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

Preliminary Stormwater Drainage Study

Prepared for:
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April 5, 2021

STATE OF MISSOURI
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INGRAM
NUMBER
E-23737
REGISTERED PROFESSIONAL ENGINEER

04-05-21

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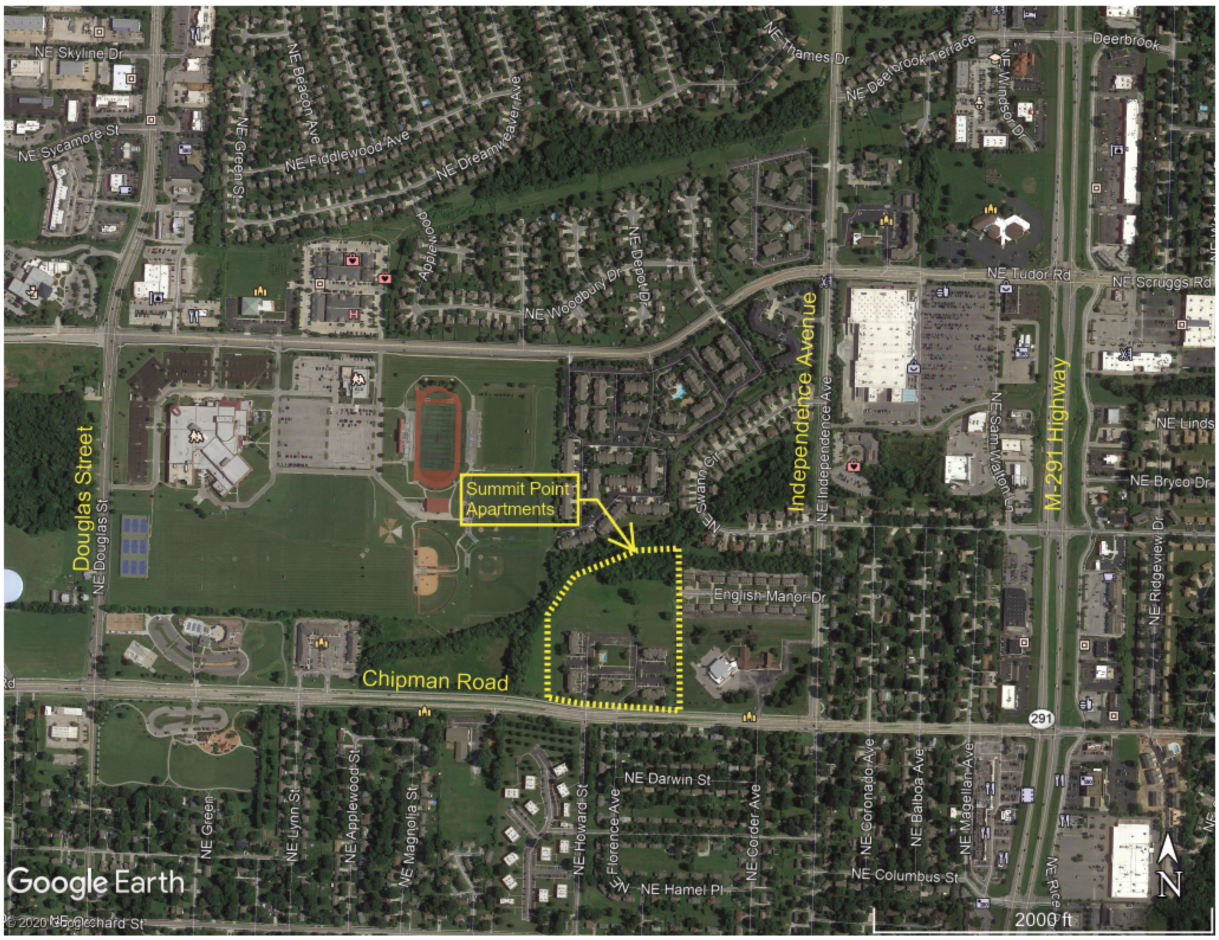
Introduction:

This Preliminary 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.

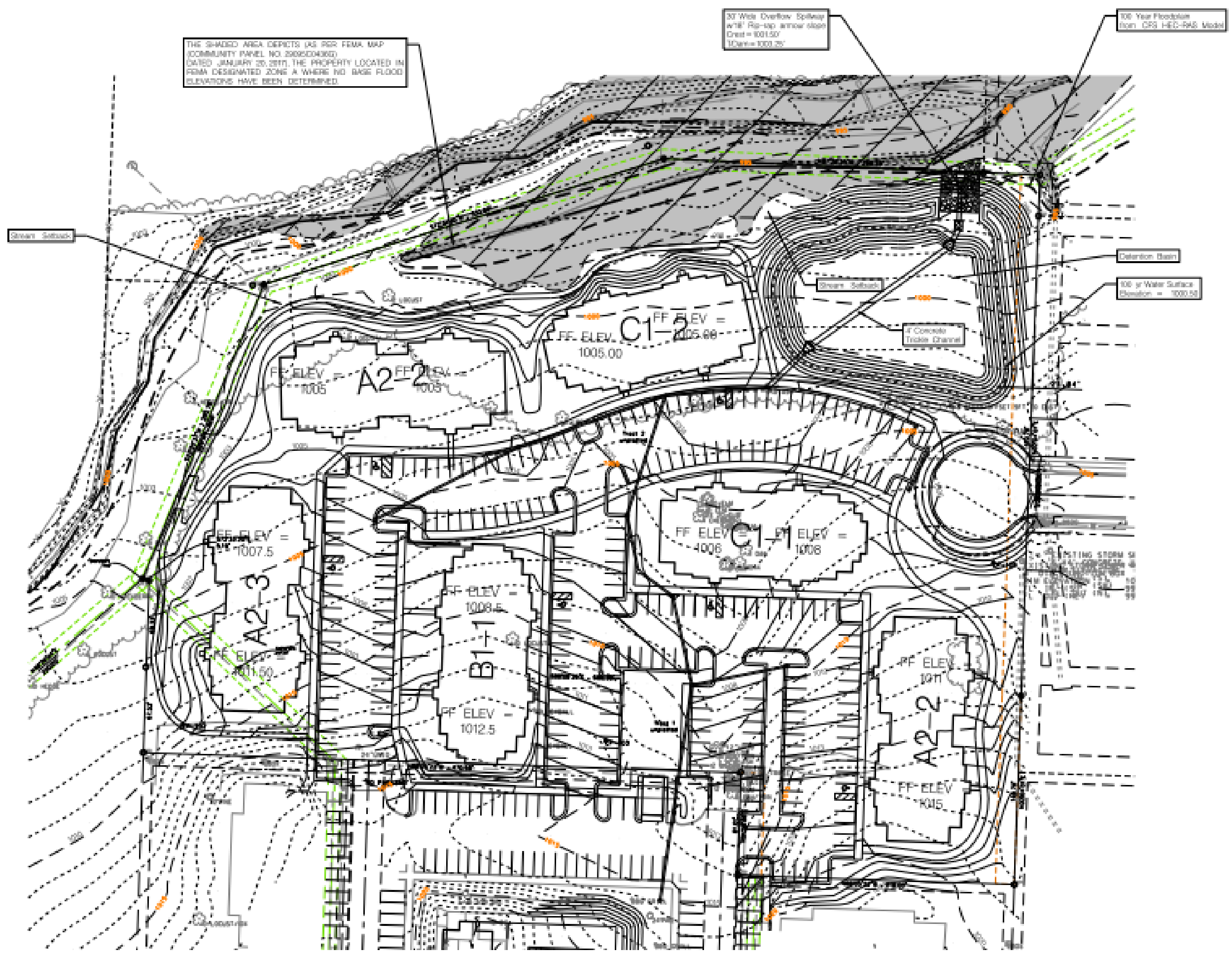


Vicinity Map of the Summit Point Apartments at 504 NE Chipman Road in Lee's Summit

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. The City requires that no construction be allowed within the stream setback, with the exception of stormwater detention basins.

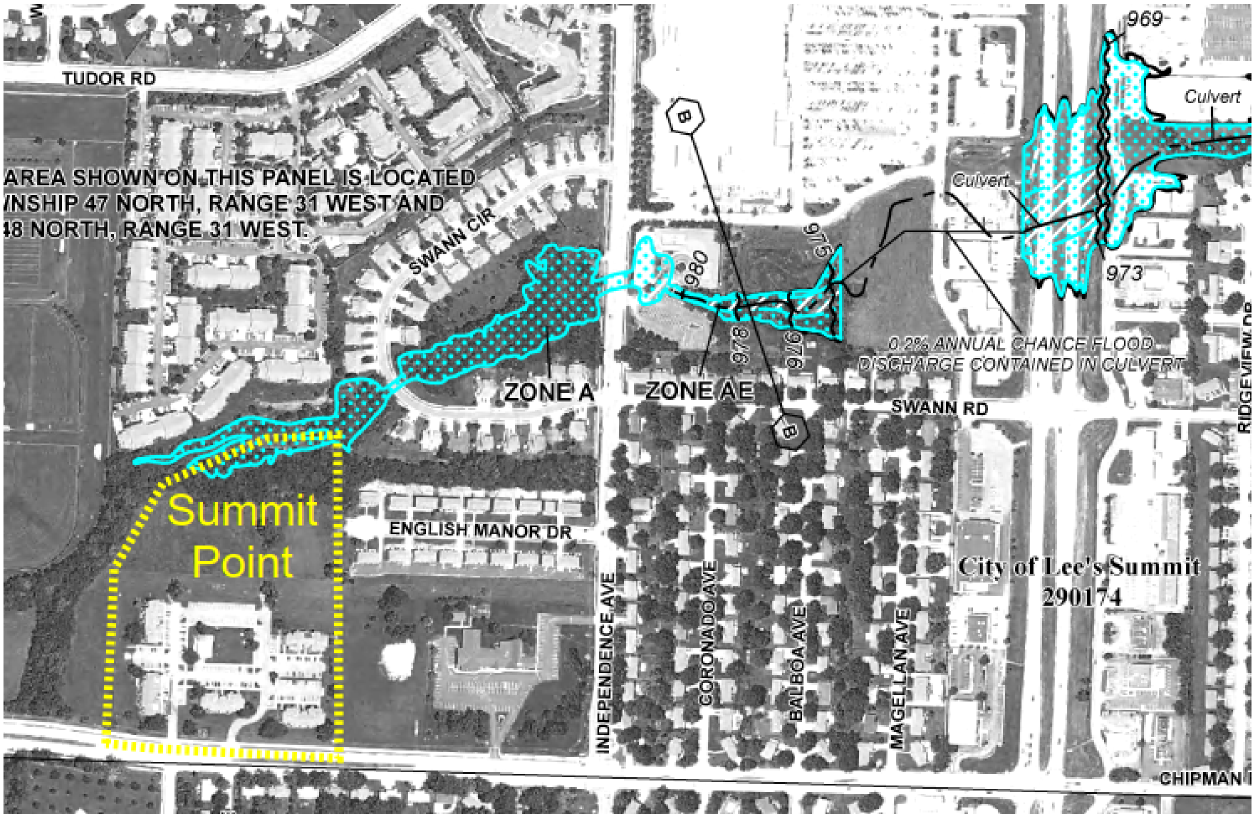
General Information:

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.

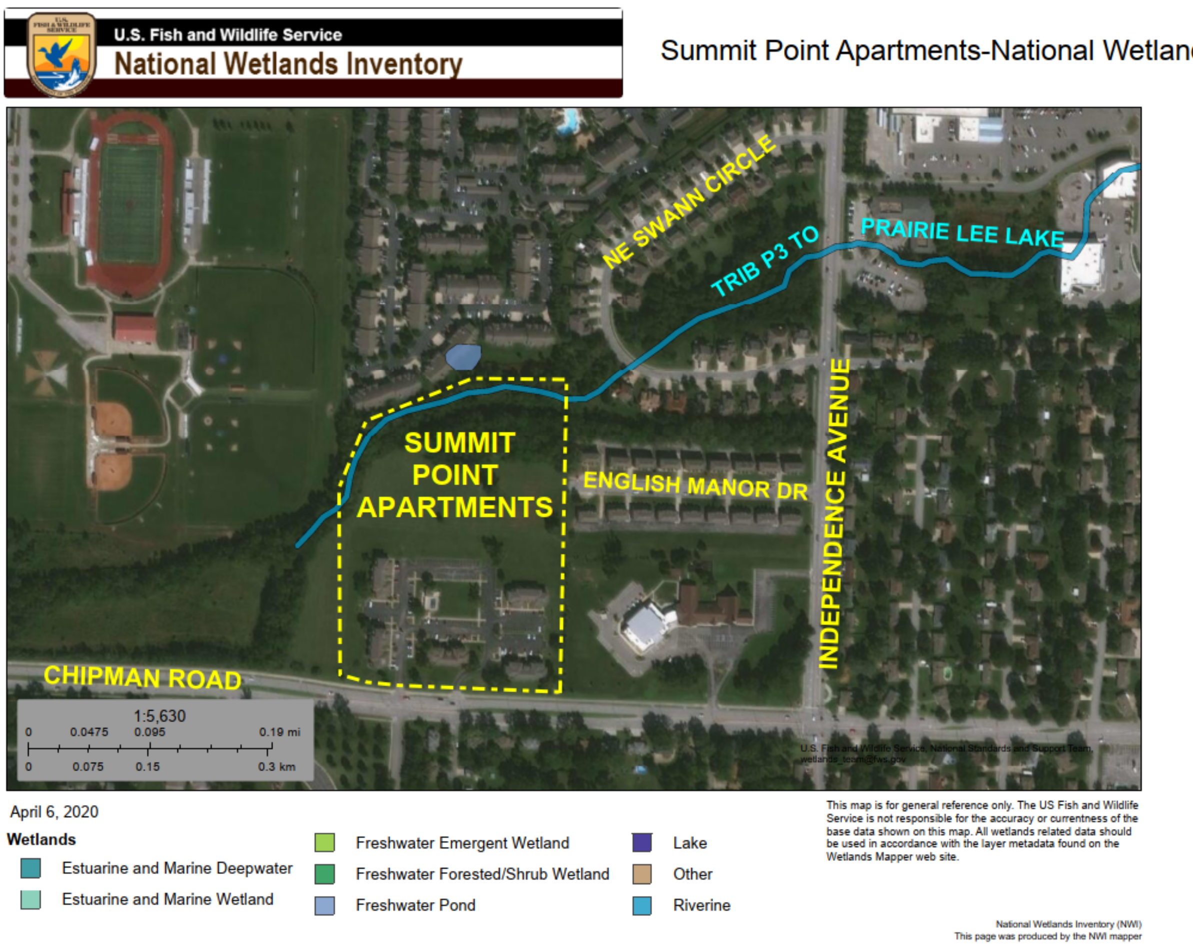
The Ordinary High Water Mark (OHWM) was determined during a field investigation which included members of the City's Public Works staff along with Frank Norman and CFS personnel. The definition of the Ordinary High Water Mark as defined in the US Clean Water Act is as follows:

(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

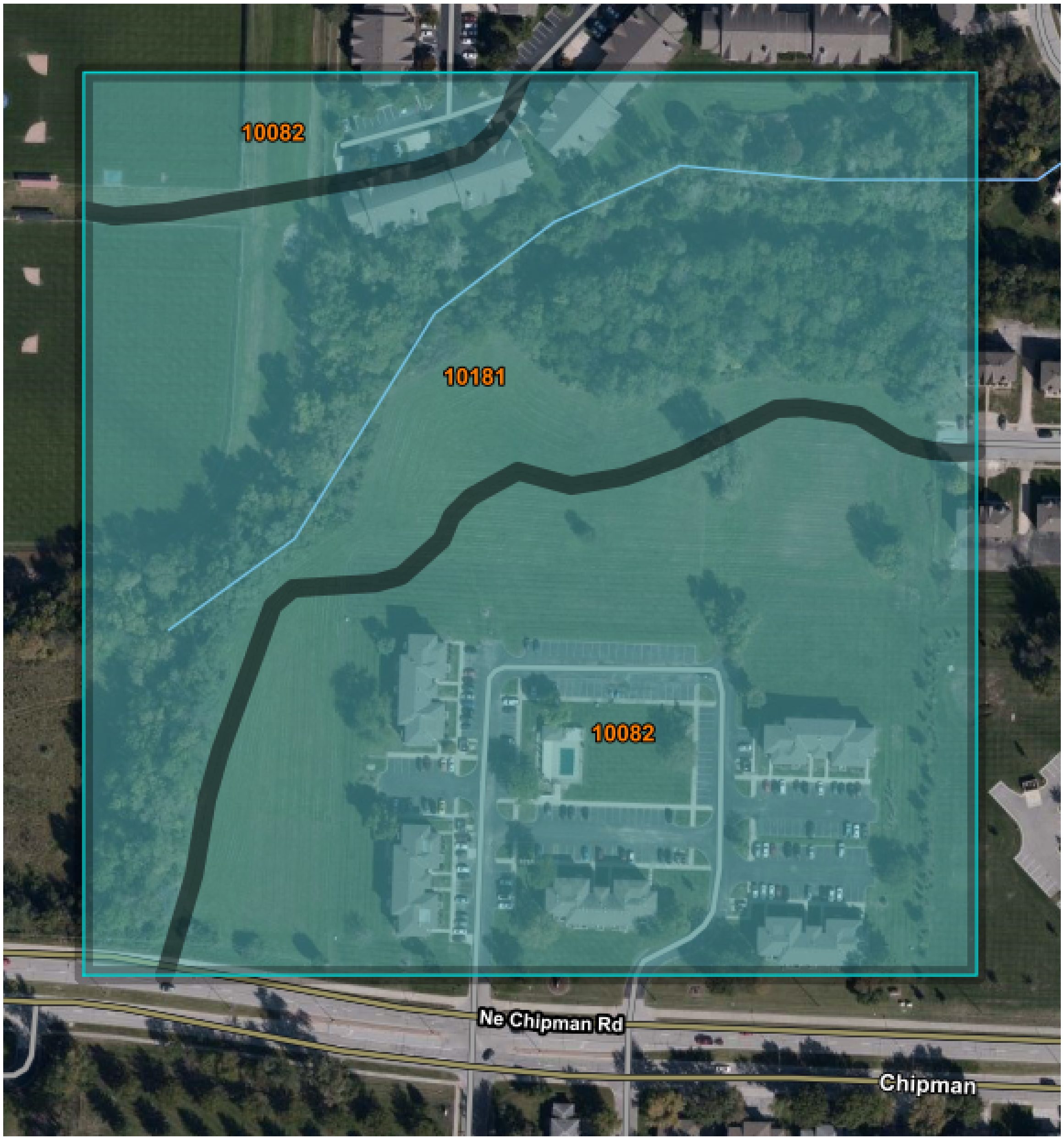
WSEL in the creek was approximately 994.4’), and the top of dam would be approximately 1003.25’ the detention basin would store approximately 1.895 ac-ft of runoff at a peak WSEL of 1000’50’ during a 100-year design storm event.

