

# 2002 PRELIMINARY ENGINEERING STUDY:

159th Street - Nall Avenue to Kenneth Road  
Mission Road - 159th Street to Blue River

Prepared for:



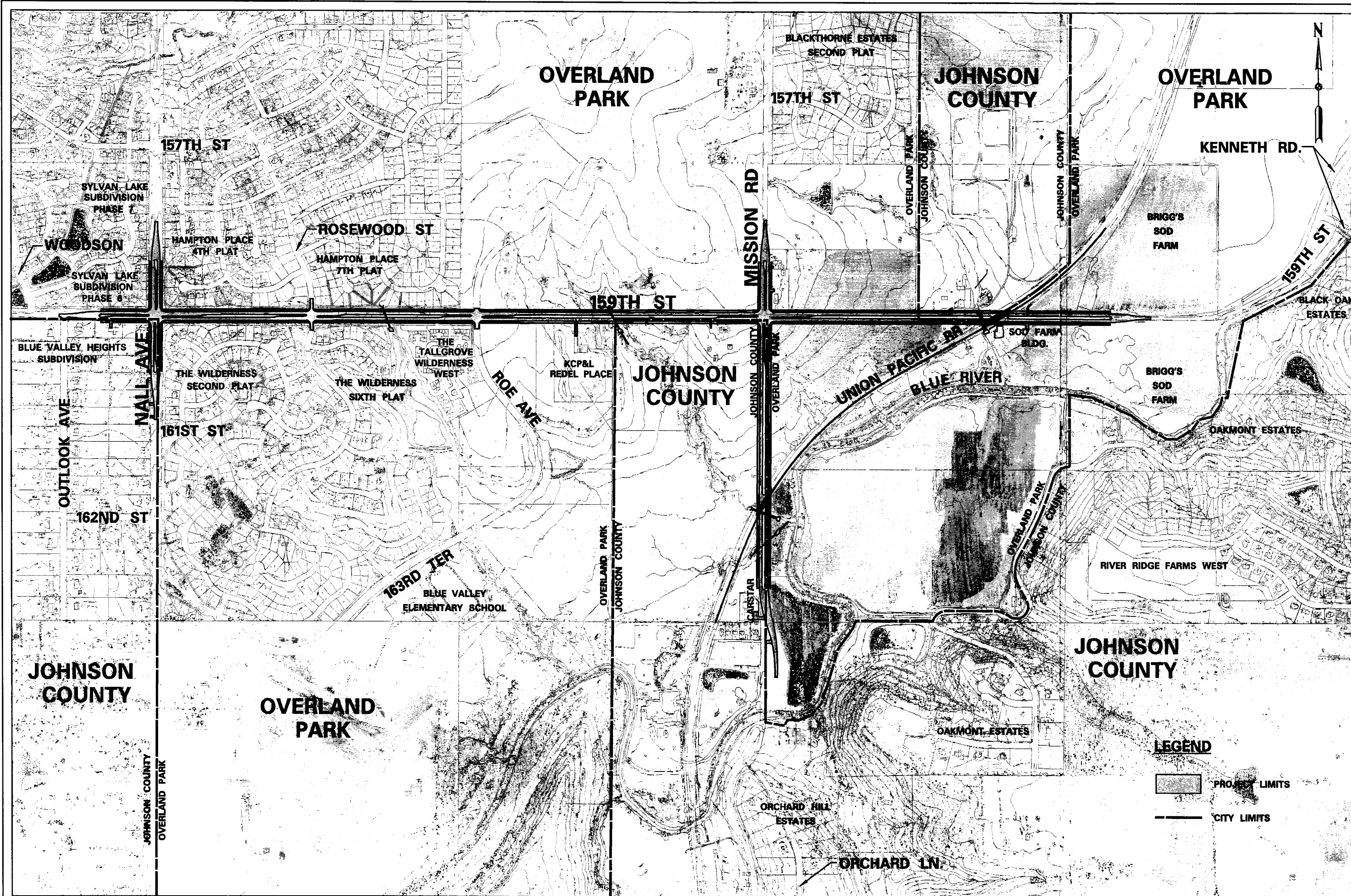
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**HNTB**

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CITY OF OVERLAND PARK, KANSAS



2002 PRELIMINARY ENGINEERING STUDY  
 PROJECT LOCATION MAP

**LEGEND**

-  PROJECT LIMITS
-  CITY LIMITS

## **EXECUTIVE SUMMARY**

This preliminary engineering study presents the results to establish preliminary horizontal and vertical alignments for 159<sup>th</sup> Street from Nall Avenue to Kenneth Road and for Mission Road from the Blue River to 159<sup>th</sup> Street. The purpose of this study was to perform a preliminary design to minimize impacts to existing development and to serve as a planning tool for future development. The findings of the study were coordinated with the City of Overland Park, Johnson County, and the Union Pacific Railroad Company.

