Flying Horse North Filing No. 5
Final Drainage Report

December 2024

Prepared For:

Mr. Drew Balsick

Vice President / Project Manager

Flying Horse Development, LLC
2138 Flying Horse Club Drive

Colorado Springs, CO 80921

(719) 785-3237

Prepared By:

HR Green Development, LLC

1975 Research Parkway, Ste. 160

Colorado Springs, CO 80920

Contact: Richie Lyon, PE

Richie.Lyon@hrgreen.com

719-318-0871

PCD File No. SF2427

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Engineer's Statement

This report and plan for the drainage design of the development, Flying Horse North Filing No. 5, was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the *El Paso County Drainage Criteria* Manual and is in conformity with the master plan of the drainage basin. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

RDL 2/14/2025

Richie Lyon, PE Date

State of Colorado No. 53921

For and on behalf of HR Green Development, LLC

RICHARD D. LYON
Richard D Lyon
53921
2/14/2025

Developer's Statement

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

Flying Horse Development, LLC

2/14/2025

Drew Balsick Date

Vice President

Flying Horse Development, LLC
2138 Flying Horse Club Drive

Colorado Springs, CO 80921

El Paso County:

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

Joshua Palmer, P.E. Date

County Engineer/ECM Administrator

Final Drainage Report – Flying Horse North

I. General Purpose, Location and Description

a. Purpose and Scope

The Purpose of this Final Drainage Report (FDR) is to identify specific solutions to drainage concerns for onsite and offsite tributary areas resulting from the development of the subdivision to be platted. The FDR is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure as it relates to water quality and stormwater detention for any proposed or existing facilities, the planned storm water management for Flying Horse North Filing No. 5.

The Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1 is a combined Preliminary Drainage Report (PDR) and Final Drainage Report (FDR) that was developed by Classic Consulting, latest revision June 2018. The combined PDR/FDR was approved by the County in September of 2018 and is included in Appendix E.

A more recent Master Development Drainage Plan (MDDP) was prepared by HR Green Development, LLC. and was approved by the County in September of 2022, entitled *Flying Horse North Master Development Drainage Plan* latest revision date of September 9, 2022. This MDDP also referenced the Classic Consulting report from 2018 for master drainage design of the proposed Filing No. 5 area.

The items discussed in this FDR include final plat layout, land uses, and drainage patterns for Flying Horse North Filing No. 5. Included in this report are final hydrologic and hydraulic drainage calculations and design as required for the final design of the development of the single-family residential estate lot areas. This report references the aforementioned reports to compare and contrast findings in the final design to ensure that existing infrastructure and facilities are not negatively impacted by this development.

b. DBPS Investigations

Flying Horse North is split by the Arkansas River Basin and South Platte Basin. Within the South Platte Basin, the site is withing the East Cherry Creek Drainage Basin. A Drainage Basin Planning Study (DBPS) does not currently exist for the East Cherry Creek Drainage Basin. This FDR is consistent with the 2022 MDDP which complies with standard El Paso County regulations regarding drainage within this corridor.

The Filing No. 5 area falls within the East Cherry Creek Basin which is to consist of 21 single-family residential estate lots of 2.5-acres minimum area within 58 acres. The remainder of the filing consists of a 52.7-acre open space park area. Proposed developed areas are provided with water quality and full spectrum detention (FSD) prior to release offsite. Areas that are tributary to Flying Horse Filing No. 5 have no increase in required stormwater quality or detention volumes. The west side of the Filing No. 5 site drains to the west through the existing golf course into the existing Irrigation Reservoir. The east side of the site drains to the north to the existing detention facility, Pond B, within Filing No. 4. Development of the Filing No. 5 areas tributary to this pond were accounted for within the Filing No. 4 Final Drainage Report (FDR) and pond design.

c. Stakeholder Process

There are no amendments to the current DBPS.

d. Agency Jurisdictions

Listed below are the jurisdictions that this project will conform to:

El Paso County

Federal Emergency Management Agency

e. General Project Description

Flying Horse North Filing No. 5 is in El Paso County jurisdiction and is located within the larger Flying Horse North subdivision. The overall Flying Horse North development is bordered by Highway 83 to the west, Black Forest Road to the east, Cathedral Pines to the south, and High Forest Ranch to the north. The greater Flying Horse North area contains approximately 1,459 acres within the whole Section 36, Township 11 South, Range 66 West of the Sixth Principal Meridian, and a portion of Section 30 and 31, Township 11 South, and Range 65 West of the Sixth Principal Meridian.

The Filing No. 5 area totals approximately 115 acres including 21 total 2.5-acre single-family residential estate lots for 58 acres (50%) of the filing. There is a park area within Tract A that consists of 52.7 acres (46%) of the filing. The remained of the filing area is right-of-way consisting of 4.5 acres (4%). The development includes the single-family residential estate lots, 60’ width rights-of-way that consist of asphalt paved roadways with roadside swale sections, electric easements, and storm infrastructure including culverts.

Filing No. 5 was previously assessed in the 2018 Classic Consulting report with a similar land use plan that included 2-acre single-family residential estate lots and roadways. This report assesses the lots as 2.5-acre lots. The layout shown in the developed conditions hydrology map of this report and the corresponding construction drawings differs slightly from the approved FDR/PDR with adjusted roadway alignments and lot lines. However, the drainage patterns, typical roadway section, and land use densities are similar.

The existing vegetative cover is 90 percent as evidenced by a field survey and aerial imagery. The existing vegetation includes native grasses and weeds, shrubs, and pinyon pine trees. Previous clearing of future planned roadways was done several years ago, and native grass and weeds have covered those areas.

f. Data Sources

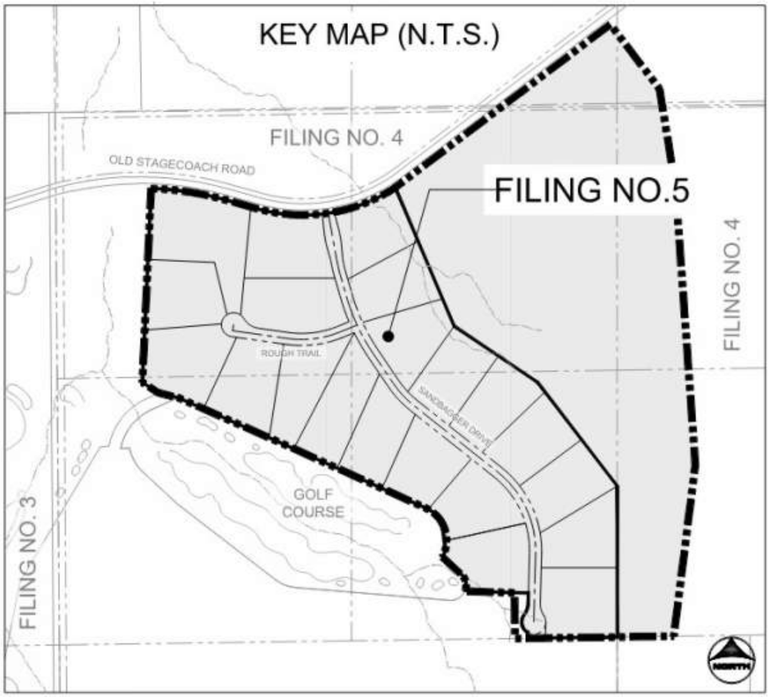


Figure 1 – Vicinity Map

Listed Below are the technical resources reviewed in the preparation of this FDR:

El Paso County Drainage Criteria Manual (DCM)

Mile High Flood District

NOAA Atlas 14

NRCS Soil Survey for El Paso County Area, Colorado

FEMA FIRM 08041C0305G and FIRM 08041C0315G (eff. 12/7/2018)

El Paso County Assessor Property Records

Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1 prepared by Classic Consulting – June 2018

Flying Horse North Master Development Drainage Report prepared by HR Green Development, LLC. – latest revision September 9, 2022

Flying Horse North Final Drainage Report prepared by HR Green Development, LLC. – latest revision September 2024

g. Applicable Criteria and Standards

Per El Paso County Criteria Manual, flows from the proposed site will be limited to historic flows to maintain the stability of the existing channels within the drainage basins. The final drainage plan follows the Drainage Criteria Manual for El Paso County which refers to the City of Colorado Springs Drainage Criteria Manuals as amended. Criteria within the County and City manuals refer to the Mile High Flood

District manuals, particularly for extended detention basin design.

A distinct difference in the 2018 FDR/PDR and this report are the hydrologic methodologies utilized to compute peak runoff values. The 2018 Classic Consulting report utilized the NRCS Curve Number method in order to be consistent with their previous MDDP for the greater Flying Horse North master development. The NRCS Curve Number method was used for Filing No. 1 and the future development of Filing No. 5 for sub-basins that did not exceed 100 acres. Typically, the Rational Method is used for hydrologic computations when basin analysis is under 100 acres due to the NRCS Curve Number method yielding smaller minor and major storm event peak runoff values. The resultant hydraulics in this report are similar to that of the approved 2018 FDR/PDR on a basin-by-basin basis, however, any differences in calculated stormwater runoff will be discussed. The difference in methodologies between the 2018 report and this report result in larger cumulative stormwater runoff values reported for the minor and major storm events. Due to the more conservative nature of the Rational Method, cumulative peak flow rates are greater than that of the 2018 FDR/PDR for the minor and major storm events for downstream design points.

HR Green has discussed this discrepancy in hydrologic methodology with El Paso County engineering staff and it has been expressed that the chosen method for hydrologic computations is the Rational Method for this report to ensure sound design of the storm infrastructure for Filing No. 5 including swales, channels, culvert pipes, inlets, and roadway capacities. Due to the use of the NRCS Curve Number method in the 2018 FDR/PDR, the peak runoff values in this report are larger than that of the approved 2018 FDR/PDR. To complete a fair assessment of the impacts downstream of the site, existing hydrology calculations have been completed and included in appendix B. There are no anticipated negative impacts to downstream offsite infrastructure because of this development as all other drainage parameters remain consistent with the 2018 FDR/PDR.

II. Project Characteristics

a. Location in Drainage Basin, Offsite Flows, Size

Flying Horse North Filing No. 5 is located within the East Cherry Creek Basin. There is not a current planning study of the drainage basin, but generally it slopes from southwest to northeast. The basin eventually flows into the South Platte River.

Within the portion of the East Cherry Creek Basin investigated with this Report, two major drainage basins have been designated by the detention facility in which the area is draining to. One drainage basin consists of seven sub-basins, “B” basins, conveyed to the existing detention pond, Pond B. This pond is located to the north of Old Stagecoach Road and drainage from the Filing No. 5 site will reach this pond via an existing public dual 48-inch culvert. The respective contributing flow from the sub-basins is shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
B1	57.79	15.9	97.5
B2.1	6.72	4.1	16.9
B2.2	2.80	1.8	7.3
B2.3	2.61	1.8	6.9
B2.4	25.16	12.6	51.2

Drainage within the “B” drainage basin flows from the southeast to northwest to reach the existing Pond B constructed under Flying Horse North, Filing No. 4 (SF2422). Design points are located at proposed culverts and inlets within roadside ditches that direct flow to the detention pond. Drainage outfalls from Pond B into an existing channel that ultimately outfalls to the South Platte River. Drainage Basin B1 is an existing basin that was analyzed in the Filing No. 4 Final Drainage Report and has been included in this analysis to ensure consistency in routing calculations and final flow rates.

The second drainage basin consists of three sub-basins, “I” basins, conveyed to the existing Pond 13. The respective contributing flow from the sub-basins is shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
I1	1.02	0.8	3.4
I2	15.87	9.2	37.7
I3	9.51	6.3	26.0

Drainage within the “I” drainage basin flows ultimately from the southeast to the north and west to reach the existing pond, Pond 13, constructed under Flying Horse North, Filing No. 1 (SF181). Drainage from these basins flows offsite, through an existing golf course and then collected in the existing reservoir.

This Filing No. 5 FDR utilizes similar tributary areas, runoff coefficients (when comparing the NRCS Curve Number method and the Rational Method), and percent imperviousness for respective sub-basins and downstream detention facilities compared to 2018 Classic Consulting FDR/PDR. Any deviation in the sub-basin area, coefficient, or percent imperviousness is due to slight roadway alignment adjustments for the final design as compared to the preliminary layout in the 2018 report. Any change in the peak runoff numbers as compared to the 2018 report is due to the change in hydrologic computation methodology as discussed in a previous section of this report. Due to these differences in the computational methodology between the previously approved 2018 FDR and the values being reported in this report, additional analysis of existing conditions has been completed on the entire site. The existing conditions major flow values have been added to Appendix B. A table showing the Classic 2018 FDR/PDR NRCS Method peak runoff values compared to the HR Green 2024 FDR Rational Method peak runoff values for proposed and existing conditions is provided below. This table is for basins that qualify for large lot exclusion under ECM code I.7.1.B.5:

Basin Name		**Area (acre)**		**Proposed Q5 (cfs)**		**Proposed Q100 (cfs)**	
Classic	**HRG**	**Classic**	**HRG**	**Classic**	**HRG**	**Classic**	**HRG**
CC-10	B1	85.6	57.78	14.1	15.9	91.9	97.5
CC-8	B2.1	7.7	9.19	2.5	4.1	12.0	16.9
CC-10	B2.2	85.6	2.80	14.1	1.8	91.9	7.3
	B2.3		2.61		1.8		6.9
	B2.4		25.16		12.6		51.2
CC-9	I1	5.6	1.02	2.1	0.8	9.8	3.4
CC-4A	I2	108.7	15.87	39.0	9.2	156.0	54.4
CC-3	I3	52.5	9.51	8.8	6.3	54.5	6.8

Under ECM code I.7.1.B.5 a single-family residential lot greater or equal to 2.5 acres in size per dwelling is excluded from the requirement of having to install stormwater quality control measures at the completion of the site. All of the lots within Filing No. 5 are 2.5-acre single-family lots and therefore are exempt from the water quality requirements. The proposed roadways are not included in the large lot exclusion and therefore will still be captured and treated for water quality. The runoff within the Filing No. 5 site will be captured in one of two existing water quality and detention ponds, Pond B and Pond 13. The delineated “B” basins will discharge to the existing detention Pond B and the delineated “I” basins will discharge to the existing Pond 13.

It is important to note that while there is an increase in peak runoff for these basins as compared to the 2018 report, there is a discrepancy in methodology. The difference in flow rates provided in the table may have significant differences as the basin area being analyzed in one report may be significantly bigger than in the other report. The proposed improvements will be designed using the updated values and pond sizing, which relies on a historic model, in the CUHP / SWMM to ensure that the developed flow rates are less than the historical flow rates. It is shown in the Flying Horse North Filing No. 4 Final Drainage Report, that the total flowrates being released off-site into Cherry Creek basin has been reduced overall.

b. Compliance with DBPS

This FDR is in general conformance with the current drainage flows of the East Cherry Creek Basin. Flying Horse North will construct multiple full spectrum detention facilities to limit the effects of development and mimic natural flow patterns. Flying Horse North Filing No. 5 development will follow historic drainage patterns and utilize the existing natural swales throughout the area for conveyance of stormwater runoff toward respective proposed detention facilities.

c. Site Characteristics

Per the NRCS web soil survey, the site is made up entirely of Type B soils. Filing No. 5 is within the East Cherry Creek Basin which consists of Peyton sandy loam and Peyton-Pring complex. See Appendix A for the NRCS soil map.

The current ground cover in Filing No. 5 is short to mid-grass prairie grasslands and former farmland which consists of non-native weeds and grasses. This portion of the site has very few, if any, trees and a minimal number of shrubs are found on the site.

d. Major Drainage Ways and Structures

No major drainage ways exist within the development; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries. These informal drainage ways are assessed within this report for stormwater runoff capacity and water surface elevations during the 100-year event as future development of single-family residential lots with basement or walkout conditions is considered. Roadside swales are included as a part of the typical roadway section and are assessed within sub-basins to ensure that swale and culvert pipe capacities are met and do not result in excessive pooling in the roadway sections per code.

The existing minor drainage channels within the site are planned to be maintained to the maximum extent possible. These will continue to be used for conveyance of storm drainage flows. The limits of construction and disturbance plan for no significant earthwork alterations to the existing minor drainage channels that would affect the drainage patterns or capacity of the sections throughout the filing as they are proven to have sufficient capacities for their respective tributary areas and to maintain the natural features of the site including existing trees and vegetation.

Drainageways of note including roadside swales are described within this report with parameters to demonstrate compliance with swale design criteria and capacities. Culvert pipes are sized to convey upstream flow under proposed roadways and maintain historic drainage patterns.

e. Existing and proposed land uses

The existing Filing No. 5 area is open rangeland within a forested area consisting of sparse native grasses, weeds, and pinyon pine trees as well as baren pervious soil. An open space area was planned for in the approved 2016 PUD and is consistent with this filing. The park area is approximately 53 acres and is to be developed as a public park.

The 2018 Classic Consulting PDR/FDR assumed 2-acre single-family residential estate lot development with the same percent imperviousness within the filing area. This report includes the final design layout of 2.5-acre lots with rural roadway sections. Any deviations in basin areas, land use acreages, and resultant composite coefficients are shown within this report and demonstrated to meet downstream stormwater runoff and volume capacities for proposed and existing facilities.

III. Hydrologic Analysis

a. Major Basins and Sub-basins

b. Major Basin Description

Per FEMA FIRM 08041C0315G (eff. 12/7/2018), there are no FEMA Floodplains within this Filing.

The site has been divided into several major drainage basins where each basin is tributary to a full spectrum detention pond facility. These basins and associated sub-basins are described in more detail in the next section of this report.

c. Existing Subbasin Description

The existing conditions for Filing No. 5 have been analyzed and the delineated basins presented in the Existing Conditions Map in Appendix F are described as follows:

Existing Basin B2: 35.76 acres, undeveloped (Q_5 = 8.3 cfs, Q_{100} = 61.0 cfs)

Runoff generated in this basin sheet flows over existing topography to the north and travels through an existing tertiary swale. The flows are collected in an existing public dual 48-inch RCP culvert and directed north under Old Stagecoach Road to the existing water quality and detention pond, Pond B. Slopes in this basin average between 4% and 13% with a maximum elevation of 7630’ and a minimum elevation of 7540’.

Existing Basin I1: 1.08 acres, undeveloped (Q_5 = 0.3 cfs, Q_{100} = 2.4 cfs)

Runoff generated in this basin sheet flows over existing topography to the west towards design point I1 and will eventually combine with flows in Basin I2. Discharge from this basin ultimately outfalls into the existing detention pond located west of the Filing No. 5 site, Pond 13. Slopes in this basin average between 3% and 8% with a maximum elevation of 7590’ and a minimum elevation of 7560’.

Existing Basin I2: 14.87 acres, undeveloped (Q_5 = 4.0 cfs, Q_{100} = 29.5 cfs)

Runoff generated in this basin sheet flows over existing topography to the west. Combined flows from basin I1 and I2 will ultimately outfall into the existing detention pond located west of the Filing No. 5 site, Pond 13. Slopes in this basin average between 3% and 15% with a maximum elevation of 7595’ and a minimum elevation of 7535’.

Existing Basin I3: 80.01 acres, undeveloped / golf course (Q_5 = 16.6 cfs, Q_{100} = 122.0 cfs)

Runoff generated in this basin sheet flows over existing topography to the southwest and flows offsite onto an existing golf course. The runoff will flow through the golf course to the northwest and outfall to the existing detention pond, Pond 13. Slopes in this basin average between 2% and 30% with a maximum elevation of 7660’ and a minimum elevation of 7540’.

d. Proposed Subbasin Description

The net area of some basins described in this report may differ from the 2018 Classic Consulting FDR/PDR due to changes of alignment of proposed roads and slight adjustments of the delineations with new topographic survey information. The net Q_5 & Q_{100} values may differ in this report because of the different methodologies used between the reports. Classic Consulting’s FDR had used a Curve Number Method to report 5-year and 100-year drainage flows while this report utilizes the Rational Method to determine peak flow values. The Rational Method yields higher minor and major storm peak runoff values. Because of these two discrepancies, the values reported in this FDR may be higher across all design points that had also been evaluated in Classic Consulting’s FDR from 2018.

The following design points are presented on the Developed Conditions Drainage Map and are described as follows:

Proposed Basin B2.1: 6.72 acres, residential (2.5 acre lots) (Q_5 = 4.1 cfs, Q_{100} = 16.9 cfs)

Runoff generated in this basin travels first overland through existing topography to the north and east and travels shallow concentrated flow in roadside ditches along Holmes Road. The flows are collected in a proposed public Type-13 Inlet (IN-B2.1) and directed east through a proposed public 24-inch RCP to eventually outfall into Basin B2.4.

From Classic Consulting’s FDR for Flying Horse North Filing No. 1, Basin B2.1 (and part of Basin B2.3) was identified as Basin CC-8. Classic’s FDR reported a total basin area for CC-10 to be 7.7 acres with a

Q_5=2.5 CFS and a Q_{100}=12.0 CFS.

Proposed Basin B2.2: 2.80 acres, residential (2.5 acre lots) (Q_5 = 1.8 cfs, Q_{100} = 7.3 cfs)

Runoff generated in this basin travels first overland through existing topography to the north and travels shallow concentrated flow in roadside ditches along Holmes Road and Rough Trail. The flows are directed through a proposed public 18-inch RCP culvert at design point 2.3 to Basin B2.3.

Proposed Basin B2.3: 2.61 acres, roadway (minor collector) / residential (2.5 acre lots) (Q_5 = 1.8 cfs, Q_{100} = 6.9 cfs)

Runoff generated in this basin travels first overland through existing topography to the north and travels shallow concentrated flow in roadside ditches along Holmes Road and Rough Trail. The flows are collected in a proposed public Type-13 Inlet (IN-B2.4) and directed east through a proposed public 24-inch RCP to eventually outfall into Basin B2.4.

Proposed Basin B2.4: 25.16 acres, residential (2.5 acre lots) (Q_5 = 12.6 cfs, Q_{100} = 51.2 cfs)

Runoff generated in this basin travels overland flow over existing topography to the north. Runoff is eventually collected in an existing drainage channel, denoted as Section A-A on the drainage plans, flowing north to design point B2 where drainage will be directed through an existing public dual 48-inch RCP culvert to Basin B3. Stormwater will eventually be collected in an existing water quality and detention pond, Pond B, located in Filing No. 4. See Water Quality and Detention Facilities section for information on Pond B.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin B2.5 (as well as Basin B2.2 and Basin B2.4) was identified as Basin CC-10. Classic's FDR reported a total basin area for CC-10 to be 85.6 acres with a Q_5=14.1 CFS and a Q_{100}=91.9 CFS. The cumulative flow at design point 26 (this includes basins CC-8 and CC-10) shown in this report have a net area of 93.3 acres, a net Q_5= 15.9 CFS, and a net Q_{100}=102 CFS.

From Flying Horse North Filing No. 4 FDR, Basin B2 was analyzed as one basin draining to Pond B. Basin B2 has been delineated into more detailed basins in this report to provide a more accurate analysis based on detailed grading and finalized lot locations and road alignments. The total combined flows at design point B2 in the Filing No. 4 report are Q_5 = 33.2 CFS and Q_{100} = 285.8 CFS. The new combined flows total at design point B2 calculated in this report are Q_5 = 29.4 CFS and Q_{100} = 264.7 CFS.

Proposed Basin I1: 1.02 acres, residential (2.5 acre lots) (Q_5 = 0.8 cfs, Q_{100} = 3.4 cfs)

Runoff generated in this basin will travel through the street and in roadside ditches along Rough Trail to a proposed public 18-inch culvert that will outfall to Basin I2. The concentrated flow from the proposed culvert will outfall to a level spreader to disperse the discharge from concentrated to sheet flow. The runoff from this basin will combined with the runoff from Basin I2 and eventually discharge into the existing Pond 13 to be treated for water quality.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin I1 was identified as Basin CC-9. Classic's FDR reported a total basin area for CC-9 to be 5.6 acres with a Q_5=2.1 CFS and a Q_{100}=9.8 CFS.

Proposed Basin I2: 15.87 acres, residential (2.5 acre lots) (Q_5 = 9.2 cfs, Q_{100} = 37.7 cfs)

Runoff generated in this basin will combine with flow from Basin I1 and sheet flow over existing topography before eventually flowing off site to the west to existing Pond 13.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin I2 was identified as a part of Basin CC-4A. Classic's FDR reported a total basin area for CC-4A to be 108.7 acres with a Q_5=39.0 CFS and a Q_{100}=156.0 CFS.

Proposed Basin I3: 9.51 acres, residential (2.5 acre lots) (Q_5 = 6.3 cfs, Q_{100} = 26.0 cfs)

Runoff generated in this basin will sheet flow over existing topography before eventually flowing off site to the west. Offsite flow will first travel through an existing golf course before being collected in existing Pond 13 located just west of the Filing No. 5 site.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin I3 was identified as a part of Basin CC-3. Classic's FDR reported a total basin area for CC-3 to be 52.5 acres with a Q_5=8.8 CFS and a Q_{100}=54.5 CFS. Basin CC-3 combined with runoff from basin OS-4 outfalls at the proposed design point 23. Basin CC-3 and Basin OS-4 a total tributary area of 78.9 acres. The total 5-year flow rate for the developed conditions at design point 23 is 13 cfs and the total 100-year flow rate for the developed conditions at design point 23 as 84 cfs.

A table below summarizes the existing and developed conditions of the site:

Existing Conditions				**Developed Conditions**			
Basin	**Area**	**Q5**	**Q100**	**Basin**	**Area**	**Q5**	**Q100**
B2	35.76	8.3	61.0	B2.1	9.19	5.6	23.1
				B2.2	2.80	1.8	7.3
				B2.3	2.61	1.8	6.9
				B2.4	19.91	10.0	40.6
I1	1.08	0.3	2.4	I1	1.02	0.8	3.4
I2	14.87	4.0	29.5	I2	15.87	9.2	37.7
I3	80.01	16.6	122.0	I3	9.51	6.3	26.0

The table shows that there is an increase in flow rate in the developed conditions. The discharge from these sites will be captured in existing detention ponds and the ponds will release the flow downstream at a rate equal to or less than historic rate.

e. Water Quality and Detention Facilities

There is an existing stormwater facility, Pond 13, located just west of Flying Horse North Filing No. 5. Pond 13 is designed with Flying Horse North Filing No. 1 (SF181) as a retention pond using the Mile High Flood District (MHFD) Detention workbook. The reservoir facility provides detention and water quality through a separate stormwater detention and water quality component in the form of a private concrete outlet box with an orifice plate and 30-inch RCP outlet pipe. The stormwater outlet box is constructed outside of the reservoirs dam embankment. The total tributary area contributing to Pond 13 as identified in *The Irrigation Reservoir Embankment Design Report* by Classic Consulting is 366.80 acres and of that area, only 23.5 acres comes from within the Filing No. 5 boundary. The proposed area analyzed in this report contributing to Pond 13 is slightly higher at 26.40 acres. The contributing area to Pond 13 in the Classic Consulting design report included 2-acre residential land use and golf course, so an overall imperviousness of 8.5% was calculated. The area contributing to the pond from Filing No. 5 contains only residential land use, making the calculated imperviousness 11%.

An existing Full Spectrum Detention Pond, Pond B, designed with Filing No. 4 (SF2422), will collect runoff from the Filing No. 5 site. The construction of Pond B is anticipated to be completed in the spring of 2025. Full Spectrum Detention (FSD) is a design concept introduced by the Mile High Flood District (MHFD, Urbonas and Wulliman 2005) that provides better control of the full range of runoff rates that pass through detention facilities than the conventional multi-stage concept. This concept also provides some mitigation of increased runoff volumes by releasing a portion of the increased runoff volume at a low rate over an extended period of time. Site detention ponds are designed as FSDs to provide the required volume stages for Water Quality Capture Volume (WQCV), Excess Urban Runoff Volume (EURV), and the 100-year stage (flood control volume). In FSDs, the flood volume is equal to the entire volume and is inclusive of the EURV and the WQCV. A full analysis of Pond B can be found in The *Flying Horse North Filing No. 4 Final Drainage Report* in Appendix E. The Pond B hydraulics are summarized in the table below:

	Peak Inflow (cfs)	**Design Release/Outflow (cfs)**	**Time to Drain 99% of Inflow Volume (hrs)**	**Historic Peak Flowrate at O_BASIN_B**	**Developed Peak Flowrate at O_BASIN_B**
Minor Storm (Q5)	59.1	49.2	50	58	54
Major Storm (Q100)	247.1	216.0	36	263	262

f. Methodology

Design rainfall was determined utilizing Table 6-2 from the City of Colorado Springs Drainage Criteria Manual to determine the 5-year and 100-year rainfall values for the 1-hour events. The 1-hour rainfall depths are 1.5 and 2.52 in/hr respectively.

The proposed development will consist of 21 2.5-acre single-family residential estate lots which are assumed at a percent imperviousness of 11% per the County ECM Table 3-1 Typical Values of Percent Impervious within Appendix L of the ECM which provides guidance for larger rural lot developments. Existing golf course areas are to remain undisturbed and utilize a land use category of “lawn” with a percent imperviousness of 2% per the County ECM Table 6-6 land use table. Composite coefficients, rainfall intensities, and runoff flow rates are calculated on a Rational Method spreadsheet and provided within the Appendix. As discussed previously, the Rational Method used in this report will result in higher peak flow rates for the minor and major storm events as compared to the 2018 Classic Consulting FDR/PDR which utilized the NRCS Curve Number Method. Design points within Filing No. 4 are designed per the findings of this report and existing Filing No. 1 storm infrastructure and design points are to remain as-is.

Reference to the 2018 Classic Consulting PDR/FDR set of calculations and spreadsheets is included to demonstrate compliance and consistency with the previously approved report which anticipated similar land uses and basin acreages tributary to existing stormwater facilities.

IV. Hydraulic Analysis

a. Major Drainageways

There are no major drainageways that exist within the development of Filing No. 5; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries. These tertiary drainage ways are analyzed within this report to assess the water surface elevation within the swales during the 100-year storm event and determine buildability of lots adjacent to these sections. Roadside swales are to be constructed at a minimum to meet the typical roadway section (4:1 for 10' and 3:1 for 9' resulting in a total swale depth of 2.5'). The roadside swales are assessed along the roadways that capture sub-basins and result in cumulative flow.

b. Storm Sewer Infrastructure and Culvert Pipes

The Filing No. 5 development consists of rural development with 2.5-acre single family residential estate lots and rural roadway sections with roadside swales. The storm infrastructure within these areas consist of public culvert pipes for roadway crossings and consideration for future public culvert pipes for future driveways for each lot. Culvert calculations and graphics are provided within the Appendix of this report to demonstrate culvert capacities and show any roadway/driveway overtopping as a result of peak flows. The culverts are designed to have full capacity of the minor (5-year) storm event and a maximum of 4" of roadway or driveway pooling during the major (100-year) storm event.

The level spreader located in Basin I2 to disperse concentrated flow from Culvert 4 to sheet flow was designed using the criteria outlined in the Mile High Flood District Criteria Manual, Volume 3. The width of the level spreader was calculated using the 2-year flow from the tributary area in the following equation:

$$W = Q_2 / 0.05$$

A 2-year of 0.6 cfs was used to provide a width of 12 feet. The minimum length of 14 feet was used.

V. Environmental Evaluations

a. Significant Existing or Potential Wetland and Riparian Areas Impacts

There are no significant impacts to potential wetland and riparian areas with this report.

b. Stormwater Quality Considerations and Proposed Practices

A full spectrum detention facility will be installed with Filing No. 4 prior to this filing to provide water quality for the development. The facility is designed using El Paso County criteria and provide stormwater quality by slowing the release of stormwater captured by the ponds and allowing solids to settle out. Development of the Filing No. 5 areas tributary to the detention pond were accounted for with the Filing No. 4 FDR pond design.

On site practices for the estate homes includes direct discharge of roof and hardscape runoff to the surrounding landscaped areas. This would include discharge of the gutters onto landscape areas vs. directly connecting to storm sewer and as discussed above as well using natural ditches and swales where it is logical and makes sense to convey stormwater in lieu of storm sewer piping.

c. Permitting Requirements

When work infringes upon the wetlands or floodplain a 404 Permit will be required. If the work within the waterways is minimal, it will likely be covered under a nationwide 404 permit; it is however possible that an individual permit will be required.

The Colorado Department of Public Health and Environment will require permits for any disturbance that exceeds 1 acre of land. Should groundwater be encountered, a dewatering permit will also be required.

El Paso County will require an Erosion and Stormwater Quality Control Permit, and any other construction permits required to complete the construction of the site.

Should development occur which affects the floodplain, FEMA will require a permit for work withing the floodplain prior to the commencement of any construction or development within any special flood hazard area (SFHA). If the infrastructure is to be installed within the channel the designer shall route the design through the proper FEMA channels whether that be with a no rise certification or via the CLOMR/LOMR process should a more major improvement within the floodplain be proposed. At this time the project does not propose any direct development within the floodplain, however storm infrastructure will discharge into the existing FEMA channel.

d. 4-Step Process

In accordance with the Engineering Criteria Manual I.7.2.A and DCM V2, this site has implemented the four-step process to minimize adverse impacts of urbanization. The four-step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume, and considering the need for Industrial Commercial BMPs.

Step 1 – Reducing Runoff Volumes: The majority of the development of the project site includes the land use categories of 2.5-acre single-family residential and lawn (golf course area). Both land uses have relatively minor imperviousness and runoff coefficients. The developed areas for the homes as designated by pad areas on the plans are disbursed with open land areas of vegetation and trees between which provide runoff reduction into the pervious soil.

Step 2 – Stabilize Drainageways: The existing tertiary drainage ways are assessed for stormwater runoff capacity, velocity, and shear stress. Any altered drainage ways will be designed in a manner that provides water quality benefits through infiltration and the removal of pollutants via phytoremediation. Vegetation and/or matting will also be selected to stabilize the drainage ways by reducing the velocity of flows and decreasing any scour. These improvements help stabilize drainageways and minimize erosion and sediment runoff. Roadside ditches are stabilized swales by way of compaction per the roadway typical section and are also prescribed any required seeding, erosion control blanketing, and/or matting.

Step 3 – Provide WQCV: Runoff from this development is treated through capture and slow release of the WQCV via detention ponds that are designed per current El Paso County DCM V2 and the MHFD. Existing ponds B and 13 provide WQCV for their respective tributary basins. Disturbed areas will be routed through existing detention ponds and outfall to the East Cherry Creek Basin. Areas that fall under the “large lot” exclusion I.7.1.B.5 of the El Paso County ECM have been proven to be excluded from WQCV requirements. While water quality is not required for these areas, it is understood that runoff from these areas will still be routed through the existing detention ponds. The areas that fall under the exclusion under I.7.1.B.5 of the El Paso County ECM may not exceed 10 percent imperviousness unless a study specific to the watershed and/or MS4 shows that expected soil and vegetation conditions are suitable for infiltration/filtration of the WQCV for a typical site, and the permittee accepts such study as applicable with the MS4 boundaries. The maximum total lot impervious covered under this exclusion shall be 20 percent. This exclusion does not include grading related to roadway construction.

Step 4 – Consider the need for Industrial and Commercial BMP’s: A site specific storm water quality and erosion control plan and narrative will be prepared with subsequent land use approvals prepared in conjunction with the report prior to any construction. Site specific temporary source control BMPs as well as permanent BMPs are detailed in this plan and narrative. Guidelines detailed in the El Paso DCM V2

4.2 pertaining to the covering and storage handline and spill containment and control shall be followed as necessary. This filing does not contain any commercial or industrial land use.

VI. Drawings

Please refer to the appendices for the Vicinity Map, FEMA Floodplain Map, NRCS Soils Map, hydrology and hydraulic calculations, and drainage basin maps. Reference materials from previously approved reports are included in the appendix including.

VII. Drainage and Bridge Fees

The East Cherry Creek Basin does not currently have a Drainage Basin Fee.

VIII. Summary

Flying Horse North Filing No. 5 is a 115.1 acre filing within Flying Horse North that consists of approximately 58 acres of single-family residential estate lots.

Pond B and Pond 13 located outside of the Filing No. 5 boundary account for future development within Filing No. 5, anticipated to consist of local rural residential roadways within 60’ public rights-of-way and single-family residential estate lots of 2.5 acres FSDs are proposed to provide water quality and detention to release the stormwater at or below historical rates.

The Filing No. 5 final design is assessed for stormwater capacity of roadway sections, roadside swales and the existing tertiary drainage ways to ensure that development of the 2.5-acre single-family residential estate lots will not be negatively impacted by drainage conditions, including existing and proposed altered areas for the roadway and lot construction phases.

All County and MHFD drainage design standards are met. It is anticipated that there will be no negative impacts to downstream and surrounding developments and facilities due to the development of Filing No. 5.

IX. References

El Paso County – Drainage Criteria Manual, 2014

City of Colorado Springs – Drainage Criteria Manual, May 2014

Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018

Mile High Flood District Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3; latest revisions

Mile High Flood District Software Resources and Tools (MHFD-Detention, UD-Inlet, UD-BMP)

United States Department of Agriculture National Resources Conservation Service Rock Chute Design Data Spreadsheet

Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1, Classic Consulting Engineers and Surveyors, November 2017

Flying Horse North Master Development Drainage Plan, HR Green Development, LLC., September 2022

Flying Horse North Irrigation Reservoir Embankment Design Report, Classic Consulting Engineers and Surveyors, latest revision June 2018, County approved on September 25, 2018

Flying Horse North Filing No. 4 Final Drainage Report, HR Green Development, LLC., September 2024.

APPENDIX A

VICINITY MAP

NRCS SOILS MAP

FEMA FLOODPLAIN MAP

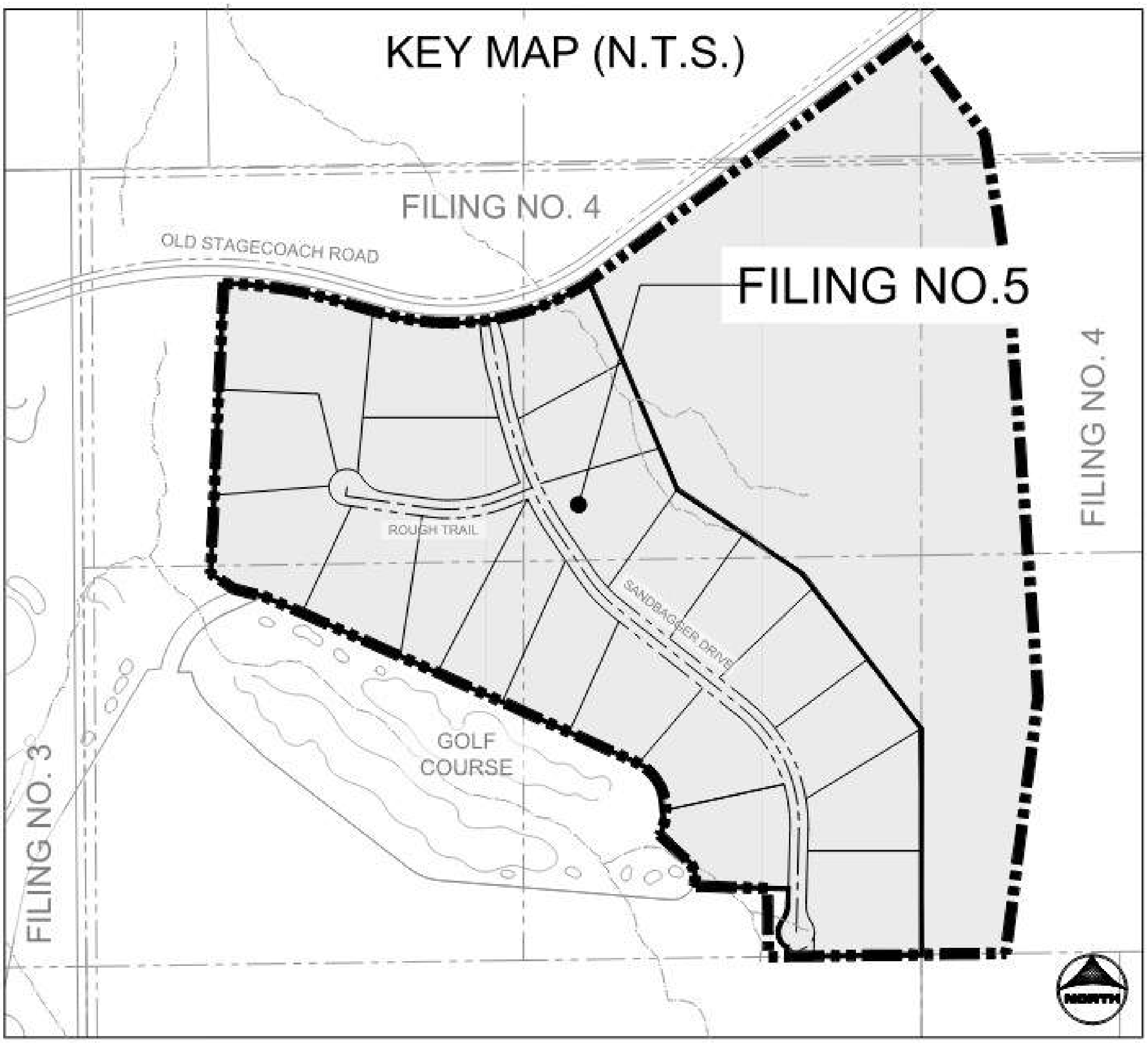
EL PASO COUNTY MAJOR DRAINAGE BASINS MAP

DRAINAGE BASIN FEE TABLE (2024)

VICINITY MAP

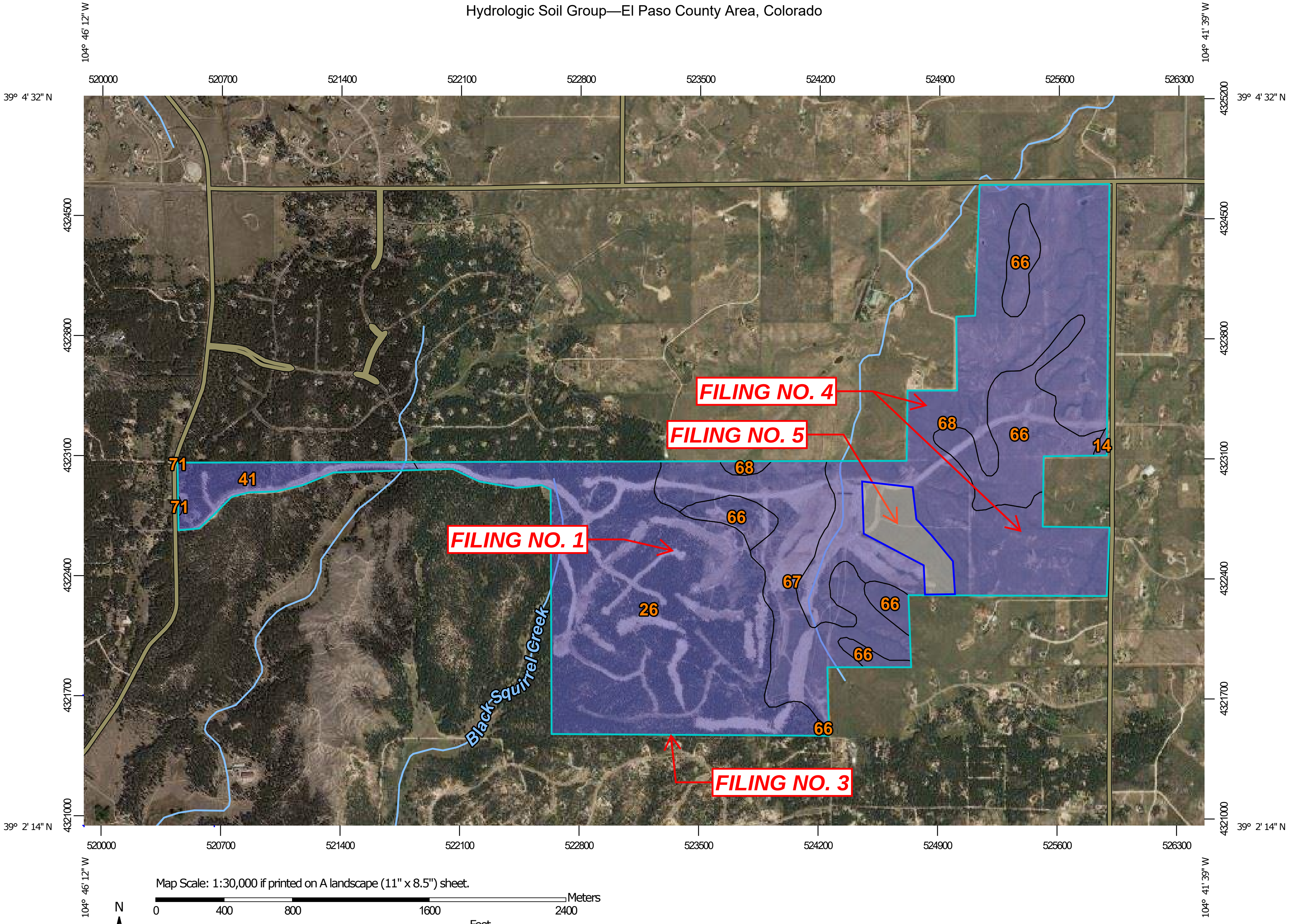
FLYING HORSE NORTH FILING NO. 5

A PORTION OF SECTION 36, TOWNSHIP 11 SOUTH, RANGE 66 WEST OF THE SIXTH PRINCIPAL MERIDIAN COUNTY OF EL PASO, STATE OF COLORADO



NO SCALE

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:30,000 if printed on A landscape (11" x 8.5") sheet.

N

0 400 800 1600 2400 Meters

0 1000 2000 4000 6000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

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.

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 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 19, 2018—May 26, 2019

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
14	Brussett loam, 1 to 3 percent slopes	B	1.9	0.1%
26	Elbeth sandy loam, 8 to 15 percent slopes	B	474.2	33.7%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	53.4	3.8%
66	Peyton sandy loam, 1 to 5 percent slopes	B	160.9	11.4%
67	Peyton sandy loam, 5 to 9 percent slopes	B	182.8	13.0%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	533.4	37.9%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	0.6	0.0%
Totals for Area of Interest			**1,407.3**	**100.0%**

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

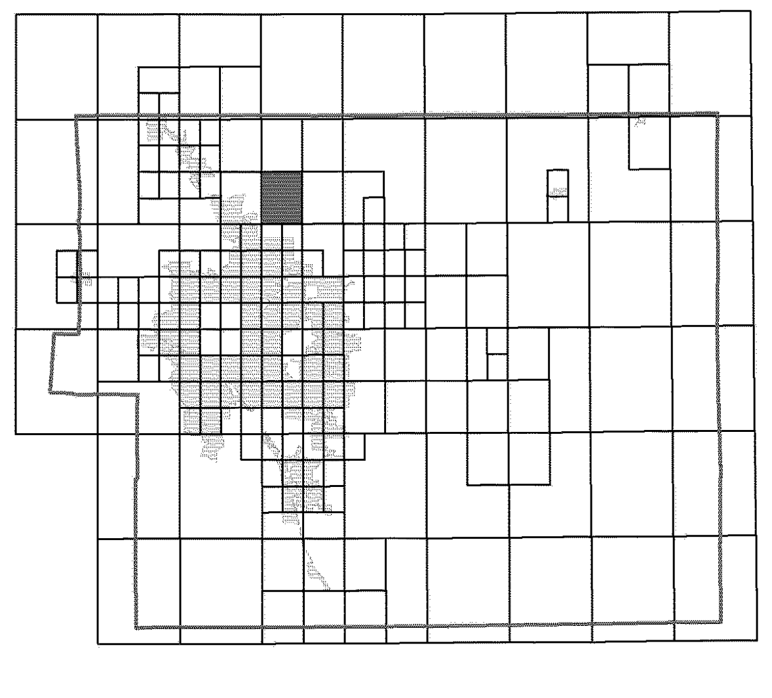
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

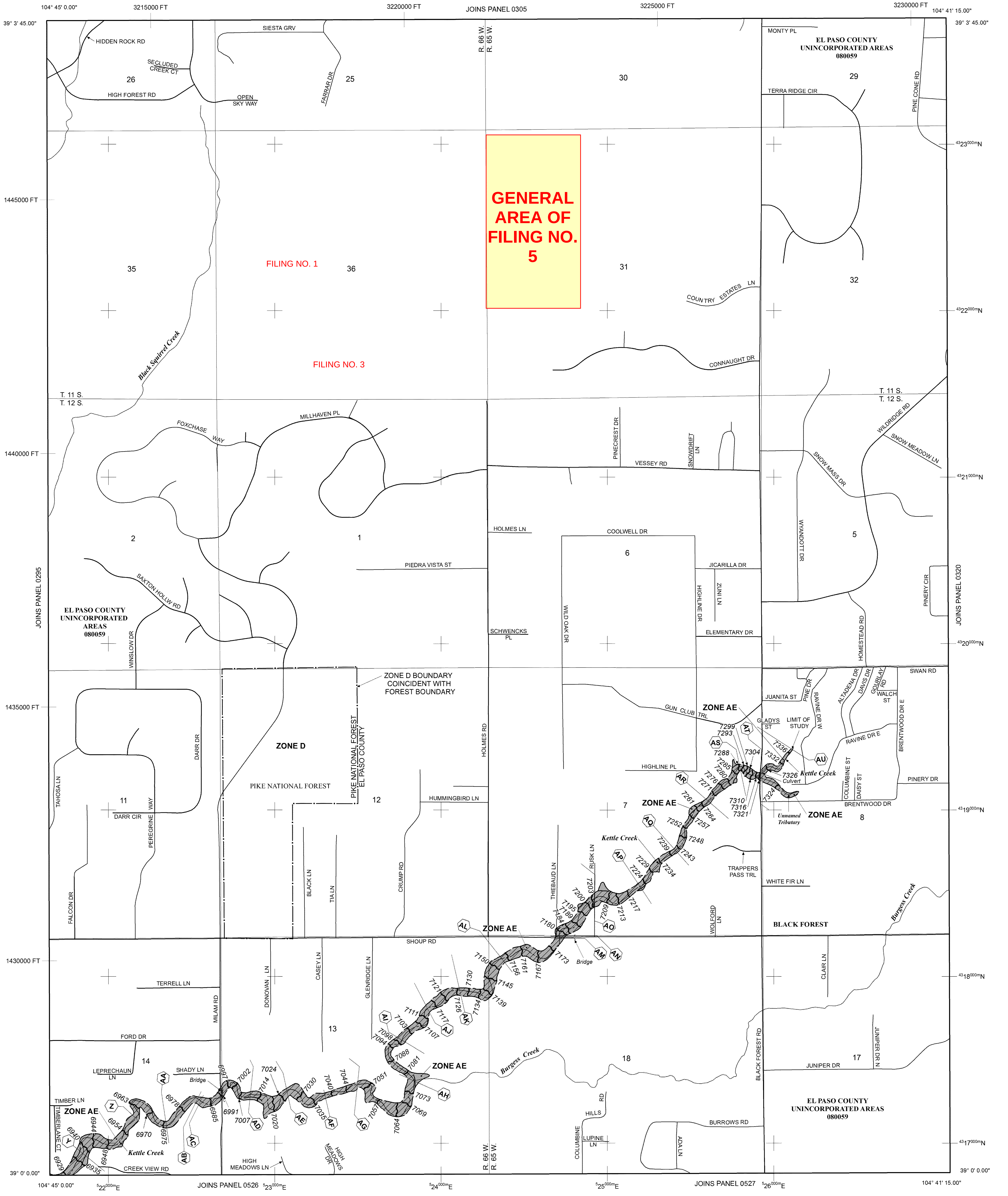
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

▒	SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
▨	FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

░	OTHER FLOOD AREAS
ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
☐	OTHER AREAS
ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.
▧	COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
▧	OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

———	Floodplain boundary
— — —	Floodway boundary
—— ——	Zone D Boundary
●●●●●●●●●●●●	CBRS and OPA boundary
▒ ←	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A——A	Cross section line
23--------23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in 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.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0315G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 315 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

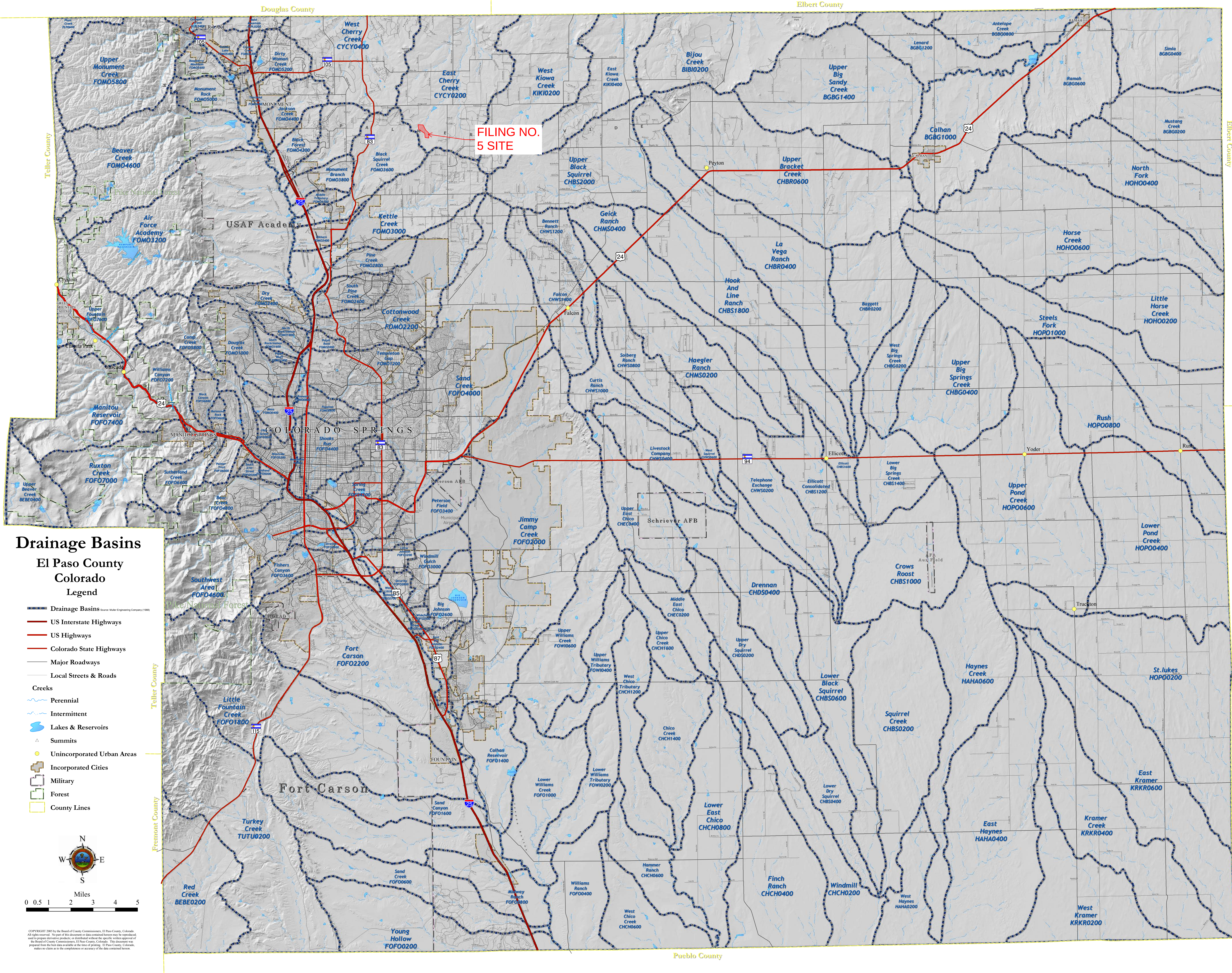
COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0315	G

Notice to User: The **Map Number** shown below should be used when placing map orders: the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0315G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency



Drainage Basins

El Paso County
Colorado

El Paso County Drainage Basin Fees

Resolution No. 23-400

Basin Number	Receiving Waters	Year Studied	Drainage Basin Name	2024 Drainage Fee (per Impervious Acre)	2024 Bridge Fee (per Impervious Acre)
Drainage Basins with DBPS's:					
CHMS0200	Chico Creek	2013	Haegler Ranch	$13,971	$2,062
CHWS1200	Chico Creek	2001	Bennett Ranch	$15,641	$6,000
CHWS1400	Chico Creek	2013	Falcon	$40,088	$5,507
FOFO2000	Fountain Creek	2001	West Fork Jimmy Camp Creek	$17,003	$5,031
FOFO2600	Fountain Creek	1991*	Big Johnson / Crews Gulch	$24,832	$3,207
FOFO2800	Fountain Creek	1988*	Widefield	$24,832	$0
FOFO2900	Fountain Creek	1988*	Security	$24,832	$0
FOFO3000	Fountain Creek	1991*	Windmill Gulch	$24,832	$372
FOFO3100 / FOFO3200	Fountain Creek	1988*	Carson Street / Little Johnson	$15,147	$0
FOFO3400	Fountain Creek	1984*	Peterson Field	$17,911	$1,358
FOFO3600	Fountain Creek	1991*	Fisher's Canyon	$24,832	$0
FOFO4000	Fountain Creek	1996	Sand Creek	$25,632	$10,484
FOFO4200	Fountain Creek	1977	Spring Creek	$12,879	$0
FOFO4600	Fountain Creek	1984*	Southwest Area	$24,832	$0
FOFO4800	Fountain Creek	1991	Bear Creek	$24,832	$1,358
FOFO5800	Fountain Creek	1964	Camp Creek	$2,752	$0
FOMO1000	Monument Creek	1981	Douglas Creek	$15,617	$345
FOMO1200	Monument Creek	1977	Templeton Gap	$16,032	$372
FOMO2000	Monument Creek	1971	Pulpit Rock	$8,234	$0
FOMO2200	Monument Creek	1994	Cottonwood Creek / S. Pine	$24,832	$1,358
FOMO2400	Monument Creek	1966	Dry Creek	$19,603	$710
FOMO3600	Monument Creek	1989*	Black Squirrel Creek	$11,275	$710
FOMO3700	Monument Creek	1987*	Middle Tributary	$20,722	$0
FOMO3800	Monument Creek	1987*	Monument Branch	$24,832	$0
FOMO4000	Monument Creek	1996	Smith Creek	$10,124	$1,358
FOMO4200	Monument Creek	1989*	Black Forest	$24,832	$676
FOMO5200	Monument Creek	1993*	Dirty Woman Creek	$24,832	$1,358
FOMO5300	Fountain Creek	1993*	Crystal Creek	$24,832	$1,358
Miscellaneous Drainage Basins: [1]					
CHBS0800	Chico Creek		Book Ranch	$23,300	$3,373
CHEC0400	Chico Creek		Upper East Chico	$12,694	$368
CHWS0200	Chico Creek		Telephone Exchange	$13,947	$327
CHWS0400	Chico Creek		Livestock Company	$22,973	$273
CHWS0600	Chico Creek		West Squirrel	$11,975	$4,970
CHWS0800	Chico Creek		Solberg Ranch	$24,832	$0
FOFO1200	Fountain Creek		Crooked Canyon	$7,497	$0
FOFO1400	Fountain Creek		Calhan Reservoir	$6,259	$365
FOFO1600	Fountain Creek		Sand Canyon	$4,522	$0
FOFO2000	Fountain Creek		Jimmy Camp Creek	$24,832	$1,161
FOFO2200	Fountain Creek		Fort Carson	$19,603	$710
FOFO2700	Fountain Creek		West Little Johnson	$1,636	$0
FOFO3800	Fountain Creek		Stratton	$11,911	$533
FOFO5000	Fountain Creek		Midland	$19,603	$710
FOFO6000	Fountain Creek		Palmer Trail	$19,603	$710
FOFO6800	Fountain Creek		Black Canyon	$19,603	$710
FOMO4600	Monument Creek		Beaver Creek	$14,846	$0
FOMO3000	Monument Creek		Kettle Creek	$13,410	$0
FOMO3400	Monument Creek		Elkhorn	$2,253	$0
FOMO5000	Monument Creek		Monument Rock	$10,763	$0
FOMO5400	Monument Creek		Palmer Lake	$17,210	$0
FOMO5600	Monument Creek		Raspberry Mountain	$5,789	$0
PLPL0200	Monument Creek		Bald Mountain	$12,337	$0
Interim Drainage Basins: [2]					
FOFO1800	Fountain Creek		Little Fountain Creek	$3,175	$0
FOMO4400	Monument Creek		Jackson Creek	$9,829	$0
FOMO4800	Monument Creek		Teachout Creek	$6,825	$1,026

1. The miscellaneous drainage fee previous to September 1999 resolution was the average of all drainage fees for basins with Basin Planning Studies performed within the last 14 years.

2. Interim Drainage Fees are based upon draft Drainage Basin Planning Studies or the Drainage Basin Identification and Fee Estimation Report. (Best available information suitable for setting a fee.)

EPC Stormwater Management

Joshua Palmer, P.E.

EAST CHERRY CREEK BASIN
IS NOT INCLUDED

APPENDIX B

HYDROLOGY CALCULATIONS

RATIONAL METHOD CALCULATIONS – EXISTING CONDITIONS

HRGreen

FLYING HORSE NORTH FILING NO. 5

EXISTING CONDITIONS

EL PASO COUNTY, COLORADO

Calc'd by: TMM
Checked by: RDL
Date: 11/12/2024

COMPOSITE 'C' FACTORS

BASIN	GOLF COURSE / UNDEVELOPED	ROADWAY	RESIDENTIAL (2.5 AC LOT)	RESIDENTIAL (5.0 AC LOT)	TOTAL	SOIL TYPE	GOLF COURSE / UNDEVELOPED			ROADWAY			RESIDENTIAL (2.5 AC LOT)			RESIDENTIAL (5.0 AC LOT)			COMPOSITE IMPERVIOUSNESS & C		
	ACRES						%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}
B1	57.79	0.00	0.00	0.00	57.79	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	2.0	0.08	0.35
B2	35.76	0.00	0.00	0.00	35.76	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	8	0.14	0.39	2.0	0.08	0.35
I1	1.08	0.00	0.00	0.00	1.08	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	8	0.14	0.39	2.0	0.08	0.35
I2	14.87	0.00	0.00	0.00	14.87	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	9	0.14	0.39	2.0	0.08	0.35
I3	80.01	0.00	0.00	0.00	80.01	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	10	0.14	0.39	2.0	0.08	0.35
GRAND TOTAL	**189.51**	**0.00**	**0.00**	**0.00**	**189.51**														**2.00%**	**0.08**	**0.35**

NOTES:

🟦	BASIN PULLED DIRECTLY FROM FLYING HORSE NORTH FILING NO. 4 FINAL DRAINAGE REPORT

HRGreen

FLYING HORSE NORTH FILING NO. 5

EXISTING CONDITIONS

EL PASO COUNTY, COLORADO

Calc'd by:	**TMM**
Checked by:	**RDL**
Date:	**11/12/2024**

TIME OF CONCENTRATION

BASIN DATA			**OVERLAND TIME (T_i)**			**TRAVEL TIME (T_t)**					**TOTAL**	*tc=(L/180)+10*	**Design tc**
DESIGNATION	C_5	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_V	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)	*tc max*	*tc design (min)*
B1	0.08	57.79	300	4.5	19.6	10	2400	4.00	2.0	20.0	39.6	25.0	25.0
B2	0.08	35.76	300	6.3	17.5	10	1970	3.90	2.0	16.6	34.2	22.6	22.6
I1	0.08	1.08	300	5.7	18.1	10	215	6.50	2.5	1.4	19.5	12.9	12.9
I2	0.08	14.87	300	6.6	17.3	10	875	5.50	2.3	6.2	23.5	16.5	16.5
I3	0.08	80.01	300	2.6	23.6	10	2900	6.00	2.4	19.7	43.3	27.8	27.8

FLYING HORSE NORTH FILING NO. 5	**Calc'd by:**	**TMM**
EXISTING CONDITIONS	**Checked by:**	**RDL**
DESIGN STORM: 5-YEAR	**Date:**	**11/12/2024**

		DIRECT RUNOFF						**TOTAL RUNOFF**				**REMARKS**
DESIGN POINT	**BASIN ID**	**AREA (ac)**	**C_5**	**t_c (min)**	**C_5*A (ac)**	**I (in./ hr.)**	**Q (cfs)**	**t_c (min)**	**C_5*A (ac)**	**I (in./ hr.)**	**Q (cfs)**	
B1	B1	57.79	0.08	25.0	4.62	2.75	**12.7**					FLOW TO DP B1
B2	B2	35.76	0.08	22.6	2.86	2.91	**8.3**					BASIN FLOW TO DPB2
								25.0	7.48	2.75	**20.6**	COMBINED FLOW FROM BASIN B1 AND B2 THROUGH EX. DUAL 48" RCP
I1	I1	1.08	0.08	12.9	0.09	3.75	**0.3**					BASIN FLOW TO DPI1
I2	I2	14.87	0.08	16.5	1.19	3.38	**4.0**					BASIN FLOW TO DPI2
								16.5	1.28	3.38	**4.3**	COMBINED FROM FROM BASIN I1 AND I2 TO POND 13
I3	I3	80.01	0.08	27.8	6.40	2.60	**16.6**					BASIN FLOW TO DPI3

HRGreen

FLYING HORSE NORTH FILING NO. 5

EXISTING CONDITIONS

DESIGN STORM: 100-YEAR

Calc'd by: TMM

Check RDL

Date: 11/12/2024

		DIRECT RUNOFF						TOTAL RUNOFF				REMARKS
DESIGN PONT	**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)**	
B1	B1	57.79	0.35	25.0	20.23	4.62	**93.5**					FLOW TO DP B1
B2	B2	35.76	0.35	22.6	12.52	4.88	**61.0**					BASIN FLOW TO DPB2
								47.6	32.7	6.94	**227.2**	COMBINED FLOW FROM BASIN B1 AND B2 THROUGH EX. DUAL 48" RCP
I1	I1	1.08	0.35	12.9	0.38	6.30	**2.4**					BASIN FLOW TO DPI1
I2	I2	14.87	0.35	16.5	5.20	5.67	**29.5**					BASIN FLOW TO DPI2
								16.5	5.58	8.53	**47.6**	COMBINED FROM FROM BASIN I1 AND I2 TO POND 13
I3	I3	80.01	0.35	27.8	28.00	4.36	**122.0**					BASIN FLOW TO DPI3

RATIONAL METHOD CALCULATIONS

HRGreen

FLYING HORSE NORTH FILING NO. 5

PROPOSED CONDITIONS

EL PASO COUNTY, COLORADO

Calc'd by: TMM
Checked by: RDL
Date: 11/19/2024

COMPOSITE 'C' FACTORS

BASIN	GOLF COURSE / UNDEVELOPED	ROADWAY	RESIDENTIAL (2.5 AC LOT)	RESIDENTIAL (5.0 AC LOT)	TOTAL	SOIL TYPE	GOLF COURSE / UNDEVELOPED			ROADWAY			RESIDENTIAL (2.5 AC LOT)			RESIDENTIAL (5.0 AC LOT)			COMPOSITE IMPERVIOUSNESS & C FACTOR		
	ACRES						%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}
B1	48.38	0.41	9.00	0.00	57.79	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	4.1	0.10	0.36
B2.1	0.00	0.00	6.72	0.00	6.72	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	11.0	0.17	0.42
B2.2	0.00	0.00	2.80	0.00	2.80	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	11.0	0.17	0.42
B2.3	0.00	0.07	2.54	0.00	2.61	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	13.3	0.19	0.43
B2.4	0.00	0.12	25.04	0.00	25.16	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	11.4	0.17	0.42
I1	0.00	0.00	1.02	0.00	1.02	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	11.0	0.17	0.42
I2	0.00	0.00	15.87	0.00	15.87	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	11.0	0.17	0.42
I3	0.00	0.00	9.51	0.00	9.51	B	2	0.08	0.35	100	0.90	0.96	11	0.17	0.42	7	0.14	0.39	11.0	0.17	0.42
GRAND TOTAL	**48.38**	**0.60**	**72.50**	**0.00**	**121.48**															**7.86%**	**0.14**	**0.39**

NOTES:

	BASIN PULLED DIRECTLY FROM FLYING HORSE NORTH FILING NO. 4 FINAL DRAINAGE REPORT

HRGreen	**FLYING HORSE NORTH FILING NO. 5**	**Calc'd by:**	**TMM**
	PROPOSED CONDITIONS	**Checked by:**	**RDL**
	EL PASO COUNTY, COLORADO	**Date:**	**11/19/2024**

TIME OF CONCENTRATION

BASIN DATA			**OVERLAND TIME (T_i)**			**TRAVEL TIME (T_t)**					**TOTAL**	*tc=(L/180)+10*	**Design tc**
DESIGNATION	C_5	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_V	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)	*tc max*	*tc design (min)*
B1	0.10	57.79	300	4.5	19.2	10	2400	6.70	2.6	15.5	34.7	25.0	25.0
B2.1	0.17	6.72	300	6.3	16.0	10	491	3.60	1.9	4.3	20.3	14.4	14.4
B2.2	0.17	2.80	245	6.7	14.2	10	330	3.00	1.7	3.2	17.3	13.2	13.2
B2.3	0.19	2.61	150	4.6	12.3	10	508	6.40	2.5	3.3	15.7	13.7	13.7
B2.4	0.17	25.16	300	11.4	13.1	10	2014	6.70	2.6	13.0	26.0	22.9	22.9
I1	0.17	1.02	30	10.0	4.3	10	340	6.20	2.5	2.3	6.6	12.1	6.6
I2	0.17	15.87	300	12.9	12.6	10	842	4.30	2.1	6.8	19.4	16.3	16.3
I3	0.17	9.51	250	6.0	14.8	10	50	6.00	2.4	0.3	15.2	11.7	11.7

FLYING HORSE NORTH FILING NO. 5	**Calc'd by:**	**TMM**
PROPOSED CONDITIONS	**Checked by:**	**RDL**
DESIGN STORM: 5-YEAR	**Date:**	**11/19/2024**

		DIRECT RUNOFF						**TOTAL RUNOFF**				**REMARKS**
DESIGN POINT	**BASIN ID**	**AREA (ac)**	**C_5**	**t_c (min)**	**C_5*A (ac)**	***I* (in./ hr.)**	**Q (cfs)**	**t_c (min)**	**C_5*A (ac)**	***I* (in./ hr.)**	**Q (cfs)**	
B1	B1	57.79	0.10	25.0	5.77	2.75	**15.9**					OVERLAND FLOW TO DP B1
2.1	B2.1	6.72	0.17	14.4	1.14	3.58	**4.1**					BASIN FLOW IN ROADSIDE DITCH TO DPB2.1
2.2	B2.2	2.80	0.17	13.2	0.48	3.71	**1.8**					BASIN FLOW IN ROADSIDE DITCH TO DPB2.2
												COMBINED PIPE FLOW
2.3	B2.3	2.61	0.19	13.7	0.49	3.66	**1.8**					BASIN FLOW IN ROADSIDE DITCH TO DPB2.4
								26.9	1.0	2.65	**2.6**	COMBINED PIPE FLOW
B2	B2.4	25.16	0.17	22.9	4.37	2.89	**12.6**					
								26.9	11.11	2.65	**29.4**	COMBINED FLOW THROUGH EXISTING CULVERT TO POND B
I1	I1	1.02	0.17	6.6	0.17	4.75	**0.8**					FLOW TO DP I1 TO FLOW TO BASIN I2
I2	I2	15.87	0.17	16.3	2.70	3.39	**9.2**					FLOW TO DP I2
								23.0	2.87	2.88	**8.3**	COMBINED FLOW FROM BASIN I1 AND BASIN I2 TO POND 13
I3	I3	9.51	0.17	11.7	1.62	3.90	**6.3**					FLOW TO DP I3

FLYING HORSE NORTH FILING NO. 5	**Calc'd by:**	**TMM**
PROPOSED CONDITIONS	**Check**	**RDL**
DESIGN STORM: 100-YEAR	**Date:**	**11/19/2024**

		DIRECT RUNOFF						**TOTAL RUNOFF**				**REMARKS**
DESIGN PONT	**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)**	
B1	B1	57.79	0.36	25.0	21.08	4.62	**97.5**					OVERLAND FLOW TO DP B1
2.1	B2.1	6.72	0.42	14.4	2.80	6.01	**16.9**					BASIN FLOW IN ROADSIDE DITCH TO DPB2.1
2.2	B2.2	2.80	0.42	13.2	1.17	6.23	**7.3**					BASIN FLOW IN ROADSIDE DITCH TO DPB2.2
												COMBINED PIPE FLOW
2.3	B2.3	2.61	0.43	13.7	1.12	6.15	**6.9**					BASIN FLOW IN ROADSIDE DITCH TO DPB2.4
								26.9	2.29	7.80	**17.9**	COMBINED PIPE FLOW
B2	B2.4	25.16	0.42	22.9	10.56	4.85	**51.2**					
								26.9	33.94	7.80	**264.7**	COMBINED FLOW THROUGH EXISTING CULVERT TO POND B
I1	I1	1.02	0.42	6.6	0.43	7.98	**3.4**					FLOW TO DP I1 TO FLOW TO BASIN I2
I2	I2	15.87	0.42	16.3	6.62	5.69	**37.7**					FLOW TO DP I2
								23.0	7.04	8.03	**56.6**	COMBINED FLOW FROM BASIN I1 AND BASIN I2 TO POND 13
I3	I3	9.51	0.42	11.7	3.97	6.54	**26.0**					FLOW TO DP I3

APPENDIX C

HYDRAULIC CALCULATIONS

PIPE HYDRAULICS

CULVERT CALCULATIONS

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 19 2024

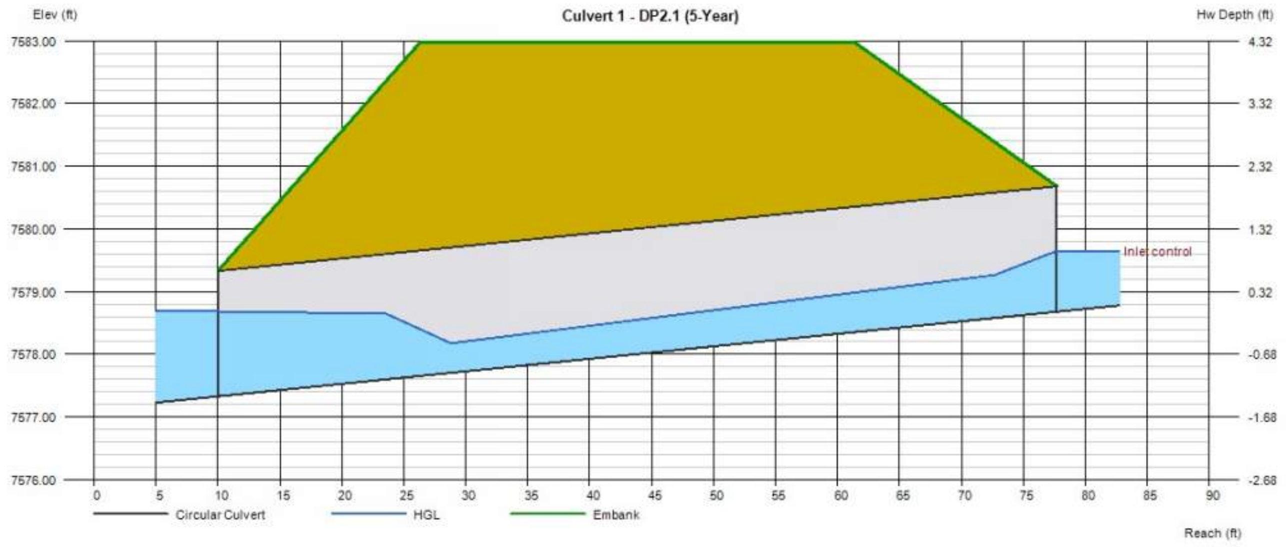
Culvert 1 - DP2.1 (5-Year)

Invert Elev Dn (ft) = 7577.33
Pipe Length (ft) = 67.69
Slope (%) = 1.99
Invert Elev Up (ft) = 7578.68
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment
Top Elevation (ft) = 7582.98
Top Width (ft) = 35.00
Crest Width (ft) = 50.00

Calculations
Qmin (cfs) = 4.10
Qmax (cfs) = 4.10
Tailwater Elev (ft) = (dc+D)/2

Highlighted
Qtotal (cfs) = 4.10
Qpipe (cfs) = 4.10
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 1.81
Veloc Up (ft/s) = 4.10
HGL Dn (ft) = 7578.69
HGL Up (ft) = 7579.39
Hw Elev (ft) = 7579.65
Hw/D (ft) = 0.48
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 19 2024

Culvert 1 - DP2.1 (100-Year)

Invert Elev Dn (ft) = 7577.33
Pipe Length (ft) = 67.69
Slope (%) = 1.99
Invert Elev Up (ft) = 7578.68
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

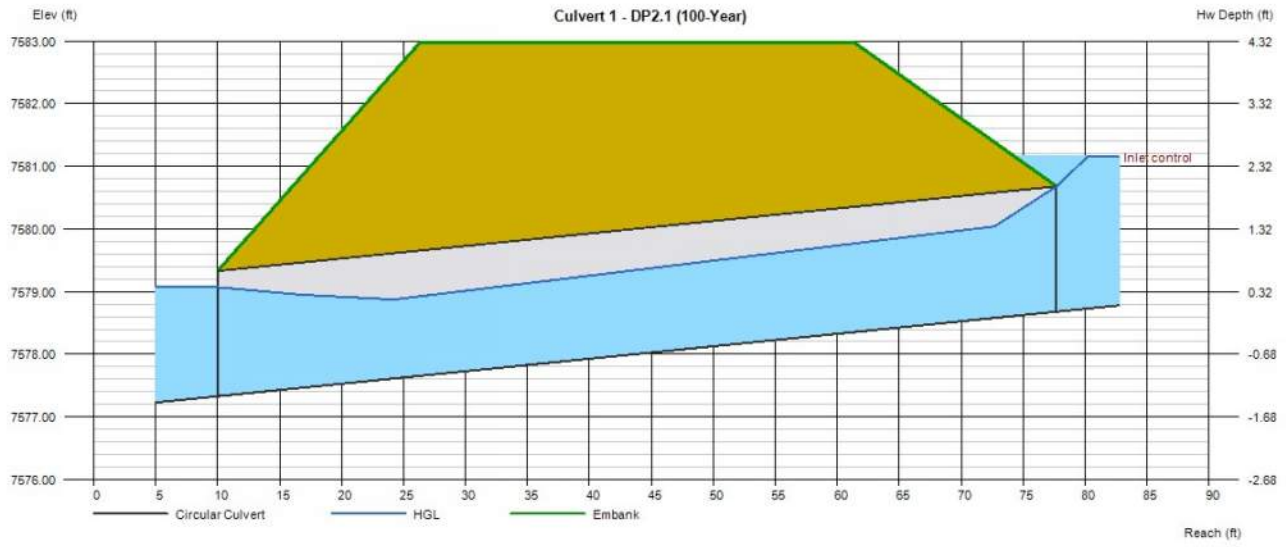
Top Elevation (ft) = 7582.98
Top Width (ft) = 35.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 16.90
Qmax (cfs) = 16.90
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 16.90
Qpipe (cfs) = 16.90
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 5.82
Veloc Up (ft/s) = 6.78
HGL Dn (ft) = 7579.07
HGL Up (ft) = 7580.16
Hw Elev (ft) = 7581.15
Hw/D (ft) = 1.24
Flow Regime = Inlet Control



Culvert Report

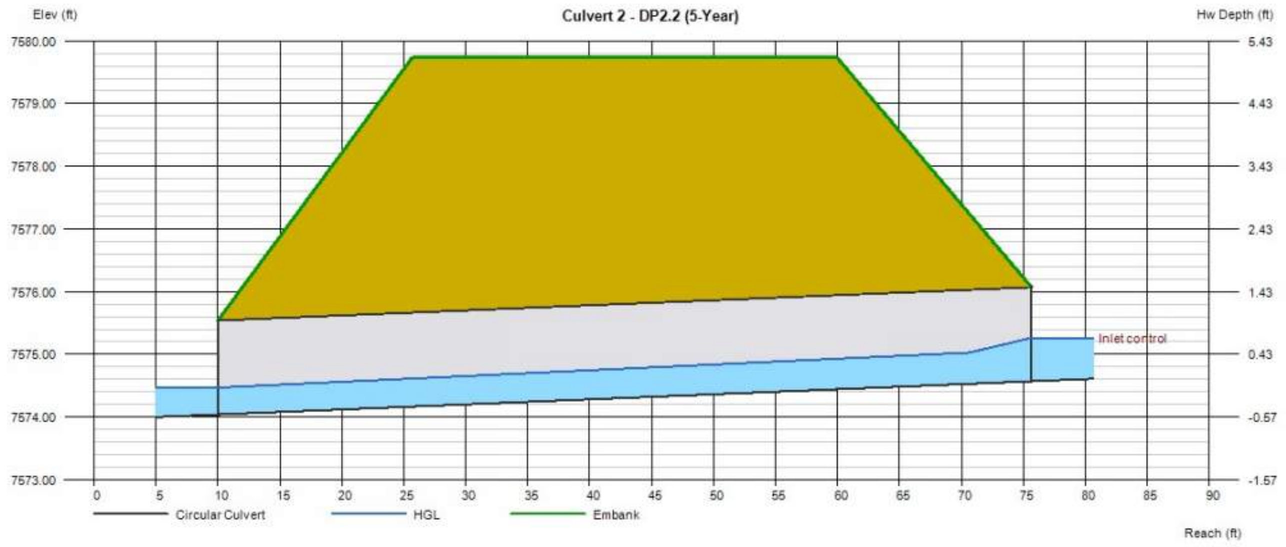
Culvert 2 - DP2.2 (5-Year)

Invert Elev Dn (ft) = 7574.04
Pipe Length (ft) = 65.65
Slope (%) = 0.81
Invert Elev Up (ft) = 7574.57
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment
Top Elevation (ft) = 7579.73
Top Width (ft) = 34.30
Crest Width (ft) = 50.00

Calculations
Qmin (cfs) = 1.80
Qmax (cfs) = 1.80
Tailwater Elev (ft) = Normal

Highlighted
Qtotal (cfs) = 1.80
Qpipe (cfs) = 1.80
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 4.30
Veloc Up (ft/s) = 3.45
HGL Dn (ft) = 7574.47
HGL Up (ft) = 7575.07
Hw Elev (ft) = 7575.26
Hw/D (ft) = 0.46
Flow Regime = Inlet Control



Culvert Report

Culvert 2 - DP2.2 (100-Year)

Invert Elev Dn (ft) = 7574.04
Pipe Length (ft) = 65.65
Slope (%) = 0.81
Invert Elev Up (ft) = 7574.57
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

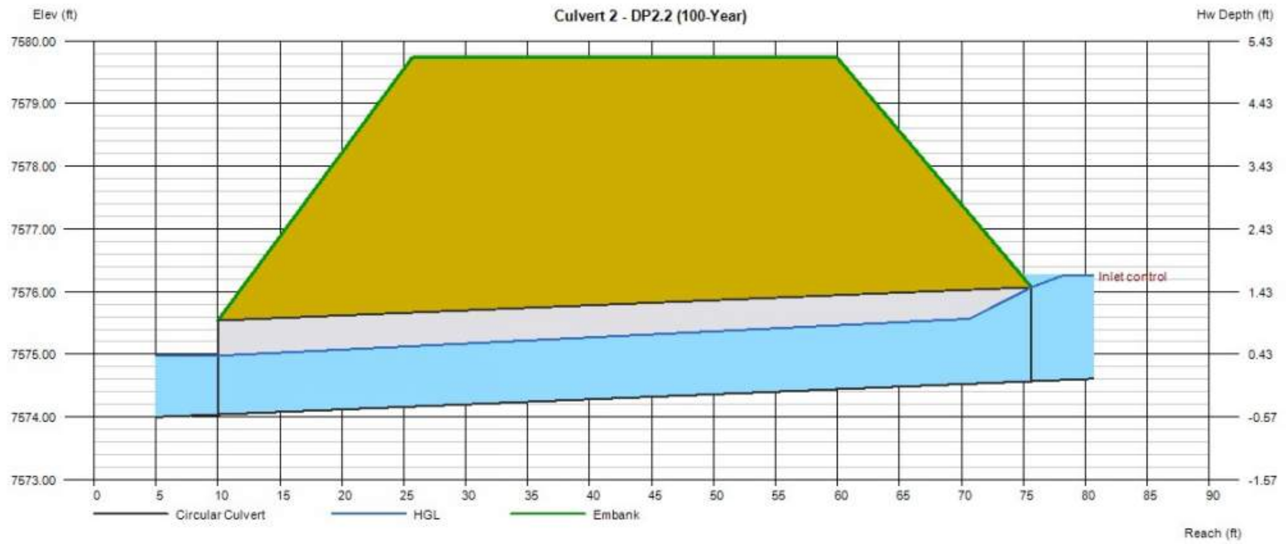
Top Elevation (ft) = 7579.73
Top Width (ft) = 34.30
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 7.30
Qmax (cfs) = 7.30
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 7.30
Qpipe (cfs) = 7.30
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 6.27
Veloc Up (ft/s) = 5.55
HGL Dn (ft) = 7574.98
HGL Up (ft) = 7575.62
Hw Elev (ft) = 7576.26
Hw/D (ft) = 1.12
Flow Regime = Inlet Control



Culvert Report

Culvert 3 - DP2.3 (5-Year)

Invert Elev Dn (ft) = 7540.10
Pipe Length (ft) = 160.16
Slope (%) = 2.00
Invert Elev Up (ft) = 7543.30
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

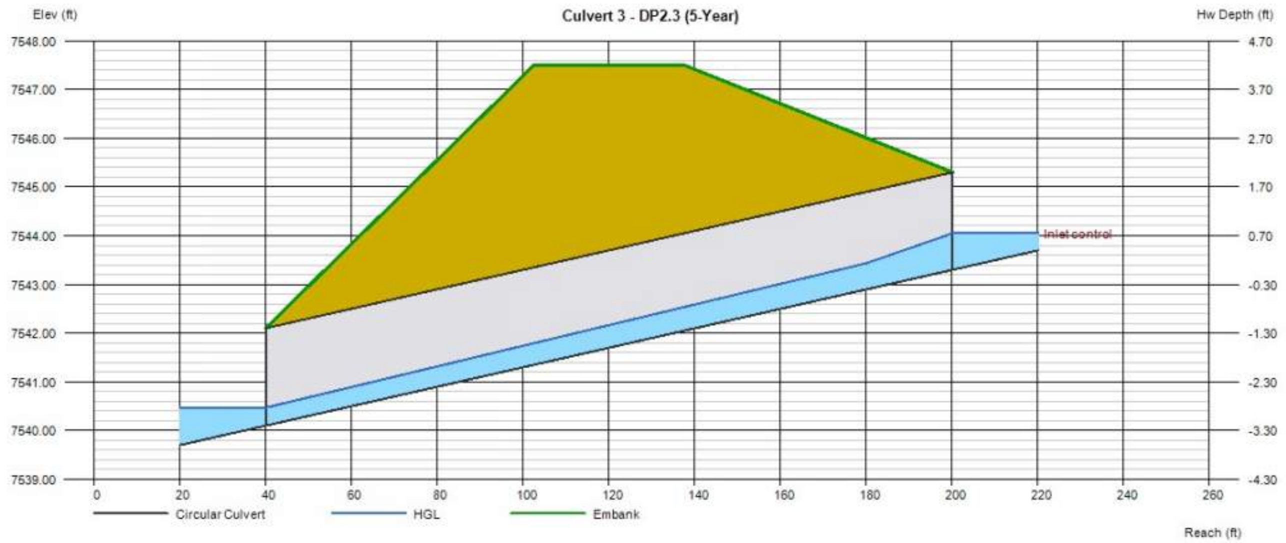
Top Elevation (ft) = 7547.50
Top Width (ft) = 35.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 2.60
Qmax (cfs) = 2.60
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 2.60
Qpipe (cfs) = 2.60
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 6.49
Veloc Up (ft/s) = 3.60
HGL Dn (ft) = 7540.47
HGL Up (ft) = 7543.86
Hw Elev (ft) = 7544.05
Hw/D (ft) = 0.37
Flow Regime = Inlet Control



Culvert Report

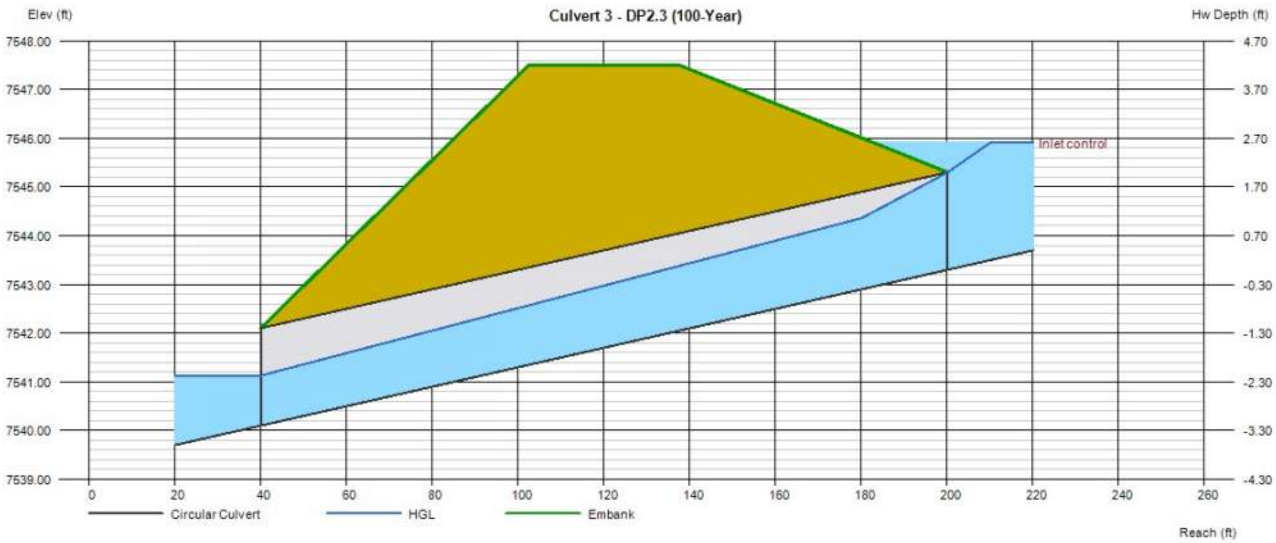
Culvert 3 - DP2.3 (100-Year)

Invert Elev Dn (ft) = 7540.10
Pipe Length (ft) = 160.16
Slope (%) = 2.00
Invert Elev Up (ft) = 7543.30
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment
Top Elevation (ft) = 7547.50
Top Width (ft) = 35.00
Crest Width (ft) = 50.00

Calculations
Qmin (cfs) = 17.90
Qmax (cfs) = 17.90
Tailwater Elev (ft) = Normal

Highlighted
Qtotal (cfs) = 17.90
Qpipe (cfs) = 17.90
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 10.99
Veloc Up (ft/s) = 6.97
HGL Dn (ft) = 7541.13
HGL Up (ft) = 7544.82
Hw Elev (ft) = 7545.91
Hw/D (ft) = 1.31
Flow Regime = Inlet Control



Culvert Report

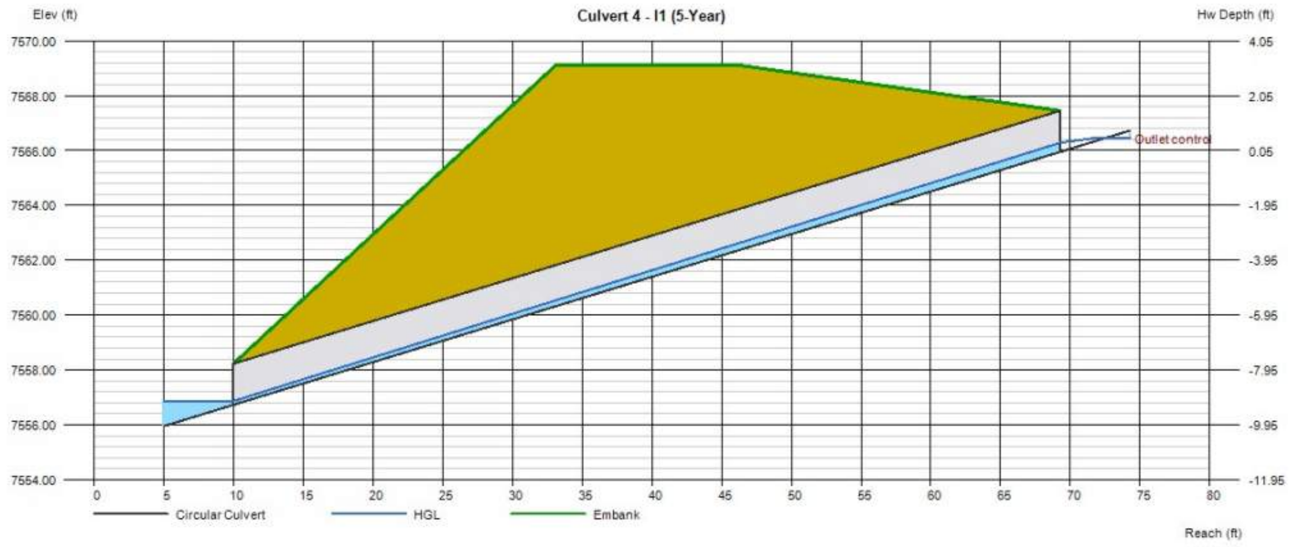
Culvert 4 - I1 (5-Year)