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 preliminary 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.

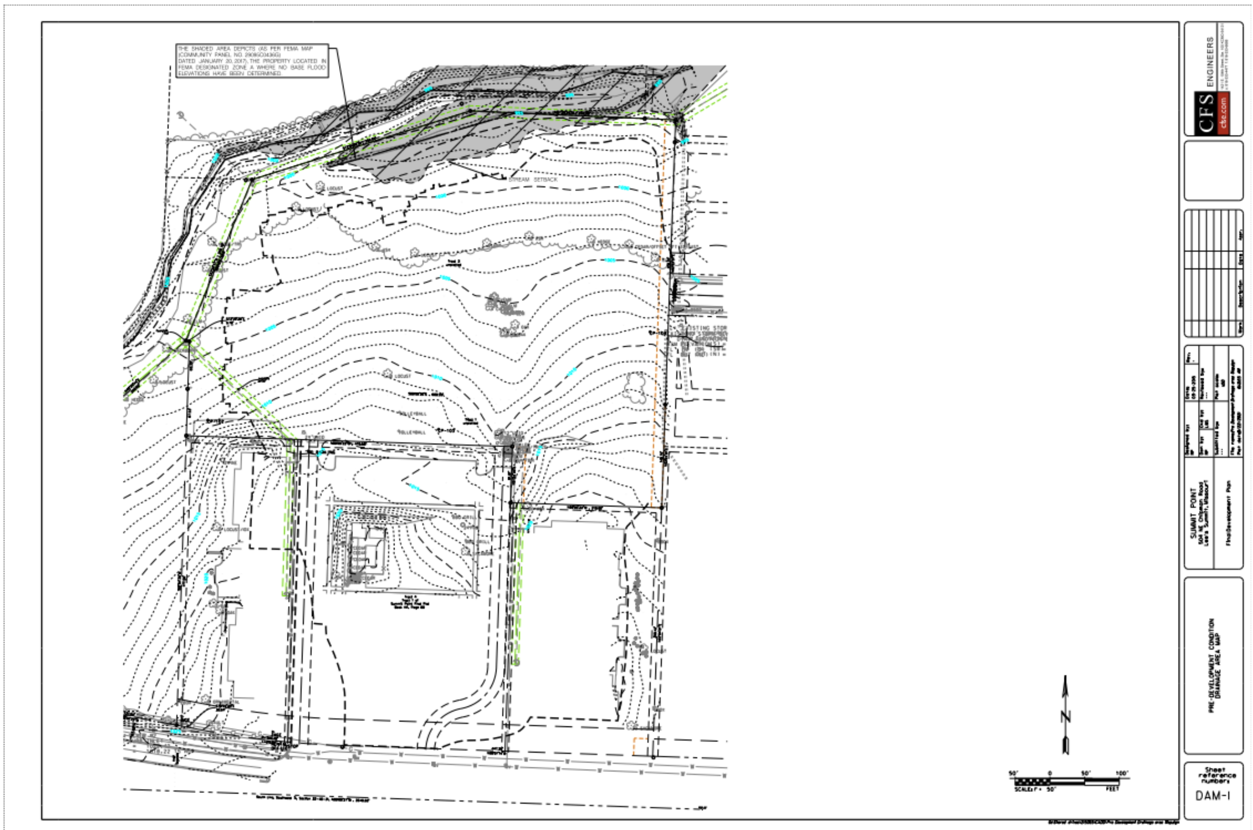
The surface areas for the proposed contour grading for the stormwater detention basin was measured at one foot intervals to derive stage versus storage curves for performing stormwater routing. The outlet structure consisted of a small 2-¼" diameter orifice for storing and metering the outflow from the 1.37"/24-hour rainfall, and a 27" rectangular weir 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 6" above the peak 100-year WSEL. Calculations showed that the overflow from a second 100-year storm under full conditions with all other outlets blocked would rise approximately 1.01 ft above the crest of the overflow spillway to elevation 1002.01'. The top of the dam would be set at 1003.25' 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 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 existing 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 4.21 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 4.21 acres was estimated to contain approximately 2.55 acres of impervious surface and approximately 1.66 acres of pervious green-space. The composite SCS runoff curve number was estimated to be 88.5. 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.



Pre-Development Conditions Drainage Map

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. 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.

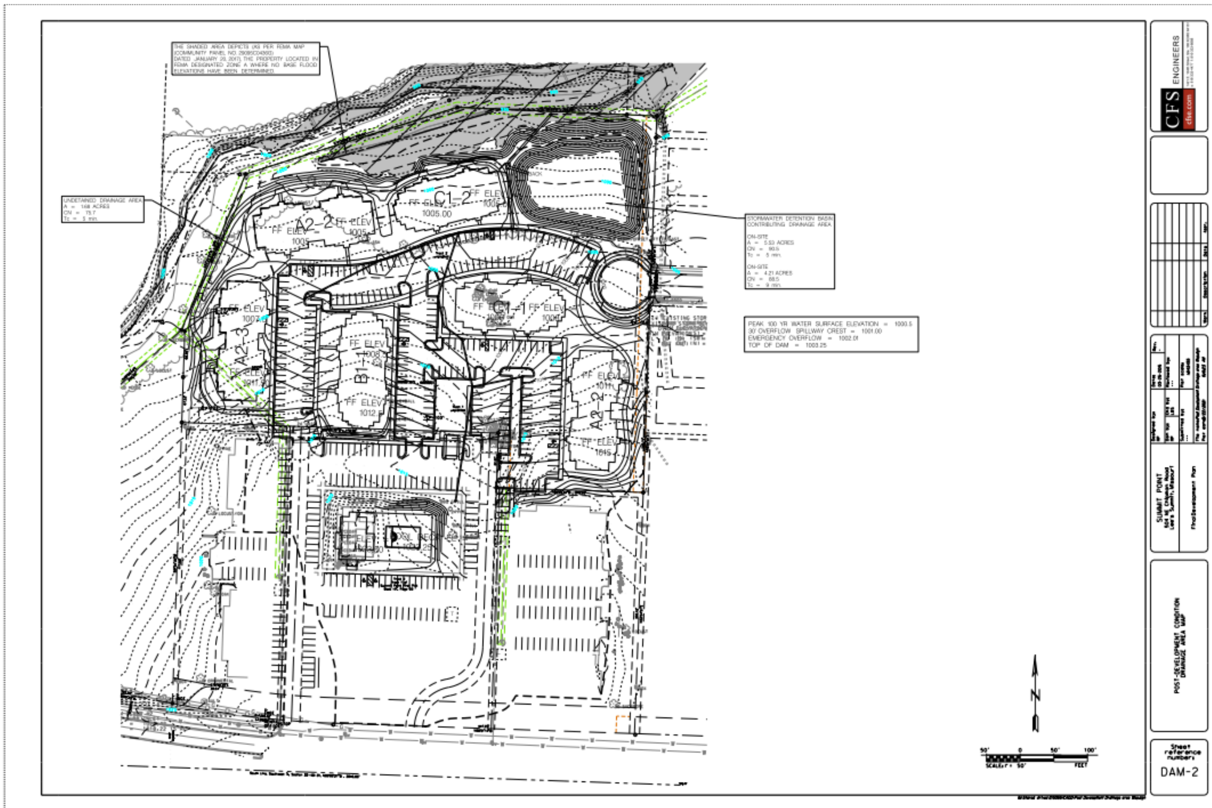
Contributing off site areas unaffected by the construction would be allowed to release drainage at their pre-development rates.

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 4.21 acres with an SCS Curve Number of CN = 88.5 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 13.58 cfs, 22.37 cfs and 36.18 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
10% (10-Year)	13.58 cfs	3.61 cfs	17.19 cfs
2% (50-Year)	22.37 cfs	14.42 cfs	36.79 cfs
1% (100-Year)	36.18 cfs	21.63 cfs	57.81 cfs

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. A portion of the proposed stormwater detention basin would be located within the stream buffer area, which is allowable with the City on a case-by-case review basis. The stormwater detention basin would have a bottom elevation of approximately 995.30', and a top of impoundment dam elevation of approximately 1003.25' with full storage capacity was estimated at approximately 3.134 ac-ft. Approximately 5.53 acres at CN = 90.5 of the Phase-II on-site drainage would flow into the detention pond along with approximately 4.21 acres at CN = 88.5 of contributing drainage from the Phase-I off-site area.



Post-Development Conditions Drainage Map

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.

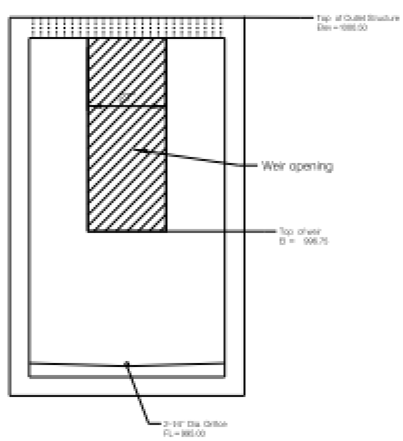
Approximately 1.68 acres of the Phase-II site would be undetained by-passing the proposed stormwater detention basin. The undetained area was located along the northern and western fringes of the Phase-II site where the ground was too low for runoff to be caught and piped into the detention basin.

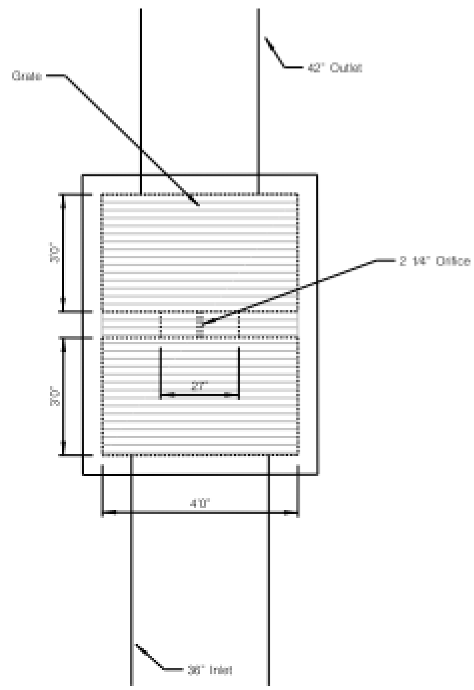
The required water quality storage for the 1.37” rainfall from the Phase-II development was calculated based on the total proposed impervious surface area over the 7.21 acre site. The total impervious and pervious surface areas were measured for the proposed site and the Water Quality Volume (WQv) was 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 996.72’.

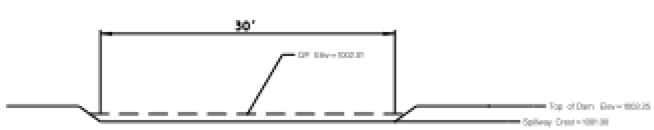
The invert elevation of the outlet orifice was set at 995.00’ inside the proposed outlet structure, so that the maximum storage depth would be 1.72 ft and the average depth would be half of that value at 0.86 ft. Dividing the 19,338 cubic feet of Water Quality Volume by 40 hours yields an average outflow rate of approximately 0.1343 cfs. Sizing calculations for the proposed low-flow outflow orifice indicated that a circular diameter of approximately 2.35 inches would be needed to release the storage volume over the 40 hour interval. For simplicity of construction, a 2-¼ inch diameter orifice was designed in the bottom of the outlet structure.

The proposed 2-¼ inch diameter Water Quality Volume outflow orifice at invert elevation 995.00’ was conjoined with a 27 inch wide outlet weir at crest elevation 996.75’ to meter the outflow from the 2, 10 and 100-year design storms. The proposed outlet structure would be constructed on the western side of the proposed stormwater detention basin to house the 2-¼ inch orifice and 27 inch weir.





OUTLET STRUCTURE DETAIL



EMERGENCY SPILLWAY DETAIL

A 42” HDPE storm sewer pipe from the south and another 15” HDPE stormwater pipe from the west would collect the surface drainage from the sita and drain it into the outlet structure. Another 42” HDPE equalized pipe would connect the outlet structure with the stormwater detention basin and would allow runoff to back-up and be stored inside the detention basin and then be released through the outlet orifices. A 36” HDPE outlet pipe would drain out of the north side of the outlet structure and discharge into the existing creek on the north side of the site. The 100-year water surface elevation of the creek was calculated to be approximately 994.4’, 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:

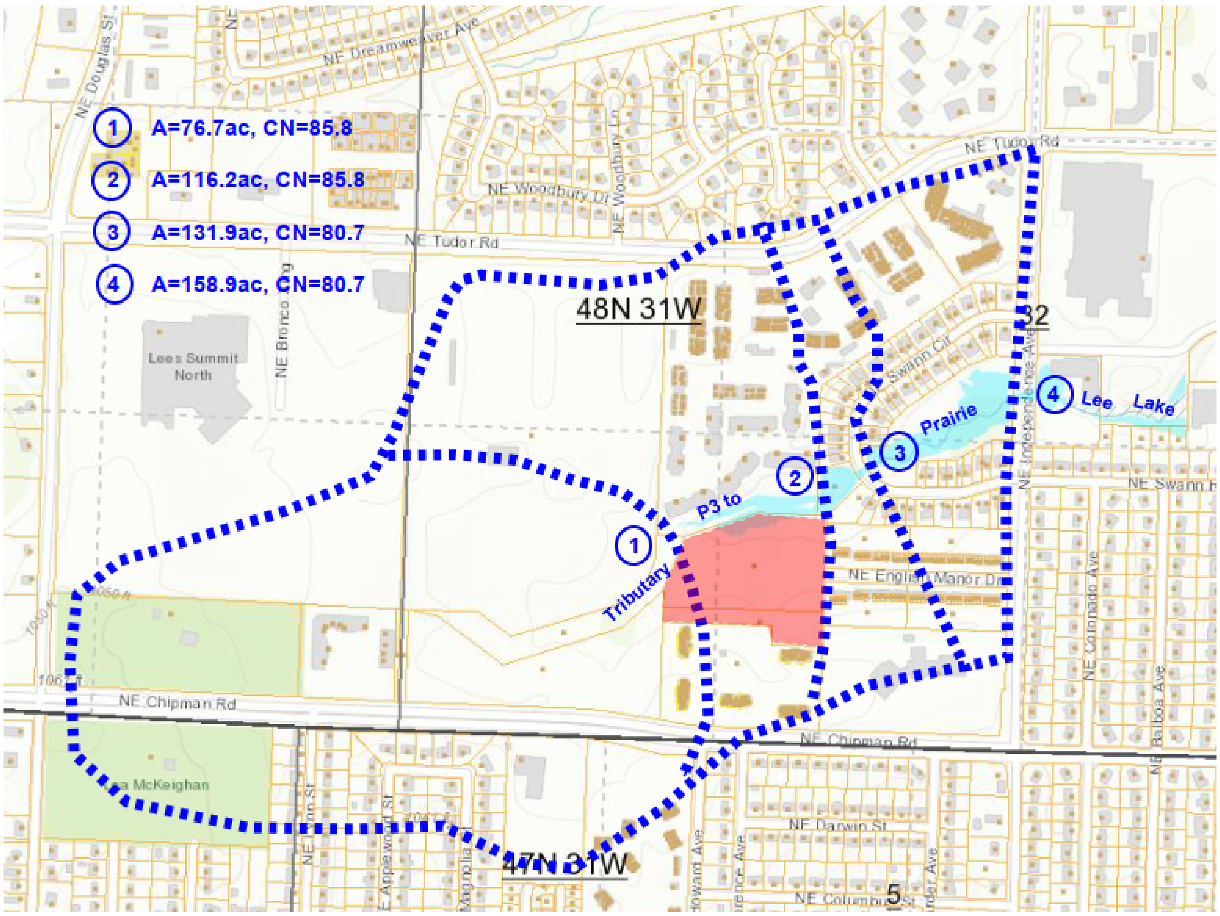
Stormwater Detention Basin Routing Summary

Storm Frequency	Peak Inflow	Peak Outflow	Peak WSEL	Peak Storage	Total Release Rate	Allowable Release Rate
50% (2-Year)	33.73 cfs	11.37 cfs	998.14’	0.927 ac-ft	12.58 cfs	17.19 cfs
10% (10-Year)	54.40 cfs	27.10 cfs	999.25’	1.358 ac-ft	30.93 cfs	36.79 cfs
1% (100-Year)	86.74 cfs	48.87 cfs	1000.48’	1.882 ac-ft	56.36 cfs	57.81 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.

Drainage Channel Analysis of Tributary P3 to Prairie Lee Lake:

CFS Engineers created a HEC-RAS model to evaluate the water surface elevations of stormwater in the Tributary P3 to Prairie Lee Lake creek channel along the north side of the proposed Summit Point Apartments, Phase II site. Stream flows were calculated at three key locations along the northern property line and where the creek crosses NE Swann Circle approximately 200 ft downstream of the Summit Point Apartments, Phase-II site.