More specifically, the major objectives of this study were as follows:

- **Establish Design Criteria** – Establish design guidelines, typical roadway sections, and right-of-way widths for 159<sup>th</sup> Street, Nall Avenue, and Mission Road.
- **Develop Preliminary Horizontal/Vertical Alignment** – Develop preliminary horizontal and vertical alignments for 159<sup>th</sup> Street, Nall Avenue, and Mission Road.
- **Investigate Options for Railroad Crossings** – Develop separate preliminary profiles and optional horizontal alignments of 159<sup>th</sup> Street and Mission Road associated with both at-grade and grade-separated overpass railroad crossings.
- **Determine Total Project Cost** – Estimate the total project cost including construction, utility relocation, right-of-way and easement acquisition, administration, legal and engineering services.
- **Cost Comparison of Railroad Crossing Options** – Compare the costs of constructing at-grade railroad crossings to the costs of bridge overpasses.

The comprehensive solution to meet the objectives set forth is summarized in subsequent pages in this report:

### **159<sup>th</sup> Street**

Overland Park's standard divided thoroughfare street section, centered on the section line was incorporated for the entire length of 159<sup>th</sup> Street. The corridor between Nall Avenue and Mission Road is primarily developed and the main goal in this area was to minimize impacts to existing development. East of Mission Road, through undeveloped sections of the corridor, the objective was to develop two alignment alternatives, one consisting of an at-grade railroad crossing and a second consisting of a bridge overpass crossing at the Union Pacific Railroad.

### **Nall Avenue**

Overland Park's standard divided thoroughfare street section, centered on the section line, was used. The profile of Nall Avenue was set to minimize impacts to existing adjacent development.

### **Mission Road**

Overland Park's standard divided thoroughfare street section was used. The horizontal alignment matches the current alignment of Mission Road from the Blue River bridge to the point where it merges with the section line. North of this point the alignment is centered on the section line for the remaining length of the study. Efforts were made to keep the roadway out of the Blue River 100-year floodplain. Two vertical profiles were developed to accommodate at-grade and grade-separated overpass crossing options at the Union Pacific Railroad.

## INTRODUCTION

The study presented herein was authorized in an agreement between the City of Overland Park and HNTB Corporation on May 20, 2002. The agreement calls for the preparation of a preliminary engineering study and report together with preliminary scaled plans and drawings.

The study establishes recommended horizontal/vertical alignments for 159<sup>th</sup> Street (from Nall Avenue to Kenneth Road) and Mission Road (from the Blue River to 159<sup>th</sup> Street). Specifically, the study includes the following:

- Recommended typical sections.
- Required right-of-way widths.
- Plan sheets showing existing right-of-way, ownership, utilities, and topographic features, in addition to locations for retaining walls, construction limits, and locations of major drainage crossings.
- Proposed horizontal/vertical roadway alignments of both at-grade and grade-separated overpass railroad crossings.
- Bridge analysis including type, size, and location.
- Preliminary cost estimates.

Each of these items is discussed in the following sections. In addition, plan and profile drawings are part of the report appendix to illustrate the recommended roadway improvements.

This Preliminary Engineering Study was prepared by HNTB Corporation at the direction of the Overland Park Public Works Department and represents the best information available to the City Engineer.

## **BASIC INFORMATION AND PROCEDURES**

In the development of the preliminary design study, the following information and procedures were utilized:

- Topographic mapping, property information, and aerial photography along the 159<sup>th</sup> Street, Nall Avenue, and Mission Road corridors was obtained from AIMS in English units and incorporated into 40 scale Plan and Profile sheets.
- The latest topographic and property information available at the time of this study was from 1998. HNTB surveys and aerial photography from 2001 was used to supplement this information.
- The existing surface was modeled from 2-foot AIMS contours (also from 1998). The created surface has a tolerance of  $\pm 1$  ft. at any given point on the surface.
- Field surveys were performed by HNTB to establish the flowlines of the existing major drainage facilities and to assist in the validation of the elevations shown on the AIMS mapping. New construction such as berms that have been constructed since 1998 were surveyed and added to the existing surface model.
- City ownership and plat maps were utilized to determine property owners and to plot existing R/W and property lines.
- Utility companies were contacted to determine the location of utility lines and easements in the corridor area. The utility information shown in the plan sheets was taken from utility location maps supplied to HNTB by each of the utility companies and does not represent field-verified locations.
- The following development plans for the corridor were obtained from the City of Overland Park and were considered in the layout of proposed roadways:
  - “Sylvan Lake Subdivision - Phase 1” prepared by Ponzer, Sears, Youngquist, P.A., submitted December 1985.
  - “Sylvan Lake Subdivision – Phase 6” prepared by Ponzer-Youngquist, P.A., submitted August 1991.
  - “Sylvan Lake Subdivision – Phase 7” prepared by Ponzer-Youngquist, P.A., submitted February 1992.
  - “Hampton Place 3<sup>rd</sup> Plat” prepared by Payne & Brockway, P.A., submitted March 1993.
  - “Hampton Place 4<sup>th</sup> Plat” prepared by Payne & Brockway, P.A., submitted May 1994.
  - “The Wilderness” prepared by Phelps Engineering, Inc., submitted July 1997.
  - “The Wilderness Second Plat” prepared by Phelps Engineering, Inc., submitted July 1998.
  - “Final Plat of: KCP&L Redel Place” prepared by KCP&L Co., submitted March 1999.
  - “Hampton Place 7<sup>th</sup> Plat” prepared by Payne & Brockway, P.A., submitted April 1999.
  - “The Wilderness Sixth Plat” prepared by Phelps Engineering, Inc., submitted June 1999.
  - “Hampton Place 8<sup>th</sup> Plat” prepared by Payne & Brockway, P.A., submitted June 2000.
  - “Plat of 163<sup>rd</sup> Terrace Street Extension” prepared by Schlagel & Associates, P.A., submitted December 2000.
  - “The Wilderness Seventh Plat” prepared by Phelps Engineering, Inc., submitted January 2001.
  - “The Tallgrove at the Wilderness West” prepared by Phelps Engineering, Inc., submitted January 2001.
- The City of Overland Park provided turn bay locations and storage length requirements, along with traffic counts and projections.
- Design criteria is in accordance with ordinances for the City of Overland Park, the Kansas Department of Transportation, and the American Association of State Highway and Transportation Officials’ publication, *A Policy on Geometric Design of Highways and Streets*.
- The Union Pacific Railroad Company was contacted to obtain information regarding the criteria for design associated with roadway-railroad at-grade and grade-separated crossings.
- The Mission Road realignment and bridge replacement plans over the Blue River were obtained from Johnson County Public Works and were used in developing the Mission Road horizontal alignment.
- Estimates of construction costs, utility relocation costs, and right-of-way and easement acquisition costs are based on 2002 dollar values.

