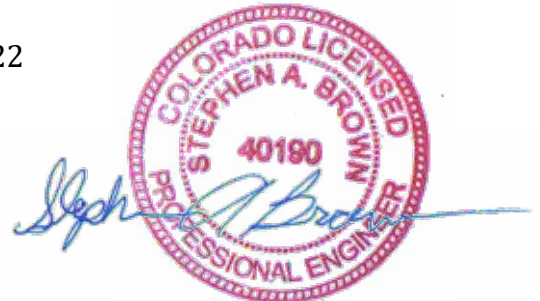
Prepared for:
Lake Woodmoor Holdings, LLC
9540 Federal Drive, Suite 200
Colorado Springs, Colorado 80921
(719) 260-7477

Prepared by:
Kiowa
Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235

Kiowa Project No. 15073

October 25, 2021

Revised September 1, 2022



VI. HYDROLOGY MODEL RESULTS

Existing and future conditions HEC-HMS Model results are shown in Tables A and B below. Full output tables are included in the Appendices C and D.

Table A: Existing Conditions Peak Flows (cfs)

	Existing Conditions				
	2-Hour Storm		24-Hour Storm		
	100-Year Peak Flow (cfs)	10-Year Peak Flow (cfs)	100-Year Peak Flow (cfs)	10-Year Peak Flow (cfs)	
Element					Location
DP83	94	24	109	58	Upper Basin
DP91	58	15	68	36	Winding Hills Road
DP99	306	81	325	169	Woodmoor Drive
DP103	410	110	420	218	Lower Basin
DP107	472	125	459	234	Dear Creek Road
DP109	514	137	506	257	Woodmoor Lake In
DP111	573	142	558	302	Woodmoor Lake Outlet

Table B: Future Conditions Peak Flows (cfs)

	Future Conditions				Location
	2-Hour Storm		24-Hour Storm		
	100-Year	10-Year	100-Year	10-Year	
DP83	94	24	109	58	Upper Basin
DP91	58	15	68	36	Winding Hills Road
DP99	306	81	325	169	Woodmoor Drive
DP103	410	110	420	218	Lower Basin
DP107	472	125	459	234	Dear Creek Road
DP109	520	138	514	263	Woodmoor Lake In
DP111	579	144	563	306	Woodmoor Lake Outlet

As seen from Tables A and B, the 2-hour storm was the critical storm due to the higher peak flows. This is consistent with the results of the 1993 Dirty Woman Creek and Crystal Creek DBPS.