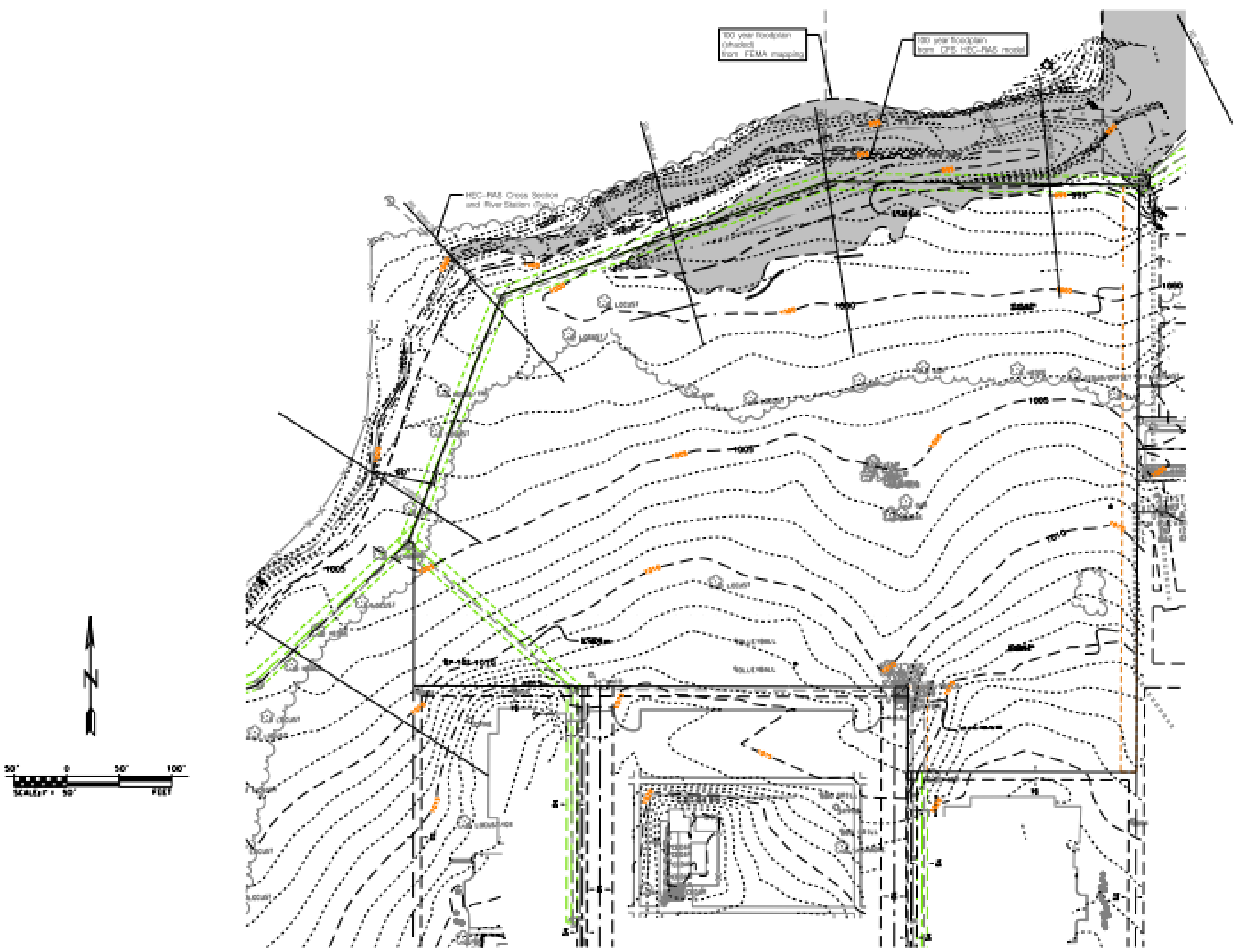


Schematic Off-Site Drainage Area Map for Tributary P3 to Prairie Lee Lake

Drainage areas were estimated using the City GIS mapping. Channel cross-sections for the HEC-RAS models were cut across the surveyed ground surface, based on a recent topographic field survey of the site done by CFS Engineers. The FEMA FIRM Flood Map of the region (FEMA FIRM Flood Map 29095C0436G, Panel 436 of 625, January 20, 2017), shows the Tributary P3 to Prairie Lee Lake directly to the north of the site as Zone A (Special Flood Hazard Area subject to inundation by the 1% annual chance flood where no base flood elevations have been determined).

The existing triple 48” HDPE culverts at NE Swann Circle were also included in the HEC-RAS model to evaluate the potential back-up of flood water in the creek from the culvert crossing. Six cross-sections were cut along the Summit Point Apartments, Phase-II site, and an additional three cross-sections were cut downstream to model the NE Swann Circle culverts. CFS’ surveyors measured the invert elevations of all three 48” HDPE culverts along with the top of road elevation for determining overflow.

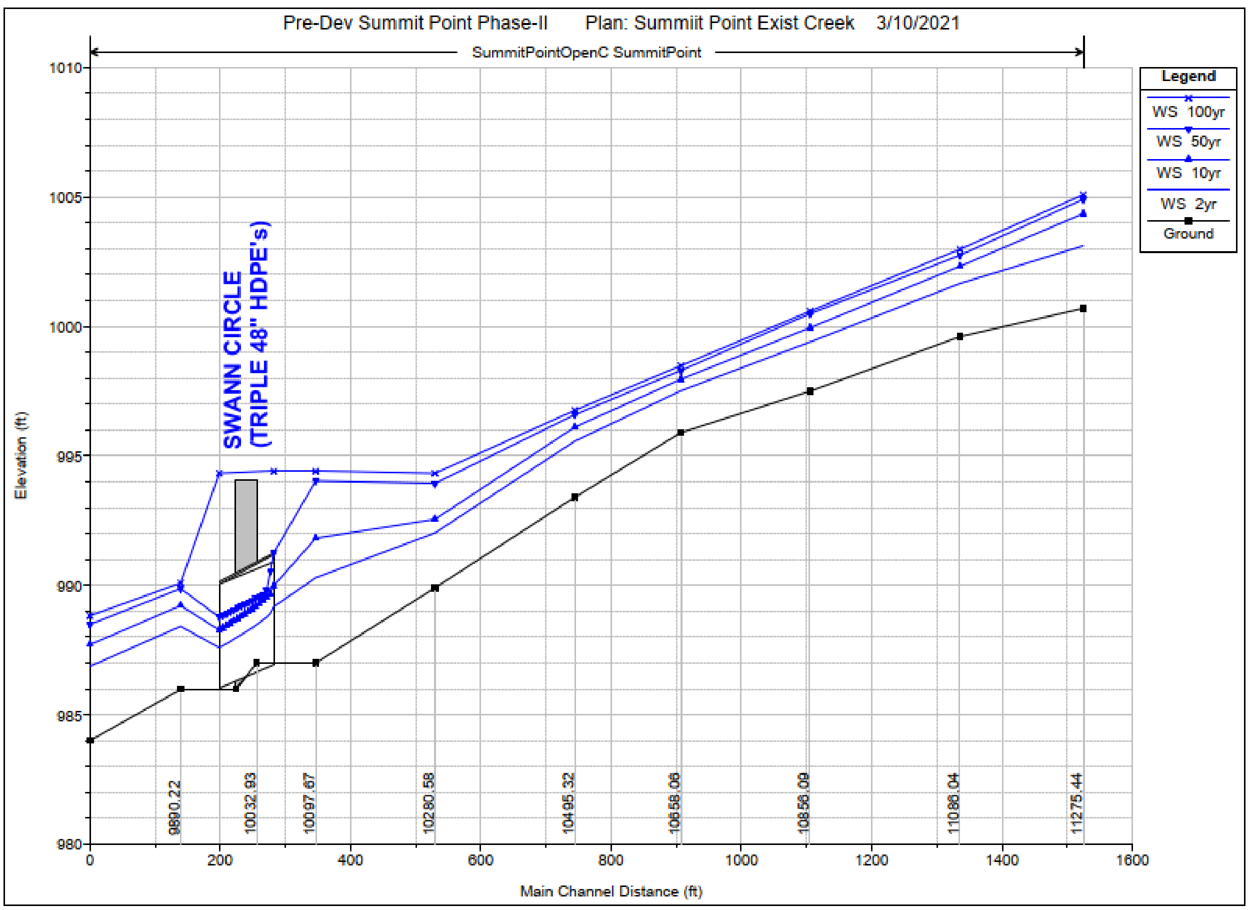
The results of the HEC-RAS model showed that the 100-year flood elevations along the Summit Point Apartments, Phase-II site ranged from approximately 994.3’ to 1005.1’. The proposed buildings and the bottom of the proposed open-graded stormwater detention basin were set above the calculated 100-year flood elevation. The existing culverts at NE Swann Circle produced a modest backwater that merged into the regular channel approximately 300 ft upstream. Copies of the HEC-RAS output calculations have been summarized in the table below and also included in the appendix of this study.



HEC-RAS Channel Cross-Section Locations on Tributary P-3 to Prairie Lee Lake

Tributary P3 to Prairie Lee Lake along the North Side of Summit Point Apts, Phase-II
Summary of HEC-RAS Channel Flows and Water Surface Elevations

Storm Frequency	RS 11275.44	RS 11086.04	RS 10856.09	RS 10658.06	RS 10495.32	RS 10280.58
2-Yr Q	77 cfs	77 cfs	77 cfs	117 cfs	117 cfs	135 cfs
10-Yr Q	146 cfs	146 cfs	146 cfs	222 cfs	222 cfs	255 cfs
100-Yr Q	264 cfs	264 cfs	264 cfs	398 cfs	398 cfs	454 cfs
Channel FL	1000.7	999.6	997.5	995.9	993.4	989.9
2-Yr WSEL	1003.12	1001.65	999.40	997.52	995.57	992.02
10-Yr WSEL	1004.36	1002.32	999.95	997.96	996.11	992.55
100-Yr WSEL	1005.09	1002.98	1000.59	998.48	996.76	994.32

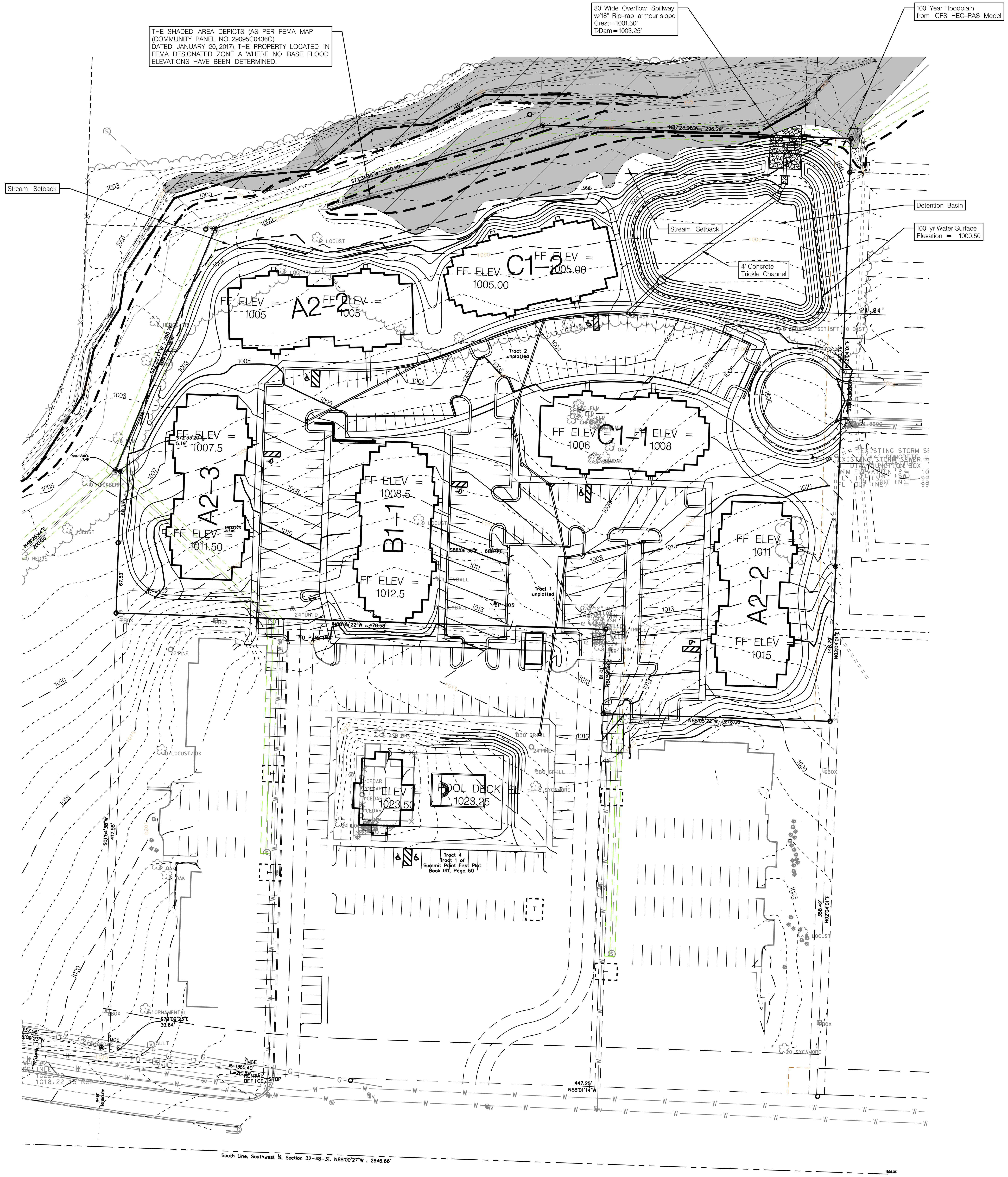


HEC-RAS Channel Profile of the Tributary P3 to Prairie Lee Lake
Calculations show that Swann Circle is Overtopped by the 1% (100-Year) Streamflow

Conclusions:

For preliminary 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 that would require flood permitting from FEMA or MDNR. 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.

PRELIMINARY PLAN
SUMMIT POINT 2nd PLAT
LEE'S SUMMIT, MISSOURI



CFS ENGINEERS
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	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

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Submitted by: ---		Plot scale: 1:50	
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GRADING PLAN

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PRELIMINARY PLAN
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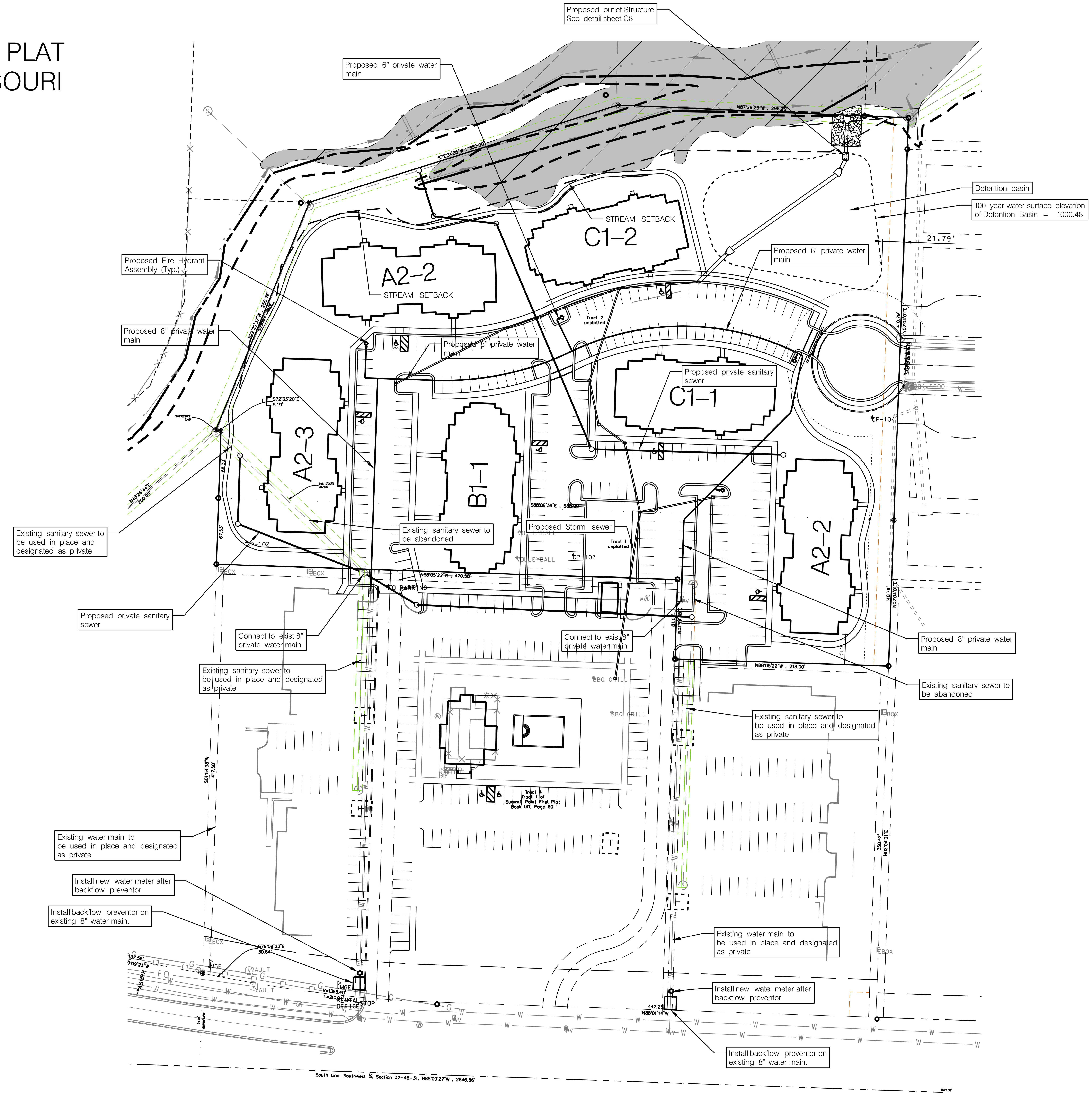
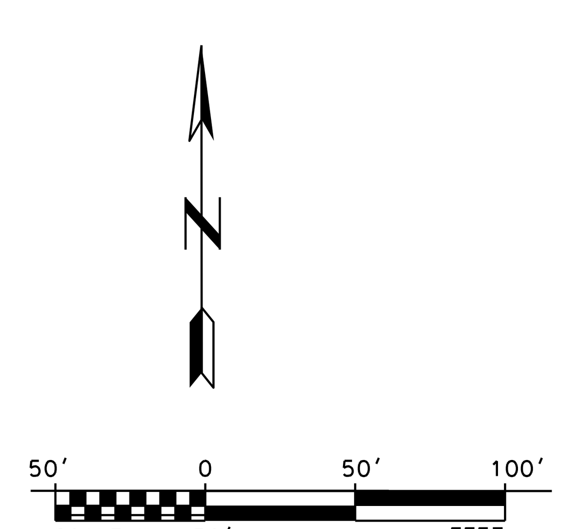
LEE'S SUMMIT, MISSOURI





