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

HEC-RAS Analysis of Tributary P3 To Prairie Lee Lake

Prepared for:
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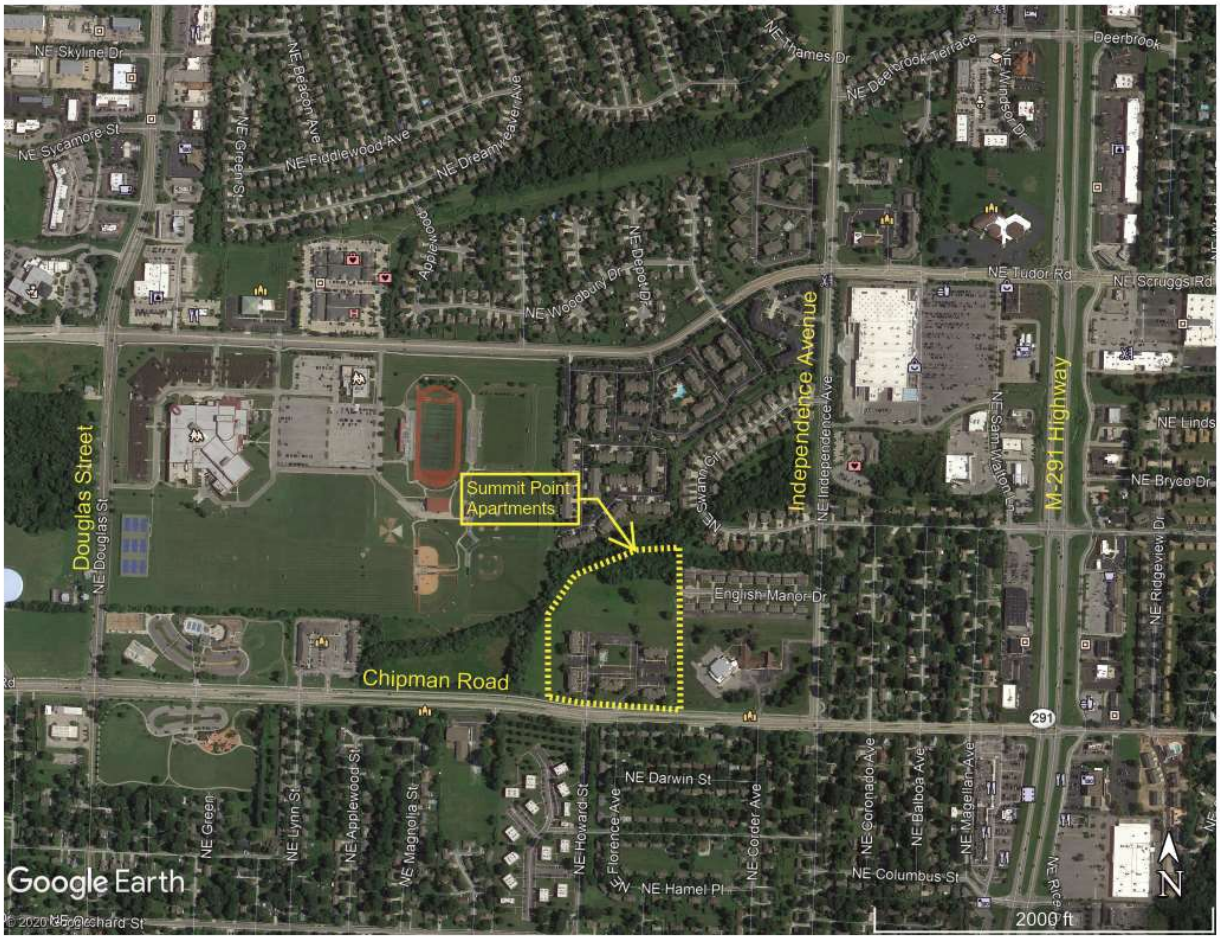
April 21, 2021

HEC-RAS Analysis of Tributary P3 To Prairie Lee Lake
Adjacent to the Proposed Summit Point Apartments, Phase-II
504 NE Chipman Road
City of Lee's Summit, Jackson County, Missouri 64063
CFS Project #21-5065 / #19-5293
April 21, 2021

General: The owners of the proposed Summit Point Apartments at 504 NE Chipman Road have proposed to develop the Phase-II of the site. 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.

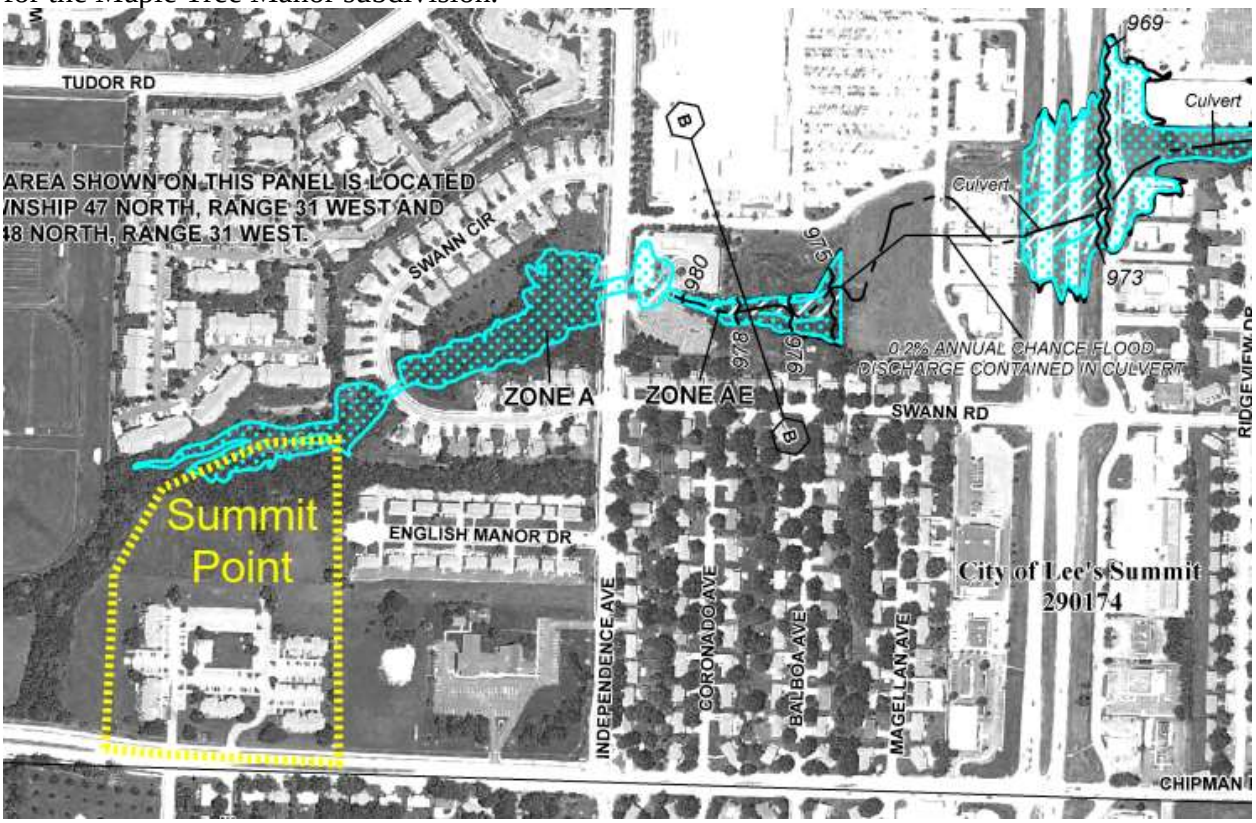


Vicinity Map of the Summit Point Apartments at 504 NE Chipman Road in Lee's Summit

The site slopes downwards to the north where an existing creek (Tributary P3 to Prairie Lee Lake) flows eastwards along the site's northern boundary. The existing 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 NE Independence Avenue is located approximately 800 ft downstream. The creek crossing at NE Swann Circle has triple 48" HDPE culverts have upstream flowline elevations of approximately 986.91'and the top of the roadway

has an overflow elevation of approximately 994'. The creek bed upstream of NE Swann Circle serves as a stormwater detention basin for the Maple Tree Manor subdivision.

NE Independence Avenue is located approximately 1000 ft downstream from NE Swann Circle downstream and has a single 48" RCP culvert with an upstream flowline elevation of approximately 979.25' and an overflow elevation across the top of NE Independence Avenue of approximately 985.41'. The creek bed upstream of NE Independence Avenue serves as a stormwater detention basin for the Maple Tree Manor subdivision.



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

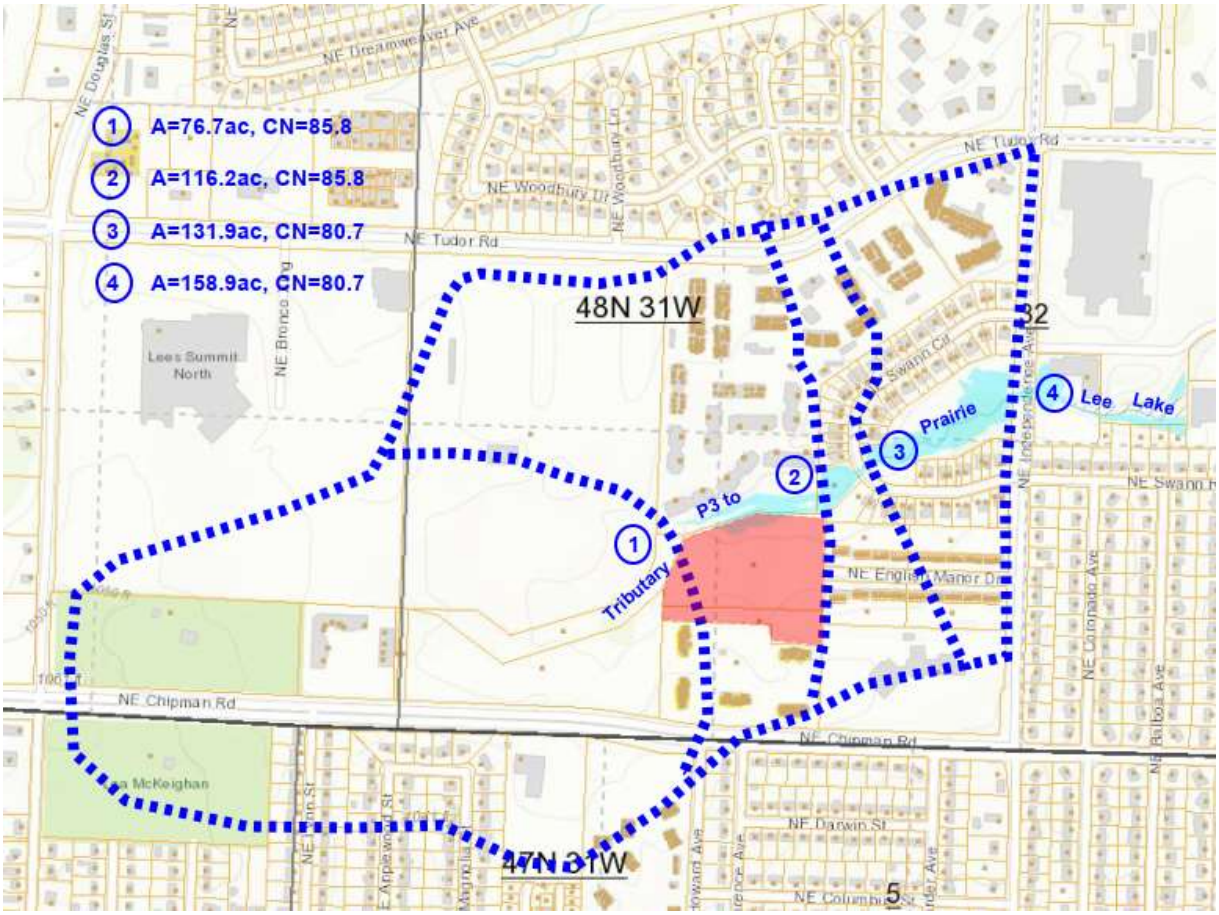
The FEMA flood map shows the defined 1% (100-year) flood elevations to the east along the creek stop short of Independence Avenue. A portion of the northern side of the site is within the FEMA 1% (100-year) floodplain, with the remaining ground above the flood limits.

HEC-RAS Analysis: 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 four locations along the northern property line and where the creek crosses NE Swann Circle and NE Independence Avenue.

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 performed 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, defined as a Special Flood Hazard Area subject to inundation

by the 1% annual chance flood where no base flood elevations have been determined. The time of concentration for each drainage basin was determined using TR-55 methodology for overland flow, shallow concentrated flow and channelized flow segments. Estimates of flow path length and slope were estimated using Jackson County GIS topography and the USGS Quadrangle maps of the vicinity. The USGS StreamStats web-based hydrologic analysis program was used to check the contributing drainage areas to the points of interest along the creek. The StreamStat flows appeared to be overly conservative when checked against the flows calculated using the conventional TR-55 methodologies. Calculations have been included in the appendix.

The existing triple 48" HDPE culverts at NE Swann Circle and the existing 48" RCP culvert at NE Independence Avenue were also included in the HEC-RAS model to evaluate the potential back-up of flood water in the creek from the culvert crossings. Channel cross-sections were cut along the Summit Point Apartments, Phase-II site, and additional cross-sections were cut downstream to model the NE Swann Circle and NE Independence Avenue culverts. CFS surveyors measured the invert elevations of all three 48" HDPE culverts along with the top of road elevation at NE Swann Circle. Available storm sewer as-built plans were used to model the existing 48" RCP culvert at NE Independence Avenue.



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

The CFS survey topography was used to cut cross-sections for the HEC-RAS models. Jackson County GIS topography was also used to supplement the cross-section data outside of the limits of the CFS survey. Manning's roughness factors for the main channel and overbank areas were assumed based on photos and field observations of the creek. A roughness factor of n=0.030 was used for the main channel that was generally clean, straight and full with no rifts or deep pools. A roughness factor of

n=0.060 was used for the left and right overbanks that generally consisted of light brush and trees under summer conditions.

Cross-sections were cut across the digital contours to set the station-elevations. The cross-sections in the river channel were stationed based on an assumed 10000 ft at the point where the centerline of NE Swann Circle crossed the Tributary P3 to Prairie Lee Lake creek. The left and right stream bank locations were set based on the apparent break in slope locations along the sides of the main creek channel. The main channel lengths were based on the digital alignment of the creek's flowline and the left and right overbank lengths were estimated based on the general curvature of the creek alignment.