Invert Elev Dn (ft) = 7556.73
Pipe Length (ft) = 59.26
Slope (%) = 15.56
Invert Elev Up (ft) = 7565.95
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment
Top Elevation (ft) = 7569.12
Top Width (ft) = 13.00
Crest Width (ft) = 30.00

Calculations
Qmin (cfs) = 0.80
Qmax (cfs) = 0.80
Tailwater Elev (ft) = Normal

Highlighted
Qtotal (cfs) = 0.80
Qpipe (cfs) = 0.80
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 9.67
Veloc Up (ft/s) = 2.75
HGL Dn (ft) = 7556.87
HGL Up (ft) = 7566.28
Hw Elev (ft) = 7566.46
Hw/D (ft) = 0.34
Flow Regime = Outlet Control



Culvert Report

Culvert 4 - I1 (100-Year)

Invert Elev Dn (ft) = 7556.73
Pipe Length (ft) = 59.26
Slope (%) = 15.56
Invert Elev Up (ft) = 7565.95
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

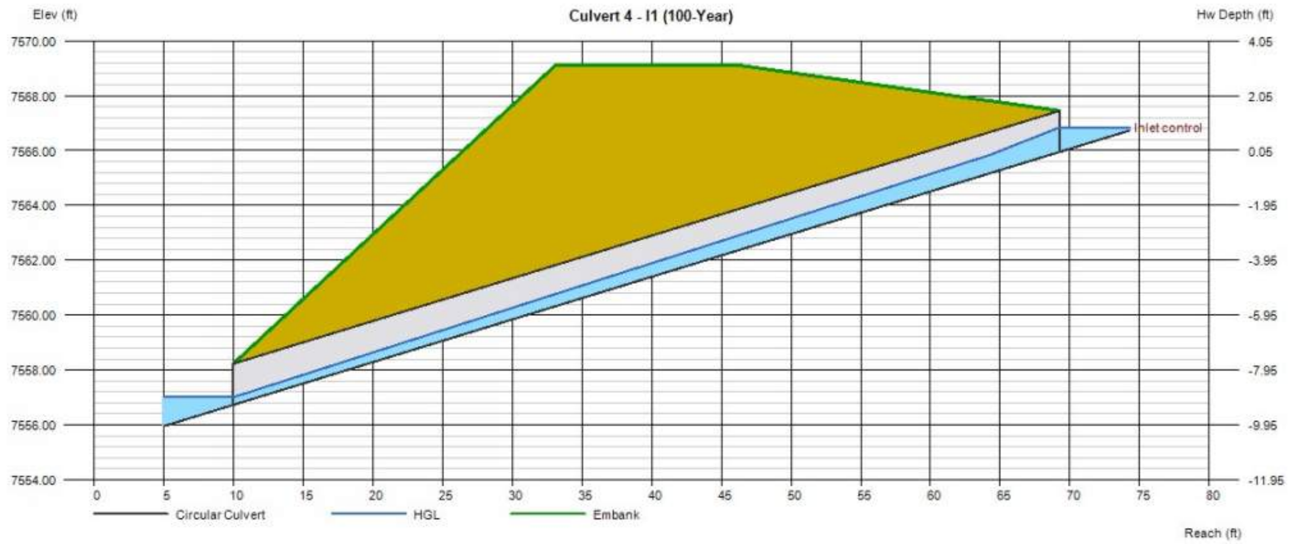
Top Elevation (ft) = 7569.12
Top Width (ft) = 13.00
Crest Width (ft) = 30.00

Calculations

Qmin (cfs) = 3.40
Qmax (cfs) = 3.40
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 3.40
Qpipe (cfs) = 3.40
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 14.85
Veloc Up (ft/s) = 4.18
HGL Dn (ft) = 7557.01
HGL Up (ft) = 7566.65
Hw Elev (ft) = 7566.85
Hw/D (ft) = 0.60
Flow Regime = Inlet Control



SWALE CALCULATIONS

Roadside Ditch Analysis for Street Section 1 - Basin B2.1 (100-Year)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	2.00 %
Left Side Slope	3.000 H:V
Right Side Slope	4.000 H:V
Discharge	16.90 cfs

100-year flow from Basin B2.1

Results

Normal Depth	1.1 ft
Flow Area	4.3 ft²
Wetted Perimeter	8.1 ft
Hydraulic Radius	0.5 ft
Top Width	7.75 ft
Critical Depth	1.1 ft
Critical Slope	2.31 %
Velocity	3.94 ft/s
Velocity Head	0.24 ft
Specific Energy	1.35 ft
Froude Number	0.934
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.1 ft
Critical Depth	1.1 ft
Channel Slope	2.00 %
Critical Slope	2.31 %

Roadside Ditch Analysis for Street Section 1 - Basin B2.5 (100-Year)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	2.00 %
Left Side Slope	4.000 H:V
Right Side Slope	3.000 H:V
Discharge	12.40 cfs

100-year flow from part of Basin B2.5

Results

Normal Depth	1.0 ft
Flow Area	3.4 ft²
Wetted Perimeter	7.2 ft
Hydraulic Radius	0.5 ft
Top Width	6.90 ft
Critical Depth	1.0 ft
Critical Slope	2.41 %
Velocity	3.65 ft/s
Velocity Head	0.21 ft
Specific Energy	1.19 ft
Froude Number	0.916
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.0 ft
Critical Depth	1.0 ft
Channel Slope	2.00 %
Critical Slope	2.41 %

Roadside Ditch Analysis for Street Section 2 - Basin B2.4 (100-Year)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	7.60 %
Left Side Slope	4.000 H:V
Right Side Slope	3.000 H:V
Discharge	17.90 cfs

100-year flow from
Basin B2.4

Results

Normal Depth	0.9 ft
Flow Area	2.7 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	0.4 ft
Top Width	6.16 ft
Critical Depth	1.1 ft
Critical Slope	2.30 %
Velocity	6.60 ft/s
Velocity Head	0.68 ft
Specific Energy	1.56 ft
Froude Number	1.752
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.9 ft
Critical Depth	1.1 ft
Channel Slope	7.60 %
Critical Slope	2.30 %

Roadside Ditch Analysis for Street Section 2 - Basin B2.5 (100-Year)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	7.60 %
Left Side Slope	4.000 H:V
Right Side Slope	3.000 H:V
Discharge	3.30 cfs

100-year flow from
part of Basin B2.5

Results

Normal Depth	0.5 ft
Flow Area	0.8 ft²
Wetted Perimeter	3.4 ft
Hydraulic Radius	0.2 ft
Top Width	3.27 ft
Critical Depth	0.6 ft
Critical Slope	2.88 %
Velocity	4.32 ft/s
Velocity Head	0.29 ft
Specific Energy	0.76 ft
Froude Number	1.577
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.5 ft
Critical Depth	0.6 ft
Channel Slope	7.60 %
Critical Slope	2.88 %

Roadside Ditch Analysis for Street Section 3 - Basin I1 (100-Year)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	4.20 %
Left Side Slope	4.000 H:V
Right Side Slope	3.000 H:V
Discharge	3.40 cfs

100-year flow from Basin I1

Results

Normal Depth	0.5 ft
Flow Area	1.0 ft²
Wetted Perimeter	3.8 ft
Hydraulic Radius	0.3 ft
Top Width	3.69 ft
Critical Depth	0.6 ft
Critical Slope	2.87 %
Velocity	3.49 ft/s
Velocity Head	0.19 ft
Specific Energy	0.72 ft
Froude Number	1.196
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.5 ft
Critical Depth	0.6 ft
Channel Slope	4.20 %
Critical Slope	2.87 %

DRAINAGE CHANNEL

SECTION CALCULATIONS

Worksheet for Section A-A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	2.00 %
Left Side Slope	7.000 H:V
Right Side Slope	6.000 H:V
Bottom Width	12.00 ft
Discharge	78.40 cfs

100-year flow from Basin B2.5 and combined flow from Basins B2.1 and B2.2

Results

Normal Depth	0.9 ft
Flow Area	16.7 ft²
Wetted Perimeter	24.2 ft
Hydraulic Radius	0.7 ft
Top Width	24.05 ft
Critical Depth	0.9 ft
Critical Slope	2.03 %
Velocity	4.69 ft/s
Velocity Head	0.34 ft
Specific Energy	1.27 ft
Froude Number	0.992
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.9 ft
Critical Depth	0.9 ft
Channel Slope	2.00 %
Critical Slope	2.03 %

Channel Section B-B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	2.90 %
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	16.90 cfs

100-year flow from Basin B2.1

Results

Normal Depth	1.0 ft
Flow Area	3.8 ft²
Wetted Perimeter	8.1 ft
Hydraulic Radius	0.5 ft
Top Width	7.84 ft
Critical Depth	1.0 ft
Critical Slope	2.33 %
Velocity	4.40 ft/s
Velocity Head	0.30 ft
Specific Energy	1.28 ft
Froude Number	1.109
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.0 ft
Critical Depth	1.0 ft
Channel Slope	2.90 %
Critical Slope	2.33 %

CHANNEL LINING CALCULATIONS

FROUDE NUMBER CALCULATIONS		CALCULATED BY:	TMM	DATE:	11/15/2024
PROJECT: 211030 FILING NO. 5		CHECKED BY:	RHL		

Froude Number Calculations: 100-YR

Section	Velocity	Gravitational Constant	Hydraulic depth	Xsectional Area	top Width	Froude #
-	ft/s	ft/s^2	ft	ft^2	ft	N/A
A-A	4.69	32.17	0.69	16.70	24.05	0.99
B-B	5.64	31.17	0.71	8.1	11.37	1.20
STREET SECTION 1	3.94	32.17	0.70	5.4	7.75	0.83
STREET SECTION 2	6.6	32.17	0.44	2.7	6.16	1.76
STREET SECTION 3	3.49	32.17	0.27	1.0	3.69	1.18

Shear Stress Calculations: 100-YR

Section	unit weight of wa	Depth of flow	Slope	Shear Stress
-	lb/ft^3	ft	ft/ft	lb/ft^2
A-A	62.43	0.90	0.020	1.12
B-B	62.43	1.40	0.029	2.53
STREET SECTION 1	62.43	1.10	0.020	1.37
STREET SECTION 2	62.43	0.90	0.076	4.27
STREET SECTION 3	62.43	0.50	0.042	1.31

Channel Lining Determination

	Calculated Values		P300 Max Values		
Section	Shear Stress	Velocity	Shear Stress	Velocity	Lining Required
A-A	1.12	4.69	3	9	P300
B-B	2.53	5.64	3	9	P300
STREET SECTION 1	1.37	3.94	3	9	P300
STREET SECTION 2	4.27	6.60	3	9	TMAX
STREET SECTION 3	1.31	3.49	3	9	P300

RIPRAP SIZING ANALYSIS

HRGreen	FLYING HORSE NORTH FILING NO. 4	**Calc'd by:**	TMM
	211030	**Checked by:**	RHL
	FES 1D RIPRAP	**Date:**	11/19/2024

Input Parameters		
Flow (Q)	16.9	cfs
Tailwater depth (Y_t)	0.80	ft
Conduit Diameter (D_c)	24	in
Expansion Factor (per Fig. 9-35)	4.5	
Soil Type	Non-Cohesive Soils	

Calculated Parameters		
Froude Parameter ($Q/D^{2.5}$)	2.99	
D_{50} =	4.95	in
UDFCD Riprap Type =	Type VL	
Design D_{50} =	6	in
Minimum Mantle Thickness =	12	in
Minimum Length of Apron =	10.01	ft

Calculated D_{50} for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) \qquad \text{Equation 9-11}$$

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

$$A_t = \frac{Q}{V} \qquad \text{Equation 9-12}$$

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_t = required area of flow at allowable velocity (ft²)

Note:

[1] Calculations follow criteria in the USDCM Vol.2 Chapter 9

[2] Calculations assume a circular culvert

[3] This spreadsheet assumes y_t/D_t=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

[4] Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6

HRGreen	FLYING HORSE NORTH FILING NO. 4	**Calc'd by:**	TMM
	211030	**Checked by:**	RHL
	FES 2D RIPRAP	**Date:**	11/13/2024

Input Parameters		
Flow (Q)	7.3	cfs
Tailwater depth (Y_t)	0.60	ft
Conduit Diameter (D_c)	18	in
Expansion Factor (per Fig. 9-35)	4.75	
Soil Type	Non-Cohesive Soils	

Calculated Parameters		
Froude Parameter ($Q/D^{2.5}$)	2.65	
D_{50} =	3.29	in
UDFCD Riprap Type =	Type VL	
Design D_{50} =	6	in
Minimum Mantle Thickness =	12	in
Minimum Length of Apron =	4.5	ft

Calculated D_{50} for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) \qquad \text{Equation 9-11}$$

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

$$A_t = \frac{Q}{V} \qquad \text{Equation 9-12}$$

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_t = required area of flow at allowable velocity (ft²)

Note:

[1] Calculations follow criteria in the USDCM Vol.2 Chapter 9

[2] Calculations assume a circular culvert

[3] This spreadsheet assumes y_t/D_t=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

[4] Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6

HRGreen	**FLYING HORSE NORTH FILING NO. 4**	**Calc'd by:**	**TMM**
	211030	**Checked by:**	**RHL**
	FES 3D RIPRAP	**Date:**	**11/13/2024**

Input Parameters		
Flow (Q)	20.3	cfs
Tailwater depth (Y_t)	1.20	ft
Conduit Diameter (D_c)	36	in
Expansion Factor (per Fig. 9-35)	6.25	
Soil Type	Non-Cohesive Soils	

Calculated Parameters		
Froude Parameter ($Q/D^{2.5}$)	1.30	
D_{50} =	3.24	in
UDFCD Riprap Type =	Type VL	
Design D_{50} =	6	in
Minimum Mantle Thickness =	12	in
Minimum Length of Apron =	9	ft

Calculated D_{50} for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) \qquad \text{Equation 9-11}$$

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

$$A_t = \frac{Q}{V} \qquad \text{Equation 9-12}$$

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_t = required area of flow at allowable velocity (ft²)

Note:

[1] Calculations follow criteria in the USDCM Vol.2 Chapter 9

[2] Calculations assume a circular culvert

[3] This spreadsheet assumes $y_t/D_t=0.4$ in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

[4] Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6

HRGreen	**FLYING HORSE NORTH FILING NO. 4**	**Calc'd by:**	**TMM**
	211030	**Checked by:**	**RHL**
	FES 4D RIPRAP	**Date:**	**11/13/2024**

Input Parameters		
Flow (Q)	3.4	cfs
Tailwater depth (Y_t)	0.60	ft
Conduit Diameter (D_c)	18	in
Expansion Factor (per Fig. 9-35)	6.25	
Soil Type	Non-Cohesive Soils	

Calculated Parameters		
Froude Parameter ($Q/D^{2.5}$)	1.23	
D_{50} =	1.53	in
UDFCD Riprap Type =	Type VL	
Design D_{50} =	6	in
Minimum Mantle Thickness =	12	in
Minimum Length of Apron =	4.5	ft

Calculated D_{50} for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) \qquad \text{Equation 9-11}$$

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

$$A_t = \frac{Q}{V} \qquad \text{Equation 9-12}$$

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_t = required area of flow at allowable velocity (ft²)

Note:

[1] Calculations follow criteria in the USDCM Vol.2 Chapter 9

[2] Calculations assume a circular culvert

[3] This spreadsheet assumes y_t/D_t=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

[4] Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6

1

214070

GRADING AND STORM DRAIN IMPROVEMENTS
MAJESTIC COMMERCENTER DETENTION PONDS IG-A and IG-B
CHANNEL EXTENSION to POND IG-A

GENERAL NOTES

1. CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, OF DIMENSIONS AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE . THE CITY OF AURORA, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.
2. ALL ROADWAY CONSTRUCTION SHALL CONFORM TO THE CITY OF AURORA ROADWAY DESIGN AND CONSTRUCTION STANDARDS AND SPECIFICATIONS, LATEST EDITION.
3. ALL WATER DISTRIBUTION, SANITARY SEWER AND STORM DRAINAGE CONSTRUCTION SHALL CONFORM TO THE CITY OF AURORA PUBLIC STANDARDS AND SPECIFICATIONS REGARDING WATER, SEWER, AND STORM DRAINAGE INFRASTRUCTURE, LATEST REVISION.
4. ALL MATERIALS AND WORKMANSHIP SHALL BE SUBJECT TO INSPECTION BY THE CITY. THE CITY RESERVES THE RIGHT TO ACCEPT OR REJECT ANY MATERIALS AND WORKMANSHIP THAT DOES NOT CONFORM TO THE CITY STANDARDS AND SPECIFICATIONS.
5. THE CONTRACTOR SHALL NOTIFY THE CITY PUBLIC IMPROVEMENT INSPECTIONS, (303) 739-7420, 24 HOURS PRIOR TO THE BEGINNING OF CONSTRUCTION.
6. LOCATION OF EXISTING UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO ACTUAL CONSTRUCTION. FOR INFORMATION, CONTACT UTILITY NOTIFICATION CENTER OF COLORADO, 1-800-922-1987 OR 811.
7. THE CONTRACTOR SHALL HAVE ONE SIGNED COPY OF PLANS (APPROVED BY THE CITY OF AURORA), ONE COPY OF THE APPROPRIATE STANDARDS AND SPECIFICATIONS AT THE JOB SITE AT ALL TIMES AND A COPY OF ANY PERMITS AND EXTENSION AGREEMENTS NEEDED AT THE JOB SITE AT ALL TIMES.
8. IT IS THE CONSULTANT'S RESPONSIBILITY TO ACCURATELY SHOW EXISTING CONDITIONS, BOTH ON-SITE, AND OFF-SITE, ON THE CONSTRUCTION PLANS. ANY MODIFICATIONS NEEDED DUE TO CONFLICTS, OMISSIONS, OR CHANGED CONDITIONS, EITHER ON-SITE OR OFF-SITE, THAT ARISE IN THE FIELD, WILL BE ENTIRELY THE DEVELOPERS' RESPONSIBILITY . THE COST TO RECTIFY ANY ADVERSE SITUATION TO MEET THE CITY STANDARDS AND SPECIFICATIONS AND THE CITY CODE SHALL BE BORNE SOLELY BE THE DEVELOPER.
9. THE OWNER/DEVELOPER MUST OBTAIN THE WRITTEN PERMISSION OF THE ADJACENT PROPERTY OWNER(S) FOR ANY OFF-SITE GRADING OR CONSTRUCTION.
10. CONCRETE SHALL NOT BE PLACED UNTIL THE FORMS HAVE BEEN INSPECTED AND A POUR SLIP ISSUED. POUR SLIPS WILL NOT BE ISSUED UNLESS THE CONTRACTOR HAS, AT THE JOB SITE, A COPY OF THE APPROVED PLANS BEARING THE SIGNATURE OF THE CITY ENGINEER AND WITH THE APPROVED FOR CURB AND GUTTER ONLY BLOCK INITIALED BY THE CITY ENGINEER'S REPRESENTATIVE.
11. PAVING SHALL NOT START UNTIL A SOIL REPORT AND PAVEMENT DESIGN IS APPROVED BY THE CITY ENGINEER, AND SUBGRADE COMPACTION TESTS ARE TAKEN BY THE DEVELOPERS GEO-TECH AND ARE APPROVED BY PUBLIC WORKS INSPECTIONS.
12. STANDARD CITY OF AURORA HANDICAP RAMPS SHALL BE CONSTRUCTED AT ALL CURB RETURNS, AT ALL "T" INTERSECTIONS, AND AT ALL CURBSIDE KIOSKS OR CLUSTERS, UNLESS OTHERWISE MODIFIED BY THESE PLANS.
13. ALL STATIONING IS BASED ON CENTERLINE OF ROADWAYS UNLESS OTHERWISE NOTED.
14. ALL PROFILE ELEVATIONS REFER TO FLOWLINW UNLESS OTHERWISE NOTED.
15. THE CITY OF AURORA SHALL NOT BE LIABLE FOR THE MAINTENANCE OF PRIVATE STORM DRAIN IMPROVEMENTS OR ANYTHING ELSE LABELED AS PRIVATE. THESE FACILITIES MAY NOT MEET CITY STANDARDS AND SHALL REMAIN IN PRIVATE MAINTENANCE IN PERPETUITY.
16. THE CONTRACTOR/DEVELOPER IS RESPONSIBLE FOR CONTACTING CDOT TO ENSURE THAT ALL WORK ON OR ADJACENT TO STATE HIGHWAYS OR CDOT R.O.W. MEETS CDOT REQUIREMENTS.
17. THE STREET LIGHT INSTALLATION COST IS FUNDED BY THE DEVELOPER/OWNER. COORDINATE THE STREET LIGHT LOCATIONS AND INSTALLATION WITH THE PUBLIC WORKS DEPARTMENT 303-739-7300.
18. THE OWNER/CONTRACTOR MUST OBTAIN A CDPS STORM WATER DISCHARGE PERMIT FROM THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, IF REQUIRED.
19. THE OWNER/CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH THE ARMY CORP OF ENGINEERS FOR WETLAND MITIGATION OR WORK WITHIN THE WATERS OF THE U.S., IF REQUIRED. IT IS THE RESPONSIBILITY OF THE OWNER/CONTRACTOR TO INFORM THE CITY OF AURORA OF THE ARMY CORP OF ENGINEER'S REQUIREMENTS. CITY APPROVAL OF THE CONSTRUCTION PLANS IS SUBJECT TO THE OWNER/CONTRACTOR OBTAINING A 404 PERMIT, IF APPLICABLE.
19. CONTRACTOR TO COORDINATE ALL ACTIVITIES ON GATEWAY EAST @ TOWER, LLC LAND WITH SAND CREEK METROPOLITAN DISTRICT BY CONTACTING MIKE SERRA III, SECRETARY AT 303-371-9000, AT A MINIMUM, 48 HOURS IN ADVANCE OF ANY ACTIVITIES ON SAID PROPERTY.

STANDARD UTILITY NOTES

1. ALL MATERIALS, WORKMANSHIP, CONSTRUCTION DETAILS, AND TESTING FOR THE WATER LINE CONSTRUCTION SHALL CONFORM TO STANDARDS AND SPECIFICATIONS REGARDING WATER, SANITARY SEWER AND STORM DRAINAGE INFRASTRUCTURE, LATEST REVISION AS SET FORTH BY THE CITY OF AURORA WATER DEPARTMENT, LATEST REVISION.

2. ALL FIRE HYDRANTS SHALL BE LOCATED NOT LESS THAN THREE FEET - SIX INCHES (3' - 6") AND NOT MORE THAN 8 FEET FROM THE BACK OF CURB TO THE CENTER OF THE HYDRANT AND BE UNOBSTRUCTED ON THE STREET SIDE. MINIMUM CLEARANCE ON ALL OTHER SIDES SHALL BE 5 FEET. FIRE HYDRANTS MUST BE GRADE STAKED IN THE FIELD. FIRE HYDRANTS ARE NOT ALLOWED IN SIDEWALKS.

3. ALL FIRE HYDRANTS MUST BE GRADE STAKED IN THE FIELD WHENEVER CURB AND GUTTER HAS NOTBEEN INSTALLED.

4. ALL UTILITY EASEMENTS MUST REMAIN UNOBSTRUCTED AND FULLY ACCESSIBLE ALONG THEIR ENTIRELENGTH FOR MAINTENANCE EQUIPMENT.

5. WATER MAIN RESTRAINT SHALL BE IN ACCORDANCE WITH STANDARDS AND SPECIFICATIONS REGARDING WATER, SANITARY SEWER AND STORM DRAINAGE INFRASTRUCTURE, LATEST REVISION.
MEGALUGS OR UNI-FLANGE MAY BE USED IN PLACE OF RODS AND CLAMPS.

6. WATER LINE VALVES ARE NOT ALLOWED IN CROSS PANS.

7. ALL WATER METERS, WATER SERVICE LINES AND SANITARY SEWER SERVICE LINES ARE NOT ALLOWED IN OR UNDER DRIVEWAYS.

8. ALL SANITARY SERVICE LINES SHALL BE TEES OFF OF MAINS. WYES SHALL BE USED FOR LOTS AT BACK OF CUL-DE-SACS.

9. WATER PRESSURE ZONE 3.. ZERO (0) PSI @ ELEVATION 5720 STATIC. A PRESSURE REDUCING VALVE (PRV) IS REQUIRED WHEN THE PRESSURE AT THE UNIT IS GREATER THAN (80) PSI. PRV'S ARE NOT ALLOWED IN CITY OF AURORA OWNED AND MAINTAINED METER PITS.

10. ADJUST ALL MANHOLES, FIRE HYDRANTS, AND VALVE BOXES TO GRADE PER AURORA WATER STANDARDS AND SPECIFICATIONS REGARDING WATER, SANITARY SEWER AND STORM SEWER INFRASTRUCTURE, LATEST REVISION, AS NECESSARY.

11. ALL FIRE LINES AND COMMERCIAL WATER SERVICE LINES WILL REQUIRE REDUCED PRESSURE BACK FLOW PREVENTER OR DOUBLE CHECK VALVES AS REQUIRED BY THE CITY OF AURORA UTILITY DEPARTMENT. CONTACT THE BUILDING DIVISION AT 303-739-7420 TO SCHEDULE FLOW TEST FOR PRIVATE FIRE LINES PRIOR TO THE ISSUANCE OF A CERTIFICATE OF OCCUPANCY.

12. THE CONTRACTOR SHALL CONTACT AURORA WATER ENGINEERING AT (303) 739-7300 FOR INSPECTION OF ANY REQUIRED GREASE TRAPS OR SAND/OIL INTERCEPTORS PRIOR TO THE ISSUANCE OF THE CERTIFICATE OF OCCUPANCY.

13. THE CONTRACTOR SHALL CONTACT THE AURORA WATER INSPECTION LINE AT (303) 739-7385 AT LEAST 24 HOURS IN ADVANCE OF COMMENCING CONSTRUCTION OF ANY WET UTILITY TO SCHEDULE INSPECTIONS.

14. N/A.

15 . ALL FIRE SERVICE LINES SHALL BE INSTALLED, IN THEIR ENTIRETY, BY A STATE LICENSED CONTRACTOR. LICENSING CAN BE OBTAINED FROM THE COLORADO DIVISION OF FIRE SAFETY LOCATED AT 690 KIPLING STREET, LAKEWOOD, CO 80215 (303-239-4600). IN ADDITION, APPROVED CIVIL PLANS FROM THE CITY OF AURORA WATER DEPARTMENT ARE REQUIRED FOR ALL FIRE SERVICE LINE CONNECTIONS. THE CONTRACTOR MUST PRESENT LICENSE AND APPROVED CIVIL PLANS TO THE PUBLIC IMPROVEMENTS DIVISION OF THE PUBLIC WORKS DEPARTMENT BEFORE PERMITS ARE ISSUED. ONCE THE PERMIT HAS BEEN ISSUED CONTACT THE CITY OF AURORA BUILDING CODES DIVISION AT 303-739-7420 TO SCHEDULE A FLUSH INSPECTION WITH A LIFE SAFETY INSPECTOR. FIRE SERVICE LINES SHALL BE RESTRAINED FOR THEIR ENTIRE LENGTH. REFER TO THE CITY OF AURORA PUBLIC UTILITY IMPROVEMENTS RULES AND REGULATIONS REGARDING STANDARDS AND SPECIFICATIONS, SECTION 15.00.

16. NO CONNECTIONS ARE ALLOWED TO THE FIRE SERVICE LINE BETWEEN THE GATE VALVE AT THE WATER LINE MAIN AND THE BACKFLOW PREVENTER (WITHIN THE BUILDING).

17. OTHER THAN THE 90 DEGREE VERTICAL BEND IN THE FIRE SERVICE LINE AT THE BUILDING RISER, FIRE SERVICE LINES MAY HAVE ONE 90 DEGREE BEND, OR MORE THAN ONE BEND WHEN THE SUM OF ALL BENDS DOES NOT EXCEED 90 DEGREES, IN THE LENGTH OF LINE FROM THE WATER MAIN TEE TO THE RISER.

18. ALL FIRE LINES, LANDSCAPE IRRIGATION LINES AND COMMERCIAL WATER SERVICE LINES WILL REQUIRE A REDUCED PRESSURE BACKFLOW PREVENTION ASSEMBLY OR DOUBLE CHECK BACKFLOW PREVENTION ASSEMBLY AS REQUIRED BY THE CITY OF AURORA WATER DEPARTMENT. CONTACT THE BUILDING DIVISION AT (303) 739-7420 TO SCHEDULE FLOW TESTS FOR PRIVATE FIRE LINES PRIOR TO THE ISSUANCE OF A CERTIFICATE OF OCCUPANCY. FOR MORE INFORMATION ON BACKFLOW PREVENTION, CONTACT AURORA WATER AT (303) 326-8129.

19. ALL BACKFLOW PREVENTION ASSEMBLIES WILL BE INSTALLED AND CONFORM TO THE CITY OF AURORA "PUBLIC UTILITY RULES AND REGULATIONS REGARDING STANDARDS AND SPECIFICATIONS", LATEST REVISION. ONLY APPROVED BACKFLOW PREVENTION ASSEMBLIES SHALL BE INSTALLED APPLICABLE FOR THE DEGREE OF HAZARD, AS DETERMINED BY AURORA WATER.

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024 — 06/04/14 DATE

STORMWATER MANAGEMENT PLAN NOTES

STANDARD STATEMENT AND NOTES:
"PURSUANT TO SECTION 138-440 AND 138-442 OF THE AURORA MUNICIPAL CODE, THE PERMITTEE SHALL LOCATE, INSTALL, AND MAINTAIN ALL BEST MANAGEMENT PRACTICES, INCLUDING, BUT NOT LIMITED TO, EROSION CONTROLS, SEDIMENT CONTROLS, DRAINAGE CONTROLS, AND WATER QUALITY BMPs AS INDICATED IN THE APPROVED STORMWATER MANAGEMENT PLAN (SWMP). THE FOLLOWING NOTES ARE A REQUIREMENT AND SHALL BE INCLUDED ON THE SWMP DESIGN DRAWINGS DEVELOPED FOR THIS PROJECT AND SUBMITTED FOR APPROVAL BY THE CITY. BMP INSTALLATIONS SHALL BE INSTALLED PER THE COA STANDARD DETAIL IN EFFECT AT THE TIME OF INSTALLATION OR PER THE APPROVED SWMP DESIGN DRAWING, A COA APPROVED VARIANCE, OR A COA APPROVED DESIGN DRAWING PLAN AMENDMENT."

1. THE PERMITTEE SHALL BE RESPONSIBLE FOR REMEDIATION OF ANY ADVERSE IMPACTS TO ADJACENT WATERWAYS, WETLANDS, STORM SEWERS, STORM SEWER APPURTENANCES, OTHER PROPERTIES, ETC., RESULTING FROM WORK DONE AS PART OF THIS PROJECT.

2. ADDITIONAL EROSION AND SEDIMENT CONTROL BMPS MAY BE REQUIRED DURING AND AFTER CONSTRUCTION AND SHALL BE EXECUTED AND COMPLETED BY THE PERMITTEE. THE PERMITTEE SHALL PLAN, INSTALL, AND MAINTAIN ALL EROSION, AND SEDIMENT CONTROL MEASURES, INCLUDING DRAINAGE AND WATER QUALITY BMPS AS INDICATED ON THIS PLAN AND AS NECESSARY TO REDUCE THE DISCHARGE OF POLLUTANTS TO THE MAXIMUM EXTENT PRACTICABLE ADVERSE IMPACTS, EROSION AND SEDIMENT DEPOSITION ONTO PAVED SECTIONS, INTO STORM SEWERS, STORM SEWER APPURTENANCES, RECEIVING WATERS, OR OFF THE PROJECT SITE.

3. THE PERMITTEE SHALL TAKE APPROPRIATE PREVENTIVE MEASURES TO MINIMIZE TO THE MAXIMUM EXTENT PRACTICABLE DIRT AND MUD FROM BEING TRACKED OR DEPOSITED ONTO PAVED SECTIONS VIA MULTIPLE BMPS. SEDIMENT, MUD, AND CONSTRUCTION DEBRIS THAT MAY BE TRACKED, DEPOSITED, OR ACCUMULATED ON PAVED SECTIONS, IN THE FLOW LINES, PRIVATE PROPERTY, AND/OR PUBLIC RIGHTS.QF-WAY OF THE CITY AS A RESULT OF THIS CONSTRUCTION PROJECT SHALL BE CLEANED UP.

4. AREAS REACHING SUBSTANTIAL COMPLETION OF GRADING AND TOPSOIL PLACEMENT OPERATIONS MUST BE DRILL SEEDED AND CRIMP MULCHED WITHIN 14 DAYS OF SUBSTANTIAL COMPLETION OF GRADING AND TOPSOIL OPERATIONS. IF AN INCOMPLETE AREA IS TO REMAIN INACTIVE FOR LONGER THAN 30 DAYS, IT MUST BE DRILL SEEDED AND CRIMP MULCHED OR OTHERWISE LANDSCAPED WITHIN 14 DAYS FROM THE SUSPENSION OR COMPLETION OF LAND DISTURBANCE ACTIVITIES.

5. THIS APPROVED SWMP DESIGN DRAWING, THE ASSOCIATED APPROVED SWMP NARRATIVE, A COPY OF THE STORMWATER QUALITY DISCHARGE PERMIT, AND THE RULES AND REGULATIONS REGARDING STORM WATER DISCHARGES ASSOCIA TED WITH CONSTRUCTION ACTIVITIES MANUAL SHALL BE KEPT ON SITE AT ALL TIMES.

6. ACCUMULATED SEDIMENT AND DEBRIS SHALL BE REMOVED FROM A BMP (MAINTENANCE) WHEN THE SEDIMENT LEVEL OR DEBRIS ADVERSELY IMPACTS THE FUNCTIONING OF THE BMP OR AS DEFINED WITHIN THE RULES AND REGULATIONS REGARDING STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES MANUAL, WHICHEVER IS MORE RESTRICTIVE. IF MAINTENANCE OF THE BMP DOES NOT RESTORE THE INTENDED FUNCTION, THEN THE BMP MUST BE REPLACED.

7. THE DISCHARGING OF CEMENT, CONCRETE, OR MORTAR FROM READY MIX DELIVERY TRUCKS, PUMP TRUCKS, BATCH PLANTS OR SMALL MECHANICAL MIXERS DIRECTLY ONTO PAVED SURFACES OR DISTURBED GROUND HAVING NO CONTAINMENT IS PROHIBITED. THE DISPOSAL OF ANY LIQUID WASTES OR WASH WATER FROM ANY OPERATIONS SUCH AS PAINTING, DRYWALL, OR TILE INSTALLATIONS DIRECTLY ONTO PAVED SURFACES OR THE GROUND WITHOUT CONTAINMENT IS PROHIBITED. THE PERMITTEE SHALL PROTECT ALL CURB FLOW LINES, ADJACENT WATERWAYS, WETLANDS, STORM SEWERS, STORM SEWER APPURTENANCES, OTHER PROPERTIES, ETC., ADJACENT TO ANY LOCATION WHERE PAVEMENT CUTTING OPERATIONS INVOLVING WHEEL CUTTING, SAW CUTTING OR ABRASIVE WATER JET CUTTING ARE TO TAKE PLACE.

8. IT SHALL BE THE RESPONSIBILITY OF THE PERMITTEE TO RESOLVE CONSTRUCTION PROBLEMS DUE TO CHANGING CONDITIONS OR DESIGN ERRORS THEY MAY ENCOUNTER DURING THE PROGRESS OF ANY PORTION OF THE WORK. IF CONDITIONS IN THE FIELD REQUIRE CHANGES AND THE PROPOSED MODIFICATIONS TO THE APPROVED PLANS INVOLVE SIGNIFICANT CHANGES TO THE CHARACTER OF THE WORK OR TO FUTURE CONTIGUOUS PUBLIC OR PRIVATE IMPROVEMENTS, THE CONTRACTOR, THROUGH THE ENGINEER OF RECORD, SHALL BE RESPONSIBLE TO REVISE PLANS AND SUBMIT THEM TO THE CITY OF AURORA FOR APPROVAL PRIOR TO ANY FURTHER CONSTRUCTION RELATED TO THAT PORTION OF THE WORK. ANY CONTROLS, FEATURES OR IMPROVEMENTS NOT CONSTRUCTED IN ACCORDANCE WITH THE APPROVED SWMP, CITY OF AURORA STANDARD DETAIL DESIGNS, CITY OF AURORA APPROVED VARIANCES, OR AN APPROVED DESIGN DRAWING AMENDMENT SHALL BE REMOVED AND THE CONTROLS, FEATURES AND/OR IMPROVEMENTS SHALL BE RECONSTRUCTED.

9. SECONDARY CONTAINMENT FEATURES SHALL BE IN PLACE FOR ANY BULK FUEL STORAGE, MIXERS, GENERATORS, OR ANY OTHER SPILL OR LEAK SOURCE THAT REMAINS ONSITE FOR A PERIOD LONGER THAN 7 CALENDAR DAYS. A RECOVERY OR SALVAGE DRUM SHALL BE KEPT On]SITE FOR STORAGE OF CONTAMINATED SOILS.

10. STRAW BALES AND RECYCLED ASPHALT OR CONCRETE ARE NOT ACCEPTABLE FOR THE CONSTRUCTION OF BMPS WITHIN THE CITY OF AURORA AND MAY NOT BE USED.

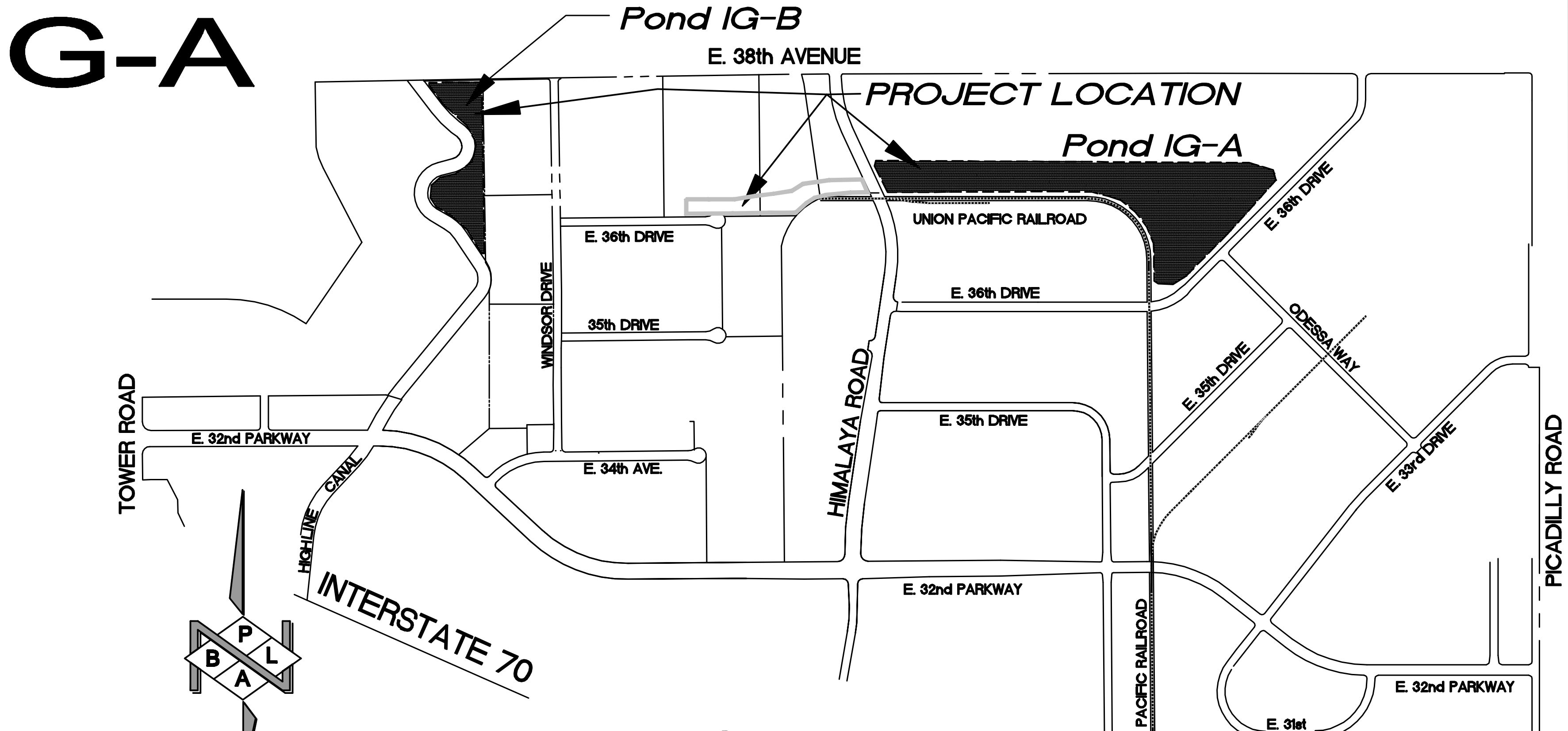
NOTICE TO CONTRACTOR

Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project including safety of all persons and property; that these requirements shall apply continuously and not be limited to normal working hours; and that the contractor shall defend, indemnify, and hold the owner and engineer harmless from any and all liability, real or alleged, in connection with the performance of work on this project, excepting for liability arising from the sole negligence

The existence and location of any underground utility pipes or structures shown on these plans were obtained by a search of available records. These locations are approximate and shall be confirmed in the field by the contractor, so that any necessary adjustment can be made in alignment and/or grade of the proposed improvement. The contractor is required to take due precautionary measures to protect any utility lines shown and any other lines

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).



VICINITY MAP

NO SCALE

THIS STORMWATER MANAGEMENT PLAN HAS BEEN PLACED IN THE CITY OF AURORA FILE FOR THIS PROJECT AND HAS BEEN DETERMINED TO COMPLY WITH THE APPLICABLE CITY OF AURORA STORMWATER MANAGEMENT CRITERIA. ADDITIONAL STORMWATER MANAGEMENT, EROSION AND SEDIMENT CONTROL MEASURES MAY BE REQUIRED OF THE OWNER OR HIS/HER AGENTS, DUE TO UNFORESEEN EROSION PROBLEMS OR IF THE SUBMITTED PLAN DOES NOT FUNCTION AS INTENDED. THE REQUIREMENTS OF THE SWMP SHALL RUN WITH THE LAND AND BE THE OBLIGATION OF THE PERMITEE(S) UNTIL SUCH TIME AS THE SWMP IS PROPERLY COMPLETED, MODIFIED OR VOIDED.

PROJECT OWNER/DEVELOPER SIGNATURE BLOCK

I HAVE REVIEWED THE INFORMATION CONTAINED WITHIN THE STORMWATER MANAGEMENT PLAN AND ACCEPT RESPONSIBILITY FOR THE REQUIREMENT SET FORTH.

06/05/2014
JACK W. BAILEY — DATE

PLAN PREPARER SIGNATURE BLOCK
THE STORMWATER MANAGEMENT PLAN INCLUDED HEREIN HAS BEEN PREPARED UNDER MY DIRECT SUPERVISION IN ACCORDANCE WITH CONSTRUCTION ACTIVITIES MANUAL, AS AMENDED.

06/05/2014
HAYWARD PARDUE, P.E.
REGISTERED PROFESSIONAL ENGINEER STATE OF COLORADO NO. 31024
PBLA ENGINEERING INC.

INDEX OF SHEETS

No.	DESCRIPTION
1	TITLE SHEET
2	GRADING POND: IG-B MODIFICATION
3	STORM DRAIN POND IG-B OUTFALL
4	STORM DRAIN POND IG-B OUTFALL
5	CHANNEL EXTENSION TO POND IG-A
6	STORM DRAIN POND IG-A OUTFALL
7	GRADING: POND IG-A MODIFICATION
8	GRADING: POND IG-A MODIFICATION
9	STORM DRAIN INLET DETAILS
10	STORM DRAIN INLET DETAILS
11	STORM DRAIN INLET DETAILS
12	TRASH RACK DETAILS
13	BARRIER DETAILS
14	STORM DRAIN DETAILS
15	SWMP: IG-B MODIFICATION
16	SWMP: POND IG-A MODIFICATION
17	SWMP: POND IG-A MODIFICATION
18	SWMP: CHANNEL EXTENSION TO POND IG-A
19	SWMP: HAUL ROUTE AND STOCKPILE PLAN

20-21 GRADING PLAN DETENTION POND IG-A

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215145

APPROVED FOR ONE YEAR FROM THIS DATE
06.27.14

AD
AURORA WATER — DATE 6/26/14
CDP
CITY ENGINEER — DATE 6/26/2014

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

GRADING and STORM DRAIN IMPROVEMENTS
TITLE SHEET
MAJESTIC COMMERCENTER PONDS IG-A and IG-B
CHANNEL EXTENSION TO PONG IG-A

AURORA, COLORADO

PLAN DATE
06/02/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD,. STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 1

APPROVED ON 06.27.14

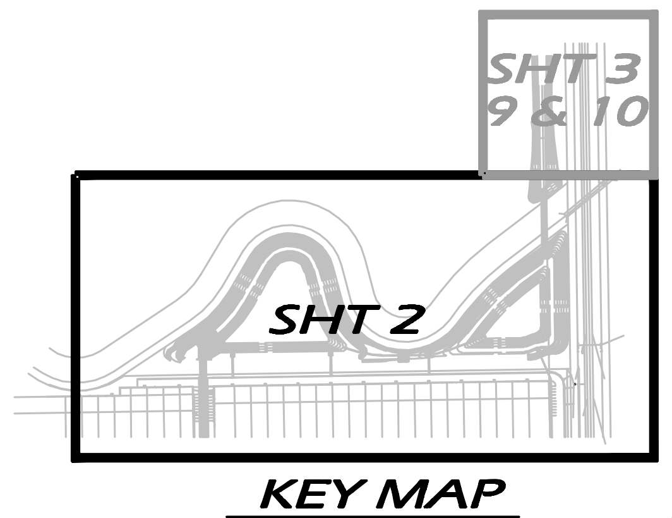
2

214070

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215145.

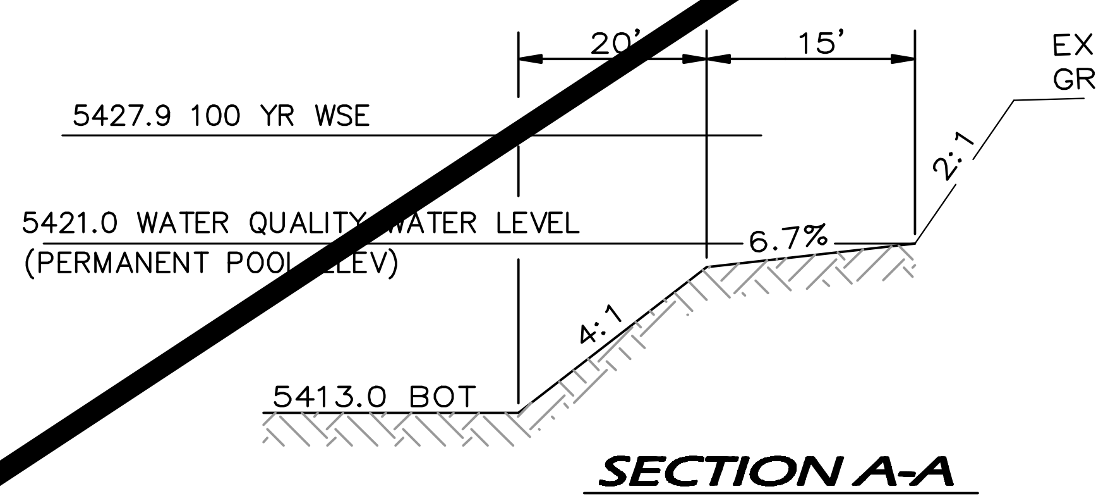
REQUIRED DETENTION VOLUME, INCLUDING THE WQCV WHEN USED, IS MET. THE CERTIFICATION SHALL SHOW THE AS-BUILT VOLUMES AND SHALL BE PROVIDED TO THE CITY OF AURORA ENGINEERING CONTROL SECTION SENIOR ENGINEER BEFORE A CERTIFICATE OF OCCUPANCY CAN BE ISSUED.

SEE BOLLING DRIVE TRIBUTARY CHANNEL IMPROVMENTS BY OTHERS
HEADWALL PER CDOT STD. M-601-10 SEE STORM DRAIN PLANS FOR DETAILS
1-48" and 2-42" RCP SD SEE SHEET 3
PROTECT EXIST POWER POLE
INLET STRUCTURE, SEE SHEETS 4 THRU 8
= LITTORAL ZONE TO BE PLANTED WITH SEED MIX PER CITY STANDARDS (0.82 AC)
= WATER QUALITY POOL=5421.0 (16.92 AC-FT)
RETENTION POND
POND IG-B
(PRIVATE)
INFLOW 541 CFS
OUTFLOW: 409 CFS
MAX ELEV 5431.0
MAX DEPTH 18.0'
WQCV ELEV = 5423
(19.31 AC-FT REQ, 24.2 PROVIDED)
MAX AVAILABLE DETENTION STORAGE 45.68 ACRE-FT
100 YR DETENTION REQUIREMENT= 25.9 AC-FT
100 YR W.S. ELEV=5427.9
10 YR W.S. ELEV=5425.0
℄ HIGHLINE CANAL
R/W
100' R/W
75'
25'
3+08.30 END
SEE EMERGENCY OVERFLOW DETAIL SHEET 14
Limits of Construction
PERMANENT POOL ELEV= 5421.0
BOTTOM ELEV= 5413.0
PROPOSED 12" MIN. CLASS M RIP-RAP, LIMITS AS SHOWN THICKNESS=2' MIN
EXISTING RIP-RAP
18" PVC SDR-35 STORM DRAIN, SEE SHEET 4
5421.0 INLET 5417.0 INVERT
5413.0 INV.
6" THICK MIN 3/4" GRAVEL ALL WEATHER ACCESS
65' PUBLIC SERVICE EASEMENT
N00°56'18"W 170.64'
N00°55'53"W 1023.17'
EX. 3-48" RCP SD CULVERT
120' R/W
36'
18'
EXIST 16" WATER
MEDIAN
CURB
℄ 38TH AVE.
BUILD 22
BUILD 23
A
B
C
D



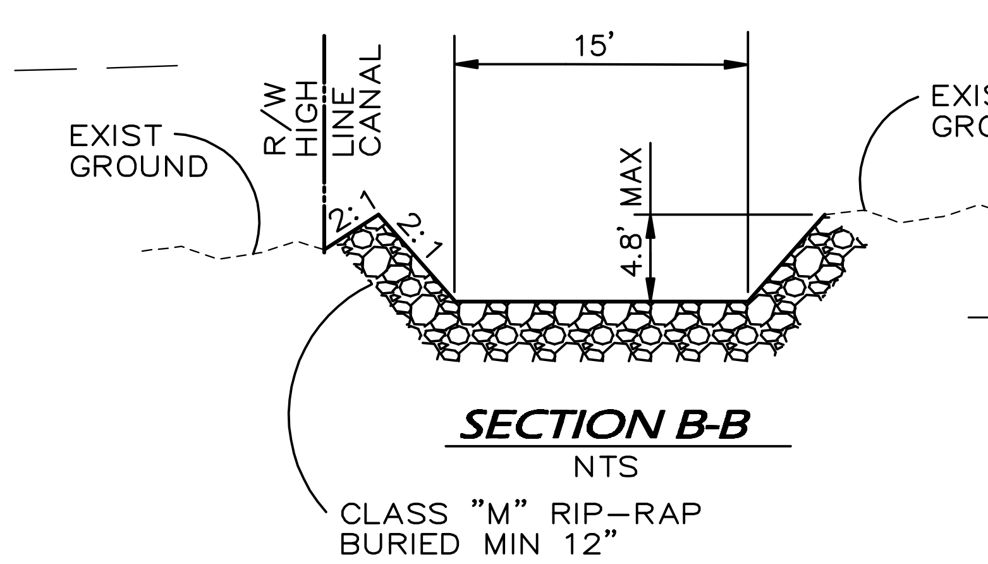
KEY MAP

NTS



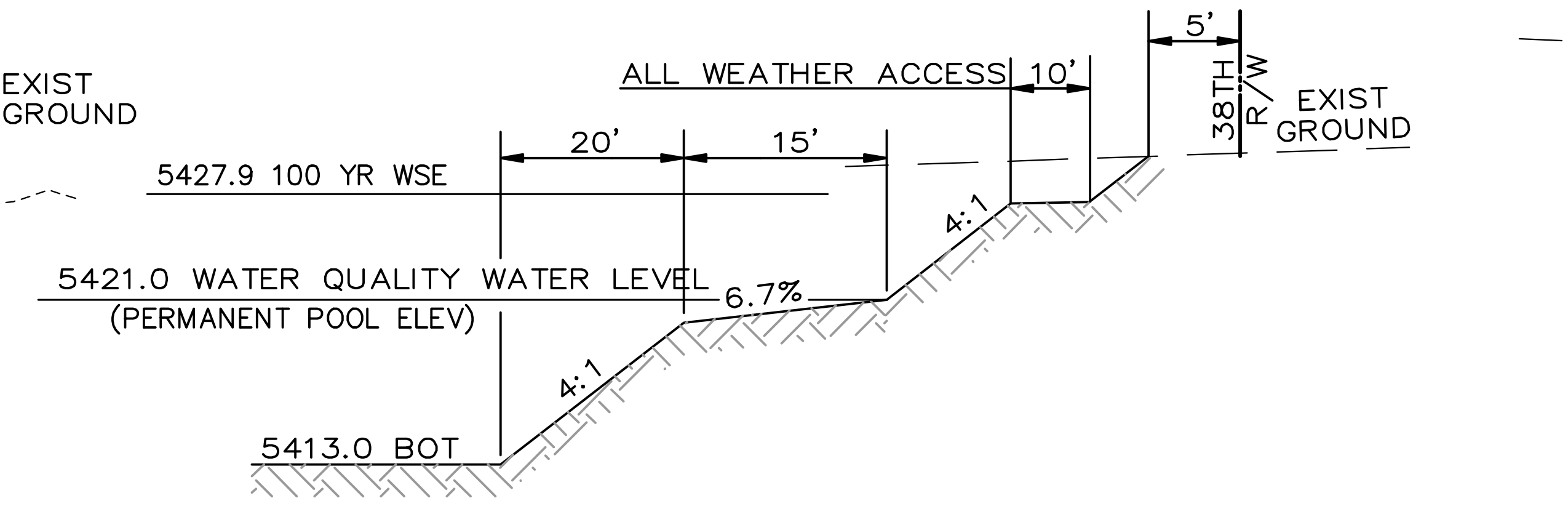
SECTION A-A

NTS



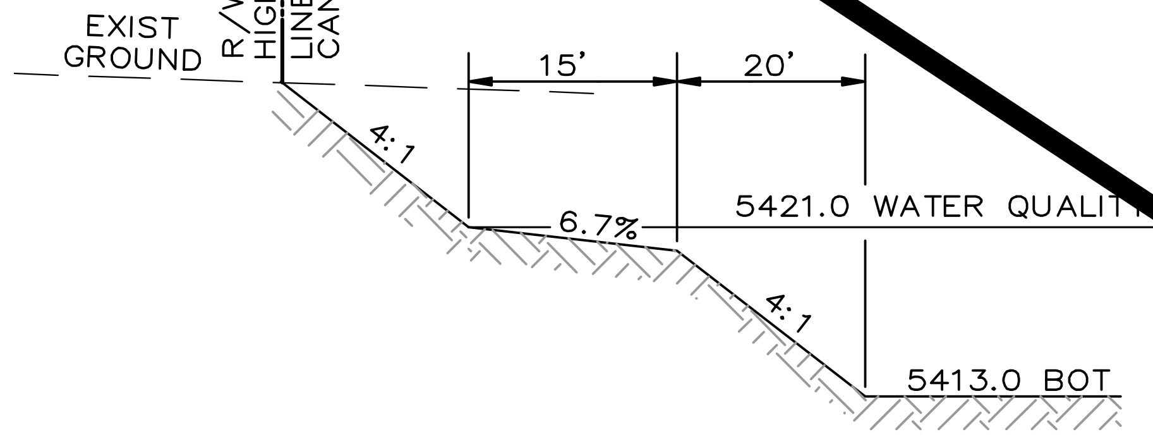
SECTION B-B

NTS



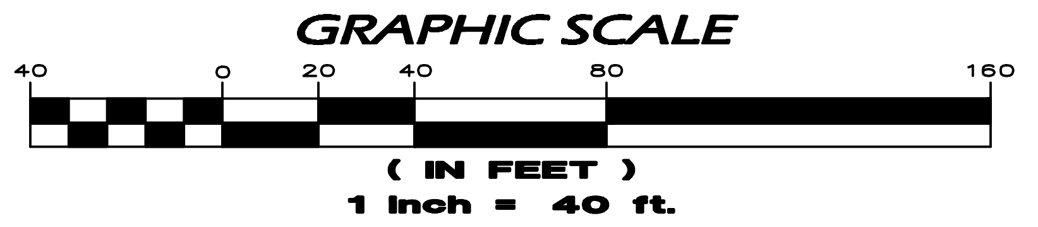
SECTION C-C

NTS



SECTION D-D

NTS



SIGNING FOR DETENTION POND OUTLET

THE DETENTION POND OUTLET IS DESIGNED TO CONTROL THE RELEASE RATES FROM THE POND. IT SHALL BE DESIGNED IN A WAY TO MINIMIZE UNAUTHORIZED MODIFICATIONS WHICH AFFECT PROPER FUNCTION. A SIGN WITH A MINIMUM AREA OF 0.75 SQUARE FEET SHALL BE ATTACHED TO THE OUTLET OR POSTED NEARBY WITH THE FOLLOWING MESSAGE:

"WARNING
UNAUTHORIZED MODIFICATION OF
THIS OUTLET IS A ZONING CODE VIOLATION"

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024

DATE

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

GRADING PLAN
DETENTION POND "IG-B" MODIFICATIONS
OUTFALL FACILITY
MAJESTIC COMMERCE CENTER

AURORA, COLORADO

PLAN DATE
02/27/14

OWNER

MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER

PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD,. STE 105-262
IRVINE, CALIF. 92620
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Sheet 2

C:\temp\MCC bldg 28\2025-1 POND IGA & IGB\IGB Rev 2 sht02-03-base_recover000.dwg Last Modified: 16 Jun 2014 - 4:02pm

APPROVED ON 06.27.14

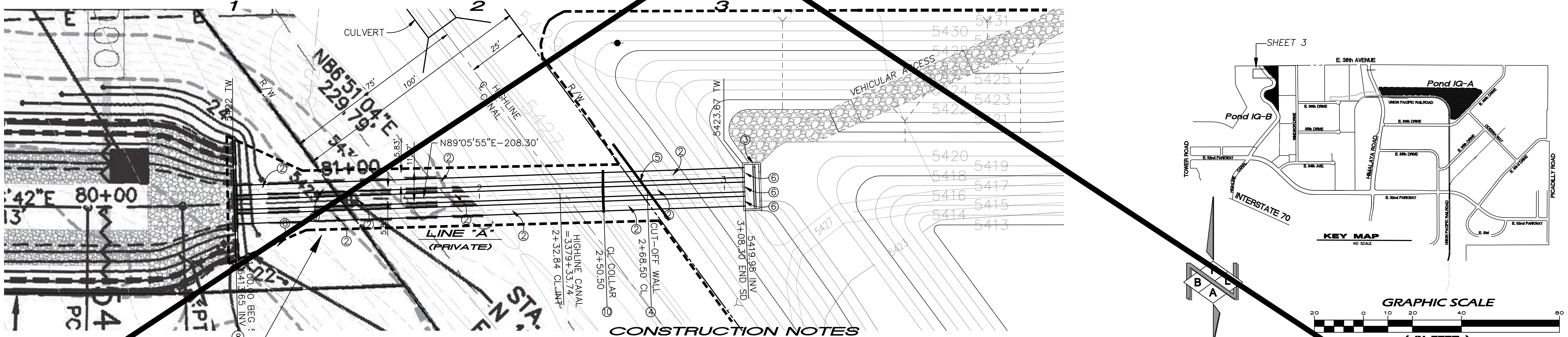
3

214070

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215145.

NOTE: CONTRACTOR TO VERIFY LOCATION AND ELEVATION OF TIE-IN POINT PRIOR TO CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES IN EXCESS OF 0.1'.

EXIST. GRADE @ CL OF PIPE
℄ HIGHLINE CANAL
R/W
PROPOSED F.S. @ CL OF PIPE
1+39.56 – R/W
PROPOSED F.S. @ CL OF PIPE
5422 TW
5426.0
HGL100
PROPOSED POND "IG-B" 100-YR WS ELEV = 5427.9
PROPOSED POND "IG-B" 10-YR WS ELEV = 5425.0
5425
3.1'
HGL100
NORMAL POOL ELEV = 5421.0
5420
PROPOSED F.S. @ CL OF PIPE
20' WIDE CHANNEL and RIP-RAP W/ 4:1 SIDE SLOPES TO DAYLIGHT TO BE COORDINATED WITH CITY OF AURORA BOLLING DR TRIBUTARY CHANNEL IMPROVEMENTS COA APPROVAL No. 212079
S=0.0020
S=0.0348
S=0.002
5415
35 LF
5415.48 INV
80+52.20 DOWNSTREAM
1+00.00 UPSTREAM = 5415.48 INV BEG SD
LINE "A" (PRIVATE)
Q=409 cfs
V=11.30 fps
2+32.84 CL INT CANAL 5415.75 INV
2+50.50 CL COLLAR AT CENTER PIPE 5415.78 INV
2+68.50 CL CUT-OFF WALL 5416.41 INV
3+08.30 END SD 5419.79 INV
5410
INSTALL 208.30 LF 1-48"(CENTER) and 2-42" CLASS III RCP
PROFILE SCALES VERT. 1"= 2' HORIZ. 1"=20'



LIMIT OF CONSTRUCTION

STORM DRAIN IMPROVEMENTS TO BE COORDINATED WITH BOLLING DR TRIBUTARY CHANNEL IMPROVEMENTS

CONSTRUCTION NOTES

① INSTALL 18" PVC STORM DRAIN (DIAMETER AND CLASS PER PROFILE) WITH CLASS B (MODIFIED) BEDDING
② INSTALL 1–48" and 2–42" R.C.P. STORM DRAIN (DIAMETER AND CLASS PER PROFILE) WITH CLASS B (MODIFIED) BEDDING, BACKFILL WITH FLOWABLE, LOW STRENGH CONCETE TO SPRINGLINE
③ CONST. INLET STRUCTURE W/ TRASH RACK – PER DETAILS SHT 9 – 13 (PRIVATE)
④ CONST 10" THICK CONC. CUT-OFF WALL PER DENVER WATER STANDARD DRAWINGS FOR CANAL CROSSING Dr. 127 No. 35
⑤ CONST. MARKER POST PER DENVER WATER STDS. & SPECS.
⑥ CONST. TEMP BRICK & MORTAR PLUG – PER DETAIL SHT 14
⑦ CONST. CONC. END SECTION FOR 18" RCP PER CDOT STD. M-603-10
⑧ CONST. HEADWALL PER CDOT STD. M-601-10 – PER DETAIL SHT 12 (MODIFY AS NEEDED FOR 3 PIPE CONNECTION)
⑨ CONST. CSP RISER INLET – PER DETAILS SHT 14
⑩ CONST. CONCRETE COLLAR – PER DETAIL SHT 14

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

THE DEVELOPER SHALL HAVE A REGISTERED LAND SURVEYOR OR REGISTERED PROFESSIONAL ENGINEER CERTIFY THAT THE DETENTION POND IS BUILT ACCORDING TO THE APPROVED PLANS AND SPECIFICATIONS, AND THAT THE REQUIRED DETENTION VOLUME, INCLUDING THE WQCV WHEN USED, IS MET. THE CERTIFICATION SHALL SHOW THE AS-BUILT VOLUMES AND SHALL BE PROVIDED TO THE CITY OF AURORA ENGINEERING CONTROL SECTION SENIOR ENGINEER BEFORE A CERTIFICATE OF OCCUPANCY CAN BE ISSUED.

PREPARED UNDER THE SUPERVISION OF:

HAYWARD PARDUE 31024

HAYWARD PARDUE P.E. # 31024 DATE

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA
STORM DRAIN PLANS
POND IG-B OUTFALL
MAJESTIC COMMERCENTER
AURORA, COLORADO

PLAN DATE 04/22/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD,. STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 3

C:\temp\MCC bldg 28\2025-1 POND IGA & IGB\sht09-10-sd_recover.dwg Last Modified: 19 Jun 2014 – 11:49am
Plotted on: 19 Jun 2014 – 11:57am by Hayward Pardue

APPROVED ON 06.27.14

4

214070

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215145.

NOTE: CONTRACTOR TO VERIFY LOCATION AND ELEVATION OF TIE-IN POINT PRIOR TO CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES IN EXCESS OF 0.1'

SHEET 4
E. 38th AVENUE
Pond IG-A
Pond IG-B
UNION PACIFIC RAILROAD
E. 36th DRIVE
35th DRIVE
KEY MAP
NO SCALE
EXIST. GRADE
PROPOSED F.S.
@ CL OF PIPE
2.50%
PROPOSED POND "IG-B"
10-YR WS ELEV = 5425.0
PROPOSED POND "IG-B"
PERM POND ELEV = 5421.0
PROPOSED POND "IG-B" BOTTOM ELEV = 5413.0
5425
5420
5415
5410
S=0.0092
5+35.92 END SD
5416.95 INV
5+30.92 BEG CSP, END RCP
CL COLLAR
5416.90 INV
4+03.21-ANG PT
5415.88 INV
LINE "B"
(PRIVATE)
Q & V NOT CALCULATED
(LOW FLOW TRANSFER ONLY)
2+36.86-ANG PT
5414.03 INV
1+00.00 BEG SD
5412.95 INV
INSTALL 5.00 LF 18" CSP
PER DETAIL 9, SHEET 11
INSTALL 430.92 LF 18" PVC SDR-35
PROFILE SCALES
VERT. 1"= 2'
HORIZ. 1"=20'
5
4
3
2
1
HIGHLINE CANAL
R/W
25'
18" CSP SD PER DETAIL 9, SHEET 14
N10°20'08"E-435.72'
N00°54'52"W-166.35'
N23°24'52"W-136.86'
5+35.92 END SD
5416.95 INV
5+32.42 END RCP
BEG CSP, CL COLLAR
4+03.21 ANG PT (11.25')
2+36.86 ANG PT (22.5')
1+00.00 BEG SD
5412.95 INV
FG
GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

CONSTRUCTION NOTES

① INSTALL 18" PVC STORM DRAIN (DIAMETER AND CLASS PER PROFILE) WITH CLASS B (MODIFIED) BEDDING
② INSTALL 48" R.C.P. STORM DRAIN (DIAMETER AND CLASS PER PROFILE) WITH CLASS B (MODIFIED) BEDDING
③ CONST. INLET STRUCTURE W/ TRASH RACK – PER DETAILS SHT 9–11 (PRIVATE)
④ CONST 10" THICK CONC. CUT–OFF WALL PER DENVER WATER STDS. FOR CANAL CROSSING
⑤ CONST. MARKER POST PER DENVER WATER STDS. & SPECS.
⑥ CONST. TEMP BRICK & MORTAR PLUG – PER DETAIL SHT 14
⑦ CONST. CONC. END SECTION FOR 18" RCP PER CDOT STD. M–603–10 WITH 3 FT CUT–OFF (TOE) WALL PER CDOT M–601–20
⑧ CONST. HEADWALL PER CDOT STD. M–601–10 – PER DETAIL SHT 14 (MODIFY AS NEEDED FOR 3 PIPE CONNECTION)
⑨ CONST. CSP RISER INLET – PER DETAILS SHT 14
⑩ CONST. CONCRETE COLLAR – PER DETAIL SHT 14

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

THE DEVELOPER SHALL HAVE A REGISTERED LAND SURVEYOR OR REGISTERED PROFESSIONAL ENGINEER CERTIFY THAT THE DETENTION POND IS BUILT ACCORDING TO THE APPROVED PLANS AND SPECIFICATIONS, AND THAT THE REQUIRED DETENTION VOLUME, INCLUDING THE WQCV WHEN USED, IS MET. THE CERTIFICATION SHALL SHOW THE AS–BUILT VOLUMES AND SHALL BE PROVIDED TO THE CITY OF AURORA ENGINEERING CONTROL SECTION SENIOR ENGINEER BEFORE A CERTIFICATE OF OCCUPANCY CAN BE ISSUED.

PREPARED UNDER THE SUPERVISION OF:

HAYWARD PARDUE 31024

HAYWARD PARDUE P.E. # 31024

06/04/14
DATE

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16–14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH–SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA
STORM DRAIN PLANS
POND IG-B OUTFALL
MAJESTIC COMMERCENTER
AURORA, COLORADO

PLAN DATE
04/22/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371–1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD,. STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 4

C:\temp\MCC bldg 28\2025-1 POND IGA & IGB\sht09-10-sd_recover.dwg Last Modified: 02 Jun 2014 – 10:27am
Plotted on: 02 Jun 2014 – 12:12pm by Hayward Pardue

APPROVED ON 06.27.14

NOTE: CONTRACTOR TO VERIFY LOCATION AND ELEVATION OF EXISTING UTILITES PRIOR TO CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES

OF PIPE
PROPOSED TOP OF CHANNEL
EXIST. GROUND
PROPOSED TOP OF CHANNEL
5450
5440
5430
5420
(5447.0) TW
5447.2 TW
HGL100
5439.75 INV
S=0.0027
S=0.0020
S=0.0020
S=0.0020
8" SEW
436.6 6" WAT
(5437.3) BW
(5437.4) BOT CUT-OFF WALL
12" WAT
5437.7 BW
Q100=435 CFS V=7.17 FPS
1380.37 LF GRADED OPEN CHANNEL SEE TYPICAL CROSS SECTION HEREON
PROPOSED BOTTOM OF CHANNEL
JOIN EXIST. BOX CULVERT 15+77.12–REMOVE HEADWALL (5439.29) INV, GB
15+87.12–REMOVE EXIST. HEADWALL and APRON
17+31.65–END BOX CLVT 5439.71 INV
Q100=435 CFS V=6.53 FPS
16 17 18 19 20 21 22 23 24 25 26 27 28 29

PROFILE SCALES
HORIZ: 1" = 40'
VERT: 1" = 4'

FUTURE DRAINAGE EASEMENT
14' 4' 14' 12'
HGL100
29.2'
5.9'
1 2
7'
3 1
MAINTENANCE PATH
SECTION "A"
NTS
Limits of Construction
REMOVE EXISTING TRIPLE 5 X 7 BOX CULVERT
12' MAINTENANCE PATH
SEE SHEET 6
BC = 17+95.73
17+31.65 BEGIN CHANNEL END 2 - 5'x8' BOX CULVERT
PRC = 18+44.09
EC = 20+17.08
BC = 23+24.45
PRC = 24+31.59
13
A
WINDSOR DRIVE
E. 38th AVENUE
SHEET 5
Pond IG-A
Pond IG-B
UNION PACIFIC RAILROAD
E. 36th DRIVE
35th DRIVE
E. 35th DRIVE
WINDSOR DRIVE
HIMALAYA ROAD
ODESSA WAY
KEY MAP
NO SCALE

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

CONSTRUCTION NOTES

⑬ INSTALL 12" MIN CLASS M RIP–RAP WITH 2 FT THICKNESS

PREPARED UNDER THE SUPERVISION OF:

HAYWARD PARDUE P.E. # 31024 | 06/04/14 DATE

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BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16–14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH–SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

CHANNEL EXTENSION
MAJESTIC COMMERCENTER
TO DETENTION POND IG-A

AURORA, COLORADO

PLAN DATE
06/02/2014

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371–1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD,. STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 5

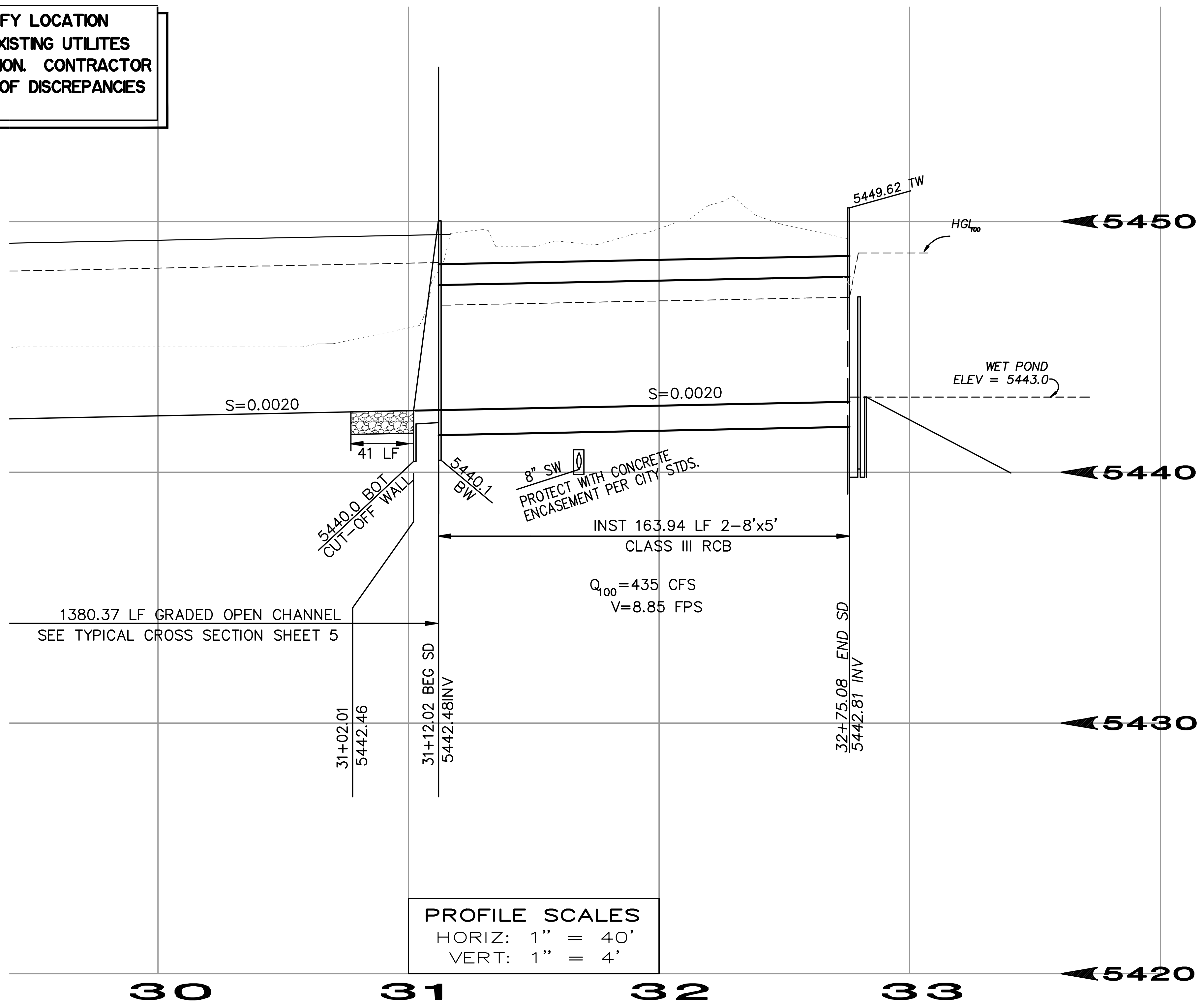
C:\temp\MCC bldg 28\2025–1 POND IGA & IGB\IGB channel base re align 1f_recover.dwg Last Modified: 04 Jun 2014 – 9:39am

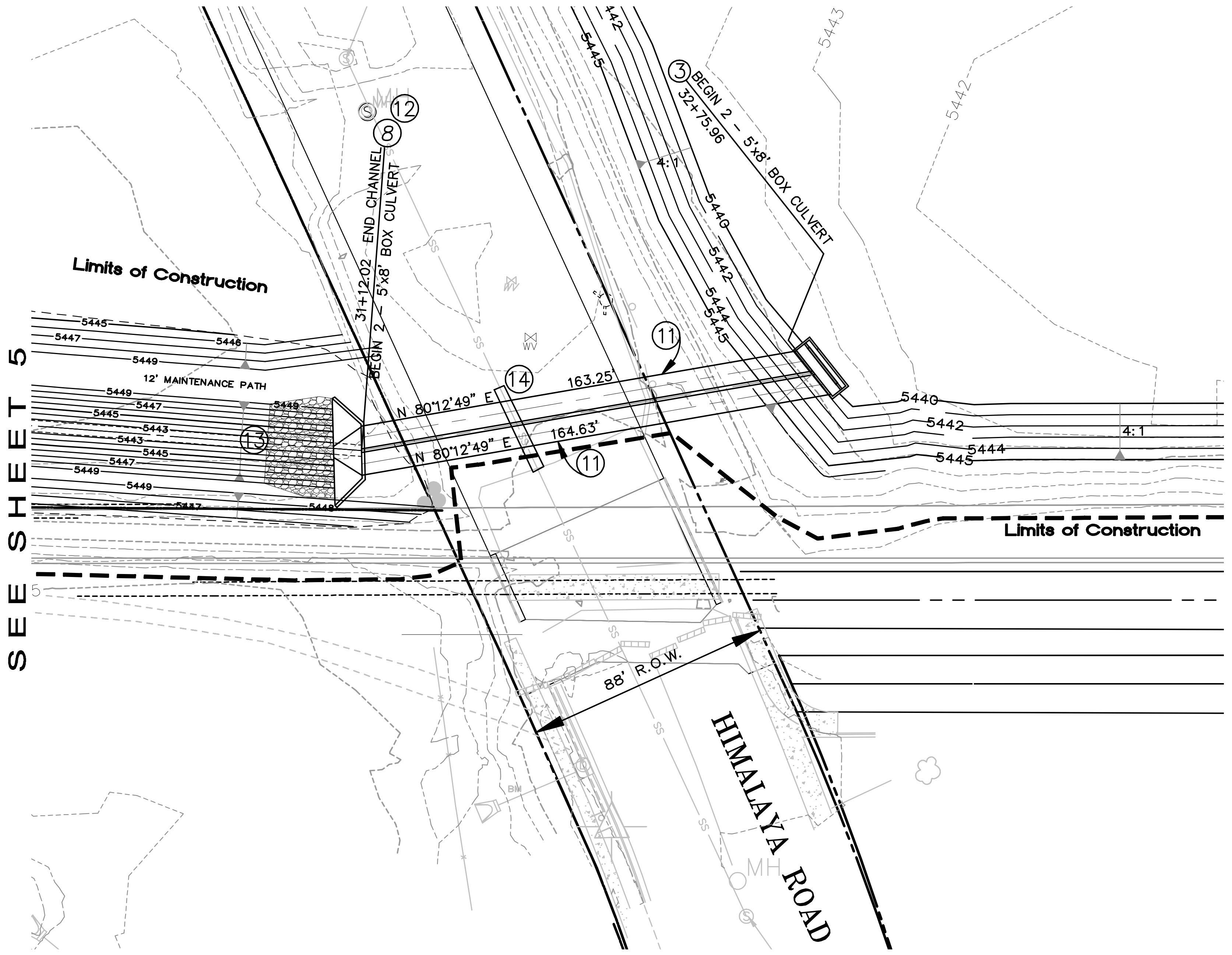
APPROVED ON 06.27.14

NOTE: CONTRACTOR TO VERIFY LOCATION AND ELEVATION OF EXISTING UTILITES PRIOR TO CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES

6

214070

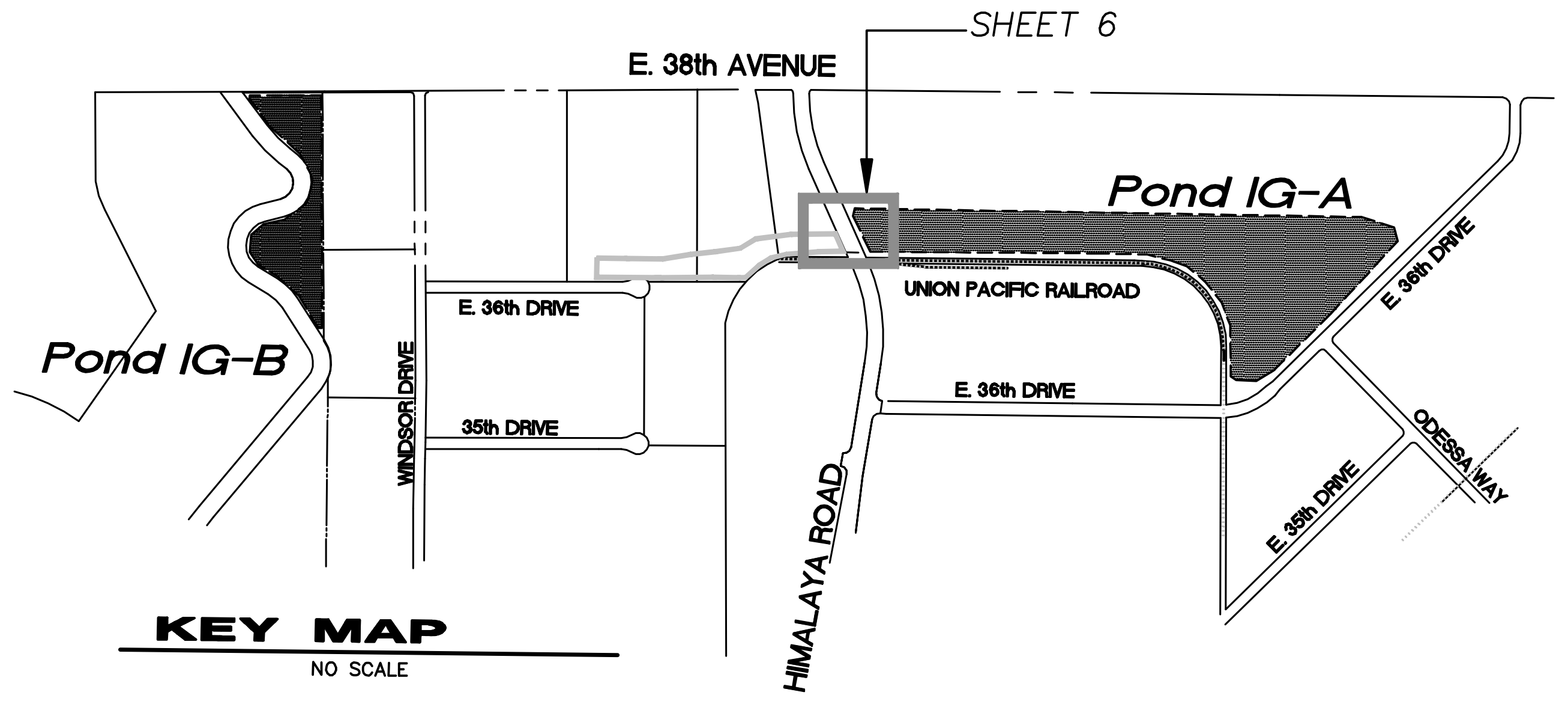




GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.



