


**THE CITY OF OKLAHOMA CITY
APPROVAL SHEET**

Project No. TC-0506

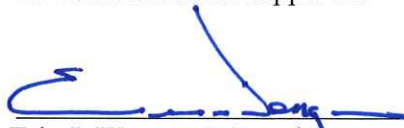
**Intersection Improvements for
NW 10th Street at N Pennsylvania Avenue and N Virginia Avenue
Oklahoma City, OK**

Prepared by:



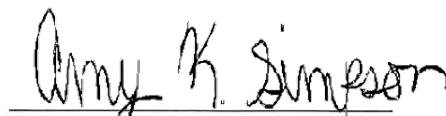

Architect/Engineer

Recommended for Approval



Eric J. Wenger, P.E., Director
Public Works/City Engineer

APPROVED by the Council of the City of Oklahoma City this 21st day of
June, 2022.

ATTEST:


City Clerk




Vice Mayor

PRELIMINARY ENGINEERING REPORT
for
OKC Project No. TC-0506
Intersection Improvements for
NW 10th Street at N Pennsylvania Avenue and N Virginia Avenue
Oklahoma City, OK

Prepared for:



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PRELIMINARY ENGINEERING REPORT
June 2022

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Project No. TC-0506

Intersection Improvements for NW 10th Street at N Pennsylvania Avenue and N Virginia Avenue Oklahoma City, OK

EXECUTIVE SUMMARY

Scope

The City of Oklahoma City desires intersection improvements for NW 10th Street at N Pennsylvania Avenue and N Virginia Avenue. The complex roadway geometry and closely spaced signalized intersections are difficult for drivers to maneuver and the City has received citizen complaints regarding traffic operations in this area. The primary need for this project is based on capacity, operational, and safety issues. LEE has partnered with HALFF Associates, Inc. (HALFF) to provide the survey and civil design services for this project.

The first part of the project was to evaluate the existing roadway configuration and provide engineering analysis as to the function and operation of design alternatives. A virtual public meeting was hosted on the City of Oklahoma City's website with a pre-recorded video presentation, the comment period ended on 3/14/2021. Three (3) conceptual layouts were presented in a concept preliminary report to the City on 5/7/2021. The Peanut Roundabout was selected as the preferred concept through the City's process of consensus building and based upon public comments received in support of this alternative. See **page 6** for the preferred concept and **page 7** for the 2 other concepts that were considered in the concept preliminary report.

The following operational and intersection improvements are intended for this contract:

- Replace three (3) signalized intersections with a multi-lane peanut (double) roundabout
- ADA improvements to allow access to all outer sides of the roundabout
- Access Management to consolidate and reconfigure driveways close to the roundabout
- Landscape improvements
- Appropriate signing and striping to guide vehicles through the roundabout

Budget

- | | |
|------------------------------------|--------------------|
| • Fixed Limit of Construction: | \$1,576,170 |
| • Preferred Concept Cost Estimate: | \$1,536,856 |

Schedule

- | | |
|--------------------------|-------------|
| • Preliminary Report: | Summer 2022 |
| • Final Plans: | Fall 2022 |
| • Begin Construction: | Early 2023 |
| • Construction Complete: | Fall 2023 |

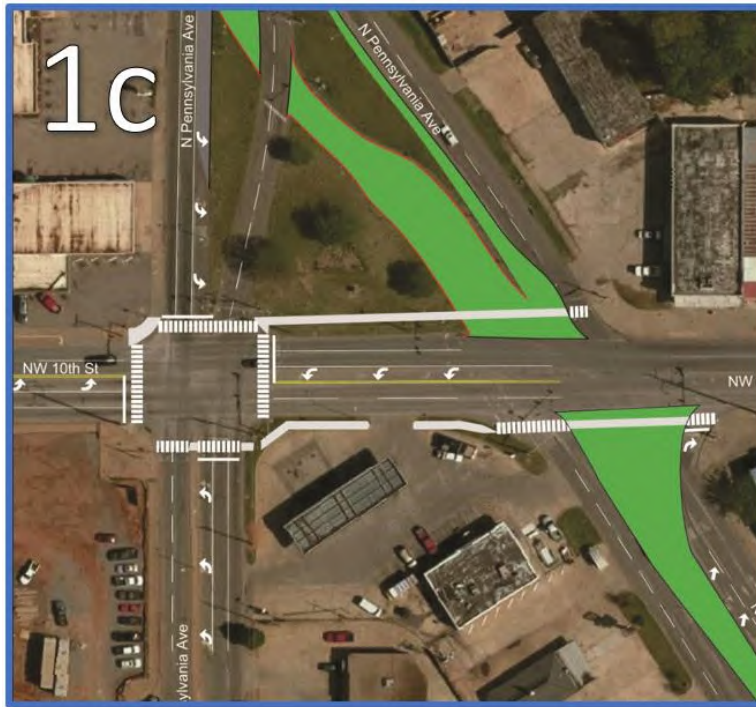
Recommendation

The intersection of NW 10th Street at N Pennsylvania Avenue and N Virginia Avenue currently has complex roadway geometry and closely spaced signalized intersections. The proposed design was developed to improve on the existing conditions regarding traffic operations, access, and safety. Arriving at the provided preliminary design required extensive iteration to determine the shape and size of the roundabout. These design outcomes minimize adverse impacts to adjacent properties and avoid identified critical constraints (e.g., gas station right-of-way and high voltage power poles). The optimized geometrics minimize adverse impacts while simultaneously meeting operational objectives and, importantly, adhering to safety design principles.

Preferred Concept – Peanut (Double) Roundabout



Concept 1c: Alternative Intersection (Partial Access)



Concept 2: Multi-Lane Roundabout



Decision Matrix

Existing Conditions	
Advantages	Disadvantages
✓ Low Cost	✓ No decrease in conflict points
✓ Familiar for drivers	✓ Higher maintenance cost for signals
✓ Easier for trucks and busses to maneuver	✓ No safety improvements for pedestrians
Preferred Concept - Peanut (Double) Roundabout	
Advantages	Disadvantages
✓ Reduced number of conflict points could improve safety	✓ Unfamiliar geometry for drivers to learn
✓ Preferred by stakeholders and the public	✓ Could be difficult for trucks and buses to maneuver
✓ Improved Visual aesthetics	✓ Potential for high queues if traffic increases more than predicted
✓ Under Budget with lower maintenance	✓ Higher Cost
✓ Eliminates all 3 traffic signals	✓ Some ROW required
Concept 1c: Alternative Intersection (Partial Access)	
Advantages	Disadvantages
✓ Efficient traffic operations (LOS C)	✓ Limited access to N Virginia Avenue
✓ Quick construction and minimal disruption	✓ Significant queuing predicted on N Virginia Ave if traffic does not reroute
✓ Meets driver expectations	✓ Signal maintenance cost
✓ Eliminates 2 of 3 traffic signals	✓ Does not significantly reduce number of conflict points and severe collisions
✓ Low Cost	
Concept 2: Multi-Lane Roundabout	
Advantages	Disadvantages
✓ Reduced number of conflict points could improve safety	✓ New geometry for drivers to learn
✓ Eliminates all 3 traffic signals (lower maintenance cost)	✓ Significant queuing predicted on at least one approach
✓ Potentially reduces serious collisions	✓ LOS E or worse for future year (2030)
✓ Enhanced aesthetics by landscaping	✓ Unprotected pedestrian crossings
	✓ Total ROW take of gas station and Higher Cost

PROJECT LOCATION MAP

Existing Vicinity Map of the Study Area



PROJECT BACKGROUND

Project Scope

The City of Oklahoma City desires intersection improvements for NW 10th Street at N Pennsylvania Avenue and N Virginia Avenue. The complex roadway geometry and closely spaced signalized intersections are difficult for drivers to maneuver and the City has received citizen complaints regarding traffic operations in this area. The primary need for this project is based on capacity, operational, and safety issues. LEE has partnered with HALFF Associates, Inc. (HALFF) to provide the survey and civil design services for this project.

The first part of the project was to evaluate the existing roadway configuration and provide engineering analysis as to the function and operation of design alternatives. A virtual public meeting was hosted on the City of Oklahoma City's website with a pre-recorded video presentation, the comment period ended on 3/14/2021. Three (3) conceptual layouts were presented in a draft preliminary report to the City on 5/7/2021. The Peanut Roundabout was selected as the preferred concept through the City's process of consensus building and based upon public comments received in support of this alternative.

The following operational and intersection improvements are intended for this contract:

- Replace three (3) signalized intersections with a multi-lane peanut style roundabout
- ADA improvements to allow access to all outer sides of the roundabout
- Access Management to consolidate and reconfigure some driveways close to the roundabout
- Landscape improvements
- Appropriate signing and striping to guide vehicles through the roundabout

Existing Conditions

The study area is fully developed with commercial uses present on all corners and single-family residences located further to the east and west along NW 10th Street. The following major businesses are located within the study area:

- Penn Avenue Church of the Nazarene is located on the northwest corner of NW 10th Street and N Pennsylvania Avenue
- Salvation Army is located on the southwest corner of NW 10th Street and N Pennsylvania Avenue
- Liquor Bin is located on the northeast corner of NW 10th Street and N Virginia Avenue
- El Potosino tire shop is located on the southeast corner of NW 10th Street and N Virginia Avenue
- Valero gas station and convenience store are located on the south side of NW 10th Street between N Pennsylvania Avenue and N Virginia Avenue

These businesses currently have vehicular access to all adjacent roadways. **Figure 1** provides an aerial image of the study area.



Figure 1: Vicinity Map of the Study Area

NW 10th Street is classified as a minor arterial and currently carries 10,770 vehicles per day (vpd), which is anticipated to increase to 12,925 vpd in 2030. The roadway currently has two travel lanes in each direction with dedicated turn lanes and a posted speed limit of 30 miles per hour (MPH) in the study area. To the east of N Virginia Avenue, the roadway has a landscaped median approximately 20 feet in width. The Oklahoma City Embark transit system includes one route along NW 10th Street (#38 – 10th St Crosstown). In the study area, there is a stop with a covered bench located on the south side of NW 10th Street, approximately 150 feet west of N Pennsylvania Avenue. There are stops with a bench (not covered) on the south side of NW 10th Street, approximately 150 feet east of N Virginia Avenue, and on the north side of NW 10th Street approximately 150 feet west of N Pennsylvania Avenue.

N Pennsylvania Avenue is classified as a principal arterial and currently carries 10,125 vpd, which is anticipated to increase to 12,150 in 2030. The roadway has a posted speed limit of 40 MPH and currently has 2 to 4 travel lanes north of NW 10th Street with a landscaped median that varies between 6 and 30 feet in width. The Oklahoma City Embark transit system includes two routes along N Pennsylvania Avenue (#7 – N May and #8 – N Penn/NW 63rd). The nearest stops north of NW 10th Street are on the west side of N Pennsylvania Avenue approximately 120 feet north of NW 11th Street (bench without cover) and the east side approximately 150 feet north of NW 12th Street (bench without cover).

N Virginia Avenue is classified as a minor arterial and merges with N Pennsylvania Avenue approximately 400 feet north of NW 10th Street. It currently carries 5,500 vpd and is anticipated to increase to 6,600 vpd in 2030. The roadway has a posted speed limit of 40 MPH and currently has three travel lanes in each direction with dedicated turn lanes and a landscaped median that varies between 8 and 17 feet in width. The Oklahoma City Embark transit system routes #7, and #8 merge to/from N Pennsylvania Avenue to N Virginia Avenue at NW 10th Street. There is a stop with a covered bench on the east side of N Virginia Avenue, approximately 150 feet north of NW 10th Street. There is another stop on the west side of N Virginia Avenue with a covered bench approximately 120 feet south of NW 10th Street.

The study area intersections operate with three (3) coordinated traffic signals at closely spaced intersections; at NW 10th Street and N Pennsylvania Avenue, at NW 10th Street and N Virginia Avenue, and at the intersection where N Pennsylvania Avenue and N Virginia Avenue cross approximately 200 feet north of NW 10th Street. The NW 10th Street intersections at N Pennsylvania Avenue and N Virginia Avenue are approximately 260 feet apart. The existing intersection and roadway configurations are provided in **Figure 2**.

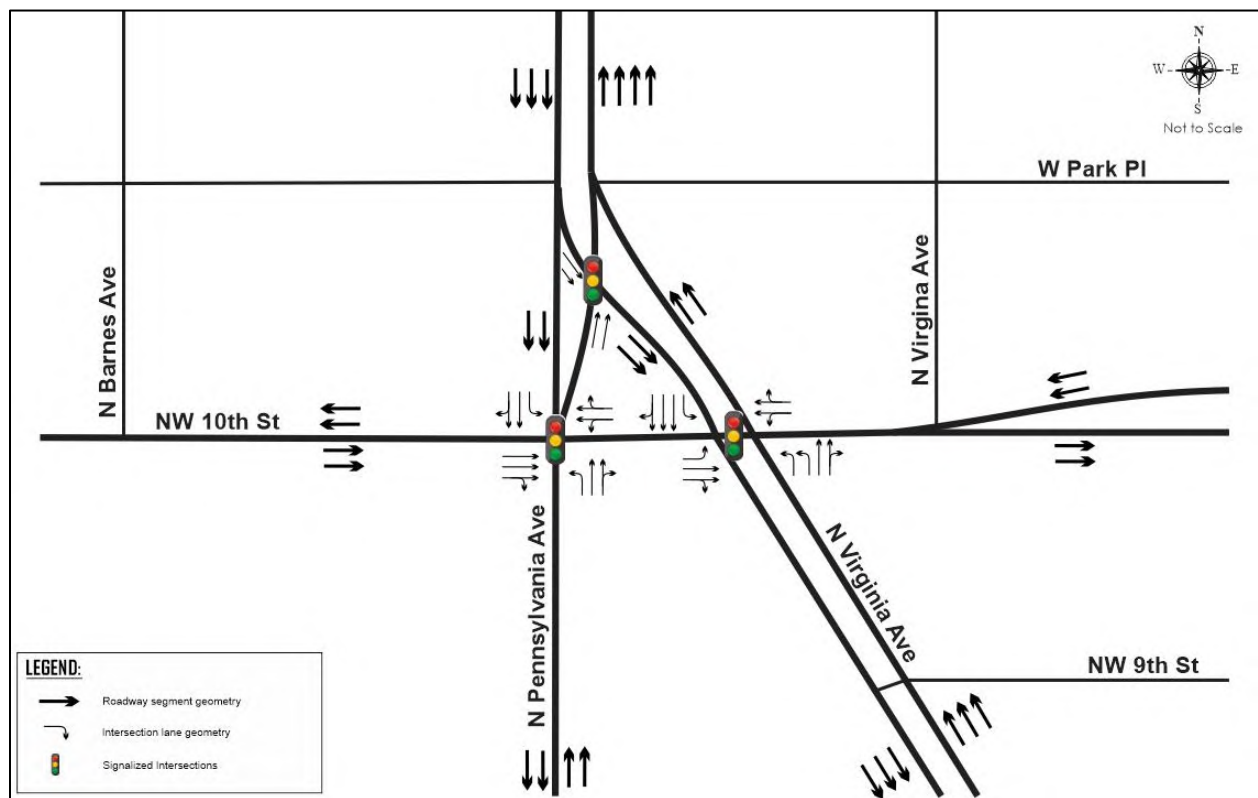


Figure 2: Existing Roadway and Intersection Configuration

Signal pole luminaires are present on the southwest and northeast corners of NW 10th Street and N Pennsylvania Avenue, the northbound crossing signal pole, as well as all four corners of NW 10th Street and N Virginia Avenue. The intersections are actuated-coordinated and use loop detectors for detection. The intersections along NW 10th Street allow for all turning movements

except for eastbound left-turns at N Pennsylvania Avenue, which are prohibited. Eastbound vehicles desiring to travel northbound on N Pennsylvania Avenue must make a left turn onto N Virginia Avenue and then merge onto N Pennsylvania Avenue. Protected only left-turn phasing is provided on the northbound approach at N Pennsylvania Avenue and the northbound and southbound approaches at N Virginia Avenue. Protected/permitted left turns are provided on the eastbound approach at N Virginia Avenue and the westbound approach at N Pennsylvania Avenue. All other left turns are permitted phasing only.