Current Effective Model: There was no readily available HEC-RAS model of Tributary P3 to Prairie Lee Lake. The FEMA FIRM flood map showed the creek within the limits of Zone AE on the eastern/downstream side of NE Independence Avenue, located approximately 900 ft downstream from the Summit Point site. The flood map showed that the creek along the northern side of Summit Point, was set inside Zone A where the defined base flood elevations were not determined. This indicates that the detailed HEC-RAS model of the Tributary P3 to Prairie Lee Lake stopped short of NE Independence Avenue and did not extend upstream to cover the Summit Point site.

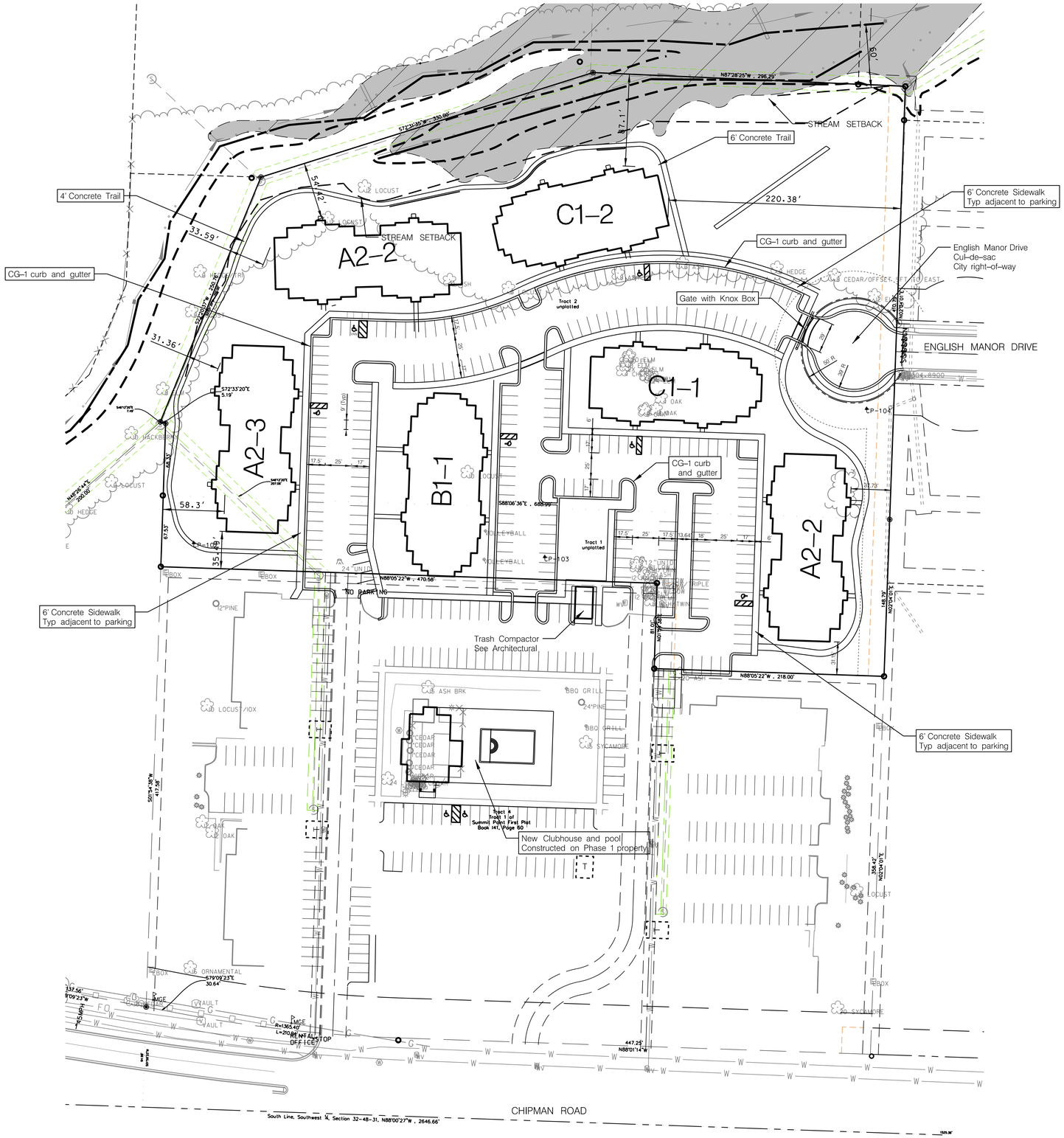
Duplicate Effective Model: CFS Engineers created a HEC-RAS model using the recent topographic survey and the Jackson County GIS data. The cross-sections cut along the northern side of the Summit Point site and other cross-sections cut further downstream to model the NE Swann Circle roadway crossing and the NE Independence Avenue roadway crossing. The methods for setting the left and right bank stations and overbank lengths were described above. RS 8693.92 was the furthest downstream located approximately 530 ft downstream from the centerline of NE Independence Avenue. RS 11275.44 was the furthest upstream located on the western side of the Summit Point site. The stream flows for the 2 year storm ranged from 144 cfs at the lower end of the creek by NE Independence Avenue, to 77 cfs at the upstream end. Likewise, the 10-year stream flows ranged from 273 cfs to 146 cfs, and the 100-year stream flows ranged from 485 cfs to 264 cfs. The channel slope averaged approximately 1.1%. 100-year flow depths along the Summit Point site ranged from 2.58 ft to 4.42 ft, with corresponding flow velocities ranging from 3.52 fps to 6.78 fps.

Alternate Scenario Model for Clogged Independence Avenue Culvert: Using the Duplicate Effective Model, CFS modified the model to change the 48" diameter RCP culvert at Independence Avenue to a 6" diameter pipe for the purpose of simulating a clogged culvert condition. With the dramatically reduced culvert size, the heavier stream flows would overtop the roadway and increase the backwater depth at the Swann Circle culvert crossing. The reason for performing the scenario was two-fold.

The first reason was that the available record construction plans for Independence Avenue showed a 48" RCP culvert under the roadway connecting into a 54" RCP before discharging into the open creek, and the City's current digital stormwater utility data showing that two 24" diameter pipes were installed downstream from the existing 48" RCP and 54" RCP. While the configuration of installing two 24" pipes downstream from a 54" makes little hydraulic sense, it could have been done purposely to constrict the channel flow and store runoff in the channel upstream of Independence Avenue. Since the Independence Avenue channel crossing was over 1000' downstream from the Summit Point site, CFS Engineers did not survey the area.

The second reason for performing the clogged Independence Avenue culvert scenario was to model the worst-case conditions where the stream flow would be forced to overtop the roadway and possibly cause an increased tailwater backup at the Swann Circle culvert and higher WSEL's along the Summit Point site. After running the clogged Independence Avenue culvert scenario, it was found that the increased downstream tailwater depth had negligible impact on the WSEL's, and that the base flood elevations were unaffected along the Summit Point site.

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



CFS ENGINEERS
cfse.com
1421 E. 104th Street, Ste. 100 KCMO 64131
O 816-333-4477 F 816-333-8888

LANCE W. SCOTT NUMBER E-22205 4/5/21

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

Rev. -
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Drawn by: RP
Checked by: LWS
Reviewed by: ---
Submitted by: ---
Plot scale: 1:50
Plot date: 4/14/2020 2:59:29 PM
File name: 215065-ST-SH-SitePlan.dgn

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

Preliminary Development Plan

SITE PLAN

Sheet reference number:
C3

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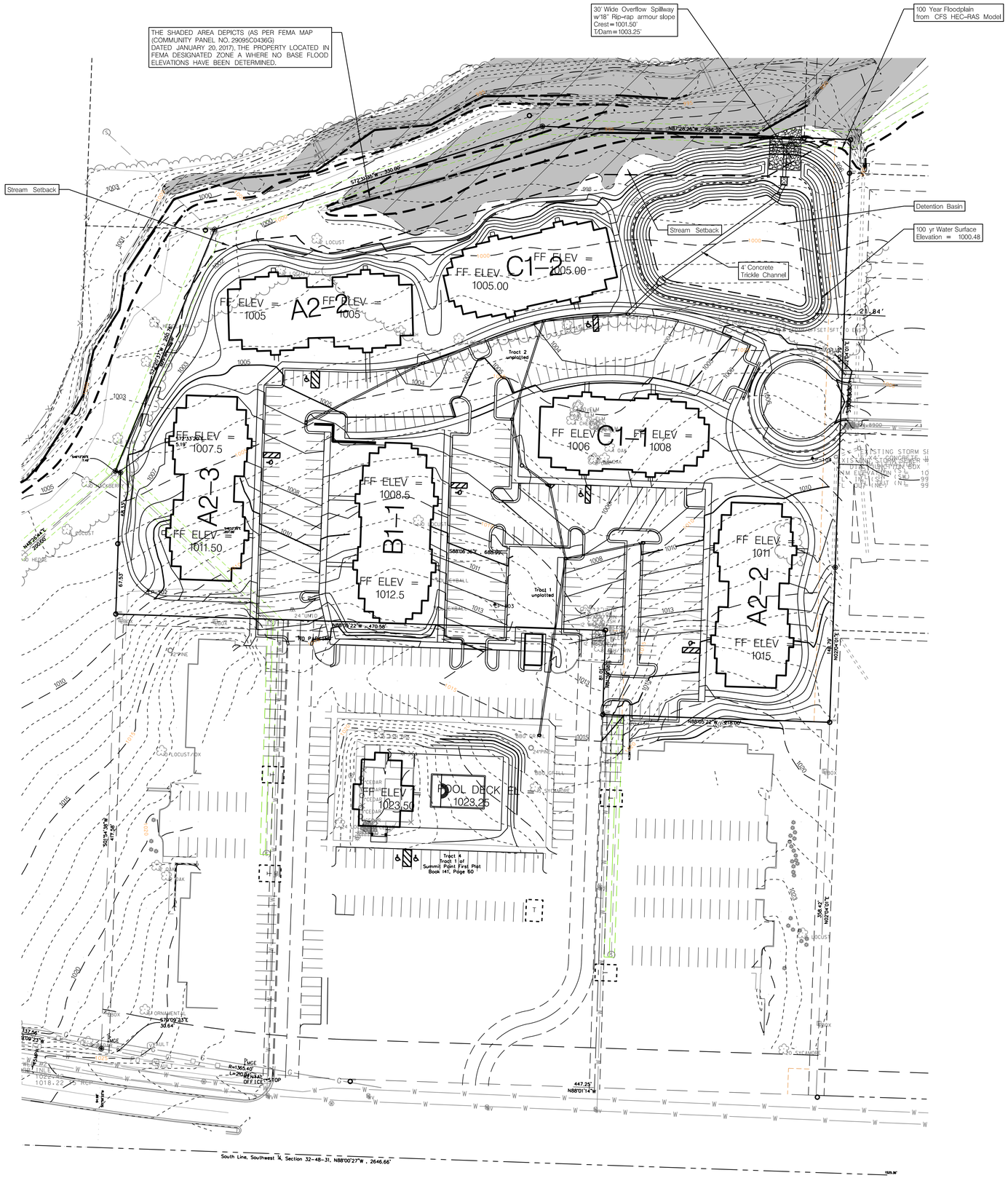
PRELIMINARY PLAN
SUMMIT POINT 2nd PLAT
LEE'S SUMMIT, MISSOURI



CFS ENGINEERS
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LANCE W. SCOTT NUMBER E-22285 4/15/21

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	REVISED PER COMMENTS	03/22/21	
	CITY SUBMITTAL	02/18/21	

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Date: 03-25-2105
Reviewed by: ---
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File name: 215065-ST-SH-GradingPlan.dgn
Plot date: 4/14/2021 2:33:3 PM

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

Preliminary Development Plan

GRADING PLAN

Sheet reference number:
C4

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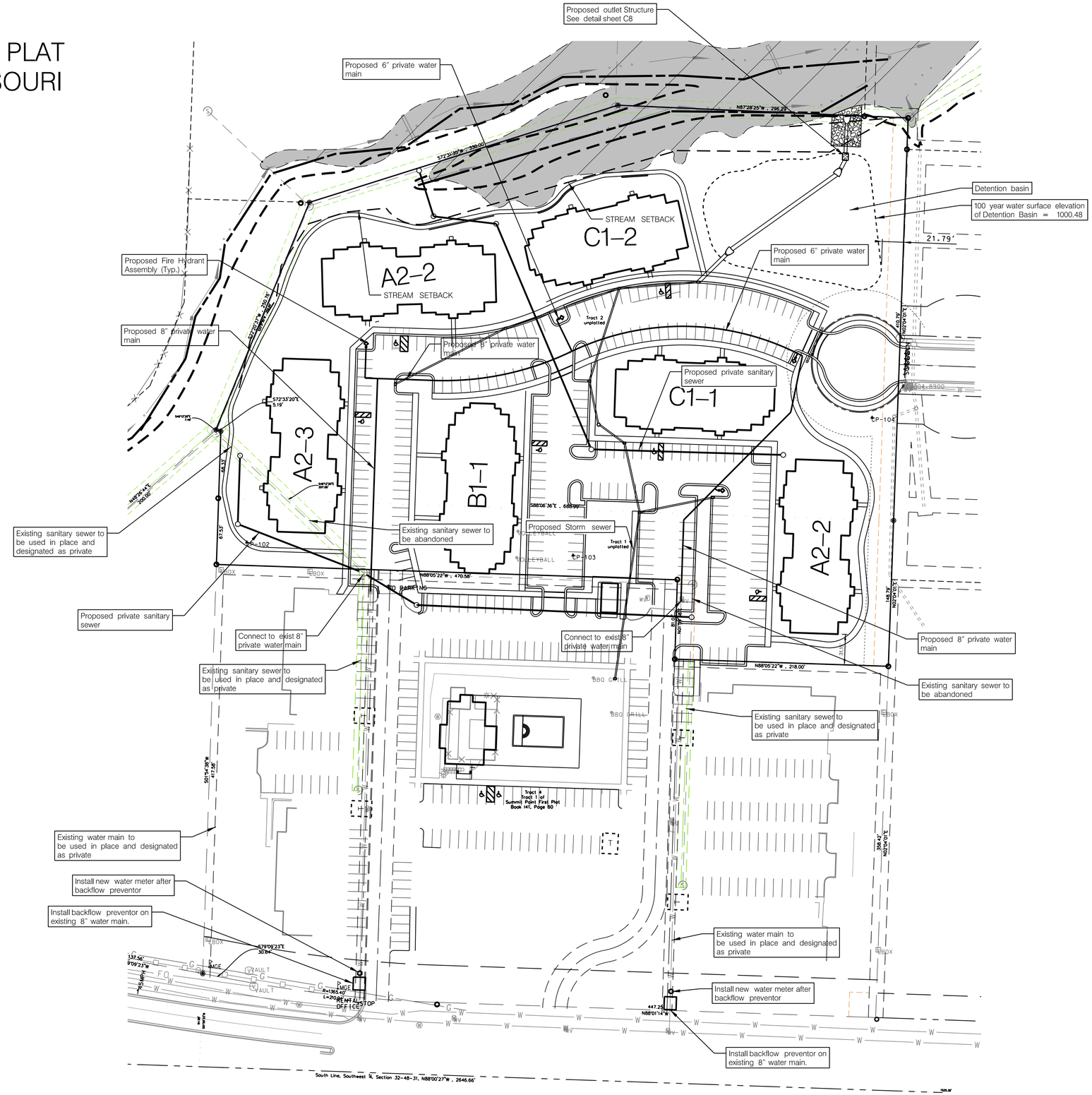
PRELIMINARY PLAN
SUMMIT POINT 2nd PLAT
LEE'S SUMMIT, MISSOURI