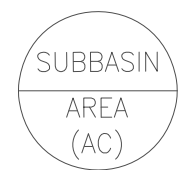
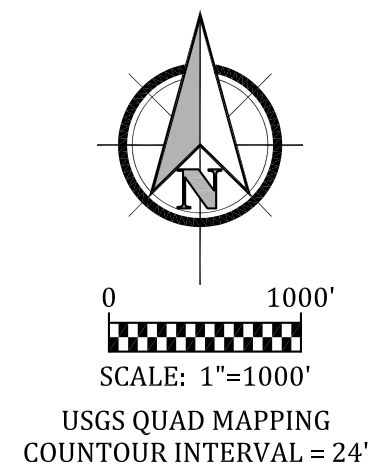
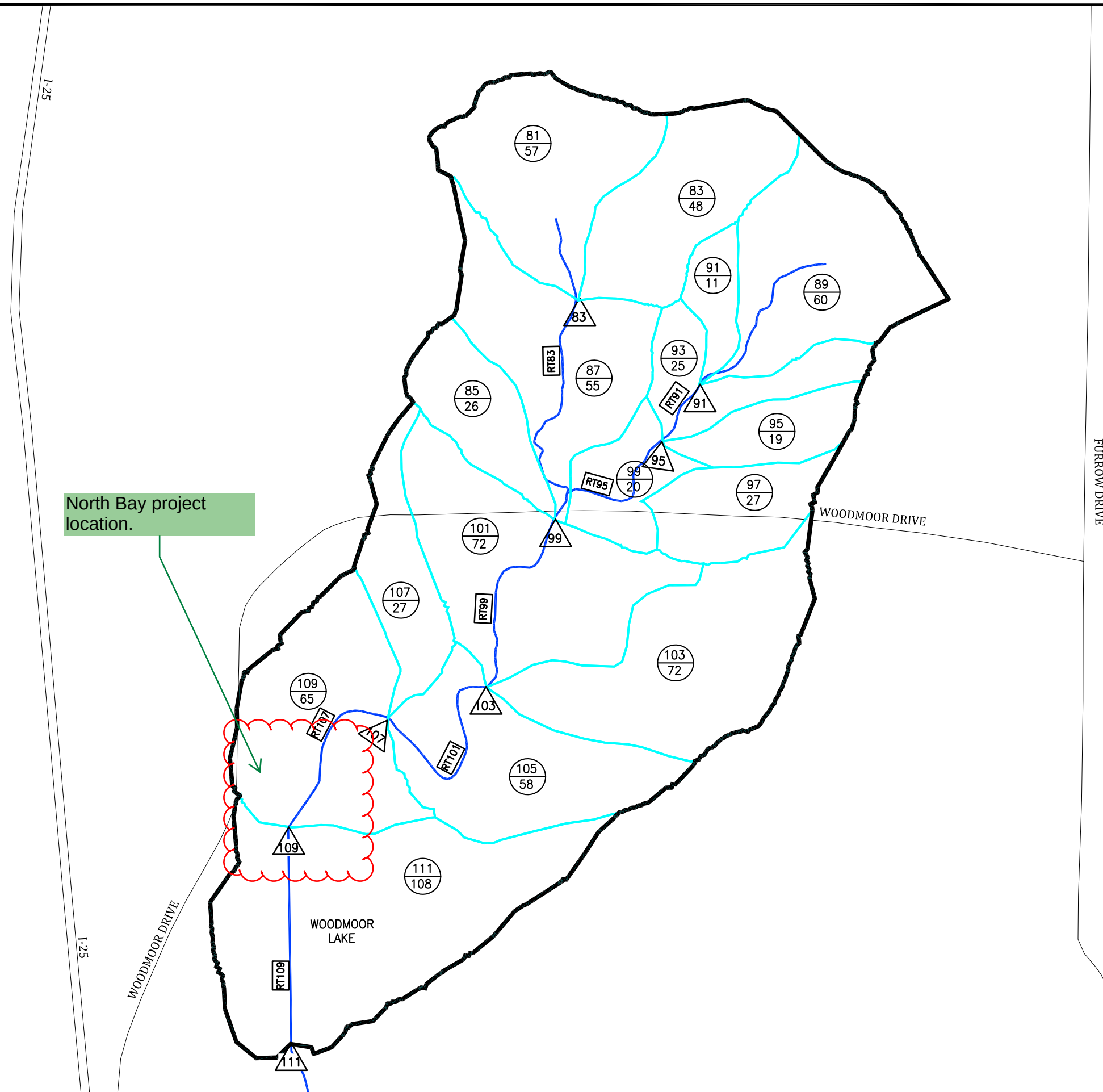
Tables C and D show existing and future conditions results comparisons to the original DBPS. As seen from the tables, peak flow rates decrease approximately 50%. This reduction is attributed primarily to increased infiltration of the lower CN values associated with larger lot sizes when compared to the original study.

Table C: Existing Conditions Peak Flows (cfs)

	Existing Conditions				
	2021 Update		1993 DBPS		
	100-Year Peak Flow (cfs)	10-Year Peak Flow (cfs)	100-Year Peak Flow (cfs)	10-Year Peak Flow (cfs)	
Element					Location
DP83	94	24	195	75	Upper Basin
DP91	58	15	112	41	Winding Hills Road
DP99	306	81	594	226	Woodmoor Drive
DP103	410	110	883	334	Lower Basin
DP107	472	125	1016	381	Dear Creek Road
DP109	514	137	1107	417	Woodmoor Lake In
DP111	573	142	1240	413	Woodmoor Lake Outlet

Table D: Future Conditions Peak Flows (cfs)

	Future Conditions				Location
	2021 Update		1993 DBPS		
	100-Year	10-Year	100-Year	10-Year	
DP83	94	24	195	75	Upper Basin
DP91	58	15	112	41	Winding Hills Road
DP99	306	81	594	226	Woodmoor Drive
DP103	410	110	883	334	Lower Basin
DP107	472	125	1016	381	Dear Creek Road
DP109	520	138	1107	417	Woodmoor Lake In
DP111	579	144	1240	413	Woodmoor Lake Outlet



