Summit Point Apartments, Phase-II
504 NE Chipman Road
Lee's Summit, Missouri 64063
CFS Project No. 21-5065/19-5293

SW ¼, Section 32 Township 48 North, Range 31 West
Jackson County, Missouri
Tributary P3 to Prairie Lee Lake Watershed

Final Stormwater Drainage Study

Prepared for:
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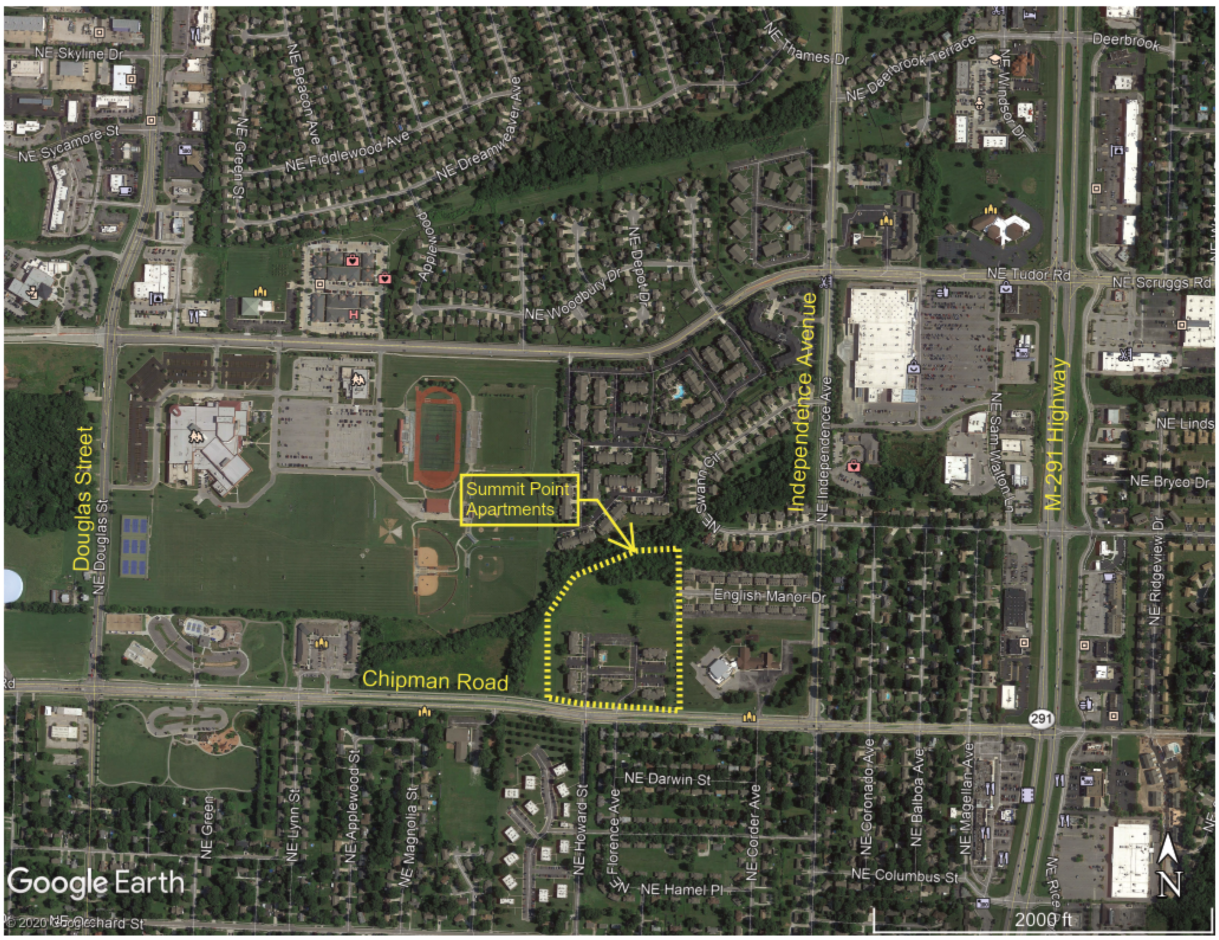
Introduction:

This Final Stormwater Drainage Study for the proposed Summit Point Apartments, Phase-II has been done at the request of the Canyon View Properties of Santa Cruz, California. The Phase-II addition would be constructed directly to the north of the existing Phase-I apartments located at 504 NE Chipman Road in Lee's Summit, Missouri. Phase I included five multi-unit apartment buildings plus a swimming pool on a 6.49 acre site constructed in 1980. The proposed Phase-II addition would cover 7.21 acres and include six new multi-apartment buildings along with parking lots and service drives.



Vicinity Map of the Summit Point Apartments at 504 NE Chipman Road in Lee's Summit

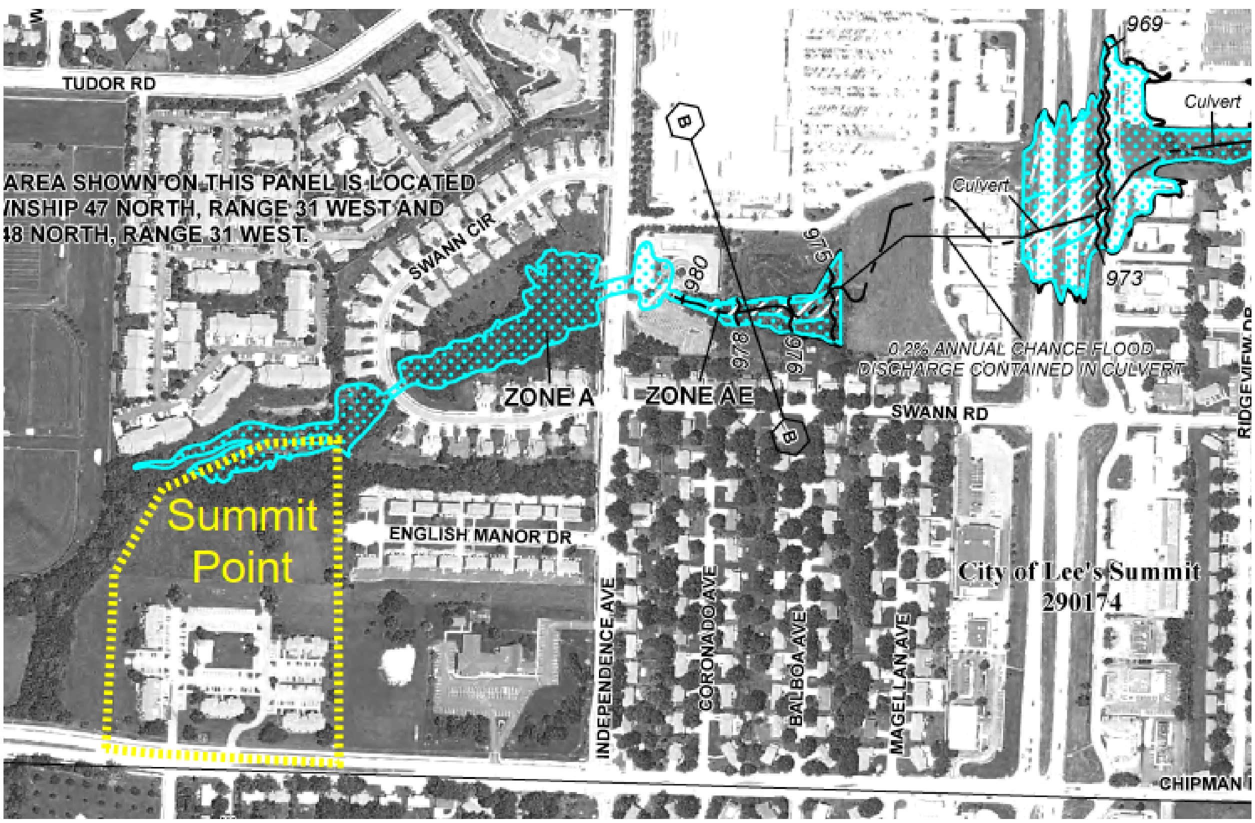
The site would include stormwater detention with an open-graded detention basin on the northeast corner of the project. The stormwater detention release rate for the proposed Phase-II development would comply with the City's allowable release rates for the 2, 10 and 100-year design storms, and would also provide for the extended detention of the 1.37" BMP water quality volume.

General Information:

The proposed Phase-II addition to the existing Summit Point Apartments would be constructed on the 7.21 acre parcel located directly north of the existing apartment complex. The proposed Phase-II site is completely undeveloped. The site slopes downwards to the north where an existing creek (Tributary P3 to Prairie Lee Lake) flows eastwards along the site's northern boundary.

Summit Point Apartments Phase-II Grading Plan

The existing Tributary P3 to Prairie Lee Lake creek has flowline elevations ranging between approximately 994' to 1000' along the northern side of the Summit Point Apartments, Phase II. NE Swann Circle is located directly to the east of Summit Point and has triple 48" HDPE culverts draining the existing creek below the roadway. The existing triple 48" HDPE's have upstream flowline elevations of approximately 986.91'and the top of the roadway has an overflow elevation of approximately 994'.



FEMA FIRM Flood Map 29095C0436G, Showing the Existing Tributary P3 to Prairie Lee Lake Flowing along the Northern Border of the Summit Point Apartments

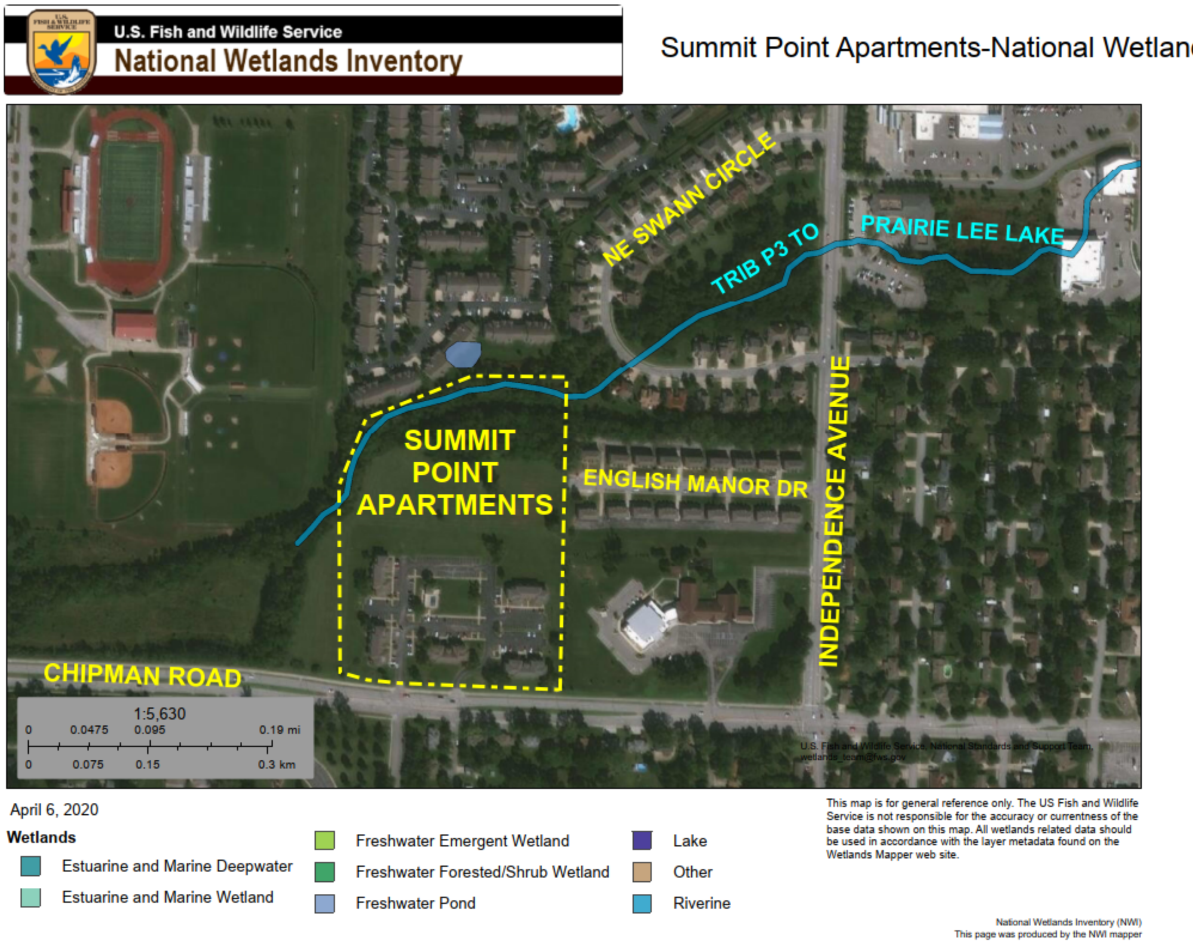
The FEMA flood map shows defined 1% (100-year) flood elevations further to the east along the creek, but stops short of Independence Avenue. A small portion of the northern side of the site is within the FEMA Zone-A 1%(100-year) floodplain, with the remaining ground above the defined flood limits.

The Ordinary High Water Mark (OHWM) was determined by CFS and verified by Frank Norman of Norman Ecological. The definition of the Ordinary High Water Mark as defined in the US Clean Water Act is as follows:

(7) Ordinary high water mark. The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

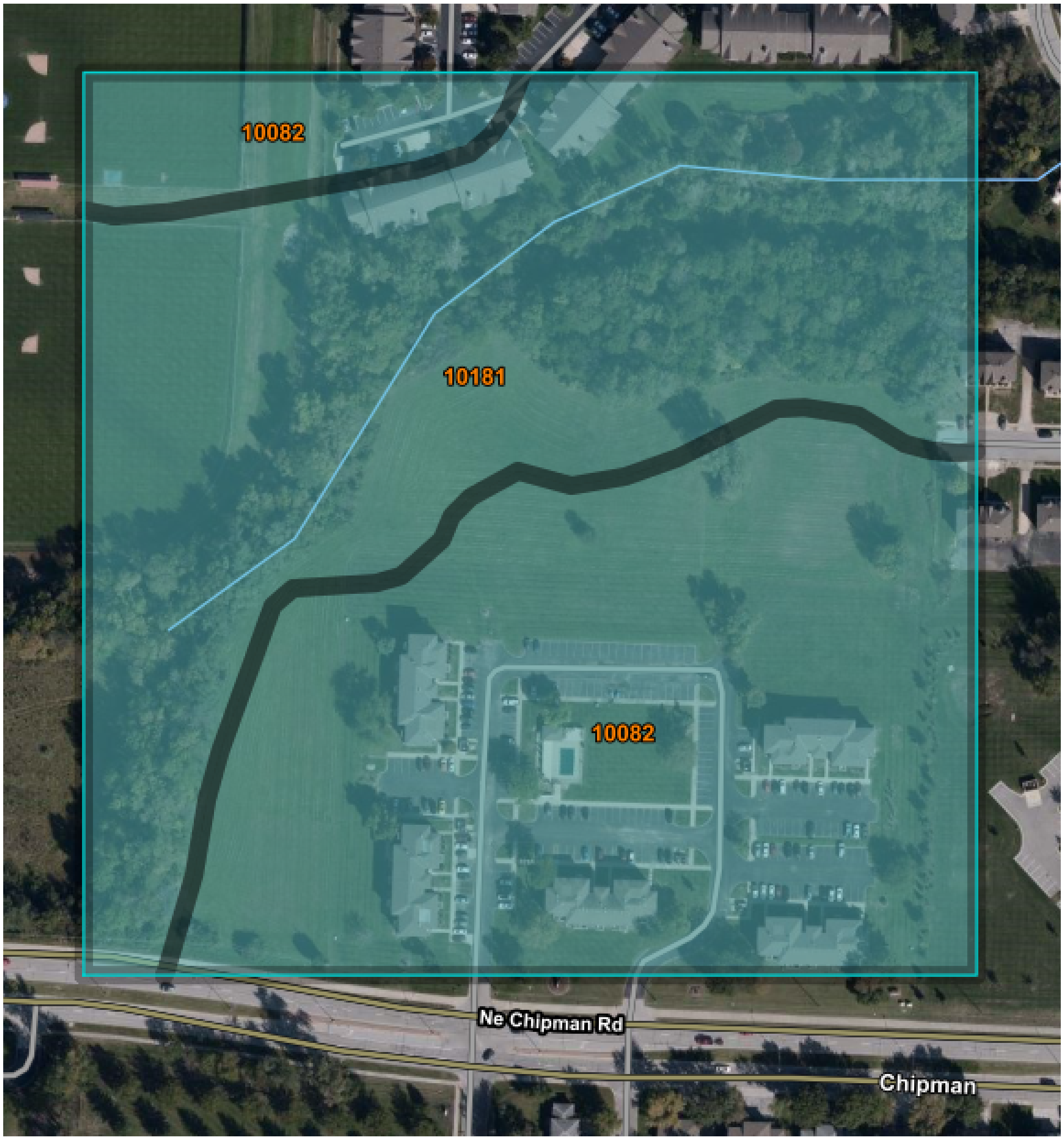
The proposed apartment buildings were placed outside of the stream setback along the existing Tributary P3 to Prairie Lee Lake. Stormwater detention for the site would be provided in the open-graded stormwater detention basin located on the northeast corner of the site. The detention basin would have a bottom elevation of approximately 995.0' (the calculated 100-year WSEL in the creek was approximately 994.4'), and the top of dam would be approximately 1003.25' the detention basin would store approximately 1.895 ac-ft of runoff at a peak WSEL of 1000'50' during a 100-year design storm event.

The US Fish and Wildlife Service's National Wetlands Inventory website was reviewed to check if the proposed Summit Point Apartments, Phase II, has any existing wetland areas or streams. The National Wetlands Inventory Map showed the existing Tributary P3 to Prairie Lee Lake as a Riverine, and no other wetlands features on the Summit Point Apartments site.



US Fish and Wildlife National Wetlands Inventory Map of Summit Point Apartments

A review of the project vicinity on the NRCS Web Soil Survey Site showed that the area surrounding the Summit Point Apartments, Phase-II, was comprised of Arisburg-Urban Land Complex soil, 1 to 5 percent slopes, Hydrologic Soil Group C, and Udfarents-Urban Land Sampsel Complex soil, 5 to 9 percent slopes, Hydrologic Soil Group C. A copy of the Natural Resources Conservation Service's Web Soil Survey for the site and surrounding region has been included in the appendix of this report.



NRCS Web Soil Survey Map of the Summit Point Apartments
(Blue shading indicates Type-C Soils)

Methodology:

This Final Stormwater Drainage Study has been prepared in accordance with Section 5600 Storm Drainage Systems and Facilities, by the American Public Works Association, Kansas City Metropolitan Chapter, and the City of Lee's Summit's Stormwater Report Requirements. The stormwater runoff analysis was analyzed using PondPack's Version 8 hydraulics/hydrology software, which utilized TR-55 hydrology methods and rainfall depths as stipulated in the APWA-5600 standards and design criteria.

SCS curve number runoff coefficients were calculated based on pervious greenspace at CN = 74 and impervious surfaces at CN = 98. The existing and proposed conditions drainage areas were derived from the existing ground contours and the proposed grading contours, and the amounts of pervious and impervious surface areas were measured and used to calculate composite SCS curve numbers. The times of concentrations for the existing conditions drainage basins were derived using the TR-55 methodology with overland sheet flow, shallow concentrated flow and channel flows. For the proposed site conditions, inlet times for each drainage basin were simplified to five minutes to account for the curbed site and enclosed storm sewer system.

The surface areas for the proposed contour grading for the stormwater detention basin was measured at one foot intervals to derive stage versus storage curves for performing stormwater routing. The outlet structure consisted of a 4” diameter orifice at flowline 995.00’ for storing and metering the outflow from the 1.37”/24-hour rainfall, and a 33” rectangular weir at threshold elevation 997.50’ for storing and metering the outflow for the 2, 10 and 100-year storms. The detention basin would also have a 30 ft long emergency overflow weir with a crest set at 1001.30’, approximately 6” above the peak 100-year WSEL of 1000.81’. Calculations showed that the overflow from a second 100-year storm under full conditions with all other outlets blocked would rise approximately 1.0 ft above the crest of the emergency overflow spillway to elevation 1002.30’. The top of the dam would be set at 1003.30’ to provide the minimum 12 “ of freeboard.

Inflow hydrographs based on the 24-hour SCS Type-II rainfall distribution were modeled from the individual drainage basins and times of concentration. Allowable release rates from the site were based on the City’s requirements for the 2, 10 and 100-year storms (2-yr at 0.5 cfs/acre, 10-yr at 2.0 cfs/acre and 100-yr at 3.0 cfs/acre) along with the water quality treatment of the 1.37”/24-hour rainfall having to be held and released over a 40-hour span.

Existing Conditions Analysis:

Under the pre-development conditions, the Summit Point Apartments Phase-II site contains approximately 7.21 acres of on-site drainage area and is completely undeveloped. The 7.21 acres was considered to be completely pervious with no impervious pavement or building area. With the Hydrologic Type-C soils covering the site, the pre-development SCS runoff curve number was estimated to be CN = 74.0. The time of concentration was calculated to be approximately 8.10 minutes based on the TR-55 methodology which included overland flow, shallow concentrated flow and channelized flow.

The Summit Point Apartments Phase-I located directly to the south of the proposed Phase-II site were built during the 1980's and contain a total of 6.49 acres. Approximately 4.03 acres of off-site area from the Phase-I site drains directly onto the Phase-II site. There was no other off-site drainage flowing onto the Phase-II site since Chipman Road catches and conveys drainage from the area further to the south. The off-site Phase-I apartments did not have any enclosed storm sewers or inlets or catch basins to collect surface drainage and pipe it to the existing creek along the northern boundary of the Phase-II site. The 4.03 acres was estimated to contain approximately 2.38 acres of impervious surface and approximately 1.65 acres of pervious green-space. The composite SCS runoff curve number was estimated to be 88.2. The time of concentration was calculated to be approximately 9.00 minutes based on the TR-55 methodology which included overland flow, shallow concentrated flow and channelized flow.

Proposed Conditions Analysis:

The proposed site improvements for the post-development drainage conditions included the construction of six new multi-unit apartment buildings along with parking lots and connecting service drives. The proposed improvements would also include an enclosed storm sewer system to collect the surface drainage from the Phase-II site along with runoff contributed from the existing Phase-I areas. The proposed Phase-II improvements would also include a new open-graded stormwater detention basin on the northeast corner of the site to provide detention and meet the City's required water quality treatment standards for new developments.

Allowable Release Rates: The City of Lee's Summit uses the APWA Section 5608.4, Performance Criteria, C, Release Rates, for setting the post-development release rates from an improved site:

The 50% (2-year Storm) would be limited to 0.5 cfs per acre
The 10% (10-year Storm) would be limited to 2.0 cfs per acre
The 1% (100-year Storm) would be limited to 3.0 cfs per acre.

Contributing off-site areas unaffected by the construction would be allowed to release drainage at their pre-development rates.

Using the existing Tributary P3 to Prairie Lee Lake at the northeast corner of the proposed Phase-II site as the Point of Interest (POI) for the cumulative stormwater runoff from the Summit Point Apartments Phases I and II sites, the existing Phase-I Apartments had a contributing off-site area of 4.03 acres with an SCS Curve Number of CN = 88.2 and a time of concentration of Tc = 9.00 minutes. The calculated flow rates from Phase-I at the POI at the existing Tributary P3 to Prairie Lee Lake were 12.83 cfs, 21.25 cfs and 34.48 cfs, respectively for the 50%, 10% and 1% storms (2, 10 and 100-year). The allowable release rates from the 7.21 acre Phase-II site were calculated using the 0.5, 2.0 and 3.0 cfs per acre designated release rates for the 50%, 10% and 1% storms (2, 10 and 100-year). The following table summarizes the Phase-I and Phase-II flows and the composite allowable release rates at the POI at the northeast corner of the Phase-II development:

Post-Development Allowable Release Rates

Storm Frequency	Existing Off-Site Phase-I Runoff	Allowable On-Site Phase-II Runoff	Composite Allowable Release Rate
50% (2-Year)	12.83 cfs	3.61 cfs	16.44 cfs
10% (10-Year)	21.25 cfs	14.42 cfs	35.67 cfs
1% (100-Year)	34.48 cfs	21.63 cfs	56.11 cfs

Stormwater Detention Basin Characteristics: Stormwater detention for the post-development Phase-II site would be provided with an open-graded detention basin on the northeast corner of the site. The stormwater detention basin would have a bottom elevation of approximately 995.00’, and a top of impoundment dam elevation of approximately 1003.30’ with full storage capacity was estimated at approximately 2.859 ac-ft. Approximately 5.54 acres at CN = 89.9 of the Phase-II on-site drainage would flow into the detention pond along with approximately 4.03 acres at CN = 88.2 of contributing drainage from the Phase-I off-site area.

The time of concentration for the on-site Phase-I drainage area was estimated at a minimal 5 minutes and the off-site Phase-I drainage area time of concentration was calculated to be approximately 9.00 minutes based on the TR-55 methodology which included overland flow, shallow concentrated flow and channelized flow.

Approximately 1.67 acres of the Phase-II site would be undetained by-passing the proposed stormwater detention basin. The undetained area was located along the northern and western fringes of the Phase-II site where the ground was too low for runoff to be caught and piped into the detention basin.

BMP Water Quality Volume: The required water quality storage for the 1.37” rainfall from the Phase-II development was calculated based on the total proposed impervious surface area over the 7.21 acre site. The total impervious and pervious surface areas were measured for the proposed site and the Water Quality Volume (WQv) was calculated based on the 2012 MARC Best Management Practices Manual. The Water Quality Volume was calculated to be approximately 19,338 cubic feet or 0.444 ac-ft.

The City of Lee’s Summit requires that the BMP Water Quality Volume be detained and slowly released over a 40-hour interval. The BMP Water Quality Volume storage volume in the bottom of the proposed stormwater detention basin was estimated to correspond to elevation 997.47’. The invert elevation of the outlet orifice was set at 995.00’ inside the proposed outlet structure, so that the maximum storage depth would be 2.47 ft and the average depth would be half of that value at 1.24 ft. Dividing the 19,338 cubic feet of Water Quality Volume by 40 hours yields an average outflow rate of approximately 0.1343 cfs. Sizing calculations for the proposed low-flow outflow orifice indicated that a circular diameter of approximately 2.15 inches would be needed to release the storage volume over the 40 hour interval. The MARC BMP Manual recommends that the minimum diameter for an outflow orifice from a detention basin should be 4 inches in diameter to prevent clogging.

Trash Rack: To prevent the outlet orifice from clogging, a MMMPS Trash Rack was sized based on the BMP guidelines. The total water quality outlet area, Aot, was calculated to be approximately 3.61 sq-in. The corresponding single outlet orifice diameter was sized at 2.15 in. The required trash rack open area was calculated as shown below:

At = Aot(3.61sq-in) * 77 * e^(-0.124*D(2.15in))
At = 213 sq-in = 1.48 sqft

A MMMPS Multi-Purpose Trash Screen manufactured by Mascot Engineering has an open Mesh Area of approximately 1.81 sqft, and could be readily secured over the outlet orifice to prevent clogging from trash accumulation. The maintenance staff would be responsible for keeping the detention basin clean of trash and inspecting and cleaning the trash screen to keep the detention system operational.

Detention Basin Routing: A 42” HDPE storm sewer pipe would enter the basin from the South and the storm would exit to the North. The proposed 4 inch diameter Water Quality Volume outflow orifice at invert elevation 995.00’ was conjoined with a 33 inch wide rectangular weir at crest elevation 997.50’ to meter the outflow from the 2, 10 and 100-year design storms. The proposed outlet structure would be constructed on the northern side of the proposed stormwater detention basin to house the 4 inch orifice and 33” wide rectangular weir. A 42” HDPE outlet pipe would drain out of the north side of the outlet structure and discharge toward the existing creek on the north side of the site. The 100-year water surface elevation of the creek was calculated to be approximately 994.65’, and the bottom of the detention storage outlet orifice was set at 995.0’, so that backwater from the creek would not surcharge the detention basin during a 100-year flood event. A summary of the stormwater routing characteristics for the stormwater detention basin has been tabulated below:

Stormwater Detention Basin Routing Summary

Storm Frequency	Peak Inflow	Peak Outflow	Peak WSEL	Peak Storage	Total Release Rate	Allowable Release Rate
50% (2-Year)	32.71 cfs	9.55 cfs	998.56’	0.830 ac-ft	10.32 cfs	16.44 cfs
10% (10-Year)	53.25 cfs	25.38 cfs	999.61’	1.242 ac-ft	28.29 cfs	35.67 cfs
1% (100-Year)	85.42 cfs	49.10 cfs	1000.81’	1.768 ac-ft	56.06 cfs	56.11 cfs

The Total Release Rates from the contributing on and off-site drainage areas that were either detained or undetained were all less than their corresponding allowable release rates required by the City. The proposed Summit Point Phase II development would provide on-site stormwater detention in accordance with the City of Lee's Summit's requirements. The peak post-development runoff rates from the proposed development would not increase above the peak pre-development runoff rates.

Concrete Trickle Channel: The stormwater detention basin would include a concrete trickle channel extending from the outlet 42" flared end section of Storm Sewer Line 2, to the inlet 42" flared end section of Storm Sewer Line 1. The concrete trickle channel would have a minimum slope of 1%. The outflow from the 42" HDPE outlet of Storm Sewer Line 2 discharging into the detention basin during a 10-year design storm was approximately 45.89 cfs with a velocity of 8.56 fps exiting the pipe and reducing to 3.9 cfs at the concrete trickle channel. During the 100-year design storm, the discharge was approximately 81.73 cfs with a velocity of 9.45 fps exiting the pipe and reducing to 4.4 cfs at the concrete trickle channel.

Riprap Blanket: The outlet channel downstream of the 42" HDPE outlet culvert from the detention basin outlet structure would be lined with a 24" diameter riprap blanket with a 2 ft high rock check dam to further dissipate the energy of the outflow and prevent erosion in the downstream channel. The 42" HDPE outlet pipe was modeled using HY-8 to determine the peak outflow velocities at the end of the circular pipe section and at the end of the flared end section discharging into the riprap blanket.

For the 10-year storm, the peak outflow from the stormwater detention basin was calculated to be approximately 25.38 cfs.with an outlet velocity of approximately 6.12 fps, and approximately 49.10 cfs.with an outlet velocity of approximately 7.77 fps during the 100-year storm. During the 10-year storm, the discharge velocity would slow to approximately 3.35 fps and approximately 4.07 fps during the 100-year storm, before flowing out of the riprap blanket and 2 ft high rock check dam.

East Property Line Drainage Channels: The terrain along the property line on the eastern side of the proposed site forms a swale along the embankment for the stormwater detention basin. Estimates of the drainage area culminating in the existing drainage swale paralleling the east property line indicated that the total drainage basin area would be approximately 0.41 acres with an estimated Rational Runoff Coefficient of C=0.53 and nominal five minute time of concentration. The peak 100-year runoff rate was calculated as follows:

> A = 0.41 acres, C = 0.53, Tc = 5 min
> Q100 = K(1.25)*C(0.53)*i100(10.32in/hr)*A(0.41ac)
> Q100 = 2.80 cfs

A cross-section was cut in the irregular channel near the lowest part of the basin. The main channel slope was relatively steep at over 7.1%, and a Manning's roughness coefficient of n = 0.045 was used for the ground cover with unkempt grass and shrub growth. A hydraulic analysis of the open channel indicated that the 2.80 cfs from a 100-year storm would flow at a depth of less than 0.2 ft at a velocity of 2.2 fps.