## **EXISTING CONDITIONS AND FUTURE PLANNING**

### **Roadways**

159<sup>th</sup> Street, Mission Road, and Nall Avenue are identified as thoroughfare corridors serving Overland Park and Johnson County residents. 159<sup>th</sup> Street and Nall Avenue are two-lane paved roadways with no shoulders and open ditches. Mission Road is a two-lane paved roadway with open ditches the entire length. Shoulder improvements were recently added to the section near the Blue River bridge. 159<sup>th</sup> Street is bordered on the north side entirely by Overland Park except a small section near the railroad crossing which is part of Johnson County. Sections at the southwest corners of both the 159<sup>th</sup> Street and Nall Avenue intersection and the 159<sup>th</sup> Street and Mission Road intersection are part of Johnson County. Mission Road is bordered almost entirely by Johnson County on the west side and is bordered by Overland Park on the east side.

159<sup>th</sup> Street has two intersecting thoroughfares – Nall Avenue and Mission Road. There are also two intersecting side streets (Rosewood Street and Roe Avenue) and several driveways on 159<sup>th</sup> Street.

Mission Road and Nall Avenue are each intersected by 159<sup>th</sup> Street and have several driveways on them. Mission Road crosses over the Blue River at the beginning of the project and is adjacent to the river for several hundred feet before crossing the Union Pacific Railroad.

### **Railroads**

An existing railroad line owned by the Union Pacific Railroad Company runs southwest to northeast crossing Mission Road south of 159<sup>th</sup> Street and 159<sup>th</sup> Street west of Mission Road. The existing railroad track is centered within 100' of railroad right-of-way. A future railroad track is assumed to be planned within the railroad right-of-way to the east of the existing track.

### **Right-of-Way**

The existing right-of-way ranges between 20 feet to 40 feet on either side of the section line through undeveloped tracts of land, and 60 feet on either side of the section line where subdivisions have been platted. The existing right-of-way is shown on the plan drawings in the Appendix.

Proposed right-of way requirements are indicated on the plan drawings in the Appendix and on Exhibit 1. All thoroughfare sections will be located within 120' of right-of-way. Permanent drainage easements will be necessary at the ends of the crossroad drainage structures. Temporary construction easements will be necessary along most properties adjacent to construction. Permanent utility easements are present in most of the sub-divided properties. Adjustments and modifications to utility easements should be determined during the project design phase when more accurate utility information is available.

### **Traffic Counts**

Traffic counts indicate 4100 Average Daily Traffic (ADT) along 159<sup>th</sup> Street and 1900 ADT along Mission Road. Projected counts of 14,000 ADT for 159<sup>th</sup> Street and 6000 ADT for Mission Road are anticipated for the year 2020. The roadways are currently signed for 35mph.

### **Land Use**

The land adjacent to the roadways in this study includes platted residential subdivisions and small to large tracts of unplatted land. The 159<sup>th</sup> Street corridor is distinctly split between platted subdivisions west of Roe and unplatted agricultural land east of Roe. Some of the platted subdivision properties on 159<sup>th</sup> Street are currently vacant but are quickly developing. A KCP&L utility tract is located on the south side of 159<sup>th</sup> Street between Roe Avenue and Mission Road. There are single-family tracts of land on the northeast and southwest corners of 159<sup>th</sup> Street and Mission Road. West of Mission Road is primarily

agricultural except for the Brigg's Sod Farm property, which is zoned as commercial. The land adjacent to Nall Avenue in this study consists of single-family tracts. The Mission Road corridor consists of large agricultural tracts with the following exceptions near the Blue River bridge. The Carstar facility on the west side of Mission Road south of the railroad is considered commercial. There are two single-family tracts, one on each side of the road and an industrial zoned tract for the abandoned Kuhlman Diecasting Co. on the west side of the road at the southern end of the study area.