Kiowa
Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

FIGURE 3
SWMM MODEL SCHEMATIC
LAKE FORK DIRTY WOMAN CREEK



**Natural Features, Wetland, Wildfire, Noxious Weeds & Wildlife
Report
for
North Bay at Lake Woodmoor in El Paso County, Colorado**

REVISED

June 1, 2022

Prepared for:

Lake Woodmoor Development, Inc.
1755 Telstar Drive, Suite 211
Colorado Springs, CO 80920

Prepared by:



1455 Washburn Street
Erie, Colorado 80516
(p): 970-812-3267

Project Number: 2021-13-1



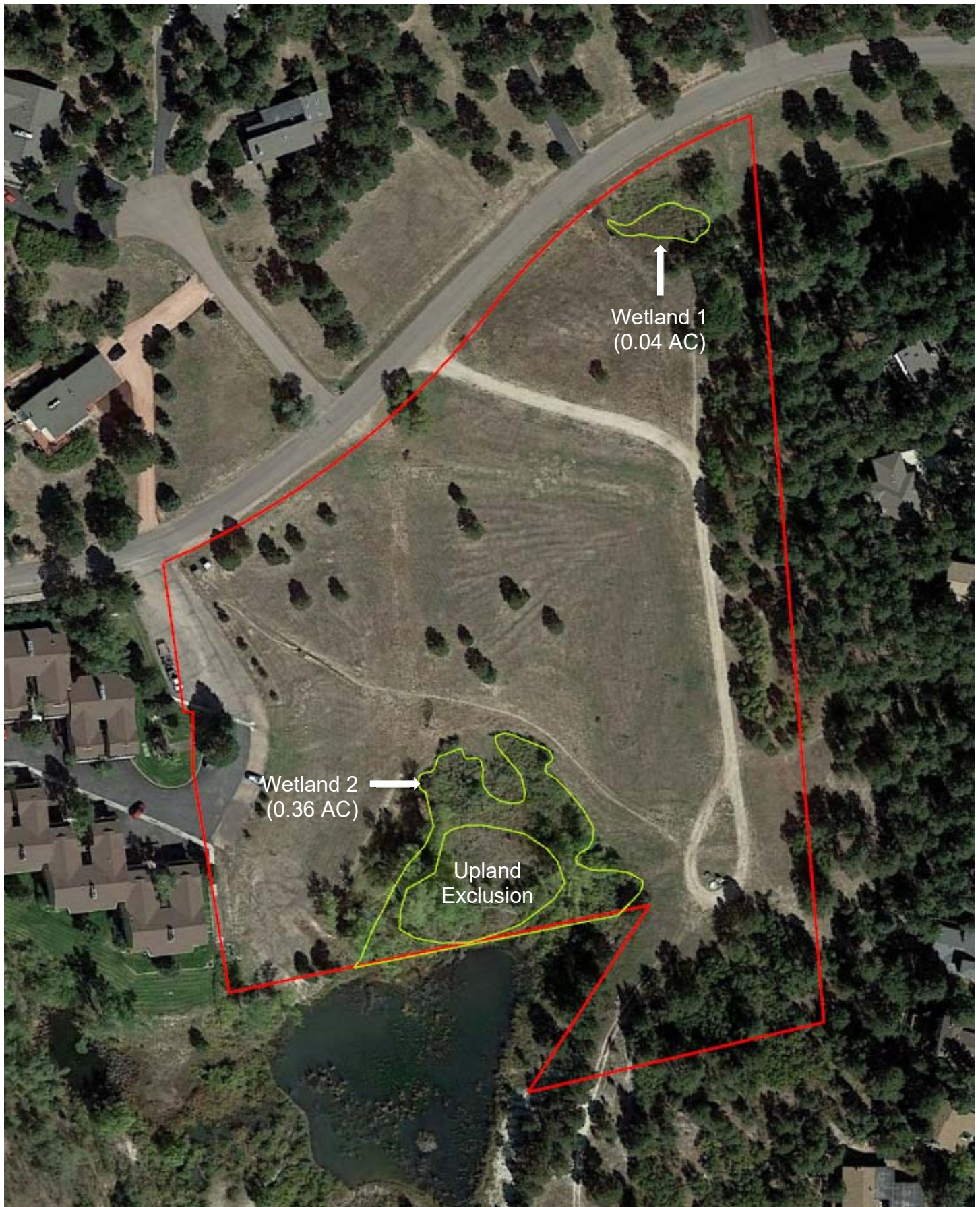
- Non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically three months); and
- Wetlands that directly abut such tributaries.