KEY MAP
NO SCALE

CONSTRUCTION NOTES

③— *CONST. INLET STRUCTURE W/ TRASH RACK – PER DETAILS SHT 9 – 13 (PRIVATE)*
⑧— *CONST. HEADWALL PER CDOT STD. M-601-10 – PER DETAIL SHT 12*
⑪— CONST. 8' x 5' R.C.B. STORM DRAIN WITH CLASS B BEDDING PER CDOT STD. M-601-1
⑫— CONSTRUCT WINGWALL PER CDOT STANDARD M-601-20 – SEE DETAIL ON SHEET 12
⑬— INSTALL 12" MIN CLASS M RIP-RAP WITH 2 FT THICKNESS
⑭— CONSTUCT CONCRETE ENCASEMENT TO PROTECT EXISTING SEWER PER CITY STANDARD

PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024

06/04/14
DATE

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APPROVED ON 06.27.14

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

STORM DRAIN
MAJESTIC COMMERCENTER
DETENTION POND IG-A OUTFALL

AURORA, COLORADO

PLAN DATE
06/02/2014

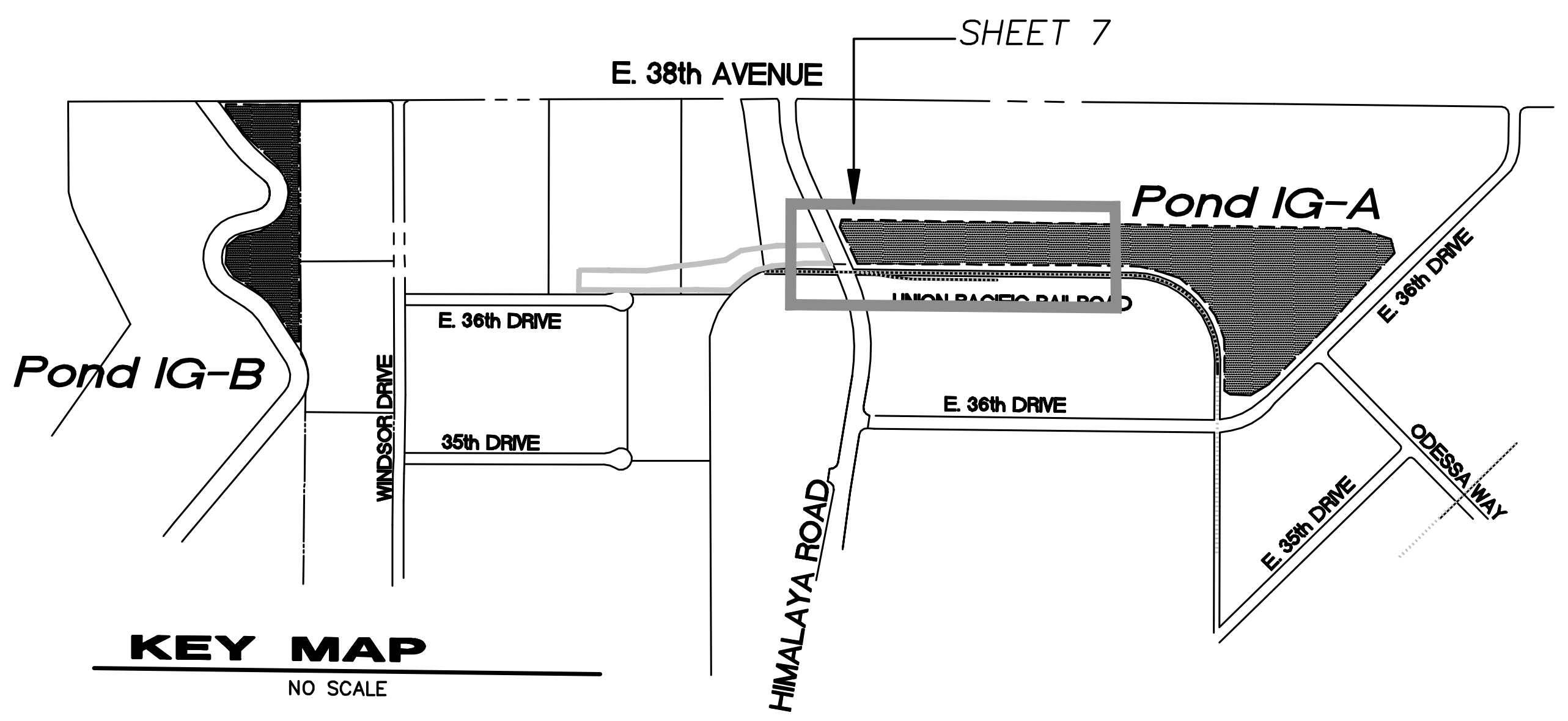
OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD., STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 6

C:\temp\MCC bldg 28\2025-1 POND IGA & IGB\IGB channel base re align 1f_recover.dwg Last Modified: 04 Jun 2014 - 9:35pm

SEE EMERGENCY OVERFLOW DETAIL SHEET 14
Limits of Construction
DETENTION POND IG-A
(PRIVATE)
INFLOW 1,470 CFS
OUTFLOW: 435 CFS
MAX ELEV 5449
MAX DEPTH 9.0'
BOTTOM ELEV = 5440
WET POND ELEV = 5443
(0.00 AC-FT REQ, 31.2 AC-FT PROVIDED)
MAX AVAILABLE DETENTION STORAGE 74.96 ACRE-FT
100 YR DETENTION REQUIREMENT= 57.2 AC-FT
100 YR W.S. ELEV=5447.6
10 YR W.S. ELEV=5443.8
BEGIN 2 - 5'x8' BOX CULVERT 32+75.96
31+12.02 END CHANNEL BEGIN 2 - 5'x8' BOX CULVERT
CIP
N 80°12'49" E 163.25'
N 80°12'49" E 164.63'
MAINTENANCE ACCESS FROM HIMALAYA RD
88' R.O.W.
HIMALAYA ROAD
EXISTING RAIL LINE
SEE SHEET 8
5440
5441
5442
5443
5444
5445
5450
4:1



KEY MAP
NO SCALE

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

PREPARED UNDER THE SUPERVISION OF:
31024
HAYWARD PARDUE P.E. # 31024
DATE

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

OVERLOT GRADING PLAN
MAJESTIC COMMERCENTER
DETENTION POND IG-A

AURORA, COLORADO

PLAN DATE
06/02/2014

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

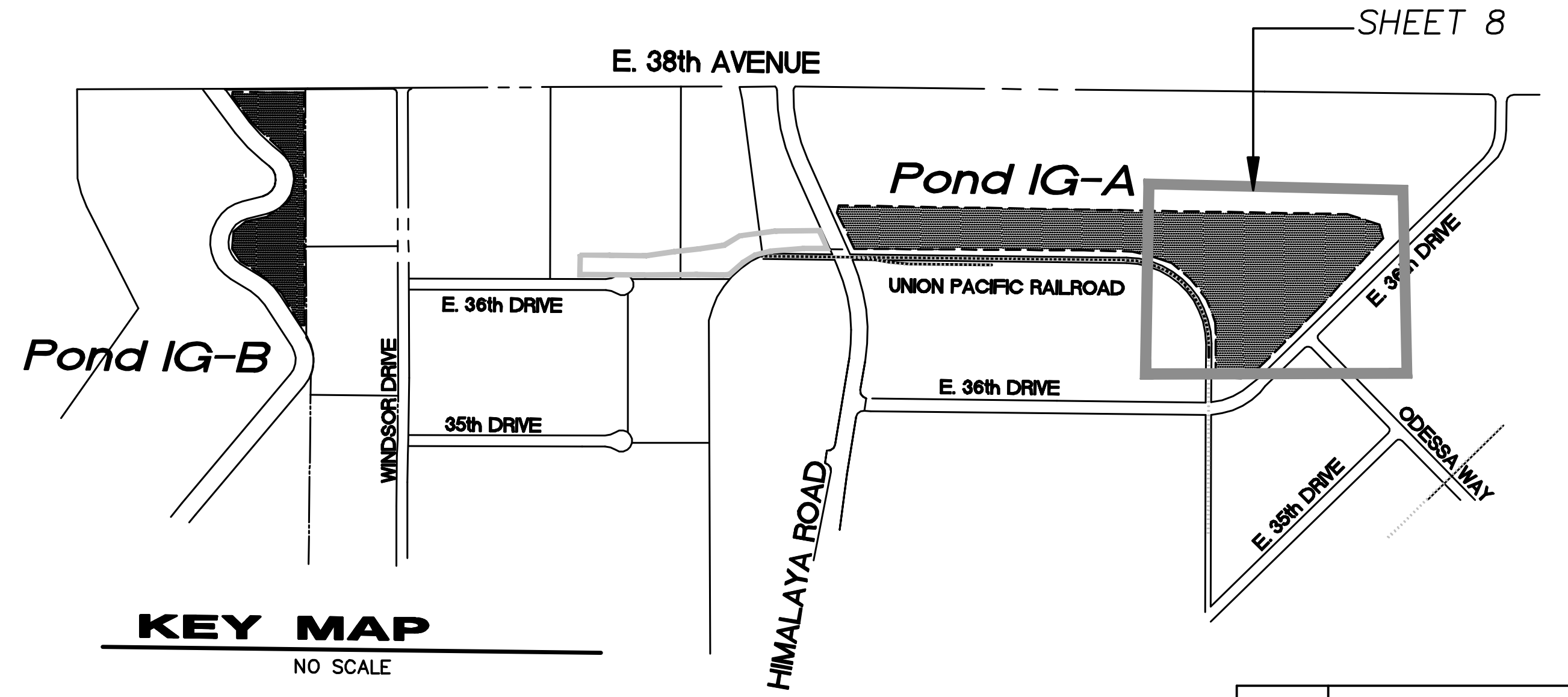
ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD., STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 7

APPROVED ON 06.27.14

214070

SEE SHEET 7
Limits of Construction
DETENTION POND IG-A
(PRIVATE)
INFLOW 1,470 CFS
OUTFLOW: 435 CFS
MAX ELEV 5449
MAX DEPTH 9.0'
BOTTOM ELEV = 5440
WET POND ELEV = 5443
(0.00 AC–FT REQ, 31.2 AC–FT PROVIDED)
MAX AVAILABLE
DETENTION STORAGE
74.4 ACRE–FT
100 YR DETENTION
REQUIREMENT= 57.2 AC–FT
100 YR W.S. ELEV=5447.6
10 YR W.S. ELEV=5443.8
5440
5441
5442
5443
5444
5445
5446
5448
5450
5452
5454
5456
5451
4:1
EXISTING RAIL LINE
13
MAINTENANCE ACCESS FROM 36TH DRIVE



KEY MAP
NO SCALE

CONSTRUCTION NOTES

⑬—INSTALL 12" MIN CLASS M RIP–RAP WITH 2 FT THICKNESS

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

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PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024 DATE

BENCH MARK

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ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

OVERLOT GRADING PLAN
MAJESTIC COMMERCENTER
DETENTION POND IG-A

AURORA, COLORADO

PLAN DATE
06/02/2014

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
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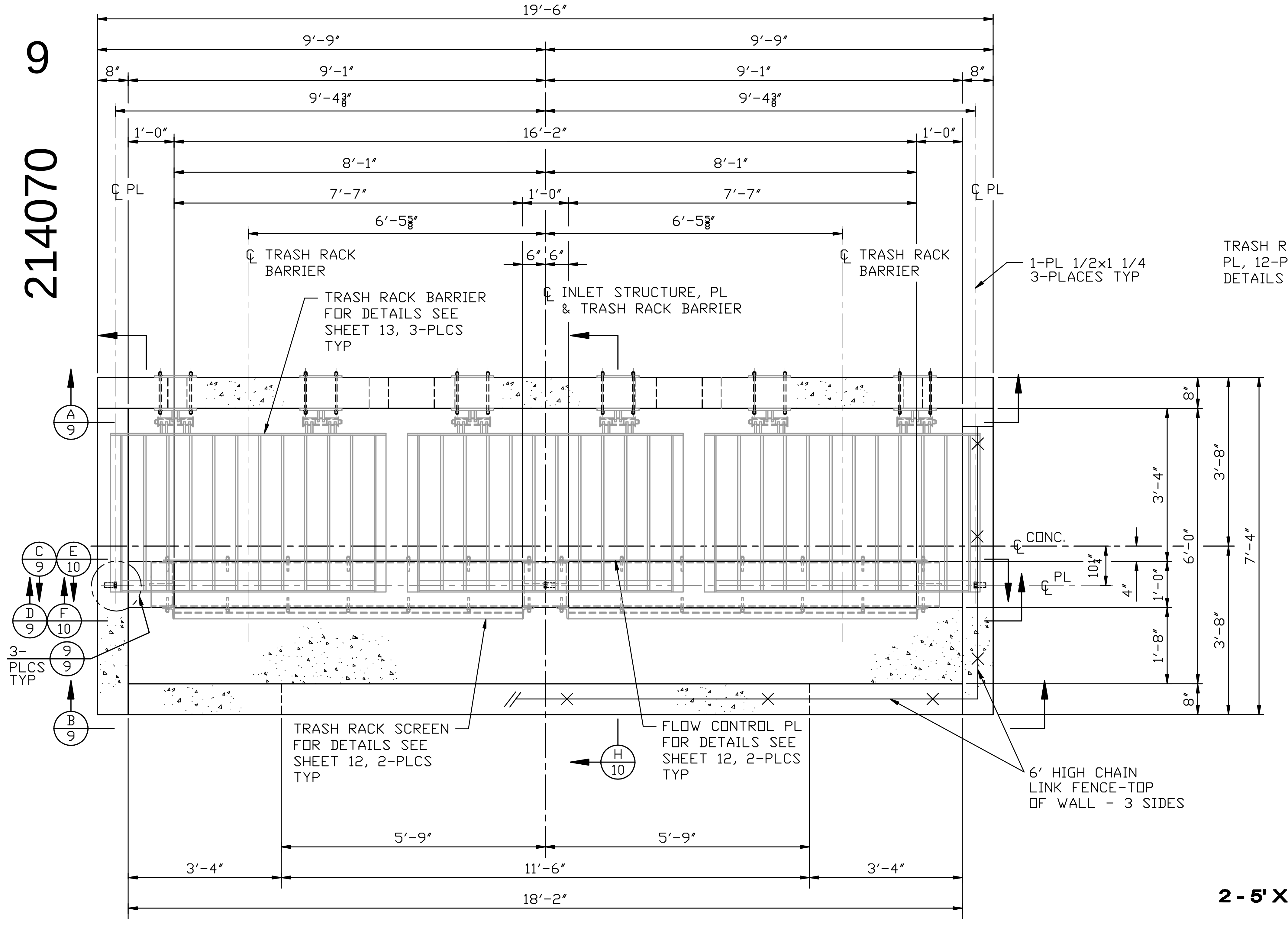
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 8

APPROVED ON 06.27.14

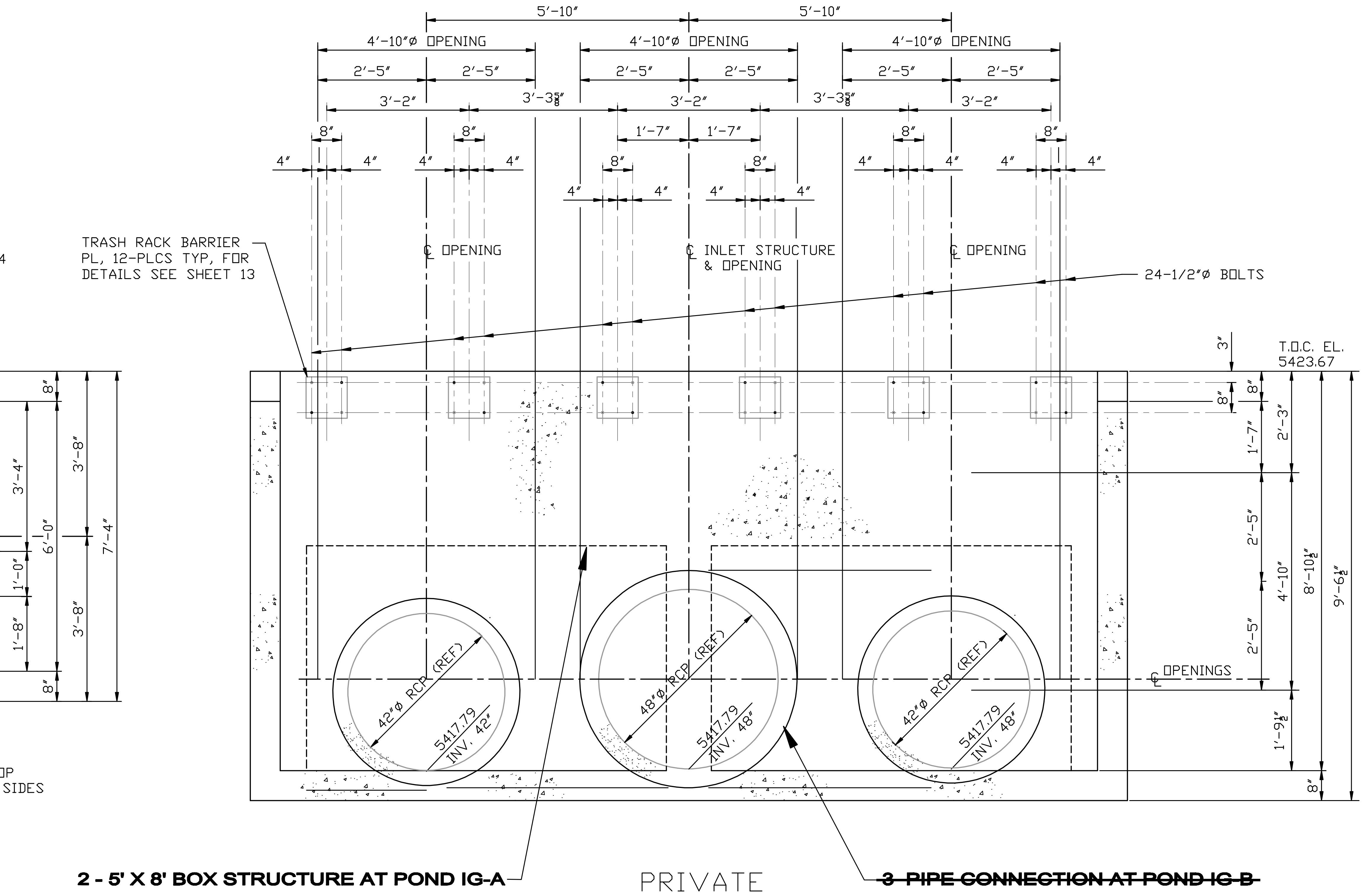
9

214070



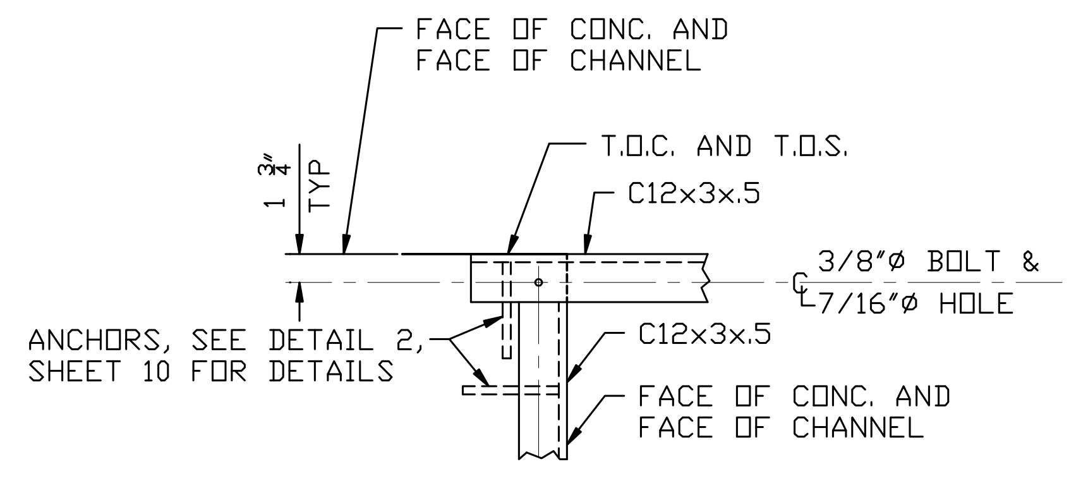
PRIVATE
INLET STRUCTURE

PLAN
1/2"=1'-0"



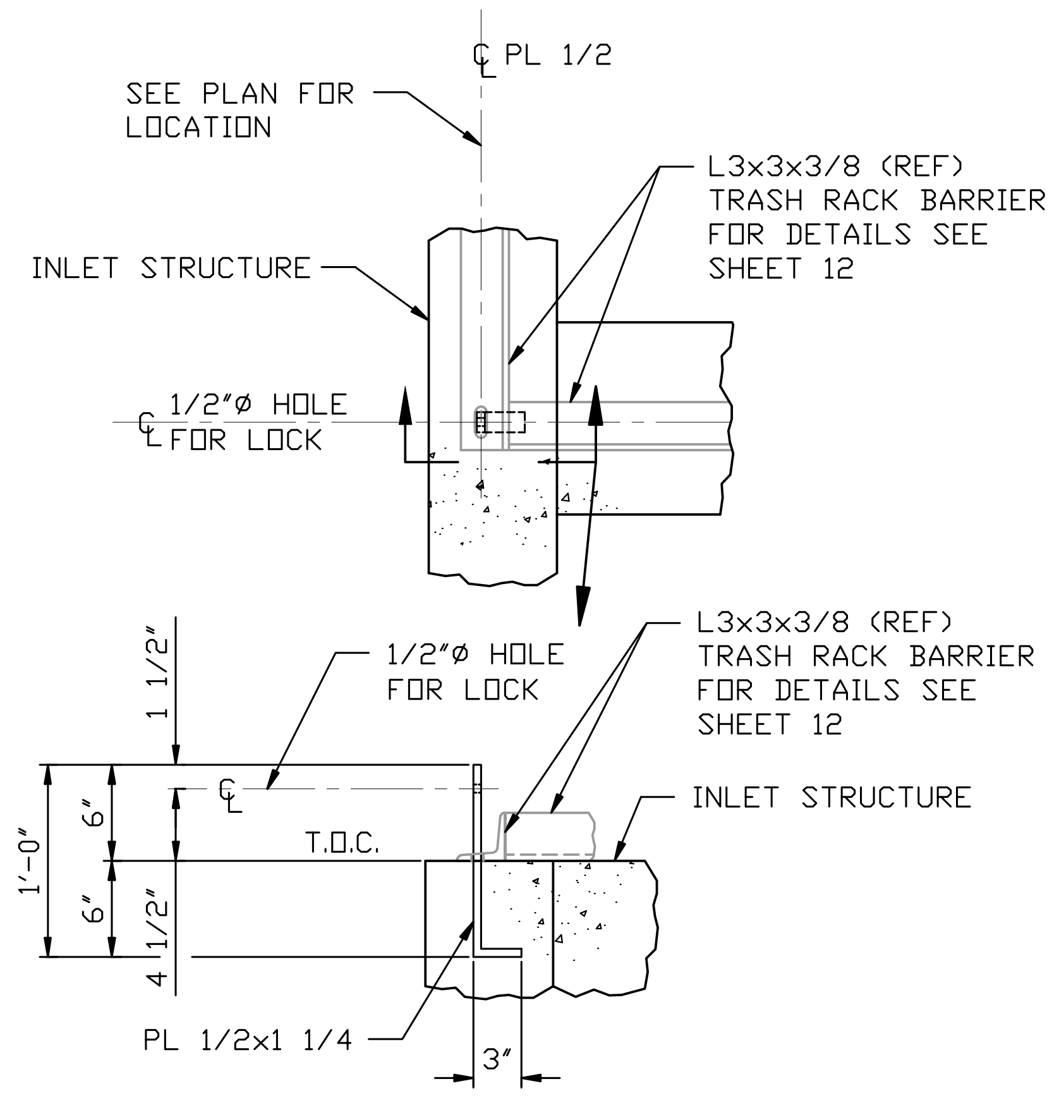
PRIVATE
INLET STRUCTURE

A 9 SECTION
1/2"=1'-0"



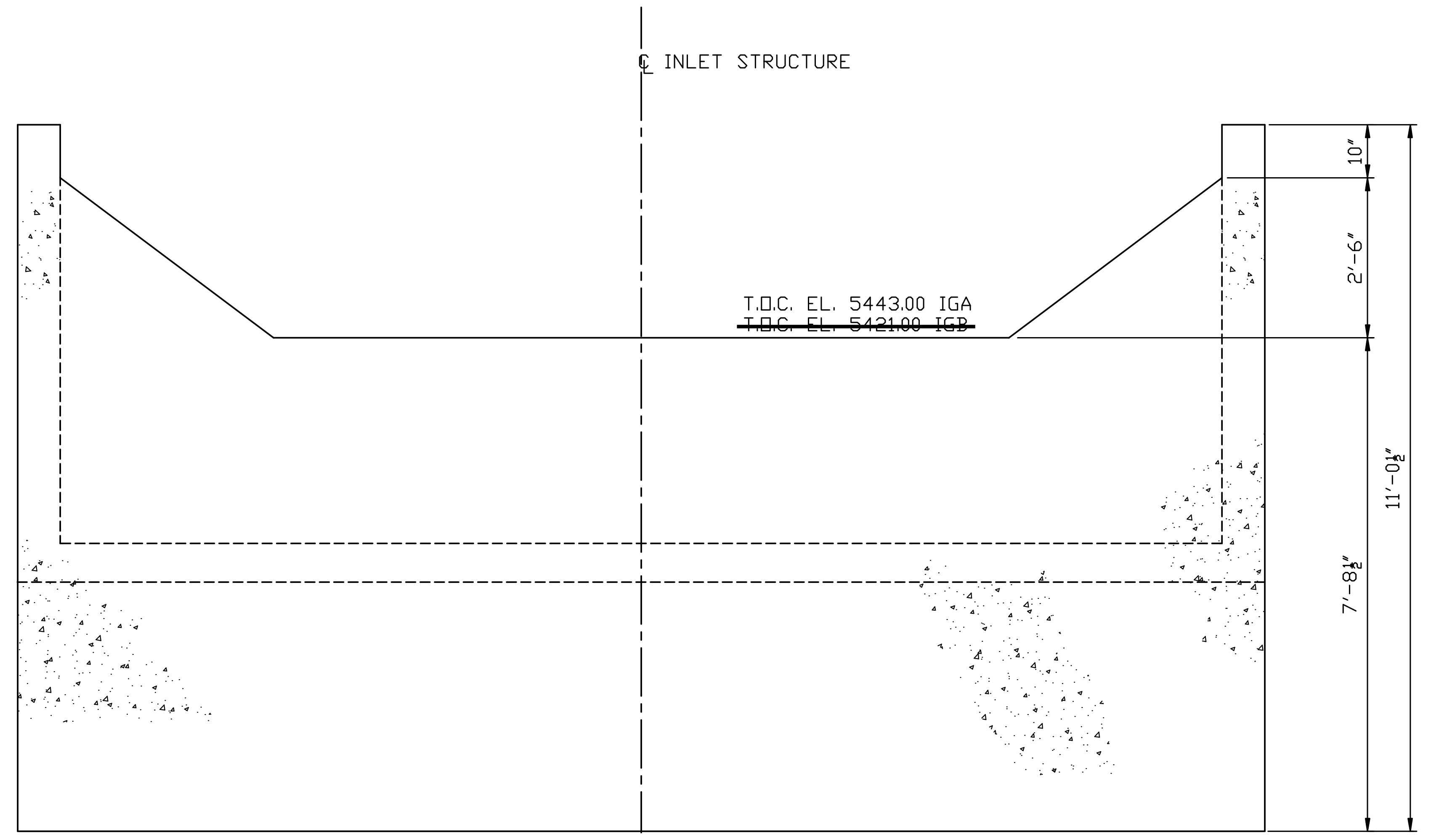
FACE OF CONC. AND FACE OF CHANNEL
1 3/4" TYP
T.O.C. AND T.O.S.
C12x3x5
3/8"ø BOLT & 7/16"ø HOLE
ANCHORS, SEE DETAIL 2, SHEET 10 FOR DETAILS
C12x3x5
FACE OF CONC. AND FACE OF CHANNEL

1 9 DETAIL
1"=1'-0"



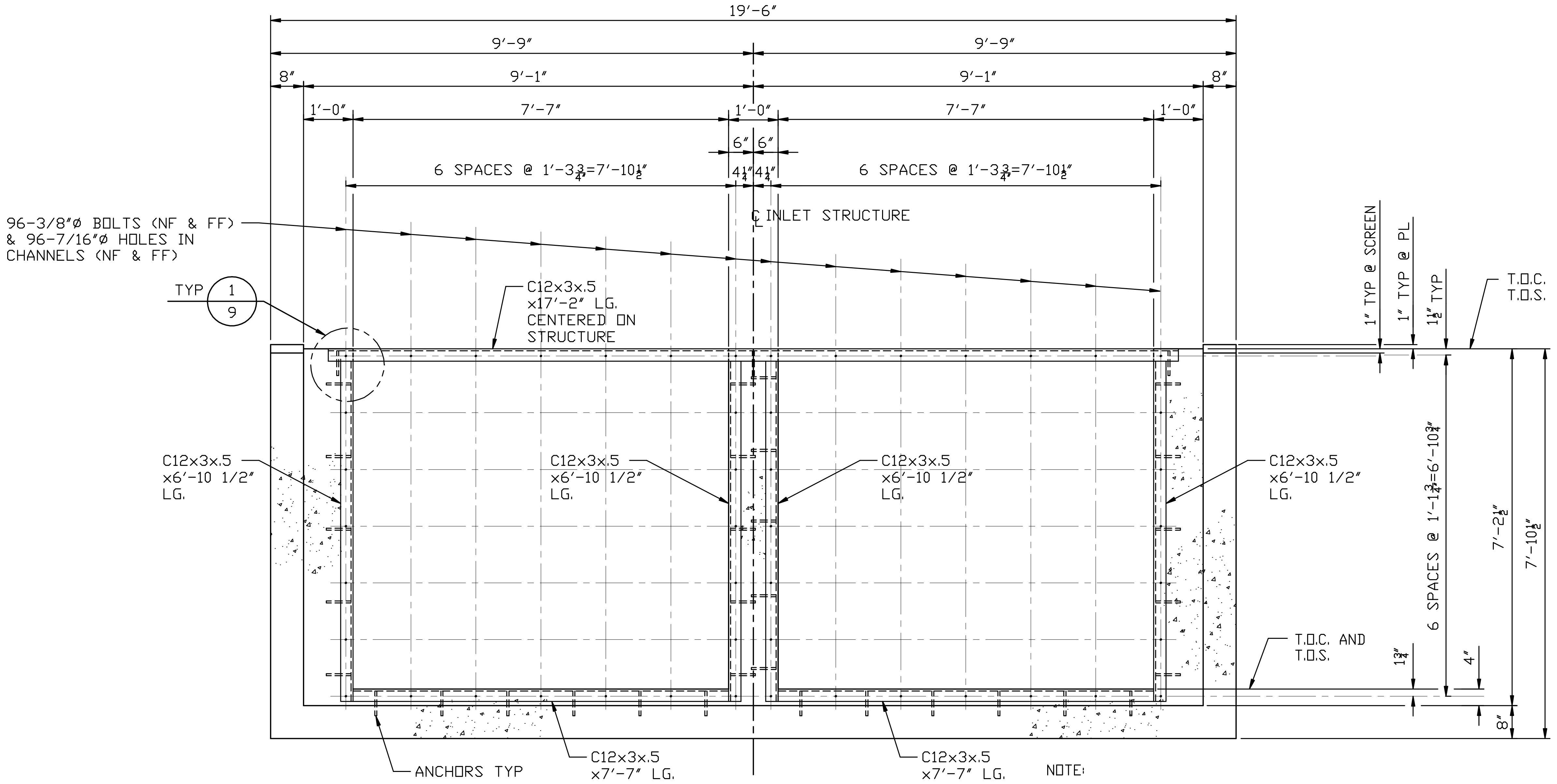
9 9 DETAIL
1"=1'-0"
3-PLATES REQUIRED

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215XXX.



PRIVATE
INLET STRUCTURE

B 9 SECTION
1/2"=1'-0"



NOTE:
FOR DETAILS NOT SHOWN
SEE PLAN, THIS SHEET

PRIVATE
INLET STRUCTURE

C 9 D 9 SECTION
1/2"=1'-0"

NOTES:
1. ALL STRUCTURAL CONCRETE SHALL BE 3500 psi COMPRESSIVE STRENGTH CONCRETE.
2. ALL STRUCTURAL STEEL SHALL CONFORM TO CDOT STD. M-601-10.
3. ALL STRUCTURAL STEEL SHALL BE HOT-DIPPED GALVANIZED STEEL OR ALUMINUM.

APPROVED ON 06.27.14

THIS IS A FACSIMILE OF A SIGNED AND SEALED
DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

PREPARED UNDER THE SUPERVISION OF:
31024
HAYWARD PARDUE P.E. # 31024
DATE

BENCH MARK
CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

CITY OF AURORA
PRIVATE INLET DETAILS
POND IG-B OUTFALL
MAJESTIC COMMERCENTER
AURORA, COLORADO
PLAN DATE 06/02/14

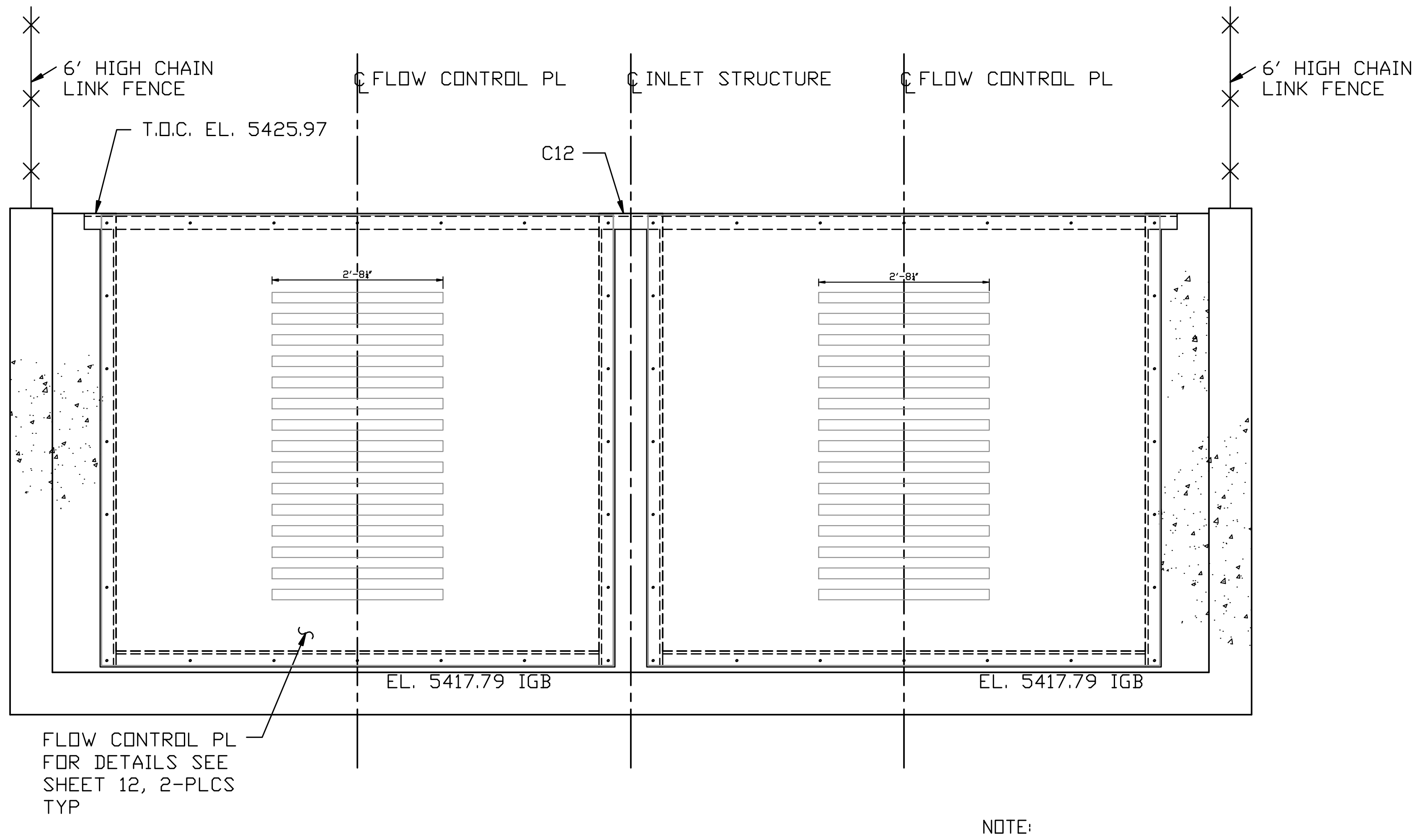
OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD., STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 9

10

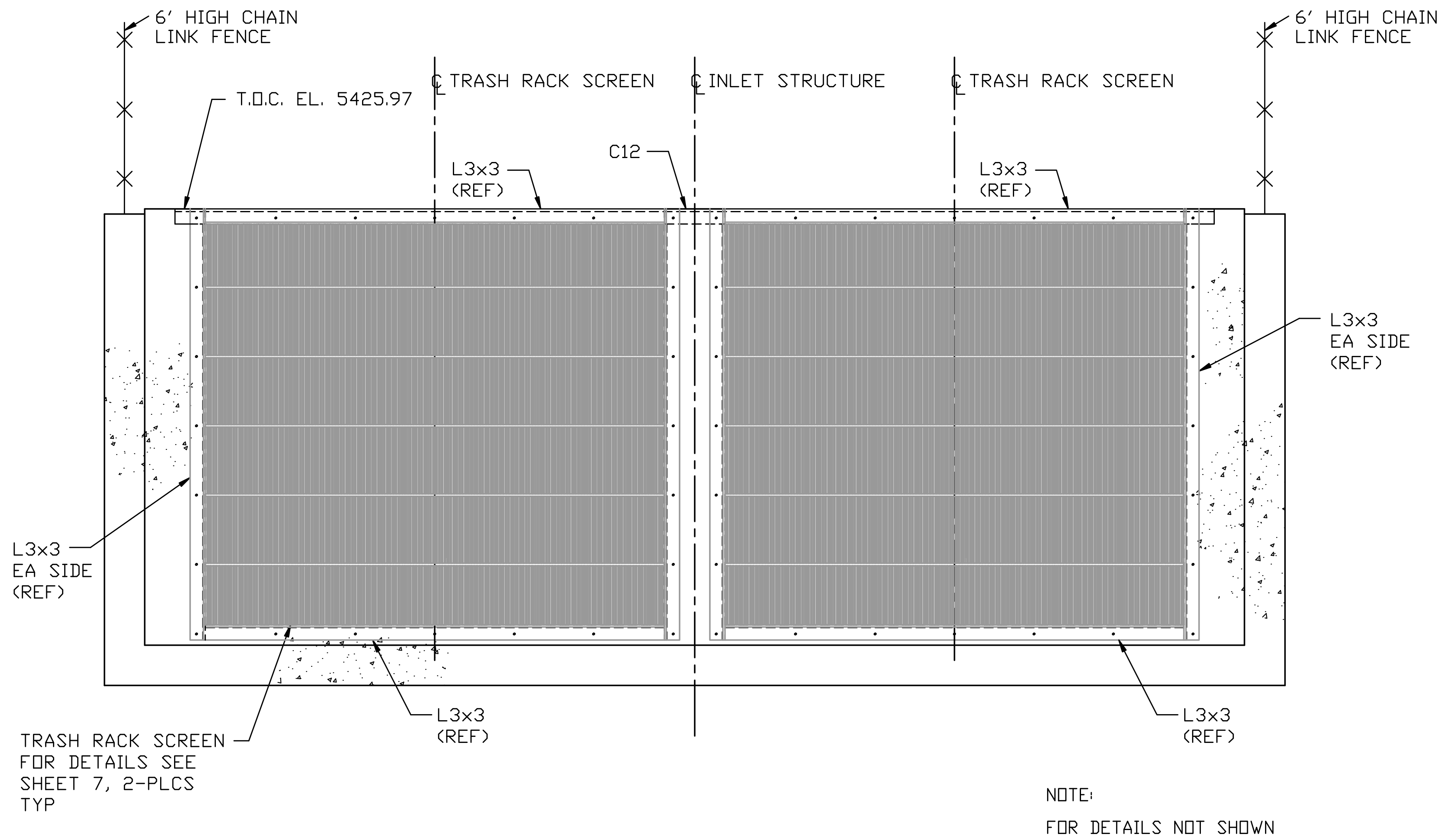
214070



NOTE:
FOR DETAILS NOT SHOWN
SEE SHEET 9

PRIVATE
INLET STRUCTURE

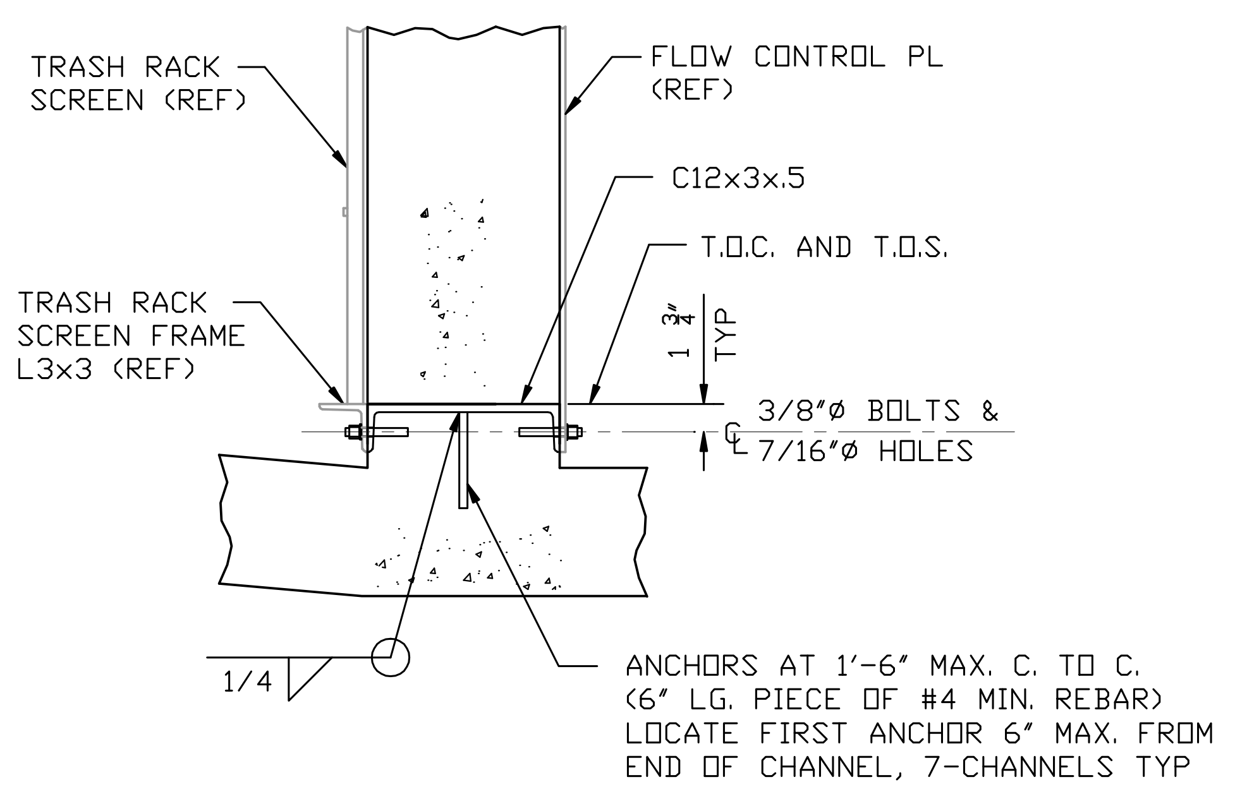
E
10
SECTION
1/2"=1'-0"



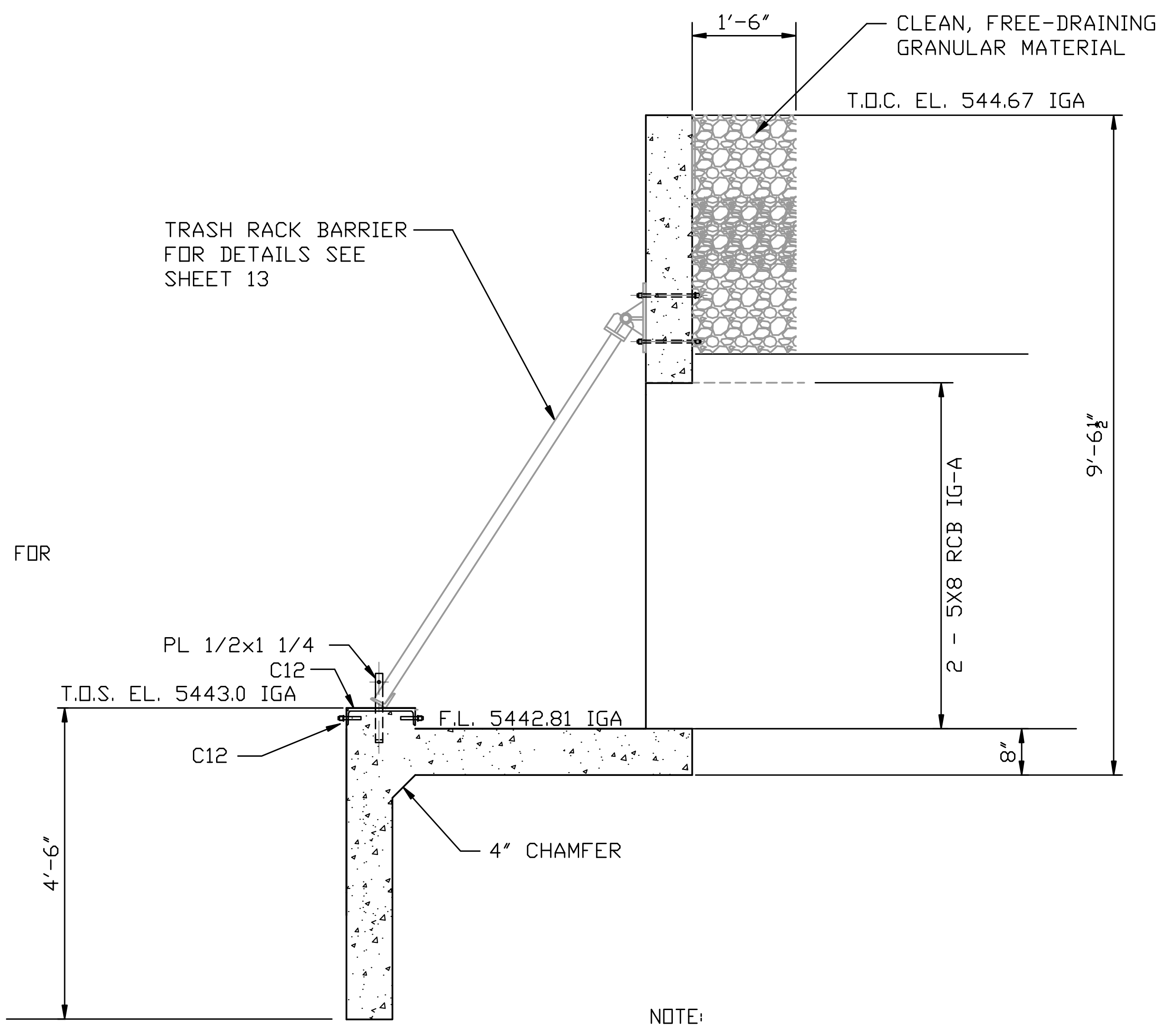
NOTE:
FOR DETAILS NOT SHOWN
SEE SHEET 9

PRIVATE
INLET STRUCTURE

F
10
SECTION
1/2"=1'-0"


TRASH RACK SCREEN (REF)
FLOW CONTROL PL (REF)
C12x3x.5
T.O.C. AND T.O.S.
1 3/4" TYP
TRASH RACK SCREEN FRAME L3x3 (REF)
3/8"Ø BOLTS & 7/16"Ø HOLES
1/4
ANCHORS AT 1'-6" MAX. C. TO C. (6" LG. PIECE OF #4 MIN. REBAR) LOCATE FIRST ANCHOR 6" MAX. FROM END OF CHANNEL, 7-CHANNELS TYP

2
10
DETAIL
1"=1'-0"

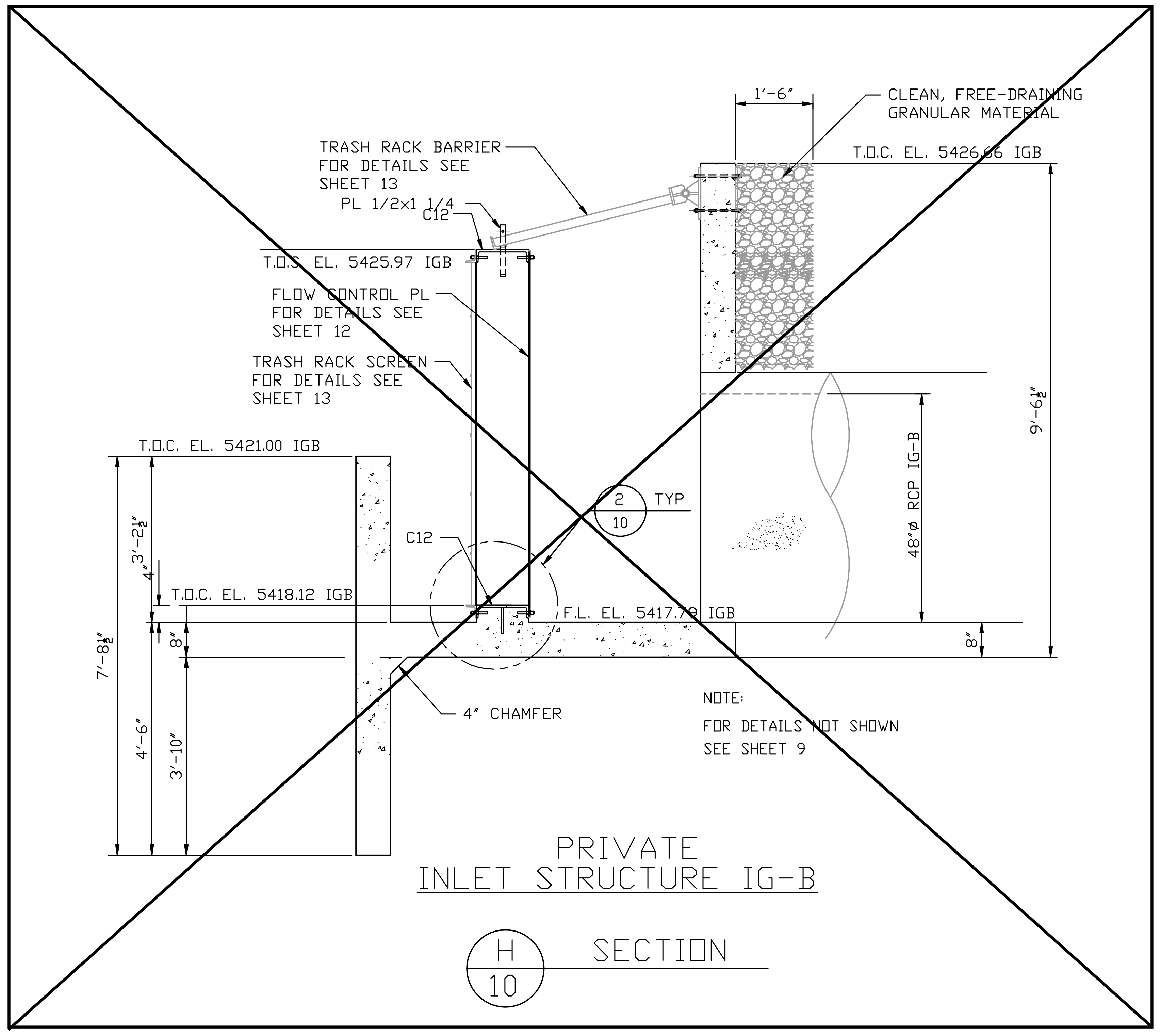


NOTE:
FLOW CONTROL PLATE NOT REQUIRED FOR OUTFALL AT IG-A

NOTE:
FOR DETAILS NOT SHOWN
SEE SHEET 9

PRIVATE
INLET STRUCTURE IG -A

I
10
SECTION



NOTE:
FOR DETAILS NOT SHOWN
SEE SHEET 9

PRIVATE
INLET STRUCTURE IG-B

H
10
SECTION

NOTES:
1. ALL STRUCTURAL CONCRETE SHALL BE 3500 psi COMPRESSIVE STRENGTH CONCRETE.
2. ALL STRUCTURAL STEEL SHALL CONFORM TO CDOT STD. M-601-10.
3. ALL STRUCTURAL STEEL SHALL BE HOT-DIPPED GALVANIZED STEEL OR ALUMINUM.

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215XXX.

APPROVED ON 06.27.14

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

PREPARED UNDER THE SUPERVISION OF:
31024
HAYWARD PARDUE P.E. # 31024
DATE

BENCH MARK
CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

CITY OF AURORA
PRIVATE INLET DETAILS
POND IG-B OUTFALL
MAJESTIC COMMERCENTER
AURORA, COLORADO
PLAN DATE 06/02/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
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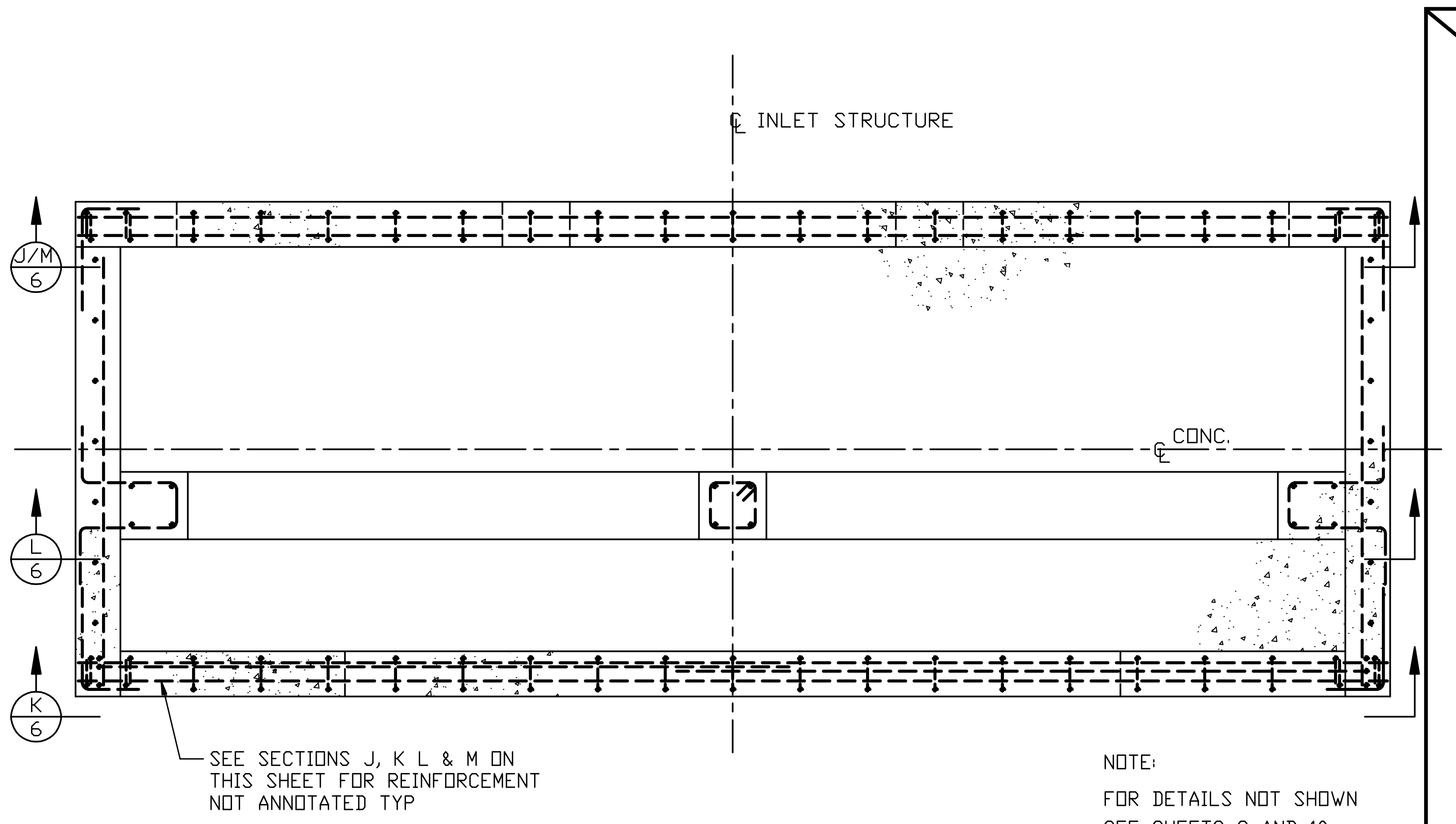
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 10

C:\temp\MCC bldg 28\2025-1 POND IGA & IGB\sht04-08-details.dwg Last Modified: 19 Jun 2014 - 11:41am

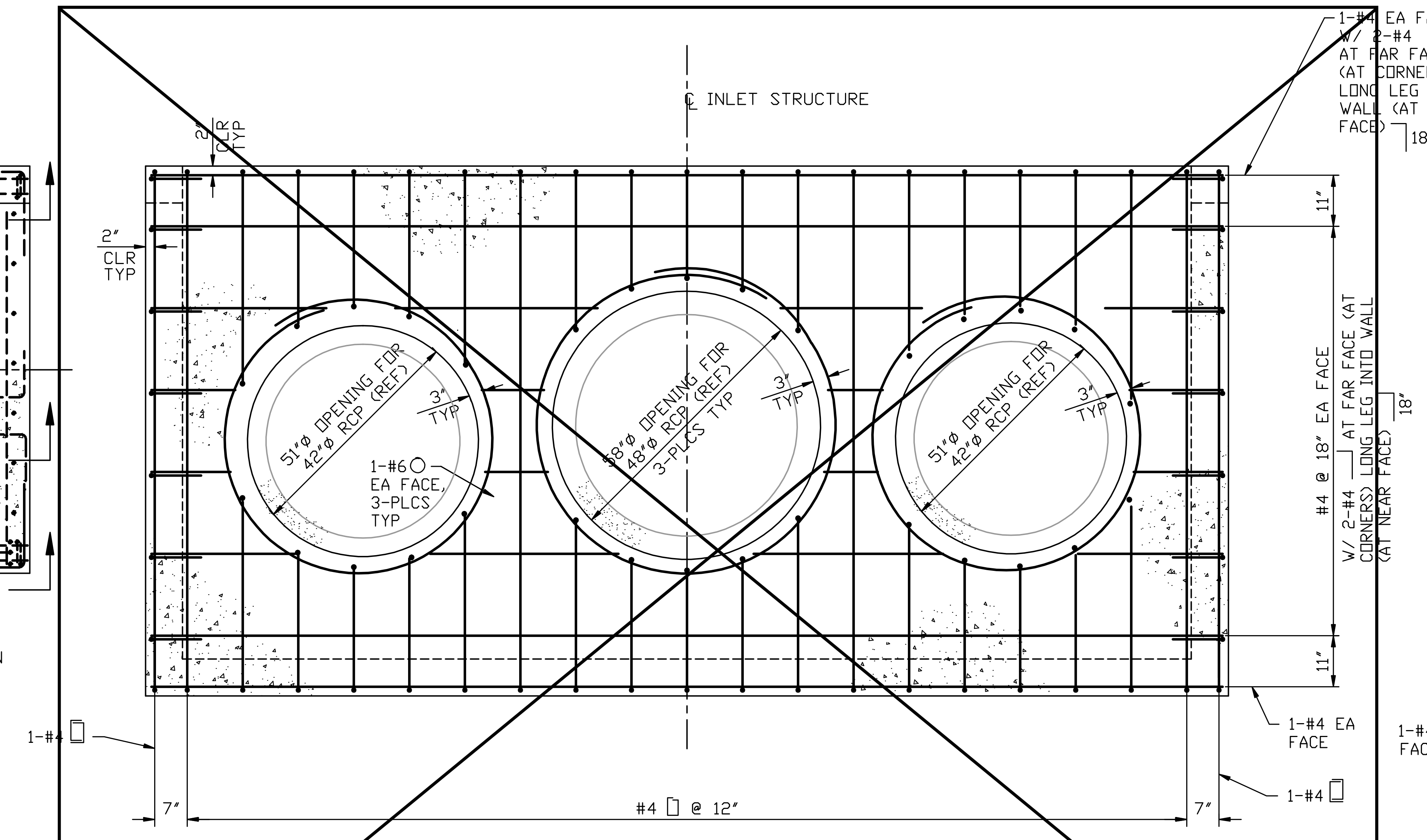
214070


℄ INLET STRUCTURE
J/M
6
L
6
K
6
℄ CONC.
SEE SECTIONS J, K, L & M ON THIS SHEET FOR REINFORCEMENT NOT ANNOTATED TYP

NOTE:
FOR DETAILS NOT SHOWN
SEE SHEETS 9 AND 10

PRIVATE
INLET STRUCTURE

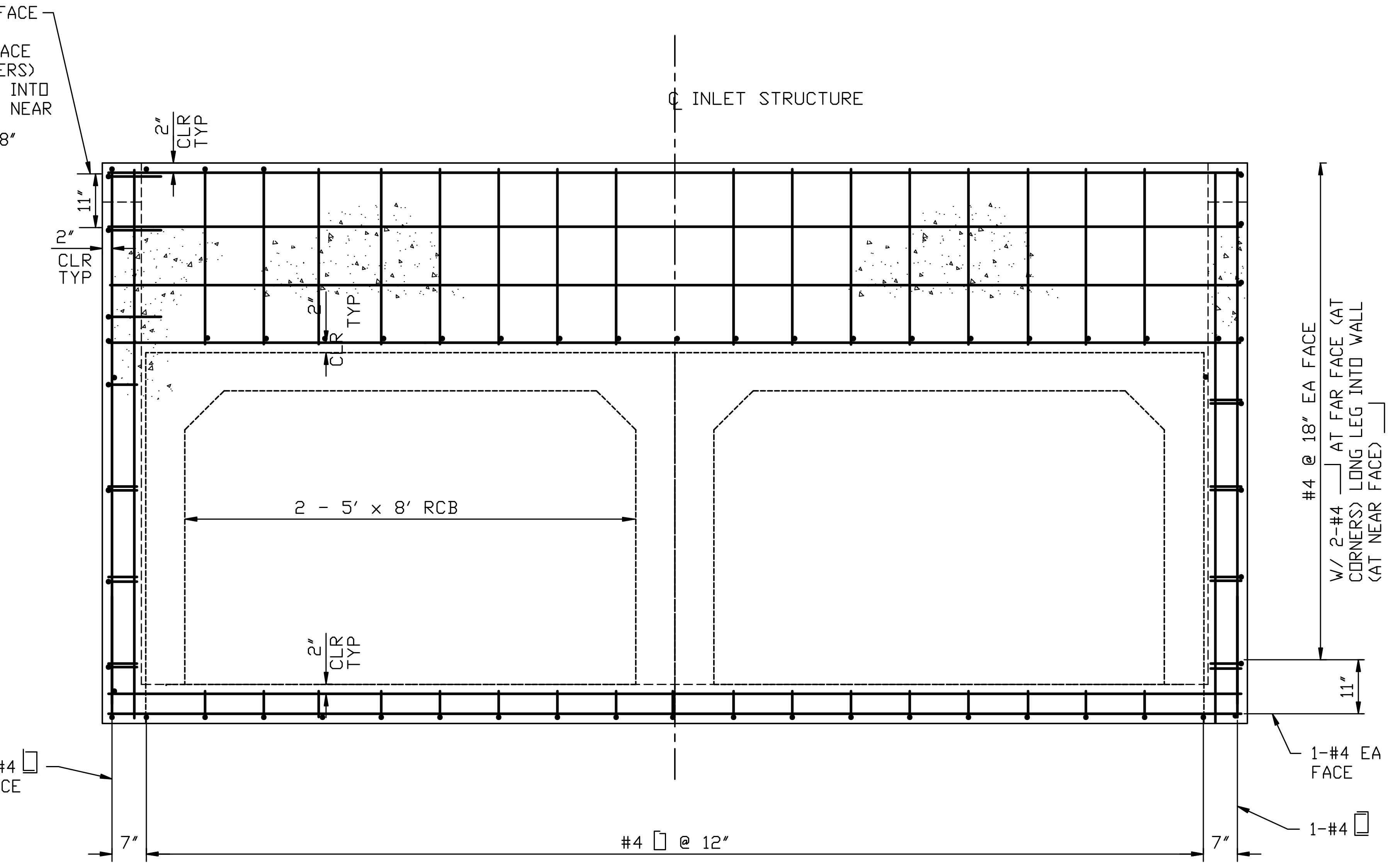
REINFORCEMENT PLAN
1/2"=1'-0"


℄ INLET STRUCTURE
2" CLR TYP
2" CLR TYP
51"ø OPENING FOR 42"ø RCP (REF)
3" TYP
1-#6 ○ EA FACE, 3-PLCS TYP
48"ø OPENING FOR 48"ø RCP (REF) 3-PLCS TYP
3" TYP
51"ø OPENING FOR 42"ø RCP (REF)
3" TYP
1-#4 EA FACE W/ 2-#4 AT FAR FACE (AT CORNERS) LONG LEG INTO WALL (AT NEAR FACE) 18"
11"
#4 @ 18" EA FACE
W/ 2-#4 AT FAR FACE (AT CORNERS) LONG LEG INTO WALL (AT NEAR FACE) 18"
11"
1-#4 EA FACE
1-#4
1-#4
7"
#4 @ 12"
7"

NOTE:
FOR DETAILS NOT SHOWN
SEE SHEETS 9 AND 10

PRIVATE
INLET STRUCTURE IG-B

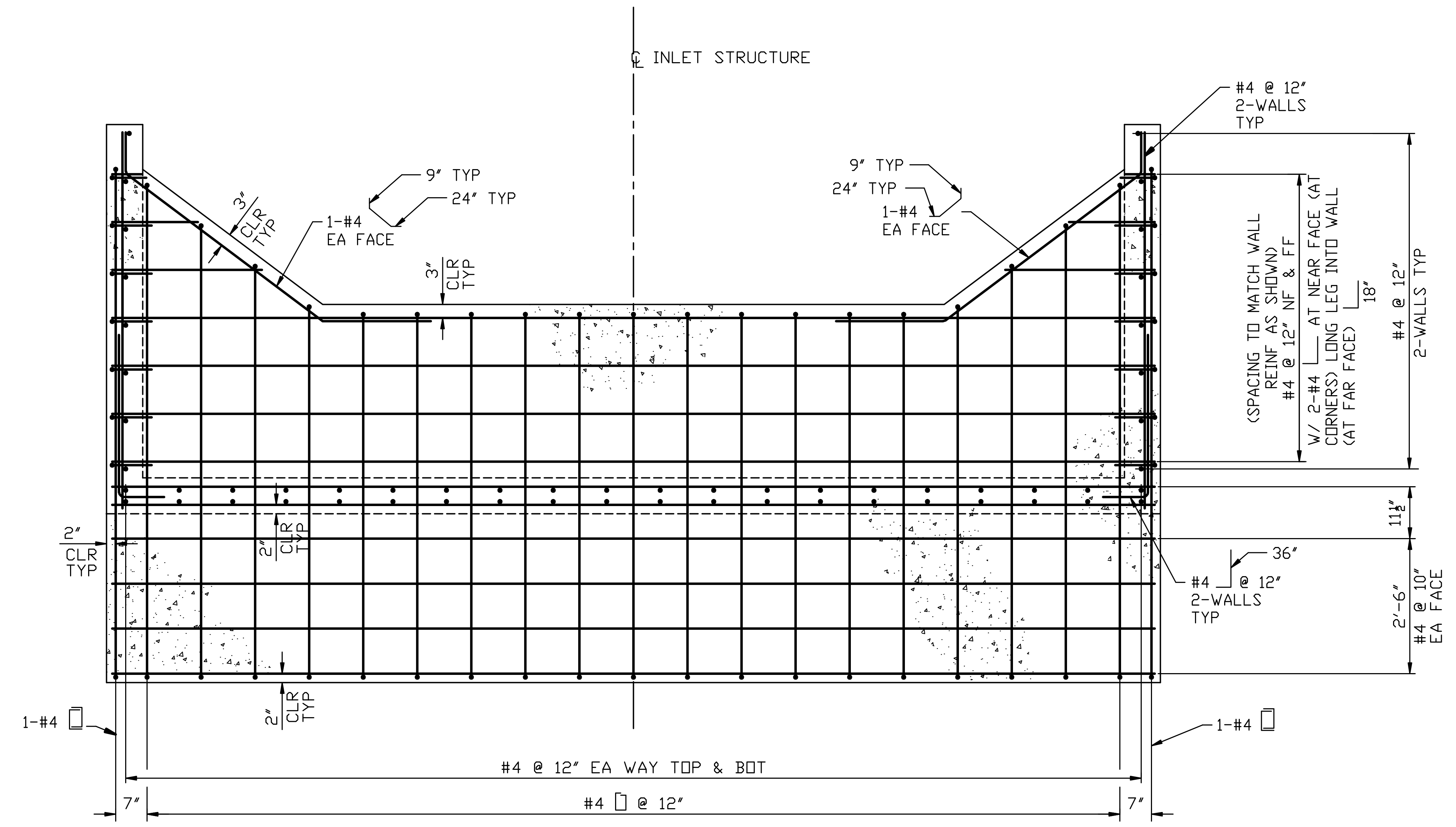
REINFORCEMENT SECTION
J
11
1/2"=1'-0"



PRIVATE
INLET STRUCTURE IG-A

REINFORCEMENT SECTION
M
11
1/2"=1'-0"

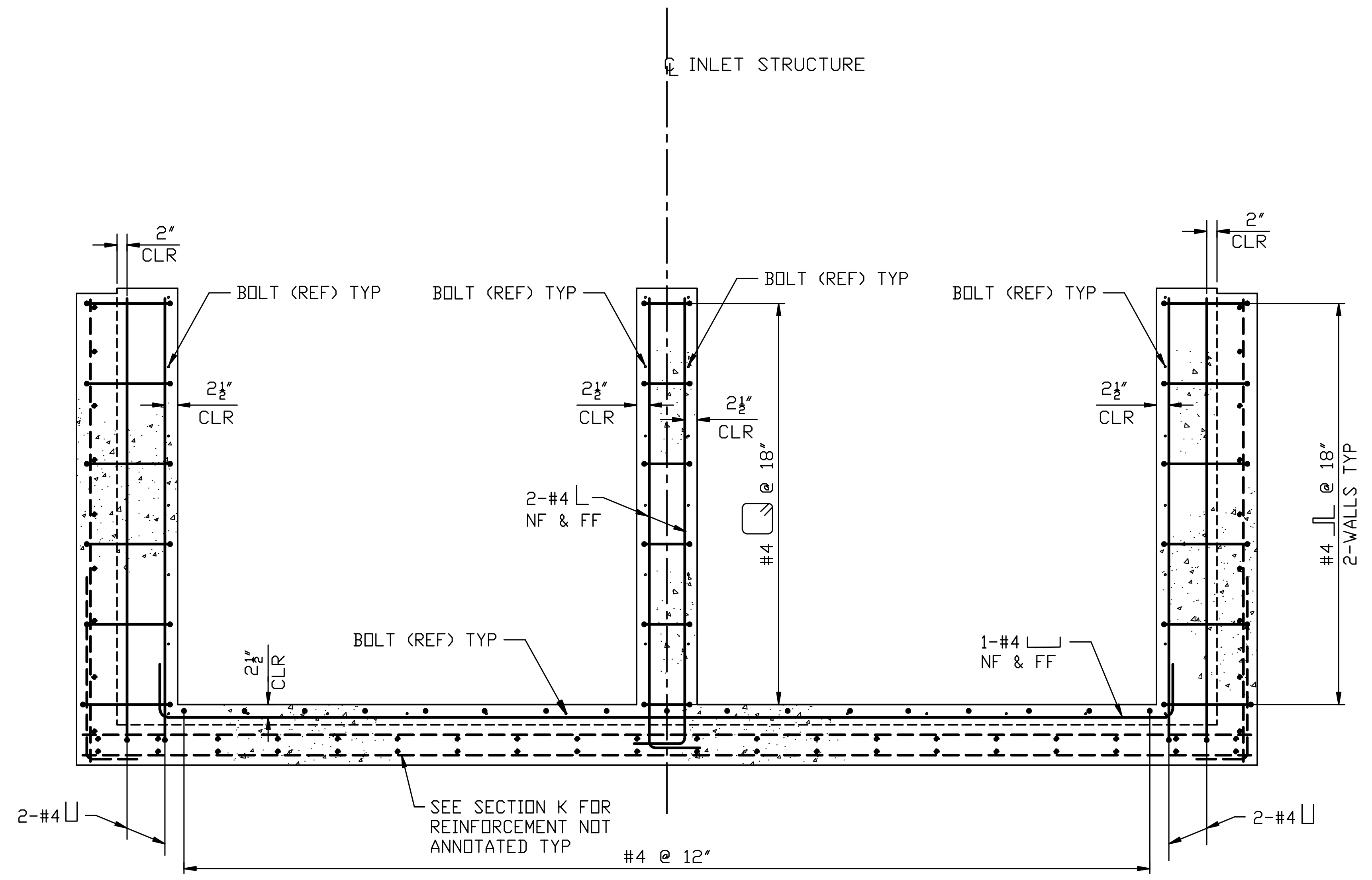
NOTE:
FOR DETAILS NOT SHOWN
SEE SHEETS 9 AND 10



PRIVATE
INLET STRUCTURE

REINFORCEMENT SECTION
K
11
1/2"=1'-0"

NOTE:
FOR DETAILS NOT SHOWN
SEE SHEETS 9 AND 10



NOTE:
FOR DETAILS NOT SHOWN
SEE SHEETS 9 AND 10

PRIVATE
INLET STRUCTURE

REINFORCEMENT SECTION
L
11
1/2"=1'-0"

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215XXX.

NOTES:

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2. ALL STRUCTURAL STEEL SHALL CONFORM TO CDOT STD. M-601-10.
3. ALL STRUCTURAL STEEL SHALL BE HOT-DIPPED GALVANIZED STEEL OR ALUMINUM.

APPROVED ON 06.27.14

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PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024

DATE

BENCH MARK

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CITY OF AURORA
PRIVATE INLET DETAILS
POND IG-B OUTFALL
MAJESTIC COMMERCENTER
AURORA, COLORADO

PLAN DATE 06/02/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

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Sheet 11

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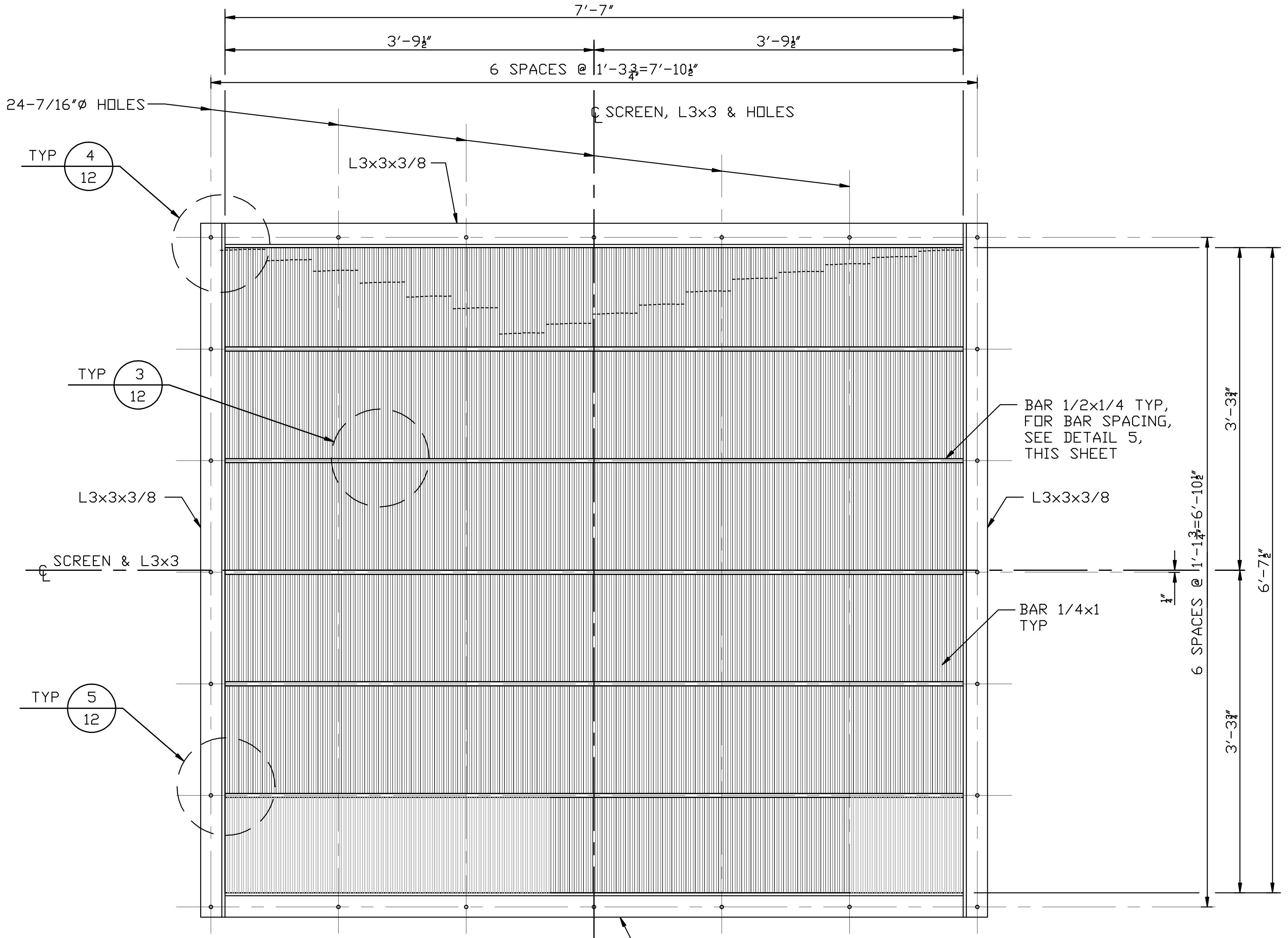
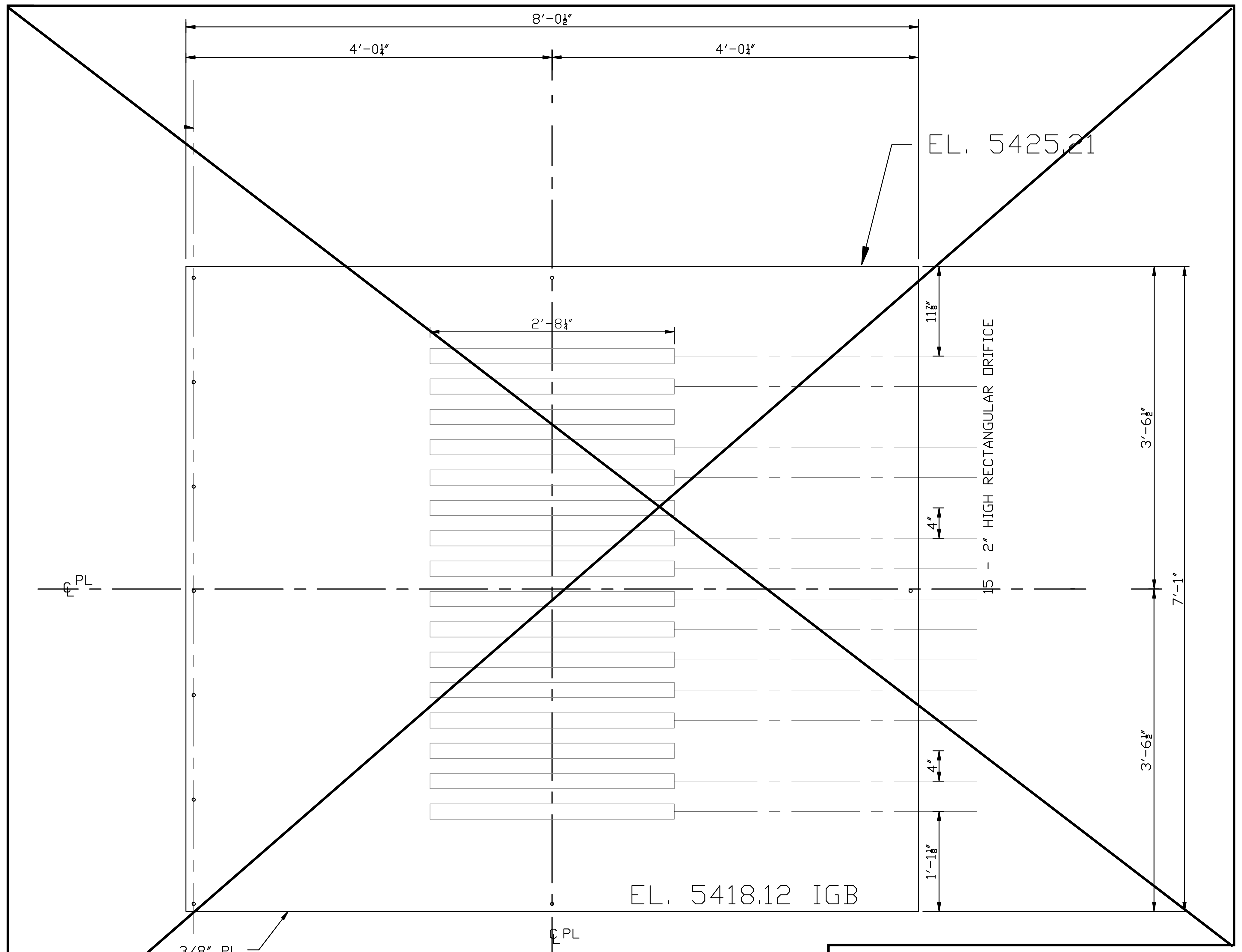
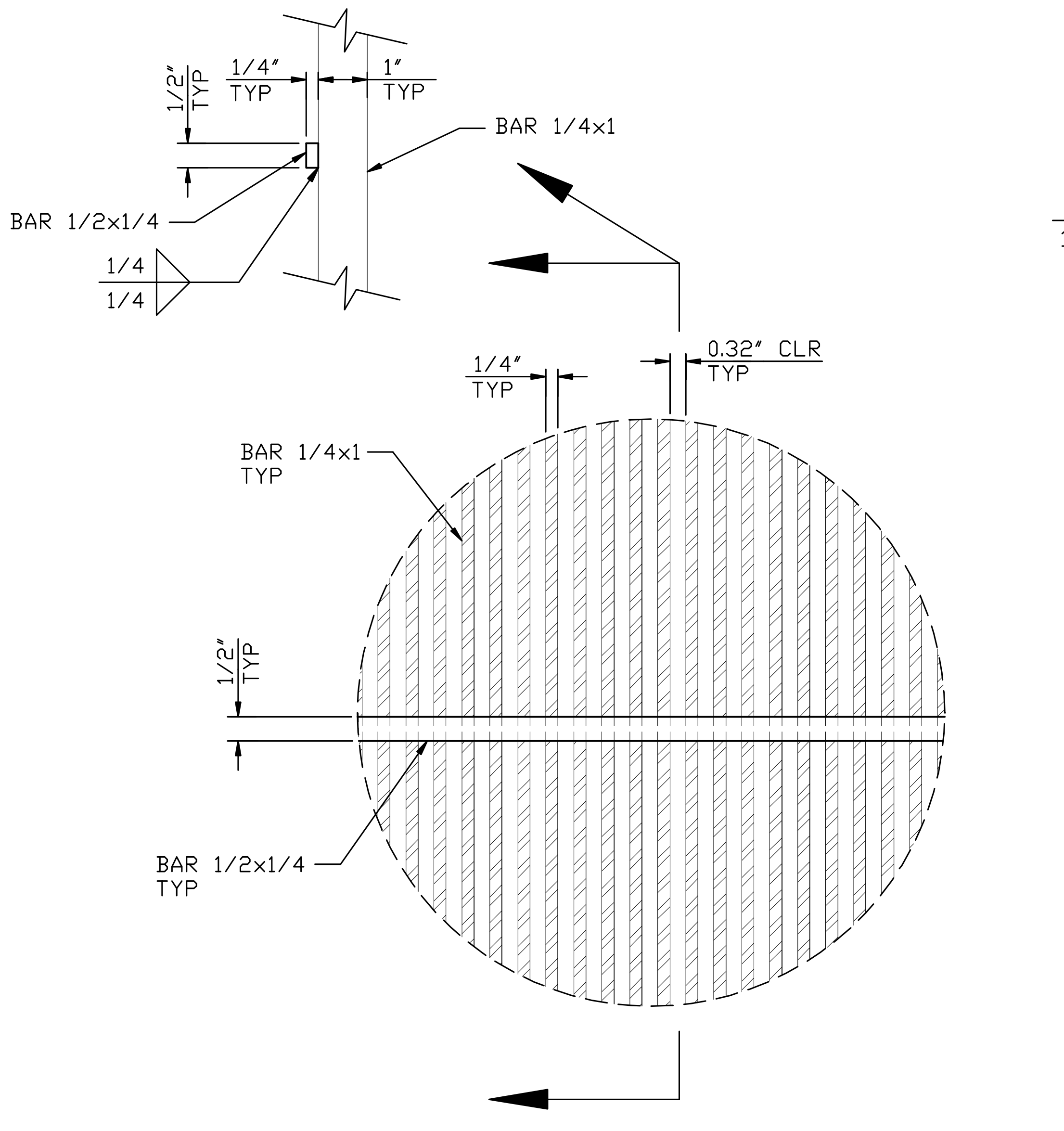


PRIVATE
TRASH RACK SCREEN ELEVATION
1"=1'-0"
2-TRASH RACK SCREENS REQUIRED (TOTAL CLEAR AREA PROVIDED=25,280 SQ IN)

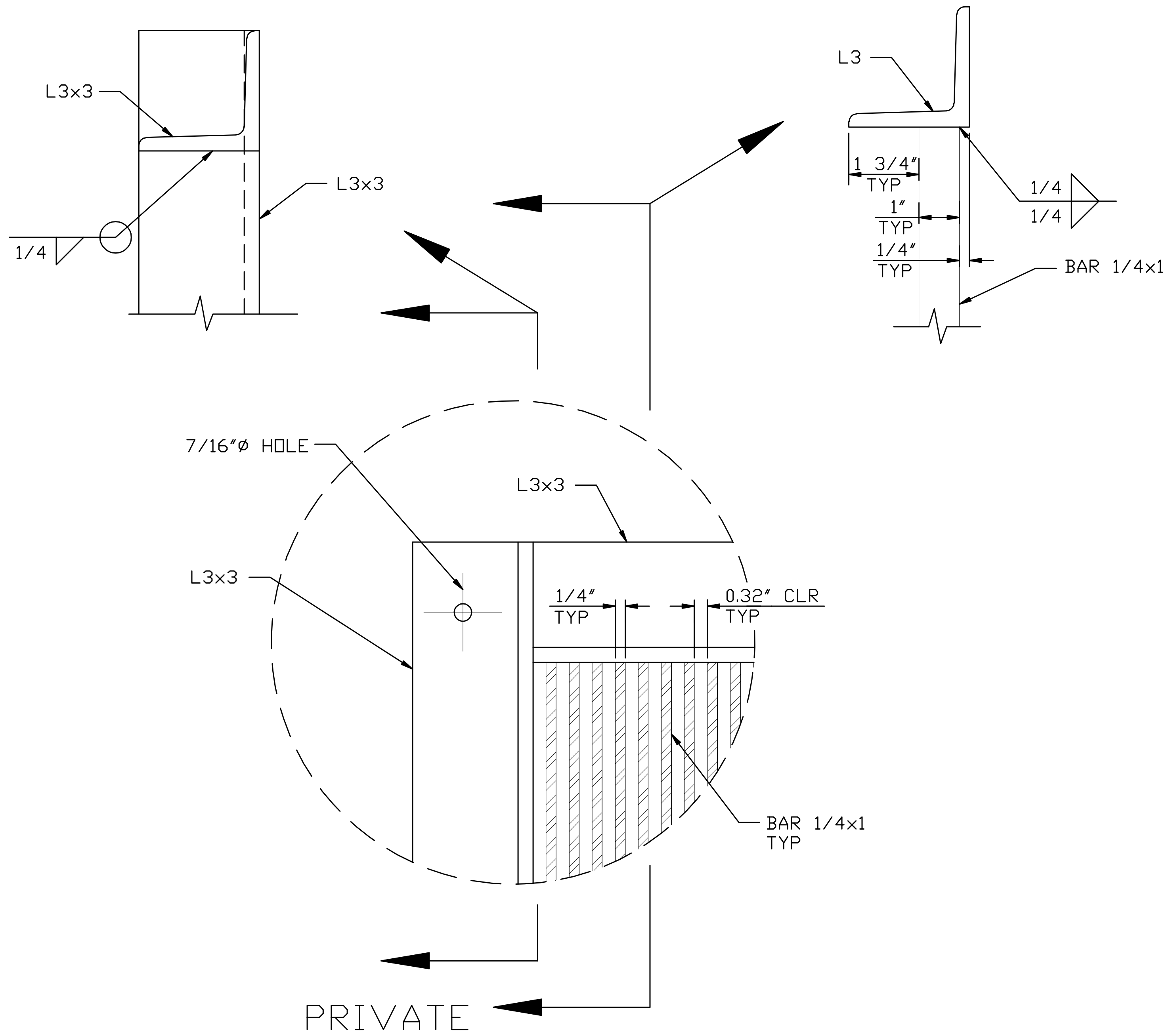


PRIVATE
FLOW CONTROL PLATE ELEVATION
1"=1'-0"
2-FLOW CONTROL PLATES REQUIRED



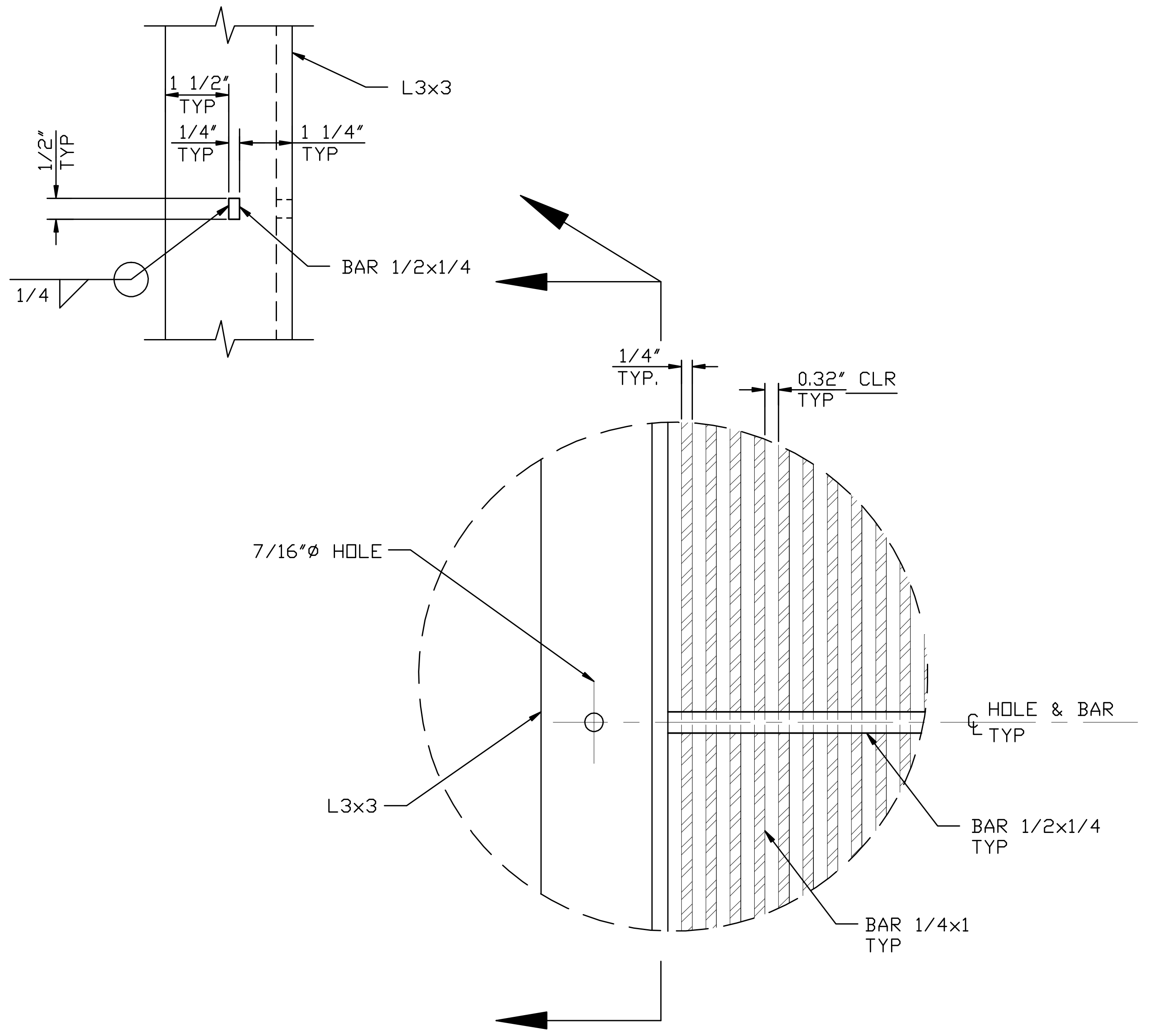
PRIVATE
TRASH RACK SCREEN ELEVATION

3/12 DETAIL
4"=1'-0"



PRIVATE
TRASH RACK SCREEN ELEVATION

4/12 DETAIL
4"=1'-0"



PRIVATE
TRASH RACK SCREEN ELEVATION

5/12 DETAIL
4"=1'-0"

NOTES:

1. ALL STRUCTURAL STEEL SHALL CONFORM TO CDOT STD. M-601-10.
2. STRUCTURAL STEEL FOR FLOW CONTROL PLATE AND FLOW RESTRICTION PLATE SHALL BE HOT-DIPPED GALVANIZED STEEL OR ALUMINUM ALLOY.
3. STRUCTURAL STEEL FOR TRASH RACK SHALL BE 304 STAINLESS STEEL OR ALUMINUM ALLOY.

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215XXX.