There is a significant amount of pedestrian and bicycle traffic in the study area. Bicycle lanes are not present on any of the study area roadways, but NW 10th Street to the east of N Pennsylvania Avenue is identified as an existing bicycle route through signing and striping (sharrows). No additional bicycle facilities are planned in this area, according to the City of Oklahoma City's *bikewalkokc* plan.

The existing pedestrian facilities in this area consist of marked crosswalks and pedestrian pushbuttons for all movements at the signalized intersections along NW 10th Street. Several of the existing pushbuttons are worn or broken, and some of the pedestrian signal heads are not functioning. Pedestrian push buttons are located on each signal pole, and many are inaccessible for persons with disabilities. Additionally, most of the marked crosswalks are worn and lack visibility.



Photo 1: Inaccessible Pedestrian Pushbuttons (Southeast corner of NW 10th & Virginia)



Photo 2: Worn Crosswalk Pavement Markings (South leg of NW 10th & Virginia)

Sidewalk is present along the south side of NW 10th Street to the west of N Pennsylvania Avenue and along the north and south sides to the east of N Virginia Avenue. Sidewalk is also present along portions of N Pennsylvania Avenue and N Virginia Avenue. Directional wheelchair ramps, compliant with the *Americans with Disabilities Act (ADA)*, were recently constructed at NW 10th Street and N Pennsylvania Avenue.



Photo 3: Crosswalk Pavement Markings Needed
(South leg of NW 10th & Pennsylvania)



Photo 4: Restriped Crosswalk Pavement Markings Needed
(North leg of NW 10th & Pennsylvania)

Wheelchair ramps are not provided at the NW 10th Street and N Virginia Avenue intersection. Marked crosswalks are missing or and lack visibility on all except the west leg.

There are existing drainage inlets at several locations, as can be seen on the preliminary plans in the **Appendix**. There are no known or identified drainage or flooding issues to be corrected within the project limits.

The City of Oklahoma City has several planned roadway projects near the study area:

- Linwood Boulevard from Indiana Avenue to Lee Avenue – Roadway will be reduced to one travel lane, marked parking lane, and bicycle lane in each direction.
- Western Avenue from NW 10th Street to Reno Avenue – Roadway will be reduced to one travel lane and bicycle lane in each direction.
- Classen Boulevard from NW 16th Street to Sheridan Avenue – Roadway will likely be reduced to two travel lanes and bicycle lanes in each direction.

These projects have the potential to increase or decrease traffic volumes in the study area. Lane reductions along parallel corridors may lead to an increase in traffic volumes along Pennsylvania Avenue. The project planned along Linwood Boulevard may reduce traffic volumes along Virginia Avenue, which may improve levels of service at NW 10th Street.

Traffic Data

48-hour turning movement data was collected at the study area intersections on Tuesday, February 11, 2020, and Thursday, February 13, 2020. Based on the traffic count data, the AM peak hour is from 7:30 to 8:30 AM, and the PM peak hour is from 4:30 to 5:30 PM. Peak hour turning movement data was also collected at NW 10th Street and N Indiana Avenue and at N Pennsylvania Avenue and NW 7th Street to assist with the design analysis. Future Year (2030) traffic volumes were projected based on historical traffic data and an assumed annual growth rate of 2%. Existing (2020) traffic count data is provided in **Figure 3**. Future Year (2030) traffic projections are provided in **Figure 4**.

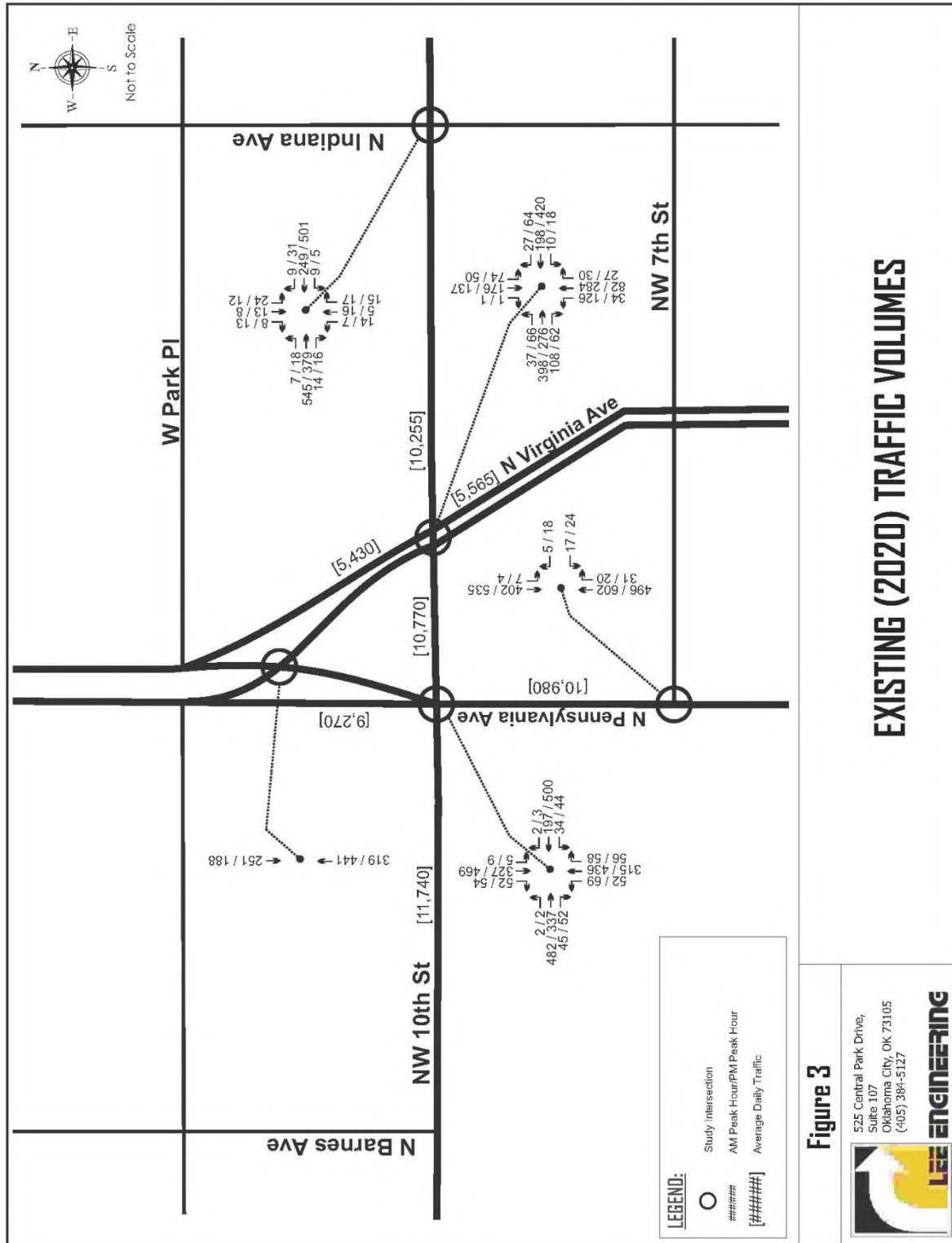


Figure 3: Existing (2020) Traffic Volumes

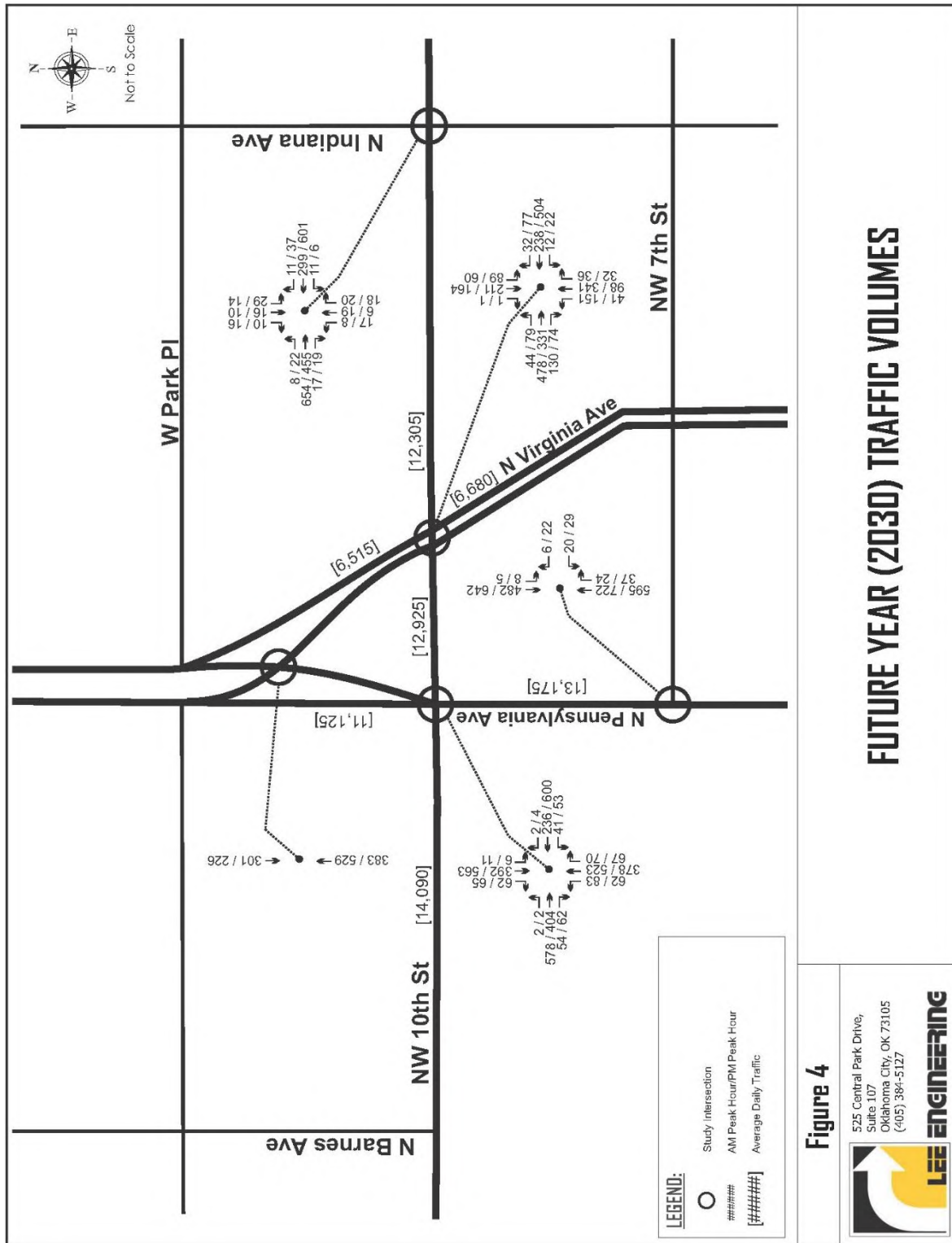


Figure 4: Future Year (2030) Traffic Volumes

Operational Analysis

Intersection capacity analyses were conducted using the *Highway Capacity Manual* (HCM) methodologies in the *Synchro* traffic analysis software package. This analysis determined the existing level of service (LOS) based on current lane configurations, stop control, and existing traffic data. Future Year (2030) LOS was based on current lane configurations, stop control, and future traffic forecasts.

The LOS of an intersection is a qualitative measure of capacity and operating conditions and is directly related to vehicle delay. The LOS criteria for a signalized intersection are shown in **Table 1**. LOS is given a letter designation from A to F, with LOS A representing very short delays (less than 10 seconds of average control delay per vehicle) and LOS F representing very long delays (more than 80 seconds of average control delay per vehicle). The LOS criteria for an unsignalized intersection are shown in **Table 2**. LOS is given a letter designation from A to F, with LOS A representing very short delays (less than 10 seconds of average control delay per vehicle) and LOS F representing very long delays (more than 50 seconds of average control delay per vehicle). Additional performance measures such as volume to capacity (v/c) ratios and queue lengths also provide an indication of operations.

Table 1: Level of Service Criteria for Signalized Intersections

Level-of-Service (LOS)	Average Control Delay (seconds/vehicle)	Description
A	≤ 10.0	Very low vehicle delays, free flow, signal progression extremely favorable, most vehicles arrive during given signal phase.
B	10.1 to 20.0	Good signal progression, more vehicles stop and experience higher delays than for LOS A.
C	20.1 to 35.0	Stable flow, fair signal progression, significant number of vehicles stop at signals.
D	35.1 to 55.0	Congestion noticeable, longer delays, and unfavorable signal progression, many vehicles stop at signals.
E	55.1 to 80.0	Limit of acceptable delay, unstable flow, poor signal progression, traffic near roadway capacity, frequent cycle failures.
F	> 80.0	Unacceptable delays, extremely unstable flow and congestion, traffic exceeds roadway capacity, stop-and-go conditions.

