

MEMORANDUM—

I-76 / Weld County Road 8 Interchange—Level 1 Screening Documentation

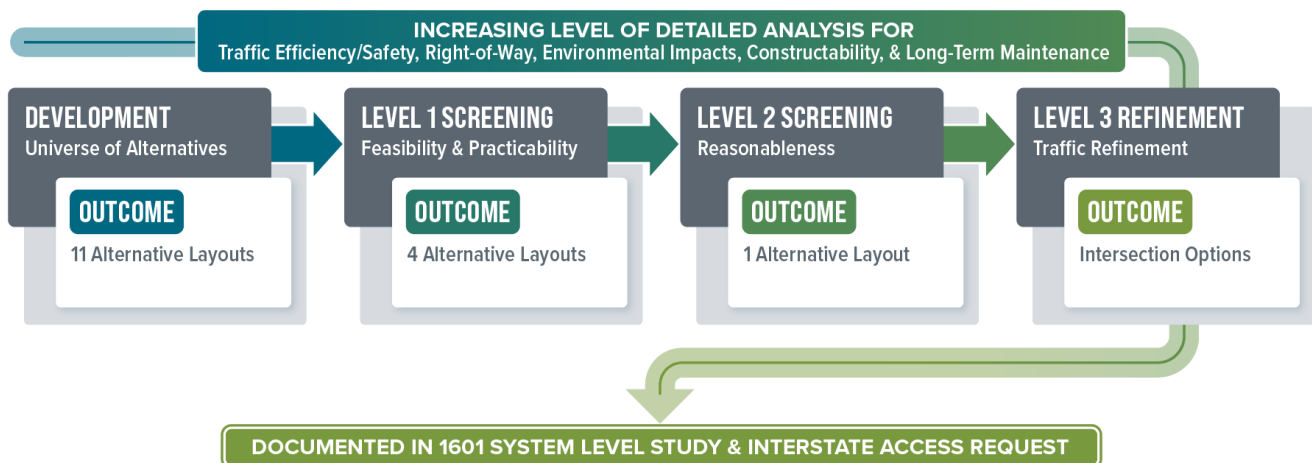
This memorandum discusses the Alternative Screening process and the results of the Level 1 Screening for the I-76 and Weld County Road 8 Interchange. This interchange is needed to adequately support a relocated BNSF Intermodal Facility (IMF) and construction of a new Logistics Park (LP) just east of I-76. This memorandum is intended to provide documentation of the overall alternative development and the result of Level 1. The subsequent phases of screening will also be documented in memoranda. These will then be consolidated into a single report which will be incorporated in the I601 System Level Study and National Environmental Policy Act (NEPA) documents.

Each level of screening is being prepared in this format to gain approval from the Colorado Department of Transportation (CDOT) and the Federal Highway Administration (FHWA) on each step along the project development path.

Alternative Development and Screening

This section describes the process that the project team is using to develop, analyze, and select an alternative and intersection configuration. **Figure 1** presents the alternative development and screening process that is being used to identify the most favorable alternative configuration for Traffic Efficiency/Safety, Right-of-Way, Environmental Impacts, Constructability, and Long-term Maintenance.

Figure 1 – Alternative Development and Screening Process



This process is intended to analyze various alternatives with an increasing level of detail. This is advantageous by efficiently applying resource efforts at the appropriate times, in other words, using the best available information at the time to inform decision-making.

Alternative Development

The initial step in the screening process is to develop the universe of alternatives that will then be carried through the various screening evaluation steps. The development focused on very high-level engineering and different interchange configurations. The goal of this step was to determine enough interchange alternatives that would be differentiated between each other using the measures of Traffic Efficiency/Safety, Right-of-Way, Environmental Impacts, Constructability, and Long-term Maintenance.

The project team conducted an alternative workshop to identify eleven (11) unique interchange alternatives. These alternatives are presented in the following figures (**Figures 2** through **12**). The figures show the alternative layouts in relation to I-76 and the BNSF Railroad. Additionally, the shading identifies the property where the IMF will be located. The approximate location of the various rail lines needed to serve the IMF are also shown in red on the figures. The approximate location and extent of bridge structures are highlighted in green.

