SUMMIT 470 LOGISTICS CENTER PRELIMINARY STORM DRAINAGE STUDY

Prepared for:

Ryan A+E, Inc.
533 South Third Street, Suite 100
Minneapolis, MN 55415
Contact Name: Dustyn Curran
Email: dustyn.curran@ryancompanies.com
Phone: 515-309-8544

November 2022

Olsson Project No. 022-03974

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1. GENERAL INFORMATION

Summit 470 Logistics Center is a proposed 41.93-acre industrial development. This study will provide storm analysis and detention calculations of the project. The development will be split into two lots. Lot 1 (35.99 ac.) contains a 465,000 sq ft building, paved parking lots and driveways, two detention tracts, and utility main extensions. Lot 2 (5.94 ac.) will be partially graded to generate earthwork for Lot 1 and tie in a private drive while the rest of the lot will remain undisturbed. The entire site lies within the Little Cedar Creek – Little Blue River watershed with multiple outfalls throughout the site. Approximately 16.43 acres discharges west through an existing culvert and 6.86 discharges north through an existing culvert.

1.1 Project Location

Summit 470 Logistics Center is located partially in the City of Lee's Summit, Missouri and partially in Unity Village, Missouri. The area to be developed is bounded by a railroad and industrial park to the south, Main St. to the west, I-470 to the north, and a medical facility to the east.

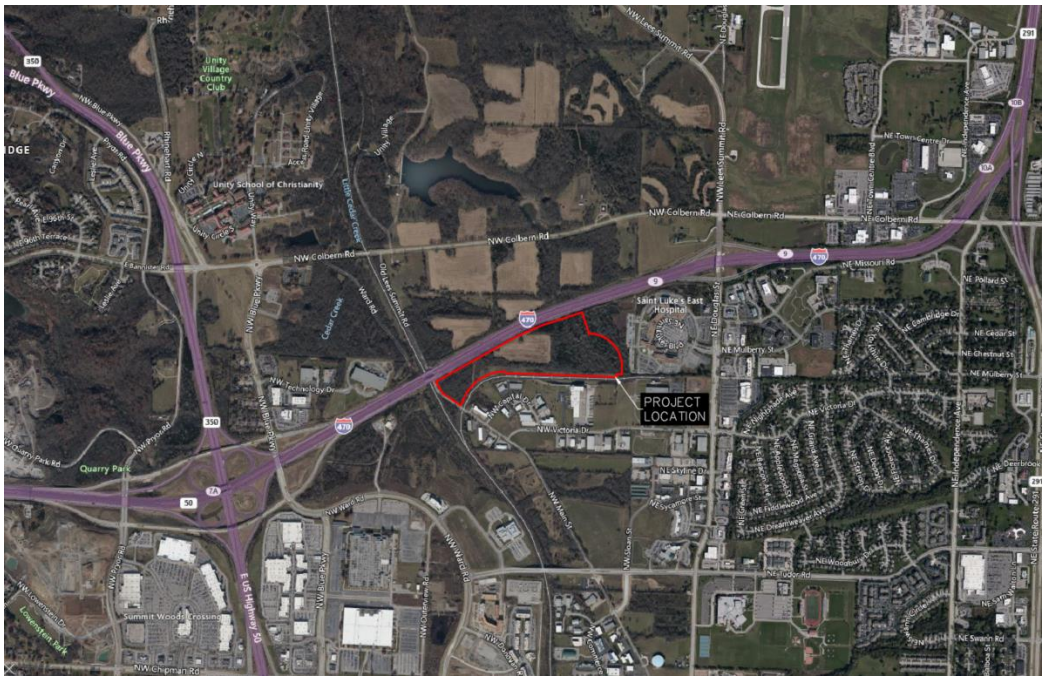

Figure 1. Summit 470 Logistics Center Location Map

1.2 Federal Emergency Management Agency Floodplain Classification

The site lies entirely within areas determined to be outside the 0.2% annual chance floodplain (unshaded Zone X) as depicted on the FEMA Flood Insurance Rate Map (FIRM) Community Panel No 29095C0409G (Village of Unity; City of Kansas City; City of Lee's Summit), revised January 20th, 2017. A copy of the FEMA FIRM panel is included in Appendix E.