SOURCE: *Highway Capacity Manual*, Transportation Research Board, latest edition

Table 2: Level of Service Criteria for Unsignalized Intersections

Level-of-Service (LOS)	Average Control Delay (seconds/vehicle)	Description
A	≤ 10.0	No delays at intersections with continuous flow of traffic. Uncongested operations: high frequency of long gaps available for all left and right turning traffic. No observable queues.
B	10.1 to 15.0	No delays at intersections with continuous flow of traffic. Uncongested operations: high frequency of long gaps available for all left and right turning traffic. No observable queues.
C	15.1 to 25.0	Moderate delays at intersections with satisfactory to good traffic flow. Light congestion; infrequent backups on critical approaches.
D	25.1 to 35.0	Increased probability of delays along every approach. Significant congestion on critical approaches, but intersection functional. No standing long lines formed.
E	35.1 to 50.0	Heavy traffic flow condition. Heavy delays probable. No available gaps for cross-street traffic or main street turning traffic. Limit of stable flow.
F	> 50.0	Unstable traffic flow. Heavy congestion. Traffic moves in forced flow condition. Average delays greater than one minute highly probable. Total breakdown.

SOURCE: *Highway Capacity Manual*, Transportation Research Board, latest edition

The operational analysis results for the study area under Existing (2020) and Future Year (2030) traffic conditions are shown in **Table 3**. The study area intersections currently operate at LOS C, or better and field reconnaissance confirmed that peak hour traffic flows efficiently through the existing network.

Table 3: Operational Analysis Results – Existing Configuration

NW 10 th Street & N Pennsylvania Avenue (Signalized)						
Scenario	Peak Hour	Intersection	EB	WB	NB	SB
Existing (2020)	AM	28.6 (C) ¹	25.8 (C)	1.0 (A)	29.4 (C)	48.4 (D)
	PM	29.6 (C)	31.6 (C)	1.0 (A)	34.7 (C)	52.3 (D)
Future Year (2030)	AM	30.6 (C)	29.1 (C)	1.1 (A)	29.2 (C)	52.1 (D)
	PM	30.8 (C)	33.7 (C)	1.3 (A)	35.0 (C)	54.6 (D)
NW 10 th Street & N Virginia Avenue (Signalized)						
Scenario	Peak Hour	Intersection	EB	WB	NB	SB
Existing (2020)	AM	6.8 (A)	7.1 (A)	7.9 (A)	5.6 (A)	9.4 (A)
	PM	6.7 (A)	6.4 (A)	6.9 (A)	7.5 (A)	7.8 (A)
Future Year (2030)	AM	7.0 (A)	7.2 (A)	5.5 (A)	8.8 (A)	10.8 (B)
	PM	6.9 (A)	6.4 (A)	7.0 (A)	8.3 (A)	8.7 (A)

¹ Delay in seconds/vehicle (Level of Service)

In addition to the operational analysis, a queuing analysis was performed. The 95th-percentile queue is the queue length (in feet or vehicles) that has a 5-percent probability of being exceeded during the analysis time period. In a queue, it is typically assumed that 25-feet is the equivalent of one vehicle. To estimate 95th-percentile queue lengths, the *Synchro* network was run through *SimTraffic*, a micro-simulation software. *SimTraffic* measures the full impact of queuing and blocking of movements as it can be calibrated to simulate actual driving conditions. **Table 4** provides the queueing analysis results for the Existing (2020) and Future Year (2030) traffic conditions.

Table 4: Queueing Analysis Results – Existing Configuration

NW 10 th Street & N Pennsylvania Avenue (Signalized)				
Movement	Peak Hour	Storage (feet)	Existing (2020) (feet)	Future Year (2030) (feet)
EB Through	AM	>1,000	200	234
	PM		163	190
WB Through	AM	130	74	90
	PM		76	94
NB Left	AM	150	92	112
	PM		130	180
NB Through	AM	>1,000	180	199
	PM		230	282
SB Left	AM	85	28	27
	PM		32	37
SB Through	AM	>1,000	91	89
	PM		91	85
NW 10 th Street & N Virginia Avenue (Signalized)				
Movement	Peak Hour	Storage (feet)	Existing (2020)	Future Year (2030)
EB Left	AM	140	33	41
	PM		82	105
EB Through	AM	140	48	57
	PM		52	56
WB Through	AM	>1,000	128	181
	PM		235	286
NB Left	AM	260	42	52
	PM		138	150
NB Through	AM	>1,000	89	86
	PM		169	188
SB Left	AM	75	60	60
	PM		57	59
SB Through	AM	200	77	78
	PM		75	76

Queue length represents the 95th-percentile queue reported by SimTraffic software.

Bold/red queue lengths indicate available storage is exceeded.

Based on the queuing analysis, none of the existing storage bays or approaches currently exceed capacity. The northbound left-turn storage capacity on N Pennsylvania Avenue at NW 10th Street is predicted to be exceeded by 30 feet during the PM peak hour under Future Year (2030) traffic conditions.

The longest observed queue during the AM peak hour occurred on the NW 10th Street eastbound approach at N Pennsylvania Avenue with a maximum of 15 vehicles.



Photo 5: Typical AM Queues on NW 10th Street – Looking West

During the PM peak hour, the maximum queues occurred on the NW 10th Street westbound approach at N Virginia Avenue and the N Pennsylvania Avenue northbound approach at NW 10th Street. All observed vehicle queues cleared within one signal cycle. At the traffic signal where N Pennsylvania Avenue and N Virginia Avenue cross, the southbound vehicle queue blocked southbound through traffic in the center lane for a brief period several times.



Photo 6: Typical PM Queues on NW 10th Street – Looking East



Photo 7: Typical PM Queues on N Pennsylvania Avenue – Looking North

Collision History

Collision data along NW 10th Street was obtained for the most recent five (5) full years (2016-2020) via the ODOT SAFE-T collision database. Partial collision data was also obtained for the year 2021, although the database will not be finalized until fall 2022. There were 82 reported collisions in the study corridor along NW 10th Street, N Pennsylvania Avenue, and N Virginia Avenue. **Figure 5** shows the general location, density, and severity of reported collisions in a heat-map format.



Figure 5: Heat Map of Reported Collisions (2016-2020)

Out of the total 82 collisions reported, none included a fatality, 1 collision included at least one suspected serious injury (1 person), 33 collisions included at least one non-incapacitating injury, or possible injury (46 persons), and 46 collisions resulted in property damage only. Most of the reported collisions (39 collisions) occurred at the intersection of NW 10th Street and N Pennsylvania Avenue. At NW 10th Street and N Virginia Avenue, 24 collisions were reported. The remaining 19 collisions occurred near these intersections and where N Virginia Avenue merges with N Pennsylvania Avenue.

There were four collisions involving pedestrians or bicyclists within the study extents. Three pedestrian or bicyclist collisions occurred along NW 10th Street and Pennsylvania Avenue and one collision occurred at NW 10th Street and Virginia Avenue. **Table 5** provides details related to the pedestrian and bicycle-related collisions.

Table 5: Pedestrian/Bicycle-Related Collisions (2016-2020)

Date/Time	Location	Type of Collision	Causal Factor	Notes
Wednesday 11-16-2016 2:11 PM	NW 10 th St & N Pennsylvania Ave	Pedal-Cycle (Non-Incapacitating Injury)	Followed too Closely (for): Human Element	Northbound driver turned left and collided with bicyclist (riding with traffic).
Monday 11-6-2017 4:36 PM	NW 10 th St & N Pennsylvania Ave	Pedestrian (Possible Injury)	Pedestrian Action	Westbound driver collided with pedestrian crossing away from crosswalk.
Wednesday 12-5-2018 5:32 PM	NW 10 th St & N Pennsylvania Ave	Pedestrian (Possible Injury)	Not Known	Southbound driver turned right and collided with pedestrian (crossing in crosswalk). Pedestrian had odor of alcoholic beverage.
Friday 07-30-2021 11:25 PM	NW 10 th St & N Virginia Ave	Pedestrian (Non-Incapacitating)	Pedestrian Action	Northbound driver collided with pedestrian crossing away from crosswalk.

Safety Considerations

Several variables contribute to the likeliness of a collision occurring. These variables include roadway geometric design, lighting conditions, speed, driver awareness, pavement condition, signing and marking presence and condition, weather conditions, and others. One method of comparing the safety features of various concepts is to document the number of conflict points. **Figure 6** below illustrate the number of conflict points for a traditional signalized intersection and for a simplified roundabout.

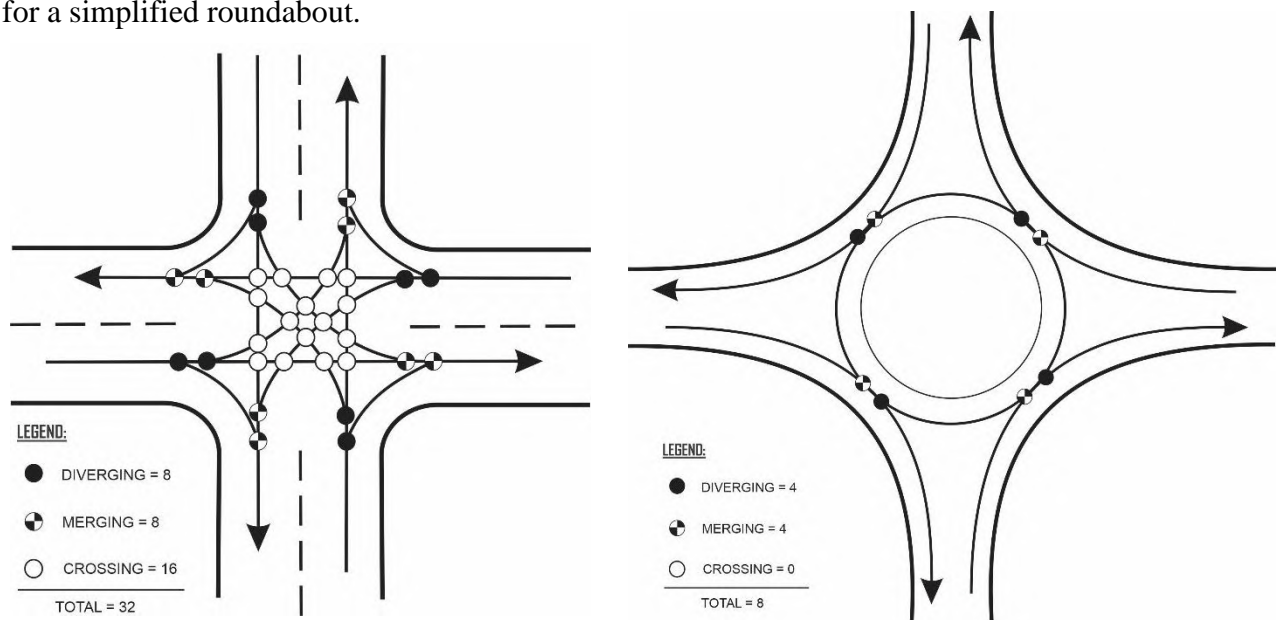


Figure 6: Typical Conflict Points

In general, crossing conflicts have the most likely occurrence of severe collisions such as fatalities and suspected serious injuries. Although the collision data for the last five years at the study intersections did not indicate a significant issue with severe collisions, the geometry lends itself to these types of collisions. The roundabout configurations mitigate severe collisions by eliminating crossing conflicts.

DESIGN PARAMETERS

Roadway Design

This design considers a multi-lane peanut roundabout for the study area that would eliminate all three existing traffic signals. The peanut roundabout can be referred to as two roundabouts, east and west, with interior lanes connecting them. The design includes five total approaches. The east roundabout includes approaches for northbound N Virginia Avenue, westbound NW 10th Street, and eastbound NW 10th Street coming from the west roundabout. The west roundabout includes approaches for northbound and southbound N Pennsylvania Avenue, and eastbound and westbound NW 10th Street. The proposed layout is shown in **Figure 7**.



Figure 7: Proposed Layout

The configuration includes dual entry lanes for northbound and southbound N Pennsylvania Avenue. All other approaches have single lane entries. The eastbound approach to the west roundabout has two (2) approach lanes that split into a single roundabout entry lane and a right turn only slip lane. The eastbound single exit lane from the west roundabout also splits into two lanes, one for entry into the east roundabout and the other for a right turn only slip lane. The westbound exit from the east roundabout is a single lane that adds a lane before entering into the west roundabout. Both roundabouts have single circulating lanes except for the westbound portion of the west roundabout, which has two (2) lanes. It is recommended that lane changes within the roundabout be discouraged or prohibited since all desired maneuvers can be accommodated without the need for a lane change.

Safety is improved by limiting weaving movements and lane changes. Instead of changing lanes, drivers should be in their appropriate lane approaching the roundabout to be able to make the

correct exit. The roundabout spirals from the inside lane to the outside, in order to prevent vehicles from becoming stuck inside a center circulating lane. The number of conflict points is reduced by introducing spiralized lanes, disabling lane changes on the circulatory area, and by allowing vehicles to exit with the assistance of lane marking. A combination of overhead guide signs and ground mount regulatory signs will be used to inform drivers on what lane to be in when approaching the roundabout, which will guide them to their exit without any lane changes.

This design has smaller circulatory diameters allowing for slower speeds but causes more difficulty for trucks and buses to navigate. The percentage of large trucks through this area is very low; however, the design can accommodate trucks through the roundabout. Trucks will need to use both lanes through some of the roundabout, but the mountable interior truck apron will allow truck turning movements and will have a contrasting color to visibly separate the truck apron from the regular travel lane area. Additionally, signs will be installed (example below) to warn vehicles that trucks can use both lanes. The roundabout is also designed to accommodate buses and will allow them to within a single lane.



Landscape Design

The existing site has crossing intersections with wide grass medians and a green open space between trafficways. Although there's existing green space, the site does not have mature trees that provide shade and character. The provided roundabout will involve low speeds for traffic entering and driving through the roundabout; deflection is used to slow entering traffic and enhance safety.

