WEST DAVIS
CORRIDOR

# Technical Memorandum 24: Shepard Lane Interchange Design Selection

in support of the
Environmental Impact Statement

## West Davis Corridor Project

Federal Highway Administration
Utah Department of Transportation

UDOT Project No. S-0067(14)0

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WEST DAVIS CORRIDOR

## Contents



## Tables

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# 1.0 Introduction

The purpose of this technical memorandum is to describe the process that the West Davis Corridor (WDC) Environmental Impact Statement (EIS) team used to evaluate interchange options at the intersection of the WDC and Interstate 15 (I-15) in the vicinity of Shepard Lane. This memorandum contains analysis of a connection that could be built if the WDC were to be routed through southern Kaysville and northern Farmington. A separate memorandum (*Technical Memorandum 23: Glovers Lane Interchange Design Selection*) has been prepared for the Glovers Lane interchange options for the WDC alternatives that go through western and southern Farmington.

The first draft of this technical memorandum was released to the public in May 2013 at the time of the release of the Draft EIS. After the Draft EIS was released, this memorandum was updated based on a more detailed design developed as part of the Federal Highway Administration (FHWA) Interstate Access Change Request process for both the Shepard Lane and Glovers Lane interchanges. The Utah Department of Transportation (UDOT) cannot add points of access to, or exits from, an interstate without approval from FHWA.

FHWA has an interest in ensuring that the National Highway System provides the highest level of service in terms of safety and mobility. FHWA's decision to approve new or revised access points to the National Highway System must be supported by substantiated information justifying and documenting that the proposed designs maintain the safety and performance of the highway system.

The evaluation of the Shepard Lane interchange after the Draft EIS was released also included updated traffic data from the Wasatch Front Regional Council's 2015–2040 Regional Transportation Plan, which was adopted after the Draft EIS was released. Therefore, UDOT decided to update this technical memorandum to reflect the evaluation that was conducted for FHWA's Interstate Access Change Request and the updated travel demand model from the Wasatch Front Regional Council.

# 2.0 Concept Development

The objective of the proposed Shepard Lane interchange is to allow traffic to move to and from the proposed WDC to and from I-15 and Legacy Parkway. This general objective has a number of possibilities, so different design concepts have been developed for comparison and selection of one or more favorable options.

The Shepard Lane design concepts have been developed by considering design criteria, design variables, and other factors.

## 2.1 Design Criteria

In preparing the concept-level design for the interchange options in the Shepard Lane area, the WDC team initially considered the following criteria:

- Prepare designs that meet the standards of UDOT and the American Association of State Highway and Transportation Officials (AASHTO)
- Provide designs that allow traffic to move in a reasonably direct manner between destinations with design speeds appropriate for the facility
- Avoid permanent impacts to rail lines that would preclude the future operation of the rail lines
- Avoid reducing the existing number of though lanes on I-15
- Avoid permanently eliminating existing traffic movements (although they might be reconfigured)
- Propose an overall design that is feasible and reasonable (with respect to obvious major impacts, structure layouts, etc.)
- Allow for sufficient lanes on I-15 to provide an acceptable level of service (LOS) of LOS D or better

These initial considerations provided guidance to the WDC team's design effort to determine the feasibility of the concepts before advancing them to more detailed design and analysis. One of the key design criteria shown above is the level of service requirement of LOS D or better. Before advancing concepts for further design, the WDC team evaluated initial designs up front through computer traffic modeling to determine whether the concepts met this level of service criterion. Those concepts that could not meet this criterion were dismissed in a pre-screening process.

In addition to the above design criteria, other factors were considered during the development of each option. Some examples of these factors include avoiding or minimizing impacts to the natural and built environment, exceeding minimum safety and operational standards, and minimizing cost. Note that some of these factors might directly conflict with one another, so some options might favor one factor over another.

## 2.2 Design Variables

A number of possible interchange concepts could meet the design criteria. Some of the variables for these interchange concepts could include:

- Connection type (system or service)
- Collector-distributor (CD) ramps, auxiliary lanes, or a combination
- Relocate/shift I-15 or conform to existing alignment
- Relocate/shift railroad tracks or conform to existing alignment
- Rebuild existing structures or conform to existing alignment
- Combine local interchange movements with system movements, keep separate, or a combination
- Build CD roads that collect all movements, split CD roads, or partial CD roads
- Provide independent WDC/Legacy Parkway/I-15 movements or allow them to combine

This is not meant to be a comprehensive list of all possible variables, but it does reflect some of the factors that the WDC team considered. There are a number of minor variations as well, which can be applied to many of the concepts considered.

