

A graphic for the US Highway 16 Corridor Study. It features a light green background with a stylized landscape of rolling hills in shades of green and blue. At the top, there is an orange horizontal bar containing the text "US Highway 16" in white. Below this bar, the words "CORRIDOR STUDY" are written in a smaller, dark green font.

US Highway 16

CORRIDOR STUDY

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# US16/Neck Yoke Road Intersection Build Option Evaluation

Pennington County, South Dakota

July 14, 2021



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Appendix A. US16/Neck Yoke Road Intersection Build Options

## 1.0 Introduction

The South Dakota Department of Transportation (SDDOT) has initiated a study of the US16 corridor between the Keystone Wye (US16A) and Cathedral Drive/Fairmont Boulevard. Within the overarching corridor study, the SDDOT has identified a future project, currently planned for fiscal year 2026, at the US16/Neck Yoke Road intersection.

The purpose of this report is to present and evaluate Build Options developed to address transportation issues and needs at the US16/Neck Yoke Road intersection and other area access points. This report supports the US16/Neck Yoke Road Intersection Build Options Report, which is the full technical analysis of the proposed Build Options, and serves as a transition document between the technical study and environmental process.

This report lists benefits, drawbacks, and recommendations for each Build Option and identifies a recommended Build Option to be carried forward into the NEPA review.

Criteria used to evaluate the Build Options include (not necessarily in order of importance):

- Whether a Build Option meets project purpose and need
- Traffic operations
- Traffic safety
- Local network
- Right of way (ROW) needs
- Construction costs
- Public input
- Potential environmental impacts

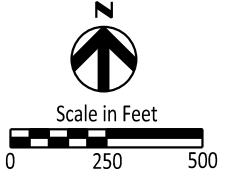
The following Build Options were developed for evaluation:

- 1.1a: RCI at Neck Yoke Road
- 1.1b: RCI at Neck Yoke Road plus Northern  $\frac{3}{4}$  Access
- 1.1c: RCI at Neck Yoke Road plus Northern Partial Access
- 1.1d: RCI at Neck Yoke Road (West)
- 1.1e: RCI at Neck Yoke Road (West) plus Central Partial Access
- 1.2a: RCI at Central Driveway
- 1.2b: RCI at Central Driveway plus Northern  $\frac{3}{4}$  Access
- 1.3a: RCI at Central Driveway with US16 Realignment
- 1.3b: RCI at Central Driveway with US16 Realignment plus Northern  $\frac{3}{4}$  Access
- 2.1a: Signalized Intersection at Neck Yoke Road
- 2.1b: Signalized Intersection at Neck Yoke Road plus Northern  $\frac{3}{4}$  Access
- 2.2a: Signalized Intersection at Central Driveway
- 2.2b: Signalized Intersection at Central Driveway plus Northern  $\frac{3}{4}$  Access

## 2.0 Study Area

The study area for the US16/Neck Yoke Road intersection project area extends along US16 from the Croell quarry main entrance to Sammis Trail intersection. Potential intersection improvements are focused around the Neck Yoke Road intersection and surrounding access points in the Spring Creek valley. The study area also includes the US16 service road along the east (south) side of US16, north of Spring Creek. **Figure 1** summarizes key features in the area referenced in this memo.

This intersection is part of the overall US16 Corridor Study, which extends approximately 20 miles along US16 between the Keystone Wye and Cathedral Drive/Fairmont Boulevard in Rapid City.



Rushmore Candy Company  
(formerly America's Founding  
Fathers Exhibit)

US16 / Central Driveway  
Intersection

US16 / East Driveway  
Intersection

US16 / Neck Yoke Road /  
West Driveway Intersection

Reptile Gardens

Dinosaur  
Museum

Happy Holiday RV  
Resort & Motel

US16 Service Road

Shipwrecks  
Bar & Grill

Spring Creek

Spring Creek Road

Neck Yoke Road



US16/Neck Yoke Road  
Intersection Area Map  
US16 Corridor Study

Rapid City, SD

Figure  
1

### 3.0 Background

The US16/Neck Yoke Road intersection was previously studied in a 2004 as part of a US16 corridor study between Neck Yoke Road and Cathedral Drive/Fairmont Boulevard. That study recommended consolidating all access points in the Neck Yoke Road/Reptile Gardens area to a single access point. A traffic signal was noted for consideration when warranted by traffic signal warrants.

The SDDOT has an intersection project planned for fiscal year 2025.

In the early stages of this US16 Corridor Study, seven intersection concepts were developed to evaluate different types of intersections.

- Concept 1: Neck Yoke Road Realignment Options
  - Concepts would be implemented in conjunction with an applicable intersection concept noted below.
- Concept 2: Standard Diamond Interchange South of Neck Yoke Road
- Concept 3: Tight Diamond Interchange North of Neck Yoke Road
- Concept 4: Reduced Conflict Intersection (RCI) at Neck Yoke Road
- Concept 5: RCI at Central Driveway
- Concept 6: Traffic Signal at Neck Yoke Road
- Concept 7: Traffic Signal at Central Driveway

Two intersection types across four concepts, an RCI and signalized intersection shown in Concepts 4-7, were carried forward as Build Options from a Study Advisory Team meeting held on October 28, 2019. While the larger interchange and realignment concepts were eliminated from consideration (Concepts 1-3), they will still be considered as part of the long-range planning process for the overall US16 corridor.

The intersection type concept screening process is documented in the *US16/Neck Yoke Road Intersection Concept Evaluation* memo.

### 4.0 Purpose and Need Summary

The draft purpose and need statement for a project at the US16/Neck Yoke Road intersection is as follows (as of April 2, 2021):

The purpose of the US16Neck Yoke Road Intersection Project is to improve safety and access management in the area of Neck Yoke Road.

This purpose is to address the following needs:

- High severity crash rate
- Multiple access points in close proximity

Refer to the latest version of the US16/Neck Yoke Road Intersection Project purpose and need document for additional information.

## 5.0 Evaluation Methodology

The following methodology was used to compare Build Options and determine the feasibility, benefits, and drawbacks of each.

### 5.1 Evaluation Categories

#### *Meets Purpose and Need*

Each Build Option was evaluated on whether it meets the US16/Neck Yoke Road project purpose and need.

#### *Year 2050 Intersection Traffic Operations*

This category uses HCM6 traffic operations methodology measures of average intersection delay (seconds per vehicle) and associated level of service (LOS). The 2050 Planning Horizon US16/Neck Yoke Road intersection LOS goal for this study is LOS B.

This category also asks the question to whether ‘US16 through traffic needs to stop at the intersection?’ The proposed intersection is located at the bottom of the Spring Creek valley with steep 6.5 percent sustained grades heading either direction out of the valley. Stopping the high volume, high truck percent movements on US16 leads to both operational and safety issues at the intersection and segments extending to and from the intersection.

#### *Traffic Safety*

This measure demonstrates a Build Options’ predicted improvement over the No Build condition as well as establishes a comparative framework for gauging predicted safety improvements between each Build Option. IHSDM output reflecting the expected decrease or increase in crashes between years 2026 and 2050 for each Build Option is summarized in terms of:

- ‘Total Crashes’ consists of all crash types (property damage only, injury, and fatal).
- ‘Fatal and Injury Crashes’ reflects the higher severity type crashes.

#### *Local Network*

The local network category considers potential operational and safety issues with traffic movements between US16 and the US16 service road, adjacent businesses and their parking lots, and other local network connections.

Neck Yoke Road or central driveway approach queues:

- Queue storage between US16 and US16 service road is limited due to existing development and US16 service road access points. There is between 80 and 105 feet of available storage between the northbound approach stop bar to US16 and the US16 service road eastbound lane, depending on Build Option.
- Queues extending beyond this distance could potentially block southbound Neck Yoke Road or central driveway traffic from US16 trying to turn left across this queue onto the US16 service road. This could create operational and safety issues back onto the US16 mainline, particularly in situations where there are multiple cars or RVs that follow each other trying to complete this movement.



- This category identifies which Build Options exhibit measured queues that extend beyond the available storage length. Movements, and associated peak period, that exceed the available storage are identified.

Intersection geometry and driver expectancy considerations:

- Does traffic between US16 and US16 service road need to turn left across turn lanes?
- Is the main intersection large, with multiple access points coming into the intersection? Will it be easy to navigate and meet driver expectancy navigating between US16 and US16 service road?
- Ability to sign in relation to the high tourist traffic/unfamiliar drivers in the area.
- A rating of 5 to 1 was applied to each Build Option that summarizes answers to these questions, with 5 being the most favorable and 1 being the least favorable.

### *Right of Way Needs and Total Costs*

Build Option right of way and total cost components include:

- Right of way and easement acquisition (total acres)
- Total cost (construction cost + ROW cost + contingency)

### *Constructability*

Constructability is measured by considerations such as:

- Overall timeline for construction and construction limits
- Maintenance of traffic along US16 and access to adjacent businesses
- Exposure of workers to traffic

A rating of 5 to 1 was applied to each Build Option based on the above considerations, where a 5 is the most favorable and 1 is the least favorable.

### *Public Input*

This measure accounts for input provided by the public and project stakeholders during the December 10, 2019, and February 2021 stakeholder and public meetings. Much of the feedback the study team received focused on the following:

- Intersection location
- Number of access points
- Does US16 through traffic need to stop?
- Parking lot impacts (extent of new frontage roads)
- Ease of mobility and safety between US16 and businesses, US16 service road, and Neck Yoke Road. This includes considerations for longer vehicles such as RVs.
- US16 grade along turn lanes

The measure is based on support provided by the public and stakeholders in the form of written comments and verbal comments at the meetings. A rating of 5 to 1 was applied to each Build Option that summarizes the overall support for each Build Option based on the considerations noted above. A 5 is the most favorable and 1 is the least favorable.

## Potential Environmental Impacts

Two resource categories were used to qualitatively evaluate potential impacts of the Build Options:

- Wetlands/floodplains
- Socioeconomics
- Displacements

## 5.2 Evaluation Measure

Each Build Option was evaluated on how they compare with other Build Options in a given category and/or whether they meet study goals. This evaluation is summarized through the following color coding in the evaluation matrix.

- **Bold Green** text indicates a Build Option measure was favorable compared to the other Build Options in a category
- Black text indicates a Build Option measure was in the middle compared to other Build Options in a category
- **Bold Red** text indicates a Build Option measure was unfavorable compared to the other Build Options in a category or the measure does not meet study goals.

## 6.0 Evaluation

The following presents US16/Neck Yoke Road intersection Build Options, evaluation findings, and recommendations. A graphical layout (see Appendix A for a full-size pdf), description, summary of benefits and drawbacks, and recommendation is provided for each Build Option.

### 6.1 No Build Condition

The No Build option is carried throughout the technical and environmental analysis for consideration as an option and as a baseline comparison for the Build Options. However, as noted in the evaluation matrix, the No Build option does not:

- Meet project purpose and need.
- Achieve LOS goals at the US16/Neck Yoke Road intersection in the 2050 Planning Horizon.
- The existing traffic control at Neck Yoke Road (stop signs on the side-street, free movement for US16 through traffic) leads to significant delay on the side street during peak hours.
- Improve intersection safety.

### 6.2 Build Option Overview

Build Options developed for the US16/Neck Yoke Road intersection are as follows:

- 1.1a: RCI at Neck Yoke Road
- 1.1b: RCI at Neck Yoke Road plus Northern  $\frac{3}{4}$  Access

- 1.1c: RCI at Neck Yoke Road plus Northern Partial Access
- 1.2a: RCI at Central Driveway
- 1.2b: RCI at Central Driveway plus Northern  $\frac{3}{4}$  Access
- 1.3a: RCI at Central Driveway with US16 Realignment
- 1.3b: RCI at Central Driveway with US16 Realignment plus Northern  $\frac{3}{4}$  Access
- 2.1a: Signalized Intersection at Neck Yoke Road
- 2.1b: Signalized Intersection at Neck Yoke Road plus Northern  $\frac{3}{4}$  Access
- 2.2a: Signalized Intersection at Central Driveway
- 2.2b: Signalized Intersection at Central Driveway plus Northern  $\frac{3}{4}$  Access

All Build Options incorporate some level of consolidation of the following existing US16 access points:

- Neck Yoke Road/Reptile Gardens South (US16/Neck Yoke Road)
- US16 Service Road Central Access/Reptile Gardens Central Driveway (US16/Central Driveway)
- US16 Service Road North Access/Reptile Gardens North Driveway (US16/North Driveway)
- Unknown road

Frontage connections are incorporated to provide access to parcels dependent on a proposed modified or closed access point.

There are several key design features incorporated in the RCI and signalized intersection Build Options, such as:

- RCI
  - ‘a’, ‘b’/’c’, ‘d’, and ‘e’ Build Options
    - ‘a’: a single, main RCI. All other area access points closed.
    - ‘b’/’c’: a main RCI plus a northern partial access. All other access points closed.
    - ‘d’: a main RCI at a shifted west location plus a central partial access.
    - ‘e’: a main RCI at a shifted west location plus a central partial access. All other access points closed.
  - Downstream U-turn spacing
    - Target distances between the main intersection and the downstream U-turn was approximately 800 feet.
    - 1.1a, 1.1b, and 1.1c west U-turn location is spaced at approximately 900 feet due to exiting bridges.
  - Left-turn lane for downstream U-turns
    - The left-turn lane for the downstream U-turn movement is extended back to the main intersection. This allows side-street left-turn traffic

to cross directly into this U-turn lane to minimize exposure and weaving across US16 through traffic.

- Traffic control
  - All RCI intersections are anticipated to be stop-controlled from the side-street approach.
  - Left-turns and U-turn movements within the median would be yield-controlled.
  - Through US16 traffic would have a free movement through the intersection.
- Available northbound Neck Yoke Road queue storage to US16, measured between stop bar and eastbound lane of US16 service road:
  - 1.1a, 1.1b, and 1.1c: 105 feet
  - 1.1d and 1.1e: 230 feet
  - 1.2a and 1.2b: 80 feet
  - 1.3a and 1.3b: 100 feet
  - 2.1a and 2.1b: 95 feet
  - 2.2a and 2.2b: 90 feet
  - Queues exceeding these distances could potentially block southbound Neck Yoke Road left turn movements onto eastbound US16 service road.
- Signalized intersection
  - ‘a’ and ‘b’ Build Options
    - ‘a’: a single, main signalized intersection. All other area access points closed.
    - ‘b’: a main signalized intersection plus a northern  $\frac{3}{4}$  access. All other access points closed.
      - The northern  $\frac{3}{4}$  access in Build Options 2.1b and 2.2b is similar to what is shown in RCI Build Options 1.1b and 1.2b.
  - Third eastbound US16 through lane
    - A third eastbound through lane is incorporated in all signalized intersection Build Options based on a lane utilization supplemental analysis. The lane is added on the eastbound US16 approach to the signalized intersection and is carried east to the top of the grade near Moon Meadows.
  - Northern  $\frac{3}{4}$  access traffic control (signalized intersection ‘b’ Build Options)
    - Anticipated to be stop-controlled from the side-street approach.
    - Left-turns and U-turn movements within the median would be yield-controlled.
    - Through US16 traffic would have a free movement through the intersection.