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Date: 03-25-2015
Rev. -
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Ckd by: LWS
Reviewed by: ---
Submitted by: ---
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SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

Preliminary Development Plan

UTILITY PLAN

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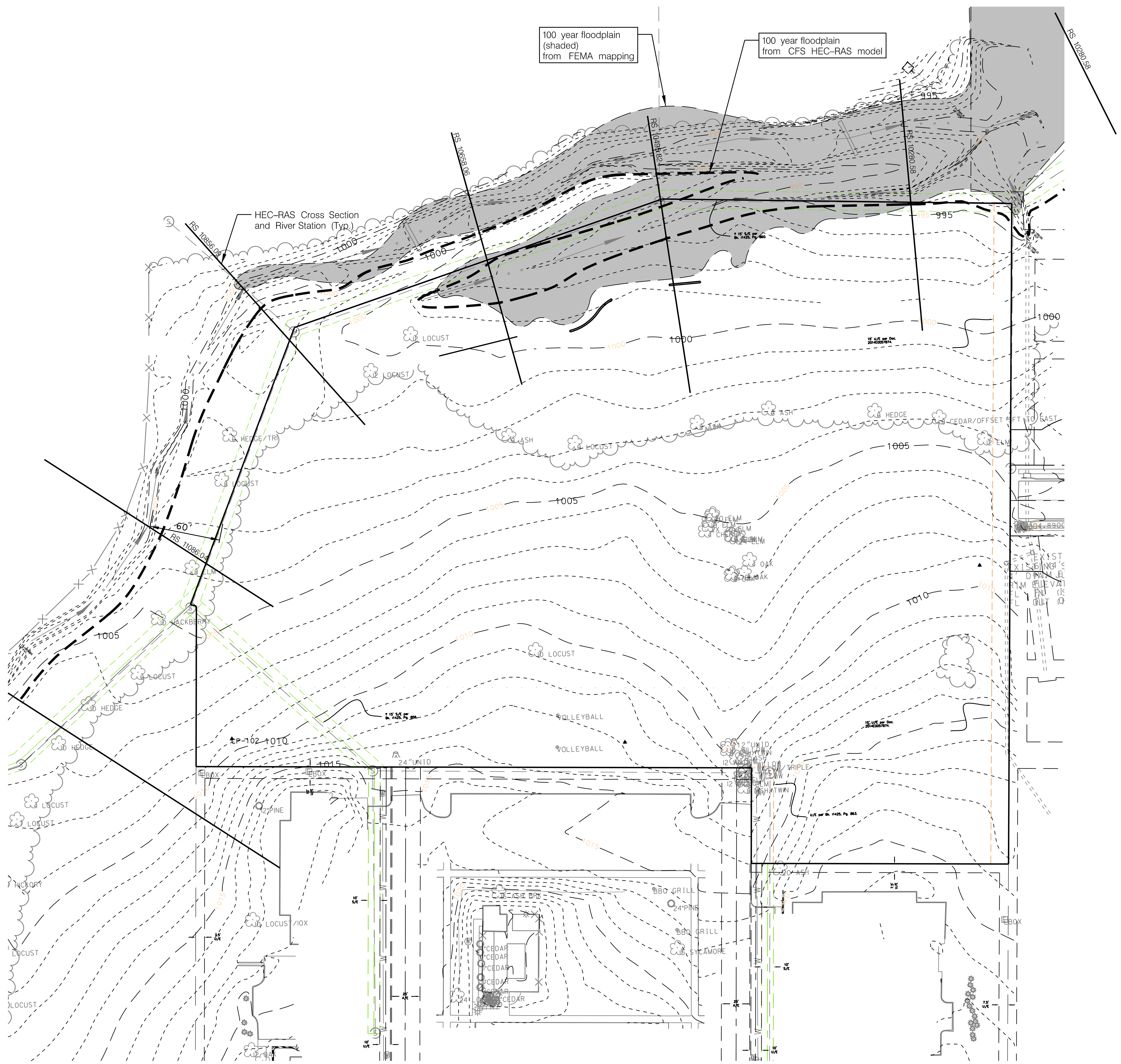
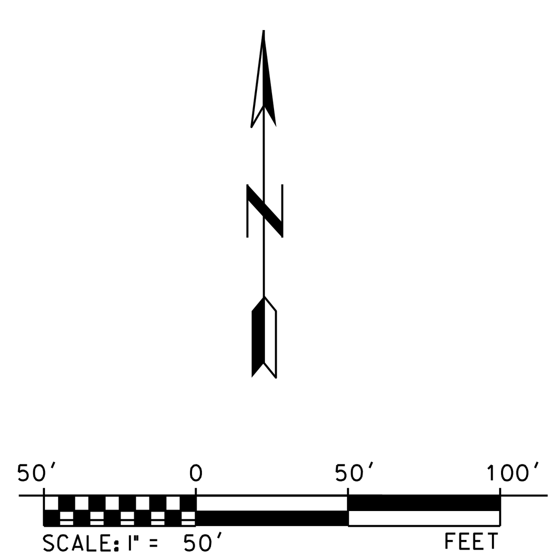
PRELIMINARY PLAN
SUMMIT POINT 2nd PLAT
LEE'S SUMMIT, MISSOURI





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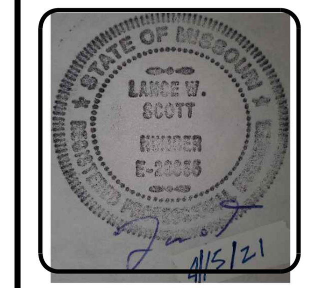

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Submitted by: ---	Plot scale: 1:50	
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FLOODPLAIN EXHIBIT

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PRELIMINARY PLAN
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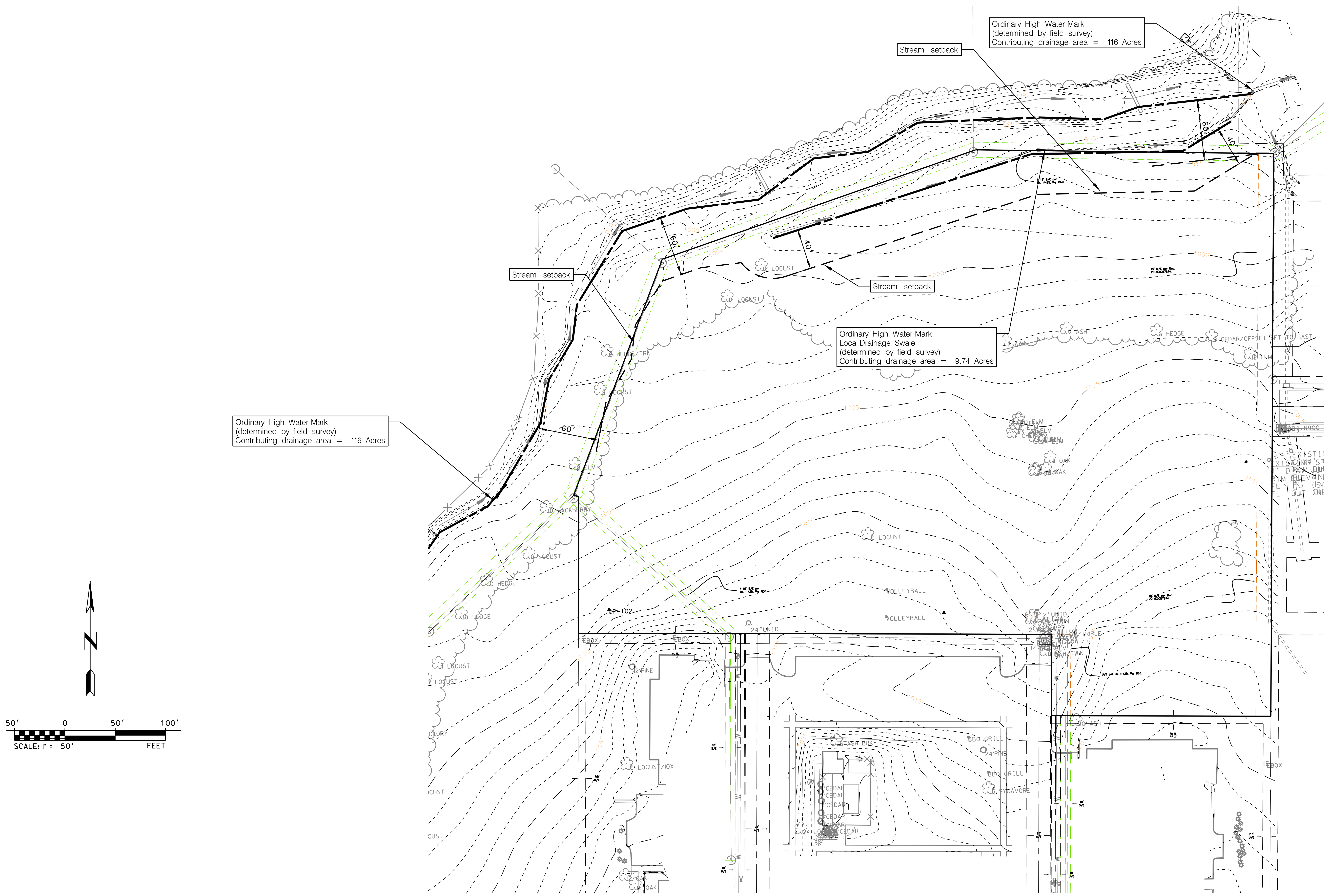
LEE'S SUMMIT, MISSOURI



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504 NE Chipman Road
Lee's Summit, Missouri

Preliminary Development Plan

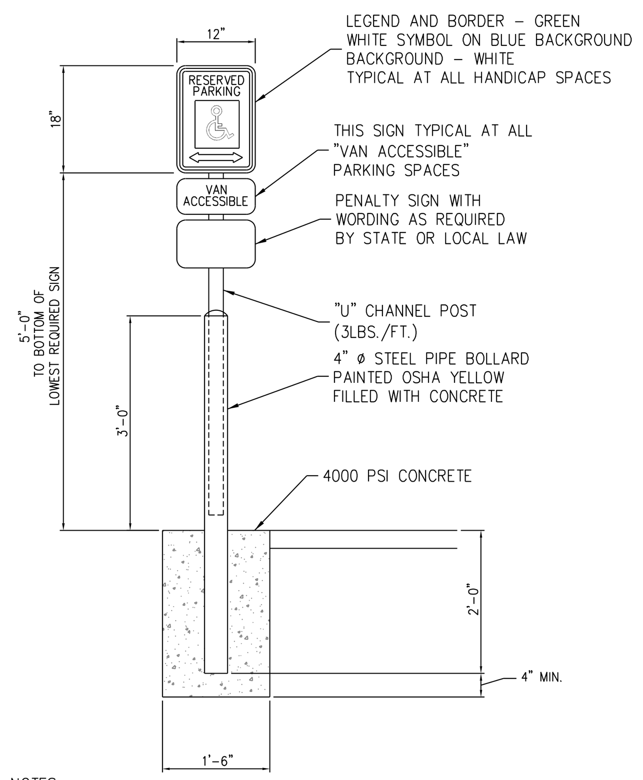
Designed by: RP
Date: 03-25-2015
Rev. -
Dwn by: RP
Ckd by: LWS
Reviewed by: ---
Submitted by: ---
Plot scale: 1:50
File name: Summit Point Stream Setback exhibit.dgn
Plot date: 4/14/2021 2:22:29 PM

STREAM SETBACK EXHIBIT

Sheet reference number:
C7

G:\Shared drives\215065\CADD\Summit Point Stream Setback exhibit.dgn

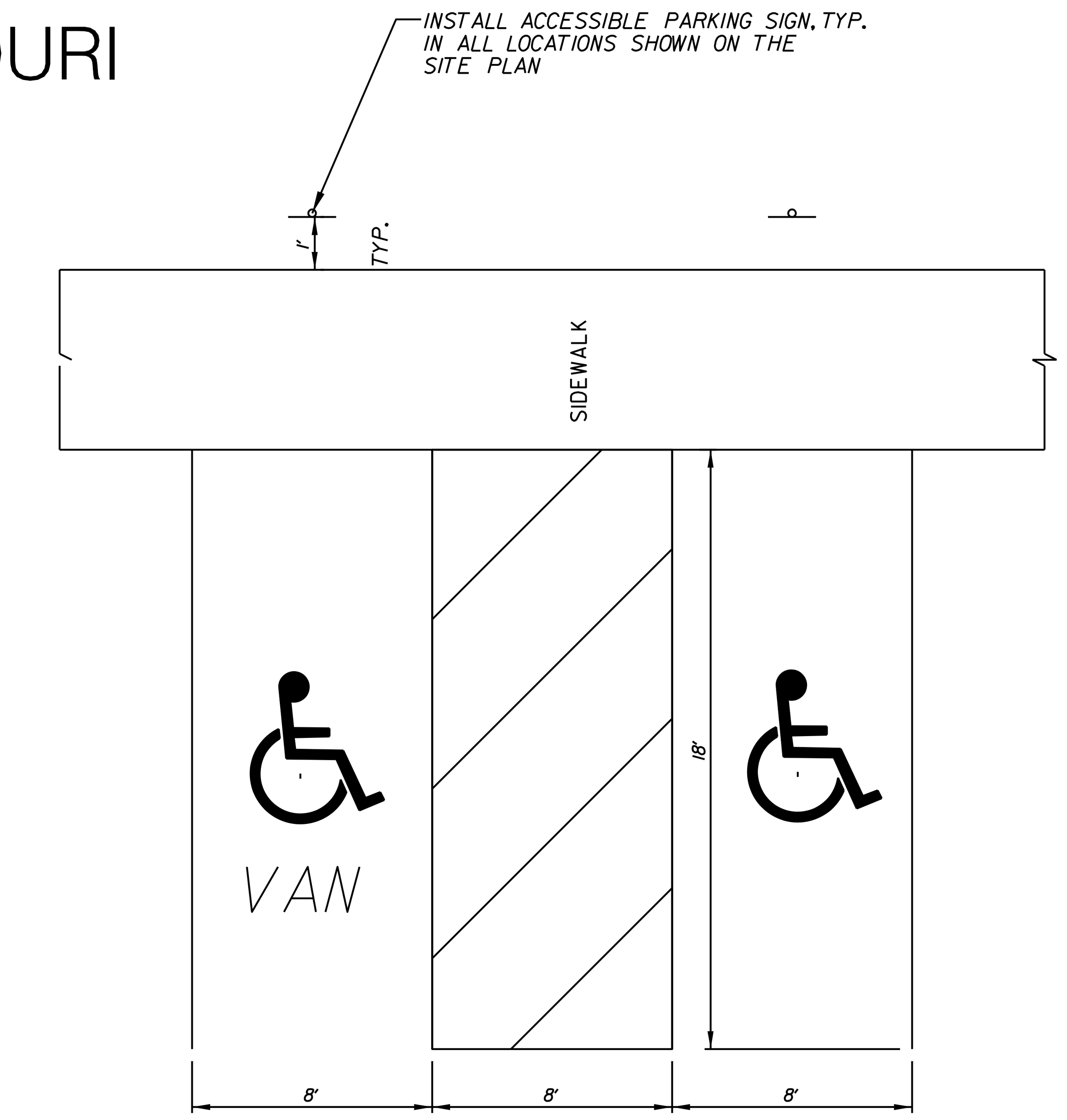
PRELIMINARY PLAN
SUMMIT POINT 2nd PLAT
LEE'S SUMMIT, MISSOURI



