Macro Storm Water Study
for:

Lot 1 – Lee's Summit Town Centre
Lee's Summit, MO 64064

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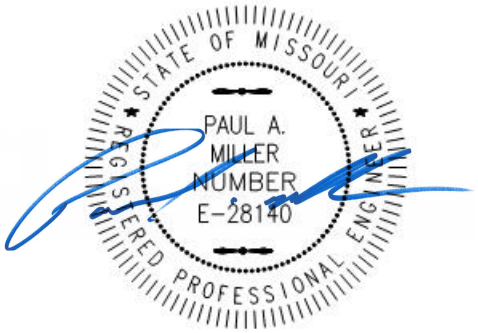

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General Information

Lot 1 of the Lee's Summit Town Centre development is located at the northeast corner of NE Town Centre Blvd. and NE Town Centre Drive in Lee's Summit, MO. The site contains 11.61 acres of undeveloped grass pasture.

The site is located in the Northwest 1/4, Sec. 29-Twp. 48N. - Range. 31W. The development will contain a large self-storage facility and two separate pad sites. Refer to Appendix A for the site plan.

There are two different soil types represented on the project site, 10136-Sibley-Urban Land Complex and 30080-Greenton Silty Clay Loam, with 10136-Sibley-Urban Land Complex occupying the largest area at 9.50 acres. The hydrological soil group for 10136 is rated as C and the area is classified as Grass/Prairie land with 2 to 5 percent slopes. 30080- Greenton Silty Clay Loam represents 2.11 acres in the southwest corner of the site. The hydrological soil group for 30080 is rated as C/D and the area is classified as Grass/Prairie land with 5 to 9 percent slopes.