**Table 1: US16/Neck Yoke Road Intersection Build Option Evaluation Matrix**

| Build Option | Description   | Meets Purpose and Need |                            | 2050 Planning Horizon Traffic Operations |                                      |   | Safety (2026 Year of Opening to 2050 Planning Horizon) |   | Local Network   |   | ROW Needs       | Total Costs                            |                                    | Public Input  | Potential Environmental Impacts                   |   |
|--------------|---|------------------------|----------------------------|--|--------------------------------------|---|--|---|---|---|-----------------|--|------------------------------------|---|---|---|
|              |   | Improves Safety        | Improves Access Management | US16 Main Intersection LOS               | US16 Main Intersection Delay (**ETT) | Does US16 Through Traffic Need to Stop at Intersection? | Total Crashes  | Fatal and Injury Crashes                  | Do Analysis Side Street Queues Block Access to US16 Service Road? | Intersection Geometry and Driver Expectancy | ROW Acquisition | Construction + ROW Costs + Contingency | Constructability                   | Build Option Support based on Stakeholder & Public Feedback | Wetlands / Floodplains                            | Socioeconomics  |
|              |   |                        |                            | AM/PM                                    | AM/PM                                |   | + increase<br>- decrease<br>from No Build              | + increase<br>- decrease<br>from No Build | Yes/No  | 5 - Best<br>3 - Middle<br>1 - Poor          | Acre            | \$ mil                                 | 5 - Best<br>3 - Middle<br>1 - Poor | 5 - Greatest<br>3 - Middle<br>1 - Least                     | Wetlands and 100-yr floodplain along Spring Creek |   |
| 1.1a         | RCI at Neck Yoke Road   | Yes                    | Yes                        | A / A                                    | 3.8 / 8.1                            | No  | -207   | -105                                      | Yes   | 3   | 1.8             | 8.7                                    | 4                                  | 3   | Potential impact to Spring Creek                  | Loss of direct access for business and residential/agricultural use. Parking alterations for Reptile Gardens  |
| 1.1b         | RCI at Neck Yoke Road + Northern ¾ Access                         | Yes                    | Yes                        | A / A                                    | 3.3 / 5.7                            | No  | -180   | -93                                       | No  | 3   | 0.8             | 9.4                                    | 4                                  | 3   | Potential impact to Spring Creek                  | Loss of direct access for business but northern access for residential/agricultural use retained.   |
| 1.1c         | RCI at Neck Yoke Road + Northern Partial Access                   | Yes                    | Yes                        | A / A                                    | 3.8 / 6.1                            | No  | -180   | -93                                       | No  | 3   | 0.8             | 9.4                                    | 4                                  | 3   | Potential impact to Spring Creek                  | Loss of direct access for business but northern access for residential/agricultural use retained.   |
| 1.1d         | RCI at Neck Yoke Road (West)                                      | Yes                    | Yes                        | A / A                                    | 3.8 / 8.1                            | No  | -235   | -118                                      | No  | 4   | 2.7             | 10.8                                   | 4                                  | 3   | Potential impact to Spring Creek                  | Displacement of one parcel. Loss of direct access for business and residential/agricultural use. Parking alterations for Reptile Gardens  |
| 1.1e         | RCI at Neck Yoke Road (West) + Central Partial Access             | Yes                    | Yes                        | A / A                                    | 3.8 / 6.1                            | No  | -190   | -103                                      | No  | 4   | 2.3             | 10.8                                   | 4                                  | 5   | Potential impact to Spring Creek                  | Displacement of one parcel. Loss of direct access for business but northern access for agricultural use on west side of US16 retained. Retain direct access for business but loss of direct access for residential/agricultural use on east side of US16. |
| 1.2a         | RCI at Central Driveway   | Yes                    | Yes                        | A / A                                    | 3.8 / 8.1                            | No  | -207   | -105                                      | Yes   | 2   | 1.8             | 8.4                                    | 4                                  | 2   | Potential impact to Spring Creek                  | Loss of multiple accesses for business and residential but maintain direct access for Happy Holidays. Loss of parking for Reptile Gardens.  |
| 1.2b         | RCI at Central Driveway + Northern ¾ Access                       | Yes                    | Yes                        | A / A                                    | 3.3 / 5.7                            | No  | -180   | -93                                       | No  | 2   | 1.8             | 9.1                                    | 4                                  | 3   | Potential impact to Spring Creek                  | Loss of multiple accesses for business and residential but maintains direct access for Happy Holidays. Parking alterations for Reptile Gardens. Northern access for agricultural use.   |
| 1.3a         | RCI at Central Driveway with US16 Realignment                     | Yes                    | Yes                        | A / A                                    | 3.8 / 8.1                            | No  | -207   | -105                                      | Yes   | 2   | 1.8             | 10.0                                   | 3                                  | 2   | Potential impact to Spring Creek                  | Loss of multiple accesses for business but maintains direct access for Happy Holidays. Loss of parking for Reptile Gardens.   |
| 1.3b         | RCI at Central Driveway with US16 Realignment + Northern ¾ Access | Yes                    | Yes                        | A / A                                    | 3.3 / 5.5                            | No  | -180   | -93                                       | No  | 3   | 1.6             | 10.2                                   | 3                                  | 3   | Potential impact to Spring Creek                  | Loss of multiple accesses for business but maintains direct access for Happy Holidays. Parking alterations for Reptile Gardens. Northern access for agricultural use.   |
| 2.1a         | Signalized Intersection at Neck Yoke Road                         | Yes                    | Yes                        | B / B                                    | 16.6 / 19.8                          | Yes   | -170   | -90                                       | Yes   | 2   | 2.0             | 10.8                                   | 2                                  | 1   | Potential impact to Spring Creek                  | Loss of direct access for business and residential/agricultural use. Loss of parking for Reptile Gardens  |
| 2.1b         | Signalized Intersection at Neck Yoke Road + Northern ¾ Access     | Yes                    | Yes                        | B / B                                    | 14.5 / 17.2                          | Yes   | -137   | -78                                       | Yes   | 2   | 1.0             | 11.4                                   | 2                                  | 2   | Potential impact to Spring Creek                  | Loss of direct access for business but northern access for residential/agricultural use. Least amount of parking impacts to Reptile Gardens   |
| 2.2a         | Signalized Intersection at Central Driveway                       | Yes                    | Yes                        | B / B                                    | 16.6 / 19.8                          | Yes   | -170   | -90                                       | Yes   | 1   | 1.9             | 10.8                                   | 2                                  | 1   | Potential impact to Spring Creek                  | Loss of multiple access for business and residential but maintains direct access for Happy Holidays. Loss of parking for Reptile Gardens.   |
| 2.2b         | Signalized Intersection at Central Driveway + Northern ¾ Access   | Yes                    | Yes                        | B / B                                    | 14.5 / 17.2                          | Yes   | -137   | -78                                       | Yes   | 1   | 1.8             | 11.9                                   | 2                                  | 2   | Potential impact to Spring Creek                  | Loss of multiple access for business and residential but maintains direct access for Happy Holidays. Parking alterations for Reptile Gardens. Northern access for agricultural use.   |
| No Build     | No Build  | No                     | No                         | C / F                                    | 22.8 / 590.7                         | No  | 370 (baseline)   | 168 (baseline)                            | Yes   | 1   | 0               | 0                                      | n/a                                | 1   | No Impacts  | Access remains  |

## 6.3 Reduced Conflict Intersection Build Options

### 6.3.1 Build Option 1.1a: RCI at Neck Yoke Road

Build Option 1.1a is an RCI at the existing US16/Neck Yoke Road intersection. Approximate spacing between the main intersection and downstream U-turn intersections is 900 feet to the west (to extend beyond the Spring Creek bridge) and 800 feet to the east.

All existing access points in the area are consolidated to the Neck Yoke Road intersection. This requires a frontage road connection on the west side of US16 to provide access to area parcels impacted by the consolidation of access points.

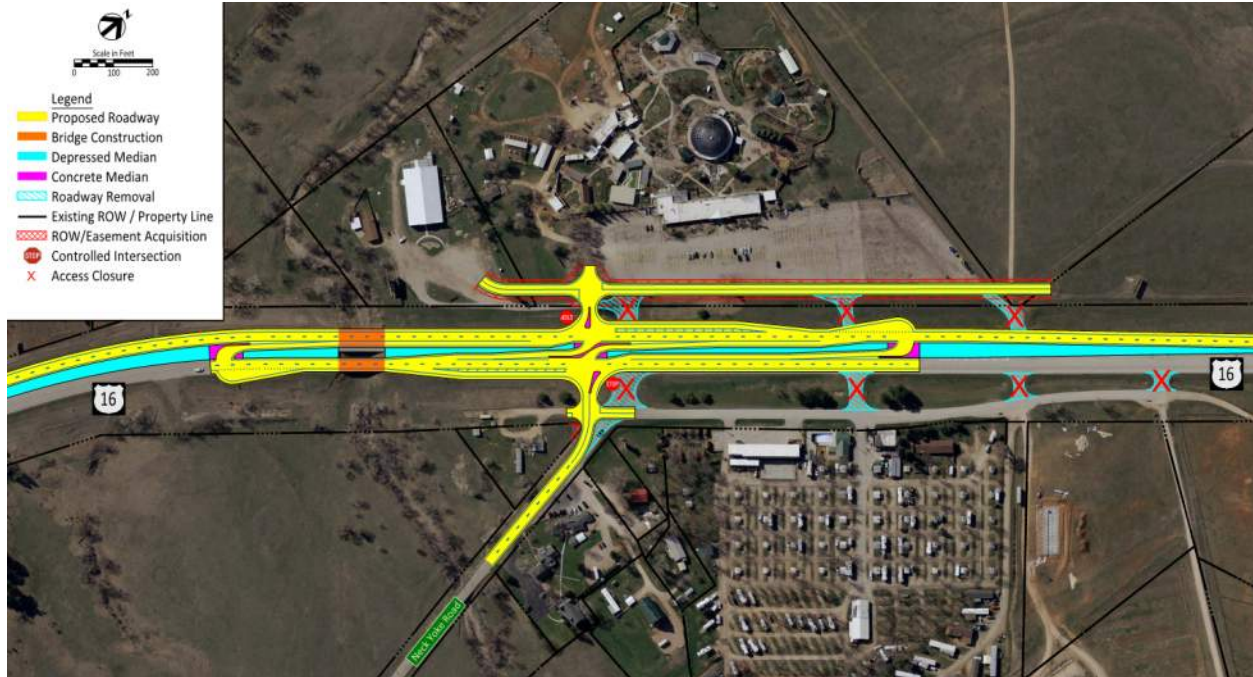


Figure 2: Build Option 1.1a, RCI at Neck Yoke Road

#### Benefits of Build Option 1.1a

##### *Applicable to all RCI Build Options*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Can be constructed using traditional methods. Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.

##### *Unique to Build Option 1.1a*

- Second greatest reduction in crashes of all Build Options.
- Second lowest cost of all Build Options.
- All US16 turn lanes located on flatter 1.5 percent grade.

### **Drawbacks of Build Option 1.1a**

- NB Neck Yoke Road queues measured at 140 feet (exceeds 105 feet available between US16 stop bar and eastbound lane of US16 service road).
- One access point requires US16 to US16 service road traffic to turn across northbound Neck Yoke Road traffic/queues.
- Greater side-street delay than the multiple access point Build Options.
- Travel distance of approximately 4,000 feet to cross US16 for parcels located at existing north Reptile Gardens/US16 service road access point.
- Potential parking impacts.
- Stakeholder/public support favored two access points.

### **Recommendation**

*It is recommended that Build Option 1.1a be eliminated from further evaluation for this future intersection project for the following reasons:*

1. *Single access point*
  - a. *Potential for queues and traffic volumes to block access to eastbound US16 service road, leading to operational and safety concerns at the US16/Neck Yoke Road intersection.*
  - b. *A single access limits flexibility in traffic spreading across multiple access points during congested time periods.*
2. *Public and stakeholder support*
  - a. *The public and stakeholders supported multiple access points to better accommodate large vehicles, tourist traffic, and local traffic. Ultimately, there was less support for an RCI Build Option with only one main access point.*

### 6.3.2 Build Option 1.1b: RCI at Neck Yoke Road plus Northern $\frac{3}{4}$ Access

Build Option 1.1b includes the same RCI at Neck Yoke Road as shown in Build Option 1.1a, but also includes a  $\frac{3}{4}$  access at the northern Reptile Garden/US16 service road access point. Separation between the centers of the full RCI and  $\frac{3}{4}$  access is approximately 1,100 feet.

All existing access points in the area are consolidated to these two intersections. A second access point to the north of Neck Yoke Road notably reduces the extent of frontage roads needed on the west side of US16 to provide access to affected parcels.

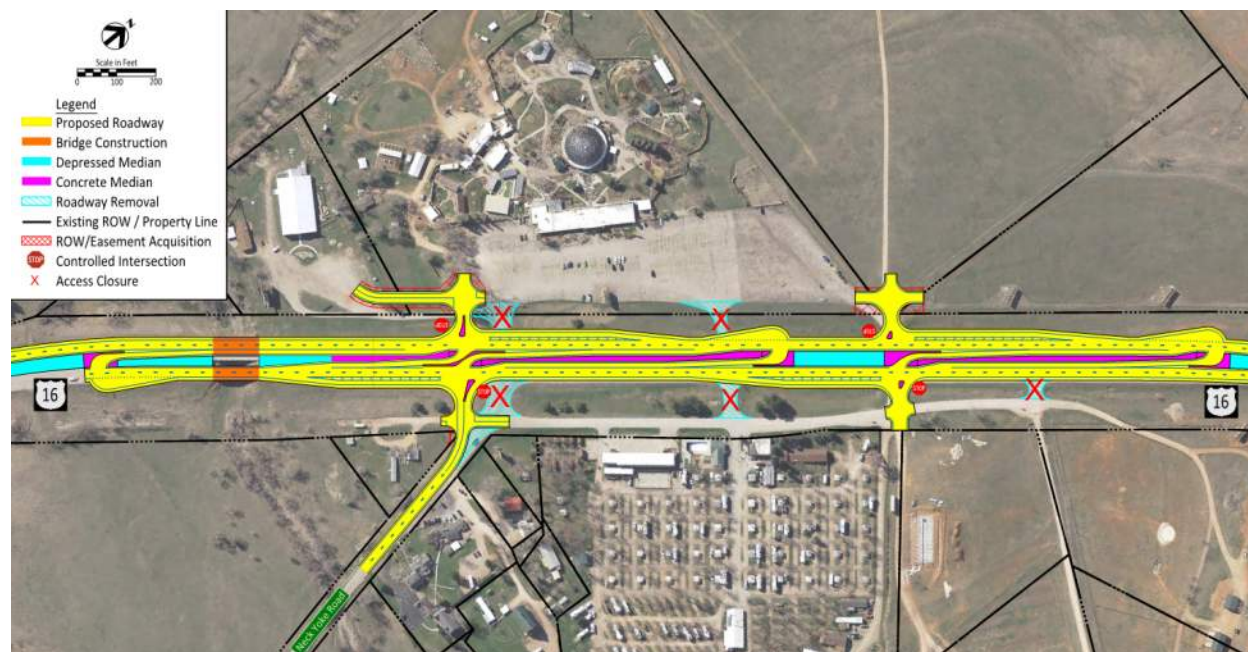


Figure 3: Build Option 1.1b, RCI at Neck Yoke Road plus Northern  $\frac{3}{4}$  Access

#### Benefits of Build Option 1.1b

*Applicable to all RCI 'b', 'c', and 'e' Build Options (1.1b, 1.1c, 1.1e, 1.2b, and 1.3b)*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Measured NB Neck Yoke Road queues less than 80 feet (accommodated by 105 feet of available space between US16 stop bar and eastbound lane of US16 service road).
- Two access points:
  - Provides a second option to turn between US16 and US16 service road, provides a right-turn movement onto US16 service road.
  - Reduces the length of frontage road needed on west side of US16.
  - Provides flexibility in signing local destinations across multiple access points.
- Can be constructed using traditional methods.
  - Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored two access points.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.



*Unique to Build Option 1.1b*

- Lowest intersection delay of all Build Options.
- Shortest side-street queues of all Build Options.
- Least amount of ROW impacts of all Build Options.

**Drawbacks of Build Option 1.1b**

- More conflict points than the single RCI 'a' and 'd' Build Options.
- Least reduction in crashes of all RCI Build Options.
- More conflict points than the RCI Build Option 1.1c.
- Westbound turn lanes located on steep 6.5 percent grade.

**Recommendation**

*It is recommended that Build Option 1.1b be eliminated from further evaluation for this future intersection project for the following reasons:*

- *In comparison with Build Option 1.1c, Build Option 1.1b exhibits more conflict points with the northern partial access U-turn movement.*
- *The eastern U-turn is located on the steep 6.5 percent grade.*

### 6.3.3 Build Option 1.1c: RCI at Neck Yoke Road plus Northern Partial Access

Build Option 1.1c is nearly identical to Build Option 1.1b. The only difference is that the eastbound to westbound U-turn is omitted to reduce the overall number of conflict points.