A second drainage analysis of the east property line was done behind the proposed Building A2-1, with the drainage area culminating on the southern side of the existing cul-de-sac at the end of English Manor Drive. Estimates of this drainage area showed that the total drainage basin area would be approximately 0.33 acres with an estimated Rational Runoff Coefficient of C=0.45 and nominal five minute time of concentration. The peak 100-year runoff rate was calculated as follows:

A = 0.33 acres, C = 0.45, Tc = 5 min
Q100 = K(1.25)*C(0.45)*i100(10.32in/hr)*A(0.33ac)
Q100 = 1.92 cfs

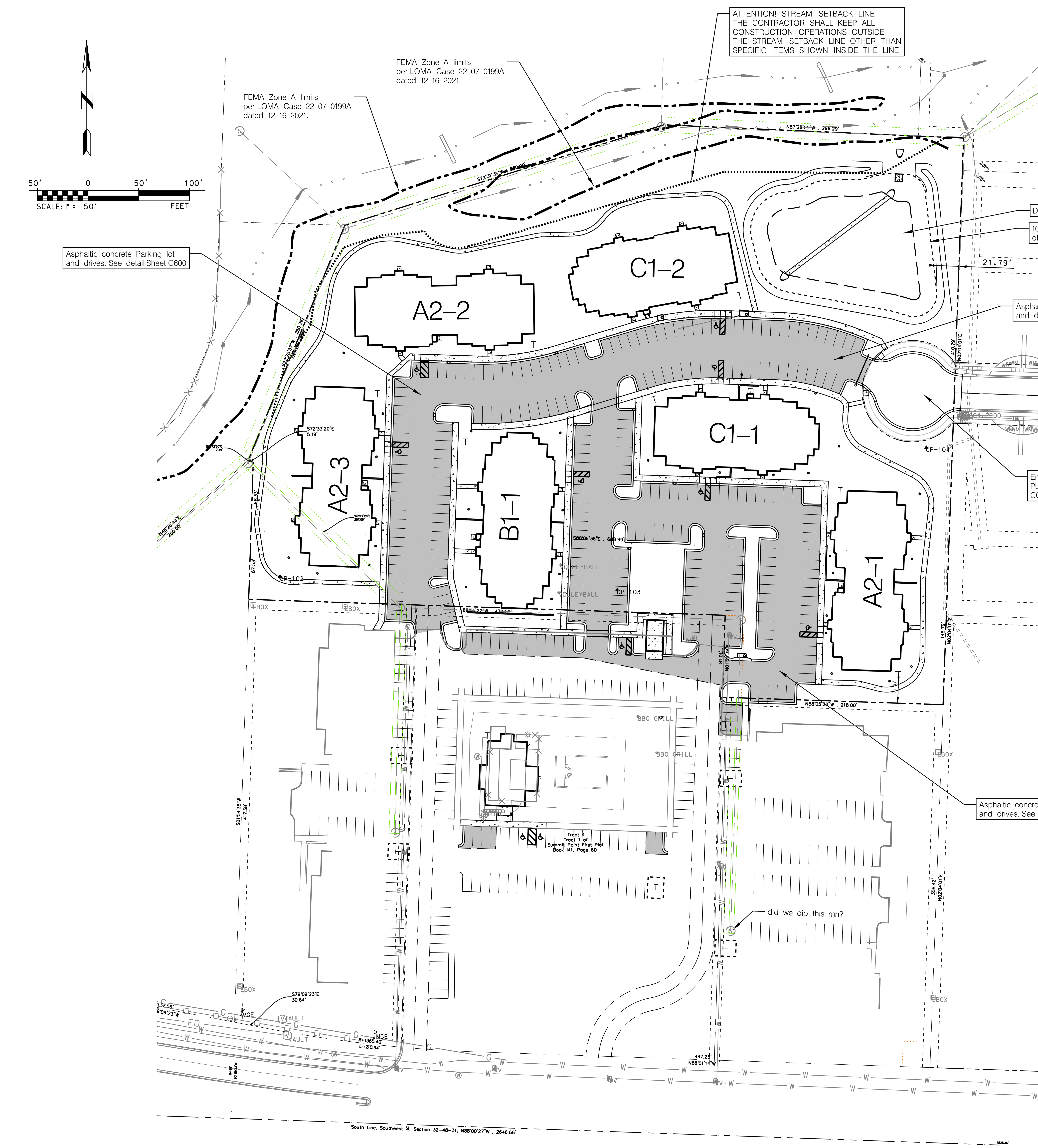
A cross-section was cut in the irregular channel south of English Manor Drive. The main channel slope was relatively steep at over 7.5%, and a Manning's roughness coefficient of n = 0.045 was used for the ground cover with grass and landscaping plants and shrubs. A hydraulic analysis of the open channel indicated that the 1.92 cfs from a 100-year storm would flow at a depth of less than 0.1 ft at a velocity of 2.3 fps.

Drainage Channel Analysis of Tributary P3 to Prairie Lee Lake:

CFS Engineers created a HEC-RAS model and prepared a separate study to evaluate the water surface elevations of stormwater in the Tributary P3 to Prairie Lee Lake creek channel along the east and north side of the proposed Summit Point Apartments, Phase II site. The results of the HEC-RAS model showed that the highest 100-year floodplain elevation on the site was 998.81', and the lowest proposed buildings BFE's were set at 1005.00'. The bottom of the proposed open-graded stormwater detention basin was set at 995.0'. The detention basin was located in the northeast corner of the Summit Point site with the bottom set above the adjacent 100-year flood elevation of 994.65'.

Conclusions:

For the final evaluation and sizing of the stormwater detention system for the proposed Phase-II Addition of the Summit Point Apartments, the calculated post-development release rates were less than the required allowable release rates. The 100-year water surface elevations along the Tributary P3 to Prairie Lee Lake creek along the northern boundary of the proposed development were calculated using HEC-RAS, and the proposed building elevations and the bottom of the proposed stormwater detention basin were set accordingly. There would be no grading or placement of embankment material in the creek channel below the calculated 100-year water surface elevations. The site would provide water quality treatment storage for the 1.37" 90th percentile average annual rainfall and provide detention for the 50%, 10% and 1% (2, 10 and 100-year) storms in accordance with the City of Lee's Summit's requirements.



NOTES:

1. ALL DIMENSIONS ARE TO BACK OF CURB UNLESS OTHERWISE NOTED.
2. CONTRACTOR IS RESPONSIBLE FOR PROTECTION OF ALL PROPERTY CORNERS.
3. CONTRACTOR SHALL MATCH EXISTING PAVEMENT IN GRADE AND ALIGNMENT TO PROVIDE SMOOTH SURFACE TRANSITIONS BETWEEN NEW ENTRANCE DRIVES AND EXISTING STREETS.
4. CONTRACTOR SHALL MATCH EXISTING CURB & GUTTER IN GRADE, SIZE, TYPE, AND ALIGNMENT AT CONNECTIONS TO EXISTING STREETS.
5. CONTRACTOR IS RESPONSIBLE FOR REPAIRS OF DAMAGE TO ANY EXISTING IMPROVEMENTS DURING CONSTRUCTION SUCH AS, BUT NOT LIMITED TO: DRAINAGE UTILITIES, PAVEMENT, STRIPING, CURB, ETC., AND TO INCLUDE ANY WORK IN DOT R.O.W. AND/OR CITY R.O.W. REPAIRS SHALL BE EQUAL TO OR BETTER THAN EXISTING CONDITIONS.
6. ALL WORK ON THIS PLAN SHALL BE DONE IN STRICT ACCORDANCE WITH GEOTECHNICAL REPORT.
7. CONTRACTOR SHALL REFER TO ARCHITECTURAL PLANS FOR EXACT LOCATIONS AND PRECISE BUILDING DIMENSIONS. SIDEWALK AND SPECIFIC BUILDING AREA TREATMENTS AND IMPROVEMENTS.
8. ALL DIMENSIONS SHOWN ON BUILDINGS ARE TO OUTSIDE FACE OF BUILDING.
9. ALL RADII SHALL BE 4.0' MEASURED AT THE BACK OF CURB UNLESS OTHERWISE NOTED.
10. THE EARTHWORK FOR ALL BUILDING FOUNDATIONS AND SLABS SHALL BE IN ACCORDANCE WITH THE ARCHITECTURAL SPECIFICATIONS AND GEOTECH REPORT.
11. PARKING LOT STRIPING SHALL BE ACCORDING TO KANSAS CITY METROPOILTON CHAPTER OF APWA. ALL STRIPING IS TO HAVE TWO COATS OF PAINT (MIN.). ALL STRIPING OTHER THAN ACCESSIBLE SHALL BE WHITE. ACCESSIBLE STRIPING SHALL BE BLUE.
12. ALL CONSTRUCTION WITHIN THE RIGHT-OF-WAY SHALL CONFORM TO THE CITY OF LEE'S SUMMIT, MISSOURI STANDARDS AND SPECIFICATIONS.
13. ALL ACCESSIBLE PARKING SIGNAGE AND STRIPING SHALL BE IN ACCORDANCE WITH THE AMERICANS WITH DISABILITIES ACT (ADA) REQUIREMENTS.
14. THE CONTRACTOR SHALL SUPPLY THE OWNER WITH A LIST OF ALL SUB-CONTRACTORS PRIOR TO COMMENCEMENT OF ANY CONSTRUCTION OPERATIONS.
15. ALL CURB AND GUTTER SHALL BE TYPE CG-1 OR CG-2 AS NOTED ON THE PLAN.
16. ALL WORK SHALL CONFORM TO THE APPLICABLE SECTIONS OF THE STANDARD SPECIFICATIONS AND DESIGN CRITERIA OF THE METROPOLITAN CHAPTER OF APWA AND THE CITY OF LEE'S SUMMIT, MISSOURI, IN CURRENT USAGE EXCEPT AS NOTED.

Legend

Major Contour
Minor Contour
Right-of-Way Line
Section Line
Easement Line
Storm Sewer Line
Sanitary Sewer Line
Waterline
Fence Line
Vegetation Line
Found Survey Monument
Set Iron Bar with Cap CF&S CLS 1999141100
Section Corner
{88} Schedule B-2 Exception
Storm Sewer Manhole
Sanitary Sewer Manhole
Tree

Water Meter
Water Valve
Fire Hydrant
Light Pole
Center Line
Found F
Bar & Cap B&C
Existing Contour (Index)
Existing Contour (Intermediate)
Proposed Contour
Regulatory Floodplain
Stream Setback

CFS ENGINEERS
cfse.com
LANCE W. SCOTT NUMBER E-28255
STATE OF MISSOURI REGISTERED PROFESSIONAL ENGINEER

Mark	Description	Date	Appr.
	CITY SUBMITTAL	02/02/22	
	REVISED PER COMMENTS	04/25/22	

Designed by: RP
Dwn by: RP
Ckd by: LWS
Date: 03-25-2015
Rev. -
Reviewed by: ---
Submitted by: ---
Plot scale: 1:50
File name: 215065-ST-SH-CD Overall Site Plan.dgn
Plot date: 4/27/2022 9:05:16 AM

SUMMIT POINT

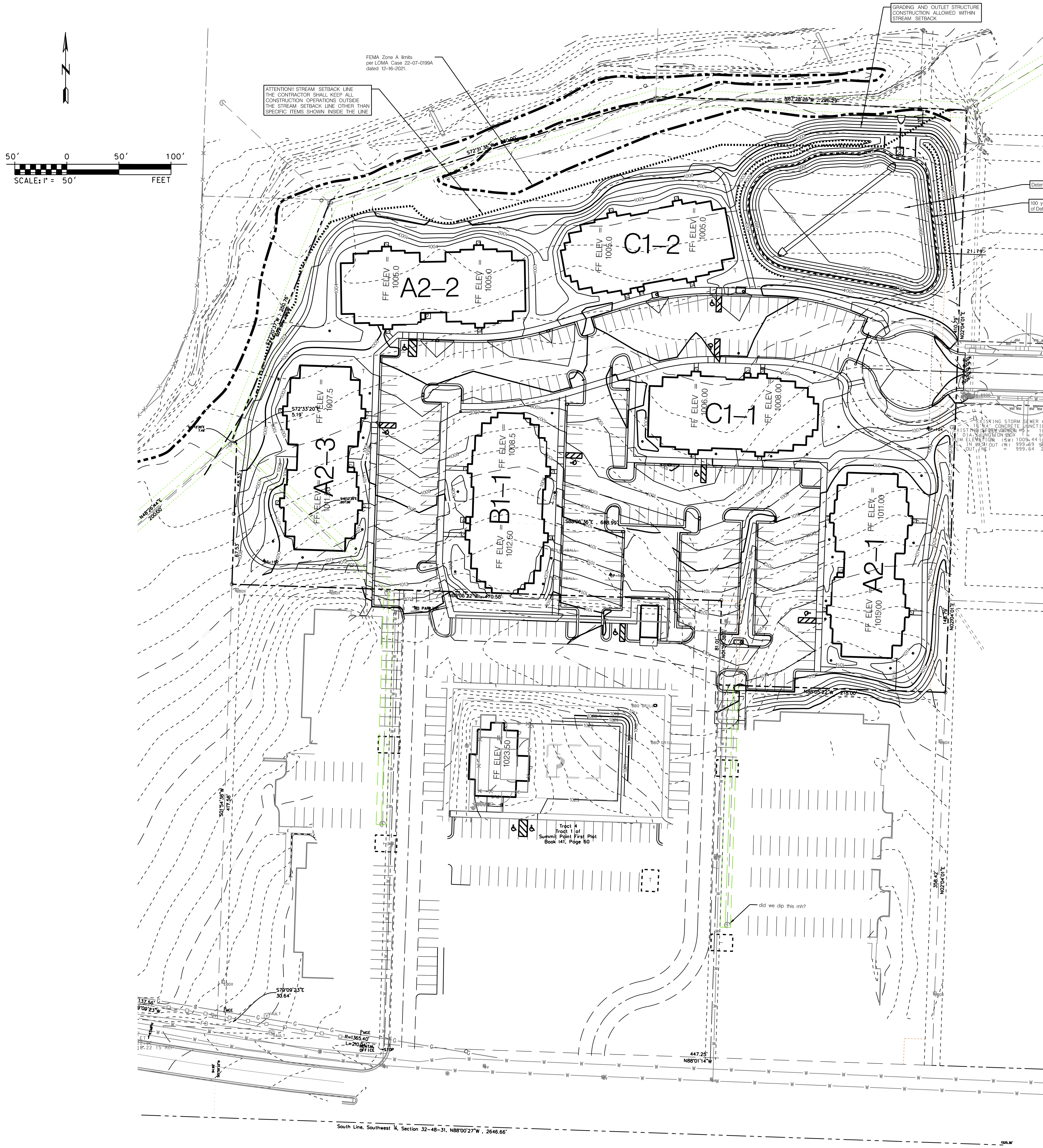
504 NE Chipman Road
Lee's Summit, Missouri

Construction Drawings

OVERALL SITE PLAN

Sheet reference number:

C200



Legend

	Major Contour		Water Meter
	Minor Contour		Water Valve
	Right-of-Way Line		Fire Hydrant
	Section Line		Light Pole
	Easement Line		Center Line
	Storm Sewer Line	Found	F
	Sanitary Sewer Line	Bar & Cap	B&C
	Waterline		
	Fence Line	Existing Contour (Index)	
	Vegetation Line	Existing Contour (Intermediate)	
	Found Survey Monument		
	Set Iron Bar with Cap CF&S CLS 1999141100		
	Section Corner	Proposed Contour	970
(88)	Schedule B-2 Exception		
	Storm Sewer Manhole		
	Sanitary Sewer Manhole		
	Tree		

GRADING NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR REPAIRS OF DAMAGE TO ANY EXISTING IMPROVEMENTS DURING CONSTRUCTION, SUCH AS, BUT NOT LIMITED TO: DRAINAGE, UTILITIES, PAVEMENT, STRIPING, CURBS, ETC. AND TO INCLUDE ANY WORK IN STATE RIGHT OF WAY AND/OR CITY RIGHT OF WAY. REPAIRS SHALL BE EQUAL TO OR BETTER THAN EXISTING CONDITIONS.
2. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTION OF ALL PROPERTY CORNERS.
3. EXISTING AND PROPOSED CONTOURS ARE SHOWN AT ONE FOOT (1') INTERVALS AND ARE REFERENCED TO USGS DATUM.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SECURING THE NECESSARY PERMITS FOR THE COMPLETION OF EARTHWORK AS SHOWN AND FOR HAULING BORROW MATERIAL IN AND WASTE MATERIAL OFF OF THE SITE.
5. AREAS OF PROPOSED CONSTRUCTION SHALL BE STRIPPED OF ALL VEGETATION AND TOPSOIL TO A DEPTH OF SIX INCHES (6") OR AS DIRECTED BY THE GEOTECHNICAL ENGINEER. THE TOPSOIL SHALL BE STOCKPILED AND REDISTRIBUTED PER THE SPECIFICATIONS. TOPSOIL SHALL NOT BE USED FOR STRUCTURAL FILL IN BUILDING AND PAVEMENT AREAS.
6. TESTING AND INSPECTION OF EARTHWORK SHALL BE PROVIDED BY A TESTING LABORATORY SELECTED BY THE OWNER. THE OWNER SHALL BE RESPONSIBLE FOR THE COST OF TESTING.
7. THE CONTRACTOR SHALL BE RESPONSIBLE TO FIELD ADJUST THE TOPS OF ALL MANHOLES AND VALVE/METER BOXES AS NECESSARY TO MATCH THE FINISH GRADE OF ADJACENT AREAS, NO SEPARATE OR ADDITIONAL COMPENSATION SHALL BE MADE TO THE CONTRACTOR FOR MAKING FINAL ADJUSTMENTS TO MANHOLES AND BOXES.
8. SOIL FOR FILLING SHOULD BE GRADED AS IT ARRIVES.
9. GRADING SHALL NOT EXCEED A 3' HORIZONTAL TO A 1' VERTICAL SLOPE.
10. THE CONTRACTOR SHALL NOT GRADE OUTSIDE THE PROPERTY LINE UNTIL APPROVED FROM APPROPRIATE REGULATORY AGENCIES.
11. REMOVE FROM THE SITE MATERIAL ENCOUNTERED IN GRADING OPERATIONS THAT, IN THE OPINION OF THE OWNER OR OWNER'S REPRESENTATIVE, IS UNSUITABLE OR UNDESIRABLE FOR BACKFILLING SUBGRADE OR FOUNDATION PURPOSES. SHALL BE DISPOSED OF IN A MANNER SATISFACTORY TO THE OWNER. BACKFILL AREAS WITH LAYERS OF SUITABLE MATERIAL SHALL BE COMPACTED AS SPECIFIED.
12. UNLESS OTHERWISE INDICATIED ON THE DRAWINGS, REMOVE TREES, SHRUBS, GRASS, OTHER VEGETATION, IMPROVEMENTS, OR OBSTRUCTIONS INTERFERING WITH INSTALLATION OF NEW CONSTRUCTION. REMOVAL INCLUDES DIGGING OUT STUMPS AND ROOTS. DO NOT REMOVE ITEMS ELSEWHERE IN SITE OR PREMISES UNLESS SPECIFICALLY INDICATED.
13. STRIP TOPSOIL TO WHATEVER DEPTHS ENCOUNTERED TO PREVENT INTERMINGLING WITH UNDERLYING SUBSOIL OR OTHER OBJECTIONABLE MATERIAL. CUT HEAVY GROWTHS OF GRASS FROM AREAS BEFORE STRIPPING. TOPSOIL SHALL CONSIST OF SANDY CLAY SURFICIAL SOIL FOUND IN DEPTH OF NOT LESS THAN 6". SATISFACTORY TOPSOIL IS REASONABLY FREE OF SUBSOIL, CLAY, LUMPS, STONES, AND OTHER OBJECTS OVER 2" IN DIAMETER, WEEDS, ROOTS, AND OTHER OBJECTIONABLE MATERIAL.
14. STOCKPILE TOPSOIL IN STORAGE PILES IN AREAS SHOWN OR WHERE DIRECTED. CONSTRUCT STORAGE PILES TO FREELY DRAIN SURFACE WATER. COVER STORAGE PILES IF REQUIRED TO PREVENT WINDBLOWN DUST. DISPOSE OF UNSUITABLE WASTE MATERIAL. EXCESS TOPSOIL SHALL BE REMOVED FROM THE SITE BY THE CONTRACTOR UNLESS SPECIFICALLY NOTED OTHERWISE ON THE DRAWINGS.
15. COMPLETELY REMOVE STUMPS, ROOTS, AND OTHER DEBRIS BELOW PROPOSED SUBGRADE ELEVATION. FILL DEPRESSIONS CAUSED BY CLEARING AND GRUBBING OPERATIONS WITH SATISFACTORY SOIL MATERIAL. UNLESS FURTHER EXCAVATION OR EARTHWORK IS REQUIRED.
16. REMOVE EXISTING SOIL ABOVE AND BELOW GRADE IMPROVEMENTS AND ABANDON UNDERGROUND PIPING OR CONDUIT NECESSARY TO PERMIT CONSTRUCTION AND OTHER WORK.
17. UNLESS SPECIFICALLY INDICATIED OTHERWISE ON THE DRAWINGS OR IN THE SOIL INVESTIGATION REPORT, AREAS EXPOSED BY EXCAVATION OR STRIPPING AND ON WHICH SUBGRADE PREPARATIONS ARE TO BE PREFORMED SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 8" AND COMPACTED TO A MINIMUM OF 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY, IN ACCORDANCE WITH ASTM D 698. AT A MOISTURE CONTENT OF NOT LESS THAN 2% BELOW AND NOT MORE THAN 2% ABOVE THE OPTIMUM MOISTURE CONTENT AS DETERMINED BY THE STANDARD PROCTOR. THESE AREAS SHALL THEN BE PROOFROLLED TO DETECT ANY AREASOF INSUFFICIENT COMPACTION. PROOFROLLING SHALL BE ACCOMPLISHED BY MAKING TWO (2) COMPLETE PASSES WITH A FULLY-LOADED TANDEM-AXLE DUMP TRUCK, OR APPROVED EQUIVALENT, IN EACH OF THE TWO PERPENDICULAR DIRECTIONS UNDER THE SUPERVISION AND DIRECTION OF A FIELD GEOTECHNICAL ENGINEER. AREAS OF FAILURE SHALL BE EXCAVATED AND RE-COMPACTED AS STATED ABOVE.
18. UNLESS SPECIFICALLY INDICATED OTHERWISE ON THE DRAWINGS, FILL MATERIALS USED IN PREPARATION OF SUBGRADE SHALL BE PLACED IN LIFTS OR LAYERS NOT TO EXCEED 8" LOOSE MEASURE AND COMPACTED TO A MINIMUM DENSITY OF 95% OF THE STANDARD PROCTOR DRY DENSITY. IN ACCORDANCE WITH ASTM D 698, AT A MOISTURE CONTENT OF NOT LESS THAN 2% BELOW AND NOT MORE THAN 2% ABOVE THE OPTIMUM MOISTURE CONTENT. THE COMPACTION SHOULD BE INCREASED TO 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY IN THE UPPER 24 INCHES OF FILL SUPPORTED PAVEMENT AREAS.
19. ALL GRADING SHALL COMPLY WITH THE GEOTECHNICAL REPORT.
20. THE CONTRACTOR SHALL PROVIDE EROSION CONTROL IN ACCORDANCE WITH THE APPROVED LAND DISTURBANCE PERMIT ISSUED BY THE CITY OF LEE'S SUMMIT, MISSOURI PUBLIC WORKS.
21. SEE SHEETS C301 AND C302 FOR SPOT ELEVATIONS.

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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-28355
REGISTERED PROFESSIONAL ENGINEER
4/26/22

Mark	Description	Date	Appr.
	REVISED PER COMMENTS	04/25/22	
	CITY SUBMITTAL	02/02/22	

SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

Construction Drawings

Designed by: RP		Date: 03-25-2015	Rev. -
Dwn by: RP	Ckd by: LWS	Reviewed by: ---	
Submitted by: ---		Plot scale: 1:50	
File name: 215065-ST-SH-CD Overall Grading Plan.dgn			
Plot date: 4/26/2022		4:43:57 PM	

OVERALL GRADING PLAN

Sheet reference number:
C300

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STATE OF MISSOURI — LANCE W. SCOTT — NUMBER E-28855 — REGISTERED PROFESSIONAL ENGINEER — 4/25/22

Mark	Description	Date	Appr.
	REVISED PER COMMENTS	04/25/22	
	CITY SUBMITTAL	02/02/22	

Designed by: RP
Dwn by: RP
Ckd by: LWS
Date: 03-25-2015
Rev. -
Submitted by: ---
Reviewed by: ---
Plot scale: 1:20
File name: 215065-ST-SH-CD West Side Grading Plan.dgn
Plot date: 4/26/2022 4:46:09 PM

SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

Construction Drawings

WEST SIDE GRADING PLAN

C301

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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-28855
REGISTERED PROFESSIONAL ENGINEER
4/25/22

Mark	Description	Date	Appr.
	REVISED PER COMMENTS	04/25/22	
	CITY SUBMITTAL	02/02/22	

SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

Construction Drawings

Designed by: RP
Date: 03-25-2015
Rev.: -
Dwn by: RP
Ckd by: LWS
Reviewed by: ---
Submitted by: ---
Plot scale: 1:20
File name: 215065-ST-SH-CD East Side Grading Plan.dgn
Plot date: 4/26/2022 4:59:21 PM

EAST SIDE GRADING PLAN

C302

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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-28355
PROFESSIONAL ENGINEER

Work	Description	Date	Appr.
	CITY SUBMITTAL	02/02/22	
	REVISED PER COMMENTS	04/25/22	

Designed by: RP
Date: 03-25-205
Rev. -
Dwn by: RP
Ckd by: LWS
Reviewed by: ---
Submitted by: ---
Plot scale: 1:20
File name: 215065-ST-SH-CD West Side Drainage Plan.dgn
Plot date: 4/25/2022

SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

Construction Drawings

WEST SIDE DRAINAGE PLAN
L2, L9, L10, L11 & L12

C401

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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-28255
REGISTERED PROFESSIONAL ENGINEER

Mark	Description	Date	Appr.
	CITY SUBMITTAL	02/02/22	
	REVISED PER COMMENTS	04/25/22	

Designed by: RP | Dwn by: RP | Ckd by: LWS | Date: 03-25-205 | Rev. | Reviewed by: | Submitted by: | Plot scale: 1:20

File name: 215065-ST-SH-CD East Side Drainage Plan.dgn
Plot date: 4/25/2022 2:40:32 PM

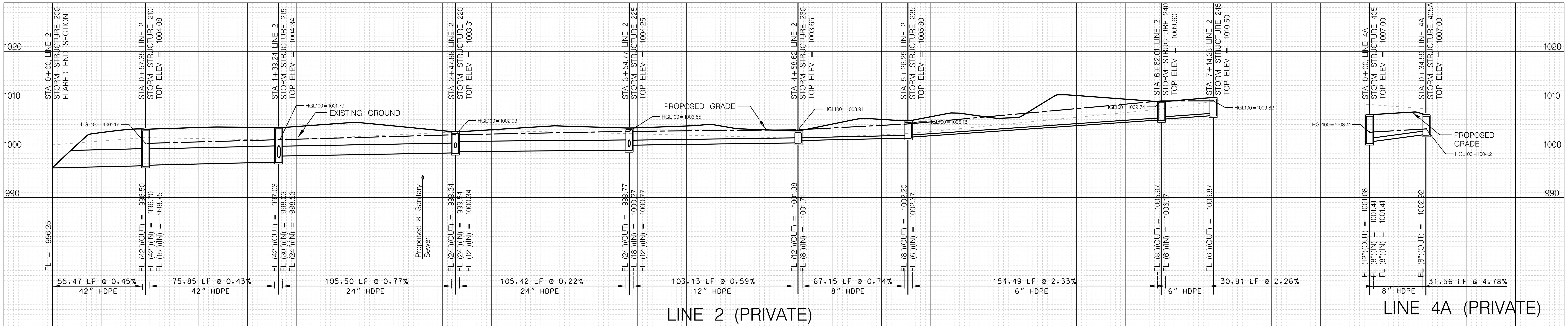
SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

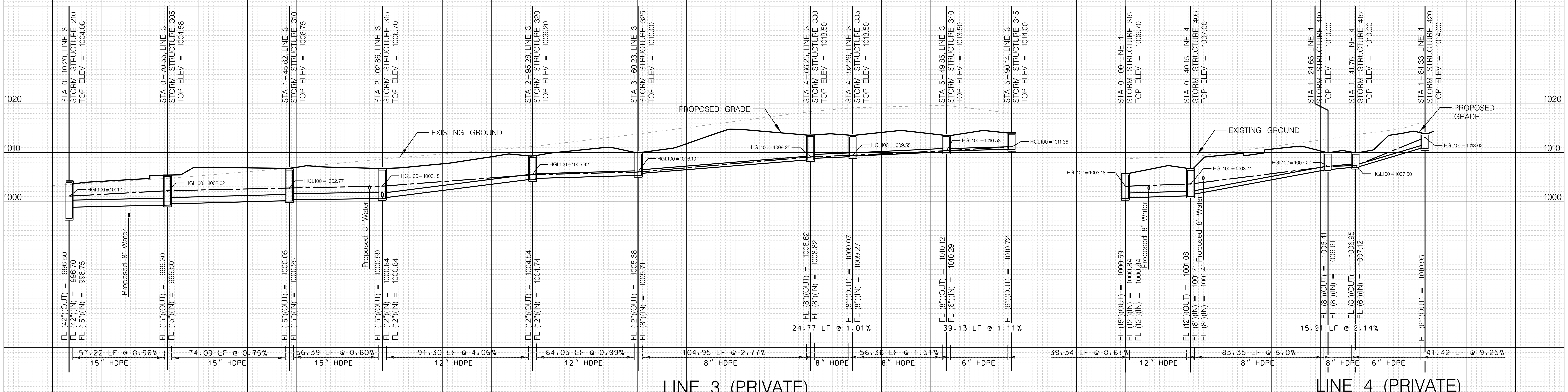
Construction Drawings

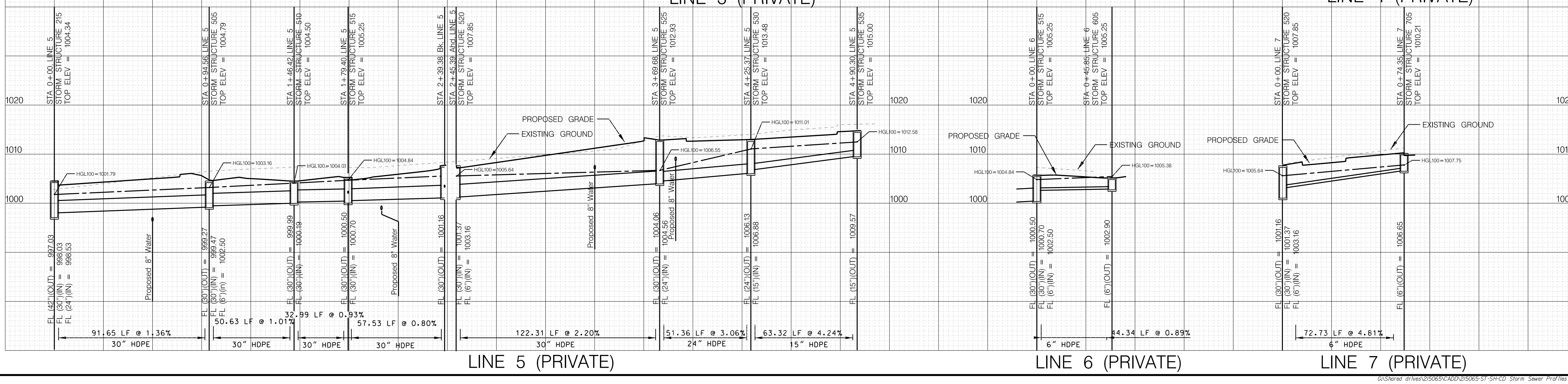
EAST SIDE DRAINAGE PLAN
L1, L2, L3, L4, L4A, L5, L6 & L7