Overland Park's Future Development Plan shows significant development along the 159<sup>th</sup> Street corridor. The majority of the currently zoned agricultural land will become low/medium density residential and light industrial/business park. The area between Roe Avenue and Mission Road will become light/medium density residential except for the southwest corner of 159<sup>th</sup> Street and Mission Road, which is planned as industrial/business park. From Mission Road to the Union Pacific Railroad, the development will be mainly light industrial/ business park with the exception of the northeast corner of 159<sup>th</sup> Street and Mission Road, which is planned to be low density residential with the potential for an office park area. All land east of the railroad will remain agricultural/park space. On Mission Road south of 159<sup>th</sup> Street, the development plan shows industrial/business park development in the south quadrants of the intersection with park space beyond that.

The Johnson County Planning Department was contacted to obtain information regarding possible development on the Johnson County land throughout the study area. The property at the southwest corner of 159<sup>th</sup> Street and Mission Road is zoned multi-family, which differs from Overland Park's assumption of industrial/business park. The remaining property on the west side of Mission from 159<sup>th</sup> Street to the railroad crossing is zoned as an office park district which also differs from Overland Park's assumption of park/recreational land. The Williams Pipeline property at the northwest corner of 159<sup>th</sup> Street and the Union Pacific Railroad crossing is zoned as light industrial which corresponds with Overland Park's assumption. Johnson County Planning had received no development plans at the time of this study for any of its properties.

### **Vertical Alignments**

According to the AASHTO design criteria, adequate stopping sight distance and/or intersection site distance is not currently available at several locations along 159<sup>th</sup> Street and Mission Road. Roe Avenue and Mission Road are located near high points in the 159<sup>th</sup> Street profile, which will need to be lowered as a result of the new design speed. Currently the speed limit along 159<sup>th</sup> Street is 35 mph and the existing profile was designed to accommodate that speed. Because the proposed design speed is now 50 mph, existing high spots in the profile will need to be cut down and low spots will need to be filled in to meet the new criteria.

As the Mission Road intersection is near a high point in the 159<sup>th</sup> Street profile, the same is the case with the intersection on the Mission Road profile. This high point in the Mission Road profile will also need to be lowered as a result of stopping sight distance and/or intersection sight distance criteria. The Mission Road alignment is adjacent to the Blue River south of the railroad crossing and the existing roadway is actually below the river's 100-year flood elevation from the railroad crossing to the new bridge over the Blue River. In order to keep the roadway above the 100-year elevation; the proposed grade would have to be raised as much as 15' above the existing roadway grade – this was not achieved.

### **Existing Drainage**

There are currently open ditches adjacent to 159<sup>th</sup> Street, Mission Road, and Nall Avenue. There are three existing drainage structures crossing 159<sup>th</sup> Street and three existing drainage structures crossing Mission Road. All of the existing structures on 159<sup>th</sup> Street are reinforced concrete boxes ranging from 4'x2' to 10'x6.5'. One of the structures on Mission Road is a reinforced concrete box, the other two are corrugated metal pipes. The majority of these structures do not meet Overland Park's criteria of 7" of street overtopping for a 100-year event. None of the structures are long enough to accommodate the proposed typical section with adequate clear zone.

## UTILITIES

The major underground utilities in the study area are telephone, water, power, gas, sanitary sewers, cable, and fiber optic. There is also a major petroleum line in the study area along the railroad. These utility lines and their respective sizes are shown on the plan drawings in the Appendix and are described as follows:

### Johnson County Wastewater District

#### *159<sup>th</sup> Street*

The Wastewater District has an 8" sanitary line that runs parallel to 159<sup>th</sup> Street 50' north of the centerline from Roe Avenue to about 700' east of Roe Avenue. There are two sewer crossings beneath 159<sup>th</sup> Street: The first crossing is an 8" line about 700' east of Roe Avenue. The second crossing is a 42" line that crosses 159<sup>th</sup> Street about 200' east of the railroad crossing.

#### *Mission Road*

One 42" sanitary sewer crosses Mission Road about 300' north of the railroad crossing.

### Water District No. 1 of Johnson County

#### *159<sup>th</sup> Street*

The Water District has a 12" line along the north side of 159<sup>th</sup> Street from the beginning of the project to Mission Road. An 8" water line is located along the south side of 159<sup>th</sup> Street for the length of the project.

#### *Mission Road*

The Water District has an 8" line along the west side of Mission Road from the beginning of the project to 159<sup>th</sup> Street. From Mission Road to the north there is a 12" line of the west side of the road.

#### *Nall Avenue*

The Water District has an 8" line along the east side of Nall Avenue for the length of the project.

### Kansas Gas Service

#### *159<sup>th</sup> Street*

Kansas Gas Service has a 3" line along the north side of 159<sup>th</sup> Street from the beginning of the project to Mission Road. From Mission Road to the end of the project there is a 4" gas line along the north side of 159<sup>th</sup> Street. A 4" line also crosses 159<sup>th</sup> Street between Nall Avenue and Rosewood Street and runs parallel to the road on the south side for about 500'.

#### *Mission Road*

Kansas Gas Service has a 4" line that starts out west of Mission Road at the Blue River crossing and then crosses the road as the road swings over onto the section line. The 4" gas then runs parallel to Mission Road along the east side and crosses back over to the west side at 159<sup>th</sup> Street.

#### *Nall Avenue*

Kansas Gas Service has a 3" line along the west side of Nall Avenue from the beginning of the project to 159<sup>th</sup> Street. A 6" line runs on the west side of Nall Avenue from 159<sup>th</sup> Street to the end of the project.