Figure 2 – Standard Diamond Alternative

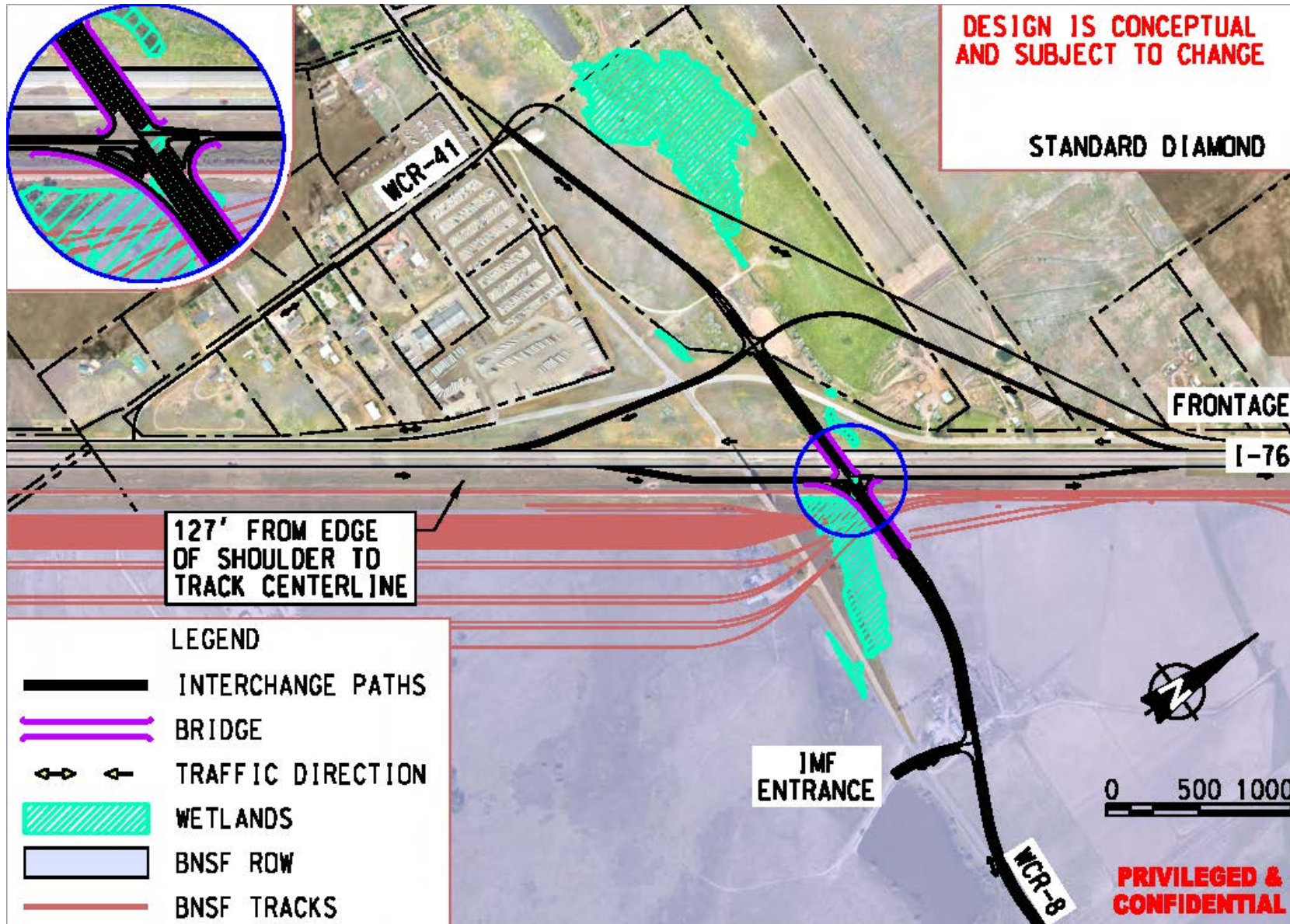


Figure 3 – Tight Diamond Alternative

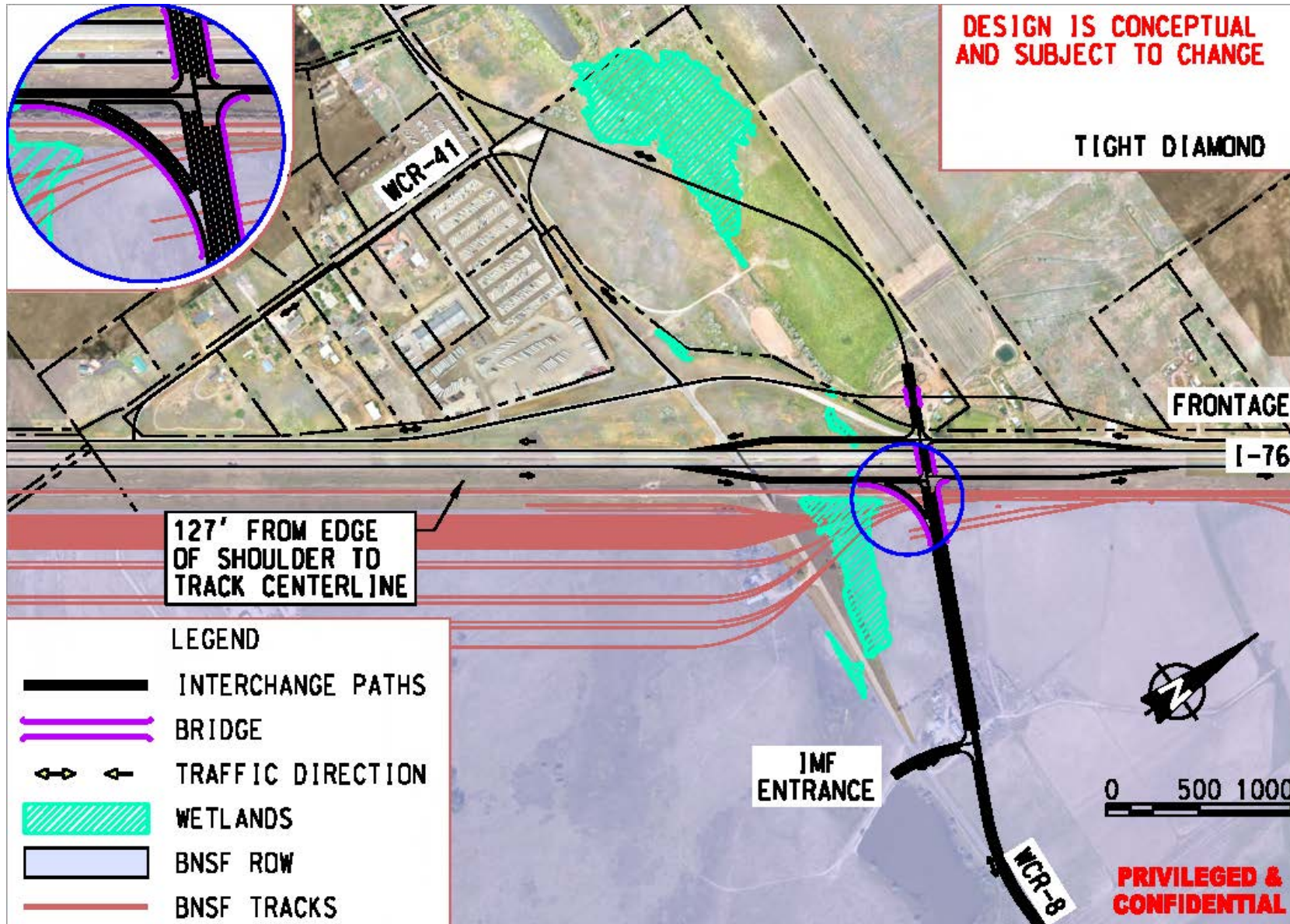


Figure 4 – Partial Cloverleaf

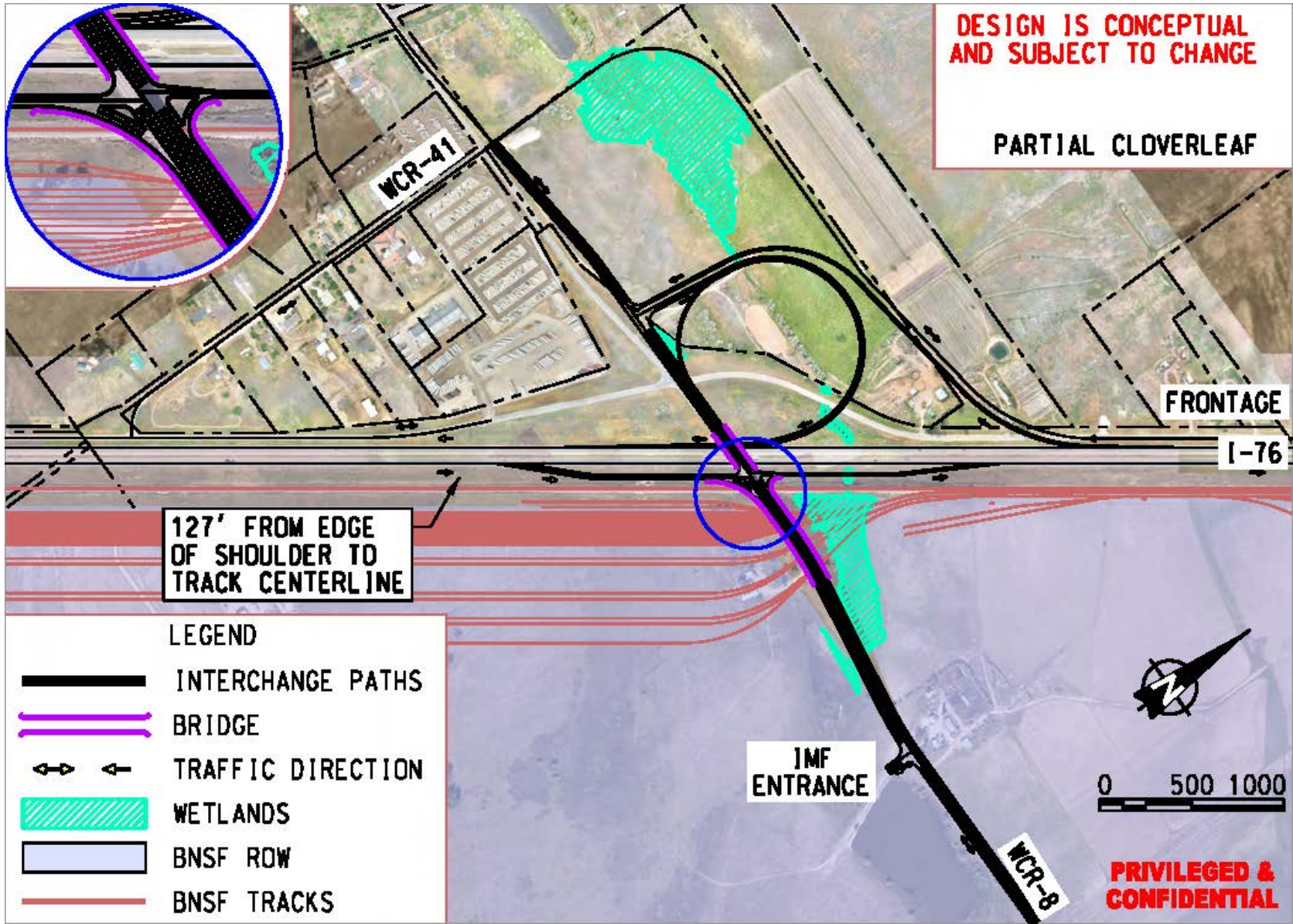