New landscape will consist of shade and flowering trees and minimal shrub planting that have been proven to work in Central Oklahoma and provides ease of maintenance for City staff. Proposed tree planting will be focused along the street edge and pedestrian areas to create shade. A mix of shade and flowering trees will be used to enhance streetscape character, provide shade, and reduce air pollution. Shrub planting will be focused within the two proposed roundabouts and plantings will be 6" to 3' height to limit visibility conflicts. The main green open space on the north side between the merging streets will have a curvilinear concrete paving path that will be partially shaded with canopy trees. See **Appendix B** for plant and materials palette.

Any irrigation system will be limited to the use of the existing system within the medians if the median configuration is kept. Other landscape areas will have an initial watering establishment period with the use of Gator Bag watering bags for trees or hand watering for trees and groundcover. This can be initiated through a landscape maintenance agreement with a contractor or provided by another organization. The site landscape and irrigation will meet the requirements for the City of Oklahoma City landscape ordinance.

Operational Analysis

The two-roundabout system design allows for reduced circulating flows in each roundabout by removing traffic that would otherwise be required to navigate the entire system in a single roundabout, which reduces the number of lanes needed.

The east roundabout provides LOS B for future traffic conditions as a single-lane roundabout with an auxiliary free right turn lane for the eastbound entry. All entries, legs, and the bypass have LOS A or LOS B for 2030 traffic except for the westbound entry, which has LOS C.

The West roundabout provides LOS C for future traffic conditions. The eastbound entry provides LOS B as a single-lane entry with a yield right -turn lane. The yield right provides operational benefit even though right turn flows are low for the future conditions. Additionally, it provides a transition from the two-lane approach. Southbound entry shows sensitivity as a single thru lane on 2020 traffic and LOS E on 2030 traffic. Northbound entry has LOS C as single thru lane on 2030 traffic. The West roundabout layout allows for a potential interim/ultimate design approach. The design as shown allows for ease of conversion from single lane northbound and southbound thru lanes to an ultimate design with dual thru lanes in the future if or when additional capacity is desired. The ultimate design will provide LOS A for the northbound and southbound entries.

Optimizing the closely spaced two-roundabout system includes designing the connecting leg entries to minimize queuing between the roundabouts and to not exceed available storage between them. The eastbound free right turn lane aids in minimizing queuing and the flared two-lane entry of the westbound entry also helps reduce any queuing between the roundabouts.

Multimodal Considerations

Pedestrians at roundabouts can have safety concerns, particularly for those that are visually impaired. Therefore, high visibility crosswalk pavement markings, splitter island pedestrian refuge areas, and highly visible signing will be used to better warn drivers approaching a crosswalk. The roundabout was designed in such a way to reduce approaching and exiting vehicle speeds for pedestrians to use the crosswalks safely. It is recommended that the crosswalks be raised crosswalks to reduce speeds and increase safety for pedestrians. The roadway and pedestrian lighting in the project area will be improved by installing additional light poles.

For this project, a few bus stops are recommended to be relocated a little further away from the roundabouts to reduce queuing on single lanes. Embark has requested sidewalk connectivity be provided to all new bus stop locations. These items will be incorporated into project final design. Future conversations with Embark will need to be made to discuss appropriate bus stop locations and routes.

Geotechnical Analysis

Geotechnical testing will be performed after the preliminary phase is completed if required.

Access Management

This design will require the closure of two (2) driveways, one on the north side of the Valero gas station and one on the east side of the Penn Ave Church of the Nazarene. A few driveways will also be relocated to move them further away from roundabout exit lanes. All other driveways will remain open. Several driveways will be changed to a right-in and right-out only configuration to mitigate wrong-way travel.

Construction Sequencing

Construction activities will be implemented to minimize disruptions to traffic flow and to maintain traffic flows in both directions during construction. Local property access will also be maintained during construction.

DRAINAGE ANALYSIS

The 5.5-acre site currently drains through existing storm drains to the south-southeast under Virginia Avenue. The proposed drainage will connect into the existing system. Drainage inlets can be added and tied to the existing trunk lines running along the N Virginia Avenue alignment. This design will have several new inlets to accommodate drainage and low areas to be determined. Some of these new inlets and proposed locations can be found in the preliminary plans in the **Appendix**. Drainage areas and calculations will be performed to size relocated/new inlets also during the final design process. The re-design of the intersection will result in a reduction in impervious area; therefore, no mitigation is required, and no stormwater detention is proposed. The full drainage report is attached in the **Appendix**.

UTILITIES

Existing Utilities

There are several utilities located in and around the NW 10th Street corridor. Some of these are located within the right-of-way, both under the roadway pavement and between N Pennsylvania and N Virginia Avenues. Coordination with utility providers is on-going. Known utilities within the project limits include:

- OCWUT Water Lines
- OCWUT Sanitary Sewer Lines
- OKC Storm Sewer Lines
- AT&T Telephone Lines (AT&T)
- Cox Communications (Cox)
- Oklahoma Natural Gas (ONG)
- Oklahoma Gas & Electric (OGE)
- Street Lighting
- Signalization Wiring

Water and Sewer

The public utilities are shown in the preliminary plans in the **Appendix**, and the proposed relocation of storm sewer inlets and laterals are shown, which may affect a few of the existing water lines. Several of the water and sewer lines have been in place since 1910, and this project may provide an opportunity to replace and upgrade those lines during construction.

The following projects were built in the years listed below (in parenthesis) and are shown in **Figure 8**:

Sewer:

- 22E35 (1910)
- SC-0123 (1989)
- SC-0317 (1992)
- SC-0442 (1995)

Water:

- WBI-10-1 20" (1930)
- 362 16" (1938)
- Penn 10" Unknown – offline
- WC-0333 (1995)

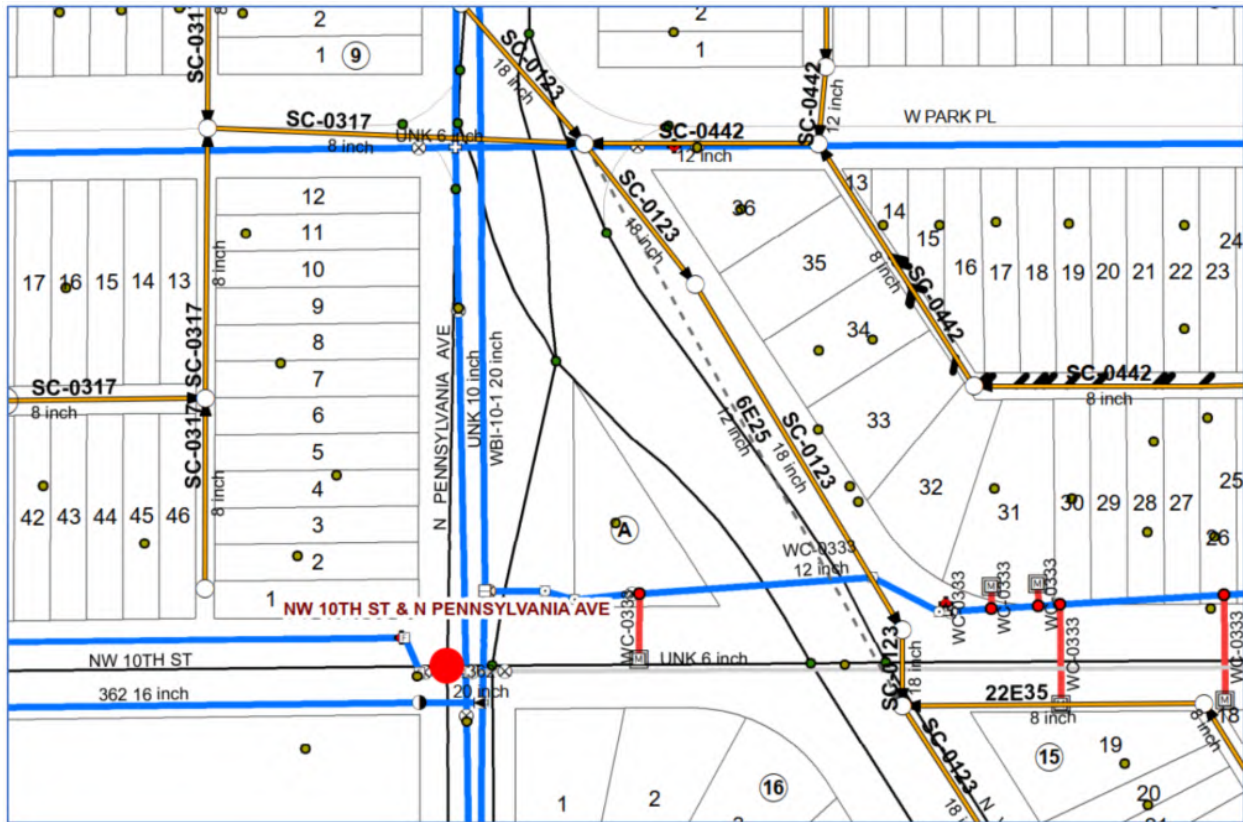


Figure 8: Existing Sewer and Water Lines within Project Limits

Overhead Power

There are no major transmission power lines on the south side of NW 10th Street affected by the proposed construction; however, there are several OG&E power lines on private utility poles on the north side of NW 10th Street which will be affected.

Natural Gas

Oklahoma Natural Gas (ONG) is known to exist within the project limits; however, no known conflicts are present at this time.

Utility Considerations

This project is designed to limit conflicts with existing utilities, however a few power poles and a fire hydrant with connecting waterline will need to be relocated, see **Figure 9**. The island between the eastbound entry and right turn slip lane of the West roundabout was located and sized to avoid and protect a high voltage transmission pole within the island.

RIGHT-OF-WAY

Ownership & Easements of Record

The present right-of-way (ROW) width varies from 66 feet on NW 10th Street to wider sections for N Pennsylvania Avenue and N Virginia Avenue.

Right-of-Way Considerations

The roundabout limits will require the purchase of right-of-way corner sight triangles for each of the northwest, northeast, and southwest corners of the project, see **Figure 10 and 11**. The proposed northwest right-of-way will most likely eliminate at least half of the current parking spaces and could require a full property take of the former Hungry Frog diner. The southwest right-of-way will require the removal and replacement of some rod-iron fence and the Salvation Army's Center of Hope sign structure. The northeast right-of-way is small but may result in the removal of one or two parking spaces from the Liquor Bin.

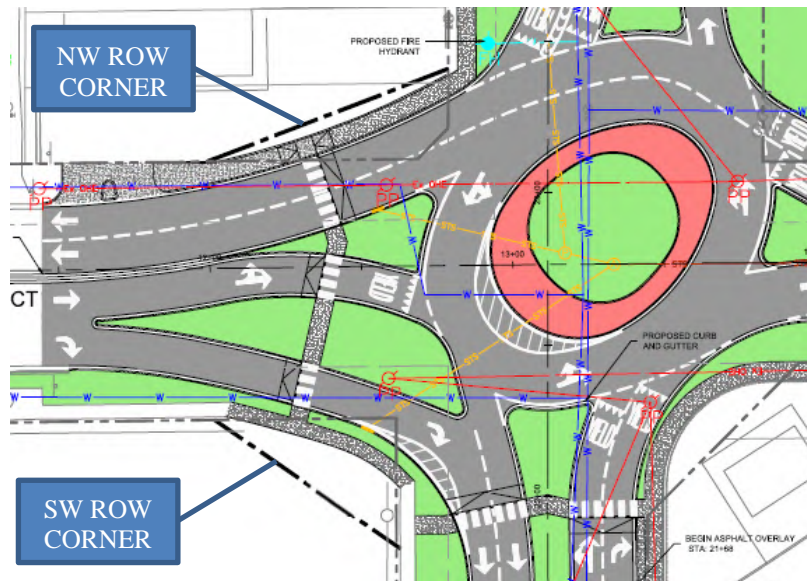


Figure 10: ROW - NW & SW corners of West Roundabout

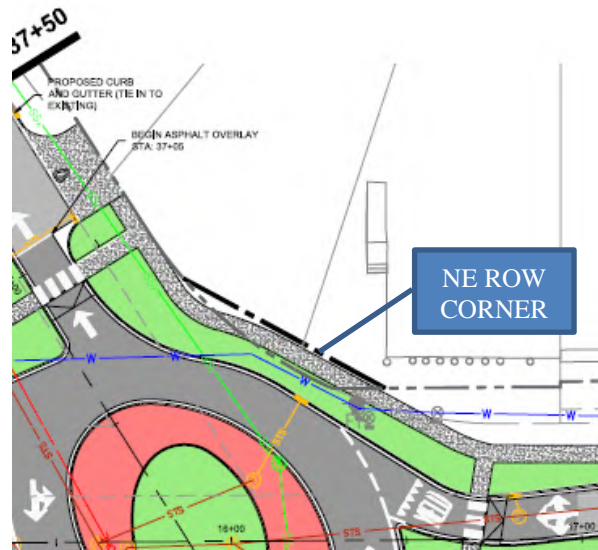



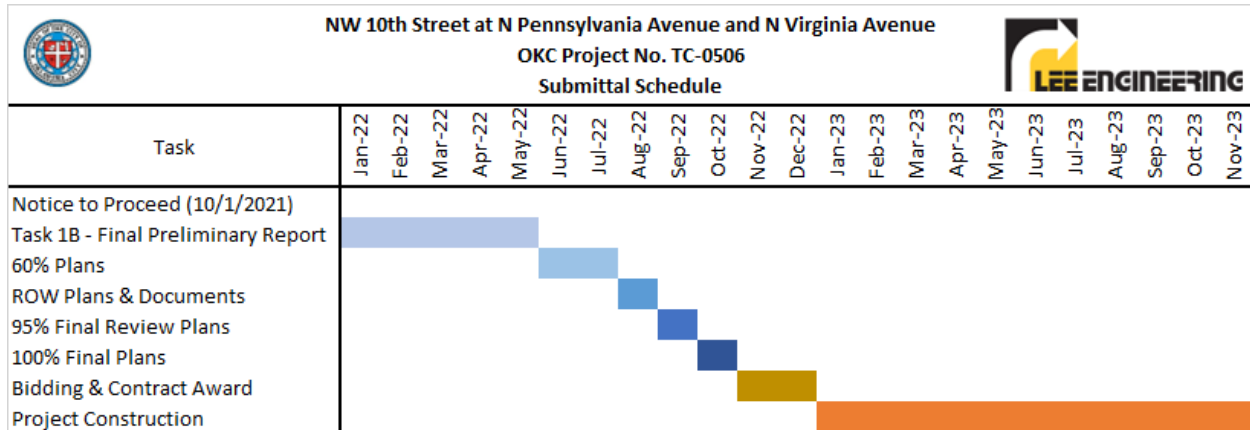
Figure 11: ROW - NE corner of East roundabout

