

Summit Point Apartments, Phase-II
504 NE Chipman Road
Lee's Summit, Missouri 64063
CFS Project No. 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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February 18, 2021

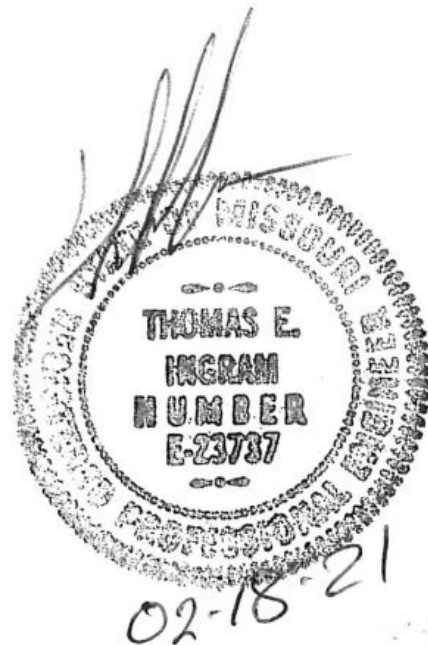


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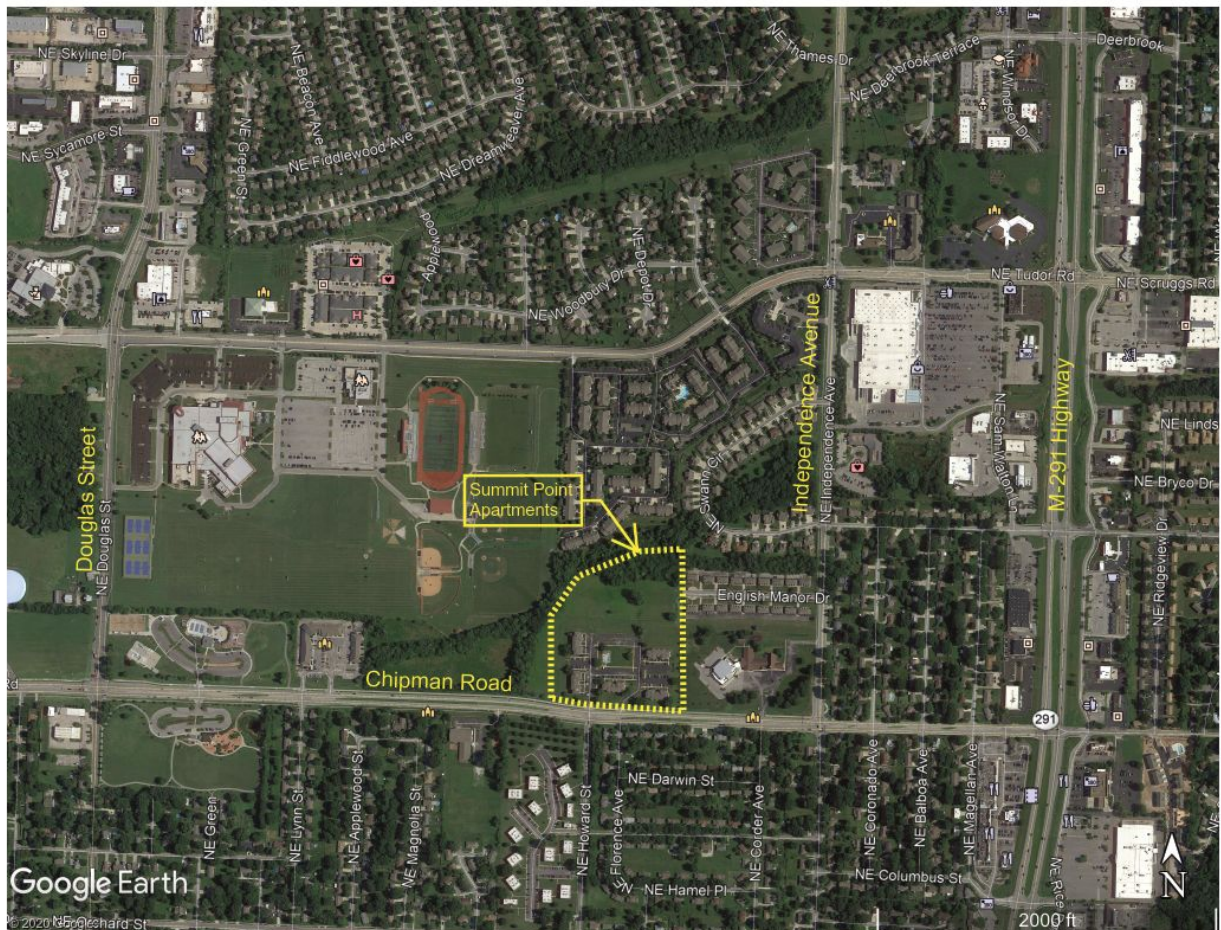
Appendix A: Preliminary Site and Grading Plans

Appendix B: PondPack Stormwater Drainage Calculations (2, 10 and 100-Year Storms)

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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 two open-graded detention basins along the north side 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 a 100 ft setback from the existing creek ordinary high water level, with the exception of stormwater detention basins.

General Information:

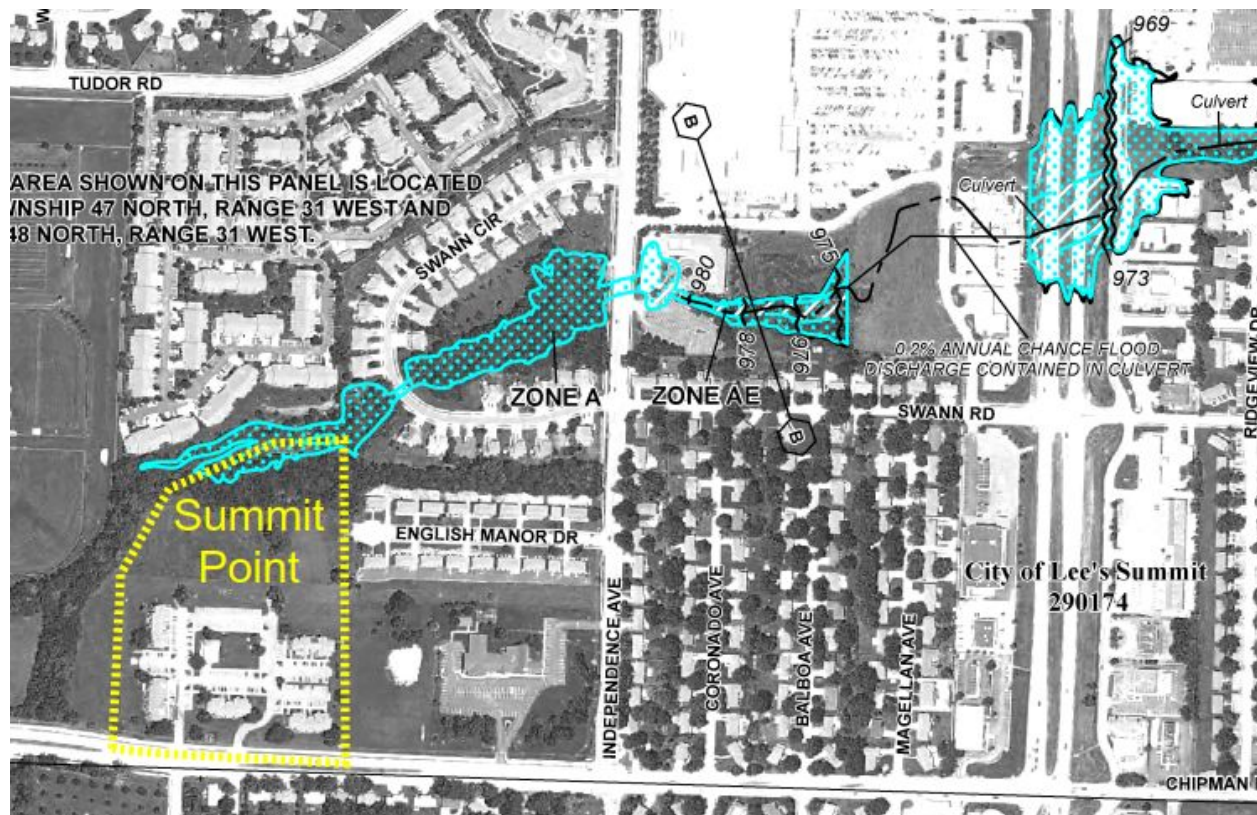
The proposed Phase-II addition to the existing Summit Point Apartments would be constructed on the 7.21 acre parcel located directly north of the existing apartment complex. The proposed Phase-II site is completely undeveloped. The site slopes downwards to the north where an existing creek (Tributary 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 proposed East Stormwater Detention basin on the Phase-II site has a bottom elevation of approximately 992', and it was assumed that backwater from a 100-year storm would have minimal impact on the free outfall of drainage from the proposed detention basin. The proposed apartment buildings were placed outside of the 100 ft stream setback along the existing Tributary P3 to Prairie Lee Lake, and portions of the grading for the proposed East and West Stormwater Detention basins were located within the stream setback.

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.



April 6, 2020

Wetlands

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

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

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 east and west stormwater detention basins were measured at one foot intervals to derive stage versus storage curves for performing stormwater routing. Complex outlet structures consisting of circular orifices and rectangular overflow weirs were modeled to create stage versus discharge curves for both the east and west detention basins. 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 is completely undeveloped. The Phase-I apartments to the south were built in the 1980's and are completely developed. The 6.49 acres of the Phase-I site drain directly onto the 7.21 acre Phase-II site. There was no other off-site drainage flowing onto the Phase-I site since Chipman Road catches and conveys drainage from the area further to the south. The 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. Runoff from the central portion of the Phase-I site was channeled onto the surface of the Phase-II site through the existing driveway stubs ending at the north boundary line, where runoff simply discharged onto the ground and flowed northwards overland towards the existing creek.