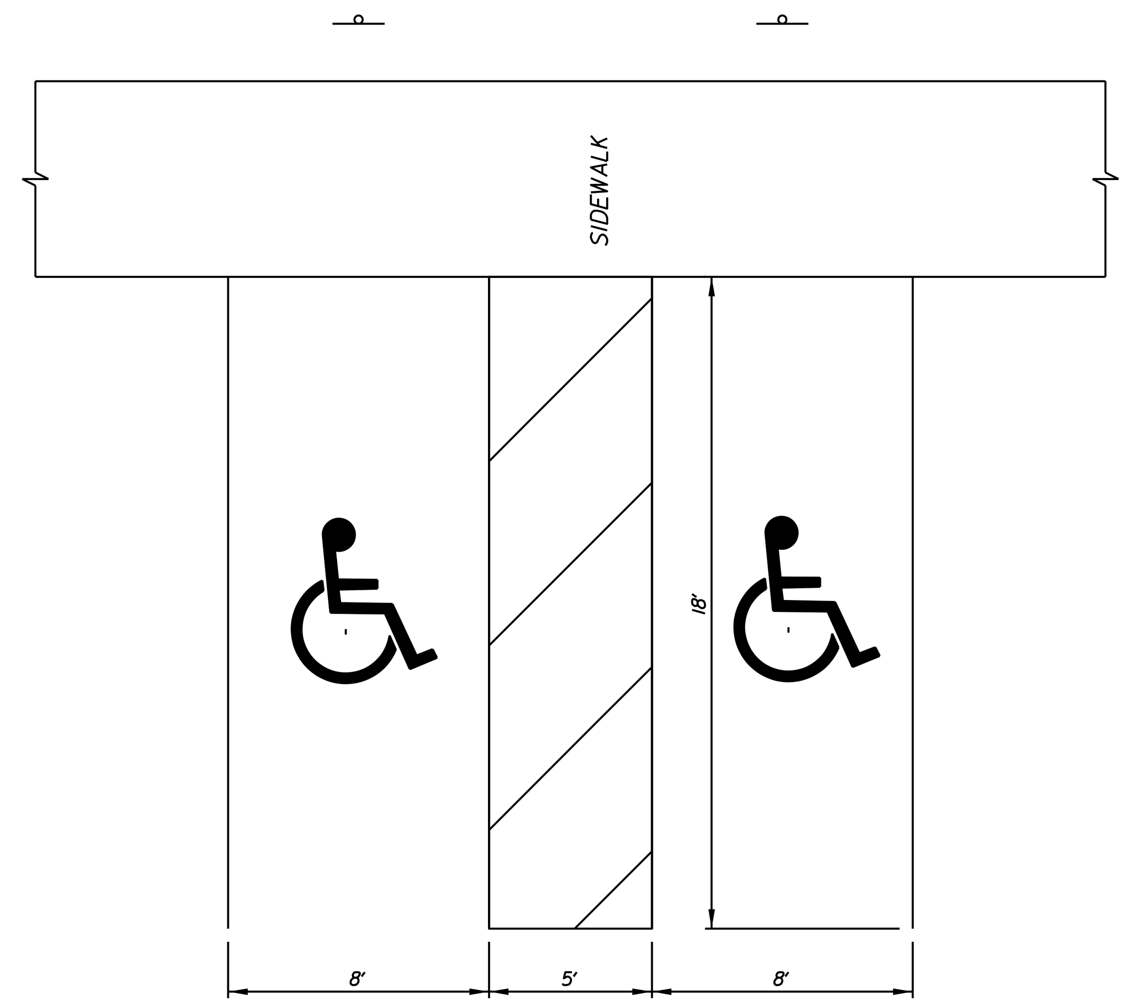
NOTES

1. ONE SIGN AT EACH HANDICAP SPACE.
2. WHERE HANDICAP SPACES FACE EACH OTHER WITHOUT WALKWAY, THERE SHALL BE ONE POST WITH SIGNS MOUNTED BOTH SIDES

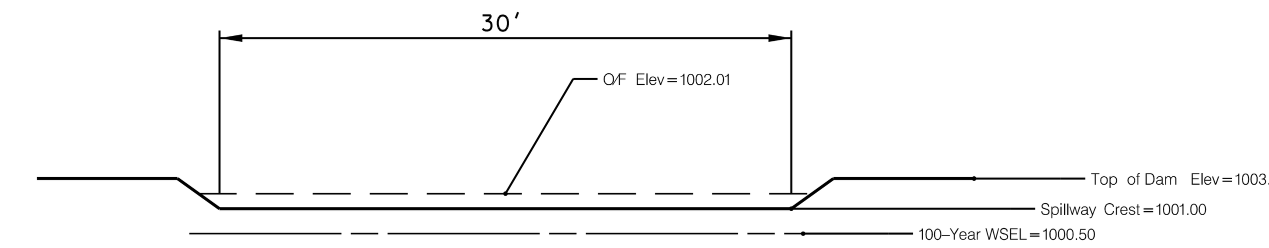
HANDICAP PARKING SIGN



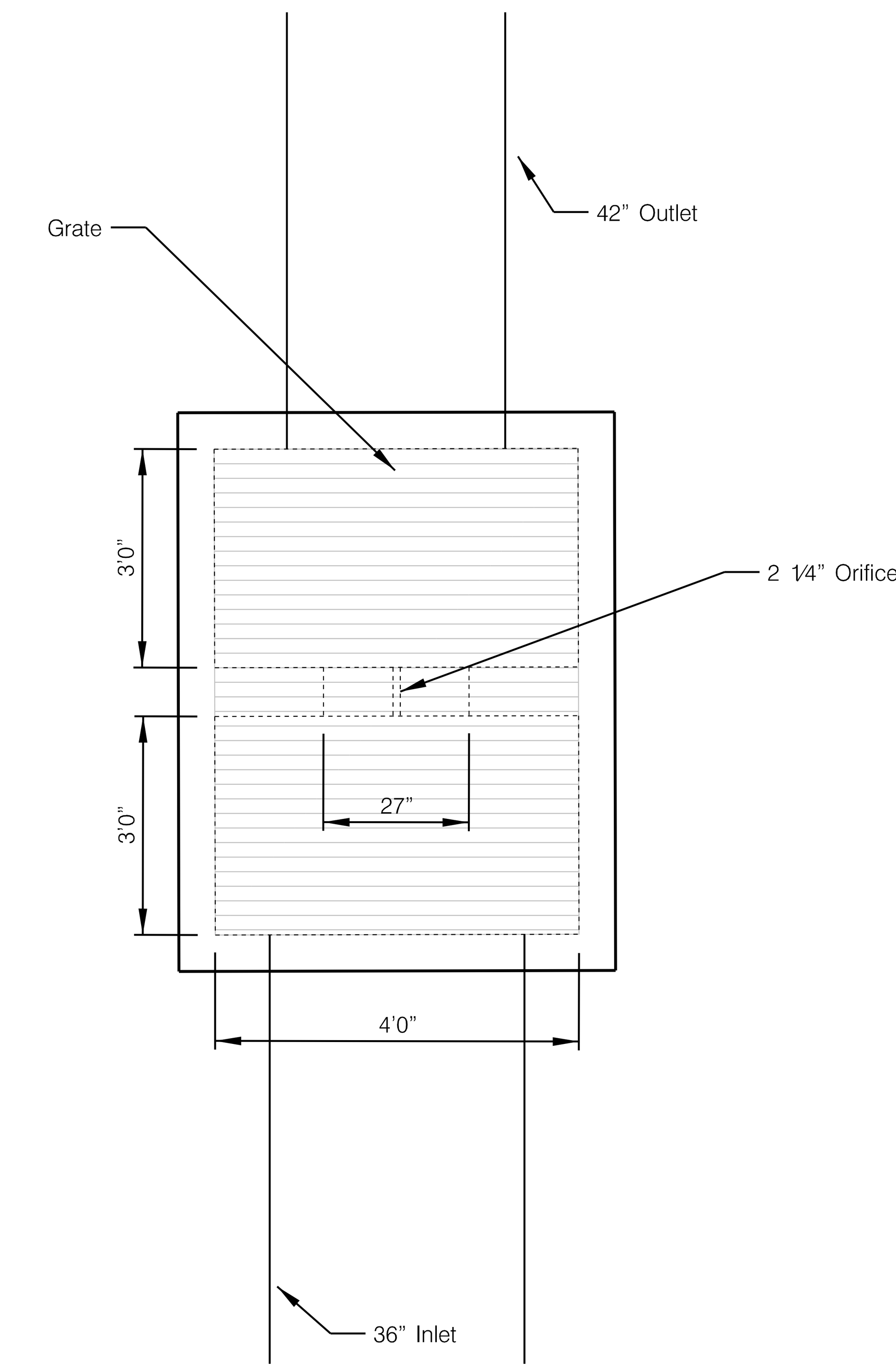
VAN ACCESSIBLE PARKING SPACES
NOT TO SCALE

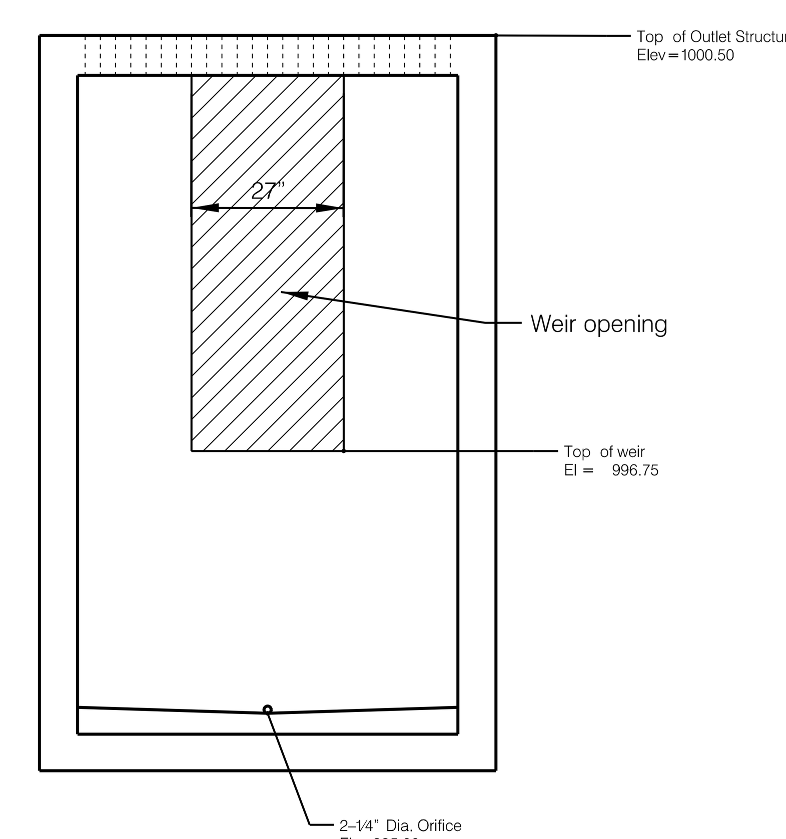


STANDARD ACCESSIBLE PARKING SPACES
NOT TO SCALE

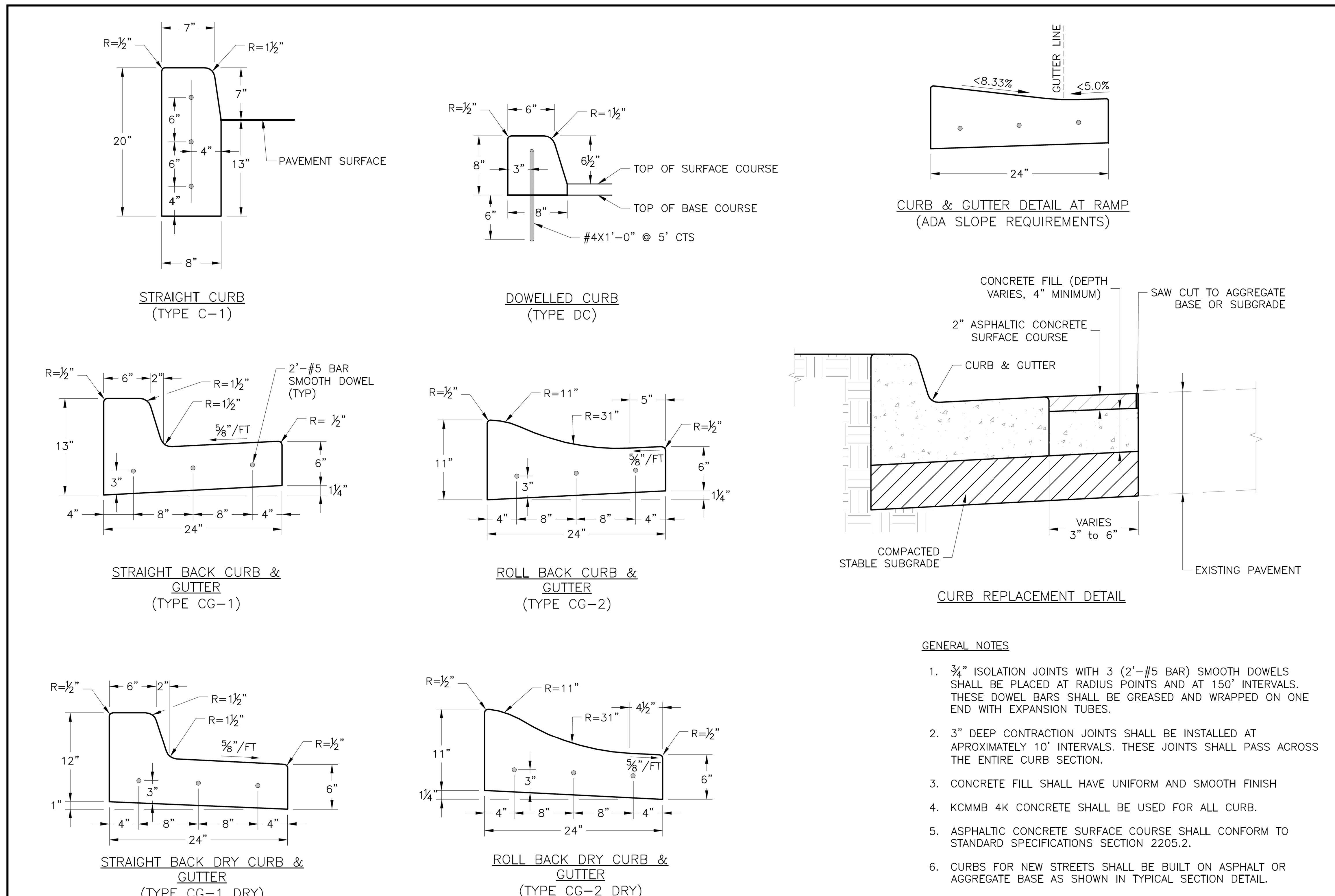


EMERGENCY SPILLWAY DETAIL





OUTLET STRUCTURE DETAIL



GENERAL NOTES

1. ¾" ISOLATION JOINTS WITH 3 (2'-#5 BAR) SMOOTH DOWELS SHALL BE PLACED AT RADIUS POINTS AND AT 150' INTERVALS. THESE DOWEL BARS SHALL BE GREASED AND WRAPPED ON ONE END WITH EXPANSION TUBES.
2. 3" DEEP CONTRACTION JOINTS SHALL BE INSTALLED AT APROXIMATELY 10' INTERVALS. THESE JOINTS SHALL PASS ACROSS THE ENTIRE CURB SECTION.
3. CONCRETE FILL SHALL HAVE UNIFORM AND SMOOTH FINISH
4. KCMMB 4K CONCRETE SHALL BE USED FOR ALL CURB.
5. ASPHALTIC CONCRETE SURFACE COURSE SHALL CONFORM TO STANDARD SPECIFICATIONS SECTION 2205.2.
6. CURBS FOR NEW STREETS SHALL BE BUILT ON ASPHALT OR AGGREGATE BASE AS SHOWN IN TYPICAL SECTION DETAIL.
7. WHITE CURING COMPOUND MUST BE APPLIED UNIFORMLY TO THE CONCRETE SURFACE IMMEDIATELY AFTER FINAL FINISHING.

LEE'S SUMMIT MISSOURI
PUBLIC WORKS ENGINEERING DIVISION | 220 SE GREEN STREET | LEE'S SUMMIT, MO 64063

STANDARD DETAILS
CITY OF LEE'S SUMMIT, MO
LEE'S SUMMIT, JACKSON COUNTY, MO
CURB & GUTTER DETAIL

Drawn By: MJF
Checked By: DL
Date: 04/17

GEN-4

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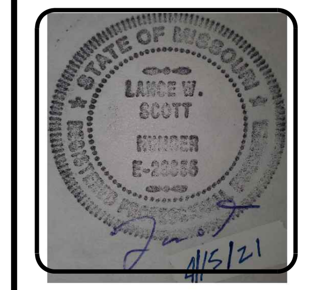

Mark	Description	Date	Appr.
	REVISED PER COMMENTS	04/15/21	
	REVISED PER COMMENTS	03/22/21	
	CITY SUBMITTAL	02/18/21	

Designed by: RP
Date: 03-25-2015
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Reviewed by: ---
Submitted by: ---
Plot scale: 1:20
File name: 215065-ST-SH-Details.dgn
Plot date: 4/14/2021 2:25:20 PM

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

Preliminary Development Plan

DETAILS

Sheet reference number:
C8

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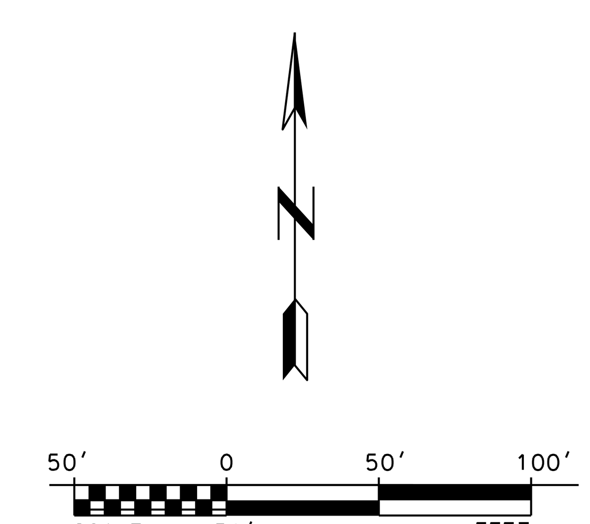

CFS ENGINEERS
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1421 E. 104th Street, Ste. 100 KCMO 64131
o: 816-333-4477 f: 816-333-6688

Mark	Description	Date	Appr.