C402

G:\Shared drives\215065\CADD\215065-ST-SH-CD East Side Drainage Plan.dgn







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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-26355
REGISTERED PROFESSIONAL ENGINEER

Mark	Description	Date	Appr.
	CITY SUBMITTAL	02/02/22	
	REVISED PER COMMENTS	04/25/22	

SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

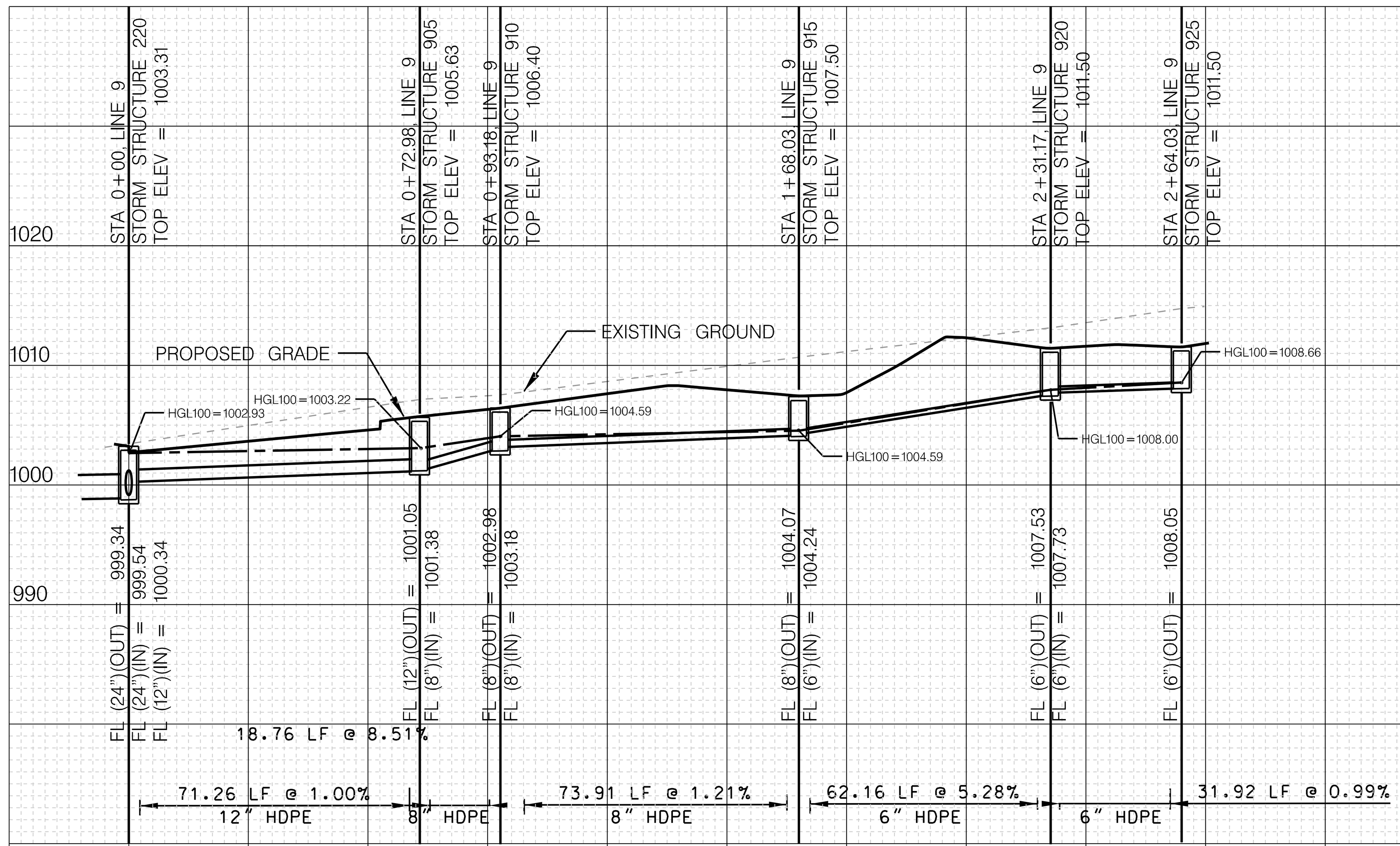
Construction Drawings

Designed by: RP		Date: 03-25-2015	Rev. -
Dwn by: RP	Ckd by: LWS	Reviewed by: ---	
Submitted by: ---		Plot scale: 1:30	
File name: 215065-ST-SH-CD Storm Sewer Profiles Sheet1.dgn			
Plot date: 04/25/2022		8:50:52 PM	

DRAINAGE PROFILES
L2, L3, L4, L4A, L5, L6 & L7

C403

G:\Shared drives\215065\CADD\215065-ST-SH-CD Storm Sewer Profiles Sheet1.dgn



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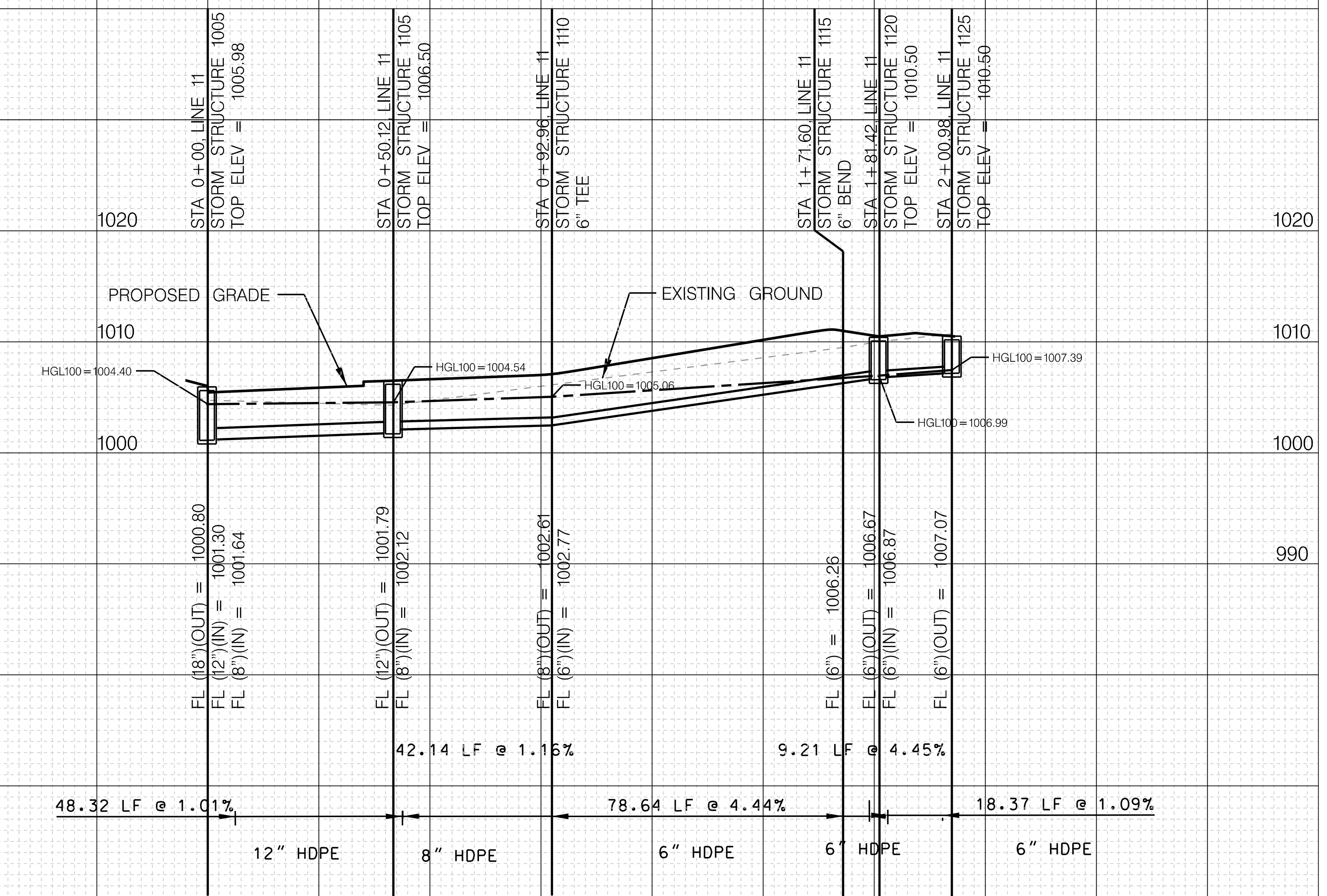

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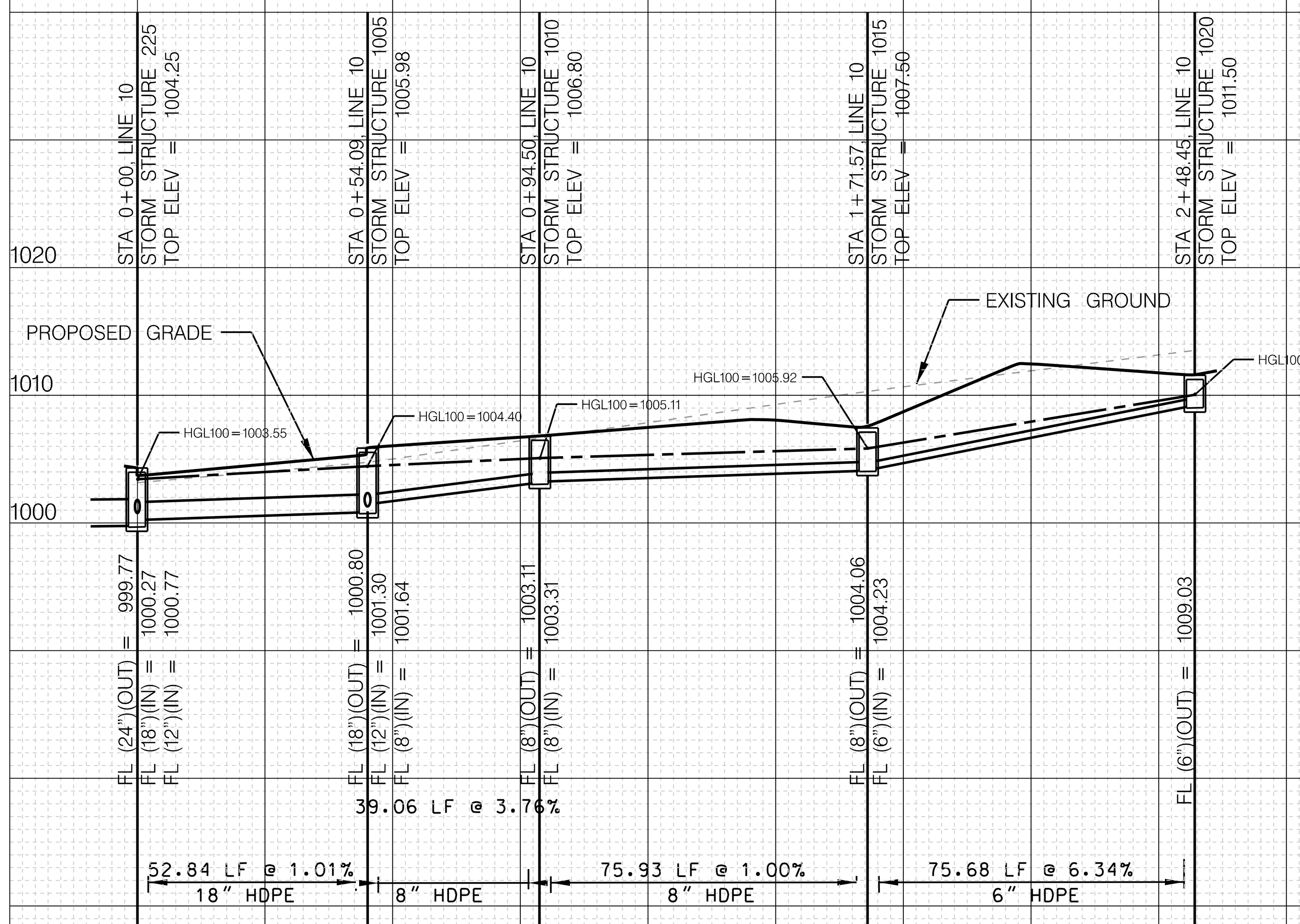

LINE 10 (PRIVATE)

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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-28855
REGISTERED PROFESSIONAL ENGINEER
4/25/22

Mark	Description	Date	Appr.
	REVISED PER COMMENTS	04/25/22	
	CITY SUBMITTAL	02/02/22	

Designed by: RP
Date: 03-25-205
Rev. -
Dwn by: RP
Ckd by: LWS
Reviewed by: ---
Submitted by: ---
Plot scale: 1:30
File name: 215065-ST-SH-CD Storm Sewer Profiles Sheet 2.dgn
Plot date: 4/25/2022 9:05:36 PM

SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

Construction Drawings

DRAINAGE PROFILES
L9, L10 & L11

C404

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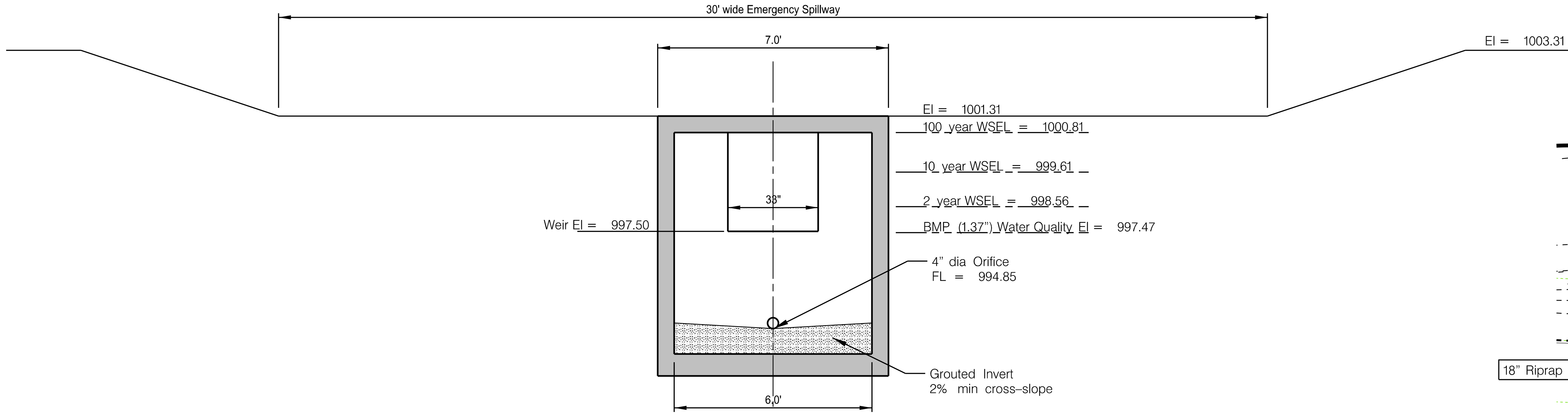
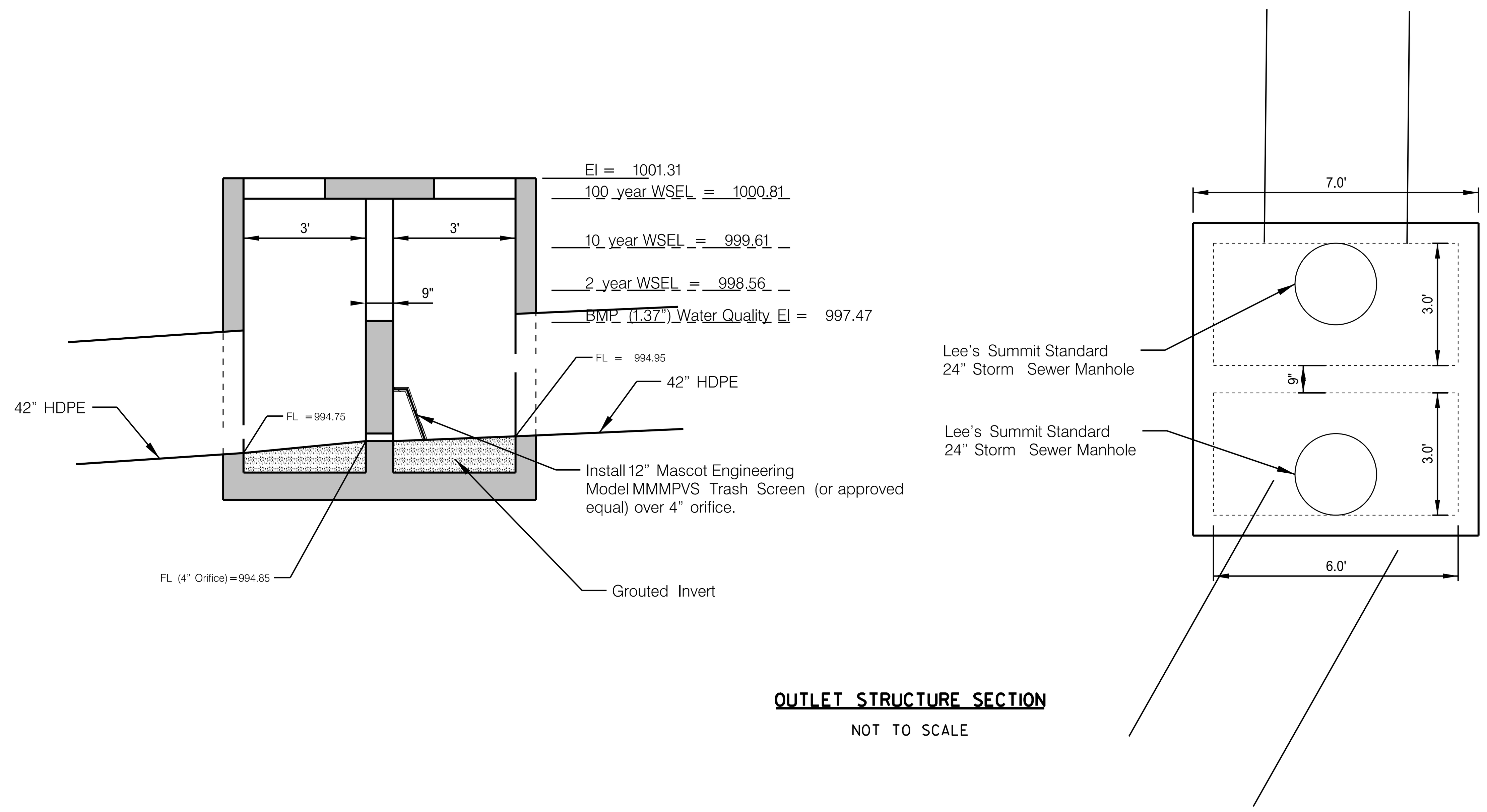
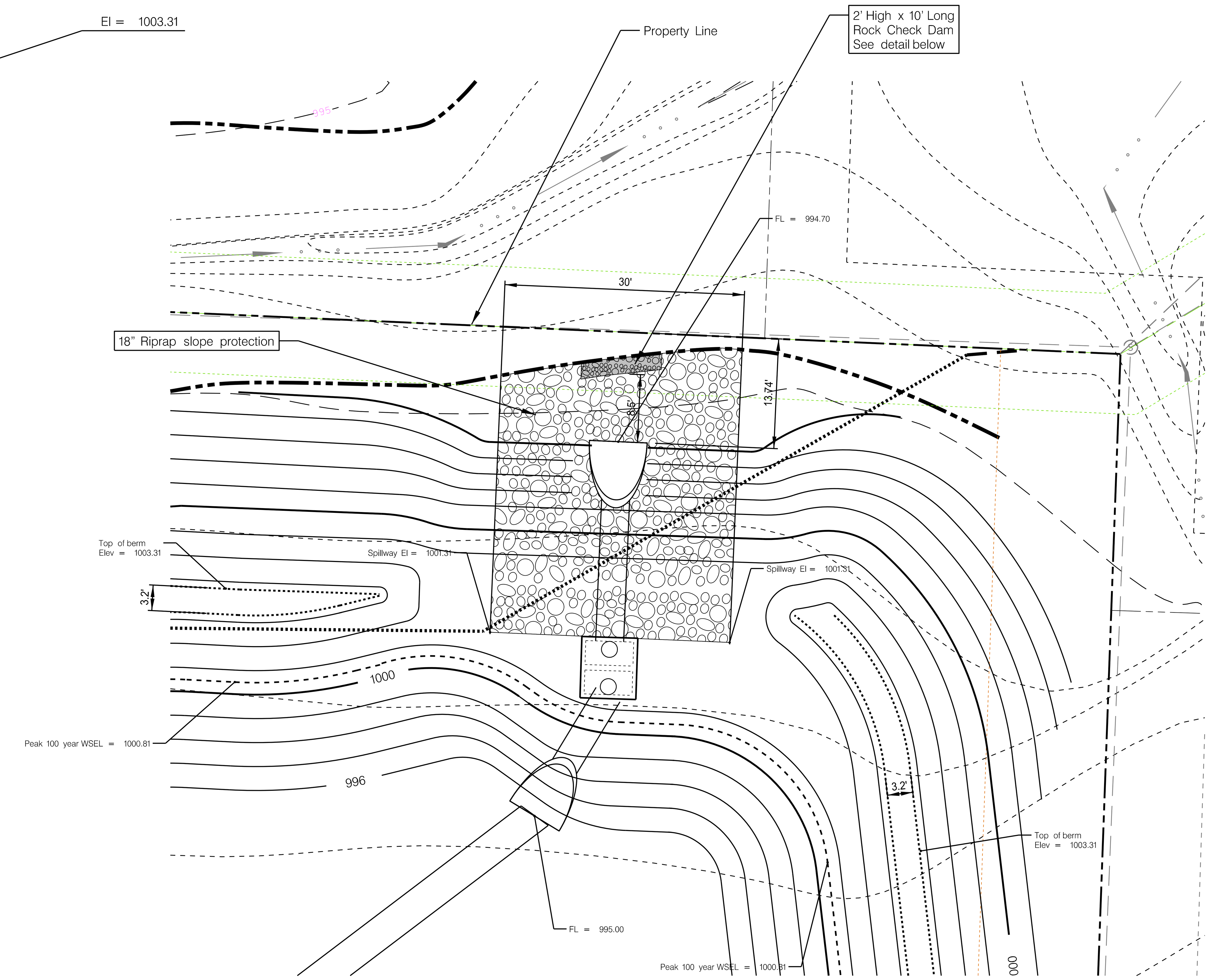
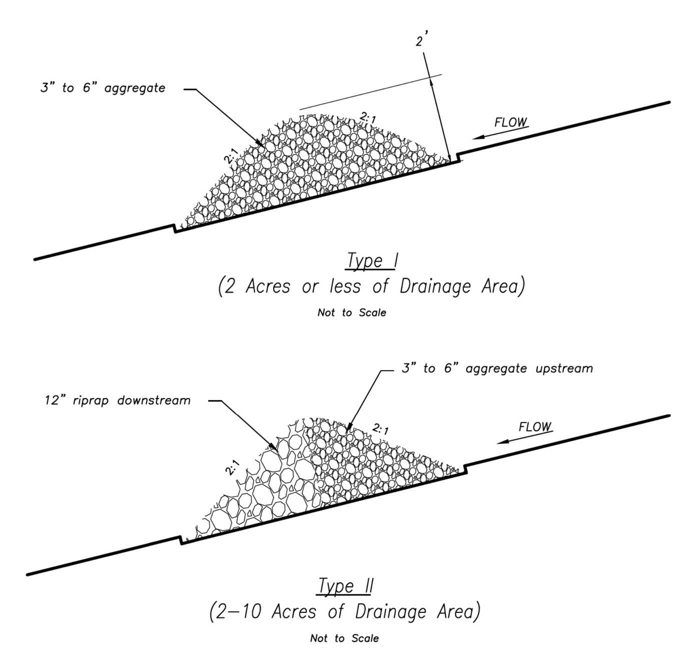




OUTLET STRUCTURE SECTION

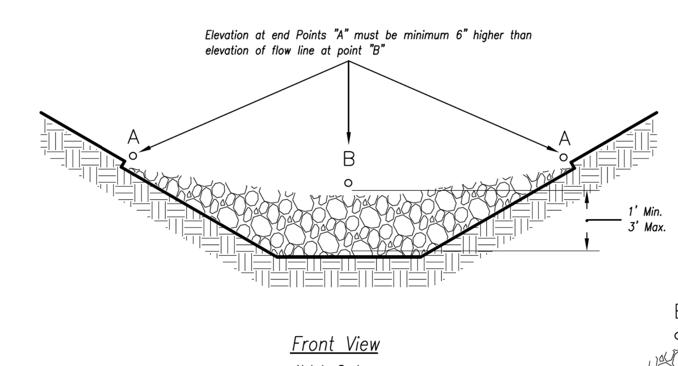
NOT TO SCALE





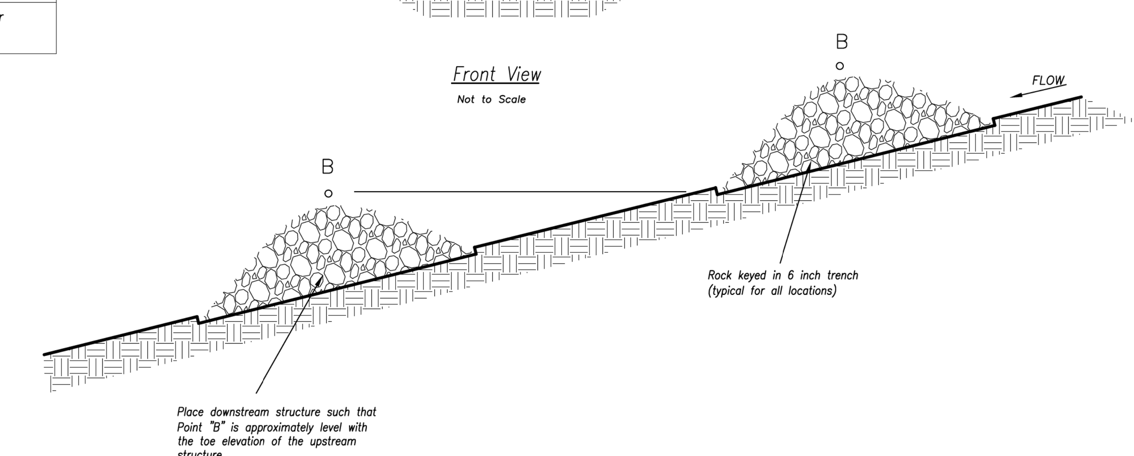
ROCK DITCH CHECK

Temporary Rock Ditch Check Spacing	
Ditch Centerline Slope (%)	Spacing Interval (Feet)
5.0	60
6.0	50
7.0	43
8.0	36
9.0	33
10.0	29
Note: Use this spacing only for Rock Ditch Checks.	



Front View

Not to Scale



Spacing Between Check Dams (all types)

Not to Scale

Notes:

1. Rock check dams shall be used only for drainage areas less that 10 acres unless approved by the City Engineer.
2. Use rock checks only in situations where the ditch slope exceeds 6%.

Maintenance:

1. Remove and dispose of sediment deposits when the deposit approaches ½ the height of the ditch check.
2. Replace and reshape as necessary to maintain function and integrity of installation.

Modified from 2015 Overland Park Standard Details for Erosion and Sediment Control.