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PREPARED UNDER THE SUPERVISION OF:

HAYWARD PARDUE P.E. # 31024

DATE

31024

BENCH MARK

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CITY OF AURORA
PRIVATE TRASH RACK DETAILS
POND IG-B OUTFALL
MAJESTIC COMMERCENTER
AURORA, COLORADO

PLAN DATE
06/02/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
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Sheet 12

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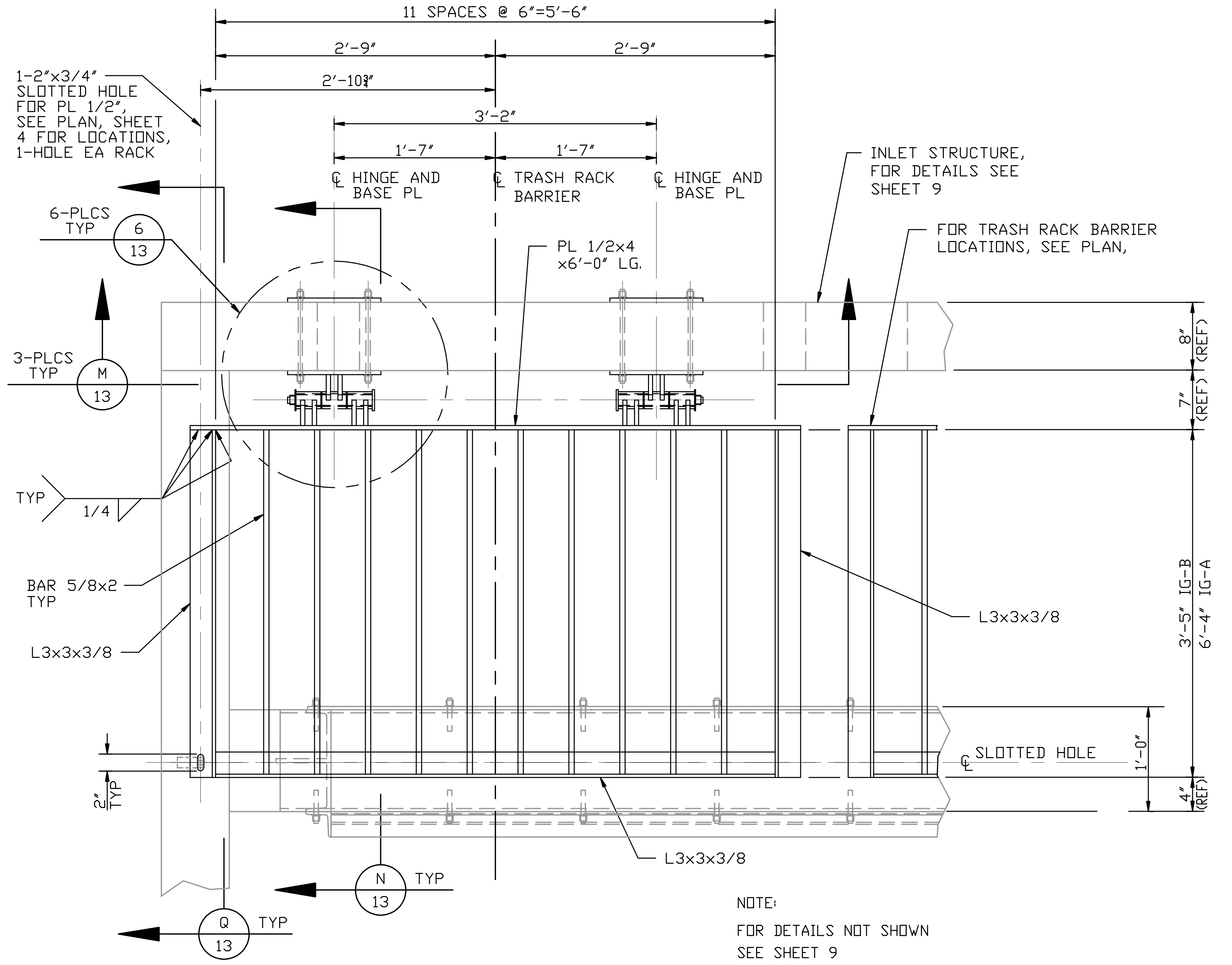
Plotted on: 19 Jun 2014 – 10:05am by Hayward Pardue

APPROVED ON 06.27.14

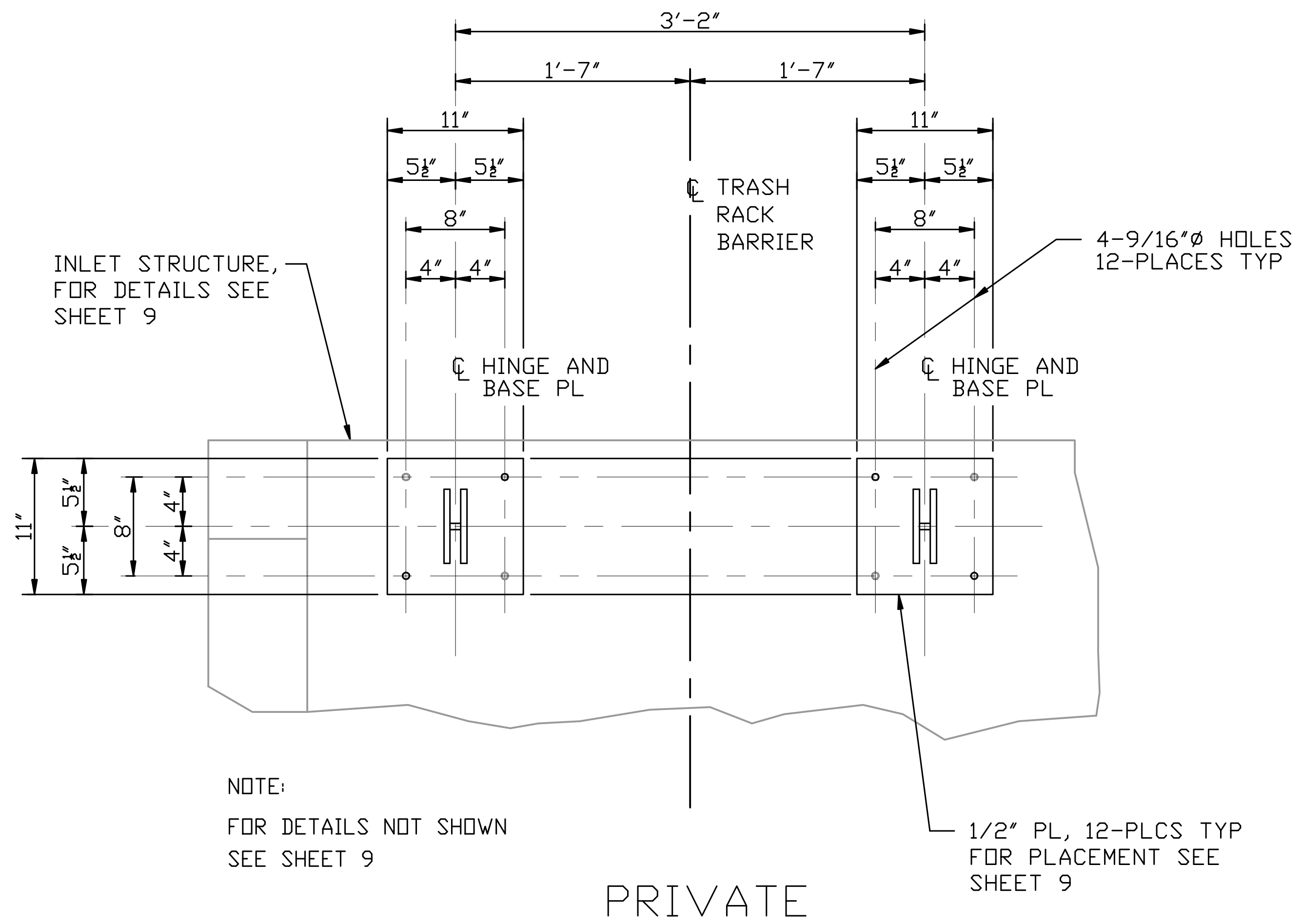
13

214070



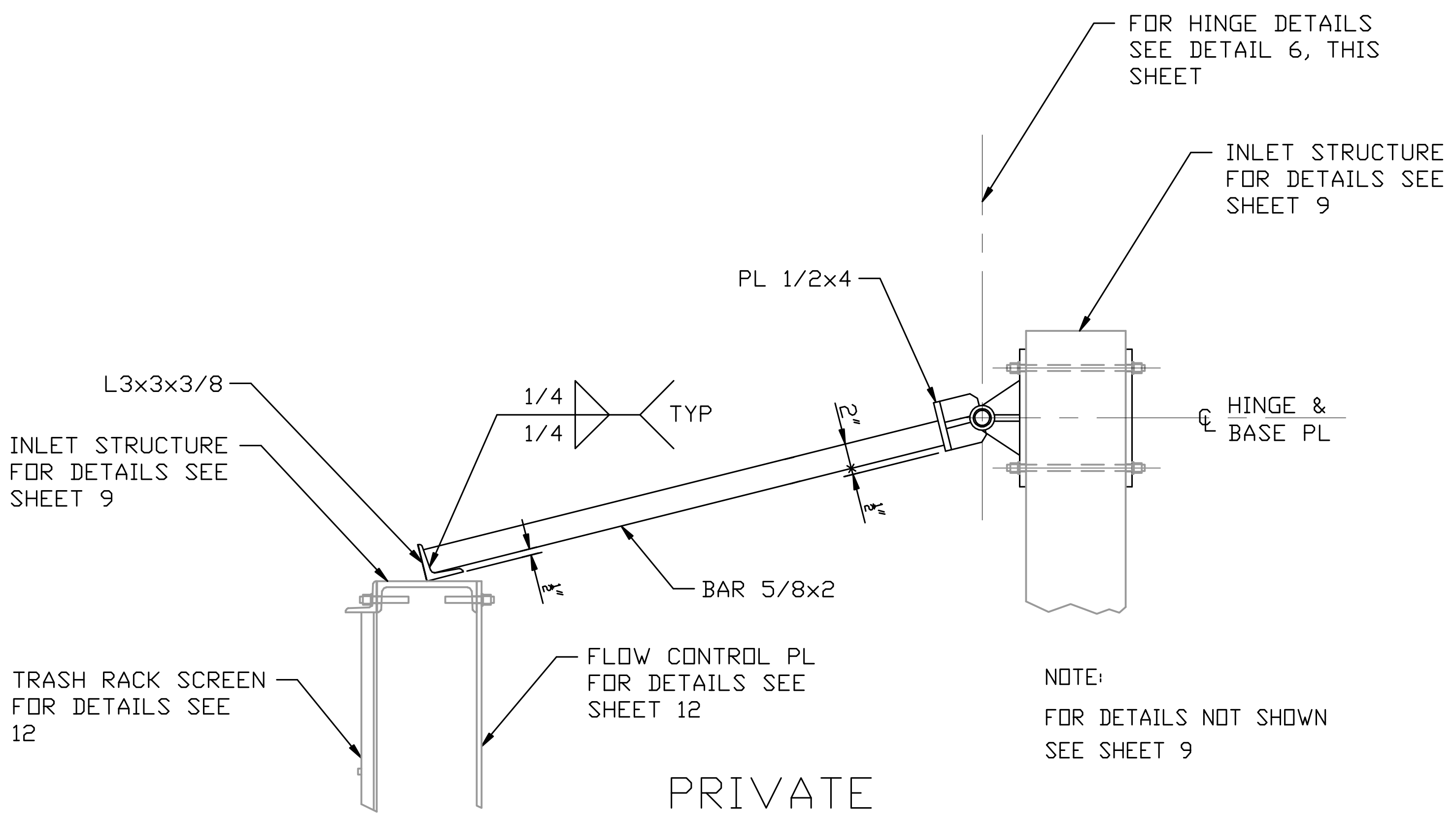
NOTE:
FOR DETAILS NOT SHOWN
SEE SHEET 9

PRIVATE TRASH RACK BARRIER
PLAN
1"=1'-0"
3-TRASH RACK BARRIERS REQUIRED



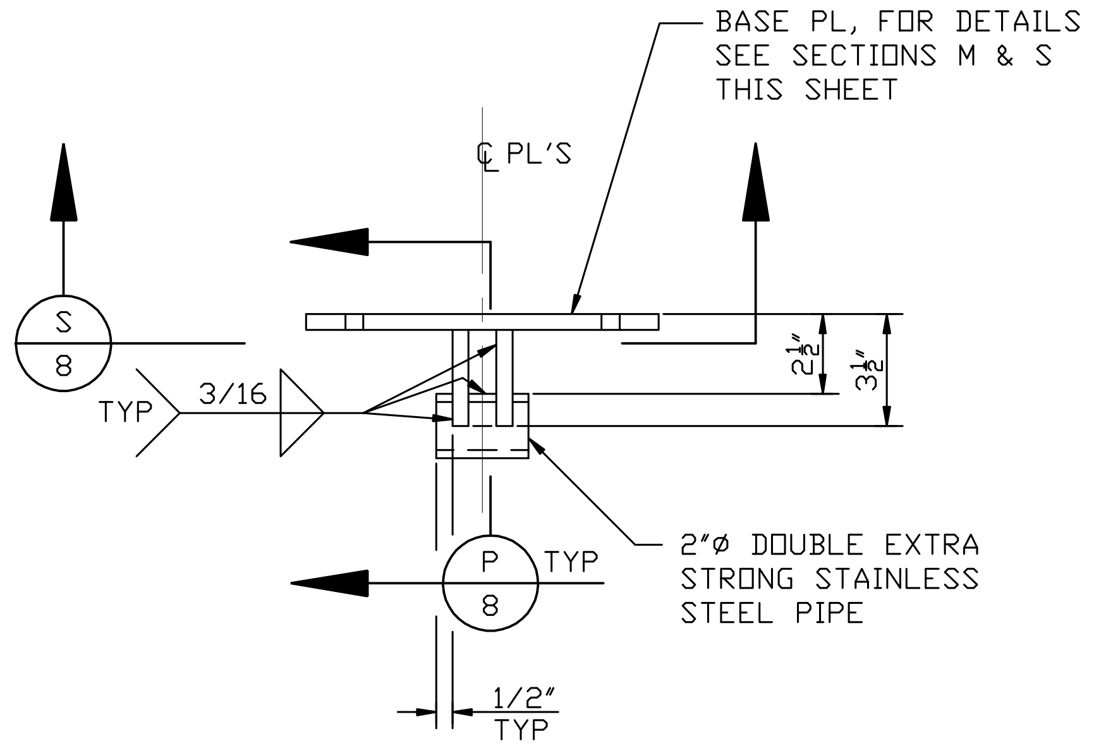
NOTE:
FOR DETAILS NOT SHOWN
SEE SHEET 9

PRIVATE TRASH RACK BARRIER
M
13
SECTION
1"=1'-0"

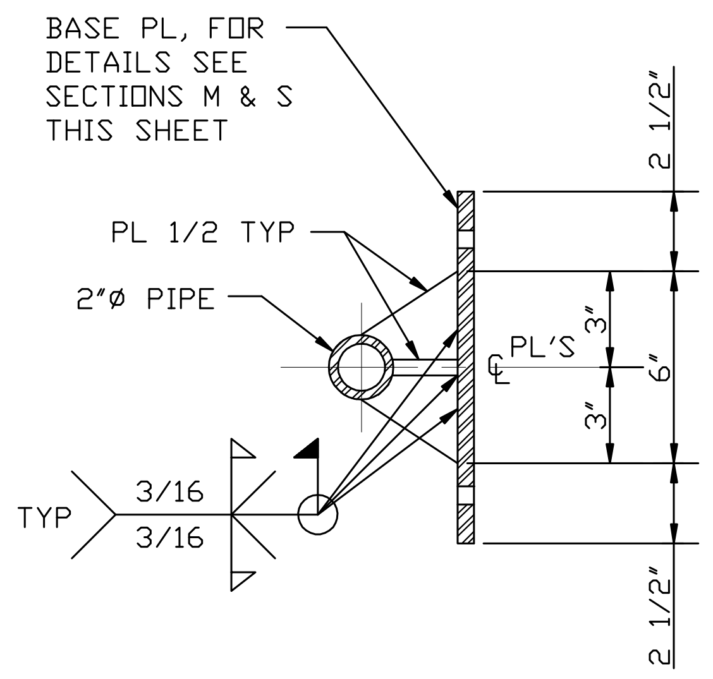

FOR HINGE DETAILS SEE DETAIL 6, THIS SHEET
INLET STRUCTURE FOR DETAILS SEE SHEET 9
PL 1/2x4
L3x3x3/8
1/4
1/4
TYP
℄ HINGE & BASE PL
INLET STRUCTURE FOR DETAILS SEE SHEET 9
BAR 5/8x2
TRASH RACK SCREEN FOR DETAILS SEE 12
FLOW CONTROL PL FOR DETAILS SEE SHEET 12

NOTE:
FOR DETAILS NOT SHOWN
SEE SHEET 9

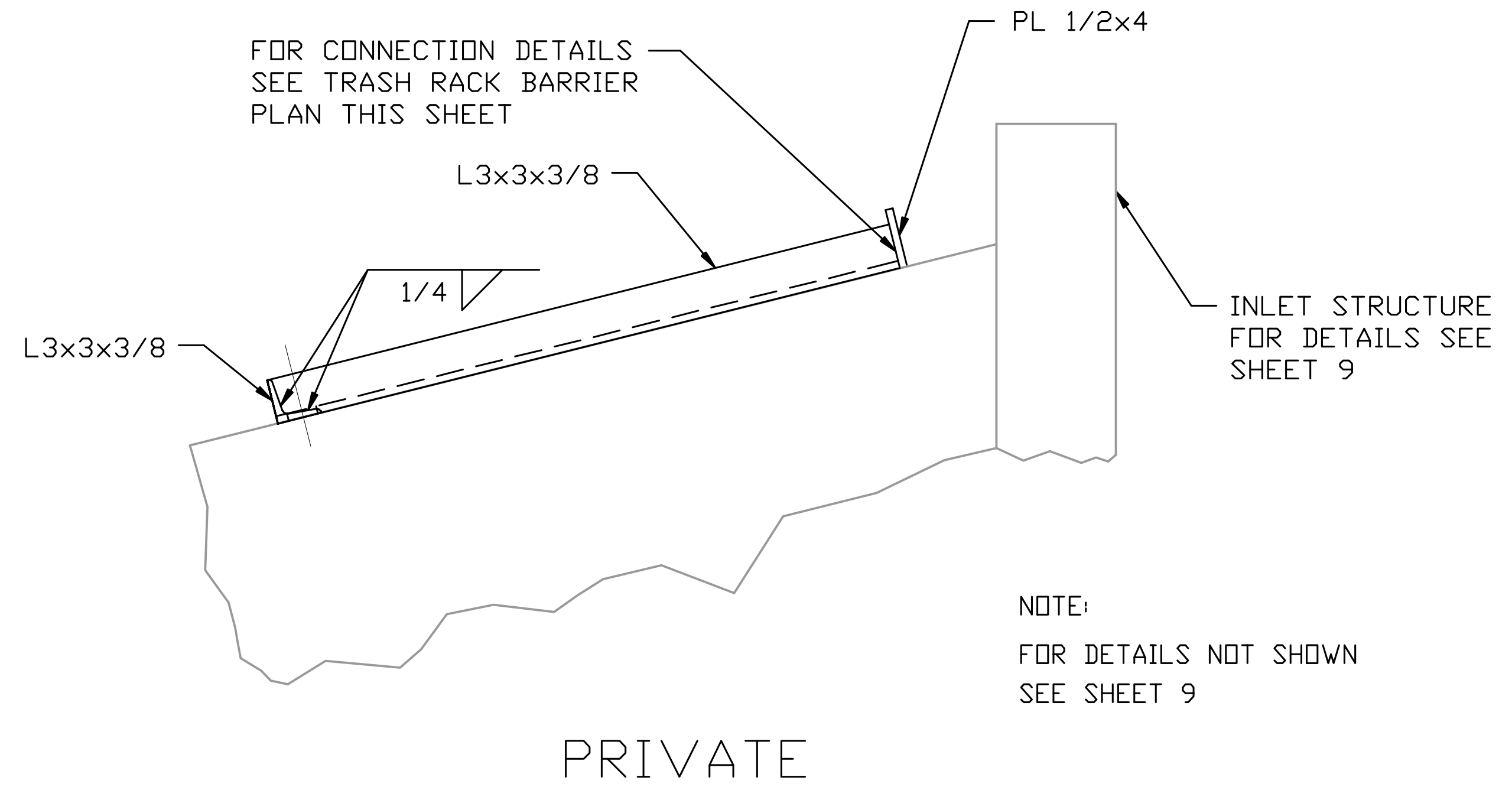
PRIVATE TRASH RACK BARRIER
N
13
SECTION
1"=1'-0"


BASE PL, FOR DETAILS SEE SECTIONS M & S THIS SHEET
℄ PL'S
S
8
TYP
3/16
2½"
3½"
2"ø DOUBLE EXTRA STRONG STAINLESS STEEL PIPE
P
8
TYP
1/2" TYP

HINGE
7
13
DETAIL
2"=1'-0"

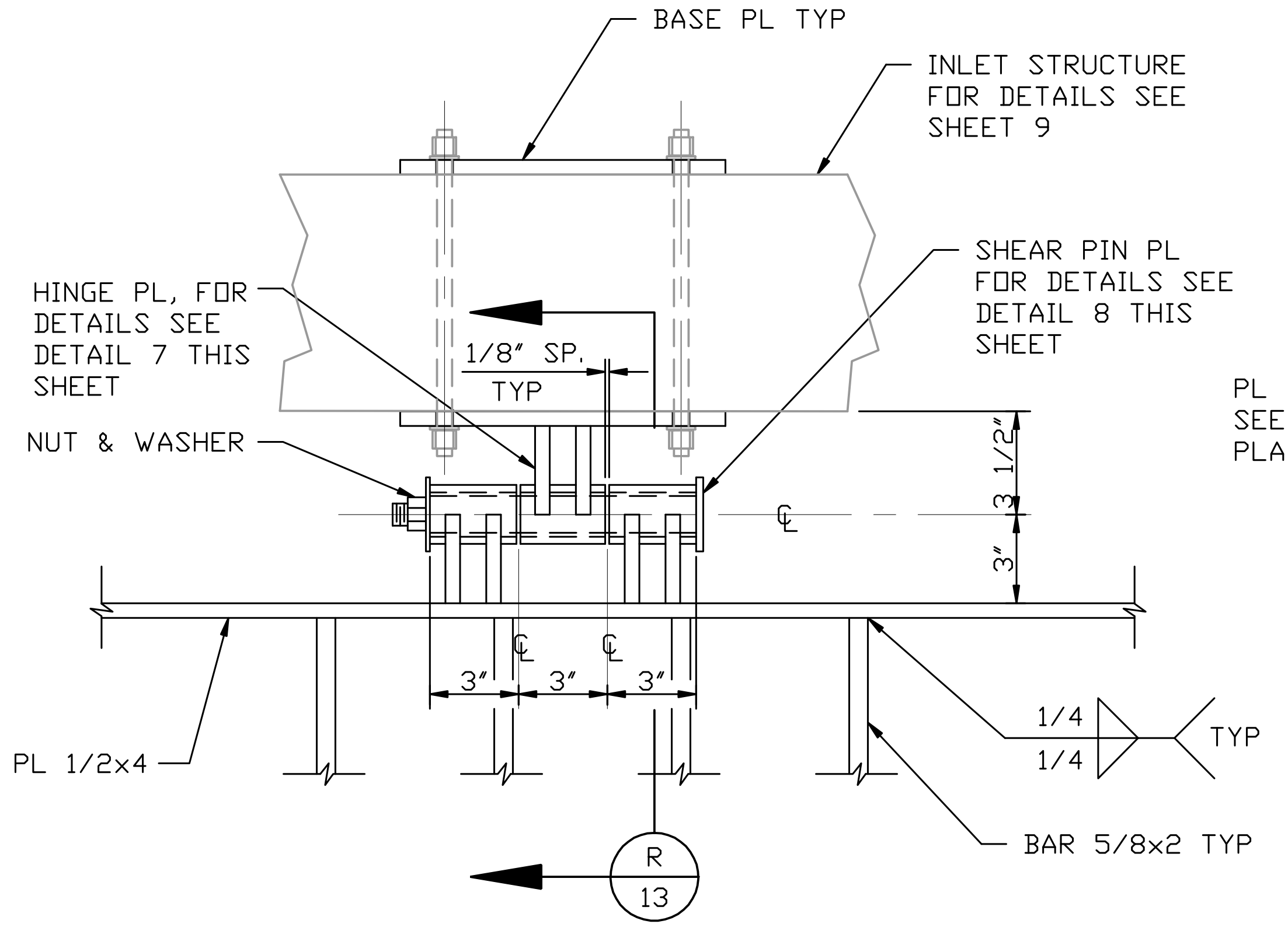


HINGE
P
13
SECTION
2"=1'-0"

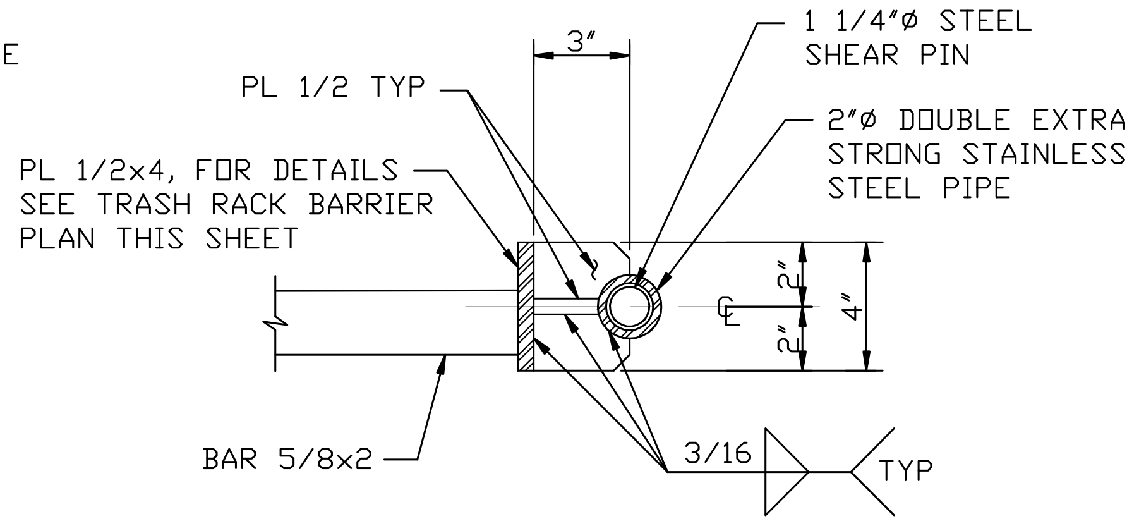

FOR CONNECTION DETAILS SEE TRASH RACK BARRIER PLAN THIS SHEET
PL 1/2x4
L3x3x3/8
1/4
L3x3x3/8
INLET STRUCTURE FOR DETAILS SEE SHEET 9

NOTE:
FOR DETAILS NOT SHOWN
SEE SHEET 9

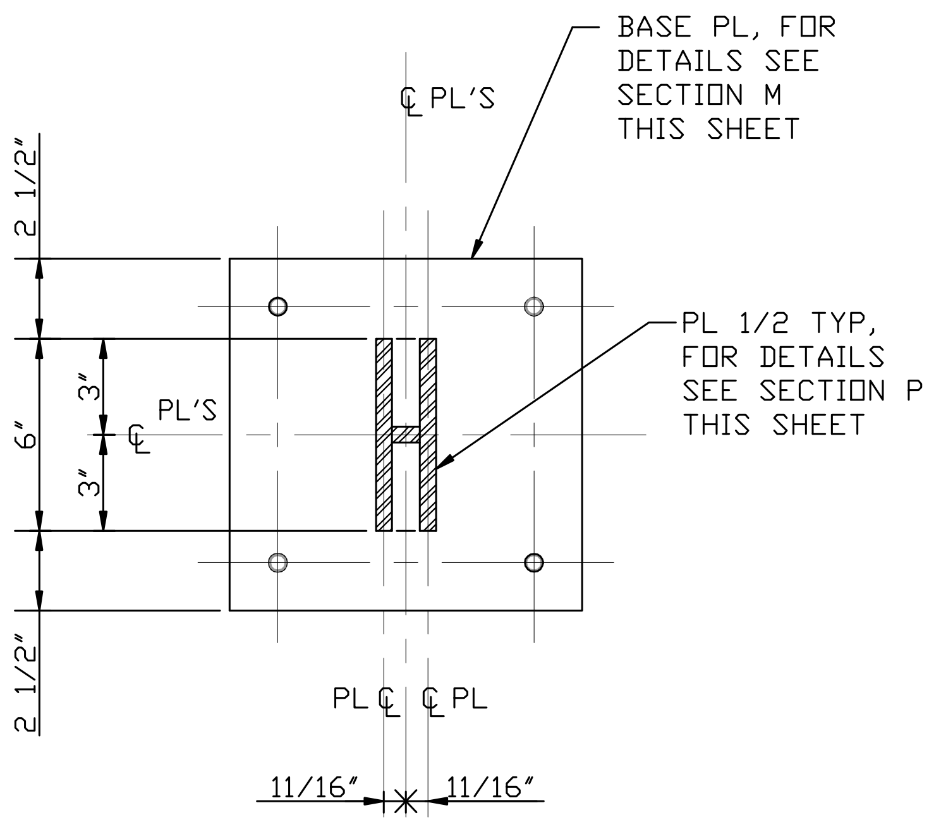
PRIVATE TRASH RACK BARRIER
Q
13
SECTION
1"=1'-0"


BASE PL TYP
INLET STRUCTURE FOR DETAILS SEE SHEET 9
HINGE PL, FOR DETAILS SEE DETAIL 7 THIS SHEET
SHEAR PIN PL FOR DETAILS SEE DETAIL 8 THIS SHEET
1/8" SP. TYP
NUT & WASHER
3 1/2"
3"
℄
3"
3"
3"
℄
℄
PL 1/2x4
1/4
1/4
TYP
BAR 5/8x2 TYP
R
13

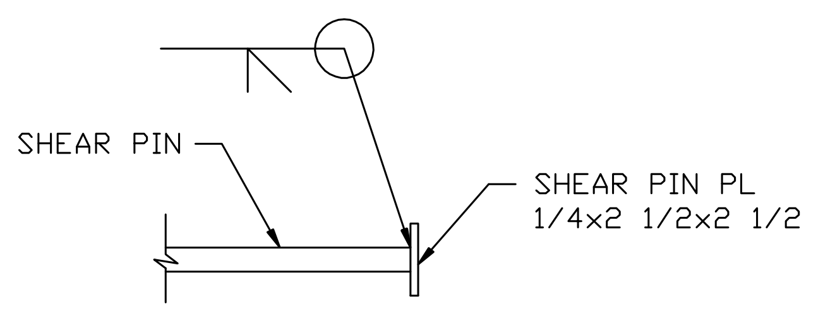
HINGE
6
13
DETAIL
2"=1'-0"


3"
PL 1/2 TYP
1 1/4"ø STEEL SHEAR PIN
2"ø DOUBLE EXTRA STRONG STAINLESS STEEL PIPE
PL 1/2x4, FOR DETAILS SEE TRASH RACK BARRIER PLAN THIS SHEET
℄
2"
2"
4"
BAR 5/8x2
3/16
TYP

HINGE
R
13
SECTION
2"=1'-0"


℄ PL'S
BASE PL, FOR DETAILS SEE SECTION M THIS SHEET
2 1/2"
3"
3"
6"
℄ PL'S
PL 1/2 TYP, FOR DETAILS SEE SECTION P THIS SHEET
2 1/2"
PL ℄ ℄ PL
11/16"
11/16"

BASE PL & HINGE
S
13
SECTION
2"=1'-0"



HINGE
8
13
DETAIL
2"=1'-0"

NOTES:

1. ALL STRUCTURAL STEEL SHALL CONFORM TO CDOT STD. M-601-10.
2. ALL STRUCTURAL STEEL SHALL BE HOT-DIPPED GALVANIZED STEEL OR ALUMINUM ALLOY.

APPROVED ON 06.27.14

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PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024

DATE

BENCH MARK

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ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

CITY OF AURORA
PRIVATE BARRIER DETAILS
PONDS IG-A and IG-B OUTFALL
MAJESTIC COMMERCENTER
AURORA, COLORADO

PLAN DATE
06/02/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
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Sheet 13

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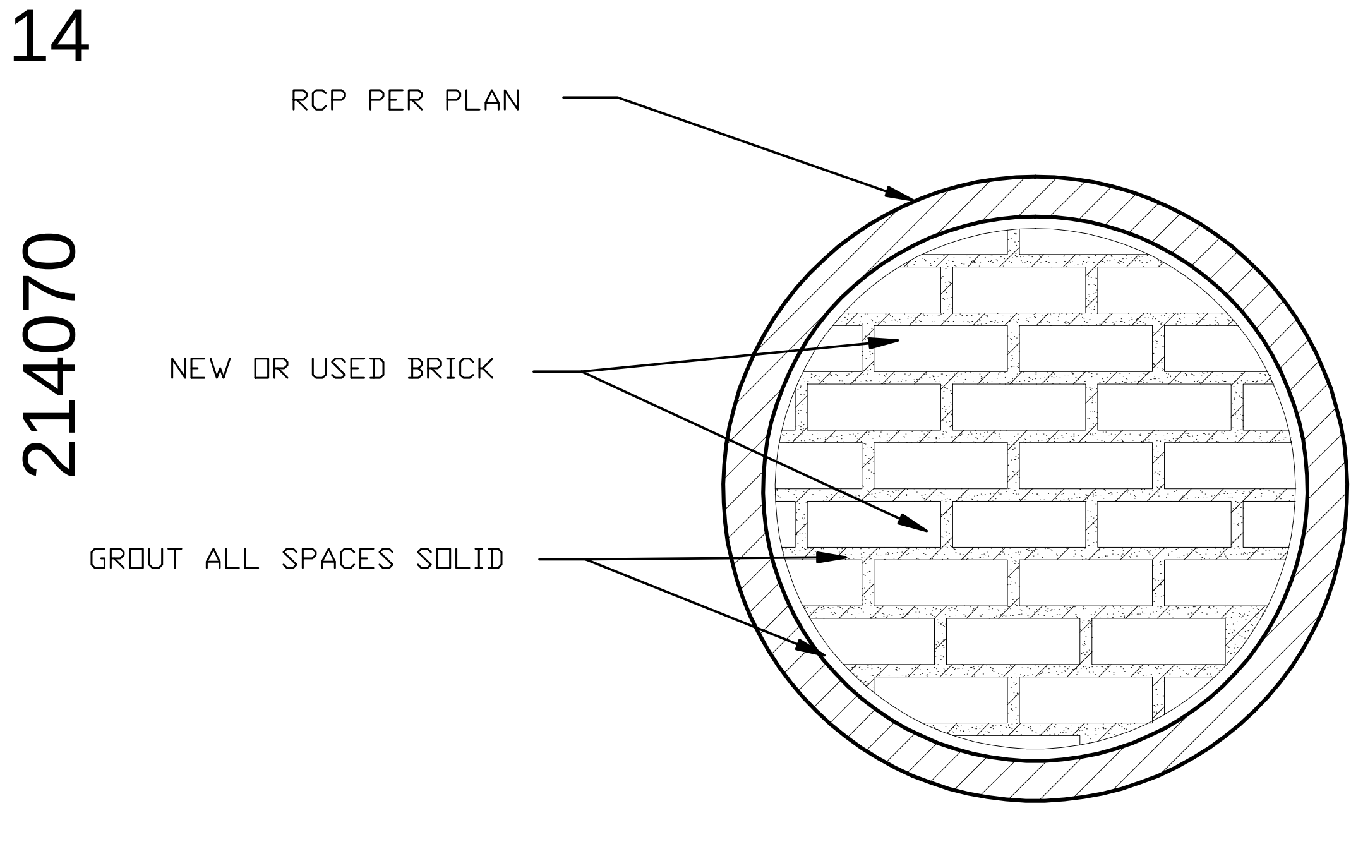
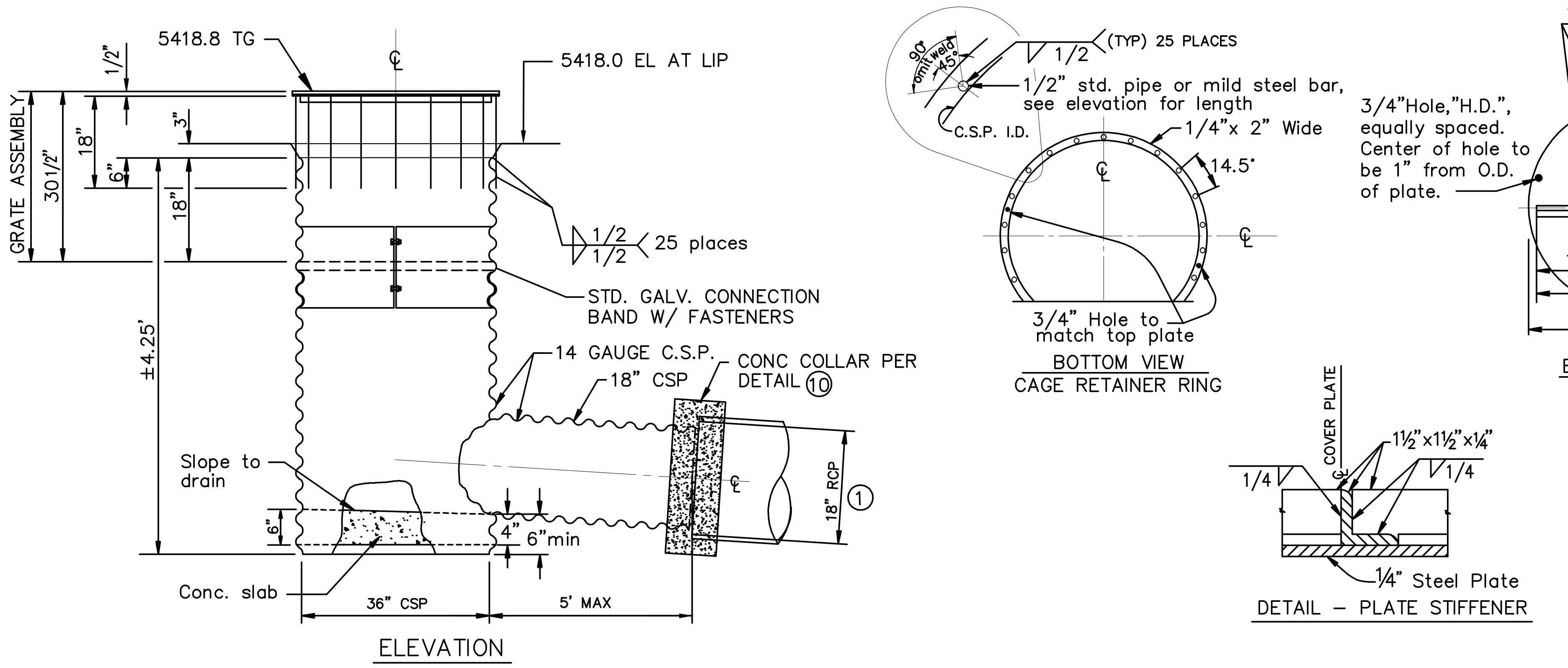
Plotted on: 19 Jun 2014 - 12:09pm by Hayward Pardue

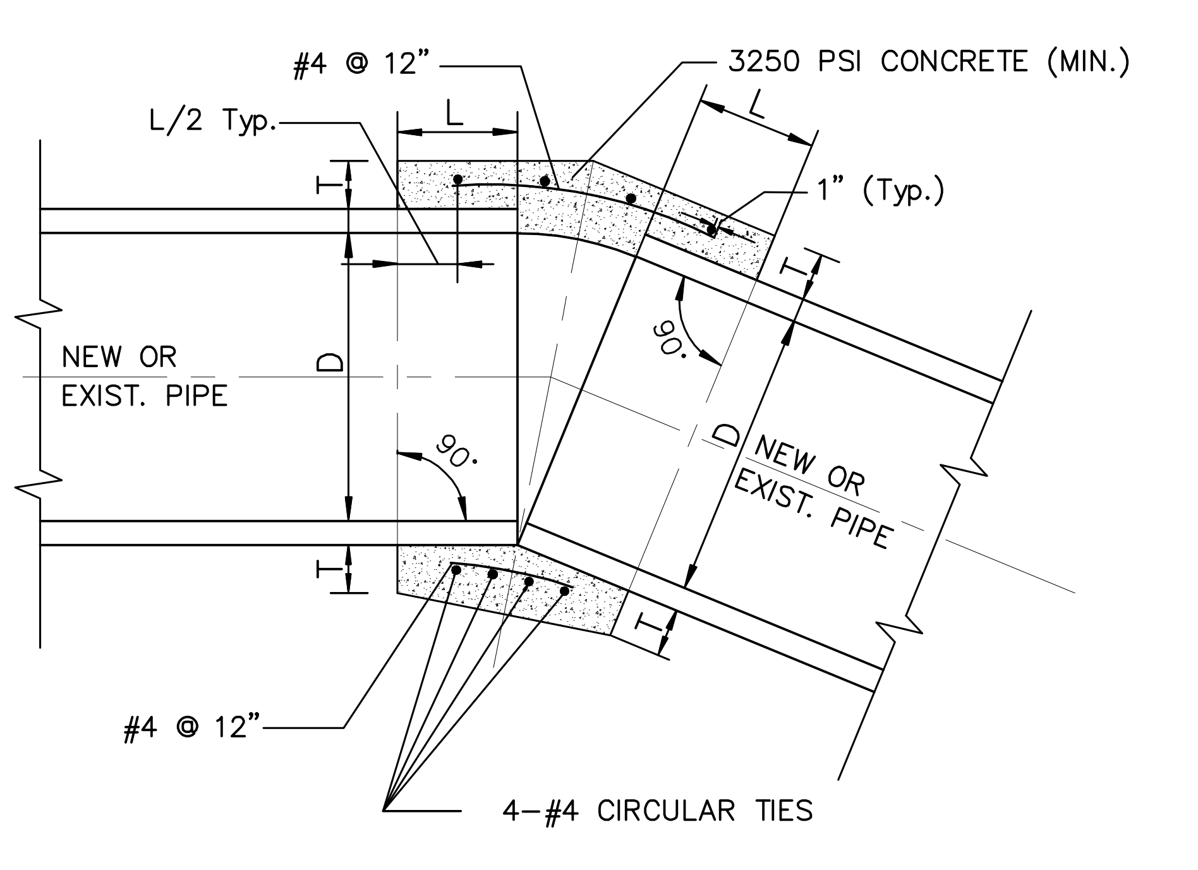


⑥ **BRICK & MORTAR PLUG DETAIL**
NO SCALE



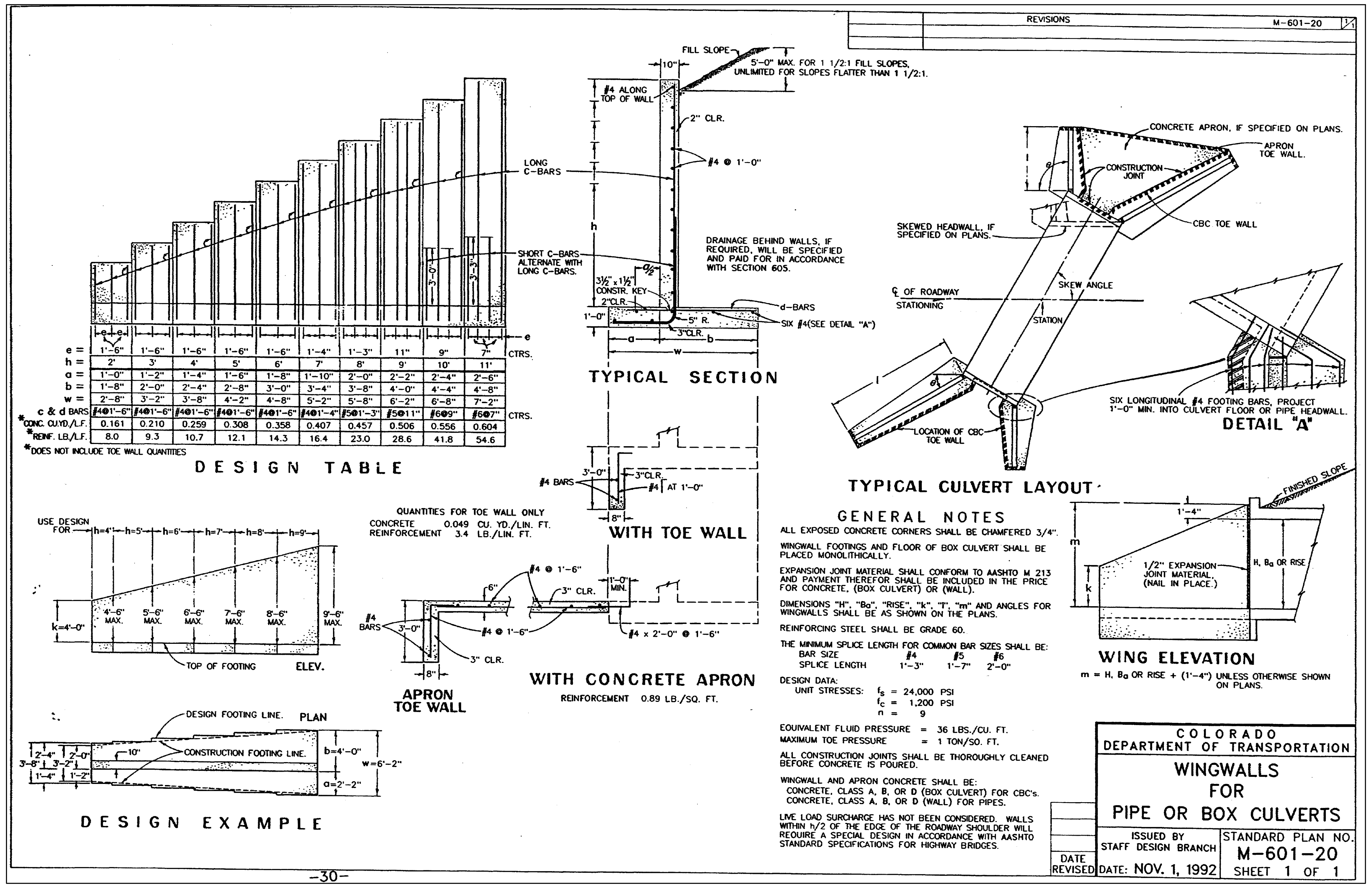
⑨ **CSP RISER INLET**
NO SCALE

1. Corrugated steel pipe shall conform to AASHTO M–36.
2. Grate assembly shall be galvanized after fabrication.
3. Riser and stub shall be shop fabricated and galvanized after welding.



D	L	T
18"	12"	6"
48"	18"	6"

⑩ **CONCRETE COLLAR**
NO SCALE



GENERAL NOTES

ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4".

WINGWALL FOOTINGS AND FLOOR OF BOX CULVERT SHALL BE PLACED MONOLITHICALLY.

EXPANSION JOINT MATERIAL SHALL CONFORM TO AASHTO M 213 AND PAYMENT THEREFOR SHALL BE INCLUDED IN THE PRICE FOR CONCRETE, (BOX CULVERT) OR (WALL).

DIMENSIONS "H", "Ba", "RISE", "k", "l", "m" AND ANGLES FOR WINGWALLS SHALL BE AS SHOWN ON THE PLANS.

REINFORCING STEEL SHALL BE GRADE 60.

THE MINIMUM SPLICE LENGTH FOR COMMON BAR SIZES SHALL BE:

BAR SIZE	#4	#5	#6
SPLICE LENGTH	1'–3"	1'–7"	2'–0"

DESIGN DATA:
UNIT STRESSES: f_s = 24,000 PSI
f_c = 1,200 PSI
n = 9

EQUIVALENT FLUID PRESSURE = 36 LBS./CU. FT.
MAXIMUM TOE PRESSURE = 1 TON/SQ. FT.

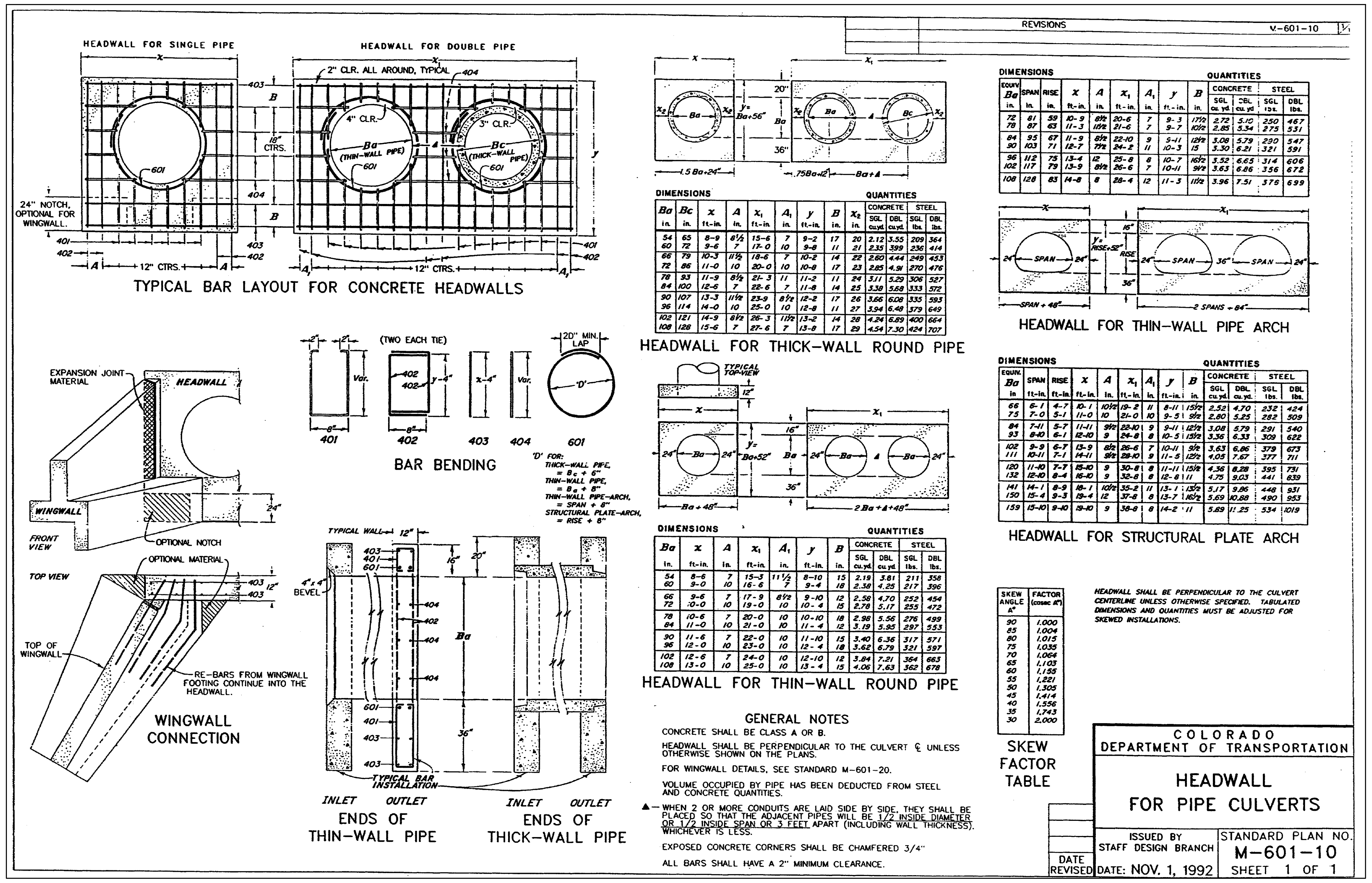
ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE CONCRETE IS POURED.

WINGWALL AND APRON CONCRETE SHALL BE:
CONCRETE, CLASS A, B, OR D (BOX CULVERT) FOR CBC's.
CONCRETE, CLASS A, B, OR D (WALL) FOR PIPES.

LIVE LOAD SURCHARGE HAS NOT BEEN CONSIDERED. WALLS WITHIN h/2 OF THE EDGE OF THE ROADWAY SHOULDER WILL REQUIRE A SPECIAL DESIGN IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES.

m = H, Ba OR RISE + (1'–4") UNLESS OTHERWISE SHOWN ON PLANS.

COLORADO
DEPARTMENT OF TRANSPORTATION
WINGWALLS
FOR
PIPE OR BOX CULVERTS
ISSUED BY STAFF DESIGN BRANCH
DATE: NOV. 1, 1992
STANDARD PLAN NO. M–601–20
SHEET 1 OF 1
DATE REVISED


REVISIONS
M-601-10
HEADWALL FOR SINGLE PIPE
HEADWALL FOR DOUBLE PIPE
TYPICAL BAR LAYOUT FOR CONCRETE HEADWALLS
HEADWALL FOR THICK-WALL ROUND PIPE
HEADWALL FOR THIN-WALL PIPE ARCH
HEADWALL FOR STRUCTURAL PLATE ARCH
BAR BENDING
WINGWALL CONNECTION
ENDS OF THIN-WALL PIPE
ENDS OF THICK-WALL PIPE
HEADWALL FOR THIN-WALL ROUND PIPE
SKEW FACTOR TABLE

HEADWALL SHALL BE PERPENDICULAR TO THE CULVERT CENTERLINE UNLESS OTHERWISE SPECIFIED. TABULATED DIMENSIONS AND QUANTITIES MUST BE ADJUSTED FOR SKEWED INSTALLATIONS.

SKEW ANGLE A°	FACTOR
90	1.000
85	1.004
80	1.015
75	1.035
70	1.064
65	1.103
60	1.155
55	1.221
50	1.305
45	1.414
40	1.556
35	1.743
30	2.000

SKEW FACTOR TABLE

GENERAL NOTES

CONCRETE SHALL BE CLASS A OR B.

HEADWALL SHALL BE PERPENDICULAR TO THE CULVERT ℄ UNLESS OTHERWISE SHOWN ON THE PLANS.

FOR WINGWALL DETAILS, SEE STANDARD M–601–20.

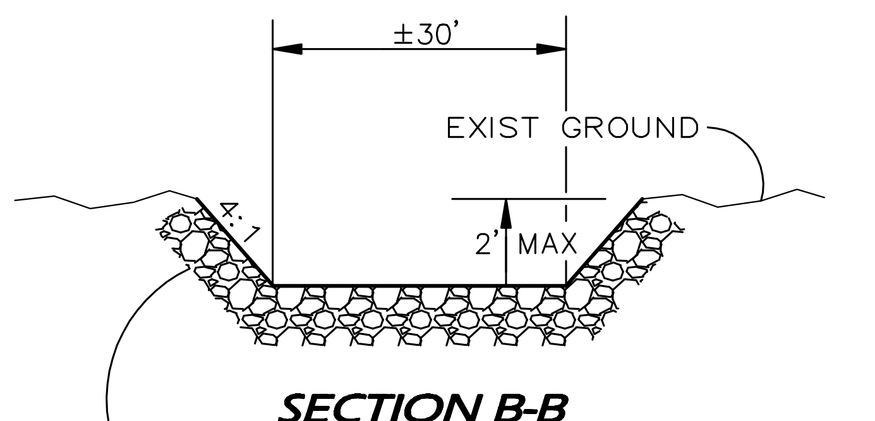
VOLUME OCCUPIED BY PIPE HAS BEEN DEDUCTED FROM STEEL AND CONCRETE QUANTITIES.

▲— WHEN 2 OR MORE CONDUITS ARE LAID SIDE BY SIDE, THEY SHALL BE PLACED SO THAT THE ADJACENT PIPES WILL BE 1/2 INSIDE DIAMETER OR 1/2 INSIDE SPAN OR 3 FEET APART (INCLUDING WALL THICKNESS), WHICHEVER IS LESS.

EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4"

ALL BARS SHALL HAVE A 2" MINIMUM CLEARANCE.

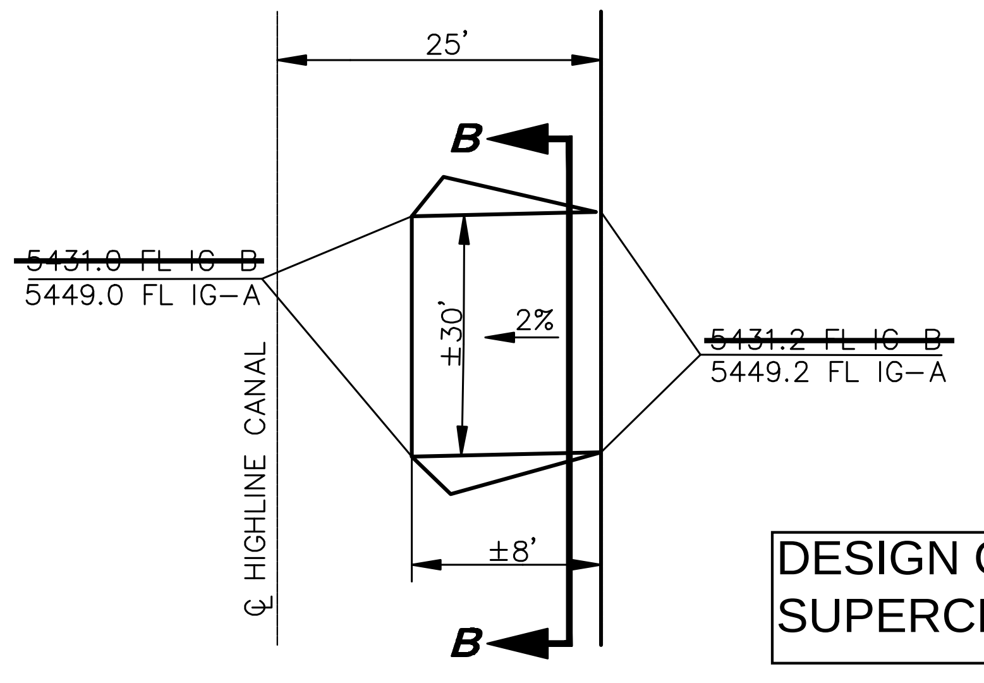
COLORADO
DEPARTMENT OF TRANSPORTATION
HEADWALL
FOR PIPE CULVERTS
ISSUED BY STAFF DESIGN BRANCH
DATE: NOV. 1, 1992
STANDARD PLAN NO. M–601–10
SHEET 1 OF 1
DATE REVISED



SECTION B-B
NTS

CLASS "M" RIP-RAP
BURIED MIN 12"

EMERGENCY OVERFLOW DETAIL
NTS
(SEE SHEET 2)



SECTION A-A
NTS

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215XXX.

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

APPROVED ON 06.27.14

PREPARED UNDER THE SUPERVISION OF:
31024
HAYWARD PARDUE P.E. # 31024
DATE

BENCH MARK
CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16–14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH–SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

CITY OF AURORA
STORM DRAIN DETAILS
POND IG-B OUTFALL
MAJESTIC COMMERCENTER
AURORA, COLORADO
PLAN DATE 06/15/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371–1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD., STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 14

214070

DESIGN OF POND IG-B HAS BEEN SUPERCEDED BY EDN 215145.

STORMWATER MANAGEMENT BMP REQUIREMENTS

ECB	STRAW MULCH EROSION CONTROL BLANKET
ECB	STRAW MULCH EROSION CONTROL BLANKET WITH COCANUT
SF	SILT FENCE ALONG TOE OF ALL SLOPES NOT DIRECTED INTO PONDS or DRAINAGE CHANNEL
IPC	CULVERT INLET PROTECTION
SR	SURFACE ROUGHENING
VTC	VEHICLE TRACKING CONTROL
SM	SEEDING and MULCHING

ECB ▨ = LITTORAL ZONE TO BE PLANTED WITH NON-ANNUAL SEED MIX PER CITY STANDARD (0.82 AC)

☐ = WATER QUALITY POOL=5421.0 (16.92 AC-FT)

DETENTION POND IG-B
(PRIVATE)

INFLOW 541 CFS
OUTFLOW: 409 CFS
MAX ELEV 5431.0
MAX DEPTH 18.0'

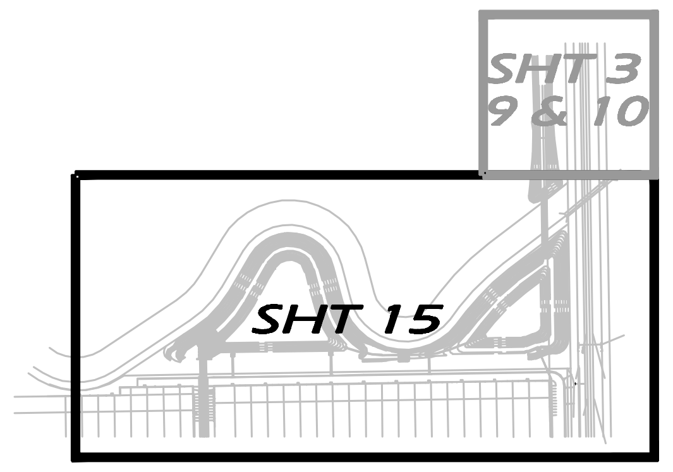
WQCV ELEV = 5423
(16.1 AC-FT REQ, 24.2 PROVIDED)

MAX AVAILABLE DETENTION STORAGE 45.68 ACRE-FT

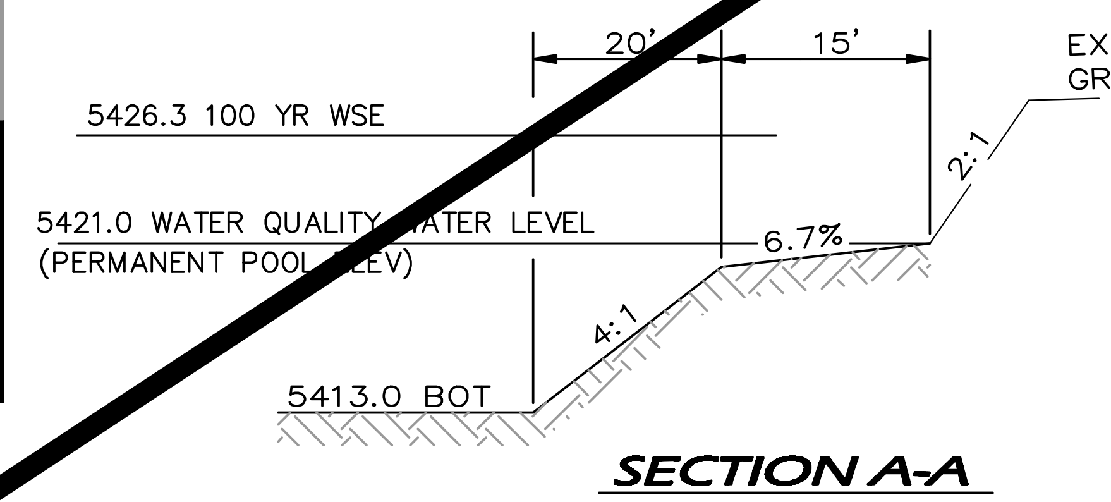
100 YR DETENTION REQUIREMENT= 25.9 AC-FT
100 YR W.S. ELEV=5427.9
10 YR W.S. ELEV=5425.0

SEE BOLLING DRIVE TRIBUTARY CHANNEL IMPROVMENTS BY OTHERS
HEADWALL PER CDOT STD. M-601-10 SEE STORM DRAIN PLANS FOR DETAILS
BEFORE A CERTIFICATE OF OCCUPANCY CAN BE ISSUED.
3-48" RCP SD, SEE SHEET 3
PROTECT EXIST POWER POLE
INLET STRUCTURE, SEE SHEETS 4 THRU 8
℄ HIGHLINE CANAL
℄ HIGHLINE CANAL
100' R/W
75'
25'
3+08.30 END
SEE EMERGENCY OVERFLOW DETAIL SHEET 14
PERMANENT POOL ELEV= 5421.0
BOTTOM ELEV= 5413.0
PERMANENT POOL ELEV= 5421.0
BOTTOM ELEV= 5413.0
PROPOSED 12" MIN. CLASS M RIP-RAP, LIMITS AS SHOWN THICKNESS=2' MIN
PROPOSED 12" MIN. CLASS M RIP-RAP, LIMITS AS SHOWN. THICKNESS=2' MIN
18" PVC SDR-35 STORM DRAIN, SEE SHEET 4
EXISTING RIP-RAP
6" THICK MIN 3/4" GRAVEL ALL WEATHER ACCESS
6" THICK MIN 3/4" GRAVEL ALL WEATHER ACCESS
5421.0 INLET 5417.0 INVERT
5413.0 INV
65' PUBLIC SERVICE EASEMENT
Limits of Construction
N00°56'18"W 170.64'
N00°55'53"W 1023.17'
EX. 3-48" RCP SD CULVERT
BUILD 22
BUILD 23
℄ 38TH AVE.
EXIST 16" WATER
MEDIAN
CURB
120' R/W
36'
36'
18'
A
B
C
D
CF
SF
SR
SM
ECB
IPC
VTC

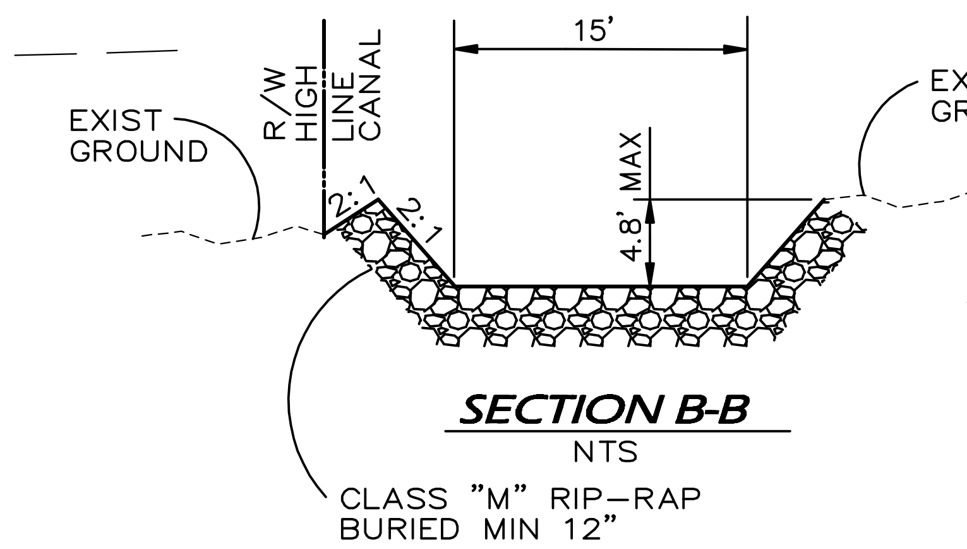
GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.



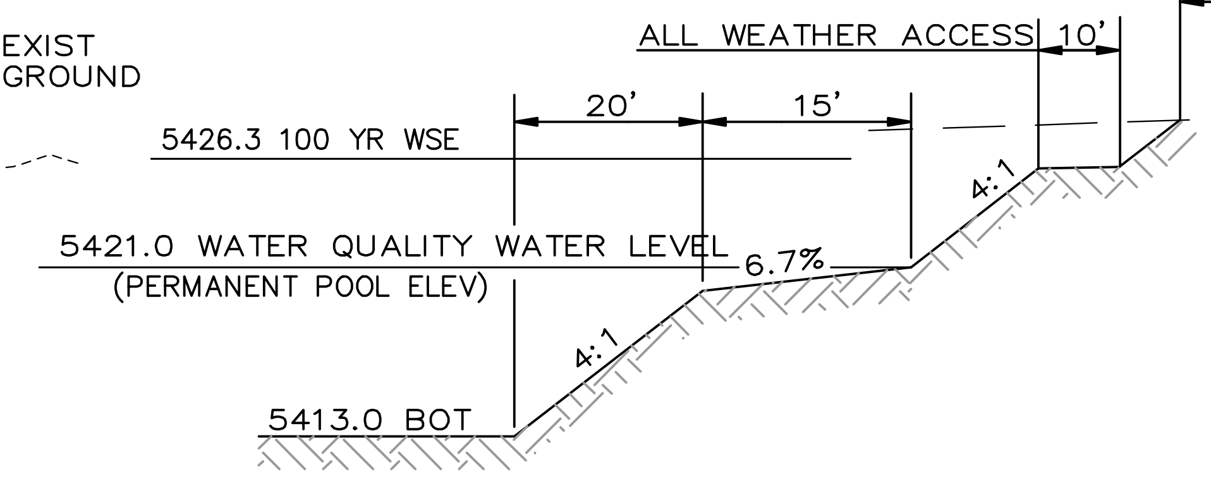
KEY MAP
NTS



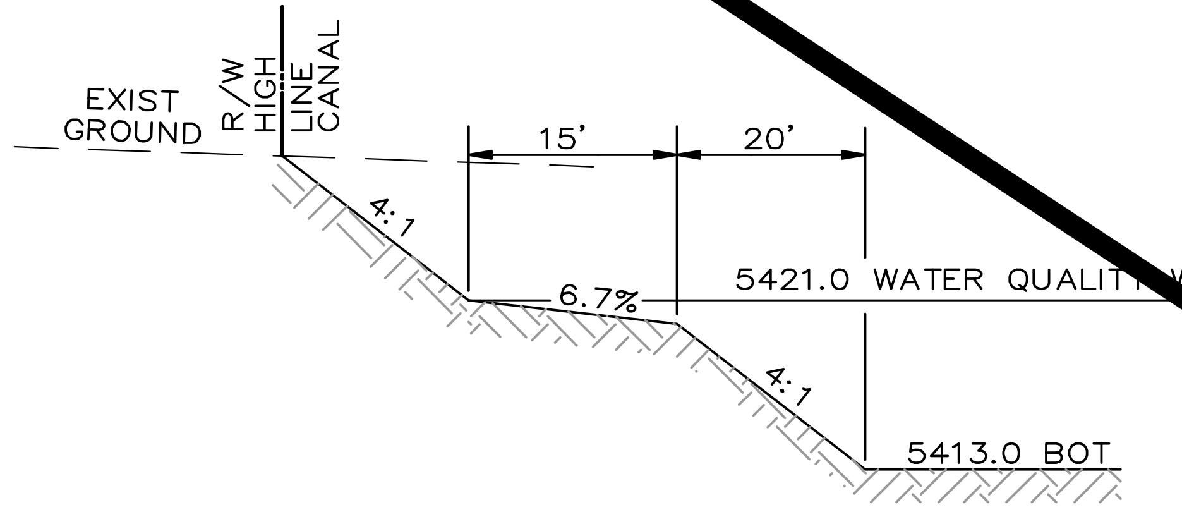
SECTION A-A
NTS



SECTION B-B
NTS



SECTION C-C
NTS



SECTION D-D
NTS

NOTE REGARDING DE-WATERING

Possibly required at existing detention ponds until proposed outfall structures are complete. This will be accomplished by grading berms and pumping to hold water in certain areas as determined by the contractor to complete the site grading and storm drain construction.

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APPROVED ON 06.27.14

PREPARED UNDER THE SUPERVISION OF:
31024
HAYWARD PARDUE P.E. # 31024
06/04/14
DATE

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

EROSION CONTROL PLAN
DETENTION POND "IG-B" MODIFICATIONS
OUTFALL FACILITY
MAJESTIC COMMERCE CENTER

AURORA, COLORADO

PLAN DATE 06/02/2014

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

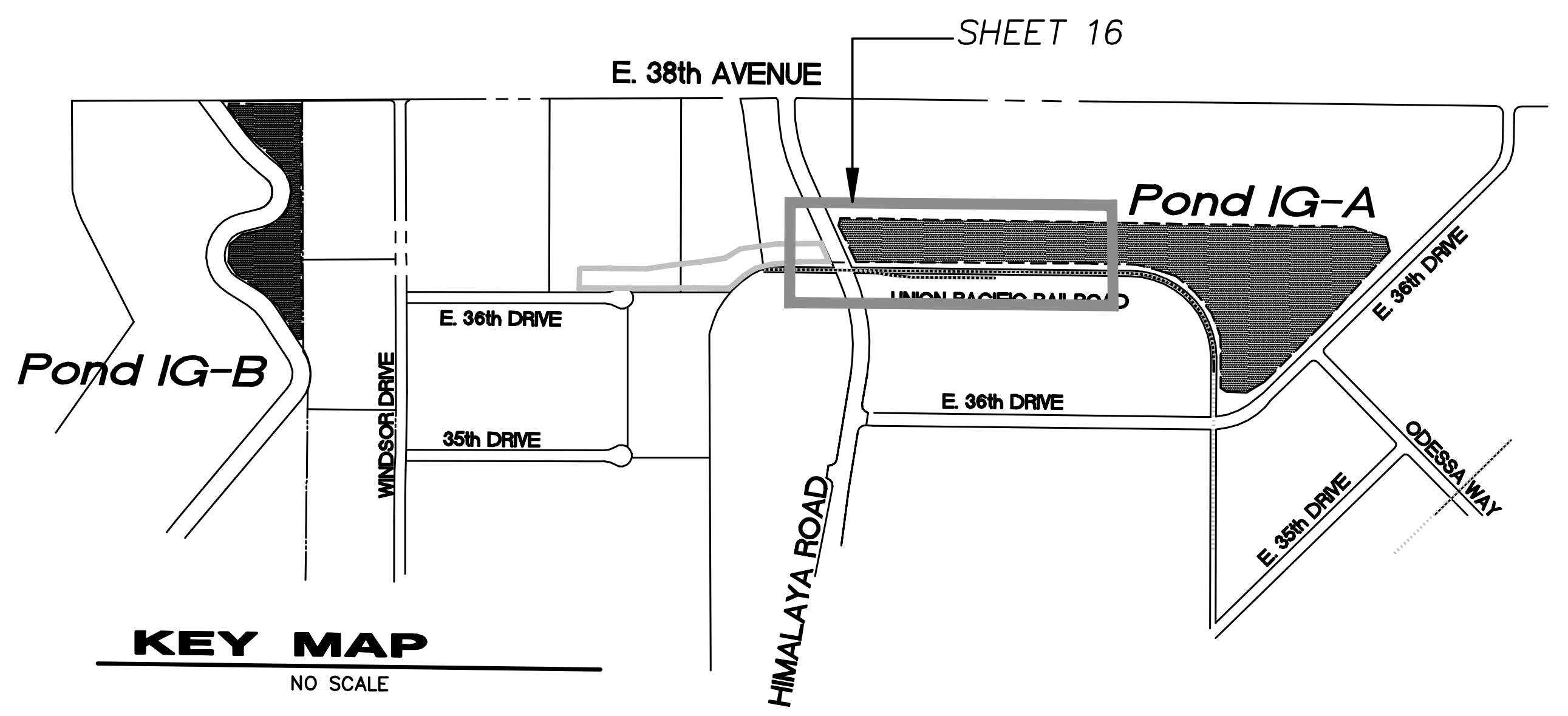
ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD., STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 15

C:\temp\MCC bldg 28\2025-1 POND IGA & IGB\ERC IGB GRADING.dwg Last Modified: 02 Jun 2014 – 9:06am

SEE SHEET 19
SEE SHEET 18
SEE SHEET 17
SEE EMERGENCY OVERFLOW DETAIL SHEET 14
Limits of Construction
CF
SM
SR
IPC
4:1
5440
5441
5442
5443
5444
5445
5450
BEGIN 2 - 5'x8' BOX CULVERT 32+75.96
END CHANNEL BEGIN 2 - 5'x8' BOX CULVERT 31+12.02
N 80°12'49" E 163.25'
MAINTENANCE PATH
88' R.O.W.
HIMALAYA ROAD
EXISTING RAIL LINE
MH
LOT 1
BLK 1
FLG 2

NOTE: CONSTRUCTION FENCE WHERE NOTED IS ALONG THE LOC UNLESS INDICATED OTHERWISE



KEY MAP
NO SCALE

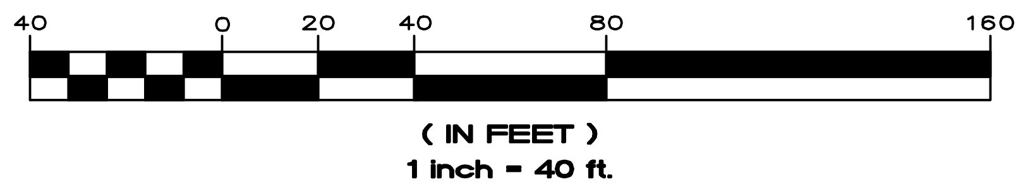
STORMWATER MANAGEMENT BMP REQUIREMENTS

IPC	CULVERT INLET PROTECTION
SR	SURFACE ROUGHENING
CF	CONSTRUCTION FENCE
SM	SEEDING and MULCHING

NOTE REGARDING DE-WATERING

Possibly required at existing detention ponds until proposed outfall structures are complete. This will be accomplished by grading berms and pumping to hold water in certain areas as determined by the contractor to complete the site grading and storm drain construction.

GRAPHIC SCALE



(IN FEET)
1 inch = 40 ft.

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024 — 06/04/14 DATE

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

EROSION CONTROL PLAN
MAJESTIC COMMERCENTER
DETENTION POND IG-A

AURORA, COLORADO

PLAN DATE 06/02/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD,. STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 16

APPROVED ON 06.27.14

SEE SHEET 16
Limits of Construction
CF
SR
SM
4:1
5440
5441
5442
5443
5444
5445
5446
5448
5450
5452
5454
5456
EXISTING RAIL LINE
13
MAINTENANCE ACCESS FROM 36TH DRIVE

NOTE: CONSTRUCTION FENCE WHERE NOTED IS ALONG THE LOC UNLESS INDICATED OTHERWISE

STORMWATER MANAGEMENT BMP REQUIREMENTS

SR — SURFACE ROUGHENING
CF — CONSTRUCTION FENCE
SM — SEEDING and MULCHING

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

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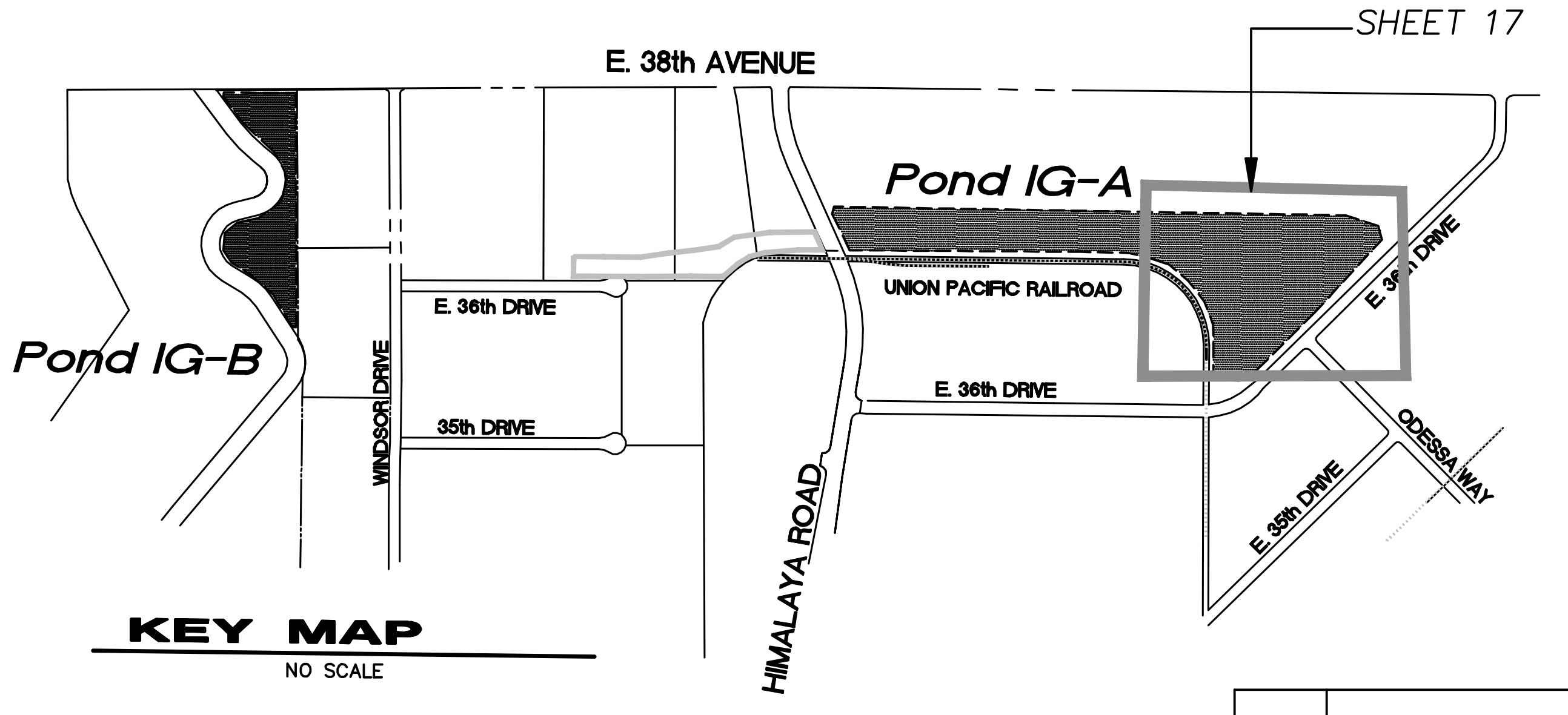
PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024 06/04/14
DATE



KEY MAP
NO SCALE

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

NOTE REGARDING DE-WATERING

Possibly required at existing detention ponds until proposed outfall structures are complete. This will be accomplished by grading berms and pumping to hold water in certain areas as determined by the contractor to complete the site grading and storm drain construction.

CITY OF AURORA

EROSION CONTROL PLAN
MAJESTIC COMMERCENTER
DETENTION POND IG-A

AURORA, COLORADO

PLAN DATE
06/02/14

OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD,. STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 17

APPROVED ON 06.27.14

NOTE: CONTRACTOR TO VERIFY LOCATION AND ELEVATION OF EXISTING UTILITES PRIOR TO CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES

CL OF PIPE
PROPOSED TOP OF CHANNEL
PROPOSED TOP OF CHANNEL
EXIST. GROUND
5450
5440
5430
5420
(5447.0) TW
5447.2 TW
HGL100
HGL100
5439.75 INV
S=0.0027
S=0.0020
S=0.0020
S=0.0020
8" SEW
5436.6 6" WAT
(5437.3) BW
(5437.4) BOT CUT-OFF WALL
12" WAT
5437.7 BW
Q100=435 CFS V=7.17 FPS
Q100=435 CFS V=7.17 FPS
Q100=435 CFS V=7.17 FPS
1380.37 LF GRADED OPEN CHANNEL SEE TYPICAL CROSS SECTION HEREON
1380.37 LF GRADED OPEN CHANNEL SEE TYPICAL CROSS SECTION HEREON
PROPOSED BOTTOM OF CHANNEL
PROPOSED BOTTOM OF CHANNEL
PROPOSED BOTTOM OF CHANNEL
JOIN EXIST. BOX CULVERT 15+77.12–REMOVE HEADWALL (5439.29) INV, GB
15+87.12–REMOVE EXIST. HEADWALL and APRON
17+31.65–END BOX CLVT 5439.71 INV
Q100=435 CFS V=6.53 FPS
PROFILE SCALES HORIZ: 1" = 40' VERT: 1" = 4'
16
17
18
19
20
21
22
23
24
25
26
27
28
29

SEE SHEET 19
Limits of Construction
Limits of Construction
Limits of Construction
Limits of Construction
FUTURE DRAINAGE EASEMENT
14'
4'
14'
12'
HGL100
29.2'
5.9'
MAINTENANCE PATH
SECTION "A"
NTS
12' MAINTENANCE PATH
REMOVE EXISTING TRIPLE 5 X 7 BOX CULVERT
ECB
SF
SM
SR
SCL
CF
IPC
17+31.65 BEGIN CHANNEL END 2 – 5'x8' BOX CULVERT
BC = 17+95.73
EC = 20+17.08
BC = 23+24.45
PRC = 18+98.55
PRC = 18+44.09
PRC = 24+31.59
A
A
WINDSOR DRIVE
SEE SHEET 16
SHEET 18
E. 38th AVENUE
Pond IG-A
Pond IG-B
UNION PACIFIC RAILROAD
E. 36th DRIVE
E. 36th DRIVE
35th DRIVE
E. 38th DRIVE
E. 35th DRIVE
ODESSA WAY
WINDSOR DRIVE
HIMALAYA ROAD
KEY MAP
NO SCALE

WINDSOR DRIVE

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

STORMWATER MANAGEMENT BMP REQUIREMENTS

ECB	STRAW MULCH EROSION CONTROL BLANKET
SF	SILT FENCE ALONG TOE OF ALL SLOPES NOT DIRECTED INTO PONDS or DRAINAGE CHANNEL
IPC	CULVERT INLET PROTECTION
SR	SURFACE ROUGHENING
SCL	SEDIMENT CONTROL LOG
CF	CONSTRUCTION FENCE
SM	SEEDING and MULCHING

PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024

06/04/14
DATE

APPROVED ON 06.27.14

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BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16–14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH–SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA
EROSION CONTROL PLAN
CHANNEL EXTENSION
MAJESTIC COMMERCENTER
TO DETENTION POND IG-A
AURORA, COLORADO

PLAN DATE
06/02/14

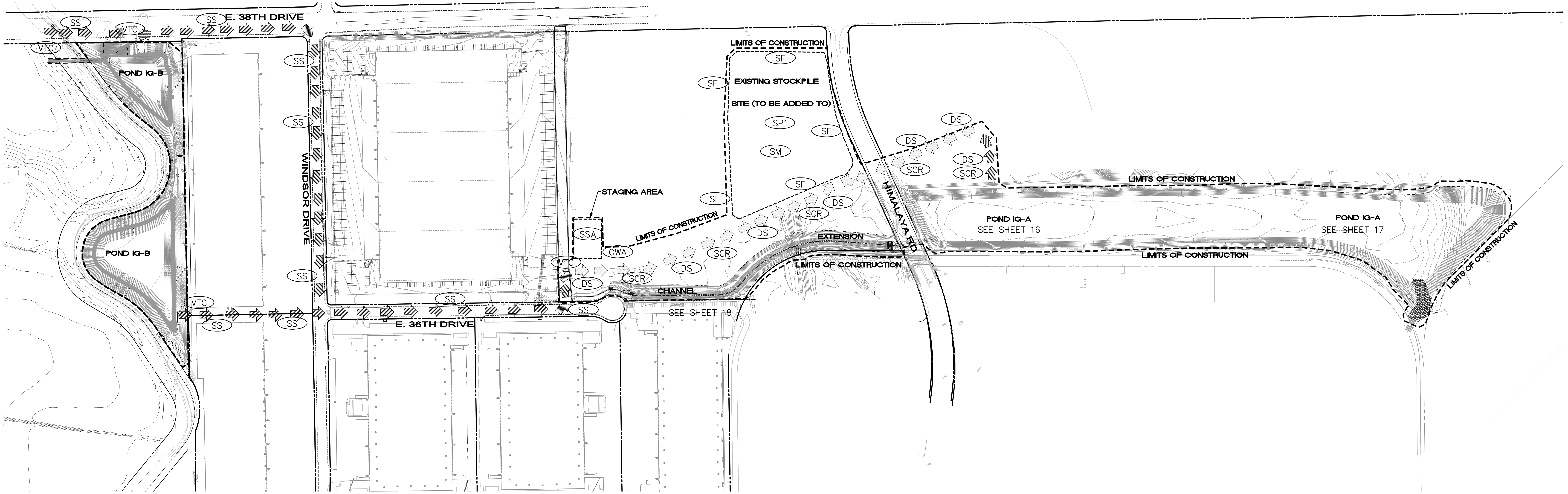
OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371–1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD., STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 18

C:\temp\MCC bldg 28\2025-1 POND IGA & IGB\ERC IGB channel base.dwg Last Modified: 02 Jun 2014 - 9:46am

214070



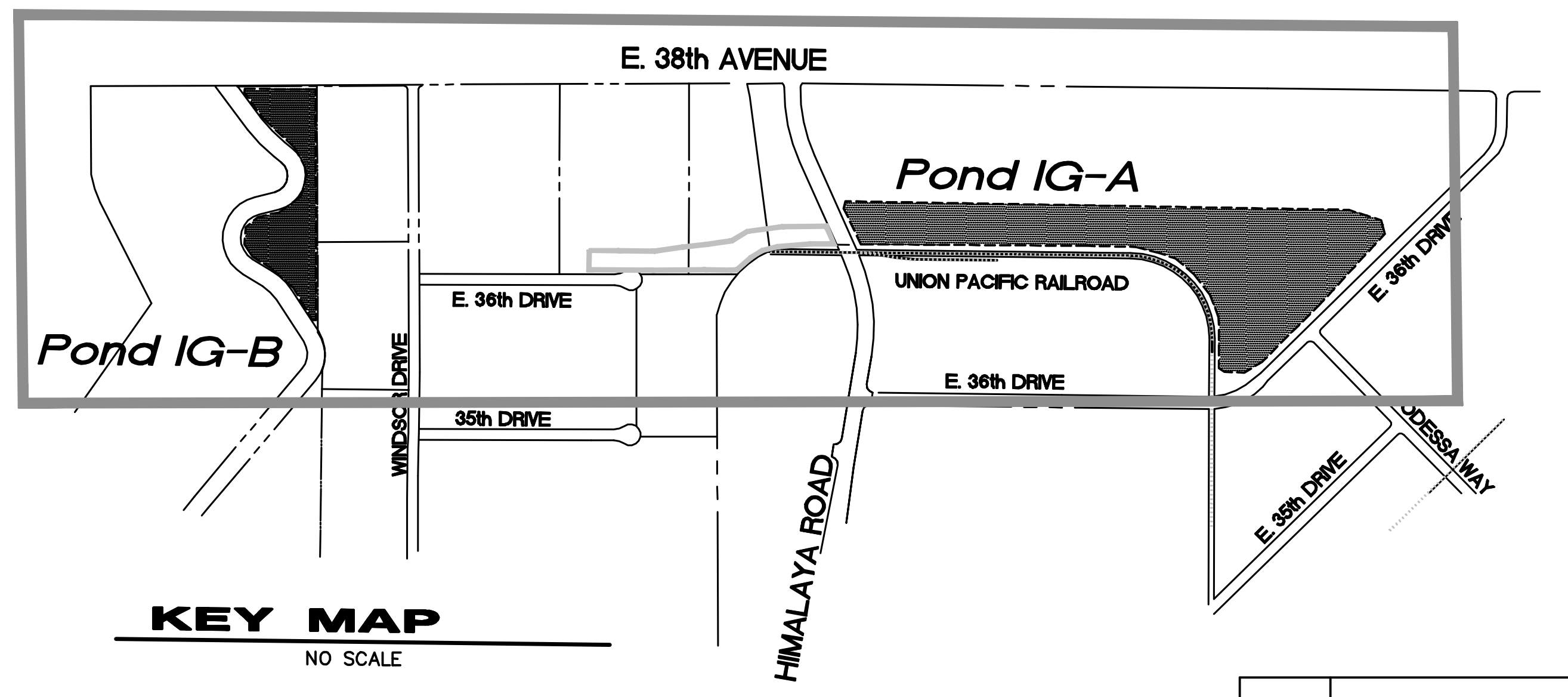
⇨ EXISTING HAUL ROUTE

▨ PROPOSED ADDTIONAL HAUL ROUTE

NOTE: HAUL ROUTE TO BE DEFINED ON BOTH SIDED BY BERMS.
EXISTING BERMS TO BE RE-CONSTRUCTED AS NECESSARY.

STORMWATER MANAGEMENT BMP REQUIREMENTS

CWA	CONCRETE WASHOUT AREA
VTC	VEHICLE TRACKING CONTROL
SSA	STABILIZED STAGING AREA
SS	STREET SWEEPING AND VACUUMING
CF	CONSTRUCTION FENCE
SP1	STOCKPILE MANAGEMENT
SF	SILT FENCE
DS	DUST SUPRESSION
SCR	STABILIZED CONSTRUCTION ROADWAY
SM	SEEDING and MULCHING



KEY MAP
NO SCALE

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

THIS IS A FACSIMILE OF A SIGNED AND SEALED DOCUMENT TRANSMITTED TO THE CITY OF AURORA.

PREPARED UNDER THE SUPERVISION OF:

31024

HAYWARD PARDUE P.E. # 31024

06/04/14
DATE

BENCH MARK

CITY OF AURORA ID # 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LANDLINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE.
ELEVATION = 5455.101 (NAVD 88).

No.	Description	Date	Init.

REVISIONS

CITY OF AURORA

STOCKPILE and HAUL ROUTE
MAJESTIC COMMERCENTER
DETENTION POND IG-A

AURORA, COLORADO

PLAN DATE
04/22/15

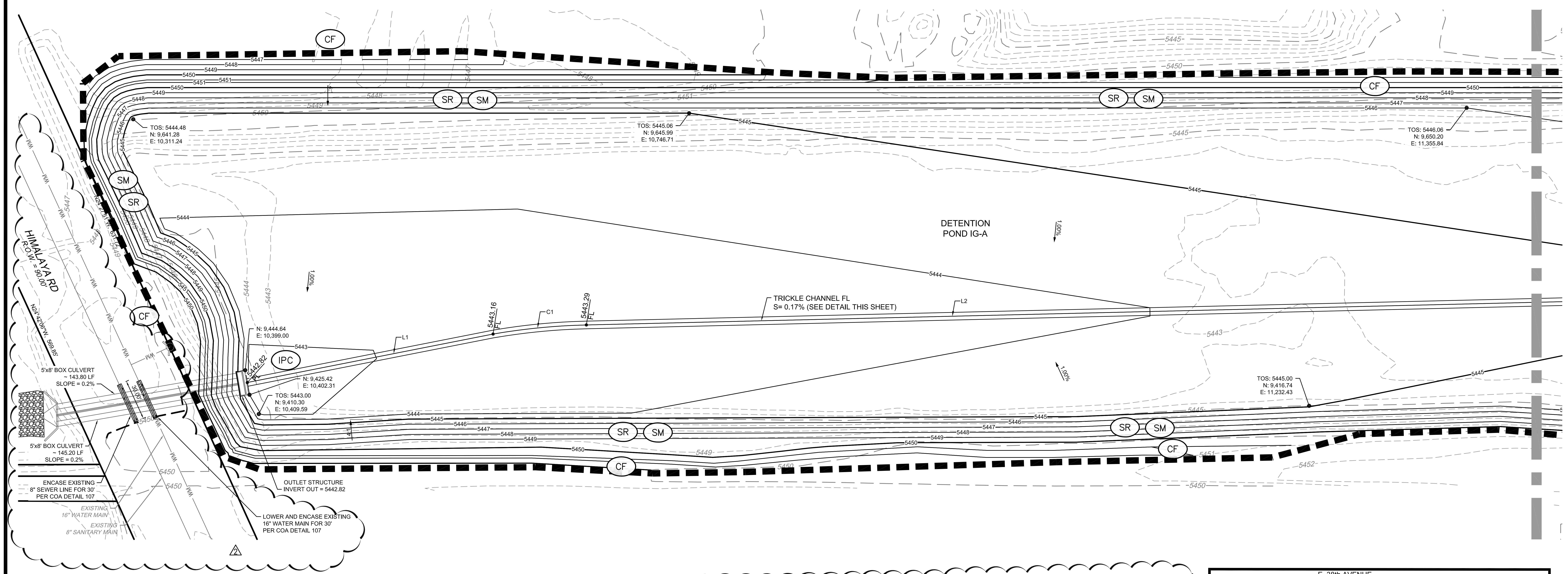
OWNER
MAJESTIC REALTY CO.
20100 EAST 32nd PKWY, SUITE 150
AURORA, CO 80011
(303) 371-1400
CONTACT: TONY STOFFLE

ENGINEER
PBLA ENGINEERING, INC.
Planning • Engineering • Surveying
4790 IRVINE BLVD,. STE 105-262
IRVINE, CALIF. 92620
(888) 714-9642 • (714)389-9191 FAX

Sheet 19

APPROVED ON 06.27.14

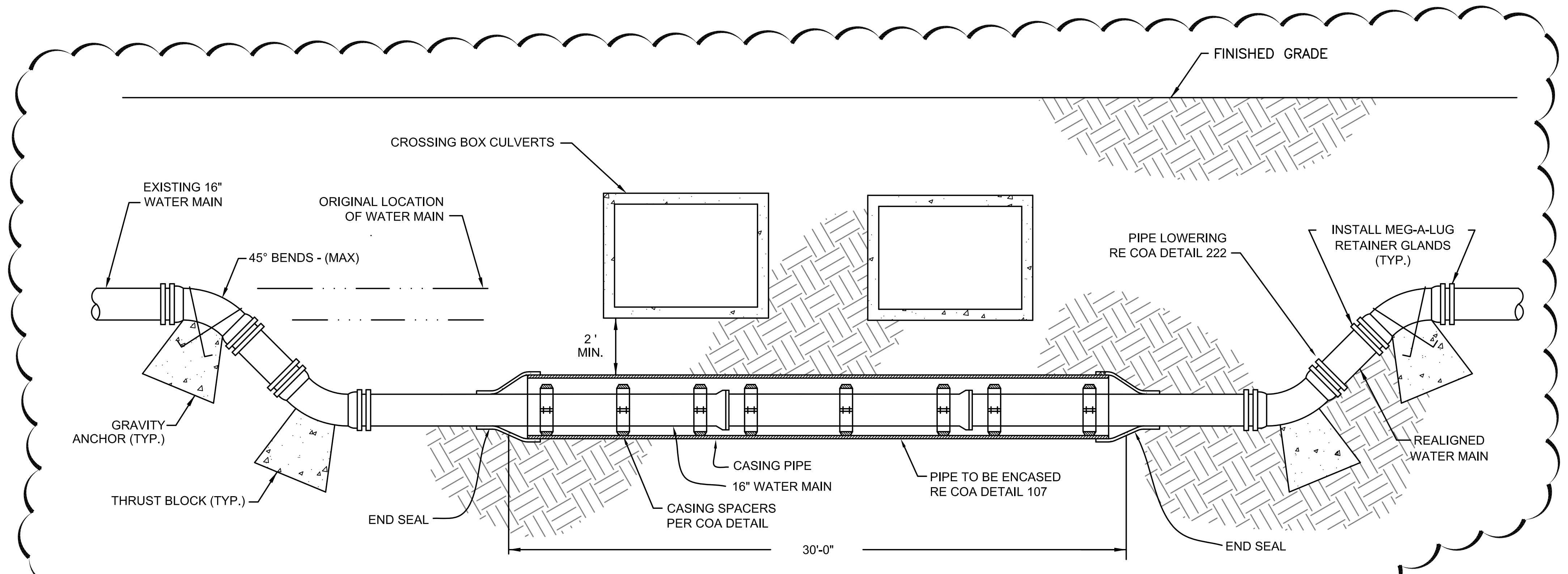
REV. 214070


CF
SR
SM
IPC
DETENTION POND IG-A
TRICKLE CHANNEL FL S= 0.17% (SEE DETAIL THIS SHEET)
TOS: 5444.48 N: 9,641.28 E: 10,311.24
TOS: 5445.06 N: 9,645.99 E: 10,746.71
TOS: 5446.06 N: 9,650.20 E: 11,355.84
TOS: 5445.00 N: 9,416.74 E: 11,232.43
TOS: 5443.00 N: 9,410.30 E: 10,409.59
N: 9,444.64 E: 10,399.00
N: 9,425.42 E: 10,402.31
5443.16 FL
5443.29 FL
5442.82
L1
C1
L2
1.00%
HIMALAYA RD R.O.W. = 90.00'
5'x8' BOX CULVERT ~ 143.80 LF SLOPE = 0.2%
5'x8' BOX CULVERT ~ 145.20 LF SLOPE = 0.2%
ENCASE EXISTING 8" SEWER LINE FOR 30' PER COA DETAIL 107
EXISTING 16" WATER MAIN
EXISTING 8" SANITARY MAIN
OUTLET STRUCTURE INVERT OUT = 5442.82
LOWER AND ENCASE EXISTING 16" WATER MAIN FOR 30' PER COA DETAIL 107
5444
5445
5446
5447
5448
5449
5450
5451
5452
MATCHLINE (SEE SHEET 21)

LEGEND:

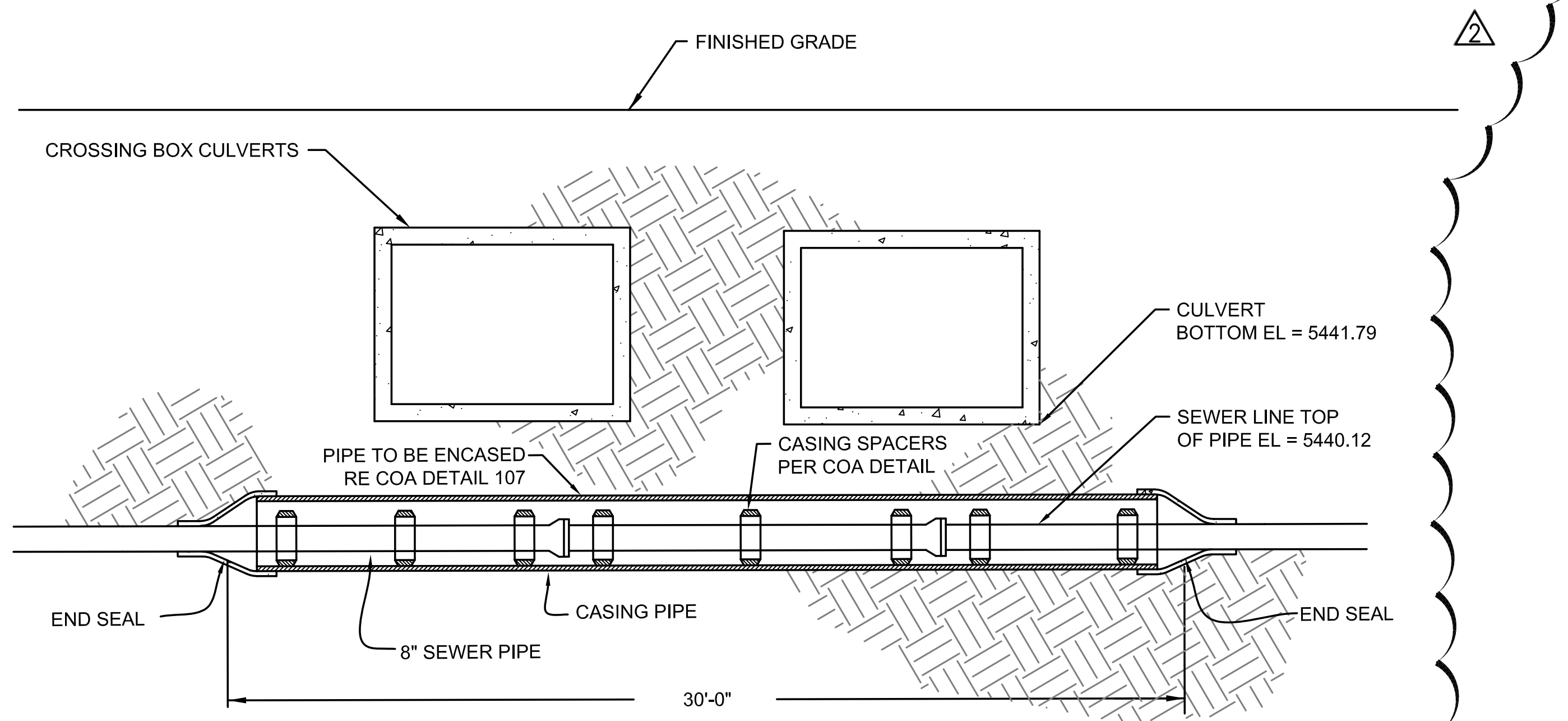
▬	PROPERTY LINE
— 5820 —	PROPOSED 5' CONTOUR
— 5821 —	PROPOSED 1' CONTOUR
- - 5820 - -	EXISTING 5' CONTOUR
- - 5821 - -	EXISTING 1' CONTOUR
▬ ▬ ▬	PROPOSED STORM LINE
▬ ▬ ▬	EXISTING STORM LINE
▭	PROPOSED STORM INLET
▭	EXISTING STORM INLET
→ · · ·	PROPOSED SWALE
.XX.XX	PROPOSED SPOT ELEVATION (AT FLOWLINE UNLESS OTHERWISE INDICATED)
X.XX%	PROPOSED SLOPE AND DIRECTION
→	FLOW DIRECTION

HP	HIGH POINT
LP	LOW POINT
ME	MATCH EXISTING
GB	GRADE BREAK
TOS	TOE OF SLOPE ELEVATION
TOW	TOP OF WALL
FGW	FINISH GRADE AT WALL
IPC	CULVERT INLET PROTECTION
SR	SURFACE ROUGHENING
CF	CONSTRUCTION FENCE
SM	SEEDING AND MULCHING



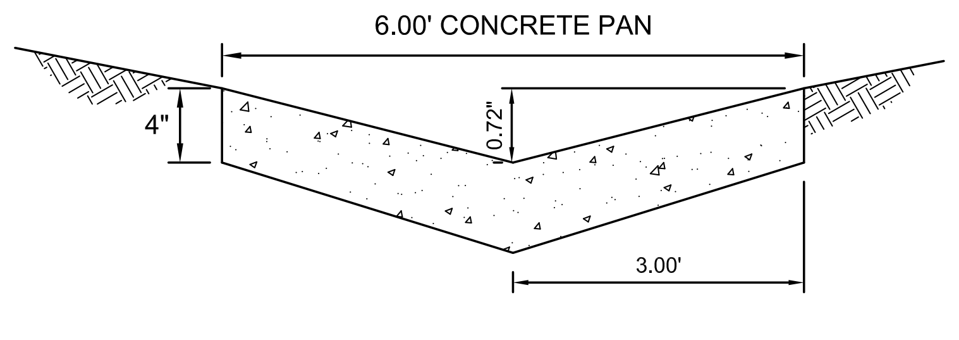
EXISTING 16" WATER MAIN LOWERING AND ENCASEMENT DETAIL

N.T.S.


