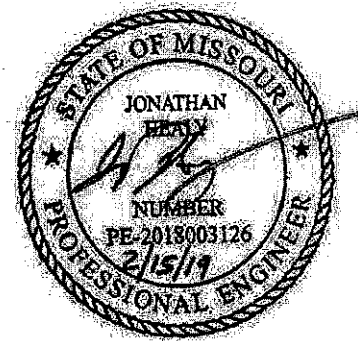


# PRELIMINARY STORMWATER DRAINAGE STUDY PARAGON STAR MIXED-USE DEVELOPMENT

Prepared for Paragon Star, LLC  
GBA NO. 12720

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**TABLE OF CONTENTS**

|  |     |
|--|-----|
| Introduction:.....   | 2   |
| Methodology:.....  | 2   |
| Existing Conditions:.....  | 3   |
| Wetland Impacts:.....  | 4   |
| Proposed Conditions:.....  | 4   |
| Stream Buffer Zone:.....   | 5   |
| Water Quality:.....  | 5   |
| Flood Study:.....  | 6   |
| Stormwater Detention Study:.....                                     | 8   |
| Summary and Recommendations:.....                                    | 9   |
| APPENDIX A – LOCATION INFORMATION .....                              | A-1 |
| Exhibit 1 - Location Maps  |     |
| Figure 1 – Location Map  |     |
| Figure 2 – USGS Topographic Map                                      |     |
| APPENDIX B – EXISTING CONDITIONS.....                                | A-2 |
| Exhibit 2 - FEMA Insurance Rate Maps, FIRMette                       |     |
| Exhibit 3 - USDA Soil Resource Report                                |     |
| Exhibit 4 – Historic Topographic and Aerial Map with Lagoon Location |     |
| Exhibit 5 - Longview Dam Breach EAP Exhibit                          |     |
| Plan Sheets C002 - Existing Conditions Plan                          |     |
| APPENDIX C – PROPOSED CONDITIONS.....                                | A-3 |
| Plan Sheet C004 - Grading Plan                                       |     |
| Plan Sheet C005 and C006 - Utility Plans                             |     |
| Exhibit 6 - Drainage Map and Calculations                            |     |
| Exhibit 7 - Regional Drainage Map                                    |     |
| Exhibit 8 - U.S. Army Corps of Engineers 404 Permit                  |     |
| Exhibit 9 - MDNR 401 Water Quality Certification and Permit          |     |
| APPENDIX D – WETLAND DELINEATION & PERMITS .....                     | A-4 |
| APPENDIX E – FLOOD STUDY EXHIBITS.....                               | A-5 |
| APPENDIX F – MASS GRADING CULVERT ANALYSIS & STREAM ASSESSMENT ..... | A-6 |

## **Introduction:**

Paragon Star, LLC proposes to construct a multi-use development on a 120 acre site located at the northeast corner of Interstate 470 and View High Drive in Lee's Summit, Missouri. The development includes a sporting complex with 10 synthetic turf fields with lighting, multi-purpose clubhouse, and associated parking areas. The development also includes a mixed-use building zone or "village" that includes hotel, restaurant, and entertainment accommodations, new housing and office options and, associated parking areas. A roadway network, trail system, and utilities, including storm sewer, sanitary sewers, natural gas, and electric service, will also be constructed within the development.

In addition to discussing the overall development conditions, this report will serve as the preliminary stormwater drainage study for the mixed-use portion of the Paragon Star development. The mixed-use development will encompass approximately 38 acres of the Paragon Star property. The proposed site is situated between Interstate 470 and the Little Blue River. Paragon Parkway will be constructed running east-west and will bisect the mixed-use development. Paragon Parkway will connect to the south roundabout on River Road on the east and the new roundabout on View High Drive to the west.

## **Methodology:**

The Study methodology is based on allowable methods and procedures outlined in "The City of Lee's Summit Design and Construction Manual and the Kansas City Metro Chapter of the American Public Works Association (APWA) Section 5600. A summary of each component of the report is provided below.