### KCP&L

#### *159<sup>th</sup> Street*

KCP&L has overhead facilities along the north side of 159<sup>th</sup> Street for the length of the project. KCP&L was in the process of relocating their facilities along the north side of 159<sup>th</sup> Street during this study. The overhead facilities through the developed areas were relocated into private easements on the north side of the road. Large overhead power transmission lines cross 159<sup>th</sup> Street between Roe Avenue and Mission Road. Miscellaneous underground crossings exist throughout the project.

#### *Mission Road*

KCP&L has overhead facilities along the west side of Mission Road from the beginning of the project to just south of the Carstar facility where it crosses over to the east. The overhead line then runs along the east side of Mission to 159<sup>th</sup> Street where it crosses back over to the west for the remaining length of the project. Miscellaneous underground crossings exist throughout the project.

*Nall Avenue*

KCP&L has overhead facilities on both sides of Nall Avenue from the beginning of the project to 159<sup>th</sup> Street. North of 159<sup>th</sup> Street there is an overhead power line along the east side of Nall Avenue.

**Southwestern Bell Telephone**

*159<sup>th</sup> Street*

SWBT has buried facilities along 159<sup>th</sup> Street in the following locations: buried copper cable along 159<sup>th</sup> Street from the beginning of the project to Mission Road, buried copper cable and fiber optic cable along 159<sup>th</sup> Street east of Mission Road.

*Mission Road*

SWBT has buried copper cable and fiber optic cable along Mission Road for the length of the project.

*Nall Avenue*

SWBT has buried copper cable along Nall Avenue for the length of the project.

**Time Warner Cable**

*159<sup>th</sup> Street*

Time Warner Cable has underground facilities on both sides of 159<sup>th</sup> Street from the beginning of the project to Roe Avenue with a crossing just west of Nall Avenue. All other Time Warner facilities along 159<sup>th</sup> Street are attached to KCP&L's poles.

*Nall Avenue*

Time Warner Cable has underground facilities on both sides of Nall Avenue. There are also cable lines connected to KCP&L's poles in this area.

**Blue Valley School District**

*159<sup>th</sup> Street*

Blue Valley School District has buried fiber optic line on the north side of 159<sup>th</sup> Street from the beginning of the project to Nall Avenue.

*Nall Avenue*

There is a buried fiber optic line on the west side of Nall Avenue for the length of the project.

**Sinclair Pipeline**

Sinclair Pipeline has an 8" steel petroleum pipeline that runs along the railroad on the north side and is within railroad right-of-way. The pipeline crosses 159<sup>th</sup> Street about 300' west of the railroad crossing and crosses Mission Road about 150' north of the railroad crossing.

**PRELIMINARY DESIGN**

**Design Criteria**

***Roadway:***

	<u>159<sup>th</sup> Street</u>	<u>Nall Avenue</u>	<u>Mission Road</u>
Classification:	Thoroughfare	Thoroughfare	Thoroughfare
Design Speed:	50 mph (80 km/h)	50 mph (80 km/h)	50 mph (80 km/h)
Posted Speed:	45 mph (70 km/h)	45 mph (70 km/h)	45 mph (70 km/h)
Min. Horizontal Radii:	1400' (426.72 m)	1400' (426.72 m)	1400' (426.72 m)
Max. Grade:	6%	6%	6%
Min. Grade:	1%	1%	1%
Stopping Sight Distance*	400'-475' (122-140m)	400'-475' (122-140m)	400'-475' (122-140m)
Crest Vertical Curve (K)*	110-160 (32-49)	110-160 (32-49)	110-160 (32-49)
Sag Vertical Curve (K)*	90-110 (25-32)	90-110 (25-32)	90-110 (25-32)
Superelevation Runoff (Max. Relative Slope)	1:200	1:200	1:200

\*Using 1990 (1994) AASHTO "Green Book" Criteria

***Drainage:***

Hydrology Method	Rational Method (< 600 Acres); SCS TR-55 (>600 Acres)
Ditch Design	5 years (2% Min. Grade)
Drainage Structures (Culverts)	25 Year (design); 100 year (7" roadway overtopping maximum)

**Typical Sections**

The typical sections for the proposed roadways are shown on Exhibit #1. Thoroughfare sections consist of a 10" thick asphaltic concrete pavement, 6" aggregate base course, and an 8" fly ash treated subgrade. This section includes a 24' raised median and a 5' sidewalk located 1' inside the right-of-way line. The roadway width consists of a 13' outside lane and a 12'-2" inside lane. The median becomes 13' wide where an 11' wide left turn lane is added. The median curbs will be 10" Type D and the outside curbs will be 2' Type B Curb and Gutter. 4:1 cut and fill slopes were used in all areas except for near culverts and on the approaches to the railroad overpasses where 3:1 slopes were used. The bridge and railroad typical sections are shown on Exhibit #2.