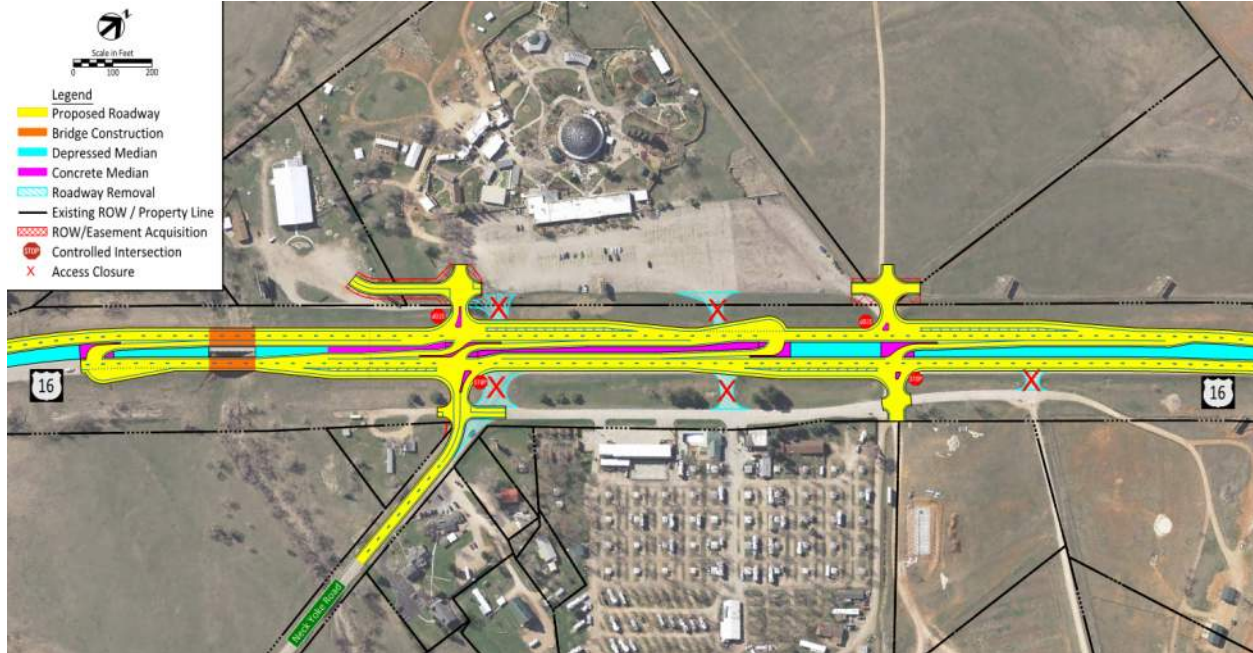


Figure 4: Build Option 1.1c, RCI at Neck Yoke Road plus Northern Partial Access

#### Benefits of Build Option 1.1c

*Applicable to all RCI 'b', 'c', and 'e' Build Options (1.1b, 1.1c, 1.1e, 1.2b, and 1.3b)*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Measured NB Neck Yoke Road queues less than 100 feet (accommodated by 105 feet of available space between US16 stop bar and eastbound lane of US16 service road).
- Two access points:
  - Provides a second option to turn between US16 and US16 service road, provides a right-turn movement onto US16 service road.
  - Reduces the length of frontage road needed on west side of US16.
  - Provides flexibility in signing local destinations across multiple access points.
- Can be constructed using traditional methods.
  - Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored two access points.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.

### *Unique to Build Option 1.1c*

- Least ROW impact of all Build Options.
- Less side-street delay than RCI 'a' and 'd' Build Options.

### **Drawbacks of Build Option 1.1c**

- More conflict points than the single RCI 'a' and 'd' Build Options.
- Least reduction in crashes of all RCI Build Options.
- Westbound US16 turn lanes located on steep 6.5 percent grade.
- While main intersection delay is less than RCI 'a' and 'd' Build Options, it is approximately 0.5 seconds higher than RCI 'b' Build Options.
- Potential for notable out of the way travel to cross US16 or easement across Reptile Gardens parking lot for parcels located at existing north Reptile Gardens/US16 service road access point.

### **Recommendation**

*It is recommended that Build Option 1.1c be eliminated from further evaluation for this future intersection project for the following reasons:*

- *In comparison with 1.1e, 1.1c exhibited the following deficiencies:*
  - *Southbound turn lanes located on the steep WB US16 downgrade.*
  - *Little stakeholder support for a secondary access located on the south side of US16 at the northern access point. Stakeholders supported more of a centrally located access to facilitate a direct turn into Happy Holiday Campground.*
  - *Less predicted reduction in crashes.*

### 6.3.4 Build Option 1.1d: RCI at Neck Yoke Road (West)

Build Option 1.1d is similar to Build Option 1.1a in that all access points are consolidated to a single RCI. The primary difference is the shifted west intersection and increased separation along Neck Yoke Road to 230 feet between US16 and US16 service road.

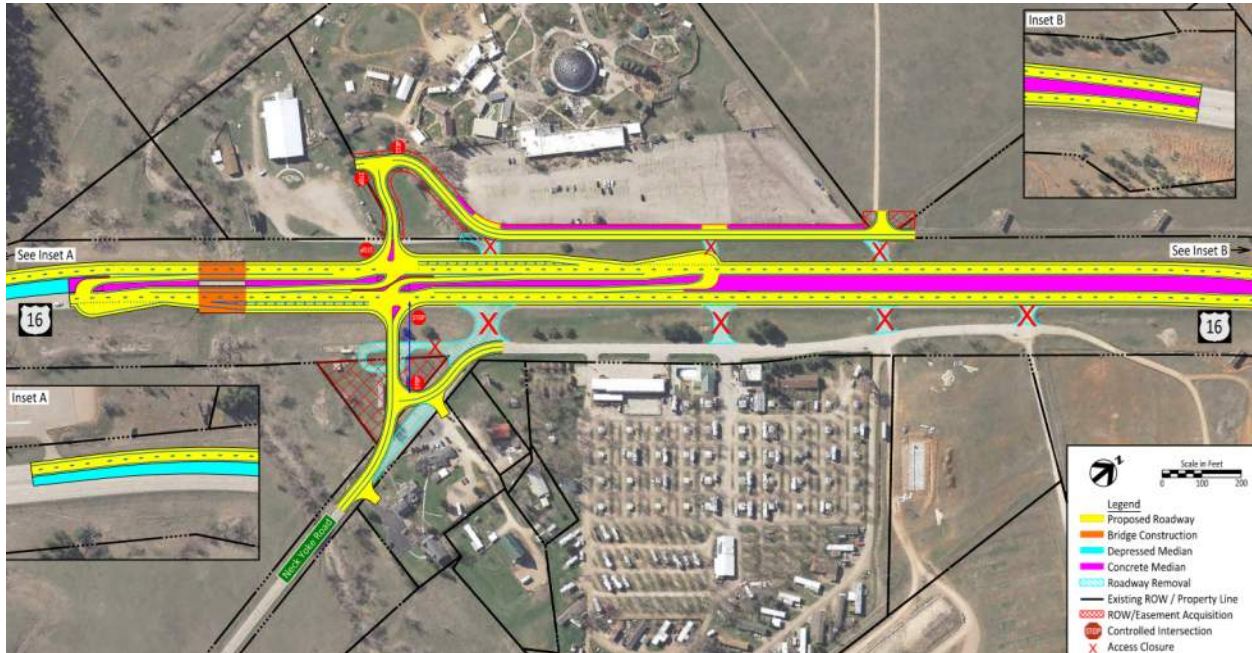


Figure 5: Build Option 1.1d, RCI at Neck Yoke Road (West)

#### Benefits of Build Option 1.1d

*Applicable to all RCI Build Options*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Can be constructed using traditional methods. Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.

*Unique to Build Option 1.1d*

- Greatest reduction in crashes of all Build Options.
- All US16 turn lanes located on flatter 1.5 percent grade.
- Increases Neck Yoke Road intersection spacing between US16 and US16 service road to 230 feet.
- Benefit-cost ratio of 4.5, which was the greatest amongst RCI 1.1c, 1.1d, and 1.1e.

#### Drawbacks of Build Option 1.1d

- Slightly greater side-street delay than the multiple access point Build Options.
- Stakeholder/public support favored two access points.
- Requires displacement of one parcel and the highest overall ROW impacts.

## Recommendation

*It is recommended that Build Option 1.1d be carried forward as the recommended alternative due to:*

- *US16 through traffic does not need to stop through the intersection (free movement).*
- *Safety benefits:*
  - *Greatest reduction in crashes of all Build Options.*
  - *70 percent reduction in fatal and injury crashes compared to No Build condition.*
  - *64 percent reduction in total crashes compared to No Build condition.*
- *Overall intersection operations of LOS A in Year 2050.*
- *Increases Neck Yoke Road intersection spacing between US16 and US16 service road to 230 feet.*
- *Frontage roads on west and east side distributes local traffic to access points and provides local connectivity for area parcels.*
- *Public/stakeholder support for Build Options:*
  - *Improved local network access via frontage roads, better intersection spacing, and internal connectivity*
  - *US16 through traffic does not need to stop at the bottom of the valley.*
  - *All turn lanes located entirely on the flatter 1.5 percent grade*
- *Benefit-cost ratio of 4.5, the greatest of all RCI finalist Build Options.*

### 6.3.5 Build Option 1.1e: RCI at Neck Yoke Road (West) plus Central Partial Access

Build Option 1.1e expands upon the RCI shown in 1.1d with secondary access points at the central driveway. Two options were developed, with and without a frontage Road.

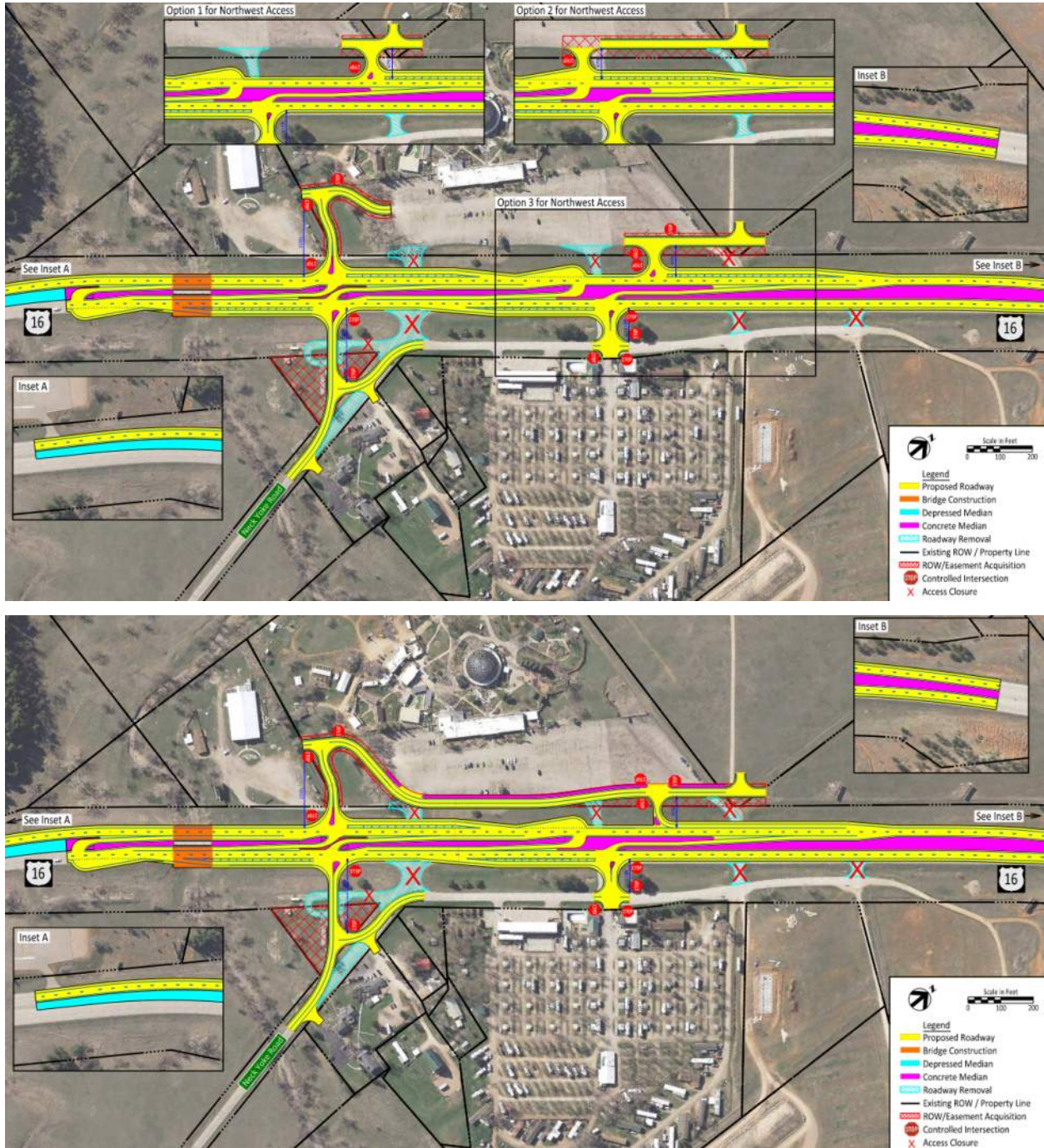


Figure 6: Build Option 1.1e, RCI at Neck Yoke Road (West) plus Central Partial Access

### **Benefits of Build Option 1.1e**

*Applicable to all RCI 'b', 'c', and 'e' Build Options (1.1b, 1.1c, 1.1e, 1.2b, and 1.3b)*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Measured NB Neck Yoke Road queues less than 100 feet.
- Two access points:
  - Provides a second option to turn between US16 and US16 service road, provides a right-turn movement onto US16 service road.
  - Reduces the length of frontage road needed on west side of US16.
  - Provides flexibility in signing local destinations across multiple access points.
- Can be constructed using traditional methods.
  - Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored two access points.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.

*Unique to Build Option 1.1e*

- Less side-street delay than RCI 'a' and 'd' Build Options.
- Third greatest reduction in predicted crashes of all Build Options.
- All US16 turn lanes located on flatter 1.5 percent grade.
- Strongest stakeholder support of all Build Options.
- Benefit-cost ratio of 4.1.

### **Drawbacks of Build Option 1.1e**

- More conflict points than the single RCI 'a' and 'd' Build Options.
- Higher side-street delay than RCI 'b' Build Options.
- Potential for notable out of the way travel to cross US16 or easement across Reptile Gardens parking lot for parcels located at existing north Reptile Gardens/US16 service road access point.

### **Recommendation**

*It is recommended that Build Option 1.1e eliminated from further consideration unless it is determined that stakeholder, public, and elected official support is required for implementation.*

*When compared to RCI 1.1d, the primary drawback is associated with predicted safety:*

- *Fatal and injury crashes: 70% reduction with 1.1d vs. 61% reduction with 1.1e.*
- *Benefit-cost ratio: 4.5 for 1.1d and 4.1 for 1.1e.*

*Benefits of 1.1e vs. 1.1d are generally associated with access and intersection operations:*

- *1.1e provides more direct access between US16 and adjacent stakeholders*
- *1.1e spreads traffic across multiple intersections and thus lowers delay at the RCI.*

### 6.3.6 Build Option 1.2a: RCI at Central Driveway

Build Option 1.2a depicts an RCI at the central driveway intersection. Approximate spacing between the main intersection and downstream U-turn intersections is 800 feet to the west and east.

All area access points are consolidated to the single RCI main intersection. This requires a frontage road on the west side of US16. On the east side, Neck Yoke Road is rerouted up the existing US16 service road.

Space limitations, truck turning paths, and the need to accommodate all movements to/from US16 and existing development/parcels on the east side creates a large intersection extending east of US16 to US16 service road. This leads to several movements entering and exiting a large area of pavement.



Figure 7: Build Option 1.2a, RCI at Central Driveway

#### Benefits of Build Option 1.2a

##### *Applicable to all RCI Build Options*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Can be constructed using traditional methods. Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.

##### *Unique to Build Option 1.2a*

- Second greatest reduction in crashes of all Build Options.
- Main intersection is at tourist destination access points.
- All US16 turn lanes located on flatter 1.5 percent grade.



### **Drawbacks of Build Option 1.2a**

- Large main intersection blends between US16 and US16 service road. There are several access points within this large intersection area.
- NB Neck Yoke Road queues measured at 140 feet (exceeds 80 feet available between US16 stop bar and eastbound lane of US16 service road).
- One access point requires US16 to US16 service road traffic to turn across northbound Neck Yoke Road traffic/queues. May create spillback impacts with US16 mainline.
- Over 2x more ROW impact as other Build Options.
- Parking impacts due to frontage road on west side of US16.
- Stakeholder/public support favored two access points. Limited support for the large main intersection between US16 and US16 service road.