FINISHED GRADE
CROSSING BOX CULVERTS
CULVERT BOTTOM EL = 5441.79
SEWER LINE TOP OF PIPE EL = 5440.12
PIPE TO BE ENCASED RE COA DETAIL 107
CASING SPACERS PER COA DETAIL
END SEAL
CASING PIPE
8" SEWER PIPE
END SEAL
30'-0"

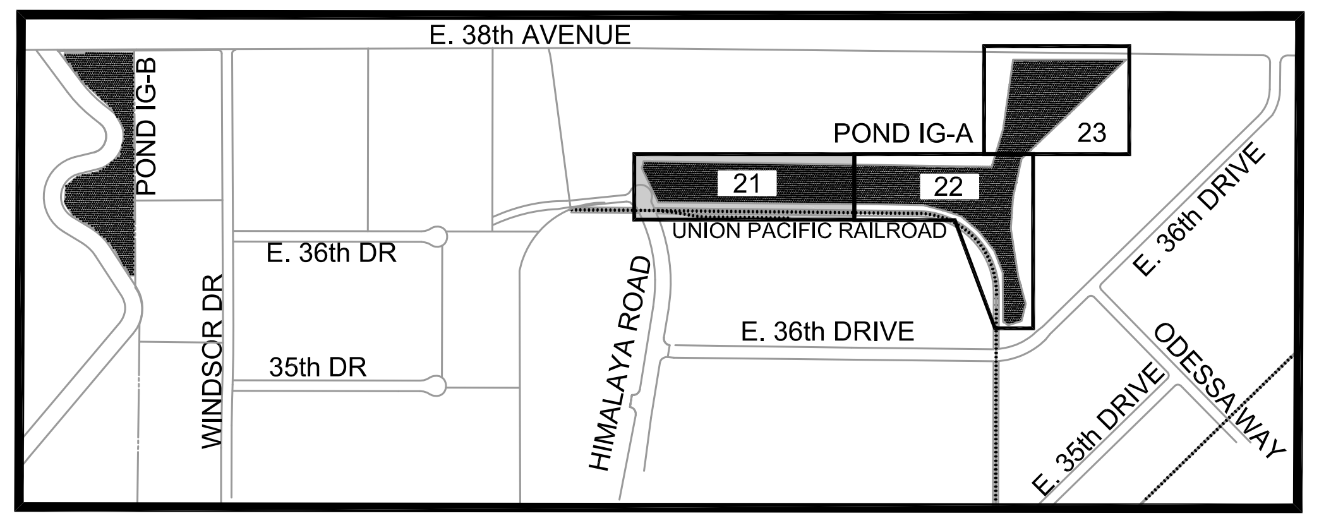
EXISTING 8 " SEWER ENCASEMENT DETAIL

N.T.S.



CONCRETE PAN DETAIL

N.T.S.



KEYMAP

N.T.S.

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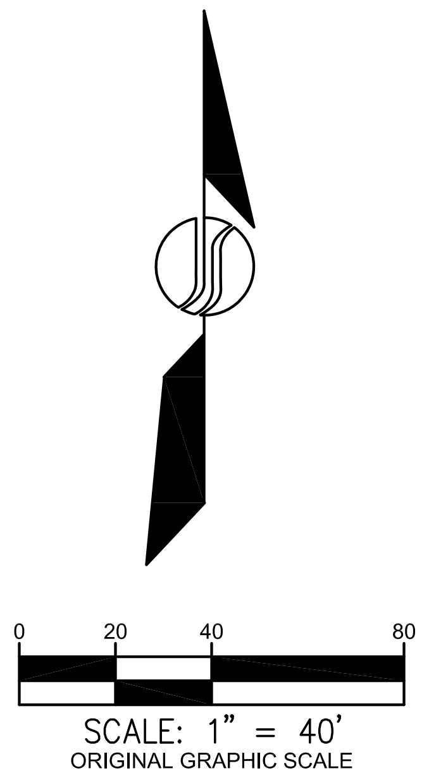
Signature 4-6-16

Date



SCALE: 1" = 40'

ORIGINAL GRAPHIC SCALE

REVISED ON 04.14.16

JANSEN STRAWN
CONSULTING ENGINEERS

45 WEST 2ND AVENUE
DENVER, CO 80223
P.303.561.3333
F.303.561.3339

FOR AND ON BEHALF OF
JANSEN STRAWN CONSULTING ENGINEERS, INC.

BENCHMARK:

CITY OF AURORA ID# 3S6626NW005 (OLD ID# 16-14 1981) 3" BRASS CAP SET IN THE NORTHWEST WINGWALL OF A CONCRETE HEADWALL WEST OF A NORTH-SOUTH RAILROAD TRACK ALONG THE LIVERPOOL LAND LINE, APPROXIMATELY AT THE SOUTH LINE OF THE EAST 36TH AVE. ELEVATION = 5455.101 (NAVD 88)

CALL UTILITY NOTIFICATION CENTER OF COLORADO

811

CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

No.	Description of Revisions	Date	By
2	UTILITY CROSSING DETAILS	04/04/2016	R.A.A.
1	CONSTRUCTION PLANS	01/15/2016	R.A.A.

Designed By: R.A.A.
Checked By: C.S.S.

MAJESTIC COMMERCENTER

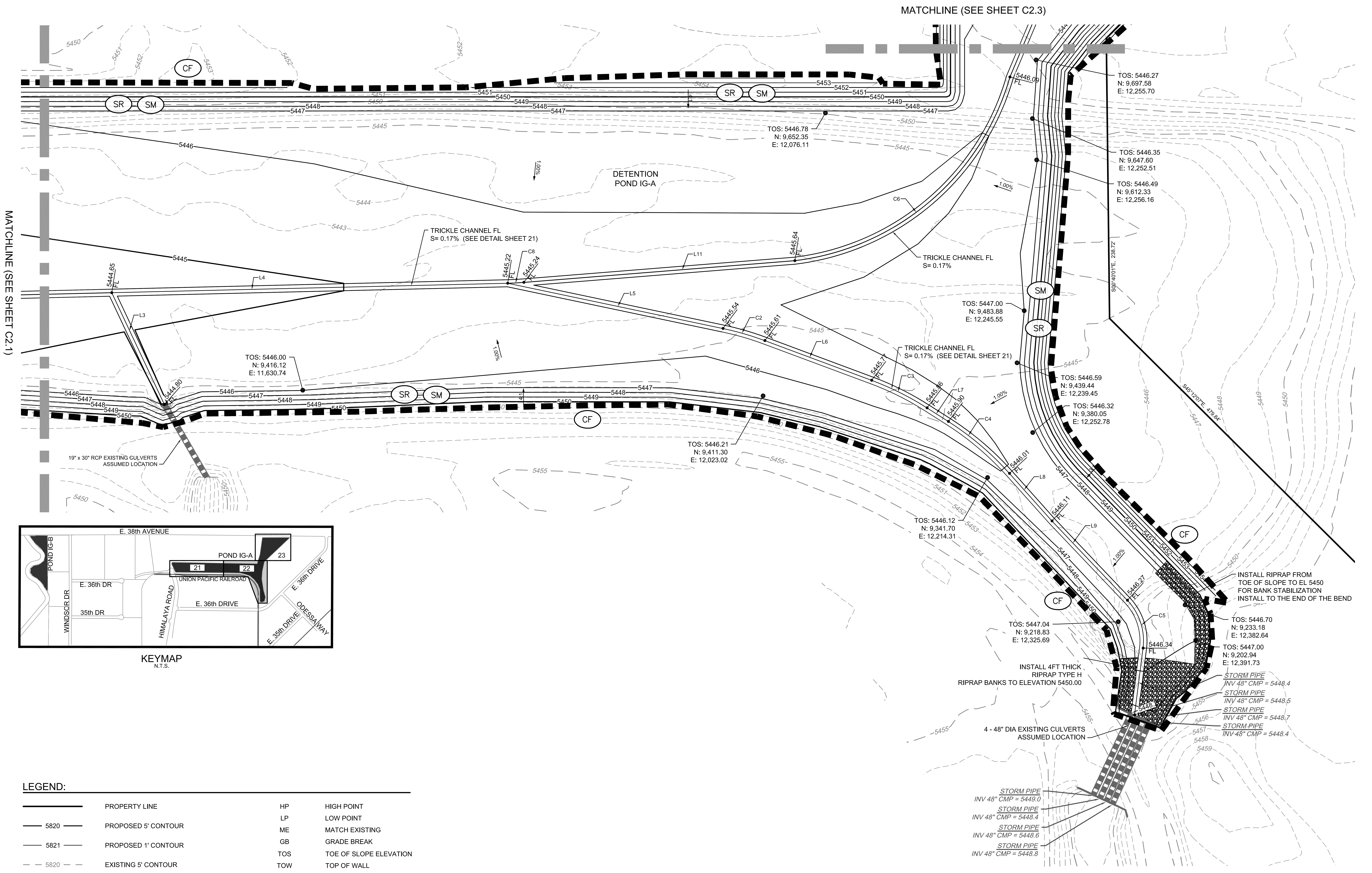
DETENTION POND IG-A

GRADING PLAN AND WATERLINE LOWERING

Date: 01/15/2016
Job No.: 15073
Sheet:

20

Sheet of


MATCHLINE (SEE SHEET C2.3)
MATCHLINE (SEE SHEET C2.1)
DETENTION POND IG-A
TRICKLE CHANNEL FL S= 0.17% (SEE DETAIL SHEET 21)
TRICKLE CHANNEL FL S= 0.17%
TRICKLE CHANNEL FL S= 0.17% (SEE DETAIL SHEET 21)
CF
SR
SM
TOS: 5446.78 N: 9,652.35 E: 12,076.11
TOS: 5446.27 N: 9,697.58 E: 12,255.70
TOS: 5446.35 N: 9,647.60 E: 12,252.51
TOS: 5446.49 N: 9,612.33 E: 12,256.16
TOS: 5447.00 N: 9,483.88 E: 12,245.55
TOS: 5446.59 N: 9,439.44 E: 12,239.45
TOS: 5446.32 N: 9,380.05 E: 12,252.78
TOS: 5446.00 N: 9,416.12 E: 11,630.74
TOS: 5446.21 N: 9,411.30 E: 12,023.02
TOS: 5446.12 N: 9,341.70 E: 12,214.31
TOS: 5447.04 N: 9,218.83 E: 12,325.69
TOS: 5446.70 N: 9,233.18 E: 12,382.64
TOS: 5447.00 N: 9,202.94 E: 12,391.73
5446.09 FL
5445.64 FL
5445.22 FL
5445.24 FL
5444.65 FL
5444.80 FL
5445.54 FL
5445.61 FL
5445.71 FL
5445.85 FL
5445.90 FL
5446.01 FL
5446.11 FL
5446.27 FL
5446.34 FL
L1 L3 L4 L5 L6 L7 L8 L9 L11
C2 C3 C4 C5 C6 C8
1.00%
S00°40'01"E 238.72'
S45°12'0"E 479.84'
19" x 30" RCP EXISTING CULVERTS ASSUMED LOCATION
INSTALL RIPRAP FROM TOE OF SLOPE TO EL 5450 FOR BANK STABILIZATION INSTALL TO THE END OF THE BEND
INSTALL 4FT THICK RIPRAP TYPE H RIPRAP BANKS TO ELEVATION 5450.00
4 - 48" DIA EXISTING CULVERTS ASSUMED LOCATION
STORM PIPE INV 48" CMP = 5448.4
STORM PIPE INV 48" CMP = 5448.5
STORM PIPE INV 48" CMP = 5448.7
STORM PIPE INV 48" CMP = 5448.4
STORM PIPE INV 48" CMP = 5449.0
STORM PIPE INV 48" CMP = 5448.4
STORM PIPE INV 48" CMP = 5448.6
STORM PIPE INV 48" CMP = 5448.8
5443 5444 5445 5446 5447 5448 5449 5450 5451 5452 5453 5454 5455 5456 5457 5458 5459
E. 38th AVENUE
POND IG-B
POND IG-A
21
22
23
UNION PACIFIC RAILROAD
E. 36th DR
E. 36th DRIVE
E. 36th DRIVE
WINDSOR DR
35th DR
HIMALAYA ROAD
E. 35th DRIVE
ODESSA WAY
KEYMAP
N.T.S.

LEGEND:

───	PROPERTY LINE	HP	HIGH POINT
── 5820 ──	PROPOSED 5' CONTOUR	LP	LOW POINT
── 5821 ──	PROPOSED 1' CONTOUR	ME	MATCH EXISTING
─ ─ 5820 ─ ─	EXISTING 5' CONTOUR	GB	GRADE BREAK
‐ ‐ 5821 ‐ ‐	EXISTING 1' CONTOUR	TOS	TOE OF SLOPE ELEVATION
▪▪▪▪▪▪	PROPOSED STORM LINE	TOW	TOP OF WALL
▫▫▫▫▫▫	EXISTING STORM LINE	FGW	FINISH GRADE AT WALL
▣	PROPOSED STORM INLET	IPC	CULVERT INLET PROTECTION
▢	EXISTING STORM INLET	SR	SURFACE ROUGHENING
→ · · ·	PROPOSED SWALE	CF	CONSTRUCTION FENCE
XX.XX	PROPOSED SPOT ELEVATION (AT FLOWLINE UNLESS OTHERWISE INDICATED)	SM	SEEDING AND MULCHING
X.XX% →	PROPOSED SLOPE AND DIRECTION		
➞	FLOW DIRECTION		

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2-16-16

Signature Date

0 20 40 80

SCALE: 1" = 40'
ORIGINAL GRAPHIC SCALE

JANSEN STRAWN
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No.	Description of Revisions	Date	By
1	CONSTRUCTION PLANS	01/15/2016	R.A.A.

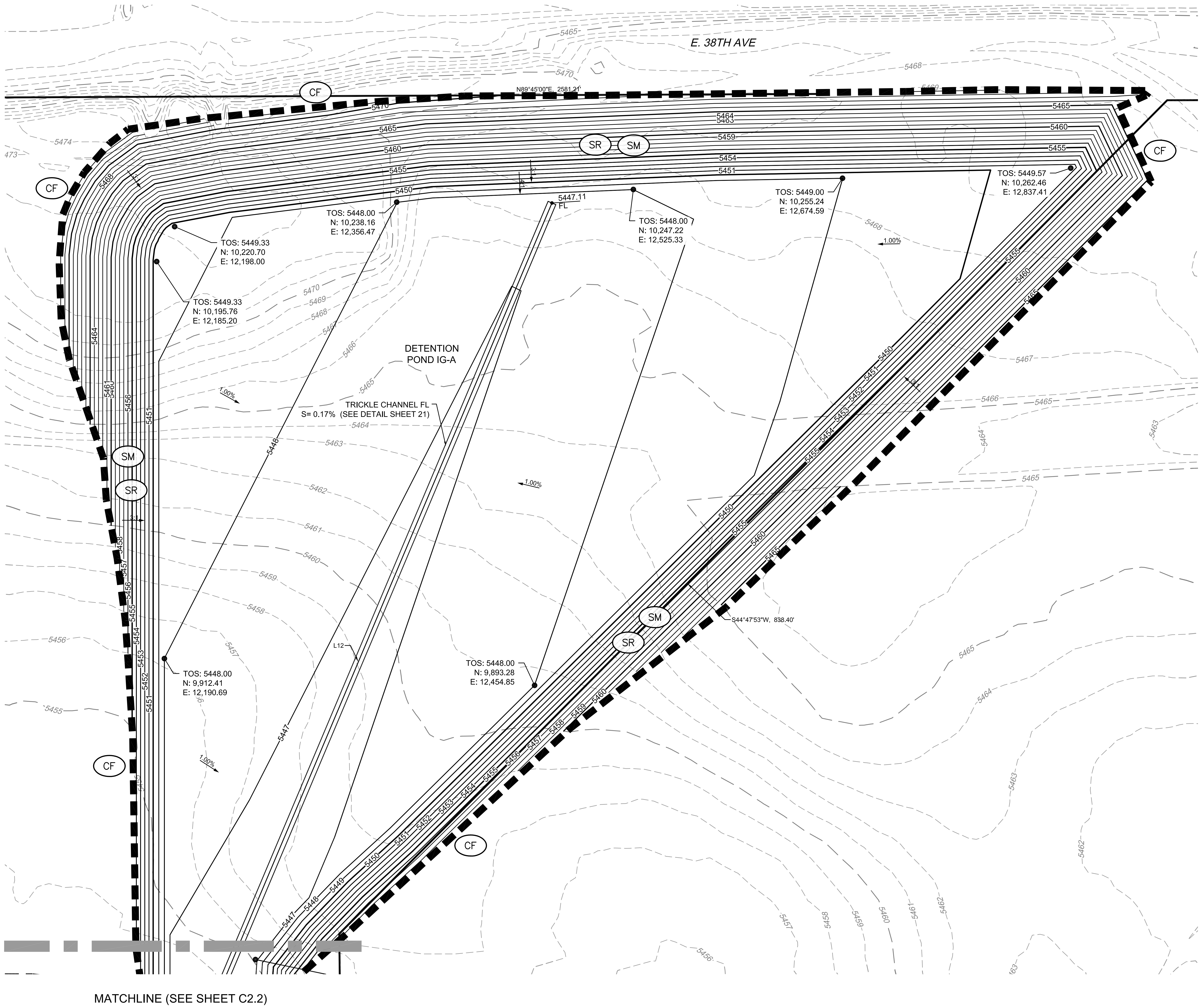
Designed By: R.A.A.
Checked By: C.S.S.

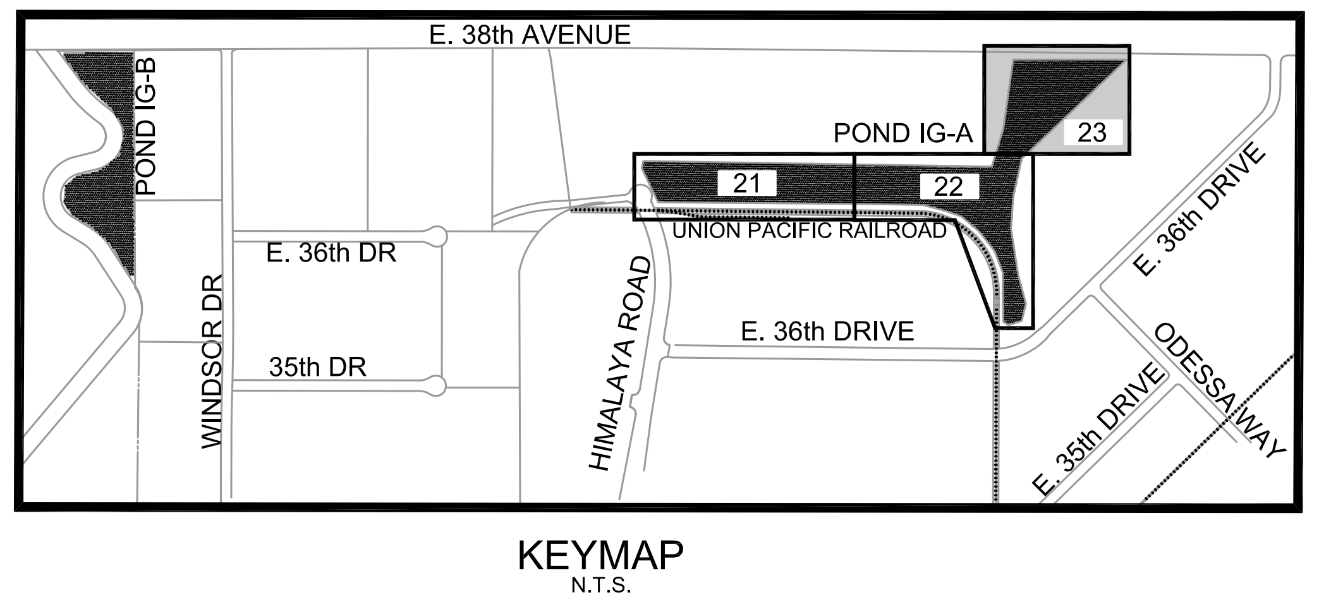
MAJESTIC COMMERCENTER
DETENTION POND IG-A
GRADING PLAN

Date: 01/15/2016
Job No.: 15073
Sheet:
21

Sheet of

APPROVED ON 02.23.16





LEGEND:

▬	PROPERTY LINE
— 5820 —	PROPOSED 5' CONTOUR
— 5821 —	PROPOSED 1' CONTOUR
– – 5820 – –	EXISTING 5' CONTOUR
– – 5821 – –	EXISTING 1' CONTOUR
▬	PROPOSED STORM LINE
▬	EXISTING STORM LINE
▭	PROPOSED STORM INLET
▭	EXISTING STORM INLET
→ · · · —	PROPOSED SWALE
XX.XX	PROPOSED SPOT ELEVATION (AT FLOWLINE UNLESS OTHERWISE INDICATED)
X.XX% →	PROPOSED SLOPE AND DIRECTION
➡	FLOW DIRECTION

HP	HIGH POINT
LP	LOW POINT
ME	MATCH EXISTING
GB	GRADE BREAK
TOS	TOE OF SLOPE ELEVATION
TOW	TOP OF WALL
FGW	FINISH GRADE AT WALL
IPC	CULVERT INLET PROTECTION
SR	SURFACE ROUGHENING
CF	CONSTRUCTION FENCE
SM	SEEDING AND MULCHING

LINE TABLE

LINE #	DIRECTION	LENGTH
L1	N78°50'58"E	196.18
L2	N88°38'06"E	802.01
L3	N25°12'23"W	105.65
L4	N88°38'06"E	337.49
L5	S78°07'32"E	187.40
L6	S69°36'09"E	97.07
L7	S57°29'24"E	21.57
L8	S41°47'27"E	54.37
L9	S43°33'48"E	93.28
L10	S07°15'14"W	57.30
L11	N85°25'00"E	231.76
L12	N22°52'08"E	601.84

CURVE TABLE

CURVE #	DELTA	RADIUS	LENGTH	CHORD DIRECTION	CHORD LENGTH
C1	8°25'18"	500.00	73.49	S84°25'28"W	73.43
C2	8°31'23"	250.00	37.19	N73°51'50"W	37.15
C3	12°06'45"	250.00	52.85	N63°32'46"W	52.75
C4	15°41'57"	250.00	68.50	N49°38'25"W	68.29
C5	50°49'02"	50.00	44.35	N18°09'17"W	42.91
C6	67°10'13"	217.85	255.39	N49°29'49"E	241.02
C8	3°08'28"	250.28	13.72	N86°59'17"E	13.72

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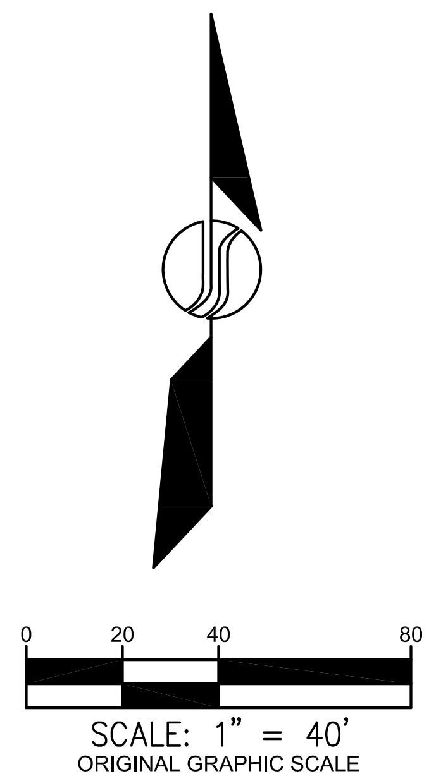
Signature 2-16-16
Date



APPROVED ON 02.23.16

JANSEN STRAWN
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F.303.561.3339

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No.	Description of Revisions	Date	By
1	CONSTRUCTION PLANS	01/15/2016	R.A.A.

Checked By: C.S.S.

Designed By: R.A.A.

MAJESTIC COMMERCENTER
DETENTION POND IG-A
GRADING PLAN

Date: 01/15/2016
Job No.: 15073
Sheet:
22

Sheet of

APPENDIX D

WATER QUALITY AND DETENTION CALCULATIONS

Flying Horse North Filing No. 4 - Detention Modeling Summary

Pond A Developed Parameters			
Catchment Name/ID	**Area (sq.mi.)**	**Area (ac.)**	**Percent Imperv.**
A1	0.017	10.84	10.2
A2	0.017	10.79	11.0
A3	0.111	71.16	4.1
A4	0.029	18.71	11.0
A5	0.004	2.47	11.0
A6	0.010	6.38	11.0
A7	0.013	8.13	11.0
Total		**128.48**	**7.1**

Peak Storage Volume		Peak Release
(cu-ft)	**(ac-ft)**	**(cfs)**
111,834	2.6	160.8

Pre-Development Flow	
Catchment Name/ID	**Peak Flow (cfs)**
A1	97.1
A2	71.2
G1	10.8
H1	94.0
Total	**273.2**
O_BASIN_H	**267.4**

Post-Development Flow		
Catchment Name/ID	**Peak Flow (cfs)**	
A1	14.3	
A2	19.6	
A3	101.6	
A4	20.0	
A5	4.7	
A6	11.7	
A7	17.1	
G1	5.7	
G2	7.2	
H1	7.7	
H2	35.0	
H3	66.9	
Total	**311.6**	Direct summation
O_BASIN_H	**248.5**	Less than or equal to historic at same location

Pond B Developed Parameters			
Catchment Name/ID	**Area (sq.mi.)**	**Area (ac.)**	**Percent Imperv.**
B1	0.090	57.78	4.1
B2	0.056	35.77	11.7
B3	0.002	1.10	33.7
Total		**94.65**	**7.3**

Peak Storage Volume		Peak Release
(cu-ft)	**(ac-ft)**	**(cfs)**
103,808	2.4	216.7

Pre-Development Flow	
Catchment Name/ID	**Peak Flow (cfs)**
B1	148.9
B2	75.8
B3	18.8
B4	19.6
Total	**263.0**
O_BASIN_B	**262.7**

Post-Development Flow		
Catchment Name/ID	**Peak Flow (cfs)**	
B1	182.0	Detained
B2	49.5	Detained
B3	3.0	Detained
B4	15.1	Detained
B5	18.9	Undetained
B6	33.9	Undetained
Total	**302.3**	Direct summation
O_BASIN_B	**262.4**	Less than or equal to historic at same location

Pond C Developed Parameters			
Catchment Name/ID	**Area (sq.mi.)**	**Area (ac.)**	**Percent Imperv.**
C1	0.025	15.94	10.5
C2	0.003	1.98	20.9
C3	0.033	21.39	9.3
Total		**39.31**	**10.4**

Peak Storage Volume		Peak Release
(cu-ft)	**(ac-ft)**	**(cfs)**

Pre-Development Flow	
Catchment Name/ID	**Peak Flow (cfs)**
C1	24.7
C2	39.8
C3	9.7
C4	4.0
Total	**78.2**
O_BASIN_C	**78.0**

Post-Development Flow		
Catchment Name/ID	**Peak Flow (cfs)**	
C1	27.7	Detained
C2	3.0	Detained
C3	39.0	Detained
C4	10.3	Undetained
C5	4.0	Undetained
Total	**84.1**	Direct summation
O_BASIN_C	**73.2**	Less than or equal to historic at same location

HRGreen

FLYING HORSE NORTH FILING NO. 5
EXISTING CONDITIONS
EL PASO COUNTY, COLORADO

Calc'd by:	**TMM**
Checked by:	**RDL**
Date:	**12/12/2024**

Water Quality Treatment Summary Table

Basin	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Tributary to Pond B (ac)	Area Tributary to Pond 13 (ac)	Disturbed Area from Roads and Ditches (ac)	Disturbed Area Excluded from WQ per ECM App I.7.1.B.5 (ac)
B2.1	6.7	6.7	6.7		0.9	5.8
B2.2	2.8	2.8	2.8		0.5	2.3
B2.3	2.6	2.6	2.6		0.7	1.9
B2.4	25.2	25.2	25.2		1.2	18.7
I1	1.0	1.0		1.0	1.0	
I2	15.9	15.9		15.9	0.6	15.3
I3	9.5	9.5		9.5		9.5
Total	63.7	63.7	37.29	26.4	4.2	53.6
Comments					*Disturbed area from roads and ditches is not included in the large lot exclusion (1.7.1.B.5)*	*2.5-acre single-family lots*

Total Proposed Disturbed Area (ac)	**Total Proposed Treated Area (ac)**	**Total Proposed Disturbed Area Excluded from WQ (ac)**
	63.7	53.6

APPENDIX E

REFERENCE MATERIALS

INNOVATIVE DESIGN. **CLASSIC RESULTS.**

PRELIMINARY DRAINAGE REPORT
FOR
FLYING HORSE NORTH PRELIMINARY PLAN
AND
FINAL DRAINAGE REPORT
FOR
FLYING HORSE NORTH FILING NO. 1

NOVEMBER 2017
Revised June 2018

Prepared for:
PRI #2 LLC
6385 CORPORATE DRIVE SUITE 200
COLORADO SPRINGS CO 80919
(719) 592-9333

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. CASCADE AVE SUITE 200
COLORADO SPRINGS CO 80903
(719) 785-0790

Job no. 1096.11
PCD File No. SP-17-012 and SF-18-001

CLASSIC CONSULTING

and B-B channel calculations) These facilities not only meet all current drainage criteria but also remain consistent with the intent of the DBPS. It is also noted that these facilities release well under the pre-development flows as established by the DBPS. Thus, the downstream corridor within the existing Reach 13 on the adjacent property will not be significantly affected with the installation of these full-spectrum facilities. Portions of the Cathedral Pines Development to the south contributes developed flows to this property. These flows will be accommodated in the various on-site facility designs. A smaller on-site basin at the southeast corner of section 36 releases historic flows onto the Cathedral Pines and the Edmonds Subdivision. An on-site detention/storm water quality facility is planned in this corridor to help mitigate development.

East Cherry Creek Drainage Basin

The Palmer Divide traverses the eastern half of section 36 which defines the major basin line between the Black Squirrel Creek and the East Cherry Creek Basins. The vegetation also changes drastically in this area. The majority of the East Cherry Creek Basin contains very little trees and more grazing prairie land and meadows. This area defines the edge of Black Forest. In general, historic flow patterns in this basin travel in a northeasterly direction towards Hodgen Road. The MDDP designates several major design points along the north boundary. Again, multiple detention/storm water quality facilities are planned for these corridors and to be constructed along with future land development. This report has analyzed the downstream corridors along the north property line for the pre-development condition (per MDDP hydrology) and post-development condition (per UD-detention designed release). No significant erosion currently exists in these channels and we have been consistently maintaining proper BMPs along this property boundary. This effort will continue through final construction and revegetation of the permanent detention/SWQ facilities. (See Appendix for Sections D-D and E-E channel calculations). Portions of the Palmer Divide Subdivision and multiple large unplatted properties the south contribute developed flows to this property. These flows will be accommodated in the various on-site facility designs.

PROPOSED DRAINAGE CONDITIONS

The proposed land development within the Flying Horse North Filing No. 1 and future development within the remaining portions of the Preliminary Plan will be 2.5-5 acre large lot residential with associated paved streets and roadside ditches. The 18-hole private Golf Course with a club house site, driving range and maintenance facility is also planned as a part of Filing No. 1. Based on the current El Paso County ECM Section I.7.1.B. and given the size of the lots within this entire development area, stormwater quality is not required to be provided. However, detention/EURV will still be provided in specific locations on-site to limit the on-site development flow release to remain consistent with pre-development conditions within the major drainage corridors. These proposed facilities will aide in limiting any detrimental effects on downstream corridors. At specific areas where the Filing No. 1 development creates concentrated flows into future development areas, temporary sediment basins will be constructed to minimize sediment transfer downstream and off-site. The Filing No. 1 Final Drainage Report portion of this report will define the permanent facilities providing an Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume with an outlet control device. Frequent and infrequent inflows are released at rates approximating undeveloped conditions. This concept provides some mitigation of increased runoff volume by releasing a portion of the increased runoff at a low rate over an extended period of time, up to 72 hours. This means that frequent storms, smaller than the 2 year event, will be reduced to very low flows near or below the sediment carrying threshold value for downstream drainage ways. Also, by incorporating an outlet structure that limits the 100-year runoff to the undeveloped condition rate, the discharge hydrograph for storms between the 2 year and the 100 year event will approximate the hydrograph for the undeveloped conditions and will help effectively mitigate the effects of this development. Again, prior to any land development beyond the Filing No. 1 Final Plat area, additional final drainage reports, final plats and construction plans will be required detailing this criteria.

Given the rural nature of this development, roadside ditches are planned along all roadways. Concrete curb and gutter will only be used at the round-about locations and along the jurisdictional dam embankment as required by the State. The typical roadside ditch will be designed as a V-ditch with a depth of 24 inches. The natural terrain within much of this development creates some steeper slopes on many of the roadways. These slopes range from 1% to 10%. An analysis of the roadside ditches was performed in order to determine the necessary ditch lining required to maintain allowable velocity and shear stress.

The following three basic ditch improvements are recommended throughout the development:
(See Appendix for reference)

1. Revegetation with native seeding (Grass lined only)
   Slope 2% or less and minimal flow

2. Erosion Control Blanket (North American Green SC150 or equiv.) with native seeding Slope 5% or less and max. flow range of 7-43 cfs.
3. Turf Reinforcement Mat (North American Green P300 or equiv.) with natives seeding Slope 10% or less and max. flow of 70 cfs.

The specific ditch lining locations will be shown on the street improvements plans

The following hydrology descriptions will start at the western edge of the Flying Horse North property and move east into the East Cherry Creek Basin, describing the development within the Filing No. 1 area first.

FLYING HORSE NORTH FILING NO. 1

Black Squirrel Creek Drainage Basin

As mentioned previously, Flying Horse North is located in the upper region of the Black Squirrel Creek Drainage Basin. Per the approved DBPS for Black Squirrel Creek, the reaches in this area were proposed to remain as natural as possible. There were no recommendations for detention facilities within the area that is Flying Horse North, but due to current drainage criteria, detention/EURV facilities will be proposed with this development.

High Forest Ranch Detention Pond 26 outfalls onto the property at the very northwest corner of the site. These existing flows will continue to enter the site and travel within the natural channel towards the existing 48” CMP culvert crossing at Hwy. 83. Drainage easements across the proposed lots in this area will be provided on the final plat. The existing stock pond within lots 2 and 3 will be removed with grading of the road in this area. Tract B is platted in order to provide a detention/EURV facility for the lots and public road in this area. This facility will be constructed with Filing No. 1 with ownership and maintenance by the Flying Horse North HOA.

Design Point 1 (Q_2 = 2 cfs Q_5 = 3 cfs, Q_{100} = 11 cfs) represents the existing off-site and on-site developed flows from Basins OS-1A and BS-2B. The combined flow from these basins travel to a low point just east of Stagecoach Road where a proposed 24” RCP culvert will be installed to convey these flows under the road. (See Appendix for culvert design)

Design Point 26 (Q_2 = 3 cfs Q_5 = 16 cfs, Q_{100} = 102 cfs) represents the full build-out developed flows from Basins CC-8 and CC-10. Basin CC-8 represents future residential lots and CC-10 mostly future passive park area. These flows will continue to sheet flow towards the low-point where a 48" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) After crossing Stagecoach Road, these flows will continue to flow directly into the existing stock pond just north of the roadway. This facility will provided sediment control for the small developed roadway area. Upon future development and plating of the lots planned within these basins, this stock pond will be formally designed into a detention facility.

Basin CC-15 (Q_2 = 1 cfs Q_5 = 4 cfs, Q_{100} = 20 cfs) represents the full build-out developed flows from the future residential lots tributary to this basin. These flows will continue to sheet flow towards the low-point where a 30" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Basin CC-16 (Q_2 = 1 cfs Q_5 = 5 cfs, Q_{100} = 24 cfs) represents the full build-out developed flows from the future residential lots tributary to this basin. These flows will continue to sheet flow towards the low-point at the southwest corner of Old Stagecoach Road and Rubble Drive where a 24" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Design Point 30 (Q_2 = 0.7 cfs Q_5 = 2 cfs, Q_{100} = 10 cfs) represents the full build-out developed flows from Basin CC-18. This Basin represents future residential lots. The flows will continue to sheet flow towards the low-point where a 24" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Design Point 31 (Q_2 = 0.9 cfs Q_5 = 3 cfs, Q_{100} = 15 cfs) represents the full build-out developed flows from Basin CC-19 and the upstream release from DP-30. This Basin represents future residential 5 ac. lots. The flows will continue to sheet flow within a proposed drainage easement towards the existing low-point where an existing 24" CMP culvert will adequately handle the fully developed flows at this location.

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS, UNDEVELOPED WOODS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

CN VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	**GOLF COURSE / WOODS (B)**		**2 AC. RESIDENTIAL (B)**		**COMPOSITE CN**
		CN	AREA (Ac.)	CN	AREA (Ac.)	
CC-1A	9.8	61	0.0	65	9.8	**65.0**
CC-1B	12.6	61	0.5	65	12.1	**64.8**
CC-2A	11.0	61	0.0	65	11.0	**65.0**
CC-2B	20.8	61	0.0	65	20.8	**65.0**
CC-2C	6.4	61	0.0	65	6.4	**65.0**
CC-3	52.5	61	25.0	65	27.5	**63.1**
CC-4A	108.7	61	65.0	65	43.7	**62.6**
CC-4B	8.1	85	4.5	65	3.6	**76.1**
CC-4C (Pre-Dev.)	7.4	61	7.4	65	0.0	**61.0**
CC-5	22.4	61	0.0	65	22.4	**65.0**
CC-6	27.8	61	0.0	65	27.8	**65.0**
CC-7	18.4	61	0.0	65	18.4	**65.0**
CC-8	7.7	61	0.0	65	7.7	**65.0**
CC-9	5.6	61	0.0	65	5.6	**65.0**
CC-10	85.6	61	51.0	65	34.6	**62.6**
CC-11	18.6	61	9.0	65	9.6	**63.1**
CC-12	12.2	61	0.0	65	12.2	**65.0**
CC-13A	19.3	61	0.0	65	19.3	**65.0**
CC-13B	25.5	61	0.0	65	25.5	**65.0**
CC-13C	9.9	61	0.0	65	9.9	**65.0**
CC-13D	18.8	61	0.0	65	18.8	**65.0**
CC-14	4.6	61	0.0	65	4.6	**65.0**
CC-15	12.8	61	0.0	65	12.8	**65.0**
CC-16	16.3	61	0.0	65	16.3	**65.0**
CC-17	25.0	61	0.0	65	25.0	**65.0**
CC-18	6.2	65	5.8	89	0.4	**66.5**
CC-19	3.7	61	0.0	65	3.7	**65.0**
CC-20	39.3	61	0.0	65	39.3	**65.0**
CC-21	6.2	61	6.2	65	0.0	**61.0**
CC-22	13.8	61	0.0	65	13.8	**65.0**
CC-23	5.7	61	0.4	65	5.3	**64.7**
CC-24	39.6	61	0.0	65	39.6	**65.0**
CC-25	3.5	61	0.0	65	3.5	**65.0**
CC-26	16.7	61	0.0	65	16.7	**65.0**
CC-27	18.9	61	3.0	65	15.9	**64.4**
CC-28	154.8	61	23.0	65	131.8	**64.4**

TIME OF CONCENTRATION - DEVELOPED

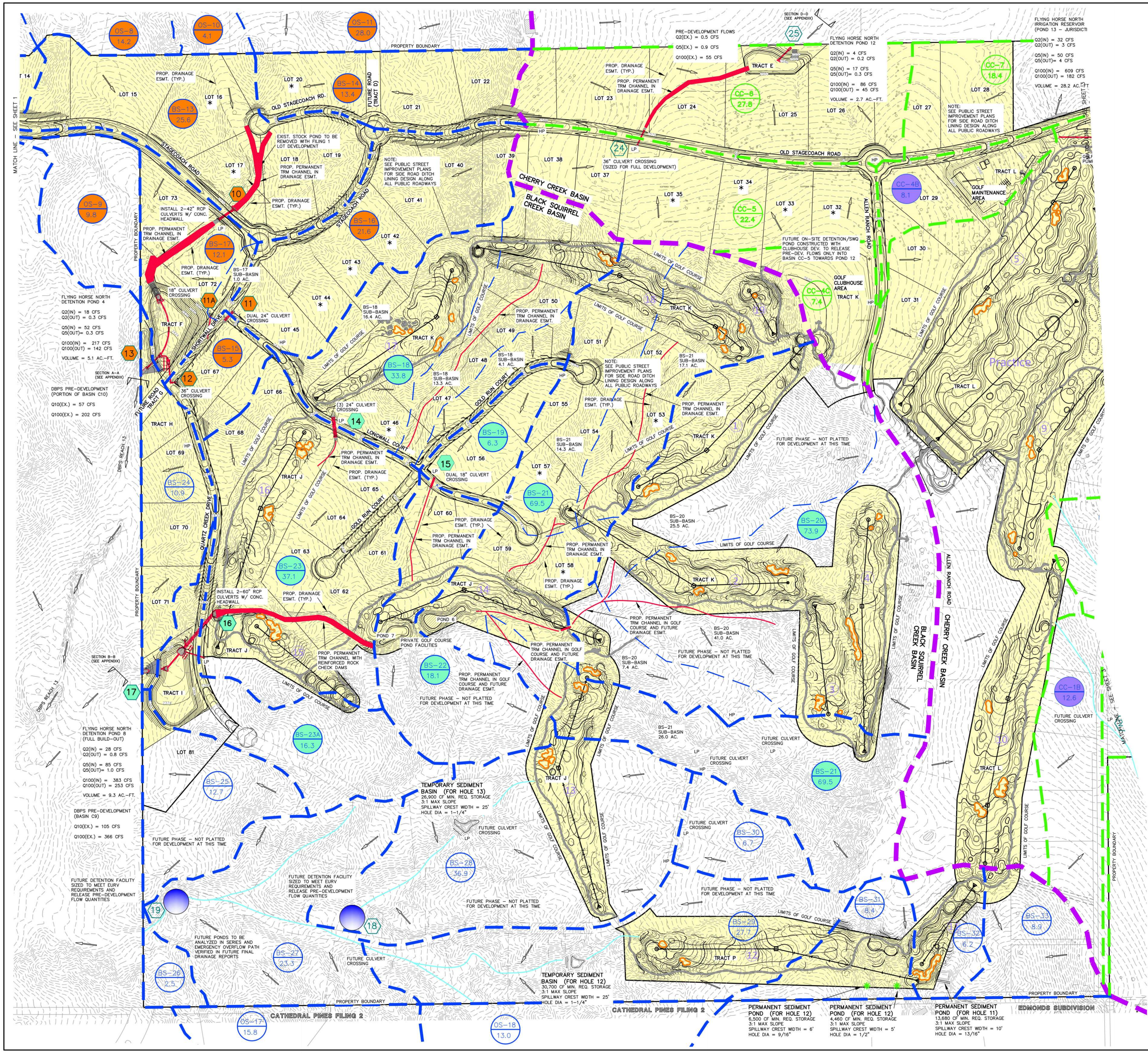
BASIN	COMPOSITE Cn	C(5)		OVERLAND		STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25)				Tc TOTAL *(min)*	Tc LAG (0.6tc) *(min)*	Tc LAG (0.6tc) *(hr)*
			Length *(ft)*	Height *(ft)*	Tc *(min)*	Length *(ft)*	Slope *(%)*	Velocity *(fps)*	Tc *(min)*			
CC-1A	65.0	0.08	300	16	18.4	500	5.0%	1.7	4.9	23.3	14.0	0.23
CC-1B	64.8	0.08	300	14	19.2	700	4.0%	2.0	5.8	25.0	15.0	0.25
CC-2A	65.0	0.08	300	14	19.2	250	3.0%	1.5	2.8	22.0	13.2	0.22
CC-2B	65.0	0.08	300	14	19.2	280	3.0%	1.5	3.1	22.3	13.4	0.22
CC-2C	65.0	0.08	300	18	17.7					17.7	10.6	0.18
CC-3	63.1	0.08	300	18	17.7	2300	3.0%	1.5	25.6	43.2	25.9	0.43
CC-4A	62.6	0.08	300	14	19.2	2700	2.0%	1.8	25.0	44.2	26.5	0.44
CC-4B	76.1	0.08	300	12	20.2	600	3.0%	1.6	6.3	26.4	15.9	0.26
CC-4C (Pre-Dev.)	61.0	0.08	40	0.8	9.3	350	3.0%	1.5	3.9	13.2	7.9	0.13
CC-5	65.0	0.08	300	18	17.7	1000	4.0%	2.0	8.3	26.0	15.6	0.26
CC-6	65.0	0.08	300	14	19.2	550	2.5%	1.6	5.7	24.9	14.9	0.25
CC-7	65.0	0.08	300	16	18.4	1000	3.0%	1.6	10.4	28.8	17.3	0.29
CC-8	65.0	0.08	300	10	21.4	250	2.0%	1.2	3.5	24.9	14.9	0.25
CC-9	65.0	0.08	300	18	17.7	100	2.0%	1.2	1.4	19.0	11.4	0.19
CC-10	62.6	0.08	300	22	16.5	2400	3.0%	1.8	22.2	38.7	23.2	0.39
CC-11	63.1	0.08	300	18	17.7	450	5.0%	2.1	3.6	21.2	12.7	0.21
CC-12	65.0	0.08	300	11	20.8	650	4.0%	2.0	5.4	26.2	15.7	0.26
CC-13A	65.0	0.08	300	14	19.2	1400	4.0%	2.0	11.7	30.9	18.5	0.31
CC-13B	65.0	0.08	300	18	17.7	1300	3.0%	1.6	13.5	31.2	18.7	0.31
CC-13C	65.0	0.08	300	14	19.2	350	4.0%	2.0	2.9	22.1	13.3	0.22
CC-13D	65.0	0.08	300	20	17.1	900	4.0%	2.0	7.5	24.6	14.7	0.25
CC-14	65.0	0.08	300	10	21.4					21.4	12.9	0.21
CC-15	65.0	0.08	300	14	19.2	550	3.0%	1.8	5.1	24.3	14.6	0.24
CC-16	65.0	0.08	300	10	21.4	650	2.5%	1.3	8.3	29.8	17.9	0.30
CC-17	65.0	0.08	300	9	22.2	950	2.0%	1.2	13.2	35.4	21.2	0.35
CC-18	66.5	0.08	300	7	24.1	400	2.0%	1.2	5.6	29.7	17.8	0.30
CC-19	65.0	0.08	300	8	23.1	100	2.0%	1.0	1.7	24.7	14.8	0.25
CC-20	65.0	0.08	300	9	22.2	350	6.0%	2.2	2.7	24.8	14.9	0.25
CC-21	61.0	0.08	300	18	17.7	200	3.0%	1.8	1.9	19.5	11.7	0.20
CC-22	65.0	0.08	300	14	19.2	700	4.0%	2.0	5.8	25.0	15.0	0.25
CC-23	64.7	0.08	300	10	21.4	850	2.0%	1.2	11.8	33.2	19.9	0.33
CC-24	65.0	0.08	300	20	17.1	900	4.0%	1.9	7.9	25.0	15.0	0.25
CC-25	65.0	0.08	300	16	18.4	500	3.0%	1.8	4.6	23.0	13.8	0.23
CC-26	65.0	0.08	300	14	19.2	900	5.0%	2.1	7.1	26.3	15.8	0.26
CC-27	64.4	0.08	300	14	19.2	1300	3.0%	1.8	12.0	31.2	18.7	0.31
CC-28	64.4	0.08	300	14	19.2	4700	3.0%	1.8	43.5	62.7	37.6	0.63

BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	**AREA** (acres)	**COMPOSITE CN**	**TOTAL LAG TIME** (hours)	**Q 2 Yr.** (cfs)	**Q 5 Yr.** (cfs)	**Q 100 Yr.** (cfs)
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-2C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev.)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0
CC-8	7.70	65.0	0.25	0.6	2.5	12.0
CC-9	5.60	65.0	0.19	0.6	2.1	9.8
CC-10	85.60	62.6	0.39	2.6	14.1	91.9
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	**Contributing Basins**	**Q 2 Yr.** Q (cfs)	**Q 5 Yr.** Q (cfs)	**Q 100 Yr.** Q (cfs)
DP-18 DEV	BS-28, BS-29, BS-30, OS-18	5.0	21.6	115
DP-19 DEV	BS-27, OS-17, Release from DP-18	3.8	16.8	126
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev.), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	**CC-4C, CC-5, CC-6**	**6**	**9**	**85**
DP-25 DEV	**Release from FHN Pond 12**	**0.2**	**0.3**	**45**
DP-26 DEV	CC-8, CC-10	3.0	15.9	102
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168



BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-8	14.20	65.0	0.27	2.1	6.2	24.7
OS-9	9.80	60.0	0.37	0.1	1.0	9.1
OS-10	4.10	65.0	0.17	0.7	2.1	8.2
OS-11	28.00	65.0	0.35	2.4	8.2	38.7
OS-12	68.10	62.7	0.37	2.2	11.9	75.8
OS-13	36.90	63.0	0.33	1.4	7.4	45.0
OS-14	26.40	62.0	0.31	0.7	4.6	31.0
OS-15	70.80	63.9	0.38	3.3	14.8	84.2
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
BS-13	25.60	65.0	0.23	3.7	10.2	40.7
BS-14	13.40	65.0	0.23	2.6	6.8	26.5
BS-15	5.30	65.0	0.18	1.6	3.7	12.2
BS-16	21.60	65.0	0.34	4.6	11.8	44.1
BS-17	12.10	65.0	0.21	3.1	7.7	26.7
BS-18	33.80	63.6	0.41	3.5	12.4	56.0
BS-19	6.30	65.0	0.18	2.1	4.6	15.0
BS-20	73.90	63.4	0.31	7.4	24.6	112.4
BS-21	69.50	64.3	0.35	7.8	23.9	103.0
BS-22	18.10	64.4	0.22	3.7	9.6	36.5
BS-23	37.10	63.3	0.33	4.5	13.6	58.2
BS-23A	16.30	64.4	0.29	5.5	12.0	38.3
BS-24	10.90	63.0	0.17	0.6	3.3	17.6
EX-24 (Pre-Dev.)	13.20	60.0	0.17	0.2	2.2	17.8
BS-25	12.70	63.0	0.23	0.4	2.7	17.3
BS-26	2.50	60.0	0.18	0.0	0.4	3.4
BS-27	23.30	65.0	0.22	2.1	8.0	38.8
BS-28	36.90	64.4	0.32	2.2	9.3	49.4
BS-29	27.70	64.0	0.33	1.4	6.5	35.9
BS-30	6.70	65.0	0.20	0.7	2.4	11.7
BS-31	8.40	62.5	0.23	0.3	1.9	11.8
BS-32	6.20	62.6	0.20	0.3	1.6	9.4
BS-33	8.90	64.7	0.19	0.8	3.2	15.3
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-2C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev.)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-10 DEV	OS-8, OS-10, OS-11, BS-13, BS-14	10.7	32.0	143
DP-11 DEV	BS-16	4.6	11.8	36
DP-12 DEV	DP-11, 1.0 Ac. Portion of BS-17 and BS-15	4.2	11.8	46
TOTAL INFLOW TO POND 4 (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**10**	**16**	**217**
DP-13 DEV	**Release from FHN Pond 4**	**0.3**	**0.3**	**142**
DP-14 DEV	BS-18	3.5	12.4	56
DP-15 DEV	BS-19	2.1	4.6	15
DP-16 DEV	DP-14, DP-15, BS-20, BS-21, BS-22, BS-23	25.0	78.0	362
TOTAL INFLOW TO FHN POND 8 (Full Build-out) (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**24**	**37**	**390**
DP-17 DEV (Full Build-out)	**Release from FHN Pond 8**	**0.8**	**1.0**	**253**
TOTAL INFLOW TO FHN POND 8 (Filing 1 Only) (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**9**	**14**	**301**
DP-17 DEV (Filing 1 Only)	**Release from FHN Pond 8**	**0.4**	**0.5**	**219**
DP-18 DEV	BS-28, BS-29, BS-30, OS-18	5.0	21.6	115
DP-19 DEV	BS-27, OS-17, Release from DP-18	3.8	16.8	126
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev.), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	**CC-4C, CC-5, CC-6**	**6**	**9**	**85**
DP-25 DEV	**Release from FHN Pond 12**	**0.2**	**0.3**	**45**

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY EAST CHERRY CREEK	🟩 🟩 🟩
MAJOR BASIN BOUNDARY	🟪 🟪 🟪
BASIN BOUNDARY BLACK SQUIRREL	🟦 🟦 🟦
DESIGN POINT	3
LOTS WITH NON–STANDARD CULVERT SIZE	*
BASIN IDENTIFIER	BB
AREA IN ACRES	10.0
EXISTING DIRECTION OF FLOW	⇨
PROPOSED DIRECTION OF FLOW	➡
STORM SEWER	🟥
FILING NO. 1 PLAT AREA	🟨

N

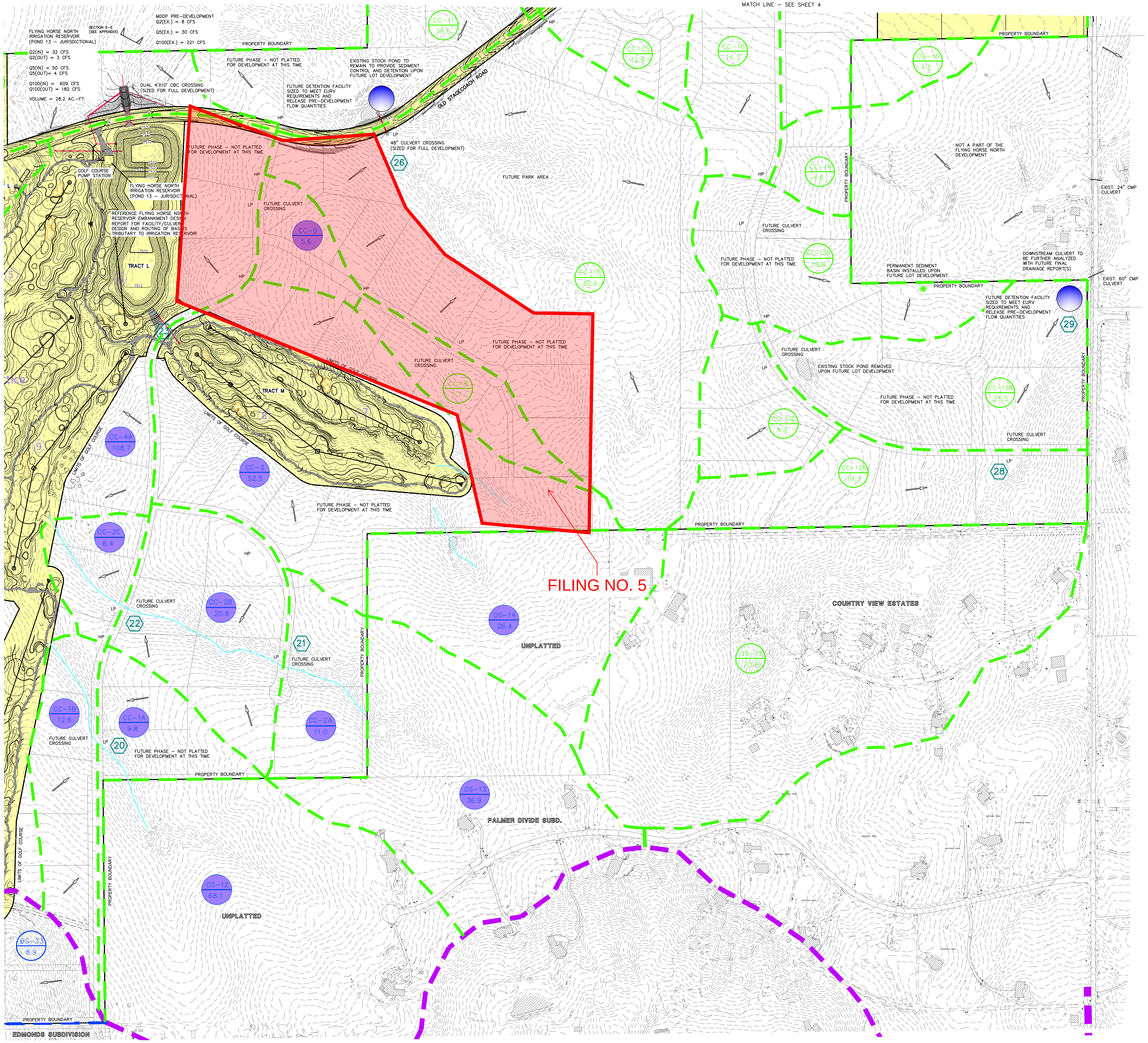
200 100 0 200 400

SCALE: 1" = 200'

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785–0790
(719)785–0799 (Fax)

FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 10–25–17
DRAWN BY	MAW	(H) 1"= 200'	SHEET 2 OF 4
CHECKED BY		(V) 1"= N/A	JOB NO. 1096.11



BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-8	14.20	65.0	0.27	2.1	6.2	24.7
OS-9	9.80	60.0	0.37	0.1	1.0	9.1
OS-10	4.10	65.0	0.17	0.7	2.1	8.2
OS-11	28.00	65.0	0.35	2.4	8.2	38.7
OS-12	68.10	62.7	0.37	2.2	11.9	75.8
OS-13	36.90	63.0	0.33	1.4	7.4	45.0
OS-14	26.40	62.0	0.31	0.7	4.6	31.0
OS-15	70.80	63.9	0.38	3.3	14.8	84.2
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-2C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev.)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0
CC-8	7.70	65.0	0.25	0.6	2.5	12.0
CC-9	5.60	65.0	0.19	0.6	2.1	9.8
CC-10	85.60	62.6	0.39	2.6	14.1	91.9
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev.), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	**CC-4C, CC-5, CC-6**	**6**	**9**	**85**
DP-25 DEV	**Release from FHN Pond 12**	**0.2**	**0.3**	**45**
DP-26 DEV	CC-8, CC-10	3.0	15.9	102
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY EAST CHERRY CREEK	🟩 🟩 🟩 🟩
MAJOR BASIN BOUNDARY	🟪 🟪 🟪 🟪
DESIGN POINT	3
BASIN IDENTIFIER AREA IN ACRES	BB 10.0
EXISTING DIRECTION OF FLOW	⇨
PROPOSED DIRECTION OF FLOW	➡
STORM SEWER	🟥
FILING NO. 1 PLAT AREA	🟨

N

200 100 0 200 400

SCALE: 1" = 200'

FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 AND
PRELIMINARY PLAN DRAINAGE MAP

CLASSIC CONSULTING ENGINEERS & SURVEYORS

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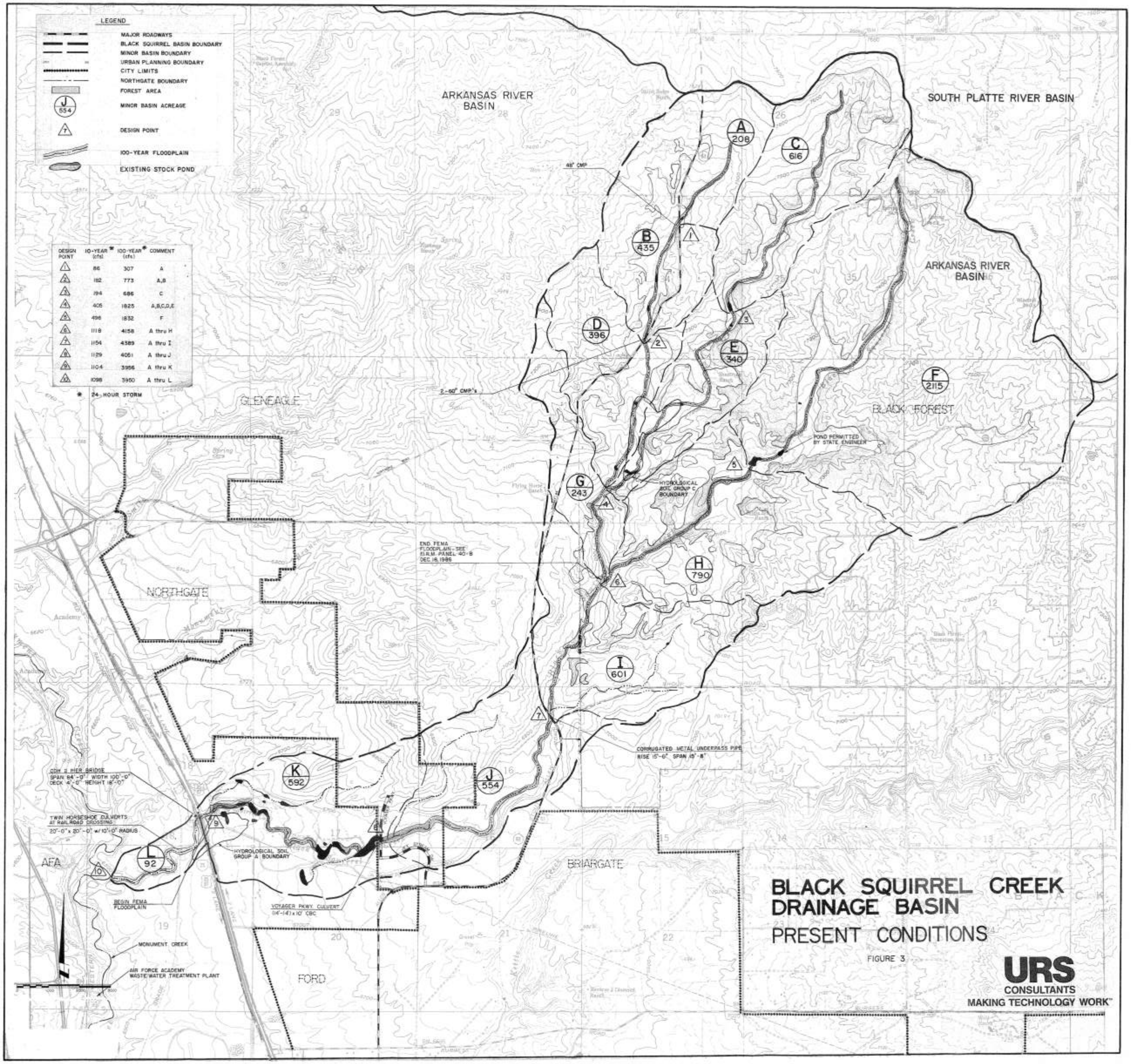
DESIGNED BY MAW	SCALE	DATE	10–25–17
DRAWN BY MAW	(H) 1"= 200'	SHEET 3	OF 4
CHECKED BY	(V) 1"= N/A	JOB NO.	1096.11



DESIGN POINT	10-YEAR* (cfs)	100-YEAR* (cfs)	COMMENT
1	86	307	A
2	182	773	A,B
3	194	686	C
4	405	1825	A,B,C,D,E
5	496	1832	F
6	1118	4158	A thru H
7	1154	4389	A thru I
8	1129	4051	A thru J
9	1104	3956	A thru K
10	1098	3960	A thru L

* 24-HOUR STORM

BLACK SQUIRREL CREEK DRAINAGE BASIN

PRESENT CONDITIONS

FIGURE 3

URS CONSULTANTS
MAKING TECHNOLOGY WORK™

Flying Horse North
Master Development Drainage Plan

March 09, 2022

Revised: July 28, 2022

Revised: September 9th, 2022

HR Green Project No: 211030.01

Prepared For:

Mr. Drew Balsick

Vice President / Project Manager

Flying Horse Development, LLC
2138 Flying Horse Club Drive

Colorado Springs, CO 80921

(719) 785-3237

Prepared By:

HR Green Development, LLC

Contact: Gregory Panza, PE

gpanza@hrgreen.com

720-602-4956

PCD File No. SKP223

c. Site Characteristics

Per the NRCS web soil survey, the site is made up entirely of Type B soils. The ridge line between the Arkansas River and South Platte River Basins creates different soil environments for each. The portion of site that is within the Black Squirrel Drainage Basin, which includes Flying Horse Norse Filing No. 2 and No. 3, are predominately Elbeth sandy loam. The remaining filings are within the East Cherry Creek Basin which consists of Peyton sandy loam and Peyton-Pring complex. See Appendix A for the NRCS soil map.

Current ground cover varies between the two basins as well. Filings No. 2 and 3 are predominantly covered by Ponderosa Pine trees as a part of Black Forest and pasture. The remaining filings are short- to mid-grass prairie grasslands and former farmland which consists of non-native weeds and grasses. This portion of the site has very few, if any, trees and a minimal number of shrubs are found on the site.

d. Major Drainage Ways and Structures

No major drainage ways exist within the development; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries of the East Cherry Creek and Black Squirrel Creek. Additionally, as part of the Flying Horse North Filing 1 development, a large irrigation pond was built for water storage and flood control. This drains to the north and to the aforementioned unnamed tributary.

Existing minor drainage channels within the site are planned to be maintained to the maximum extent possible within parkways and greenways with the development. These will continue to be used for conveyance of storm drainage flows.

The Franktown Parker Dam (080130) is located near the northwest corner of site. The dam is designated as a jurisdictional dam and has a low hazard class. It is located along East Cherry Creek. See Appendix A for characteristics and location of dam.

e. Existing and proposed land uses

The existing site is open rangeland on the eastern portion of the site and the western site is single family homes on large (~2.5 acre) home site within a heavily forested area. As part of Filing 1, a road was constructed along with facilities to support a golf course. Structures, outside of the homes are scattered throughout the overall development which will either be removed as part of the project or were built as part of Filing 1. The proposed development will consist of estate, low and medium lots, along with a future hotel site and multiple green spaces and small parks. The current land plan assumes approximately 897 dwelling units will be constructed on the site, not including an approximate 225 provided the proposed hotel.

Land Use	MAX DU/AC
Estate Lots (2.5 Acres)	0.32
Estate Lots (5 Acres)	0.2
Low	1.9
Medium	3.0

III. Hydrologic Analysis

a. Major Basins and subbasins

Major Basin Description

- Previous basin study: Black Squirrel Drainage Basin Planning Study
- Per FEMA FIRM 08041C0305G and 08041C0315G (eff. 12/7/2018), Flying Horse North has the East Cherry Creek run through the northwest portion of the site. Currently, FEMA shows a LOMR effective April 4th, 2019 Base Flood Elevations and Zone A. Per the El Paso County Land Development Code Chapter 8 Section 8.4.2.B.1.e.i, the base flood elevations for Zone A will be determined once the platted lots are solidified and are confirmed within 300-ft of the current floodplain designation. Certification of the flood elevations will be via the FEMA CLOMR/LOMR process or Floodplain Certification Letter.
- There is a large irrigation pond that accounts for water storage and water control on the east side of the site.

The site has been divided into several major drainage basins per where each basin is tributary to a full spectrum detention pond facility. These basins and associated sub basins are described in more detail in the next section of this report.

Existing Subbasin Description

The site's flows are split by the major ridgeline of the Arkansas River Basin and South Platte Basin. Within the South Platte Basin, flow is generally carried northeast throughout the site. On the other side of the ridgeline, the Arkansas River Basin flows in a southwest direction. Subbasin IDs with single letters are part of the South Platte Basin and Subbasin IDs with double letters are part of the Arkansas River Basin.

- Subbasin A is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin B1. The basin is 18.99 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 20.84 cfs and 43.83 cfs respectively.
- Subbasin B is located north of Subbasin A. The basin drains towards the northwest into a natural drainageway that flows directly to an existing irrigation pond. The basin is 59.74 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 103.48 cfs and 221.28 cfs respectively.
- Subbasin C is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin B2. The basin is 36.39 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 33.36 cfs and 71.27 cfs respectively.
- Subbasin D is located north of Subbasin B. The basin drains towards the northwest and towards the existing irrigation pond. The basin is 38.84 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 31.56 cfs and 67.84 cfs respectively.
- Subbasin E is in a central location of the site and includes the existing irrigation pond. The basin drains towards the north and towards existing irrigation pond. The basin is 106.53 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 223.69 cfs and 483.10 cfs respectively.

- Subbasin F is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin G. The basin is 25.25 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 24.27 cfs and 51.63 cfs respectively.
- Subbasin G is directly north of Subbasin D and east of Subbasin E. The basin drains towards the northwest and towards Subbasin E with the irrigation pond. The basins consist of the existing golf course. The basin Is 52.19 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 79.17 cfs and 166.51 cfs respectively.
- Subbasin H is located directly downstream of Subbasin E and on the north side of Stagecoach Rd. The basin drains towards the north through a natural drainageway. There are existing lots on the west side of the basin. The basin is 20.63 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 18.59 cfs and 39.78 cfs respectively.
- Subbasin I is located west of Subbasin E and northeast of the major ridgeline between basins. The basin drains towards the northwest and towards an existing culvert. There are existing lots on the west side of the basin. The basin is 31.93 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 34.58 cfs and 72.63 cfs respectively
- Subbasin J is located downstream of Subbasin I. The basin drains towards the northeast to an unnamed tributary of the East Cherry Creek. The basin is 28.47 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 56.31 cfs and 120.46 cfs respectively.
- Subbasin K is located south of proposed section of Stagecoach Rd. The basin drains towards the northwest and into an existing 48" culvert. The basin is 93.15 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 92.05 cfs and 195.43 cfs respectively
- Subbasin L is downstream of Subbasin K and is located on the north side of the proposed section of Stagecoach Rd. The basin drains towards the northwest to a natural drainageway of East Cherry Creek. The basin is 16.39 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 107.58 cfs and 228.73 cfs respectively.
- Subbasin M is located on the east side of the site and between Subbasin N and V1. The basin drains towards the northwest and into an existing 30" culvert. The basin is 13.85 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 11.48 cfs and 24.61 cfs respectively.
- Subbasin N is located south of Subbasin O and north of proposed Stagecoach Rd. The basin drains towards the northwest to a nearby unnamed tributary and eventually East Cherry Creek. The basin is 49.00 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 64.68 cfs and 143.11 cfs respectively.
- Subbasin O is located south of Subbasin P. The basin drains towards the northwest and towards the north. The basin is 24.76 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 22.69 cfs and 48.54 cfs respectively.
- Subbasin P is in the northeast corner of the site and downstream of Subbasin O. The basin drains towards the northeast to an unnamed tributary of East Cherry Creek. The basin is 43.80 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 38.52 cfs and 82.17 cfs respectively.

Proposed Subbasin Description

- Subbasin A is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin B1. The basin is 18.99 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 20.84 cfs and 43.83 cfs respectively.
- Subbasin B1 is located north of Subbasin A. The basin drains towards the northwest and towards proposed Detention Pond 11. Current planning documents call for low density dwelling units. The basin is 59.74 acres, with a composite impervious value of 29.83% and runoff rates for the 5 and 100 year of 66.93 cfs and 133.69 cfs respectively.
- Subbasin B2 is located northeast of Subbasin B1. The basin drains towards the northwest and towards the proposed Detention Pond 11. Current planning documents call for low density dwelling units. The basin is 19.99 acres, with a composite impervious value of 24.55% and runoff rates for the 5 and 100 year of 17.99 cfs and 37.14 cfs respectively.
- Subbasin C is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin B2. The basin is 36.39 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 35.31 cfs and 75.28 cfs respectively.
- Subbasin D is located north of north of Subbasins B1 and B2. The basin drains towards the northwest and towards Detention Pond 15. Current planning documents call for low density dwelling units. The basin is 40.87 acres, with a composite impervious value of 37.20% and runoff rates for the 5 and 100 year of 61.12 cfs and 117.38 cfs respectively.
- Subbasin E is in a central location of the site and includes the existing irrigation pond. The basin drains towards the north and towards existing irrigation pond. Current planning documents call for two small parking lots. The basin is 106.53 acres, with a composite impervious value of 14.35% and runoff rates for the 5 and 100 year of 74.68 cfs and 157.91 cfs respectively.
- Subbasin F is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin G. The basin is 25.25 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 24.27 cfs and 51.63 cfs respectively.
- Subbasin G is directly north of Subbasin D and east of Subbasin E. The basin drains towards the northwest and towards Subbasin E. Current planning documents call for a small amount of low density dwelling units, where most of the basin consist of the existing golf course. The basin is 31.45 acres, with a composite impervious value of 12.48% and runoff rates for the 5 and 100 year of 27.18 cfs and 57.12 cfs respectively.
- Subbasin H is located located directly downstream of Subbasin E and on the north side of Stagecoach Rd. The basin drains towards the north and towards Detention Pond 10. Current planning documents call for medium density dwelling units. There are existing lots on the west side of the basin. The basin is 21.96 acres, with a composite impervious value of 10.00% and runoff rates for the 5 and 100 year of 17.86 cfs and 37.8 cfs respectively.
- Subbasin I is located west of Subbasin E and northeast of the major ridgeline between basins. The basin drains towards the northwest and towards proposed Detention Pond 16. There are existing lots on the west side of the basin. Current planning documents call for a commercial golf club. The basin is 28.99 acres, with a composite impervious value of 34.66% and runoff rates for the 5 and 100 year of 40.37 cfs and 78.06 cfs respectively

- Subbasin J is located downstream of Subbasin I. The basin drains towards the northeast to an unnamed tributary of the East Cherry Creek. Current planning documents do not call for any changes to this basin. The basin is 28.07 acres, with a composite impervious value of 10% and runoff rates for the 5 and 100 year of 24.25 cfs and 51.19 cfs respectively.
- Subbasin K is located south of proposed section of Stagecoach Rd. The basin drains towards the northwest and towards proposed Detention Pond 7. Current planning documents call for high, medium, and low density dwelling units and a few pocket parks. The basin is 114.73 acres, with a composite impervious value of 38.08% and runoff rates for the 5 and 100 year of 200.94 cfs and 382.3 cfs respectively
- Subbasin L is downstream of Subbasin K and is located on the north side of the proposed section of Stagecoach Rd. The basin drains towards the northwest into proposed Detention Pond 8. Current planning documents call for medium density dwelling units. The basin is 15.89 acres, with a composite impervious value of 24.82% and runoff rates for the 5 and 100 year of 15.97 cfs and 32.4 cfs respectively. The pond will discharge at predevelopment rates into an unnamed tributary of the East Cherry Creek via the ponds outlet structure.
- Subbasin M is located on the east side of the site and between Subbasin N and V1. The basin drains towards the northwest and towards proposed Detention Pond 6. Detention Pond 6 outlets into a culvert under proposed Stagecoach Rd. and eventually to Subbasin N. Current planning documents call for medium density dwelling units, potential fitness center, and a park. The basin is 26.83 acres, with a composite impervious value of 33.19% and runoff rates for the 5 and 100 year of 46.54 cfs and 89.08 cfs respectively.
- Subbasin N is located south of Subbasin O and North of proposed Stagecoach Rd. The basin drains towards the northwest towards proposed Detention Pond 5. Detention Pond 5 outlets to a nearby unnamed tributary and eventually East Cherry Creek. Current planning documents call for medium density dwelling units along with a pocket park. The basin is 41.57 acres, with a composite impervious value of 29.60% and runoff rates for the 5 and 100 year of 73.48 cfs and 141.24 cfs respectively.
- Subbasin O is located south of Subbasin P. The basin drains towards the northwest and towards Detention Pond 3. Current planning documents call for medium density dwelling units. The basin is 52.52 acres, with a composite impervious value of 30.10% and runoff rates for the 5 and 100 year of 63.86 cfs and 127.4 cfs respectively. The pond will discharge at predevelopment rates and into Pond 1 via a swale.
- Subbasin P is in the northeast corner of the site and downstream of Subbasin O. The basin drains towards the northeast to proposed Detention Pond 1. Current planning documents call for low density dwelling units. The basin is 43.71 acres, with a composite impervious value of 20.71% and runoff rates for the 5 and 100 year of 40 cfs and 82.83 cfs respectively. The pond will discharge at predevelopment rates into an unnamed tributary of the East Cherry Creek via the ponds outlet structure.
- Subbasin Q is located off site and on the southeast corner. The basin drains towards the northeast and towards Subbasin R. The basin is 72.29 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 64.68 cfs and 137.8 cfs respectively.

The above-mentioned basins are large planning area basins and as drainage reports are developed for the individual developed parcels additional drainage reports and calculations will be required. It is expected that storm drainage infrastructure consisting of inlets, storm sewer and open drainage channels will be constructed as the property develops.

- Although mentioned above, offsite basins include basins A, C, F, and Q. Flow contributing to the site from these basins will be routed through the proposed detention ponds. Flow rates are shown below.

Offsite Flow Summary

Basin Description	Ultimate Design Point	Basin Area (ac)	Receiving Detention Pond	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)
A	A	18.99	Pond 11	20.84	43.83
C	C	36.39	Pond 11	33.36	71.27
F	F	25.25	Irr. Pond	24.27	51.63
Q	Q	72.29	Pond 9	64.68	137.80

b. Methodology

Design rainfall was determined utilizing Table 6-2 from the City of Colorado Springs Drainage Criteria Manual to determine the 5-year and 100-year rainfall values for the 1-hour events. The 1-hour rainfall depths are 1.5 and 2.52 in/hr respectively.

Composite percent impervious calculations were completed for each subbasin based on the density of lots and can be found in Appendix B. The El Paso County Drainage Criteria Manual Table 5-1 was used for reference when correlating land use to percent impervious values and located in Appendix F. Impervious values for 5-Acre Lots, 2.5-Acre Lots, Medium Density, Low Density, and Commercial Lots had impervious values of 10%, 15%, 45%, 55% and 75% respectively. The rainfall and percent impervious values were then used as inputs into the Colorado Urban Hydrograph Procedure (CUHP) spreadsheets to determine runoff values for both pre-development and post-development site.

CUHP is an evolution of the Snyder unit hydrograph and is calibrated for use along the Colorado Front Range. 1 Hour rainfall amounts are input into the program to produce a storm hyetograph that is then uses to calculate a storm hydrograph for each basin depending on the subbasins properties including slope, length, shape, impervious area, pervious depression storage area, and various infiltration rates. Tabular hydrographs are then computed and can be used in EPA SWMM. The CUHP results are included within Appendix B.

EPA SWMM was used to determine flow routing via the kinematic wave method. Subbasins were routed to their respective design points and detention ponds for both the developed and predeveloped condition to determine peak runoff amounts for the 5-year and 100-year storm events. Information from these models along with information and calculations performed in the Mile High Flood District BMP spreadsheets was used to determine pond sizing calculations and release rates.

c. Basin Hydrology

A summary of the flows for both the predeveloped and developed cases for each basin, subbasin and Pond are found on next page along with the full computation found in Appendix B.

Existing SWMM Basin Summary				
Basin Description	**Basin Area (ac)**	**% Impervious**	**5 Year Peak Runoff (cfs)**	**100 Year Peak Runoff (cfs)**
A	18.99	2.00	20.84	43.83
B	59.74	2.00	103.48	221.48
C	34.87	2.00	33.36	71.27
D	38.84	2.00	31.56	67.84
E	127.86	2.00	223.69	483.10
F	25.25	2.00	24.27	51.63
G	52.19	2.00	79.17	166.51
H	20.63	2.00	18.59	39.78
I	31.93	2.00	34.58	72.63
J	28.47	2.00	56.31	120.46
K	93.14	2.00	92.05	195.43
L	16.39	2.00	107.58	228.73
M	13.87	2.00	11.48	24.61
N	49.00	2.00	68.16	143.11
O	24.76	2.00	22.69	48.54
P	43.80	2.00	38.52	82.17
Q	72.29	2.00	64.68	137.80
R	54.98	2.00	108.65	232.13
S	24.36	2.00	25.99	48.54
T	5.24	2.00	4.04	8.68
U	5.48	2.00	4.15	8.95
V	38.47	2.00	29.63	63.92
W	3.76	2.00	3.45	7.33
X	190.88	2.00	167.76	361.56
AA	33.49	10.00	38.76	80.22
BB	37.15	10.00	40.62	84.15
CC	6.33	10.00	6.53	13.57
DD	70.06	10.00	58.42	123.69
EE	69.47	10.00	81.16	167.45
FF	17.62	2.00	162.77	340.42
GG	16.35	2.00	14.93	31.99
HH	12.61	2.00	13.01	27.42
II	97.53	2.00	81.77	175.59
JJ	8.72	2.00	9.74	20.50
KK	8.12	2.00	7.51	15.99
LL	6.10	2.00	6.88	14.48

Proposed SWMM Basin and Pond Summary

Basin Description	Basin Area (ac)	% Impervious	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)	5 Year Pond Volume (ac-ft)	100 Year Pond Volume (ac-ft)
P	43.71	20.71%	40.00	82.83		
			Pond 1		1.03	1.97
X1	76.38	29.50%	80.91	163.27		
			Pond 2		6.56	8.80
O	52.52	30.10%	63.86	127.40		
			Pond 3		3.79	6.37
X2	36.33	33.33%	41.46	82.46		
X3	61.99	13.53%	47.59	100.73		
V2	15.34	15.00%	16.15	33.25		
V1	11.57	38.62%	13.99	27.67		
			Pond 4		7.21	7.35
N	41.57	29.60%	73.48	141.24		
			Pond 5		1.86	2.55
M	26.83	33.19%	46.54	89.09		
			Pond 6		0.84	0.94
K	114.73	38.03%	200.94	382.30		
			Pond 7		8.38	12.59
L	15.89	24.82%	15.97	32.40		
			Pond 8		1.05	1.09
S	21.67	40.88%	30.83	58.96		
R	56.16	21.81%	56.59	116.06		
Q	72.29	2.00%	64.68	137.80		
			Pond 9		6.28	10.31
H	21.96	10.00%	17.86	37.80		
			Pond 10		0.66	0.94
B2	19.99	24.55%	17.99	37.14		
B1	59.74	29.83%	66.93	133.69		
A	18.99	2.00%	20.84	43.83		
C	36.39	2.00%	35.31	75.28		
			Pond 11		1.94	3.23
J	28.07	10.00%	24.25	51.19		
			Existing Pond 12			
EE2	16.36	75.00%	35.71	63.62		
EE3	6.67	55.00%	10.38	19.93		
			Pond 13		1.33	1.61
II3	23.97	10.0%	28.32	58.65		
II2	23.13	10.0%	28.04	116.62		
II1	50.43	10.0%	34.94	74.39		
			Pond 14		1.06	3.99
D	40.87	37.20%	61.12	117.38		
			Pond 15		1.94	3.23
E	106.53	14.35%	74.68	157.91		

I	26.99	34.66%	40.37	78.06		
			Pond 16		1.40	1.79
JJ	8.9	20.70%	11.49	22.8		
KK	8.4	12.09%	8.14	16.95		
LL	6.2	10.00%	7.36	15.07		
			Pond 17		1.09	1.23
G	31.45	12.48%	37.69	107.75		
			Irrigation Pond			
JJ	8.90	20.70%	11.06	28.04		
LL	6.2	12.09%	5.85	15.68		
KK	8.4	10.00%	5.9	16.72		
			Natural Drainage Way			
DD	69.5	10.0%	42.26	120.76		
EE1	50.87	10.0%	42.6	154.16		
			Existing Flying Horse North Detention Pond 6			
CC	6.33	10.0%	4.74	13.39		
FF	18.1	10.0%	100.02	325.29		
			Existing Flying Horse North Detention Pond 7			
GG	16.35	10.0%	11.25	32.04		
AA	33.8	10.0%	28.57	80.08		
BB	37.15	10.0%	29.52	83.01		
			Existing Flying Horse North Detention Pond 8			
HH	12.7	10.0%	9.86	27.77		
			Natural Drainage Way			
T	5.24	2.00%	2.92	8.56		
U	5.86	10.0%	3.63	10.37		
W	3.76	10.0%	2.6	7.36		
			Natural Drainage Way			

IV. Hydraulic Analysis

a. Major Drainageways

There are no major drainage ways exist within the development; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries of the East Cherry Creek and Black Squirrel Creek.

V. Environmental Evaluations

a. Significant Existing or Potential Wetland and Riparian Areas Impacts

As part of this work, the developer has engaged Bristlecone Ecology, LLC to perform environmental studies of the site that will be submitted with the planning documents. Major information in the report concerning wetlands concludes that there is a wetland associated with Black Squirrel Creek. Black Squirrel Creek is known to be a jurisdictional stream.

At this time, there are no improvements proposed for Black Squirrel Creek. The minimal impact to the stream will keep the natural habitat intact and the natural function of the Creek as it is to maintain the wetland habitat.

b. Stormwater Quality Considerations and Proposed Practices

As part of the development, full spectrum detention facilities will be installed to provide water quality for the development. The facilities will be designed using El Paso County criteria and provide stormwater quality by slowing the release of stormwater captured by the ponds and allowing solids to settle out. Additionally, when possible, the existing natural drainage ways will be used to convey stormwater to more closely mimic the natural hydrologic and hydraulic cycle. Some of the drainage ways will be used to convey water to the ponds and others will receive water from the ponds and in both scenarios will provide additional water quality benefits.

On site practices for the homes, schools, churches, and other buildings should use means such that impervious areas drain across pervious area to allow for infiltration during the minor events. This would include discharge of the gutters onto landscape areas vs. directly connecting to storm sewer and as discussed above as well using natural ditches and swales where it is logical and makes sense to convey stormwater in lieu of storm sewer piping.

c. Permitting Requirements

When work infringes upon the wetlands or floodplain a 404 Permit will be required. If the work within the waterways is minimal, it will likely be covered under a nationwide 404 permit; it is however possible that an individual permits will be required.

The Colorado Department of Public Health and Environment will require permits for any disturbance that exceed 1 acre of land. Should groundwater be encountered, a dewatering permit will also be required.

El Paso County will require an Erosion and Stormwater Quality Control Permit and any other construction permits required to complete the construction of the site.

Should development occur which effects the floodplain, FEMA will require a permit for work withing the floodplain prior to the commencement of any construction or development within any special flood hazard area (SFHA). If the infrastructure is to be installed within the channel the designer shall route the design through the proper FEMA channels whether that be with a no rise certification or via the CLOMR/LOMR process should a more major improvement within the floodplain be proposed. At this time the project does not propose any direct development within the floodplain however storm infrastructure will discharge into the existing FEMA channel.

d. 4-Step Process

In accordance with the Engineering Criteria Manual I.7.2.A and DCM V2, this site has implemented the four-step process to minimize adverse impacts of urbanization. The four-step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume, and considering the need for Industrial Commercial BMPs.

Step 1 – Reducing Runoff Volumes: The development of the project site includes a variety of land uses including open and vegetated areas interspersed to help disconnect imperious areas and reduce runoff volumes.