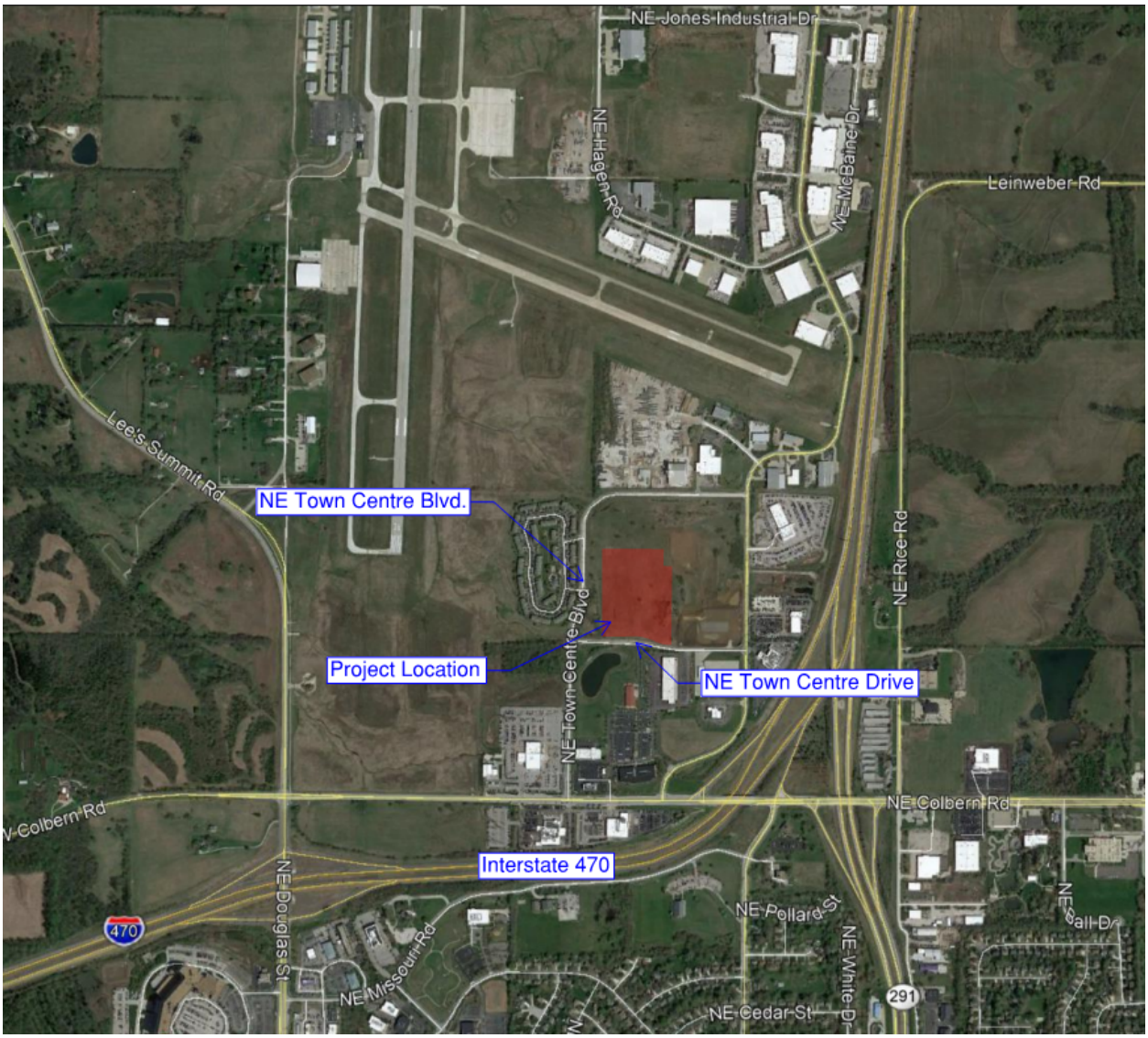

Figure 1. - Location Map (no scale)

Methodology

KCAPWA IDF curves were used to determine the rainfall intensity for the 2, 10, and 100-year storm events. Existing and proposed conditions were modeled and analyzed using Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2021 (Hydraflow). Hydrograph routing within Hydraflow used the Rational Method with depths of 3.71", 5.2", and 7.8" for the 50% (2-Yr), 10% (10-Yr), and 1% (100-Yr) storm events, respectively. This method is also used in SCS TR-55. Convolution is known as linear superpositioning, and means that each ordinate of the rainfall hyetograph is multiplied by each ordinate of the unit hydrograph, thus creating a series of hydrographs. These hydrographs are then summed to form the final runoff hydrograph. Rainfall frequencies were determined by using TECHNICAL PAPER NO.40, RAINFALL FREQUENCY ATLAS OF THE UNITED STATES, by the U.S. Department of Commerce, Weather Bureau. The October 2012 American Public Works Association BMP Manual was used for this storm study.

Existing Condition Analysis

The project site is located on the southwest corner of the Lee's Summit Town Centre development at the northeast corner of NE Town Centre Blvd. and NE Town Centre Dr. in Lee's Summit, MO. Lee's Summit Town Centre is located northwest of the Highway 291 and Interstate 470 interchange. The existing undeveloped site is 11.61 acres, with the entirety of the property being pervious.

Runoff from the site currently generally flows from the north to south and into a pond located on the east side of the property. A portion of the property in the southwest corner drains from east to west and down the sloped, moderately-wooded area into curb inlets located on NE Town Centre Dr. The site was analyzed as a greenfield site with a rational "c" value of 0.30.

Soils encountered on the site are 10136-Sibley-Urban land complex, 2 to 5 percent slopes, and 30080-Greenton Silty Clay Loam, 5 to 9 percent slopes. The Hydrologic Soil Groups of the encountered soils are C and C/D respectively (see Appendix A, Hydrologic Soil Group).

The site lies entirely outside of the 100-year floodplain as depicted on the FEMA Flood Insurance Rate Map (FIRM) Map Panel No. 0430G, Map Number 29095C0430G Dated January 20, 2017, Note: This area is shown as being completely within zone X. The Flood Insurance Rate Map is included in Appendix A.

There are 3.35 acres of pervious area to the north of the property that currently drains onto the proposed site. The resulting drainage area for the site is approximately 14.96 acres of pervious area. The Existing Drainage Area Map, provided in Appendix A, depicts the existing drainage patterns for the site. Area A shown on this map currently sheet flows off the property to the west and eventually discharges into curb inlets near the intersection of NE Town Centre Dr. and NE Town Centre Blvd. Area B sheet flows across the site and discharges to the property to the east into a drainage swell that eventually discharges runoff into the existing detention basin on the neighboring property adjacent to NE Independence Ave.

The existing detention basin on the newly developed property to the east was sized to handle and detain the runoff from the existing pre-developed proposed site. The proposed site currently drains to a swale located just north of the neighboring property to the east, and into the existing detention basin to the east.

The existing site results in the following conditions:

Table 1 – Existing Site Runoff Hydraflow Results

Storm Event	Area A (cfs)	Area B (cfs)	Total Site Runoff (cfs)
2-Yr	1.79	14.87	16.66
10-Yr	2.50	20.76	23.26
100-Yr	3.77	31.27	35.04

Proposed Condition Analysis

The proposed development consists of the construction of a large self-storage complex and two separate buildings with their own parking lots. The improvements will increase impervious area on-site by approximately 8.21 acres. The remaining 3.40 pervious acres will be covered in grass or native vegetation that is either preserved or reestablished after land disturbance activities have been completed. The post development rational "c" values for the project site have been developed based on soil types and proposed conditions. The rational "c" values for the proposed development can be found on the Proposed Drainage Area Map located in Appendix A.