### **Recommendation**

*It is recommended that Build Option 1.2a be eliminated from further evaluation for this future intersection project for the following reasons:*

- *Large main intersection that blends between US16 and US16 service road. Several access points within this large intersection area leads to notable traffic operations, safety, and driver expectancy concerns.*
- *NB Neck Yoke Road queues measured at 140 feet (approximately 80 feet of separation between US16 stop bar and eastbound lane of US16 service road).*
- *Stakeholder/public support favored two access points. Limited support for the large main intersection between US16 and US16 service road.*

### 6.3.7 Build Option 1.2b: RCI at Central Driveway plus Northern $\frac{3}{4}$ Access

Build Option 1.2b maintains the same RCI at the central driveway as shown in Build Option 1.2a, but also incorporates a  $\frac{3}{4}$  access to the north. Approximate separation from center of the full RCI and the center of the  $\frac{3}{4}$  access is approximately 850 feet.

There are two notable geometric and access features in this Build Option that are different from Build Option 1.1b. First, the full RCI east U-turn location also provides access to the parcel triangle on the west side of US16 via a frontage road. Build Option 1.1b keeps these movements separate. Second, the separation between the full RCI and the  $\frac{3}{4}$  access is approximately 250 feet shorter than Build Option 1.1b. The westbound left-turn location into the northern US16 service road access occurs directly north of the full RCI eastern U-turn location. The primary reasoning for both design differences is the steep grade extending out of the Spring Creek valley and minimizing the extent of new frontage road needed to connect affected parcels.



Figure 8: Build Option 1.2b, RCI at Central Driveway plus Northern  $\frac{3}{4}$  Access

#### Benefits of Build Option 1.2b

*Applicable to all RCI 'b', 'c', and 'e' Build Options (1.1b, 1.1c, 1.1e, 1.2b, and 1.3b)*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Measured NB Neck Yoke Road queues less than 80 feet (accommodated by 85 feet of available space between US16 stop bar and eastbound lane of US16 service road).
- Two access points:
  - Provides a second option to turn between US16 and US16 service road, provides a right-turn movement onto US16 service road.
  - Reduces the length of frontage road needed on west side of US16.
  - Provides flexibility in signing local destinations across multiple access points.

- Can be constructed using traditional methods.
  - Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored two access points.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.

#### *Unique to Build Option 1.2b*

- Second greatest reduction in crashes of all Build Options.
- Third lowest cost of all Build Options.
- Can be constructed using traditional methods. Eastbound US16 can be reconstructed on existing alignment.

#### **Drawbacks of Build Option 1.2b**

- Large main intersection blends between US16 and US16 service road. There are several access points within this large intersection area.
- Westbound US16 turn lanes located on steep grade.
- Limited stakeholder/public support for the large main intersection between US16 and US16 service road.

#### **Recommendation**

*It is recommended that Build Option 1.2b be eliminated from further evaluation for this future intersection project for the following reasons:*

- *Large main intersection that blends between US16 and US16 service road. Several access points within this large intersection area leads to notable traffic operations, safety, and driver expectancy concerns.*
- *Limited stakeholder/public support for the large main intersection between US16 and US16 service road.*

### 6.3.8 Build Option 1.3a: RCI at Central Driveway with US16 Realignment

The Build Option 1.3a layout is similar to Build Option 1.2a except that the US16 alignment is shifted to the west, closer to Reptile Gardens. This was done to increase separation between US16 and the US16 service road and improve the functionality of the US16 service road intersection.

Overall, spacing is increased by approximately 20 feet. This accommodates a side-street approach queue to US16 of approximately 100 feet (compared to 80 feet or less in Build Options 1.1 and 1.2). However, this increased separation does not extend far enough to address many of the same drawbacks of Build Options 1.2a and 1.2b.

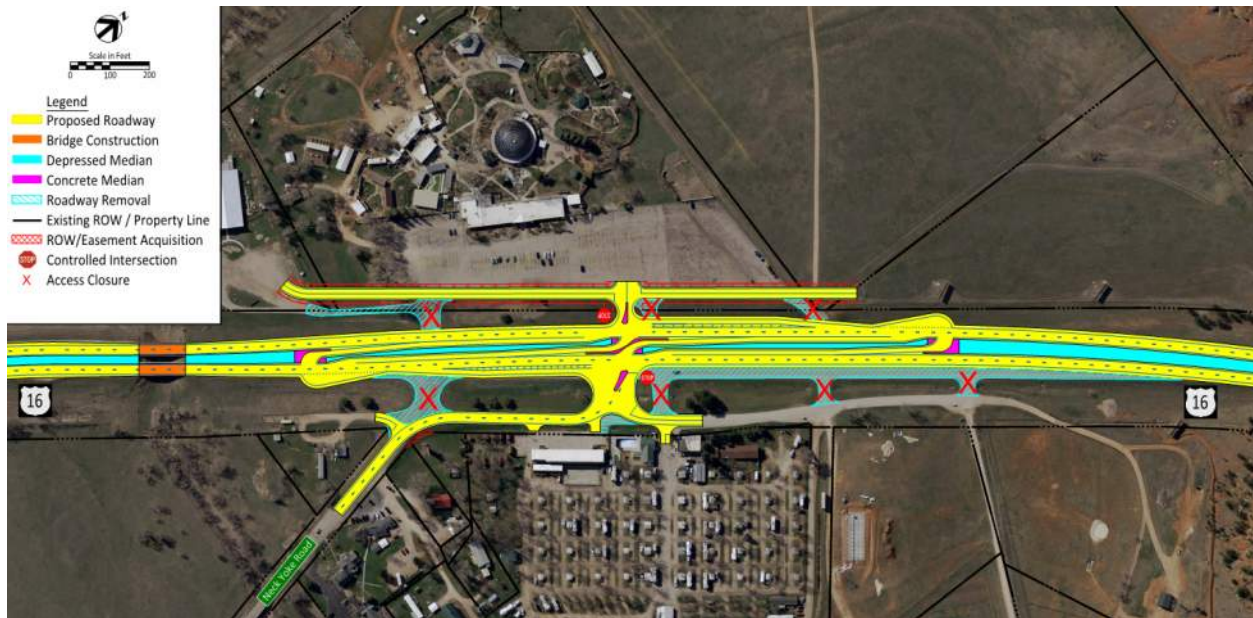


Figure 9: Build Option 1.3a, RCI at Central Driveway with US16 Realignment

#### Benefits of Build Option 1.3a

##### *Applicable to all RCI Build Options*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Can be constructed using traditional methods. Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.

##### *Unique to Build Option 1.2a*

- Main intersection is in close proximity to tourist destination access points.
- Distance between US16 and US16 service road increased to approximately 100 feet.
- All US16 turn lanes located on flatter 1.5 percent grade.

### **Drawbacks of Build Option 1.3a**

- Even with the shift in alignment, a large main intersection blends between US16 and US16 service road. There are several access points within this large intersection area.
- NB Neck Yoke Road queues measured at 140 feet (exceeds 100 feet available between US16 stop bar and eastbound lane of US16 service road).
- One access point requires US16 to US16 service road traffic to turn across northbound Neck Yoke Road traffic/queues. May create spillback impacts with US16 mainline.
- Over twice as much ROW impact as other Build Options.
- High costs and ROW impacts compared to other RCI Build Options.
- New eastbound and westbound alignment.
- Parking impacts due to frontage road on west side of US16.
- Stakeholder/public support favored two access points. Limited support for the large main intersection between US16 and US16 service road.

### **Recommendation**

*It is recommended that Build Option 1.3a be eliminated from further evaluation for this future intersection project for the following reasons:*

- *Large main intersection that blends between US16 and US16 service road. Several access points within this large intersection area leads to notable traffic operations, safety, and driver expectancy concerns.*
- *NB Neck Yoke Road queues measured at 140 feet (approximately 100 feet of separation between US16 stop bar and eastbound lane of US16 service road).*
- *Stakeholder/public support favored two access points. Limited support for the large main intersection between US16 and US16 service road.*
- *High costs and ROW impacts compared to other RCI Build Options.*

### 6.3.9 Build Option 1.3b: RCI at Central Driveway with US16 Realignment plus Northern $\frac{3}{4}$ Access

Build Option 1.3b is based on 1.3a and brings in a northern  $\frac{3}{4}$  access. The purpose of this layout is to provide a shift in US16 alignment to increase separation between US16 and US16 service road as well as provide two access points. Spacing between the full RCI and the northern  $\frac{3}{4}$  access is approximately 850 feet, similar to Build Option 1.2b.



Figure 10: Build Option 1.3b, RCI at Central Driveway with US16 Realignment plus Northern  $\frac{3}{4}$  Access

#### Benefits of Build Option 1.3b

*Applicable to all RCI 'b', 'c', and 'e' Build Options (1.1b, 1.1c, 1.1e, 1.2b, and 1.3b)*

- LOS A (AM and PM peak hours, 2050 Planning Horizon).
- Measured NB Neck Yoke Road queues less than 80 feet (accommodated by 100 feet of available space between US16 stop bar and eastbound lane of US16 service road).
- Two access points:
  - Provides a second option to turn between US16 and US16 service road, provides a right-turn movement onto US16 service road.
  - Reduces the length of frontage road needed on west side of US16.
  - Provides flexibility in signing local destinations across multiple access points.
- Can be constructed using traditional methods.
  - Eastbound US16 can be reconstructed on existing alignment.
- Stakeholder/public support favored two access points.
- Stakeholder/public support favored an RCI Build Option over a signalized intersection.

### *Unique to Build Option 1.3b*

- Distance between US16 and US16 service road increased to approximately 100 feet.

### **Drawbacks of Build Option 1.3b**

- Even with the shift in alignment, a large main intersection blends between US16 and US16 service road. There are several access points within this large intersection area.
- Limited stakeholder/public support for the large main intersection between US16 and US16 service road.
- Westbound US16 turn lanes located on steep grade.
- High costs and ROW impacts compared to other RCI Build Options.

### **Recommendation**

*It is recommended that Build Option 1.3b be eliminated from further evaluation for this future intersection project for the following reasons:*

- *Large main intersection that blends between US16 and US16 service road. Several access points within this large intersection area leads to notable traffic operations, safety, and driver expectancy concerns.*
- *Limited stakeholder/public support for the large main intersection between US16 and US16 service road.*
- *High costs and ROW impacts compared to other RCI Build Options.*

## 6.4 Signalized Intersection Build Options

### 6.4.1 Build Option 2.1a: Signalized Intersection at Neck Yoke Road

Build Option 2.1a reflects a signalized intersection at the US16/Neck Yoke Road intersection. Left and right-turn lanes are incorporated on all four intersection approaches. A third eastbound lane is introduced at the intersection's eastbound approach to address anticipated operational and safety issues related to high volumes of high vehicles, unbalanced lane utilization, and stopping at the bottom of a steep grade.

All existing access points in the area are consolidated to a single signalized intersection at Neck Yoke Road. Similar to the single RCI Build Options, a long frontage road is needed on the west side of US16 to connect parcels affected by access consolidation in the area.



Figure 11: Build Option 2.1a, Signalized Intersection at Neck Yoke Road

#### Benefits of Build Option 2.1a

##### *Applicable to all Signalized Intersection Build Options*

- LOS B (AM and PM peak hours, 2050 Planning Horizon).
  - Greater intersection delay than RCI Build Options.
- Notable predicted reduction in crashes compared to No Build condition.
- Drivers are familiar with signalized intersections.

#### Drawbacks of Build Option 2.1a

- Overall intersection delay is greatest of all Build Options.
- US16 through traffic may need to stop.
- Results in greater number of predicted crashes than all RCI Build Options.



- NB Neck Yoke Road queues measured at 157 and 217 feet, in the AM and PM peak hours (exceeds 95 feet available between US16 stop bar and eastbound lane of US16 service road).
- High ROW impact.
- High costs.
- Third eastbound lane needed to Moon Meadows Drive.
- Low public support for a signalized intersection at the bottom of steep grades.

### **Recommendation**

*It is recommended that Build Option 2.1a be eliminated from further evaluation for this future intersection project for the following reasons:*

- *RCI Build Options result in better traffic operations and predicted safety.*
- *NB Neck Yoke Road queues extend well beyond US16 service road intersection.*
- *High costs and ROW impacts.*
- *Third eastbound lane needed to Moon Meadows.*
- *Low public/stakeholder support for a signalized intersection at the bottom of steep grades.*

### 6.4.2 Build Option 2.1b: Signalized Intersection at Neck Yoke Road plus Northern ¾ Access

Build Option 2.1b expands Build Option 2.1a to include a northern ¾ access. Approximate separation from center of the signalized intersection and the center of the northern ¾ access is approximately 1,100 feet. The layout for this ¾ access is similar to what is shown in RCI Build Option 1.1b.

All existing access points in the area are consolidated to these two intersections. A second access point to the north of Neck Yoke road notably reduces the extent of frontage road needs on the west side of US16. The northern access provides access to the triangle of parcels on the north edge of Reptile Gardens.

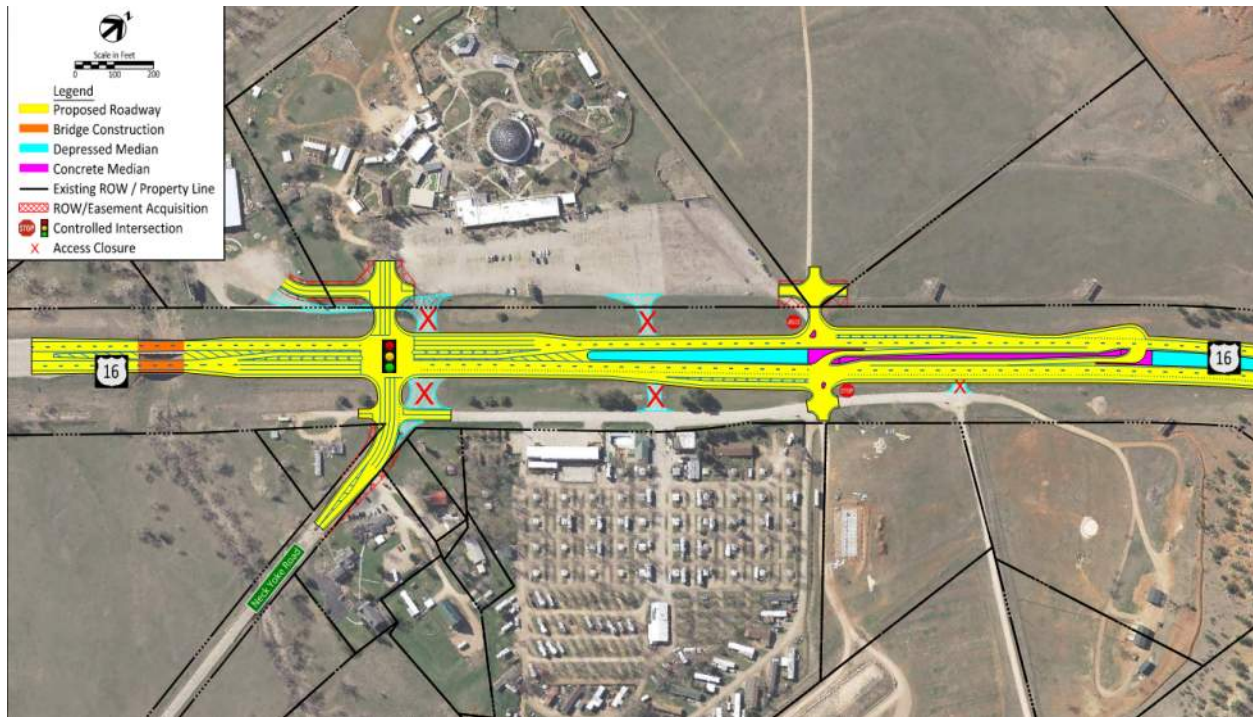


Figure 12: Build Option 2.1b, Signalized Intersection at Neck Yoke Road plus Northern ¾ Access

#### Benefits of Build Option 2.1b

##### *Applicable to all Signalized Intersection Build Options*

- LOS B (AM and PM peak hours, 2050 Planning Horizon).
  - Greater intersection delay than RCI Build Options.
- Notable predicted reduction in crashes compared to No Build condition.
- Drivers are familiar with signalized intersections.

##### *Unique to Build Option 2.1b*

- Low ROW impacts compared to other Build Options.
- Two access points:

- Provides a second option to turn between US16 and US16 service road, provides a right-turn movement onto US16 service road.
- Reduces the length of frontage road needed on west side of US16.
- Provides flexibility in signing local destinations across multiple access points.

#### **Drawbacks of Build Option 2.1b**

- Overall intersection delay is 2x-3x greater than the RCI Build Options.
- US16 through traffic may need to stop.
- Least predicted reduction in crashes of all Build Options.
- NB Neck Yoke Road queues measured at 124 and 146 feet, in the AM and PM peak hours (exceeds 95 feet available between US16 stop bar and eastbound lane of US16 service road).
- Second highest cost of all Build Options.
- Third eastbound lane needed to Moon Meadows Drive.
- Westbound US16 turn lanes located on steep grade.
- Low public support for a signalized intersection at the bottom of steep grades.