- Storm depths are based on TR-55 (24 hour duration).
- The October 2012 Edition of the MARC BMP Manual was used for water quality calculations.
- The flood study is based on analysis performed with HEC-RAS 4.1.0 software and the FEMA flood study for the area dated October 10, 2014.
- The Stormwater Detention Study was performed using XP-SWMM. See Flood Study portion of this report for further information.
- The Flood Study HEC-RAS data was obtained from FEMA.

**Existing Conditions:**

The 120 acre project site is located in Lee's Summit, Jackson County, Missouri at the northeast corner of Interstate 470 and View High Drive. The site ranges in elevation from approximately 796 feet along the Little Blue River and approximately 920 feet to the north. The site sits within the Little Blue River watershed. The Little Blue River flows through the southern portion of the site from west to east. The Little Blue River enters the site via a triple 20'x15' RCB under the existing View High Drive. The site is covered by both wooded areas and open grassed areas and drains via overland flow and through small unnamed tributaries to the Little Blue River. A total of 66.4 square miles drain to the Little Blue River before it exits the project site. The existing floodplain boundary for the Little Blue River covers approximately half the project site, with 22 acres of existing wetlands in the floodplain.

Of the 120 total acres, 38 acres will be developed within Lee's Summit for the mixed-use portion of the property.

Wastewater lagoons were previously constructed on the site, and since abandoned and filled in. The fill has since settled and created a low lying area and the majority of the wetlands which exist on site today. The location of previous lagoons can be found in Appendix B.

The currently adopted FEMA Flood Insurance Rate Maps (FIRM) for the project site are designated Community Panel No. 29095C0279F, revised September 29, 2006 and Community Panel No. 29095C0287F, revised September 29, 2006. However, as instructed by the City of Lee's Summit and FEMA, GBA has used the preliminary FIRM numbered 29095C0404G and 29095C0412G, both dated October 10, 2014. The preliminary FIRMs are to be adopted as the current standard in the near future and were used in the analysis of the site. The property lies partially within an area designated as Zone X and Zone AE. Zone X areas, when not hatched, are areas determined to be outside the 0.2% annual chance floodplain. Zone X, when hatched, are areas of 0.2% annual chance flood and areas of 1% annual chance flood with average depths less than 1 foot. Zone AE is described as a special flood hazard area subject to inundation by the 1% annual chance flood, with base flood elevations determined. See Appendix B for details.

According to the NRCS soil report, the undisturbed site consisted of group C and group D soil groups. Existing soils have been considered as group C for conservative water quality calculations. A negligible amount of impervious surface is located on site, however approximately 1.54 acres of gravel surface has been created near the southern property line. Using this data, a composite curve number (CN) of 76 was calculated for the existing site. See Appendix C for details.

No stormwater detention facilities are currently located on site. The project site is located within the Little Blue River watershed.

The Little Blue River and its tributaries are subject to APWA Section 5605.3 - Stream Preservation and Buffer Zones. Stream buffer zone widths are dependent on each stream's tributary area. The stream buffer zone is measured from the ordinary high water mark of the stream and extends outwards, on each side of the waterway, the appropriate length. Streams with tributary areas greater than 5000 acres have a stream buffer zone of 120 feet on either side. The current condition of the buffer through the project site is dense hardwood vegetation.

The site is located downstream of Longview Dam, and therefore is included in the *Longview Lake Emergency Action Plan*, dated July 2011, produced by the US Army Corps of Engineers. In the unlikely event Longview Dam fails, the project area would be inundated by the high flows produced by the failure. An exhibit from the aforementioned emergency action plan has been included in Appendix B to show the limits of inundation in the event of dam failure.

Approximately 103 acres upstream of the site drain through the project area, under Interstate 470 through a concrete culvert and an unnamed tributary to the Little Blue River. The tributary is located near the southeast corner of the project area.