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o: 816-333-4477 f: 816-333-6688

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

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Rev. 1
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Check by: LJW2
Reviewed by: ---
Submitted by: ---
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SUMMIT POINT
504 NE Chipman Road
Lee's Summit, Missouri

Preliminary Development Plan

UTILITY PLAN

Sheet reference number:
C5

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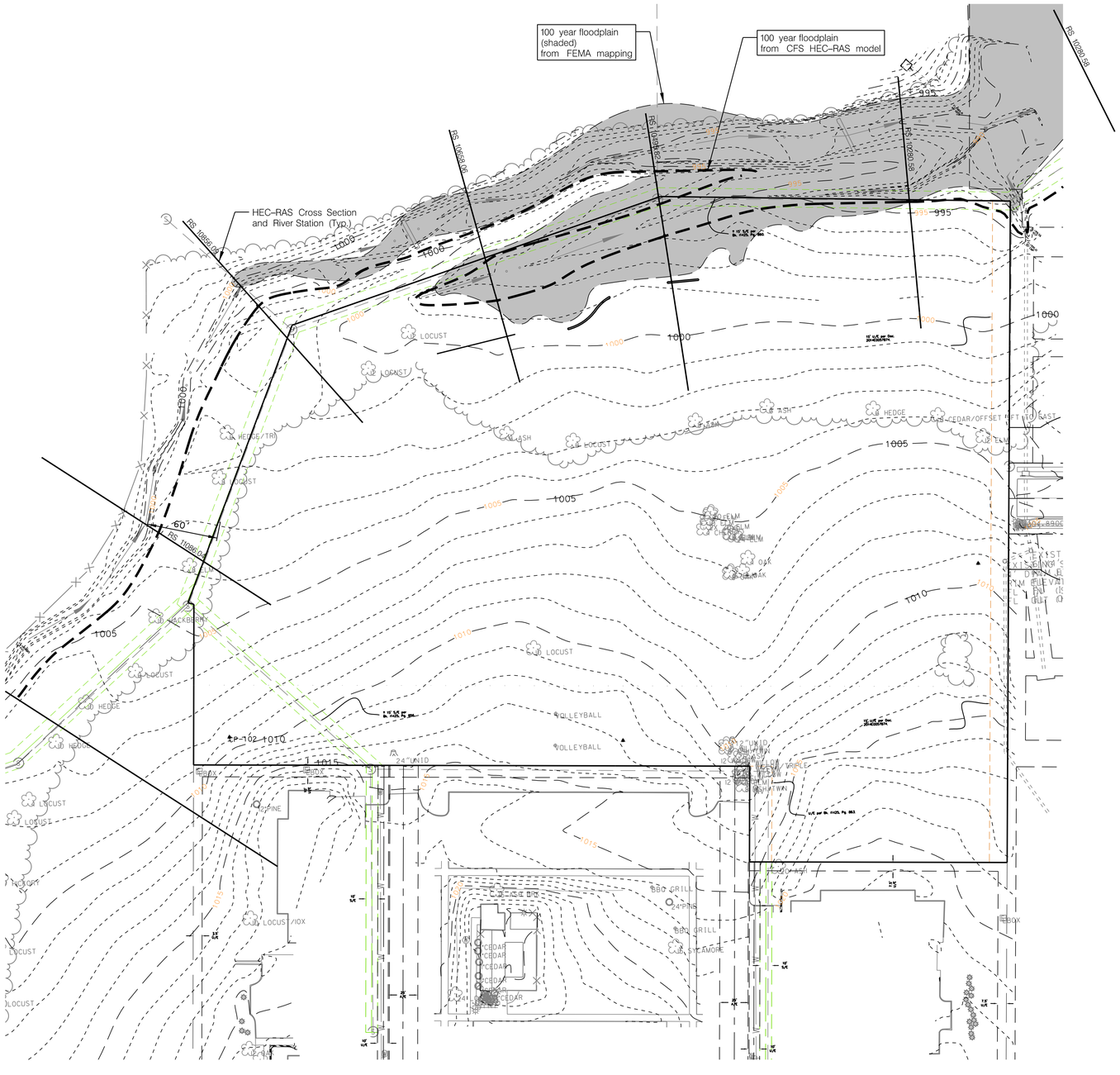
PRELIMINARY PLAN
SUMMIT POINT 2nd PLAT
LEE'S SUMMIT, MISSOURI



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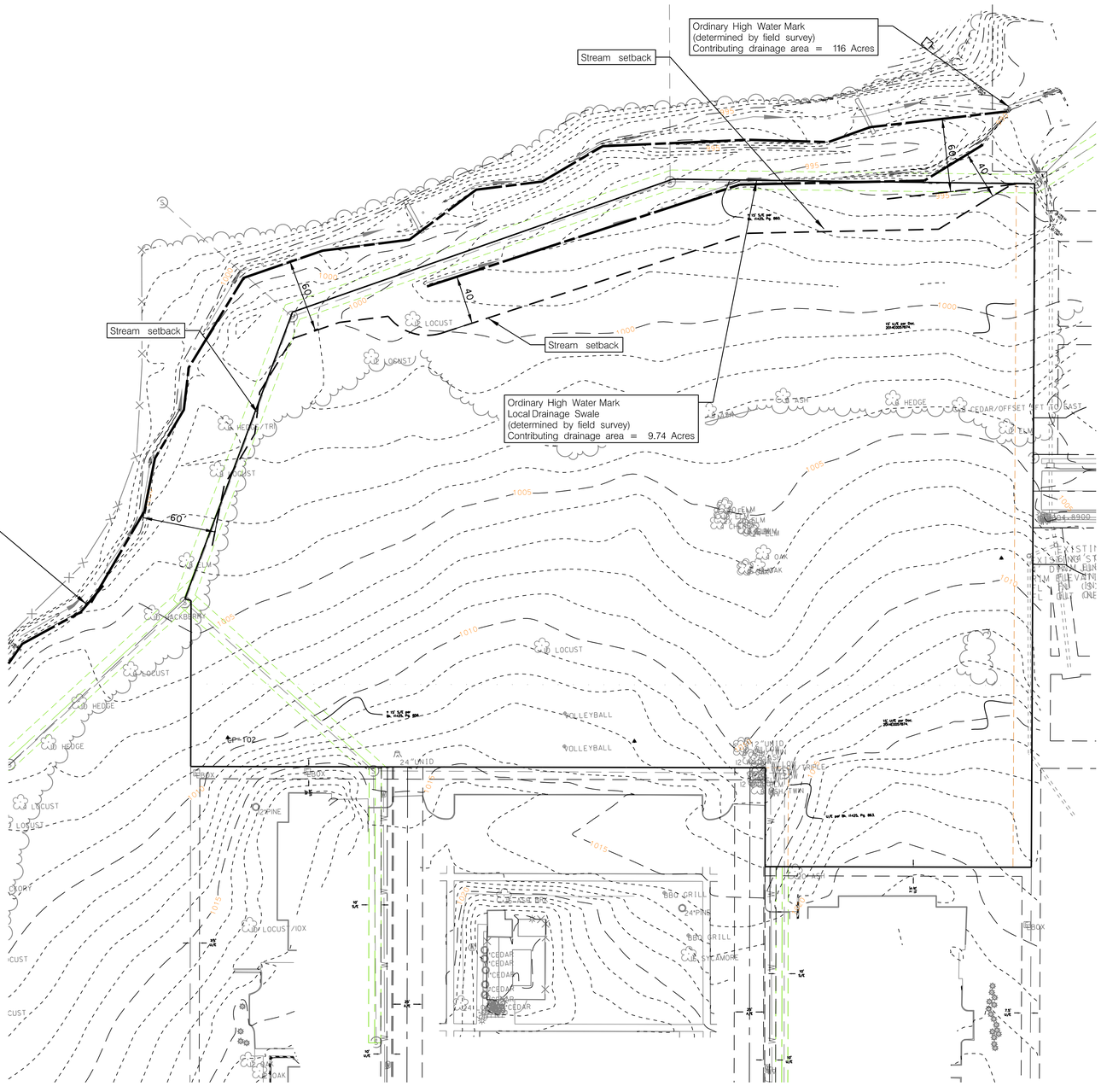
SUMMIT POINT 2nd PLAT
LEE'S SUMMIT, MISSOURI



CFS ENGINEERS
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STATE OF MISSOURI
LANCE W. SCOTT
NUMBER E-22265
4/5/21

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

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Drawn by: RP
Submitted by: ---
File name: Summit Point Stream Setback exhibit.dgn
Plot date: 4/7/2021

Date: 03-25-2015
Checked by: LWS
Reviewed by: ---
Plot scale: 1:50
Rev. -

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

Preliminary Development Plan

STREAM SETBACK EXHIBIT

Sheet reference number:
C7

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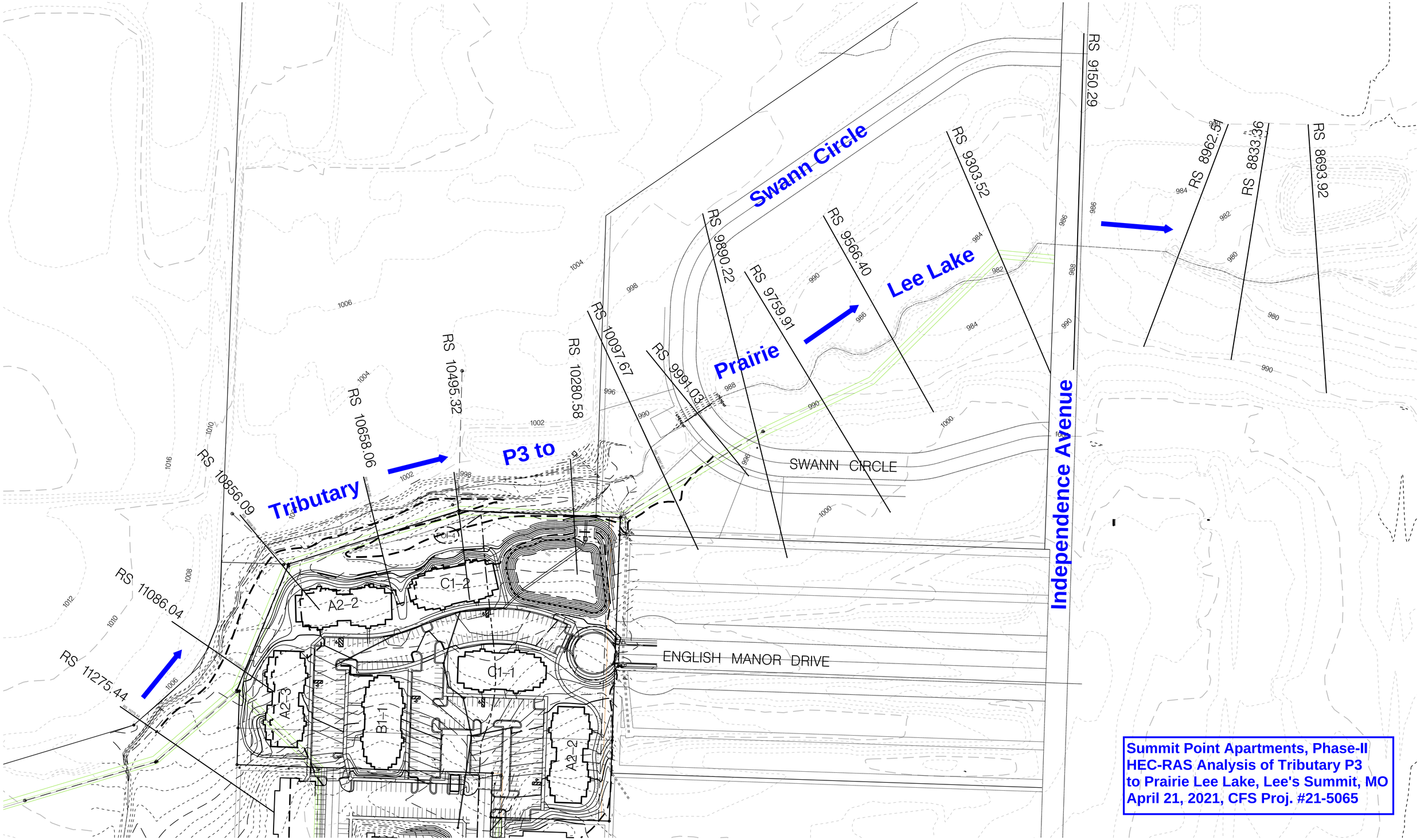

Summit Point Apartments, Phase-II
HEC-RAS Analysis of Tributary P3 to Prairie Lee Lake, Lee's Summit, MO
April 21, 2021, CFS Proj. #21-5065

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HEC-RAS Analysis of Tributary P3
to Prairie Lee Lake, Lee's Summit, MO
April 21, 2021, CFS Proj. #21-5065