Basin Description	Park/Open Space	5 Acre	2.5 Acre	Low Density	Med Density	Commercial	Total Impervious	Total Acreage	Composite Percent Impervious	Predominant Soil Group	5 Year C Factor	100 Year C Factor
Impervious Percentage	10%	10%	15%	45%	55%	75%						
P	15.55	14.78	0.00	13.38	0.00	0.00	9.05	43.71	20.71%	B	0.15	0.41
						Pond 1		**43.71**	**20.71%**			
X1	38.32	3.30	0.00	25.66	0.00	9.10	22.53	76.38	29.50%	B	0.24	0.47
						Pond 2		**76.38**	**29.50%**			
O	13.17	0.00	10.72	28.63	0.00	0.00	15.81	52.52	30.10%	B	0.19	0.44
						Pond 3		**52.52**	**30.10%**			
X2	12.11	0.00	0.00	24.22	0.00	0.00	12.11	36.33	33.33%	B	0.19	0.44
X3	38.88	16.85	0.00	6.26	0.00	0.00	8.39	61.99	13.53%	B	0.13	0.40
V2	0.00	0.00	15.34	0.00	0.00	0.00	2.30	15.34	15.00%	B		
V1	2.11	0.00	0.00	9.46	0.00	0.00	4.47	11.57	38.62%	B	0.20	0.45
						Pond 4		**125.23**	**20.85%**			
N	10.44	11.52	0.00	6.77	12.84	0.00	12.30	41.57	29.60%	B	0.19	0.46
						Pond 5		**41.57**	**29.60%**			
M	14.55	0.00	0.00	1.24	6.94	4.10	8.91	26.83	33.19%	B	0.28	0.52
						Pond 6		**26.83**	**33.19%**			
K	26.45	2.93	0.00	61.89	23.46	0.00	43.69	114.73	38.08%	B	0.21	0.47
						Pond 7		**114.73**	**38.08%**			
L	6.93	5.54	0.00	0.00	2.72	0.00	2.74	15.19	18.06%	B	0.15	0.42
						Pond 8		**15.19**	**18.06%**			
S	2.31	0.24	0.00	19.12	0	0.00	8.86	21.67	40.88%	**B**	0.21	0.45
R	26.63	16.11	0.00	21.77	0.00	0.00	14.07	64.51	21.81%	B	0.15	0.41
						Pond 9		**86.18**	**21.81%**			
H	17.65	4.31	0.00	0.00	0.00	0.00	2.20	21.96	10.00%	B	0.12	0.39
						Pond 10		**21.96**	**10.00%**			
B2	7.20	4.48	0.00	8.31	0.00	0.00	4.91	19.99	24.55%	B	0.16	0.42
B1	12.86	13.03	0.00	33.85	0.00	0.00	17.82	59.74	29.83%	B	0.18	0.43
						Pond 11		**79.73**	**28.51%**			
J	28.07	0.00	0.00	0.00	0.00	0.00	2.81	28.07	10.00%	B	0.12	0.39
						Exisiting Pond 12						
I	17.99	0.00	0.00	0.00	0.00	11.00	10.05	28.99	34.66%	B	0.38	0.58
						Pond 16		**57.06**	**22.53%**			
EE2	0.00	0.00	0.00	0.00	0.00	16.36	12.27	16.36	75.00%	B	0.81	0.88
EE3	0.00	0.00	0.00	0.00	6.67	0.00	3.67	6.67	55.00%	B	0.30	0.58
						Pond 13		**23.03**	**69.21%**			
II2	0.00	23.13	0.00	0.00	0.00	0.00	2.31	23.13	10.00%	B	0.12	0.39
II3	0.00	23.97	0.00	0.00	0.00	0.00	2.40	23.97	10.00%	B	0.12	0.39
II1	15.77	34.66	0.00	0.00	0.00	0.00	5.04	50.43	10.00%	B	0.12	0.39
						Pond 14		**97.53**	**10.00%**			
D	4.41	4.70	0.00	31.76	0.00	0.00	15.20	40.87	37.20%	B	0.20	0.44
						Pond 15		**40.87**	**37.20%**			
E	99.63	8.80	0.00	1.72	0.00	6.90	16.79	117.05	14.35%	B	0.16	0.42
G	25.81	3.41	0.00	2.23	0.00	0.00	3.93	31.45	12.48%	B	0.13	0.39
						Irrigation Pond		**148.50**	**13.95%**			
JJ	1.86	4.32	0.00	2.72	0.00	0.00	1.84	8.90	20.70%	B	0.15	0.41
LL	4.39	1.44	0.00	0.37	0.00	0.00	0.75	6.20	12.09%	B	0.13	0.39
						Pond 17		**15.10**	**17.16%**			
KK	5.98	2.42	0.00	0.00	0.00	0.00	0.84	8.40	10.00%	B	0.12	0.39
AA	0.00	33.88	0.00	0.00	0.00	0.00	3.39	33.88	10.00%	B	0.12	0.39
BB	0.00	37.15	0.00	0.00	0.00	0.00	3.72	37.15	10.00%	B	0.12	0.39
CC	0.00	6.33	0.00	0.00	0.00	0.00	0.63	6.33	10.00%	B	0.12	0.39
DD	0.00	69.5	0.00	0.00	0.00	0.00	6.95	69.50	10.00%	B	0.12	0.39
FF	0.00	18.1	0.00	0.00	0.00	0.00	1.81	18.10	10.00%	B	0.12	0.39
GG	0.00	16.35	0.00	0.00	0.00	0.00	1.64	16.35	10.00%	B	0.12	0.39
HH	0.00	12.7	0.00	0.00	0.00	0.00	1.27	12.70	10.00%	B	0.12	0.39

*2% imperviousness for all, and runoff coefficients are .09 and .36 for 5 and 100 yr respectively

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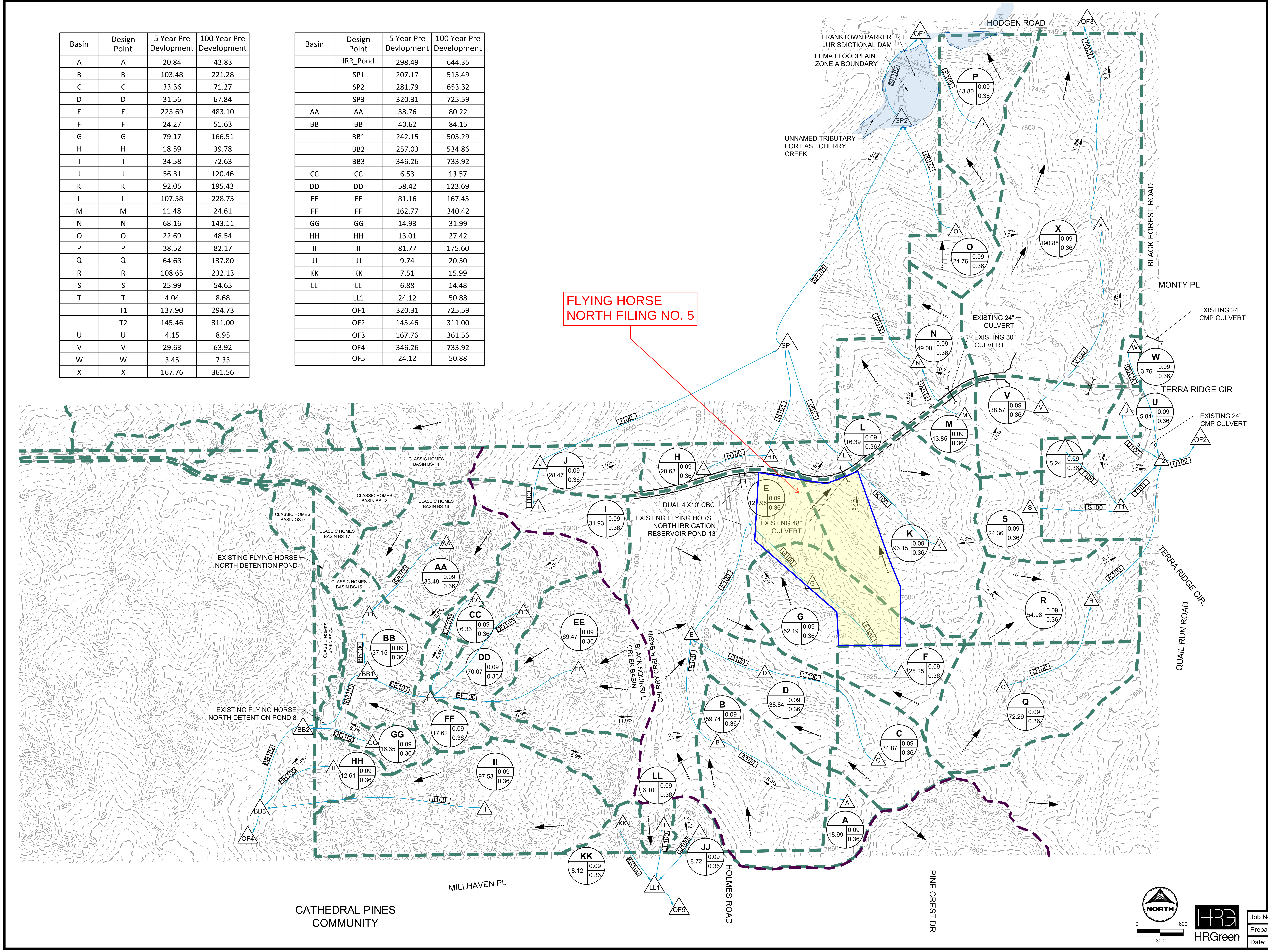
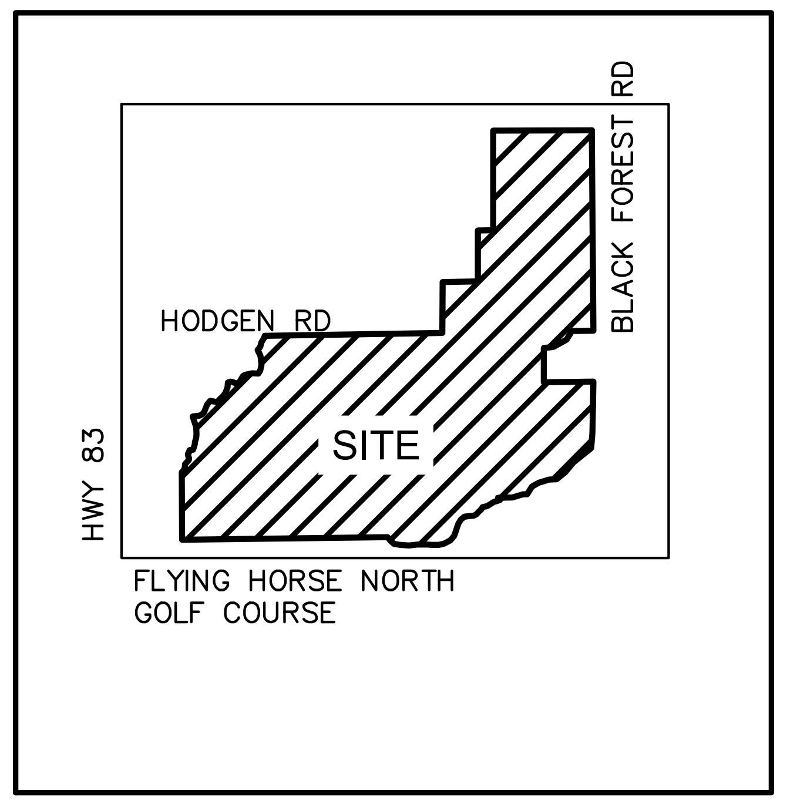
Basin	Design Point	5 Year Pre Devlopment	100 Year Pre Development
A	A	20.84	43.83
B	B	103.48	221.28
C	C	33.36	71.27
D	D	31.56	67.84
E	E	223.69	483.10
F	F	24.27	51.63
G	G	79.17	166.51
H	H	18.59	39.78
I	I	34.58	72.63
J	J	56.31	120.46
K	K	92.05	195.43
L	L	107.58	228.73
M	M	11.48	24.61
N	N	68.16	143.11
O	O	22.69	48.54
P	P	38.52	82.17
Q	Q	64.68	137.80
R	R	108.65	232.13
S	S	25.99	54.65
T	T	4.04	8.68
	T1	137.90	294.73
	T2	145.46	311.00
U	U	4.15	8.95
V	V	29.63	63.92
W	W	3.45	7.33
X	X	167.76	361.56

Basin	Design Point	5 Year Pre Devlopment	100 Year Pre Development
	IRR_Pond	298.49	644.35
	SP1	207.17	515.49
	SP2	281.79	653.32
	SP3	320.31	725.59
AA	AA	38.76	80.22
BB	BB	40.62	84.15
	BB1	242.15	503.29
	BB2	257.03	534.86
	BB3	346.26	733.92
CC	CC	6.53	13.57
DD	DD	58.42	123.69
EE	EE	81.16	167.45
FF	FF	162.77	340.42
GG	GG	14.93	31.99
HH	HH	13.01	27.42
II	II	81.77	175.60
JJ	JJ	9.74	20.50
KK	KK	7.51	15.99
LL	LL	6.88	14.48
	LL1	24.12	50.88
	OF1	320.31	725.59
	OF2	145.46	311.00
	OF3	167.76	361.56
	OF4	346.26	733.92
	OF5	24.12	50.88





VICINITY MAP

LEGEND:

PROPOSED MAJOR CONTOUR ——5250——
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR — — —5250— — —
EXISTING MINOR CONTOUR
EXISTING CULVERT
PROPOSED DRAINAGE CHANNEL
PROPOSED ROAD
PROPERTY LINE
DIRECTIONAL FLOW ARROW
EMERGENCY OVERFLOW ARROW
EXISTING 100-YR FLOODWAY
EXISTING 100-YR FLOODPLAIN
PROPOSED 100-YR FLOODPLAIN
WATERSHED BOUNDARY
MAJOR BASIN LINE
100YR ZONE A FLOODPLAIN
PROPOSED DETENTION LOCATION A
POTENTIAL WATER QUALITY LOCATION WQ
SWMM CONVEYANCE ELEMENT SWMM
PROPOSED PEAK FLOW RATE (CFS) 850
DESIGN POINT X
PROPOSED BASIN LABEL XX BASIN DESIGNATION
AREA (AC.) XX XX C5
XX C100

NOTES:

HRGreen

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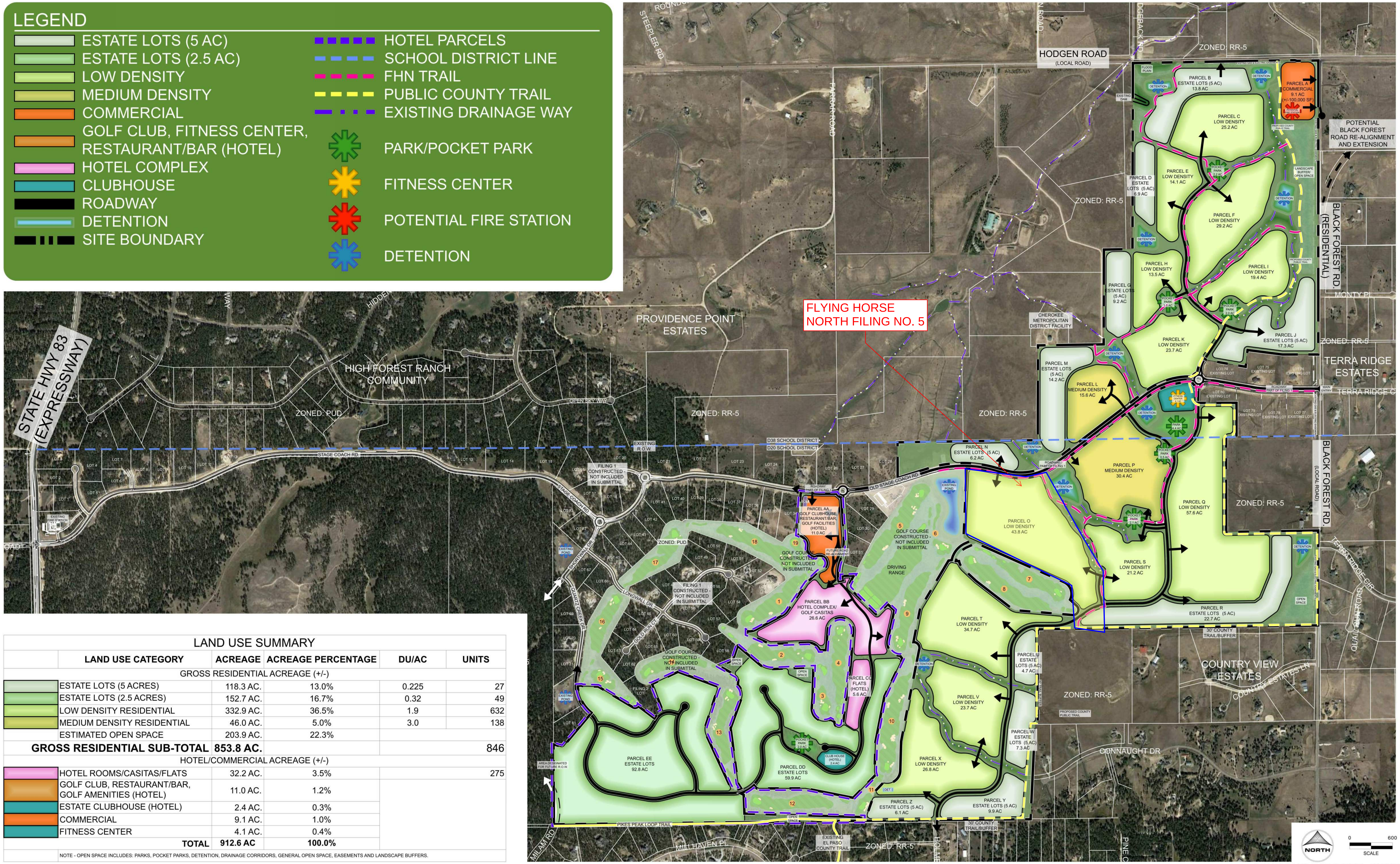
Prepared By:	CLB
Date:	02/21/2022

EXISTING EX1

FIG.EX1

FLYING HORSE NORTH SKETCH PLAN



LEGEND

▭	ESTATE LOTS (5 AC)
▭	ESTATE LOTS (2.5 AC)
▭	LOW DENSITY
▭	MEDIUM DENSITY
▭	COMMERCIAL
▭	GOLF CLUB, FITNESS CENTER, RESTAURANT/BAR (HOTEL)
▭	HOTEL COMPLEX
▭	CLUBHOUSE
▬	ROADWAY
▭	DETENTION
▬ ▮▮ ▬	SITE BOUNDARY
▪ ▪ ▪	HOTEL PARCELS
- - -	SCHOOL DISTRICT LINE
- - -	FHN TRAIL
- - -	PUBLIC COUNTY TRAIL
- · -	EXISTING DRAINAGE WAY
✳	PARK/POCKET PARK
✳	FITNESS CENTER
✳	POTENTIAL FIRE STATION
✳	DETENTION

LAND USE SUMMARY

	LAND USE CATEGORY	ACREAGE	ACREAGE PERCENTAGE	DU/AC	UNITS
	GROSS RESIDENTIAL ACREAGE (+/-)				
▭	ESTATE LOTS (5 ACRES)	118.3 AC.	13.0%	0.225	27
▭	ESTATE LOTS (2.5 ACRES)	152.7 AC.	16.7%	0.32	49
▭	LOW DENSITY RESIDENTIAL	332.9 AC.	36.5%	1.9	632
▭	MEDIUM DENSITY RESIDENTIAL	46.0 AC.	5.0%	3.0	138
	ESTIMATED OPEN SPACE	203.9 AC.	22.3%		
GROSS RESIDENTIAL SUB-TOTAL		**853.8 AC.**			846
	HOTEL/COMMERCIAL ACREAGE (+/-)				
▭	HOTEL ROOMS/CASITAS/FLATS	32.2 AC.	3.5%		275
▭	GOLF CLUB, RESTAURANT/BAR, GOLF AMENITIES (HOTEL)	11.0 AC.	1.2%		
▭	ESTATE CLUBHOUSE (HOTEL)	2.4 AC.	0.3%		
▭	COMMERCIAL	9.1 AC.	1.0%		
▭	FITNESS CENTER	4.1 AC.	0.4%		
	TOTAL	**912.6 AC**	**100.0%**		
	NOTE - OPEN SPACE INCLUDES: PARKS, POCKET PARKS, DETENTION, DRAINAGE CORRIDORS, GENERAL OPEN SPACE, EASEMENTS AND LANDSCAPE BUFFERS.				

COUNTY FILE NUMBER: SKP223

HR GREEN Xrefs: EX-Topo; EX-Alta; xgt-1-ARCH DH01; EX-Parcels

DRAWN BY:	JAG	JOB DATE:	05/21/2023
APPROVED:	PLS	JOB NUMBER:	211030
CAD DATE:	07/01/2022		
CAD FILE:	J:\2021\211030\CAD\Dwgs\C\Sketch-Plan\BUBBLE-PLAN		

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

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FLYING HORSE NORTH
DEVELOPMENT, LLC.
EL PASO COUNTY, COLORADO

FLYING HORSE NORTH SKETCH PLAN
SKETCH PLAN DRAWING

SHEET
SP.2

FERNANDEZ, SARAH, 9/9/2022 9:13 AM

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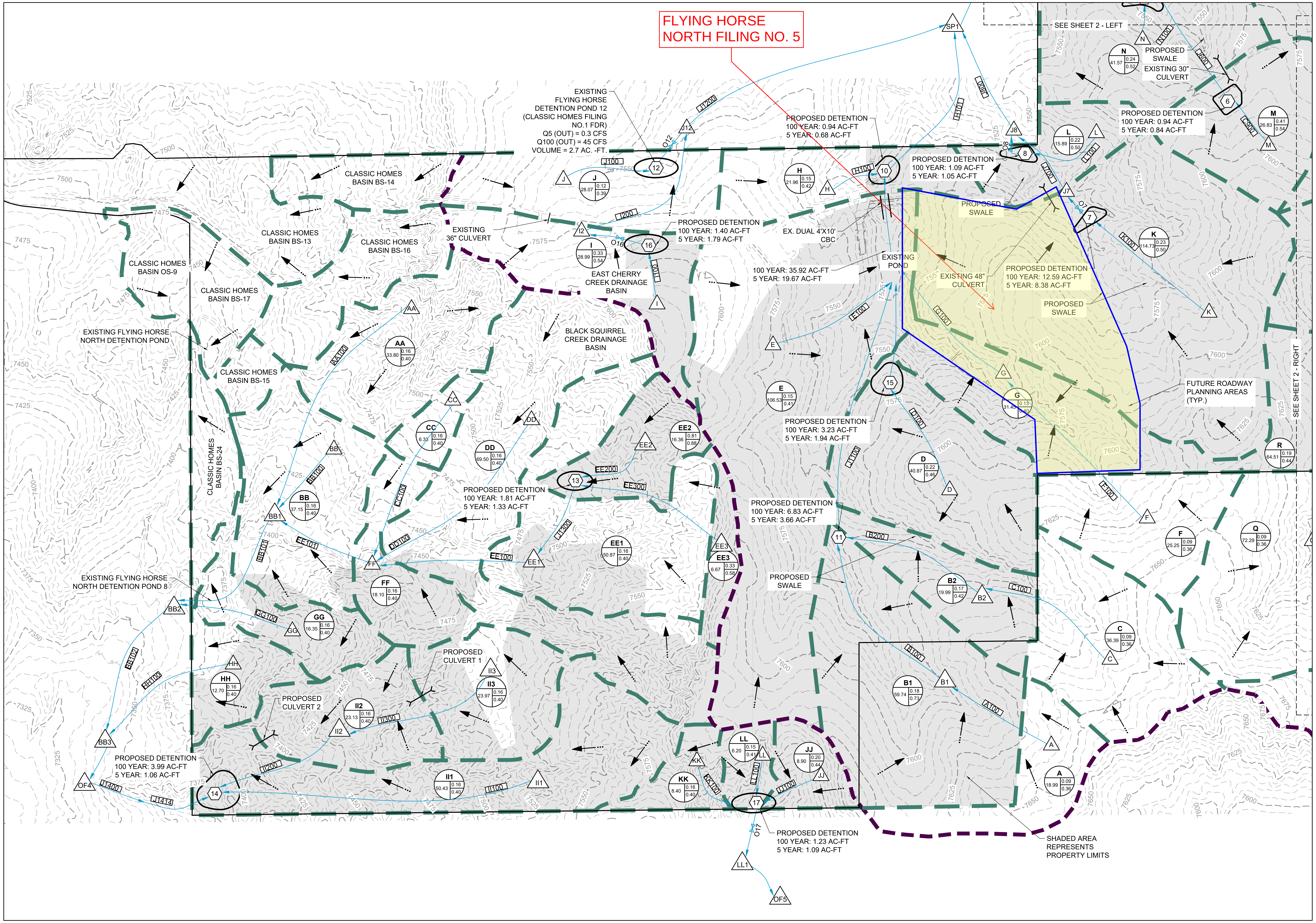
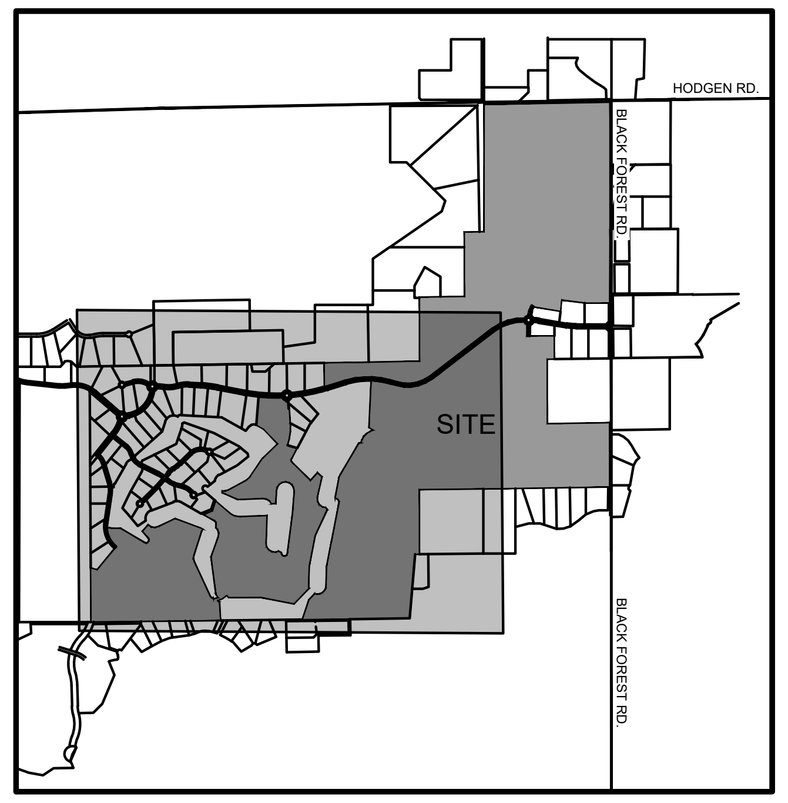




VICINITY MAP

LEGEND:

PROPOSED MAJOR CONTOUR	5250
PROPOSED MINOR CONTOUR	
EXISTING MAJOR CONTOUR	5250
EXISTING MINOR CONTOUR	
PROPOSED STORM DRAIN PIPE	
EXISTING STORM DRAIN PIPE	
PROPOSED DRAINAGE CHANNEL	
PROPOSED ROAD	
PROPERTY LINE	
DIRECTIONAL FLOW ARROW	←
EMERGENCY OVERFLOW ARROW	⇦
EXISTING 100-YR FLOODWAY	
EXISTING 100-YR FLOODPLAIN	
PROPOSED 100-YR FLOODPLAIN	
WATERSHED BOUNDARY	
MAJOR BASIN LINE	
100YR ZONE A FLOODPLAIN	▨
PROPOSED DETENTION LOCATION	⬡ A
POTENTIAL WATER QUALITY LOCATION	⬡ WQ
SWMM CONVEYANCE ELEMENT	SWMM
PROPOSED PEAK FLOW RATE (CFS)	850
DESIGN POINT	△ X
PROPOSED BASIN LABEL	XX BASIN DESIGNATION AREA (AC.) XX XX C5 XX C100

NOTES:

SEE SHEET 2 FOR DESIGN FLOWS

NORTH
0 200 400

HRGreen

Job No.:	211030.01
Prepared By:	TBI
Date:	9/9/2022

PROPOSED DRAINAGE BASINS

FIG.1

Flying Horse North Filing No. 4
Final Drainage Report

November 2024

Prepared For:

Mr. Drew Balsick

Vice President / Project Manager

Flying Horse Development, LLC
2138 Flying Horse Club Drive

Colorado Springs, CO 80921

(719) 785-3237

Prepared By:

HR Green Development, LLC

1975 Research Parkway, Ste. 160

Colorado Springs, CO 80920

Contact: Richie Lyon, PE

Richie.Lyon@hrgreen.com

719-318-0871

PCD File No. SF422_

infrastructure because of this development as all other drainage parameters remain consistent with the 2018 FDR/PDR. Review of the CUHP / SWMM generated hydrology results in peak values generally less than calculated with the Rational Method. The resultant peak runoff figures are used to assess all existing and proposed stormwater infrastructure associated with Filing No. 4's development, as well as a future Filing No. 5 development for Pond B in particular.

II. Project Characteristics

a. Location in Drainage Basin, Offsite Flows, Size

Filing No. 4 is located within the East Cherry Creek Basin. There is not a current planning study of the drainage basin, but generally it slopes from southwest to northeast. The basin eventually flows into the South Platte River.

Within the portion of the East Cherry Creek Basin investigated with this Report, three major drainage basins have been designated by the proposed pond in which the area is draining to. One drainage basin consists of seven sub-basins, "A" basins, conveyed to the proposed detention pond at Design Point A6, Pond A. The respective contributing flow from the sub-basins is shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
A1	9.6	5.2	22.1
A2	10.8	6.7	27.6
A3	72.7	21.2	126.2
A4	18.4	10.2	42.0
A5	6.1	3.7	15.4
A6	2.8	1.8	7.2
A7	8.1	5.1	20.9

Drainage within the "A" drainage basin flows ultimately from the southwest to northeast to reach Pond A. Design points are located at proposed culverts underneath roadways and proposed swales that direct flow to the detention pond. Drainage outfalls from Pond A into an existing channel that ultimately outfalls to the South Platte River.

The second drainage basin consists of six sub-basins, "B" basins, conveyed to the proposed detention pond at Design Point B3, Pond B. Two Basins, B5 and B6, flow directly offsite. Additional volume has been included in Pond B to compensate for these basins, see additional discussion below. The respective contributing flow from the sub-basins is shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
B1	57.8	15.9	97.5
B2	35.8	18.2	73.1
B3	1.1	1.5	4.0
B4	11.0	8.0	28.1
B5	10.6	6.3	25.9
B6	16.0	8.7	35.8

Proposed Basin A6: 2.76 acres, residential (2.5 acre lots) (Q_5 = 1.8 cfs, Q_{100} = 7.2 cfs)

Runoff generated in this basin sheet flows over existing topography through proposed 2.5-acre lots and combines with flows from upstream tributary basins A3 and A4 in a proposed public channel represented as section H-H on the plans. Runoff will also be collected in roadside ditches along the north side of Rubble Drive. Combined flows from basins A1-A6 will discharge at a 100-year rate 102.7 CFS via a rundown rock chute into proposed detention Pond A.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin A6 was identified as Basin CC-13B. Classic's FDR reported a total basin area for CC-13B to be 25.5 acres with a Q_5=7.2 CFS and a Q_{100}=36.1 CFS. The cumulative flow at design point 29 (this includes basins CC-13A – CC-13C and OS-15) shown in this report have a net area of 125.5 acres, a net Q_5= 26.6 CFS, and a net Q_{100}=155 CFS. See the statement preceding Basin A1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Proposed Basin A7: 8.11 acres, residential (2.5 acre lots) (Q_5 = 5.1 cfs, Q_{100} = 20.9 cfs)

Runoff generated in this basin travels via sheet flow over existing topography into the proposed Pond A. Within the pond, flows travel through trickle channels and outfall through a proposed private Type-C modified outlet structure. The reduced 100-year flow outfalling from Pond A is 160 CFS.

Proposed Basin B1: 57.78 acres, undeveloped / roadway (minor collector) / residential (2.5 acre lots) (Q_5 = 15.9 cfs, Q_{100} = 97.5 cfs)

Runoff generated in this basin sheet flows over existing topography from southeast to northwest through proposed 2.5-acre lots. Runoff is collected in an existing private tertiary swale and existing roadside ditches along Old Stagecoach Road and directed to basin B2.

Proposed Basin B2: 35.77 acres roadway (minor collector) / residential (2.5 acre lots) (Q_5 = 18.2 cfs, Q_{100} = 73.1 cfs)

Runoff generated in this basin sheet flows over existing topography from south to north. Minimal flow produced within Basin B2 will travel shallow concentrated flow in existing roadside ditches along Old Stagecoach Road. Combined flows from basin B1 and B2 are directed to the north to basin B3 through an existing public 48-inch RCP culvert.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin B2 (and Basin B1) was identified as Basin CC-10. Classic's FDR reported a total basin area for CC-10 to be 85.6 acres with a Q_5=14.1 CFS and a Q_{100}=91.9 CFS. The cumulative flow at design point 26 (this includes basins CC-8 and CC-10) shown in this report have a net area of 93.3 acres, a net Q_5= 15.9 CFS, and a net Q_{100}=102 CFS. The cumulative flow calculated with this report at design point B2 is significantly higher at Q5 = 33.2 CFS and Q100 = 285.8 CFS due to the discrepancies in methodology used between reports. The existing 48-inch RCP culvert must be modified to a dual 48-inch RCP culvert accommodate the increase in flows. See Appendix C for calculations on this existing culvert calculations and proposed culvert improvement calculations.

Proposed Basin B3: 1.10 acres, roadway (minor collector) / residential (2.5 acre lots) (Q_5 = 1.5 cfs, Q_{100} = 3.8 cfs)

Proposed Basin F3: 16.74 acres, undeveloped (Q_5 = 4.5 cfs, Q_{100} = 58.1 cfs)

Runoff generated in this basin will sheet flow across existing topography and flow in the existing roadside ditches along Old Stagecoach Road to the east until eventually flowing to the north under the road and following existing drainage conditions. Runoff from this basin is anticipated to be collected in a future detention pond that is to be built with the future filing to the north of Filing No. 4.

Proposed Basin G1: 2.55 acres, residential (2.5 acre lots) (Q_5 = 1.7 cfs, Q_{100} = 6.9 cfs)

Runoff from this basin will sheet flow over existing topography through proposed 2.5-acre lots. The runoff will follow existing drainage patterns and sheet flow to the east and be collected in an existing tertiary swale in Basin G2. This area is included in the large lot exclusion (ECM I.7.1.B.5) and are excluded from water quality treatment requirements.

Proposed Basin G2: 4.42 acres, roadway (minor arterial) (Q_5 = 1.3 cfs, Q_{100} = 9.7 cfs)

Runoff in from this basin is generated on existing ground cover. The runoff will follow existing drainage patterns and travel shallow concentrated flow through an existing tertiary swale to an existing stock pond that has no records or design plans. Runoff will continue to an existing private channel represented as D-D on the plans.

Proposed Basin H1: 5.20 acres, residential (2.5 acre lots) (Q_5 = 3.4 cfs, Q_{100} = 13.9 cfs)

Runoff generated in this basin sheet flows from west to east through proposed 2.5 acre-lots and travels shallow concentrated flow in the proposed roadside ditches on the west side of Rubble Drive. The flows are directed to the east under Rubble Drive through a proposed public 18-inch RCP culvert (Culvert 5) to Basin H2. This area is included in the large lot exclusion (ECM I.7.1.B.5) and are excluded from water quality treatment requirements.

Proposed Basin H2: 14.46 acres, residential (2.5 acre lots) (Q_5 = 9.1 cfs, Q_{100} = 37.5 cfs)

Runoff generated in this basin sheet flows through 2.5-acre lots and travels shallow concentrated flow in an existing private channel represented as section C-C on the plans. The flows in this channel are directed to the east offsite and continue to follow existing drainage patterns.

Proposed Basin H3: 36.80 acres, roadway (minor arterial) (Q_5 = 9.1 CFS, Q_{100} = 66.9 CFS)

Runoff generated in this basin is offsite flow collected in an existing private channel that captures all the flows from Basins G1 and G2 and Basins H1 and H2. This existing channel follows existing drainage patterns and is represented as section D-D on the plan.

Runoff Comparison of Existing and Proposed Conditions			
Historic Design Point	**Proposed Design Point**	**Historic Q_{100} (cfs)**	**Proposed Q_{100} (cfs)**
A2 + H1	A7	267.4	248.5
B1+B2+B3+B4	B4	262.7	262.4
C2+C3+C4	C3	78	73.2

*Summary of routing included in Appendix D

b. Water Quality and Detention Facilities

There are three Full Spectrum Detention ponds that are proposed within this filing. Full Spectrum Detention (FSD) is a design concept introduced by the Mile High Flood District (MHFD, Urbonas and Wulliman 2005) that provides better control of the full range of runoff rates that pass through detention facilities than the conventional multi-stage concept. This concept also provides some mitigation of increased runoff volumes by releasing a portion of the increased runoff volume at a low rate over an extended period of time. Site detention ponds are designed as FSDs to provide the required volume stages for Water Quality Capture Volume (WQCV), Excess Urban Runoff Volume (EURV), and the 100-year stage (flood control volume). In FSDs, the flood volume is equal to the entire volume and is inclusive of the EURV and the WQCV.

Areas tributary to storage facilities are greater than 5 acres. Therefore, detention volumes have been determined using the CUHP/MHFD SWMM methodology. When multiple basins are tributary to a single pond, basins are first routed together within the SWMM program to develop a combined detention pond inflow hydrograph. The hydrographs were then added to a Mile High Flood District MHFD-Detention workbook for each pond. Then the release curve / estimated outlet condition was adjusted until the desired peak pond outflow was achieved. Once the 100-year peak release rate was confirmed, resultant stage-release curves were transferred back to the prepared SWMMs and re-run to confirm the similar results as found with the MHFD-Detention analysis.

The MHFD-Detention workbook is utilized to design the outlet structures with orifice plates and restrictor plates. The outlet structures and plates are designed to achieve the target release rates of the various stages: WQCV at 40 hours, and EURV and 100-year release rates within the requisite 120 hours, with the goal of being in the range of 52 to 72 hours, as feasible for the runoff conditions. The developed condition outlet flow rates are not to exceed predeveloped conditions, and over-detention is provided within the three ponds to account for sub-basins that drain directly offsite without capture per the existing drainage patterns of the site.

The ponds include the required infrastructure such as concrete forebays, an emergency spillway with rip-rap weirs, concrete trickle channels, and a 2.5-foot depth micro-pool attached to the outlet structure. Ponds include 15’-20’ width maintenance paths with vehicular access to the bottom of pond to access forebays and outlet structures for continued maintenance. The pathways have access from the public right-of-way and proper turning radii and longitudinal and cross slopes for a maintenance vehicle. The ponds include 1.0-foot of freeboard to the emergency spillway berm of the pond with the crest elevation at or above the 100-year water surface elevation. The spillways are sized with a trapezoidal weir for the 100-year inflow with rip-rap prescribed for the outflow velocity as energy dissipation.

The proposed ponds are described below.

Pond A (Design Point A5) provides WQCV and EURV for the stormwater runoff from the A basins and includes over-detention to account for nearby sub-basins that drain directly offsite to ensure that the released stormwater to downstream properties and infrastructure is equal to or less than historical runoff. This is confirmed by comparing the routed peak flows of similar basins in the historic condition, to the routed peak flows inclusive of detention in the developed condition. Both historic and developed SWMM models note this location as O_BASIN_H and modeling results at this location are included in the table below.

The A basins include areas of upstream offsite developed single-family residence RR-5 lots, undeveloped open space area, onsite developed area for proposed 2.5-acre single-family residential lots and rural local residential roadways. The pond includes a minimum 1.0-foot of freeboard to the top of berm and the 100-year water surface elevation is below the crest of the emergency spillway weir.

The MHFD-Detention / SWMM analysis yields the following pond sizing results:

Proposed Pond A

(Ownership and maintenance by the Flying Horse North HOA)

WQCV (ac-ft)	EURV (ac-ft)	100-year / Total Volume (ac-ft)
0.53	0.83	2.23

Pond A hydraulics are summarized in the following table:

	Peak Inflow (cfs)	Design Release / Outflow (cfs)	Time to Drain 99% of Inflow Volume (hrs)	Historic Peak Flowrate at O_BASIN_H	Developed Peak Flowrate at O_BASIN_H
Minor Storm (Q5)	42.5	31.3	52	52	38
Major Storm (Q100)	183.8	156.0	41	267	249

Pond A includes a concrete forebay sized for the required volume of the inflow, a 4-foot width concrete trickle channel with 6” vertical concrete curb, a 2.5-foot depth concrete micro pool, and an outlet structure that is includes a top trash rack, orifice plate, and restrictor plate on the outlet pipe.

Pond B (Design Point B) provides WQCV and EURV for the stormwater runoff from the B basins as well as over-detention of nearby sub-basins that drain directly offsite and converge with the ultimate downstream drainageway that Pond B outfalls to. This is confirmed by comparing the routed peak flows of similar basins in the historic condition, to the routed peak flows inclusive of detention in the developed condition. Both historic and developed SWMM models note this location as O_BASIN_B and modeling results at this location are included in the table below.

It is noted that the B basins include future developed conditions for a future Filing No. 5 so that this future development may be designed and constructed to drain to Pond B with minimal future improvements or retrofits to the pond.

The B basins consist of Filing No. 4 site area for 2.5-acre single-family residential development and local rural residential roadways. The pond includes a minimum 1.0-foot of freeboard to the top of berm and the 100-year water surface elevation is below the crest of the emergency spillway weir.

The MHFD-Detention / SWMM analysis yields the following pond sizing results:

Proposed Pond B

(Ownership and maintenance by the Flying Horse North HOA)

WQCV (ac-ft)	EURV (ac-ft)	100-year / Total Volume (ac-ft)
0.50	0.81	2.17

Pond B hydraulics are described in the following table:

	Peak Inflow (cfs)	Design Release/Outflow (cfs)	Time to Drain 99% of Inflow Volume (hrs)	Historic Peak Flowrate at O_BASIN_B	Developed Peak Flowrate at O_BASIN_B
Minor Storm (Q5)	59.1	49.2	50	58	54
Major Storm (Q100)	247.1	216.0	36	263	262

Pond B includes a concrete forebay sized for the required volume of the inflow, a 4-foot width concrete trickle channel with 6” vertical concrete curb, a 2.5-foot depth concrete micro pool, and an outlet structure that is includes a top trash rack, orifice plate, and restrictor plate on the outlet pipe.

Pond C (Design Point C) provides WQCV and EURV for the stormwater runoff from the C basins as well as over-detention of nearby sub-basins that drain directly offsite and converge with the ultimate downstream drainageway that Pond C outfalls to. This is confirmed by comparing the routed peak flows of similar basins in the historic condition, to the routed peak flows inclusive of detention in the developed condition. Both historic and developed SWMM models note this location as O_BASIN_C and modeling results at this location are included in the table below.

Proposed Pond C

(Ownership and maintenance by the Flying Horse North HOA)

WQCV (ac-ft)	EURV (ac-ft)	100-year / Total Volume (ac-ft)
0.23	0.39	0.90

Pond C hydraulics are described in the following table:

	Peak Inflow (cfs)	Design Release/Outflow (cfs)	Time to Drain 99% of Inflow Volume (hrs)	Historic Peak Flowrate at O_BASIN_C	Developed Peak Flowrate at O_BASIN_C
Minor Storm (Q5)	18.0	10.2	59	19	11
Major Storm (Q100)	69.0	62.4	50	78	73

Pond C includes a concrete forebay sized for the required volume of the inflow, a 4-foot width concrete trickle channel with 6” vertical concrete curb, a 2.5-foot depth concrete micro pool, and an outlet structure that is includes a top trash rack, orifice plate, and restrictor plate on the outlet pipe.

A comparison of the existing conditions as identified in the 2022 MDDP, and proposed conditions releasing off-site from the identified Filing No. 4 boundary into Cherry Creek is provided below to show that the detention being provided on site from the proposed ponds in Filing No. 4 will negate any impact downstream.

Basin ID	Existing Conditions (HRG MDDP 2022)	Proposed Conditions (HRG Filing 4 FDR 2024)
Cherry Creek	371.2 CFS	24.0 CFS

c. Methodology

Design rainfall was determined utilizing Table 6-2 from the City of Colorado Springs Drainage Criteria Manual to determine the 5-year and 100-year rainfall values for the 1-hour events. The 1-hour rainfall depths are 1.5 and 2.52 in/hr respectively.

The proposed development will consist of 48 2.5-acre single-family residential estate lots which are assumed at a percent imperviousness of 11% per the County ECM Table 3-1 Typical Values of Percent Impervious within Appendix L of the ECM which provides guidance for larger rural lot developments. Existing golf course areas are to remain undisturbed and utilize a land use category of “lawn” with a percent imperviousness of 2% per the County ECM Table 6-6 land use table. Composite coefficients, rainfall intensities, and runoff flow rates are calculated on a Rational Method spreadsheet and provided within the Appendix. As discussed previously, the Rational Method used in this report will result in higher peak flow rates for the minor and major storm events as compared to the 2018 Classic Consulting FDR/PDR which utilized the NRCS Curve Number Method. Design points within Filing No. 4 are designed per the findings of this report which utilizes the Rational Method and CUHP/SWMM modeling.

Mile High Flood District (MHFD) UD-BMP Runoff Reduction calculations are provided to demonstrate WQCV reduction for the sub-basins that drain directly offsite, however the sub-basins that drain directly off-site do fall under ECM code I.7.1.B.5, which excludes areas of “large lots” to require detention. The provided Runoff Reduction calculations are to show the good stormwater management practices of the site.

Areas tributary to storage facilities are greater than 5 acres. Therefore, detention volumes have been determined using the CUHP/MHFD SWMM methodology. When multiple basins are tributary to a single pond, basins are first routed together within the SWMM program to develop a combined detention pond inflow hydrograph. The hydrographs were then added to a MHFD-Detention workbook for each pond. Then the release curve / estimated outlet condition was adjusted until the desired peak pond outflow was achieved. Once the 100-year peak release rate was confirmed, resultant stage-release curves were transferred back to the prepared SWMMs and re-run to confirm the similar results as found with the MHFD-Detention analysis.

The MHFD-Detention workbook is utilized to design the outlet structures with orifice plates and restrictor plates. The outlet structures and plates are designed to achieve the target release rates of the various stages: WQCV at 40 hours, and EURV and 100-year release rates within the requisite 120 hours, with the goal of being in the range of 52 to 72 hours, as feasible for the runoff conditions.

Reference to the 2018 Classic Consulting PDR/FDR set of calculations and spreadsheets is included to demonstrate compliance and consistency with the previously approved report which anticipated similar land uses and basin acreages tributary to existing stormwater facilities.

CULVERT CALCULATIONS

Culvert Report

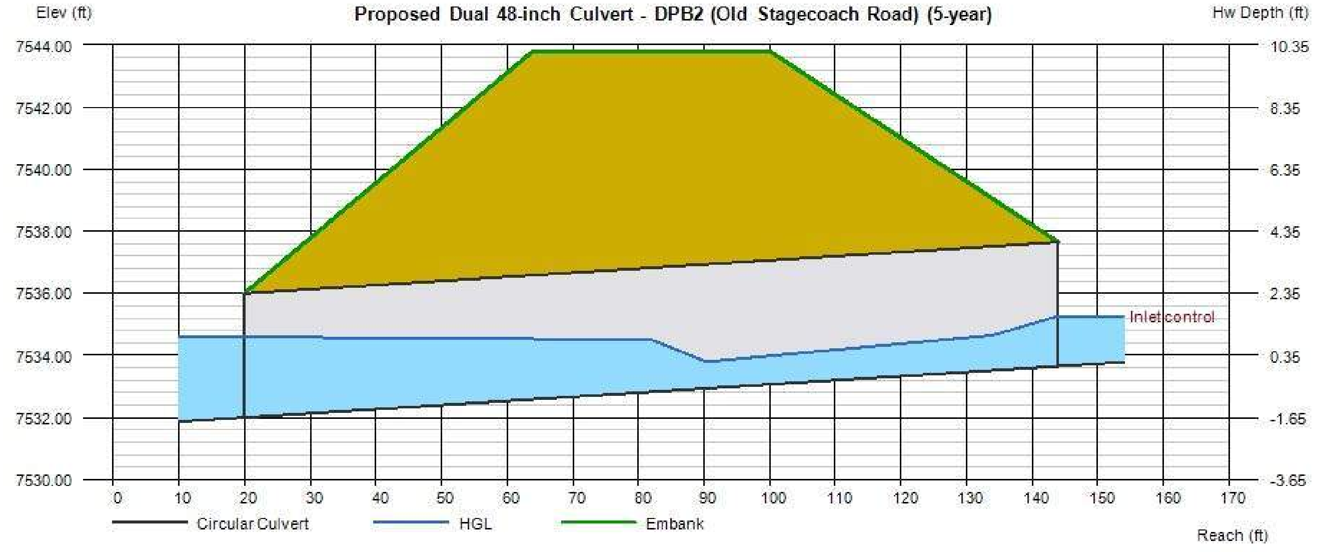
Proposed Dual 48-inch Culvert - DPB2 (Old Stagecoach Road) (5-year)

Invert Elev Dn (ft) = 7532.00
Pipe Length (ft) = 123.98
Slope (%) = 1.33
Invert Elev Up (ft) = 7533.65
Rise (in) = 48.0
Shape = Circular
Span (in) = 48.0
No. Barrels = 2
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment
Top Elevation (ft) = 7543.81
Top Width (ft) = 36.00
Crest Width (ft) = 50.00

Calculations
Qmin (cfs) = 33.20
Qmax (cfs) = 33.20
Tailwater Elev (ft) = (dc+D)/2

Highlighted
Qtotal (cfs) = 33.20
Qpipe (cfs) = 33.20
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 1.92
Veloc Up (ft/s) = 5.27
HGL Dn (ft) = 7534.60
HGL Up (ft) = 7534.84
Hw Elev (ft) = 7535.27
Hw/D (ft) = 0.40
Flow Regime = Inlet Control



Culvert Report

Proposed Dual 48-inch Culvert - DPB2 (Old Stagecoach Road) (100-year)

Invert Elev Dn (ft) = 7532.00
Pipe Length (ft) = 123.98
Slope (%) = 1.33
Invert Elev Up (ft) = 7533.65
Rise (in) = 48.0
Shape = Circular
Span (in) = 48.0
No. Barrels = 2
n-Value = 0.012
Culvert Type = Circular Concrete
Culvert Entrance = Square edge w/headwall (C)
Coeff. K,M,c,Y,k = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

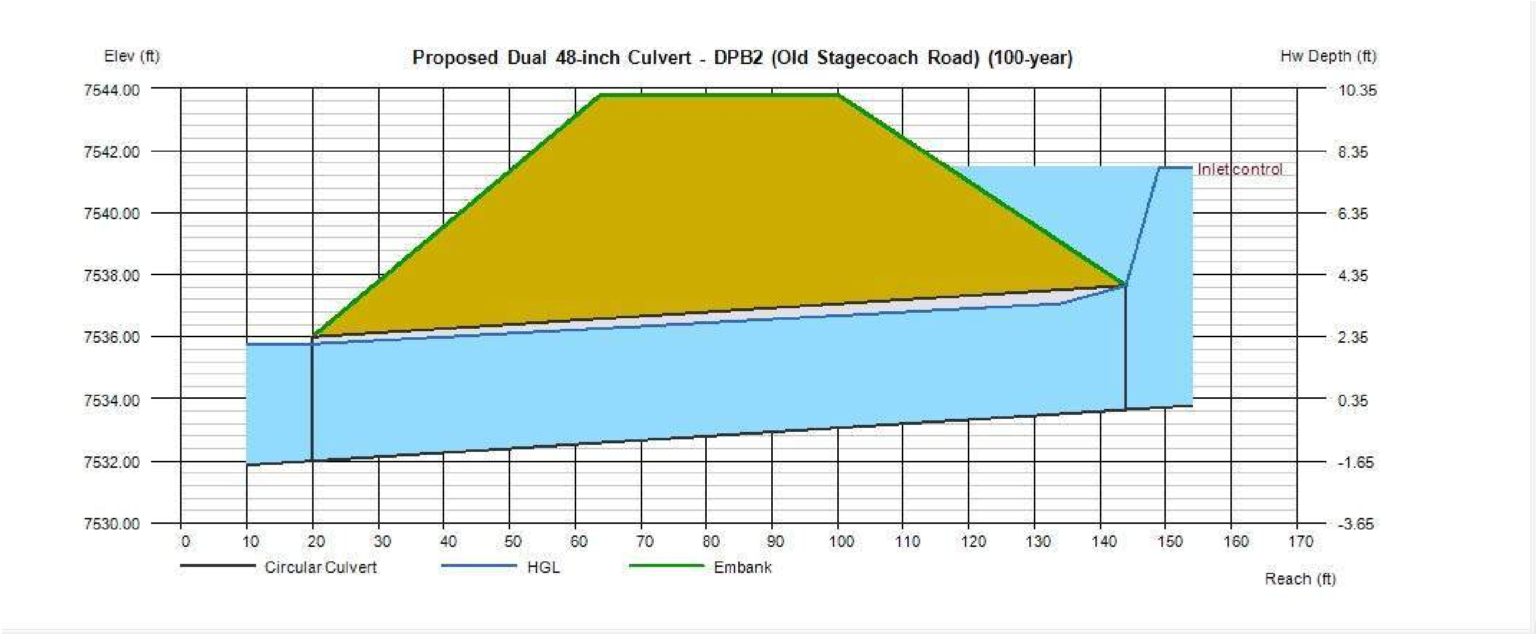
Top Elevation (ft) = 7543.81
Top Width (ft) = 36.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 285.80
Qmax (cfs) = 285.80
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 285.80
Qpipe (cfs) = 285.80
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 11.64
Veloc Up (ft/s) = 12.16
HGL Dn (ft) = 7535.77
HGL Up (ft) = 7537.19
Hw Elev (ft) = 7541.45
Hw/D (ft) = 1.95
Flow Regime = Inlet Control



SWALE CALCULATIONS

APPENDIX D

WATER QUALITY AND DETENTION CALCULATIONS

Flying Horse North Filing No. 4 - Detention Modeling Summary

Pond A Developed Parameters			
Catchment Name/ID	Area (sq.mi.)	Area (ac.)	Percent Imperv.
A1	0.017	10.84	10.2
A2	0.017	10.79	11.0
A3	0.111	71.16	4.1
A4	0.029	18.71	11.0
A5	0.004	2.47	11.0
A6	0.010	6.38	11.0
A7	0.013	8.13	11.0
Total		**128.48**	**7.1**

Peak Storage Volume		Peak Release
(cu-ft)	(ac-ft)	(cfs)
111,834	2.6	160.8

Pre-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
A1	97.1
A2	71.2
G1	10.8
H1	94.0
Total	**273.2**
O_BASIN_H	**267.4**

Post-Development Flow		
Catchment Name/ID	Peak Flow (cfs)	
A1	14.3	
A2	19.6	
A3	101.6	
A4	20.0	
A5	4.7	
A6	11.7	
A7	17.1	
G1	5.7	
G2	7.2	
H1	7.7	
H2	35.0	
H3	66.9	
Total	**311.6**	Direct summation
O_BASIN_H	**248.5**	Less than or equal to historic at same location

Pond B Developed Parameters			
Catchment Name/ID	Area (sq.mi.)	Area (ac.)	Percent Imperv.
B1	0.090	57.78	4.1
B2	0.056	35.77	11.7
B3	0.002	1.10	33.7
Total		**94.65**	**7.3**

Peak Storage Volume		Peak Release
(cu-ft)	(ac-ft)	(cfs)
103,808	2.4	216.7

Pre-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
B1	148.9
B2	75.8
B3	18.8
B4	19.6
Total	**263.0**
O_BASIN_B	**262.7**

Post-Development Flow		
Catchment Name/ID	Peak Flow (cfs)	
B1	182.0	Detained
B2	49.5	Detained
B3	3.0	Detained
B4	15.1	Detained
B5	18.9	Undetained
B6	33.9	Undetained
Total	**302.3**	Direct summation
O_BASIN_B	**262.4**	Less than or equal to historic at same location

Pond C Developed Parameters			
Catchment Name/ID	Area (sq.mi.)	Area (ac.)	Percent Imperv.
C1	0.025	15.94	10.5
C2	0.003	1.98	20.9
C3	0.033	21.39	9.3
Total		**39.31**	**10.4**

Peak Storage Volume		Peak Release
(cu-ft)	(ac-ft)	(cfs)

Pre-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
C1	24.7
C2	39.8
C3	9.7
C4	4.0
Total	**78.2**
O_BASIN_C	**78.0**

Post-Development Flow		
Catchment Name/ID	Peak Flow (cfs)	
C1	27.7	Detained
C2	3.0	Detained
C3	39.0	Detained
C4	10.3	Undetained
C5	4.0	Undetained
Total	**84.1**	Direct summation
O_BASIN_C	**73.2**	Less than or equal to historic at same location

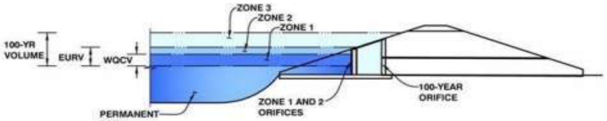
POND B

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **FLYING HORSE NORTH FILING NO. 4**

Basin ID: **POND B**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type = **EDB**
Watershed Area = 105.65 acres
Watershed Length = 3,000 ft
Watershed Length to Centroid = 1,000 ft
Watershed Slope = 0.035 ft/ft
Watershed Imperviousness = 8.25% percent
Percentage Hydrologic Soil Group A = 0.0% percent
Percentage Hydrologic Soil Group B = 100.0% percent
Percentage Hydrologic Soil Groups C/D = 0.0% percent
Target WQCV Drain Time = 40.0 hours
Location for 1-hr Rainfall Depths = User Input

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.50	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.81	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.27	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.93	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	4.61	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	7.66	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	9.71	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	12.69	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	18.09	acre-feet		inches
Approximate 2-yr Detention Volume =	0.50	acre-feet		
Approximate 5-yr Detention Volume =	0.80	acre-feet		
Approximate 10-yr Detention Volume =	1.83	acre-feet		
Approximate 25-yr Detention Volume =	2.63	acre-feet		
Approximate 50-yr Detention Volume =	2.73	acre-feet		
Approximate 100-yr Detention Volume =	3.57	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) = 0.50 acre-feet
Zone 2 Volume (EURV - Zone 1) = 0.31 acre-feet
Zone 3 Volume (User Defined - Zones 1 & 2) = 1.51 acre-feet
Total Detention Basin Volume = 2.32 acre-feet

Total detention volume is less than 100-year volume.

Depth Increment = ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ^{2})	Optional Override Area (ft ^{2})	Area (acre)	Volume (ft ^{3})	Volume (ac-ft)
7526	**Top of Micropool**	--	0.00	--	--	--	10	0.000		
	7526.5	--	0.50	--	--	--	2,138	0.049	537	0.012
	7527.0	--	1.00	--	--	--	7,169	0.165	2,864	0.066
	7527.5	--	1.50	--	--	--	13,715	0.315	8,085	0.186
	7528.0	--	2.00	--	--	--	18,729	0.430	16,196	0.372
	7528.5	--	2.50	--	--	--	23,635	0.543	26,787	0.615
	7529.0	--	3.00	--	--	--	27,602	0.634	39,596	0.909
	7529.5	--	3.50	--	--	--	30,042	0.690	54,007	1.240
	7530.0	--	4.00	--	--	--	32,274	0.741	69,586	1.597
	7530.5	--	4.50	--	--	--	34,626	0.795	86,311	1.981
	7531.0	--	5.00	--	--	--	37,052	0.851	104,230	2.393
	7531.5	--	5.50	--	--	--	39,551	0.908	123,381	2.832
	7532.0	--	6.00	--	--	--	42,125	0.967	143,800	3.301
	7532.5	--	6.50	--	--	--	44,776	1.028	165,525	3.800
	7533.0	--	7.00	--	--	--	47,667	1.094	188,636	4.330
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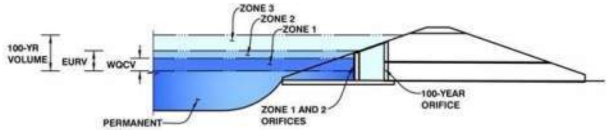
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 4
Basin ID: POND B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.28	0.500	Orifice Plate
Zone 2 (EURV)	2.84	0.307	Circular Orifice
Zone 3 (User)	4.92	1.513	Weir&Pipe (Restrict)
Total (all zones)		2.320	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.28	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.20	inches
Orifice Plate: Orifice Area per Row =	2.19	sq. inches (diameter = 1-5/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.521E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.60					
Orifice Area (sq. inches)	2.19	2.19	2.19					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.28	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.84	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	1.00	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.01	N/A	ft^2
Vertical Orifice Centroid =	0.04	N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.85	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	30.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.85	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.89	N/A	
Overflow Grate Open Area w/o Debris =	104.40	N/A	ft^2
Overflow Grate Open Area w/ Debris =	52.20	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	3.70	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	60.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	50.75		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	17.71	N/A	ft^2
Outlet Orifice Centroid =	2.28	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.33	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.10	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	100.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.86	feet
Stage at Top of Freeboard =	6.96	feet
Basin Area at Top of Freeboard =	1.09	acres
Basin Volume at Top of Freeboard =	4.29	acre-ft

Routed Hydrograph Results

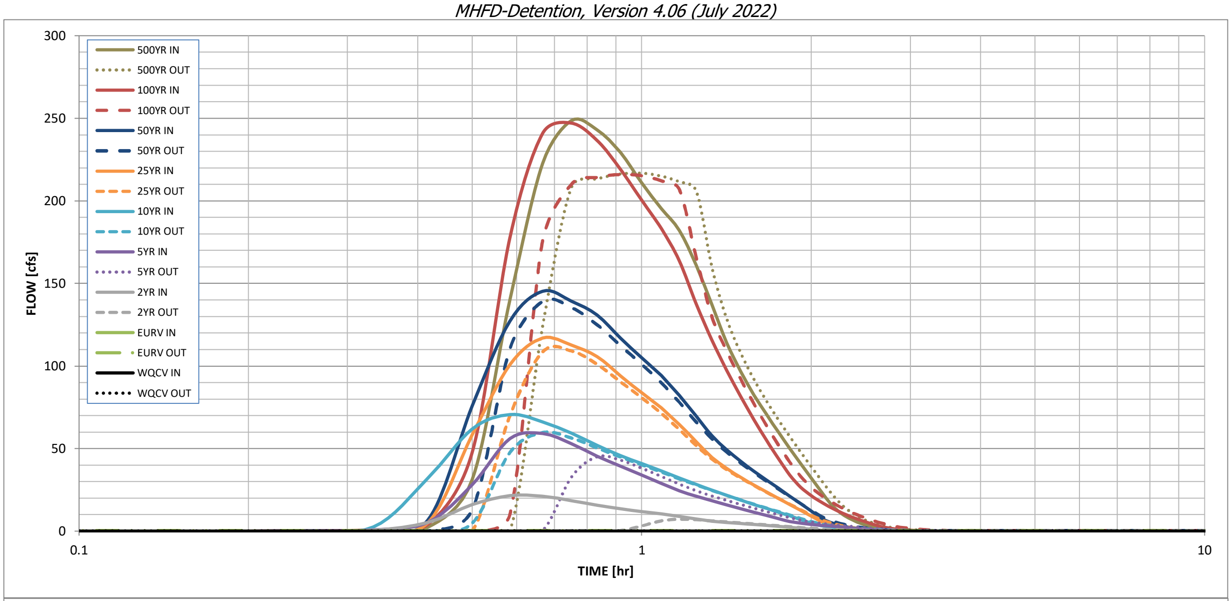
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

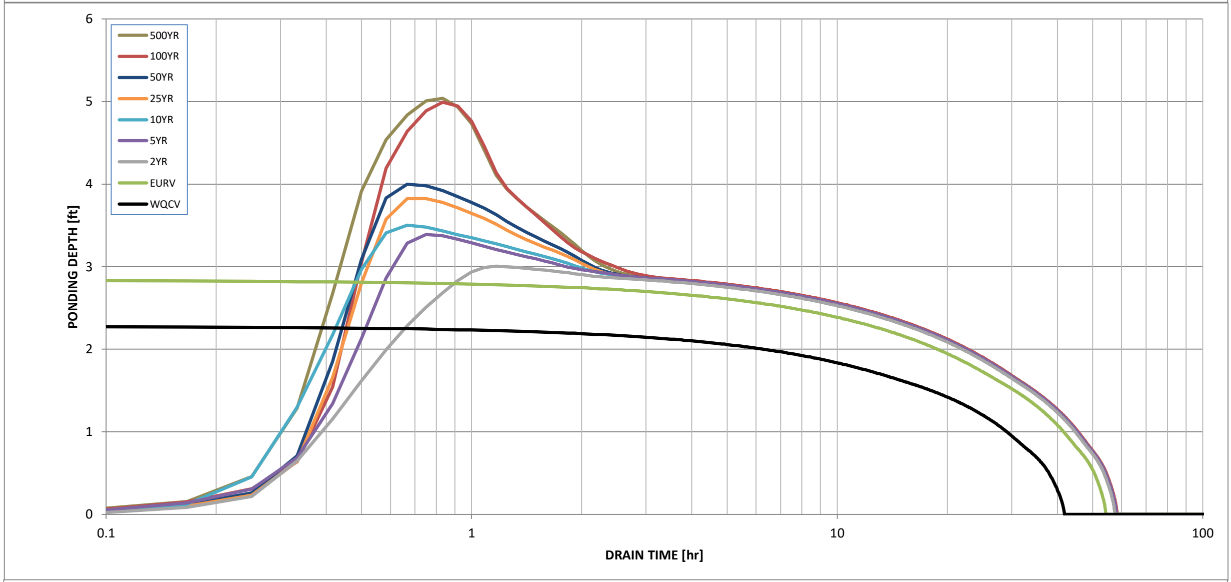
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.500	0.807	1.270	2.932	4.609	7.657	9.710	12.690	18.086
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.270	3.472	4.609	7.657	9.710	17.082	18.086
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	14.9	41.7	63.1	109.6	138.0	172.8	240.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						216.0	
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.39	0.60	1.04	1.31	2.04	2.28
Peak Inflow Q (cfs) =	N/A	N/A	21.5	59.1	70.7	116.9	145.3	247.1	248.6
Peak Outflow Q (cfs) =	0.3	0.3	7.2	45.1	59.7	109.1	139.2	216.0	216.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	0.9	1.0	1.0	1.0	0.9
Structure Controlling Flow =	Plate	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	0.06	0.4	0.6	1.0	1.3	2.1	2.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	48	48	41	38	31	27	16	14
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	54	50	48	44	42	36	35
Maximum Ponding Depth (ft) =	2.28	2.84	3.00	3.39	3.50	3.83	4.00	4.99	5.04
Area at Maximum Ponding Depth (acres) =	0.49	0.60	0.63	0.68	0.69	0.72	0.74	0.85	0.85
Maximum Volume Stored (acre-ft) =	0.50	0.81	0.91	1.16	1.24	1.47	1.59	2.38	2.42
Elevation (ft) =	7528.28	7528.84						7530.99	
Pond Bottom (ft) =	7526.00								

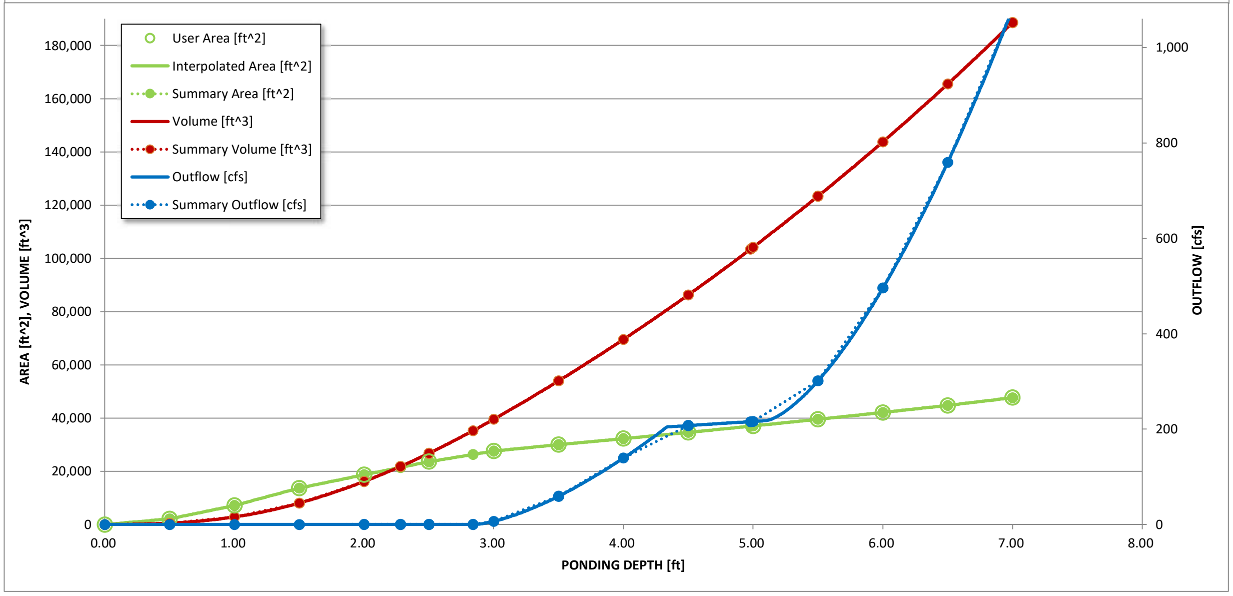
SWMM volume 103,808

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.03	0.05
	0:15:00	0.00	0.00	0.13	0.29	0.25	0.17	0.22	0.32	0.32
	0:20:00	0.00	0.00	0.50	0.84	2.56	0.51	0.61	0.81	2.42
	0:25:00	0.00	0.00	5.28	5.28	32.00	5.01	6.58	4.04	31.16
	0:30:00	0.00	0.00	16.15	28.18	61.85	58.31	75.74	47.72	140.12
	0:35:00	0.00	0.00	21.48	55.99	70.65	100.78	127.30	177.86	222.60
	0:40:00	0.00	0.00	21.19	59.11	66.12	116.93	145.33	240.83	248.61
	0:45:00	0.00	0.00	18.41	52.91	59.32	112.63	139.24	247.06	242.92
	0:50:00	0.00	0.00	15.77	45.39	51.88	105.76	130.83	236.61	229.34
	0:55:00	0.00	0.00	13.51	39.31	45.74	94.10	116.93	219.08	210.73
	1:00:00	0.00	0.00	11.89	33.91	40.89	83.71	104.89	200.33	195.31
	1:05:00	0.00	0.00	10.45	28.93	36.47	74.57	94.22	183.22	182.16
	1:10:00	0.00	0.00	8.87	24.45	32.13	64.62	82.26	163.76	160.97
	1:15:00	0.00	0.00	7.27	21.11	28.23	54.18	69.62	137.51	137.05
	1:20:00	0.00	0.00	6.00	18.47	24.80	44.69	57.74	115.66	114.12
	1:25:00	0.00	0.00	5.21	15.99	21.68	37.99	49.23	97.45	96.67
	1:30:00	0.00	0.00	4.56	13.64	18.77	32.53	42.20	81.53	82.47
	1:35:00	0.00	0.00	3.98	11.47	16.17	27.90	36.24	67.41	70.56
	1:40:00	0.00	0.00	3.40	9.51	13.77	23.69	30.82	54.87	59.85
	1:45:00	0.00	0.00	2.83	7.57	11.49	19.86	25.89	43.86	50.04
	1:50:00	0.00	0.00	2.28	5.83	9.29	16.17	21.17	33.94	40.82
	1:55:00	0.00	0.00	1.71	4.79	7.07	12.63	16.64	26.61	32.21
	2:00:00	0.00	0.00	1.15	4.12	4.87	9.19	12.28	21.52	24.12
	2:05:00	0.00	0.00	0.67	3.56	3.31	5.81	7.96	17.61	16.50
	2:10:00	0.00	0.00	0.42	3.01	2.45	3.59	5.15	14.31	11.29
	2:15:00	0.00	0.00	0.30	2.51	1.89	2.28	3.44	11.60	7.89
	2:20:00	0.00	0.00	0.23	2.04	1.47	1.48	2.35	9.28	5.46
	2:25:00	0.00	0.00	0.18	1.60	1.14	0.95	1.58	7.30	3.68
	2:30:00	0.00	0.00	0.13	1.18	0.86	0.62	1.08	5.61	2.39
	2:35:00	0.00	0.00	0.10	0.81	0.63	0.40	0.71	4.07	1.45
	2:40:00	0.00	0.00	0.07	0.55	0.45	0.25	0.46	2.75	0.84
	2:45:00	0.00	0.00	0.06	0.40	0.31	0.17	0.31	1.87	0.55
	2:50:00	0.00	0.00	0.05	0.31	0.21	0.12	0.22	1.28	0.38
	2:55:00	0.00	0.00	0.04	0.24	0.15	0.09	0.17	0.88	0.30
	3:00:00	0.00	0.00	0.03	0.19	0.11	0.06	0.13	0.58	0.24
	3:05:00	0.00	0.00	0.02	0.15	0.08	0.05	0.09	0.37	0.18
	3:10:00	0.00	0.00	0.01	0.12	0.06	0.03	0.07	0.23	0.13
	3:15:00	0.00	0.00	0.01	0.09	0.03	0.02	0.05	0.15	0.09
	3:20:00	0.00	0.00	0.01	0.07	0.02	0.01	0.03	0.11	0.05
	3:25:00	0.00	0.00	0.00	0.05	0.01	0.01	0.02	0.08	0.03
	3:30:00	0.00	0.00	0.00	0.04	0.00	0.00	0.01	0.07	0.01
	3:35:00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.05	0.00
	3:40:00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.04	0.00
	3:45:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.00
	3:50:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	10	0.000	0	0.000	0.00
	0.50	2,138	0.049	537	0.012	0.05
	1.00	7,169	0.165	2,864	0.066	0.11
	1.50	13,715	0.315	8,085	0.186	0.15
	2.00	18,729	0.430	16,196	0.372	0.23
	2.28	21,476	0.493	21,824	0.501	0.26
	2.50	23,635	0.543	26,787	0.615	0.29
	2.84	26,333	0.605	35,281	0.810	0.33
	3.00	27,602	0.634	39,596	0.909	6.89
	3.50	30,042	0.690	54,007	1.240	59.48
	4.00	32,274	0.741	69,586	1.597	139.49
	4.50	34,626	0.795	86,311	1.981	207.54
	4.98	36,955	0.848	103,490	2.376	215.79
	5.00	37,052	0.851	104,230	2.393	216.13
	5.50	39,551	0.908	123,381	2.832	301.25
	6.00	42,125	0.967	143,800	3.301	495.87
	6.50	44,776	1.028	165,525	3.800	759.26
	7.00	47,667	1.094	188,636	4.330	1,080.97

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Area [ft^2]	Stage Area	Total Outflow [cfs]	Stage Release
10	0 10	0.00	0 0
2,138	0.5 2138.28	0.05	0.5 0.05
7,169	1 7169.09	0.11	1 0.11
13,715	1.5 13715.31	0.15	1.5 0.15
18,729	2 18728.56	0.23	2 0.23
21,476	2.28 21475.96	0.26	2.28 0.26
23,635	2.5 23634.63	0.29	2.5 0.29
26,333	2.84 26332.66	0.33	2.84 0.33
27,602	3 27602.32	6.89	3 6.89
30,042	3.5 30042.07	59.48	3.5 59.48
32,274	4 32273.85	139.49	4 139.49
34,626	4.5 34626.01	207.54	4.5 207.54
36,955	4.98 36954.82	215.79	4.98 215.79
37,052	5 37051.85	216.13	5 216.13
39,551	5.5 39551.39	301.25	5.5 301.25
42,125	6 42124.62	495.87	6 495.87
44,776	6.5 44775.53	759.26	6.5 759.26
47,667	7 47666.69	1,080.97	7 1080.97

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: **RICHARD LYON, PE**
Company: **HR GREEN**
Date: **August 19, 2024**
Project: **FLYING HORSE NORTH - FILING NO. 4**
Location: **POND B**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 7.5 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.075
C) Contributing Watershed Area	Area = 109.200 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ● Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= 0.475 ac-ft
I) NRCS Hydrologic Soil Groups of Tributary Watershed	
i) Percentage of Watershed consisting of Type A Soils	HSG_A = 0 %
ii) Percentage of Watershed consisting of Type B Soils	HSG_B = 100 %
iii) Percentage of Watershed consisting of Type C/D Soils	$HSG_{C/D}$ = 0 %
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ = ac-f t
K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)	$EURV_{DESIGN\ USER}$= 0.752 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	
5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.014 ac-ft
B) Actual Forebay Volume	V_F = 0.014 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 18.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 187.60 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 3.75 cfs
E) Forebay Discharge Design	Choose One ○ Berm With Pipe ● Wall with Rect. Notch ○ Wall with V-Notch Weir **Flow too small for berm w/ pipe**
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 11.0 in

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 2 of 3

Designer: RICHARD LYON, PE
Company: HR GREEN
Date: August 19, 2024
Project: FLYING HORSE NORTH - FILING NO. 4
Location: POND B

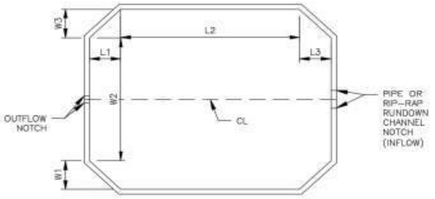
6. Trickle Channel	
A) Type of Trickle Channel	Choose One ● Concrete ○ Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 10 sq ft
C) Outlet Type	Choose One ● Orifice Plate ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = inches
E) Total Outlet Area	A_{ot} = square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 62 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = inches

HR GREEN FOREBAY SIZING

PROJECT: **FLYING HORSE NORTH FILING 4**
DATE: **8/19/2024**
DESIGNED BY: **RDL**
CHECKED BY: **RDL**
POND OR DP: **POND B**

	INNER DIMENSIONS			OUTER DIMENSIONS	
LENGTH					
L1	5	FT		5.83	FT
L2	22.333	FT		23.166	FT
L3	5	FT		5.83	FT
INNER L	32.333	FT	OUTER TOTAL L	33.999	FT
WIDTH					
W1	5	FT		5.83	FT
W2	16.74975	FT (75% of L2)		17.58	FT
W3	5	FT		5.83	FT
INNER W	26.750	FT	OUTER TOTAL W	28.416	FT

BAFFLE (6'x0.83' + 4'x0.83')
AREA 8.33 SF

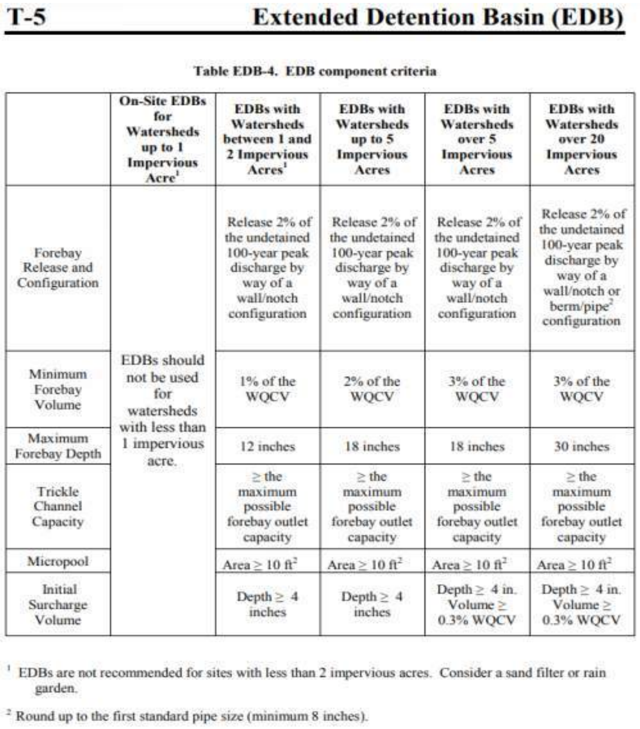


TRIANGLES	50	
RECTANGLE	374.0721668	
BAFFLE	8.33	
TOTAL SURFACE AREA	**415.7421668**	**SQ FT**
FOREBAY HT.	**1.5**	**FT**

FOREBAY VOLUME	**623.6132501**	**CF**
	23.09678704	**CY**
	0.01431619	**AC-FT**

SUFFICIENT VOLUME?	**YES**

REQ'D VOL (3% WQCV)	0.01425	AC-FT
(per UD-BMP calc)	620.73	CF
Notch Width per UD-BMP	11.0	in



T-5 **Extended Detention Basin (EDB)**

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre[1]	EDBs with Watersheds between 1 and 2 Impervious Acres[1]	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration	EDBs should not be used for watersheds with less than 1 impervious acre.	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe[2] configuration
Minimum Forebay Volume		1% of the WQCV	2% of the WQCV	3% of the WQCV	3% of the WQCV
Maximum Forebay Depth		12 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity		≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity
Micropool		Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2
Initial Surcharge Volume		Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

[1] EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

[2] Round up to the first standard pipe size (minimum 8 inches).

Worksheet for Pond B Spillway

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	247.10 cfs
Crest Elevation	7,531.10 ft
Tailwater Elevation	7,522.00 ft
Crest Surface Type	Gravel
Crest Breadth	75.00 ft
Crest Length	100.0 ft

Results

Headwater Elevation	7,532.02 ft
Headwater Height Above Crest	0.92 ft
Tailwater Height Above Crest	-9.10 ft
Weir Coefficient	2.81 ft^(1/2)/s
Submergence Factor	1.000
Adjusted Weir Coefficient	2.81 ft^(1/2)/s
Flow Area	91.8 ft²
Velocity	2.69 ft/s
Wetted Perimeter	101.8 ft
Top Width	100.00 ft

APPENDIX F

DRAINAGE MAPS

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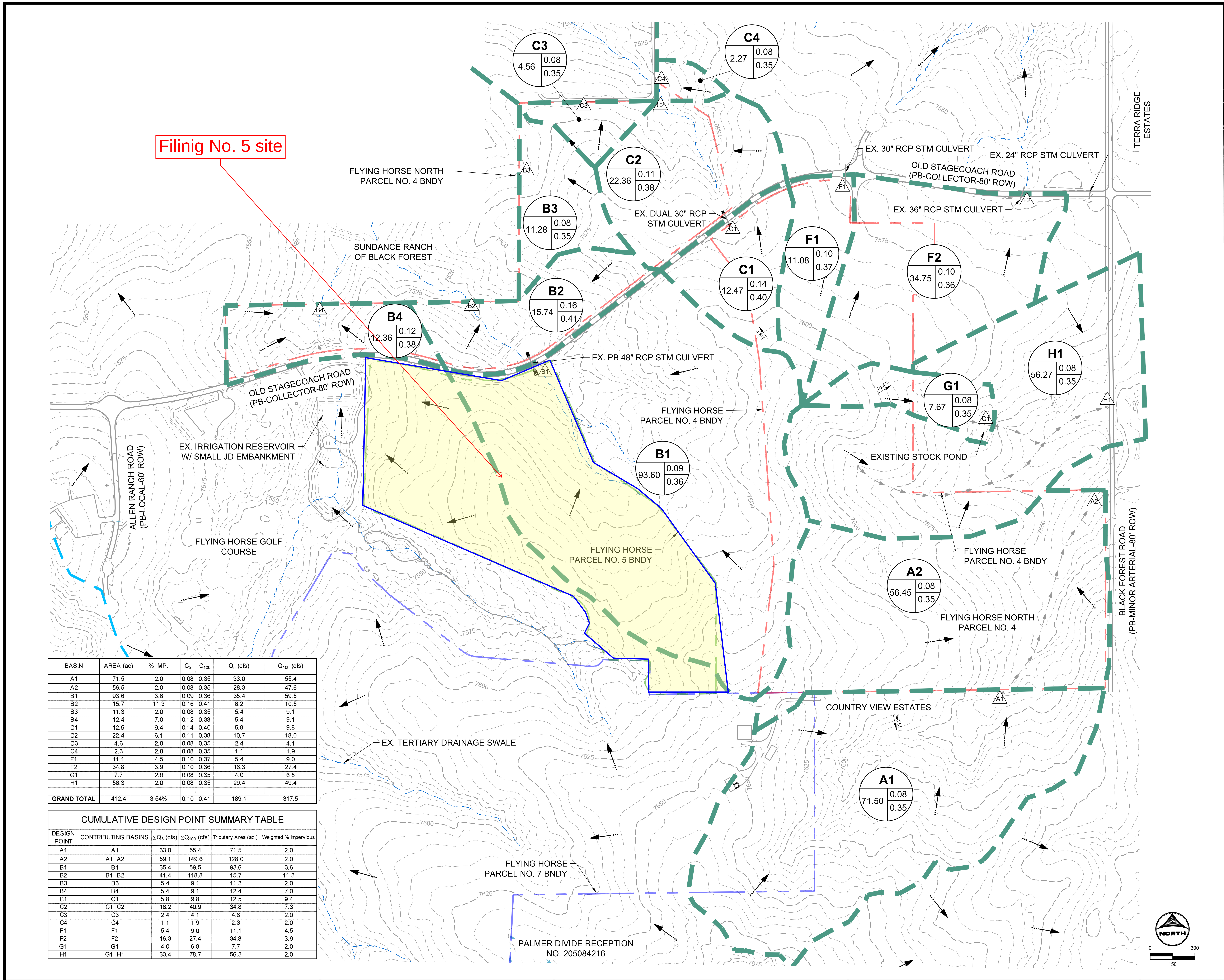


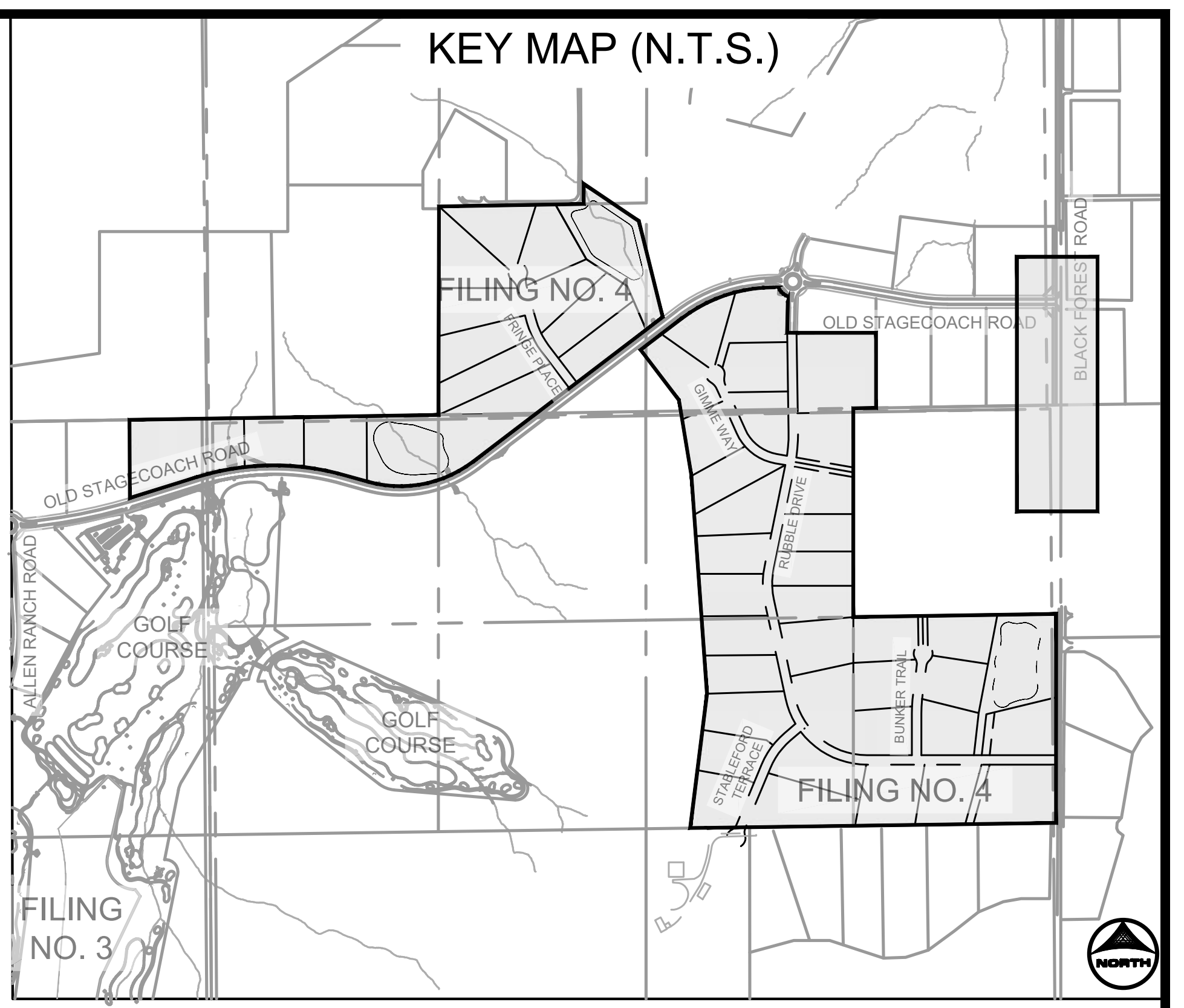
C3 4.56 0.08 0.35
C4 2.27 0.08 0.35
C2 22.36 0.11 0.38
B3 11.28 0.08 0.35
B2 15.74 0.16 0.41
B4 12.36 0.12 0.38
C1 12.47 0.14 0.40
F1 11.08 0.10 0.37
F2 34.75 0.10 0.36
G1 7.67 0.08 0.35
H1 56.27 0.08 0.35
B1 93.60 0.09 0.36
A2 56.45 0.08 0.35
A1 71.50 0.08 0.35
Filinig No. 5 site
FLYING HORSE NORTH PARCEL NO. 4 BNDY
SUNDANCE RANCH OF BLACK FOREST
EX. DUAL 30" RCP STM CULVERT
EX. 30" RCP STM CULVERT
EX. 24" RCP STM CULVERT
OLD STAGECOACH ROAD (PB-COLLECTOR-80' ROW)
EX. 36" RCP STM CULVERT
TERRA RIDGE ESTATES
EX. PB 48" RCP STM CULVERT
FLYING HORSE PARCEL NO. 4 BNDY
ALLEN RANCH ROAD (PB-LOCAL-60' ROW)
EX. IRRIGATION RESERVOIR W/ SMALL JD EMBANKMENT
EXISTING STOCK POND
FLYING HORSE GOLF COURSE
FLYING HORSE PARCEL NO. 5 BNDY
FLYING HORSE PARCEL NO. 4 BNDY
FLYING HORSE NORTH PARCEL NO. 4
BLACK FOREST ROAD (PB-MINOR ARTERIAL-80' ROW)
COUNTRY VIEW ESTATES
EX. TERTIARY DRAINAGE SWALE
FLYING HORSE PARCEL NO. 7 BNDY
PALMER DIVIDE RECEPTION NO. 205084216
NORTH
0 150 300

BASIN	AREA (ac)	% IMP.	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
A1	71.5	2.0	0.08	0.35	33.0	55.4
A2	56.5	2.0	0.08	0.35	28.3	47.6
B1	93.6	3.6	0.09	0.36	35.4	59.5
B2	15.7	11.3	0.16	0.41	6.2	10.5
B3	11.3	2.0	0.08	0.35	5.4	9.1
B4	12.4	7.0	0.12	0.38	5.4	9.1
C1	12.5	9.4	0.14	0.40	5.8	9.8
C2	22.4	6.1	0.11	0.38	10.7	18.0
C3	4.6	2.0	0.08	0.35	2.4	4.1
C4	2.3	2.0	0.08	0.35	1.1	1.9
F1	11.1	4.5	0.10	0.37	5.4	9.0
F2	34.8	3.9	0.10	0.36	16.3	27.4
G1	7.7	2.0	0.08	0.35	4.0	6.8
H1	56.3	2.0	0.08	0.35	29.4	49.4
GRAND TOTAL	412.4	3.54%	0.10	0.41	189.1	317.5

CUMULATIVE DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)	Tributary Area (ac.)	Weighted % Impervious
A1	A1	33.0	55.4	71.5	2.0
A2	A1, A2	59.1	149.6	128.0	2.0
B1	B1	35.4	59.5	93.6	3.6
B2	B1, B2	41.4	118.8	15.7	11.3
B3	B3	5.4	9.1	11.3	2.0
B4	B4	5.4	9.1	12.4	7.0
C1	C1	5.8	9.8	12.5	9.4
C2	C1, C2	16.2	40.9	34.8	7.3
C3	C3	2.4	4.1	4.6	2.0
C4	C4	1.1	1.9	2.3	2.0
F1	F1	5.4	9.0	11.1	4.5
F2	F2	16.3	27.4	34.8	3.9
G1	G1	4.0	6.8	7.7	2.0
H1	G1, H1	33.4	78.7	56.3	2.0

KEY MAP (N.T.S.)