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

Final 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: Pre Development Drainage area Map.dgn			
Plot date: 3/22/2021		8:12:55 AM	

PRE-DEVELOPMENT CONDITION DRAINAGE AREA MAP

Sheet reference number:

DAM-1

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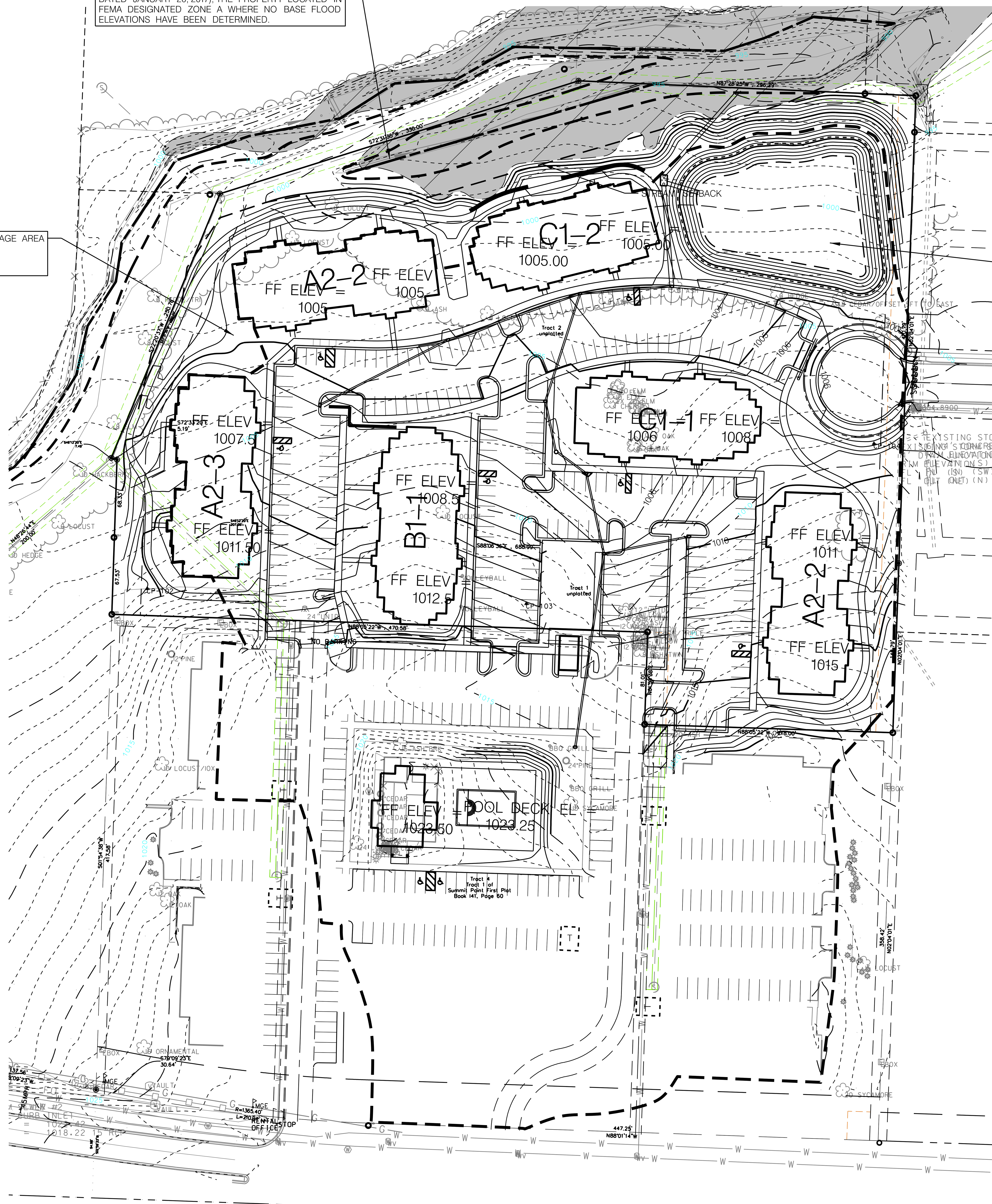

THE SHADED AREA DEPICTS (AS PER FEMA MAP (COMMUNITY PANEL NO. 29095C0436G) DATED JANUARY 20, 2017), THE PROPERTY LOCATED IN FEMA DESIGNATED ZONE A WHERE NO BASE FLOOD ELEVATIONS HAVE BEEN DETERMINED.

UNDETAINED DRAINAGE AREA
A = 1.68 ACRES
CN = 75.7
Tc = 5 min.

STORMWATER DETENTION BASIN CONTRIBUTING DRAINAGE AREA

ON-SITE
A = 5.53 ACRES
CN = 90.5
Tc = 5 min.

ON-SITE
A = 4.21 ACRES
CN = 88.5
Tc = 9 min.

PEAK 100 YR WATER SURFACE ELEVATION = 1000.5
30' OVERFLOW SPILLWAY CREST = 1001.00
EMERGENCY OVERFLOW = 1002.01
TOP OF DAM = 1003.25

SCALE: 1" = 50' FEET

CFS ENGINEERS
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1421 E. 104th Street, Ste. 100 KCMO 64131
o 816-333-4477 f 816-333-6688

Mark	Description	Date	Appr.

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

Final Development Plan

Designed by: RP		Date: 03-25-2015	Rev. -
Dwn by: RP	Ckd by: LWS	Reviewed by: ---	
Submitted by: ---		Plot scale: 1:54.5455	
File name: Post Development Drainage area Map.dgn			
Plot date: 3/22/2021		8:10:23 AM	

POST-DEVELOPMENT CONDITION DRAINAGE AREA MAP

Sheet reference number:
DAM-2

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

Cook, Flatt & Strobel Engineers, P.A. 1421 E 104th Street, Suite #100 Kansas City, Missouri 64131 Telephone (816) 333-4477 www.cfse.com	Project: Summit Point Apartments Phase-II Project# 21-5065/#19-5293 Designer: TEI Date: 03/18/21 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) = 996.72'
WQV Storage Depth: D = 1.72 ft
Average Depth: 1/2*D = 0.86 ft

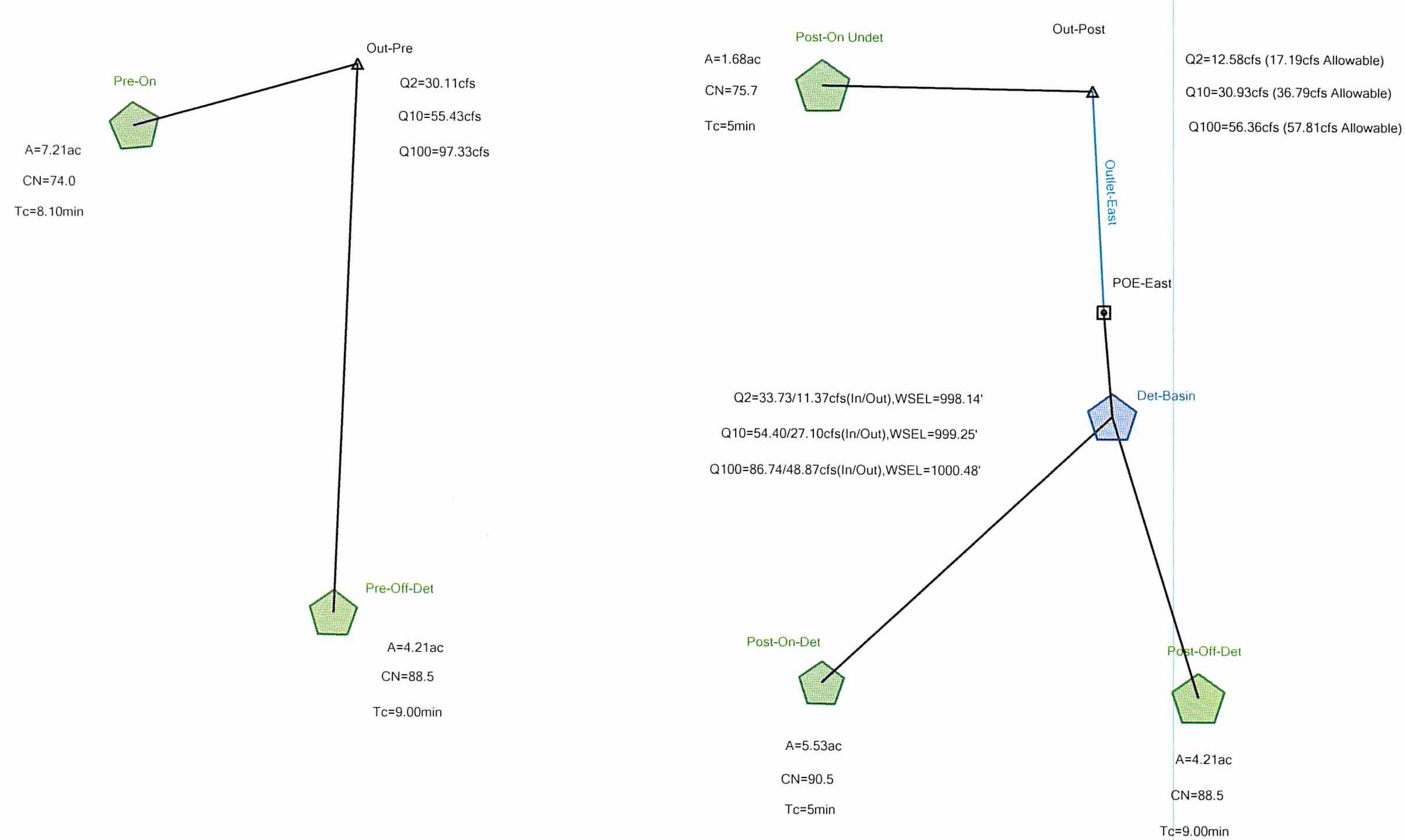
40-Hour Water Quality Volume Release Rate

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*0.86 ft)^1/2))
A = 0.0301 sqft
A = 4.3311 in^2
Equivalent Circular Diameter
A = pi*D^2 /4
D = (4*A/pi)^1/2
D = 2.35 in
Use 2'1/4" Diameter Orifice to meter Water Quality Volume release over 40-hours

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	1.170	11.900	21.00
Post-On-Det	Post-10yr	10	1.920	11.900	33.75
Post-On-Det	Post-100yr	100	3.133	11.900	53.67
Pre-Off-Det	Post-2yr	2	0.827	11.950	13.57
Pre-Off-Det	Post-10yr	10	1.388	11.950	22.37
Pre-Off-Det	Post-100yr	100	2.302	11.950	36.18
Post-On Undet	Post-2yr	2	0.193	11.950	3.49
Post-On Undet	Post-10yr	10	0.380	11.900	6.87
Post-On Undet	Post-100yr	100	0.709	11.900	12.86
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	0.827	11.950	13.58
Post-Off-Det	Post-10yr	10	1.388	11.950	22.37
Post-Off-Det	Post-100yr	100	2.302	11.950	36.18

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Out-Pre	Post-2yr	2	1.591	12.000	26.19
Out-Pre	Post-10yr	10	2.926	11.950	48.66
Out-Pre	Post-100yr	100	5.225	11.950	86.14
Out-Post	Post-2yr	2	1.721	12.050	12.58
Out-Post	Post-10yr	10	3.200	12.050	30.93
Out-Post	Post-100yr	100	5.627	12.050	56.36

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	1.997	11.950	33.73	(N/A)	(N/A)
Det-Basin (OUT)	Post-2yr	2	1.528	12.100	11.37	998.14	0.927
Det-Basin (IN)	Post-10yr	10	3.308	11.950	54.40	(N/A)	(N/A)
Det-Basin (OUT)	Post-10yr	10	2.820	12.100	27.10	999.25	1.358
Det-Basin (IN)	Post-100yr	100	5.436	11.950	86.74	(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	4.918	12.050	48.87	1,000.48	1.882

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	0.267	0.267	0.027	0.027
996.00	0.0	0.289	0.834	0.195	0.221
997.00	0.0	0.330	0.928	0.309	0.531
998.00	0.0	0.363	1.039	0.346	0.877
999.00	0.0	0.397	1.140	0.380	1.257
1,000.00	0.0	0.433	1.245	0.415	1.672
1,001.00	0.0	0.471	1.356	0.452	2.124
1,002.00	0.0	0.509	1.470	0.490	2.613
1,003.00	0.0	0.533	1.563	0.521	3.134

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	2.25" Orifice	Forward	TW	995.00	1,003.00
Rectangular Weir	27" Weir	Forward	TW	996.75	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)

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

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

Structure ID: 2.25" Orifice Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	995.00 ft
Orifice Diameter	2.3 in
Orifice Coefficient	0.600

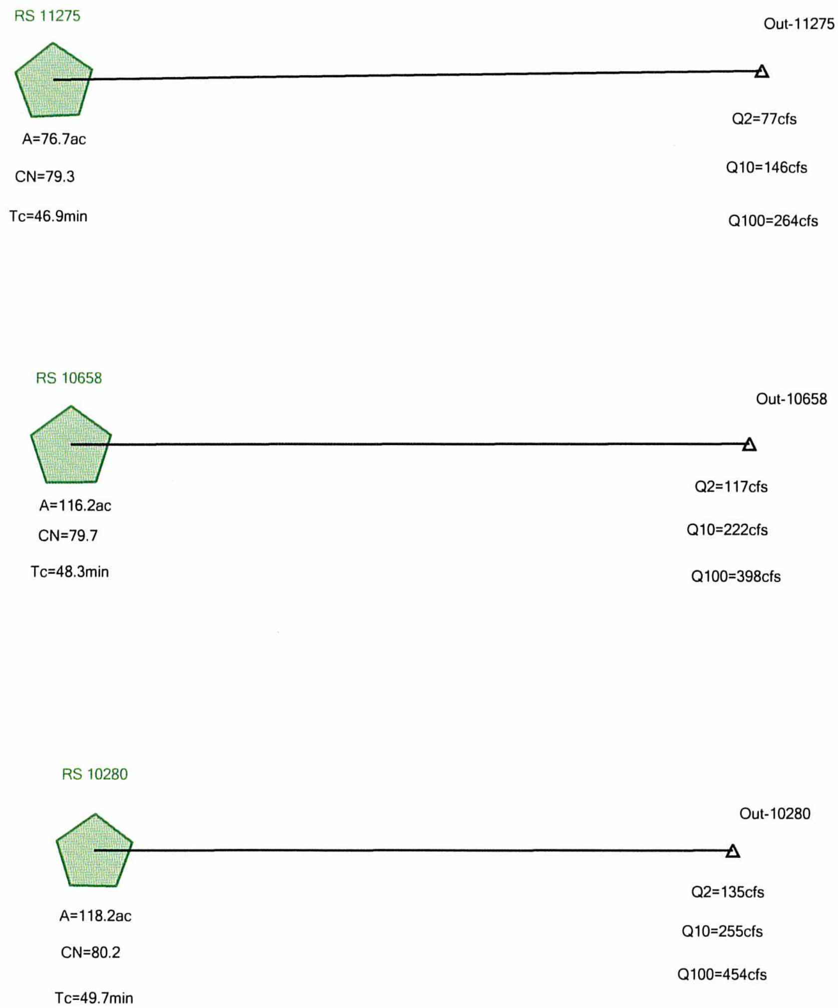
Structure ID: 27" Weir Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	996.75 ft
Weir Length	2.25 ft
Weir Coefficient	3.00 (ft^0.5)/s

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 ft^3/s
Flow Tolerance (Maximum)	10.000 ft^3/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 ft²
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, %

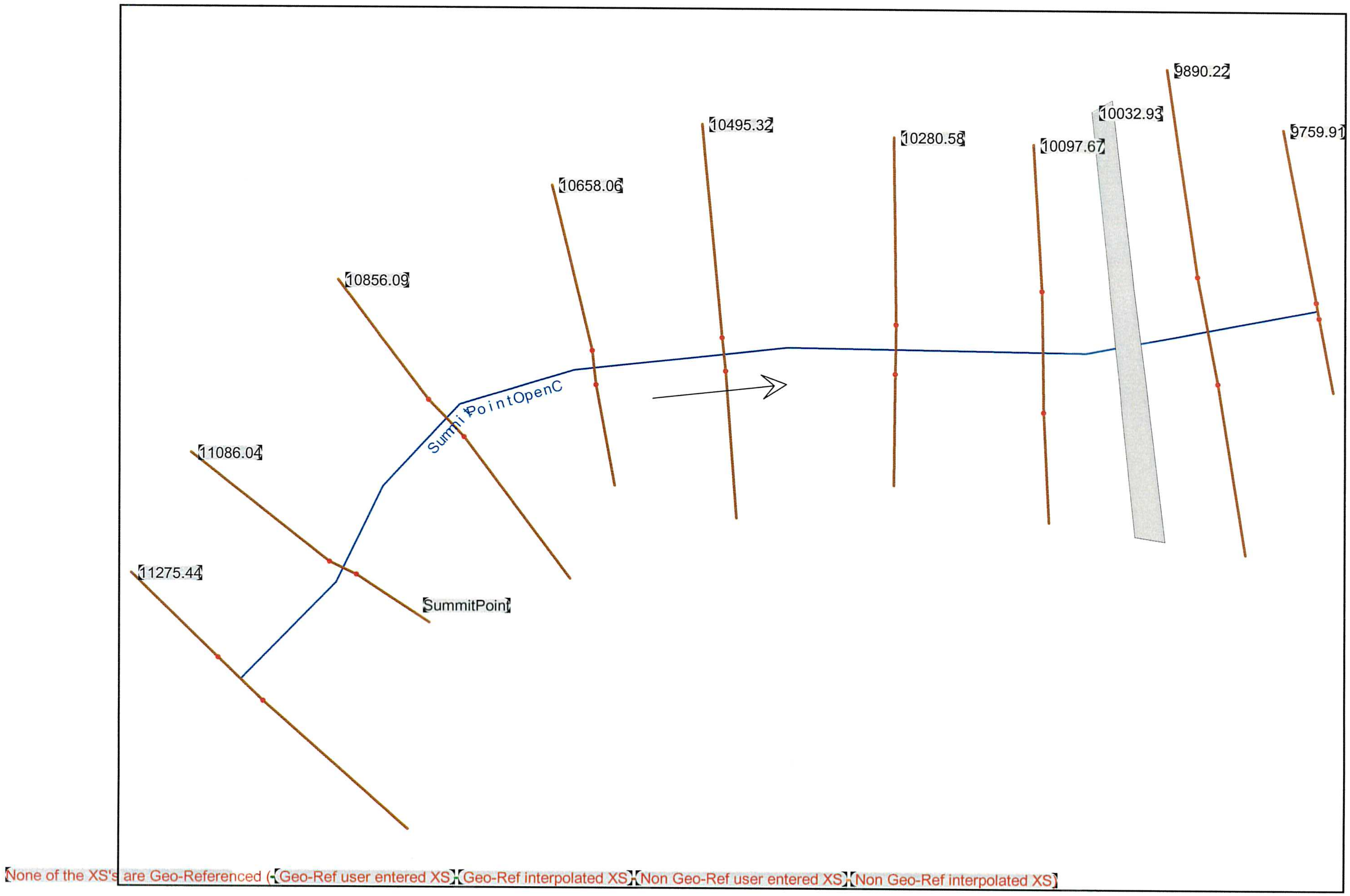
RS 9890.22
RS 9759.91
RS 10097.67
RS 9991.03
RS 10280.58
RS 10495.32
RS 10658.06
RS 10856.09
RS 11086.04
S 11275.44
SWANN CIRCLE
ENGLISH MANOR DRIVE
POI-4
A2-2
C1-2
C1-1
A2-3
B1-1
A2-2
1006
1004
1002
998
996
990
988
1000
1010
1016
1008