1.3 Soil Classifications

A geotechnical investigation has not been completed for this site. Soil Maps published in the NRCS Web Soils Survey for Jackson County, Missouri categorizes soils in the watershed as:

Table 1. Soil Classifications

Symbol	Name	Slopes	Hydrologic Soil Group
10082	Arisburg-Urban land complex	1-5%	C
10120	Sharspburg silt loam	2-5%	C
10129	Sharpsburg-Urban land complex	5-9%	D
30080	Greenton silty clay loam	5-9%	C/D
40107	Snead-Rock outcrop complex, warm	5-14%	D

NRCS Runoff Curve Numbers (CN's) in this study have been assigned to tributary areas onsite based upon these Hydrologic Soil Groups and associated existing and proposed land use. Land uses were determined using zoning maps, aerial photos, and site visits. A copy of the NRCS printout is included in Appendix D.

1.4 Existing Stormwater Studies and Systems

No existing stormwater studies have been discovered.

2. METHODOLOGY

The base data for the models prepared for this report has been obtained from available online maps and aerial imagery. Stormwater management is based upon methods and objectives defined in the Kansas City Metropolitan Chapter of the American Public Works Association's (KC-APWA) 2011 design guidance document called "Section 5600 Storm Drainage Systems & Facilities" (2011).

The Existing Conditions hydrology will be evaluated in Section 3, and Proposed Conditions hydrology will be computed in Section 4. The Proposed Conditions discharge data for each stage of development will be compared to the Existing Conditions results; variations in quantity and rate of stormwater discharge between these models will represent the hydrologic impact generated by the proposed development. The overall stormwater management plan will be designed utilizing this information. Section 3 assumes current land use within the tributary sub-watersheds, and pre-development conditions within the project boundary. Section 4 assumes current land use within the tributary sub-watersheds, and proposed conditions within the project area boundary.

The following methods were used in this study to model existing and proposed conditions for stormwater runoff:

Hydraflow Hydrographs Extension Version 12

- Soil Conservation Survey (SCS) Unit Hydrograph Method
  - 2-year, 10-year, and 100-year Return Frequency Storms
  - Antecedent Moisture Conditions (AMC) II Soil Moisture Conditions
  - 24-Hour SCS Type II Rainfall Distribution
  - SCS Runoff Curve Numbers per SCS TR-55 (Tables 2-2a – 2-2c)
  - SCS TR-55 methods for determination of time of concentration and travel time. Where specific data pertaining to channel geometry is not available, length and velocity estimates for channel flow travel time is used per Section 5600, KC-APWA Standard Specifications and Design Criteria.

In addition to the hydrologic evaluation, analysis is also required to provide extended detention control of the 90% mean annual event storm event.

Stormwater runoff models were created for the 2-, 10-, and 100-year design storm events. The precipitation depths used in the analyses have been interpolated from the "Technical Paper No.40 Rainfall Frequency Atlas of the United States" (TP-40) isopluvial maps (May 1961). The following Table 2 summarizes the rainfall depths used in this analysis:

Table 2. Precipitation Depths.

Return Period	24-Hour Precipitation Depth (in.)
90% Mean Annual Event	1.37
2-Year (50% Storm)	3.60
10-Year (10% Storm)	5.34
100-Year (1% Storm)	7.90

The following is a summary of the primary points of interest to the watersheds modeled in this report:

- **Outfall A** is the discharge point for the northern area of Summit 470 Logistics Center as well as for small portion of Missouri Department of Transportation (MoDOT) right-of-way (R/W) along Interstate 470. This outfall is an existing culvert conveying flow under I-470 to Unity Village Lake, and then discharging into Little Cedar Creek. Runoff from the proposed project area discharging through Outfall A will be controlled by an extended dry detention basin.
- **Outfall B** is the discharge point for the western & southern area of Summit 470 Logistics Center as well as the existing industrial park and a couple of industrial sites along NW Victoria Drive. This outfall is an existing 6'x6' reinforced concrete box culvert conveying flow under Main St., and then discharging into Little Cedar Creek. Runoff from the proposed project area discharging through Outfall B will be controlled by an extended dry detention basin.