Figure 5 – Diverging Diamond Alternative

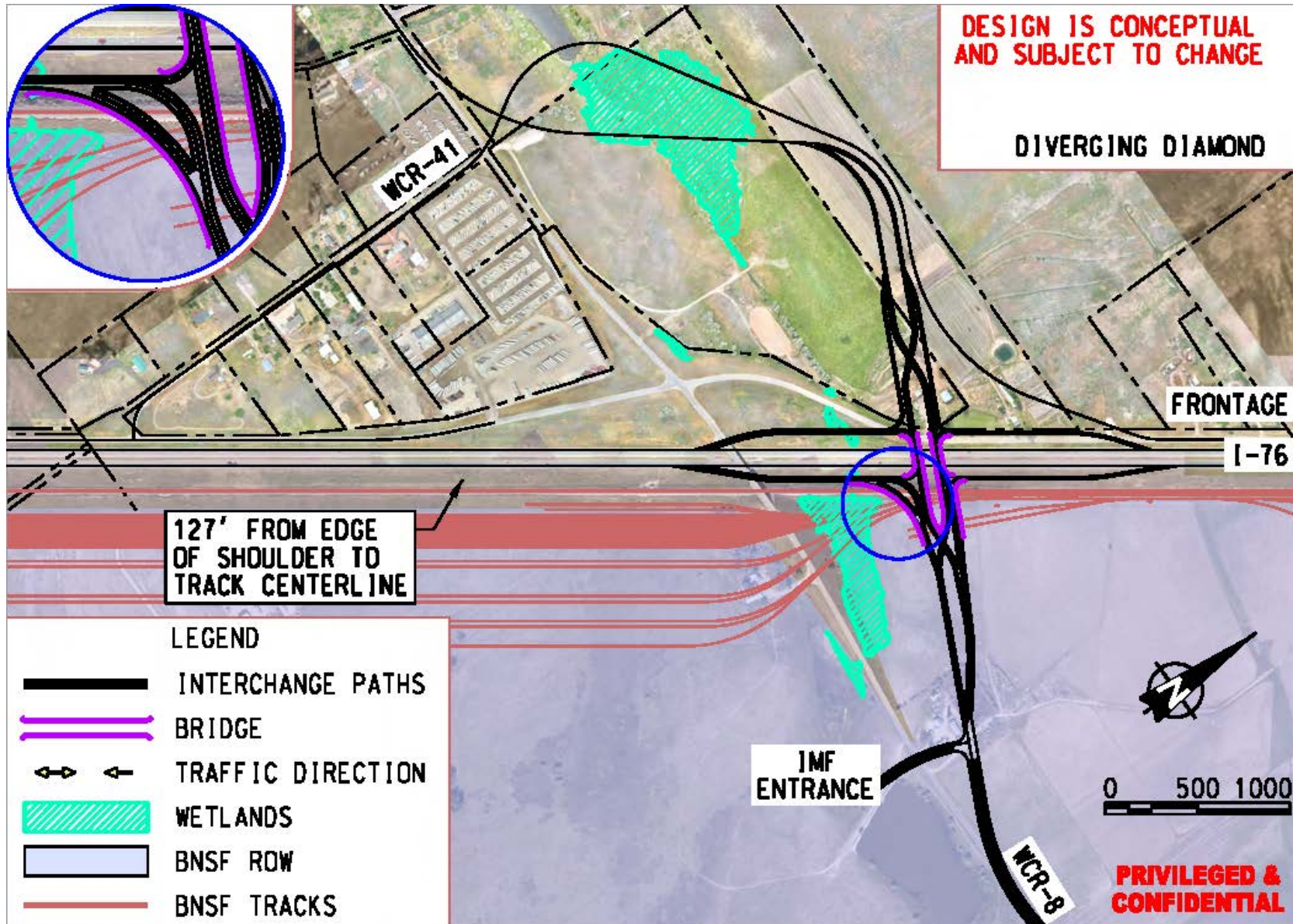


Figure 6 – Standard Diamond Option 2

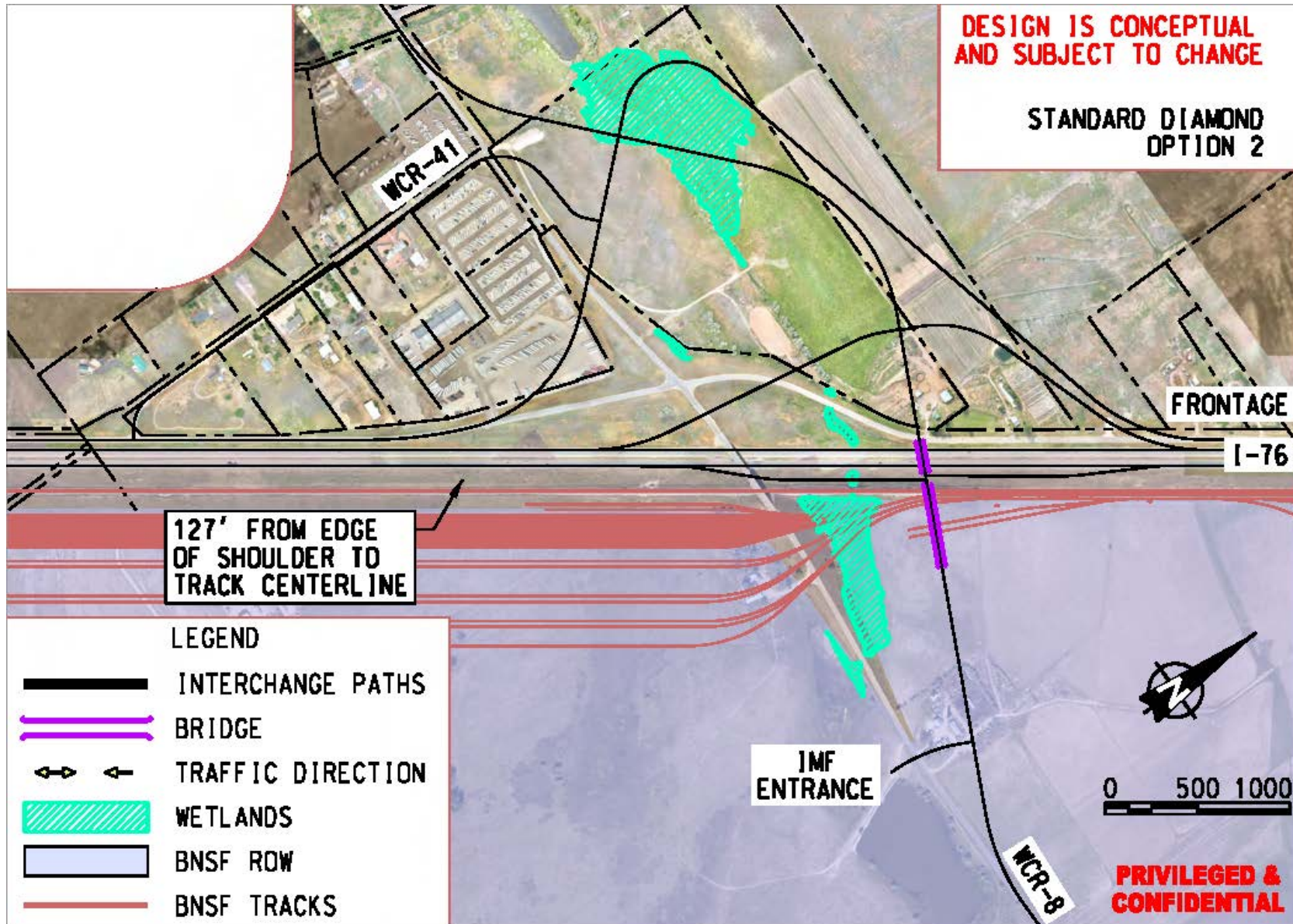


Figure 7 – Single Point Urban Interchange Alternative