AMERICAN PUBLIC WORKS ASSOCIATION

KANSAS CITY METRO CHAPTER

ROCK DITCH CHECKS

STANDARD DRAWING NUMBER ESC-10

ADOPTED: 10/24/2016

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STATE OF MISSOURI — LANCE W. SCOTT — NUMBER E-28855 — REGISTERED PROFESSIONAL ENGINEER — 4/25/22

Mark	Description	Date	Appr.
	CITY SUBMITTAL	02/02/22	
	REVISED PER COMMENTS	04/25/22	

Designed by: RP | Date: 03-25-2015 | Rev. -

Dwn by: RP | Ckd by: LWS | Reviewed by: ---

Submitted by: --- | Plot scale: 1:0

File name: 215065-ST-SH-CD Detention Basin Details.dgn

Plot date: 4/27/2022 9:21:58 AM

SUMMIT POINT

504 NE Chipman Road
Lee's Summit, Missouri

Construction Drawings

DETENTION BASIN DETAILS

C601

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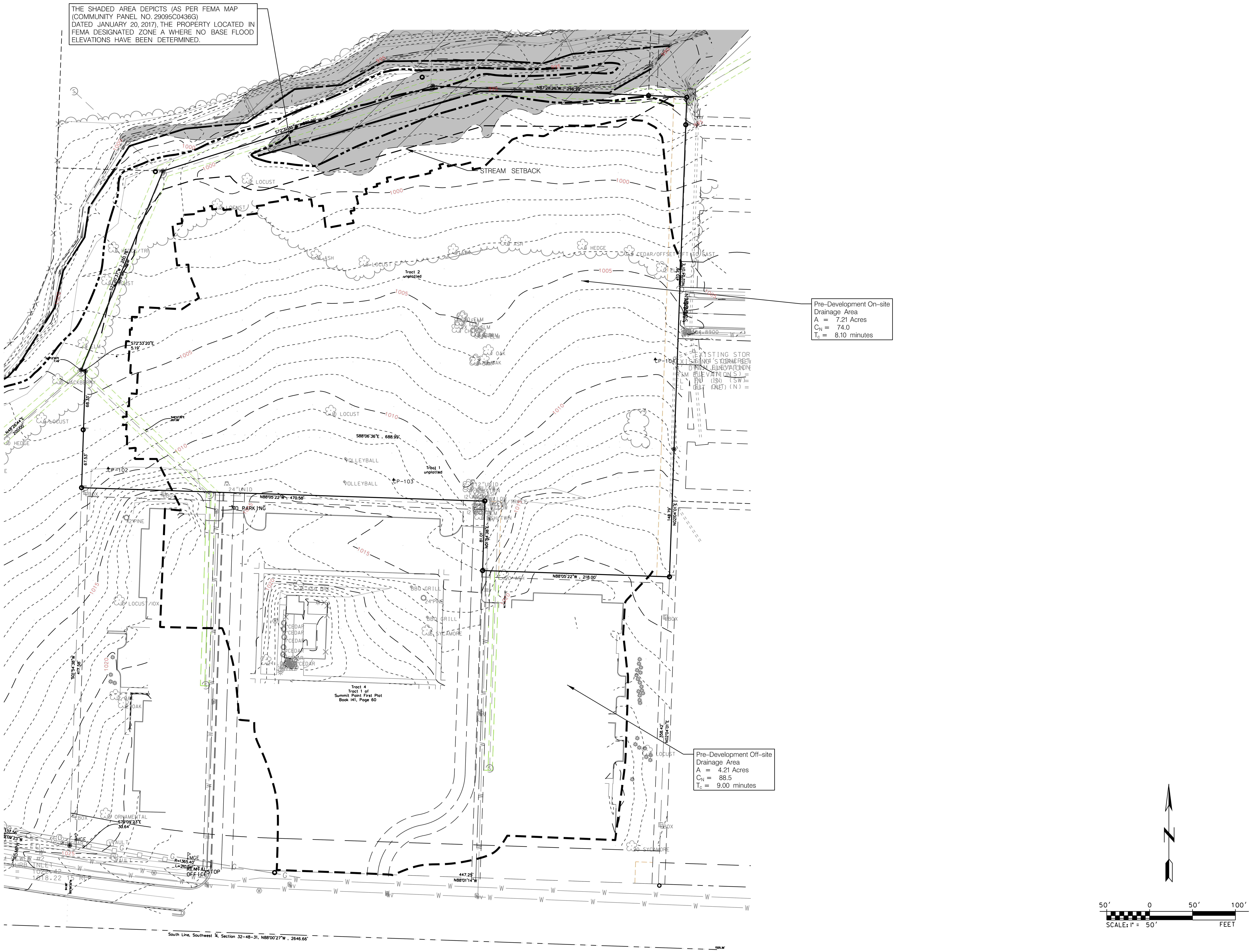

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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-28855
REGISTERED PROFESSIONAL ENGINEER
5/13/21

Mark	Description	Date	Appr.
	REVISED PER COMMENTS	05/13/21	
	REVISED PER COMMENTS	04/15/21	
	REVISED PER COMMENTS	03/22/21	
	CITY SUBMITTAL	02/18/21	

Designed by: RP	Date: 03-25-2015	Rev. -
Dwn by: RP	Ckd by: LWS	Reviewed by: ---
Submitted by: ---	Plot scale: 1:50	
File name: Pre Development Drainage area Map.dgn		
Plot date: 5/14/2021 9:12:15 AM		

SUMMIT POINT

504 NE Chipman Road
Lee's Summit, Missouri

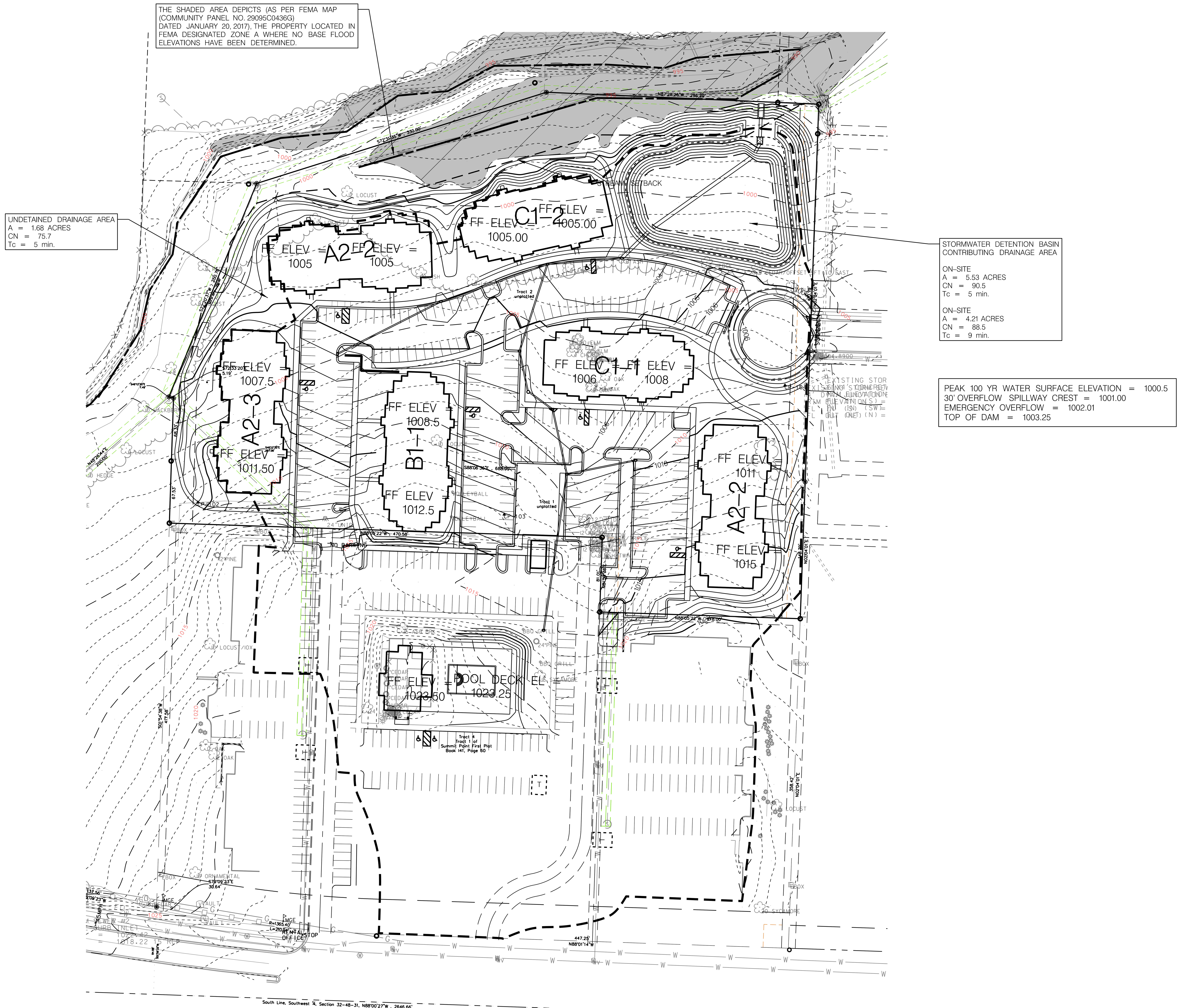
Preliminary Development Plan

PRE-DEVELOPMENT CONDITION DRAINAGE AREA MAP

Sheet reference number:

DAM-1

G:\Shared drives\2150651\CADD\Pre Development Drainage area Map.dgn



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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-28855
REGISTERED PROFESSIONAL ENGINEER
5/13/21

Mark	Description	Date	Appr.
	REVISED PER COMMENTS	05/13/21	
	REVISED PER COMMENTS	04/15/21	
	REVISED PER COMMENTS	03/22/21	
	CITY SUBMITTAL	02/18/21	

SUMMIT POINT

504 NE Chipman Road
Lee's Summit, Missouri

Preliminary Development Plan

Designed by: RP		Date: 03-25-2015	Rev. -
Dwn by: RP	Ckd by: LWS	Reviewed by: ---	
Submitted by: ---		Plot scale: 1:50	
File name: Post Development Drainage area Map.dgn			
Plot date: 5/14/2021		9:13:26 AM	

POST-DEVELOPMENT CONDITION
DRAINAGE AREA MAP

Sheet reference number:

DAM-2

G:\Shared drives\215065\CADD\Post Development Drainage area Map.dgn

STORM SEWER DESIGN CALCULATION TABLE (10-YEAR RETURN FREQUENCY)

Line No.	Up-stream Node No.	Down-stream Node No.	Direct Area "A" (acres)	Runoff Coef. "C"	A x C (acres)	Total A x C (acres)	Direct Inlet Time (min)	Total Flow Time (min)	Rainfall Intensity "i" (in/hr)	Antec. Precip. Factor "K"	Runoff "Q" Q=KCiA (cfs)	Dia. "D" (in)	Pipe Mat.	Rough -ness "n"	Slope "S" (%)	Length (ft)	Capacity (Full flowing) (cfs)	Velocity (Full flowing) (fps)	Q/Qf	V/Vf	Velocity (Design flow) (fps)	Velocity Head V^2/2g (ft)	d/Dia	Flow Depth d (ft)	Req. Friction Slope (%)
1	120	110	0.74	0.33	0.33	7.18	25.0	25.0	4.14	1	29.73	42	HDPE	0.011	0.28	18.00	62.67	6.51	0.47	0.98	6.40	0.64	0.48	1.68	0.06
	110	100			0.00	7.18	5.0	25.0	4.14	1	29.70	42	HDPE	0.011	0.21	24.00	54.27	5.64	0.55	1.02	5.73	0.51	0.52	1.82	0.06
2	245	240	0.05	0.42	0.02	0.02	5.0	5.0	7.35	1	0.15	6	HDPE	0.011	2.26	30.91	1.00	5.08	0.15	0.72	3.64	0.21	0.26	0.13	0.05
	240	235	0.07	0.90	0.06	0.08	5.0	5.1	7.31	1	0.61	6	HDPE	0.011	2.33	154.49	1.01	5.16	0.61	1.05	5.39	0.45	0.56	0.28	0.86
	235	230	0.07	0.90	0.06	0.15	5.0	5.6	7.17	1	1.05	8	HDPE	0.011	0.73	67.15	1.22	3.49	0.86	1.12	3.93	0.24	0.71	0.47	0.54
	230	225	0.07	0.56	0.04	0.19	5.0	5.9	7.08	1	1.32	12	HDPE	0.011	0.59	103.13	3.24	4.12	0.41	0.94	3.89	0.24	0.44	0.44	0.10
	225	220	0.28	0.77	0.22	1.39	5.0	6.3	6.96	1	9.69	24	HDPE	0.011	0.22	105.42	12.49	3.98	0.78	1.10	4.39	0.30	0.66	1.32	0.13
	220	215	0.40	0.84	0.34	1.92	5.0	6.7	6.85	1	13.14	24	HDPE	0.011	0.77	105.50	23.43	7.46	0.56	1.02	7.64	0.91	0.53	1.06	0.24
	215	210	0.21	0.81	0.17	5.93	5.0	7.0	6.79	1	40.26	42	HDPE	0.011	0.44	75.85	78.43	8.15	0.51	1.00	8.15	1.03	0.50	1.75	0.11
	210	200	0.30	0.76	0.23	6.80	5.0	7.1	6.75	1	45.89	42	HDPE	0.011	0.45	55.47	79.82	8.30	0.57	1.03	8.56	1.14	0.54	1.89	0.15
3	345	340	0.09	0.57	0.05	0.05	5.0	5.0	7.35	1	0.38	6	HDPE	0.011	1.10	39.14	0.70	3.54	0.54	1.02	3.60	0.20	0.52	0.26	0.32
	340	335			0.00	0.05	5.0	5.2	7.30	1	0.37	8	HDPE	0.011	1.51	56.36	1.75	5.02	0.21	0.79	3.97	0.24	0.31	0.21	0.07
	335	330	0.07	0.30	0.02	0.07	5.0	5.4	7.23	1	0.52	8	HDPE	0.011	1.01	24.77	1.43	4.11	0.36	0.91	3.75	0.22	0.41	0.27	0.13
	330	325	0.08	0.60	0.05	0.12	5.0	5.5	7.19	1	0.87	8	HDPE	0.011	2.77	104.95	2.38	6.81	0.36	0.91	6.22	0.60	0.41	0.27	0.37
	325	320	0.14	0.64	0.09	0.21	5.0	5.8	7.11	1	1.49	12	HDPE	0.011	1.00	64.05	4.21	5.36	0.35	0.91	4.89	0.37	0.41	0.41	0.13
	320	315	0.08	0.60	0.05	0.26	5.0	6.0	7.05	1	1.82	12	HDPE	0.011	4.05	91.30	8.48	10.79	0.21	0.79	8.53	1.13	0.31	0.31	0.19
	315	310	0.07	0.30	0.02	0.49	5.0	6.2	7.00	1	3.42	15	HDPE	0.011	0.60	56.39	5.93	4.83	0.58	1.03	4.98	0.39	0.54	0.68	0.20
	310	305	0.06	0.90	0.05	0.54	5.0	6.4	6.95	1	3.77	15	HDPE	0.011	0.74	74.09	6.58	5.36	0.57	1.03	5.53	0.48	0.54	0.68	0.24
	305	210	0.11	0.90	0.10	0.64	5.0	6.6	6.89	1	4.42	15	HDPE	0.011	0.96	57.22	7.48	6.10	0.59	1.04	6.34	0.62	0.55	0.69	0.33
4	420	415	0.12	0.80	0.10	0.10	5.0	5.0	7.35	1	0.71	6	HDPE	0.011	9.25	41.42	2.02	10.27	0.35	0.90	9.27	1.33	0.40	0.20	1.13
	415	410			0.00	0.10	5.0	5.1	7.33	1	0.70	8	HDPE	0.011	2.14	15.91	2.09	5.98	0.34	0.90	5.40	0.45	0.40	0.27	0.24
	410	405			0.00	0.10	5.0	5.1	7.31	1	0.70	8	HDPE	0.011	6.00	83.35	3.50	10.02	0.20	0.78	7.78	0.94	0.30	0.20	0.24
	405	315	0.07	0.81	0.06	0.21	5.0	5.3	7.26	1	1.52	12	HDPE	0.011	0.61	39.34	3.29	4.19	0.46	0.97	4.08	0.26	0.47	0.47	0.13
4A	405A	405	0.07	0.81	0.06	0.06	5.0	5.0	7.35	1	0.42	8	HDPE	0.011	4.78	31.56	3.12	8.95	0.13	0.68	6.12	0.58	0.24	0.16	0.09
5	535	530	0.31	0.80	0.25	0.25	5.0	5.0	7.35	1	1.82	15	HDPE	0.011	4.32	62.32	15.86	12.92	0.11	0.65	8.41	1.10	0.22	0.28	0.06
	530	525	2.52	0.79	1.99	2.24	5.0	5.1	7.31	1	16.38	24	HDPE	0.011	3.06	51.36	46.74	14.88	0.35	0.90	13.42	2.80	0.40	0.80	0.38
	525	520	0.25	0.68	0.17	2.41	5.0	5.2	7.30	1	17.57	30	HDPE	0.011	2.20	122.31	71.89	14.65	0.24	0.82	11.97	2.22	0.33	0.83	0.13
	520	515	0.81	0.83	0.67	3.14	5.0	5.4	7.24	1	22.73	30	HDPE	0.011	0.80	57.53	43.35	8.83	0.52	1.01	8.90	1.23	0.51	1.28	0.22
	515	510	0.54	0.72	0.39	3.57	5.0	5.5	7.21	1	25.78	30	HDPE	0.011	0.94	32.99	46.99	9.57	0.55	1.02	9.73	1.47	0.52	1.30	0.28
	510	505	0.06	0.60	0.04	3.61	5.0	5.5	7.20	1	25.98	30	HDPE	0.011	1.03	50.63	49.13	10.01	0.53	1.01	10.09	1.58	0.51	1.28	0.29
	505	215	0.27	0.86	0.23	3.84	5.0	5.6	7.17	1	27.55	30	HDPE	0.011	1.35	91.65	56.38	11.49	0.49	0.99	11.39	2.01	0.49	1.23	0.32
6	605	515	0.06	0.80	0.05	0.05	5.0	5.0	7.35	1	0.35	6	HDPE	0.011	0.90	44.34	0.63	3.21	0.56	1.02	3.29	0.17	0.53	0.27	0.28
7	705	520	0.07	0.81	0.06	0.06	5.0	5.0	7.35	1	0.42	6	HDPE	0.011	4.80	72.73	1.45	7.40	0.29	0.86	6.33	0.62	0.36	0.18	0.40
9	925	920	0.08	0.60	0.05	0.05	5.0	5.0	7.35	1	0.35	6	HDPE	0.011	1.00	31.92	0.66	3.38	0.53	1.01	3.41	0.18	0.51	0.26	0.28
	920	915			0.00	0.05	5.0	5.2	7.31	1	0.35	6	HDPE	0.011	5.29	62.16	1.53	7.77	0.23	0.80	6.25	0.61	0.32	0.16	0.28
	915	910	0.08	0.68	0.05	0.10	5.0	5.3	7.25	1	0.74	8	HDPE	0.011	1.20	73.91	1.57	4.49	0.47	0.98	4.41	0.30	0.48	0.32	0.27
	910	905	0.07	0.51	0.04	0.14	5.0	5.6	7.17	1	0.99	8	HDPE	0.011	8.53	18.76	4.17	11.95	0.24	0.82	9.76	1.48	0.33	0.22	0.48
	905	220	0.07	0.73	0.05	0.19	5.0	5.6	7.16	1	1.36	12	HDPE	0.011	1.00	71.26	4.20	5.35	0.32	0.89	4.77	0.35	0.39	0.39	0.10
10	1020	1015	0.08	0.56	0.04	0.04	5.0	5.0	7.35	1	0.33	6	HDPE	0.011	6.34	75.68	1.67	8.51	0.20	0.78	6.60	0.68	0.30	0.15	0.25
	1015	1010	0.08	0.68	0.05	0.10	5.0	5.2	7.29	1	0.72	8	HDPE	0.011	0.99	75.93	1.42	4.07	0.51	1.00	4.07	0.26	0.50	0.33	0.26
	1010	1005	0.07	0.51	0.04	0.13	5.0	5.5	7.20	1	0.97	8	HDPE	0.011	3.76	39.06	2.77	7.94	0.35	0.90	7.16	0.80	0.40	0.27	0.46
	1005	225	0.86	0.82	0.71	0.99	5.0	5.6	7.17	1	7.11	18	HDPE	0.011	1.00	52.84	12.43	7.04	0.57	1.03	7.26	0.82	0.54	0.81	0.33
11	1125	1120	0.03	0.50	0.02	0.02	5.0	5.0	7.35	1	0.11	6	HDPE	0.011	1.09	18.37	0.69	3.52	0.16	0.72	2.52	0.10	0.26	0.13	0.03
	1120	1115	0.04	0.68	0.03	0.04	5.0	5.1	7.32	1	0.31	6	HDPE	0.011	4.45	9.21	1.40	7.13	0.22	0.79	5.63	0.49	0.31	0.16	0.22
	1115	1110			0.00	0.04	5.0	5.1	7.31	1	0.31	6	HDPE	0.011	4.44	78.64	1.40	7.11	0.22	0.79	5.62	0.49	0.31	0.16	0.22
	1110	1105			0.00	0.11	5.0	5.4	7.24	1	0.81	8	HDPE	0.011	1.16	42.14	1.54	4.41	0.52	1.01	4.45	0.31	0.51	0.34	0.32
	1105	1005	0.06	0.65	0.04	0.15	5.0	5.5	7.19	1	1.08	12	HDPE	0.011	1.01	48.52	4.23	5.39	0.26	0.83	4.47	0.31	0.34	0.34	0.07
11A	1110A	1110	0.09	0.77	0.07	0.07	5.0	5.0	7.35	1	0.51	6	HDPE	0.011	11.72	4.35	2.27	11.56	0.22	0.80	9.30	1.34	0.32	0.16	0.59
12	1220	1215	0.12	0.90	0.11	0.11	5.0	5.0	7.35	1	0.79	8	HDPE	0.011	1.01	157.72	1.44	4.12	0.55	1.02	4.22	0.28	0.53	0.35	0.31
	1215	1210			0.00	0.11	5.0	5.6	7.17	1	0.77	8	HDPE	0.011	1.03	38.97	1.45	4.14	0.53	1.02	4.21	0.28	0.52	0.35	0.29
	1210	1205			0.00	0.11	5.0	5.8	7.12	1	0.77	12	HDPE	0.011	0.81	159.60	3.80	4.84	0.20	0.78	3.76	0.22	0.30	0.30	0.03
	1205	1200			0.00	0.11	5.0	6.5	6.92	1	0.75	12	HDPE	0.011	0.83	48.03	3.84	4.89	0.19	0.76	3.73	0.22	0.29	0.29	0.03

HYDRAULIC GRADE LINE CALCULATION TABLE (10-YEAR RETURN FREQUENCY)

Line No.	Down-stream Node No.	Top of Struct. Elev. (ft)	FL in Elev. (ft)	D.S. H.G.L. Elev. (ft)	D.S. E.G.L. Elev. (ft)	Runoff "Q" (cfs)	Dia. "D" (in)	Pipe Mat.	Rough-ness "n"	Slope "S" (%)	Length (ft)	Capacity (Full flowing) (cfs)	Q/Qf	Pressure Gravity, or Submergec Flow?	Velocity (Design Flow) (fps)	Velocity Head V^2/2g (ft)	Head Loss Condition	Head Loss Coef. "k"	Flow Depth d (ft)	Req. Friction Slope (%)	Up-stream Node No.	Top of Struct. Elev. (ft)	FL out Elev. (ft)	U.S. H.G.L. Elev. (ft)	U.S. E.G.L. Elev. (ft)
1	110	1000.48	994.95	998.71	998.86	29.73	42	HDPE	0.011	0.28	18.00	62.67	0.47	Submerge	3.09	0.15	>50% surface	1.0	n/a	0.06	120	998.88	995.00	998.87	999.02
	100	998.58	994.70	998.20	998.71	29.70	42	HDPE	0.011	0.21	24.00	54.27	0.55	Gravity	5.73	0.51	>50% surface	1.0	1.82	n/a	110	1000.48	994.75	998.71	999.22
2	240	1009.60	1006.17	1006.70	1006.91	0.15	6	HDPE	0.011	2.26	30.91	1.00	0.15	Gravity	3.64	0.21	>50% surface	1.0	0.13	n/a	245	1010.50	1006.87	1007.21	1007.41
	235	1005.80	1002.37	1002.75	1003.20	0.61	6	HDPE	0.011	2.33	154.49	1.01	0.61	Gravity	5.39	0.45	>50% surface	1.0	0.28	n/a	240	1009.60	1005.97	1006.70	1007.15
	230	1003.65	1001.71	1002.18	1002.42	1.05	8	HDPE	0.011	0.73	67.15	1.22	0.86	Gravity	3.93	0.24	45 Deg. Bend	0.3	0.47	n/a	235	1005.80	1002.20	1002.75	1002.98
	225	1004.25	1000.77	1001.21	1001.45	1.32	12	HDPE	0.011	0.59	103.13	3.24	0.41	Gravity	3.89	0.24	45 Deg. Bend	0.3	0.44	n/a	230	1003.65	1001.38	1001.89	1002.13
	220	1003.31	999.54	1000.98	1001.28	9.69	24	HDPE	0.011	0.22	105.42	12.49	0.78	Gravity	4.39	0.30	Junction	0.4	1.32	n/a	225	1004.25	999.77	1001.21	1001.51
	215	1004.34	998.53	1000.62	1001.52	13.14	24	HDPE	0.011	0.77	105.50	23.43	0.56	Gravity	7.64	0.91	Junction	0.4	1.06	n/a	220	1003.31	999.34	1000.98	1001.89
	210	1004.08	996.70	1000.21	1001.24	40.26	42	HDPE	0.011	0.44	75.85	78.43	0.51	Gravity	8.15	1.03	Junction	0.4	1.75	n/a	215	1004.34	997.03	1000.62	1001.65
	200	1000.13	996.25	999.75	1000.89	45.89	42	HDPE	0.011	0.45	55.47	79.82	0.57	Gravity	8.56	1.14	Junction	0.4	1.89	n/a	210	1004.08	996.50	1000.21	1001.34
3	340	1013.50	1010.29	1010.55	1010.75	0.38	6	HDPE	0.011	1.10	39.14	0.70	0.54	Gravity	3.60	0.20	>50% surface	1.0	0.26	n/a	345	1014.00	1010.72	1011.18	1011.38
	335	1013.50	1009.27	1009.48	1009.72	0.37	8	HDPE	0.011	1.51	56.36	1.75	0.21	Gravity	3.97	0.24	90 Deg. Bend	0.4	0.21	n/a	340	1013.50	1010.12	1010.42	1010.67
	330	1013.50	1008.82	1009.09	1009.31	0.52	8	HDPE	0.011	1.01	24.77	1.43	0.36	Gravity	3.75	0.22	45 Deg. Bend	0.3	0.27	n/a	335	1013.50	1009.07	1009.41	1009.63
	325	1010.00	1005.71	1005.98	1006.58	0.87	8	HDPE	0.011	2.77	104.95	2.38	0.36	Gravity	6.22	0.60	45 Deg. Bend	0.3	0.27	n/a	330	1013.50	1008.62	1009.07	1009.67
	320	1009.20	1004.74	1005.19	1005.56	1.49	12	HDPE	0.011	1.00	64.05	4.21	0.35	Gravity	4.89	0.37	45 Deg. Bend	0.3	0.41	n/a	325	1010.00	1005.38	1005.90	1006.27
	315	1006.70	1000.84	1001.32	1002.45	1.82	12	HDPE	0.011	4.05	91.30	8.48	0.21	Gravity	8.53	1.13	45 Deg. Bend	0.3	0.31	n/a	320	1009.20	1004.54	1005.19	1006.32
	310	1006.75	1000.25	1000.93	1001.31	3.42	15	HDPE	0.011	0.60	56.39	5.93	0.58	Gravity	4.98	0.39	Thru Flow	0.2	0.68	n/a	315	1006.70	1000.59	1001.32	1001.71
	305	1004.58	999.50	1000.45	1000.93	3.77	15	HDPE	0.011	0.74	74.09	6.58	0.57	Gravity	5.53	0.48	90 Deg. Bend	0.4	0.68	n/a	310	1006.75	1000.05	1000.92	1001.39
	210	1004.08	998.75	1000.21	1000.83	4.42	15	HDPE	0.011	0.96	57.22	7.48	0.59	Gravity	6.34	0.62	Junction	0.4	0.69	n/a	305	1004.58	999.30	1000.45	1001.08
4	415	1010.00	1007.12	1007.35	1008.69	0.71	6	HDPE	0.011	9.25	41.42	2.02	0.35	Gravity	9.27	1.33	>50% surface	1.0	0.20	n/a	420	1014.00	1010.95	1012.48	1013.82
	410	1010.00	1006.61	1006.99	1007.44	0.70	8	HDPE	0.011	2.14	15.91	2.09	0.34	Gravity	5.40	0.45	45 Deg. Bend	0.3	0.27	n/a	415	1010.00	1006.95	1007.35	1007.80
	405	1007.00	1001.41	1001.94	1002.88	0.70	8	HDPE	0.011	6.00	83.35	3.50	0.20	Gravity	7.78	0.94	Junction	0.4	0.20	n/a	410	1010.00	1006.41	1006.99	1007.92
	315	1006.70	1000.84	1001.84	1002.10	1.52	12	HDPE	0.011	0.61	39.34	3.29	0.46	Gravity	4.08	0.26	Junction	0.4	0.47	n/a	405	1007.00	1001.08	1001.94	1002.20
4A	405	1007.00	1001.41	1002.08	1002.66	0.42	8	HDPE	0.011	4.78	31.56	3.12	0.13	Gravity	6.12	0.58	>50% surface	1.0	0.16	n/a	405A	1007.00	1002.92	1003.66	1004.24
5	530	1013.48	1006.88	1009.73	1010.83	1.82	15	HDPE	0.011	4.32	62.32	15.86	0.11	Gravity	8.41	1.10	>50% surface	1.0	0.28	n/a	535	1015.00	1009.57	1010.94	1012.04
	525	1012.93	1004.56	1005.55	1008.35	16.38	24	HDPE	0.011	3.06	51.36	46.74	0.35	Gravity	13.42	2.80	>50% surface	1.0	0.80	n/a	530	1013.48	1006.13	1009.73	1012.53
	520	1007.85	1001.37	1002.93	1005.15	17.57	30	HDPE	0.011	2.20	122.31	71.89	0.24	Gravity	11.97	2.22	45 Deg. Bend	0.3	0.83	n/a	525	1012.93	1004.06	1005.55	1007.78
	515	1005.25	1000.70	1002.39	1003.62	22.73	30	HDPE	0.011	0.80	57.53	43.35	0.52	Gravity	8.90	1.23	Junction	0.4	1.28	n/a	520	1007.85	1001.16	1002.93	1004.16
	510	1004.50	1000.19	1001.74	1003.21	25.78	30	HDPE	0.011	0.94	32.99	46.99	0.55	Gravity	9.73	1.47	Junction	0.4	1.30	n/a	515	1005.25	1000.50	1002.39	1003.86
	505	1004.79	999.47	1001.22	1002.80	25.98	30	HDPE	0.011	1.03	50.63	49.13	0.53	Gravity	10.09	1.58	45 Deg. Bend	0.3	1.28	n/a	510	1004.50	999.99	1001.74	1003.32
	215	1004.34	998.03	1000.62	1002.63	27.55	30	HDPE	0.011	1.35	91.65	56.38	0.49	Gravity	11.39	2.01	45 Deg. Bend	0.3	1.23	n/a	505	1004.79	999.27	1001.22	1003.24
6	515	1005.25	1002.50	1003.00	1003.17	0.35	6	HDPE	0.011	0.90	44.34	0.63	0.56	Gravity	3.29	0.17	>50% surface	1.0	0.27	n/a	605	1005.25	1002.90	1003.33	1003.50
7	520	1007.85	1003.16	1003.66	1004.28	0.42	6	HDPE	0.011	4.80	72.73	1.45	0.29	Gravity	6.33	0.62	>50% surface	1.0	0.18	n/a	705	1010.21	1006.65	1007.45	1008.07
9	920	1011.50	1007.73	1007.99	1008.17	0.35	6	HDPE	0.011	1.00	31.92	0.66	0.53	Gravity	3.41	0.18	>50% surface	1.0	0.26	n/a	925	1011.50	1008.05	1008.49	1008.67
	915	1007.50	1004.24	1004.44	1005.04	0.35	6	HDPE	0.011	5.29	62.16	1.53	0.23	Gravity	6.25	0.61	45 Deg. Bend	0.3	0.16	n/a	920	1011.50	1007.53	1007.87	1008.48
	910	1006.40	1003.18	1003.79	1004.09	0.74	8	HDPE	0.011	1.20	73.91	1.57	0.47	Gravity	4.41	0.30	Thru Flow	0.2	0.32	n/a	915	1007.50	1004.07	1004.44	1004.74
	905	1005.63	1001.38	1001.60	1003.08	0.99	8	HDPE	0.011	8.53	18.76	4.17	0.24	Gravity	9.76	1.48	90 Deg. Bend	0.4	0.22	n/a	910	1006.40	1002.98	1003.79	1005.27
	220	1003.31	1000.34	1001.34	1001.69	1.36	12	HDPE	0.011	1.00	71.26	4.20	0.32	Gravity	4.77	0.35	90 Deg. Bend	0.4	0.39	n/a	905	1005.63	1001.05	1001.58	1001.93
10	1015	1007.50	1004.23	1004.65	1005.33	0.33	6	HDPE	0.011	6.34	75.68	1.67	0.20	Gravity	6.60	0.68	>50% surface	1.0	0.15	n/a	1020	1011.50	1009.03	1009.86	1010.53
	1010	1006.80	1003.31	1003.70	1003.95	0.72	8	HDPE	0.011	0.99	75.93	1.42	0.51	Gravity	4.07	0.26	>50% surface	1.0	0.33	n/a	1015	1007.50	1004.06	1004.65	1004.91
	1005	1005.98	1001.64	1002.10	1002.89	0.97	8	HDPE	0.011	3.76	39.06	2.77	0.35	Gravity	7.16	0.80	90 Deg. Bend	0.4	0.27	n/a	1010	1006.80	1003.11	1003.70	1004.49
	225	1004.25	1000.27	1001.77	1002.59	7.11	18	HDPE	0.011	1.00	52.84	12.43	0.57	Gravity	7.26	0.82	Junction	0.4	0.81	n/a	1005	1005.98	1000.80	1002.10	1002.92
11	1120	1010.50	1006.87	1007.00	1007.10	0.11	6	HDPE	0.011	1.09	18.37	0.69	0.16	Gravity	2.52	0.10	>50% surface	1.0	0.13	n/a	1125	1010.50	1007.07	1007.30	1007.40
	1115	1007.19	1006.26	1006.56	1007.05	0.31	6	HDPE	0.011	4.45	9.21	1.40	0.22	Gravity	5.63	0.49	Thru Flow	0.2	0.16	n/a	1120	1010.50	1006.67	1006.90	1007.39
	1110	1003.87	1002.77	1003.07	1003.56	0.31	6	HDPE	0.011	4.44	78.64	1.40	0.22	Gravity	5.62	0.49	45 Deg. Bend	0.3	0.16	n/a	1115	1007.19	1006.26	1006.56	1007.05
	1105	1006.50	1002.12	1002.46	1002.77	0.81	8	HDPE	0.011	1.16	42.14	1.54	0.52	Gravity	4.45	0.31	Junction	0.4	0.34	n/a	1110	1003.87	1002.61	1003.07	1003.38
	1005	1005.98	1001.30	1002.30	1002.61	1.08	12	HDPE	0.011	1.01	48.52	4.23	0.26	Gravity	4.47	0.31	90 Deg. Bend	0.4	0.34	n/a	1105	1006.50	1001.79	1002.42	1002.73
11A	1110	1003.87	1002.77	1003.27	1004.61	0.51	6	HDPE	0.011	11.72	4.35	2.27	0.22	Gravity	9.30	1.34	>50% surface	1.0	0.16	n/a	1110A	1006.50	1003.28	1004.78	1006.12
12	1215	1002.00	998.70	999.05	999.33	0.79	8	HDPE	0.011	1.01	157.72	1.44	0.55	Gravity	4.22	0.28	>50% surface	1.0	0.35	n/a	1220	1003.30	1000.30	1000.93	1001.21
	1210	1001.50	998.20	998.55	998.82	0.77	8	HDPE	0.011	1.03	38.97	1.45	0.53	Gravity	4.21	0.28	45 Deg. Bend	0.3	0.35	n/a	1215	1002.00	998.60	999.03	999.31
	1205	1001.50	996.70	997.26	997.48	0.77	12	HDPE	0.011	0.81	159.60	3.80	0.20	Gravity	3.76	0.22	45 Deg. Bend	0.3	0.30	n/a	1210	1001.50	998.00	998.37	998.58
	1200	997.37	996.20	997.20	997.42	0.75	12	HDPE	0.011	0.83	48.03	3.84	0.19	Gravity	3.73	0.22	45 Deg. Bend	0.3	0.29	n/a	1205	1001.50	996.60	997.26	997.48