3. EXISTING CONDITIONS

3.1 Existing Site Description

The existing site consists of mostly grassed and wooded vegetation, and straight row crops. It is bounded by Main St., I-470, a railroad, an industrial park, and a medical facility as described in Section 1, above. The total onsite Project Area encompasses 41.93 acres. Overall, the modeled stormwater drainage area encompasses 114.18 acres and is divided into the 3 areas and subareas that are tributary to the outfalls described in Section 2, above.

3.2 Existing Site Hydrology

Site topography and hydrology for project areas that are tributary to each outfall are as follows:

Outfall A

Onsite area that are tributary to Outfall A generally slope from south to north with surface grades up to 16%. Offsite areas north of the site that are tributary to Outfall A slope from north to south, with surface grades up to 33%. Steep slopes (3H:1V) are present in the wooded areas along the MoDOT R/W. Runoff is conveyed via sheet flow and shallow concentrated flow across the project area and offsite areas. No natural channels have been observed throughout the tributary area to Outfall A. This outfall is an existing culvert conveying flow under I-470 to Unity Village Lake, and then discharging into Little Cedar Creek.

Outfall B

There are two onsite areas that are tributary to Outfall B with the difference in the way of conveyance to the discharge point. Approximately half of the onsite tributary area slopes from northeast to southwest, with surface grades up to 33%. Runoff is conveyed via sheet flow and shallow concentrated flow, as well as via channel flow through an existing swale along the north side of the railroad to an existing 6’x6’ reinforced concrete box culvert at Point of Interest B1.

The other half of onsite tributary area slopes from north to south, with surface grades up to 10%, which gets picked up by existing culvert under the railroad. The culvert is a part of an existing complex storm sewer network, which conveys stormwater through the industrial park, then discharges into an existing detention basin at Point of Interest B2.

Offsite areas south of the site that are tributary to Outfall B slope from east to west and are conveyed to the existing detention basin at Point of Interest B2 through an existing storm sewer network.

Runoff Curve Numbers have been developed for each outfall area based upon the current land use obtained from survey data, aerial photography, and site visits. Existing site model input data is summarized in Table 3-1, below. Refer to the Existing Conditions - Drainage Map (EXH-01)

and Existing Conditions - Land Cover (EXH-02) in Appendix A, and model calculations in Appendix B for Runoff Curve Number (CN) and Time of Concentration (Tc) calculations.

Table 3-1. Existing Site Data

Existing Site Data					
Subbasin	On-Site Area (ac.)	Off-site Area (ac.)	Total Drainage Area (ac.)	CN	Tc (min)
A	5.21	1.65	6.86	78.68	11.8
B1	9.32	7.11	16.43	82.00	16.2
B2	12.13	78.76	90.89	86.54	17.0

These routings, drainage area, CN and Tc values for the corresponding areas were used as input to the Existing Conditions model to evaluate the existing stormwater hydrology for the project. The resulting peak flows of the hydrologic routing are provided in Table 3-2, below. Hydrographs and model output data can be found in its entirety in Appendix B.

Table 3-2. Existing Peak Discharge Rates

Existing Peak Discharge Rates			
Outfall	**Q_2 (cfs)**	**Q_{10} (cfs)**	**Q_{100} (cfs)**
Outfall A	16.21	30.63	52.78
Outfall B	151.19	203.36	419.23

Per APWA Section 5608.4 and the City of Lee's Summit criteria, the performance criteria for comprehensive control is to provide detention to limit peak flow rates at downstream points of interest to maximum release rates:

- 50 percent storm peak rate less than or equal to 0.5 cubic feet per second (cfs) per site acre
- 10 percent storm peak rate less than or equal to 2.0 cfs per site acre
- 1 percent storm peak rate less than or equal to 3.0 cfs per site acre

Extended detention of the 90 percent mean annual event is also required for comprehensive control per APWA Section 5608.4.

Allowable release rates were calculated for the points of interest, allowing that off-site peak discharges would be permitted to bypass the detention. Off-site bypass peak flow rates were calculated as the site's percentage of the existing conditions, relating to the percentage of off-

site area flowing to each point. The release rates for the proposed development on the development site were calculated based on the detention criteria. The development release rates were added to the bypass peak flow rates to calculate an allowable peak flow rate for each outfall as follows. Tables 3-3 and 3-4 below summarize the amount of area on-site and the allowable discharges for each storm event.