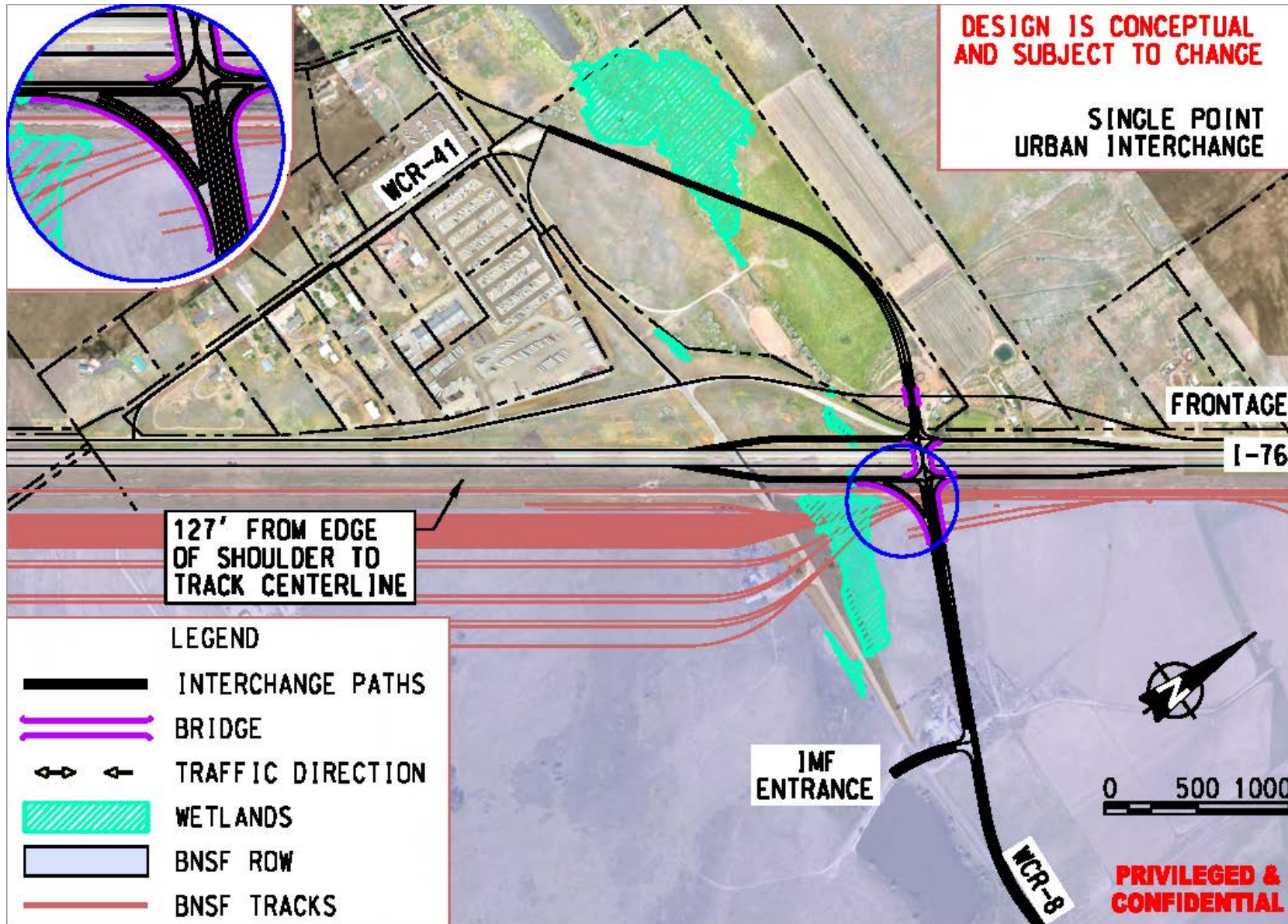


Figure 8 – Trumpet Alternative

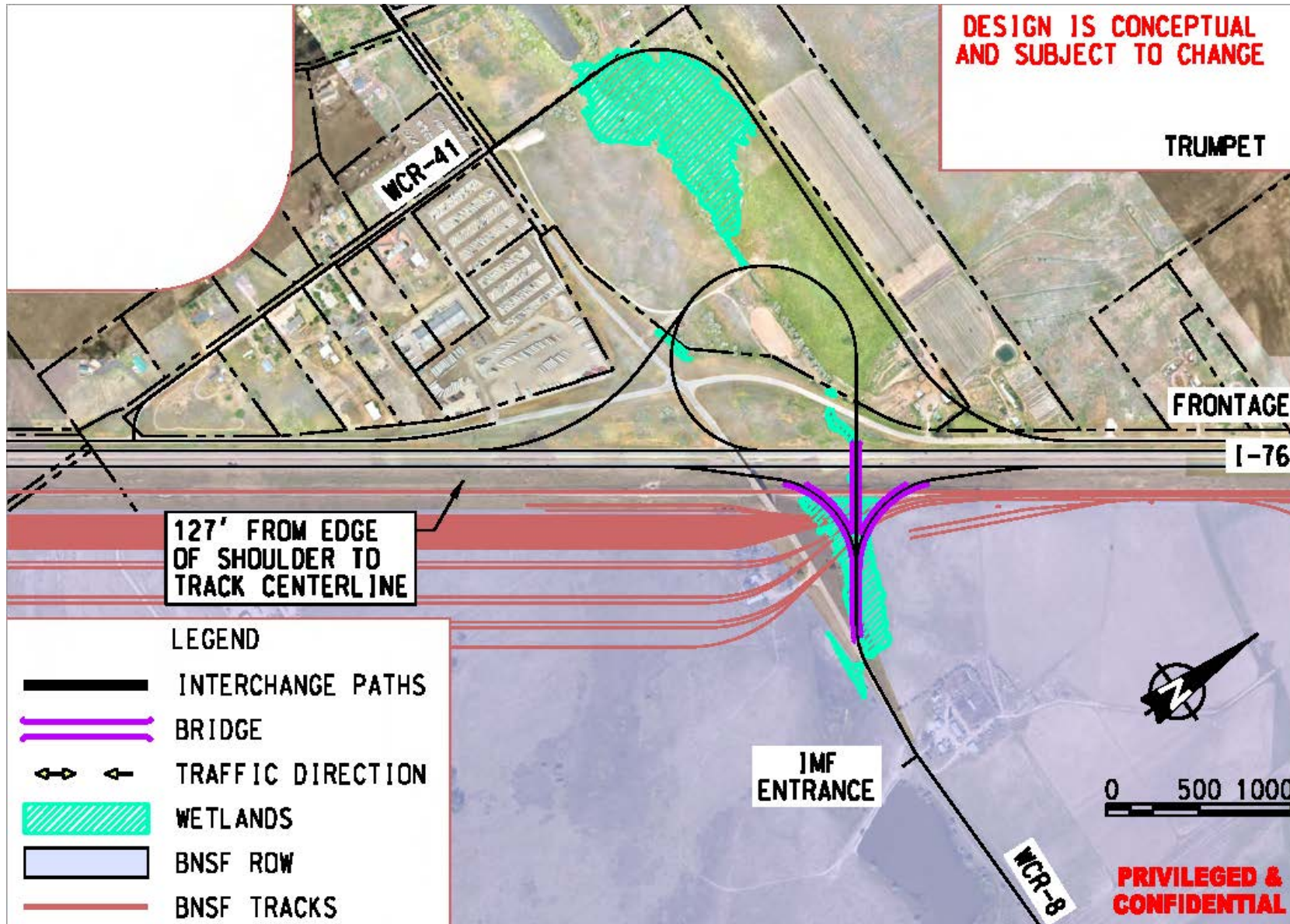


Figure 9 – Modified Trumpet Alternative

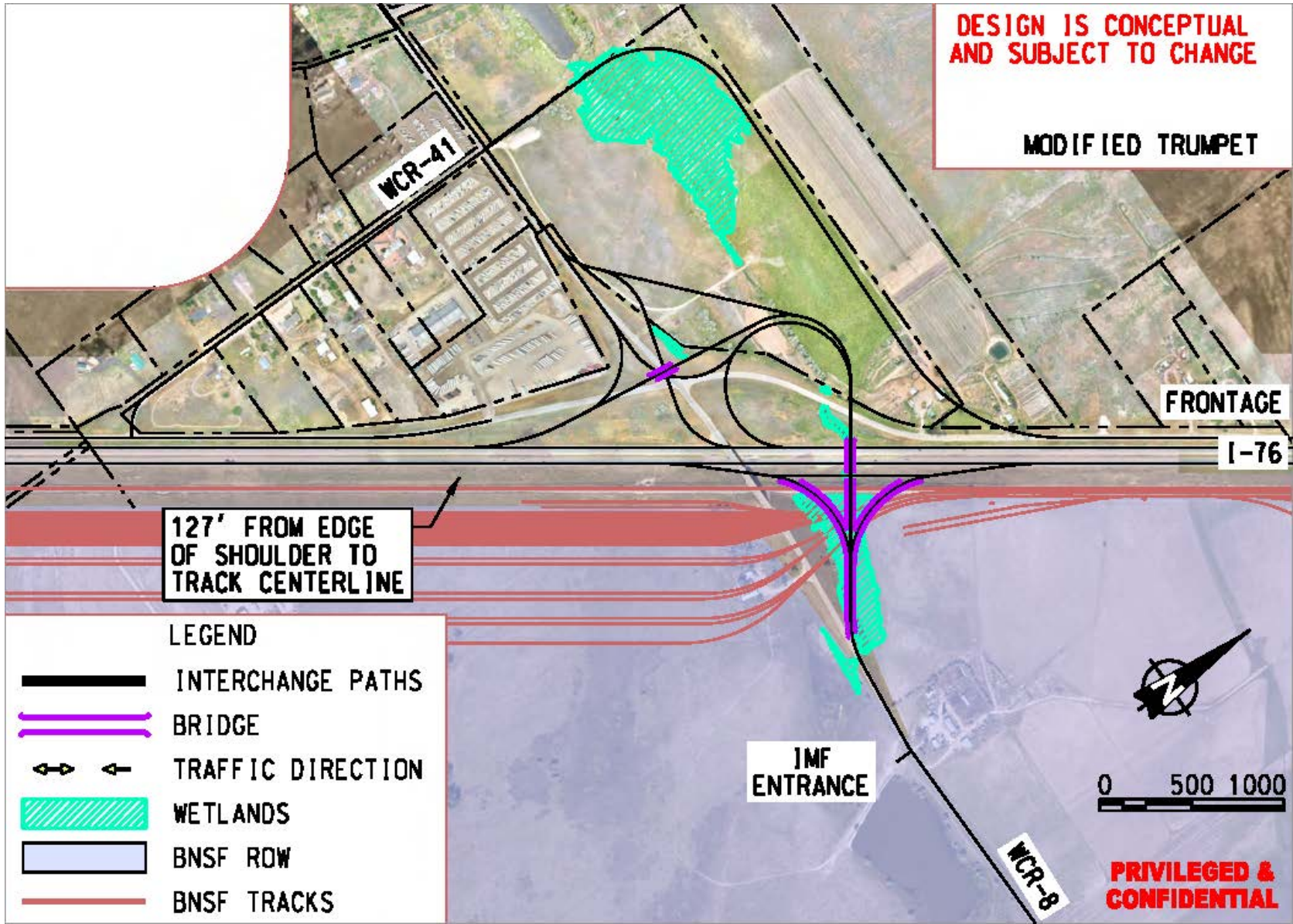