## 2.3 Concept Development

Design concepts for the Shepard Lane Option were developed for both the northbound (NB) and southbound (SB) travel directions. Many of these NB and SB concepts are generally independent of each other (though not always), and thus can be mixed and matched to create several possible combinations. In addition, minor variations of each concept are possible.

Representative design concepts were selected for both the NB and SB movements.

A description of each selected concept is included in Section 3.0, with figures included in Appendix C.

Each representative design concept is compared side by side to the other concepts for certain criteria. The comparison criteria include transportation performance, roadway design and operations, and impacts. A description of each criterion is included in Appendix B.

# 3.0 Concepts Selected for Comparison

## 3.1 Northbound Concepts

This category includes concepts that provide the following traffic movements:

- NB I-15 to WDC
- NB I-15 to Shepard Lane
- Legacy Parkway to NB I-15
- Legacy Parkway to WDC
- Legacy Parkway to Shepard Lane
- NB Park Lane to NB I-15
- NB Park Lane to WDC
- NB Park Lane to Shepard Lane
- Shepard Lane to NB I-15
- Shepard Lane to NB WDC
- WDC to NB I-15

The northbound concepts considered are described below.

***Concept NB-1, Auxiliary Lanes.*** Northbound movements from Legacy Parkway and Park Lane join I-15 as additional auxiliary lanes. These lanes continue NB and eventually split to WDC and Shepard Lane movements. See Figure NB-1 in Appendix C. A number of different traffic moves must occur on these lanes as traffic bound for I-15 would need to exit these lanes, and traffic bound for the WDC or Shepard Lane interchange would need to enter the lanes. This crisscrossing traffic movement is called a "weave."

***Concept NB-2, NB CD Road.*** Traffic from all movements is combined into a multi-lane CD road that generally parallels the freeway. Weaving movements occur on this CD road as needed for vehicles to position themselves to take the desired ramp. See Figure NB-2 in Appendix C for an example of this concept.

***Concept NB-3, Northbound Split CD Road.*** Generally, the concept of a split CD road is to provide a CD road for some of the movements, with one or more of the movements separate and independent of the CD road (or on an additional CD road). These movements could be connected with slip ramps or branch connections as necessary. The objective is to isolate certain traffic movements that do not weave with the others, allowing for a reduced-length CD road.

Figure NB-3 in Appendix C shows one example of this concept. It includes a CD road and a ramp that carries traffic movements to the WDC, which uses a separate ramp that splits from I-15. Traffic to the WDC from Legacy Parkway and Park Lane joins this ramp directly via a slip ramp from the CD road or indirectly via the Shepard Lane interchange and associated connector road. All other traffic uses the northbound CD road and weaves as necessary for each movement.

***Concept NB-4, Northbound CD Ramps.*** This concept is dependent on a "Shepard Connector" road that connects Shepard Lane to a new local road to the area south and west of

Shepard Lane. It is similar to a "Split CD" concept but uses two different local ramps that provide access to Shepard Lane. See Figure NB-4 in Appendix C for an example of this concept. Combining this NB concept with the equivalent SB concept would provide a full interchange on the "Shepard Connector" in addition to the full I-15 interchange at Shepard Lane.

***Concept NB-5, Northbound Braided Ramps.*** This concept is based on a design suggestion received during the public comment period. The design team modified the suggestion somewhat to enable it to meet basic geometric standards and allow for traffic operation. The principle behind this concept is to reduce or eliminate the need for weaving by providing a dedicated ramp for each potential traffic maneuver, and then grade-separating and braiding these ramps such that weaving and lane changes are either not required or minimized. See Figure NB-5 in Appendix C for an example of this concept.

***Southern Connection (SC) Concept.*** A major variation to the concepts described above would place a connection from I-15 to Legacy Parkway south of this area near Glovers Lane. Traffic originating on I-15 and bound for the WDC (and, under some variations, Shepard Lane) would use this connection. This variation eliminates the need for a connection to the WDC from I-15 anywhere in the Park Lane/Shepard Lane area. An independent off ramp to Shepard Lane from I-15 would be provided. It would be undesirable for local I-15–to–Shepard Lane traffic to be required to exit I-15 so far in advance of Shepard Lane, especially considering that two I-15 exits (the U.S. Highway 89 [US 89] and Park Lane exits) are located between Glovers Lane and Shepard Lane. This variation was studied as a variation to Concepts NB-3 and NB-4. See Figures NB-3SC, NB-4 SC, and NB-SC in Appendix C for examples of this concept.