LEGEND:

PROPOSED MAJOR CONTOUR	5250
PROPOSED MINOR CONTOUR	
EXISTING MAJOR CONTOUR	5250
EXISTING MINOR CONTOUR	
PROPOSED STORM SEWER	
EXISTING STORM SEWER	
EXISTING DRAINAGE SWALE	
PROPOSED DRAINAGE SWALE	
EXISTING TERTIARY DRAINAGE WAY	
PARCEL BOUNDARY	
FLOW DIRECTION	←
DRAINAGE BASIN	
DESIGN POINT	△ X
BASIN LABEL	

BASIN DESIGNATION
A1
AREA (AC.) 1.00
MINOR 5-YR RUNOFF COEF. 0.40
MAJOR 100-YR RUNOFF COEF. 0.60

ECM LARGE LOT EXCLUSION (I.7.1.B.5)	🟪

HR GREEN Xrefs: Parcel_Boundary; xv-row-1030; xv-util-1030; xv-dsgn-1030; Legend_FDR_Map_Filing4; key_map; xgt-1-dh01-1030.240

PCD FILE NO.: SF2422

DRAWN BY: TMM
APPROVED: RHL
CAD DATE: 9/5/2024
CAD FILE: J:\2021\211030\CAD\Dwgs\C\Drainage\FDR Filing 4\FHN_FH4_EX
JOB DATE: 11/1/2024
JOB NUMBER: 210742.24

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
HR GREEN - COLORADO SPRINGS
1975 RESEARCH PARKWAY SUITE 160
COLORADO SPRINGS, CO 80920
PHONE: 719.300.4140
FAX: 713.965.0044

FLYING HORSE NORTH FILING 4
PRI #2, LLC.
EL PASO COUNTY, CO

FINAL DRAINAGE REPORT
EXISTING CONDITIONS DRAINAGE MAP

SHEET
DR1
1

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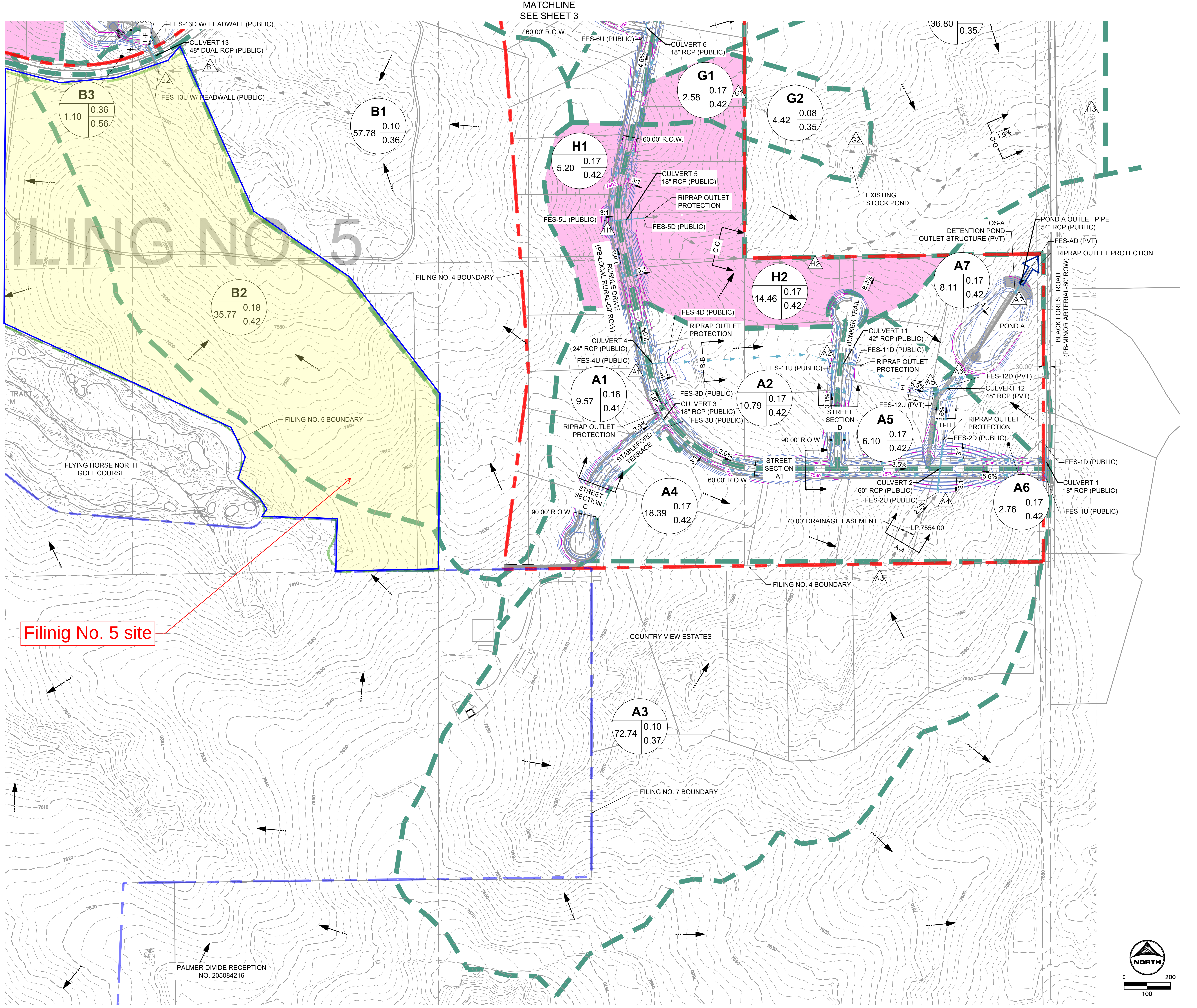

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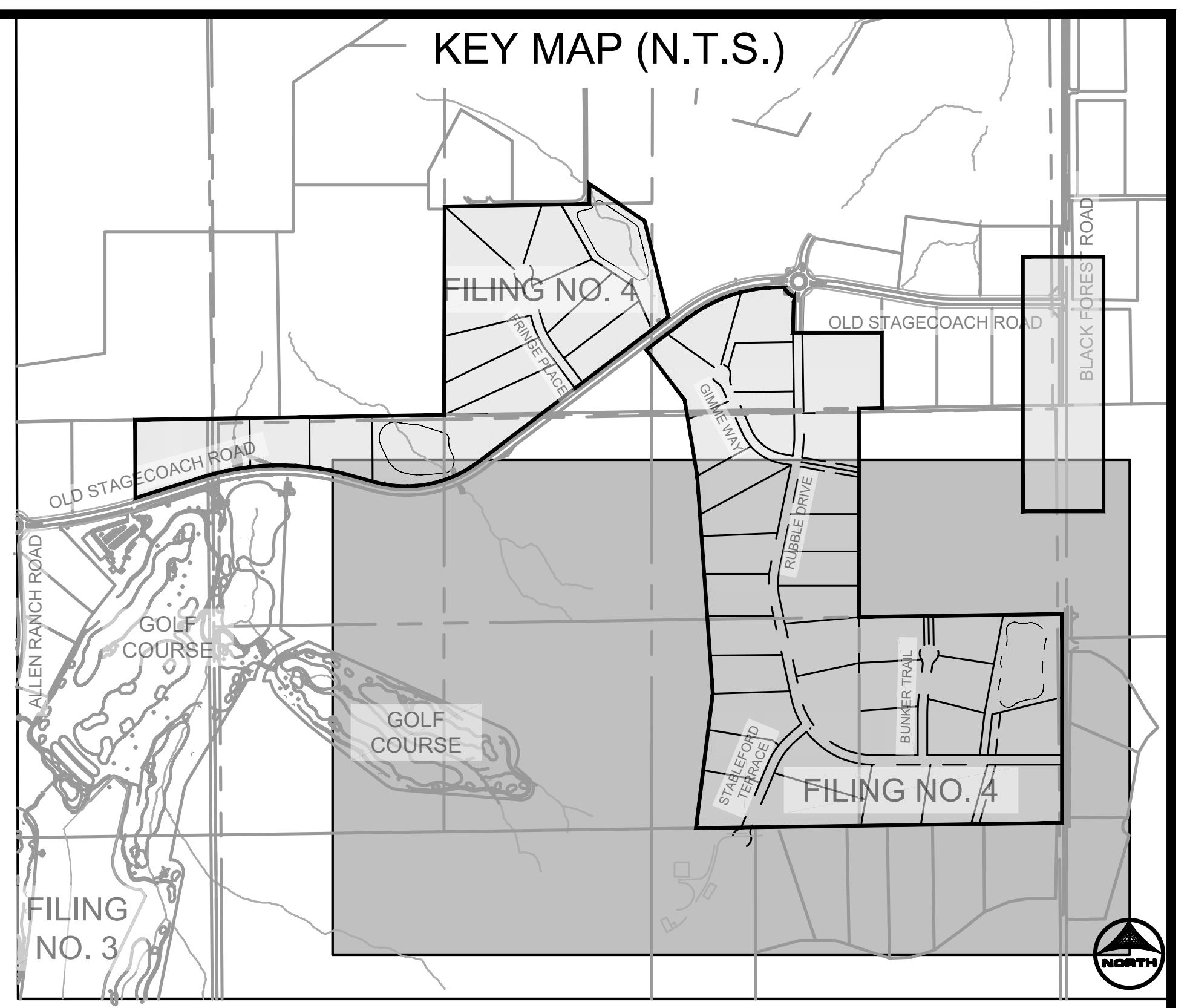

LEGEND:

PROPOSED MAJOR CONTOUR	5250
PROPOSED MINOR CONTOUR	
EXISTING MAJOR CONTOUR	5250
EXISTING MINOR CONTOUR	
PROPOSED STORM SEWER	
EXISTING STORM SEWER	
EXISTING DRAINAGE SWALE	
PROPOSED DRAINAGE SWALE	
EXISTING TERTIARY DRAINAGE WAY	
PARCEL BOUNDARY	
FLOW DIRECTION	←
DRAINAGE BASIN	
DESIGN POINT	X
BASIN LABEL	

BASIN DESIGNATION: A1
AREA (AC.): 1.00
MINOR 5-YR RUNOFF COEF.: 0.40
MAJOR 100-YR RUNOFF COEF.: 0.60

ECM LARGE LOT EXCLUSION (I.7.1.B.5) 🟪

PCD FILE NO.: SF2422

DRAWN BY: TMM	JOB DATE: 11/1/2024		
APPROVED: RHL	JOB NUMBER: 210742.24		
CAD DATE: 9/5/2024			
CAD FILE: J:\2021\211030\CAD\Dwgs\C\Drainage\FDR Filing 4\FHN_FN4_FDR			

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

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HRGreen
HR GREEN - COLORADO SPRINGS
1975 RESEARCH PARKWAY SUITE 160
COLORADO SPRINGS, CO 80920
PHONE: 719.300.4140
FAX: 713.965.0044

FLYING HORSE NORTH FILING 4
PRI #2, LLC.
EL PASO COUNTY, CO

FINAL DRAINAGE REPORT
DEVELOPED CONDITIONS DRAINAGE MAP

SHEET
DR2

2

HR GREEN Xrefs: xv–util–1030; xv–dsgn–1030; xv–row–1030; xc–row–030.240; Legend_FDR_Map_Filing4; key_map; xc–dsgn–240; XC–BASIN; xgt–1–dh01–1030.240

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HR GREEN Xrefs: xv-util-1030; xv-dsgn-1030; xv-row-1030; xc-row-030.240; Legend_FDR_Map_Filing4; key_map; xc-dsgn-240; XC-BASIN; xgt-1-dh01-1030.240

SUMMARY RUNOFF TABLE

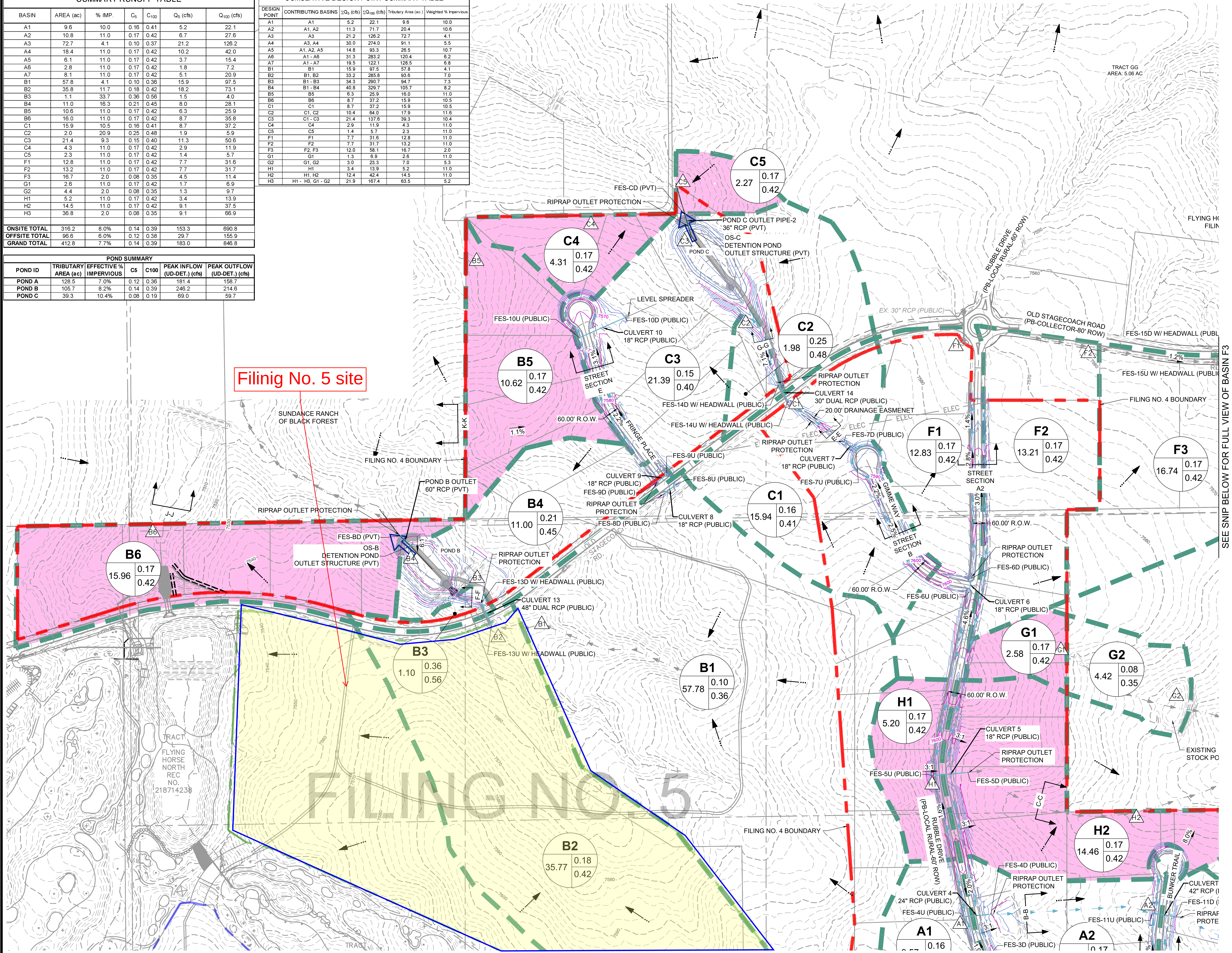
BASIN	AREA (ac)	% IMP.	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
A1	9.6	10.0	0.16	0.41	5.2	22.1
A2	10.8	11.0	0.17	0.42	6.7	27.6
A3	72.7	4.1	0.10	0.37	21.2	126.2
A4	18.4	11.0	0.17	0.42	10.2	42.0
A5	6.1	11.0	0.17	0.42	3.7	15.4
A6	2.8	11.0	0.17	0.42	1.8	7.2
A7	8.1	11.0	0.17	0.42	5.1	20.9
B1	57.8	4.1	0.10	0.36	15.9	97.5
B2	35.8	11.7	0.18	0.42	18.2	73.1
B3	1.1	33.7	0.36	0.56	1.5	4.0
B4	11.0	16.3	0.21	0.45	8.0	28.1
B5	10.6	11.0	0.17	0.42	6.3	25.9
B6	16.0	11.0	0.17	0.42	8.7	35.8
C1	15.9	10.5	0.16	0.41	8.7	37.2
C2	2.0	20.9	0.25	0.48	1.9	5.9
C3	21.4	9.3	0.15	0.40	11.3	50.6
C4	4.3	11.0	0.17	0.42	2.9	11.9
C5	2.3	11.0	0.17	0.42	1.4	5.7
F1	12.8	11.0	0.17	0.42	7.7	31.6
F2	13.2	11.0	0.17	0.42	7.7	31.7
F3	16.7	2.0	0.08	0.35	4.5	11.4
G1	2.6	11.0	0.17	0.42	1.7	6.9
G2	4.4	2.0	0.08	0.35	1.3	9.7
H1	5.2	11.0	0.17	0.42	3.4	13.9
H2	14.5	11.0	0.17	0.42	9.1	37.5
H3	36.8	2.0	0.08	0.35	9.1	66.9
ONSITE TOTAL	316.2	8.0%	0.14	0.39	153.3	690.8
OFFSITE TOTAL	96.6	6.0%	0.12	0.38	29.7	155.9
GRAND TOTAL	412.8	7.7%	0.14	0.39	183.0	846.8

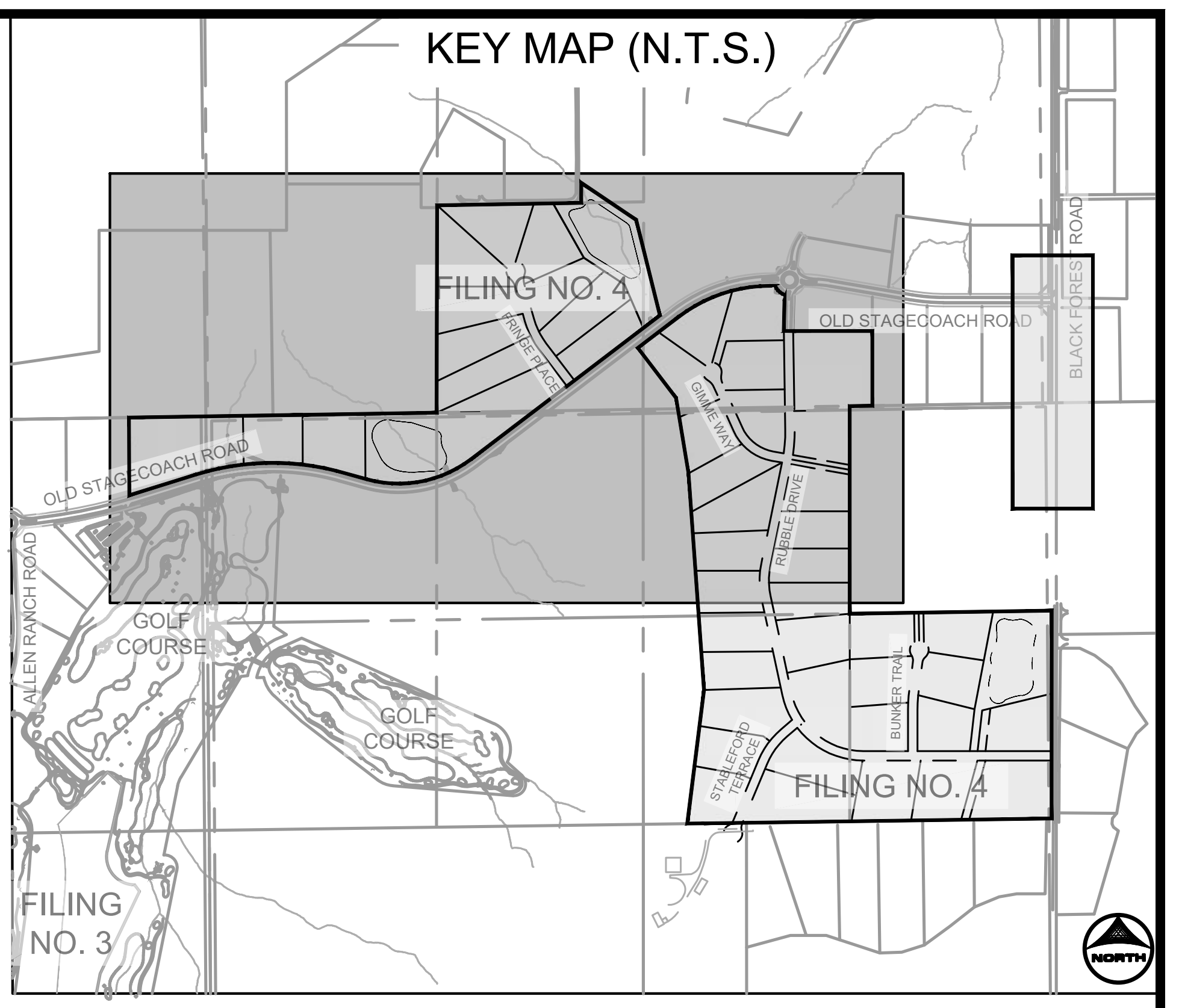
POND SUMMARY

POND ID	TRIBUTARY AREA (ac)	EFFECTIVE % IMPERVIOUS	C5	C100	PEAK INFLOW (UD-DET.) (cfs)	PEAK OUTFLOW (UD-DET.) (cfs)
POND A	128.5	7.0%	0.12	0.36	181.4	158.7
POND B	105.7	8.2%	0.14	0.39	246.2	214.6
POND C	39.3	10.4%	0.08	0.19	69.0	59.7

CUMULATIVE DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)	Tributary Area (ac.)	Weighted % Impervious
A1	A1	5.2	22.1	9.6	10.0
A2	A1, A2	11.3	71.7	20.4	10.6
A3	A3	21.2	126.2	72.7	4.1
A4	A3, A4	30.0	274.0	91.1	5.5
A5	A1, A2, A5	14.8	93.3	26.5	10.7
A6	A1 - A6	31.3	283.2	120.4	6.2
A7	A1 - A7	19.5	122.1	128.5	6.8
B1	B1	15.9	97.5	57.8	4.1
B2	B1, B2	33.2	285.8	93.6	7.0
B3	B1 - B3	34.3	290.7	94.7	7.3
B4	B1 - B4	40.8	329.7	105.7	8.2
B5	B5	6.3	25.9	16.0	11.0
B6	B6	8.7	37.2	15.9	10.5
C1	C1	8.7	37.2	15.9	10.5
C2	C1, C2	10.4	64.0	17.9	11.6
C3	C1 - C3	21.4	137.6	39.3	10.4
C4	C4	2.9	11.9	4.3	11.0
C5	C5	1.4	5.7	2.3	11.0
F1	F1	7.7	31.6	12.8	11.0
F2	F2	7.7	31.7	13.2	11.0
F3	F2, F3	12.0	58.1	16.7	2.0
G1	G1	1.3	6.9	2.6	11.0
G2	G1, G2	3.0	23.3	7.0	5.3
H1	H1	3.4	13.9	5.2	11.0
H2	H1, H2	12.4	42.4	14.5	11.0
H3	H1 - H3, G1 - G2	21.9	167.4	63.5	5.2

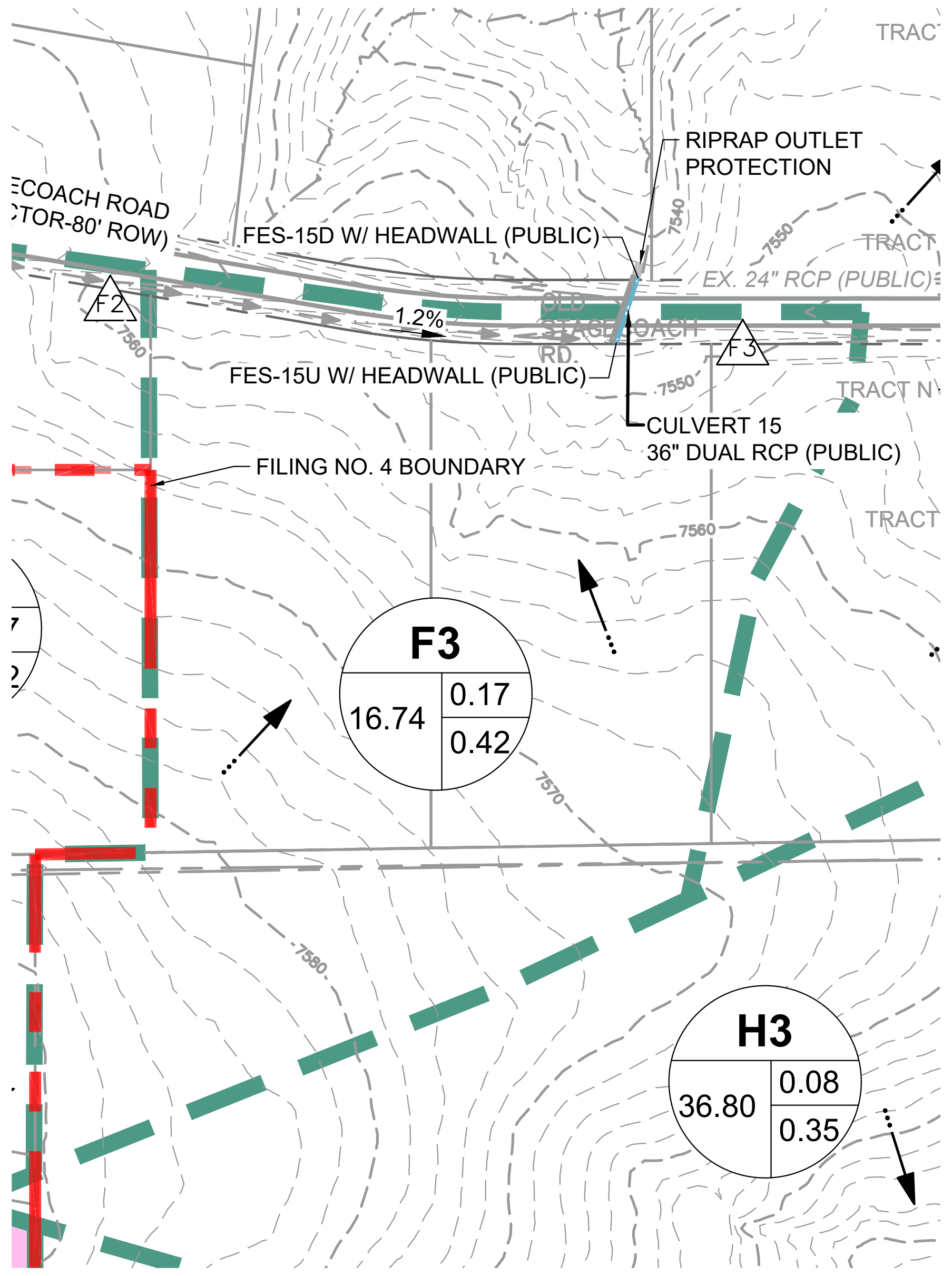




LEGEND:

PROPOSED MAJOR CONTOUR	5250
PROPOSED MINOR CONTOUR	
EXISTING MAJOR CONTOUR	5250
EXISTING MINOR CONTOUR	
PROPOSED STORM SEWER	
EXISTING STORM SEWER	
EXISTING DRAINAGE SWALE	
PROPOSED DRAINAGE SWALE	
EXISTING TERTIARY DRAINAGE WAY	
PARCEL BOUNDARY	
FLOW DIRECTION	←
DRAINAGE BASIN	
DESIGN POINT	△ X
BASIN LABEL	
ECM LARGE LOT EXCLUSION (I.7.1.B.5)	🟪

A1		BASIN DESIGNATION
AREA (AC.)	1.00	
	0.40	MINOR 5-YR RUNOFF COEF.
	0.60	MAJOR 100-YR RUNOFF COEF.


RIPRAP OUTLET PROTECTION
OLD STAGECOACH ROAD (PB-COLLECTOR-80' ROW)
FES-15D W/ HEADWALL (PUBLIC)
EX. 24" RCP (PUBLIC)
FES-15U W/ HEADWALL (PUBLIC)
CULVERT 15 36" DUAL RCP (PUBLIC)
FILING NO. 4 BOUNDARY
F3 16.74 0.17 0.42
H3 36.80 0.08 0.35
TRACT

NORTH

0 100 200

MATCHLINE
SEE SHEET 2

PCD FILE NO.: SF2422

DRAWN BY: TMM
APPROVED: RHL
CAD DATE: 9/5/2024
CAD FILE: J:\2021\211030\CAD\Dwgs\C\Drainage\FDR Filing 4\FHN_FN4_FDR

JOB DATE: 11/1/2024
JOB NUMBER: 210742.24

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen

HR GREEN - COLORADO SPRINGS
1975 RESEARCH PARKWAY SUITE 160
COLORADO SPRINGS, CO 80920
PHONE: 719.300.4140
FAX: 713.965.0044

FLYING HORSE NORTH FILING 4
PRI #2, LLC.
EL PASO COUNTY, CO

FINAL DRAINAGE REPORT
DEVELOPED CONDITIONS DRAINAGE MAP

SHEET
DR3

3

FLYING HORSE NORTH

IRRIGATION RESERVOIR EMBANKMENT

DESIGN REPORT

DAMID: 080459
Construction File No.: C-2085

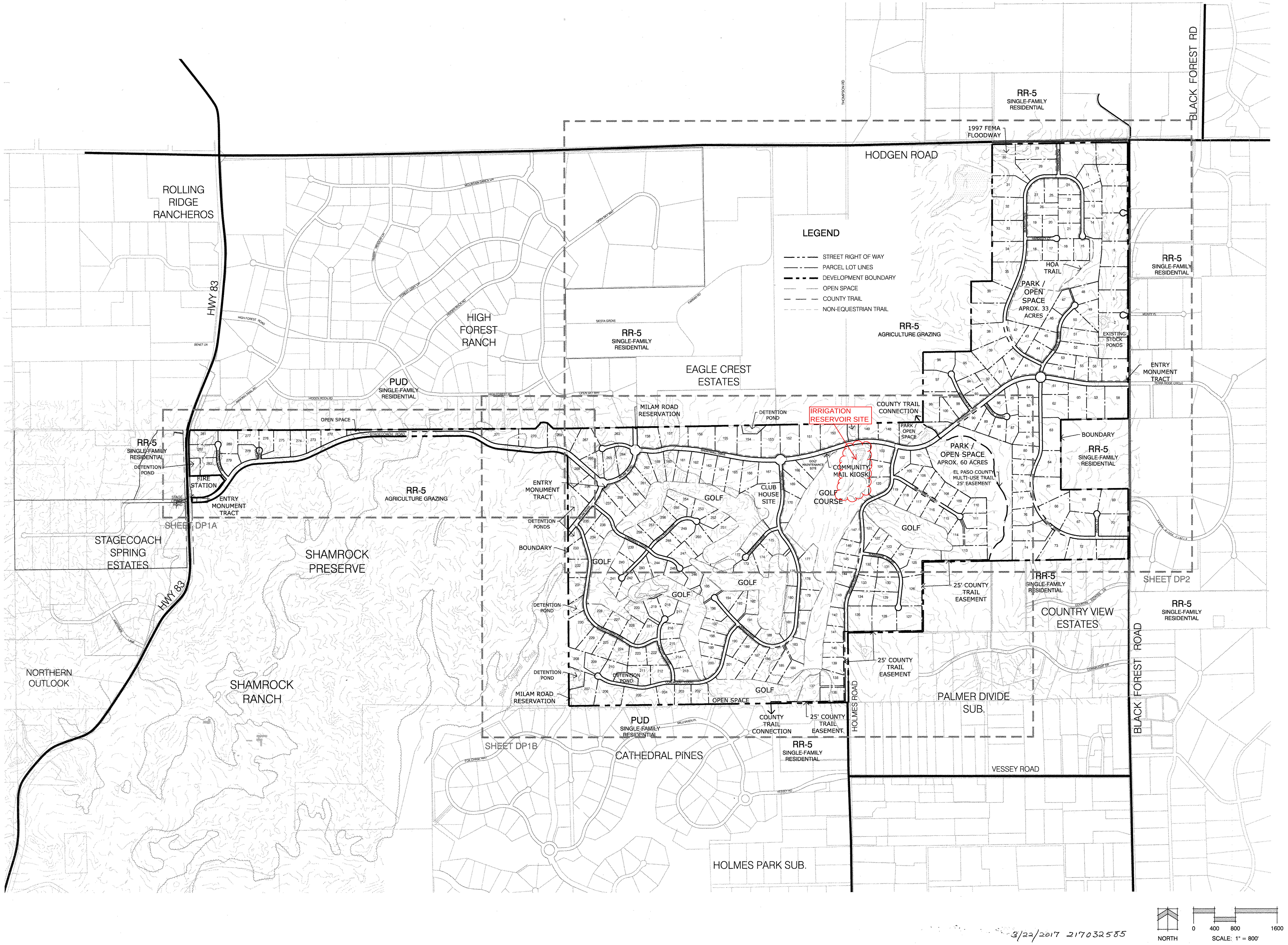
AUGUST 2018

Prepared for:
PRI #2 LLC
6385 CORPORATE DRIVE SUITE 200
COLORADO SPRINGS CO 80919
(719) 592-9333

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. CASCADE AVE SUITE 200
COLORADO SPRINGS CO 80903
(719) 785-0790

Job no. 1096.11
PCD File No. SF-18-001

CLASSIC CONSULTING



3/22/2017 217032585

P:\Classic2\Shamrock Ranch\Drawings\Planning\Develop\Dp-layout\Flying_Horse_North-DP.dwg [FULLPLAN] 2/8/2017 4:06:11 PM kmarshall

Land Planning
Landscape Architecture
Urban Design

NES

N.E.S. Inc.
619 N. Cascade Avenue, Suite 200
Colorado Springs, CO 80903

Tel. 719.471.0073
Fax 719.471.0267

www.nescolorado.com

PLANNER / LANDSCAPE ARCHITECT

IN ASSOCIATION WITH

FLYING HORSE NORTH

PLANNED UNIT DEVELOPMENT

PROJECT INFO

DATE: 04-18-2016
PROJECT MGR: J. MAYNARD
PREPARED BY: K. MARSHALL

SEAL

ISSUE INFO

ISSUE / REVISION

DATE:	BY:	DESCRIPTION:
07-25-16	KMM	Per review comments
09-07-16	KMM	Per 2nd review comments
11-28-16	KMM	Milam Revisions

SHEET TITLE

DEVELOPMENT PLAN
OVERALL SITE

SHEET NUMBER

DP
2 OF 6

PLAN FILE #

FIGURE 1.2

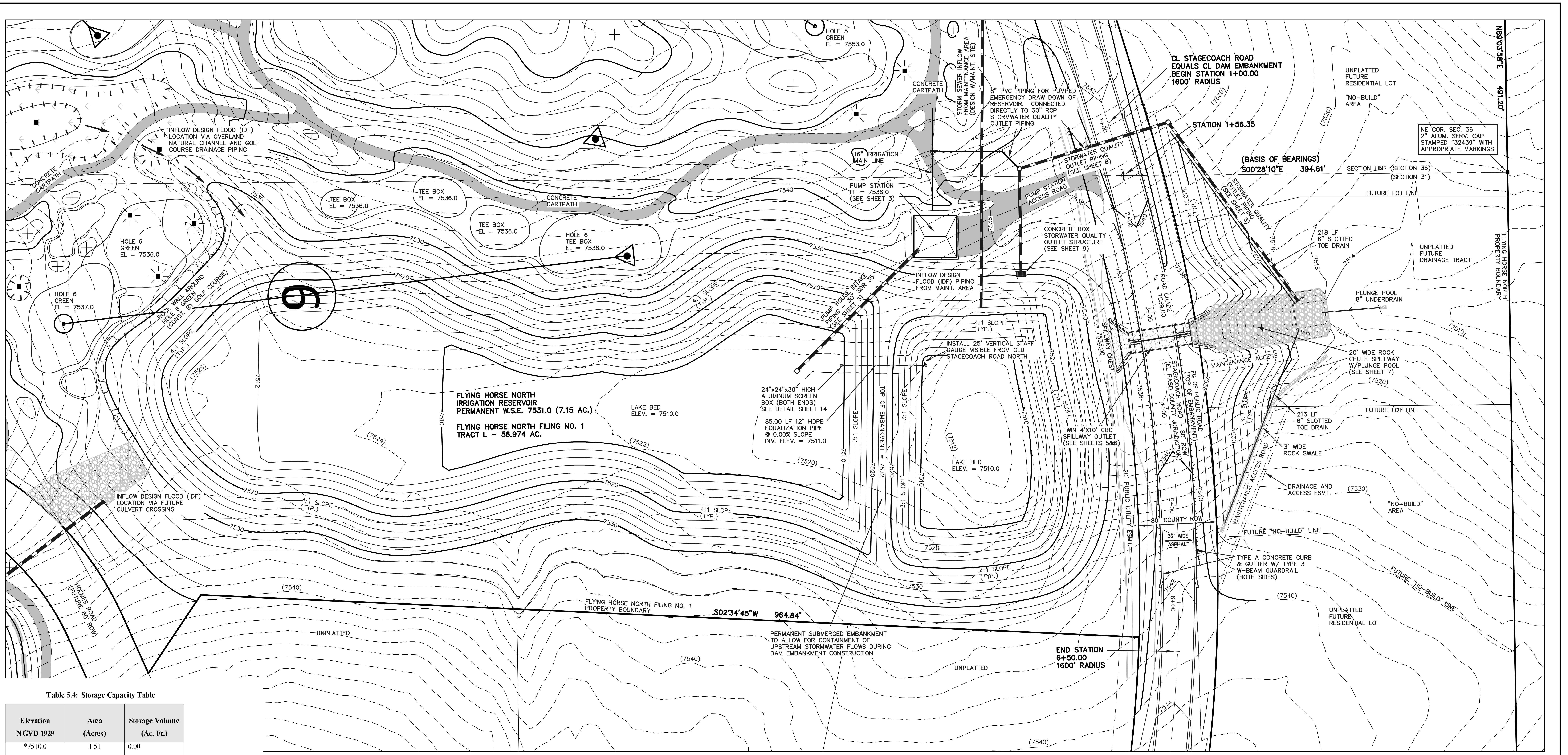

HOLE 5
GREEN
EL = 7553.0
CONCRETE CARTPATH
STORM SEWER INFLOW FROM MAINTENANCE AREA (DESIGN W/MAINT. SITE)
8" PVC PIPING FOR PUMPED EMERGENCY DRAW DOWN OF RESERVOIR. CONNECTED DIRECTLY TO 30" RCP STORMWATER QUALITY OUTLET PIPING
CL STAGECOACH ROAD EQUALS CL DAM EMBANKMENT BEGIN STATION 1+00.00 1600' RADIUS
STATION 1+56.35
UNPLATTED FUTURE RESIDENTIAL LOT
"NO-BUILD" AREA
N89°03'58"E 491.20'
NE COR. SEC. 36 2" ALUM. SERV. CAP STAMPED "32439" WITH APPROPRIATE MARKINGS
(BASIS OF BEARINGS) S00°28'10"E 394.61'
SECTION LINE (SECTION 36) (SECTION 31)
FUTURE LOT LINE
INFLOW DESIGN FLOOD (IDF) LOCATION VIA OVERLAND NATURAL CHANNEL AND GOLF COURSE DRAINAGE PIPING
CONCRETE CARTPATH
16" IRRIGATION MAIN LINE
PUMP STATION FF = 7536.0 (SEE SHEET 3)
STORWATER QUALITY OUTLET PIPING (SEE SHEET 8)
PUMP STATION ACCESS ROAD
STORWATER QUALITY OUTLET PIPING (SEE SHEET 8)
TEE BOX EL = 7536.0
TEE BOX EL = 7536.0
CONCRETE CARTPATH
TEE BOX EL = 7536.0
HOLE 6 TEE BOX EL = 7536.0
HOLE 6 GREEN EL = 7536.0
HOLE 6 GREEN EL = 7537.0
ROCK WALL AROUND HOLE 6 GREEN (CONST. BY GOLF COURSE)
CONCRETE BOX STORWATER QUALITY OUTLET STRUCTURE (SEE SHEET 9)
218 LF 6" SLOTTED TOE DRAIN
UNPLATTED FUTURE DRAINAGE TRACT
FLYING HORSE NORTH PROPERTY BOUNDARY
INFLOW DESIGN FLOOD (IDF) PIPING FROM MAINT. AREA
PUMP HOUSE INTAKE PIPING – 30" SDR 35 (SEE SHEET 3)
PLUNGE POOL 8" UNDERDRAIN
9
4:1 SLOPE (TYP.)
INSTALL 25' VERTICAL STAFF GAUGE VISIBLE FROM OLD STAGECOACH ROAD NORTH
SPILLWAY CREST = 7533.00
ROAD GRADE EL = 7539.00
20' WIDE ROCK CHUTE SPILLWAY W/PLUNGE POOL (SEE SHEET 7)
MAINTENANCE ACCESS
FLYING HORSE NORTH IRRIGATION RESERVOIR PERMANENT W.S.E. 7531.0 (7.15 AC.)
FLYING HORSE NORTH FILING NO. 1 TRACT L – 56.974 AC.
LAKE BED ELEV. = 7510.0
24"x24"x30" HIGH ALUMINUM SCREEN BOX (BOTH ENDS) SEE DETAIL SHEET 14
85.00 LF 12" HDPE EQUALIZATION PIPE @ 0.00% SLOPE INV. ELEV. = 7511.0
TOP OF EMBANKMENT = 7522
3:1 SLOPE
LAKE BED ELEV. = 7510.0
TWIN 4'X10' CBC SPILLWAY OUTLET (SEE SHEETS 5&6)
STAGECOACH ROAD – 80' ROW (EL PASO COUNTY JURISDICTION)
FG OF PUBLIC ROAD (TOP OF EMBANKMENT)
213 LF 6" SLOTTED TOE DRAIN
3' WIDE ROCK SWALE
MAINTENANCE ACCESS ROAD
DRAINAGE AND ACCESS ESMT.
"NO-BUILD" AREA
20' PUBLIC UTILITY ESMT.
80' COUNTY ROW
32' WIDE ASPHALT
FUTURE "NO-BUILD" LINE
TYPE A CONCRETE CURB & GUTTER W/ TYPE 3 W-BEAM GUARDRAIL (BOTH SIDES)
FUTURE "NO-BUILD" LINE
INFLOW DESIGN FLOOD (IDF) LOCATION VIA FUTURE CULVERT CROSSING
HOLMES ROAD (FUTURE 80' ROW)
FLYING HORSE NORTH FILING NO. 1 PROPERTY BOUNDARY
S02°34'45"W 964.84'
PERMANENT SUBMERGED EMBANKMENT TO ALLOW FOR CONTAINMENT OF UPSTREAM STORMWATER FLOWS DURING DAM EMBANKMENT CONSTRUCTION
END STATION 6+50.00 1600' RADIUS
UNPLATTED FUTURE RESIDENTIAL LOT
UNPLATTED
UNPLATTED
1+00
2+00
3+00
4+00
5+00
6+00
7510
7512
7520
7522
7524
7526
7530
7536
7538
7540
7542
7544

Table 5.4: Storage Capacity Table

Elevation NGVD 1929	Area (Acres)	Storage Volume (Ac. Ft.)
*7510.0	1.51	0.00
*7511.0	1.99	1.74
*7512.0	2.52	3.99
*7513.0	2.85	6.68
*7514.0	3.05	9.63
*7515.0	3.26	12.78
7516.0	3.48	16.15
7517.0	3.70	19.74
7518.0	3.93	23.56
7519.0	4.16	27.60
7520.0	4.40	31.88
7521.0	4.64	36.40
7522.0	4.88	41.16
7523.0	5.14	46.17
7524.0	5.36	51.42
7525.0	5.59	56.89
7526.0	5.84	62.61
7527.0	6.08	68.57
7528.0	6.33	74.77
7529.0	6.57	81.22
7530.0	6.81	87.91
7531.0	7.15	94.89
7532.0	7.52	102.22
7533.0	7.83	109.90
7534.0	8.37	118.00
7535.0	8.77	126.57
7536.0	9.17	135.53

*Indicates dead storage below pumping ability

Table 5.5: Reservoir Discharge Table

Elevation	Discharge (cfs) (SWQ Outlet Box)	Discharge (cfs) (Twin CBC Spillway)	Discharge (cfs) (Total)
7531.0	0.0	0.0	0.0
7532.0	13.89	0.0	13.89
7533.0	27.77	0.0	27.77
7534.0	51.31	49.05	100.36
7535.0	69.52	138.56	208.08
7536.0	74.61	254.72	329.33

Permanent WSE = 7531.0

Top of SWQ Outlet box = 7533.0

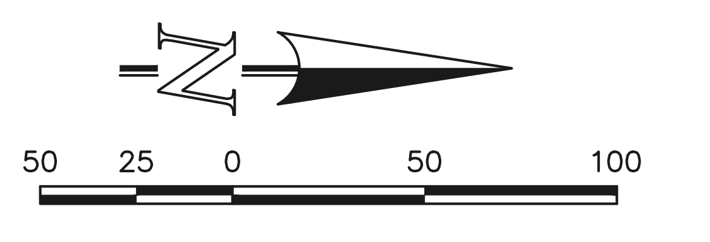
Spillway elevation = 7533.0

NOTES:

1. TOPOGRAPHIC BASE MAPPING PRODUCED FROM AERIAL PHOTOGRAPHY PROVIDED BY NORTH AMERICAN MAPPING IN 2009. HORIZONTAL CONTROL IS BASED ON LOCAL CALIBRATION TIED TO SECTION CORNER AND VERTICAL CONTROL IS BASED ON NGVD 1929 DATUM.
2. PERMANENT WSE = 7531.0
3. RESERVOIR LINER INSTALLED UP TO ELEVATION 7534.0

STAFF GAUGE DETAILS:

1. 12"X25'X1/2" PVC
2. LASER CUT ACRYLIC NUMBERS AND HATCH MARKS LIQUID WELDED TO PVC ON 1 FT. INCREMENTS
3. MOUNTED ON ALUMINUM FRAME WITH CROSS BRACKETS ANCHORED INTO SLOPE
4. BASE FASTENED TO 12" PIPE
5. ELEVATION DISPLAY RANGE: 7512–7535



SCALE: 1" = 50'

FIGURE 1.3

STATE ENGINEER'S CONSTRUCTION FILE NUMBER: C–2085

48 HOURS BEFORE YOU DIG,
CALL UTILITY LOCATORS
811
UTILITY NOTIFICATION CENTER OF COLORADO
IT'S THE LAW

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE CAUSED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NO.	REVISION	DATE
1	REVISED PER STATE COMMENTS	5–14–18
2	REVISED PER COUNTY COMMENTS	7–31–18

REVIEW:

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

MARC A. WHORTON, COLORADO P.E. #37155 DATE

CLASSIC℠
CONSULTING
ENGINEERS & SURVEYORS

619 N. Cascade Avenue, Suite 200 (719)785–0790
Colorado Springs, Colorado 80903 (719)785–0799(Fax)

FLYING HORSE NORTH
IRRIGATION RESERVOIR EMBANKMENT
SITE LAYOUT WITH GRADING
DAM ID – 080459

DESIGNED BY	MAW	SCALE	DATE 1–4–18
DRAWN BY	MAW	(H) 1"= 50'	SHEET 4 OF 14
CHECKED BY		(V) 1"= N/A	JOB NO. 1096.11

CLASSIC CONSULTING ENGINEERS & SURVEYORS

N:\109611\DRAWINGS\CONSTRUCTION\Jurisdictional Plans\4-JD POND - Site Grading.dwg, 8/21/2018 3:14:51 PM, 1:1

SECTION 4: RESERVOIR AND DAM

4.1 DESIGN CRITERIA

The proposed dam for the Flying Horse North Irrigation Reservoir was designed in accordance with Rule 5 of the State of Colorado Rules and Regulations for Dam Safety and Dam Construction, dated January 2007.

4.2 RESERVOIR

This watershed will contain development of a private golf course (currently under construction) including an outdoor golf maintenance facility, along with 2.5 ac. rural residential lot development accessed by rural County paved roadways. As such, the irrigation reservoir will also be designed with a separate stormwater detention and SWQ component per El Paso County criteria. This separate structure will be in the form of a concrete outlet box with an orifice plate and 30" RCP outlet allowing the release of the smaller storm events to meet the standards as specified per this criteria and the County's MS4 permit with the State. This SWQ release through the 30" RCP will be constructed outside of the reservoir embankment. The specific location of this reservoir is within a portion of Section 36, township 11 south, range 66 west of the sixth principal meridian, and a portion of Section 31 township 11 south, range 65 west of the sixth principal meridian, El Paso County Colorado. **(See Figure 1.3)**

The reservoir has a surface area at its permanent WSE (Elev. 7531.0) of 7.0 acres with a storage volume of 94.9 acre feet. The maximum depth at this elevation is 21 feet with the lake bed at 7510. The reservoir will have a liner constructed of a flexible membrane. This liner will be laid up to a maximum elevation of 7534. The reservoir is supplied by water from a well located on the Clubhouse site within the development approximately 1/4 mile west of the reservoir. The level in the reservoir is controlled by the two outlet structures. The Detention/SWQ structure will facilitate the State required 72 hr. drain time for the smaller stormwater events and help maintain the permanent water level while the twin box culvert spillway will allow for the County required 100 yr. detention release of the major stormwater events. The total storage capacity table is found in Section 5, Table 5.4.

4.3 DAM EMBANKMENT

The dam embankment for this reservoir will be constructed within the County owned and maintained Old Stagecoach Road (80' ROW - Collector). The subdivision Improvement Agreement (SIA) as required by El

Paso County for this subdivision, will be recorded along with the Final Plat and specify ownership and maintenance responsibilities related to the embankment and associated drainage structures. The crest of the embankment, which will be the finished grade of asphalt for the roadway is at elevation 7539.0 at the lowest point. The regulatory height from the twin box culvert emergency spillway invert to the native channel grade equals 23.0'. The length of the embankment measured from the toe of slopes on each side is approximately 450'. Both the upstream and downstream slopes of the embankment will be constructed at no greater than a 4:1 slope. The roadway will have a typical 2% crown with an asphalt width of 32.0' with El Paso County Type A concrete curb and gutter on both sides and then 6:1 maximum to edge of ROW with a County required clear zone of 14.0'. The twin box culvert emergency spillway structure is outside this clear zone. El Paso County will also require CDOT Type 3 W-Beam guardrail along both sides of the embankment. The embankment itself will be constructed of local material found on-site and tested by the Geotech. According to the State of Colorado Rules and Regulations for Dam Safety and Dam Construction, Rule 4.2.5.4, this facility is considered a "**Small Jurisdictional Dam"** given the jurisdictional height greater than 20 feet but less than 50 feet and a capacity greater than 100 acre-feet.

4.4 SPILLWAY AND OUTLET WORKS

This facility will be designed with two separate outlet structures. One will facilitate the State/County required detention/SWQ component of the facility while the other will allow for the 100 yr. stormwater event and emergency flow situations. A low level outlet will be built into the pump station design allowing for an emergency drawdown of the reservoir to be with connection to the SWQ outlet piping.

Detention / SWQ Outlet

Per the County's MS4 permit with the State, this development is required to provide detention and stormwater quality within this reservoir facility. The design for this is being handled by a separate concrete outlet box constructed outside the formal dam embankment. This structure is a 4'x8' concrete box with a steel flow control plate and protective well screen located on the front. The control plate is designed with three rectangular holes to facilitate the State required drain times. The first hole is located at elevation 7531.0 with the top of box at elevation 7533.0. The top of box will be constructed with a grate to allow flows to enter the box as well. A 30" RCP outlet pipe will allow for the release of all the flows entering the box structure. The design of this structure meets all State and County requirements for both EURV and

WQCV. The 30” RCP outlet piping will be routed around the dam embankment and into the rock chute and plunge pool at the base of the emergency spillway.

Spillway Outlet

Given that the embankment for this reservoir will be a County roadway, the conventional emergency spillway channel design at the crest of the embankment was not appropriate. But rather a concrete box culvert spillway design under the roadway to allow for both the major stormwater events and emergency release has been employed. Twin 4’x10’ concrete box culverts (CBC) will facilitate the required releases. The crest of the spillway will be constructed at elevation 7533.0 where the release will then travel under the roadway and into a 20’ wide rock chute. The rock chute will have a 4:1 slope with 3:1 side slopes and a total drop of 18.0’ into a 2.0’ deep plunge pool. The following roughness coefficients were used: CBCs 0.013 and Rock Chute 0.035. The rip-rap thickness will be 56” with a gradation specified by the Geotech. (See Design Plans) The spillway CBCs and Rock Chute have been designed to accommodate both the 100 yr. release of 182 cfs with a headwater depth ratio (Hw/D) of 0.54 and the total basin inflow of 609 cfs with a (Hw/D) of 1.31. This design is within the maximum County criteria of (Hw/D) of 1.40. The freeboard design is as follows: 100 Yr. = 4.39’ and 500 Yr. = 3.03’. The velocity at inlet of chute = 15.6 fps and velocity at outlet of chute = 6.99 fps, both at normal depth. 1.76’ of Freeboard is included in chute design.

Low Level Outlet

This reservoir will not be designed with a formal low level outlet given the nature of the facility and the ability for the pump station to facilitate the draining of the reservoir for embankment inspection or emergency purposes. Thus, directly off of the 16” irrigation main just outside the pump station, a 16”x8” tee with gate valves and a 8” drain line will be installed to allow for the pumped release and draining of the reservoir. This 8” drain line will then connect directly to the 30” RCP storm system via a Type II concrete storm manhole constructed as a part of the release of the Detention/SWQ component as required by El Paso County. This 30” storm system then daylights into the base of the rock chute and plunge pool on the backside of the embankment. The 8” drain line @ 110 psi is expected to release 800-1200 GPM. However, using the maximum pump station capacity of 2,250 GPM while opening system drain valves and irrigation heads, the drain time is as follows: As mentioned earlier, the pumps will allow for release down to an elevation of 7515.67. Based on the permanent WSE of 7531, this equates to a total of approximately 26 million gallons (MG) to be drained. The total drain time is estimated at approximately 8 days.

Hazard Classification" as described in section 5.6 of this report the Inflow Design Flood Requirements (IDF) as found in Rule 5.9.1, Table 5.1 utilize the (NOAA 14 – 24 Hr. duration) 100 Yr. storm event. The UD-Detention v3.07 spreadsheet (Per Urban Drainage Vol. 3) will also be utilized in the final design of the Detention and SWQ aspects of this facility. This spreadsheet uses 1 Hr. precipitation depths. See Table 5.1 for precipitation depth comparison. Please note that the higher precipitation amounts have been used for each return period.

Table 5.1: Precipitation Depth Comparison

Return Period	1-Hr. Depth (City/County)	1-Hr. Depth (NOAA 14)	24-Hr. Depth (City/County)	24-Hr. Depth (NOAA 14)
2	1.19	0.92	2.10	1.93
5	1.50	1.20	2.70	2.44
50	2.25	2.15	4.20	**4.33**
100	2.52	2.49	**4.60**	**5.04**

5.2 WATER RIGHTS

Based on the water decree filed October 6, 2017 (See Appendix), PRI #2, LLC has the water rights to pump and store in the on-site Flying Horse North reservoir. PRI #2, LLC has a lease from the State Land Board for the following water rights: 515 AF in the Dawson, 577 AF in the Denver, 239 AF in the Arapahoe and 182 AF in the Laramie Fox Hills. The Arapahoe and Laramie Fox Hills are both deemed non-tributary reservoirs. The Flying Horse North Golf Course will take an average of 200 AF per year from their Arapahoe well that will be pumped into the reservoir. Evaporative loss is not an issue when pumping from a non-tributary source. Upon termination of the State Land Board Lease in 2048, all water rights revert automatically back to PRI #2, LLC who will own them in perpetuity.

5.3 WATERSHED CHARACTERISTICS

The watershed of the irrigation reservoir includes a total area of 366.8 acres within the East Cherry Creek drainage basin and just north of the Palmer Divide. A portion of this area is outside the Flying Horse North development as shown in basins OS-12, OS-13 and OS-14. These basins are both currently undeveloped and developed as County zoned RR-5 (5 ac. rural residential). All the on-site basins are zoned PUD for either 2.5 ac. rural residential or golf course/open space. (See Tables 5.2 and 5.3 for sub-basin CN values and associated Tc times) Nearly the entire watershed is outside of the black forest tree line and mainly consists of prairie grasses with grades ranging from 2%-20% with three major natural ravines that drain in a northwesterly direction directly towards the planned irrigation reservoir. The golf course layout aides in the natural conveyance of the majority of the stormwater flows to the reservoir. The storage capacity table for the reservoir is listed in Table 5.4.

Table 5.2: Sub-basin CN Values

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

C_N VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	**GOLF COURSE (B)**		**2 AC. RESIDENTIAL (B)**		**COMPOSITE C_N**
		CN	AREA (Ac.)	CN	AREA (Ac.)	
CC-1	22.3	61	0.0	65	22.3	**65.0**
CC-2	36.4	61	0.0	65	36.4	**65.0**
CC-3	51.9	61	19.1	65	32.8	**63.5**
CC-4A	108.2	61	63.2	65	45.0	**62.7**
CC-4B	17.0	61	5.5	65	11.5	**63.7**
OS-12	67.7	61	0.0	65	67.7	**65.0**
OS-13	36.9	61	0.0	65	36.9	**65.0**
OS-14	26.4	61	0.0	65	26.4	**65.0**

Table 5.3: Sub-basin Time of Concentration

TIME OF CONCENTRATION DEVELOPED

	COMPOSITE	OVERLAND			STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25)				Tc	Tc
BASIN	Cn	Length (ft)	Height (ft)	Tc (hr)	Length (ft)	Slope (%)	Velocity (fps)	Tc (hr)	TOTAL (hr)	LAG (0.6tc) (hr)
CC-1	65.0	300	10	0.40	900	2.0%	1.8	0.14	0.53	0.32
CC-2	65.0	300	10	0.40	1700	2.0%	1.8	0.26	0.66	0.39
CC-3	63.5	300	14	0.35	900	2.5%	2.4	0.10	0.45	0.27
CC-4A	62.7	300	14	0.35	2900	2.0%	2.1	0.38	0.73	0.44
CC-4B	63.7	300	12	0.37	900	3.0%	2.5	0.10	0.47	0.28
OS-12	65.0	300	14	0.35	1500	3.0%	2.5	0.17	0.51	0.31
OS-13	65.0	300	16	0.33	900	3.0%	2.5	0.10	0.43	0.26
OS-14	65.0	300	14	0.35	600	3.5%	2.7	0.06	0.41	0.24

Table 5.4: Storage Capacity Table

Elevation NGVD 1929	Area (Acres)	Storage Volume (Ac. Ft.)
*7510.0	1.51	0.00
*7511.0	1.99	1.74
*7512.0	2.52	3.99
*7513.0	2.85	6.68
*7514.0	3.05	9.63
*7515.0	3.26	12.78
7516.0	3.48	16.15
7517.0	3.70	19.74
7518.0	3.93	23.56
7519.0	4.16	27.60
7520.0	4.40	31.88
7521.0	4.64	36.40
7522.0	4.88	41.16

7523.0	5.14	46.17
7524.0	5.36	51.42
7525.0	5.59	56.89
7526.0	5.84	62.61
7527.0	6.08	68.57
7528.0	6.33	74.77
7529.0	6.57	81.22
7530.0	6.81	87.91
7531.0	7.15	94.89
7532.0	7.52	102.22
7533.0	7.83	109.90
7534.0	8.37	118.00
7535.0	8.77	126.57
7536.0	9.17	135.53

*Indicates dead storage below pumping ability

5.4 HYDROLOGIC MODEL

The PondPack model produced peak discharges for the 2-yr, 5-yr, 50-yr and 100-yr storm events assuming a permanent pool elevation of 7531.0. Reference Appendix B for specific hydrologic model results. Table 5.5 below shows the results of these storm events upon the irrigation reservoir.

Table 5.5: Inflow Design Flood (IDF) Summary Table

Storm Event	**Peak Inflow (cfs)**	**Max. WSE (ft.)**	**Total Discharge (cfs)**
2-yr (City/County)	48	7531.40	6
5-yr (City/County)	119	7531.87	12
50-yr (NOAA 14)	431	7533.58	64
100-yr (NOAA 14)	609	7534.23	124

5.5 HYDRAULIC MODEL

Both the SWQ Outlet and the CBC Spillway were modeled using both PondPack (24-hr. precipitation) and the Urban Drainage UD Detention Spreadsheet (1-hr precipitation) as required by County design criteria. Table 5.6 below shows the results of the PondPack model. Reference Appendix B for the UD Detention – Retention Pond Spreadsheet results. As this facility is required to meet both detention and SWQ criteria, the following is applicable to these design components:

Required WQCV = 1.36 ac-ft.	Provided WQCV = 15.01 ac-ft.
Required EURV = 2.83 ac-ft.	Provided EURV = 15.01 ac-ft.
Required 100-yr. = 12.42 ac-ft.	Provided 100-yr = 27.35 ac-ft.

Table 5.6: Reservoir Discharge Table

Elevation	Discharge (cfs) (SWQ Outlet Box)	Discharge (cfs) (Twin CBC Spillway)	Discharge (cfs) (Total)
7531.0	0.0	0.0	0.0
7532.0	13.89	0.0	13.89
7533.0	27.77	0.0	27.77
7534.0	51.31	49.05	100.36
7535.0	69.52	138.56	208.08
7536.0	74.61	254.72	329.33

Permanent WSE = 7531.0
Top of SWQ Outlet box = 7533.0
Spillway elevation = 7533.0

The twin 4’x10’ CBC Spillway design has the following results:

100-yr storm release = 182 cfs	Hw/D = 0.54
Emergency release – Max. basin IDF = 609 cfs	Hw/D = 1.31
County Criteria (max.)	Hw/D = 1.40

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

CN VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	**GOLF COURSE (B)**		**2 AC. RESIDENTIAL (B)**		**COMPOSITE CN**
		CN	AREA (Ac.)	CN	AREA (Ac.)	
CC-1	22.3	61	0.0	65	22.3	**65.0**
CC-2	36.4	61	0.0	65	36.4	**65.0**
CC-3	51.9	61	19.1	65	32.8	**63.5**
CC-4A	108.2	61	63.2	65	45.0	**62.7**
CC-4B	17.0	61	5.5	65	11.5	**63.7**
OS-12	67.7	61	0.0	65	67.7	**65.0**
OS-13	36.9	61	0.0	65	36.9	**65.0**
OS-14	26.4	61	0.0	65	26.4	**65.0**

TIME OF CONCENTRATION DEVELOPED

BASIN	COMPOSITE Cn	OVERLAND Length (ft)	Height (ft)	Tc (hr)	STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25) Length (ft)	Slope (%)	Velocity (fps)	Tc (hr)	Tc TOTAL (hr)	Tc LAG (0.6tc) (hr)
CC-1	65.0	300	10	0.40	900	2.0%	1.8	0.14	0.53	0.32
CC-2	65.0	300	10	0.40	1700	2.0%	1.8	0.26	0.66	0.39
CC-3	63.5	300	14	0.35	900	2.5%	2.4	0.10	0.45	0.27
CC-4A	62.7	300	14	0.35	2900	2.0%	2.1	0.38	0.73	0.44
CC-4B	63.7	300	12	0.37	900	3.0%	2.5	0.10	0.47	0.28
OS-12	65.0	300	14	0.35	1500	3.0%	2.5	0.17	0.51	0.31
OS-13	65.0	300	16	0.33	900	3.0%	2.5	0.10	0.43	0.26
OS-14	65.0	300	14	0.35	600	3.5%	2.7	0.06	0.41	0.24

Design Procedure Form: Retention Pond (RP)

UD-BMP (Version 3.06, November 2016)

Sheet 1 of 3

Designer: **Marc A. Whorton, P.E.**
Company: **Classic Consulting**
Date: **August 20, 2018**
Project: **Flying Horse North - JD Pond**
Location: **Black Forest, CO El Paso County**

1. Baseflow

A) Is the permanent pool established by groundwater?

Choose One
○ YES
● NO

THE NET INFLUX OF WATER MUST BE AVAILABLE THROUGH A PERENNIAL BASEFLOW AND MUST EXCEED THE LOSSES.

2. Surcharge Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 8.3 %

B) Tributary Area's Imperviousness Ratio (i = I_a / 100) — i = 0.083

C) Contributing Watershed Area — Area = 366.800 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.42 in

E) Design Concept
(Select EURV when also designing for flood control)

Choose One
○ Water Quality Capture Volume (WQCV)
● Excess Urban Runoff Volume (EURV)

F) Water Quality Capture Volume (WQCV)
Based on 12-hour Drain Time
(V_{WQCV} = (0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area) — V_{WQCV}= 1.395 ac-ft

G) For Watersheds Outside of the Denver Region,
Water Quality Capture Volume (WQCV)
($V_{WQCV\ OTHER}$ = (d_6*(V_{WQCV}/0.43)) — $V_{WQCV\ OTHER}$= 1.363 ac-ft

H) User Input of Water Quality Capture Volume (WQCV)
(Only if a different WQCV Design Volume is desired) — $V_{WQCV\ USER}$= ac-ft

I) Predominant Watershed NRCS Soil Group

Choose One
○ A
● B
○ C / D

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$ — EURV = 2.827 ac-f t

3. Basin Shape
(It is recommended to have a basin length-to-width ratio between 2:1 and 3:1) — L : W = 5.0 : 1

4. Permanent Pool

A) Minimum Permanent Pool Volume — V_{POOL} = 1.363 ac-ft

B) Depth of the Safety Wetland Bench
(Depth between 6 to 12 inches recommended) — D_{LZ} = 12 in

C) Depth of the Open Water Zone
(Maximum depth of 12 feet) — D_{OWZ} = 21.0 ft **D > 12 FEET**

5. Side Slopes

A) Maximum Side Slopes Above the Safety Wetland Bench
(Horiz. dist. per unit vertical, should be no steeper than 4:1) — Z_{PP} = 4.00 ft / ft

B) Maximum Side Slopes Below the Safety Wetland Bench
(Horiz. dist. per unit vertical, should be no steeper than 3:1) — Z_{OWZ} = 4.00 ft / ft

Design Procedure Form: Retention Pond (RP)

Sheet 2 of 3

Designer:
Company:
Date: **August 20, 2018**
Project:
Location:

6. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations: Rip-Rap

7. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV): V_{FMIN} = 0.041 ac-ft

B) Actual Forebay Volume: V_F = 0.041 ac-ft

8. Outlet

A) Outlet Type

Choose One
● Orifice Plate
○ Other (Describe):

C) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention): $D_{orifice}$ = 15.8 inches

D) Total Outlet Area (A_{ot}): A_{ot} = 585.000 square inches

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = Aot * 38.5*(e^{-0.095D})$: A_t = 5020 square inches

B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.): *Aluminum Amico-Klemp SR Series with Cross Rods 4" O.C.*

Other (Y/N): N

C) Ratio of Total Open Area to Total Area (only for type 'Other'): User Ratio =

D) Total Water Quality Screen Area (based on screen type): A_{total} = 6520 square inches

E) Inundated Depth of Water Quality Screen below Permanent Pool: $D_{inundated}$ = 0.7 ft

F) Depth of Design Volume (EURV or WQCV) Based on the Design Concept Chosen Under 1.E: H= 2.0 ft

G) Height of Water Quality Screen (H_{TR}): H_{TR}= 32.04 inches

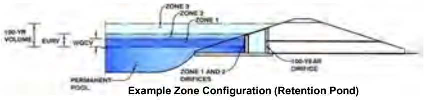
H) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended): $W_{opening}$ = 203.5 inches

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Flying Horse North

Basin ID: Golf Course Irrigation Reservoir (Pond - 13)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**RP**			
Watershed Area =	366.80	acres		
Watershed Length =	5,175	ft		
Watershed Slope =	0.015	ft/ft		
Watershed Imperviousness =	8.30%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	12.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	1.395	acre-feet	Optional User Override	
Excess Urban Runoff Volume (EURV) =	2.819	acre-feet	1-hr Precipitation	
2-yr Runoff Volume (P1 = 1.19 in.) =	1.903	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.006	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	7.525	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	21.442	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	30.109	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	41.427	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.39 in.) =	68.375	acre-feet	3.39	inches
Approximate 2-yr Detention Volume =	1.765	acre-feet		
Approximate 5-yr Detention Volume =	2.813	acre-feet		
Approximate 10-yr Detention Volume =	6.361	acre-feet		
Approximate 25-yr Detention Volume =	9.142	acre-feet		
Approximate 50-yr Detention Volume =	9.507	acre-feet		
Approximate 100-yr Detention Volume =	12.417	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	1.395	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.424	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	9.598	acre-feet
Total Detention Basin Volume =	12.417	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.5 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Permanent Pool	--	0.00	--	--	--	311,545	7.152		
7532	--	1.00	--	--	--	327,571	7.520	316,283	7.261
7533	--	2.00	--	--	--	341,084	7.830	650,475	14.933
7534	--	3.00	--	--	--	364,597	8.370	1,006,726	23.111
7535	--	4.00	--	--	--	382,021	8.770	1,380,035	31.681
7536	--	5.00	--	--	--	399,445	9.170	1,770,768	40.651
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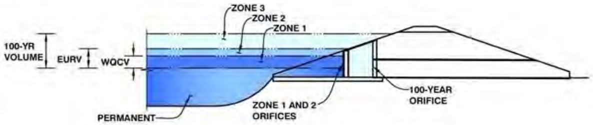
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Flying Horse North

Basin ID: Golf Course Irrigation Reservoir (Pond - 13)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.20	1.395	Orifice Plate
Zone 2 (EURV)	0.40	1.424	Orifice Plate
'one 3 (100-year)	1.67	9.598	Weir&Pipe (Restrict)
		12.417	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.00	inches
Orifice Plate: Orifice Area per Row =	195.00	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.354E+00	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.70	1.40					
Orifice Area (sq. inches)	195.00	195.00	195.00					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.00	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.04	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	24.74	N/A	ft^2
Overflow Grate Open Area w/ Debris =	12.37	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	4.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	30.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	4.91	N/A	ft^2
Outlet Orifice Centroid =	1.25	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	0.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	4.13	feet
Stage at Top of Freeboard =	7.13	feet
Basin Area at Top of Freeboard =	9.17	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.39
Calculated Runoff Volume (acre-ft) =	1.395	2.819	1.903	3.006	7.525	21.442	30.109	41.427	68.375
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.395	2.819	1.902	3.006	7.522	21.445	30.113	41.428	68.385
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.67	0.93	1.25	2.00
Predevelopment Peak Q (cfs) =	0.0	0.0	4.5	7.8	75.1	247.4	342.3	460.1	734.0
Peak Inflow Q (cfs) =	23.2	46.4	31.5	49.5	121.4	333.1	458.5	608.8	941.9
Peak Outflow Q (cfs) =	2.6	3.7	3.0	3.9	9.0	41.5	103.9	182.0	373.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.1	0.2	0.3	0.4	0.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Spillway	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.1	0.7	1.1	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	11	15	12	15	22	27	27	25	23
Time to Drain 99% of Inflow Volume (hours) =	**12**	16	14	16	24	31	31	30	29
Maximum Ponding Depth (ft) =	0.15	0.33	0.22	0.35	0.89	2.36	2.96	3.61	4.97
Area at Maximum Ponding Depth (acres) =	7.21	7.27	7.23	7.28	7.48	8.02	8.34	8.61	9.16
Maximum Volume Stored (acre-ft) =	1.077	2.308	1.510	2.453	6.436	17.865	22.693	28.205	40.376

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.95 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:09:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:14:51	1.01	1.97	1.36	2.10	4.69	9.77	11.39	12.89	15.10
1.010	0:19:48	2.74	5.42	3.70	5.77	13.49	31.71	39.07	46.76	59.45
	0:24:45	7.04	13.91	9.51	14.80	34.64	82.12	102.73	124.75	164.90
	0:29:42	19.32	38.17	26.10	40.61	94.81	223.20	277.98	336.63	444.01
	0:34:39	23.19	46.42	31.50	49.46	121.39	323.47	425.12	541.27	768.07
	0:39:36	22.19	44.52	30.16	47.44	118.28	333.14	458.54	608.77	941.94
	0:44:33	20.20	40.51	27.45	43.17	108.29	310.79	431.04	582.87	939.56
	0:49:30	18.10	36.44	24.64	38.84	97.66	281.42	390.98	535.69	878.35
	0:54:27	15.70	31.77	21.42	33.89	85.81	250.82	352.31	485.61	800.60
	0:59:24	13.65	27.68	18.60	29.53	75.09	221.36	315.01	438.24	731.15
	1:04:21	12.38	25.04	16.87	26.71	67.46	196.13	281.72	395.12	668.65
	1:09:18	10.29	20.92	14.06	22.33	56.98	169.57	244.05	343.20	594.66
	1:14:15	8.46	17.30	11.59	18.47	47.35	142.96	207.70	294.13	509.61
	1:19:12	6.60	13.63	9.08	14.56	37.87	117.65	173.58	249.28	435.39
	1:24:09	4.99	10.46	6.92	11.19	29.48	94.26	142.59	208.99	372.25
	1:29:06	3.64	7.75	5.08	8.30	22.24	74.08	115.60	173.54	316.50
	1:34:03	2.78	5.85	3.86	6.26	16.51	56.37	91.58	142.20	268.83
	1:39:00	2.28	4.73	3.14	5.06	13.16	42.77	70.68	113.81	225.24
	1:43:57	1.92	3.99	2.65	4.26	11.04	34.92	55.08	89.03	185.28
	1:48:54	1.68	3.48	2.32	3.72	9.57	29.75	45.79	70.94	149.07
	1:53:51	1.51	3.12	2.08	3.33	8.53	26.20	39.69	59.85	118.87
	1:58:48	1.39	2.86	1.91	3.05	7.79	23.63	35.39	52.61	99.74
	2:03:45	1.02	2.12	1.41	2.26	5.92	18.97	28.99	43.64	83.33
	2:08:42	0.75	1.54	1.03	1.64	4.27	13.83	21.64	33.32	65.70
	2:13:39	0.55	1.13	0.76	1.21	3.17	10.12	15.73	24.54	49.44
	2:18:36	0.41	0.84	0.56	0.90	2.35	7.55	11.63	18.13	37.08
	2:23:33	0.29	0.61	0.41	0.66	1.73	5.63	8.83	13.58	27.60
	2:28:30	0.21	0.44	0.29	0.47	1.25	4.16	6.61	10.30	20.70
	2:33:27	0.15	0.32	0.21	0.34	0.91	3.03	4.92	7.75	15.78
	2:38:24	0.10	0.22	0.14	0.24	0.64	2.25	3.67	5.84	11.98
	2:43:21	0.06	0.14	0.09	0.15	0.42	1.58	2.71	4.47	9.20
	2:48:18	0.03	0.08	0.05	0.08	0.25	1.03	1.90	3.30	7.18
	2:53:15	0.01	0.03	0.02	0.04	0.12	0.60	1.23	2.30	5.41
	2:58:12	0.00	0.01	0.00	0.01	0.04	0.28	0.71	1.49	3.89
	3:03:09	0.00	0.00	0.00	0.00	0.00	0.08	0.33	0.85	2.62
	3:08:06	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.39	1.60
	3:13:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.83
	3:18:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30
	3:22:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	3:27:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:07:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:12:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:17:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:01:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:06:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:11:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:16:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:21:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:26:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:31:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:36:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:41:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:46:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:51:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:56:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
PERMANENT WSE	0.00	311,545	7.152	0	0.000	0.00
WQCV	0.15	313,949	7.207	46,912	1.077	2.53
2 YR. WSE	0.22	314,910	7.229	65,778	1.510	2.99
EURV	0.33	316,673	7.270	100,515	2.308	3.69
5 YR. WSE	0.35	316,994	7.277	106,852	2.453	3.80
50 YR. WSE	2.96	363,656	8.348	992,161	22.777	104.11
100 YR. WSE	3.61	375,226	8.614	1,232,372	28.291	182.18

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: *Flying Horse North - JD Pond Outlet*
County: *EL Paso*
Designer: *Marc Whorton*
Checked by:
Date: 8/20/2018
Date:

Input Channel Geometry

→ ***Inlet Channel***	→ ***Chute***	→ ***Outlet Channel***
Bw = *20.8* ft.	Bw = *20.0* ft.	Bw = *20.0* ft.
Side slopes = *0.0* (m:1)	Factor of safety = *1.20* (F_s)	Side slopes = *4.0* (m:1)
n-value = *0.013*	Side slopes = *3.0* (m:1) → ***2.0:1 max.***	n-value = *0.035*
Bed slope = *0.0100* ft./ft.	Bed slope (4:1) = *0.250* ft./ft. → ***2.5:1 max.***	Bed slope = *0.0100* ft./ft.
Freeboard = *1.0* ft.	Outlet apron depth, d = *2.0* ft.	Base flow = *40.0* cfs

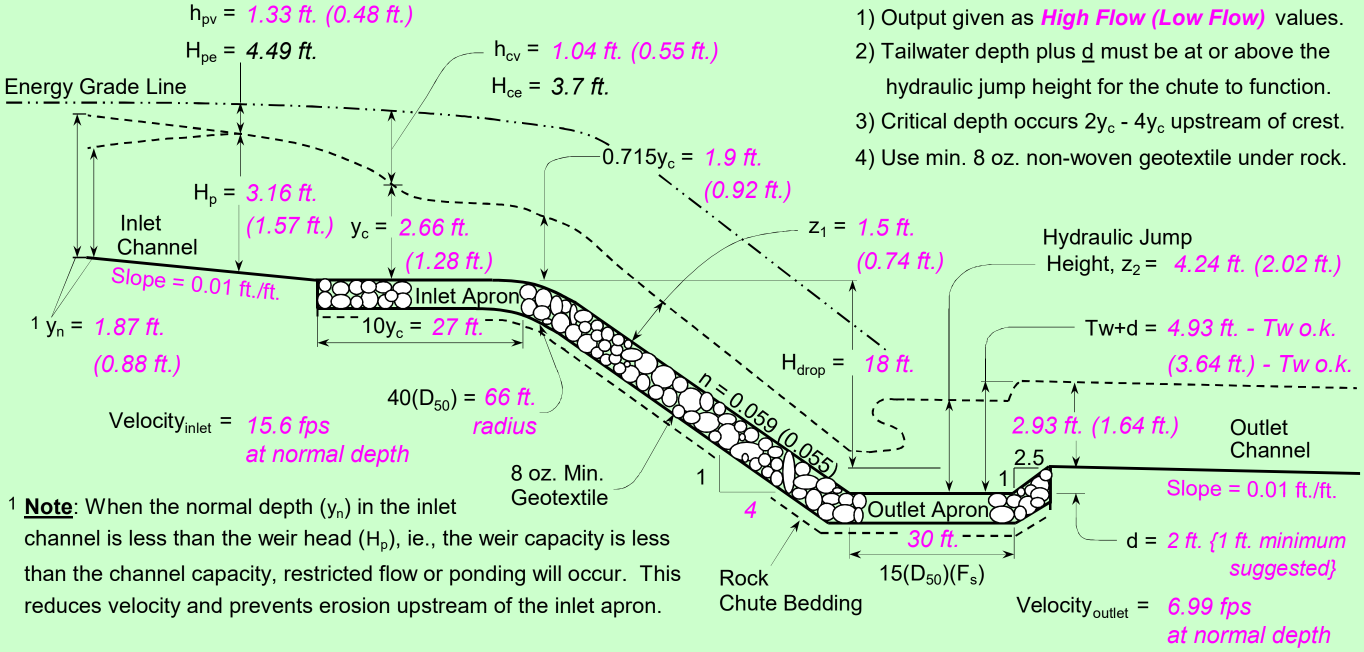
Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = acres Rainfall = ○ 0 - 3 in. ● 3 - 5 in. ○ 5+ in.
Apron elev. --- Inlet = *7531.2* ft. --- Outlet =*7511.2* ft. --- (H_{drop} = 18 ft.)
Chute capacity = Q25-year
Total capacity = Q100-year
Minimum capacity (based on a 5-year, 24-hour storm with a 3 - 5 inch rainfall)
Q_{high}= *609.0* cfs High flow storm through chute → Tw (ft.) = *Program* 0.25
Q_{low} = *182.0* cfs Low flow storm through chute → Tw (ft.) = *Program*

Note: *The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*
Input tailwater (Tw):

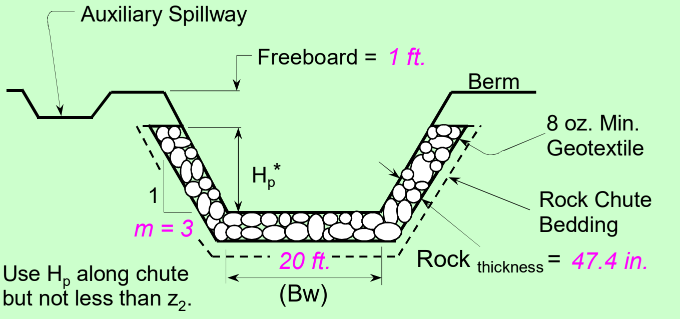
Profile and Cross Section (Output)

Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.


Energy Grade Line
h_{pv} = 1.33 ft. (0.48 ft.)
H_{pe} = 4.49 ft.
h_{cv} = 1.04 ft. (0.55 ft.)
H_{ce} = 3.7 ft.
$0.715y_c$ = 1.9 ft. (0.92 ft.)
H_p = 3.16 ft. (1.57 ft.)
y_c = 2.66 ft. (1.28 ft.)
Inlet Channel
Slope = 0.01 ft./ft.
1 y_n = 1.87 ft. (0.88 ft.)
Inlet Apron
$10y_c$ = 27 ft.
z_1 = 1.5 ft. (0.74 ft.)
Hydraulic Jump Height, z_2 = 4.24 ft. (2.02 ft.)
Tw+d = 4.93 ft. - Tw o.k. (3.64 ft.) - Tw o.k.
H_{drop} = 18 ft.
n = 0.059 (0.055)
$40(D_{50})$ = 66 ft. radius
$Velocity_{inlet}$ = 15.6 fps at normal depth
8 oz. Min. Geotextile
1
4
2.93 ft. (1.64 ft.)
Outlet Channel
2.5
1
Slope = 0.01 ft./ft.
Outlet Apron
30 ft.
$15(D_{50})(F_s)$
Rock Chute Bedding
d = 2 ft. {1 ft. minimum suggested}
$Velocity_{outlet}$ = 6.99 fps at normal depth

[1] **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

Typical Cross Section

q_t = *24.67 cfs/ft.* Equivalent unit discharge
F_S = *1.20* Factor of safety (multiplier)
z_1 = *1.5 ft.* Normal depth in chute
n-value = *0.059* Manning's roughness coefficient
$D_{50}(F_s)$ = *23.7 in. (971 lbs. - 50% round / 50% angular)*
$2(D_{50})(F_s)$ = *47.4 in.* Rock chute thickness
Tw + d = *4.93 ft.* Tailwater above outlet apron
z_2 = *4.24 ft.* Hydraulic jump height
****** The outlet will function adequately***

High Flow Storm Information

Rock Chute Design - Plan Sheet

(Version 4.0 - 07/10/00, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Flying Horse North - JD Pond Outlet
Designer: Marc Whorton
Date: 8/20/2018
County: EL Paso
Checked by:
Date:

Design Values

Angular D_{50} dia. = *23.7* in.
$Rock_{chute}$ thickness = *47.4* in.
Inlet apron length = *27* ft.
Outlet apron length = *30* ft.
Radius = *66* ft.
Will bedding be used? *Yes* ----------

Rock Gradation Envelope

% Passing	*Diameter, in. (weight, lbs.)*
D_{100} ---------	36 - 47 (3274 - 7761)
D_{85} ---------	31 - 43 (2131 - 5658)
D_{50} ---------	24 - 36 (970 - 3274)
D_{10} ---------	19 - 31 (497 - 2131)

Depth (in.) = *6.0*

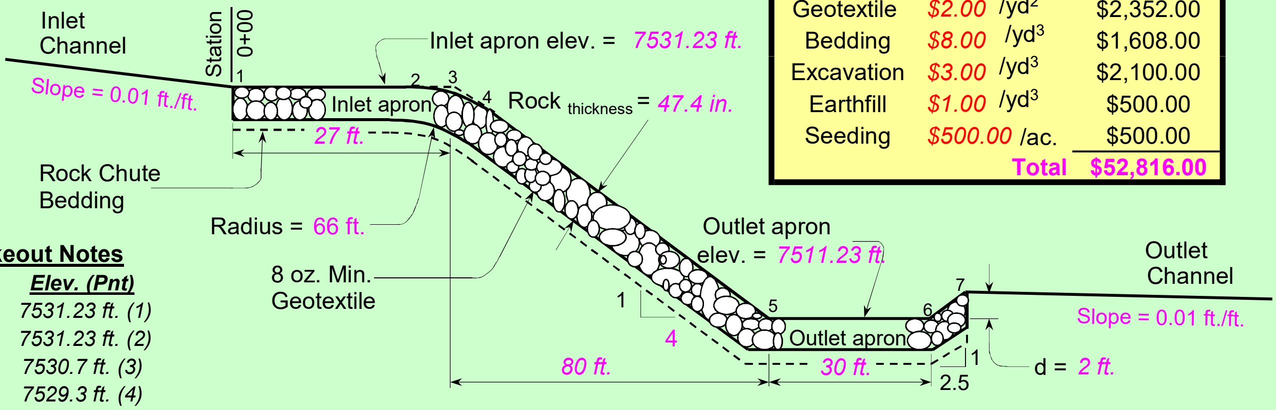
Quantities [a]

Angular Rock = 1271 yd^3
Geotextile (8 oz.)[b] = 1176 yd^2
Bedding (6 in.) = 201 yd^3
Excavation = *700* yd^3
Earthfill = *500* yd^3
Seeding = *1.0* acres

Notes: [a] *Rock, bedding, and geotextile quantities are determined from the x-section below (neglect radius).*
[b] *Geotextile shall be overlapped (18-in. min.) and anchored (18-in. min. along sides and 24-in. min. on the ends).*

Rock Chute Cost Estimate

Unit	*Unit Cost*	*Cost*
Rock	*$36.00* /$yd^3$	$45,756.00
Geotextile	*$2.00* /$yd^2$	$2,352.00
Bedding	*$8.00* /$yd^3$	$1,608.00
Excavation	*$3.00* /$yd^3$	$2,100.00
Earthfill	*$1.00* /$yd^3$	$500.00
Seeding	*$500.00* /ac.	$500.00
	Total	**$52,816.00**

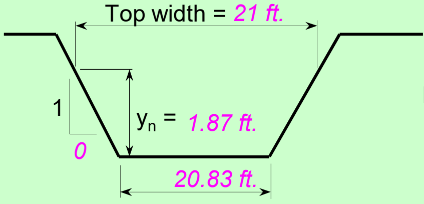


Profile Along Centerline of Rock Chute

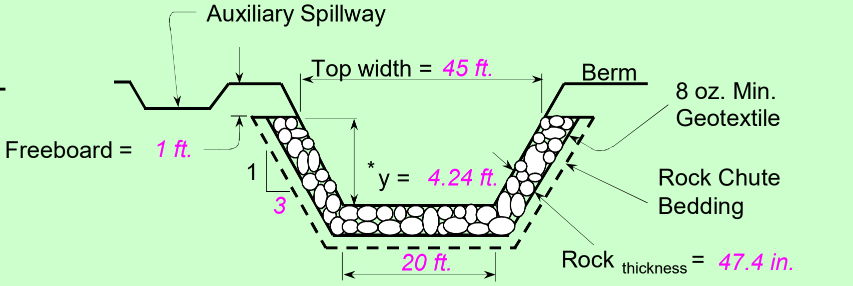
Stakeout Notes

Sta.	*Elev. (Pnt)*
0+00	7531.23 ft. (1)
0+18.9	7531.23 ft. (2)
0+27	7530.7 ft. (3)
0+34.9	7529.3 ft. (4)
1+7	7511.23 ft. (5)
1+37	7511.23 ft. (6)
1+42	7513.23 ft. (7)

*****Note*** ***: The outlet will function adequately***

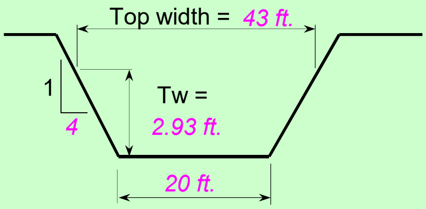


Inlet Channel Cross Section



Rock Chute Cross Section

* Use H_p throughout chute but not less than z_2.



Outlet Channel Cross Section

Profile, Cross Sections, and Quantities

Project: Flying Horse North - JD Pond Outlet
Location: EL Paso County

U.S. Department of Agriculture
Natural Resources Conservation Service

Designed: Marc Whorton
Drawn: NRCS Standard Dwg.
Traced: ________________
Checked: ______________
Approved by: ________________
Title: ________________________
Title: ________________________
Sheet No. ____ of ____
Drawing No.