### **Wetland Impacts:**

On January 19, January 28<sup>th</sup>, February 7<sup>th</sup>, and April 10, 2013 the *Preliminary Waters of the U.S. Delineation* (Delineation) was completed at the project site. In summary, the Delineation process identified 20.61 acres of wetlands to be filled and 1,089 linear feet of three ephemeral streams to be piped or filled. The project proposes to redevelop the property as a soccer complex and mixed-use development which will require multiple anticipated permanent fills within potential jurisdictional waters. See Appendix D for details. The full Wetland Delineation report, including Routine Wetland Determination Data Forms can be provided upon request.

A U.S. Army Corps of Engineers permit has been acquired for wetland and stream fills. The purchase of 20.61 acres of wetland credits and 3,403 stream credits from an approved compensatory mitigation bank in the service area of the project is required prior to project commencement. A 401 Water Quality Certification and permit has also been acquired through the Missouri Department of Natural Resources. Permits from U.S. Army Corps of Engineers and MDNR are included in Appendix C.

A tributary of the Little Blue River crosses under Interstate 470 and enters the project site near the southeast corner. This Jurisdictional Water of the U.S. has not been permitted to be filled and will be permitted prior to development of this portion of the site. The first phase of the mixed-use development does not impact this tributary.

### **Proposed Conditions:**

Paragon Star, LLC proposes to construct a mixed-use building zone or "village" that includes hotel, restaurant, entertainment accommodations, new housing, and office options with the associated parking areas and infrastructure. The purpose of this study is to analyze this mixed use development.

The mixed-use development will encompass approximately 38 acres of the Paragon Star property. The proposed site is situated between Interstate 470 and the Little Blue River. Paragon Parkway will be constructed running east-west and will bisect the mixed-use development. Paragon Parkway will connect to the south roundabout on River Road on the east and the new roundabout on View High Drive to the west.

Approximately 18.53 acres of impervious surface will be added with the mixed-use development through pavement and building area. See the Stormwater Detention section of this report for stormwater detention discussion.

The first phase of development of the mixed-use area is anticipated to include Paragon Parkway, the retail/commercial along the street, the multi-family area, one office building south of Paragon Parkway, and the associate parking and infrastructure. The hotels towards the southeast corner of the property, and the commercial buildings south of Paragon Parkway, aside from one, will be part of a later phase of development.

Storm drainage on site will be handled with enclosed storm sewer. Storm sewer has been designed per City of Lee's Summit standards, to the 10-year storm. Streets and parking lots will be provided with curb, gutter, and curb inlets to divert local drainage into the storm sewer system. Multiple storm sewer lines, consisting of RCP and HDPE, will collect stormwater from the proposed development and convey it to the Little Blue River. The enclosed storm sewer will discharge into the Little Blue River along various points throughout the project. Storm sewer layout and calculations can be found in Appendix C.

An unnamed tributary of the Little Blue River currently crosses under Interstate 470 and enters the project site near the southeast corner. Approximately 103 acres drain to the tributary, with an estimated C value of 0.40. This Jurisdictional Water of the U.S. has not been permitted to be filled through the U.S. Army Corps of Engineers and will be permitted prior to development of this portion of the site. The hotels in this area are not anticipated to be constructed with the first phase of development. When the area is developed, the tributary will be conveyed in a large diameter pipe (84" Dia.) or reinforced concrete box (7'x6').

### **Stream Buffer Zone:**

The Little Blue River within the site is subject to a 120 foot stream buffer zone. Existing trees will be preserved where possible within the entire property; however, the bulk of the preserved trees will lie within the stream buffer zone. Bridges will be constructed to allow proper floodway function and minimize scour. At locations where grading within the stream corridor is required, the graded areas are to be restored as vegetated stream corridor. See Appendix C for grading details.

### **Water Quality:**

Water quality BMPs are to be provided for the development, though no value rating or level of service is required. Water quality BMPs will be provided in the form of restored/preserved stream buffer. See attached plan sheets in Appendix B for details.

The stream corridor following the Little Blue River and its tributaries will be preserved or restored. All disturbed areas within the stream corridor will be replanted with native vegetation, aside from the fire access road on the north side of the development, which will be constructed with grass pavers.