The total tributary drainage area to the existing creek identified as Tributary P3 to Prairie Lee Lake on the FEMA map was estimated at approximately 116 acres as the creek flows eastwards past the northeast property corner of the Phase-II site. The SCS Curve Number was estimated at 80.7 with a time of concentration of approximately 22.6 minutes. A Manning's roughness coefficient of $n = 0.035$ was used for the irregular creek bed. The existing stream bed slope was estimated at approximately 1.1% and the flowline elevation by the northeast property corner

was approximately 998.35'. The following table summarizes the flows, depths and velocities of the existing creek by the northeast corner of the Phase-II site:

**Flow Characteristics of the Existing Tributary P3 to Prairie Lee Lake
by the Northeast Corner of Proposed Summit Point Phase-II Apartments**

Storm Frequency	Flow	Velocity	Depth	Flowline	WSEL
10% (10-Year)	414 cfs	5.70 cfs	3.24'	989.25'	992.49'
2% (50-Year)	629 cfs	6.05 cfs	3.82'	989.25	993.07'
1% (100-Year)	727 cfs	6.30 cfs	3.97'	989.25'	993.22'

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 two new open-graded stormwater detention basins to provide detention for the new site and also 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

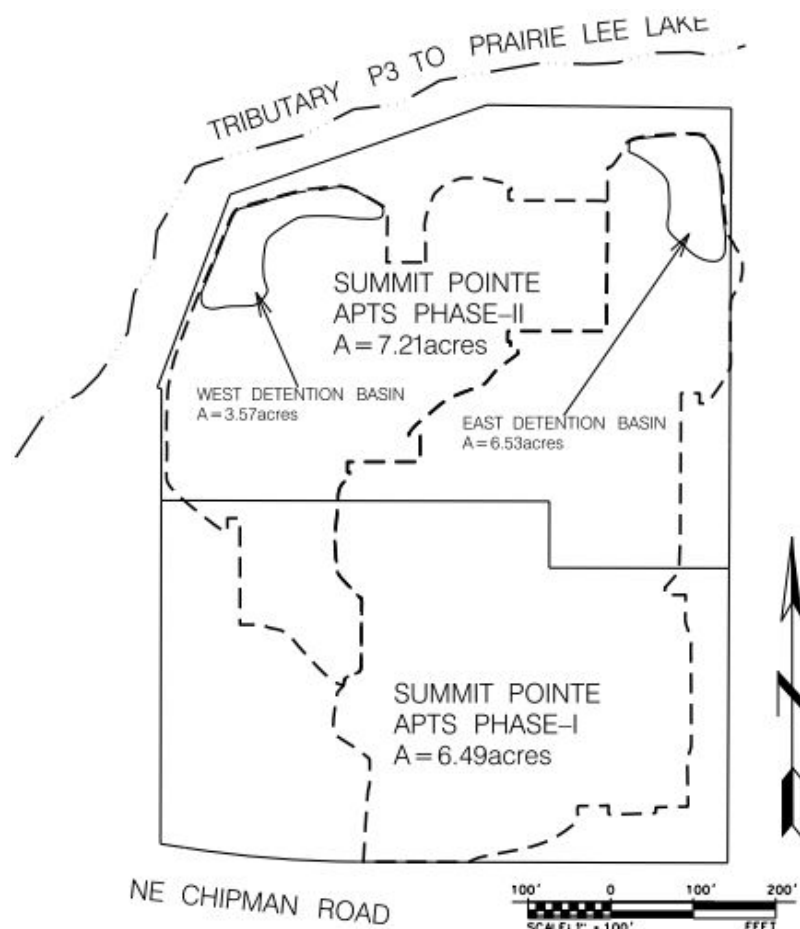
The 1% (100-year Storm) would be limited to 3.0 cfs per acre.

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

Using the 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 total area of 6.49 acres with an SCS Curve Number of CN = 86.1 and a time of concentration of $T_c = 11.58$ minutes. The calculated flow rates from Phase-I at the POI were 20.34 cfs, 34.42 cfs and 56.78 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 Phase-I Runoff	Allowable Phase-II Runoff	Composite Allowable Release Rate
10% (10-Year)	20.34 cfs	3.61 cfs	23.95 cfs
2% (50-Year)	34.42 cfs	14.42 cfs	48.84 cfs
1% (100-Year)	56.78 cfs	21.63 cfs	78.41 cfs



POST-DEVELOPMENT STORMWATER DRAINAGE MAP

Stormwater detention for the post-development Phase-II site would be provided with two open-graded detention basins along the north side of the site. The West stormwater detention basin would have a bottom elevation of approximately 996.00', and a top of impoundment dam elevation of approximately 1002.00' with full storage capacity was estimated at approximately 0.856 ac-ft. Approximately 2.91 acres at CN = 88.3 of the Phase-II on-site drainage would flow into the West pond along with approximately 0.66 acres at CN = 88.9 of contributing drainage from the Phase-I off-site area.

The East stormwater detention basin would have a bottom elevation of approximately 992.00', and a top of impoundment dam elevation of approximately 1002.00' with full storage capacity was estimated at approximately 1.052 ac-ft. Approximately 3.01 acres at CN = 88.1 of the Phase-II on-site drainage would flow into the East pond along with approximately 3.52 acres at CN = 88.6 of contributing drainage from the Phase-I off-site area.

Approximately 1.29 acres of the Phase-II site would be undetained, consisting of areas along the east, west and northern sides of the development that would be too low to be caught by the proposed storm sewer system. Approximately 2.31 acres of the Phase-I site would be undetained and by-passing the proposed Phase-I storm sewer collection system.

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. A hydrologic model of the on-site Phase-II drainage areas flowing to the east and west detention basins along with the undetained area was created to measure the total volume of runoff from the 1.37" BMP/90th percentile annual storm event. The following table summarizes the drainage areas and runoff volumes:

Water Quality Volume Computations for Summit Point Apartments Phase-II

Drainage Basin	Area	SCS Curve Number	1.37" Runoff Volume
Ph-II West Detention Basin	2.91 acres	88.3	0.121 ac-ft
Ph-II East Detention Basin	3.01 acres	88.1	0.124 ac-ft
Ph-II Undetained Area	1.29 acres	79.5	0.020 ac-ft
Totals	7.21 acres		0.265 ac-ft

Storage of the required water quality volume was divided between the East and West Detention basins. The east pond had an overall contributing drainage area of approximately 6.53 acres or 64.65% of the total detained drainage area, and the west pond had an overall contributing drainage area of approximately 3.57 acres or 35.35% of the total detained drainage area. Based on these percentages, the east pond was analyzed to hold approximately 0.171 ac-ft of water quality volume storage and release it over a 40-hour extended period. The estimated WSEL was approximately 996.33', and a 1" diameter outlet orifice was sized for the extended release of the runoff. In addition to the 1" diameter orifice, a 15" diameter orifice at FL = 996.50', a 24" orifice at FL = 998.50', a 30' wide overflow weir at threshold elevation 1001.90', and the top of dam at 1003.70'. A summary of the stormwater routing characteristics for the east detention basin has been tabulated below:

East Stormwater Detention Basin Routing Summary

Storm Frequency	Peak Inflow	Peak Outflow	Peak WSEL	Peak Storage
50% (2-Year)	23.10 cfs	13.94 cfs	999.01'	0.476 ac-ft
10% (10-Year)	38.19 cfs	25.42 cfs	1000.08'	0.650 ac-ft
1% (100-Year)	61.90 cfs	47.49 cfs	1001.28'	0.888 ac-ft
90th % Annual Rainfall (1.37")	4.95 cfs	0.06 cfs	996.85'	0.216 ac-ft

The west pond was analyzed to hold approximately 0.094 ac-ft of water quality volume storage and release it over a 40-hour extended period. The estimated WSEL was approximately 997.81', and a 1" diameter outlet orifice was sized for the extended release of the runoff. In addition to the 1" diameter orifice, a 12" diameter orifice at FL = 998.00', an 18" orifice at FL = 999.25', a 20' wide overflow weir at threshold elevation 1001.70', and the top of dam at 1003.40'. A summary of the stormwater routing characteristics for the east detention basin has been tabulated below:

West Stormwater Detention Basin Routing Summary

Storm Frequency	Peak Inflow	Peak Outflow	Peak WSEL	Peak Storage
50% (2-Year)	12.63 cfs	6.17 cfs	999.34'	0.288 ac-ft
10% (10-Year)	20.89 cfs	12.70 cfs	1000.04'	0.409 ac-ft
1% (100-Year)	33.85 cfs	21.63 cfs	1000.77'	0.557 ac-ft
90th % Annual Rainfall (1.37")	2.71 cfs	0.04 cfs	998.03'	0.113 ac-ft

The combined outflows from the east and west detention basins and the undetained drainage area from the post-development conditions was tabulated and compared to the allowable release rate from the combined Phase-I and Phase-II sites as follows:

Allowable Release Rates Versus Post-Development Runoff Rates

Storm Frequency	Allowable Release Rate	Total Post-Development Release Rate
50% (2-Year)	23.95 cfs	24.37 cfs
10% (10-Year)	48.84 cfs	48.53 cfs
1% (100-Year)	78.41 cfs	84.00 cfs

In order to evaluate the water surface elevations of stormwater in the existing creek channel along the north side of the proposed Summit Point Apartments, Phase II site, CFS Engineers created a HEC-RAS model to simulate the hydraulics during design storms ranging from 2 to 500-year frequencies. The existing creek is called Tributary P3 to Prairie Lee Lake by FEMA on the recent FIRM flood map of the region. Stream flows were determined using the USGS's StreamStat web-based hydrologic stream flow calculator. Channel cross-sections for the HEC-RAS models were cut across the digital ground surface, based on a recent topographic field survey of the site done by CFS Engineers. Based on the HEC-RAS model of the existing channel, the stormwater flow from a 100-year storm does not extend beyond the channel banks and is consistent with the FEMA flood map.