## 3.2 Southbound Concepts

This category includes concepts that provide the following traffic movements:

- SB I-15 to SB Legacy Parkway
- SB I-15 to Park Lane
- SB I-15 to Shepard Lane
- SB I-15 to WDC
- SB WDC to SB Legacy Parkway
- SB WDC to SB I-15
- SB WDC to NB I-15
- SB WDC to Park Lane
- SB WDC to Shepard Lane
- Shepard Lane to SB I-15
- Shepard Lane to SB Legacy Parkway
- Shepard Lane to Park Lane

***Concept SB-1, SB Direct Ramps.*** The WDC traffic joins Shepard Lane traffic, and this ramp makes a direct connection to I-15 using auxiliary lanes that extend to the Park Lane/Legacy Parkway exits. All movements would pass through these auxiliary lanes with necessary weaving occurring in the auxiliary lanes or on the I-15 mainline. There would be no separate CD road. See Figure SB-1 in Appendix C for an example of this concept.

***Concept SB-2, SB CD Road.*** Traffic from all movements uses a multi-lane CD road that generally parallels the freeway. This CD road could be located east or west of the railroad tracks, although a location east of the tracks would require shifting I-15 and/or relocating the tracks. Weaving movements occur on this CD road as needed for vehicles to position themselves to take the desired ramp. See Figure SB-2 in Appendix C for an example of this concept. Variations could include concepts with certain movements being independent of the CD road (for example, the exit to Park Lane).

***Concept SB-3, SB Split CD Road.*** The concept of a split CD road is to provide a CD road for some of the movements, with one or more of the movements separate and independent of the CD road (or on an additional CD road). These movements could be connected with slip ramps or branch connections as necessary. The objective is to isolate certain traffic movements that do not weave with the others. See Figure SB-3 in Appendix C for an example of this concept.

***Concept SB-4, SB CD Ramps.*** This concept is dependent on a "Shepard Connector" road that connects Shepard Lane to a new local road to the area south and west of Shepard Lane. It is similar to a "Split CD" concept but uses two different local ramps that provide access from Shepard Lane. Combining this SB concept with the equivalent NB concept would provide a full interchange on the "Shepard Connector" in addition to the full I-15 interchange at Shepard Lane. See Figure SB-4 in Appendix C for an example of this concept.

***Southern Connection (SC) Concept.*** A major variation to the concepts described above would place a connection from Legacy Parkway to I-15 south of this area, possibly near Glovers Lane. Traffic originating on I-15 and bound for the WDC (and, under some variations, Shepard Lane) would use this connection. This variation eliminates the need for a connection to I-15 anywhere in the Park Lane or Shepard Lane area. This was studied as a variation to Concepts SB-2, SB-3, and SB-4. Figures SB-2-SC, SB-3-SC, SB-4-SC, and SB-SC in Appendix C show this concept applied to Concepts SB-2, SB-3, and SB-4.

# 4.0 Concept Comparison

## 4.1 Categories

In order to rank the concepts represented, this concept comparison is organized into pre-screening, Part 1, Part 2, and Part 3.

### Pre-screening: Level of Service Criteria

As explained in Section 2.1, Design Criteria, in order for a design concept to be advanced for further consideration, it must provide a level of service of LOS D or better. Concepts that did not meet this criteria were dismissed from further consideration because they would not meet the purpose of the project.

### Part 1 Concept Comparison: Traffic Performance

For those concepts that pass pre-screening, Part 1 compares the overall traffic performance of each concept. This category considers speeds, travel time, and delay, which are also important indicators of good traffic performance.

Part 1 does not necessarily consider how well a concept is designed or the task of drivers in the interchange, but rather considers raw performance using modeled traffic data. However, good modeled traffic performance can indicate minimized congestion and delay, which in turn can be an indicator of a safer, more functional alternative.

### Part 2 Concept Comparison: Operations and Design

Part 2 is a comparison of the operational characteristics of each concept as related to its design. Various design parameters and guidelines are also considered. This evaluation takes into account the tasks of the driver and how vehicles interact within the interchange. An interchange with design features that enhance and simplify driver tasks is considered favorable. Straightforward design features that promote good operations can enhance safety, minimize congestion, reduce driver frustration or error, and generally contribute to the long-term benefits of the facility.