Table 3-3. Outfall On-Site Area

Outfall	Total Area (ac.)	On-Site Area (ac.)	Percent (%) On-Site
Outfall A	6.86	5.21	75.9
Outfall B	107.32	21.45	20.0

Table 3-4. Allowable Peak Flow Rates

Outfall	Allowable 2-Year Q (cfs)	Allowable 10-Year Q (cfs)	Allowable 100-Year Q (cfs)
Outfall A	6.50	17.79	28.32
Outfall B	131.68	205.59	399.73

4. PROPOSED CONDITIONS

4.1 Proposed Site Description

Summit 470 Logistics Center contains a 465,000 sq ft building, paved parking lots and driveways, two detention tracts, and utility main extensions. The sections below will provide updated model calculation results for Proposed Conditions. The updates will account for proposed tributary shifts caused by detention facilities, site grading, and storm sewer infrastructure within the development.

4.2 Proposed Conditions Site Hydrology

The proposed model, as in the existing model, will be divided between Outfalls A and B. Due to the tributary shifts caused by site grading and sewer construction, the limits of existing subareas will be adjusted as shown on the Proposed Conditions - Drainage Map in Appendix A. Table 4-1, below, provides a summary of the proposed subareas. To ensure accurate model results, Point of Interest B3 was introduced to account for drainage to be detained in west basin. Refer to the Proposed Conditions - Drainage Map (EXH-03) and Proposed Conditions – Land Cover (EXH-04) in Appendix A and model calculations in Appendix C for Runoff Curve Number (CN) and Time of Concentration (Tc) calculations.

The analysis provided in Section 3 established existing conditions of the development's drainage areas. The analysis in this section will provide guidance for configuring the detention basin to meet the objectives established in Section 3.

The following tables summarize the results of the proposed conditions analysis. Tables 4-1 and 4-2 assume no detention is provided, to demonstrate the effects of development for each drainage area. Refer to Appendix C for output from and a schematic of the proposed conditions Hydraflow Hydrographs model.

Table 4-1. Proposed Site Data

Proposed Site Data			
Area	Drainage Area (ac.)	CN	Tc (min)
A	16.87	92.36	21.0
B1	12.05	84.50	5.0
B2	77.35	88.64	17.0
B3	15.46	96.03	21.3

Table 4-2. Proposed (No Detention) Conditions Peak Flow Rates

Proposed (No Detention) Peak Discharge Rates			
Outfall	**Q_2 (cfs)**	**Q_{10} (cfs)**	**Q_{100} (cfs)**
Outfall A	48.26	76.19	116.92
Outfall B	169.77	235.75	369.82

Table 4-2 shows post-development peak discharge values points of interest assuming no detention is provided. Table 4-3 compares these to the existing conditions from Section 3 at the points of interest. Negative values indicate a reduction in peak flow rate, while positive values indicate an increase. Without detention, flow rates will increase at both outfalls for almost all storm events.

Table 4-3. Proposed (No Detention) vs Existing Conditions

Proposed (No Detention) Peak Discharge Rates			
Outfall	**Q_2 (cfs)**	**Q_{10} (cfs)**	**Q_{100} (cfs)**
Outfall A	32.05	45.56	64.14
Outfall B	18.58	32.39	-49.41

Two extended dry bottom detention basins, North Basin and West Basin, are going to treat runoff from Areas A and B3 respectively. Details of the detention basins are provided below.

North Basin

- Top of Basin Elevation = 983.90’
- Minimum Basin Elevation = 977.00’
- 100’ Emergency Spillway at 982.80’
  Primary Outfall:
- 5’x5’ Control Structure with: 5” circular orifice at 977.00’ and 12”x48” opening at 981.00’
- 24” Outfall Pipe Elevation = 977.00’

West Basin

- Top of Basin Elevation = 975.70’
- Minimum Basin Elevation = 965.70’
- 100’ Emergency Spillway at 974.40’
  Primary Outfall:
- 5’x5’ Control Structure with: 6” circular orifice at 965.70’ and 12”x36” opening at 970.20’

- 24” Outfall Pipe Elevation = 965.70’

Table 4-4 below includes a hydrologic summary of the proposed detention facilities.