The jurisdictional wetland area data is summarized below, with an explanation of the field indicators (parameters) of wetland habitat that were observed and documented.

- 1) Jurisdictional wetland habitat and waters of the U.S. – There are two wetland areas on Site, a small detention basin (Wetland 1); and a wetland fringe along the north shore of Woodmoor Lake (Wetland 2) as further described in 1a. and 1b. below. These features are jurisdictional, as they are tributary to Monument Creek (via Dirty Woman Creek), a documented, jurisdictional waters of the U.S.

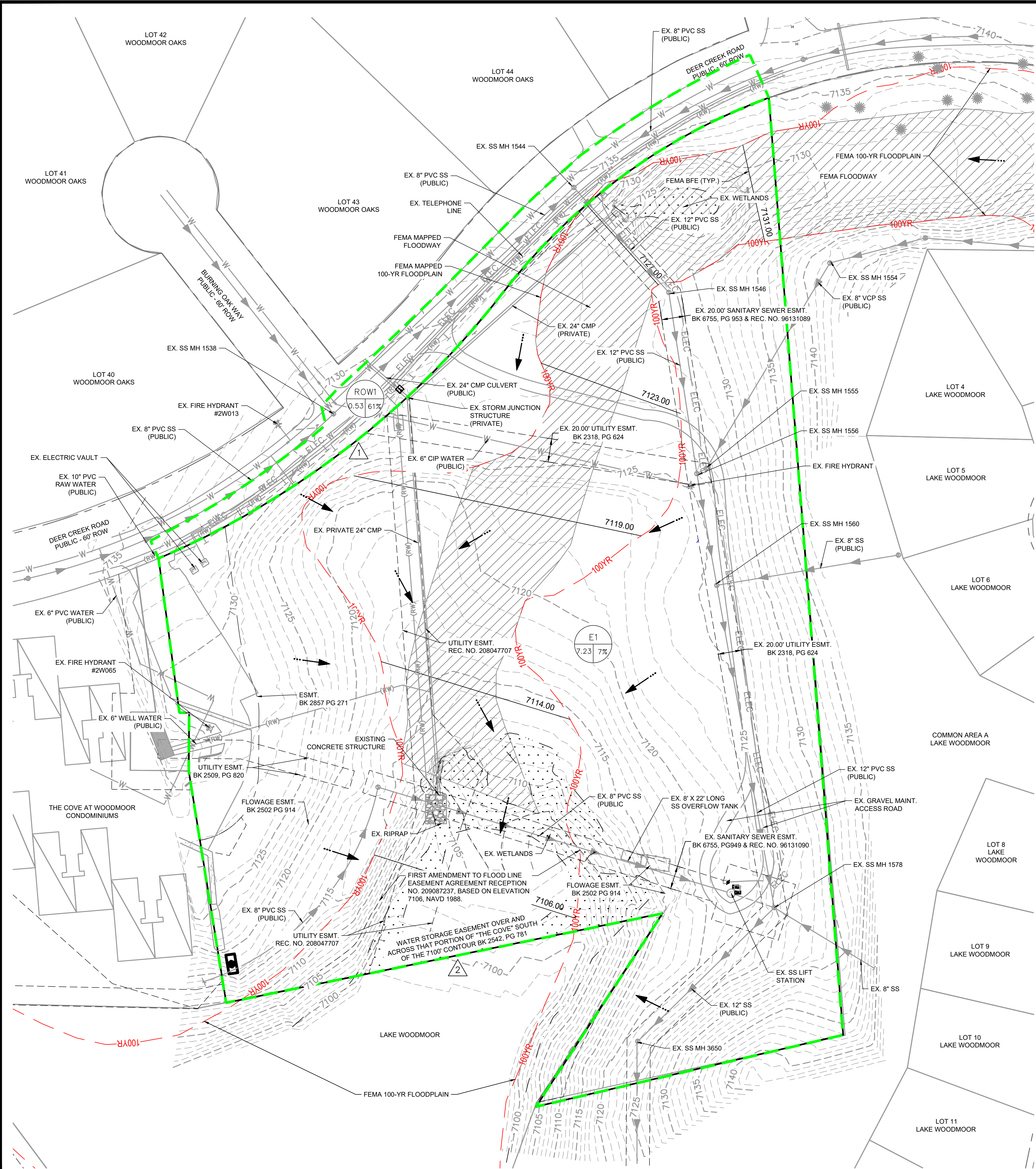
- a. **Wetland 1: PFO1/PEM Northeast Detention Basin** – There is a small (0.04 acre) detention basin located in the northeast corner of the Site, immediately south of Deer Creek Road. The dominant species are sandbar willow and American yellowrocket (*Barbarea orthoceras*). Most of the willows are dead, likely due to occasional prolonged flooding. Field indicators of hydric soils were observed at sampling point (SP) WD5-W as follows: 7.5 YR 4/1 clay loam with 7.5YR 5/1 depletions from 0-3 inches and 7.5 YR 3/2 sandy clay with 7.5YR 3/1 depletions and 5YR 4/6 concentrations from 3-7 inches. The predominantly clay soils have a red-parent material that does not match the mapped soil type and may have been imported for construction of the basin. The basin appears to have been constructed along an historic minor drainage (constructed prior to 1999 based on aerials reviewed). Surface flow provides the primary sustaining hydrology; and groundwater likely still flows into the basin, as evidenced by willows growing along the north bank of the detention basin. The basin drains to the west via a culvert (24" CMP) that is set in a headwall approximately 24" above the bottom of the basin. The culvert continues west, then turns south, and flows into Woodmoor Lake. During the Site visit, there was no surface water in the basin, but sustaining wetland hydrology was evident as soil saturation at 10-inches and water marks extending 24" up the headwall. This area meets all 3 parameters for jurisdictional wetland habitat.
- b. **Wetland 2: PSS/PF01/PEM wetland complex adjacent to Woodmoor Lake** – There is a well-developed area of riparian vegetation along the north edge of Woodmoor Lake. This structurally diverse vegetation is excellent wildlife habitat, particularly for birds. The area is characterized by dense palustrine scrub-shrub vegetation with