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	8693.92	2yr	144.00	970.00	973.53	973.53	974.45	0.014489	7.71	18.67	10.37	1.01
SummitPoint	8693.92	10yr	273.00	970.00	974.71	974.71	975.74	0.009351	8.22	38.70	29.73	0.87
SummitPoint	8693.92	100yr	485.00	970.00	975.88	975.88	976.86	0.006529	8.70	90.64	59.22	0.77
SummitPoint	8833.36	2yr	144.00	972.75	976.52	976.52	977.28	0.014109	6.96	20.69	13.84	1.00
SummitPoint	8833.36	10yr	273.00	972.75	977.39	977.39	978.34	0.013094	7.82	34.93	19.03	1.02
SummitPoint	8833.36	100yr	485.00	972.75	978.43	978.43	979.51	0.009582	8.36	62.28	44.48	0.92
SummitPoint	8962.51	2yr	144.00	974.61	977.98		978.40	0.005623	5.18	27.80	15.44	0.68
SummitPoint	8962.51	10yr	273.00	974.61	978.88		979.50	0.006207	6.29	43.38	19.33	0.74
SummitPoint	8962.51	100yr	485.00	974.61	979.64	979.40	980.68	0.008505	8.17	59.38	22.65	0.89
SummitPoint	9223.75		Culvert	**NE Independence Avenue**								
SummitPoint	9303.52	2yr	135.00	978.20	985.77	981.27	985.77	0.000024	0.71	492.77	253.18	0.05
SummitPoint	9303.52	10yr	255.00	978.20	986.32	982.13	986.33	0.000046	1.06	642.04	279.15	0.07
SummitPoint	9303.52	100yr	454.00	978.20	986.73	983.26	986.75	0.000095	1.59	758.03	289.67	0.11
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SummitPoint	9566.40	10yr	255.00	979.30	986.32		986.36	0.000186	1.85	248.99	140.74	0.15
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SummitPoint	9759.91	2yr	135.00	984.00	986.89	986.89	987.60	0.013004	6.76	19.98	14.11	1.00
SummitPoint	9759.91	10yr	255.00	984.00	987.71	987.71	988.62	0.011931	7.65	33.35	18.39	1.00
SummitPoint	9759.91	100yr	454.00	984.00	988.82	988.82	989.72	0.007060	7.81	75.44	69.51	0.83
SummitPoint	9890.22	2yr	135.00	986.00	988.41		988.56	0.003910	3.11	43.37	42.75	0.54
SummitPoint	9890.22	10yr	255.00	986.00	989.22		989.34	0.002472	2.87	88.85	70.27	0.45
SummitPoint	9890.22	100yr	454.00	986.00	990.09		990.21	0.001629	2.78	163.09	98.81	0.38
SummitPoint	10032.93		Culvert	**NE Swann Circle**								
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SummitPoint	11086.04	10yr	146.00	999.60	1002.32		1002.66	0.006662	4.63	31.57	24.53	0.72
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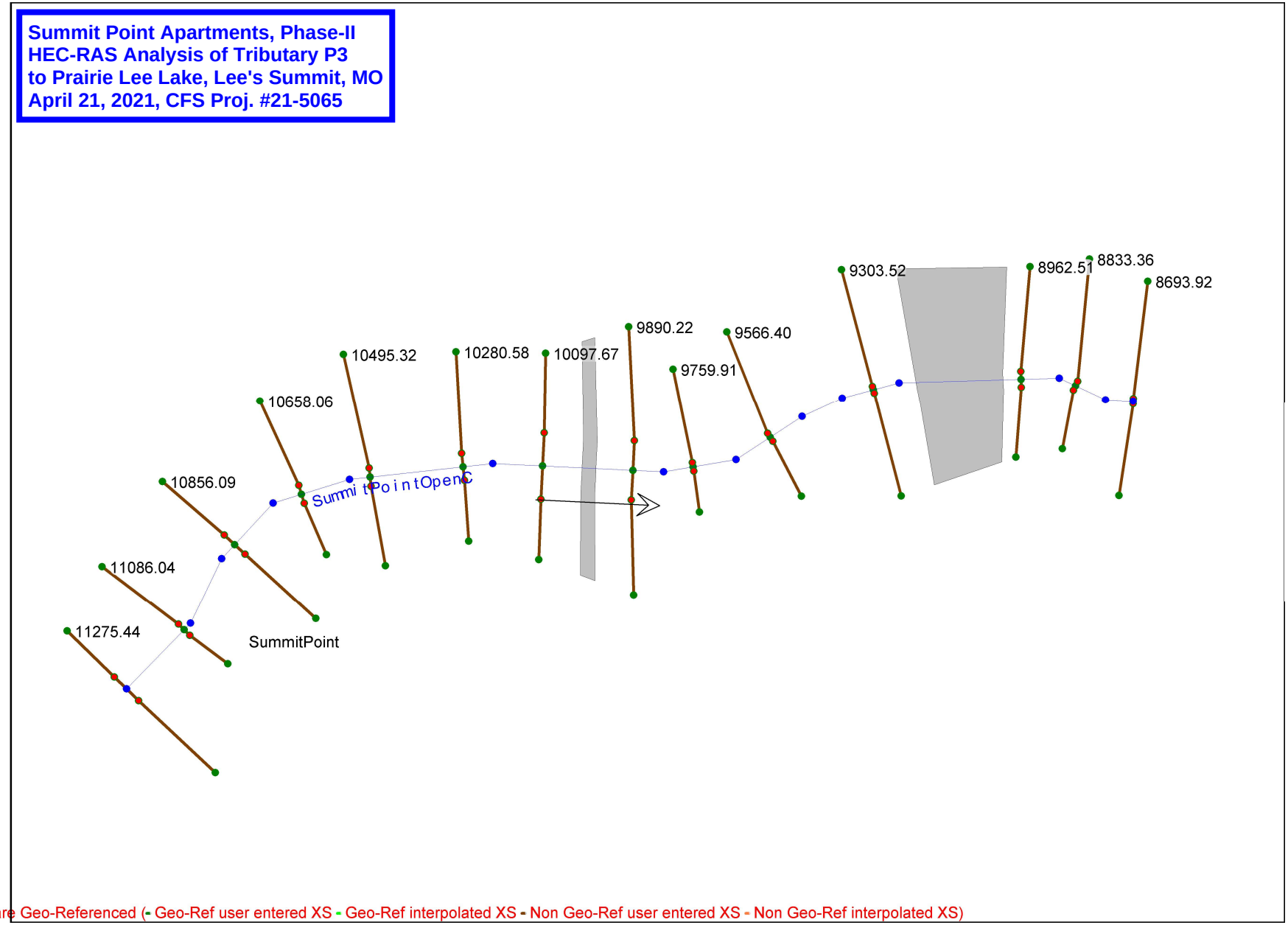
April 21, 2021, CFS Proj. #21-5065



None of the XS's are Geo-Referenced (- Geo-Ref user entered XS - Geo-Ref interpolated XS - Non Geo-Ref user entered XS - Non Geo-Ref interpolated XS)

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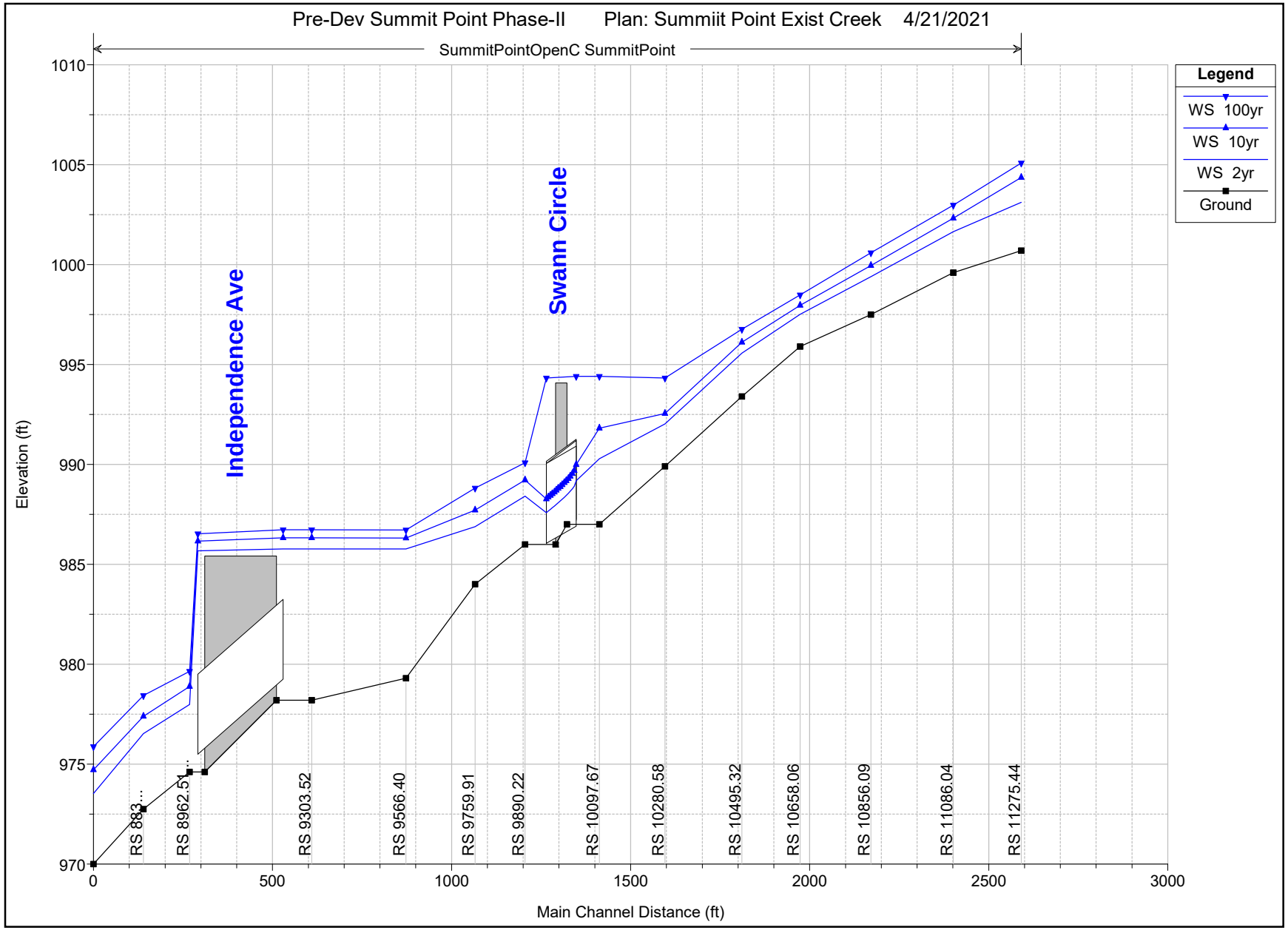

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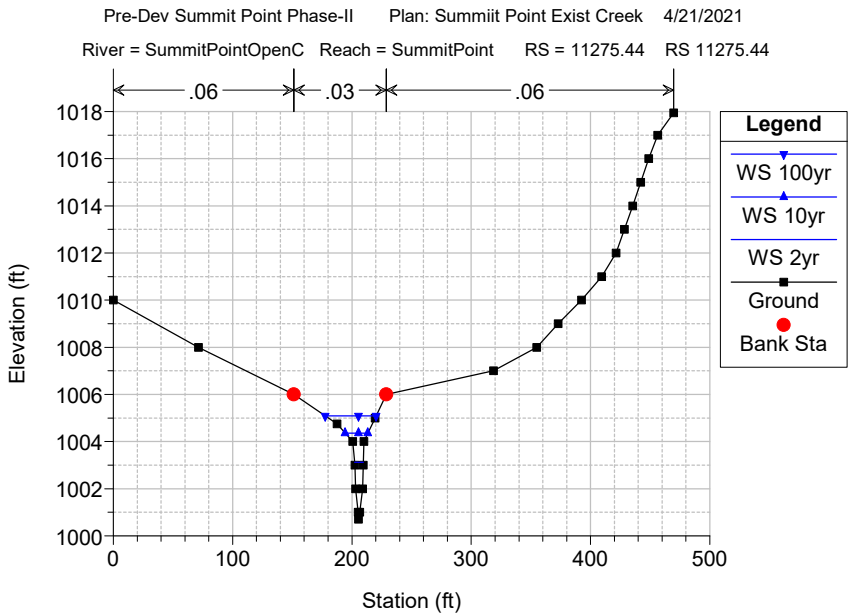
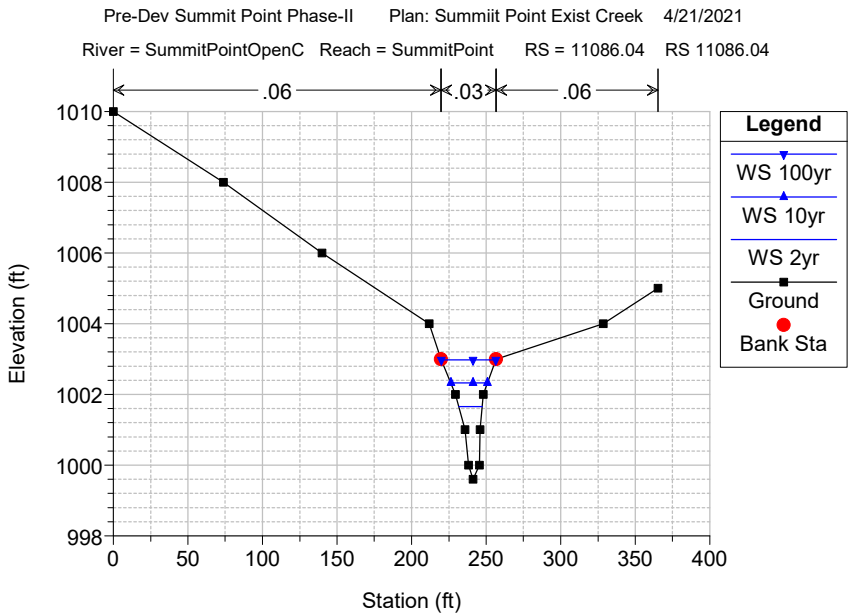
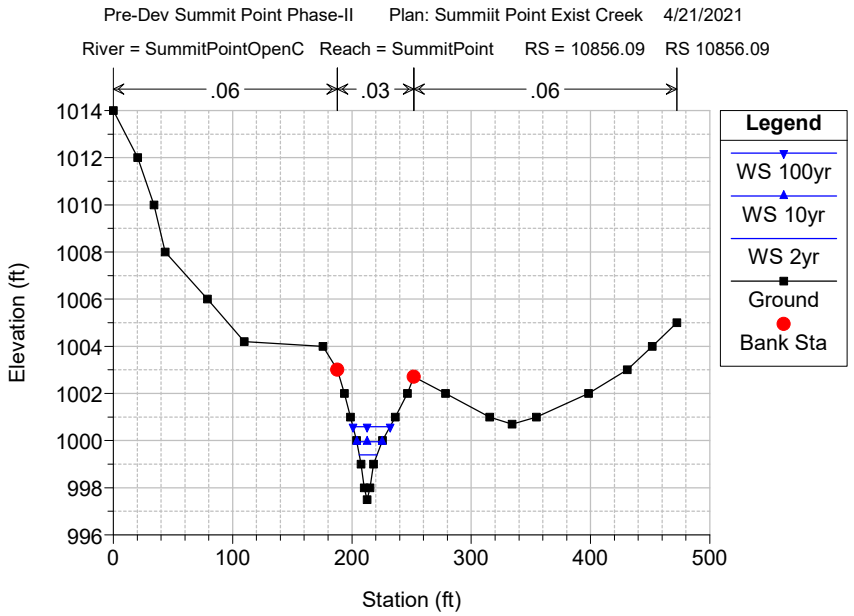
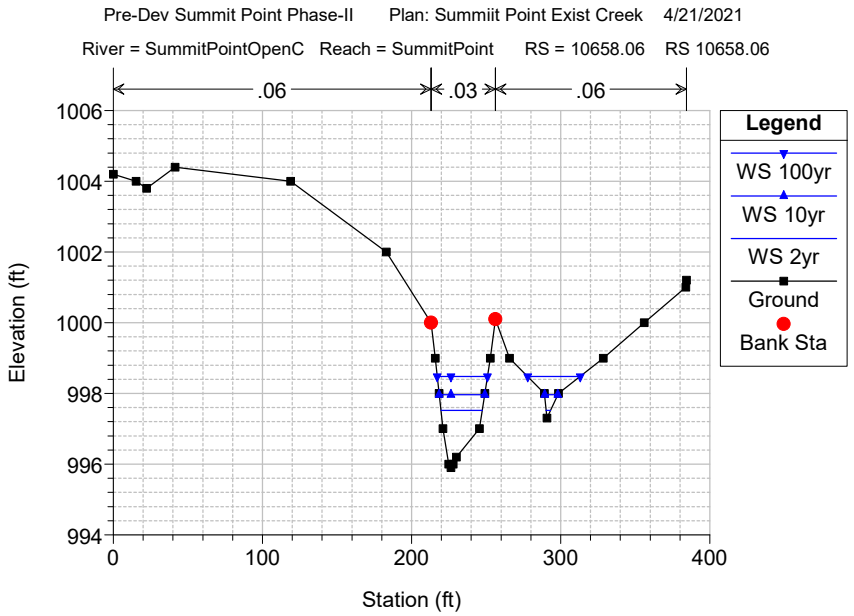
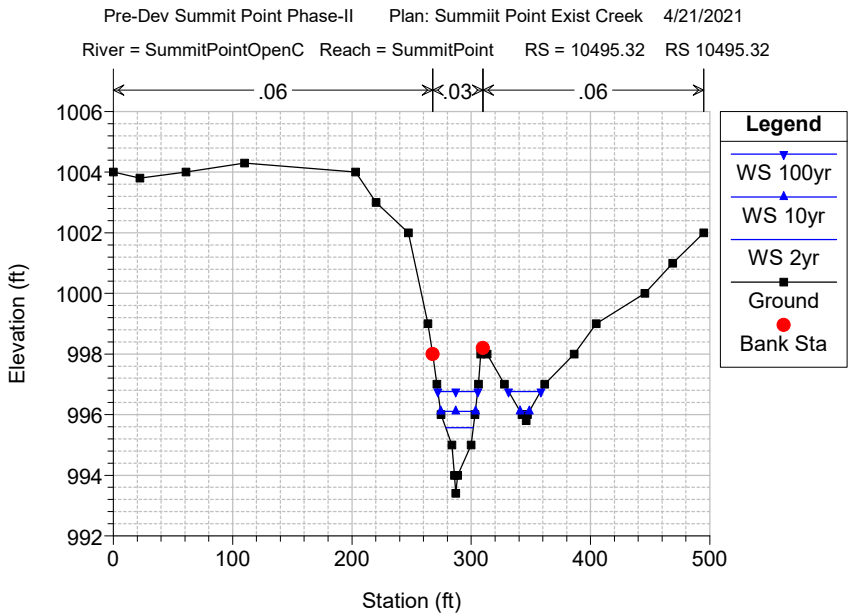


