

Preliminary Stormwater Management Plan

prepared for

Stag's Field
NE Bowlin Road and NE Jamestown Road
Lee's Summit, MO

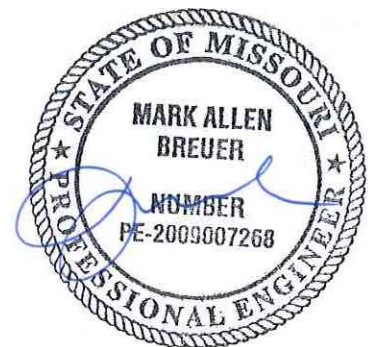
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Schlagel & Associates Project 20-107

prepared by

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EXECUTIVE SUMMARY

Schlagel & Associates, PA is submitting the Stag's Field development plan approval on behalf of our client, Stag Commercial LLC, and this Preliminary Storm Water Management Study in support of the applications. This report has been prepared to address permitting requirements and provides preliminary design calculations of the required storm water detention and BMP facilities

The 33.7-acre site is a proposed single-family and multi-family development with associated infrastructure on an existing contour crop land description. The site lies in the Lower Missouri-Crooked Watershed, with the majority of the site draining northeast in the East Fork Little Blue River tributary and a small section draining southwest in the May Brook-Little Blue River tributary. An existing freshwater wetland is located in the north central region of the site. In accordance with jurisdictional specifications, the site is required to provide detention per the Comprehensive Control Strategy as defined by APWA Section 5600. Detention will be provided to limit post-developed flows to at or below maximum flow rates for the 2-, 10-, and 100-year return events as determined by Comprehensive Control Strategy requirements with emergency overflow routing provided. City of Lee's Summit also requires extended detention for the Water Quality Volume as calculated by MARC BMP guidelines. Site runoff reduction and extended water quality detention has been obtained through use of two wet detention basins located along the north of the site.

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1.0 GENERAL INFORMATION

Stag's Field is a proposed 33.7-acre development located in Lee's Summit, Missouri. The site is generally located south of NE Bowlin Rd. and east of Interstate 470. The site location is shown in the vicinity map in Figure 1. The property is currently zoned AG - Agricultural and is proposed to be rezoned RP-1 and RP-4 (with modifications). The proposed site plan is provided in Figure 2.

1.1 OBJECTIVE

This Stormwater Management Report will address the issue of determining the site requirements for the stormwater system to comply with the City of Lee's Summit design criteria. The site will need to provide detention that meets the requirements of the APWA Comprehensive Control Strategy. This entails limiting post-development peak discharge rates from the site for the 2-year, 10-year, and 100-year design storm events, as well as providing 40-hour extended detention of runoff from the local 90% mean annual event.

1.2 METHODOLOGY

Section 5600 – Storm Drainage Systems and Facilities of the Standard Specifications and Design Criteria of the Kansas City Metropolitan Chapter of the American Public Works Association, dated February 16, 2011, The Manual of Best Management Practices for Stormwater Quality - September 2012, published by the Mid-America Regional Council and City of Lee's Summit design criteria were utilized in preparation of this document and site watershed analysis. Watersheds for the site were defined according to soil cover and type and tributary area. Soil cover was determined from inspection of the site and aerial photography. A soil survey for the project area obtained from the NRCS online portal was utilized in determining soil types on-site and can be found in Appendix A. Watershed sizes were determined from topographical survey of the existing conditions, aerial photography, and the proposed site layout. Times of concentration were compiled according to *NRCS TR-55 Urban Hydrology for Small Watersheds (1986)* methodology for sheet flow, shallow concentrated flow, and channel flow. Travel times for channel flows were determined using the length and velocity of the open channel. HydroCAD version 10.0 was used to model the runoff. All storm events were modeled using SCS 24-hour Type II distributions for the 1-year, 10-year, and 100-year storm events.

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2.0 EXISTING CONDITIONS ANALYSIS

The existing site is an existing farmstead and is generally vacant and consists row crop ground cover in good condition. Runoff is conveyed to four discharge points by sheet, shallow concentrated, and channel flow. There are no improved channels or storm sewer systems on the project site. A freshwater wetland is located north central region of the site and is depicted in the Wetlands Inventory Exhibit in Appendix A.