approximately 65 percent cover of sandbar willow and five percent cover of Rocky Mountain willow (*Salix monticola*). The tree canopy consists of plains cottonwood with approximately 20% cover. There are also a few ponderosa pines on the upland edges. There is a small cluster of non-native Russian olive (*Elaeagnus angustifolia*) trees on the lake shore and slightly south of the Site boundary. The dense willows limit the growth of herbaceous vegetation. The wettest areas along the shore have fewer willows and more herbaceous plants; emergent wetland species are common including cattail (*Typha latifolia*), Nebraska sedge (*Carex nebrascensis*), water sedge (*C. aquatilis*) and Emory's sedge (*C. emoryii*). Soil samples indicate the presence of field indicators of hydric soils. Observed soils at SP W1 - W were 10YR 5/1 silty sand from 0-6 inches and 10YR 6/1 silty clay with sand from 6-18 inches. Soils at SP W23-W were 10YR 3/2 silty sand from 0-10 inches and 10YR 4/1 silty sand from 10-16 inches. Sustaining hydrology for this wetland comes from Woodmoor Lake, the culvert from the northeast detention basin, and water from the slopes to the north. At SP W1-W, the lake provides sustaining hydrology and soil was saturated at a depth of six inches. At SP W23-W, the source of water is drainage from adjacent slopes and soil was saturated at a depth of 4 inches. This area meets all 3 parameters for jurisdictional wetland habitat.



Source: Ecosystem Services LLC, Wetland Delineation dated 10/13/21

APPENDIX F – DRAINAGE MAPS



LEGEND

EXISTING

PROPOSED

STORM SEWER

SANITARY SEWER

WATER

DRY UTILITIES

MISCELLANEOUS

DRAINAGE

BASIN TAG

DESIGN POINT

RECEIVING PVIOUS AREA (RPA)