### Part 3 Concept Comparison: Impacts, Cost, and Miscellaneous Factors

Part 3 compares aspects of an interchange that are not directly related to traffic, design, or the driving experience. These aspects include impacts to the area, costs, and other miscellaneous factors. Although they do not directly reflect a concept's functionality or operations, these categories are still considered very important when evaluating each concept.

## 4.2 Rankings

Each concept is ranked for each category as follows:

- **D** **Disadvantage.** A less-desirable situation than good design practice, and/or less favorable than other options. Might or might not meet standards and/or guidelines. Given a score of –1.
- **N** **Neutral.** Meets or exceeds minimum design standards OR is comparable to other design options. Given a score of 0.
- **A** **Advantage.** Preferable design situation OR significant superiority over other design options. Given a score of 1.

In addition, in the pre-screening traffic performance comparison, another possible category (Y/N) is used.

- **Y** **Yes.** Acceptable level of service (D or better) as predicted by traffic modeling.
- **N** **No.** Fails to meet minimum acceptable level of service of LOS D in at least one segment of the design as predicted by traffic modeling. No score; concept eliminated.

The number of D (disadvantages) and A (advantages) rankings are totaled in order to compare options. Note that lesser rankings do not necessarily mean that the concept does not meet standards. Also, note that some categories might have multiple rankings of the same type. For example, a category might have several options with A rankings and might not have any D rankings. This usually occurs in categories that evaluate design standards.

Northbound and southbound concepts are presented separately in the following tables. A summary follows the tables.

## 4.3 Northbound Concepts

Tables 1, 2, 3, and 4 show the comparisons of the northbound concepts in pre-screening, Part 1, Part 2, and Part 3.

### Table 1. Northbound Concepts, Traffic Performance Pre-Screening

| | NB-1 | NB-2 | NB-3 | NB-4 | NB-3-SC | NB-4-SC | NB-5 |
|---|---|---|---|---|---|---|---|
| Level of service D or better? | N | Y | Y | Y | N | N | Y |

Each concept was evaluated for level of service. Only those concepts with LOS D or better on all roadway links are considered acceptable for further evaluation. Note that a link can achieve LOS D or better even though individual lanes within that link might not achieve LOS D or better.

As shown in Table 1 above, Concepts NB-2, NB-3, NB-4 and NB-5 are expected to provide acceptable levels of service, and as such are further analyzed. Concepts NB-1, NB-3-SC, and NB-4-SC are not expected to provide acceptable levels of service and are not analyzed further.

## Table 2. Northbound Concepts, Part 1 Comparison: Traffic Performance

| Evaluation Category | NB-2 | NB-3 | NB-4 | NB-5 |
|---|---|---|---|---|
| Travel time through I-15 | N | N | N | N |
| Travel time through to WDC | N | A | N | A |
| Total travel time | N | N | N | N |
| Average network speed | N | N | N | N |
| Total network delay | N | N | N | N |
| Average delay per vehicle | N | N | N | N |
| **Totals** | **0** | **+1** | **0** | **+1** |

A = Superiority over other design options

N = Comparable to other design options

D = Less favorable than other design options

## Table 3. Northbound Concepts, Part 2 Comparison: Operations and Design

| Evaluation Category | NB-2 | NB-3 | NB-4 | NB-5 |
|---|---|---|---|---|
| Maximize merge/approach lanes | N | N | N | N |
| Driver expectancy | N | D | D | N |
| Maximize design speed | N | D | N | N |
| Roadway geometry and features | N | N | N | D |
| Signs | D* | D* | D* | D* |
| Decision sight distance | N | N | D | N |
| Park Lane entrance ramp metering | N | D | A | A |
| Lane density | N | D | N | A |
| Length available for lane change moves | N | D | A | D |
| Total modeled lane changes | N | A | D | N |
| System movement lane assignments | D | N | N | A |
| Separate weaving section | N | N | N | A |
| Two-exit vs. single exit | A | N | A | A |
| System connection for all moves | N | N | D | N |
| Situational complexity | N | N | N | N |
| **Totals** | **–1** | **–5** | **–2** | **+2** |

A = Preferable design situation OR significant superiority over other design options

N = Meets or exceeds minimum design standards OR comparable to other design options

D = Less-desirable situation than other design options

D* = Does not meet the *Manual on Uniform Traffic Control Devices* (*MUTCD*) standards and/or guidelines for signing