2.1 EXISTING SOIL CONDITIONS

On-site soils data was retrieved via a USDA NRCS Custom Soil Resource Report obtained from the Web Soil Survey online portal. The soils report is presented in Appendix A. The report indicates that the following soils are located on-site.

- **10000 – Arisburg Silt Loam**, 1-5 Percent Slopes; Somewhat Poorly Drained, Non-Hydric, Hydrologic Soil Group C, 76.2% of Site
- **10120 – Sharpsburg Silt Loam**, 2-5 Percent Slopes; Moderately Well-Drained, Medium Runoff Class, Non-Hydric, Hydrologic Soil Group C, 8.8% of Site
- **30080 – Greenton Silty Clay Loam**, 5-9 Percent Slopes; Somewhat Poorly Drained, Very High Runoff Class, Non-Hydric, Hydrologic Soil Group C/D, 15.0% of Site

2.2 TRIBUTARY AREAS

The existing tributaries are provided in Appendix B. The site release points have been identified as Release Points A through D (R-A, R-B, etc.). These designations correspond with the watershed model located in Appendix B.

2.3 CURVE NUMBER AND TIME OF CONCENTRATION

The existing curve numbers and time of concentrations for each sub-area have been established based on the procedures outlined in *NRCS TR-55 Urban Hydrology for Small Watersheds (1986)*. Existing curve numbers were based on aerial photography, site inspection, and the soil types present on site. A composite curve number for each sub-area was determined. The predevelopment condition of this site includes a fallow crop residue/woods/pasture combination. These areas can be seen in an aerial AIMS map provided in Appendix A. Table 2.1 summarizes the curve numbers for each of the sub-areas.

Time of concentration flow paths were based on sheet flow, shallow concentrated flow, and channel flow conditions. Sheet flow lengths were limited to 100 feet, or where a grade break occurred. Flow was then considered shallow concentrated flow until a channel was visible either from the USGS topographic map or the aerial photograph, and from that point was considered channel flow determined by the length of the channel and estimated flow velocity. The Existing Drainage Area Map presented in Appendix B illustrates the time of concentration flow paths utilized in the analysis. Times of concentration for each sub-area are presented in Table 2.1.0, and detailed calculations are included with the HydroCAD summary in Appendix B.

Table 2.3.1 Existing Cover Conditions

CN		74	98			
Catchment	Outfall	Pervious	Impervious	Total Area	Tc	Composite CN
		ac	ac			
EDA-1	R-A (N)	9.50	0.00	9.50	11.8	74.0
ODA-1	R-B (NE)	0.38	0.12	0.50	5.0	79.8
EDA-2	R-B (NE)	19.12	0.00	19.12	13.8	74.0
ODA-2.1	R-C (E)	9.81	0.00	9.81	10.2	74.0
ODA-2.2	R-C (E)	5.13	0.87	6.01	6.4	77.5
EDA-3	R-C (E)	2.52	0.00	2.52	9.9	74.0
ODA-3	R-C (E)	0.23	0.07	0.30	5.0	79.6
EDA-4	R-D (SE)	2.56	0.00	2.56	7.9	74.0
SUMMATION		49.26	1.07	50.33	---	74.5

EDA – Existing On-site Drainage Area

ODA – Offsite Drainage Area

2.4 EXISTING FLOW RATES

Existing flow rates were determined for the 2-year, 10-year, and 100-year design storms. Comparison of the Peak flow rates for the existing and proposed conditions are presented in Table 4.2, and detailed calculations are included with the HydroCAD summary in Appendix B.

2.5 DOWNSTREAM DRAINAGE ISSUES

To determine if downstream drainage issues were present, as-built and construction documents relative to the project location were requested from the City of Lee's Summit.

Existing pipe culverts under NE Bowlin Rd were analyzed for existing and proposed development flow characteristics. The existing culverts at R-NC and R-NW were determined to be in adequately sized for less frequent storm events. Culvert improvements to meet APWA 5600 and Lee's Summit design criteria will be addressed during the anticipated improvements to NE Bowlin Road as associated with this development.

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3.0 AGENCY REVIEW

Permitting requirements of the following agencies were reviewed as part of the existing conditions analysis.