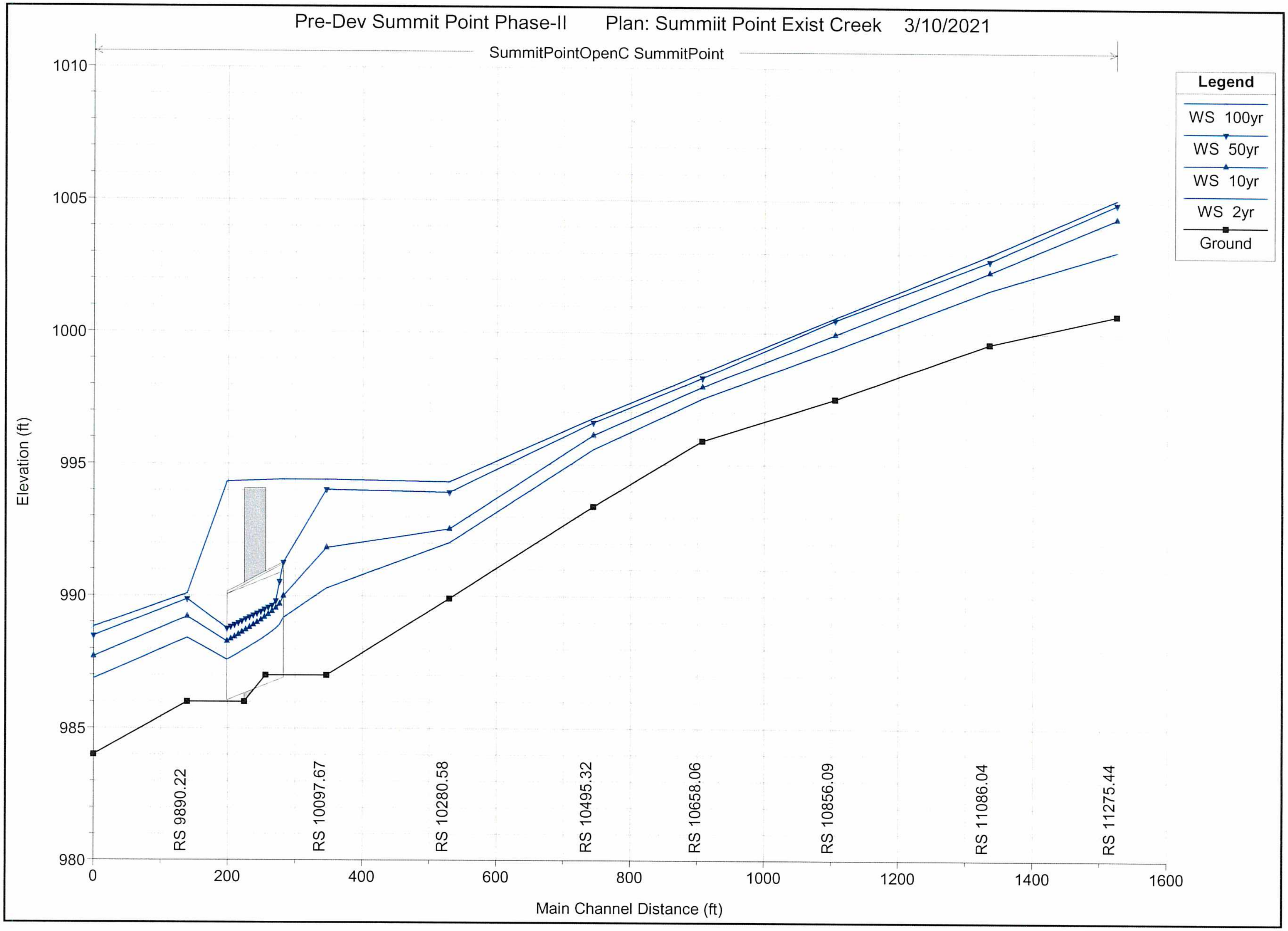
Tributary P-3 to Prairie Lee Lake
HEC-RAS Calculations
March 18, 2021

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

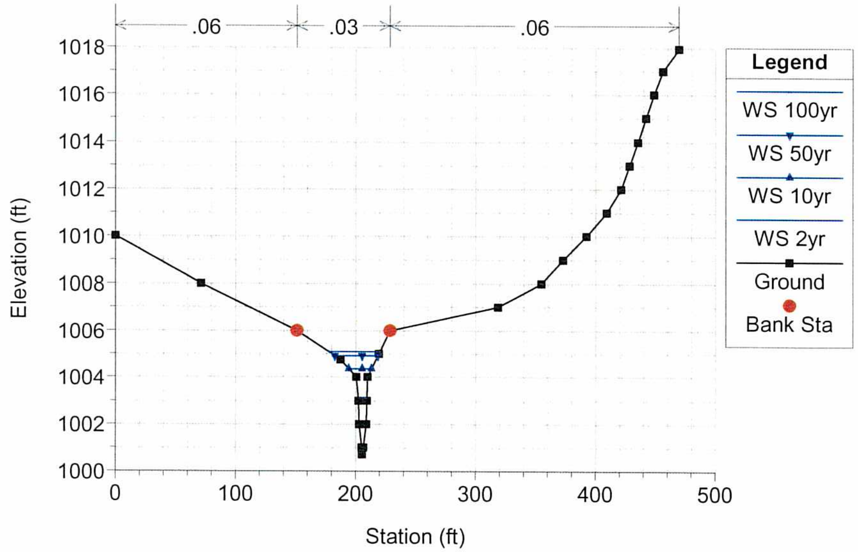
Tributary P-3 to Prairie Lee Lake
HEC-RAS Calculations
March 18, 2021




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
Main Channel Distance (ft)
RS 9890.22
RS 10097.67
RS 10280.58
RS 10495.32
RS 10658.06
RS 10856.09
RS 11086.04
RS 11275.44

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 = 11275.44   RS 11275.44



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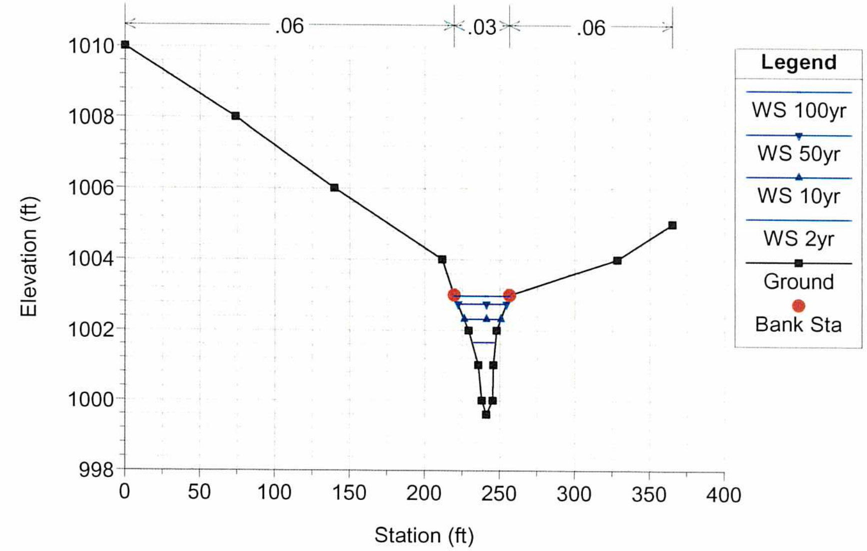
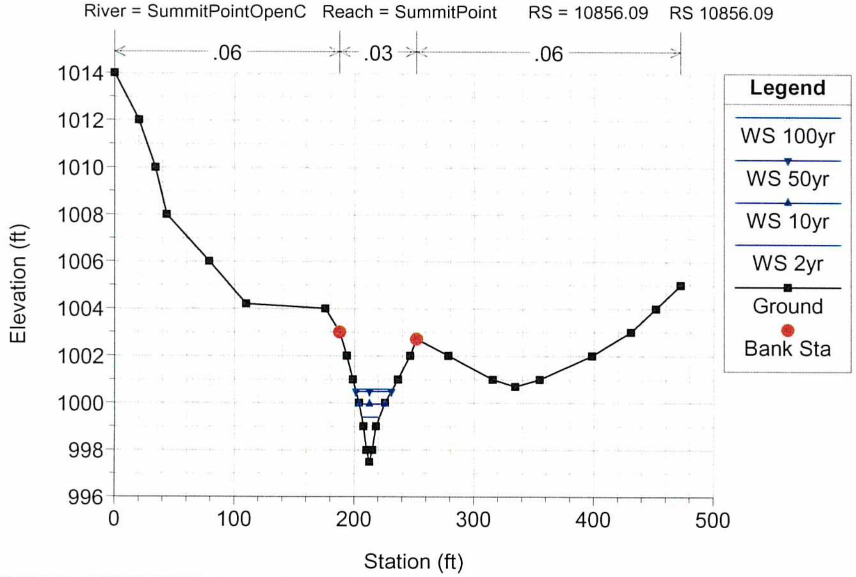


Pre-Dev Summit Point Phase-II   Plan: Summiit Point Exist Creek   3/10/2021
River = SummitPointOpenC   Reach = SummitPoint   RS = 10856.09   RS 10856.09



Pre-Dev Summit Point Phase-II   Plan: Summiit Point Exist Creek   3/10/2021
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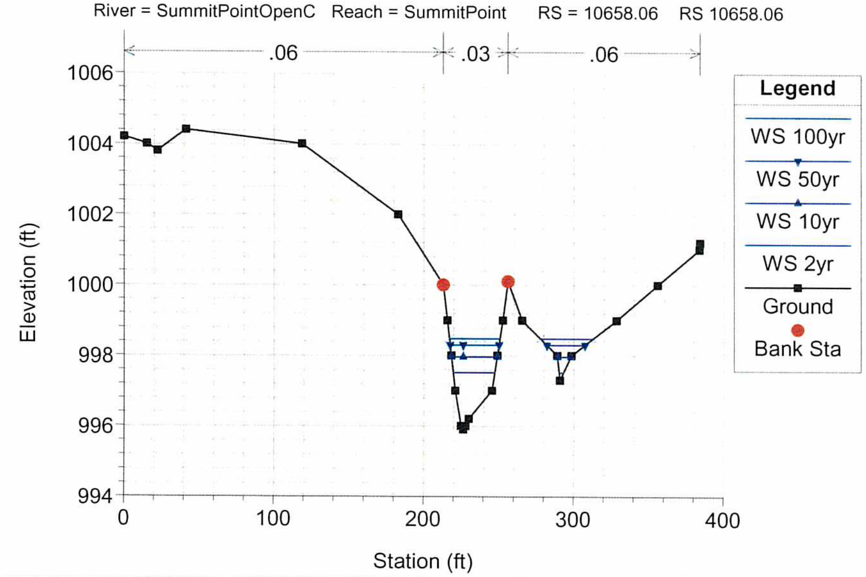
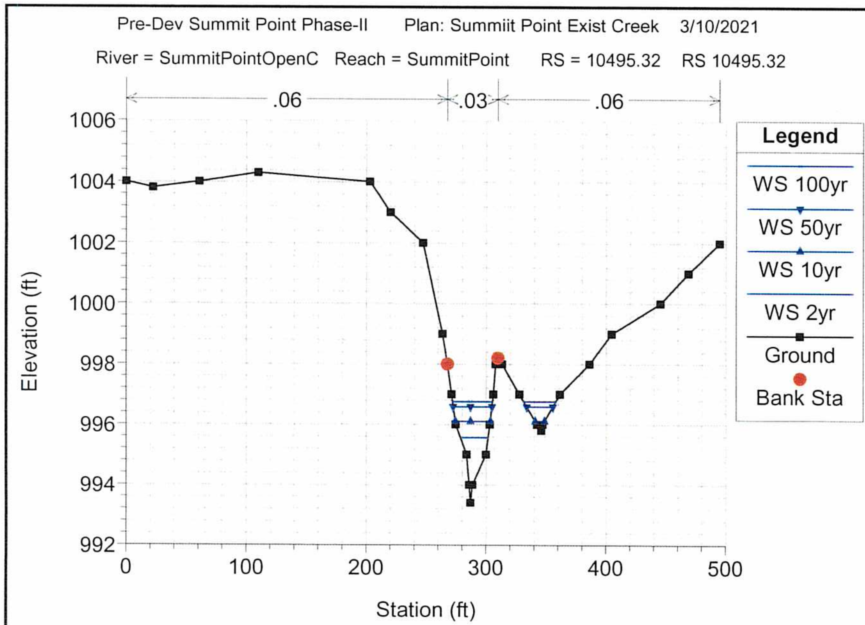
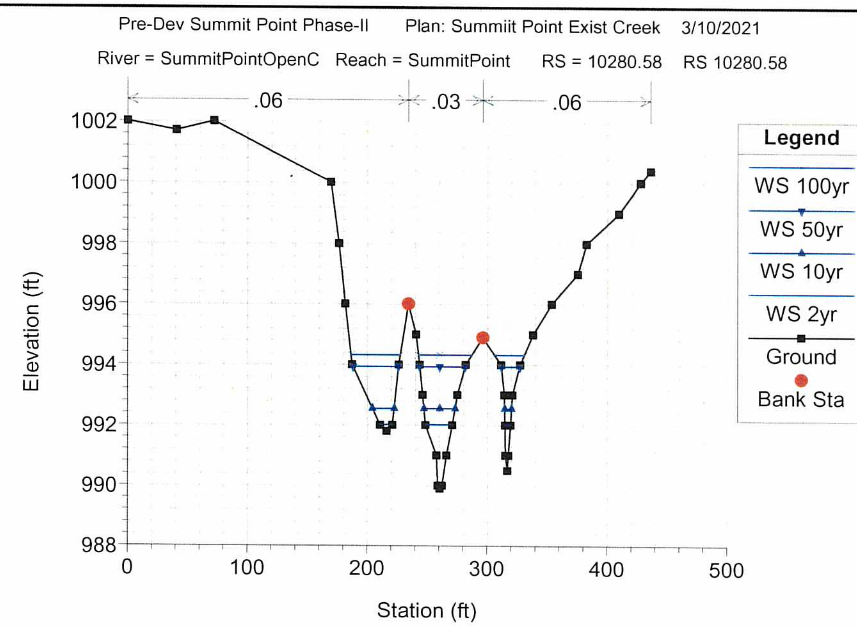
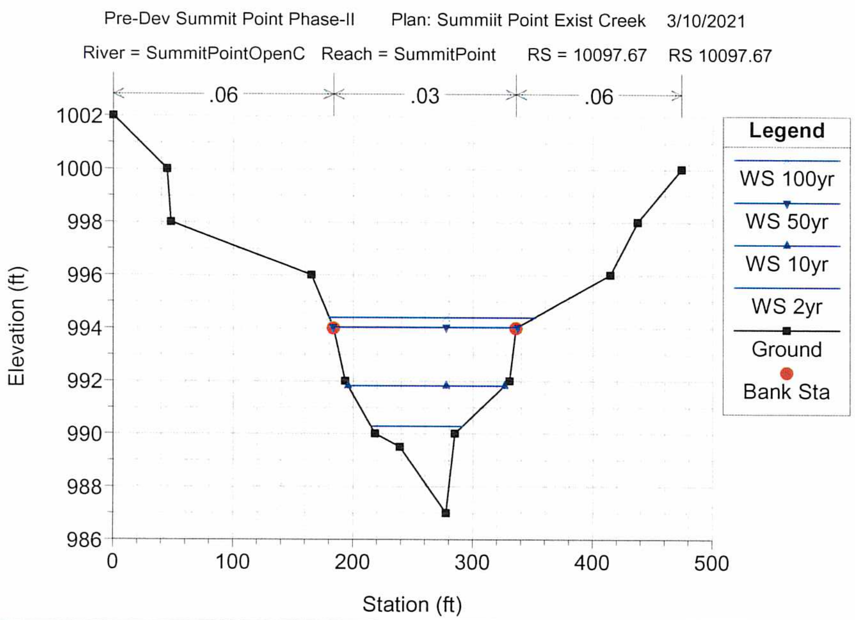
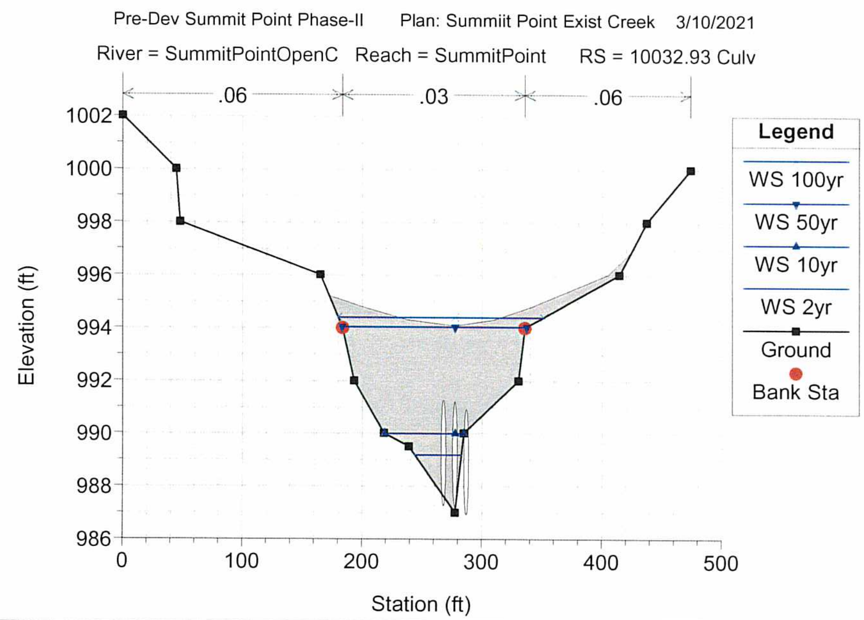
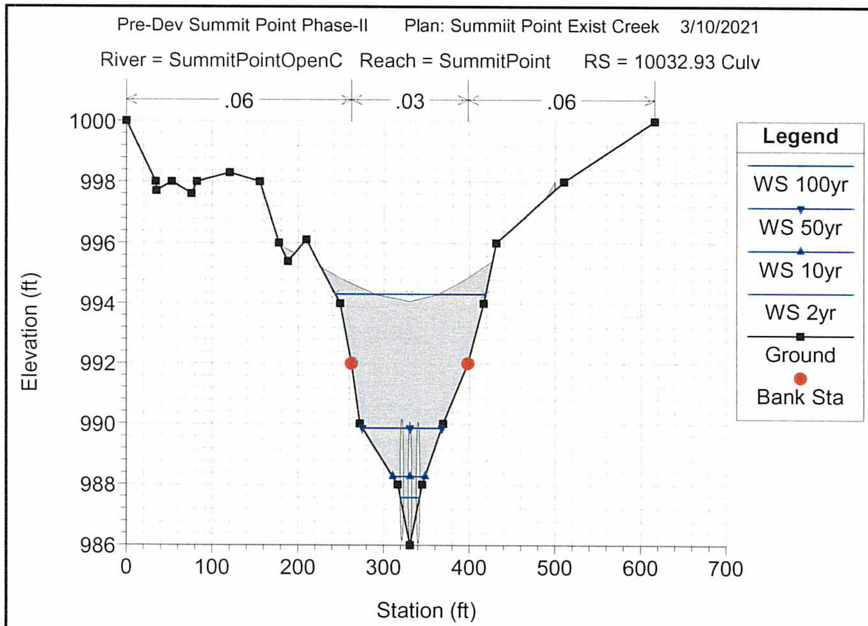