### Table 4. Northbound Concepts, Part 3 Comparison: Impacts, Costs, and Miscellaneous Factors

| Evaluation Category | NB-2 | NB-3 | NB-4 | NB-5 |
|---|---|---|---|---|
| Minimizes number and size of structures | A | N | A | D |
| Minimizes impact to developable land | A | N | D | N |
| Avoids golf course impacts | N | D | N | D |
| Provides flexibility for design of connector from WDC–Shepard Lane | N | A | D | N |
| Avoids direct wetland impacts | A | N | D | D |
| Avoids direct home impacts | D | N | N | N |
| Avoids indirect home impacts | A | N | N | N |
| Avoids other National Environmental Policy Act (NEPA) impacts [farmland, historical, Section 4(f), etc.] | N | N | N | N |
| Provides a direct off ramp from northbound I-15 to Shepard Lane | N | A | N | N |
| Provides independent emergency bypass route | A | A | A | A |
| Separation of CD and/or ramps from I-15 | D | N | N | D |
| Allows potential future expansion of I-15 | N | N | N | D |
| Estimated cost | N | A | A | D |
| **Totals** | **+3** | **+3** | **0** | **–5** |

A = Preferable design situation OR significant superiority over other design options

N = Meets or exceeds minimum design standards OR comparable to other design options

D = Less-desirable situation than other design options

## 4.4 Southbound Concepts

Tables 5, 6, 7, and 8 show the comparisons of the southbound concepts in pre-screening, Part 1, Part 2, and Part 3.

### Table 5. Southbound Concepts, Traffic Performance Pre-Screening

| | SB-1 | SB-2 | SB-3 | SB-4 | SB-2-SC | SB-3-SC | SB-4-SC |
|---|---|---|---|---|---|---|---|
| Level of service D or better? | N | Y | Y | Y | N | N | N |

Each concept was evaluated for level of service. Only those concepts with LOS D or better on all roadway links are considered acceptable for further evaluation. Note that a link can achieve LOS D or better even though individual lanes within that link might not achieve LOS D or better.

As shown in Table 5 above, Concepts SB-2, SB-3, and SB-4 are expected to provide acceptable levels of service, and as such are further analyzed. Concepts SB-1, SB-2-SC, SB-3-SC, and SB-4-SC are not expected to provide acceptable levels of service and are not analyzed further.

## Table 6. Southbound Concepts, Part 1 Comparison: Traffic Performance

| Evaluation Category | SB-2 | SB-3 | SB-4 |
|---|---|---|---|
| Travel time through I-15 | N | N | N |
| Travel time WDC to I-15 | N | N | A |
| Travel time I-15 to Legacy Parkway | N | N | A |
| Total travel time | N | N | N |
| Average network speed | N | N | N |
| Total network delay | D | A | N |
| Average delay per vehicle | D | N | N |
| **Totals** | **–2** | **+1** | **+2** |

A = Superiority over other design options

N = Comparable to other design options

D = Less favorable than other design options

## Table 7. Southbound Concepts, Part 2 Comparison: Operations and Design

| Evaluation Category | SB-2 | SB-3 | SB-4 |
|---|---|---|---|
| Maximize merge/approach lanes | N | A | N |
| Driver expectancy | N | D | N |
| Maximize design speed | N | N | N |
| Roadway geometry and features | D | N | N |
| Signs | D* | D* | D* |
| Decision sight distance | N | N | D |
| Shepard Lane entrance ramp metering | N | D | N |
| Lane density | N | N | N |
| Length available for lane change moves | D | N | A |
| Total modeled lane changes | D | N | A |
| System movement lane assignments | D | A | N |
| Separate weaving section | A | A | A |
| Two-exit vs. single exit (I-15) | A | A | D |
| System connection for all moves | N | N | N |
| Situational complexity | N | N | N |
| **Totals** | **–3** | **+1** | **0** |

A = Preferable design situation OR significant superiority over other design options

N = Meets or exceeds minimum design standards OR comparable to other design options

D = Less-desirable situation than other design options

D* = Does not meet the *MUTCD* standards and/or guidelines for signing

## Table 8. Southbound Concepts, Part 3 Comparison: Impacts Costs, and Miscellaneous Factors

| Evaluation Category | SB-2 | SB-3 | SB-4 |
|---|---|---|---|
| Minimizes number and size of structures | N | N | N |
| Minimizes impact to developable land | N | A | D |
| Does not require freeway shift (affecting NB concepts) | N | A | N |
| Provides flexibility for design of connector from WDC–Shepard Lane | A | A | N |
| Avoids direct wetland impacts | N | N | N |
| Avoids direct home impacts | N | N | N |
| Avoids indirect home impacts | N | N | N |
| Avoids other NEPA impacts [farmland, historical, Section 4(f), etc.] | N | N | N |
| Provides a direct off ramp from southbound I-15 to Park Lane | N | N | N |
| Provides independent emergency bypass route | A | A | A |
| Separation of CD and/or ramps from I-15 and railroad tracks | N | N | A |
| Reduces risk of impacting existing structures | D | N | N |
| Allows potential future expansion of I-15 | N | N | N |
| Estimated cost | N | N | D |
| **Totals** | **+1** | **+4** | **0** |