GRASS BUFFER

MANHOLE

STORM INLET

FLARED END SECTION

RIPRAP

CLEAN OUT

MANHOLE

PLUG

FIRE HYDRANT

GATE VALVE

MANHOLE

METER

TEE

REDUCER

ELECTRIC PEDESTAL

OVERHEAD POWER POLE

ELECTRICAL CABINET

FIBER OPTIC PULL BOX

ASPHALT PAVEMENT

GRAVEL AREA

FLOODWAY

WETLAND

CHANNEL LINING

BUILDABLE AREA

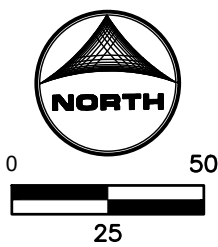
SIGN

BOLLARD

ACCESSIBLE PARKING

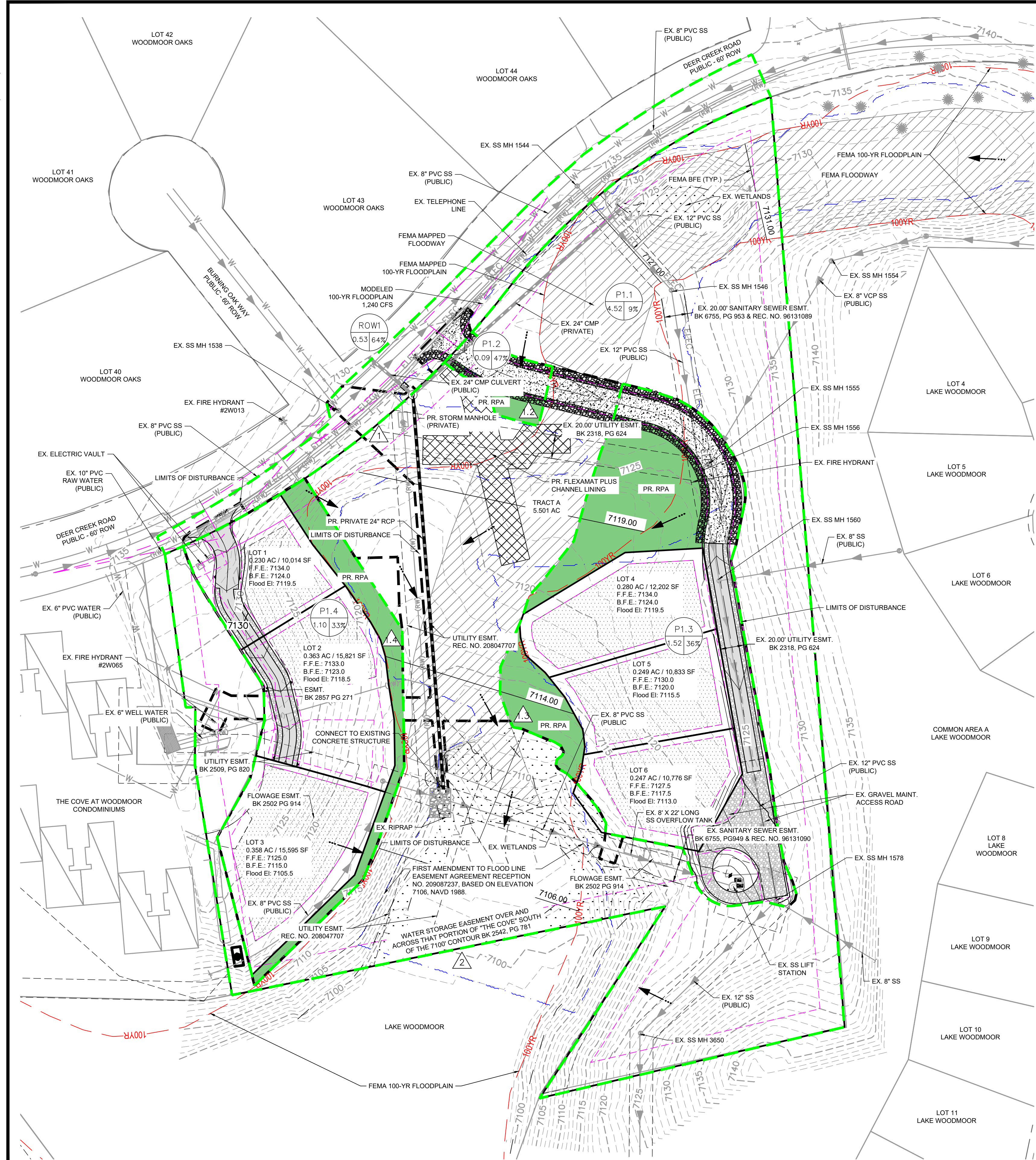
SUMMARY RUNOFF TABLE				
BASIN	AREA (ac)	% IMPERVIOUS	Q5 (cfs)	Q100 (cfs)
E1	7.23	7	3.57	17.94
ROW1	0.53	61	1.58	3.31