Figure 10 – Modified Partial Cloverleaf Option 1 Alternative

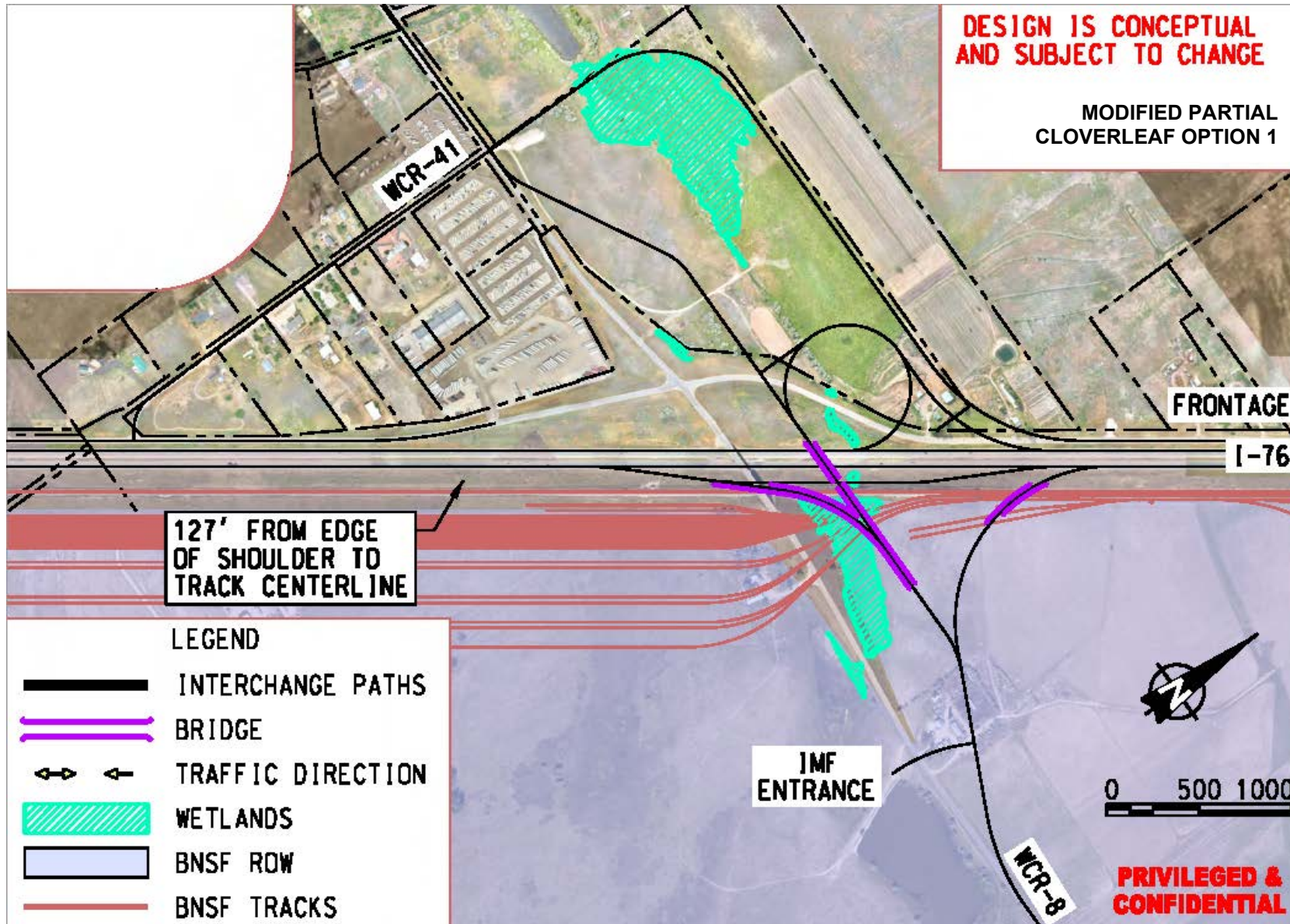


Figure 11 – Modified Diamond Option 2 Alternative

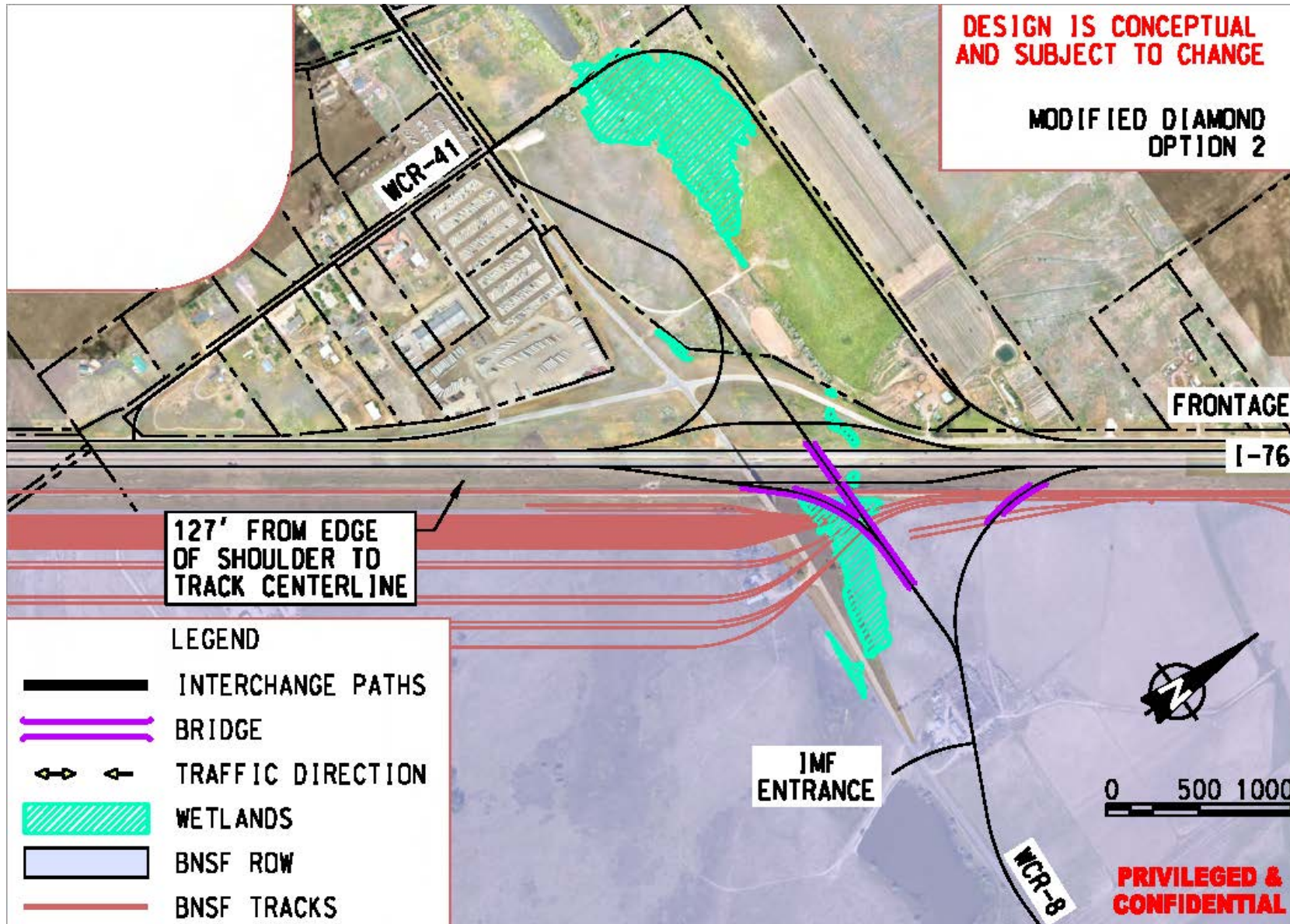
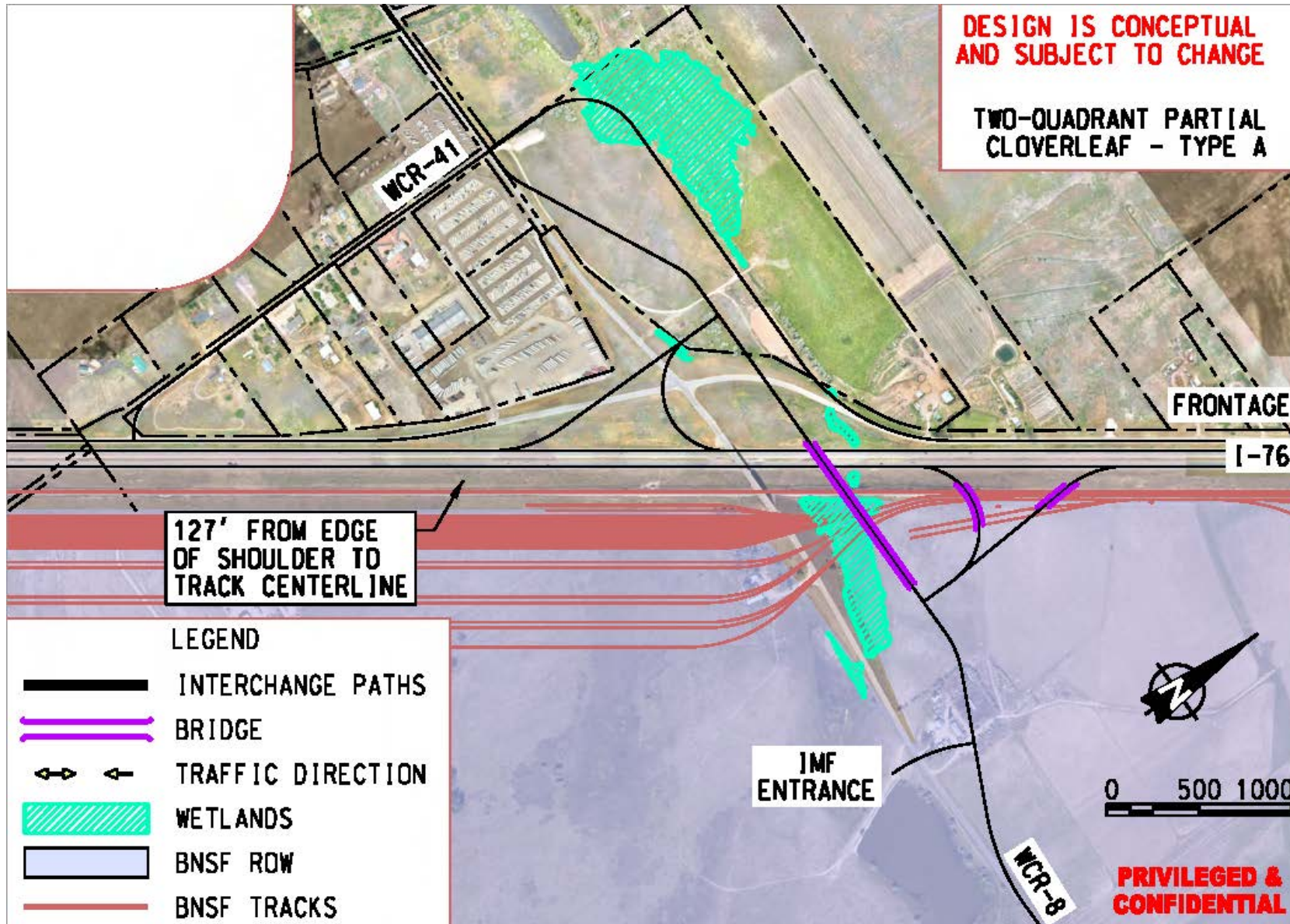