COST ESTIMATE

<div style="display: flex; justify-content: space-between; align-items: center;">  <div> CITY OF OKLAHOMA CITY PRELIMINARY COST ESTIMATE TC-0506 NW 10TH ST AT PENNSYLVANIA AVE & VIRGINIA AVE </div> <div>2/14/2022</div> </div>					
				PRELIMINARY COST ESTIMATE	
ITEM NO.	SECTION	DESCRIPTION	UNIT	UNIT COST	TOTAL COST
1	222	LIME STABILIZED SUBGRADE (8 INCHES)	SY.	6,220.00	\$ 15,550.00
2	301	SUPERPAVE, TYPE S5 (PG 76-28)	TON	653.00	\$ 65,300.00
3	301	SUPERPAVE, TYPE S3 (PG 78-28 OK)	TON	1,598.00	\$ 159,800.00
4	301	SUPERPAVE, TYPE S3 (PG 84-22 OK)	TON	836.00	\$ 75,240.00
5	304	PORTLAND CEMENT CONCRETE PAVEMENT (8")	SY.	585.00	\$ 46,800.00
6	304	PORTLAND CEMENT CONCRETE PAVEMENT (8") (APRON)	SY.	490.00	\$ 58,800.00
7	305	CURB AND GUTTER (1'-8") (8" BARRIER)	LF.	7,130.00	\$ 213,900.00
8	309	COLD MILLING PAVEMENT	S.Y.	1,991.00	\$ 19,910.00
9	453	REINFORCED CONCRETE PIPE (18 INCHES)	LF.	436.00	\$ 26,160.00
10	454	MANHOLE (4' DIA)	EA.	4.00	\$ 16,000.00
11	454	DESIGN 2-0 INLET COMPLETE IN PLACE	EA.	10.00	\$ 40,000.00
12	459	ADJUST MANHOLE TO GRADE	EA.	13.00	\$ 6,500.00
13	505	10" X 6" TAPPING SLEEVE	EA.	1.00	\$ 1,500.00
14	505	FITTINGS (MEGA-LUG SERIES 1106)	EA.	3.00	\$ 300.00
15	505	8" CAP (DIP) COMPACT (MJ)	EA.	1.00	\$ 400.00
16	505	(8") (DIP) WATERLINE PIPE (PUSH-ON) (NOM WALL THICK 0.28)	L.F.	30.00	\$ 1,800.00
17	514	(10") TAP	EA.	1.00	\$ 1,000.00
18	516	ADJUST FIRE HYDRANT	EA.	1.00	\$ 2,000.00
19	516	FIRE HYDRANT	EA.	1.00	\$ 5,000.00
20	517	REMOVAL OF FIRE HYDRANT	EA.	1.00	\$ 800.00
21	520	8" TAPPING VALVE & VALVE BOX	EA.	1.00	\$ 2,500.00
22	727	LIGHT POLE	EA.	8.00	\$ 64,000.00
23	729	REMOVE EXISTING SIGN	EA.	11.00	\$ 1,100.00
24	729	SHEET ALUMINUM SIGNS	SF.	325.00	\$ 11,375.00
25	732	SQUARE STEEL SIGN POST	LF.	450.00	\$ 11,250.00
26	735	TRAFFIC STRIPE (PLASTIC) (4 INCH WIDE)	LF.	3,342.00	\$ 10,026.00
27	735	TRAFFIC STRIPE (PLASTIC) (WORDS)	EA.	17.00	\$ 4,250.00
28	735	TRAFFIC STRIPE (PLASTIC) (ARROWS) (SINGLE)	EA.	83.00	\$ 12,450.00
29	737	24" WIDE CROSSWALK STRIPING	L.F.	300.00	\$ 6,000.00
30	801	CONSTRUCTION STAKING (CONSTRUCTION SURVEY)	L.SUM	1.00	\$ 20,000.00
31	802	CONSTRUCTION SIGNING AND TRAFFIC CONTROL	L.SUM	1.00	\$ 25,000.00
32	809	MOBILIZATION (SP)	L.SUM	1.00	\$ 50,000.00
33	811	STRUCTURE REMOVAL (TRAFFIC SIGNAL)	EA.	11.00	\$ 55,000.00
34	811	STRUCTURE REMOVAL (INLET)	EA.	7.00	\$ 14,000.00
35	812	CONCRETE PAVEMENT REMOVAL	SY.	1,160.00	\$ 13,920.00
36	812	REMOVE CURB AND GUTTER	LF.	7,150.00	\$ 71,500.00
37	812	ASPHALT PAVEMENT REMOVAL	SY.	8,064.00	\$ 80,640.00
38	812	REMOVE SIDEWALK (4' WIDE)	S.Y.	760.00	\$ 7,600.00
39	819	ADJUST EXISTING STRUCTURE (WATER METER)	EA.	5.00	\$ 7,500.00
40	819	REMOVE AND REPLACE LIGHT POLE	EA.	3.00	\$ 3,000.00
41	823	SIDEWALK (5')	SY.	1,381.00	\$ 103,575.00
42	830	TACTILE MARKERS/TRUNCATED DOMES (SPECIAL) (SP)	S.F.	312.00	\$ 10,920.00
43	840	SOLID SLAB SODDING	SY.	6,990.00	\$ 20,970.00
44	843	TREE REMOVAL	EA.	1.00	\$ 1,000.00
45	846	IRRIGATION SYSTEM-COMPLETE IN PLACE	L.SUM	1.00	\$ 15,000.00
46	SP	DESIGN 8-0 INLET COMPLETE IN PLACE	EA.	1.00	\$ 7,500.00
47	SP	RAISED CROSSWALK	EA.	13.00	\$ 65,000.00
48	SP	STREET TREE (4" CAL.)	EA.	47.00	\$ 58,750.00
49	SP	ORNAMENTAL FLOWERING TREE (2" CAL.)	EA.	23.00	\$ 12,650.00
50	SP	LANDSCAPE BEDS (PLANTS, SOIL, MULCH)	S.Y.	387.00	\$ 23,220.00
				TOTAL	\$ 1,536,856.00
				Fixed Limit of Construction \$ 1,576,170.00	

SCHEDULE

- Preliminary Report: Spring 2022
- Final Plans: Fall 2022
- Begin Construction: Early 2023
- Construction Complete: Fall 2023



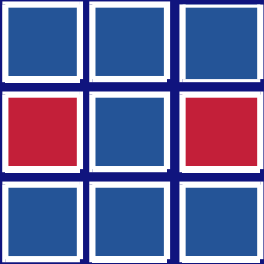
RECOMMENDATION

The intersection of NW 10th Street at N Pennsylvania Avenue and N Virginia Avenue currently has complex roadway geometry and closely spaced signalized intersections. The proposed design was developed to improve on the existing conditions regarding traffic operations, access, and safety. Arriving at the provided preliminary design required extensive iteration to determine the shape and size of the roundabout. These design outcomes minimize adverse impacts to adjacent properties and avoid identified critical constraints (e.g., gas station right-of-way and high voltage power poles). The optimized geometrics minimize adverse impacts while simultaneously meeting operational objectives and, importantly, adhering to safety design principles.

APPENDIX A – PRELIMINARY DRAINAGE DESIGN REPORT



HALFF



PENN AND 10TH ST



PRELIMINARY DRAINAGE DESIGN REPORT

January 14, 2022
AVO 37203.002

Prepared for:

City of Oklahoma City



Halff Associates, Inc.
1111 N. Lee Ave, Suite 500
Oklahoma City, OK 73103
OKPE Firm No. 707
www.halff.com

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Exhibit 1	Vicinity Map
Exhibit 2	Existing Conditions Drainage Area Map
Exhibit 3	Proposed Conditions Drainage Area Map

1.0 Introduction

Oklahoma City is updating the intersection of Penn Street, 10th Street, and Virginia Avenue. The 5.5 acre site currently drains through existing storm drains to the south-southeast under Virginia Avenue. The confluence of these three roads will become two roundabout intersections. The proposed drainage will connect into the existing system.

1.1 Project Purpose

Halff was contracted by City of Oklahoma City to re-design the intersections of 10th Street with Pennsylvania and Virginia Avenues. A drainage analysis was performed for the proposed improvements. Hydrologic and hydraulic modeling was performed to size the proposed stormwater inlets and pipes that connect into the existing system.

1.2 Project Limits

A vicinity map is shown on **Exhibit 1**. The project area is Pennsylvania Avenue running north-south, Virginia Avenue branching off Pennsylvania to the southeast, and 10th Street running east-west. This area is not within a FEMA floodplain.



Figure 1: Project Site Existing Conditions

1.3 Impervious Area

Within the limits of construction, the existing impervious area is 3.17 acres. The proposed improvement results in impervious area of 2.91 acres, a reduction of 0.26 acres. Due to the reduction of impervious area, no mitigation is required for the proposed improvements.

2.0 Existing Conditions

2.1 Location and Topography

The project area is located in the North Canadian River watershed in south-west Oklahoma County. In general, the topography ranges from 1210 to 1235 feet (NAVD88) on the site, generally sloping from north to south. The existing terrain is provided in **Exhibit 2**.

2.2 Drainage Facilities

The 5.5 acre site drains to the existing storm pipe southeast along Virginia Avenue. **Figure 1** above shows an overview of the existing conditions land use within the project area (red). Drainage area delineations and the location of the existing drainage facilities is provided in **Exhibit 2**.

2.3 Hydrology

Hydrology calculations were performed to calculate existing runoff conditions. Based on the Oklahoma City Drainage Criteria Manual (DCM), for basins under 200 acres the Rational Method is used for peak flow calculations.

The Rational Method was used to calculate peak flows based on NOAA Atlas 14 rainfall data. Time of concentration was calculated using the overland flow travel time equation from the *Oklahoma City Drainage Criteria Manual*. A weighted runoff coefficient (C) was calculated based on the existing landuse, using runoff coefficients from Table 2-3 from the *Oklahoma City Drainage Criteria Manual*. **Table 1** summarizes the Rational Method calculations for the existing conditions drainage areas.

Table 1: Existing Site Rational Calculations

Drainage Area	Area (acres)	% IMP	TC (min)	C	I ₂ (in/hr)	I ₅ (in/hr)	I ₁₀ (in/hr)	I ₂₅ (in/hr)	I ₅₀ (in/hr)	I ₁₀₀ (in/hr)
EDA01	5.37	95%	17.09	0.82	3.82	4.57	5.13	5.94	6.58	7.21
EDA02	4.92	95%	9.51	0.77	4.82	5.72	6.35	7.28	8.06	8.79
EDA03	1.27	67%	9.56	0.60	4.81	5.71	6.34	7.27	8.05	8.78
EDA04	1.07	95%	9.37	0.95	4.85	5.75	6.37	7.31	8.10	8.83
EDA05	1.44	90%	12.35	0.74	4.39	5.22	5.82	6.71	7.43	8.11
EDA06	4.25	85%	12.20	0.71	4.41	5.25	5.85	6.73	7.45	8.14
EDA07	0.46	95%	5.82	0.95	5.54	6.55	7.21	8.23	9.10	9.91
EDA08	0.86	95%	9.57	0.84	4.81	5.71	6.33	7.27	8.05	8.78

2.4 Existing Peak Flow

Based on the existing site conditions, the peak runoff for the site was calculated to provide a baseline for the allowable runoff in the proposed conditions. **Table 2** summarizes the peak flow from the existing drainage areas.

Table 2: Existing Site Peak Runoff

Outfall	Drainage Area	Q ₂ (cfs)	Q ₅ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)
Virginia Avenue Outlet	EDA01	16.8	20.1	22.6	26.1	29.0	31.7
	EDA02	18.3	21.7	24.0	27.6	30.6	33.3
	EDA03	3.7	4.3	4.8	5.5	6.1	6.7
	EDA04	4.9	5.8	6.5	7.4	8.2	9.0
	EDA05	4.7	5.5	6.2	7.1	7.9	8.6
	EDA06	13.3	15.8	17.7	20.3	22.5	24.6
	EDA07	2.4	2.9	3.2	3.6	4.0	4.3
	EDA08	3.5	4.1	4.6	5.2	5.8	6.3
	Total	67.5	80.4	89.5	103.0	114.1	124.5

3.0 Proposed Drainage Plan

3.1 Description

The proposed improvement will include two roundabouts with updated approaches. **Figure 2** shows the main components of the proposed improvements.



Figure 2: Proposed Improvements

3.2 Hydrology and Peak Flow

To develop proposed conditions runoff, the baseline existing conditions hydrology was updated to include the updated impervious cover and the revised drainage area boundaries due to on site grading. The revised drainage areas and the preliminary stormwater drainage system schematic can be found in **Exhibit 3**. The rational method calculations for the proposed conditions drainage areas are summarized in **Table 3**. **Table 4** summarizes the peak flow from the proposed drainage areas.