**Median Breaks and Left Turn Lane Storage**

As per the City of Overland Park, the median break locations and left turn lane storage requirements are as follows:

<u>Location</u>	<u>Northbound</u>	<u>Southbound</u>	<u>Eastbound</u>	<u>Westbound</u>
Nall Avenue	300 feet	300 feet	300 feet	300 feet
Rosewood	---	---	200 feet	150 feet
Roe Avenue	---	---	200 feet	200 feet
Mission Road	300 feet	300 feet	300 feet	300 feet

## **Proposed Horizontal Alignments**

### ***159<sup>th</sup> Street***

The proposed alignment for 159<sup>th</sup> Street follows the section line and is shown in the Appendix.

Existing and proposed developments along 159<sup>th</sup> Street are based on a typical thoroughfare section that is centered on the section line. During final design, it may be beneficial to look at an alternate alignment of 159<sup>th</sup> Street through the undeveloped areas east of Mission Road. An alternate alignment could include a safer skew angle at an at-grade railroad crossing or a shorter bridge length in an overpass railroad crossing. An alternate alignment would also allow the roadway to cross the railroad at the same location as the existing culvert crossing. This would lower costs by allowing for a shorter culvert length or possibly eliminate the need for a culvert in a grade-separated crossing. An alternate alignment for 159<sup>th</sup> Street is shown on Exhibit #4.

### ***Nall Avenue***

The proposed alignment for Nall Avenue follows the section line as shown in the Appendix.

### ***Mission Road***

The proposed alignment for Mission Road matches the existing alignment at the bridge over the Blue River (designed by Shafer, Kline, and Warren). Because the roadway is superelevated near the bridge, the 1214' (370m) radius will meet the AASHTO "Green Book" criteria for horizontal curvature. The horizontal alignment continues to follow the existing alignment through a 1640' radius until it merges with the section line. The alignment of Mission Road then follows the section line to the north end of the project. The proposed alignment of Mission Road is shown in the Appendix.

During final design, it may be beneficial to look at an alternate alignment of Mission Road. An alternate alignment could include a safer skew angle at an at-grade railroad crossing or a shorter bridge length in an overpass railroad crossing. An alternate alignment for Mission road is shown on Exhibit #4.

## **Proposed Vertical Alignments**

The design speed of 50 mph for thoroughfares is established in the *City of Overland Park Municipal Code*. As directed by the city, the minimum design criteria for the vertical curves was based on the 1990 Edition of the AASHTO "Green Book" *A Policy on Geometric Design of Highways and Streets* instead of the current edition. The main criteria used to establish the vertical curves were the minimum "K" values for crest and sag curves. Intersection Sight Distance was also considered when designing the crest curves near intersections.

Preliminary vertical alignments of 159<sup>th</sup> Street from Nall Avenue to Mission Road were developed by several subdivision developers. The individual developers created these alignments in order to establish grading plans that would match the future roadway grading at the right-of-way line. Initial efforts were made to "best fit" these developer alignments. The proposed alignment of 159<sup>th</sup> Street was then adjusted in the developed areas to further minimize impacts.

Special considerations were made for the vertical alignments of 159<sup>th</sup> Street and Mission Road at the at-grade railroad crossings. As discussed in the current edition of the AASHTO "Green Book", it is desirable from the standpoint of sight distance, rideability, braking, and acceleration that the intersection of roads and railroads be made as level as possible. This is discussed in more detail later in the section "At-grade Railroad Crossings".

Because of Mission Road's proximity to the Blue River, efforts were made to keep the proposed roadway above (or 7" below for overtopping) the 100-year flood elevation. In order to match the superelevation and grade of the existing railroad, the vertical alignment of Mission has to dip below the 100-year elevation a maximum 2.8' over a distance of 500'. The 100-year flood elevation was obtained from the most recent "Flood Insurance Rate Map" published by the Federal Emergency Management Agency and was determined to be 894.37 ft. (after datum adjustments). A Blue River Floodway Study was being done by CDM (Camp, Dresser, and McKee) at the time of this study although new data was not available. For final design, the newly determined 100-year flood elevation (if higher than 894.37) and revised floodway should be taken into consideration.

## Proposed Culverts

There will be a total of five culvert crossings for this study area (three along 159<sup>th</sup> Street and two along Mission Road). Ditches were utilized mostly in undeveloped areas to divert drainage along the toe of slope to a culvert crossing. The major culvert crossings were sized for a 25-year storm with a 7-inch overtopping check for the 100-year storm. Two of the culvert crossings (one on 159<sup>th</sup> Street and one on Mission Road) occur in locations that must cross under both the roadway and the railroad. In these cases, it becomes desirable to use pipes that can be bored underneath the railroad to avoid stopping railroad activity. Where pipes are bored under the railroad, steel tunnel liners will be used as support. All other structures were designed as reinforced concrete boxes with a minimum 7' height as requested by the City of Overland Park. For the overpass options, the length and/or configuration of the culverts had to be modified as shown in the Appendix. Locations of all structures are shown on the plan and profile sheets in the Appendix.