STORM SEWER DESIGN CALCULATION TABLE (100-YEAR RETURN FREQUENCY)

Line No.	Up-stream Node No.	Down-stream Node No.	Direct Area "A" (acres)	Runoff Coef. "C"	A x C (acres)	Total A x C (acres)	Direct Inlet Time (min)	Total Flow Time (min)	Rainfall Intensity "i" (in/hr)	Antec. Precip. Factor "K"	Runoff "Q" Q=KCiA (cfs)	Dia. "D" (in)	Pipe Mat.	Rough -ness "n"	Slope "S" (%)	Length (ft)	Capacity (Full flowing) (cfs)	Velocity (Full flowing) (fps)	Q/Qf	V/Vf	Velocity (Design flow) (fps)	Velocity Head V^2/2g (ft)	d/Dia	Flow Depth d (ft)	Req. Friction Slope (%)
1	120	110	0.74	0.33	0.33	7.18	34.0	34.0	5.17	1.25	46.43	42	HDPE	0.011	0.28	18.00	62.67	6.51	0.74	1.09	7.13	0.79	0.64	2.24	0.15
	110	100			0.00	7.18	5.0	34.0	5.17	1.25	46.40	42	HDPE	0.011	0.21	24.00	54.27	5.64	0.86	1.12	6.34	0.62	0.71	2.49	0.15
2	245	240	0.05	0.42	0.02	0.02	5.0	5.0	10.32	1.25	0.27	6	HDPE	0.011	2.26	30.91	1.00	5.08	0.27	0.84	4.28	0.29	0.35	0.18	0.17
	240	235	0.07	0.90	0.06	0.08	5.0	5.1	10.27	1.25	1.08	6	HDPE	0.011	2.33	154.49	1.01	5.16	1.07	1.13	5.82	0.53	0.89	0.45	2.65
	235	230	0.07	0.90	0.06	0.15	5.0	5.6	10.09	1.25	1.85	8	HDPE	0.011	0.73	67.15	1.22	3.49	1.52	1.52	5.31	0.44	1.00	0.67	1.69
	230	225	0.07	0.56	0.04	0.19	5.0	5.8	10.01	1.25	2.33	12	HDPE	0.011	0.59	103.13	3.24	4.12	0.72	1.08	4.47	0.31	0.62	0.62	0.31
	225	220	0.28	0.77	0.22	1.39	5.0	6.2	9.86	1.25	17.16	24	HDPE	0.011	0.22	105.42	12.49	3.98	1.37	1.37	5.46	0.46	1.00	2.00	0.41
	220	215	0.40	0.84	0.34	1.92	5.0	6.5	9.74	1.25	23.35	24	HDPE	0.011	0.77	105.50	23.43	7.46	1.00	1.14	8.50	1.12	0.81	1.62	0.76
	215	210	0.21	0.81	0.17	5.93	5.0	6.7	9.67	1.25	71.65	42	HDPE	0.011	0.44	75.85	78.43	8.15	0.91	1.13	9.24	1.33	0.75	2.63	0.36
	210	200	0.30	0.76	0.23	6.80	5.0	6.8	9.62	1.25	81.73	42	HDPE	0.011	0.45	55.47	79.82	8.30	1.02	1.14	9.45	1.39	0.84	2.94	0.47
3	345	340	0.09	0.57	0.05	0.05	5.0	5.0	10.32	1.25	0.66	6	HDPE	0.011	1.10	39.14	0.70	3.54	0.95	1.14	4.02	0.25	0.77	0.39	1.00
	340	335			0.00	0.05	5.0	5.2	10.26	1.25	0.66	8	HDPE	0.011	1.51	56.36	1.75	5.02	0.37	0.92	4.64	0.33	0.42	0.28	0.21
	335	330	0.07	0.30	0.02	0.07	5.0	5.4	10.17	1.25	0.92	8	HDPE	0.011	1.01	24.77	1.43	4.11	0.64	1.06	4.36	0.29	0.58	0.39	0.42
	330	325	0.08	0.60	0.05	0.12	5.0	5.5	10.13	1.25	1.52	8	HDPE	0.011	2.77	104.95	2.38	6.81	0.64	1.06	7.22	0.81	0.58	0.39	1.14
	325	320	0.14	0.64	0.09	0.21	5.0	5.7	10.04	1.25	2.63	12	HDPE	0.011	1.00	64.05	4.21	5.36	0.63	1.05	5.64	0.49	0.57	0.57	0.39
	320	315	0.08	0.60	0.05	0.26	5.0	5.9	9.96	1.25	3.21	12	HDPE	0.011	4.05	91.30	8.48	10.79	0.38	0.92	9.97	1.54	0.42	0.42	0.58
	315	310	0.07	0.30	0.02	0.49	5.0	6.0	9.91	1.25	6.05	15	HDPE	0.011	0.60	56.39	5.93	4.83	1.02	1.14	5.50	0.47	0.83	1.04	0.63
	310	305	0.06	0.90	0.05	0.54	5.0	6.2	9.84	1.25	6.67	15	HDPE	0.011	0.74	74.09	6.58	5.36	1.01	1.14	6.11	0.58	0.83	1.04	0.76
	305	210	0.11	0.90	0.10	0.64	5.0	6.4	9.76	1.25	7.83	15	HDPE	0.011	0.96	57.22	7.48	6.10	1.05	1.14	6.93	0.75	0.86	1.08	1.05
4	420	415	0.12	0.80	0.10	0.10	5.0	5.0	10.32	1.25	1.24	6	HDPE	0.011	9.25	41.42	2.02	10.27	0.61	1.05	10.75	1.79	0.56	0.28	3.49
	415	410			0.00	0.10	5.0	5.1	10.30	1.25	1.24	8	HDPE	0.011	2.14	15.91	2.09	5.98	0.59	1.04	6.22	0.60	0.55	0.37	0.75
	410	405			0.00	0.10	5.0	5.1	10.28	1.25	1.23	8	HDPE	0.011	6.00	83.35	3.50	10.02	0.35	0.91	9.15	1.30	0.41	0.27	0.75
	405	315	0.07	0.81	0.06	0.21	5.0	5.3	10.22	1.25	2.67	12	HDPE	0.011	0.61	39.34	3.29	4.19	0.81	1.11	4.66	0.34	0.68	0.68	0.40
4A	405A	405	0.07	0.81	0.06	0.06	5.0	5.0	10.32	1.25	0.73	8	HDPE	0.011	4.78	31.56	3.12	8.95	0.23	0.80	7.19	0.80	0.32	0.21	0.26
5	535	530	0.31	0.80	0.25	0.25	5.0	5.0	10.32	1.25	3.20	15	HDPE	0.011	4.32	62.32	15.86	12.92	0.20	0.78	10.03	1.56	0.30	0.38	0.18
	530	525	2.52	0.79	1.99	2.24	5.0	5.1	10.28	1.25	28.77	24	HDPE	0.011	3.06	51.36	46.74	14.88	0.62	1.05	15.57	3.76	0.56	1.12	1.16
	525	520	0.25	0.68	0.17	2.41	5.0	5.2	10.26	1.25	30.88	30	HDPE	0.011	2.20	122.31	71.89	14.65	0.43	0.95	13.98	3.03	0.45	1.13	0.41
	520	515	0.81	0.83	0.67	3.14	5.0	5.3	10.20	1.25	40.00	30	HDPE	0.011	0.80	57.53	43.35	8.83	0.92	1.13	10.01	1.56	0.75	1.88	0.68
	515	510	0.54	0.72	0.39	3.57	5.0	5.4	10.16	1.25	45.39	30	HDPE	0.011	0.94	32.99	46.99	9.57	0.97	1.14	10.90	1.85	0.79	1.98	0.88
	510	505	0.06	0.60	0.04	3.61	5.0	5.5	10.14	1.25	45.76	30	HDPE	0.011	1.03	50.63	49.13	10.01	0.93	1.14	11.36	2.00	0.76	1.90	0.89
	505	215	0.27	0.86	0.23	3.84	5.0	5.5	10.11	1.25	48.56	30	HDPE	0.011	1.35	91.65	56.38	11.49	0.86	1.12	12.90	2.58	0.71	1.78	1.00
6	605	515	0.06	0.80	0.05	0.05	5.0	5.0	10.32	1.25	0.62	6	HDPE	0.011	0.90	44.34	0.63	3.21	0.98	1.14	3.66	0.21	0.80	0.40	0.87
7	705	520	0.07	0.81	0.06	0.06	5.0	5.0	10.32	1.25	0.73	6	HDPE	0.011	4.80	72.73	1.45	7.40	0.50	1.00	7.40	0.85	0.50	0.25	1.22
9	925	920	0.08	0.60	0.05	0.05	5.0	5.0	10.32	1.25	0.62	6	HDPE	0.011	1.00	31.92	0.66	3.38	0.93	1.14	3.84	0.23	0.76	0.38	0.87
	920	915			0.00	0.05	5.0	5.1	10.27	1.25	0.62	6	HDPE	0.011	5.29	62.16	1.53	7.77	0.40	0.94	7.34	0.84	0.44	0.22	0.86
	915	910	0.08	0.68	0.05	0.10	5.0	5.3	10.21	1.25	1.31	8	HDPE	0.011	1.20	73.91	1.57	4.49	0.83	1.12	5.01	0.39	0.69	0.46	0.84
	910	905	0.07	0.51	0.04	0.14	5.0	5.5	10.11	1.25	1.74	8	HDPE	0.011	8.53	18.76	4.17	11.95	0.42	0.95	11.40	2.02	0.45	0.30	1.49
	905	220	0.07	0.73	0.05	0.19	5.0	5.6	10.10	1.25	2.39	12	HDPE	0.011	1.00	71.26	4.20	5.35	0.57	1.02	5.48	0.47	0.53	0.53	0.32
10	1020	1015	0.08	0.56	0.04	0.04	5.0	5.0	10.32	1.25	0.58	6	HDPE	0.011	6.34	75.68	1.67	8.51	0.35	0.90	7.67	0.91	0.40	0.20	0.76
	1015	1010	0.08	0.68	0.05	0.10	5.0	5.2	10.25	1.25	1.27	8	HDPE	0.011	0.99	75.93	1.42	4.07	0.90	1.13	4.59	0.33	0.73	0.49	0.79
	1010	1005	0.07	0.51	0.04	0.13	5.0	5.4	10.14	1.25	1.71	8	HDPE	0.011	3.76	39.06	2.77	7.94	0.62	1.05	8.31	1.07	0.56	0.37	1.44
	1005	225	0.86	0.82	0.71	0.99	5.0	5.5	10.11	1.25	12.52	18	HDPE	0.011	1.00	52.84	12.43	7.04	1.01	1.14	8.02	1.00	0.82	1.23	1.02
11	1125	1120	0.03	0.50	0.02	0.02	5.0	5.0	10.32	1.25	0.19	6	HDPE	0.011	1.09	18.37	0.69	3.52	0.28	0.86	3.01	0.14	0.36	0.18	0.09
	1120	1115	0.04	0.68	0.03	0.04	5.0	5.1	10.28	1.25	0.54	6	HDPE	0.011	4.45	9.21	1.40	7.13	0.39	0.93	6.66	0.69	0.43	0.22	0.67
	1115	1110			0.00	0.04	5.0	5.1	10.27	1.25	0.54	6	HDPE	0.011	4.44	78.64	1.40	7.11	0.39	0.93	6.65	0.69	0.43	0.22	0.67
	1110	1105			0.00	0.11	5.0	5.3	10.19	1.25	1.42	8	HDPE	0.011	1.16	42.14	1.54	4.41	0.92	1.13	5.00	0.39	0.75	0.50	0.99
	1105	1005	0.06	0.65	0.04	0.15	5.0	5.5	10.13	1.25	1.91	12	HDPE	0.011	1.01	48.52	4.23	5.39	0.45	0.97	5.24	0.43	0.47	0.47	0.21
11A	1110A	1110	0.09	0.77	0.07	0.07	5.0	5.0	10.32	1.25	0.89	6	HDPE	0.011	11.72	4.35	2.27	11.56	0.39	0.93	10.80	1.81	0.43	0.22	1.82
12	1220	1215	0.12	0.90	0.11	0.11	5.0	5.0	10.32	1.25	1.39	8	HDPE	0.011	1.01	157.72	1.44	4.12	0.97	1.14	4.69	0.34	0.79	0.53	0.95
	1215	1210			0.00	0.11	5.0	5.6	10.09	1.25	1.36	8	HDPE	0.011	1.03	38.97	1.45	4.14	0.94	1.14	4.71	0.34	0.77	0.51	0.91
	1210	1205			0.00	0.11	5.0	5.7	10.04	1.25	1.36	12	HDPE	0.011	0.81	159.60	3.80	4.84	0.36	0.91	4.42	0.30	0.41	0.41	0.10
	1205	1200			0.00	0.11	5.0	6.3	9.81	1.25	1.32	12	HDPE	0.011	0.83	48.03	3.84	4.89	0.34	0.90	4.41	0.30	0.40	0.40	0.10

HYDRAULIC GRADE LINE CALCULATION TABLE (100-YEAR RETURN FREQUENCY)

Line No.	Down-stream Node No.	Top of Struct. Elev. (ft)	FL in Elev. (ft)	D.S. H.G.L. Elev. (ft)	D.S. E.G.L. Elev. (ft)	Runoff "Q" (cfs)	Dia. "D" (in)	Pipe Mat.	Rough -ness "n"	Slope "S" (%)	Length (ft)	Capacity (Full flowing) (cfs)	Q/Qf	Pressure Gravity, or Submergec Flow?	Velocity (Design Flow) (fps)	Velocity Head V^2/2g (ft)	Head Loss Condition	Head Loss Coef. "k"	Flow Depth d (ft)	Req. Friction Slope (%)	Up-stream Node No.	Top of Struct. Elev. (ft)	FL out Elev. (ft)	U.S. H.G.L. Elev. (ft)	U.S. E.G.L. Elev. (ft)
1	110	1000.48	994.95	998.82	999.18	46.43	42	HDPE	0.011	0.28	18.00	62.67	0.74	Submerge	4.83	0.36	>50% surface	1.0	n/a	0.15	120	998.88	995.00	999.21	999.57
	100	998.58	994.70	998.20	998.82	46.40	42	HDPE	0.011	0.21	24.00	54.27	0.86	Gravity	6.34	0.62	>50% surface	1.0	2.49	n/a	110	1000.48	994.75	998.82	999.45
2	240	1009.60	1006.17	1009.74	1009.77	0.27	6	HDPE	0.011	2.26	30.91	1.00	0.27	Submerge	1.38	0.03	>50% surface	1.0	n/a	0.17	245	1010.50	1006.87	1009.82	1009.85
	235	1005.80	1002.37	1005.18	1005.64	1.08	6	HDPE	0.011	2.33	154.49	1.01	1.07	Pressure	5.49	0.47	>50% surface	1.0	n/a	2.65	240	1009.60	1005.97	1009.74	1010.21
	230	1003.65	1001.71	1003.91	1004.35	1.85	8	HDPE	0.011	0.73	67.15	1.22	1.52	Pressure	5.31	0.44	45 Deg. Bend	0.3	n/a	1.69	235	1005.80	1002.20	1005.18	1005.61
	225	1004.25	1000.77	1003.55	1003.69	2.33	12	HDPE	0.011	0.59	103.13	3.24	0.72	Submerge	2.97	0.14	45 Deg. Bend	0.3	n/a	0.31	230	1003.65	1001.38	1003.91	1004.05
	220	1003.31	999.54	1002.93	1003.39	17.16	24	HDPE	0.011	0.22	105.42	12.49	1.37	Pressure	5.46	0.46	Junction	0.4	n/a	0.41	225	1004.25	999.77	1003.55	1004.01
	215	1004.34	998.53	1001.79	1002.64	23.35	24	HDPE	0.011	0.77	105.50	23.43	1.00	Submerge	7.43	0.86	Junction	0.4	n/a	0.76	220	1003.31	999.34	1002.93	1003.79
	210	1004.08	996.70	1001.17	1002.03	71.65	42	HDPE	0.011	0.44	75.85	78.43	0.91	Submerge	7.45	0.86	Junction	0.4	n/a	0.36	215	1004.34	997.03	1001.79	1002.65
	200	1000.13	996.25	1000.46	1001.58	81.73	42	HDPE	0.011	0.45	55.47	79.82	1.02	Pressure	8.49	1.12	Junction	0.4	n/a	0.47	210	1004.08	996.50	1001.17	1002.29
3	340	1013.50	1010.29	1010.68	1010.93	0.66	6	HDPE	0.011	1.10	39.14	0.70	0.95	Gravity	4.02	0.25	>50% surface	1.0	0.39	n/a	345	1014.00	1010.72	1011.36	1011.61
	335	1013.50	1009.27	1009.55	1009.88	0.66	8	HDPE	0.011	1.51	56.36	1.75	0.37	Gravity	4.64	0.33	90 Deg. Bend	0.4	0.28	n/a	340	1013.50	1010.12	1010.53	1010.87
	330	1013.50	1008.82	1009.27	1009.54	0.92	8	HDPE	0.011	1.01	24.77	1.43	0.64	Gravity	4.36	0.29	45 Deg. Bend	0.3	0.39	n/a	335	1013.50	1009.07	1009.55	1009.84
	325	1010.00	1005.71	1006.10	1006.91	1.52	8	HDPE	0.011	2.77	104.95	2.38	0.64	Gravity	7.22	0.81	45 Deg. Bend	0.3	0.39	n/a	330	1013.50	1008.62	1009.25	1010.06
	320	1009.20	1004.74	1005.42	1005.92	2.63	12	HDPE	0.011	1.00	64.05	4.21	0.63	Gravity	5.64	0.49	45 Deg. Bend	0.3	0.57	n/a	325	1010.00	1005.38	1006.10	1006.59
	315	1006.70	1000.84	1003.18	1004.72	3.21	12	HDPE	0.011	4.05	91.30	8.48	0.38	Gravity	9.97	1.54	45 Deg. Bend	0.3	0.42	n/a	320	1009.20	1004.54	1005.42	1006.97
	310	1006.75	1000.25	1002.77	1003.15	6.05	15	HDPE	0.011	0.60	56.39	5.93	1.02	Pressure	4.93	0.38	Thru Flow	0.2	n/a	0.63	315	1006.70	1000.59	1003.18	1003.56
	305	1004.58	999.50	1002.02	1002.48	6.67	15	HDPE	0.011	0.74	74.09	6.58	1.01	Pressure	5.44	0.46	90 Deg. Bend	0.4	n/a	0.76	310	1006.75	1000.05	1002.77	1003.23
	210	1004.08	998.75	1001.17	1001.80	7.83	15	HDPE	0.011	0.96	57.22	7.48	1.05	Pressure	6.38	0.63	Junction	0.4	n/a	1.05	305	1004.58	999.30	1002.02	1002.65
4	415	1010.00	1007.12	1007.50	1009.29	1.24	6	HDPE	0.011	9.25	41.42	2.02	0.61	Gravity	10.75	1.79	>50% surface	1.0	0.28	n/a	420	1014.00	1010.95	1013.02	1014.82
	410	1010.00	1006.61	1007.20	1007.80	1.24	8	HDPE	0.011	2.14	15.91	2.09	0.59	Gravity	6.22	0.60	45 Deg. Bend	0.3	0.37	n/a	415	1010.00	1006.95	1007.50	1008.10
	405	1007.00	1001.41	1003.41	1004.71	1.23	8	HDPE	0.011	6.00	83.35	3.50	0.35	Gravity	9.15	1.30	Junction	0.4	0.27	n/a	410	1010.00	1006.41	1007.20	1008.50
	315	1006.70	1000.84	1003.18	1003.36	2.67	12	HDPE	0.011	0.61	39.34	3.29	0.81	Submerge	3.40	0.18	Junction	0.4	n/a	0.4	405	1007.00	1001.08	1003.41	1003.59
4A	405	1007.00	1001.41	1003.41	1004.21	0.73	8	HDPE	0.011	4.78	31.56	3.12	0.23	Gravity	7.19	0.80	>50% surface	1.0	0.21	n/a	405A	1007.00	1002.92	1004.21	1005.02
5	530	1013.48	1006.88	1011.01	1011.12	3.20	15	HDPE	0.011	4.32	62.32	15.86	0.20	Submerge	2.61	0.11	>50% surface	1.0	n/a	0.18	535	1015.00	1009.57	1011.23	1011.34
	525	1012.93	1004.56	1006.55	1010.31	28.77	24	HDPE	0.011	3.06	51.36	46.74	0.62	Gravity	15.57	3.76	>50% surface	1.0	1.12	n/a	530	1013.48	1006.13	1011.01	1014.78
	520	1007.85	1001.37	1005.64	1008.67	30.88	30	HDPE	0.011	2.20	122.31	71.89	0.43	Gravity	13.98	3.03	45 Deg. Bend	0.3	1.13	n/a	525	1012.93	1004.06	1006.55	1009.58
	515	1005.25	1000.70	1004.84	1005.87	40.00	30	HDPE	0.011	0.80	57.53	43.35	0.92	Submerge	8.15	1.03	Junction	0.4	n/a	0.68	520	1007.85	1001.16	1005.64	1006.67
	510	1004.50	1000.19	1004.01	1005.34	45.39	30	HDPE	0.011	0.94	32.99	46.99	0.97	Submerge	9.25	1.33	Junction	0.4	n/a	0.88	515	1005.25	1000.50	1004.84	1006.16
	505	1004.79	999.47	1003.16	1004.51	45.76	30	HDPE	0.011	1.03	50.63	49.13	0.93	Submerge	9.32	1.35	45 Deg. Bend	0.3	n/a	0.89	510	1004.50	999.99	1004.01	1005.36
	215	1004.34	998.03	1001.79	1003.31	48.56	30	HDPE	0.011	1.35	91.65	56.38	0.86	Submerge	9.89	1.52	45 Deg. Bend	0.3	n/a	1	505	1004.79	999.27	1003.16	1004.68
6	515	1005.25	1002.50	1004.84	1004.99	0.62	6	HDPE	0.011	0.90	44.34	0.63	0.98	Submerge	3.15	0.15	>50% surface	1.0	n/a	0.87	605	1005.25	1002.90	1005.38	1005.53
7	520	1007.85	1003.16	1005.64	1006.49	0.73	6	HDPE	0.011	4.80	72.73	1.45	0.50	Gravity	7.40	0.85	>50% surface	1.0	0.25	n/a	705	1010.21	1006.65	1007.75	1008.60
9	920	1011.50	1007.73	1008.11	1008.34	0.62	6	HDPE	0.011	1.00	31.92	0.66	0.93	Gravity	3.84	0.23	>50% surface	1.0	0.38	n/a	925	1011.50	1008.05	1008.66	1008.89
	915	1007.50	1004.24	1004.59	1005.42	0.62	6	HDPE	0.011	5.29	62.16	1.53	0.40	Gravity	7.34	0.84	45 Deg. Bend	0.3	0.22	n/a	920	1011.50	1007.53	1008.00	1008.84
	910	1006.40	1003.18	1004.09	1004.48	1.31	8	HDPE	0.011	1.20	73.91	1.57	0.83	Gravity	5.01	0.39	Thru Flow	0.2	0.46	n/a	915	1007.50	1004.07	1004.59	1004.98
	905	1005.63	1001.38	1003.22	1005.24	1.74	8	HDPE	0.011	8.53	18.76	4.17	0.42	Gravity	11.40	2.02	90 Deg. Bend	0.4	0.30	n/a	910	1006.40	1002.98	1004.09	1006.11
	220	1003.31	1000.34	1002.93	1003.07	2.39	12	HDPE	0.011	1.00	71.26	4.20	0.57	Submerge	3.04	0.14	90 Deg. Bend	0.4	n/a	0.32	905	1005.63	1001.05	1003.22	1003.36
10	1015	1007.50	1004.23	1005.92	1006.83	0.58	6	HDPE	0.011	6.34	75.68	1.67	0.35	Gravity	7.67	0.91	>50% surface	1.0	0.20	n/a	1020	1011.50	1009.03	1010.14	1011.06
	1010	1006.80	1003.31	1005.11	1005.32	1.27	8	HDPE	0.011	0.99	75.93	1.42	0.90	Submerge	3.64	0.21	>50% surface	1.0	n/a	0.79	1015	1007.50	1004.06	1005.92	1006.12
	1005	1005.98	1001.64	1004.40	1004.77	1.71	8	HDPE	0.011	3.76	39.06	2.77	0.62	Submerge	4.90	0.37	90 Deg. Bend	0.4	n/a	1.44	1010	1006.80	1003.11	1005.11	1005.48
	225	1004.25	1000.27	1003.55	1004.33	12.52	18	HDPE	0.011	1.00	52.84	12.43	1.01	Pressure	7.08	0.78	Junction	0.4	n/a	1.02	1005	1005.98	1000.80	1004.40	1005.18
11	1120	1010.50	1006.87	1007.05	1007.19	0.19	6	HDPE	0.011	1.09	18.37	0.69	0.28	Gravity	3.01	0.14	>50% surface	1.0	0.18	n/a	1125	1010.50	1007.07	1007.39	1007.53
	1115	1007.19	1006.26	1006.68	1007.37	0.54	6	HDPE	0.011	4.45	9.21	1.40	0.39	Gravity	6.66	0.69	Thru Flow	0.2	0.22	n/a	1120	1010.50	1006.67	1006.99	1007.68
	1110	1003.87	1002.77	1005.06	1005.74	0.54	6	HDPE	0.011	4.44	78.64	1.40	0.39	Gravity	6.65	0.69	45 Deg. Bend	0.3	0.22	n/a	1115	1007.19	1006.26	1006.68	1007.37
	1105	1006.50	1002.12	1004.54	1004.80	1.42	8	HDPE	0.011	1.16	42.14	1.54	0.92	Submerge	4.07	0.26	Junction	0.4	n/a	0.99	1110	1003.87	1002.61	1005.06	1005.32
	1005	1005.98	1001.30	1004.40	1004.49	1.91	12	HDPE	0.011	1.01	48.52	4.23	0.45	Submerge	2.43	0.09	90 Deg. Bend	0.4	n/a	0.21	1105	1006.50	1001.79	1004.54	1004.63
11A	1110	1003.87	1002.77	1005.06	1005.38	0.89	6	HDPE	0.011	11.72	4.35	2.27	0.39	Submerge	4.55	0.32	>50% surface	1.0	n/a	1.82	1110A	1006.50	1003.28	1005.46	1005.78
12	1215	1002.00	998.70	999.23	999.57	1.39	8	HDPE	0.011	1.01	157.72	1.44	0.97	Gravity	4.69	0.34	>50% surface	1.0	0.53	n/a	1220	1003.30	1000.30	1001.17	1001.51
	1210	1001.50	998.20	998.71	999.06	1.36	8	HDPE	0.011	1.03	38.97	1.45	0.94	Gravity	4.71	0.34	45 Deg. Bend	0.3	0.51	n/a	1215	1002.00	998.60	999.22	999.56
	1205	1001.50	996.70	997.29	997.59	1.36	12	HDPE	0.011	0.81	159.60	3.80	0.36	Gravity	4.42	0.30	45 Deg. Bend	0.3	0.41	n/a	1210	1001.50	998.00	998.50	998.80
	1200	997.37	996.20	997.20	997.50	1.32	12	HDPE	0.011	0.83	48.03	3.84	0.34	Gravity	4.41	0.30	45 Deg. Bend	0.3	0.40	n/a	1205	1001.50	996.60	997.29	997.59

HY-8 Culvert Analysis Report

Project Notes

Project Title:Summit Point Apartments, Phase-II, Detention Basin Outlet Culvert

Designer:Tom Ingram, CFS Engineers

Project Date:Wednesday, April 13, 2022

Notes:

42" HDPE Outlet Culvert from Open-Graded Stormwater Detention Basin

Project Units: U.S. Customary Units

Outlet Control Option: Profiles

Exit Loss Option: Standard Method

Crossing Notes:

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

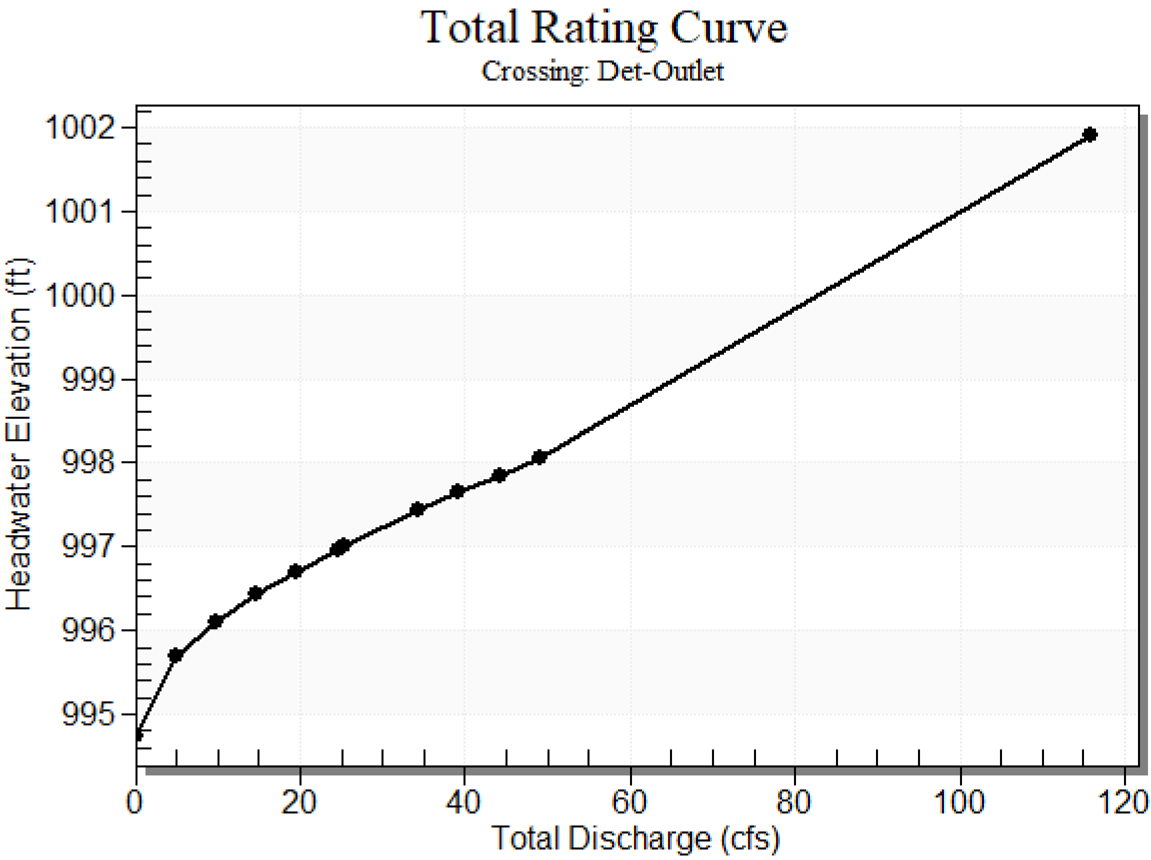
Design Flow: 25.38 cfs

Maximum Flow: 49.1 cfs

Table 1 - Summary of Culvert Flows at Crossing: Det-Outlet

Headwater Elevation (ft)	Total Discharge (cfs)	42" HDPE Outlet Discharge (cfs)	Roadway Discharge (cfs)	Iterations
994.75	0.00	0.00	0.00	1
995.69	4.91	4.91	0.00	1
996.10	9.82	9.82	0.00	1
996.43	14.73	14.73	0.00	1
996.71	19.64	19.64	0.00	1
996.96	24.55	24.55	0.00	1
997.01	25.38	25.38	0.00	1
997.43	34.37	34.37	0.00	1
997.64	39.28	39.28	0.00	1
997.85	44.19	44.19	0.00	1
998.06	49.10	49.10	0.00	1
1001.30	115.80	115.80	0.00	Overtopping