Table 3: Proposed Site Rational Calculations

Drainage Area	Area (acres)	% IMP	TC (min)	C	I ₂ (in/hr)	I ₅ (in/hr)	I ₁₀ (in/hr)	I ₂₅ (in/hr)	I ₅₀ (in/hr)	I ₁₀₀ (in/hr)
PDA01	5.37	90%	17.33	0.74	3.80	4.54	5.10	5.90	6.54	7.17
PDA02	2.08	95%	9.31	0.82	4.86	5.76	6.39	7.33	8.11	8.84
PDA03	2.84	90%	8.73	0.74	4.96	5.88	6.51	7.46	8.26	9.00
PDA04	1.12	58%	11.73	0.55	4.48	5.32	5.93	6.82	7.55	8.25
PDA05	0.10	95%	5.78	0.92	5.55	6.56	7.22	8.24	9.12	9.92
PDA06	0.29	95%	6.86	0.92	5.32	6.29	6.94	7.94	8.78	9.56
PDA07	0.86	95%	10.37	0.95	4.68	5.56	6.18	7.10	7.86	8.57
PDA08	1.44	90%	13.98	0.74	4.17	4.98	5.56	6.42	7.11	7.77
PDA09	0.71	87%	12.22	0.72	4.41	5.24	5.84	6.73	7.45	8.14
PDA10	3.55	83%	19.55	0.70	3.58	4.30	4.84	5.61	6.23	6.82
PDA11	0.43	95%	5.81	0.90	5.54	6.55	7.21	8.23	9.11	9.91
PDA12	0.86	95%	8.57	0.82	4.99	5.91	6.54	7.50	8.30	9.05

Table 4: Proposed Site Peak Runoff

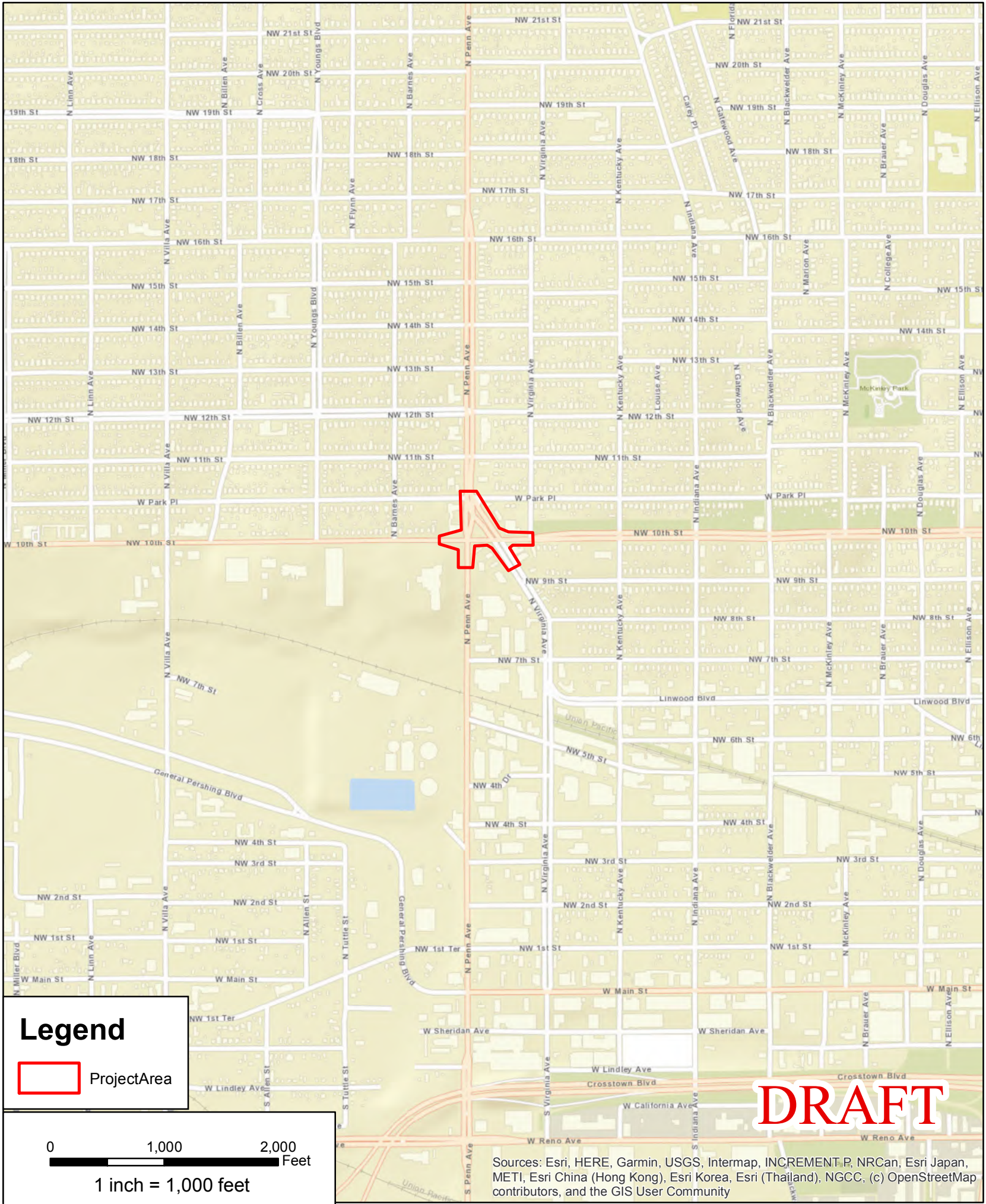
Drainage Area	Q ₂ (cfs)	Q ₅ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)
PDA01	15.1	18.1	20.3	23.5	26.0	28.5
PDA02	8.3	9.8	10.9	12.5	13.8	15.1
PDA03	10.4	12.4	13.7	15.7	17.4	18.9
PDA04	2.7	3.3	3.6	4.2	4.6	5.1
PDA05	0.5	0.6	0.7	0.7	0.8	0.9
PDA06	1.4	1.7	1.9	2.1	2.4	2.6
PDA07	3.8	4.5	5.0	5.8	6.4	7.0
PDA08	4.4	5.3	5.9	6.8	7.5	8.3
PDA09	2.2	2.7	3.0	3.4	3.8	4.1
PDA10	8.9	10.7	12.0	13.9	15.5	16.9
PDA11	2.1	2.5	2.8	3.2	3.5	3.8
PDA12	3.5	4.2	4.6	5.3	5.8	6.4
Total	63.5	75.7	84.4	97.1	107.6	117.6

4.0 Conclusion

Oklahoma City is updating the intersection of Penn Street, 10th Street, and Virginia Avenue. The 5.5 acre site currently drains through existing storm drains to the South-Southeast under Virginia Avenue. The confluence of these three roads will become two roundabout intersections with updated approaches. The proposed drainage will connect into the existing system. The re-design of the intersection will result in a reduction in impervious area; therefore, no mitigation is required and no stormwater detention is proposed.

EXHIBITS

APPENDIX A



Legend

 ProjectArea

0 1,000 2,000 Feet
1 inch = 1,000 feet

DRAFT

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Exhibit
1

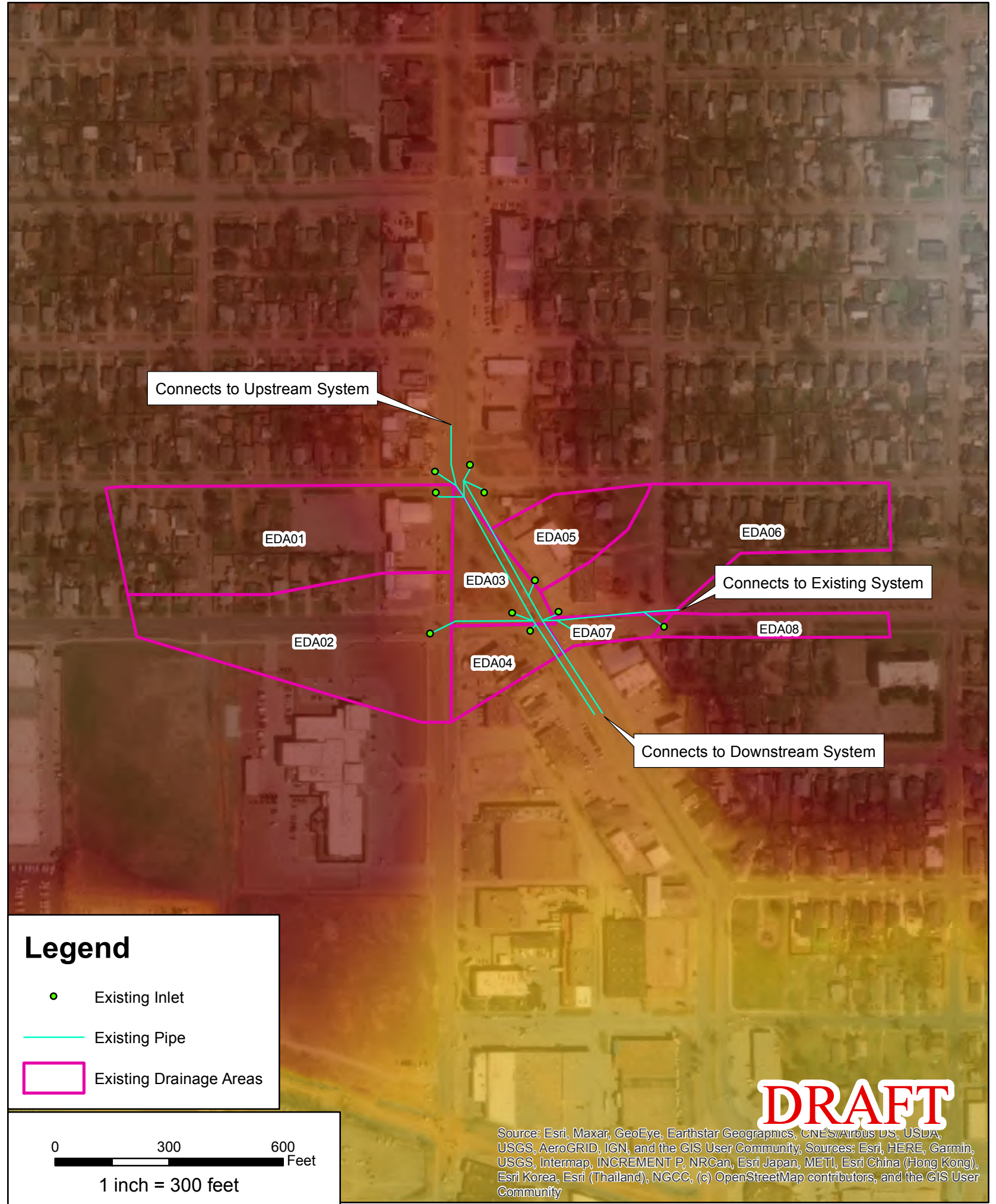


Oklahoma City
Penn and 10th

VICINITY MAP



PROJECT AVO
37203.002
DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane
Oklahoma North FIPS 3501 FIPS



Legend

- Existing Inlet
- Existing Pipe
- Existing Drainage Areas

0 300 600 Feet
1 inch = 300 feet

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Exhibit 2		Oklahoma City Penn and 10th		PROJECT AVO 37203.002
		EXISTING DRAINAGE AREAS		DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Oklahoma North FIPS 3501 FIPS

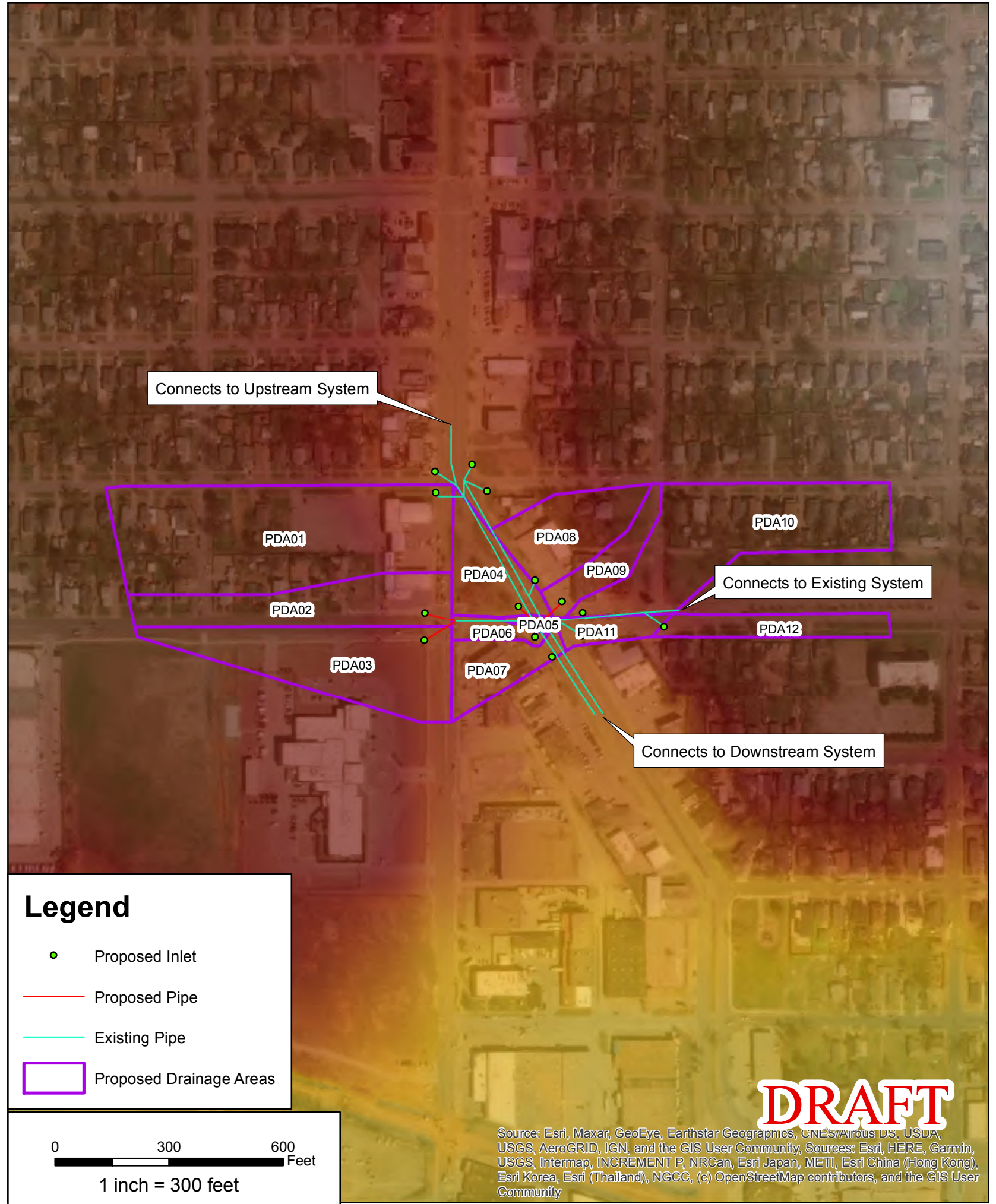


Exhibit 3		Oklahoma City Penn and 10th		PROJECT AVO 37203.002
		PROPOSED DRAINAGE AREAS		DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Oklahoma North FIPS 3501 FIPS

APPENDIX B – LANDSCAPE CONCEPT

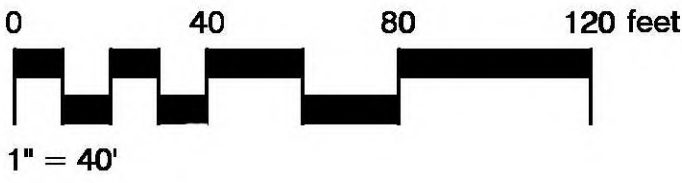


- GRASS
- EXISTING GRASS
- SHRUB PLANTING



TYPICAL SHADE TREE

TYPICAL FLOWERING TREE



APPENDIX C – LANDSCAPE PLANT & MATERIALS PALETTE

NW 10th Street & Pennsylvania Ave Roundabout Streetscape Plant & Materials Palette