Table 4-4. Proposed Conditions Detention Basin Data

	Peak Q In (cfs)	T_P In (hr.)	Peak Q Out (cfs)	T_P Out (hr.)	Max V_R (ac-ft)	Peak W.S.E. (ft)
North Basin						
2-Year	43.77	12.10	0.63	22.53	2.84	980.72
10-Year	68.40	12.10	3.78	13.77	3.85	981.37
100-Year	104.15	12.10	16.20	12.57	5.33	982.23
West Basin						
2-Year	48.65	12.10	8.75	12.53	2.17	971.01
10-Year	73.71	12.10	18.78	12.47	3.19	972.15
100-Year	110.25	12.10	26.73	12.47	4.85	973.83

4.3 Effects of Proposed Detention

The following tables compare the results of the proposed conditions analysis with the detention described above to the existing conditions from Section 3 at the outfalls. Table 4-5 shows peak discharge values at outfalls in the proposed conditions. Tables 4-6 and 4-7 compare these discharge values to existing and allowable discharge values. In Tables 4-6 and 4-7, negative values indicate a reduction in peak flows, while positive values indicate an increase. With the addition of the detention facility, peak discharges at all outfalls will be below the allowable release rates and below rates in the existing conditions

Table 4-5. Proposed Conditions Updated Outfalls Summary

Outfall	Q_2 (cfs)	T_{P-2} (hr)	Q_{10} (cfs)	T_{P-10} (hr)	Q_{100} (cfs)	T_{P-100} (hr)
A	6.45	12.00	10.85	12.00	17.96	12.50
B	131.03	12.30	180.29	11.97	320.94	12.30

Table 4-6. Proposed Conditions vs Allowable Release Rates

Outfall	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A	-0.05	-6.94	-10.36
B	-0.65	-25.30	-78.79

Table 4-7. Proposed Conditions vs Existing Conditions

Outfall	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A	-9.76	-19.78	-34.82
B	-20.16	-23.07	-98.29

5. RESULTS AND CONCLUSION

This Stormwater Drainage Study has been prepared for the proposed project to establish a comprehensive stormwater management plan for the site. The proposed stormwater management plan has been designed to achieve compliance with current design criteria in effect for the City of Lee's Summit, Missouri.

As shown in the discussion and tables in the previous sections, although total runoff volumes generated by the proposed development are increased due to increase in impervious surfaces within the site, the proposed detention basins adequately reduce the peak stormwater rate to meet Allowable Release Rates. Both outfalls A and B also show decreased flowrates compared to those in existing conditions.

This study demonstrated the overall compliance with KCAPWA Section 5600.