Table 2 below shows the increase in peak discharge rates for the 2, 10, and 100-year storm events due to the increase in impervious area.

Table 2 – Proposed Site Runoff Hydraflow Results – Without Detention

Storm Event	Post-Development Peak Flow (cfs)
2-Yr	35.58
10-Yr	49.67
100-Yr	74.83

In order to mitigate the increase in peak runoff rates from the site due to the increase in impervious area created by the proposed development, a private storm network is proposed to direct runoff to the proposed on-site detention basin located on the east side of the property. The Proposed Drainage Area Map, provided in Appendix A, depicts the proposed drainage patterns for the site. Areas 1 through 5 shown on the Proposed Drainage Area Map will flow into the private storm network structures and discharge into the proposed on-site detention basin. Area 6 will follow the existing drainage pattern of the site, flowing to the southwest corner of the site and eventually discharging into the existing public storm system near the intersection of NE Town Centre Blvd. and NE Town Centre Dr. Area 7 will flow offsite to the neighboring property to east, following the existing drainage patterns of the site.

Areas 6 and 7 on the Proposed Drainage Area Map will discharge at the same location and a rate less than the site's existing conditions. During the 100-year storm event, Existing Drainage Area A currently discharges 3.77 cfs to the curb inlets near the intersection of NE Town Centre Blvd. and NE Town Centre Dr. Proposed Drainage Area 6 will discharge 3.47 cfs to this same location. Area 7 on the Proposed Drainage Area Map is pervious, has the same rational "c" value, and follows the existing drainage patterns of the undeveloped site.

The detention basin has been designed to effectively capture and discharge the runoff from the contributing drainage area, per the requirements set by APWA Section 5601.5.A.4.a. Discharge from the detention basin will be controlled by a proposed outlet structure that will maintain release rates less than pre-developed conditions, while also maintaining water quality requirements specified in APWA Section 5608.4.C.1.b. Post-development peak discharge rates shall not exceed the requirements set by APWA Section 5608.4.C.1.a that are shown below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
  - Site specific allowable release rate: 7.48 cfs
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
  - Site specific allowable release rate: 29.92 cfs
- 1% storm peak rate less than or equal to 3.0 cfs per site acre
  - Site specific allowable release rate: 44.88 cfs

Discharge from the detention basin will be controlled by an outlet structure that discharges into an outlet pipe spanning from the detention basin's outlet structure to the existing drainage swale just north of the neighboring property to the east. For water quality considerations, the outlet structure will have an orifice placed at the bottom elevation of the pond to control the discharge from the detention basin to meet the minimum forty-hour extended detention requirement for comprehensive control. A weir will be placed just above the water surface elevation of the 90% mean annual event and discharge into the outlet pipe. The runoff from the outlet pipe will continue to the east in the existing drainage swale and eventually discharge into the existing detention basin on the neighboring property. This detention basin has been sized to handle the runoff for the peak storm events from both the proposed site in its existing, pre-developed conditions and the newly developed-neighboring property.

A spillway for the proposed on-site detention basin was designed using the 100-year water surface elevation of 1003.89. Simulating clogged outlet conditions and zero available storage in the detention basin, the spillway crest elevation was set 0.5' above the 100-year water surface elevation at 1004.39. One foot of freeboard is available above the 100-year water surface elevation in the spillway to the top of the berm at 1005.91. The spillway will allow overflow to drain over the proposed private road and into the drainage swale north of the neighboring property.

Approximately 93.7% (10.88 acres) of the site will undergo water quality via an onsite BMP. The proposed BMPs include the following: inlet filter baskets to extended dry detention in a BMP train, extended dry detention only, and preservation/establishment of native vegetation. Approximately 6.2% of the site shall go untreated and be allowed to flow offsite to the existing public storm sewer system along NE Town Centre Dr. to the south of the property.

9.46 acres of the site shall be pre-treated by inlet filter baskets before being discharged into the proposed on-site detention basin. 0.29 acres of grass or landscaping will drain directly to the proposed detention basin. 1.13 acres of the site will have native vegetation preserved or reestablished after land disturbance activities have been completed. The remaining 0.73 acres will be untreated and discharged off-site

Table 3 below shows the general conditions of the proposed stormwater detention basin.