#### **Recommendation**

*It is recommended that Build Option 2.1b be eliminated from further evaluation for this future intersection project for the following reasons:*

- *RCI Build Options result in better traffic operations and predicted safety.*
  - *Least predicted reduction in crashes of all Build Options.*
- *NB Neck Yoke Road queues extend well beyond US16 service road intersection.*
- *High costs.*
- *Third eastbound lane needed to Moon Meadows.*
- *Low public/stakeholder support for a signalized intersection at the bottom of steep grades.*

### 6.4.3 Build Option 2.2a: Signalized Intersection at Central Driveway

Build Option 2.1b signalizes a single, main intersection at the central driveway. The main intersection includes left and right turn lanes on all four approaches. A third eastbound lane is introduced at the intersection’s eastbound approach to address anticipated operational and safety issues related to high volumes of heavy vehicles, unbalanced lane utilization, and stopping at the bottom of a steep grade.

Similar to Build Option 1.1a, a long frontage road is needed on the west side of US16 to connect parcels affected by the access consolidation to a single access point.

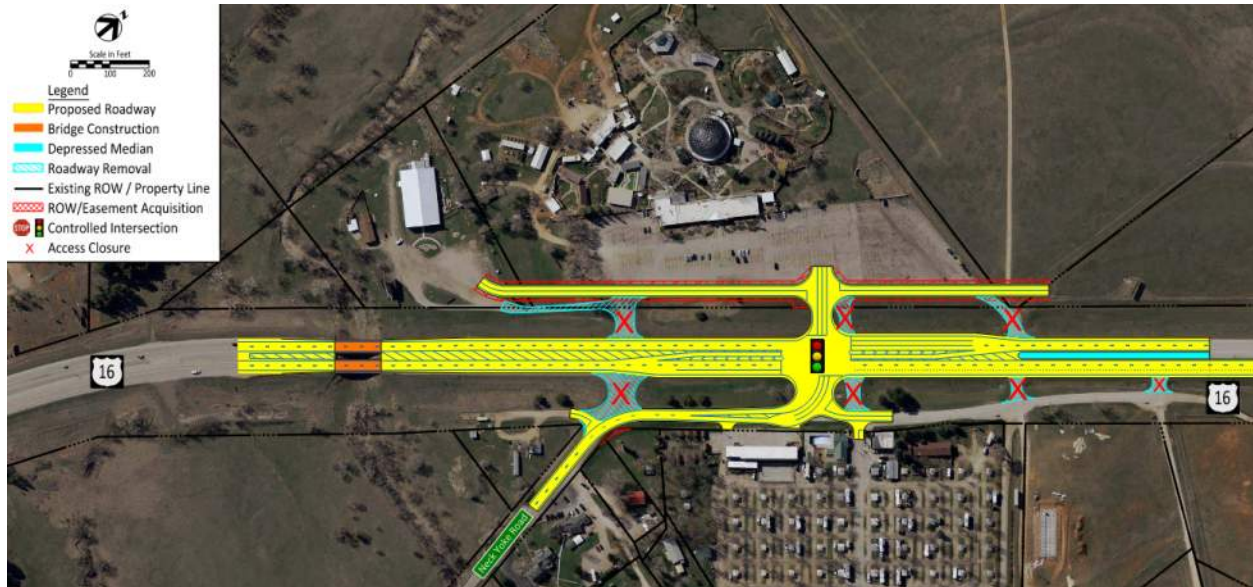


Figure 13: Build Option 2.2a, Signalized Intersection at Central Driveway

#### Benefits of Build Option 2.2a

##### *Applicable to all Signalized Intersection Build Options*

- LOS B (AM and PM peak hours, 2050 Planning Horizon).
  - Greater intersection delay than RCI Build Options.
- Notable predicted reduction in crashes compared to No Build condition.
- Drivers are familiar with signalized intersections.

#### Drawbacks of Build Option 2.2a

- Overall intersection delay is greatest of all Build Options.
- US16 through traffic may need to stop.
- Results in greater number of predicted crashes than all RCI Build Options.
- NB Neck Yoke Road queues measured at 157 and 217 feet, in the AM and PM peak hours (exceeds 90 feet available between US16 stop bar and eastbound lane of US16 service road).
- Large main intersection blends between US16 and US16 service road. There are several access points within this large intersection area.

- High costs and ROW impacts.
- Third eastbound lane needed to Moon Meadows Drive.
- Low public support for a signalized intersection at the bottom of steep grades.

### **Recommendation**

*It is recommended that Build Option 2.2a be eliminated from further evaluation for this future intersection project for the following reasons:*

- *RCI Build Options result in better traffic operations and predicted safety.*
- *NB Neck Yoke Road queues extend well beyond US16 service road intersection.*
- *Large main intersection that blends between US16 and US16 service road. Several access points within this large intersection area leads to notable traffic operations, safety, and driver expectancy concerns.*
- *High costs and ROW impacts.*
- *Third eastbound lane needed to Moon Meadows.*
- *Low public/stakeholder support for a signalized intersection at the bottom of steep grades.*

## 6.4.4 Build Option 2.2b: Signalized Intersection at Central Driveway plus Northern $\frac{3}{4}$ Access

Build Option 2.2b expands Build Option 2.2a to include a northern  $\frac{3}{4}$  access. The location of the  $\frac{3}{4}$  access is the furthest north of all Build Options and is located on part of the steepest grade heading out of the valley. This location also necessitates additional frontage road to tie back into affected properties north of Reptile Gardens, resulting in overall frontage road length similar to Build Option 2.1a and 2.2a.

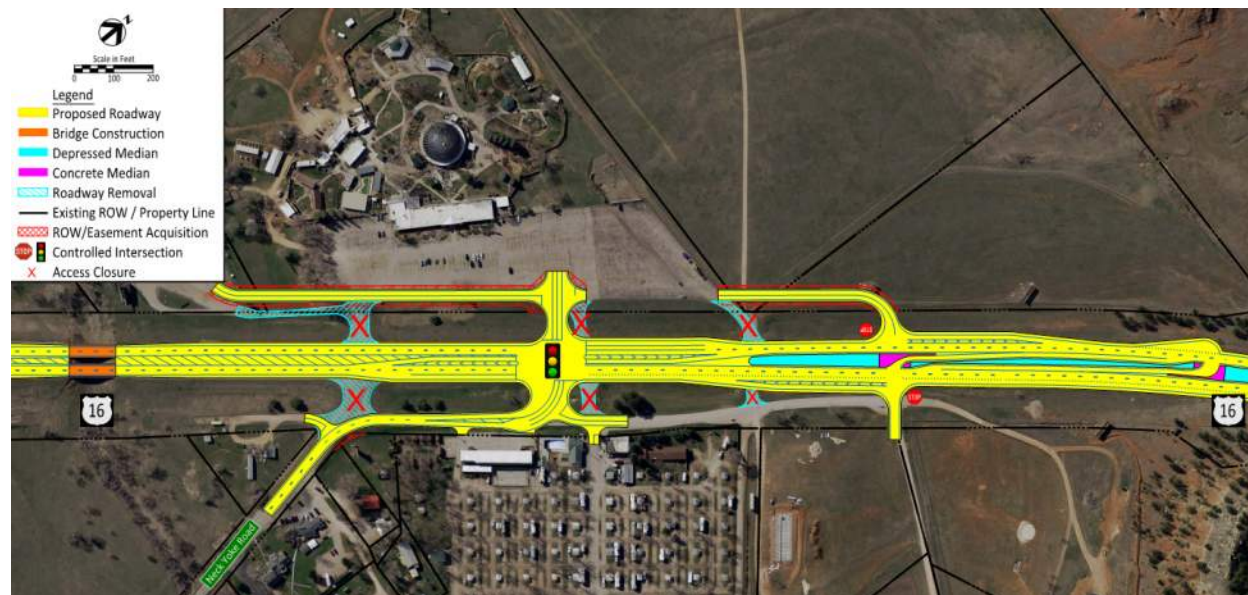


Figure 14: Build Option 2.2b, Signalized Intersection at Central Driveway plus Northern  $\frac{3}{4}$  Access

### Benefits of Build Option 2.2b

#### *Applicable to all Signalized Intersection Build Options*

- LOS B (AM and PM peak hours, 2050 Planning Horizon).
  - Greater intersection delay than RCI Build Options.
- Notable predicted reduction in crashes compared to No Build condition.
- Drivers are familiar with signalized intersections.

#### *Unique to Build Option 2.2b*

- Two access points:
  - Provides a second option to turn between US16 and US16 service road, provides a right-turn movement onto US16 service road.
  - Reduces the length of frontage road needed on west side of US16.
  - Provides flexibility in signing local destinations across multiple access points.

### Drawbacks of Build Option 2.2b

- Overall intersection delay is 2x-3x greater than the RCI Build Options.

- US16 through traffic may need to stop.
- Least predicted reduction in crashes of all Build Options.
- NB Neck Yoke Road queues measured at 124 and 146 feet, in the AM and PM peak hours (exceeds 90 feet available between US16 stop bar and eastbound lane of US16 service road).
- Large main intersection blends between US16 and US16 service road. There are several access points within this large intersection area.
- Highest cost of all Build Options.
- Third eastbound lane needed to Moon Meadows Drive.
- Westbound US16 turn lanes located on steep grade.
- Low public support for a signalized intersection at the bottom of steep grades.

### **Recommendation**

*It is recommended that Build Option 2.2b be eliminated from further evaluation for this future intersection project for the following reasons:*

- *RCI Build Options result in better traffic operations and predicted safety.*
  - *Least predicted reduction in crashes of all Build Options.*
- *NB Neck Yoke Road queues extend well beyond US16 service road intersection.*
- *Large main intersection that blends between US16 and US16 service road. Several access points within this large intersection area leads to notable traffic operations, safety, and driver expectancy concerns.*
- *High cost.*
- *Third eastbound lane needed to Moon Meadows Drive.*
- *Low public/stakeholder support for a signalized intersection at the bottom of steep grades.*

## 7.0 Recommendations

The following tables summarize recommendations from this memo regarding Build Options to carry forward or eliminate from further consideration.

**Table 2: Build Option to be Carried Forward**

| Build Option | Description                  | Main Reason(s) for Carrying Forward   |
|--------------|------------------------------|---|
| 1.1d         | RCI at Neck Yoke Road (West) | <ul style="list-style-type: none"> <li>• US16 through traffic does not need to stop through the intersection (free movement).</li> <li>• Greatest reduction in crashes of all Build Options.</li> <li>• Overall intersection operations of LOS A in Year 2050.</li> <li>• Increases Neck Yoke Road intersection spacing between US16 and US16 service road to 230 feet.</li> <li>• Frontage roads on west and east side distributes local traffic to access points and provides local connectivity for area parcels.</li> <li>• Public/stakeholder support for Build Options:                             <ul style="list-style-type: none"> <li>• Improved local network access via frontage roads, intersection spacing, and internal connectivity.</li> <li>• US16 through traffic does not need to stop at the bottom of the valley.</li> <li>• All turn lanes located entirely on the flatter 1.5 percent grade</li> </ul> </li> <li>• Benefit-cost ratio of 4.5, the greatest of all RCI finalist Build Options.</li> </ul> |

The success of any project is often predicated on the support of proposed improvements by local stakeholders, elected officials, and the traveling public. Based on feedback received during the second and third public meetings, it was evident that local stakeholders and elected officials support the multiple access points in RCI 1.1e over the single access point in RCI 1.1d. RCI 1.1e also provides notable benefit to the area with a benefit-cost ratio of 4.1. The tradeoff with multiple access points centers on the predicted increase in crashes versus a higher level of access and less delay at each individual intersection. Both Build Options satisfy the purpose and need and are considerably better than the No Build option.

The State of South Dakota access policy provides for opportunities to weigh benefits and drawbacks on the merits of each individual access. This report summarizes those benefits and drawbacks for further consideration as part of the NEPA, preliminary design, and final design processes.

**Table 3: Build Option for Further Consideration Due to Stakeholder Support**

| Build Option | Description  | Main Reason(s) for Further Consideration  |
|--------------|--|---|
| 1.1e         | RCI at Neck Yoke Road (West) plus Central Partial Access | <ul style="list-style-type: none"> <li>• US16 through traffic does not need to stop through the intersection (free movement).</li> <li>• RCI safety benefits.</li> <li>• Overall intersection operations of LOS A in Year 2050.</li> <li>• Increases Neck Yoke Road intersection spacing between US16 and US16 service road to 230 feet.</li> <li>• Possible frontage roads on west and east side distributes local traffic to access points and provides local connectivity for area parcels.</li> <li>• Public/stakeholder support for Build Options:                             <ul style="list-style-type: none"> <li>• Improved local network access via frontage roads, intersection spacing, and internal connectivity.</li> <li>• US16 through traffic does not need to stop at the bottom of the valley.</li> <li>• All turn lanes located entirely on the flatter 1.5 percent grade.</li> <li>• Greatest stakeholder support of all Build Options.</li> </ul> </li> <li>• Benefit-cost ratio of 4.1, demonstrating a notable benefit to implementation.</li> </ul> |



**Table 4: Build Options Not Carried Forward**

| Build Option           | Description  | Main Reason(s) for Not Carrying Forward  |
|------------------------|--|--|
| 1.1a                   | RCI at Neck Yoke Road                                    | <p>Provides many of the same benefits as identified for 1.1c, but in comparison, 1.1a exhibited the following key drawbacks:</p> <ul style="list-style-type: none"> <li>• Neck Yoke Road NB approach queue spillback and potential safety impacts to turning vehicles onto US16 service road (and US16 traffic).</li> <li>• Limited flexibility in spreading traffic across multiple access points, leading to potential safety impacts to US16 traffic.</li> <li>• Limited stakeholder support for a single access.</li> </ul>  |
| 1.1b                   | RCI at Neck Yoke Road plus Northern $\frac{3}{4}$ Access | <p>1.1b is nearly identical to 1.1c, except it incorporates an eastbound to westbound U-turn at the northern partial access. 1.1b was eliminated in favor of 1.1c due to:</p> <ul style="list-style-type: none"> <li>• Build Option 1.1b exhibits more conflict points than Build Option 1.1c with the northern partial access U-turn movement. This movement does not benefit the overall operations of the two intersections.</li> </ul>   |
| 1.1c                   | RCI at Neck Yoke Road plus Northern Partial Access       | <p>In comparison with 1.1e, 1.1c exhibited the following deficiencies:</p> <ul style="list-style-type: none"> <li>• Southbound turn lanes located on the steep WB US16 downgrade.</li> <li>• Little stakeholder support for a secondary access on the south side of US16 at the northern access point. Stakeholders supported more of a centrally located access to facilitate a direct turn into Happy Holiday Campground.</li> <li>• Less predicted reduction in crashes.</li> </ul>   |
| 1.2a, 1.2b, 1.3a, 1.3b | RCI at Central Driveway Build Options                    | <ul style="list-style-type: none"> <li>• Neck Yoke Road NB approach queue spillback and potential impacts to turning vehicles onto US16 service road (1.2a and 1.3a).</li> <li>• Large main intersection that blends between US16 and US16 service road. Several access points within this large intersection area leads to notable traffic operations safety, and driver expectancy concerns.</li> <li>• Frontage road needs and parking lot impacts (1.2a and 1.3a).</li> <li>• High costs and new alignment constructability for 1.3a and 1.3b.</li> <li>• Limited stakeholder support for a single access (1.2a and 1.3a).</li> </ul>  |
| 2.1a, 2.1b, 2.2a, 2.2b | Signalized Intersection Build Options                    | <ul style="list-style-type: none"> <li>• 2x to 4x greater intersection delay than RCI Build Options.</li> <li>• Reduction in predicted crashes less than RCI Build Options.</li> <li>• Low public/stakeholder support for a signalized intersection at the bottom of steep grades.</li> <li>• 3<sup>rd</sup> eastbound through lane needed from signalized intersection to Moon Meadows Drive.</li> <li>• High costs.</li> <li>• Frontage road needs and parking lot impacts (2.1a, 2.2a, and 2.2b).</li> <li>• Neck Yoke Road NB approach queue spillback and potential impacts to turning vehicles onto US16 service road.</li> <li>• Large main intersection that blends between US16 and US16 service road (2.2a and 2.2b). Several access points within this large intersection area leads to notable traffic operations safety, and driver expectancy concerns.</li> </ul> |