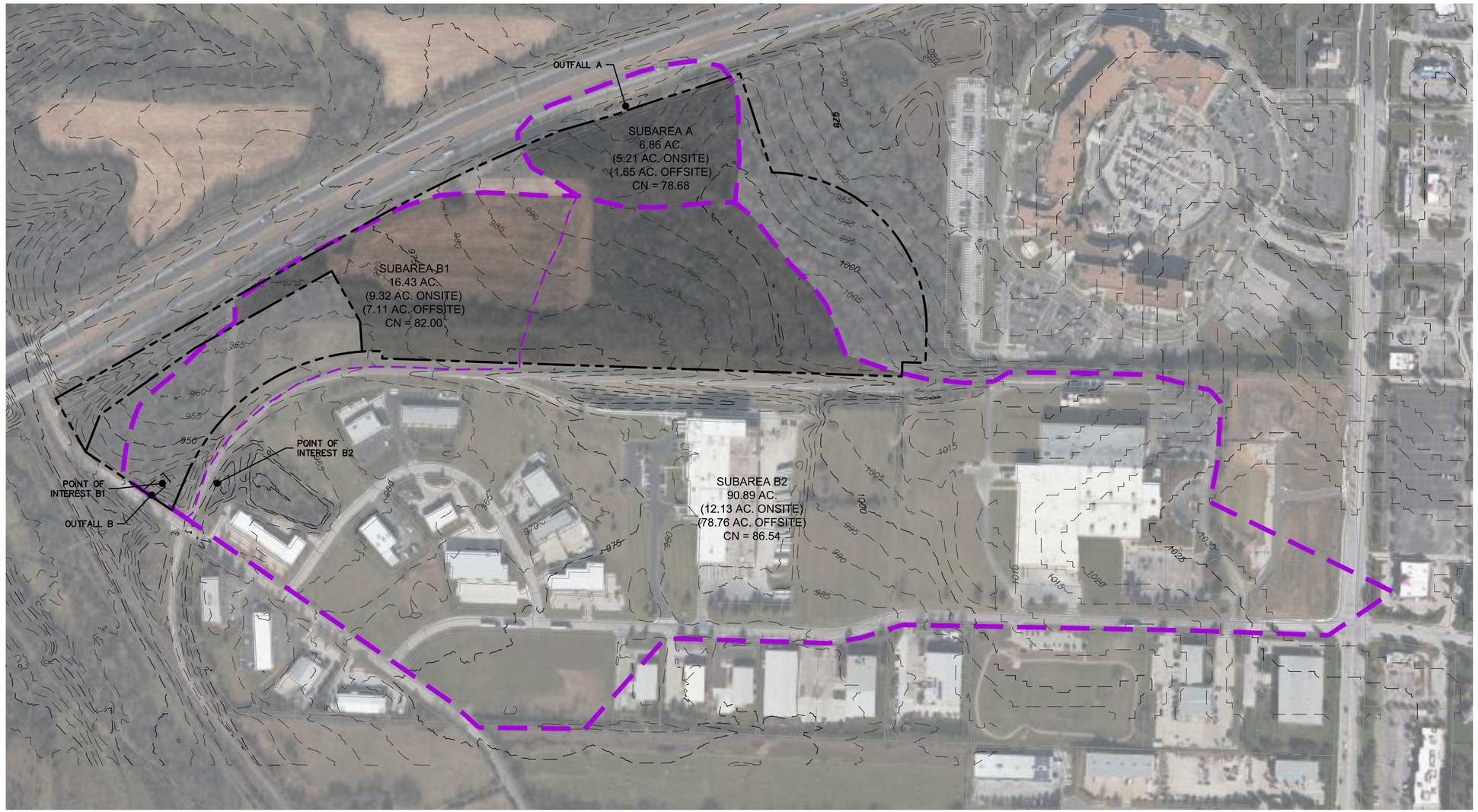

EXHIBIT LEGEND

- PROJECT BOUNDARY
- DRAINAGE AREA BOUNDARIES
- DRAINAGE SUBAREAS BOUNDARIES
- PORTION OF DRAINAGE AREA DIRECTLY FROM THE SITE
- FLOW DIRECTION

N

0' 100' 200' 400'
SCALE IN FEET

olsson
Olsson - Civil Engineering
Missouri Certificate of Authority #001592
1301 Burlington Street
North Kansas City, MO 64116
TEL 816.361.1177
FAX 816.361.1888
www.olsson.com

REV. NO.	DATE	REVISIONS DESCRIPTION	BY
		REVISIONS	

EXISTING CONDITIONS - DRAINAGE MAP

SUMMIT 470 LOGISTICS

LEE'S SUMMIT, MO

2022

drawn by:
checked by:
designed by:
QA/QC by:
project no.:
date:

SHEET
EXH-01

DWG: F:\2022\03501-04000\022-03974\40-Design\Reports\GNCV\Storm Study\Existing Conditions.dwg USER: aabdigaliyev
DATE: Nov 07, 2022 2:34pm XREFS: C_XUTIL_GIS_02203974 C_PBASE_02203974 C_PBNDY_02203974 C_XBASE_02203974