DESIGN POINT SUMMARY TABLE			
DESIGN POINT	CONTRIBUTING BASINS	SQ5 (cfs)	SQ100 (cfs)
1	E1	1.58	3.31
2	E1, DESIGN POINT [1]	4.73	20.37



Job No.: 2404118
Prepared By: SPC
Date: 7/8/2026

NORTH BAY AT LAKE WOODMOOR
EXISTING DRAINAGE MAP



LEGEND

PROPERTY LINE
EASEMENT LINE
RIGHT OF WAY
CENTERLINE
BARBED WIRE FENCE
U.G. ELECTRIC
OVERHEAD ELECTRIC
FIBER OPTIC
GAS MAIN
HIGH PRESSURE GAS
SANITARY SEWER
STORM DRAIN
TELEPHONE
WATER MAIN
SWALE
CURB & GUTTER
INDEX CONTOUR
FEMA FLOODPLAIN
MODELED 1240 CFS
100-YR FLOODPLAIN

DRAINAGE

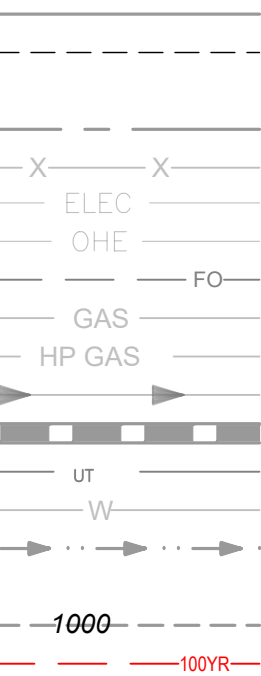
DRAINAGE BASIN

Basin Tag

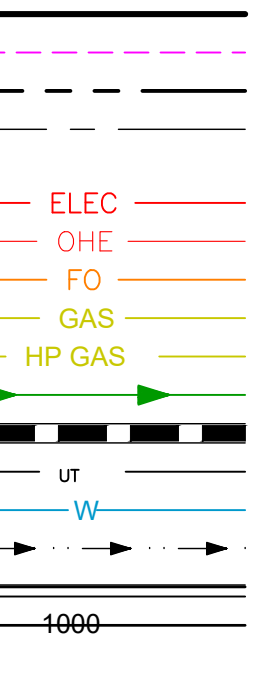
DESIGN POINT

RECEIVING PERVIOUS AREA (RPA)
GRASS BUFFER

EXISTING



PROPOSED



STORM SEWER

MANHOLE
STORM INLET
FLARED END SECTION
RIPRAP

SANITARY SEWER

CLEAN OUT
MANHOLE
PLUG

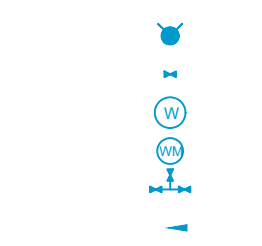
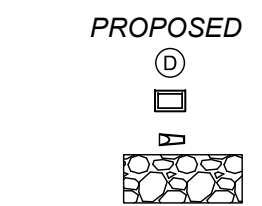
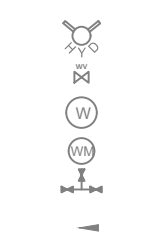
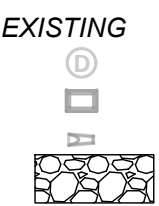
WATER

FIRE HYDRANT
GATE VALVE
MANHOLE
METER
TEE
REDUCER

DRY UTILITIES

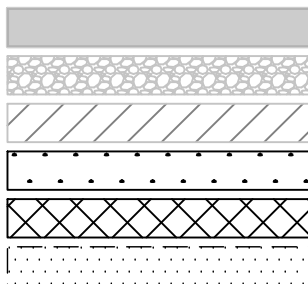
ELECTRIC PEDESTAL
OVERHEAD POWER POLE
ELECTRICAL CABINET
FIBER OPTIC PULL BOX

ASPHALT PAVEMENT
GRAVEL AREA
FLOODWAY
WETLAND
CHANNEL LINING
BUILDABLE AREA



MISCELLANEOUS

SIGN
BOLLARD
ACCESSIBLE PARKING



NOTES:

- REFER TO THE WATER QUALITY PLAN FOR DELINEATIONS OF RPA AREAS, UIA AREAS, SPA AREAS, EXCLUSION AREAS, AND UNTREATED AREAS.