Rating Curve Plot for Crossing: Det-Outlet



Culvert Notes: 42" HDPE Outlet

Table 2 - Culvert Summary Table: 42" HDPE Outlet

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	994.75	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
4.91	4.91	995.69	0.889	0.942	2-M2c	0.729	0.662	0.662	0.332	3.880	1.974
9.82	9.82	996.10	1.270	1.351	2-M2c	1.046	0.945	0.945	0.494	4.685	2.490
14.73	14.73	996.43	1.573	1.676	2-M2c	1.302	1.165	1.165	0.621	5.258	2.836
19.64	19.64	996.71	1.855	1.958	2-M2c	1.523	1.353	1.353	0.729	5.722	3.102
24.55	24.55	996.96	2.130	2.214	2-M2c	1.733	1.522	1.522	0.824	6.115	3.321
25.38	25.38	997.01	2.174	2.255	2-M2c	1.767	1.549	1.549	0.839	6.175	3.354
34.37	34.37	997.43	2.601	2.677	2-M2c	2.137	1.815	1.815	0.989	6.822	3.672
39.28	39.28	997.64	2.810	2.893	2-M2c	2.346	1.946	1.946	1.062	7.150	3.819
44.19	44.19	997.85	3.009	3.103	2-M2c	2.566	2.066	2.066	1.130	7.476	3.952
49.10	49.10	998.06	3.204	3.307	2-M2c	2.828	2.185	2.185	1.195	7.771	4.073

****

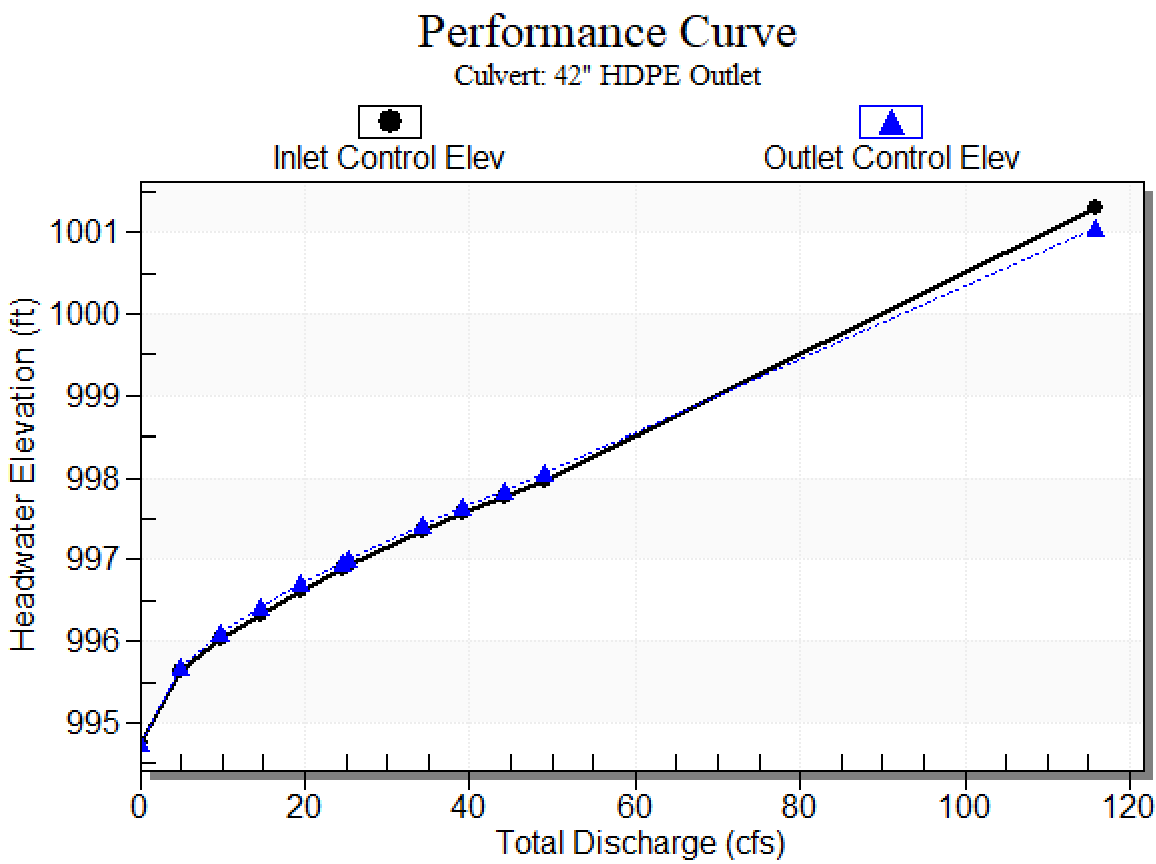
Straight Culvert

Inlet Elevation (invert): 994.75 ft,   Outlet Elevation (invert): 994.70 ft

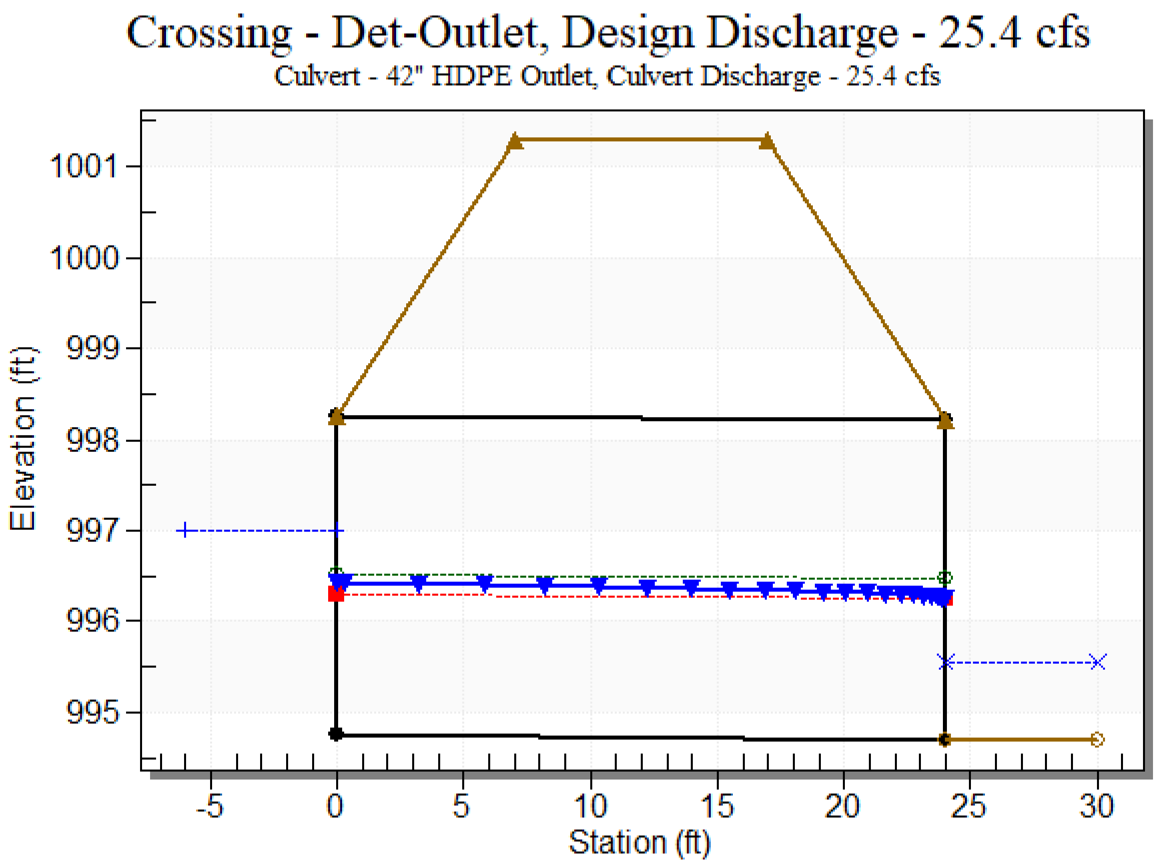
Culvert Length: 24.00 ft,   Culvert Slope: 0.0021

****

Culvert Performance Curve Plot: 42" HDPE Outlet



Water Surface Profile Plot for Culvert: 42" HDPE Outlet



Site Data - 42" HDPE Outlet

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 994.75 ft

Outlet Station: 24.00 ft

Outlet Elevation: 994.70 ft

Number of Barrels: 1

Culvert Data Summary - 42" HDPE Outlet

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1.5:1)

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Det-Outlet)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	994.70	0.00	0.00	0.00	0.00
4.91	995.03	0.33	1.97	0.23	0.64
9.82	995.19	0.49	2.49	0.35	0.68
14.73	995.32	0.62	2.84	0.44	0.70
19.64	995.43	0.73	3.10	0.51	0.72
24.55	995.52	0.82	3.32	0.58	0.73
25.38	995.54	0.84	3.35	0.59	0.73
34.37	995.69	0.99	3.67	0.70	0.75
39.28	995.76	1.06	3.82	0.75	0.75
44.19	995.83	1.13	3.95	0.80	0.76
49.10	995.90	1.20	4.07	0.84	0.76

Tailwater Channel Data - Det-Outlet

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 6.50 ft

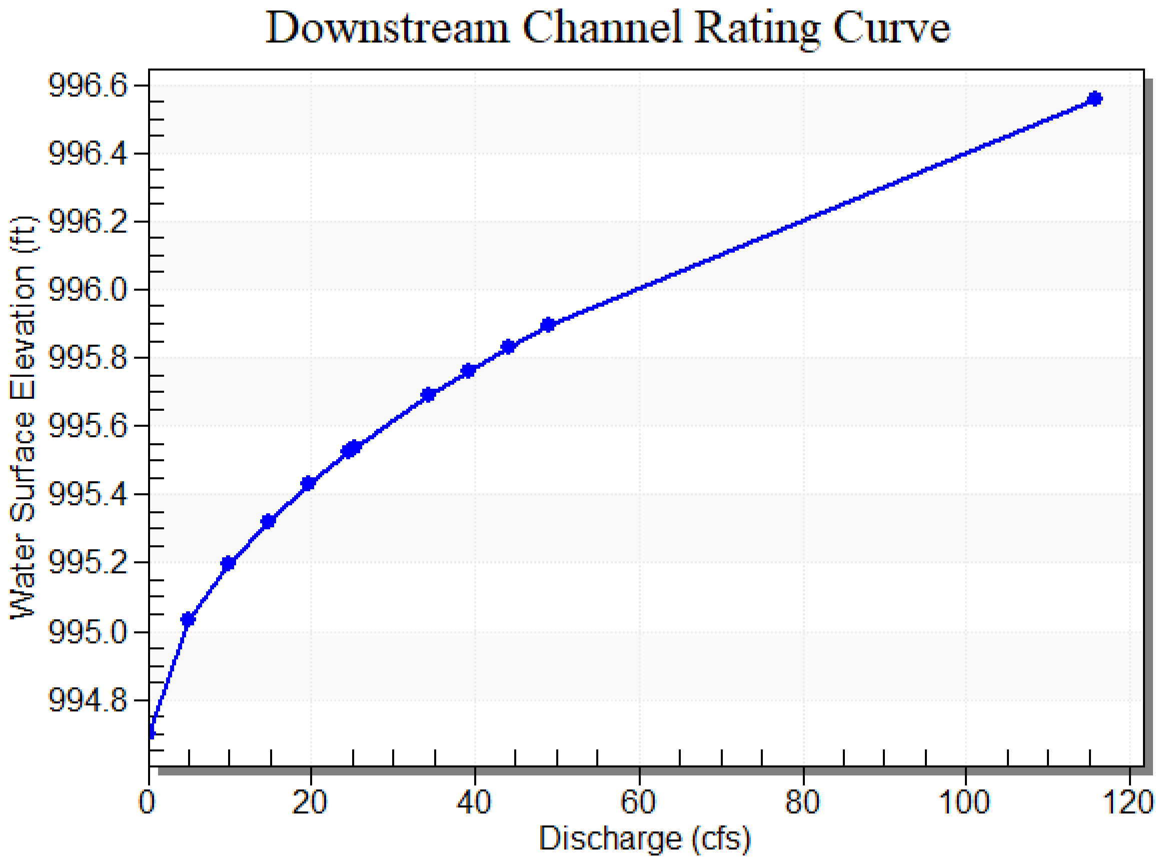
Side Slope (H:V): 3.00 (_:1)

Channel Slope: 0.0113

Channel Manning's n: 0.0350

Channel Invert Elevation: 994.70 ft

Tailwater Rating Curve Plot for Crossing: Det-Outlet



Roadway Data for Crossing: Det-Outlet

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 1001.30 ft

Roadway Surface: Gravel

Roadway Top Width: 10.00 ft

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Kansas City, Missouri 64131
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Project: Summit Point Apartments Phase-II
Project# 21-5065/#19-5293
Designer: TEI
Date: 04/23/22
File Name: "BMP-Water Quality Volume"

WATER QUALITY VOLUME AND OUTFLOW ORIFICE DESIGN

Water Quality Volume:

Contributing Drainage Area: A = 7.21 acres
Percent Impervious = 54.37% (3.92 Imp / 3.29 Perv)
Volumetric Runoff Coefficient: Rv = 0.05 + 0.009 * %Imp
Rv = 0.05 + 0.009 * %Imp(54.37%)
Rv = 0.5393
Water Quality Rainfall Depth: P = 1.37"
Water Quality Volume: WQv = P * Rv * A
WQv = P(1.37") * Rv(0.5393 * A(7.21 ac)
WQv = 0.444 ac-ft
WQv = 19,338 cf

Outflow Orifice Design

Water Quality Volume: WQv = 0.444 ac-ft, 19,338 cf
Bottom of Detention Basin: Bottom = 995.00'
Elevation at WQv: El(WQv) = 997.47'
WQV Storage Depth: D = 2.47 ft
Average Depth: 1/2*D = 1.24 ft

40-Hour Water Quality Volume Release Rate
WQv = 19,338 cf
40-Hours = 144,000 sec
Q = WQv/Time = 19,338 cf / 144,000 sec
Q = 0.1343 cfs

Outflow Orifice Design
Q = CA(2g*h)^1/2
A = Q/(C*(2g*h)^1/2))
A = 0.1343 cfs / (0.60*(2g*1.24 ft)^1/2))
A = 0.0251 sqft
A = 3.61 in^2
Equivalent Circular Diameter
A = pi*D^2 /4
D = (4*A/pi)^1/2
D = 2.15 in
A 2'1/4" Diameter Orifice would meter the Water Quality Volume release over 40-hours
The MARC BMP Manual recommends using a minimum 4" Diameter Orifice to prevent clogging

Trash Rack Analysis

Total Water Quality Outlet Area: Aot = 3.61 in^2
Outlet Orifice Diameter: D = 2.15 in
Required Trash Rack Open Area:
At = Aot * 77 * e^(-0.124 * D), for a single orifice outlet
At = 3.61 in^2 * 77 * e^(-0.124 * 2.15 in)
At = 212.9 in^2
At = 1.48 sqft

Step 6 - Calculate the horizontal perforation column spacing (S_c), center to center, when the number of columns is greater than 1. As long as the perforation diameter calculated in Step 5 is greater than 1, the horizontal perforation column spacing should be 4 inches.

Step 7 - Calculate the number of rows of perforations (n_r), center to center, based on a 4-inch vertical spacing and depth at outlet from Step 1.

Vd. Water Quality Outlet, V-Notch Weir (City of Knoxville, 2001)

Step 1 - Enter WQv depth above WQv outlet (Z_{WQ}).

Step 2 - Calculate the average head of the WQv over the v-notch invert (H_{WQ}) as ½ the WQv depth:

$$H_{WQ} = 0.5 * Z_{WQ}$$

Step 3 - Calculate the average water quality outflow rate (Q_{WQ}) that would result in the entire WQv draining over a period of 40 hours:

$$Q_{WQ} = (WQv * 43{,}560)/(40 * 3{,}600)$$

Step 4 - Select the value of the v-notch weir discharge coefficient (C_v = 2.5 typical).

Step 5 - Calculate the required v-notch weir angle (θ) from parameters determined in Steps 2, 3, and 4. If the calculated v-notch weir angle is less than 20 degrees, set to 20 degrees.

$$\theta = 2 * \arctan (Q_{WQ}/(C_v * H_{WQ}^{5/2}))$$

Step 6 - Calculate the top width of the v-notch weir (W_v):

$$W_v = 2 * Z_{WQ} * TAN(\theta/2)$$

Step 7 - To size a v-notch weir for an EDW with an irregular stage-volume relationship, use the V-Notch Weir Worksheet. Fill in the first column with cumulative volume values for each depth interval. The V-Notch Weir Worksheet uses values from Part Vd of the Main Worksheet.

VI. Water Budget

Perform water budget calculations for each zone of the EDW following the techniques in Chapter 13 of the NRCS *Engineering Field Handbook* to ensure that wetland vegetation can be sustained during the growing season.

VII. Trash Racks (Urban Drainage and Flood Control District, Denver, Colorado, 2005)

Step 1 - Calculate the total water quality outlet area (A_{ot}) from Vb, Vc, or Vd, whichever outlet configuration you selected.

Step 2 - Calculate the required trash rack open area (A_t) from the total outlet area. **Figures 8.8** and **8.9** show suggested details for trash racks over perforated riser outlets.

$A_t = A_{ot} * 77 * e^{(-0.124 * D)}$ for single orifice outlet

$A_t = (A_{ot}/2) * 77 * e^{(-0.124 * D)}$ for orifice plate or perforated riser outlet

$A_t = 4 * A_{ot}$ for v-notch weir outlet

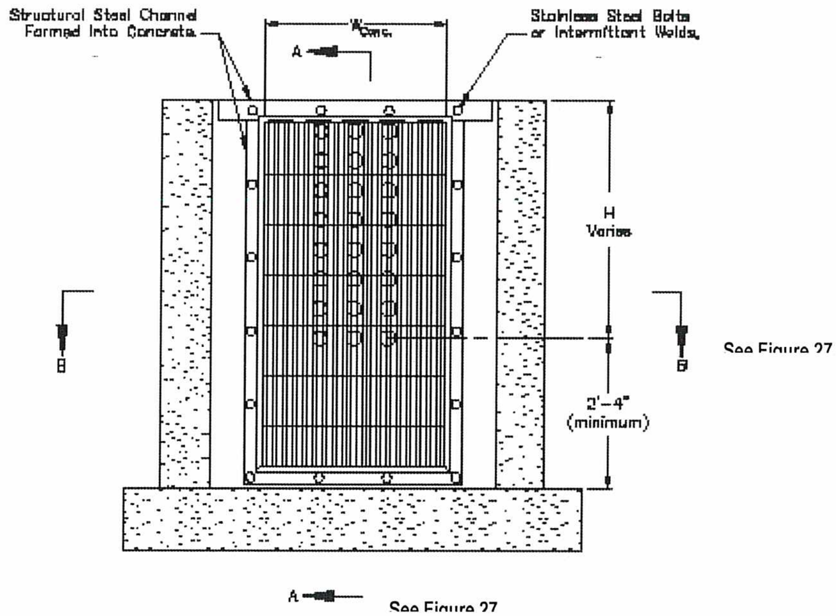
VIII. EDW Shape

Ensure that the flow path through the EDW has a length to width ratio of at least 3:1.

IX. EDW Side Slopes (Metropolitan Nashville – Davidson County, 2000)

Basin side slopes should be at least 4:1 (H:V) to facilitate maintenance and public safety. Side slopes should be stabilized, preferably with native vegetative cover.

X. Vegetation (Urban Drainage and Flood Control District, Denver, Colorado, 2005)



Elevation

WQv Trash Racks:

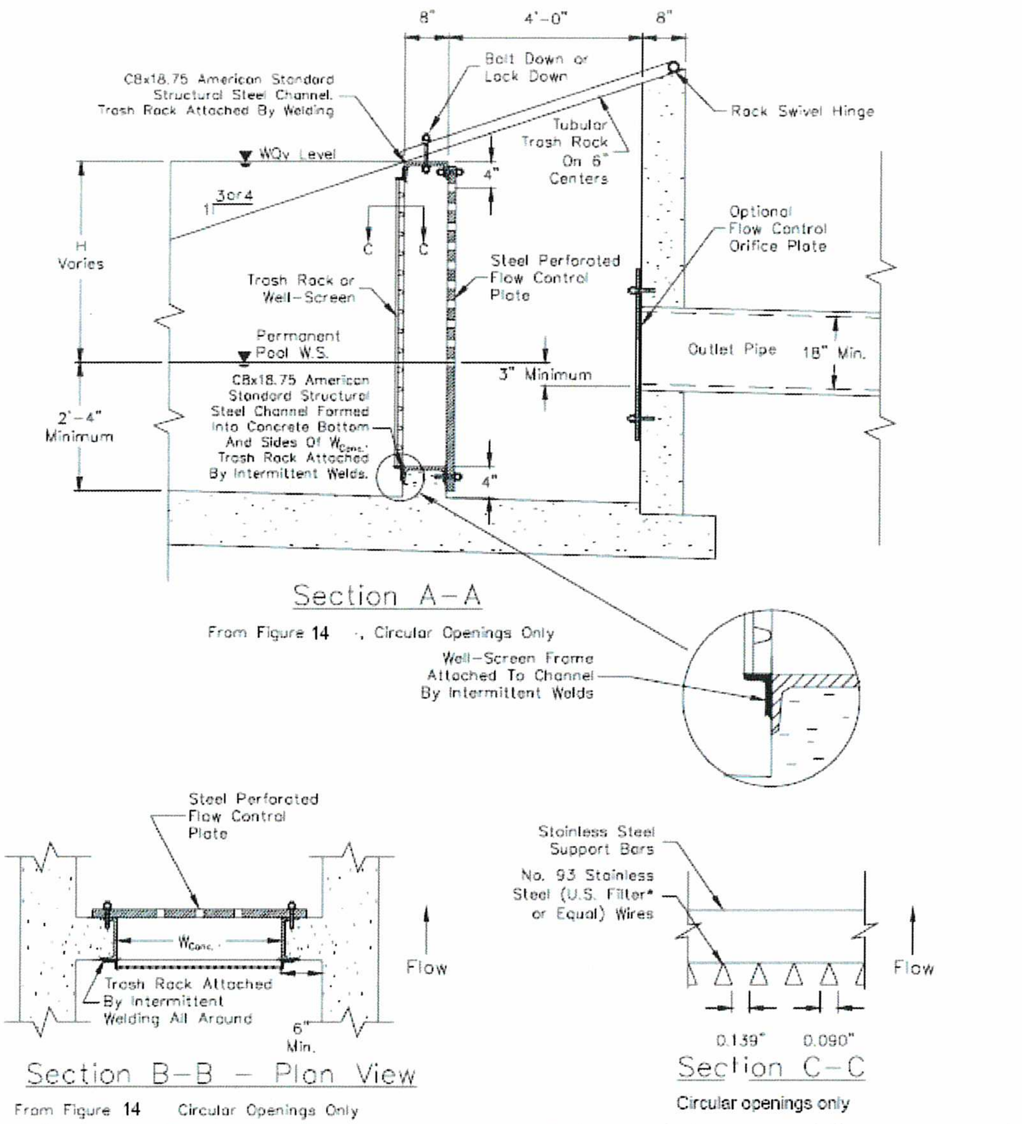
1. Well-screen trash racks shall be stainless steel and shall be attached by intermittent welds along the edge of the mounting frame.
2. Bar grate trash racks shall be aluminum and shall be bolted using stainless steel hardware.
3. Trash Rack widths are for specified trash rack material. Finer well-screen or mesh size than specified is acceptable, however, trash rack dimensions need to be adjusted for materials having a different open area/gross area ratio (R value)
4. Structural design of trash rack shall be based on full hydrostatic head with zero head downstream of the rack.

Overflow Trash Racks:

1. All trash racks shall be mounted using stainless steel hardware and provided with hinged and lockable or boltable access panels.
2. Trash racks shall be stainless steel, aluminum, or steel. Steel trash racks shall be hot dip galvanized and may be hot powder painted after galvanizing.
3. Trash Racks shall be designed such that the diagonal dimension of each opening is smaller than the diameter of the outlet pipe.
4. Structural design of trash rack shall be based on full hydrostatic head with zero head downstream of the rack.

Adapted from Denver Urban Drainage and Flood Control District

Figure 8.8 - WQv Outlet Orifice Plate and Trash Rack Design



Limits for this Standardized Design:

1. All outlet plate openings are circular.
2. Maximum diameter of opening = 2 inches.

*U.S. Filter, St. Paul, Minnesota, USA

R Value = (net open area)/(gross rack area) = 0.60

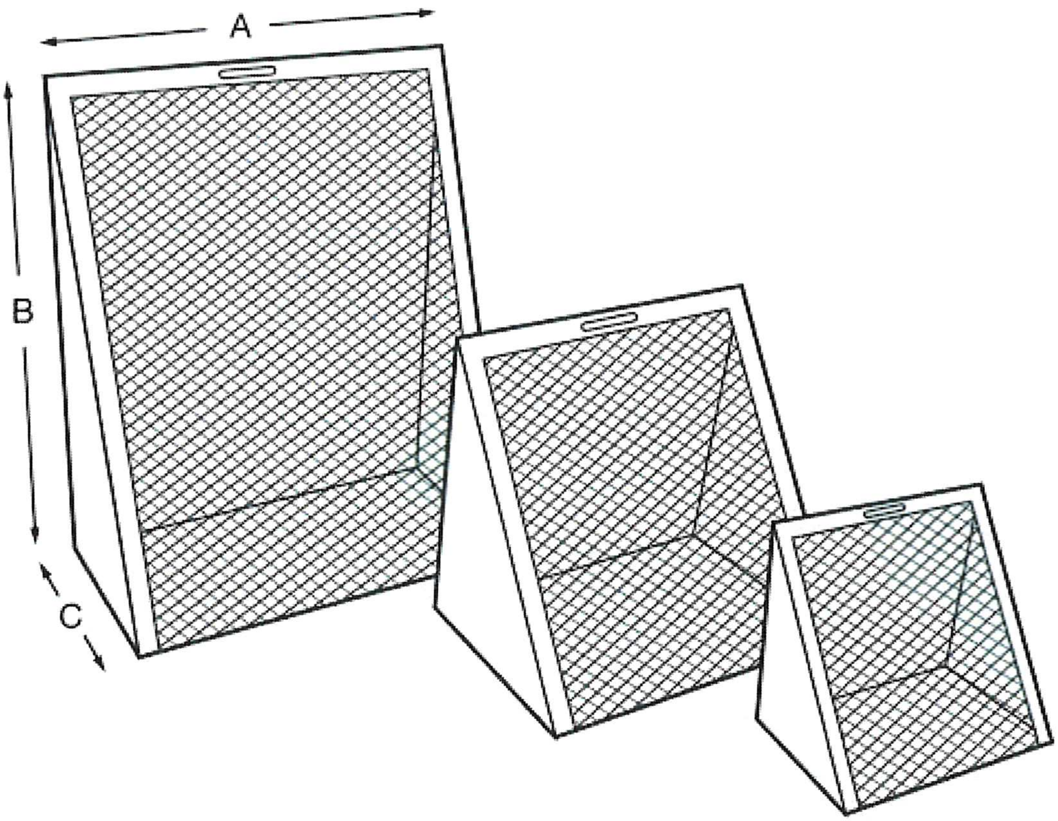
Adapted from Denver Urban Drainage and Flood Control District

Figure 8.9 - WQv Outlet Trash Rack Design

Mascot Engineering

Revision A

Galvanised Mild Steel
Multi-Purpose Trash Screen



Product Code	A (mm)	B (mm)	C (mm)
MMMPVS	300	280	200
MMMPS	400	350	250
MMMLPS	500	600	250

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Project: Concrete Trickle Channel
Project# 21-5065
Designer: TEI
Date: 04/19/22
File Name: "Conc Trickle Channel"

CONCRETE TRICKLE CHANNEL FLOW ANALYSIS

DRAINAGE AREA AND STORMWATER RUNOFF CALCULATIONS:

A = 9.03 acres, C = 0.75, Tc = 6.80 min

Q10(45.89cfs) = K(1.0)*C(0.75)*i10(6.75in/hr)*A(9.03ac)

Q100(81.73cfs) = K(1.25)*C(0.75)*i100(9.62in/hr)*A(9.03ac)

CHANNEL CROSS-SECTION CHARACTERISTICS:

Elev. (ft)	Depth (ft)	Dist. Left (ft)	Dist. Right (ft)	Area (SF)	Wetted Perim. (ft)	A/P	A/P^ (2/3)*A
996.25	0	3	3	0.00	6.00	n/a	n/a
996.50	0.25	28.00	28.00	7.75	56.00	0.14	2.07
996.75	0.50	53.00	53.00	28.00	106.00	0.26	11.53
997.00	0.75	78.00	78.00	60.75	156.01	0.39	32.40
997.25	1.00	103.00	103.00	106.00	206.01	0.51	68.06
997.50	1.25	128.00	128.00	163.75	256.01	0.64	121.56
997.75	1.50	153.00	153.00	234.00	306.01	0.76	195.67
998.00	1.75	178.00	178.00	316.75	356.02	0.89	293.01
998.25	2.00	203.00	203.00	412.00	406.02	1.01	416.04
998.50	2.25	228.00	228.00	519.75	456.02	1.14	567.11
998.75	2.50	253.00	253.00	640.00	506.02	1.26	748.49
Slope =	1.00 %			Roughness, n =		0.013	

CHANNEL FLOW CALCULATIONS:

V = 1.486 / n * R^2/3 * S^1/2 = 1.486 / n * (A/P)^2/3 * S^1/2

Q = 1.486 / n * R^2/3 * S^1/2 * A = 1.486 / n * (A/P)^2/3 * S^1/2 * A

(A/P)^(2/3) * A = Q * n / (1.486 * S^1/2)