Figure 12 – Two-Quadrant Partial Cloverleaf Alternative



Level I Screening Evaluation

After the identification of the eleven (11) interchange alternatives, each alternative was evaluated in the Level I Screening. This initial level of screening was intended to identify substantial differences between the alternatives.

The following questions were used for a baseline understanding of an alternative's performance in relation to the associated topic. These questions were asked of each alternative and were used as a comparison between each alternative.

Traffic Efficiency

- *How well does the alternative perform in relation to effectively and efficiently address dominant traffic patterns from the future BNSF Facility?*

The analysis of this effort was based primarily on information developed based on the known amount of traffic generated by an IMF and LP. This data was based upon data from other IMF and LP around the nation that are owned and operated by the BNSF. Therefore, answering these questions with the lens of addressing the dominant traffic patterns was the primary focus. The other substantial consideration of the analysis is the extremely high number of large trucks (WB-67) generated by an IMF and LP (up to 85 to 90 percent of all vehicles using the road system).

The figures on the following page present the relative amount of traffic that is generated by each facility, then in relation to each other (**Figures 13 through 15**). The traffic is generally in-bound in the AM and outbound in the PM. These figures show that the LP generates approximately three times as much traffic movement as the IMF and the dominant movement is to and from the Denver Metropolitan Area.

The strong majority of traffic demand at the proposed new interchange will be related to development of the IMF and LP, and these projected traffic patterns have been used as the primary basis for Level I screening. Traffic counts were recorded at all study intersections on May 20, 2021. These traffic counts provide baseline traffic volume information for vehicle-trips at the study intersections. A portion of the recorded traffic is likely to make use of the future new interchange. The May 2021 recorded traffic levels do not indicate a significant new interchange traffic demand arising from existing traffic levels that would affect the primary interchange traffic patterns, and therefore do not indicate a need to adjust the current conclusions of Level I Screening.

Safety

- *Does the alternative demonstrate a greater potential for reduced crashes, including those involving large trucks?*

The introduction of a new I-76 interchange and associated at-grade intersections would, by definition, introduce vehicular conflict and traffic safety concerns not currently experienced. The intent of asking this question was to rate, at a high-level, the traffic safety concerns associated with each interchange alternative relative to the others. Traffic safety elements considered at this initial level to rate the alternatives include:

1. The approximate quantity of at-grade intersection conflict points provided with each alternative
2. The relative ease of movement through the interchange for large (WB-67) trucks, which would comprise a significant portion (up to 85-90 percent of traffic during peak times) of interchange traffic. Truck safety (and the safety of mixed traffic) would be enhanced by longer turning radii, lengthy sight lines and sufficient acceleration and deceleration distances.
3. The level of consistency of each alternative with typical driver expectancy, including the ability to enter the interstate in a manner consistent with departure and the predictability of traffic movements in light of typical experience.

In more advanced levels of screening, traffic safety will remain a screening criterion and will be evaluated in more detail as design and traffic operations details emerge.