Summit Point Apartments, Phase-II, Preliminary Stormwater Report

Tributary P3 to Prairie Lee Lake along the North Side of Summit Point Apts, Phase-II

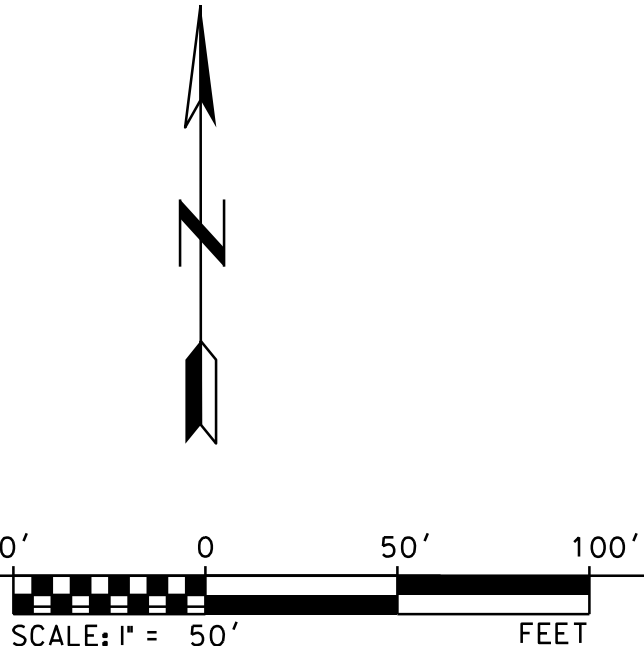
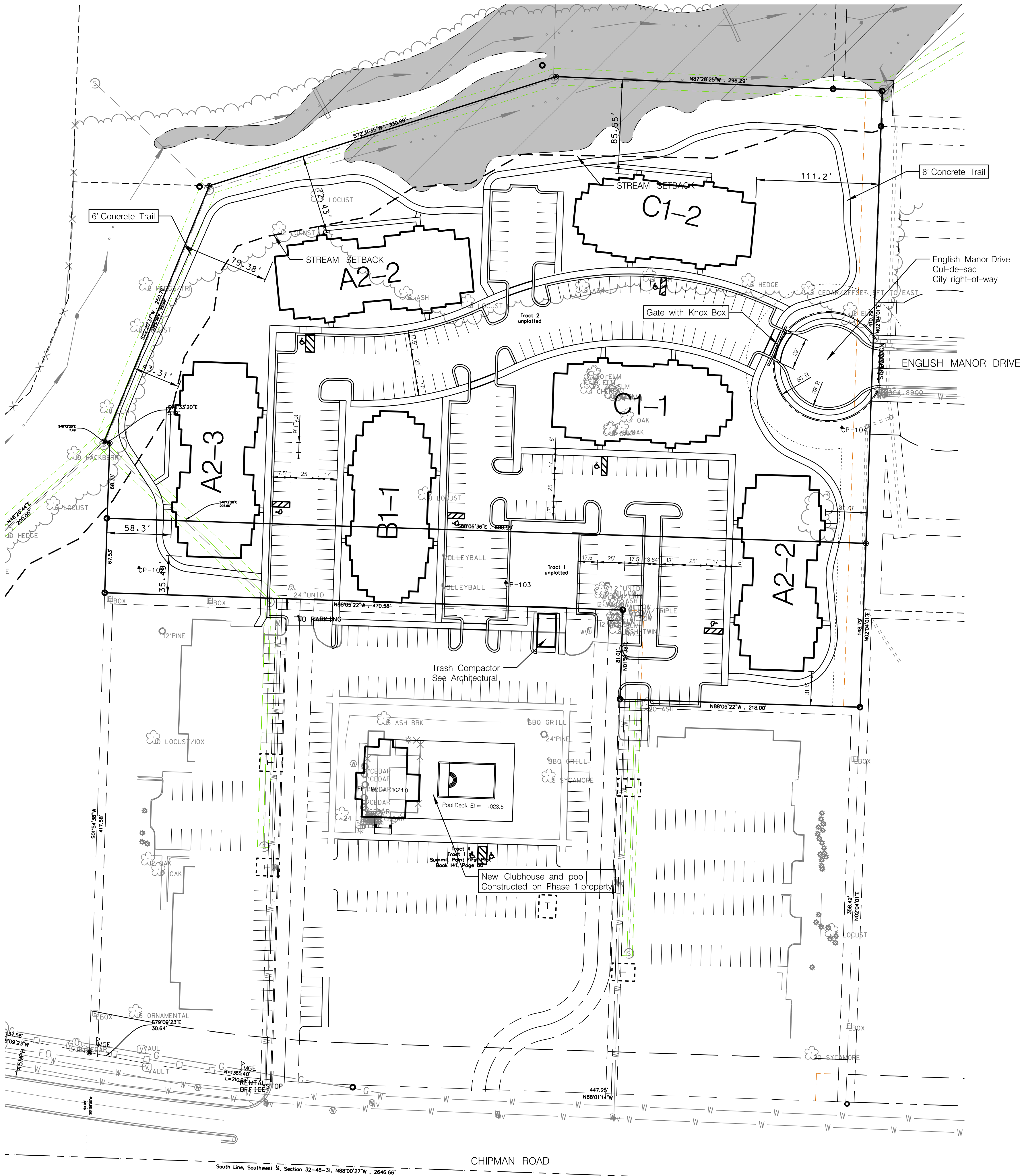
Storm Frequency	RS 11275.44	RS 11086.04	RS 10856.09	RS 10658.06	RS 10495.32	RS 10280.58
2-Yr Q	93 cfs	93 cfs	93 cfs	105 cfs	105 cfs	110 cfs
100-Yr Q	513 cfs	513 cfs	513 cfs	574 cfs	574 cfs	602 cfs
Channel FL	1000.7	999.6	997.5	995.9	993.4	989.9
2-Yr WSEL	1003.65	1001.44	998.64	997.45	995.49	991.85
2-Yr Depth	2.95	1.84	1.14	1.55	2.09	1.95
100-Yr WSEL	1005.79	1003.47	1000.57	998.93	997.21	993.47
100-Yr Depth	5.09	3.87	3.07	3.03	3.81	3.57
T/ Creek Bank	1,006.0	1,004.0	1,002.7	1,000.1	998.2	994.9

The proposed Summit Point Phase II development would provide stormwater detention in accordance with the City of Lee's Summit's requirements, so that the proposed development would not negatively impact Tributary P3 to Prairie Lee Lake and the existing downstream stormwater drainage system.

Conclusions:

For preliminary evaluation and sizing of the stormwater detention system for the proposed Phase-II Addition of the Summit Point Apartments, the post-development release rates are very close to complying with the required allowable release rates. The depth of water in the existing creek along the northern side of the property was less than 4 ft deep in the 100-year and lesser storms indicating that back-up and overflow effects onto the proposed site and open-graded stormwater detention basins should be minimal. 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. At final design, the stormwater detention system would be modified and revised to meet the City's allowable peak outflow requirements.

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



CFS ENGINEERS
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Rev.	Date	By	Description	Appr.
1	05/25/2015	SCS	Initial Design	
2	06/01/2015	SCS	Revised Design	
3	06/01/2015	SCS	Final Design	
4	06/01/2015	SCS	Final Design	
5	06/01/2015	SCS	Final Design	
6	06/01/2015	SCS	Final Design	
7	06/01/2015	SCS	Final Design	
8	06/01/2015	SCS	Final Design	
9	06/01/2015	SCS	Final Design	
10	06/01/2015	SCS	Final Design	

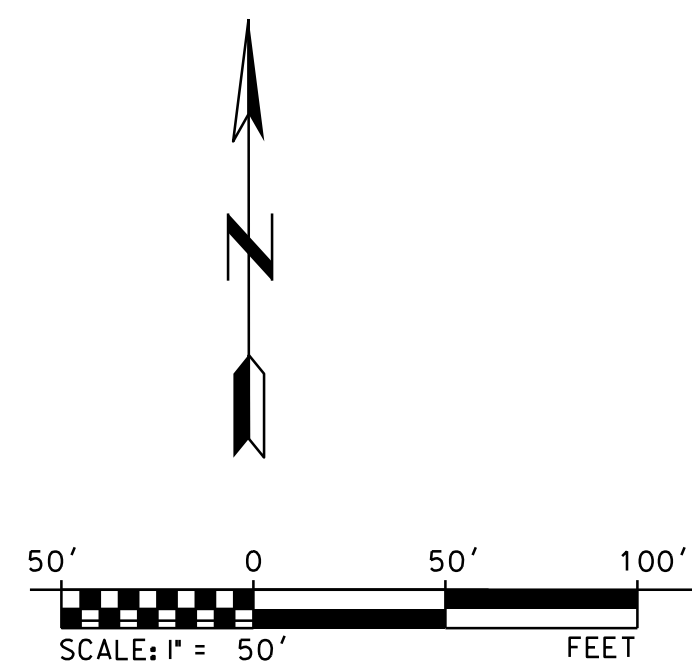
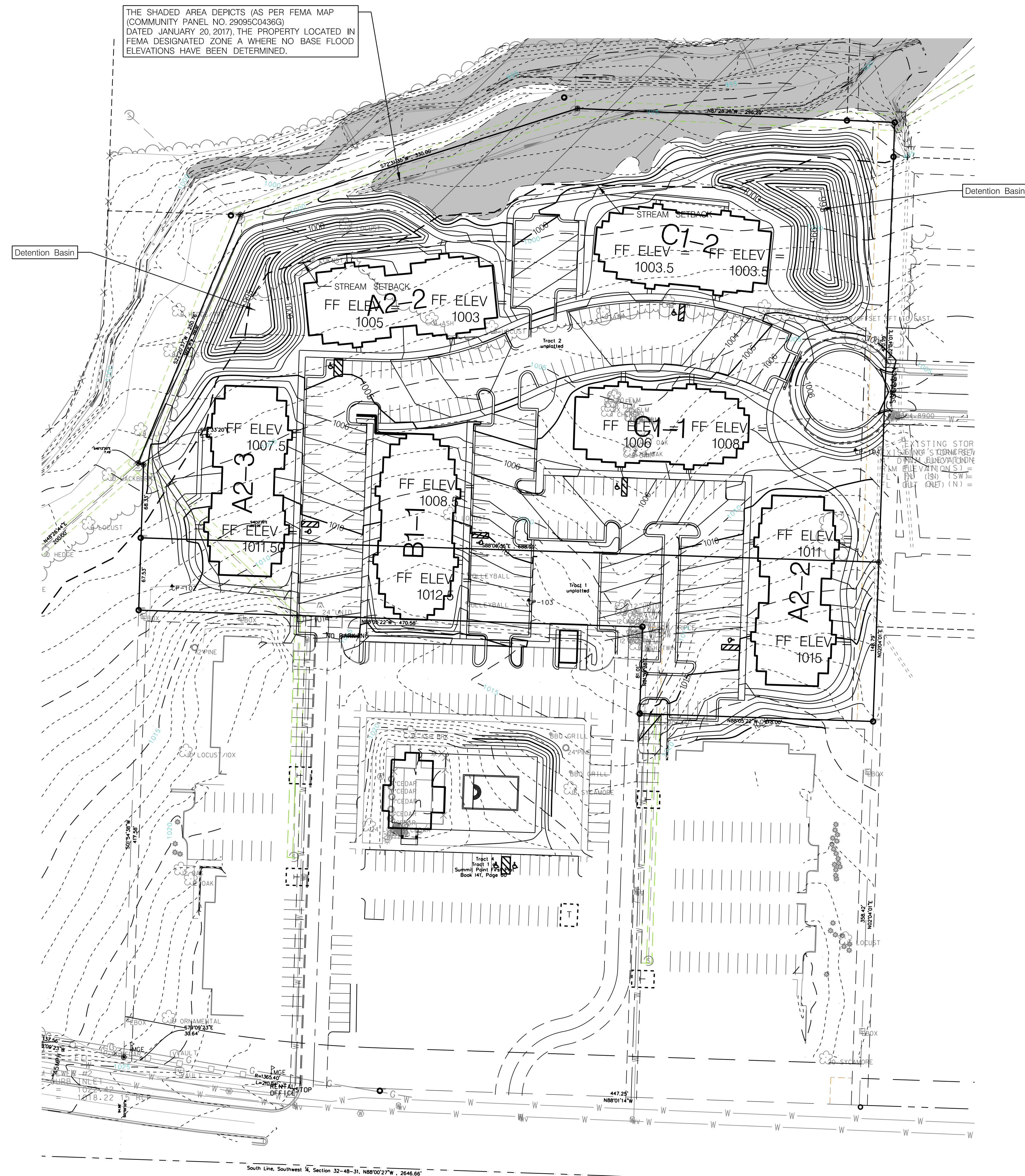
SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