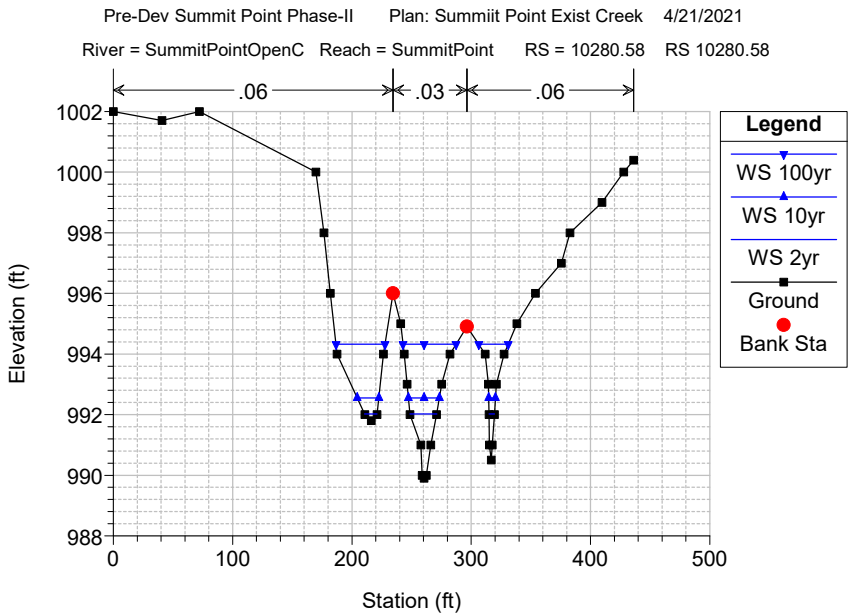


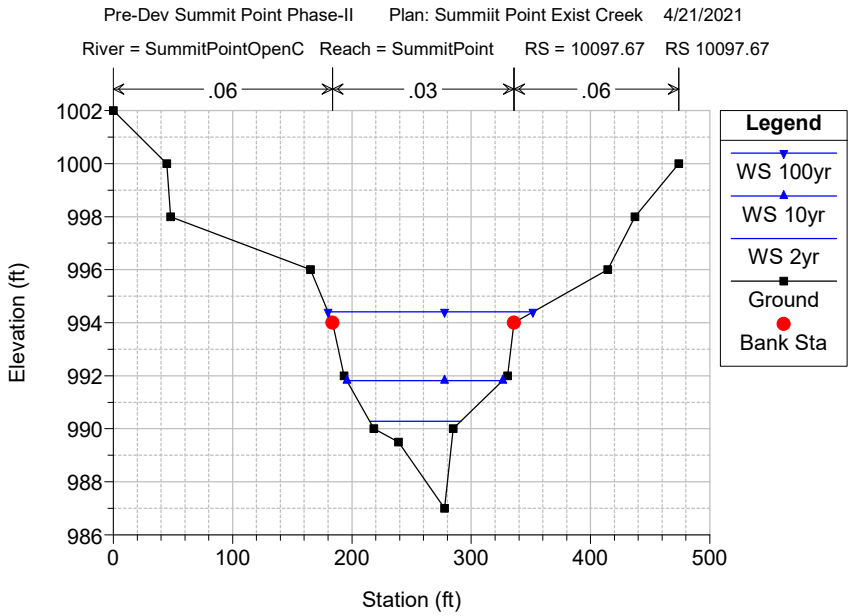


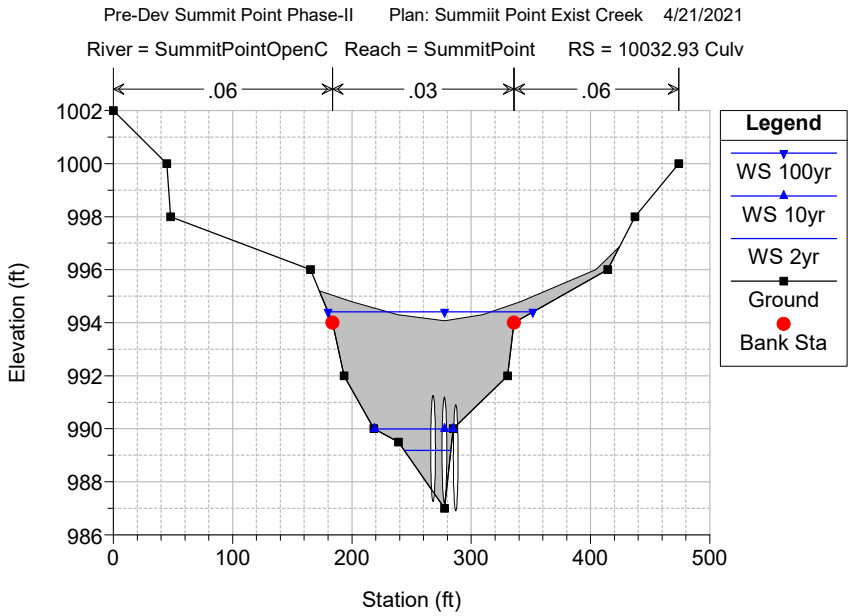


Summit Point Apartments, Phase-II
HEC-RAS Analysis of Tributary P3
to Prairie Lee Lake, Lee's Summit, MO
April 21, 2021, CFS Proj. #21-5065









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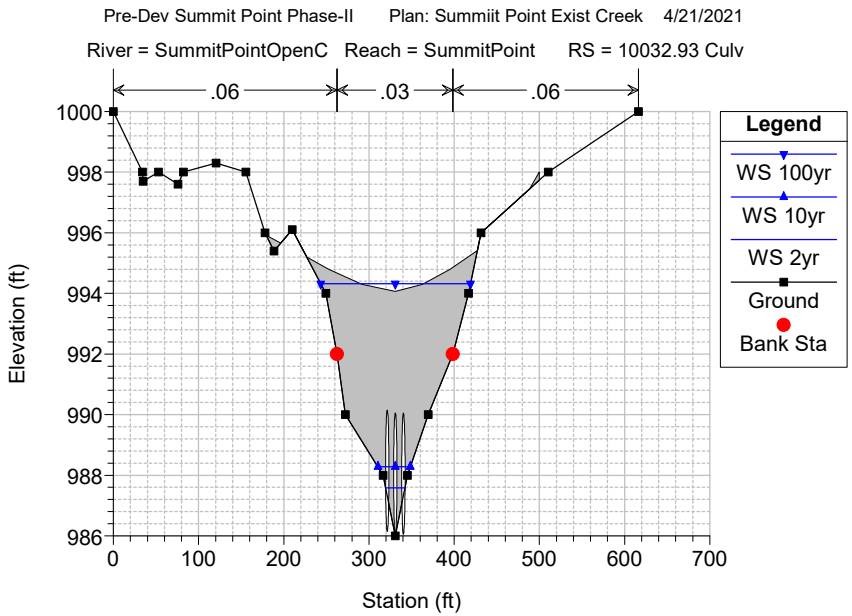