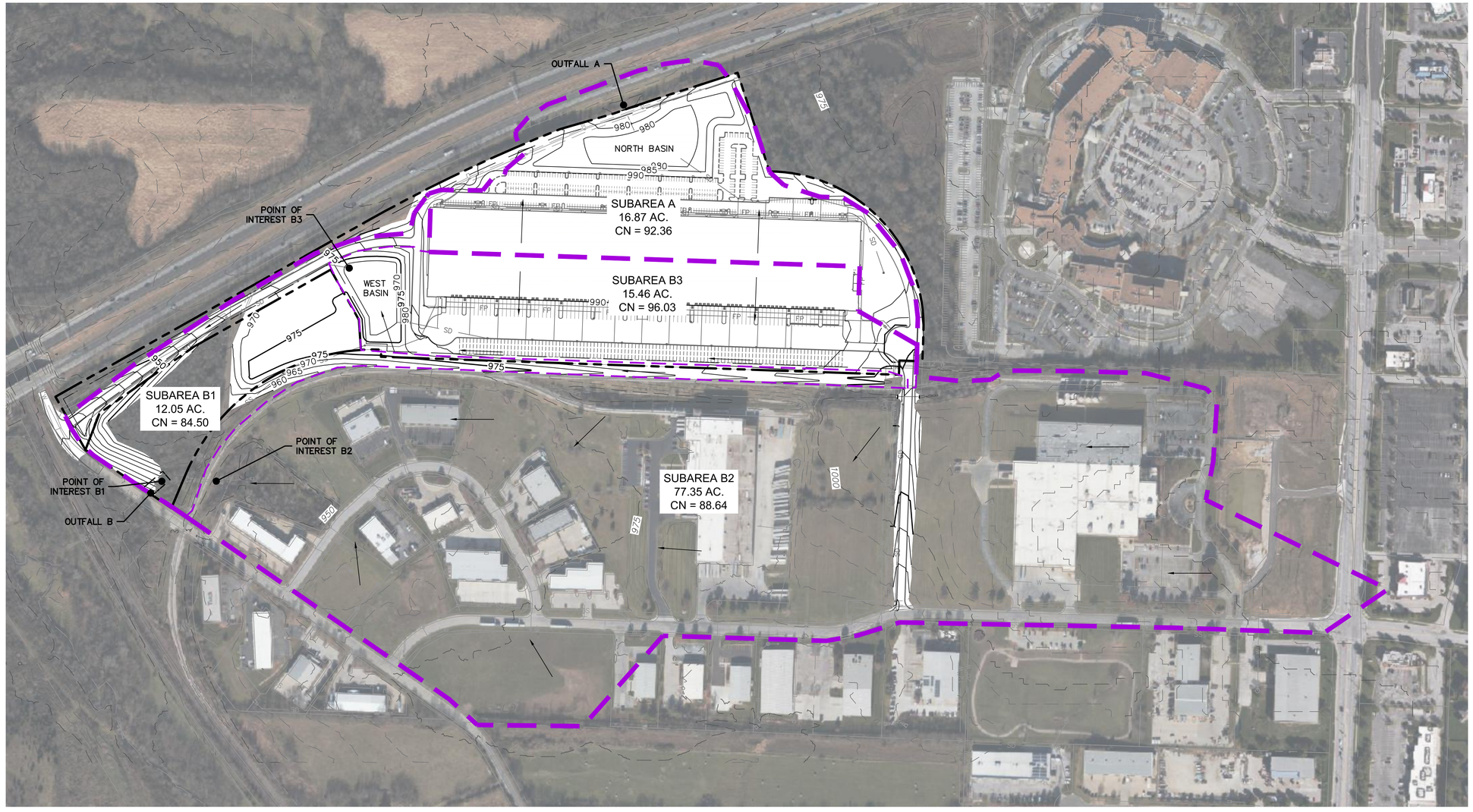

EXHIBIT LEGEND

- PROJECT BOUNDARY
- DRAINAGE AREA BOUNDARIES
- DRAINAGE SUBAREAS BOUNDARIES
- FLOW DIRECTION

N

0' 100' 200' 400'
SCALE IN FEET

olsson
Olsson - Civil Engineering
Missouri Certificate of Authority #001592
1301 Burlington Street
North Kansas City, MO 64116
TEL 816.361.1177
FAX 816.361.1888
www.olsson.com

REV. NO.	DATE	REVISIONS DESCRIPTION	BY
		REVISIONS	

PROPOSED CONDITIONS - DRAINAGE MAP

SUMMIT 470 LOGISTICS

LEE'S SUMMIT, MO

2022

drawn by:
checked by:
designed by:
QA/QC by:
project no.: 02203974
date: Nov 07, 2022

SHEET
EXH-03

DWG: F:\2022\03501-04000\022-03974\40-Design\Reports\GNCV\Storm Study\Proposed Conditions.dwg USER: aabdigalyev
DATE: Nov 07, 2022 2:47pm XREFS: C_XUTIL_GIS_02203974 C_PBASE_02203974 C_PBNDY_02203974 C_XBASE_02203974