There are five culvert crossings in this study. The data used in analyzing the storm drainage flowing from the adjacent drainage areas is shown in the table below:

Structure Location	Size/Type ft	Area Acres	C Value	Time of Concentration Min	i <sub>25</sub> in/hr	i <sub>100</sub> in/hr	Q <sub>25</sub> cfs	Q <sub>100</sub> cfs
159 <sup>th</sup> Street Sta. 120+10.00	7x7 RCB	40	0.55	6.14	6.50	7.94	157	227
159 <sup>th</sup> Street* Sta. 139+90.20	7x7 RCB	64	0.55	7.38	6.47	7.91	252	364
159 <sup>th</sup> Street** Sta. 172+12.90	3 - 78" RCP	188	0.75	19.30	6.13	7.50	949	1373
Mission Road Sta. 280+16.14	8x7 RCB	79	0.75	15.34	6.47	7.91	422	610
Mission Road Sta. 282+90.00	2 - 78" RCP	117	0.75	16.23	6.39	7.81	618	893

\*The culvert on 159<sup>th</sup> Street at Sta. 139+90.20 may need a special area inlet on the upstream end to avoid impacts to the developed properties in that area. This should be investigated during final design.

\*\*The culvert on 159<sup>th</sup> Street at Sta. 172+12.90 overtops the roadway during the 100-year storm. The City requires that the 100-year storm does not overtop the roadway in excess of 7". It overtopped the road by less than the maximum of 7".

## Retaining Walls

Retaining walls will be required at a number of locations where the extension of the roadway sideslopes would adversely affect adjacent landowners. The recommended retaining wall locations are shown on the plans in the Appendix. For the at-grade railroad crossings, retaining walls are recommended to minimize the impacts to the Carstar facility on Mission Road, to the Briggs Sod Farm building on 159<sup>th</sup> Street, and to the access road north of 159<sup>th</sup> Street on Tract 66. For the overpass railroad crossings, the retaining wall would still be needed at the Carstar facility but the other two would be replaced by the MSE retaining walls for the bridge overpass. MSE retaining walls will be required for the railroad overpasses on 159<sup>th</sup> Street and Mission Road. The overpass

crossings and MSE retaining walls are discussed in more detail later in the section called “Overpass Railroad Crossings”. Further investigation may be needed during the preliminary project design to determine the practicality of using retaining walls shown on the preliminary plans.

### **At-grade Railroad Crossings**

The main consideration when laying out the vertical alignments on 159<sup>th</sup> Street and Mission Road was to provide smooth crossings at the Union Pacific Railroad. As can be seen in the plans and the Appendix, the railroad alignment is in a horizontal curve at both of the railroad crossings. Because the railroad is in a curve, the tracks are superelevated and therefore the roadway must cross the tracks at the same slope as the superelevation. From survey shots on the railroad, it was determined that the slope across the 159<sup>th</sup> Street railroad tracks would be 1.22% and the slope across the Mission Road railroad tracks would be 3.23% (the railroad has a higher degree of curvature across Mission Road). The vertical profiles of 159<sup>th</sup> Street and Mission Road reflect these slopes and can be seen in the plan sheets. For final design, a site-specific analysis will be needed for rail clearances at both railroad crossings.

Mr. Mike Benjamin with Union Pacific Railroad was contacted to determine the current and future plans for the railroad and to establish key design criteria for the at-grade and overpass crossings. Mr. Benjamin indicated that design should include plans for a future track parallel to the existing track at a 20’ offset. The configuration of the track further to the north has an additional track on the east therefore it was assumed that the future track through this area would also be to the east of the existing track. Mr. Benjamin also stated that there should be a 1% slope between the nearest rails of the existing and future tracks in the same direction as the track superelevation. It was assumed that the existing track would be 6” higher in the future due to track renovations. UPRR indicated that for final design, the track should be surveyed 1000’ on each side of the crossing to determine whether future profile upgrades are likely.

Precast concrete panels will need to be installed at each of the railroad crossings. A standard drawing of the concrete panels, “Installation of Road Crossings with Precast Concrete Panels” was provided by UPRR and can be seen on Exhibit #3. As indicated in the current AASHTO “Green Book”, traffic control devices for railroad-highway grade crossings consist of signs, pavement markings, flashing light signals, and automatic gates. Currently all forms of these devices are in use and will be need to be replaced and upgraded as part of the project.

### **Overpass Railroad Crossings / Bridge Design**

Grade-separated solutions for the two railroad crossings in this study were investigated for a number of reasons. The Union Pacific Railroad currently carries a substantial volume of train traffic and both 159<sup>th</sup> Street and Mission Road vehicular traffic is expected to more than triple over the next 20 years. The existing skew angle of both crossings is 30° which is very extreme for an at-grade crossing. Grade-separated crossings would provide significant improvements in both safety and traffic interruptions. Plan and profile sheets of the grade-separated crossings can be found in the Appendix on Sheets 20-25.

Because of the existing topography at each of the railroad crossings, a railroad underpass would seem to be a desirable option. Unfortunately, the Blue River is in close proximity to each crossing which would make it very difficult to drain the site. This study focuses on the more plausible options of overpass bridges at the railroad crossings.

As mentioned earlier, contact was initially made with Union Pacific Railroad to determine the future plans for the railroad and to establish design criteria at the railroad crossings. Many of the design assumptions were the same for the overpass options as they were for the at-grade options. The future track was offset 20’ to the east of the existing track and a 6” allowance for future track renovations was used. Additionally, 23’ was used as the minimum clearance from the highest rail point to the lowest bridge structure point. Bridge structures such as columns or abutments must be at least 18’ away from the closest track. Any structure within 25’ of an existing or future track would require crash walls. Union Pacific Railroad indicated that they prefer grade-separated railroad crossings to at-grade crossings and that they would support at least 5% of the construction cost within railroad right-of-way if a grade-separated crossing is built.