Flow: Q =	45.89	cfs	Flow: Q =	81.73	cfs
(A/P)^(2/3) * A =	4.01		(A/P)^(2/3) * A =	7.15	
Depth: D =	0.30	ft	Depth: D =	0.38	ft
Elev: WSEL =	996.6	ft	Elev: WSEL =	996.6	ft
Area: A =	11.9	SF	Area: A =	18.6	SF
Wetted Perimeter:	66.3	ft	Wetted Perimeter:	82.9	ft
Velocity: V =	3.9	fps	Velocity: V =	4.4	fps

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Telephone (816) 333-4477
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Project: East Property Line Swale
Project# 21-5065
Designer: TEI
Date: 04/20/22
File Name: "04-20-22 East PL Swale"

EAST PROPERTY LINE SWALE BY PROPOSED STORMWATER DETENTION BASIN

DRAINAGE AREA AND STORMWATER RUNOFF CALCULATIONS:

A = 0.41 acres, C = 0.53, Tc = 5 min

Q10(1.60cfs) = K(1.0)*C(0.53)*i10(7.35in/hr)*A(0.41ac)

Q100(2.80cfs) = K(1.25)*C(0.53)*i100(10.32in/hr)*A(0.41ac)

CHANNEL CROSS-SECTION CHARACTERISTICS:

Elev. (ft)	Depth (ft)	Dist. Left (ft)	Dist. Right (ft)	Area (SF)	Wetted Perim. (ft)	A/P	A/P^ (2/3)*A
998.00	0	0	0	0.00	0.00	n/a	n/a
998.25	0.25	1.00	15.75	2.09	16.78	0.12	0.52
998.50	0.50	2.00	31.50	8.38	33.57	0.25	3.32
998.75	0.75	3.00	47.25	18.84	50.35	0.37	9.79
999.00	1.00	4.00	63.00	33.50	67.13	0.50	21.08
999.25	1.25	5.00	78.75	52.34	83.91	0.62	38.21
999.50	1.50	6.00	94.50	75.38	100.70	0.75	62.14
999.75	1.75	7.00	110.25	102.59	117.48	0.87	93.73
1000.00	2.00	8.00	126.00	134.00	134.26	1.00	133.83
1000.25	2.25	9.00	141.75	169.59	151.04	1.12	183.21
1000.50	2.50	10.00	157.50	209.38	167.83	1.25	242.64
Slope =	7.07 %			Roughness, n =		0.045	

CHANNEL FLOW CALCULATIONS:

V = 1.486 / n * R^2/3 * S^1/2 = 1.486 / n * (A/P)^2/3 * S^1/2

Q = 1.486 / n * R^2/3 * S^1/2 * A = 1.486 / n * (A/P)^2/3 * S^1/2 * A

(A/P)^(2/3) * A = Q * n / (1.486 * S^1/2)

Flow: Q =	1.60 cfs	Flow: Q =	2.80 cfs
(A/P)^(2/3) * A =	0.18	(A/P)^(2/3) * A =	0.32
Depth: D =	0.09 ft	Depth: D =	0.15 ft
Elev: WSEL =	998.1 ft	Elev: WSEL =	998.2 ft
Area: A =	0.7 SF	Area: A =	1.3 SF
Wetted Perimeter:	5.9 ft	Wetted Perimeter:	10.2 ft
Velocity: V =	2.2 fps	Velocity: V =	2.2 fps

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Project: East Property Line Swale
Project# 21-5065
Designer: TEI
Date: 04/20/22
File Name: "04-20-22 East PL Swale-2"

EAST PROPERTY LINE SWALE BY PROPOSED BUILDING A2-1

DRAINAGE AREA AND STORMWATER RUNOFF CALCULATIONS:

A = 0.33 acres, C = 0.45, Tc = 5 min

Q10(1.09cfs) = K(1.0)*C(0.45)*i10(7.35in/hr)*A(0.33ac)

Q100(1.92cfs) = K(1.25)*C(0.45)*i100(10.32in/hr)*A(0.33ac)

CHANNEL CROSS-SECTION CHARACTERISTICS:

Elev. (ft)	Depth (ft)	Dist. Left (ft)	Dist. Right (ft)	Area (SF)	Wetted Perim. (ft)	A/P	A/P^ (2/3)*A
1010.00	0	0	0	0.00	0.00	n/a	n/a
1010.25	0.25	1.00	20.43	2.68	21.46	0.12	0.67
1010.50	0.50	2.00	40.85	10.71	42.91	0.25	4.25
1010.75	0.75	3.00	61.28	24.10	64.37	0.37	12.52
1011.00	1.00	4.00	81.70	42.85	85.83	0.50	26.97
1011.25	1.25	5.00	102.13	66.95	107.29	0.62	48.89
1011.50	1.50	6.00	122.55	96.41	128.74	0.75	79.51
1011.75	1.75	7.00	142.98	131.23	150.20	0.87	119.93
1012.00	2.00	8.00	163.40	171.40	171.66	1.00	171.23
1012.25	2.25	9.00	183.83	216.93	193.12	1.12	234.41
1012.50	2.50	10.00	204.25	267.81	214.57	1.25	310.46
Slope =	7.51 %		Roughness, n =			0.045	

CHANNEL FLOW CALCULATIONS:

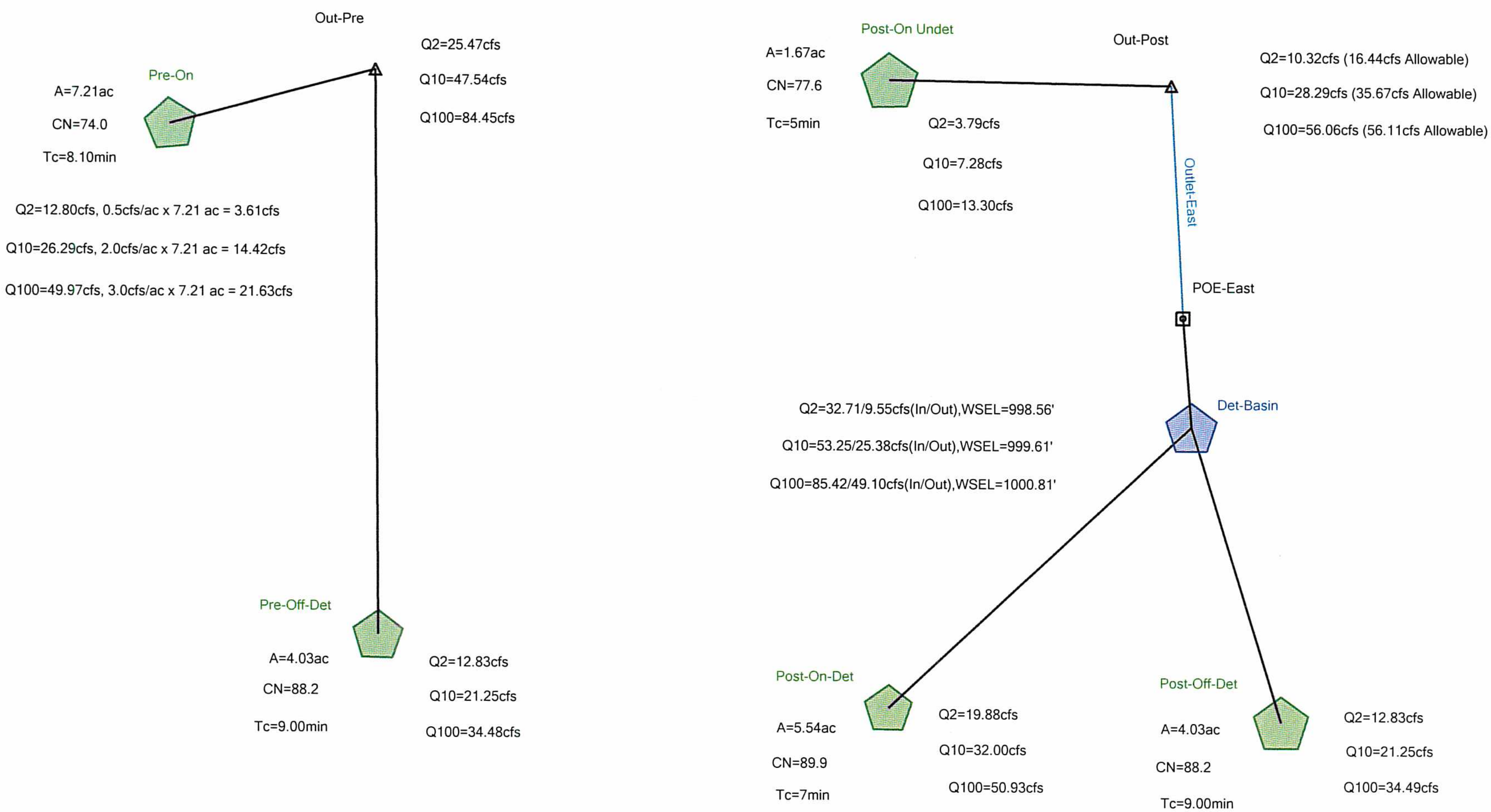
V = 1.486 / n * R^2/3 * S^1/2 = 1.486 / n * (A/P)^2/3 * S^1/2

Q = 1.486 / n * R^2/3 * S^1/2 * A = 1.486 / n * (A/P)^2/3 * S^1/2 * A

(A/P)^(2/3) * A = Q * n / (1.486 * S^1/2)

Flow: Q =	1.09 cfs	Flow: Q =	1.92 cfs
(A/P)^(2/3) * A =	0.12	(A/P)^(2/3) * A =	0.21
Depth: D =	0.05 ft	Depth: D =	0.08 ft
Elev: WSEL =	1010.0 ft	Elev: WSEL =	1010.1 ft
Area: A =	0.5 SF	Area: A =	0.8 SF
Wetted Perimeter:	3.9 ft	Wetted Perimeter:	6.8 ft
Velocity: V =	2.3 fps	Velocity: V =	2.3 fps

Scenario: Post-1yr



Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Post-On-Det	Post-2yr	2	1.146	11.950	19.88
Post-On-Det	Post-10yr	10	1.894	11.950	32.00
Post-On-Det	Post-100yr	100	3.106	11.950	50.93
Pre-Off-Det	Post-2yr	2	0.781	11.950	12.83
Pre-Off-Det	Post-10yr	10	1.316	11.950	21.25
Pre-Off-Det	Post-100yr	100	2.190	11.950	34.48
Post-On Undet	Post-2yr	2	0.210	11.950	3.79
Post-On Undet	Post-10yr	10	0.401	11.900	7.28
Post-On Undet	Post-100yr	100	0.735	11.900	13.30
Pre-On	Post-2yr	2	0.764	12.000	12.80
Pre-On	Post-10yr	10	1.538	11.950	26.29
Pre-On	Post-100yr	100	2.922	11.950	49.97
Post-Off-Det	Post-2yr	2	0.781	11.950	12.83
Post-Off-Det	Post-10yr	10	1.316	11.950	21.25
Post-Off-Det	Post-100yr	100	2.190	11.950	34.49

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Out-Pre	Post-2yr	2	1.545	12.000	25.47
Out-Pre	Post-10yr	10	2.854	11.950	47.54
Out-Pre	Post-100yr	100	5.112	11.950	84.45
Out-Post	Post-2yr	2	1.787	12.150	10.32
Out-Post	Post-10yr	10	3.177	12.050	28.29
Out-Post	Post-100yr	100	5.568	12.050	56.06

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Det-Basin (IN)	Post-2yr	2	1.927	11.950	32.71	(N/A)	(N/A)
Det-Basin (OUT)	Post-2yr	2	1.578	12.150	9.55	998.56	0.830
Det-Basin (IN)	Post-10yr	10	3.210	11.950	53.25	(N/A)	(N/A)
Det-Basin (OUT)	Post-10yr	10	2.776	12.100	25.38	999.61	1.242
Det-Basin (IN)	Post-100yr	100	5.295	11.950	85.42	(N/A)	(N/A)

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Det-Basin (OUT)	Post-100yr	100	4.833	12.100	49.10	1,000.81	1.768

Subsection: Elevation-Area Volume Curve
Label: Det-Basin
Scenario: Post-2yr

Return Event: 2 years
Storm Event: SCS-Type-II-APWA-2-Yr

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
995.00	0.0	0.000	0.000	0.000	0.000
995.30	0.0	0.001	0.001	0.000	0.000
996.00	0.0	0.161	0.175	0.041	0.041
997.00	0.0	0.330	0.721	0.240	0.281
998.00	0.0	0.357	1.030	0.343	0.625
999.00	0.0	0.390	1.120	0.373	0.998
1,000.00	0.0	0.428	1.227	0.409	1.407
1,001.00	0.0	0.473	1.351	0.450	1.857
1,002.00	0.0	0.502	1.462	0.487	2.345
1,003.00	0.0	0.526	1.542	0.514	2.859

Subsection: Outlet Input Data
Label: Weir Det Basin Outlet
Scenario: Post-2yr

Return Event: 2 years
Storm Event: SCS-Type-II-APWA-2-Yr

Requested Pond Water Surface Elevations	
Minimum (Headwater)	995.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,003.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	4" Orifice	Forward	TW	995.00	1,003.00
Rectangular Weir	33" Weir	Forward	TW	997.50	1,003.00
Rectangular Weir	O/F Weir-1001.00'	Forward	TW	1,001.00	1,003.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: 4" Orifice Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	995.00 ft
Orifice Diameter	4.0 in
Orifice Coefficient	0.600

Structure ID: 33" Weir Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	997.50 ft
Weir Length	2.75 ft
Weir Coefficient	2.90 (ft^0.5)/s

Structure ID: O/F Weir-1001.00' Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	1,001.00 ft
Weir Length	30.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Scenario: Post-1yr

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Swann Cir	Post-2yr	2	18.713	12.400	135.24
Swann Cir	Post-10yr	10	34.702	12.350	254.49
Swann Cir	Post-100yr	100	62.039	12.350	453.62
RS 10658	Post-2yr	2	15.801	12.350	116.80
RS 10658	Post-10yr	10	29.507	12.350	222.32
RS 10658	Post-100yr	100	53.028	12.350	398.33
RS 11275	Post-2yr	2	10.283	12.400	77.13
RS 11275	Post-10yr	10	19.286	12.400	146.39
RS 11275	Post-100yr	100	34.771	12.300	264.11

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Out-Swann Cir	Post-2yr	2	18.640	12.450	132.59
Out-Swann Cir	Post-10yr	10	34.612	12.450	250.14
Out-Swann Cir	Post-100yr	100	61.925	12.450	443.08
Out-11275	Post-2yr	2	10.283	12.400	77.13
Out-11275	Post-10yr	10	19.286	12.400	146.39
Out-11275	Post-100yr	100	34.771	12.300	264.11
Out-10658	Post-2yr	2	15.801	12.350	116.80
Out-10658	Post-10yr	10	29.507	12.350	222.32
Out-10658	Post-100yr	100	53.028	12.350	398.33

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Maple Tree Det (IN)	Post-2yr	2	18.713	12.400	135.24	(N/A)	(N/A)
Maple Tree Det (OUT)	Post-2yr	2	18.640	12.450	132.59	990.04	0.886
Maple Tree Det (IN)	Post-10yr	10	34.702	12.350	254.49	(N/A)	(N/A)
Maple Tree Det (OUT)	Post-10yr	10	34.612	12.450	250.14	991.30	1.544
Maple Tree Det (IN)	Post-100yr	100	62.039	12.350	453.62	(N/A)	(N/A)
Maple Tree Det (OUT)	Post-100yr	100	61.925	12.450	443.08	993.41	2.647

Subsection: Time of Concentration Calculations
Label: RS 10658
Scenario: Post-2yr

Return Event: 2 years
Storm Event: SCS-Type-II-APWA-2-Yr

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	300.00 ft
Manning's n	0.240
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.5 in
Average Velocity	0.15 ft/s
Segment Time of Concentration	0.547 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	150.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.015 hours

Segment #3: TR-55 Channel Flow	
Flow Area	70.0 ft²
Hydraulic Length	3,820.00 ft
Manning's n	0.030
Slope	0.010 ft/ft
Wetted Perimeter	85.00 ft
Average Velocity	4.36 ft/s
Segment Time of Concentration	0.243 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.805 hours

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Sheet Flow

Tc = (0.007 * ((n * Lf)**0.8)) / ((P**0.5) * (Sf**0.4))

Where:
Tc= Time of concentration, hours
n= Manning's n
Lf= Flow length, feet
P= 2yr, 24hr Rain depth, inches
Sf= Slope, %

Subsection: Time of Concentration Calculations
Label: RS 11275
Scenario: Post-2yr

Return Event: 2 years
Storm Event: SCS-Type-II-APWA-2-Yr

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	300.00 ft
Manning's n	0.240
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.5 in
Average Velocity	0.15 ft/s
Segment Time of Concentration	0.547 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	150.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.015 hours

Segment #3: TR-55 Channel Flow	
Flow Area	45.0 ft²
Hydraulic Length	3,245.00 ft
Manning's n	0.030
Slope	0.010 ft/ft
Wetted Perimeter	60.00 ft
Average Velocity	4.10 ft/s
Segment Time of Concentration	0.220 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.782 hours

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =
Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Sheet Flow

Tc =
(0.007 * ((n * Lf)**0.8)) / ((P**0.5) * (Sf**0.4))

Where:
Tc= Time of concentration, hours
n= Manning's n
Lf= Flow length, feet
P= 2yr, 24hr Rain depth, inches
Sf= Slope, %

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	300.00 ft
Manning's n	0.240
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.5 in
Average Velocity	0.15 ft/s
Segment Time of Concentration	0.547 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	150.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.015 hours

Segment #3: TR-55 Channel Flow	
Flow Area	80.0 ft^2
Hydraulic Length	4,100.00 ft
Manning's n	0.030
Slope	0.010 ft/ft
Wetted Perimeter	100.00 ft
Average Velocity	4.28 ft/s
Segment Time of Concentration	0.266 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.828 hours

==== SCS Channel Flow

Tc =	R = Qa / Wp V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n (Lf / V) / 3600
Where:	R= Hydraulic radius Aq= Flow area, square feet Wp= Wetted perimeter, feet V= Velocity, ft/sec Sf= Slope, ft/ft n= Manning's n Tc= Time of concentration, hours Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =	Unpaved surface: V = 16.1345 * (Sf**0.5) Paved Surface: V = 20.3282 * (Sf**0.5) (Lf / V) / 3600
Where:	V= Velocity, ft/sec Sf= Slope, ft/ft Tc= Time of concentration, hours Lf= Flow length, feet

==== SCS TR-55 Sheet Flow

Tc =	(0.007 * ((n * Lf)**0.8)) / ((P**0.5) * (Sf**0.4))
Where:	Tc= Time of concentration, hours n= Manning's n Lf= Flow length, feet P= 2yr, 24hr Rain depth, inches Sf= Slope, %

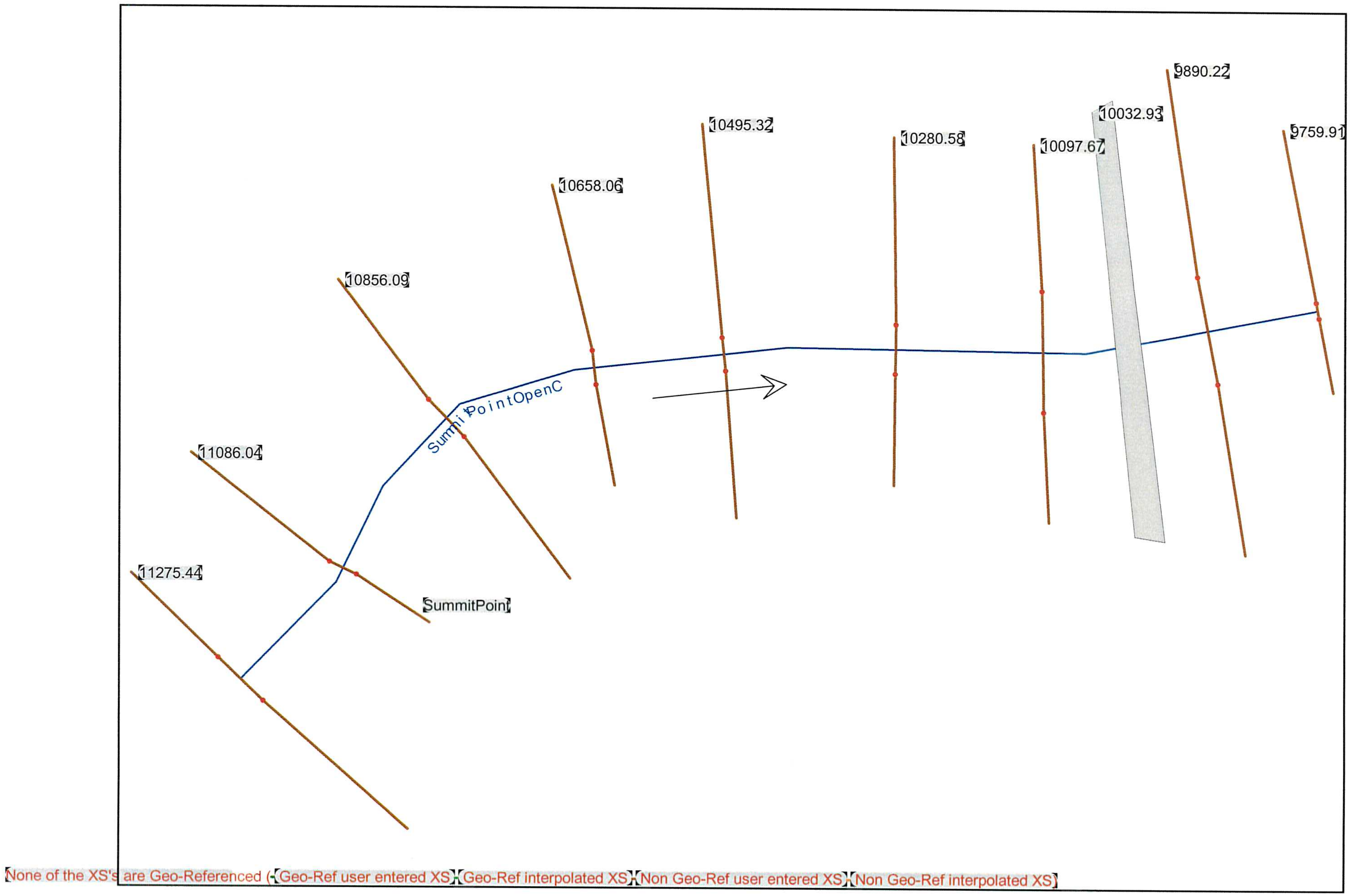
RS 9890.22
RS 9759.91
RS 10097.67
RS 9991.03
RS 10280.58
RS 10495.32
RS 10658.06
RS 10856.09
RS 11086.04
RS 11275.44
SWANN CIRCLE
ENGLISH MANOR DRIVE
POI-4
A2-2
C1-2
C1-1
A2-3
B1-1
A2-2
1006
1004
1002
1010
1016
1008
998
996
990
988
1000

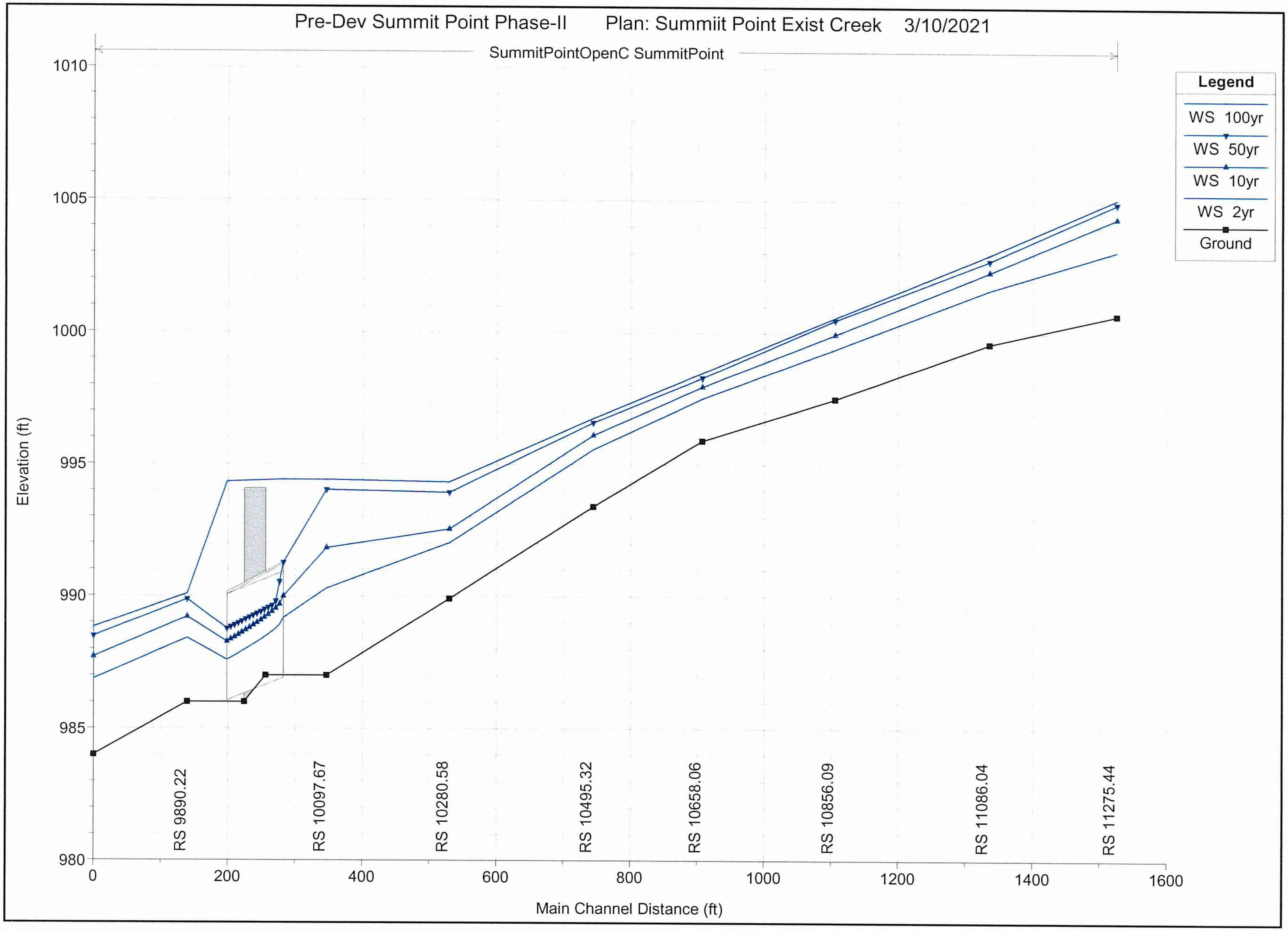
Tributary P-3 to Prairie Lee Lake
HEC-RAS Calculations
March 18, 2021

HEC-RAS Plan: SummitPtExist River: SummitPointOpenC Reach: SummitPoint

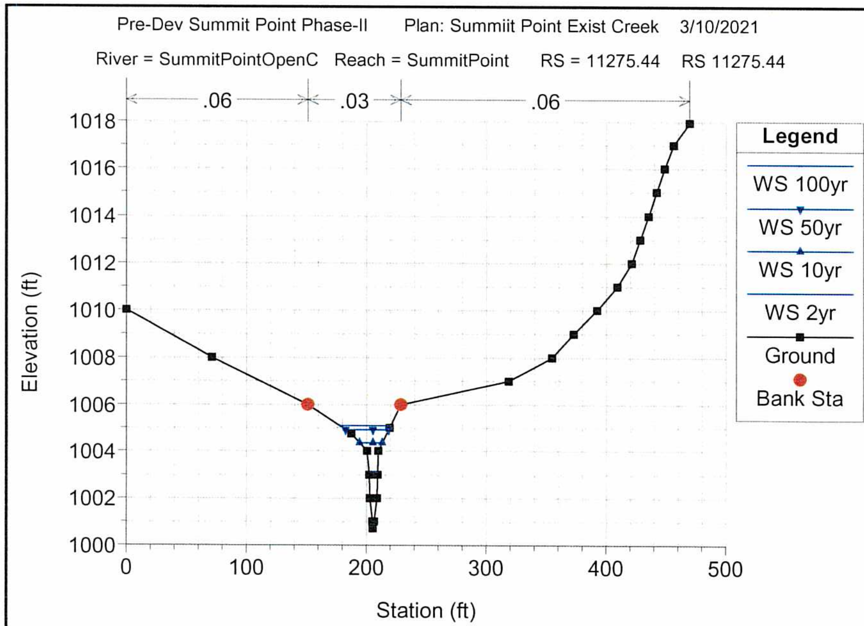
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
SummitPoint	9759.91	2yr	135.00	984.00	986.87	986.87	987.60	0.013354	6.83	19.78	14.04	1.01
SummitPoint	9759.91	10yr	255.00	984.00	987.71	987.71	988.62	0.011964	7.65	33.31	18.38	1.00
SummitPoint	9759.91	100yr	454.00	984.00	988.82	988.82	989.72	0.007025	7.80	75.67	69.72	0.82
SummitPoint	9890.22	2yr	135.00	986.00	988.42		988.56	0.003866	3.10	43.59	42.92	0.54
SummitPoint	9890.22	10yr	255.00	986.00	989.22		989.34	0.002470	2.87	88.88	70.29	0.45
SummitPoint	9890.22	100yr	454.00	986.00	990.09		990.21	0.001631	2.79	163.01	98.79	0.38
SummitPoint	10032.93		Culvert	**SWANN CIRCLE**								
SummitPoint	10097.67	2yr	135.00	987.00	990.29	988.69	990.31	0.000458	1.29	104.31	76.69	0.20
SummitPoint	10097.67	10yr	255.00	987.00	991.82	989.18	991.83	0.000152	0.97	263.02	130.59	0.12
SummitPoint	10097.67	100yr	454.00	987.00	994.40	989.80	994.41	0.000031	0.71	641.98	171.74	0.06
SummitPoint	10280.58	2yr	135.00	989.90	992.02	992.02	992.48	0.013677	5.62	27.60	37.67	1.00
SummitPoint	10280.58	10yr	255.00	989.90	992.55	992.55	993.11	0.011624	6.36	50.83	49.92	0.97
SummitPoint	10280.58	100yr	454.00	989.90	994.32		994.47	0.001931	3.53	185.24	110.33	0.43
SummitPoint	10495.32	2yr	117.00	993.40	995.57	995.57	996.04	0.014575	5.53	21.16	23.12	1.02
SummitPoint	10495.32	10yr	222.00	993.40	996.11	996.11	996.71	0.012556	6.22	36.71	37.00	0.99
SummitPoint	10495.32	100yr	398.00	993.40	996.76	996.76	997.45	0.009804	6.78	68.44	60.34	0.92
SummitPoint	10658.06	2yr	117.00	995.90	997.52		997.81	0.008351	4.38	27.00	30.65	0.79
SummitPoint	10658.06	10yr	222.00	995.90	997.96	997.84	998.43	0.008968	5.52	42.58	39.51	0.85
SummitPoint	10658.06	100yr	398.00	995.90	998.48	998.48	999.15	0.009555	6.73	70.53	69.06	0.92
SummitPoint	10856.09	2yr	77.00	997.50	999.40	999.39	999.87	0.014120	5.49	14.03	15.05	1.00
SummitPoint	10856.09	10yr	146.00	997.50	999.95	999.94	1000.52	0.013406	6.09	23.98	21.30	1.01
SummitPoint	10856.09	100yr	264.00	997.50	1000.59	1000.58	1001.24	0.012356	6.48	40.72	31.13	1.00
SummitPoint	11086.04	2yr	77.00	999.60	1001.65		1001.92	0.006053	4.13	18.63	15.65	0.67
SummitPoint	11086.04	10yr	146.00	999.60	1002.32		1002.66	0.006667	4.63	31.56	24.52	0.72
SummitPoint	11086.04	100yr	264.00	999.60	1002.98		1003.39	0.007107	5.13	51.47	36.47	0.76
SummitPoint	11275.44	2yr	77.00	1000.70	1003.12	1003.12	1003.89	0.015788	7.05	10.92	7.18	1.01
SummitPoint	11275.44	10yr	146.00	1000.70	1004.36	1004.36	1004.97	0.014598	6.26	23.31	19.08	1.00
SummitPoint	11275.44	100yr	264.00	1000.70	1005.09	1005.09	1005.62	0.014199	5.87	44.98	42.61	1.01