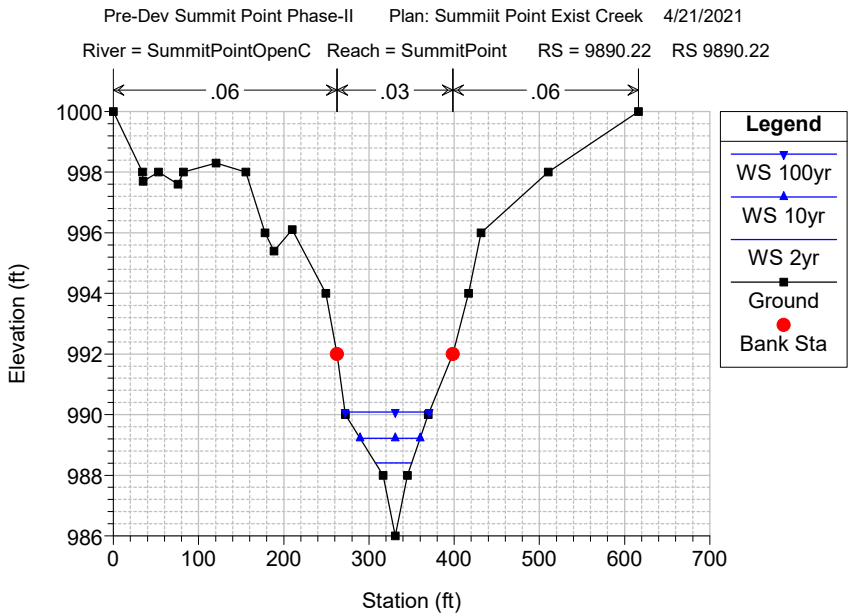

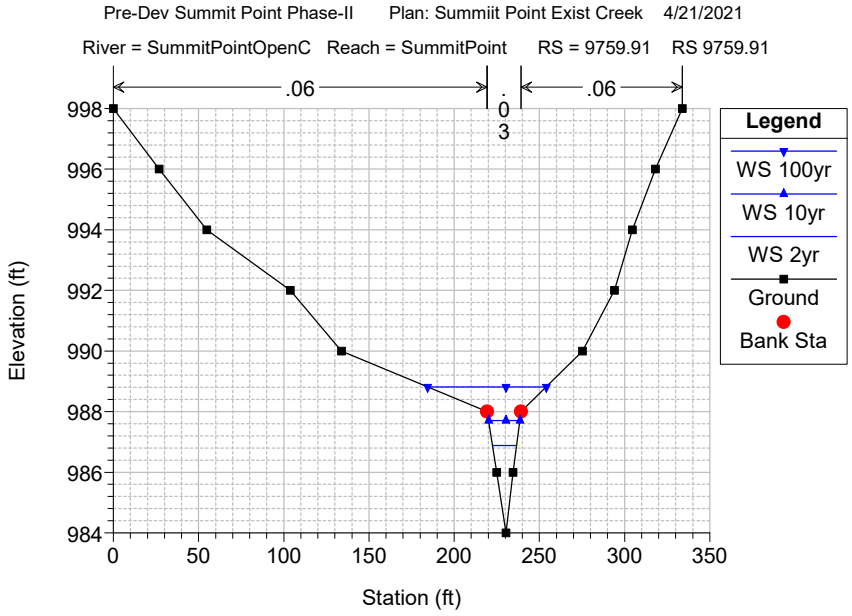

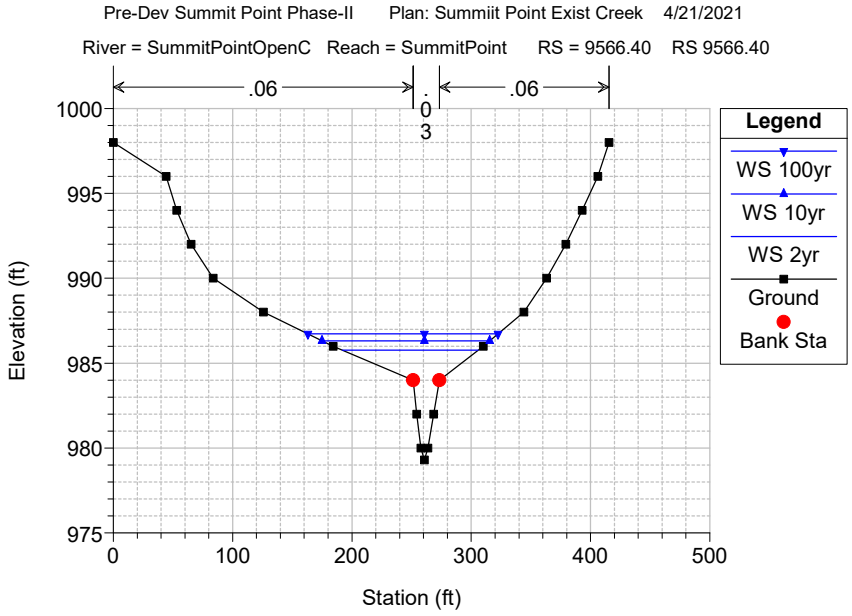

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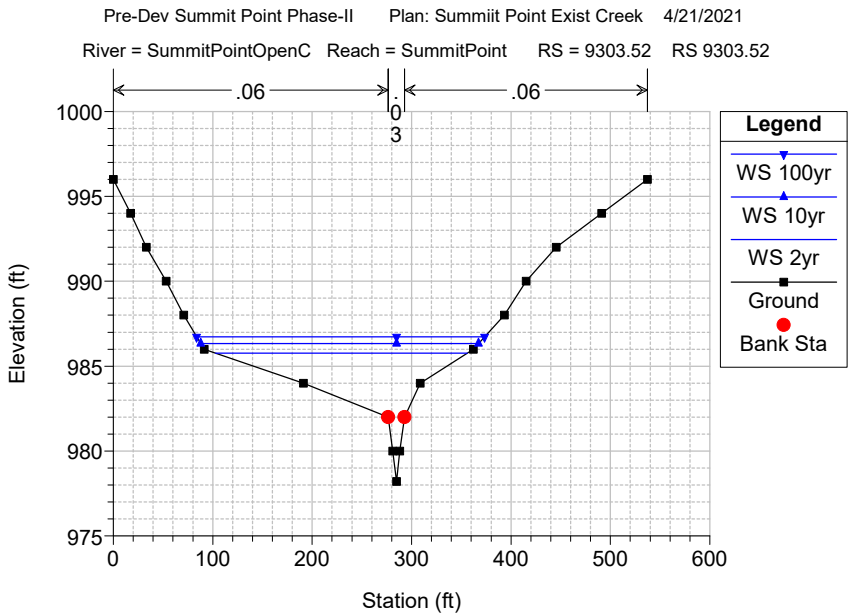
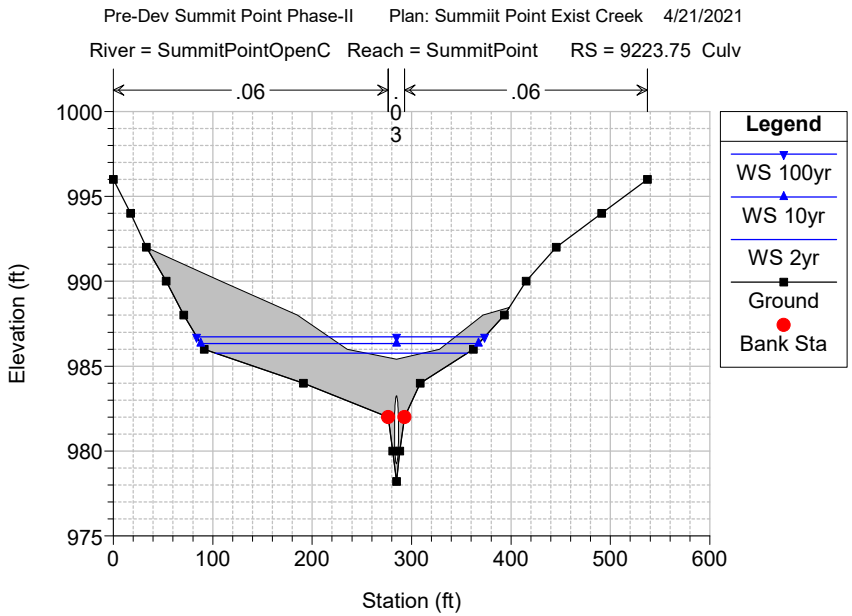
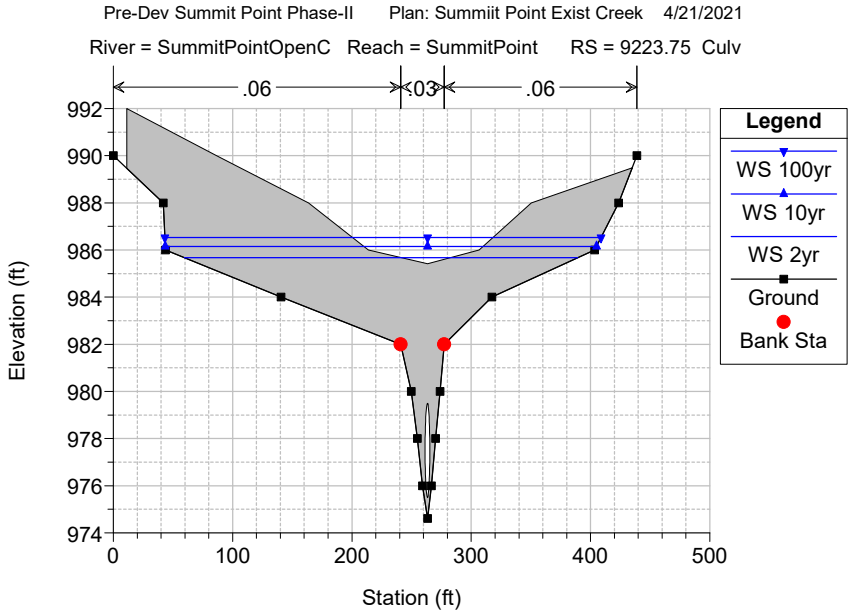
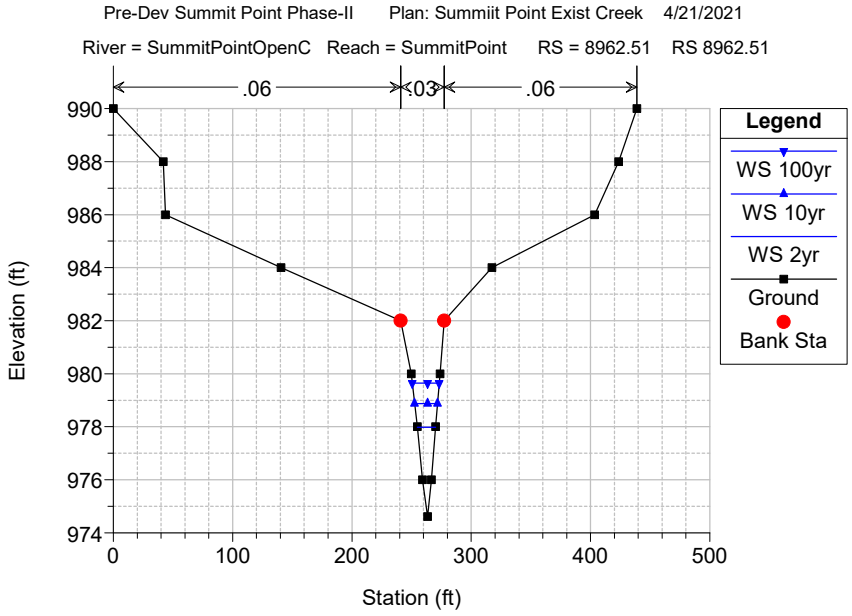
HEC-RAS Analysis of Tributary P3
to Prairie Lee Lake, Lee's Summit, MO
April 21, 2021, CFS Proj. #21-5065









Summit Point Apartments, Phase-II
HEC-RAS Analysis of Tributary P3
to Prairie Lee Lake, Lee's Summit, MO
April 21, 2021, CFS Proj. #21-5065

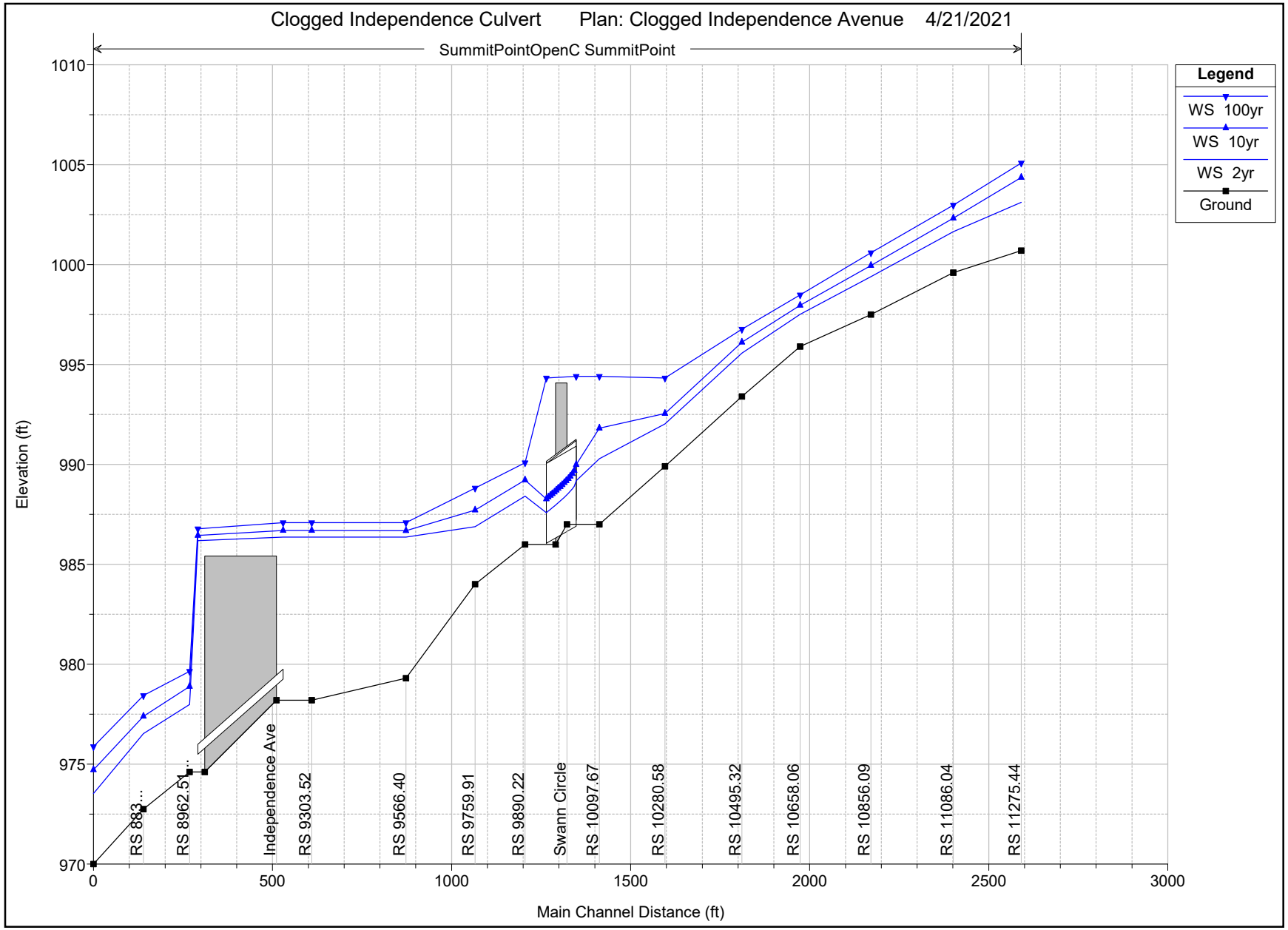
Clogged Independence Ave Culvert Conditions

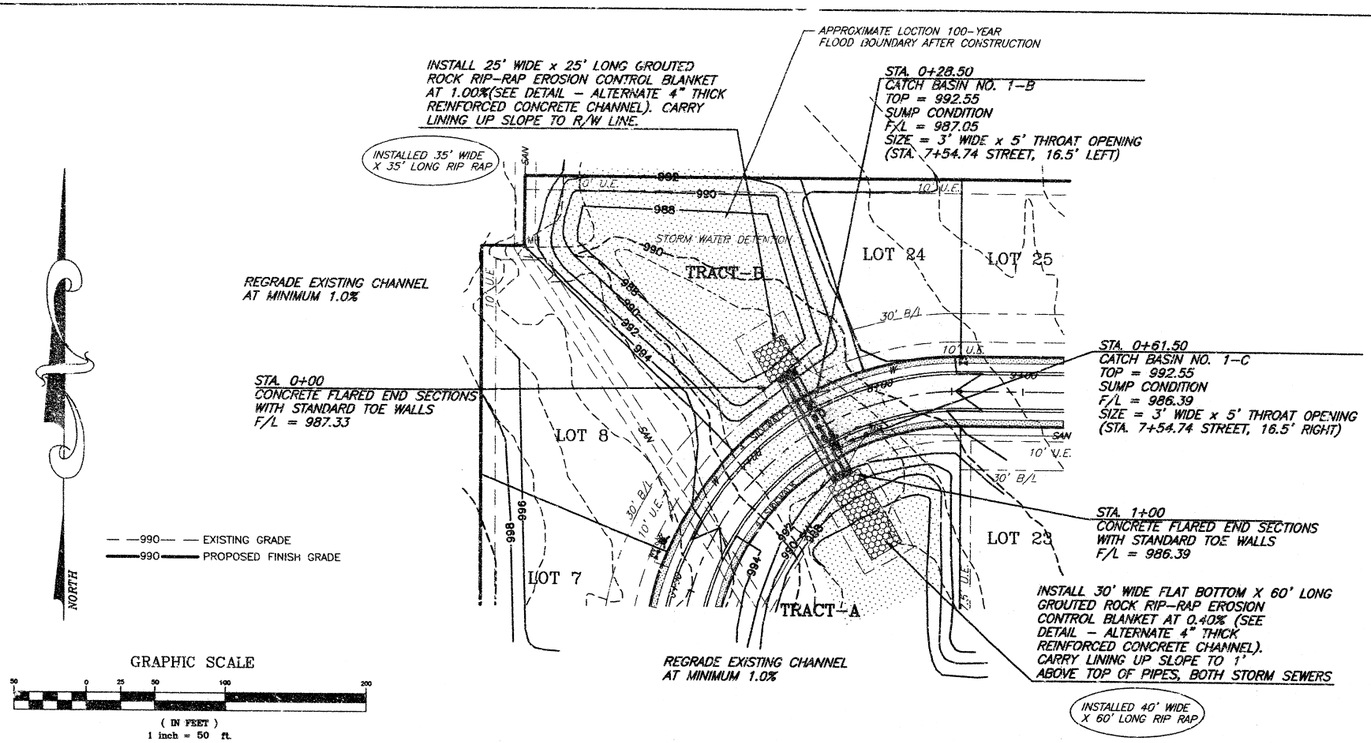
HEC-RAS Plan: ClogIndependence River: SummitPointOpenC Reach: SummitPoint