Table 3 – Proposed Detention Basin Hydraflow Results

Storm Event (yr)		Detention Basin 1
2-Yr	Discharge (cfs)	0.235
	Max. Elevation (ft)	1002.21
	Total Storage (cf)	29,585
10-Yr	Discharge (cfs)	0.275
	Max. Elevation (ft)	1002.98
	Total Storage (cf)	41,362
100-Yr	Discharge (cfs)	14.33
	Max. Elevation (ft)	1003.89
	Total Storage (cf)	56,699

Table 4 below shows the total post-developed peak discharge rates from the site with the proposed private storm network and detention basin.

Table 4 – Proposed Site Runoff Hydraflow Results – With Detention				
Storm Event	Discharge from Detention Basin 1 - **Areas 1 - 5** (cfs)	Runoff to Offsite Public Storm System – **Area 6** (cfs)	Runoff to Neighboring Property – **Area 7** (cfs)	Total Post-Development Runoff – With Detention (cfs)
2-Yr	0.235	1.65	0.77	2.58
10-Yr	0.275	2.30	1.07	3.57
100-Yr	14.33	3.47	1.62	15.50

Note: "Total Peak Qs will be less than the simple sum of the areas due to a difference in time to peak discharge. See Appendix C for Hydraflow results."

Table 5 below displays the peak runoff rates for the existing pre-developed and post-developed conditions of the site.

Table 5 – Proposed Total Site Runoff Hydraflow Results			
Storm Event (yr)	Existing Site Runoff (cfs)	Total Post-Development Runoff – With Detention (cfs)	Net Reduction in Post-Developed Site Discharge (cfs)
2-Yr	16.66	2.58	14.08
10-Yr	23.26	3.57	19.69
100-Yr	35.04	15.50	19.54

Note: "Total Peak Qs will be less than the simple sum of the areas due to a difference in time to peak discharge. See Appendix C for Hydraflow results."

Storm Water Quality

The Mid-America Regional Council, Manual of Best Management Practices for Stormwater Quality, October 2012 requires the site to be designed to capture and treat the additional impervious runoff during the 90% mean annual storm (1.37"/24 hr) created by site improvements. The outlet structure from the detention basin will control discharge from the 90% mean annual event to the minimum forty-hour extended detention requirement for comprehensive control. The impervious area for the site has increased by 8.21 acres, requiring a value rating of 6.7. To address this requirement, a majority of the runoff from the site will be pre-treated through inlet filter baskets prior to being discharged into the extended dry detention basin. BMP worksheets 1A and 2 are included in Appendix B of this report. The combination of BMP trains, the extended dry detention basin, and the establishment/preservation of native vegetation will meet the required level of service for BMP's.

Summary

Lot 1 of the Lee's Summit Town Centre development is located at the northeast corner of NE Town Centre Blvd. and NE Town Centre Dr. in Lee's Summit, MO. The existing undeveloped site is 11.61 acres, with the entirety of the property being pervious. Runoff from the site currently generally flows from the north to south and into a pond located on the east side of the property. A portion of the property in the southwest corner drains from east to west and down the sloped areas into curb inlets located near the intersection of NE Town Centre Blvd. and NE Town Centre Dr.

The on-site increase in stormwater runoff will be directed to an on-site extended dry detention basin located on the east side of the property. The detention basin and the outlet structure will reduce overall post-developed stormwater runoff to below pre-developed conditions. 1.89 acres of the proposed site will discharge off-site to either the existing public storm sewer system or the existing detention basin on the newly-developed property to the east.

Conclusions and Recommendations

It has been concluded that an extended dry detention basin will be added to Lot 1 of the Lee's Summit Town Centre Development to reduce site runoff from the increase in impervious area. A new private storm sewer system will be added to convey the runoff into the on-site detention basin and eventually into the detention basin on the neighboring property to the east.

The addition of the on-site detention basin will reduce runoff to the downstream system and will meet the requirements set forth in APWA Section 5601 and 5608 for water quality and peak-runoff. Stormwater pretreatment BMP's for the site will be provided through the extended dry detention basin, as well as pre-treatment through inlet filter baskets. These treatment systems, along with the native vegetation to be established on the east, west, and south sides of the project will enhance the water quality LOS from the site's existing conditions. No waivers from the City of Lee's Summit's Design & Construction Manual (DCM) will be requested for the proposed development. No further reduction of storm water runoff or additional BMPs should be required for this project site. This project will cause no adverse impact to the downstream structures/system.

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