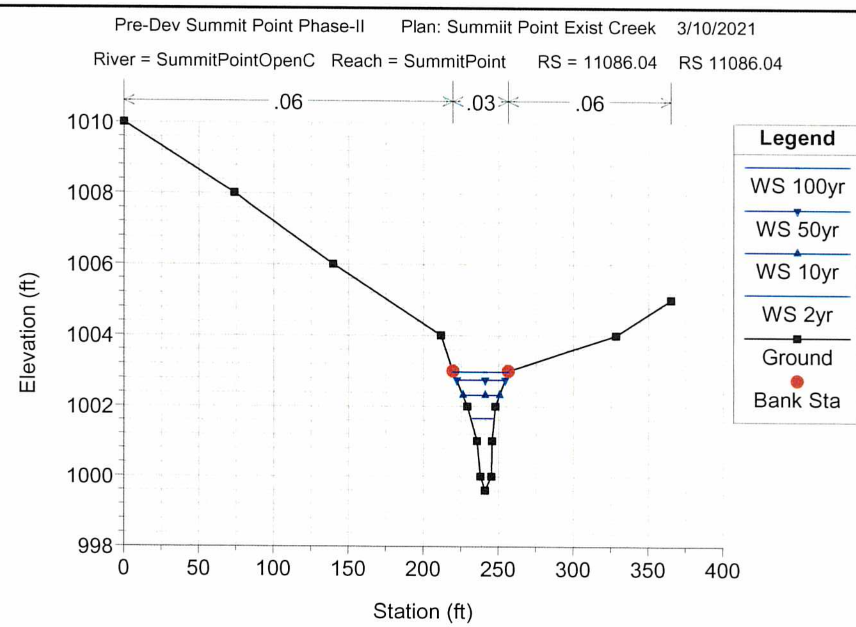
Tributary P-3 to Prairie Lee Lake
HEC-RAS Calculations
March 18, 2021

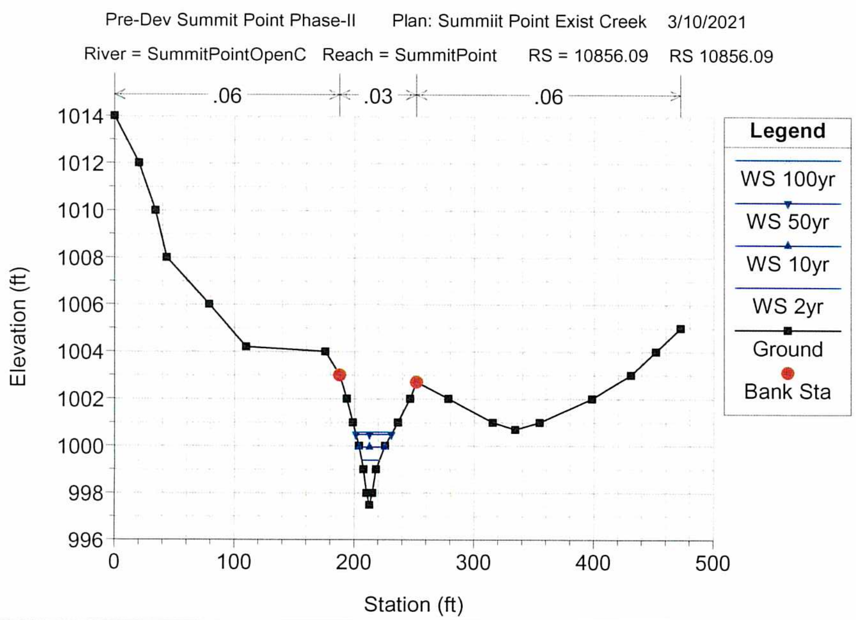


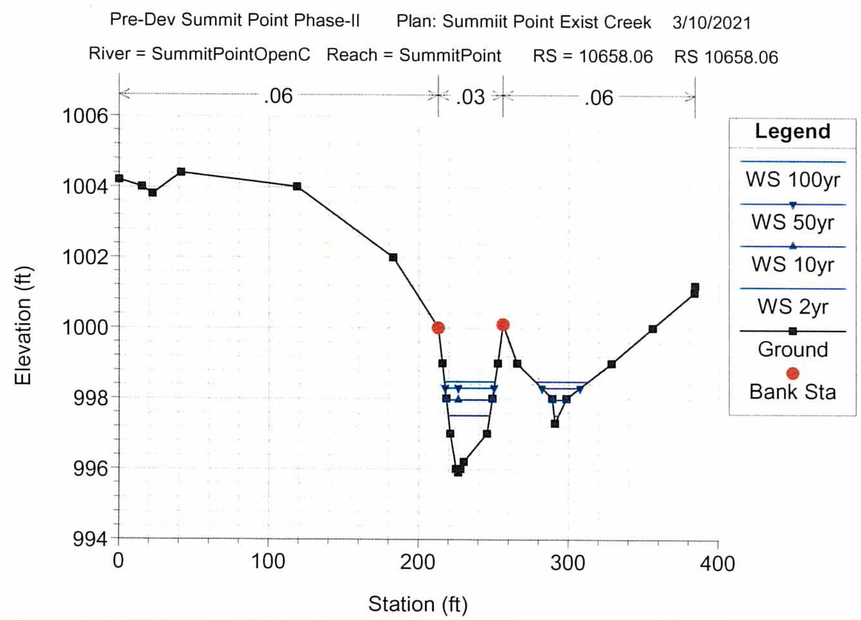

Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
SummitPointOpenC SummitPoint
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Elevation (ft)
1010
1005
1000
995
990
985
980
0
200
400
600
800
1000
1200
1400
1600
RS 9890.22
RS 10097.67
RS 10280.58
RS 10495.32
RS 10658.06
RS 10856.09
RS 11086.04
RS 11275.44
Main Channel Distance (ft)

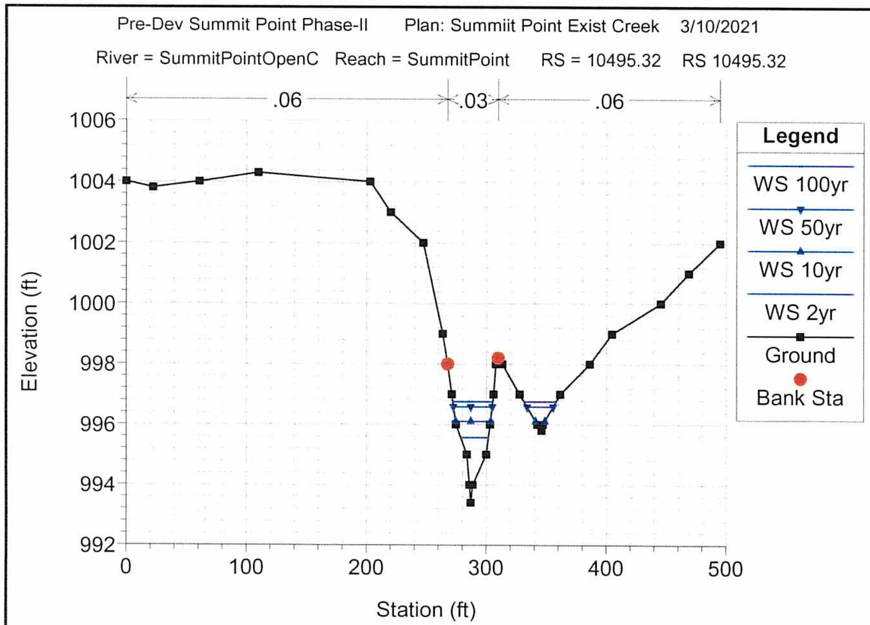
Tributary P-3 to Prairie Lee Lake
HEC-RAS Calculations
March 18, 2021

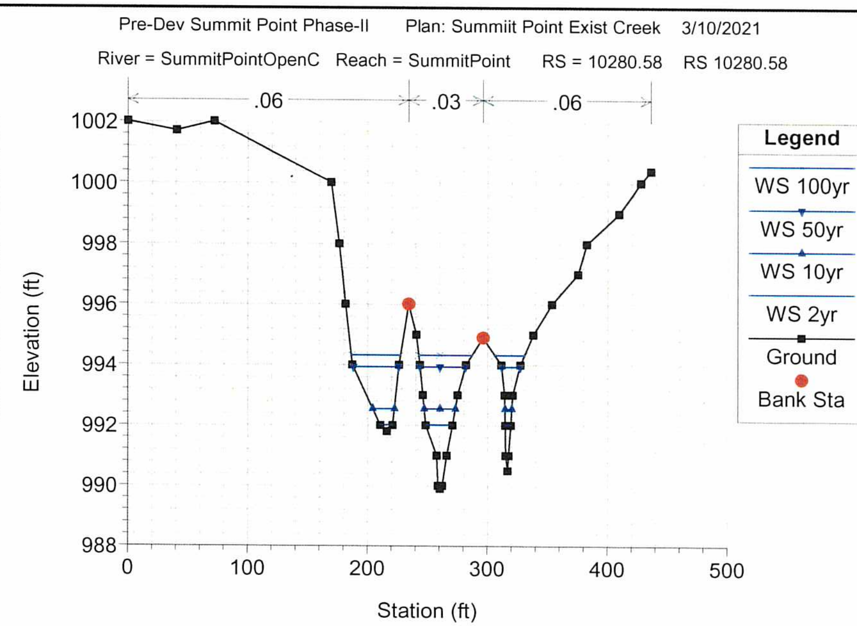









Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10495.32 RS 10495.32
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta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.06
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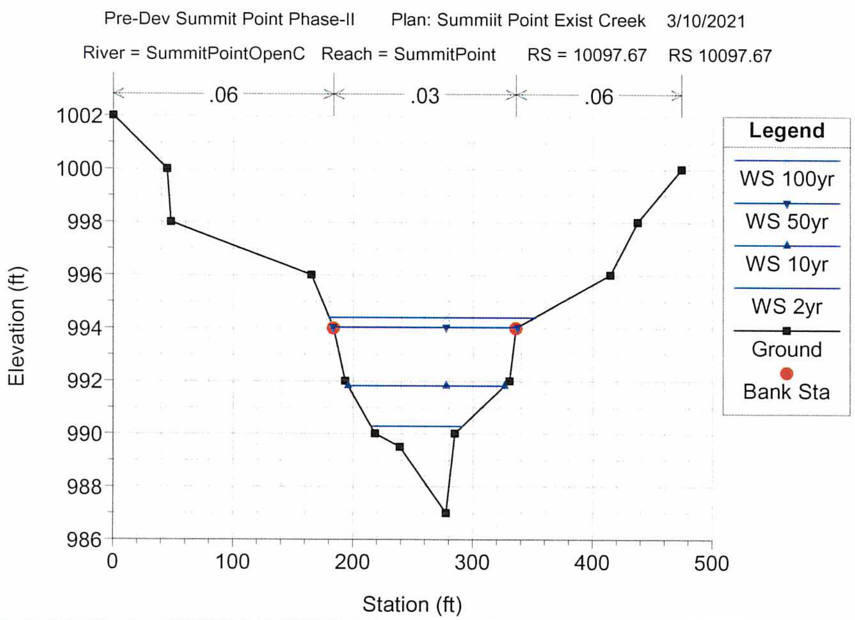
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta


Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10097.67 RS 10097.67
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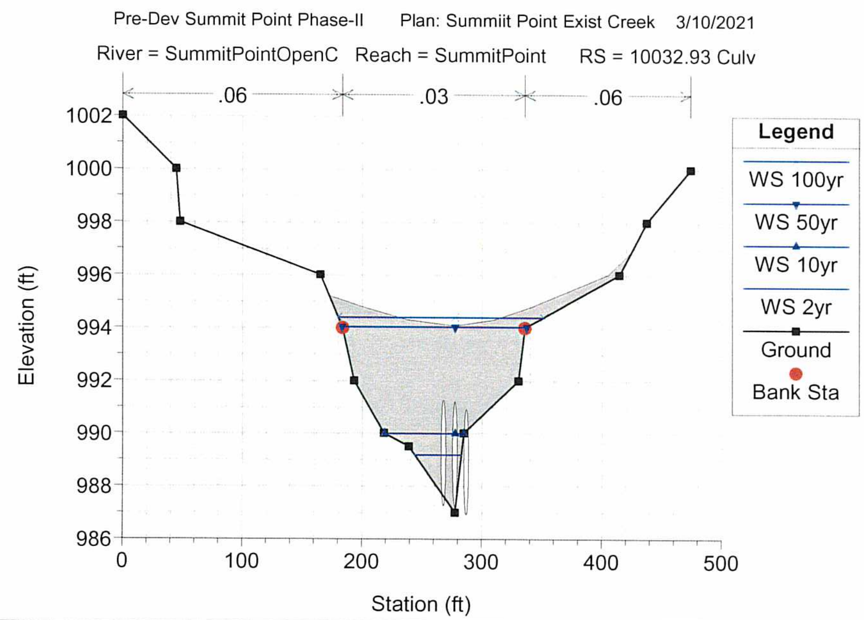
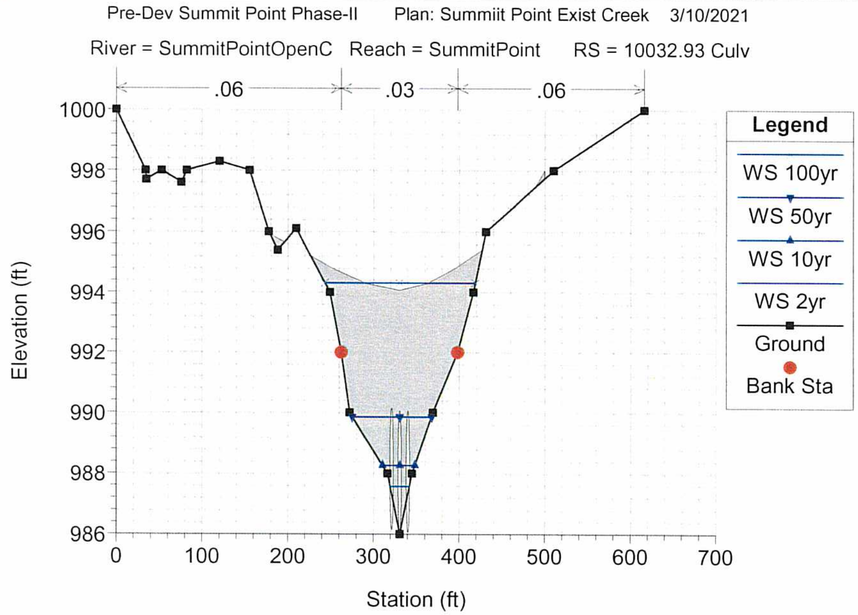
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta


Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10032.93 Culv
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta


Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10032.93 Culv
.06
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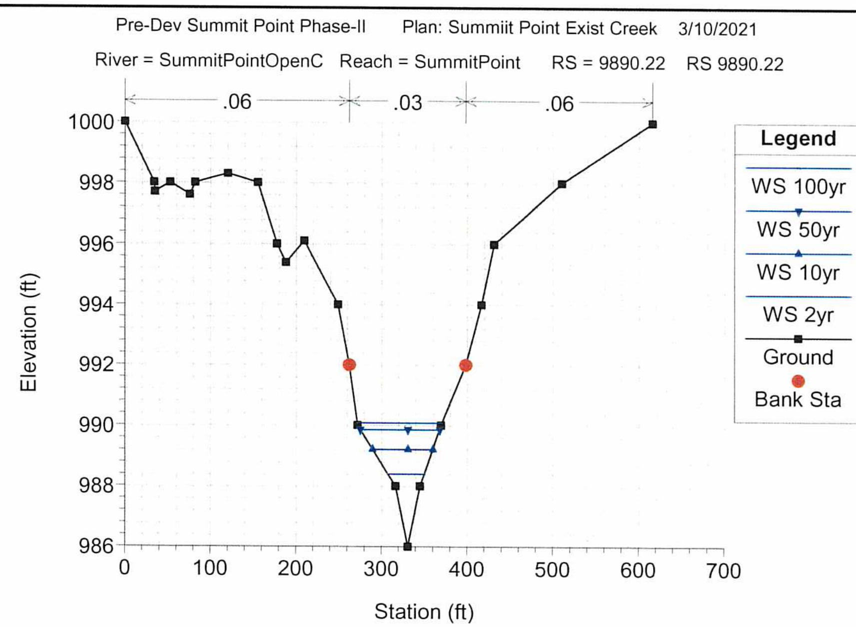
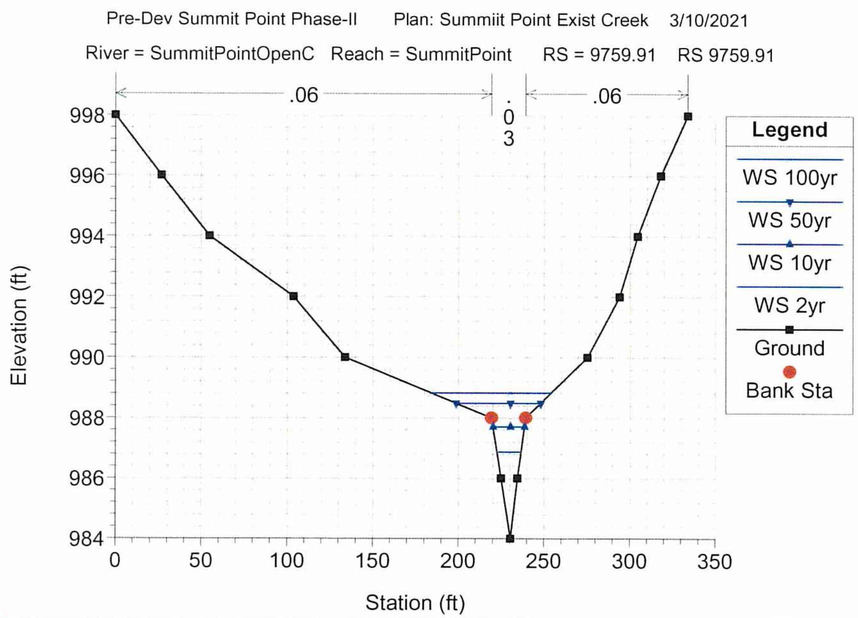
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta


Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 9890.22 RS 9890.22
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta


Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 9759.91 RS 9759.91
.06
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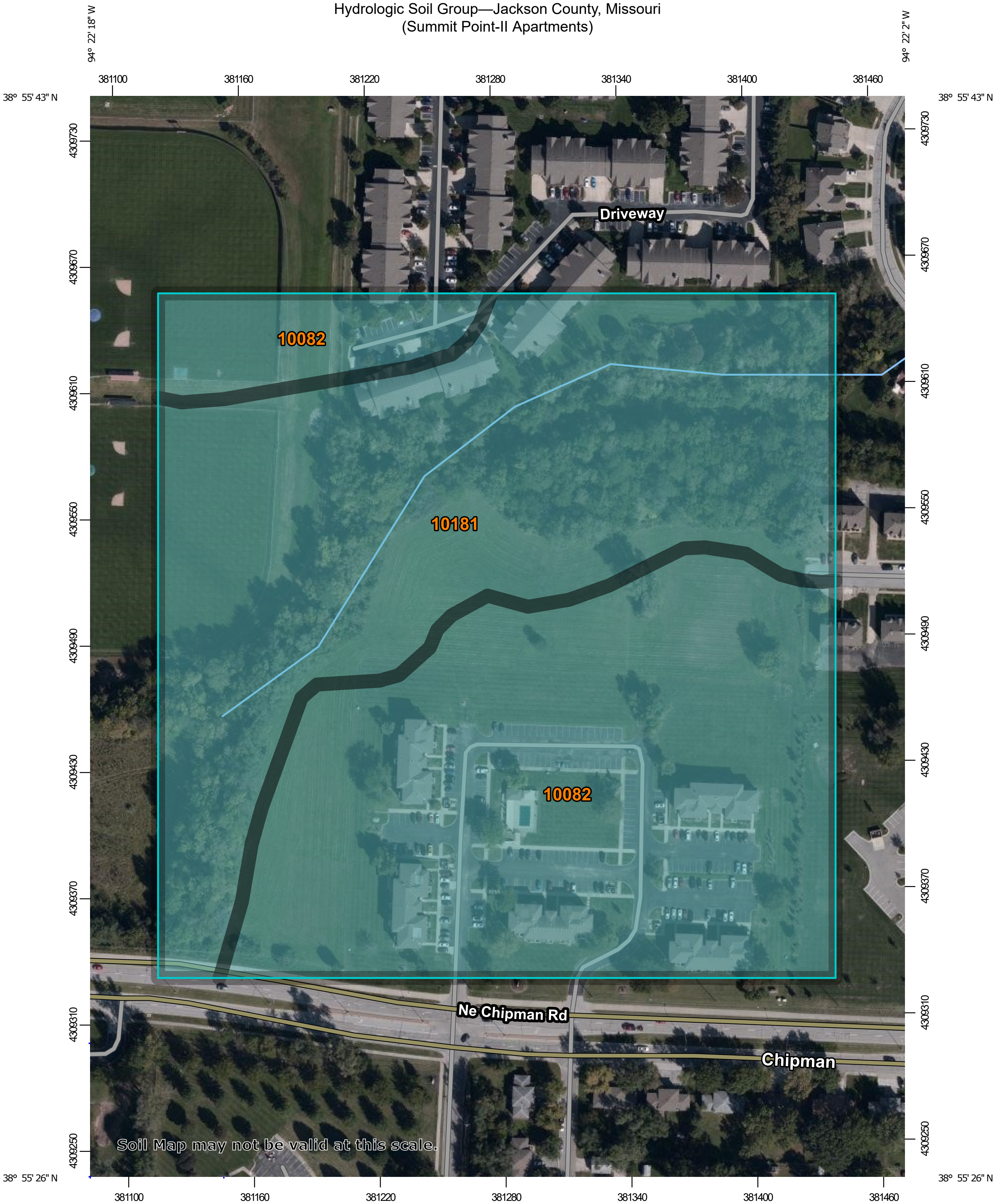
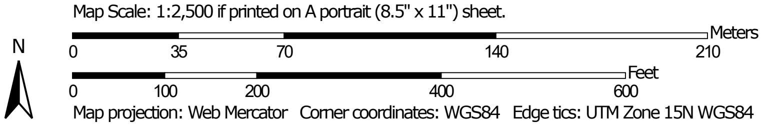
.06
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta

Hydrologic Soil Group—Jackson County, Missouri
(Summit Point-II Apartments)



Map Scale: 1:2,500 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N 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.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 20, Sep 16, 2019

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 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
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	C	13.5	51.7%
10181	Udarents-Urban land-Sampsel complex, 5 to 9 percent slopes	C	12.6	48.3%
Totals for Area of Interest			**26.1**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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.

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 Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM 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. 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, Maryland 20910-3282
(301) 713-3242

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 derived from the U.S.D.A Farm Service National Agriculture ImageryProgram (NAIP) dated 2014. Produced at scale of 1:24,000.

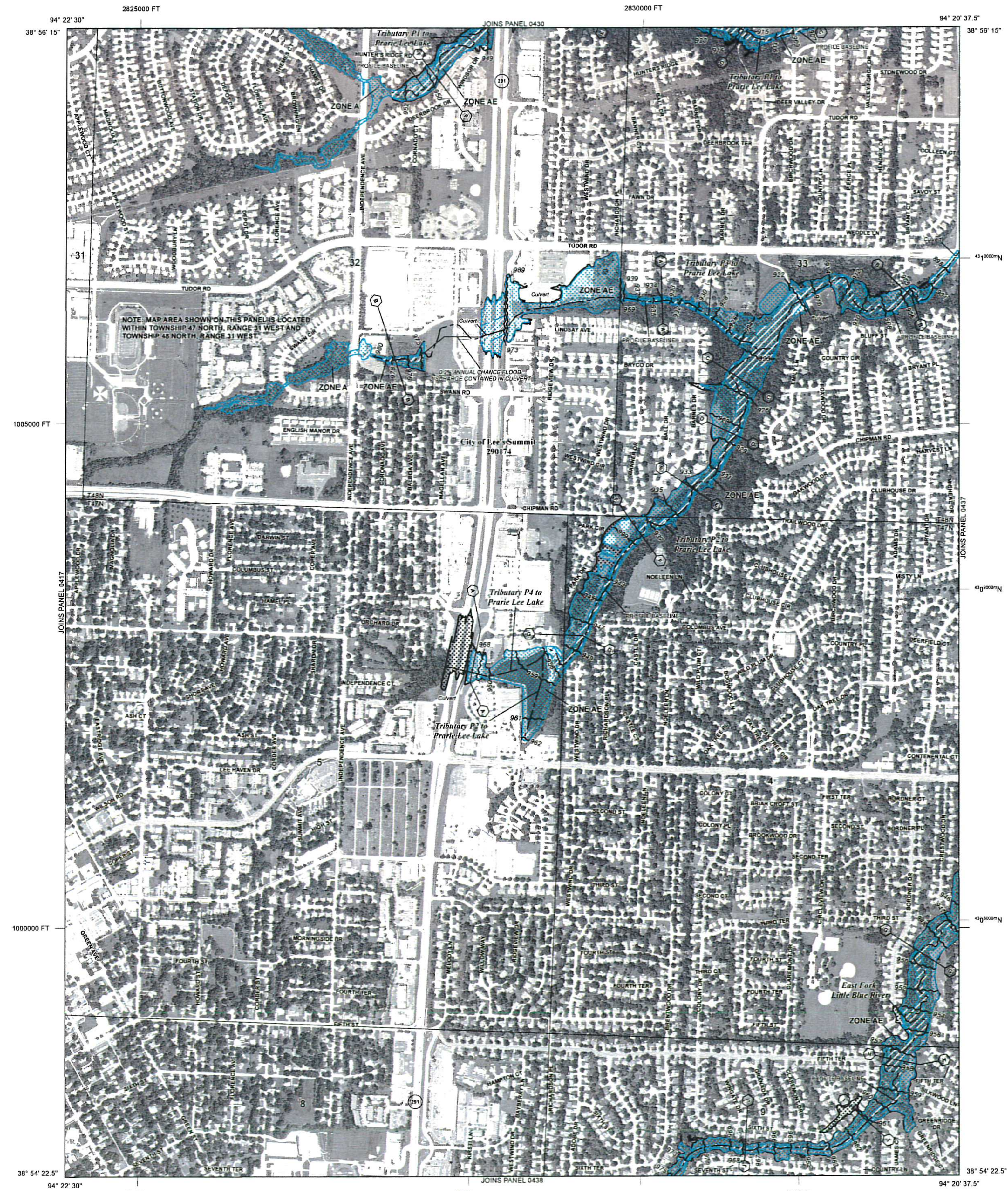
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, 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. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

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.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



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 Areas 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.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and 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

(A)—(A)	Cross section line
(23)- - - -(23)	Transect line
	Culvert
	Bridge
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
3100000 FT	5000-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator 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
September 29, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
January 20, 2017 - to change Special Flood Hazard Areas.

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.

N

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0436G

FIRM

FLOOD INSURANCE RATE MAP

JACKSON COUNTY, MISSOURI

AND INCORPORATED AREAS

PANEL 436 OF 625

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LEE'S SUMMIT, CITY OF	290174	0436	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.

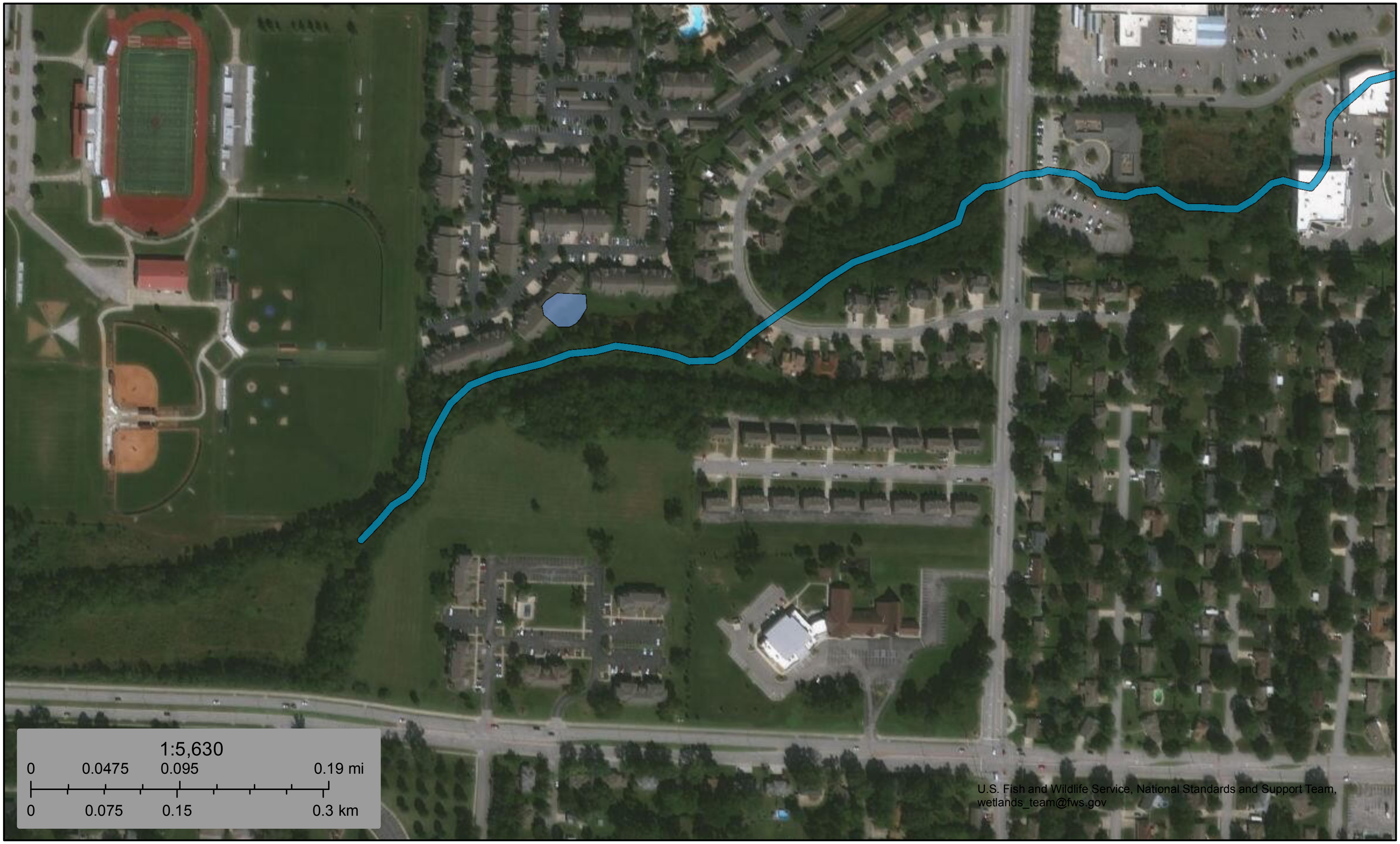
MAP NUMBER
29095C0436G

MAP REVISED
JANUARY 20, 2017

Federal Emergency Management Agency

U.S. Fish and Wildlife Service
National Wetlands Inventory

Summit Point Apartments-National Wetland



April 6, 2020

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.