Culvert Report

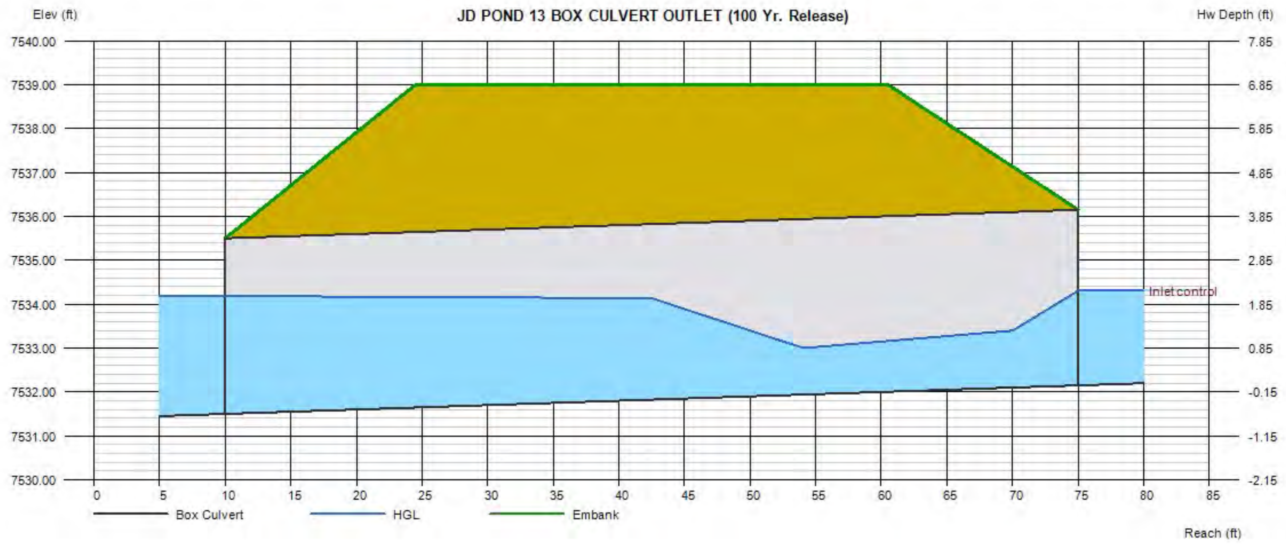
JD POND 13 BOX CULVERT OUTLET (100 Yr. Release)

Invert Elev Dn (ft) = 7531.50
Pipe Length (ft) = 65.00
Slope (%) = 1.00
Invert Elev Up (ft) = 7532.15
Rise (in) = 48.0
Shape = Box
Span (in) = 120.0
No. Barrels = 2
n-Value = 0.013
Culvert Type = Flared Wingwalls
Culvert Entrance = 30D to 75D wingwall flares
Coeff. K,M,c,Y,k = 0.026, 1, 0.0347, 0.81, 0.4

Embankment
Top Elevation (ft) = 7539.00
Top Width (ft) = 36.00
Crest Width (ft) = 230.00

Calculations
Qmin (cfs) = 0.00
Qmax (cfs) = 182.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted
Qtotal (cfs) = 182.00
Qpipe (cfs) = 182.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 3.39
Veloc Up (ft/s) = 6.64
HGL Dn (ft) = 7534.19
HGL Up (ft) = 7533.52
Hw Elev (ft) = 7534.30
Hw/D (ft) = 0.54
Flow Regime = Inlet Control



Culvert Report

JD POND 13 BOX CULVERT OUTLET (Emergency - Full developed Basin Release)

Invert Elev Dn (ft) = 7531.50
Pipe Length (ft) = 65.00
Slope (%) = 1.00
Invert Elev Up (ft) = 7532.15
Rise (in) = 48.0
Shape = Box
Span (in) = 120.0
No. Barrels = 2
n-Value = 0.013
Culvert Type = Flared Wingwalls
Culvert Entrance = 30D to 75D wingwall flares
Coeff. K,M,c,Y,k = 0.026, 1, 0.0347, 0.81, 0.4

Embankment

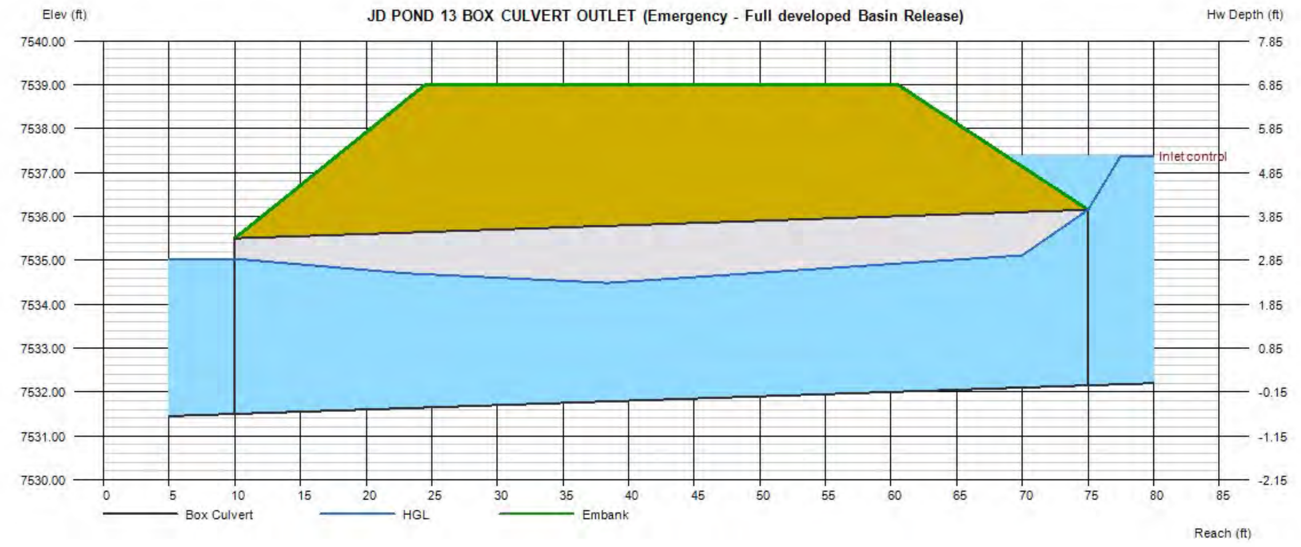
Top Elevation (ft) = 7539.00
Top Width (ft) = 36.00
Crest Width (ft) = 230.00

Calculations

Qmin (cfs) = 0.00
Qmax (cfs) = 609.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 609.00
Qpipe (cfs) = 609.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 8.62
Veloc Up (ft/s) = 9.94
HGL Dn (ft) = 7535.03
HGL Up (ft) = 7535.21
Hw Elev (ft) = 7537.38
Hw/D (ft) = 1.31
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Aug 20 2018

JD POND 13 BOX CULVERT OUTLET (Max. Capacity with 1.0' Freeboard)

Invert Elev Dn (ft) = 7531.50
Pipe Length (ft) = 65.00
Slope (%) = 1.00
Invert Elev Up (ft) = 7532.15
Rise (in) = 48.0
Shape = Box
Span (in) = 120.0
No. Barrels = 2
n-Value = 0.013
Culvert Type = Flared Wingwalls
Culvert Entrance = 30D to 75D wingwall flares
Coeff. K,M,c,Y,k = 0.026, 1, 0.0347, 0.81, 0.4

Embankment

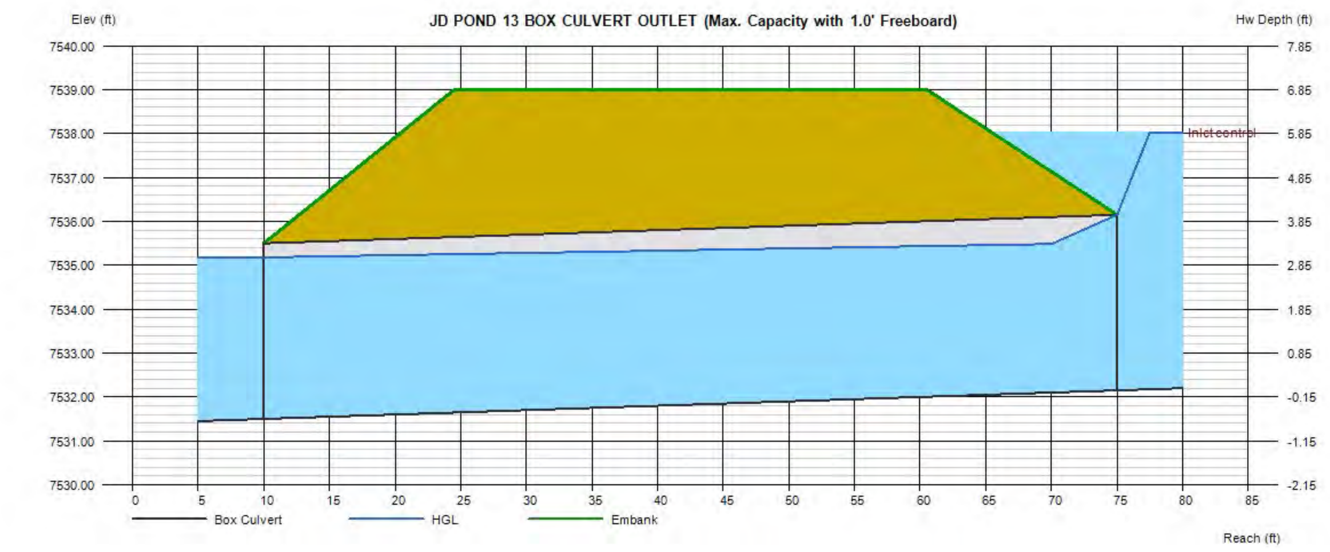
Top Elevation (ft) = 7539.00
Top Width (ft) = 36.00
Crest Width (ft) = 230.00

Calculations

Qmin (cfs) = 0.00
Qmax (cfs) = 700.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 700.00
Qpipe (cfs) = 700.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 9.51
Veloc Up (ft/s) = 10.42
HGL Dn (ft) = 7535.18
HGL Up (ft) = 7535.51
Hw Elev (ft) = 7538.03
Hw/D (ft) = 1.47
Flow Regime = Inlet Control



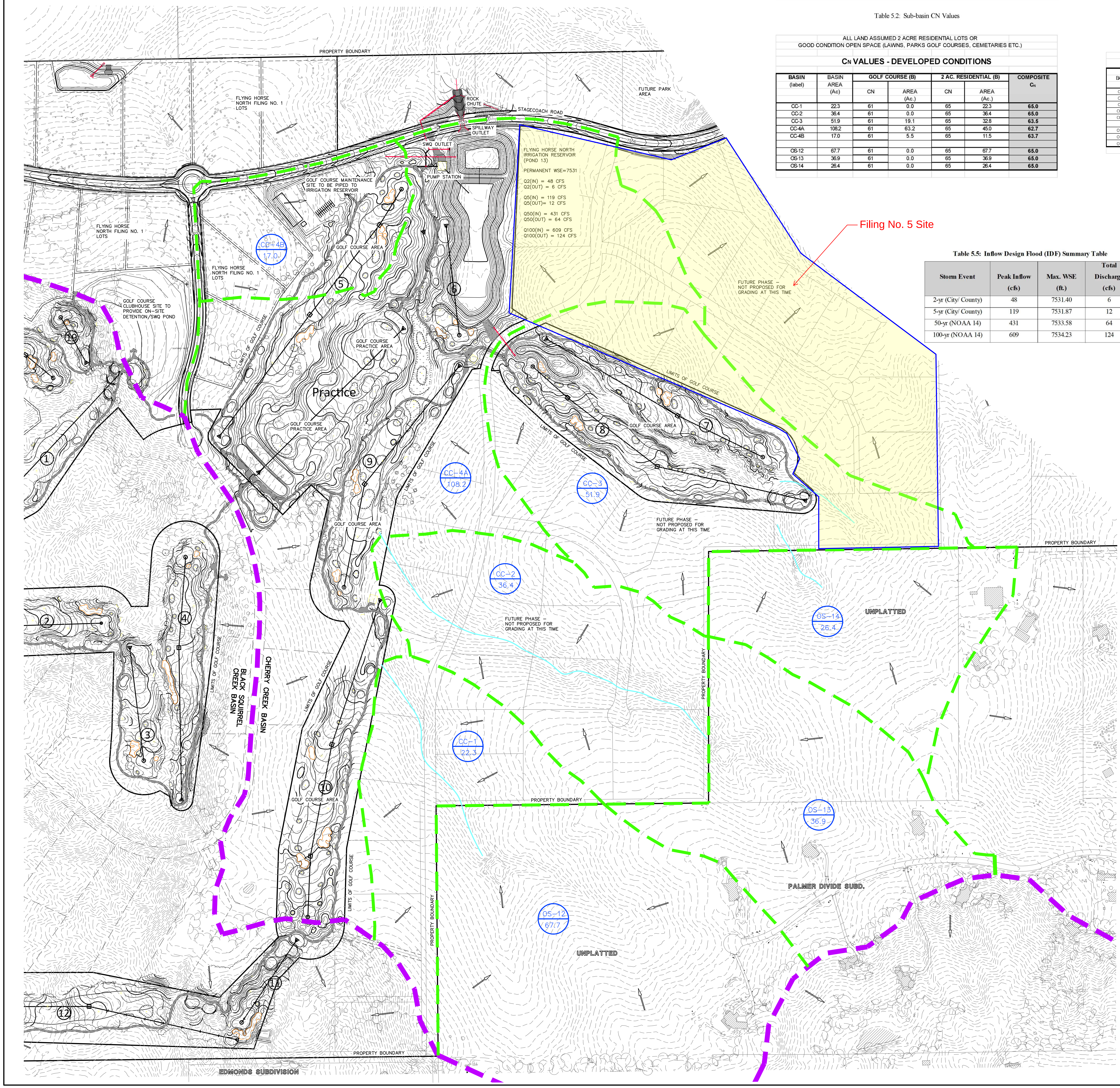


Table 5.2: Sub-basin CN Values

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

CN VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	GOLF COURSE (B)		2 AC. RESIDENTIAL (B)		COMPOSITE CN
		CN	AREA (Ac.)	CN	AREA (Ac.)	
CC-1	22.3	61	0.0	65	22.3	**65.0**
CC-2	36.4	61	0.0	65	36.4	**65.0**
CC-3	51.9	61	19.1	65	32.8	**63.5**
CC-4A	108.2	61	63.2	65	45.0	**62.7**
CC-4B	17.0	61	5.5	65	11.5	**63.7**
OS-12	67.7	61	0.0	65	67.7	**65.0**
OS-13	36.9	61	0.0	65	36.9	**65.0**
OS-14	26.4	61	0.0	65	26.4	**65.0**

Table 5.3 Sub-basin Time of Concentration

TIME OF CONCENTRATION DEVELOPED

BASIN	COMPOSITE Cn	OVERLAND			STREET / CHANNEL FLOW(DCM Vol. 1 Fig. 6-25)				Tc TOTAL (hr)	Tc LAG(0.6tc) (hr)
		Length (ft)	Height (ft)	Tc (hr)	Length (ft)	Slope (%)	Velocity (fps)	Tc (hr)		
CC-1	65.0	300	10	0.40	900	2.0%	1.8	0.14	0.53	0.32
CC-2	65.0	300	10	0.40	1700	2.0%	1.8	0.26	0.66	0.39
CC-3	63.5	300	14	0.35	900	2.5%	2.4	0.10	0.45	0.27
CC-4A	62.7	300	14	0.35	2900	2.0%	2.1	0.38	0.73	0.44
CC-4B	63.7	300	12	0.37	900	3.0%	2.5	0.10	0.47	0.28
OS-12	65.0	300	14	0.35	1500	3.0%	2.5	0.17	0.51	0.31
OS-13	65.0	300	16	0.33	900	3.0%	2.5	0.10	0.43	0.26
OS-14	65.0	300	14	0.35	600	3.5%	2.7	0.06	0.41	0.24

Table 5.5: Inflow Design Flood (IDF) Summary Table

Storm Event	Peak Inflow (cfs)	Max. WSE (ft.)	Total Discharge (cfs)
2-yr (City/ County)	48	7531.40	6
5-yr (City/ County)	119	7531.87	12
50-yr (NOAA 14)	431	7533.58	64
100-yr (NOAA 14)	609	7534.23	124

Table 5.6: Reservoir Discharge Table

Elevation	Discharge (cfs) (SWQ Outlet Box)	Discharge (cfs) (Twin CBC Spillway)	Discharge (cfs) (Total)
7531.0	0.0	0.0	0.0
7532.0	13.89	0.0	13.89
7533.0	27.77	0.0	27.77
7534.0	51.31	49.05	100.36
7535.0	69.52	138.56	208.08
7536.0	74.61	254.72	329.33

Permanent WSE = 7531.0

Top of SWQ Outlet box = 7533.0

Spillway elevation = 7533.0

Table 5.4: Storage Capacity Table

Elevation NGVD 1929	Area (Acres)	Storage Volume (Ac. Ft.)
*7510.0	1.51	0.00
*7511.0	1.99	1.74
*7512.0	2.52	3.99
*7513.0	2.85	6.68
*7514.0	3.05	9.63
*7515.0	3.26	12.78
7516.0	3.48	16.15
7517.0	3.70	19.74
7518.0	3.93	23.56
7519.0	4.16	27.60
7520.0	4.40	31.88
7521.0	4.64	36.40
7522.0	4.88	41.16
7523.0	5.14	46.17
7524.0	5.36	51.42
7525.0	5.59	56.89
7526.0	5.84	62.61
7527.0	6.08	68.57
7528.0	6.33	74.77
7529.0	6.57	81.22
7530.0	6.81	87.91
7531.0	7.15	94.89
7532.0	7.52	102.22
7533.0	7.83	109.90
7534.0	8.37	118.00
7535.0	8.77	126.57
7536.0	9.17	135.53

*Indicates dead storage below pumping ability

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	— 6910 —
BASIN BOUNDARY EAST CHERRY CREEK	🟩 🟩 🟩 🟩
MAJOR BASIN BOUNDARY	🟪 🟪
BASIN IDENTIFIER →	BB
AREA IN ACRES →	10.0
EXISTING DIRECTION OF FLOW	⇨
PROPOSED DIRECTION OF FLOW	➡
STORM SEWER	🟥 🟥 🟥 🟥

N

200 100 0 200 400

SCALE: 1" = 200'

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FLYING HORSE NORTH
IRRIGATION RESERVOIR
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 9–20–17
DRAWN BY	MAW	(H) 1"= 200'	SHEET 1 OF 1
CHECKED BY		(V) 1"= N/A	JOB NO. 1096.11

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September 2005

U.S. Department of Transportation

Federal Highway Administration

Hydraulic Engineering Circular No. 15, Third Edition

Design of Roadside Channels with Flexible Linings

National Highway Institute

Table 2.1. Typical Roughness Coefficients for Selected Linings

		Manning's n[1]		
Lining Category	**Lining Type**	**Maximum**	**Typical**	**Minimum**
Rigid	Concrete	0.015	0.013	0.011
	Grouted Riprap	0.040	0.030	0.028
	Stone Masonry	0.042	0.032	0.030
	Soil Cement	0.025	0.022	0.020
	Asphalt	0.018	0.016	0.016
Unlined	Bare Soil[2]	0.025	0.020	0.016
	Rock Cut (smooth, uniform)	0.045	0.035	0.025
RECP	Open-weave textile	0.028	0.025	0.022
	Erosion control blankets	0.045	0.035	0.028
	Turf reinforcement mat	0.036	0.030	0.024

[1] Based on data from Kouwen, et al. (1980), Cox, et al. (1970), McWhorter, et al. (1968) and Thibodeaux (1968).

[2] Minimum value accounts for grain roughness. Typical and maximum values incorporate varying degrees of form roughness.

Table 2.2. Typical Roughness Coefficients for Riprap, Cobble, and Gravel Linings

		Manning's n for Selected Flow Depths[1]		
Lining Category	**Lining Type**	**0.15 m (0.5 ft)**	**0.50 m (1.6 ft)**	**1.0 m (3.3 ft)**
Gravel Mulch	D_{50} = 25 mm (1 in.)	0.040	0.033	0.031
	D_{50} = 50 mm (2 in.)	0.056	0.042	0.038
Cobbles	D_{50} = 0.10 m (0.33 ft)	--[2]	0.055	0.047
Rock Riprap	D_{50} = 0.15 m (0.5 ft)	--[2]	0.069	0.056
	D_{50} = 0.30 m (1.0 ft)	--[2]	--[2]	0.080

[1] Based on Equation 6.1 (Blodgett and McConaughy, 1985). Manning's n estimated assuming a trapezoidal channel with 1:3 side slopes and 0.6 m (2 ft) bottom width.

[2] Shallow relative depth (average depth to D_{50} ratio less than 1.5) requires use of Equation 6.2 (Bathurst, et al., 1981) and is slope-dependent. See Section 6.1.

2.2 SHEAR STRESS

2.2.1 Equilibrium Concepts

Most highway drainage channels cannot tolerate bank instability and possible lateral migration. Stable channel design concepts focus on evaluating and defining a channel configuration that will perform within acceptable limits of stability. Methods for evaluation and definition of a stable configuration depend on whether the channel boundaries can be viewed as:

- essentially rigid (static)
- movable (dynamic).

In the first case, stability is achieved when the material forming the channel boundary effectively resists the erosive forces of the flow. Under such conditions the channel bed and banks are in protected. Therefore permissible shear stress is not significantly affected by the erodibility of the underlying soil. However, if the lining moves, the underlying soil will be exposed to the erosive force of the flow.

Table 2.3 provides typical examples of permissible shear stress for selected lining types. Representative values for different soil types are based on the methods found in Chapter 4 while those for gravel mulch and riprap are based on methods found in Chapter 7. Vegetative and RECP lining performance relates to how well they protect the underlying soil from shear stresses so these linings do not have permissible shear stresses independent of soil types. Chapters 4 (vegetation) and 5 (RECPs) describe the methods for analyzing these linings. Permissible shear stress for gabion mattresses depends on rock size and mattress thickness as is described in Section 7.2.

Table 2.3. Typical Permissible Shear Stresses for Bare Soil and Stone Linings

		Permissible Shear Stress	
Lining Category	Lining Type	N/m^2	lb/ft^2
Bare Soil[1] Cohesive (PI = 10)	Clayey sands	1.8-4.5	0.037-0.095
	Inorganic silts	1.1-4.0	0.027-0.11
	Silty sands	1.1-3.4	0.024-0.072
Bare Soil[1] Cohesive (PI $\geq$ 20)	Clayey sands	4.5	0.094
	Inorganic silts	4.0	0.083
	Silty sands	3.5	0.072
	Inorganic clays	6.6	0.14
Bare Soil[2] Non-cohesive (PI < 10)	Finer than coarse sand D_{75}<1.3 mm (0.05 in)	1.0	0.02
	Fine gravel D_{75}=7.5 mm (0.3 in)	5.6	0.12
	Gravel D_{75}=15 mm (0.6 in)	11	0.24
Gravel Mulch[3]	Coarse gravel D_{50} = 25 mm (1 in)	19	0.4
	Very coarse gravel D_{50} = 50 mm (2 in)	38	0.8
Rock Riprap[3]	D_{50} = 0.15 m (0.5 ft)	113	2.4
	D_{50} = 0.30 m (1.0 ft)	227	4.8

[1] Based on Equation 4.6 assuming a soil void ratio of 0.5 (USDA, 1987).
[2] Based on Equation 4.5 derived from USDA (1987)
[3] Based on Equation 6.7 with Shield's parameter equal to 0.047.

2.3 DESIGN PARAMETERS

2.3.1 Design Discharge Frequency

Design flow rates for permanent roadside and median drainage channel linings usually have a 5 or 10-year return period. A lower return period flow is allowable if a transitional lining is to be used, typically the mean annual storm (approximately a 2-year return period, i.e., 50 percent probability of occurrence in a year). Transitional channel linings are often used during the establishment of vegetation. The probability of damage during this relatively short time is low,

TABLE 10-1

COMPOSITE ROUGHNESS COEFFICIENTS FOR UNLINED OPEN CHANNELS (Reference: Chow, Ven Te, 1959; Open-Channel Hydraulics)

$$n = (n_o + n_1 + n_2 + n_3 + n_4)m \qquad (10\text{-}2)$$

	Channel Conditions	Value
Material Type n_o	Earth	0.020
	Fine Gravel	0.024
	Coarse Gravel	0.028
Degree of Irregularity n_1	Smooth	0.000
	Minor	0.005
	Moderate	0.010
	Severe	0.020
Variation of Channel Cross Section n_2	Gradual	0.000
	Alternating Occasionally	0.005
	Alternating Frequently	0.010 - 0.015
Relative Effect of Obstructions n_3	Negligible	0.000
	Minor	0.010 - 0.015
	Appreciable	0.020 - 0.030
	Severe	0.040 - 0.060
Vegetation n_4	Low	0.005 - 0.010
	Medium	0.010 - 0.025
	High	0.025 - 0.050
	Very High	0.050 - 0.100
Degree of Meandering m	Minor	1.000 - 1.200
	Appreciable	1.200 - 1.500
	Severe	1.500

- significant uncertainty regarding the design discharge
- consequences of failure are high

The basic procedure for flexible lining design consists of the following steps and is summarized in Figure 3.1. (An alternative process for determining an allowable discharge given slope and shape is presented in Section 3.6.)

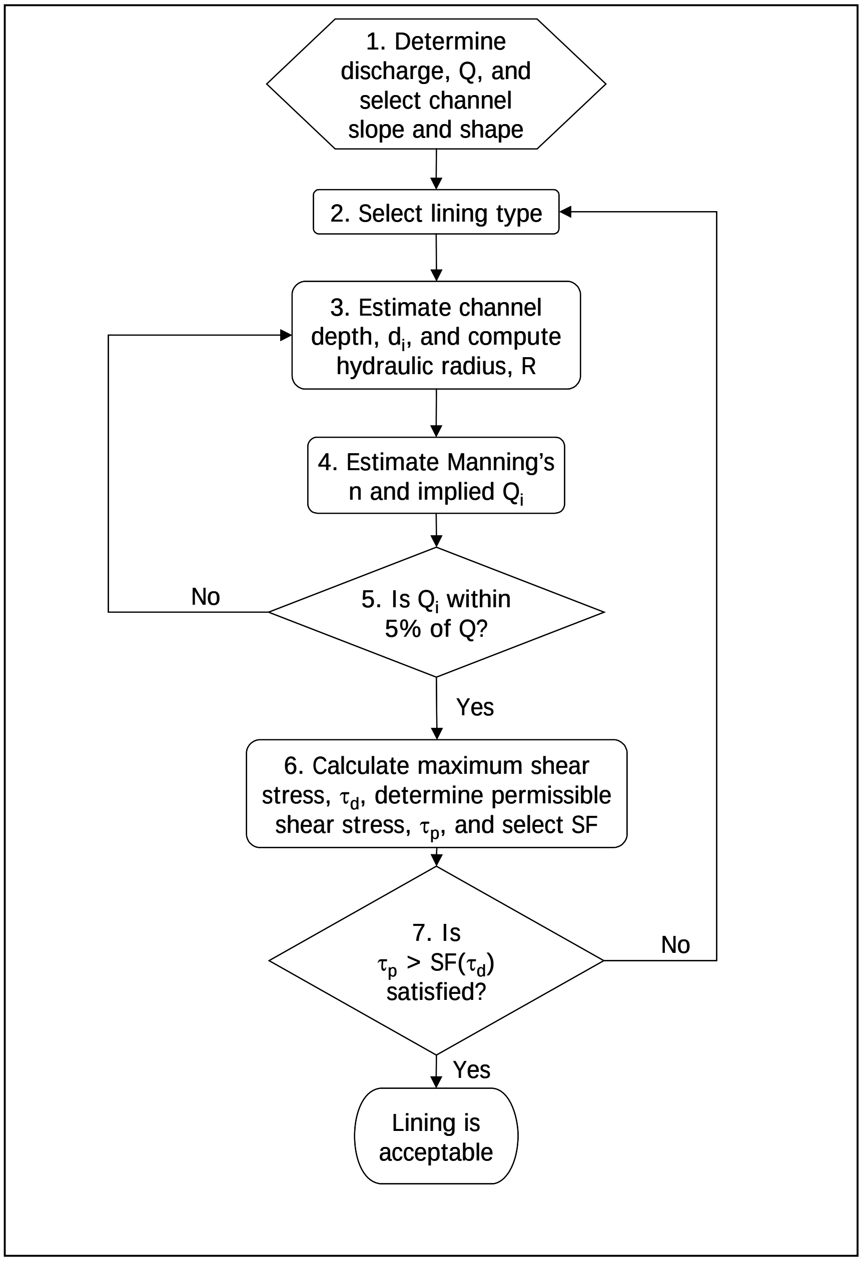
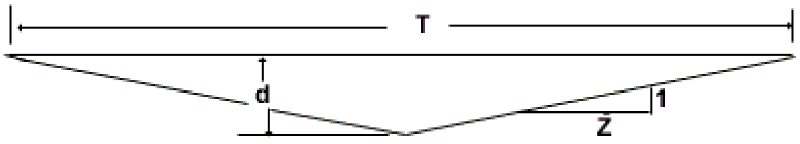

1. Determine discharge, Q, and select channel slope and shape
2. Select lining type
3. Estimate channel depth, d_i, and compute hydraulic radius, R
4. Estimate Manning's n and implied Q_i
5. Is Q_i within 5% of Q?
No
Yes
6. Calculate maximum shear stress, τ_d, determine permissible shear stress, τ_p, and select SF
7. Is $\tau_p > SF(\tau_d)$ satisfied?
No
Yes
Lining is acceptable

Figure 3.1. Flexible Channel Lining Design Flow Chart

APPENDIX B: CHANNEL GEOMETRY EQUATIONS

V- SHAPE

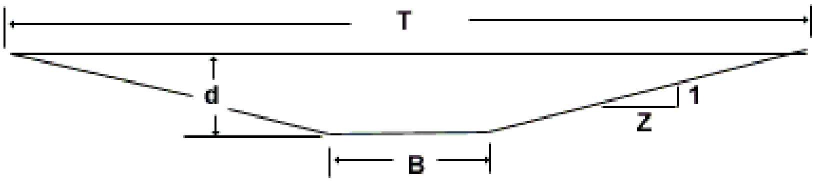


$A = Zd^2$

$p = 2d\sqrt{Z^2 + 1}$

$T = 2dZ$

TRAPEZOIDAL

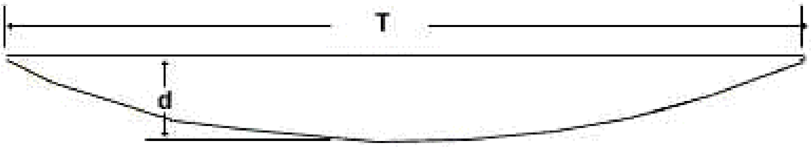


$A = Bd + Zd^2$

$P = B + 2d\sqrt{z^2 + 1}$

$T = B + 2dZ$

PARABOLIC

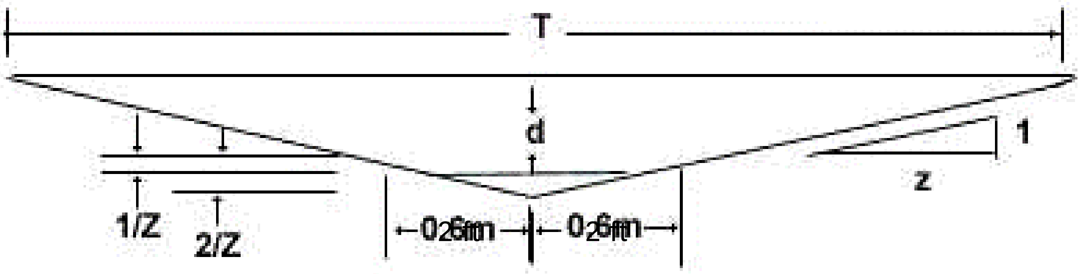


$A = \frac{2}{3} Td$

$P = \frac{1}{2}\sqrt{16d^2 + T^2} + \left(\frac{T^2}{8d}\right) \ln_e \left(\frac{4d + \sqrt{16d^2 + T^2}}{T}\right)$

$T = 1.5 \frac{A}{d}$

V-SHAPE WITH ROUNDED BOTTOM



2 CASES

No. 1

If d ≤ 1/Z, then:

$$A = \frac{8}{3} d\sqrt{dZ}$$

$$P = 2Z\ln_e\left(\sqrt{\frac{d}{Z}} + \sqrt{1+\frac{d}{Z}}\right) + 2\sqrt{d^2 + dZ}$$

$$T = 4\sqrt{dZ}$$

No. 2

If d > 1/Z, then:

$$A = \frac{8}{3} d + 4\left(d - \frac{1}{Z}\right) + Z\left(d - \frac{1}{Z}\right)^2$$

$$P = 2Z\ln_e\left(\frac{1+\sqrt{Z^2+1}}{Z}\right) + 2\frac{\sqrt{Z^2+1}}{Z} + 2\left(d - \frac{1}{Z}\right)\sqrt{1+Z^2}$$

$$T = 4 + 2Z\left(d - \frac{1}{Z}\right)$$

Note: The equations for V-shape with rounded bottom only apply in customary units for a channel with a 4 ft wide rounded bottom.

ROADSIDE DITCH CALCUALTIONS

Limits of specific Ditch Lining relative to max. slope

	Erosion Control Blanket (ECB)	**Turf Reinforcement Mat (TRM)**	**Revegetation - Grass lined**
	(North American Green - SC150)	**(North American Green - P300)**	**(Native Seed Mix)**
Given:	**(Temporary - 24 months)**	**(Permanent)**	
Max. Design Flow (cfs)	7.4	70.0	4.3
Permissible Shear (lbs/ft.^{2})	2.0	8.0	2.0
Permissible Velocity (ft./sec.)	8.0	16.0	3.0
Safety Factor	1	1	1
Max. Ditch Slope	5%	10%	2%
Ditch Section (24 in. depth)	V-Ditch	V-Ditch	V-Ditch
Flow Area (ft.^{2})	1.69	6.25	1.44
Wetted Perimeter (ft.)	5.37	10.33	4.96
Hydraulic Radius	0.31	0.61	0.29
Mannings n	0.035	0.030	0.030
Depth of Flow (max.)	0.65	1.25	0.60
Calculations:			
Shear Stress (lbs/ft.^{2})	2.0	7.8	0.7
Velocity (ft./sec.)	4.4	11.2	3.0
Allowed Flow (cfs)	7.4	70.2	4.4

ROADSIDE DITCH CALCUALTIONS

Limits of specific Ditch Lining relative to max. flow

	Erosion Control Blanket (ECB)	**Turf Reinforcement Mat (TRM)**	**Revegetation - Grass lined**
	(North American Green - SC150)	**(North American Green - P300)**	**(Native Seed Mix)**
Given:	**(Temporary - 24 months)**	**(Permanent)**	
Max. Design Flow (cfs)	43.8	70.0	4.3
Permissible Shear (lbs/ft.^{2})	2.0	8.0	2.0
Permissible Velocity (ft./sec.)	8.0	16.0	3.0
Safety Factor	1	1	1
Max. Ditch Slope	2%	10%	2%
Ditch Section (24 in. depth)	V-Ditch	V-Ditch	V-Ditch
Flow Area (ft.^{2})	9.00	6.25	1.44
Wetted Perimeter (ft.)	12.39	10.33	4.96
Hydraulic Radius	0.73	0.61	0.29
Mannings n	0.035	0.030	0.030
Depth of Flow (max.)	1.50	1.25	0.60
Calculations:			
Shear Stress (lbs/ft.^{2})	1.9	7.8	0.7
Velocity (ft./sec.)	4.9	11.2	3.0
Allowed Flow (cfs)	43.8	70.2	4.4

ROLLMAX™
ROLLED EROSION CONTROL

ROLLED
EROSION CONTROL

SYSTEMS BROCHURE

NORTH AMERICAN GREEN®

Temporary RollMax™ Solutions

Erosion control has never been so simple yet effective. North American Green RollMax™ temporary Erosion Control Blankets (ECBs) provide immediate erosion protection and vegetation establishment assistance, then degrade once the vegetation's root and stem systems are mature enough to stabilize the soil.

Our high-quality temporary solutions are available in varying functional longevities and materials:

- Short-term photodegradable blankets with a functional longevity of 45 days up to 12 months
- Extended-term and long-term photodegradable blankets for protection up to 36 months
- Short-term biodegradable blankets for protection up to 12 months
- Extended-term and long-term biodegradable products for protection and mulching from 18 to 24 months

ERONET™ EROSION CONTROL BLANKETS

North American Green EroNet™ ECBs incorporate photodegradable nettings, which means they are broken down by the ultraviolet rays in sunlight. These temporary products can be used in a variety of scenarios, including moderate to steep slopes, medium-to high-flow channels, shorelines and other areas needing protection until permanent vegetation establishment.

EroNet™ C125® Long-Term Photodegradable Double-Net Coconut Blanket

The C125® ECB is made of 100% coconut fiber stitched between heavyweight UV-stabilized polypropylene nets. It offers excellent durability, erosion control and longevity for severe slopes, steep embankments, high-flow channels and other areas where vegetation may take up to 36 months to grow in.

The EroNet temporary ECBs are designed to provide immediate erosion protection and vegetation establishment assistance, and then degrade after the vegetation is mature enough to permanently stabilize the underlying soil. Both short-term and extended-term ECBs are available.

EroNet™ SC150® Extended-Term Photodegradable Double-Net Straw/Coconut Blanket

With a layer of 70% straw and 30% coconut fiber stitched between a heavyweight UV-stabilized polypropylene top net and a lightweight photodegradable polypropylene bottom net, the SC150® ECB has increased durability, erosion control capabilities and longevity. It is suitable for steeper slopes, medium-flow channels and other areas where it may take vegetation up to 24 months to grow in.

EroNet™ S150® Short-Term Photodegradable Double-Net Straw Blanket

The S150 ECB is made with a 100% straw fiber matrix stitched between lightweight photodegradable polypropylene top and bottom nets. The S150 ECB's double-net construction has greater structural integrity than single net blankets for use on steeper slopes and in channels with moderate water flow. It provides erosion protection and mulching for up to 12 months.

EroNet™ DS150™ Ultra Short-Term Photodegradable Double-Net Straw Blanket

The DS150™ ECB is suitable for high maintenance areas where close mowing will occur soon after installation. Special additives in the thread and top and bottom net ensure it degrades in adequate sunlight within 60 days.

EroNet™ S75® Short-Term Photodegradable Single-Net Straw Blanket

The S75® ECB protects and mulches moderate slopes and low-flow channels in low maintenance areas for up to 12 months. It is constructed of 100% straw fiber stitched with degradable thread to a lightweight photodegradable polypropylene top net.

EroNet™ DS75™ Ultra Short-Term Photodegradable Single-Net Straw Blanket

Designed for high maintenance areas where close mowing will occur soon after installation, the DS75™ ECB degrades within 45 days because of special additives in the thread and top net that facilitate rapid breakdown in adequate sunlight.

Every site has its own unique characteristics and challenges. EroNet Erosion Control Blankets are available in varying longevities to suit a variety of scenarios and conditions.

With our Erosion Control Materials Design Software (ECMDS), you can select either short-term, extended-term or long-term EroNet blankets based on your specific design needs.

Permanent RollMax™ Solutions

Back in the day, rock riprap, articulated concrete blocks and poured concrete were the only way to deal with erosion in high-flow channels, on shorelines and other areas where water and/or wind exceed the shear limits of unreinforced vegetation.

Not anymore. North American Green permanent Turf Reinforcement Mats (TRMs) use 100% synthetic components or a composite of synthetic and natural materials for long-term erosion protection and vegetation establishment. Whether com-pared to rock riprap or concrete, the RollMax™ Systems' permanent TRMs offer a number of significant advantages:

- Prevent loss of precious topsoil to wind and water erosion
- Permanently reinforce vegetation root and stem structures
- Provide excellent conditions for quick, healthy vegetation growth
- Stabilize slopes from erosion to keep roadways safe and clean
- Protect water quality in lakes, rivers and streams
- Protect dormant seeding during winter months
- Easily conform to landscape features
- Lightweight for easy handling and transportation

VMAX® COMPOSITE TURF REINFORCEMENT MATS

VMax® C-TRMs combine three-dimensional matting with fiber matrix material for permanent erosion control on severe slopes, spillways, stream banks, shorelines and in high- to extreme-flow channels. These extensively tested products provide maximum performance through all three phases of reinforced vegetative lining development: unvegetated, establishment, and maturity. Incorporating the best performance features of temporary and permanent North American Green erosion control products, VMax C-TRMs deliver these tangible benefits:

- Surface-applied for the highest level of immediate soil protection
- Less than one third of the installed cost of rock or concrete
- No heavy equipment needed to install
- More attractive and effective "Green" alternative than rock riprap or concrete

VMax® High-Performance TRMs (HPTRMs)

VMax® HPTRMs utilize patent-pending woven 3-D structures that are soil-filled for use in areas experiencing high stress and strain. The VMax HPTRMs are designed to provide appropriate thickness and open area for effective erosion and vegetation reinforcement against high flow induced shear forces. Our HPTRMs are excellent for increased bearing capacity of vegetated soils subjected to heavy loads from maintenance equipment and other vehicular traffic.

The TRMs easily conform to various landscape features to prevent the loss of precious topsoil.

The RollMax TRMs are installed in a one-step operation directly over the prepared seedbed saving time and money and ensuring the highest level of erosion control and vegetation reinforcement.

VMAx® TMaxTM Permanent HPTRM

The TMax HPTRM woven polypropylene technology is designed to provide appropriate thickness and open area for effective erosion and vegetation reinforcement against high flow induced shear forces up to 15 pfs (kN/m2), and with the highest tensile strength on the market up to 5,000 lbs/ft (73 kN/m). TMax maybe used as an alternative to hard armor system in extreme erosion control applications.

VMax® P550® Permanent TRM

P550® TRM has a polypropylene fiber matrix augmenting the permanent netting structure with permanent mulching and erosion control performance. Unvegetated, the P550 TRM reduces soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 4.0 lbs/ft^2 (191 Pa). The ultra-strong structure drives the vegetated shear resistance up to 14 lbs/ft^2 (672 Pa). The P550 TRM may be used as an alternative for poured concrete or articulated concrete blocks in extreme erosion control projects.

VMax® C350® Permanent TRM

A 100% coconut fiber matrix supplements the C350's permanent three-dimensional netting structure with initial mulching and erosion control performance for up to 36 months. Unvegetated, the C350® TRM reduces soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.2 lbs/ft^2 (153 Pa) and boosts permanent vegetation performance up to 12 lbs/ft^2 (576 Pa). This environmentally friendly alternative to 30 in. (76 cm) or larger rock riprap is ideal for severe erosion control projects.

VMax® SC250® Permanent TRM

The SC250® permanent TRM has a 70% straw/30% coconut fiber matrix to enhance initial mulching and erosion control performance for up to 24 months. Unvegetated, SC250 TRMs reduce soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.0 lbs/ft^2, and increases permanent vegetation performance up to 10 lbs/ft^2 (480 Pa) for a green alternative to rock riprap.

ERONET™ PERMANENT EROSION CONTROL BLANKETS

The EroNet™ Permanent ECB provides immediate erosion protection and vegetation establishment assistance until vegetation roots and stems mature.

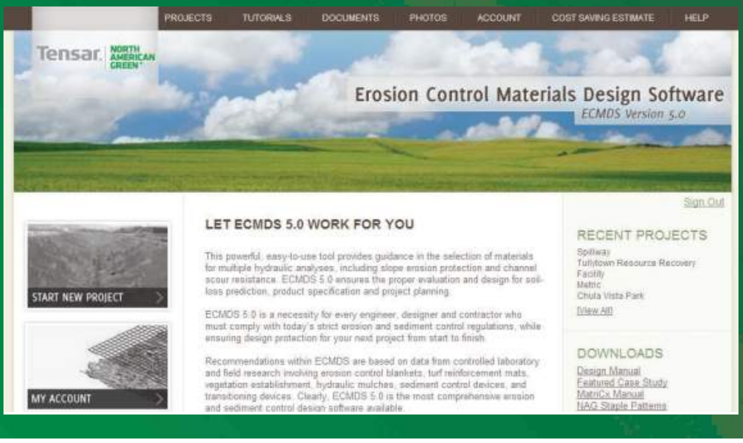
EroNet™ P300® Permanent Erosion Control Blankets

The P300® permanent erosion control blanket consists of UV-stabilized polypropylene fiber stitched between heavy-weight UV-stabilized polypropylene top and bottom nets. These mats reduce soil loss and protect vegetation from being washed away or uprooted, even under high stress. Unvegetated, they reduce soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.0 lbs/ft^2 (144 Pa), and protect vegetation from being washed away or uprooted when exposed to shear stresses up to 8 lbs/ft^2 (383 Pa).

To boost performance of the VMax turf reinforcement mats in critical applications, combine with our ShoreMax® flexible transition mat to create a system that can dramatically elevate the permissible shear stress and velocity protection beyond many hard armor solutions.

VMax Mats are perfect for pipe outlets, channel bottoms, shoreline transition zones, and other areas subjected to highly turbulent water flows.

Design and Installation Tools



Erosion Control Materials Design Software

ECMDS Version 5.0

LET ECMDS 5.0 WORK FOR YOU

This powerful, easy-to-use tool provides guidance in the selection of materials for multiple hydraulic analyses, including slope erosion protection and channel scour resistance. ECMDS 5.0 ensures the proper evaluation and design for soil-loss prediction, product specification and project planning.

ECMDS 5.0 is a necessity for every engineer, designer and contractor who must comply with today's strict erosion and sediment control regulations, while ensuring design protection for your next project from start to finish.

Recommendations within ECMDS are based on data from controlled laboratory and field research involving erosion control blankets, turf reinforcement mats, vegetation establishment, hydraulic mulches, sediment control devices, and transitioning devices. Clearly, ECMDS 5.0 is the most comprehensive erosion and sediment control design software available.

RECENT PROJECTS

Spillway
Tullytown Resource Recovery Facility
Metric
Chula Vista Park
[View All]

DOWNLOADS

Design Manual
Featured Case Study
MatriCx Manual
NAG Staple Patterns

SHIFT, CONTROL, ENTER

Professional guidance on RECP selection, design and project planning is at your fingertips with Tensar's proprietary Erosion Control Materials Design Software (ECMDS®). This web-based program incorporates design methodologies from the Federal Highway Administration and United States Department of Agriculture to analyze your specific site conditions, and make quantified recommendations based on data from controlled laboratory and field research. ECMDS is a must-have if you face tough erosion and sediment control regulations. Best of all, it's free of charge, compliments of North American Green. To learn more and access the software directly, go to **www.ECMDS.com**.

INSTRUCTIONS INCLUDED

Proper anchoring patterns and rates must be used to achieve optimal results in RECP installation. View our installation guides for stapling patterns. Site specific staple pattern recommendations based on soil type and severity of application may be acquired through our ECMDS.

HOLD ON TIGHT

When under the pressure of severe conditions, even the best erosion control products can't function to their full potential without proper installation and anchoring. North American Green supplies a wide variety of fastener options for nearly every application and soil type.

For use in cohesive soils, wire staples are a cost-effective means to fasten RECPs. Available in 6 in., 8 in., 10 in. and 12 in. lengths, our U-shaped staples can reach to various depths to ensure adequate pull-out resistance. For installation using our handy Pin Pounder installation tool, 6 in. V-top staples or 6 in. circle top pins are available.

Our biodegradable BioStakes® are available in 4 in. and 6 in. lengths and provide an environmentally friendly alternative to metal staples. For an even more durable, deeper reaching yet all-natural anchoring option, our wood EcoStakes® are available in 6 in., 12 in., 18 in. and 24 in. lengths.

For severe applications needing the ultimate, long-lasting hold, try our 12 and 18 in. rebar staples, our 12 in. plastic ShoreMax® stakes, or our complete line of percussion earth anchors. The Tensar earth anchors reach deep into the soil strata to offer enhanced anchoring in the worst conditions. Our variety of earth anchors are designed for durability and holding power under extreme hydraulic stresses and adverse soil conditions *(Table 1)*.

For more information on the RollMax Systems or other systems within the North American Green Erosion Control Solutions, call **800-772-2040** or visit **nagreen.com**.

Earth Anchor Options

					EA 400		EA 680	
	Tendon Type ($^3/_{32}$ in. x 36 in.)	**Assembly Description**	**Fast Install**	**Economic Anchor**	**Stainless**	**Galvanized**	**Stainless**	**Galvanized**
End Piece Options with a PVC Face Plate	**Copper Stop Sleeve** with Stainless Steel Washer	Manually crimped to the stainless steel cable to secure the face plate.		X	X		X	
	Grip End Piece with Stainless Steel Washer	Three-dimensional, self-securing metal end piece that does not require manual crimping for tendon tensioning.	X	X	X	X	X	X
	Wedge Grip Piece	Self-securing end piece that installs flush to the face plate. Does not require manual crimping for tendon tensioning.	X		X	X	X	X
	Aluminum Stop Sleeve with Stainless Steel Washer	Manually crimped to the galvanized cable to secure the face plate.		X		X		X

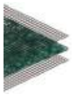
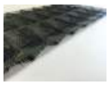
TABLE 1

The complete line of RollMax™ products offers a variety of options for both short-term and permanent erosion control needs. Reference the RollMax Products Chart below to find the right solution for your next project.

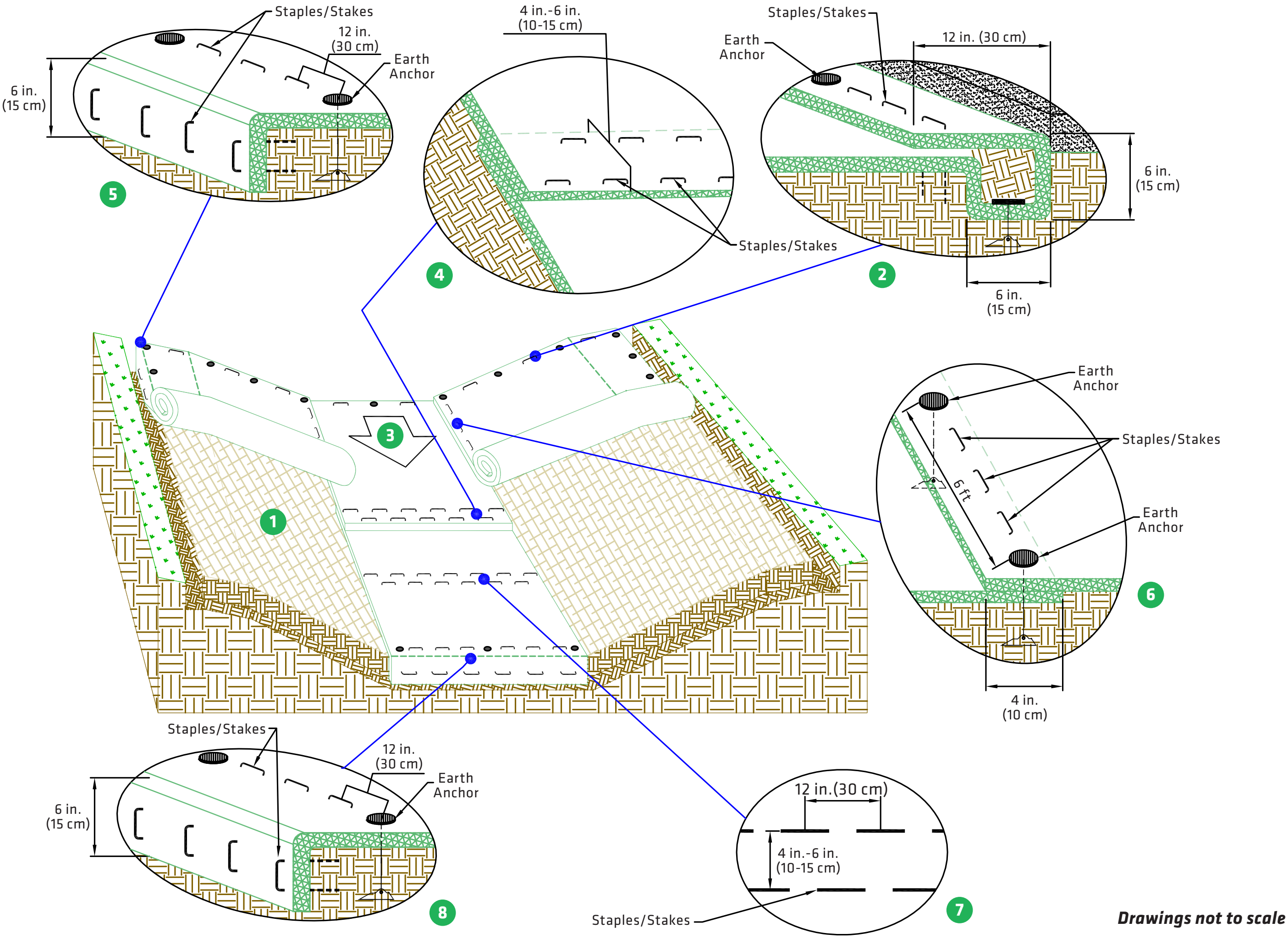
RollMax Product Selection Chart

TEMPORARY					
	Product Description	**Longevity**	**Applications**	**Design Permissible Shear Stress lbs/ft^2 (Pa)**	**Design Permissible Velocity ft/s (m/s)**
ERONET					
DS75	1.5 lb., accelerated photodegradable, polypropylene top net, 100% straw fiber matrix	45 days	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.55 (74)	Unvegetated 5.0 (1.52)
DS150	1.5 lb., photodegradable, polypropylene top & bottom net, 100% straw fiber matrix	60 days	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.75 (84)	Unvegetated 6.0 (1.83)
S75	1.5 lb., photodegradable, polypropylene top net, 100% straw fiber matrix	12 months	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.55 (74)	Unvegetated 5.0 (1.52)
S150	1.5 lb., photodegradable, polypropylene top & bottom net, 100% straw fiber matrix	12 months	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.75 (84)	Unvegetated 6.0 (1.83)
SC150	2.9 lb., UV-stable polypropylene top net, 70% straw/30% coconut fiber matrix, 1.5 lb., photodegradable polypropylene bottom net	24 months	Medium Flow Channels 2:1 - 1:1 Slopes	Unvegetated 2.0 (96)	Unvegetated 8.0 (2.44)
C125	2.9 lb., UV stable polypropylene top & bottom nets, 100% coconut fiber matrix	36 months	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.25 (108)	Unvegetated 10.0 (3.05)
BIONET					
S75BN	9.3 lb., leno woven biodegradable jute top net, 100% straw fiber matrix	12 months	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.60 (76)	Unvegetated 5.0 (1.52)
S150BN	9.3 lb., leno woven biodegradable jute top net, 100% straw fiber matrix, 7.7 lb., woven biodegradable jute bottom net	12 months	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.85 (88)	Unvegetated 6.0 (1.83)
SC150BN	9.3 lb., leno woven biodegradable jute top net, 70% straw/30% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	18 months	Medium Flow Channels 2:1 - 1:1 Slopes	Unvegetated 2.10 (100)	Unvegetated 8.0 (2.44)

TEMPORARY

	Product Description	Longevity	Applications	Design Permissible Shear Stress lbs/ft^2 (Pa)	Design Permissible Velocity ft/s (m/s)
BIONET CONT'D					
C125BN	9.3 lb., leno woven biodegradable jute top net, 100% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	24 mo.	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.35 (112)	Unvegetated 10.0 (3.05)
C700BN	143 lb., (700 g) woven biodegradable coir top net, 100% coconut fiber matrix, 7.7 lb., woven biodegrdable jute bottom net	36 mo.	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.35 (112)	Unvegetated 10.0 (3.05)
PERMANENT					
ERONET					
 P300	5.0 lb., UV-stable polypropylene top net, 100% polypropylene fiber matrix, 3.0 lb., UV-stable polypropylene bottom net	Permanent	High Flow Channels 1:1 Slopes	Unvegetated 3.0 (144) Vegetated 8.0 (383)	Unvegetated 9.0 (2.7) Vegetated 16.0 (4.9)
VMAX					
SC250	5.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 70% straw/30% coconut fiber matrix	Permanent	High Flow Channels 1:1 and Greater Slopes	Unvegetated 3.0 (144) Vegetated 10.0 (480)	Unvegetated 9.5 (2.9) Vegetated 15.0 (4.6)
C350	8.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 100% coconut fiber matrix	Permanent	High Flow Channels 1:1 and Greater Slopes	Unvegetated 3.2 (153) Vegetated 12.0 (576)	Unvegetated 10.5 (3.2) Vegetated 20.0 (6.0)
P550	24.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 100% polypropylene fiber matrix	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Unvegetated 4.0 (191) Vegetated 14.0 (672)	Unvegetated 12.5 (3.8) Vegetated 25.0 (7.6)
 TMax	100% UV-stable polypropylene monofilament yarns, woven into a 3-D structure	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Vegetated 15.0 (718)	Vegetated 25.0 (7.6)
W3000	100% UV-stable polypropylene monofilament yarns, woven into a 3-D structure	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Vegetated 16.0 (766)	Vegetated 25.0 (7.6)

Channel Installation Detail



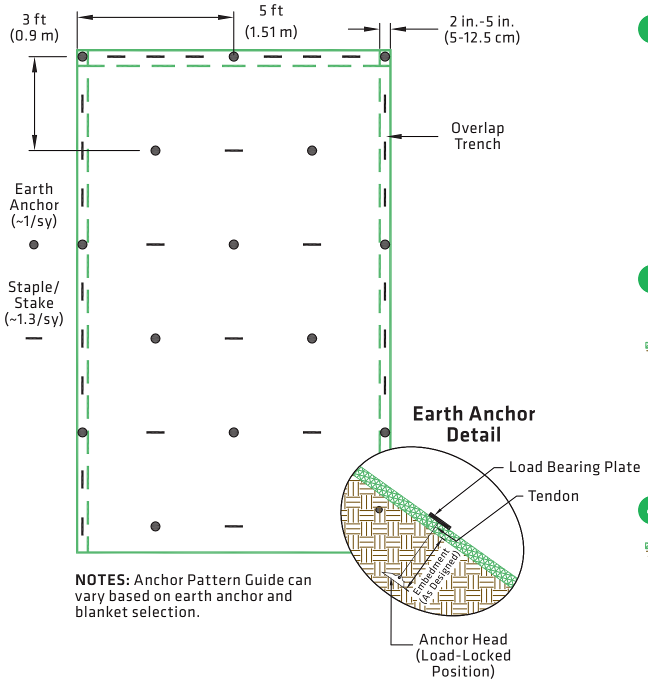
Drawings not to scale

GENERAL INSTALLATION

1. Prepare soil before installing the HPTRM, including any necessary application of soil amendments such as lime or fertilizer. See seeding and vegetating section for details regarding preseeding, overseeding or use with sod.
2. Begin at the top of the channel by anchoring the HPTRM in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench with approximately 12 in. (30 cm) of HPTRM extended beyond the upslope portion of the trench. Anchor the HPTRM with a row of anchors/staples/stakes spaced approximately 12 in. (30 cm) apart in the bottom of the trench. Backfill and compact the trench after stapling. Compact soil and fold remaining 12 in.(30 cm) portion of HPTRM back over compacted soil. Secure HPTRM over soil with a row of anchors/staples/stakes spaced approximately 12 in. (30 cm) across the width of the HPTRM.
3. Roll center HPTRM in direction of water flow in bottom of channel. HPTRMs will unroll with appropriate side against the soil surface. All HPTRMs must be securely fastened to soil surface by placing anchors/staples/stakes in appropriate locations as shown in the anchoring detail.
4. Place consecutive HPTRMs end over end (shingle style) with a 4 in. x 6 in. (10 cm-15 cm) overlap. Use a double row of staples/stakes staggered 12 in. (30 cm) apart and 12 in. (30 cm) on center to secure HPTRMs.
5. Full length edge of HPTRMs at top of side slopes must be anchored with a row of staples/stakes approximately 12 in. (30 cm) apart in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench. Backfill and compact the trench after stapling.
6. Adjacent HPTRMs must be overlapped approximately 4 in. (10 cm) and fastened.
7. In high flow channel applications, a staple/stake check slot is recommended at 30 ft to 40 ft (9 m-12 m) intervals. Use a double row of staples/stakes staggered 4 in. (10 cm) apart and 12 in. (30 cm) on center over entire width of the channel.
8. The terminal end of the HPTRMs must be anchored with a row of staples/stakes approximately 12 in. (30 cm) apart in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench. Backfill and compact the trench after stapling.

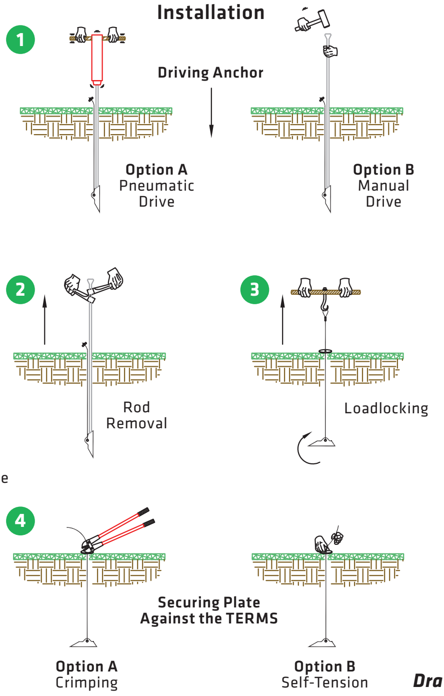
Anchoring Detail

Anchor Detail
(Shown for a 10 ft wide HPTRM)



NOTES: Anchor Pattern Guide can vary based on earth anchor and blanket selection.

Percussion
Earth Anchor
Installation



Drawings not to scale

ANCHORING DETAIL

The performance of ground anchoring devices is highly dependent on numerous site/project specific variables. It is the sole responsibility of the project engineer and/or contractor to select the appropriate anchor type and length. Anchoring shall be selected to hold the mat in intimate contact with the soil subgrade and resist pullout in accordance with the project's design intent.

1. Staples and/or stakes should be at least 6 in. (15 cm) in length and with sufficient ground penetration to resist pullout. Longer staples and/or stakes may be needed in looser soils.
2. The percussion earth anchor assembly consists of an anchor head, a tendon, a faceplate, and an end-piece device. See North American Green® Earth Anchor specification for detailed information on assembly components and associated pull-out strength.

PERCUSSION EARTH ANCHOR INSTALLATION

1. Insert the drive rod into the assembly's anchor head then use either a sledge hammer or vibratory hammer to drive the anchor to their desired depth.
2. After the desired anchor depth is achieved, retract the drive rod.
3. Lock the anchor assembly by swiftly pulling the cable upwards until the anchor head rotates as signaled by sudden resistance to pulling. A hooked setting tool may be used to aid in this step.

NOTE: *Larger anchors may require more force to set the anchor. This can be achieved through using simple mechanical equipment for greater leverage, such as a fulcrum, manual or hydraulic jack, winch, or post puller.*

4. Secure the faceplate to the High-performance Turf Reinforcement Mat (HPTRM) surface by locking the end-piece. If using a copper or aluminum stop, crimp the ferrule to secure. If using a self-tensioning end-piece (grip or wedge grip) set by simply tightening the end-piece against the faceplate. If desired, cut the remaining cable assembly, above end-piece, to desired length.

SEEDING AND VEGETATING

When using a Composite Turf Reinforcement Mat (C-TRM) with fiber components:

1. Pre-seed prepared soils prior to the installation of the C-TRM. Install matting as directed. C-TRM does not require soil infill or a top dressing of seed. Overseeding may be done as a secondary form of seeding.
2. Sod may be installed in place of seeding on top of the C-TRM. Additional staking of sod is recommended in high-flow conditions. Sodded areas should be irrigated until rooting through the mat and into subgrade occurs.

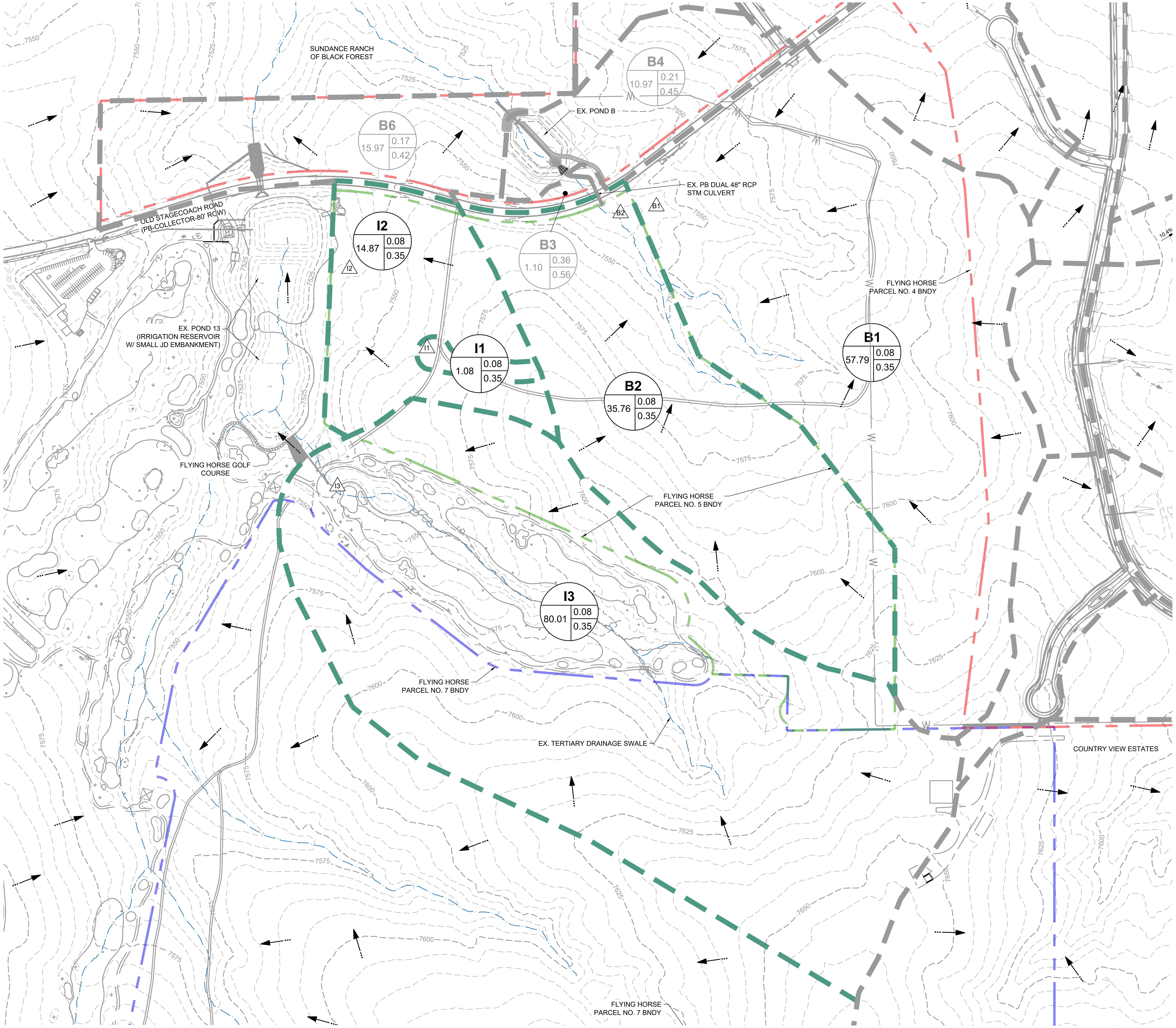
When using a woven HPTRM:

1. Install the HPTRM as directed prior to seed and soil filling.
2. Place seed into the installed HPTRM. After seeding, spread a layer of fine soil into the mat. Using the flat side of a rake, broom or other tool, completely fill the voids. Smooth soil-fill in order to just expose the top of the HPTRM matrix. Do not place excessive soil above the mat.
3. Additional seed, hydraulic mulching of the use of a temporary Erosion Control Blanket (ECB) can be applied over the soil-filled mat for increased protection.
4. Sod may be installed in place of seeding. Install HPTRM, and soil-fill as outlined above. Place sod directly onto the soil-filled HPTRM. Additional staking of sod is recommended in high-flow conditions. Sodded areas should be irrigated until rooting through the mat and into subgrade occurs.
5. Consult with a manufacturer's technical representative for installation assistance if unique conditions apply.

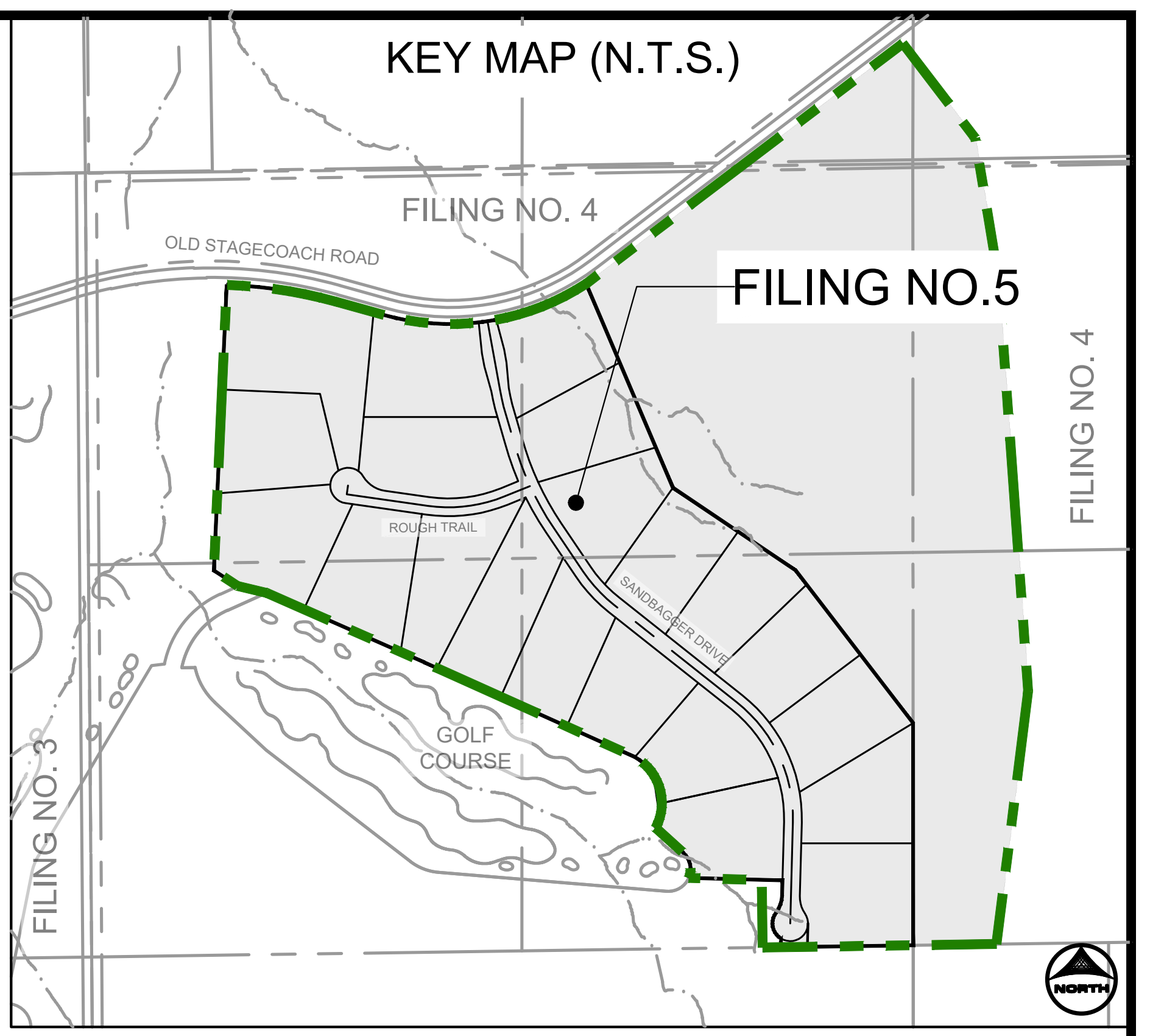
APPENDIX F

DRAINAGE MAPS

MCMUNN, THERESA, 12/12/2024 3:10 PM



KEY MAP (N.T.S.)



LEGEND:

PROPOSED MAJOR CONTOUR	5250
PROPOSED MINOR CONTOUR	
EXISTING MAJOR CONTOUR	5250
EXISTING MINOR CONTOUR	
PROPOSED STORM SEWER	
EXISTING STORM SEWER	
EXISTING DRAINAGE SWALE	
PROPOSED DRAINAGE SWALE	
EXISTING TERTIARY DRAINAGE WAY	
FILING NO. 4 PARCEL BOUNDARY	
FILING NO. 5 PARCEL BOUNDARY	
FILING NO. 7 PARCEL BOUNDARY	
FLOW DIRECTION	←
DRAINAGE BASIN	
EXISTING DRAINAGE BASIN	
DESIGN POINT	X
BASIN LABEL	

BASIN DESIGNATION: A1
AREA (AC.): 1.00
MINOR 5-YR RUNOFF COEF.: 0.40
MAJOR 100-YR RUNOFF COEF.: 0.60

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMP.	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
B1	57.8	2.0	0.08	0.35	12.7	93.5
B2	35.8	2.0	0.08	0.35	8.3	61.0
I1	1.1	2.0	0.08	0.35	0.3	2.4
I2	14.9	2.0	0.08	0.35	4.0	29.5
I3	80.0	2.0	0.08	0.35	16.6	122.0
GRAND TOTAL	189.5	2.0%	0.08	0.35	42.0	308.5

CUMULATIVE DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)	Tributary Area (ac.)	Weighted % Impervious
B1	B1	12.7	93.5	57.8	2.0
B2	B2	20.6	227.2	35.8	2.0
I1	I1	0.3	2.4	1.1	2.0
I2	I1,I2	4.3	47.6	16.0	2.0
I3	I3	16.6	122.0	80.0	2.0

PCD FILE NO.: SF2422

HR GREEN Xrefs: Parcel_Boundary; xv-row-1030; xv-util-1030; xv-dsgn-1030; xgt-1-dh01-1030.240; xc-dsgn-240; Legend_FDR_Map_Filing5_EX; key_map; XC-BASIN

DRAWN BY: TMM
APPROVED: RHL
CAD DATE: 9/5/2024
CAD FILE: J:\2021\211030\CAD\Dwgs\C\Drainage\FDR Filing 5\FHN_FDR_Filing5_EX

JOB DATE: 12/6/2024
JOB NUMBER: 211030.25.24

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

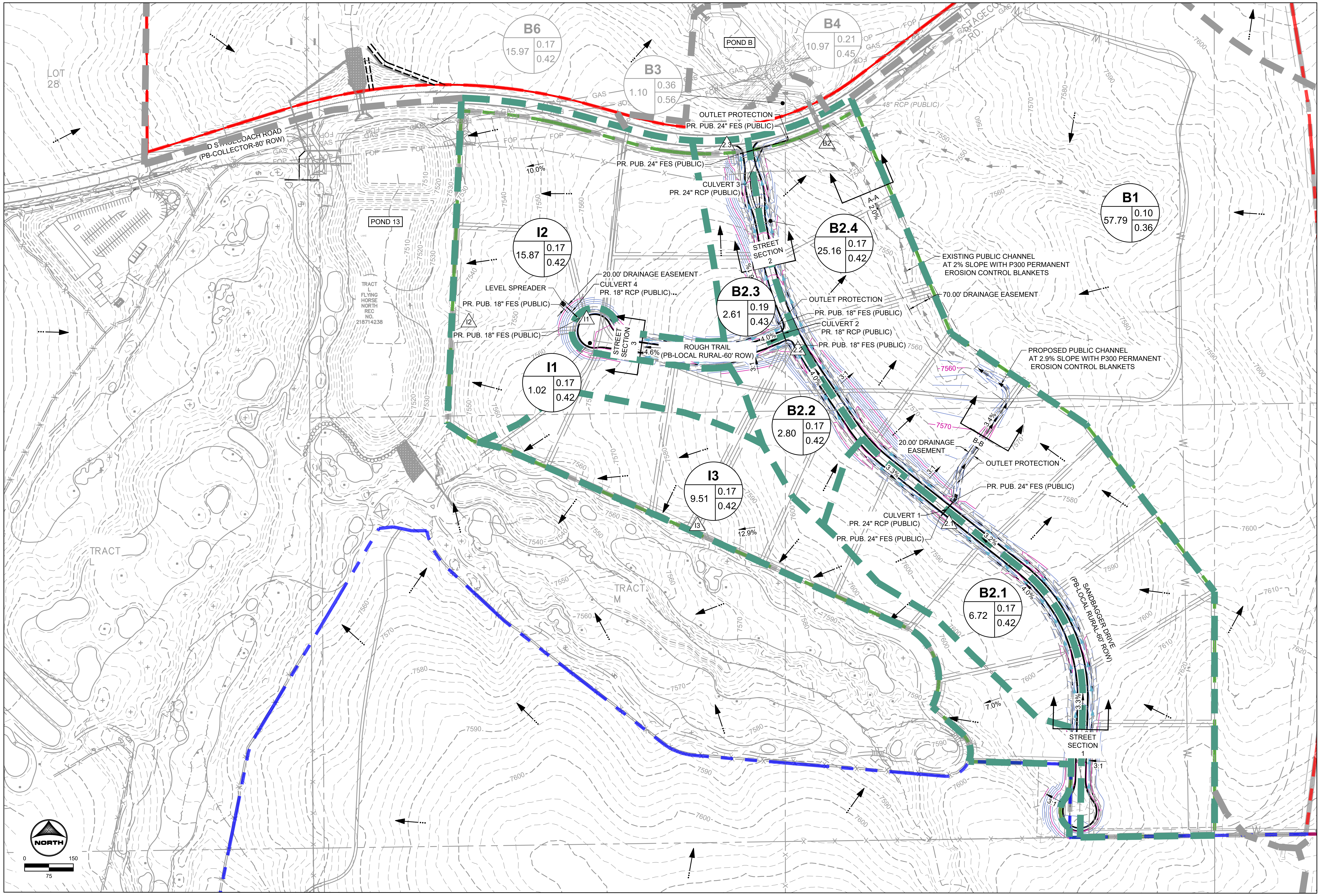
HRGreen

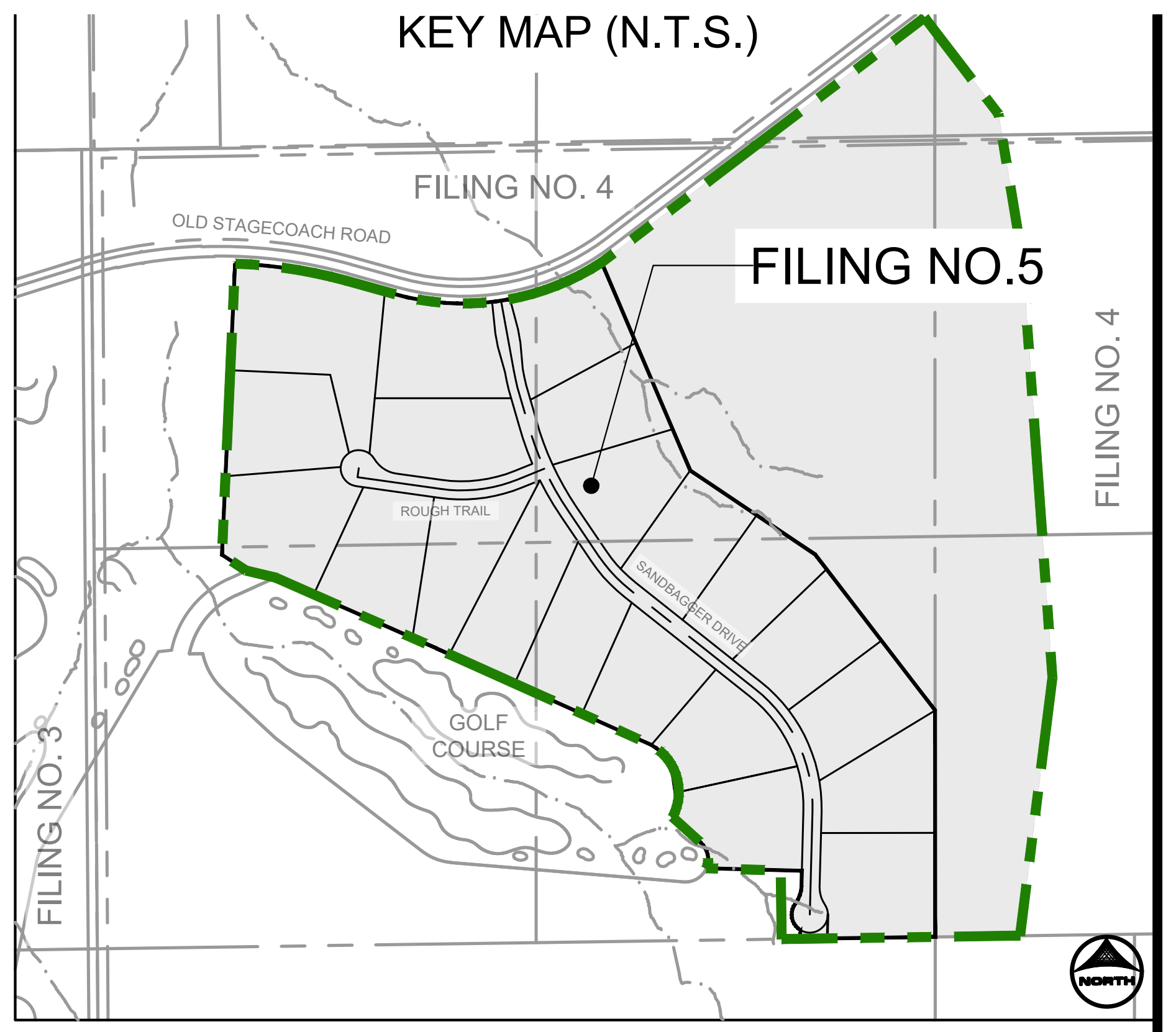
HR GREEN - COLORADO SPRINGS
1975 RESEARCH PARKWAY SUITE 160
COLORADO SPRINGS, CO 80920
PHONE: 719.300.4140
FAX: 713.965.0044

FLYING HORSE NORTH FILING 4
PRI #2, LLC.
EL PASO COUNTY, CO

FINAL DRAINAGE REPORT
EXISTING CONDITIONS DRAINAGE MAP

SHEET
DR1
1





LEGEND:

PROPOSED MAJOR CONTOUR 5250
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR 5250
EXISTING MINOR CONTOUR
PROPOSED STORM SEWER
EXISTING STORM SEWER
EXISTING DRAINAGE SWALE
PROPOSED DRAINAGE SWALE
EXISTING TERTIARY DRAINAGE WAY
FILING NO. 4 PARCEL BOUNDARY
FILING NO. 5 PARCEL BOUNDARY
FILING NO. 7 PARCEL BOUNDARY
FLOW DIRECTION ←
DRAINAGE BASIN
EXISTING DRAINAGE BASIN
DESIGN POINT X
SWALE CROSS SECTION
BASIN LABEL

A1 — BASIN DESIGNATION
1.00 — AREA (AC.)
0.40 — MINOR 5-YR RUNOFF COEF.
0.60 — MAJOR 100-YR RUNOFF COEF.

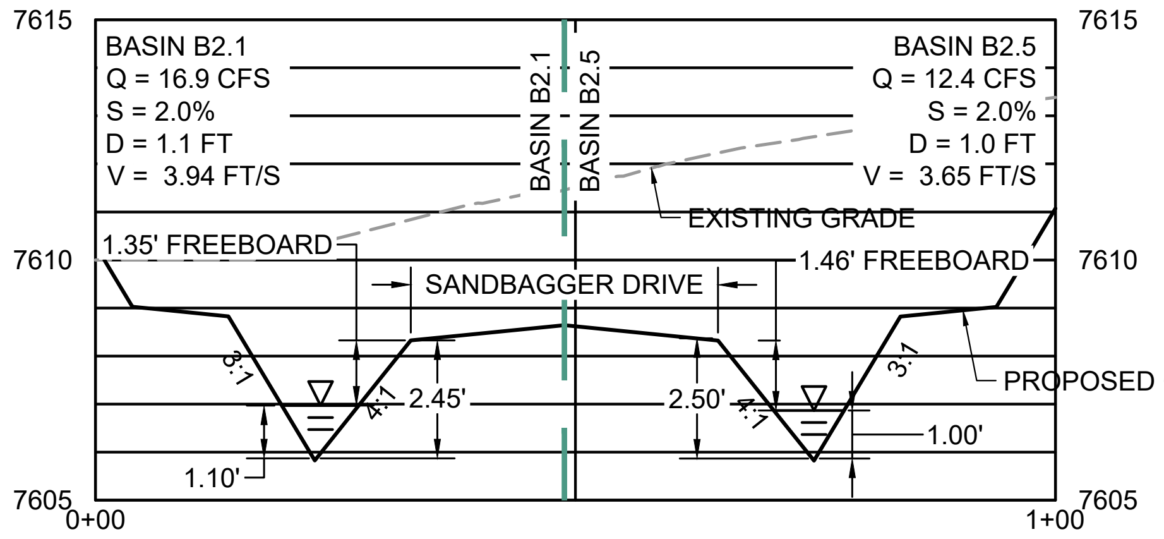
SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMP.	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
B1	57.8	4.1	0.10	0.36	15.9	97.5
B2.1	6.7	11.0	0.17	0.42	4.1	16.9
B2.2	2.8	11.0	0.17	0.42	1.8	7.3
B2.3	2.6	13.3	0.19	0.43	1.8	6.9
B2.4	25.2	11.4	0.17	0.42	12.6	51.2
I1	1.0	11.0	0.17	0.42	0.8	3.4
I2	15.9	11.0	0.17	0.42	9.2	37.7
I3	9.5	11.0	0.17	0.42	6.3	26.0
GRAND TOTAL	121.5	7.9%	0.14	0.39	52.5	246.8

CUMULATIVE DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)	Tributary Area (ac.)	Weighted % Impervious
B1	B1	15.9	97.5	57.8	4.1
2.1	B2.1	4.1	16.9	6.7	11.0
2.2	B2.2	1.8	7.3	2.8	11.0
2.3	B2.2, B2.3	2.6	17.9	2.6	13.3
B2	B1, B2.1 - B2.4	29.4	264.7	95.1	7.0
I1	C1	0.8	3.4	1.0	11.0
I2	C1, C2	8.3	56.6	16.9	11.0

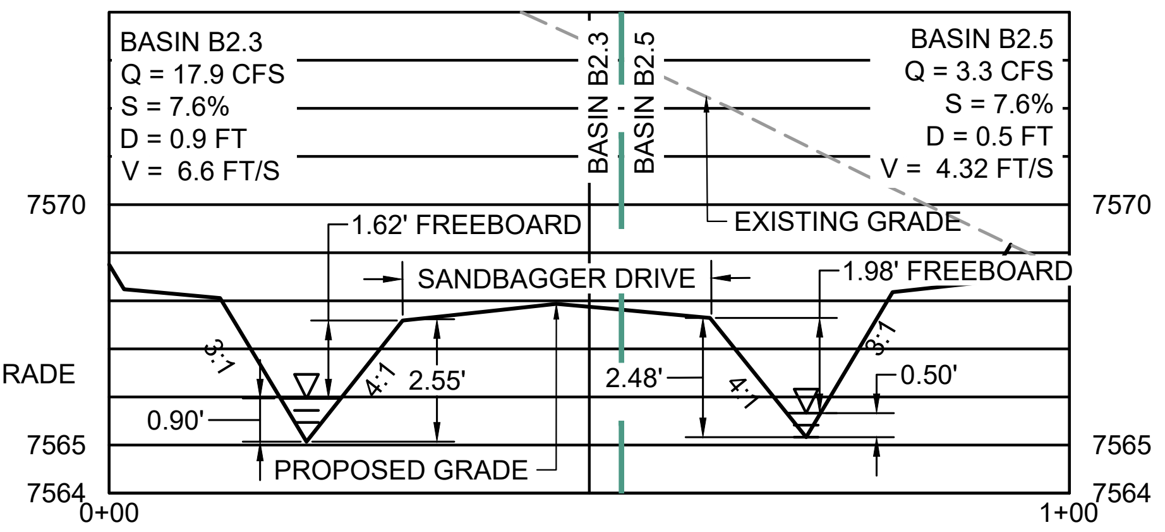
STREET SECTION 1



BASIN B2.1
Q = 16.9 CFS
S = 2.0%
D = 1.1 FT
V = 3.94 FT/S

BASIN B2.5
Q = 12.4 CFS
S = 2.0%
D = 1.0 FT
V = 3.65 FT/S

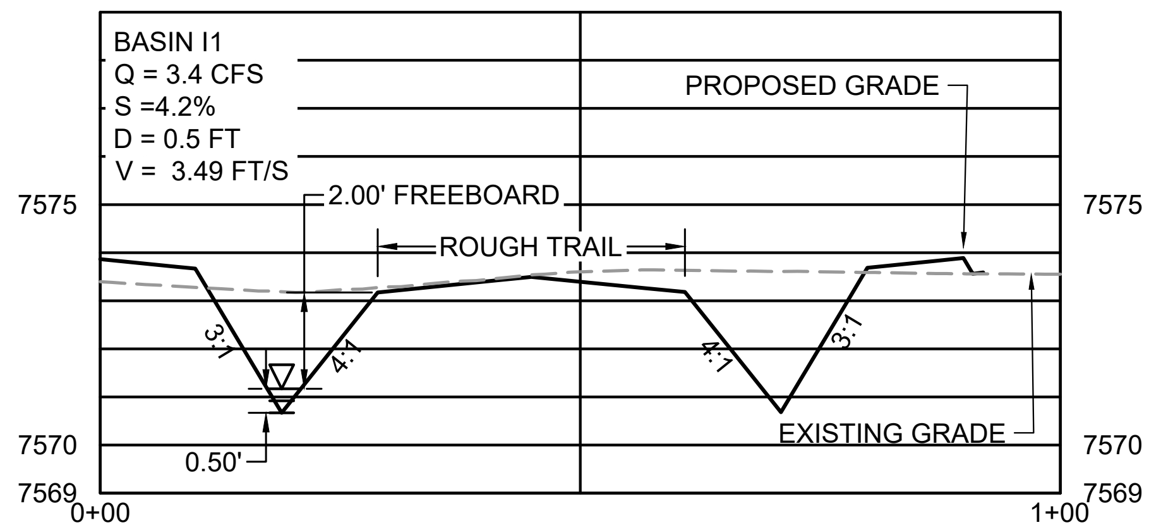
STREET SECTION 2



BASIN B2.3
Q = 17.9 CFS
S = 7.6%
D = 0.9 FT
V = 6.6 FT/S

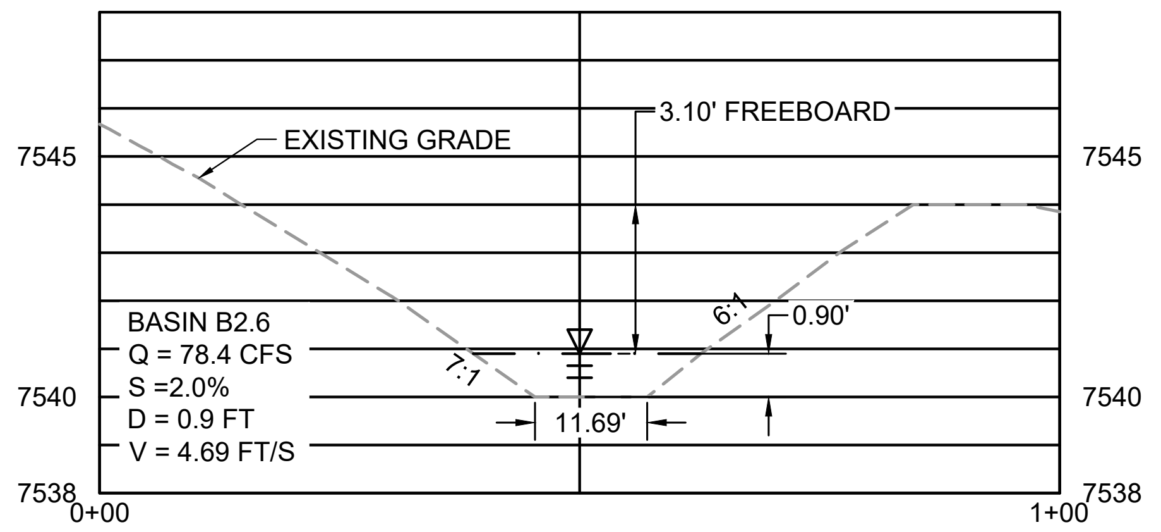
BASIN B2.5
Q = 3.3 CFS
S = 7.6%
D = 0.5 FT
V = 4.32 FT/S

STREET SECTION 3



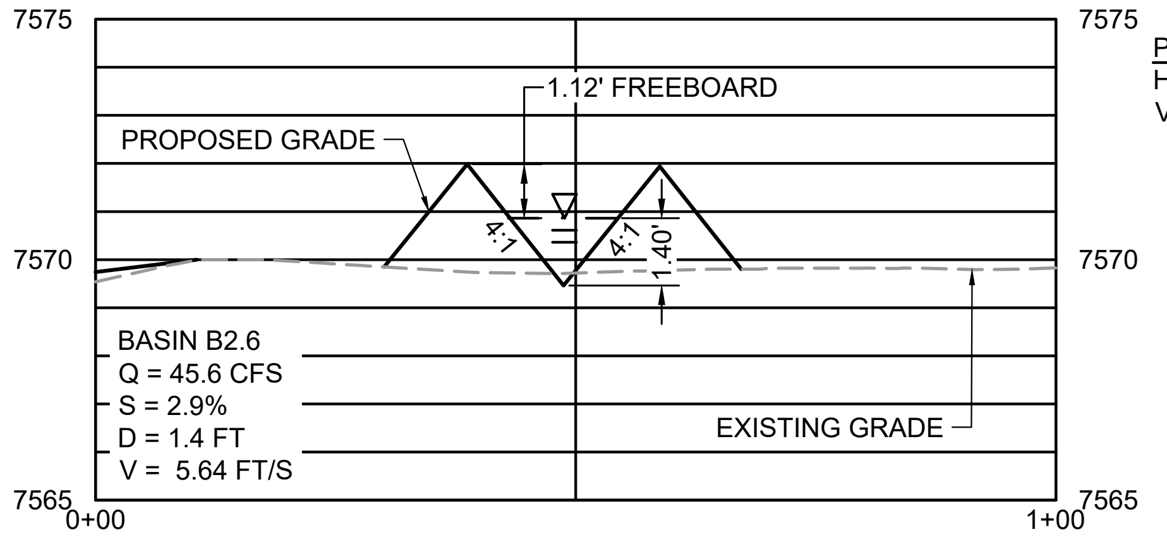
BASIN I1
Q = 3.4 CFS
S =4.2%
D = 0.5 FT
V = 3.49 FT/S

SECTION A-A



BASIN B2.6
Q = 78.4 CFS
S =2.0%
D = 0.9 FT
V = 4.69 FT/S

SECTION B-B



BASIN B2.6
Q = 45.6 CFS
S = 2.9%
D = 1.4 FT
V = 5.64 FT/S

PROFILE SCALE:
HORIZONTAL SCALE 1 " = 20'
VERTICAL SCALE 1" = 4'

PCD FILE NO.: SF2427

DRAWN BY: TMM
APPROVED: RHL
CAD DATE: 9/5/2024
CAD FILE: J:\2021\211030\CAD\Dwgs\C\Drainage\FDR Filing 5\FHN_FDR_Filing5
JOB DATE: 11/15/2024
JOB NUMBER: 211030.25

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
HR GREEN - COLORADO SPRINGS
1975 RESEARCH PARKWAY SUITE 160
COLORADO SPRINGS, CO 80920
PHONE: 719.300.4140
FAX: 713.965.0044

FLYING HORSE NORTH FILING NO. 5
PRI #2, LLC.
EL PASO COUNTY, CO

FINAL DRAINAGE REPORT
DEVELOPED CONDITIONS DRAINAGE MAP

SHEET
DR2
2

HR GREEN Xrefs: xc-row-030.250; xv-row-1030; xv-util-1030; xv-dsgn-1030; XC-BASIN; xgt-1-dh01-1030.250; key_map; Legend_FDR_Map_Filing5; xc-dsgn-250