Design criteria for the new bridges will adhere to current standards and criteria established by the City of Overland Park and the American Association of State Highway and Transportation Officials (AASHTO). The design live load for the new bridges will be AASHTO HS-20 as defined in Section 3.7 of the Standard Specifications.

Twin bridges would be constructed at the 159<sup>th</sup> Street and Mission Road locations. The single span bridges will have 26'-7" roadways, 1'-3" by 3'-6" tall barriers to meet UPRR height requirements and 5' sidewalks with 6' tall chain link fences. The total out-to-out bridge width is 35'-1". Due to the 30° skew and railroad clear zone requirements, the span length at 159<sup>th</sup> Street is 150' and at Mission Road the span length is 165'. The span lengths dictate that a welded plate girder superstructure with composite slab be used. Bridge Layouts for single span structures are shown on the plans in the Appendix. The spans were set to keep the deep abutments out of the 25' clear zone that would require them to be designed as crash walls and will also allow room for a service road for the railroad and drainage. Foundation types for the new bridges were given only brief attention for this study. The choice of foundation type would not be made until geotechnical investigation work is completed.

MSE retaining walls will be required at all four outside corners of the twin bridges to minimize the impact to adjacent landowners as well as to prevent encroaching on railroad right of way. The bridge barriers will transition to a height of 2'-8" off of the bridge and run the full length of the MSE walls. The 6' chain link fence will also run the full length of the MSE retaining walls. MSE walls could also wrap around the front of the abutments while maintaining the 25' clear zone. This would allow the abutments to be built integral or semi-integral on steel piles.

Concrete approach slabs will be constructed at the approaches. Details will conform to current KDOT standards with the concrete slab attached to the bridge abutment and a transverse expansion joint located 13' from the end of the bridge wearing surface.

A preliminary estimate of bridge construction costs has been prepared and is presented on pages 38 and 39. Preliminary construction costs have been estimated on a square meter unit cost basis.

### **Permitting**

Permits will be required before beginning construction activities on this project. Due to the continually changing nature of permitting requirements, it is recommended that the engineer analyze permitting requirements during the project's preliminary design phase. The following permits may be required and should be investigated:

- *Union Pacific Application for Railroad Right-of-Entry*
- *404 Permit*
- *DWR Permit*
- *National Pollution Discharge Elimination System (NPDES) Permit*
- *Other*

### **Construction**

This report has been set up at the request of the City to show five (5) separate sections of roadway. The quantities for each section have been calculated separately as well as the estimate of cost for each section. The separate sections of roadway are divided as follows:

- *Section A: 159<sup>th</sup> Street and Nall Avenue Intersection*
- *Section B: 159<sup>th</sup> Street – Nall Avenue to Mission Road*
- *Section C: 159<sup>th</sup> Street and Mission Road Intersection*
- *Section D: 159<sup>th</sup> Street – East of Mission Road*
- *Section E: Mission Road – South of 159<sup>th</sup> Street*

Sections A and C include all four legs of the intersection to a point where the median becomes full width or the roadway ties into existing pavement. Sections D and E will be repeated to account for the differences in the at-grade and overpass railroad crossings. A colored map detailing the limits of each section is included in the following section of the report.

The cost estimates for each section are intended to assist the City in the phasing of roadway construction. For instance, the 159<sup>th</sup> Street and Nall Avenue intersection (Section A) could be constructed as part of another project leaving 159<sup>th</sup> Street from Nall Avenue to Mission Road to be constructed as another possible project which would include sections B and C. With five separate sections (7 including the overpass options) there will be a number of different combinations from which the City can put together a cost estimate for future projects.

At the request of the City, the overall project costs will also be divided proportionally between Overland Park and Johnson County based on the percentage of frontage that each entity currently has along the section of proposed roadway. These costs are for budgeting purposes only and the actual amount that each entity will be responsible for will be determined during the design phase.

Temporary surfacing will be necessary to maintain access to residential and commercial properties throughout the study area. Bus routes should be a consideration during the construction phasing because of the close proximity of several Blue Valley Schools in the area. Detailed recommendations for construction phasing and maintenance of traffic during construction will need to be evaluated during each preliminary project design.

The cost of earthwork should also be considered during the sequencing of construction. As shown from the table below, Sections A, B, and C have an excess of material while Sections D and E are in need of fill.

	Unclassified Excavation	Embankment	Waste/Borrow
Section A	15,803 cu. yd.	10,577 cu. yd.	5266 cu. yd. Waste
Section B	53,450 cu. yd.	48,469 cu. yd.	4981 cu. yd. Waste
Section C	50,879 cu. yd.	14,629 cu. yd.	36,250 cu. yd. Waste
Section D (At-grade)	20,903 cu. yd.	44,579 cu. yd.	26,013 cu. yd. Borrow
Section E (At-grade)	9766 cu. yd.	93,198 cu. yd.	85,519 cu. yd. Borrow
Section D (Overpass)	5871 cu. yd.	236,758 cu. yd.	233,189 cu. yd. Borrow
Section E (Overpass)	4969 cu. yd.	283,437 cu. yd.	280,628 cu. yd. Borrow