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q5 (cfs)	Q100 (cfs)
P1.1	4.52	9	2.49	11.58
P1.2	0.09	47	0.21	0.50
P1.3	1.52	36	2.25	5.96
P1.4	1.10	33	1.77	4.80
P1 (OVERALL SITE)	7.23	19	6.12	21.31
ROW1	0.53	64	1.64	3.38

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	SQ5 (cfs)	SQ100 (cfs)
1	ROW1	1.64	3.38
1.2	P1.2	0.21	0.50
1.3	P1.3	2.25	5.96
1.4	P1.4	1.77	4.80
2	P1 (OVERALL SITE), DESIGN POINT [1]	7.35	23.85

Job No.: 2404118
Prepared By: SPC
Date: 7/8/2026

NORTH BAY AT LAKE WOODMOOR
PROPOSED DRAINAGE MAP

PROPERTY LINE EASEMENT LINE RIGHT OF WAY CENTERLINE BARBED WIRE FENCE U.G. ELECTRIC OVERHEAD ELECTRIC FIBER OPTIC GAS MAIN HIGH PRESSURE GAS SANITARY SEWER STORM DRAIN TELEPHONE WATER MAIN SWALE CURB & GUTTER INDEX CONTOUR FEMA FLOODPLAIN MODELED 1240 CFS 100-YR FLOODPLAIN DRAINAGE DRAINAGE BASIN BASIN TAG DESIGN POINT RECEIVING PERVIOUS AREA (RPA) GRASS BUFFER	EXISTING	PROPOSED	STORM SEWER MANHOLE STORM INLET FLARED END SECTION RIPRAP SANITARY SEWER CLEAN OUT MANHOLE PLUG WATER FIRE HYDRANT GATE VALVE MANHOLE METER TEE REDUCER DRY UTILITIES ELECTRIC PEDESTAL OVERHEAD POWER POLE ELECTRICAL CABINET FIBER OPTIC PULL BOX ASPHALT PAVEMENT GRAVEL AREA FLOODWAY WETLAND CHANNEL LINING BUILDABLE AREA	EXISTING	PROPOSED	MISCELLANEOUS SIGN BOLLARD ACCESSIBLE PARKING
---	-----------------	-----------------	--	-----------------	-----------------	---

UNCONNECTED IMPERVIOUS AREA TRIBUTARY TO RPA (UIA)	
RECEIVING PERVIOUS AREA (RPA)	
WQ EXCLUSION AREA (I.7.1.B.4 - UNDERGROUND UTILITIES)	
SEPARATE PERVIOUS AREA (SPA)	
UN-TREATED AREA	

ON-SITE WATER QUALITY TREATMENT SUMMARY			
NORTH BAY AT LAKE WOODMOOR			
Subbasin ID	Disturbed Area [AC]	Treatment CM	Notes:
P1.1	0.87	EXCLUSION	EXCLUSION I.7.1.B.4 - UNDERGROUND UTILITIES
P1.1	0.03	UNTREATED	DRAINS OFFSITE UNTREATED
P1.1	0.01	SPA	SPA AREA
P1.2	0.04	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.2	0.03	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.2	0.02	SPA	SPA AREA
P1.3	0.59	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.3	0.37	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.3	0.56	SPA	SPA AREA
P1.4	0.38	GRASS BUFFER RPA	WQ TREATMENT BY GRASS BUFFER RPA
P1.4	0.15	GRASS BUFFER RPA	GRASS BUFFER RPA AREA
P1.4	0.57	SPA	SPA AREA
ROW1	0.04	UNTREATED	DRAINS OFFSITE UNTREATED
ROW1	0.04	EXCLUSION	EXCLUSION I.7.1.B.4 - UNDERGROUND UTILITIES

Treatment CM	Area [AC]	% of total
TOTAL DIST. AREA	3.70	
WQ EXCLUSION	0.91	25%
TOTAL NON-EXCLUDED AREA	2.79	
TREATED BY RPA	2.72	98%
UNTREATED	0.07	2%
TOTAL:	2.79	100%