Other water quality BMPs are provided within the Paragon Star development, including bioretention planters, native vegetation, and an existing U.S. Army Corps of Engineers jurisdictional wetland. These BMPs are located on the north side of the Little Blue River, with the soccer complex, and are described in the associated stormwater report, dated January 28, 2019, prepared by GBA.

### **Flood Study:**

The objective of this Flood Study is to report the floodplain impacts of the proposed Paragon Star development, located near View High Drive and I-470 in Lee's Summit, Missouri. Little Blue River flows through the property and will be affected by the project. Expected changes to the hydraulics of both flooding sources were evaluated for the impacts on the flood elevations beyond the property limits and the location of the FEMA Special Flood Hazard Area (SFHA) and Floodway. The Flood Study results were also utilized to establish low opening elevations for buildings as well as street and parking lot elevations, and to size the roadway and pedestrian bridges that will cross the river.

The project proposes placing fill within a federally defined floodplain as well as redefining the regulatory floodway. Therefore, a Conditional Letter of Map Revision (CLOMR) is required. To meet the objectives of this Flood Study and the CLOMR, the analyses and discussion provided in this report are based on the following data:

- Preliminary hydraulic model (HEC-RAS 4.1.0) for Little Blue River, received from the City of Lee's Summit
- FEMA panels 29095C0404G and 29095C0412G, Preliminary October 10, 2014

Per City guidance, this Flood Study and subsequent CLOMR were based on the October 10, 2014 preliminary model and FIRM panels rather than the September 29, 2006 Effective data. The preliminary data show changes since the effective date that include an approximately 4-ft increase in the BFE and a floodway calculation.

### **Site Description**

Little Blue River enters the project site at View High Drive, flows East, and leaves the property as it flows through the abandoned railroad bridge located approximately 4,800-ft downstream of View High Drive. Cedar Creek, a tributary of Little Blue River, enters the project site approximately 520-ft upstream of the abandoned railroad bridge. The Cedar Creek floodplain is not impacted by the proposed Paragon Star development. A total of 66.4 square miles drain to the project site, with 8-square miles below and unaffected by Longview Dam (Appendix E: Exhibit A).

The existing floodplain boundary for Little Blue River is broad and covers over half of the land area of the site (Appendix E: Exhibit B). The water surface elevations through the site are currently controlled by backwater effects from the Railroad bridge. The bridge is not currently in use by the railroad. Near the downstream end of the project site, between cross section stations 56837.7 and 59234.2, approximately 22 acres of existing wetlands are in the floodplain. There are currently no bridges crossing Little Blue River between the Railroad bridge and View High Drive. Beyond the limits of the project area, Upstream of I-470, there is one building located within the Preliminary floodway.

## Model Development

The Duplicate Effective, Corrected Effective and Proposed Conditions Models contain profiles for the 100-, 10-, 4-, 2-, 1-, and 0.2-percent chance flows for existing conditions. Table 1 provides a list of the name and description of the plan files that are included in the HEC-RAS model.

Table 1: Description of model plans and water surface profiles used in the Flood Study

| HEC-RAS Plan        | Plan Short ID    | Flow Profiles                                   | Description  |
|---------------------|------------------|---|--|
| Duplicate Effective | DuplicateEffecti | 100yr, FDWY,<br>500yr, 50yr,<br>25yr, 10yr, 1yr | Copy of the 2014 Preliminary Model received from City of Lee's Summit  |
| Corrected Effective | CorrectedEff     | 100yr, FDWY,<br>500yr, 50yr,<br>25yr, 10yr, 1yr | Duplicate Effective model updated with topography collected in 2015, survey data collected in 2016, the Railroad bridge at the downstream limits of the project area, and additional cross sections placed where needed to |
| Proposed Conditions | Proposed         | 100yr, FDWY,<br>500yr, 50yr,<br>25yr, 10yr, 1yr | Corrected Effective model updated to model proposed development and its effects on the floodplain.   |

To determine if the proposed project would impact the 1-percent chance floodplain elevations outside of the project area, the model was studied sufficiently upstream and downstream of the project area. The model contains the entire studied Little Blue River reach length, though proposed changes to the model were limited to between cross section stations 56362.9 and 63690.9.