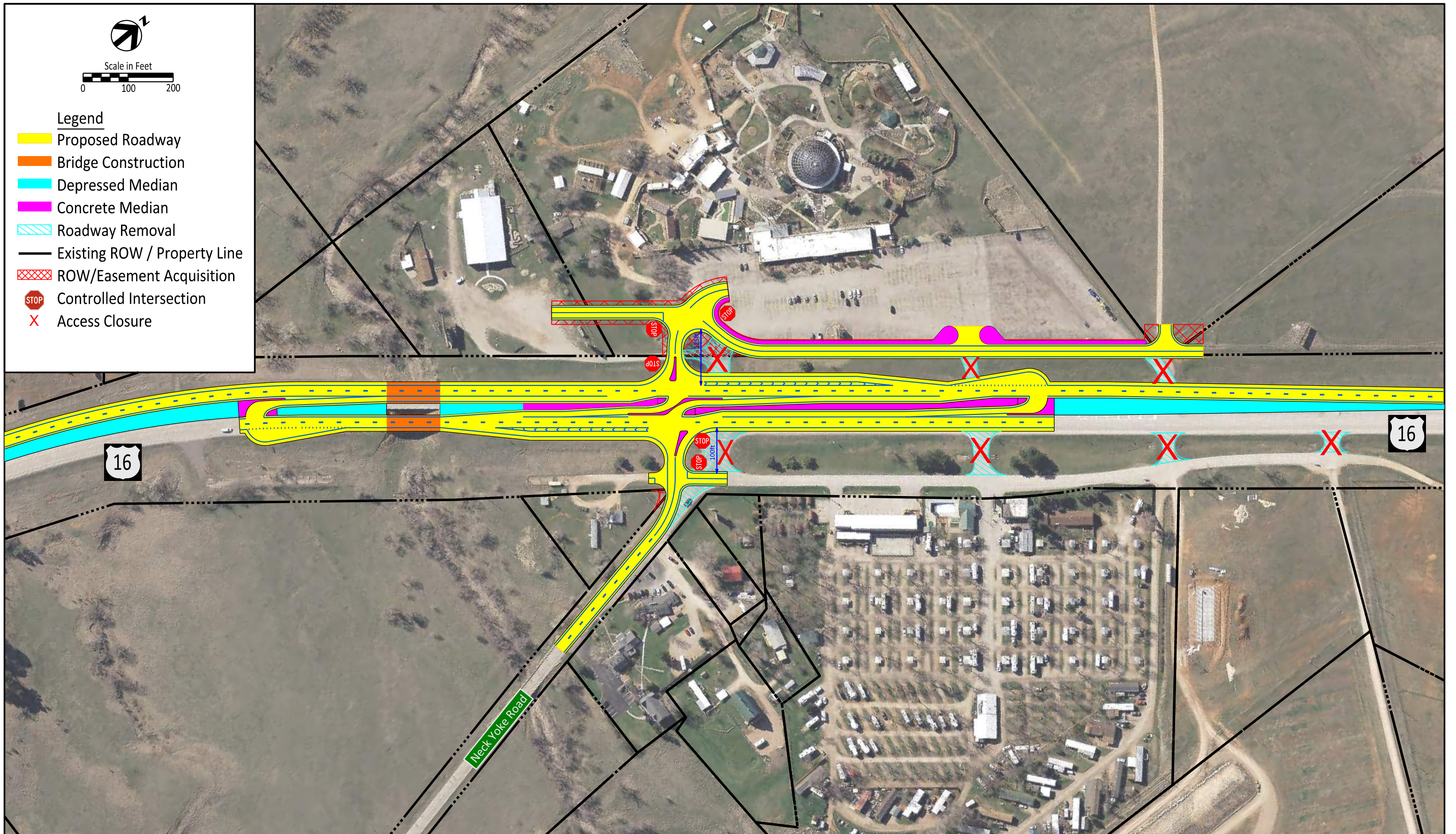
## Appendix A. US16/Neck Yoke Road Intersection Build Options



Scale in Feet  
0 100 200

**Legend**

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Roadway Removal
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP Controlled Intersection
- X Access Closure



Build Option  
1.1a



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Neck Yoke Road  
US16 Corridor Study

Rapid City, SD

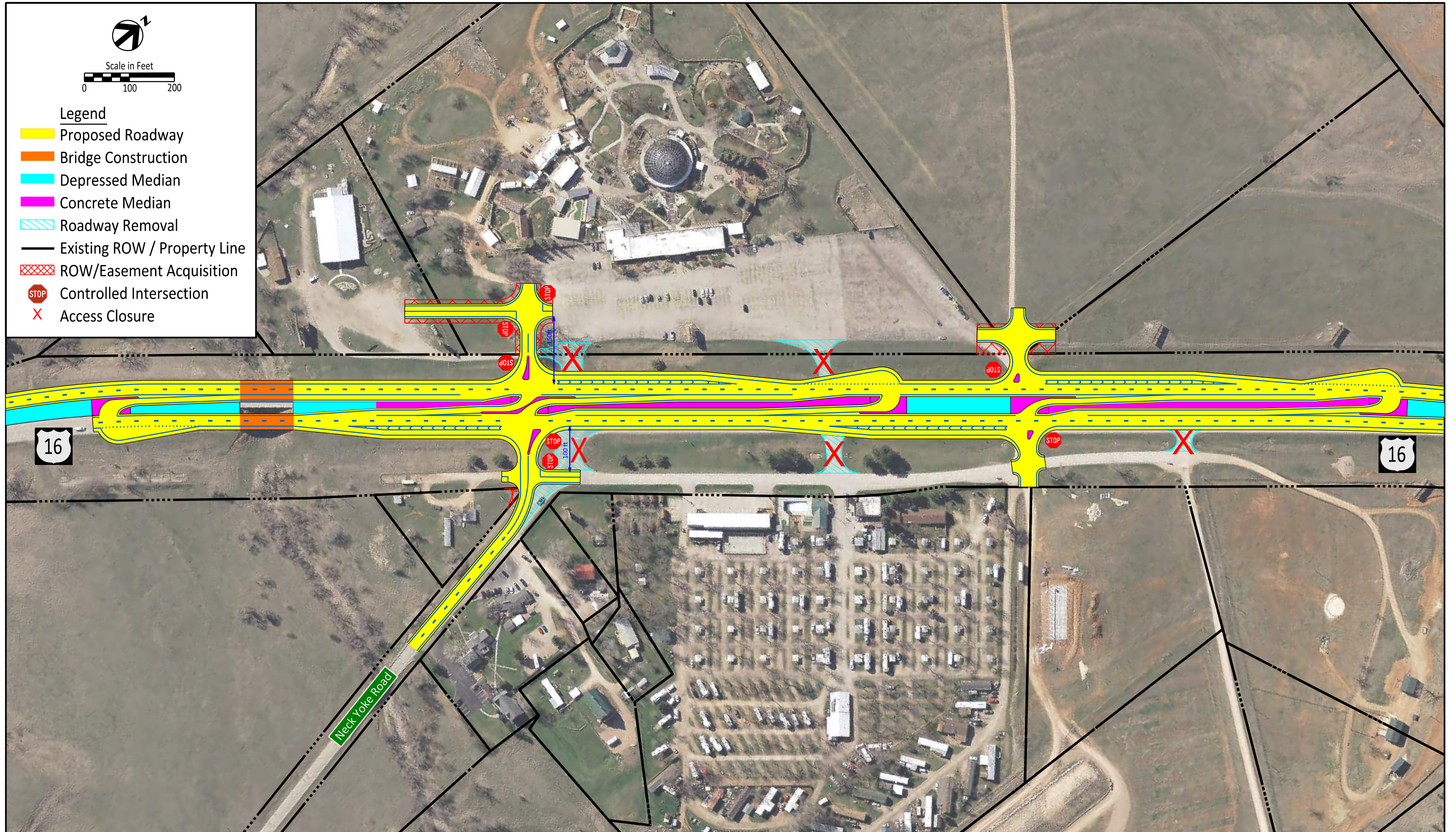
Figure  
12



Scale in Feet  
0 100 200

Legend

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Roadway Removal
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP Controlled Intersection
- X Access Closure



Build Option  
1.1b



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Neck Yoke Road  
US16 Corridor Study

Rapid City, SD

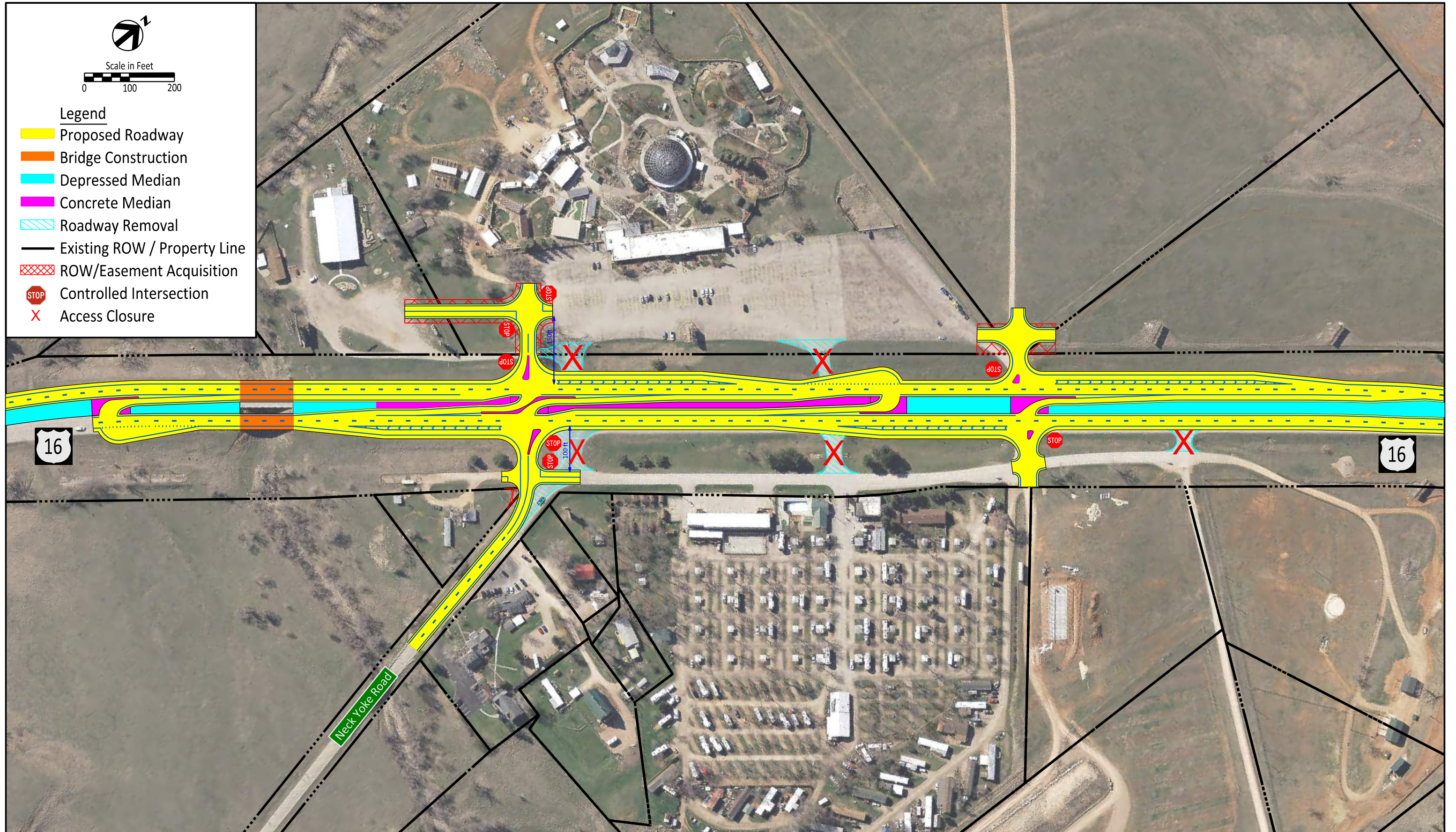
Figure  
13



Scale in Feet  
0 100 200

Legend

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Roadway Removal
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP Controlled Intersection
- X Access Closure



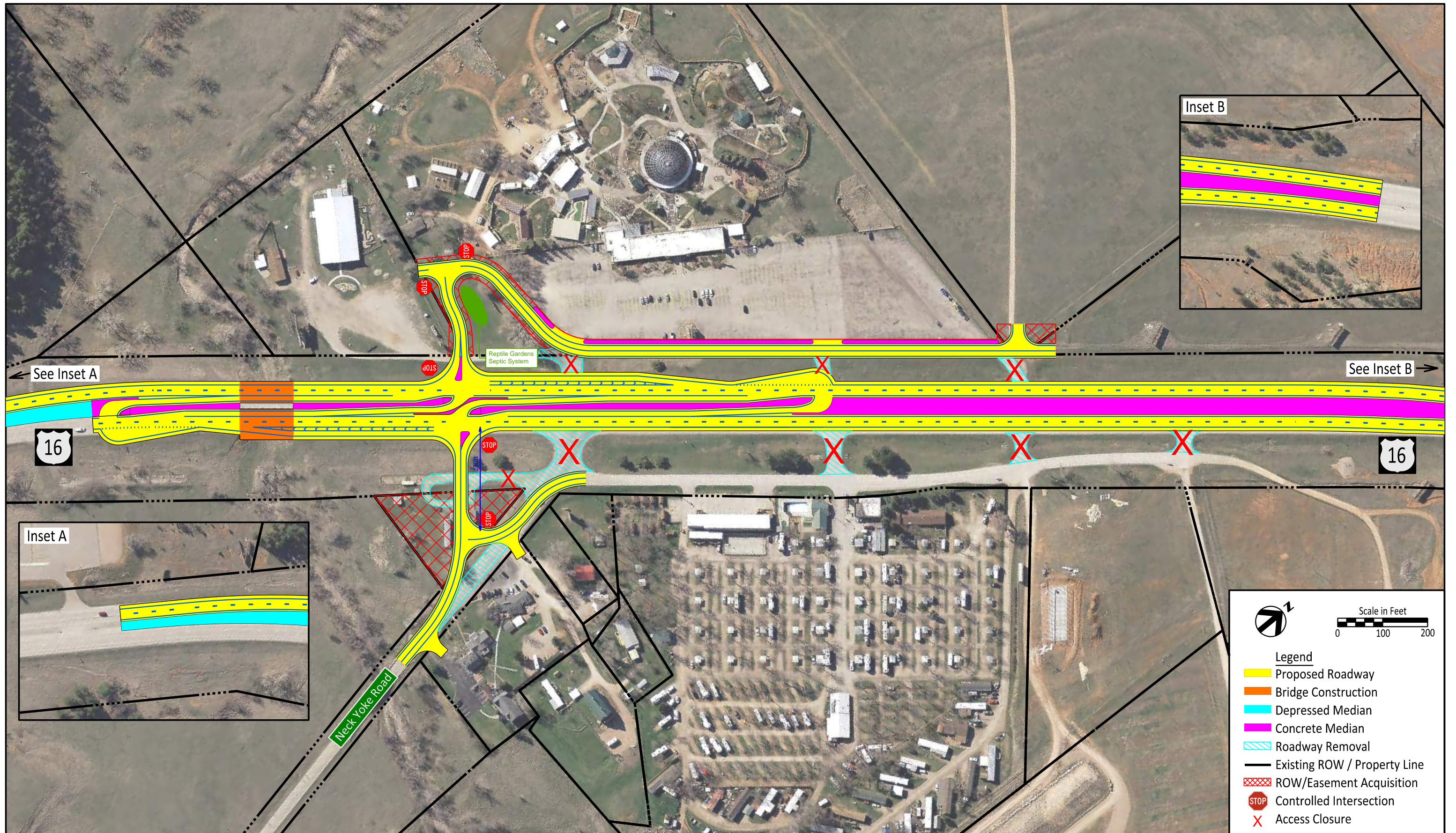
Build Option  
1.1c



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Neck Yoke Road  
US16 Corridor Study