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	8693.92	2yr	144.00	970.00	973.53	973.53	974.45	0.014489	7.71	18.67	10.37	1.01
SummitPoint	8693.92	10yr	273.00	970.00	974.71	974.71	975.74	0.009351	8.22	38.70	29.73	0.87
SummitPoint	8693.92	100yr	485.00	970.00	975.88	975.88	976.86	0.006529	8.70	90.64	59.22	0.77
SummitPoint	8833.36	2yr	144.00	972.75	976.52	976.52	977.28	0.014109	6.96	20.69	13.84	1.00
SummitPoint	8833.36	10yr	273.00	972.75	977.39	977.39	978.34	0.013094	7.82	34.93	19.03	1.02
SummitPoint	8833.36	100yr	485.00	972.75	978.43	978.43	979.51	0.009582	8.36	62.28	44.48	0.92
SummitPoint	8962.51	2yr	144.00	974.61	977.98		978.40	0.005623	5.18	27.80	15.44	0.68
SummitPoint	8962.51	10yr	273.00	974.61	978.88		979.50	0.006207	6.29	43.38	19.33	0.74
SummitPoint	8962.51	100yr	485.00	974.61	979.64	979.40	980.68	0.008505	8.17	59.38	22.65	0.89
SummitPoint	9223.75		Culvert									
SummitPoint	9303.52	2yr	135.00	978.20	986.37	981.27	986.37	0.000012	0.55	654.00	280.25	0.04
SummitPoint	9303.52	10yr	255.00	978.20	986.69	982.13	986.69	0.000031	0.91	745.66	288.57	0.06
SummitPoint	9303.52	100yr	454.00	978.20	987.09	983.26	987.10	0.000068	1.39	863.81	298.94	0.09
SummitPoint	9566.40	2yr	135.00	979.30	986.37		986.38	0.000050	0.97	255.31	142.81	0.08
SummitPoint	9566.40	10yr	255.00	979.30	986.69		986.72	0.000130	1.62	303.41	157.62	0.12
SummitPoint	9566.40	100yr	454.00	979.30	987.08		987.15	0.000283	2.51	369.60	175.97	0.18
SummitPoint	9759.91	2yr	135.00	984.00	986.89	986.89	987.60	0.013004	6.76	19.98	14.11	1.00
SummitPoint	9759.91	10yr	255.00	984.00	987.71	987.71	988.62	0.011960	7.65	33.32	18.38	1.00
SummitPoint	9759.91	100yr	454.00	984.00	988.82	988.82	989.72	0.007067	7.81	75.39	69.47	0.83
SummitPoint	9890.22	2yr	135.00	986.00	988.41		988.56	0.003910	3.11	43.37	42.75	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	0.001628	2.78	163.09	98.81	0.38
SummitPoint	10032.93		Culvert									
SummitPoint	10097.67	2yr	135.00	987.00	990.29	988.69	990.31	0.000459	1.29	104.30	76.68	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	994.41	989.80	994.41	0.000031	0.71	642.18	171.80	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	0.001927	3.52	185.39	110.41	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

Summit Point Apartments, Phase-II
HEC-RAS Analysis of Tributary P3
to Prairie Lee Lake, Lee's Summit, MO
April 21, 2021, CFS Proj. #21-5065

Clogged Independence Ave Culvert Conditions



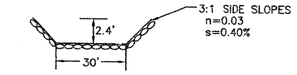


DISCHARGE AT DOWNSTREAM END OF PLAT
(AT INDEPENDENCE AVENUE)

EXISTING 48" RCP
F/L = 979.0, R/W = 983.0
AT HW/D = 1.5, Q = ±125 CFS

EXISTING STORM SEWER IS OF INADEQUATE CAPACITY TO CARRY RUNOFF FROM A FULLY DEVELOPED WATERSHED.

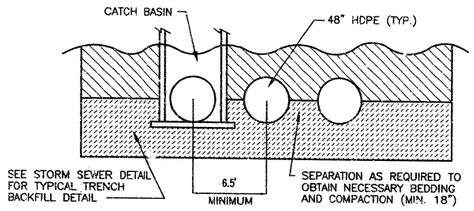
DISCHARGE FROM OUTLET EROSION CONTROL BLANKET



Q=440 CFS AT DEPTH OF 2.4'
V=4.9 FPS

NOTES:

1. CONTRACTOR TO VERIFY EXACT LOCATION AND DEPTH OF EXISTING SANITARY SEWER MAIN PRIOR TO CONSTRUCTION.
2. ALL DISTANCES ARE CENTER OF STRUCTURE TO CENTER OF STRUCTURE.



TYPICAL INSTALLATION
3 x 48" HDPE
NO SCALE

STORM RUNOFF, NE SWANN ROAD

DRAINAGE AREA = 130 ACRES
T(c) = 15 MINUTES MAXIMUM
i(10) = 5.2, i(100) = 7.4
ASSUMED FULLY DEVELOPED WATERSHED, COMBINATION COMMERCIAL AND RESIDENTIAL.
C = 0.65
Q(10) = 440 CFS, Q(100) = 625 CFS

CAPACITY OF STREET CROSSING (10 YEAR STORM)

STORM PIPE = 48" HDPE
N = 0.012
CONVEYANCE FACTOR = 1555.3
SLOPE = 1.0%

Q = KS 1/2 = 155 CFS

CROSSING = 3 x 155 = 465 CFS

V AT DISCHARGE = 12.3 FPS (FROM PIPES)

DETENTION VOLUME CALCULATIONS

DRAINAGE AREA (MAPLE TREE MANOR) = 16.7 ACRES

C(B) = 0.2
C(A) = 5 AC. @ 0.2 AND 11.7 AC. @ 0.4 (ARTICLE IV-A-3) = 0.34

T(CB) = 15 MINUTES MAXIMUM, i(25) = 6.0, Q(B) = 20.0 CFS
T(CA) = 10.4 MINUTES, i(25) = 7.0, Q(A) = 39.7 CFS

V = 30 (Q(A) - Q (B)) K T(C) = 30 (39.7 - 20.0) (1.20) (10.4)
= 7375 CUBIC FEET

DETENTION PROVIDED AT CROSSING

ELEVATION	STORAGE	RELEASE RATE
987.5	0	0
988	3,150 cf	±15 cfs
990	33,750 cf	240 cfs
992	76,950 cf	420 cfs

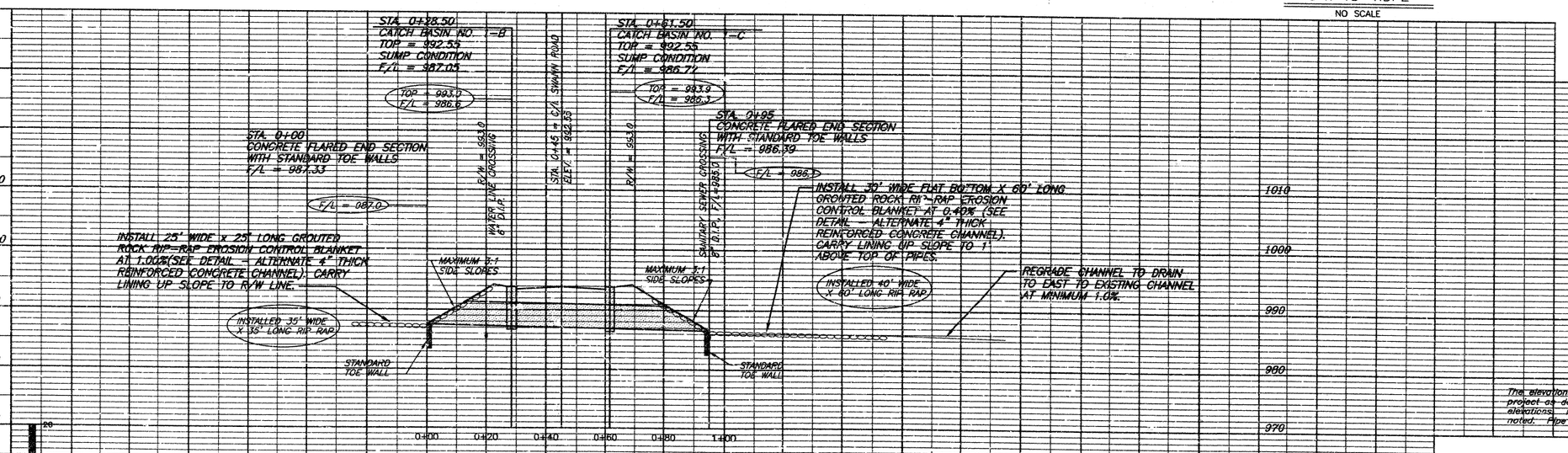
REQUIRED STORAGE = 7,375 CUBIC FEET AT ELEV. 988.2
AT R/W ELEVATION OF 993, ±105,000 CUBIC FEET OF STORAGE IS UTILIZED, BEFORE "OVER TOPPING" OF BERM.
RELEASE RATE FROM POND CONTROLLED BY HEADWATER DEPTH.

100-YEAR STORM

Q(100) = 625 CFS
Q(CAPACITY) OF STORM CROSSING = 465 CFS
ADDITIONAL RUNOFF = (625-465) = 160 CFS
ADDITIONAL RUNOFF FROM 100-YEAR STORM WILL "OVER TOP" R/W BERM AND FLOW ACROSS STREET. DEPTH OF RUNOFF CROSSING ROAD = ±0.25'.
MINIMUM LOW OPENING, LOTS 7, 8, 24 AND 25 TO BE 995.0.

100-YEAR STORM

BASED ON FEMA MAP, ESTIMATED 100-YEAR STORM ELEVATION AT STREET CROSSING = 992-994. HIGH WATER ELEVATION AFTER CONSTRUCTION = 993.25



3 PIPES
95.00' AT 1.00%
48" HDPE
(ALTERNATE 3 x 48" RCP, CLASS III)

"AS-BUILT"

The elevations shown as "⬭" represent the elevations for this storm sewer on this project as determined this date. Grades shown as "⬭" were calculated from said elevations. Horizontal alignment is in substantial conformity with this drawing unless noted. Pipe size used, depth of cover and clearances provided by contractor and City.

DATE	REVISION	NO.	BY	CK/APP
5/8	Revised Calculations	1	MGW	LRH
9/15	See Cover Sheet	2	MWH	LRH
10/30	Specified RCP End Section per City	3	MWH	LRH
8/21	"AS-BUILT"	4	DEL	LRH

MAY 15, 1996

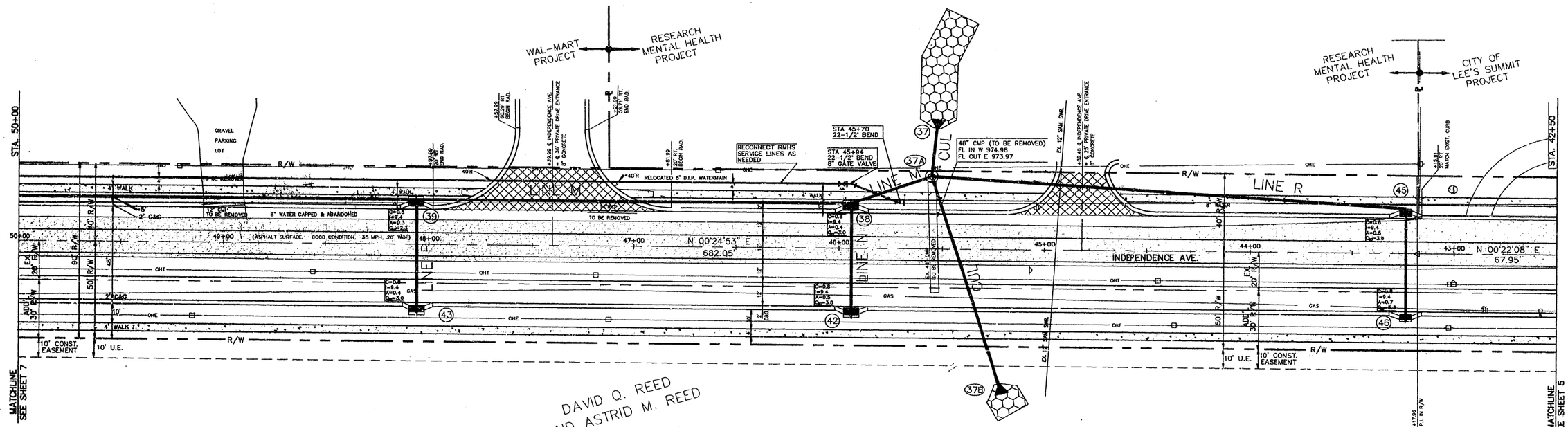
PLAN AND PROFILE
STORM SEWER NO. 1
MAPLE TREE MANOR
LOTS 1 THRU 37
LEE'S SUMMIT JACKSON COUNTY MISSOURI

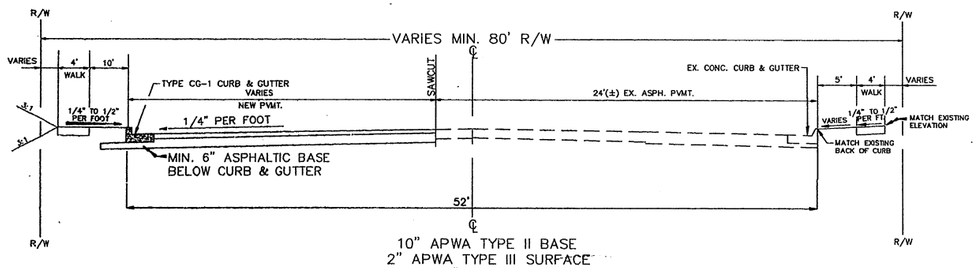
E.J. WERNER & ASSOCIATES
CONSULTING ENGINEERS LAND SURVEYORS

DESIGNED LRH CHECKED
DETAILED MWH APPROVED
SCALE NOTED DATE MAY 15, 1996

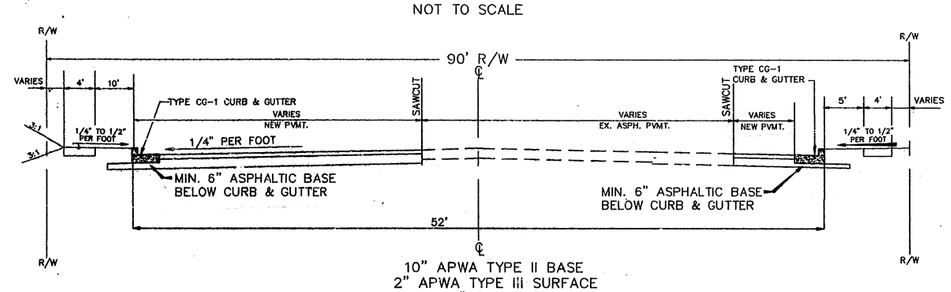
SHEET 9 OF 20

4624





10" APWA TYPE II BASE
2" APWA TYPE III SURFACE
OR 9" CONCRETE
EITHER OPTION INSTALLED ON 6"-95%
COMPACTED SUBGRADE (STD PROCTOR DENSITY)
TYPICAL SECTION - INDEPENDENCE AVE.
STA. 41+85(±) TO 43+15.81
NOT TO SCALE