Preliminary Development Plan

SITE PLAN

Sheet reference number:
C3

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



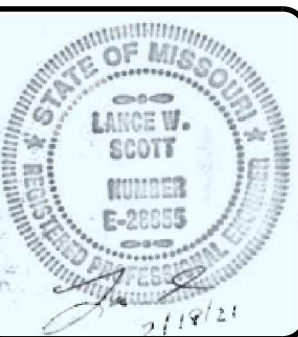
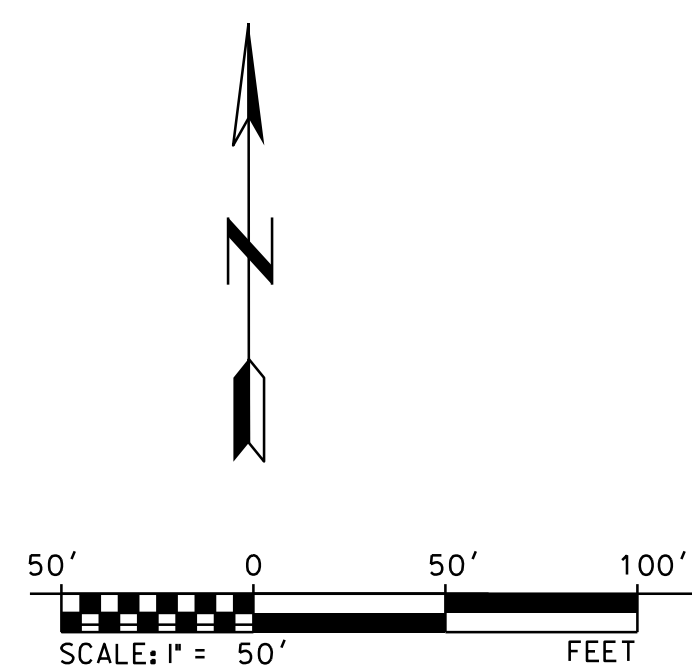
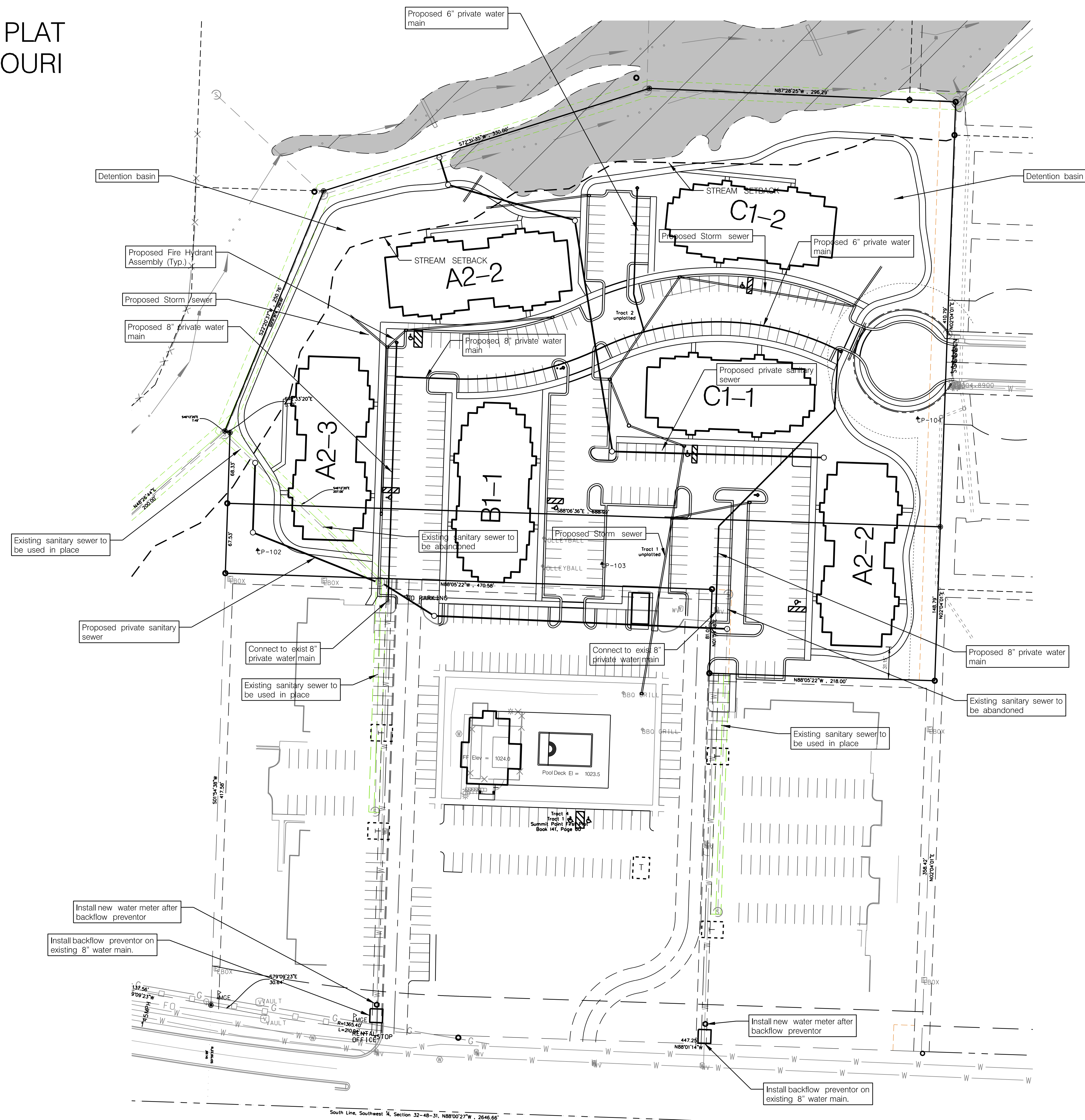
				CITY SUBMITTAL	02/18/21	

Run by: RP	Ckd by: LWS	Reviewed by: ---
Submitted by: ---		Plot scale: 1:50
File name: 25065-ST-SH-GradingPlan.dgn		

304 NE Chippawan Road
Lee's Summit, Missouri

Preliminary Development Plan

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

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RP	Turn by: RP	Card by: LWS	Reviewed by: ---	03-25-2015	Rev.:
Submitted by: ---			Plot scale: 1:60		
Preliminary Development Plan SUMMIT POINT 504 NE Crispman Road Lee's Summit, Missouri					
File name: 25065-ST-UtilityPlan.dgn Plot date: 18/2021 3:05:32 PM					

UTILITY PLAN

Sheet
reference
number:

C5

PRELIMINARY PLAN
SUMMIT POINT
LEE'S SUMMIT, MISSOURI

LEGAL DESCRIPTION:
A tract of land in the Southwest Quarter of Section 32, Township 48N,
Range 31W in Lee's Summit, Jackson County, Missouri, described as follows:

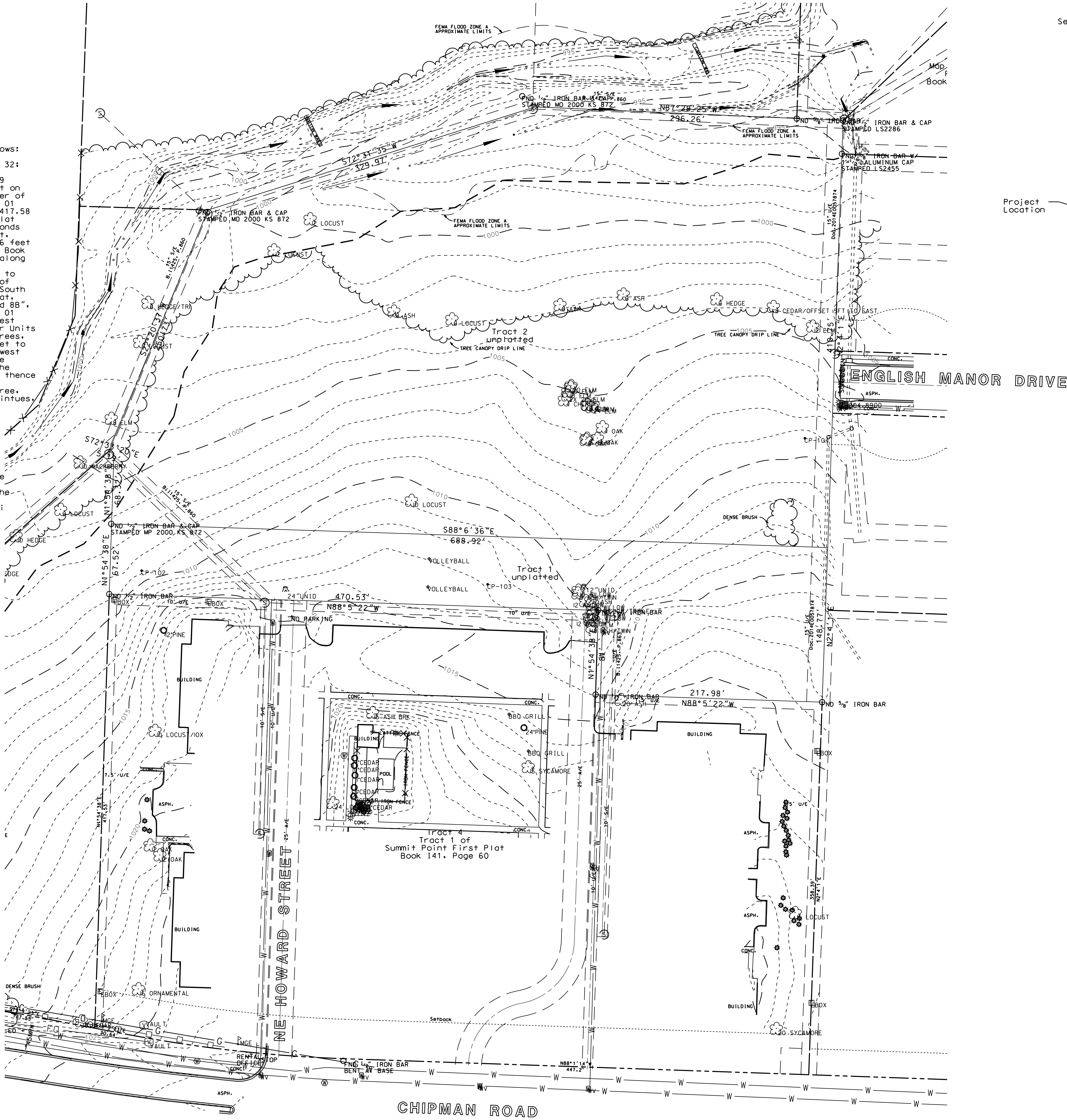
Commencing at the Southwest corner of the Southwest Quarter of Section 32; thence North 88 degrees, 00 minutes, 27 seconds West, along the South line of the Southwest Quarter, 1525.38 feet; thence North 01 degree, 59 minutes, 33 seconds East, leaving the South line, 97.98 feet to a point on the existing North right-of-way of Chipman Road and the Southwest corner of "Summit Point First Plat" recorded in Book 41 at Page 60; thence North 01 degree, 54 minutes, 38 seconds East, along the West line of the plat, 417.58 feet (measured) (420.12 feet, plat) to the Northwest corner of the plat; and the Point of Beginning; thence North 01 degree, 54 minutes, 38 seconds East, 135.86 feet; thence North 72 degrees, 33 minutes, 20 seconds West, 5.19 feet; thence North 22 degrees, 20 minutes, 37 seconds East, 250.76 feet to a point on the South line of "A.M.L. Summit Ridge Lot 1", recorded in Book 166 at Page 48; thence North 72 degrees, 31 minutes, 35 seconds East, along the South line of the plat, 330.00 feet; thence South 87 degrees, 28 minutes, 25 seconds East, continuing along the South line, 251.73 feet to the Southeast corner of the plat, also being a point on the West line of "Maple Tree Manor First Plat" recorded in Book 160 at Page 59; thence South 87 degrees, 28 minutes, 25 seconds East, along the West line of the plat, 44.56 feet to a point on the West line of "Maple Tree Manor, Lot 8A and 8B", recorded in Book 1116 at Page 85; thence South 02 degrees, 04 minutes, 01 second West, along the West line of the plat, 32.10 feet to the Southwest corner of the plat and the Northwest corner of "Replat of English Manor Units 41-72 Inclusive", recorded in Book 149 at Page 13; thence South 02 degrees, 04 minutes, 01 second West, along the West line of the plat, 439.00 feet to the Southwest corner of the Southwest quarter of the plat and the Northwest corner of "St. Matthews Acres", recorded in Book 39 at Page 160; thence South 02 degrees, 04 minutes, 01 second West, along the West line of the plat, 88.48 feet to the Northeast corner of "Summit Point First Plat"; thence along the North line of the plat the following three courses: North 88 degrees, 05 minutes, 22 seconds West, 218.00 feet; thence North 01 degree, 54 minutes, 38 seconds East, 81.01 feet; thence North 88 degrees, 05 minutes, 22 seconds West, 470.58 feet to the Point of Beginning, containing 314,151.52 square feet or 7.21 acres, more or less.

GENERAL NOTES:

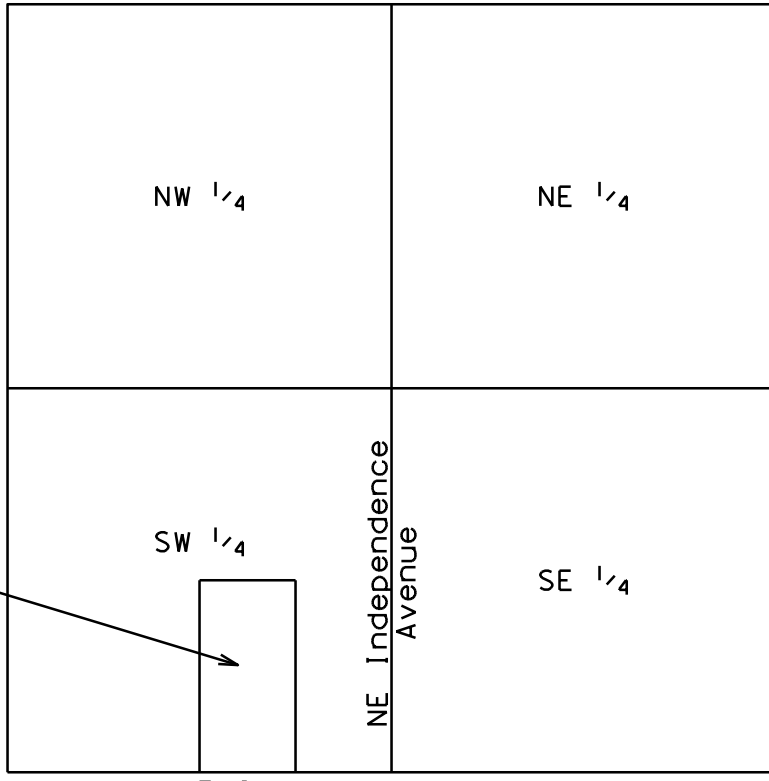
- The subject property lies within a Flood Zones Designated Zone (X) and Zone (A) per FEMA Map Community Panel Number 29095C04366, Map Revised January 20, 2017.
 - Zone (X): Areas determined to be outside the 0.2% annual change floodplain.
 - Zone (A): Special Flood Hazard Area subject to inundation by the 1% annual chance flood. No base flood elevation determined.
- Dimensions and coordinates shown hereon are based upon the Missouri State Plane Coordinate System, NAD83, Missouri West, US Foot.
 - Missouri Station JA-43 scale factor 0.9998981

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Section 32, Township 48 North, Range 31 West
Lee's Summit, Jackson County, Missouri
(not to scale)