Rapid City, SD

Figure  
14



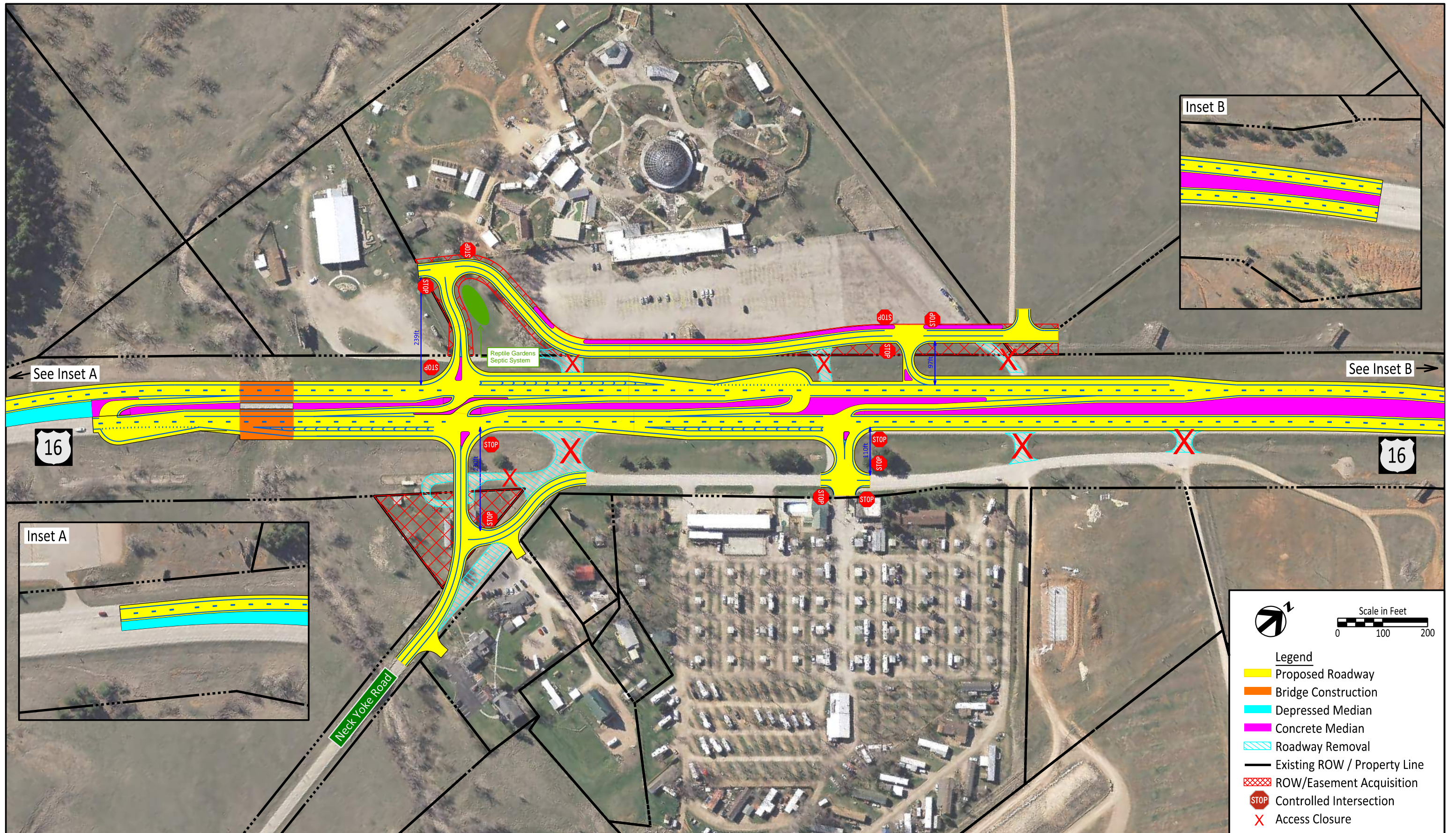
Build Option  
1.1d



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Neck Yoke Road  
US16 Corridor Study

Rapid City, SD

Figure  
15

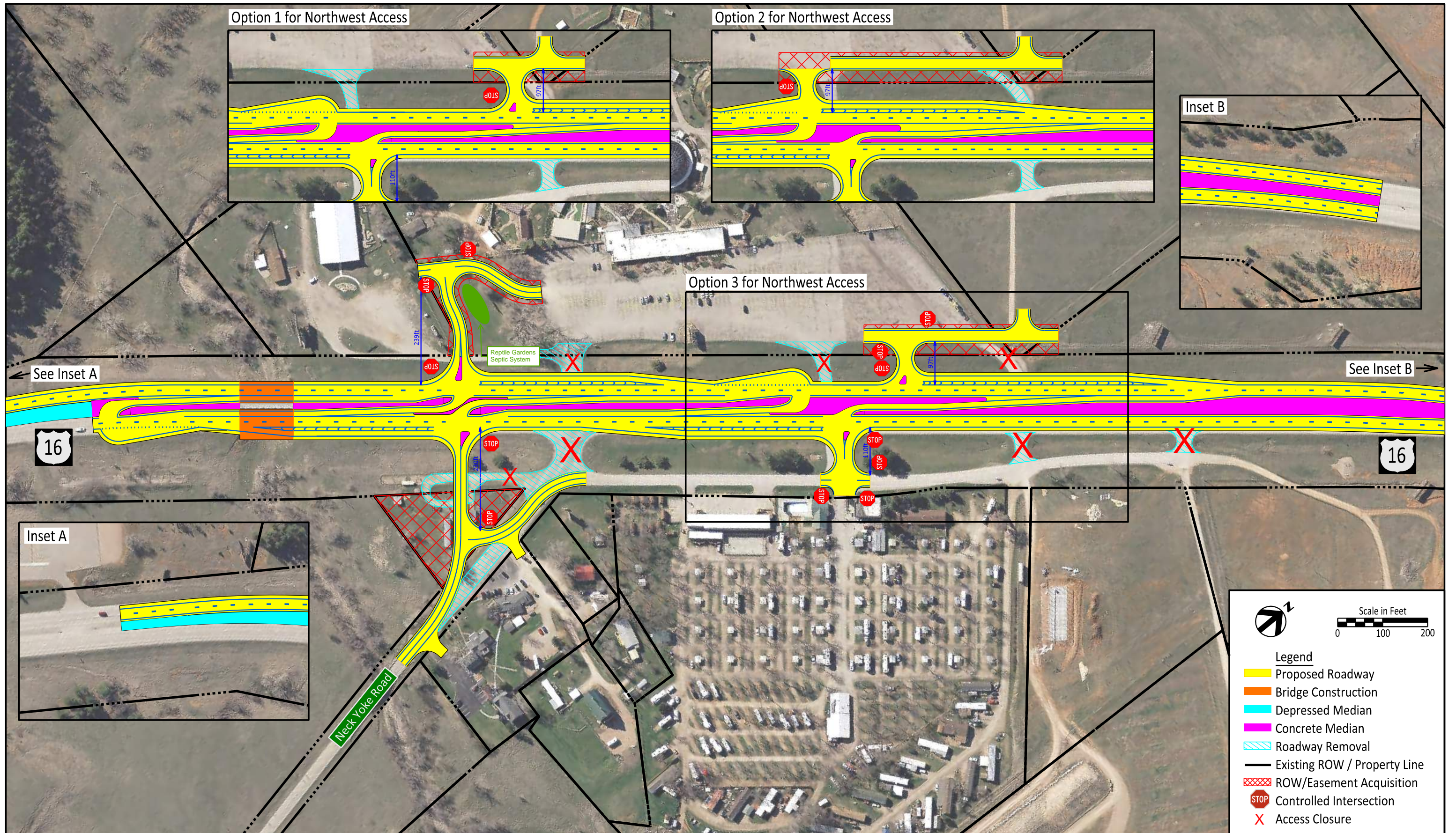


Build Option  
1.1e



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Neck Yoke Road  
US16 Corridor Study

Rapid City, SD  
Figure  
16  
Page 1 of 2



Build Option  
1.1e



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Neck Yoke Road  
US16 Corridor Study

Figure  
16  
Page 2 of 2  
Rapid City, SD





Scale in Feet  
0 100 200

**Legend**

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Roadway Removal
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP Controlled Intersection
- X Access Closure

16

16

Neck Yoke Road

Build Option  
1.2a



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Central Driveway  
US16 Corridor Study

Rapid City, SD

Figure  
17



Scale in Feet  
0 100 200

**Legend**

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Roadway Removal
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP Controlled Intersection
- X Access Closure

16

16

Neck Yoke Road

Build Option  
1.2b



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Central Driveway  
US16 Corridor Study

Rapid City, SD

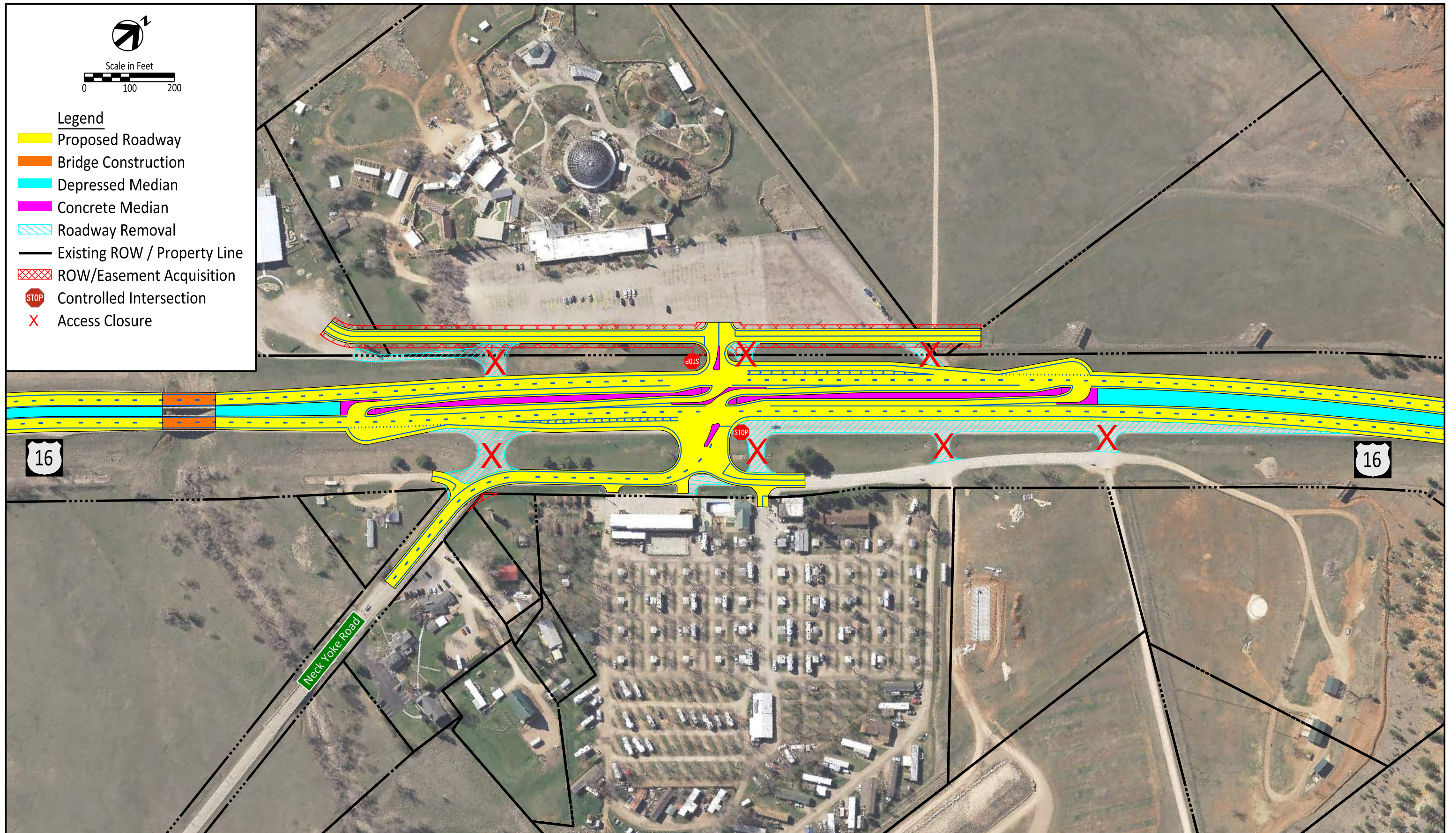
Figure  
18



Scale in Feet  
0 100 200

**Legend**

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Roadway Removal
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP Controlled Intersection
- X Access Closure



Build Option  
1.3a



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Central Driveway with US16 Realignment  
US16 Corridor Study

Rapid City, SD

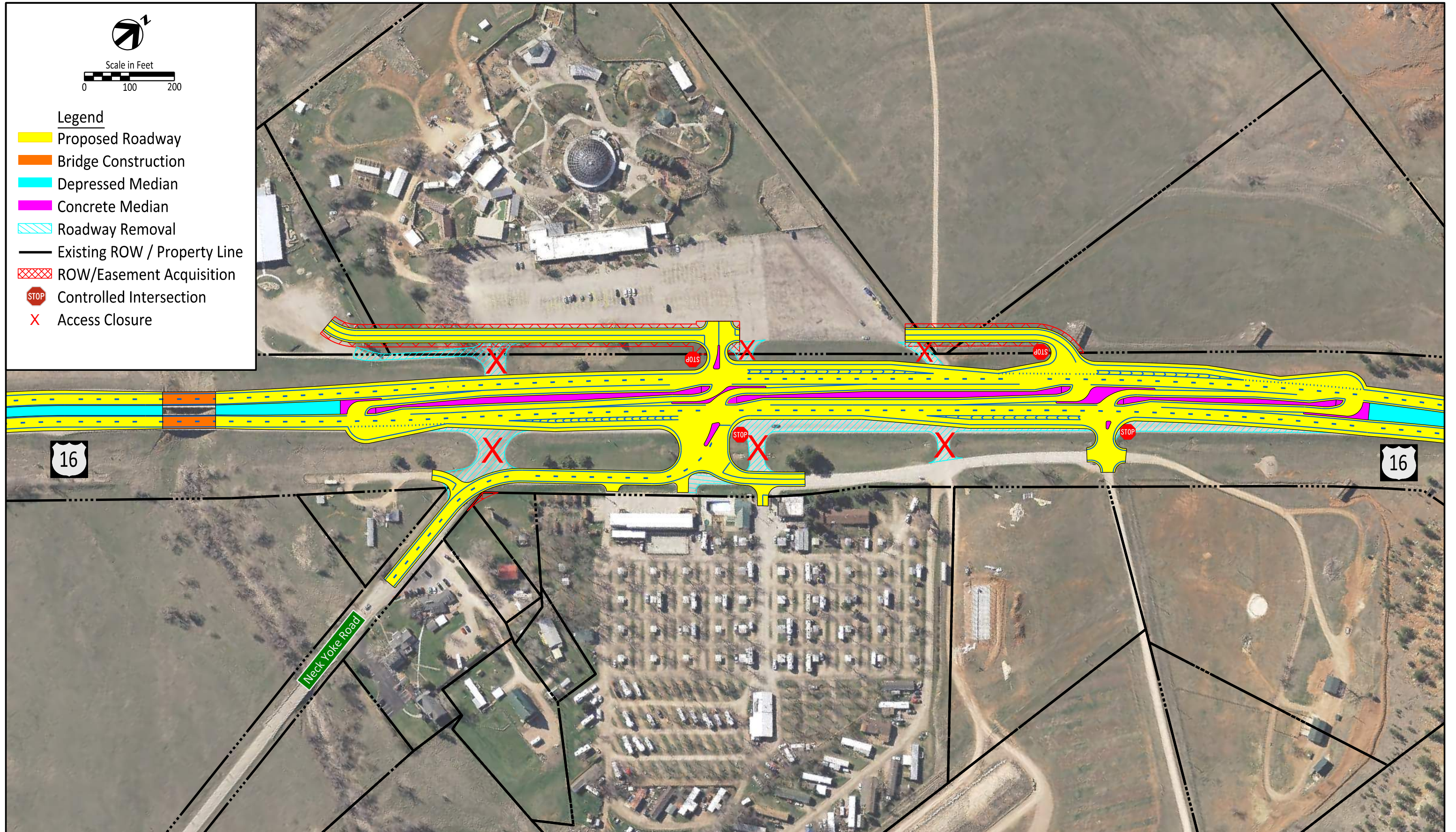
Figure  
19



Scale in Feet  
0 100 200

**Legend**

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Roadway Removal
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP Controlled Intersection
- X Access Closure



Build Option  
1.3b



Neck Yoke Road  
Reduced Conflict Intersection (RCI) - Central Driveway with US16 Realignment  
US16 Corridor Study