3.1 CORPS OF ENGINEERS REVIEW

A freshwater emergent wetland is located at the north central region of the site. The proposed development is anticipated to mitigate this wetland to establish on-site detention. Coordination regarding necessary permitting and mitigation to the and wetland area will be addressed as project phasing progresses. A National Wetland Inventory Map provided in Appendix B.

3.2 FEMA REQUIRMENTS

No FEMA identified floodplain is located on the proposed property per Flood Insurance Rate Map Panel No. 29095C0313G. There are no FEMA requirements associated with this project. Please see the attached FEMA Firmette in Appendix A.

3.3 MISSOURI DEPARTMENT OF NATURAL RESOURCES

All land disturbance activities will be permitted in accordance with the City of Lee's Summit, MO specifications as well as the Missouri Department of Water Pollution Control General Permit under the National Pollution Discharge Elimination System (NPDES). NPDES and NOI Applications will be made with the future permitting of the site in compliance with local, state and federal guidelines.

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4.0 PROPOSED STORM WATER MANAGEMENT ANALYSIS

The proposed development will generally maintain the existing site drainage patterns with the addition of on-site detention and BMP facilities to provide post development runoff control and extended water quality detention. Runoff from the interior of the site will be conveyed to two proposed on-site wet detention basins. A site plan detailing the locations and drainage areas of the proposed basins is presented in Appendix B. An on-site enclosed storm sewer is proposed to capture and convey the site runoff to the proposed detention facilities.

4.1 TRIBUTARY AREAS

The proposed tributary areas are provided in Appendix B. The proposed drainage areas have been delineated to convey runoff volumes necessary to meet requirements for runoff control and water quality extended detention. Tributary areas with an “-O” suffix indicate areas that bypass on-site detention and BMPs. Site release points generally remained unchanged from the existing conditions. These designations correspond with the watershed model located in Appendix B.

4.2 CURVE NUMBER AND TIME OF CONCENTRATION

The proposed curve numbers and time of concentrations for each sub-area have been established based on the procedures outlined in NRCS TR-55 Urban Hydrology for Small Watersheds (1986). Proposed curve numbers were based on aerial photography, site inspection, soil types present on site, and cover types associated with the proposed development. General ground cover including Single and Multi-Family residential and pervious and impervious cover types for the proposed conditions were considered and a composite curve number for each sub-area was determined. Curve numbers for the proposed pervious cover were determined based on turf and established native vegetation in good condition and proposed residential development cover was based on 1/4-acre cover type, relative to residential zoning. Hydrologic soil group D was used for the site per the USDA NRCS Custom Soil Resource Report presented in Appendix A. The proposed cover conditions are shown in appendix B. Table 4.2.1 summarizes the curve numbers for each of the sub-areas.

Time of concentration flow paths were based on sheet flow, shallow concentrated flow, and reach flow conditions. Sheet flow lengths were limited to 100 feet. Flow was then considered shallow concentrated flow until a detention basin, or storm sewer was reached at which point the flow was modeled as a pipe reach. Table 4.2.1 summarizes the time of concentration for each sub-area. Detailed calculations of the composite curve numbers and times of concentration can be found in Appendix B and the proposed flow paths utilized in the time of concentration calculations are presented in appendix A.

Table 4.2.1 Proposed Cover Conditions

CN		91	74	80	98			
Catchment	Outfall	Single Family ac	Undisturbed ac	Turf ac	Impervious ac	Total ac	Tc min	Composite CN
DA-1	R-NC	0.00	0.00	3.01	5.07	8.08	5.0	91.3
DA-1-O	R-NC	0.00	0.00	0.35	0.00	0.35	5.0	80.1
ODA-1	R-NC	0.00	0.38	0.00	0.12	0.50	5.0	79.8
DA-2	R-NE	4.20	0.00	8.68	11.49	24.37	5.0	90.4
DA-2-O	R-NE	0.00	0.00	0.47	0.00	0.47	5.0	80.1
ODA-2.1	R-NE	0.00	9.81	0.00	0.00	9.81	10.2	74.0
ODA-2.2	R-NE	0.00	5.13	0.00	0.87	6.01	6.4	77.5
DA-3-O	R-NW	0.00	0.00	0.31	0.14	0.45	5.0	85.6
ODA-3	R-NW	0.00	0.23	0.00	0.07	0.30	5.0	79.6
SUMMATION		4.20	15.56	12.81	17.77	50.33	---	85.4

DA – Proposed On-site Drainage Area to Detention

DA-O – Proposed On-site Drainage Area Bypassing Detention

ODA – Offsite Drainage Area

4.3 PROPOSED FLOW RATES

Proposed flow rates were determined for the 2-, 10-, and 100-year design storms.