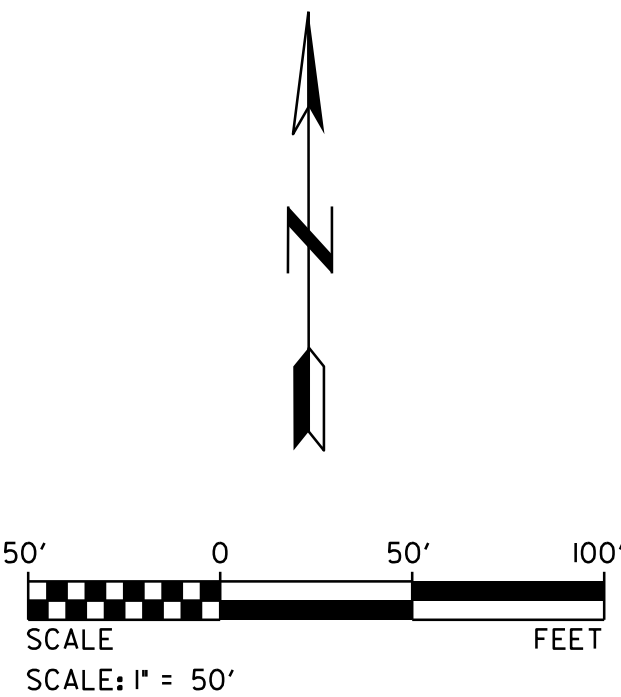


Project Location

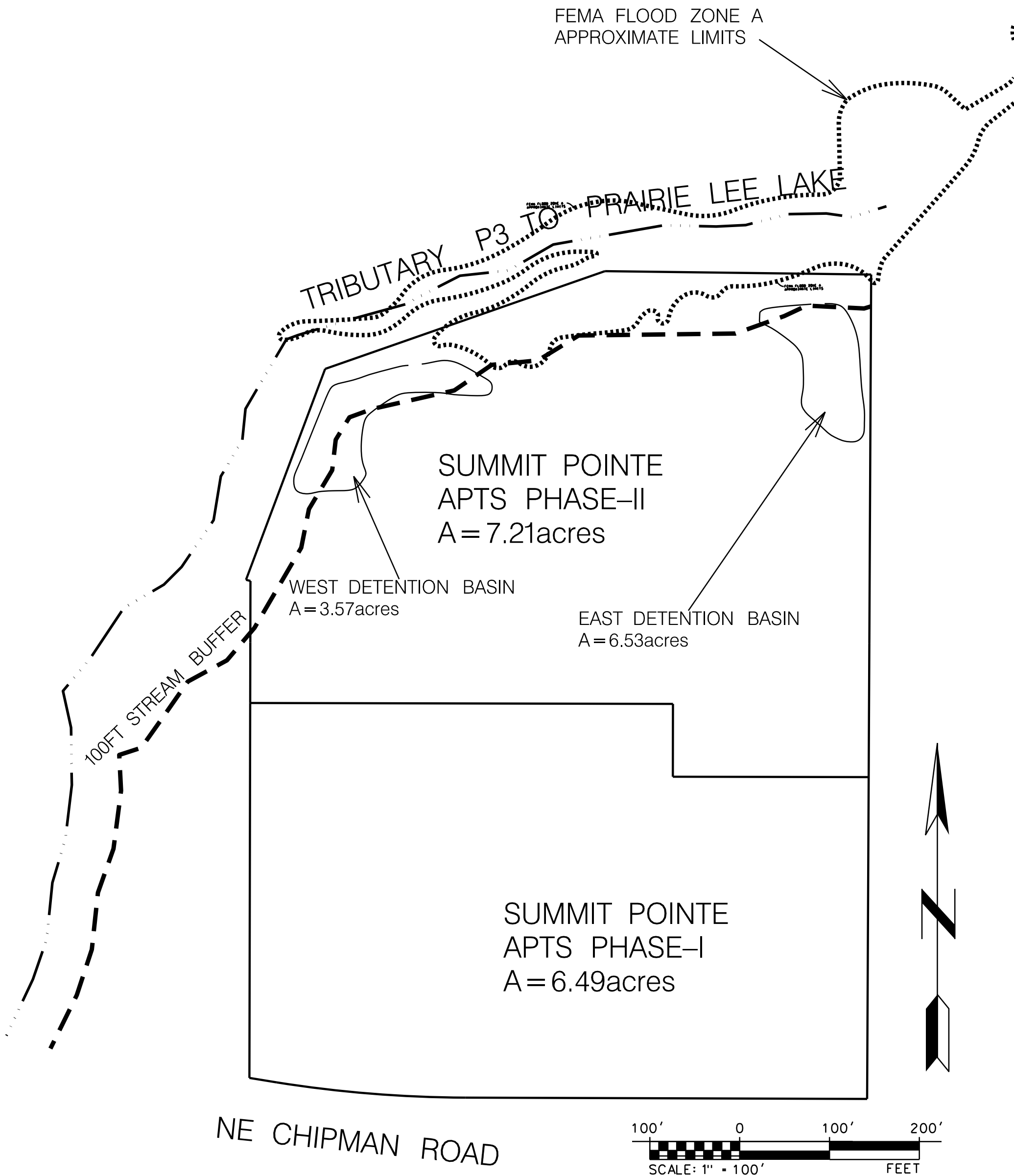
NE Independence Avenue

ENGLISH MANOR DRIVE

CHIPMAN ROAD

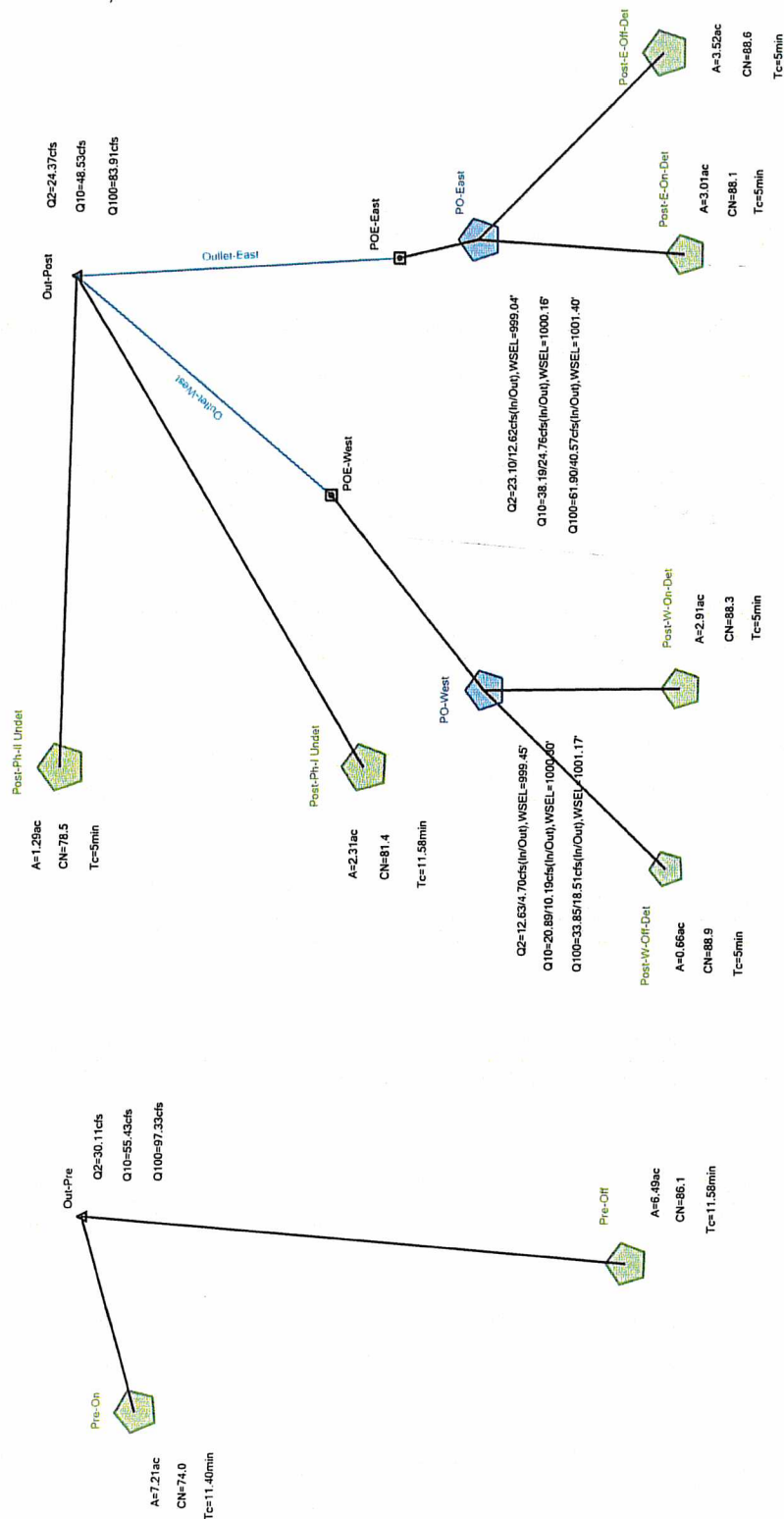


Sheet reference number: C2		Preliminary Plot		<table><tr><td colspan="2">SUMMIT POINT 504 NE Chipman Road Lee S Summit, Missouri</td><td>Designed by: RP</td><td>Date: 03-25-2005</td><td>Rev. -</td></tr><tr><td colspan="2"></td><td>Drawn by: LWS</td><td></td><td></td></tr><tr><td colspan="2"></td><td>Reviewed by: ---</td><td></td><td></td></tr><tr><td colspan="2"></td><td>Submitted by: ---</td><td>Plot scales 1/50</td><td></td></tr><tr><td colspan="2">Preliminary Development Plan</td><td colspan="3">File name:2185552-52-Preliminary Plan.dgn Plot date:04/16/2005 15:00:01 PM</td></tr></table>										SUMMIT POINT 504 NE Chipman Road Lee S Summit, Missouri		Designed by: RP	Date: 03-25-2005	Rev. -			Drawn by: LWS					Reviewed by: ---					Submitted by: ---	Plot scales 1/50		Preliminary Development Plan		File name:2185552-52-Preliminary Plan.dgn Plot date:04/16/2005 15:00:01 PM																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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POST-DEVELOPMENT STORMWATER DRAINAGE MAP