Figure 13 – Daily Traffic Movements to IMF and LP

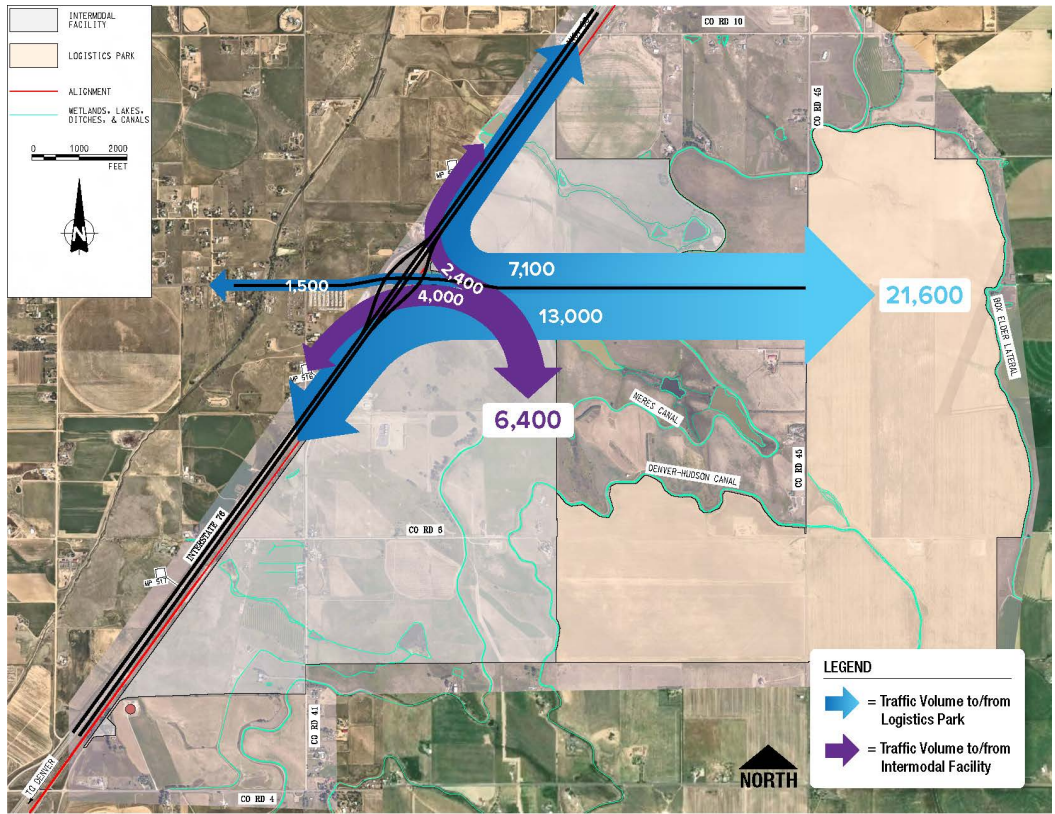


Figure 14 – Inbound AM Peak Hour Traffic Thru Interchange

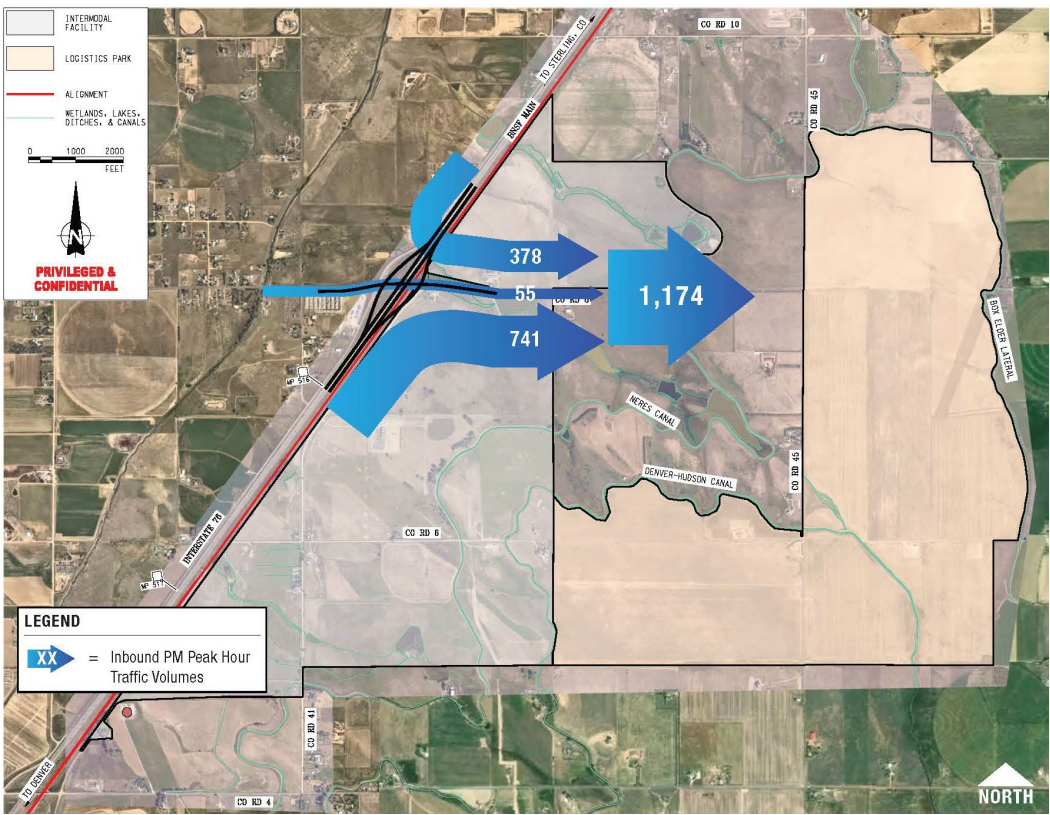
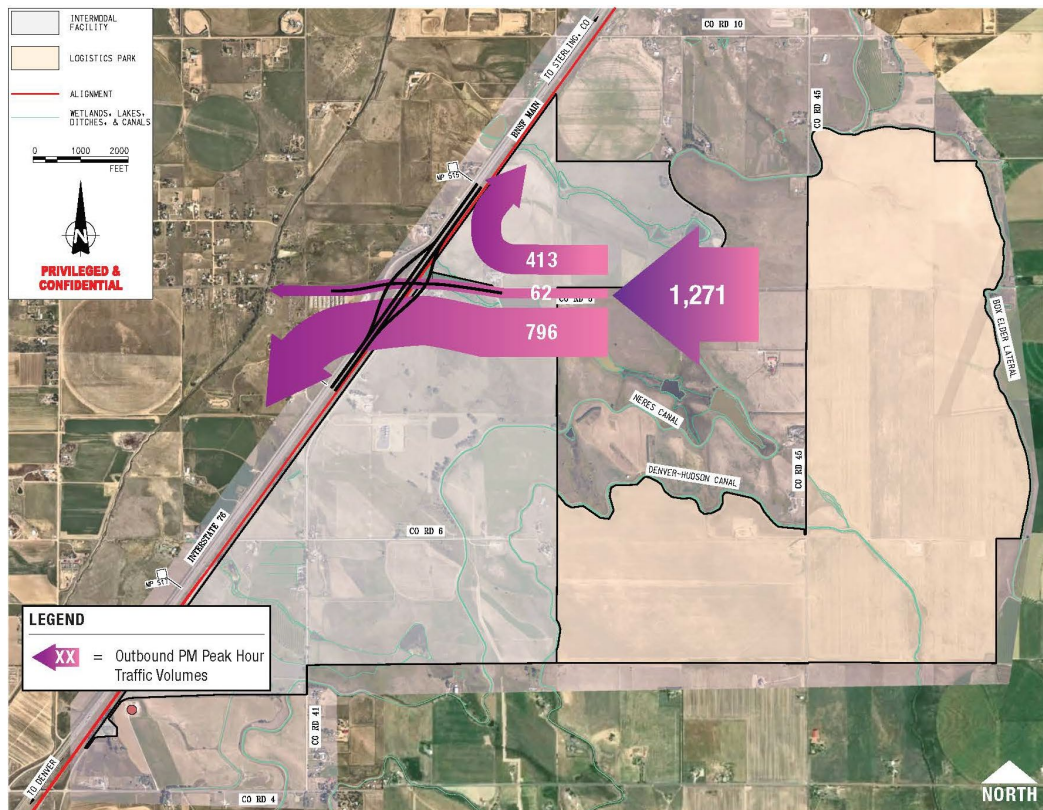


Figure 15 – Outbound PM Peak Hour Traffic Thru Interchange



Right-Of-Way

The intent of this question is to determine the amount of effect a new interchange may have on nearby residents. The BNSF understands that substantial development like an IMF and LP can have a large effect on nearby residents. The inherent effect of an IMF and LP is greater than an interchange, simply because of the necessary size of the facility. Therefore, consideration of limiting effects of an interchange to nearby residents (especially on the west—or non-IMF/LP side—of I-76) is of importance to BNSF, who strives to be long-term member of the surrounding community.

Permitting

- *Does the alternative exhibit a permissible project, in comparison to other alternatives?*

This measure is intended to capture the potential environmental effects of a various interchange type. Consideration of specific environmental permits/clearances that have regulatory 'avoidance and minimization' analysis were considered. This includes impacts to wetland resources and Section 4(f) (historic or recreational resources). While field work was completed for this screening, the professional judgement of environmental scientists used information from aerial photography to determine likely wetland areas and Weld County Assessor's Office and the State of Colorado COMPASS Database to identify potential historic resources.

Constructability

- *Does the alternative result in an unreasonably complicated construction?*

This measure attempts to compare the various interchange alternatives on the complication of construction. Because of the need to grade-separate existing/static elements (I-76, the BNSF Mainline, and a large number of tracks associated with the IMF) this can introduce unnecessarily complicated structures that may not be necessary to address traffic requirements. The goal of this measure is to identify structural

elements that do not require specialized construction experience or methods. The construction of new structures over an interstate and heavily used rail lines is inherently challenging and limiting unnecessary challenges is reasonable.

Long-Term Maintenance

- *Does the alternative lower the long-term maintenance costs, associated with complicated structural elements?*

Consideration of long-term maintenance is of importance to the stakeholders who will be required to inspect and maintain the interchange, especially structural elements. Large structures require special consideration and evaluation to ensure the safety of the traveling public for the life of the structure. Introducing elements that would greatly increase the limited resources (time and funding) of Highway Maintenance Crews is to be avoided, if possible. The location of the interchange will require substantial retaining walls to avoid impacts to I-76 and the BNSF mainline from every alternative, thus limiting additional extensive maintenance requirements is advantageous. Data to analyze detailed maintenance costs specific to the interchanges described here, such as daily and short-term maintenance requirements, as well as benefit/cost analysis over 50 years is not available at this time and may be more appropriate at later stages in project development.

Level I Screening Results

The following table presents the results of the Level I Screening based upon the evaluation previously described (**Table I**). The alternatives were color-coded based upon their resultant evaluation (favorable was highlighted green, a moderate was yellow, and negative was red). In most cases, if an alternative had a red color coding, it was eliminated from further consideration. This resulted in three alternatives that did not have any red coding—Standard Diamond and Partial Cloverleaf. These have been selected to advance to the Level 2 Evaluation and Screening. After meeting with stakeholders, it was determined that the Diverging Diamond Interchange (DDI) and Single Point Urban Interchange (SPUI) should also be evaluated further due to the ability of the DDI to handle large number of left turns and the SPUI being effective when right-of-way is limited. The Level 2 evaluation will determine if the DDI and SPUI significantly outperforms the other alternatives from a traffic/safety standpoint to outweigh its negative aspects.