Water-Wise Plants, Trees & Shrubs



Chinese Elm



Bald Cypress



Chinese Pistache



Shumard Oak



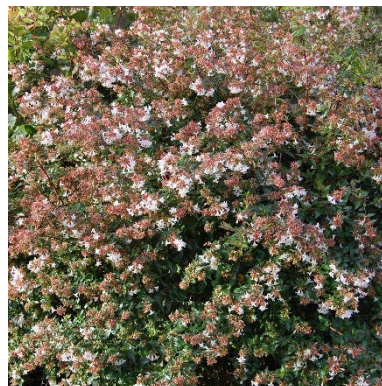
Redbud



Chaste Tree



Burford Holly



Glossy Abelia



Japanese Spirea

Low Water Use Accent Plants, Ornamental Grass & Mulches



Threadleaf giant hyssop



Blanket Flower



Goldstrum Rudbeckia



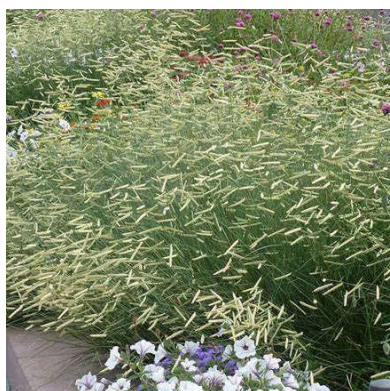
Autumn Joy Sedum



Lavender Cotton



Creeping Phlox



Blonde Ambition Blue Grama



Blue Switch Grass



Chinese Silver Grass



Mexican Feather Grass



Brakelights Red Yucca



Catmint



English Ivy



Blue Rug Juniper



Monkey Grass



Black Eagle Granite Chips



Cedar Mulch

APPENDIX D – TC-0506 PRELIMINARY PLANS



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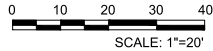
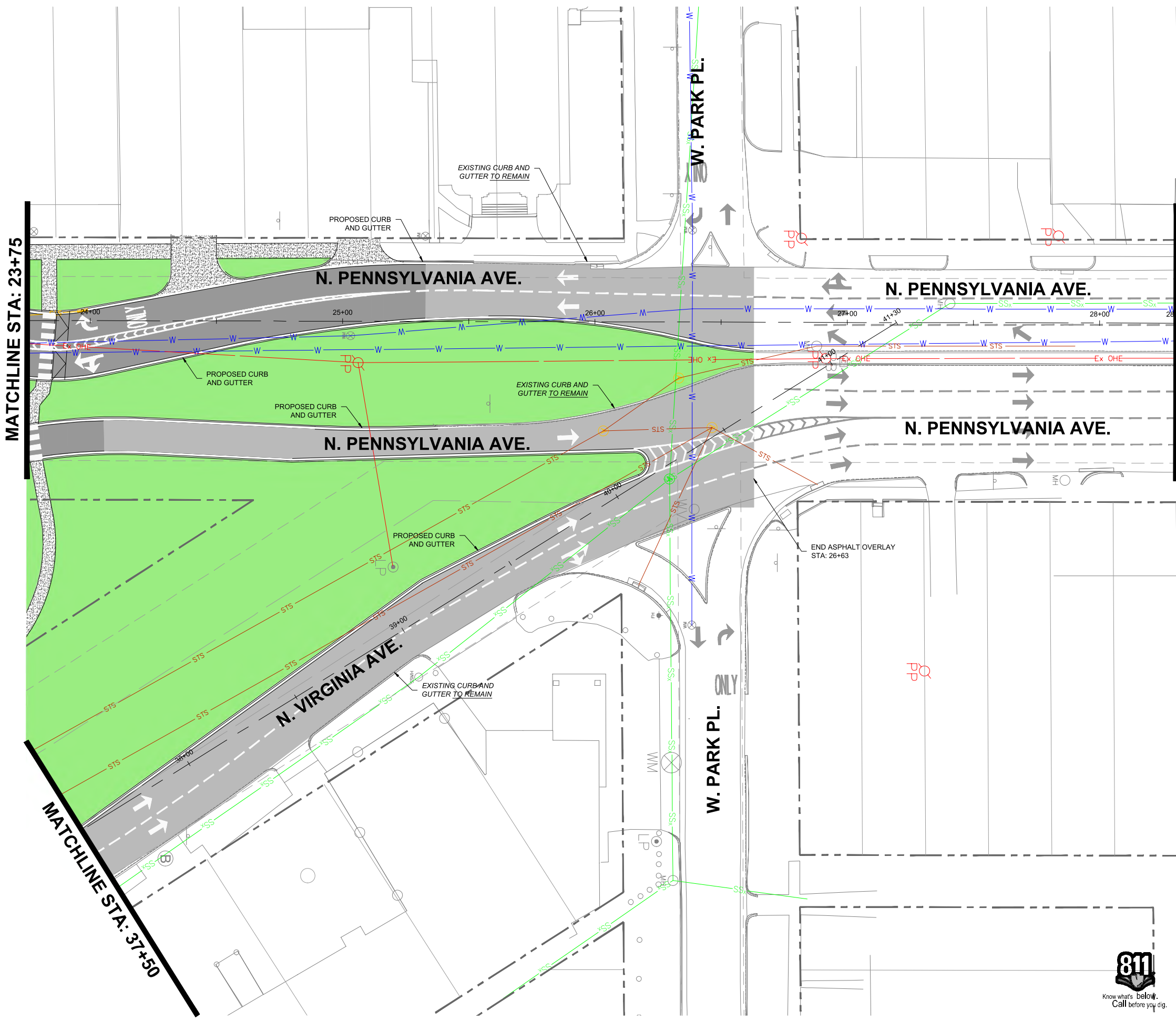
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Sheet Number	Project Page Number
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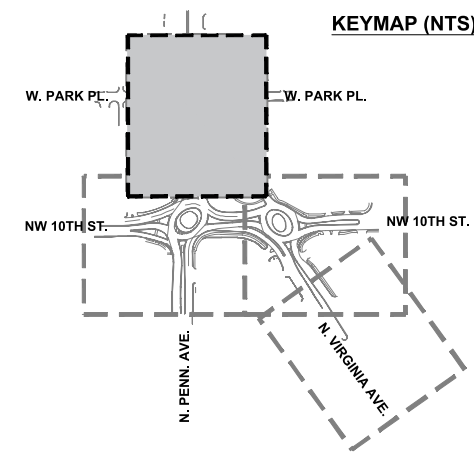
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Page No. 1 of 1



LEGEND

- FULL DEPTH ASPHALT PAVEMENT
- OVERLAY EXISTING ASPHALT
- CONCRETE SIDEWALK / DRIVEWAY
- LANDSCAPE AREA
- PAVEMENT APRON
- PROPOSED STORM MANHOLE
- ADJUST EXISTING MANHOLE
- PROPOSED DESIGN 2-0 INLET
- PROPOSED DESIGN 6-0 INLET
- EXISTING WATER LINE
- PROPOSED WATERLINE
- PROPOSED FIRE HYDRANT
- EXISTING SANITARY SEWER LINE
- EXISTING STORM SEWER LINE
- PROPOSED STORM SEWER LINE
- EXISTING OVERHEAD POWER LINE
- EXISTING POWER POLE
- BUS STOP
- PRESENT ROW
- ROW



UTILITY WARNING:

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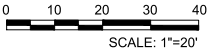
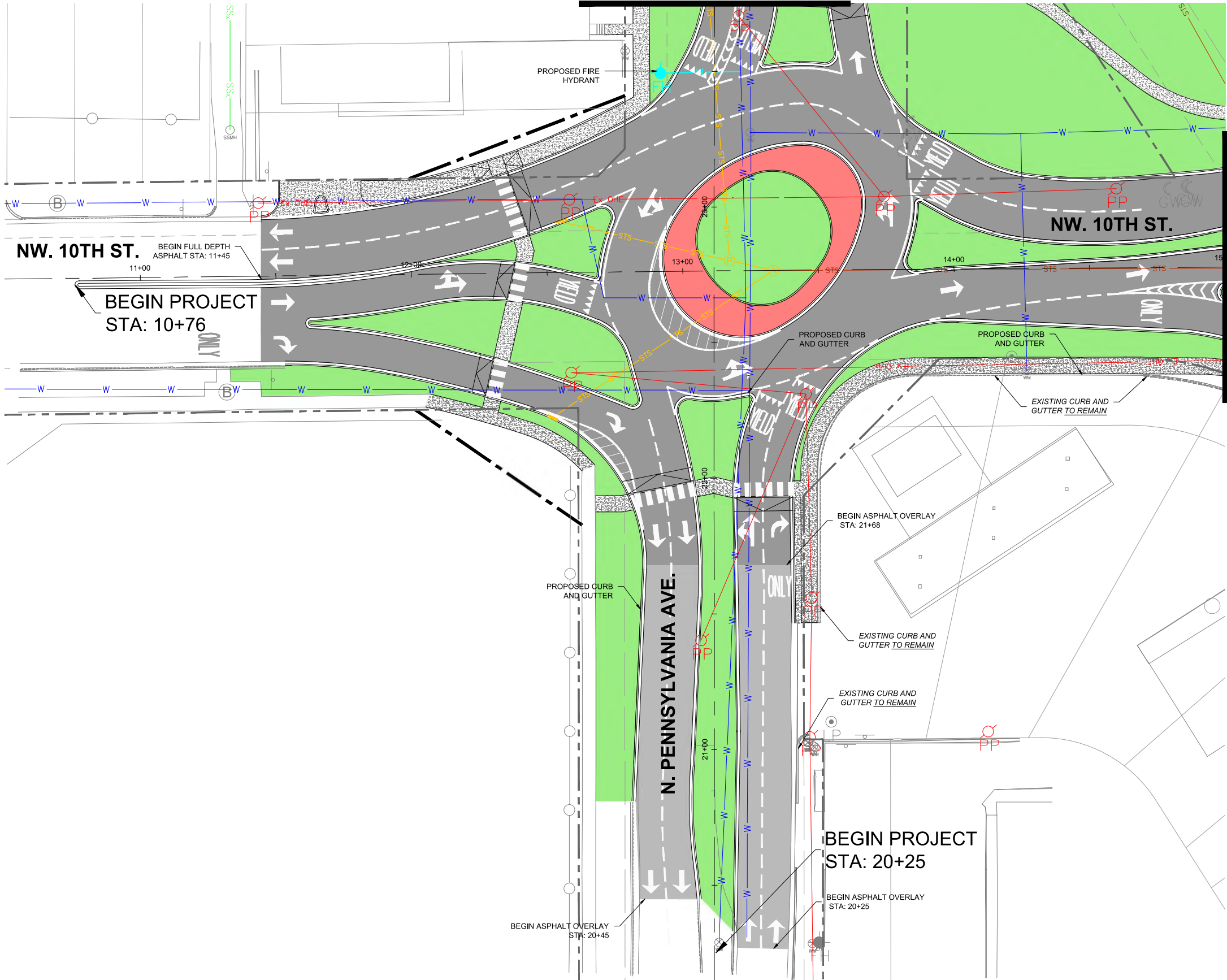


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Checked By:	JDH
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Sheet Number	C2.01
Project Page Number	Sheet No. 2 of 5

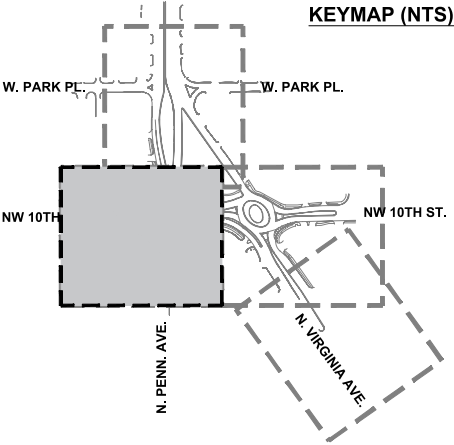
MATCHLINE STA: 23+75



LEGEND

- FULL DEPTH ASPHALT PAVEMENT
- OVERLAY EXISTING ASPHALT
- CONCRETE SIDEWALK / DRIVEWAY
- LANDSCAPE AREA
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- BUS STOP
- PRESENT ROW
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KEYMAP (NTS)



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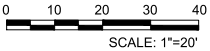
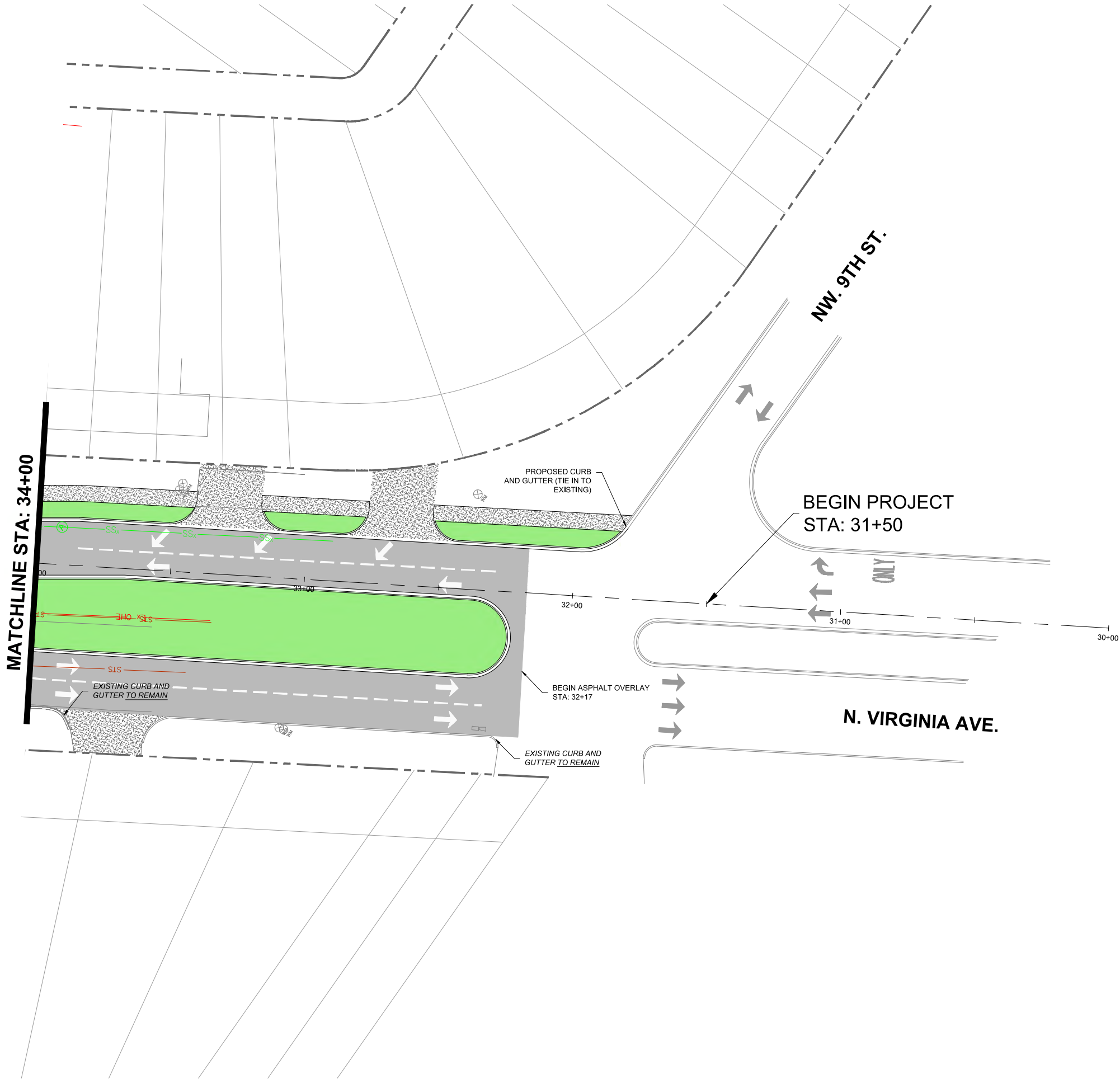