Scenario: Post-1yr



Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Post-W-On-Det	Post-2yr	2	0.566	11.900	10.26
Post-W-On-Det	Post-10yr	10	0.953	11.900	16.98
Post-W-On-Det	Post-90th% BMP	90	0.121	11.950	2.18
Post-W-On-Det	Post-100yr	100	1.585	11.900	27.55
Post-E-On-Det	Post-2yr	2	0.582	11.900	10.55
Post-E-On-Det	Post-10yr	10	0.982	11.900	17.51
Post-E-On-Det	Post-90th% BMP	90	0.124	11.950	2.23
Post-E-On-Det	Post-100yr	100	1.635	11.900	28.45
Pre-Off	Post-2yr	2	1.159	12.000	18.32
Pre-Off	Post-10yr	10	2.001	12.000	31.06
Pre-Off	Post-90th% BMP	90	0.221	12.050	3.35
Pre-Off	Post-100yr	100	3.391	12.000	51.24
Post-Ph-II Undet	Post-2yr	2	0.168	11.950	3.05
Post-Ph-II Undet	Post-10yr	10	0.319	11.900	5.79
Post-Ph-II Undet	Post-90th% BMP	90	0.020	12.000	0.30
Post-Ph-II Undet	Post-100yr	100	0.579	11.900	10.45
Pre-On	Post-2yr	2	0.763	12.000	11.79
Pre-On	Post-10yr	10	1.537	12.000	24.37
Pre-On	Post-90th% BMP	90	0.064	12.100	0.45
Pre-On	Post-100yr	100	2.920	12.000	46.09
Post-W-Off-Det	Post-2yr	2	0.132	11.900	2.38
Post-W-Off-Det	Post-10yr	10	0.220	11.900	3.90
Post-W-Off-Det	Post-90th% BMP	90	0.029	11.950	0.53
Post-W-Off-Det	Post-100yr	100	0.364	11.900	6.30
Post-E-Off-Det	Post-2yr	2	0.693	11.900	12.55
Post-E-Off-Det	Post-10yr	10	1.163	11.900	20.69
Post-E-Off-Det	Post-90th% BMP	90	0.151	11.950	2.72
Post-E-Off-Det	Post-100yr	100	1.928	11.900	33.46
Post-Ph-I Undet	Post-2yr	2	0.341	12.000	5.41
Post-Ph-I Undet	Post-10yr	10	0.623	12.000	9.83
Post-Ph-I Undet	Post-90th% BMP	90	0.050	12.050	0.69
Post-Ph-I Undet	Post-100yr	100	1.101	12.000	17.02

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Out-Pre	Post-2yr	2	1.922	12.000	30.11
Out-Pre	Post-10yr	10	3.538	12.000	55.43
Out-Pre	Post-90th% BMP	90	0.285	12.050	3.76
Out-Pre	Post-100yr	100	6.311	12.000	97.33
Out-Post	Post-2yr	2	2.170	12.050	24.37
Out-Post	Post-10yr	10	3.933	12.000	48.53
Out-Post	Post-90th% BMP	90	0.200	12.000	1.00

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Out-Post	Post-100yr	100	6.844	12.000	83.91

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)
PO-West (IN)	Post-2yr	2	0.698	11.900	12.63	(N/A)	(N/A)
PO-West (OUT)	Post-2yr	2	0.580	12.100	4.70	999.45	0.307
PO-West (IN)	Post-10yr	10	1.173	11.900	20.89	(N/A)	(N/A)
PO-West (OUT)	Post-10yr	10	1.050	12.050	10.19	1,000.30	0.460
PO-West (IN)	Post-90th% BMP	90	0.150	11.950	2.71	(N/A)	(N/A)
PO-West (OUT)	Post-90th% BMP	90	0.040	19.850	0.05	998.01	0.111
PO-West (IN)	Post-100yr	100	1.948	11.900	33.85	(N/A)	(N/A)
PO-West (OUT)	Post-100yr	100	1.816	12.050	18.51	1,001.17	0.647
PO-East (IN)	Post-2yr	2	1.276	11.900	23.10	(N/A)	(N/A)
PO-East (OUT)	Post-2yr	2	1.081	12.050	12.62	999.04	0.480
PO-East (IN)	Post-10yr	10	2.145	11.900	38.19	(N/A)	(N/A)
PO-East (OUT)	Post-10yr	10	1.942	12.050	24.76	1,000.16	0.665
PO-East (IN)	Post-90th% BMP	90	0.275	11.950	4.95	(N/A)	(N/A)
PO-East (OUT)	Post-90th% BMP	90	0.090	16.350	0.13	996.55	0.188
PO-East (IN)	Post-100yr	100	3.563	11.900	61.90	(N/A)	(N/A)
PO-East (OUT)	Post-100yr	100	3.347	12.050	40.57	1,001.40	0.916

Subsection: Elevation-Area Volume Curve
 Label: PO-East

Return Event: 100 years
 Storm Event: SCS-Type-II-APWA-100-Yr

Elevation (ft)	Planimeter (ft ²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
992.00	0.0	0.000	0.000	0.000	0.000
993.00	0.0	0.012	0.012	0.004	0.004
994.00	0.0	0.039	0.073	0.024	0.028
995.00	0.0	0.057	0.143	0.048	0.076
996.00	0.0	0.077	0.200	0.067	0.143
997.00	0.0	0.098	0.262	0.087	0.230
998.00	0.0	0.122	0.329	0.110	0.340
999.00	0.0	0.147	0.403	0.134	0.474
1,000.00	0.0	0.178	0.487	0.162	0.636
1,001.00	0.0	0.208	0.578	0.193	0.829
1,002.00	0.0	0.239	0.670	0.223	1.052
1,003.00	0.0	0.270	0.763	0.254	1.307
1,003.70	0.0	0.292	0.843	0.197	1.503

Subsection: Elevation-Area Volume Curve
 Label: PO-West

Return Event: 100 years
 Storm Event: SCS-Type-II-APWA-100-Yr

Elevation (ft)	Planimeter (ft ²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
996.00	0.0	0.000	0.000	0.000	0.000
997.00	0.0	0.069	0.069	0.023	0.023
998.00	0.0	0.108	0.263	0.088	0.110
999.00	0.0	0.146	0.379	0.126	0.237
1,000.00	0.0	0.186	0.496	0.165	0.402
1,001.00	0.0	0.227	0.618	0.206	0.608
1,002.00	0.0	0.269	0.743	0.248	0.856
1,003.00	0.0	0.311	0.869	0.290	1.146
1,003.40	0.0	0.328	0.958	0.128	1.273

Subsection: Outlet Input Data
Label: East Det Basin Outlet

Return Event: 100 years
Storm Event: SCS-Type-II-APWA-100-Yr

Requested Pond Water Surface Elevations

Minimum (Headwater)	992.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,002.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	East 1" Orifice	Forward	TW	992.00	1,003.70
Culvert-Circular	East 15" HDPE Outlet	Forward	TW	996.50	1,003.70
Culvert-Circular	East 24" HDPE Outlet	Forward	TW	998.50	1,003.70
Rectangular Weir	East O/F Weir- 1001.90'	Forward	TW	1,001.90	1,003.70
Tailwater Settings	Tailwater			(N/A)	(N/A)

Subsection: Outlet Input Data
 Label: West Det Basin Outlet

Return Event: 100 years
 Storm Event: SCS-Type-II-APWA-100-Yr

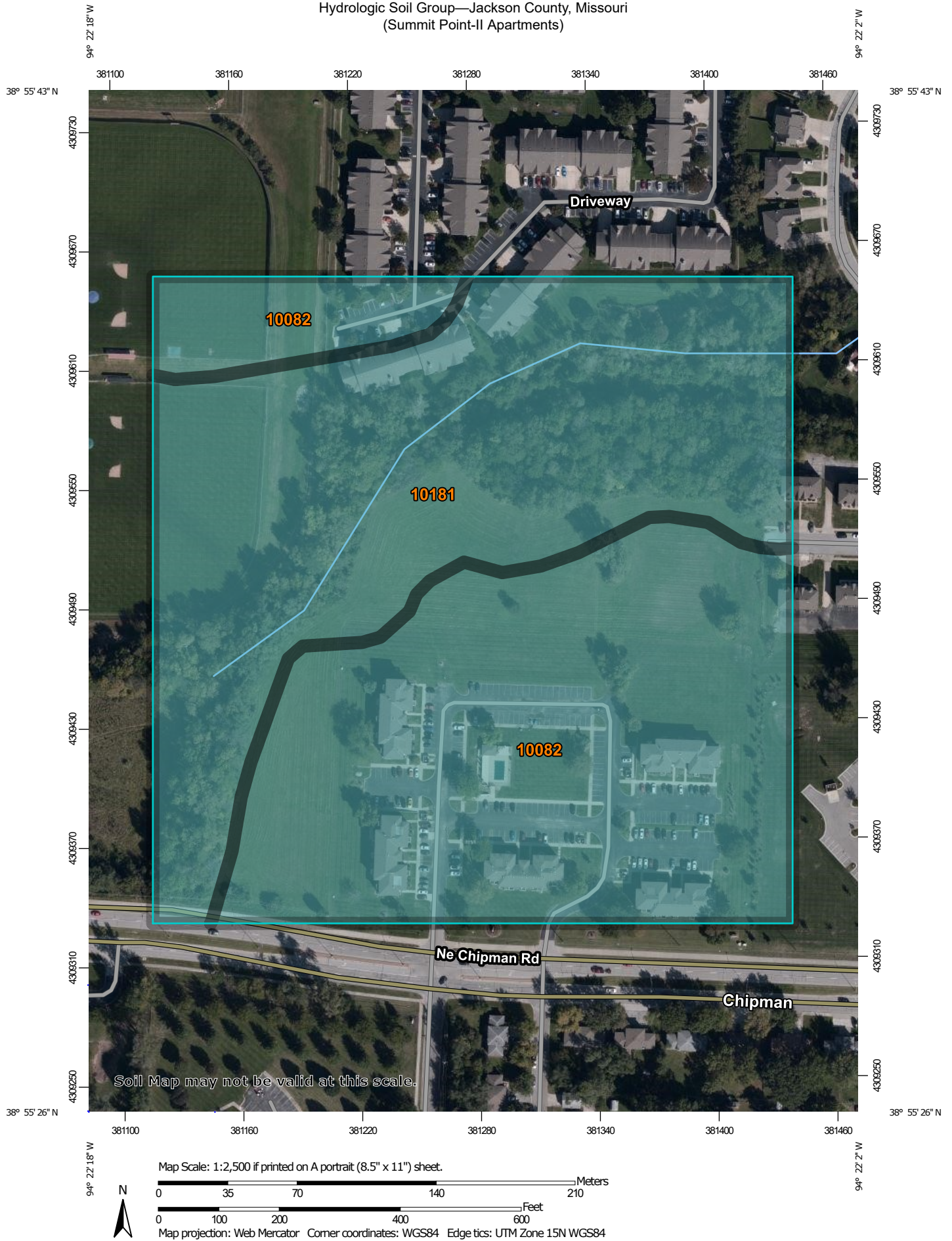
Requested Pond Water Surface Elevations	
Minimum (Headwater)	996.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,003.40 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	West 1" Orifice	Forward	TW	996.00	1,003.40
Culvert-Circular	West 12" HDPE Outlet	Forward	TW	998.00	1,003.40
Culvert-Circular	West 18" HDPE Outlet	Forward	TW	999.25	1,003.40
Rectangular Weir	West O/F Weir-1001.70'	Forward	TW	1,001.70	1,003.40
Tailwater Settings	Tailwater			(N/A)	(N/A)



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



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, NNGS12
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 Imagery Program (NAIP) dated 2014. Produced at scale of 1:24,000.