Comparison of the Peak flow rates for the existing and proposed conditions is presented in Table 4.3.1, on the next page, and detailed routing calculations can be found in Appendix B. Runoff rates presented in Table 4.3.1 include runoff from offsite drainage areas.

Table 4.3.1 Runoff Summary – HydroCAD Calculations (Flows in CFS) – Includes Bypass

Outfall	2-YR			10-YR			100-YR		
	EX	PROP	CHANGE	EX	PROP	CHANGE	EX	PROP	CHANGE
R-NC	17.33	3.12	-14.21	36.97	12.10	-24.87	65.44	29.85	-35.59
R-NE	59.11	16.76	-42.35	126.29	55.75	-70.54	223.42	89.79	-133.63
R-NW	5.38	2.55	-2.83	11.36	4.58	-6.78	19.98	7.32	-12.66
R-SW	5.18	0.00	-5.18	10.98	0.00	-10.98	19.36	0.00	-19.36
TOTAL	86.41	25.08	-61.33	184.68	85.18	-99.50	326.76	134.50	-192.26

Summations vary to due to offsetting peaks – see HydroCAD analysis in Appendix B for full routing summary.

4.4 DETENTION ANALYSIS

City of Lee's Summit codes require detention and runoff control for the 2-, 10-, and 100-yr storm events as well as extended detention for the water volume with a minimum 40-hour drawdown period per APWA Comprehensive Control Strategy requirements. Runoff from offsite drainage areas is accounted for in detention routing analysis, however, detention requirements are not applicable to bypass routing of offsite drainage areas. Runoff rates presented in Table 4.3.1 include bypass runoff from offsite drainage areas. Post development peak discharge rates per the Comprehensive Control Strategy are determined as follows:

- 2-year storm peak rate less than or equal to 0.5 cfs per site acre
- 10-year storm peak rate less than or equal to 2.0 cfs per site acre
- 100-year storm peak rate less than or equal to 3.0 cfs per site acre

Allowable release rates were calculated by summing the existing offsite runoff rate with the onsite allowable release rate, and are provided in the following table.

Allowable Release Rates (cfs)									
Outfall	2-YR			10-YR			100-YR		
	Offsite	Max Onsite (Area x 0.5)	Total Allowable	Offsite	Max Onsite (Area x 2.0)	Total Allowable	Offsite	Max Onsite (Area x 3.0)	Total Allowable
R-NC	1.48	4.21	5.69	2.81	16.85	19.66	4.65	25.27	29.92
R-NE	31.87	24.61	56.48	66.32	25.31	91.63	115.72	25.78	141.50
R-NW	0.89	0.22	1.11	1.69	0.89	2.58	2.79	1.34	4.13
TOTAL	0.00	0.00	0.00	0.00	92.89	92.89	0.00	0.00	0.00

Runoff hydrographs used to determine the peak flow volumes for each tributary area were determined using TR-55 methodology and HydroCAD Version 10.0. Two onsite detention facilities are proposed to meet the associated requirements. Detention facilities 1 and 2 utilize v-notch weirs and orifice outlets to provide runoff control. Detention routing calculations were accounted for in the site runoff rates presented in Table 4.3.1, which includes runoff from offsite drainage areas routed through the proposed site. Complete hydrograph routing and model output can be found in Appendix B.

As shown in Table 4.3.1, peak runoff rates for each proposed release point meet the Comprehensive Control Strategy requirements.

Final design of the detention basins and associated outlet structures shall be completed during the final development stages of the proposed phased construction of the development.

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5.0 SUMMARY AND RECOMMENDATIONS

The proposed development of this 33.7-acre site within the City of Lee's Summit has incorporated water quality and water quantity controls. Detention for the 2-, 10-, and 100-year events is proposed for the site with emergency overflow conveyance provided. Additionally, the required extended detention of water quality volume is achieved in accordance with APWA Comprehensive Control Strategy requirements.

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