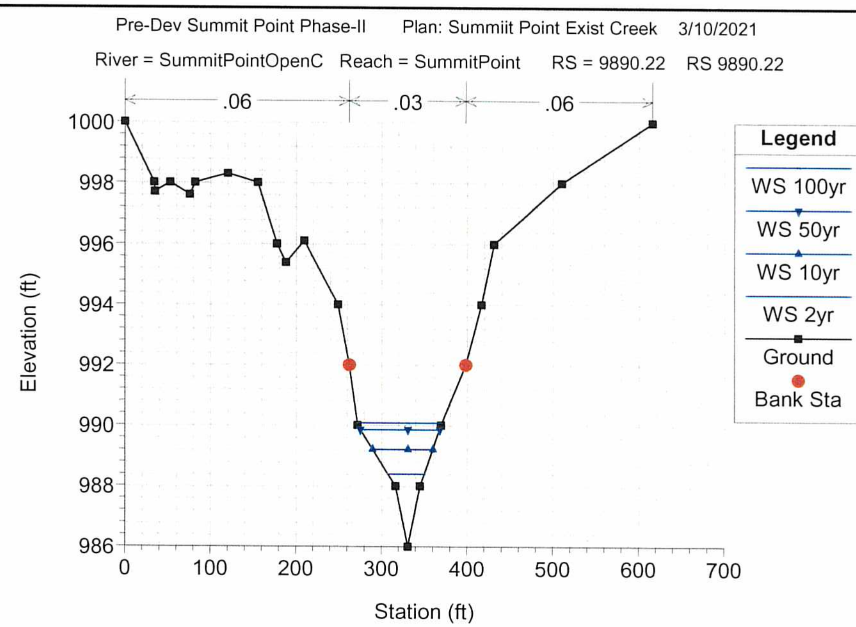

Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10495.32 RS 10495.32
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta

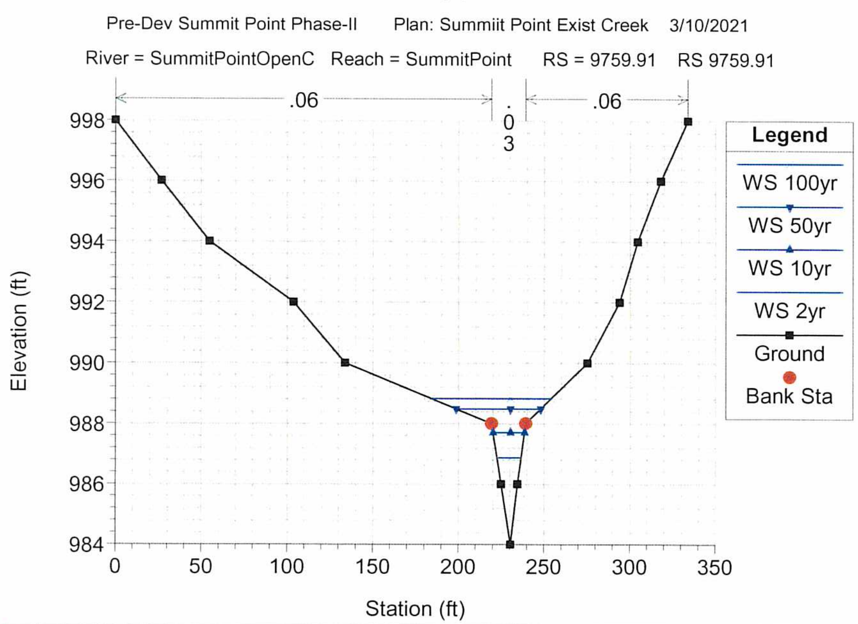

Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10280.58 RS 10280.58
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta


Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10097.67 RS 10097.67
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta

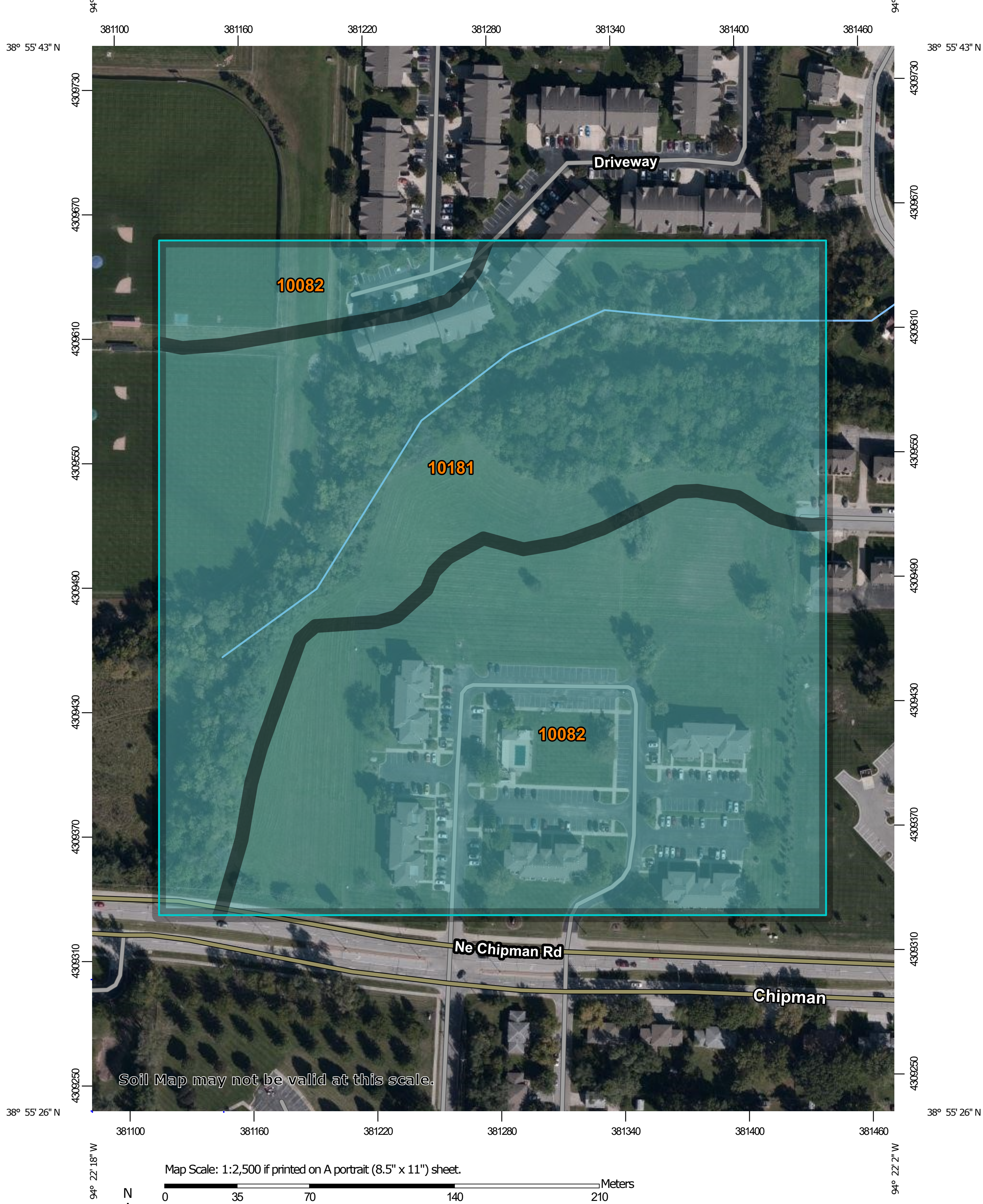

Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10032.93 Culv
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100yr
WS 50yr
WS 10yr
WS 2yr
Ground
Bank Sta


Pre-Dev Summit Point Phase-II Plan: Summiit Point Exist Creek 3/10/2021
River = SummitPointOpenC Reach = SummitPoint RS = 10032.93 Culv
.06
.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 = 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
.03
.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.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

N

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.

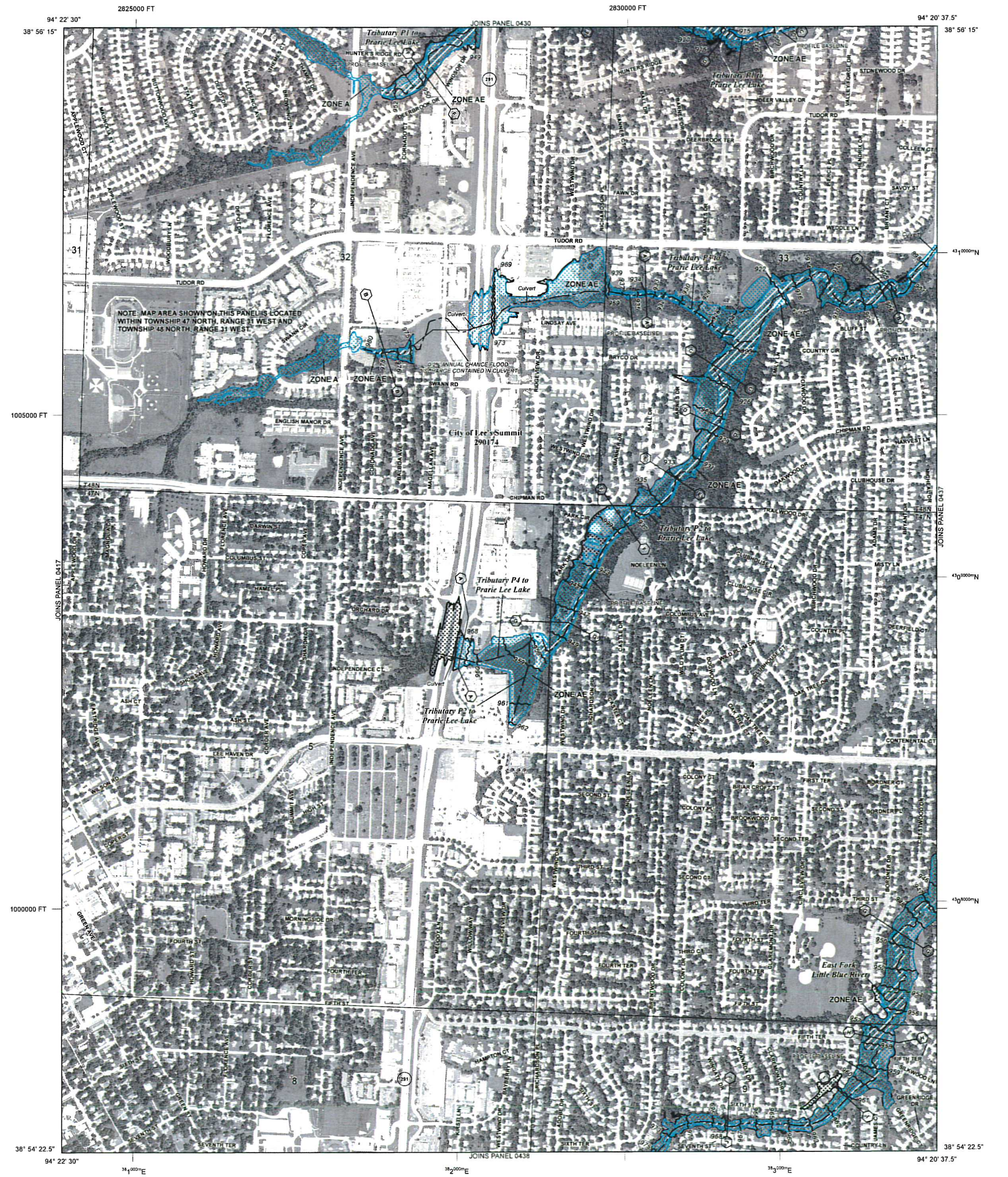
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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.

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

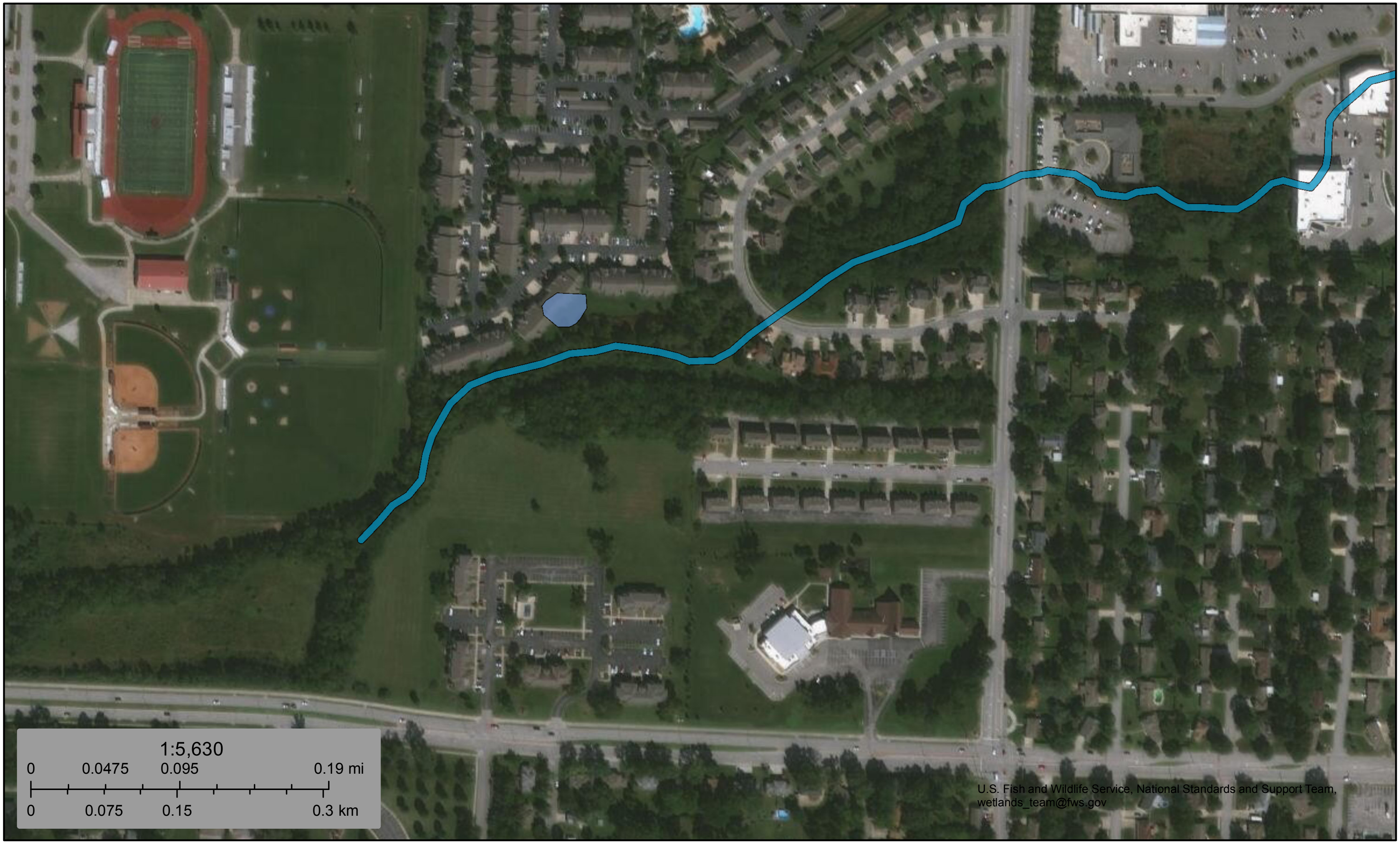
MAP REVISED
JANUARY 20, 2017

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.