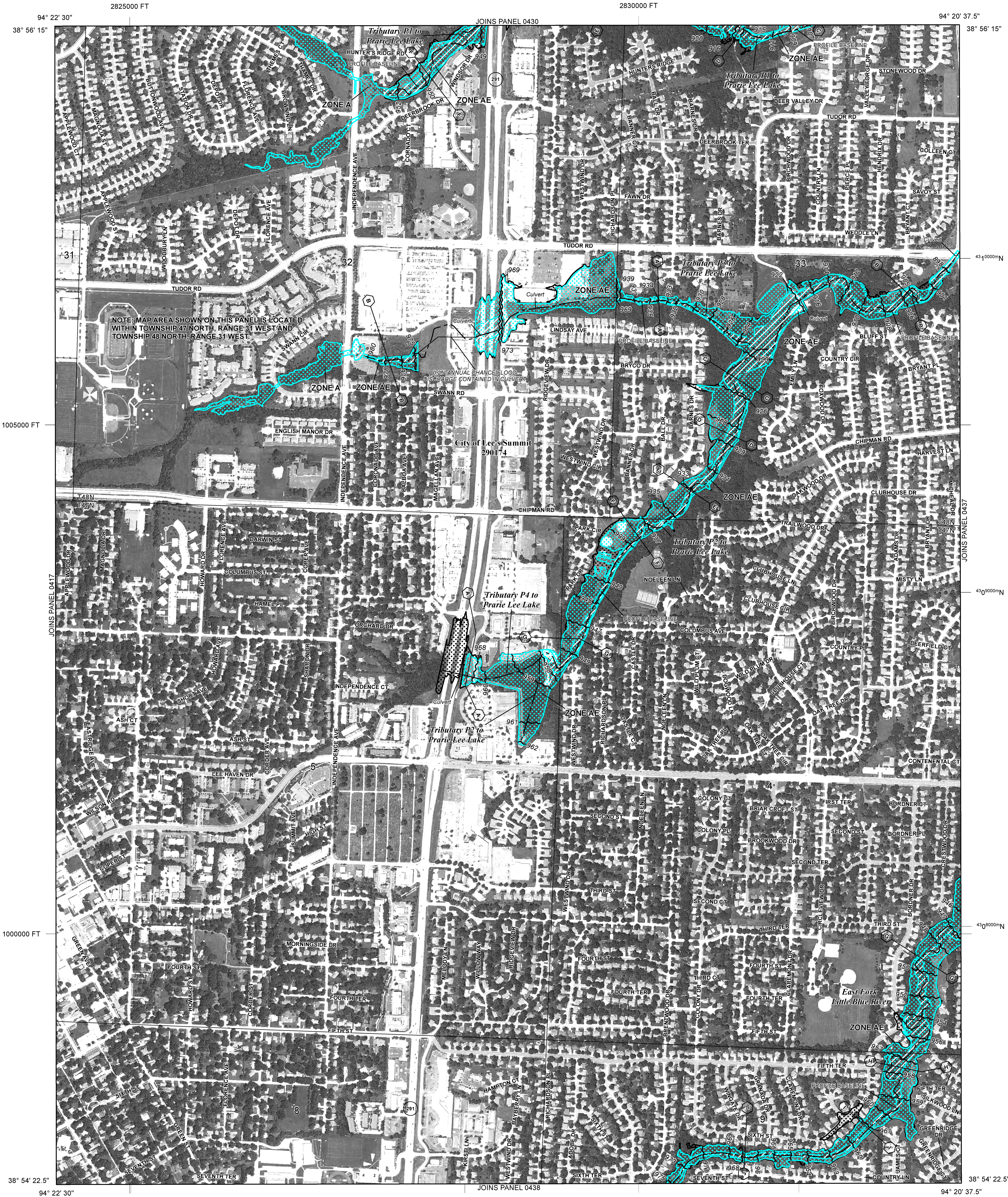
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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.

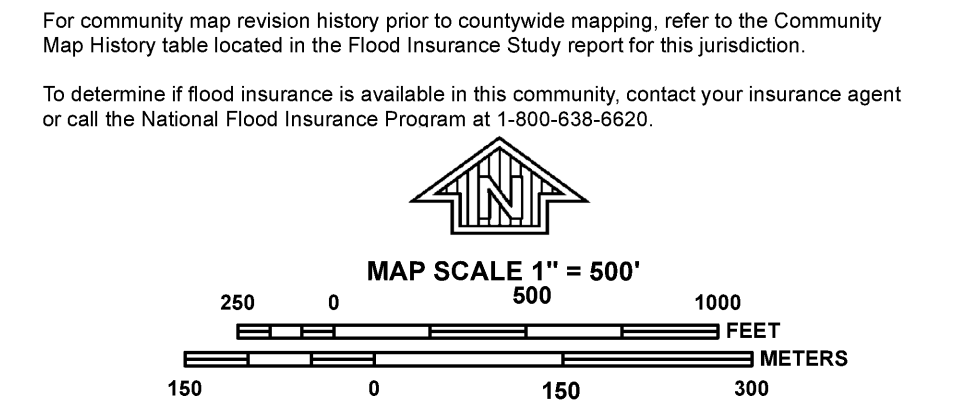
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which 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 equalled 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 defeated. 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.
Base Flood Elevation line and value; elevation in feet*
Base Flood Elevation value where uniform within zone; elevation in feet*
- *Referenced to the North American Vertical Datum of 1988
- Cross section line
Transect line
Culvert
Bridge
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
3100000 FT
DX5510 X
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



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.

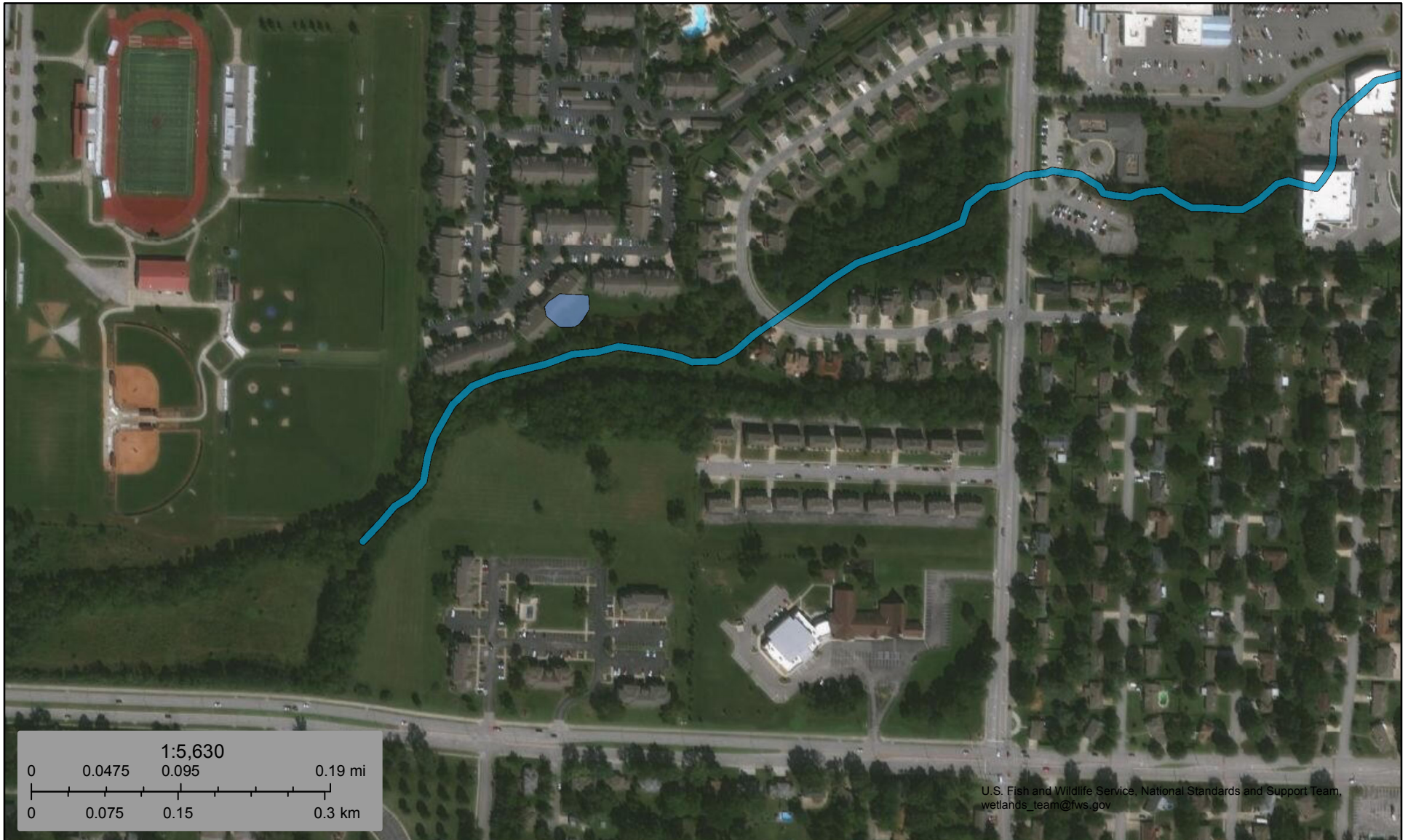
MAP NUMBER
29095C0436G
MAP REVISED
JANUARY 20, 2017
Federal Emergency Management Agency



U.S. Fish and Wildlife Service

National Wetlands Inventory

Summit Point Apartments-National Wetland



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Wetlands

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