Table 1—Level 1 Screening Table

Alternative	Screening Criteria							Results
	Traffic Efficiency	Safety	Right-Of-Way	Permitting	Constructability	Long-Term Maintenance	Relative Estimated Capital Cost	
Standard Diamond Option 1	- I-76 Frontage Road must utilize WCR 41 to maintain connectivity - At-grade signalized left turns introduce vehicular delay - Longer spacing between ramp termini accommodates signal phasing flexibility and queue storage	- Predictable layout for users (positive) - Introduces two at-grade intersections and associated conflict points (negative) Tighter turning radii for movements to/from WCR 8 east and I-76 north	Moderate to high amount of ROW needed.	- Relatively large amount of wetland impacts (2.1 acres) - Unlikely to be permitted compared to fewer impacts.	Moderate level of construction complexity.	- Moderate long-term maintenance costs associated with ~870 feet of bridge structure. - All alternatives have substantial wall structures.	\$	Passed—Standard layout is understood by drivers but does have tight turning radii for large trucks.
Partial Cloverleaf	Eliminates heavy at-grade lefts for WB WCR 8 onto WB I-76, thereby reducing delay	- Fewer conflict points by replacing at-grade left with loop west of I-76. - Potential concern with large trucks navigating loop ramp.	Moderate amount of ROW needed.	- Least amount of wetland impacts (0.3 acres). - Most feasible to be permitted.	Moderate level of construction complexity	- Moderate long-term maintenance costs associated with ~1,280 feet of bridge structure. - All alternatives have substantial wall structures.	\$\$	Passed—Highest functional benefit by eliminating WB I-76 left turns from WCR 8. Has the least wetland impacts, thus is the most permissible alternative.
Single Point Urban Interchange (SPUI)	- Signal would be operationally inefficient due to unbalanced paired movements NB and SB left turn movements - Maintains I-76 Frontage Road largely along existing alignment	- Sweeping turning radii at interchange are helpful for heavy truck volume - Fewer conflict points associated with single point intersection	Moderate amount of ROW needed.	- Relatively large amount of wetland impacts (1.9 acres) - Unlikely to be permitted compared to fewer impacts.	High level of construction complexity	- Moderate long-term maintenance costs associated with sizable bridge structure (~1,420 feet of structure) to accommodate single intersection over the interstate with adequate truck storage. - All alternatives have substantial wall structures.	\$\$\$	Advanced—Despite having challenges such as not functioning well with heavy directional traffic flow and high level of construction complexity, this alternative is being carried through to Level 2 to determine if these challenges may be offset. SPUIs are effective when all movements are relatively balanced. The high AM northbound and PM southbound movements results in excessively long green signal time for minor movements. The increased complexity and maintenance of the structure (wide and curved) is unnecessary when other, less complicated structures are available.
Diverging Diamond Interchange (DDI)	Provides direct movements for heavy volumes at ramp terminals	Reduces conflict points vs. traditional diamond	- Significant amount of ROW needed - Includes additional property avoided by other alternatives	- Relatively large amount of wetland impacts (1.9 acres) - Unlikely to be permitted compared to fewer impacts.	High level of construction complexity	- Significant long-term maintenance costs associated with massive bridge structure to accommodate lane spacing and truck storage. - All alternatives have substantial wall structures.	\$\$	Advanced—Despite having numerous avoidable challenges (ROW, Constructability, and Maintenance), the DDI's ability to accommodate heavy left turns will be evaluated in Level 2 to determine if this benefit can outweigh the challenges.
Tight Diamond	- Improves turning radii for ramp movements - Maintains I-76 Frontage Road largely along existing alignment - Limited storage distance between ramp terminals for large trucks. Signal coordination between closely spaced signals is difficult.	- Predictable layout for users - Closer signal spacing places could limit signal visibility	Moderate amount of ROW needed.	- Relatively large amount of wetland impacts (1.9 acres) - Unlikely to be permitted compared to fewer impacts.	Moderate level of construction complexity	- Moderate long-term maintenance costs associated with ~670 feet of bridge structure. - All alternatives have substantial wall structures.	\$\$\$	Eliminated—Limited storage distance between intersections is insufficient to accommodate the large amount of trucks. Standard layout is understood by drivers but does have tight turning radii for large trucks. Impacts less ROW and slightly shorter bridge structures.
Standard Diamond Option 2	At-grade signalized left turns introduce vehicular delay	- Predictable layout for users - Improves turning radii	- Significant amount of ROW needed - Includes additional property avoided by other alternatives	- Large amounts of wetland impacts (3.6 acres). - Not permissible when compared to other alternatives	Moderate level of construction complexity	- Lesser long-term maintenance costs associated with ~600 feet of bridge structure. - All alternatives have substantial wall structures.	\$\$	Eliminated—Has the shortest bridge structure; however, impacts more properties that other alternatives avoid. Has substantially higher wetland impacts than other alternatives, thus making the alternative unpermissible by the USACE, when other lesser impactful alternatives.

Alternative	Screening Criteria							Results
	Traffic Efficiency	Safety	Right-Of-Way	Permitting	Constructability	Long-Term Maintenance	Relative Estimated Capital Cost	
Trumpet	• All free flow movements minimize delay • Lack of WCR 8 continuity • I-76 Frontage Road has to utilize WCR 41 to maintain connectivity	• Sweeping turning radii at interchange are helpful for heavy truck volume • Fewest at-grade conflict points	• Moderate amount of ROW needed. Primarily from the frontage road.	• Largest amount of wetland impacts (5.6 acres) • Not permissible when compared to other alternatives	• High level of construction complexity	• Significant long-term maintenance costs associated with ~2,130 feet of bridge structure (including curved structures). • All alternatives have substantial wall structures.	\$	Eliminated —Eliminated because it does not maintain the east/west connectivity of WCR 8, despite being highly advantageous to the IMF/LP facilities. The greatest amount of wetland impacts, which makes this alternative unpermissible when other lesser impactful alternatives exist. The increased complexity and maintenance of the structure (approximately 2,000 feet) is unnecessary when other, less complicated structures are available.
Modified Trumpet	• Direct connections for all movements • Maintains connectivity of WCR 8 and I-76 Frontage Road	• Results in a close weave between ramps and WCR 41 • Counterintuitive movements throughout interchange complex	• Moderate amount of ROW needed. Primarily from the frontage road.	• Largest amount of wetland impacts (5.6 acres) • Not permissible when compared to other alternatives	• High level of construction complexity	• Significant long-term maintenance costs associated with ~2,250 feet of bridge structure, including curved structures. • All alternatives have substantial wall structures.	\$\$\$	Eliminated —Significant amount of ROW along with the greatest amount of wetland impacts, which makes this alternative unpermissible when other lesser impactful alternatives exist. The increased complexity and maintenance of the structure (long and curved) is unnecessary when other, less complicated structures are available. Additionally, the unconventional nature of the alternative decreases driver expectancy.
Partial Cloverleaf Option 1	• Provides several direct connection movements, reduction delay • I-76 Frontage Road has to utilize WCR 41 to maintain connectivity	• Merge points along ramps proximate to merge with I-76, causing successive lane changes/merge movements • Tighter radii loop more difficult for trucks	• Moderate amount of ROW needed. Primarily from the frontage road.	• Relatively large amount of wetland impacts (2.8 acres) • Unlikely to be permitted compared to fewer impacts.	• High level of construction complexity	• Significant long-term maintenance costs associated with ~1,980 feet of bridge structure, including curved structures. • All alternatives have substantial wall structures.	\$\$\$	Eliminated —Significant amount of ROW, primarily from the frontage road alignment. The increased complexity and maintenance of the structure (long and curved) is unnecessary when other, less complicated structures are available.
Modified Diamond 2	• Two at-grade ramp terminal intersections introduce delay • I-76 Frontage Road has to utilize WCR 41 to maintain connectivity	• Merge points along ramps proximate to merge with I-76, causing successive lane changes/merge movements • Conflict points associated with two at-grade intersections	• Moderate amount of ROW needed. Primarily from the frontage road.	• Relatively large amount of wetland impacts (2.6 acres) • Unlikely to be permitted compared to fewer impacts.	• High level of construction complexity	• Significant long-term maintenance costs associated with ~1,980 feet of bridge structure, including curved structures. • All alternatives have substantial wall structures.	\$\$\$	Eliminated —The increased complexity and maintenance of the structure (long and curved) is unnecessary when other, less complicated structures are available.
Two-Quadrant Partial Cloverleaf Type A	• Creates heavy left turn from EB I-76 ramp onto EB WCR 8 and associated delay • I-76 Frontage Road has to utilize WCR 41 to maintain connectivity	• Multiple loops increase difficulty for trucks	• Moderate amount of ROW needed. Primarily from the frontage road.	• Relatively large amount of wetland impacts (2.1 acres) • Unlikely to be permitted compared to fewer impacts.	• High level of construction complexity	• Moderate long-term maintenance costs associated with ~1,430 feet of bridge structure, including curved structures. • All alternatives have substantial wall structures.	\$	Eliminated —All dominant traffic movements must go through left turns at signals. Does not provide sufficient functional benefit to advance. The increased complexity and maintenance of the structure (long and curved) is unnecessary when other, less complicated structures are available.