Prior to updating the model with the proposed development, a Corrected Effective Model was created to correct any errors that were observed in the Duplicate Effective Model. Modifications to the model include adding in the railroad bridge at the downstream end of the project area, just downstream of lettered cross section AT (station 56549.9). This bridge was in place at the time the model was developed for the 2014 Preliminary DFIRM, but was not included in that analysis. All of the previously modeled cross sections were updated in the overbank areas with revised topographic data collected in 2015, and in-stream data was revised with detailed survey collected in 2016. Cross sections were added at the following stations: 56658, 58764.42, 58788.61, 58807.06, 58996.41, 59645.95, and 60101.84. These sections were added to properly model the impacts of the proposed development at those locations. Lettered cross section AV (station 60784.3) was relocated to station 60736.85 for the purpose of modeling a proposed bridge and cross section AX (station 61539.3) was relocated to station 61487.2 because it was not positioned right at the upstream face of the culvert under View High Drive in the Preliminary model. Overbank Manning's N-values were revised based on a site visit conducted on April 12, 2016.

The Proposed Conditions Model was developed using the proposed 2' contours and infrastructure layout shown on Exhibit B (Appendix E). Two open span bridges that will pass the 1-percent chance event have been proposed at approximate river stations 58924.5 and 60897.3. Two pedestrian bridges which the 1-percent chance event will overtop have been proposed at approximate stations 58776.11 and 59687.6.



Manning's n values were adjusted throughout the project areas to model the proposed changes in land use due to the development.

### Flood Study Results

Exhibit B (Appendix E) displays a comparison of the Preliminary, Corrected Effective, and the Proposed Conditions floodplain and floodway. Table 2 (Appendix E), with Exhibit C (Appendix E), presents a comparison of the water surface elevation results from the Duplicate Effective, Corrected Effective, and Proposed Conditions models for Little Blue River from the downstream limits of the project area to just downstream of Longview Dam. The proposed conditions floodplain boundaries for Little Blue River decreased in width within the project area. Upstream of the proposed development, the water surface elevation increases a maximum of 0.2' from the upstream face of View High Drive to just downstream of Longview Lake.

### Stormwater Detention Study:

The objective of the detention study was to determine the impacts of increasing the impervious area of the site with the planned conditions. If the proposed project was found to increase the peak discharge of Little Blue River at any point downstream of the project site, then detention would be required onsite. The site drains directly into Little Blue River as it runs from the west to the east through the site. Little Blue River has a watershed area of 66.4 square miles (42,500 acres) where it leaves the project site. The project area is 136 acres and makes up approximately 0.3% of the total Little Blue River watershed.

Existing land use of the project area is undeveloped wetlands, wooded riparian area and floodplain, and maintained grassland. The land use for the proposed, mixed use development will consist of soccer fields, roadways, buildings, and parking lots. To model the change in land use and the resulting impacts on the hydrology of the site, the XP-SWMM model that was used in the development of the FEMA flows was obtained from the City of Lee's Summit.

The XP-SWMM model was updated to use the SCS Hydrology methodology in the runoff mode on the sub-basins within the project area. Times of Concentration were calculated for existing conditions and updated in the model. The existing model was run and the existing hydrograph was exported.

The model was then updated with the increased impervious percentages and updated times of concentration for the proposed conditions model. The proposed model was run and the proposed hydrograph was exported.

The existing hydrograph for the channel downstream of the site was compared to the proposed hydrograph (see below). The existing hydrograph has a higher peak flow because the proposed changes to the site result in a quicker peak, reducing the overall peak flow downstream. Based on this result, stormwater detention would not be beneficial to the site.