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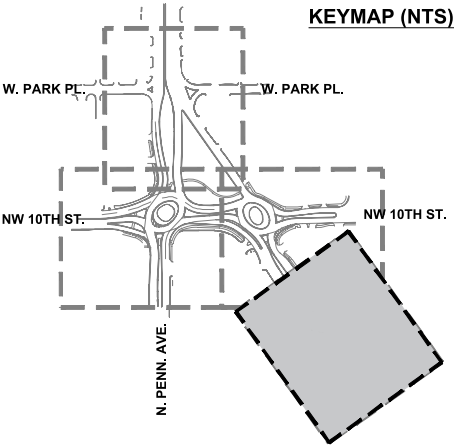
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Checked By:	JDH
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Sheet Number	C2.02
Project Page Number	Sheet No. 3 of 5



LEGEND

- FULL DEPTH ASPHALT PAVEMENT
- OVERLAY EXISTING ASPHALT
- CONCRETE SIDEWALK / DRIVEWAY
- LANDSCAPE AREA
- PAVEMENT APRON
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MATCHLINE STA: 23+75

MATCHLINE STA: 37+50

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N. PENNSYLVANIA AVE.

N. VIRGINIA AVE.

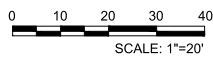
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W. PARK PL.

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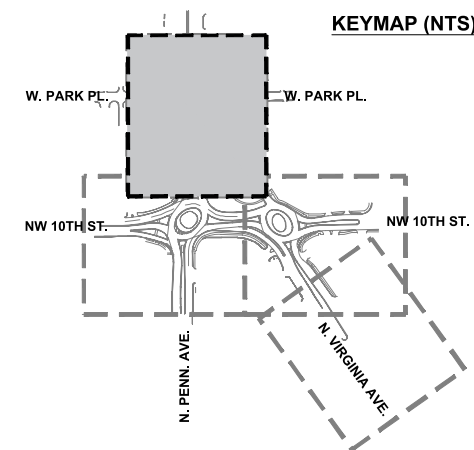
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LEGEND

- FULL DEPTH ASPHALT PAVEMENT
- OVERLAY EXISTING ASPHALT
- CONCRETE SIDEWALK / DRIVEWAY
- LANDSCAPE AREA
- PAVEMENT APRON



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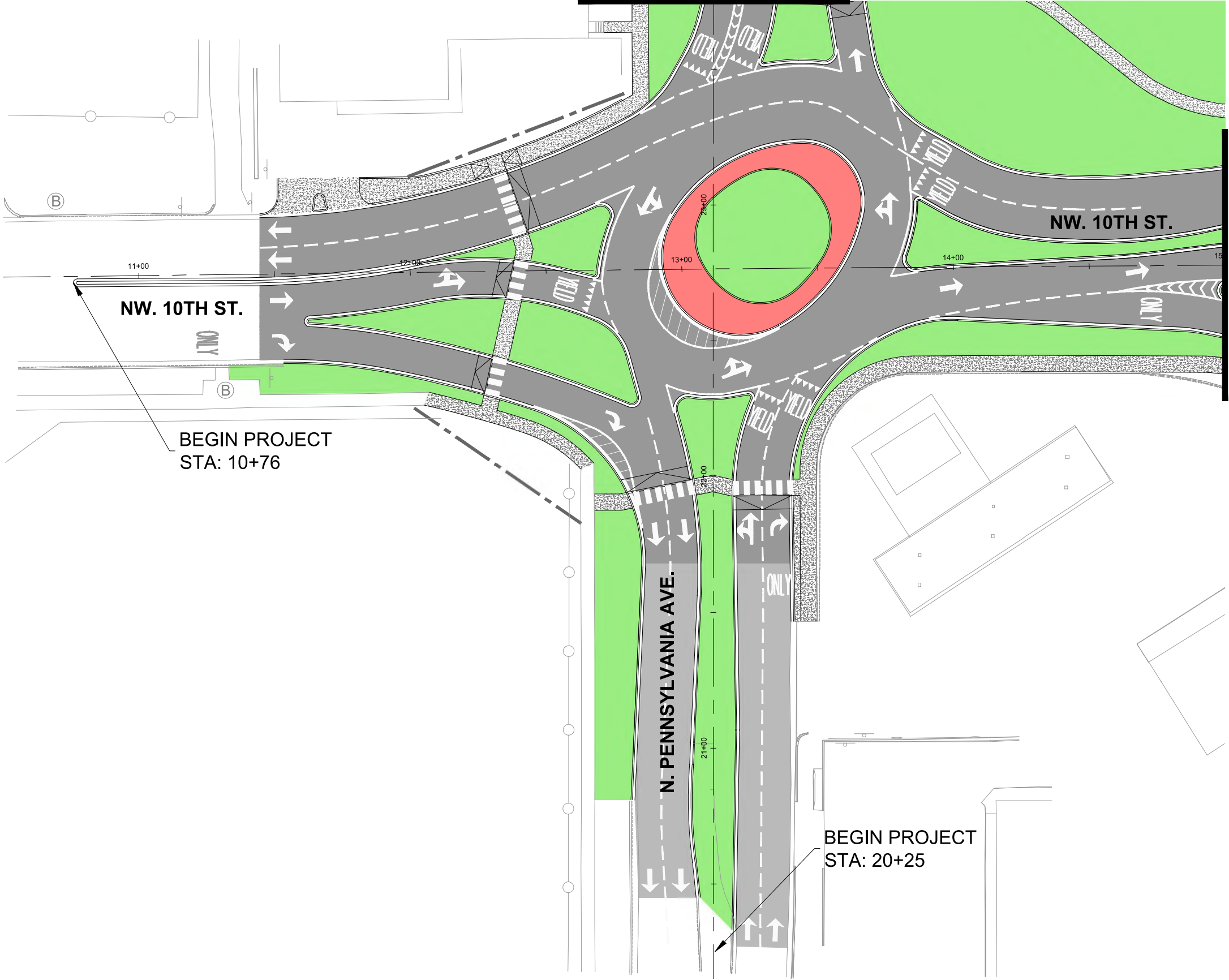


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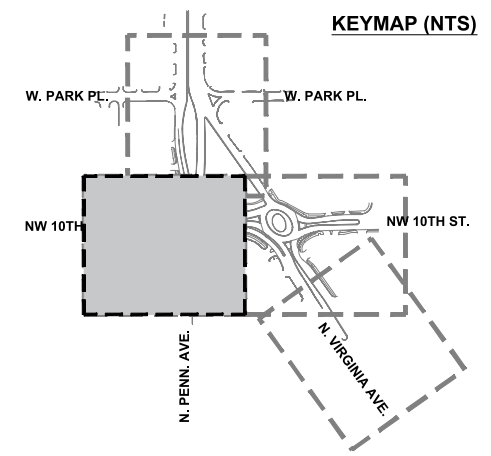
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MATCHLINE STA: 23+75



LEGEND

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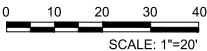
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MATCHLINE STA: 37+50

MATCHLINE STA: 15+00

MATCHLINE STA: 34+00

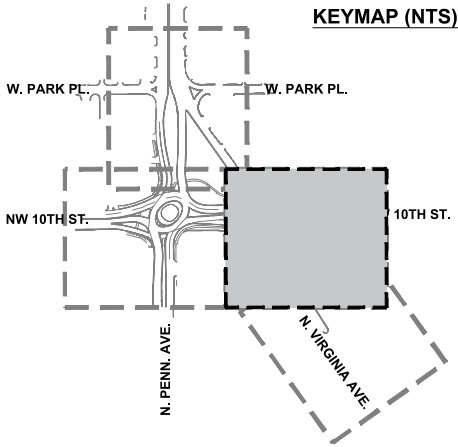


LEGEND

- FULL DEPTH ASPHALT PAVEMENT
- OVERLAY EXISTING ASPHALT
- CONCRETE SIDEWALK / DRIVEWAY
- LANDSCAPE AREA
- PAVEMENT APRON

NW. 10TH ST.

END PROJECT STA: 19+50



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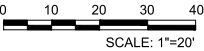


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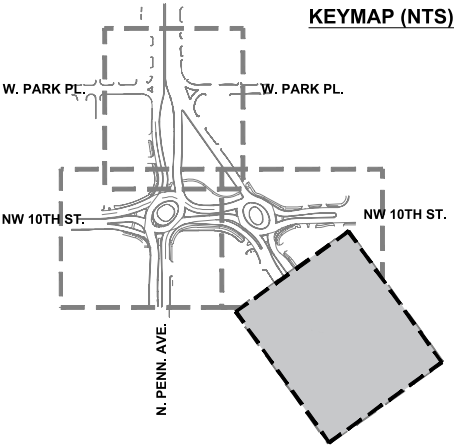
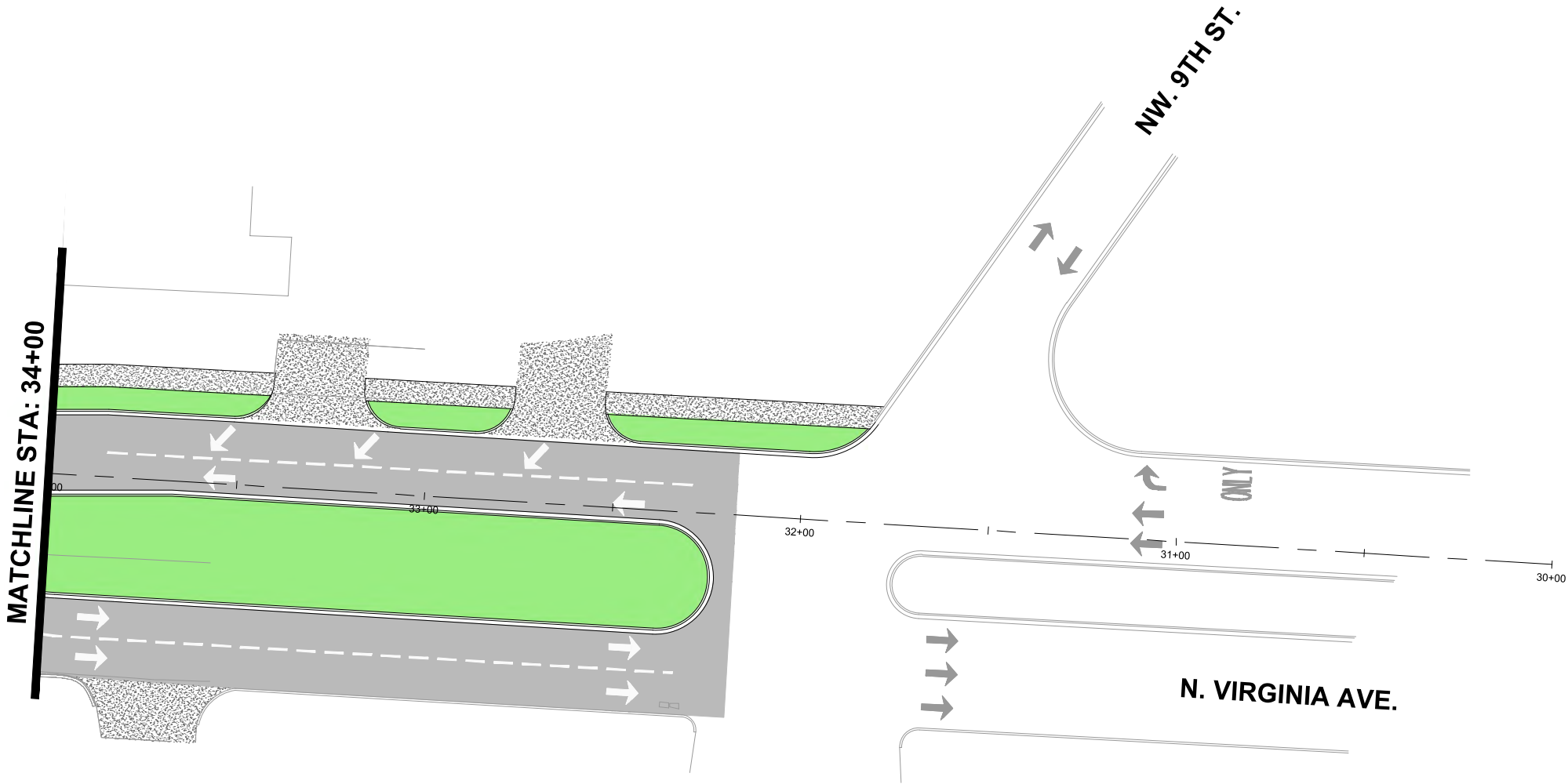
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Sheet Number	C3.03
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LEGEND

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