Rapid City, SD

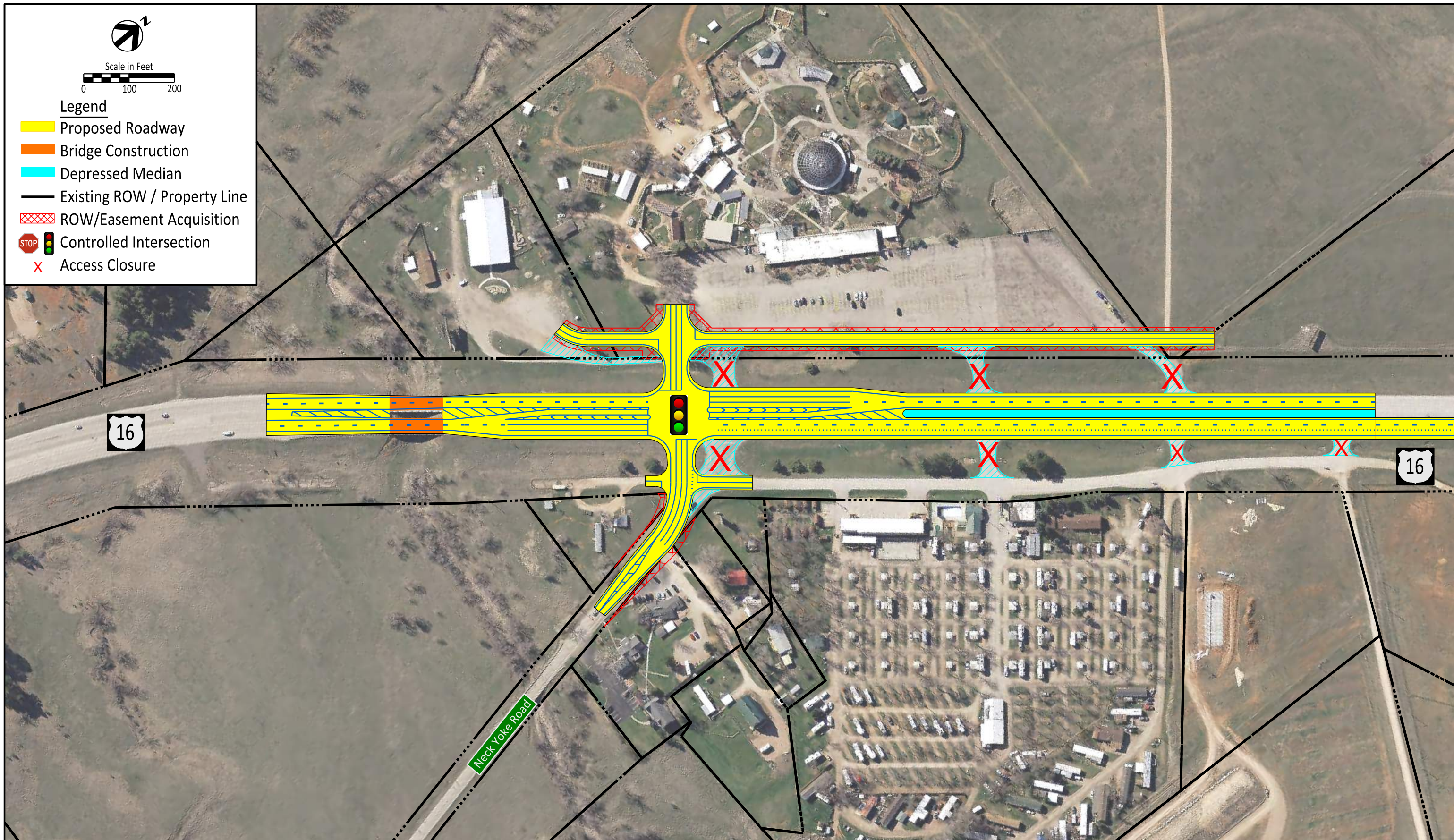
Figure  
20



Scale in Feet  
0 100 200

Legend

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP ● ● Controlled Intersection
- X Access Closure



Build Option  
2.1a



Neck Yoke Road  
Signalized Intersection - Neck Yoke Road  
US16 Corridor Study

Rapid City, SD

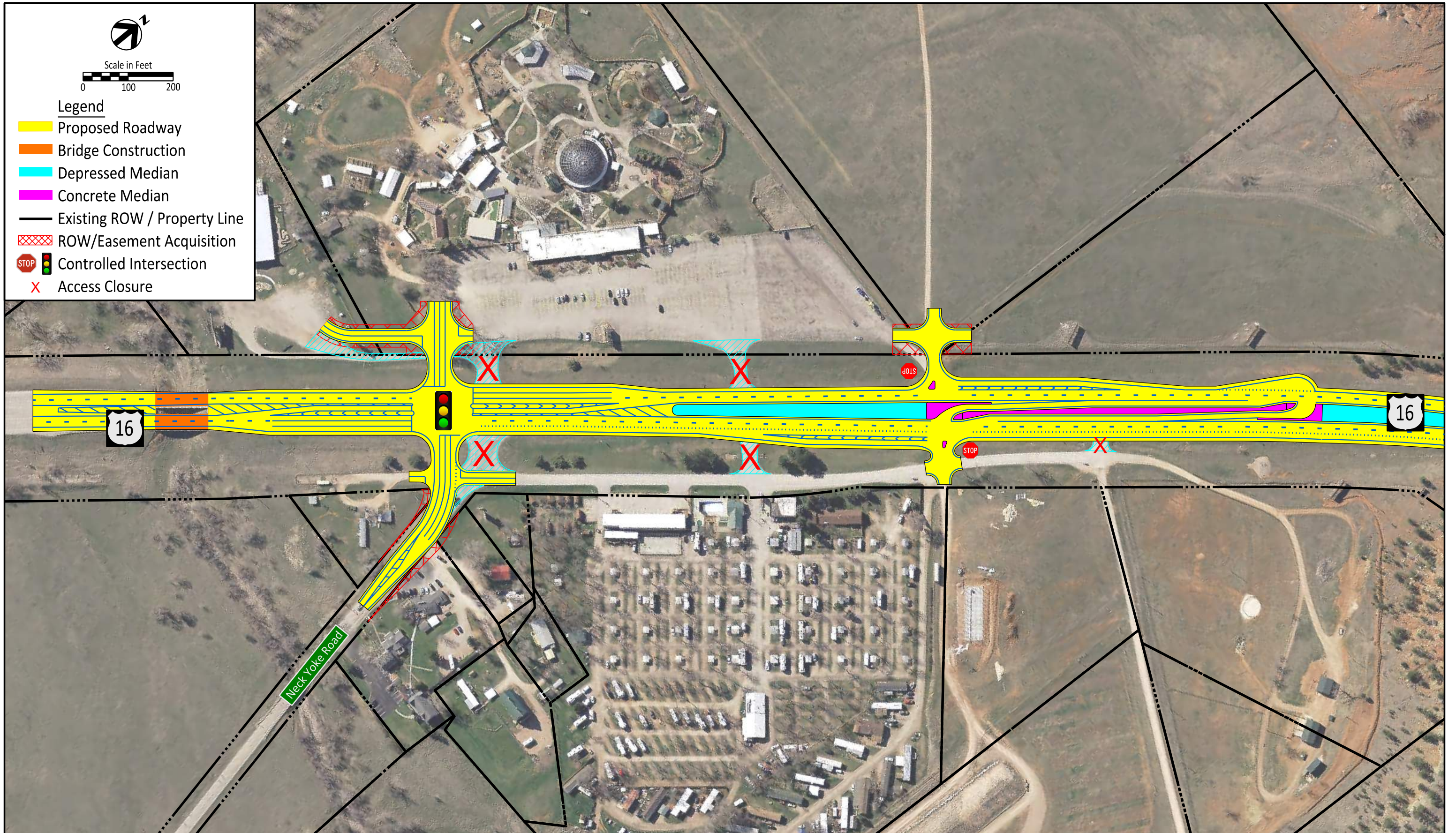
Figure  
21



Scale in Feet  
0 100 200

Legend

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Existing ROW / Property Line
- ROW/Easement Acquisition
- STOP  Controlled Intersection
- X Access Closure



Build Option  
2.1b



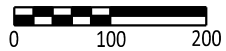
Neck Yoke Road  
Signalized Intersection - Neck Yoke Road  
US16 Corridor Study

Rapid City, SD

Figure  
22

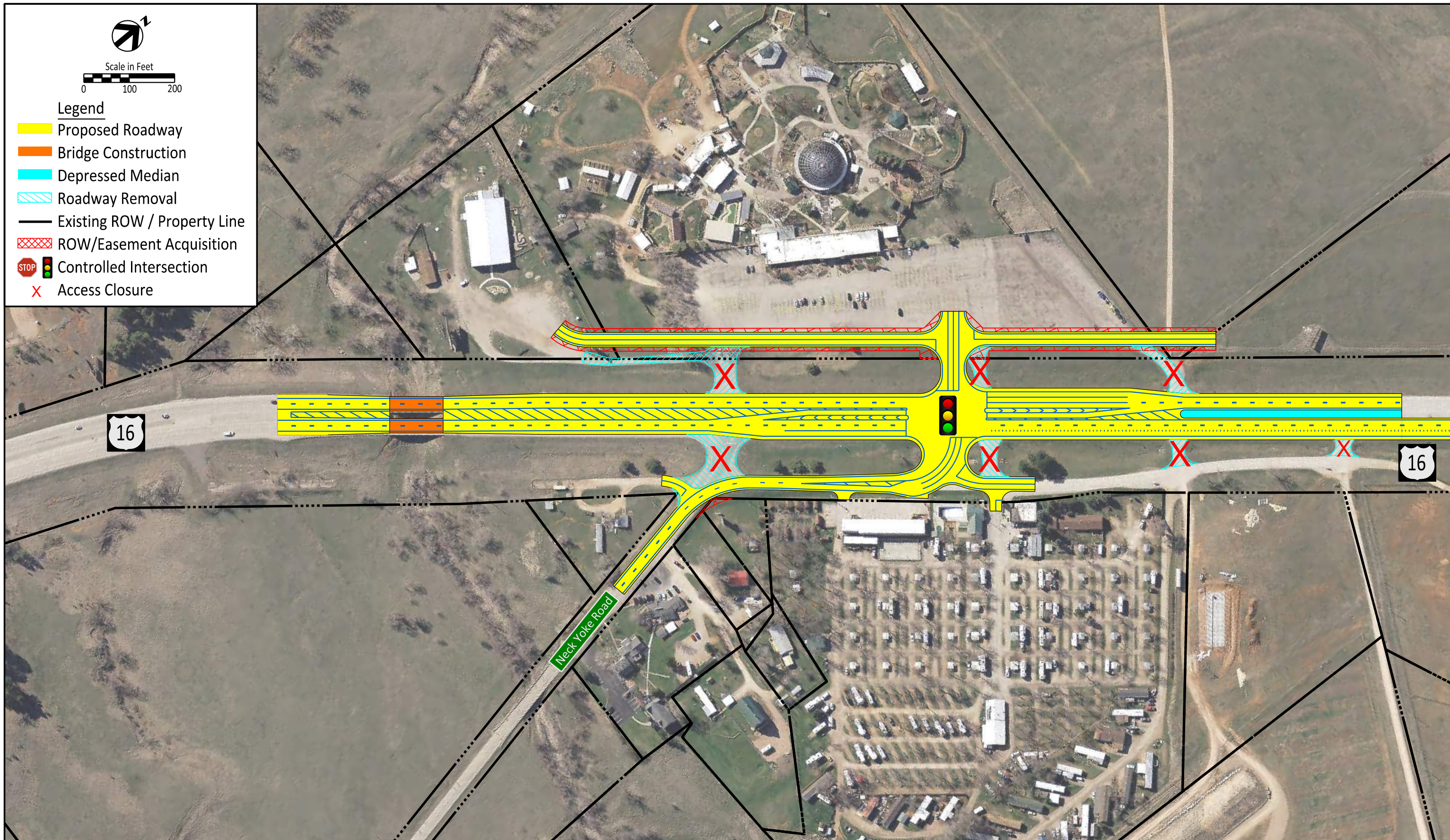


Scale in Feet



Legend

-  Proposed Roadway
-  Bridge Construction
-  Depressed Median
-  Roadway Removal
-  Existing ROW / Property Line
-  ROW/Easement Acquisition
-  Controlled Intersection
-  Access Closure



Build Option  
2.2a



Neck Yoke Road  
Signalized Intersection - Central Driveway  
US16 Corridor Study

Rapid City, SD

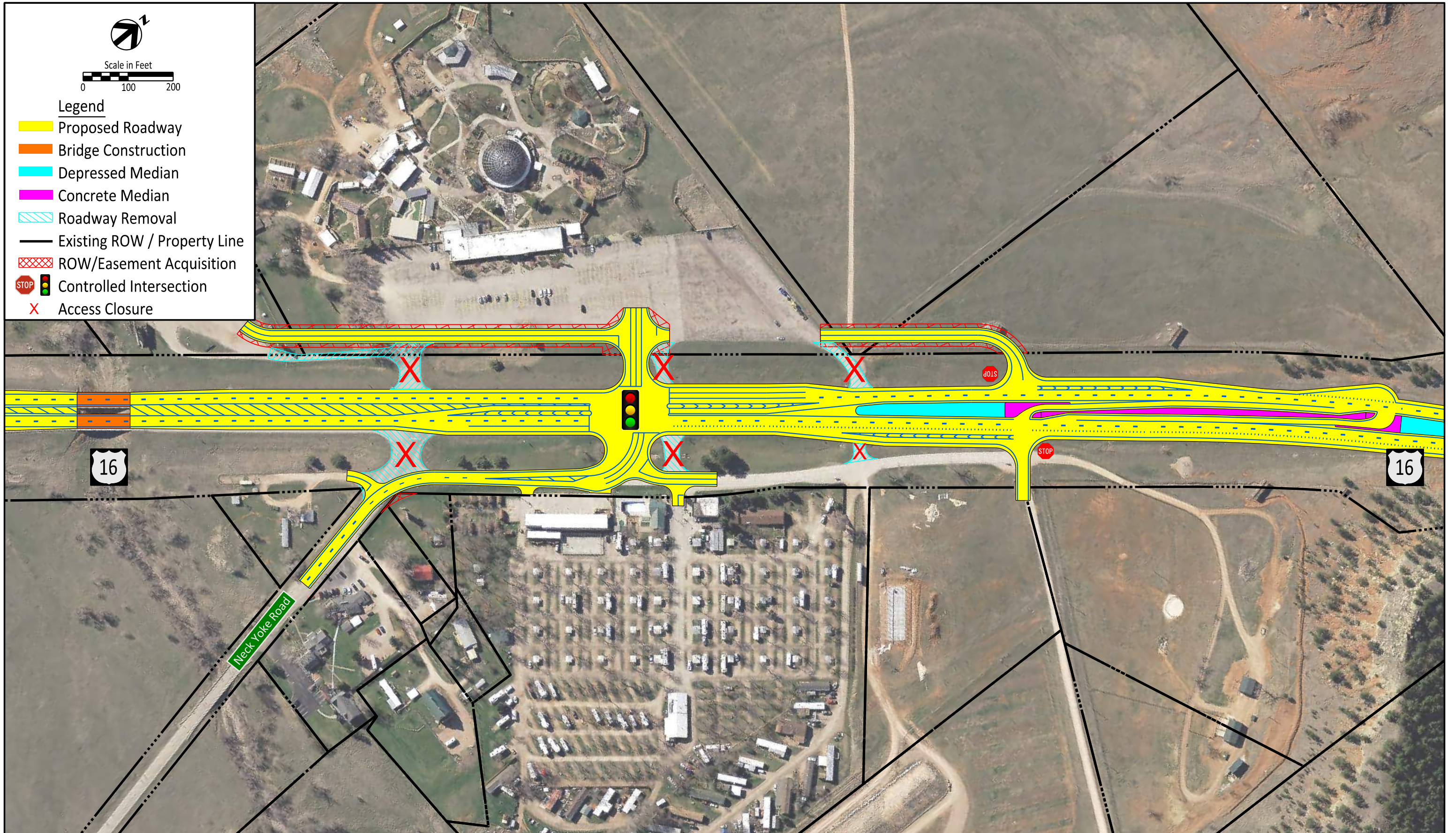
Figure  
23



Scale in Feet  
0 100 200

Legend

- Proposed Roadway
- Bridge Construction
- Depressed Median
- Concrete Median
- Roadway Removal
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Controlled Intersection
- X Access Closure



Build Option  
2.2b



Neck Yoke Road  
Signalized Intersection - Central Driveway  
US16 Corridor Study

Rapid City, SD

Figure  
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