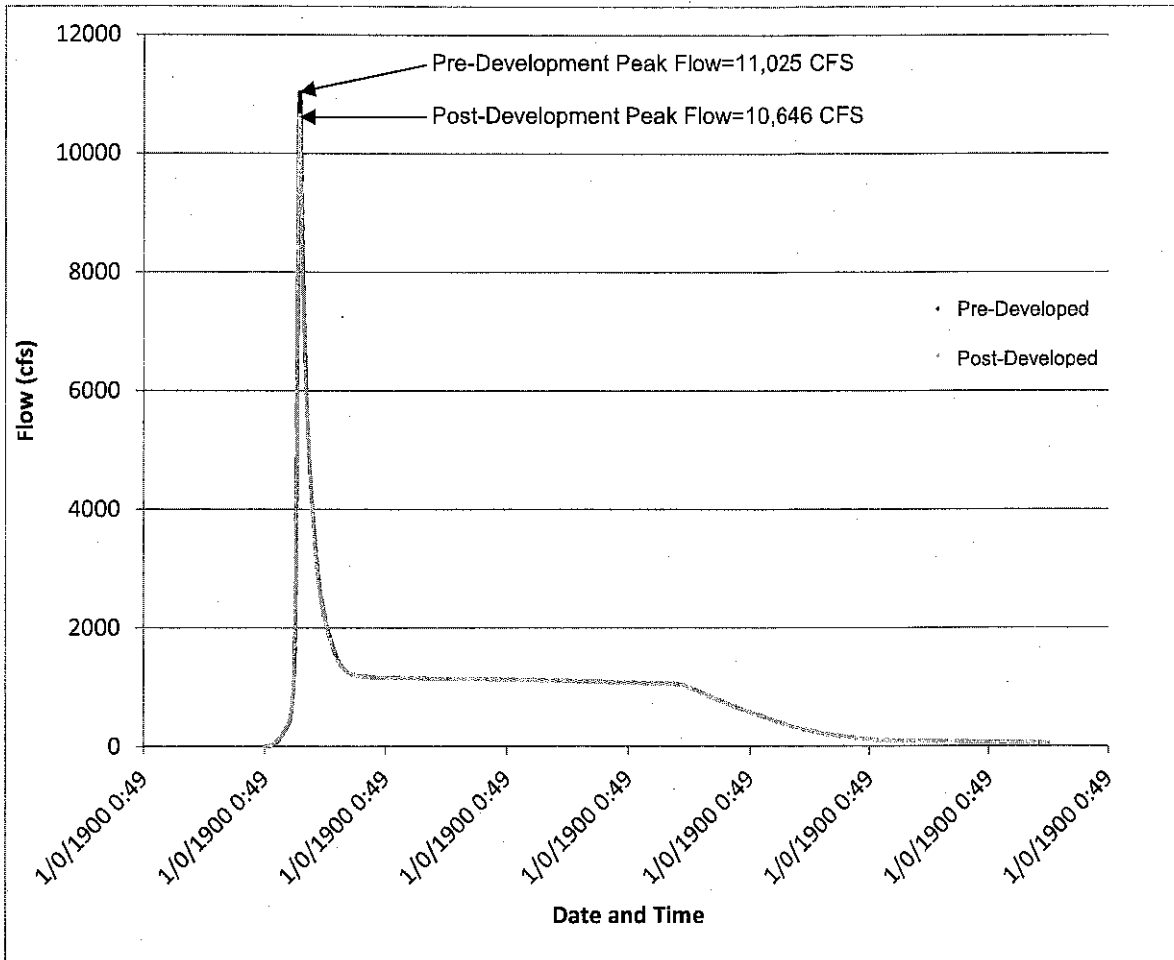


Figure 1 – Little Blue River Flow Analysis at East Property Line

**Summary and Recommendations:**

Design of the Paragon Star Soccer Complex and mixed-use development will conform to City Standards. The proposed mixed-use development will add approximately 18.53 acres of impervious area to the site, which will drain via overland flow and enclosed storm sewer to the Little blue Valley River. A full wetland delineation and flood study have been included within this report for further analysis in their respective areas.

Construction of the proposed development according to the recommendations of this report will meet or exceed the stormwater requirements of the City of Lee's Summit, Missouri. The designed stormwater management will reduce the risk of flooding for residents and businesses downstream of the project in accordance with the applicable standards.