10" APWA TYPE II BASE
2" APWA TYPE III SURFACE
OR 9" CONCRETE
EITHER OPTION INSTALLED ON 6"-95%
COMPACTED SUBGRADE (STD PROCTOR DENSITY)
TYPICAL SECTION - INDEPENDENCE AVE.
STA. 43+15.81 TO STA. 55+84.26
NOT TO SCALE

CULVERT STORM SEWER LINE

(37) STA. 45+52.53 ℄ INDEP. AVE. 66.48' RT. CONST. 29.46 LF-54" RCP @ 1.00% W/FES & TOEWALL AND 55 LF OF RIPRAP FL(out)= ~~977.90~~ 976.79

(37A) STA. 45+55.42 ℄ INDEP. AVE. 37.16' RT. CONST. 4'x7' ,B-CUL1 116.76 LF-48" RCP @ 1.00% (CULVERT) 41.08 LF-24" RCP @ 1.00% (LINE M) 232.04 LF-15" RCP @ 2.25% (LINE R) TOP = 985.~~60~~ 49 FL(ln-CUL)= ~~977.79~~ 978.08 FL(ln-M)= 978.~~69~~ 33 FL(ln-R)= ~~980.88~~ 979.68 FL(out)= 977.~~29~~ 08

(37B) STA. 45+20.57 ℄ INDEP. AVE. 74.30' LT. CONST. 48" FES & TOEWALL W/ 10 LF OF RIPRAP END OF CULVERT FL(in)=~~978.96~~ 979.25

STORM SEWER LINE N

(38) STA. 45+93.99 ℄ INDEP. AVE. 33.00' RT. CONST. 4'x5' CIS-N1 212.01 LF-18" RCP @ 2.50% (LINE M) 58.00 LF-15" RCP @ 0.50% (LINE N) TOP = 985.~~00~~ 41 FL(ln-M)= 979.~~56~~ 51 FL(ln-N)= 980.~~91~~ 61 FL(out)= ~~970.00~~ 978.91

(39) STA. 48+05.99 ℄ INDEP. AVE. 23.00' RT. CONST. 3'x5' CIS-M2 311.36 LF-15" RCP @ 2.72% (LINE M) 58.00 LF-15" RCP @ 0.50% (LINE P) TOP = ~~988.91~~ 989.48 FL(ln-M)= ~~986.41~~ 984.98 FL(ln-P)= 984.~~31~~ 68 FL(out)=~~983.80~~ 984.48

STORM SEWER LINE N

(42) STA. 45+93.99 ℄ INDEP. AVE. 35.00' LT. CONST. 3'x5' CIS-N1 END OF LINE N TOP = 985.~~20~~ 28 FL(out)= ~~981.20~~ 980.88

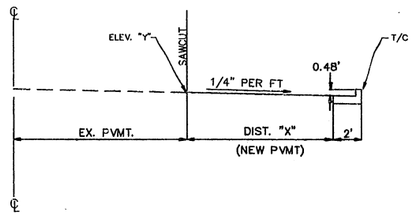
STORM SEWER LINE P

(43) STA. 48+05.99 ℄ INDEP. AVE. 35.00' LT. CONST. 3'x5' CIS-P1 END OF LINE P TOP = ~~988.71~~ 989.11 FL(out)= ~~984.60~~ 985.11

STORM SEWER LINE R

(45) STA. 43+23.81 ℄ INDEP. AVE. 23.00' RT. CONST. 3'x5' CI-R1 58.00 LF-15" RCP @ 1.00% TOP = 992.50 FL(in)= 986.~~67~~ 00 FL(out)= ~~986.10~~ 984.60

(46) STA. 43+23.81 ℄ INDEP. AVE. 35.00' LT. CONST. 3'x5' CI-R2 TOP = ~~992.55~~ 01 FL(out)=~~987.25~~ 04



STAKING FORMULA (TYP. ABOUT ℄):
ELEV. "Y" - (DIST. "X" x 1/4" PER FT.) + 0.48' = T/C
(ELEV. "Y" AND DIST. "X" VERIFIED AT EACH STA.)

LEGEND

PROPOSED CONC. WALK

EXIST. PAVEMENT

PROPOSED CONC. DRIVEWAY

SCALE: 1" = 20'

AS-BUILT

STATE OF MISSOURI — STANLEY HARRIS — NUMBER E-19737 — REGISTERED PROFESSIONAL ENGINEER

2	2/3/03	MISC. REVISIONS	SHE
1	12/14/02	CITY RESUBMITTAL	SHE

INDEPENDENCE AVE. - STA. 42+50 TO 50+00

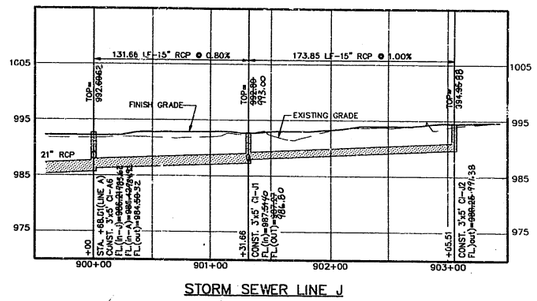
P.O. BOX 1304
2370 NORTH JACKSON
JUNCTION CITY, KANSAS
66441
(913) 762-2049
FAX 913-762-7744

KAW VALLEY ENGINEERING

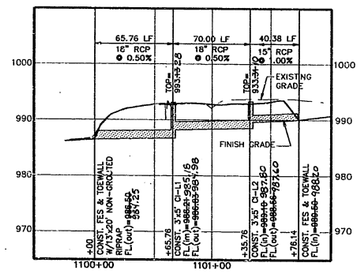
128 N.W. PARKWAY
RIVERSIDE, MISSOURI
64150
(816) 587-3232
FAX 816-587-3239

PROJ. NO.	10.521
DATE	10-28-02
CAD BY	WJB
CHECKED BY	
C.F.N.	SHEET5
SHEET 8 OF 14	

8154



STORM SEWER LINE J



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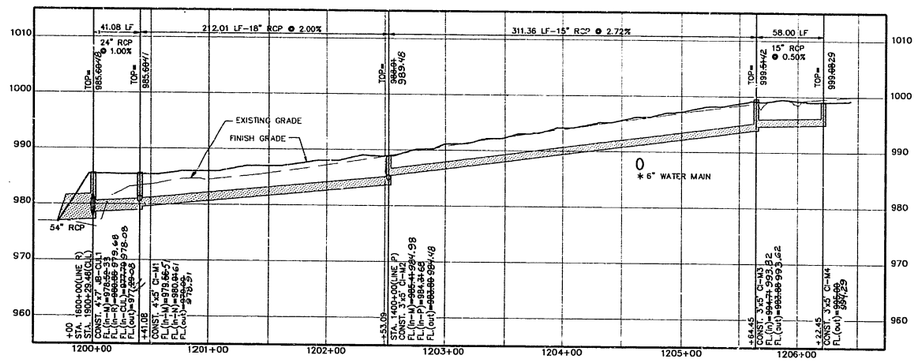

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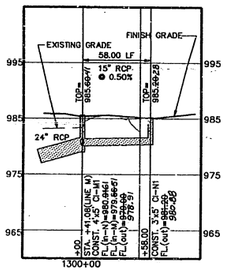
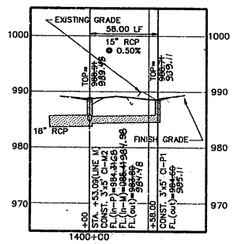
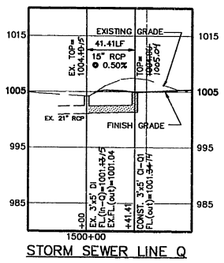


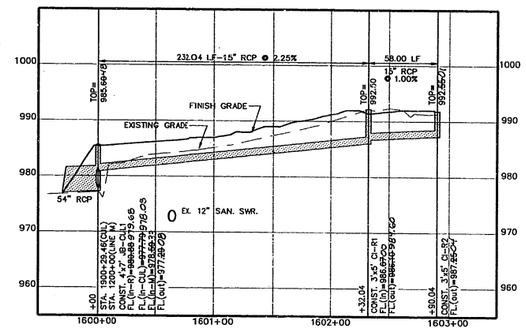
STORM SEWER LINE N



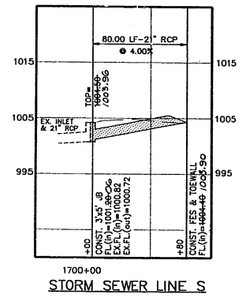
STORM SEWER LINE P



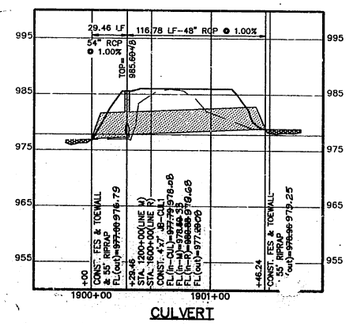
STORM SEWER LINE Q



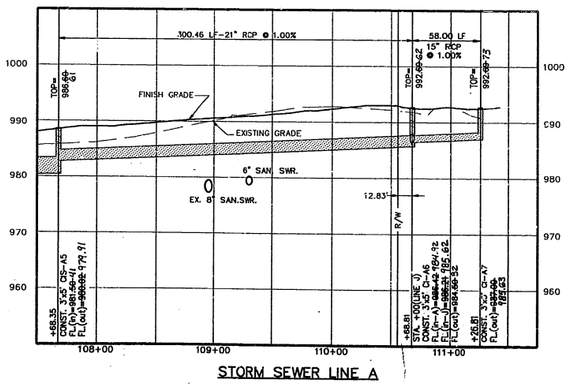
STORM SEWER LINE R



STORM SEWER LINE S



CULVERT



STORM SEWER LINE A

AS-BUILT

STATE OF MISSOURI
JEFFREY ALLEN LANGSTON
2002
PROFESSIONAL ENGINEER

* NOTE:

1. DEFLECT WATER MAIN UNDER STORM SEWER AS SHOWN, PER AWWA STANDARDS AND SPECIFICATIONS

2	2/3/93	MISC. REVISIONS	SHE
1	12/14/92	CITY RESUBMITAL	SHE

STORM SEWER PROFILES

KAW VALLEY ENGINEERING

P.O. BOX 1304
3318 NORTH JACKSON
JUNCTION CITY, KANSAS
66441
(913) 762-2040
FAX 913-762-7744

122 N.W. PARKWAY
RIVERSIDE, MISSOURI
64150
(816) 587-3033
FAX 816-587-0329

PROJ. NO.	10.691
DATE	11/30/92
CAD BY	CTD
CHECKED BY	
C.F.N.	SHEET
SHEET	9 OF 14

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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.

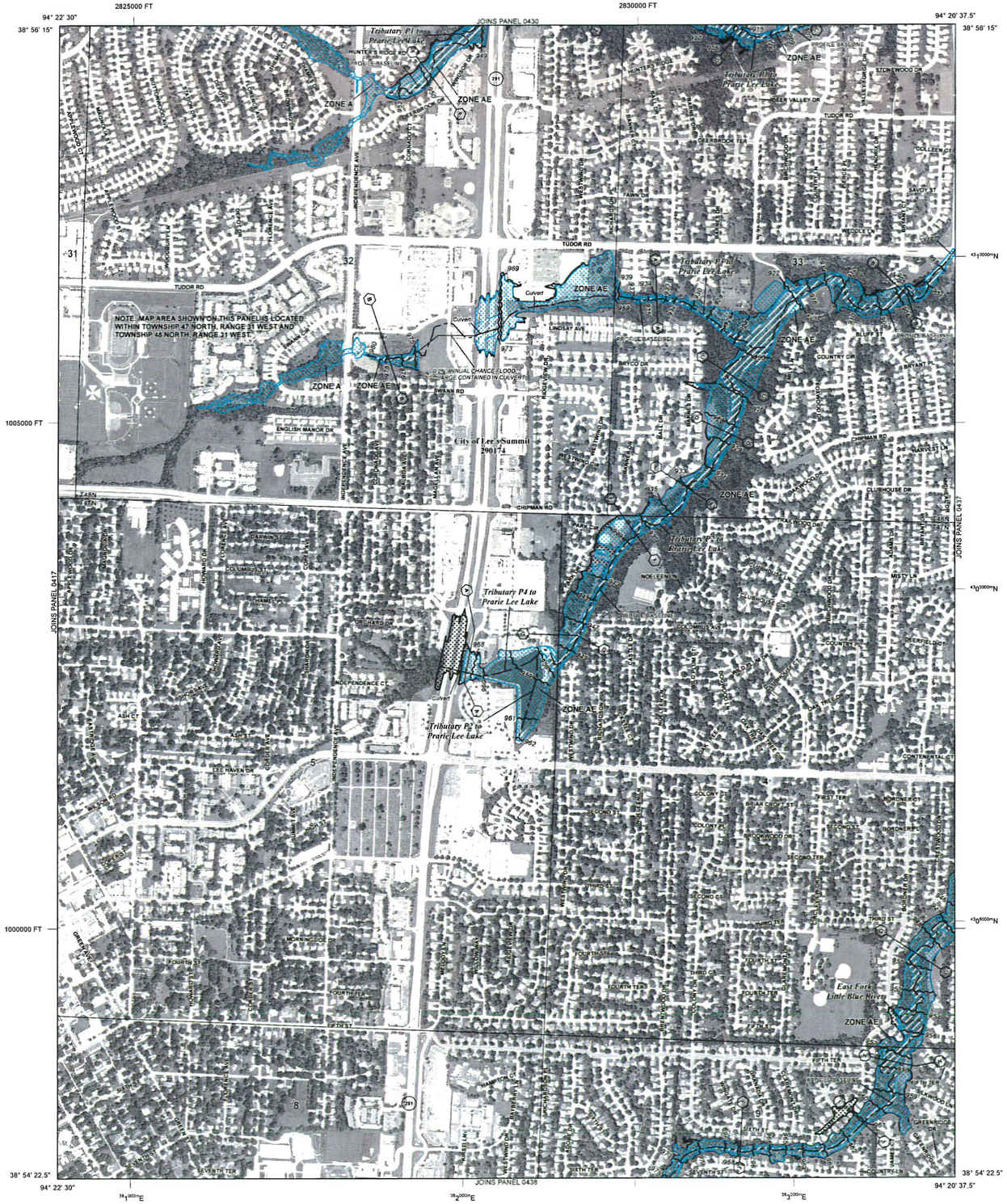
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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