A = Preferable design situation OR significant superiority over other design options

N = Meets or exceeds minimum design standards OR comparable to other design options

D = Less-desirable situation than other design options

# 5.0 Conclusion

The grand totals for northbound and southbound concepts are shown in Tables 9 and 10.

### Table 9. Grand Totals for Northbound Concepts

| Category | NB-2 | NB-3 | NB-4 | NB-5 |
|---|---|---|---|---|
| Part 1 Totals – Traffic Performance | 0 | 1 | 0 | 1 |
| Part 2 Totals – Operations and Design | –1 | –5 | –2 | 2 |
| Part 3 Totals – Impacts, Costs, and Miscellaneous Factors | 3 | 3 | 0 | –5 |
| **Grand Totals** | **+2** | **–1** | **–2** | **–2** |

### Table 10. Grand Totals for Southbound Concepts

| Category | SB-2 | SB-3 | SB-4 |
|---|---|---|---|
| Part 1 Totals – Traffic Performance | –2 | 1 | 2 |
| Part 2 Totals – Operations and Design | –3 | 1 | 0 |
| Part 3 Totals – Impacts, Costs, and Miscellaneous Factors | 1 | 4 | 0 |
| **Grand Totals** | **–4** | **+6** | **+2** |

Based on the results of the evaluation, the WDC team selected **a Shepard Lane interchange that combines the northbound Concept NB-2 and the southbound Concept SB-3**. These two concepts had the best combination of the three evaluation categories.

Concept NB-2 has a total of 2, which is the highest total of the ranked NB options. Concept SB-3 has a total of 6, which is the highest total of the ranked SB options. A Shepard Lane system interchange that features Concepts NB-2 and SB-3 was selected for analysis in the Draft EIS.

As explained in Section 1.0, Introduction, after the Draft EIS was released, UDOT prepared a more-detailed design of the Shepard Lane interchange as part of an Interstate Access Change Request to FHWA. This process required a very detailed design that included signing plans. During this process, FHWA determined that the Shepard Lane interchange option could not meet federal design and safety standards, including the signing requirements of the *MUTCD*. This was due to the close proximity of the interchange to the US 89 /Legacy Parkway system interchange on I-15 less than 1 mile to the south. Because all other Shepard Lane interchange concepts were also located in this same proximity, they too would not meet the *MUTCD* requirements.

Therefore, although Concepts NB-2 and SB-3 were the best options, these options, along with the other Shepard Lane interchange options evaluated in this technical memorandum, violate federal design and safety standards and thus were not considered in the Final EIS. See the *WDC Interstate Access Change Request*, December 2016, for more details.

# Appendix A: Previously Eliminated Concepts

This appendix presents other interchange concepts that were considered but not included in this evaluation.

### *Northbound and/or southbound CD road, or auxiliary lanes on I-15, extending farther south through the US 89/Legacy Parkway /Park Lane interchange area.*

***Why Considered:*** This would provide a much longer weave distance for all movements associated with the WDC, Park Lane, and Shepard Lane.

***Why Eliminated:*** Major impacts to existing structures would require one or more of these structures to be completely rebuilt or not meet operational requirements. The cost associated with this is considered prohibitive.

### *West Davis Corridor connects to I-15 north of Park Lane without a local Shepard Lane interchange.*

***Why Considered:*** The Shepard Lane interchange is not part of the purpose of this project. Traffic models indicate a very small travel demand for SB WDC to NB I-15 and SB I-15 to NB WDC movements. Projected travel demand and the projects' purpose and need would be met, and the future interchange could be accommodated by preserving enough room and planning ramps to accept future connections.

***Why Eliminated:*** FHWA policy requires all movements to be provided on all new interchanges. This concept would not provide two of the required movements until the future Shepard Lane interchange is built (along with the possibilities that it could be built in a different location or not built at all).

### *West Davis Corridor connects to I-15 with a local interchange at Shepard Lane.*

***Why Considered:*** The Shepard Lane local interchange is planned to be built in the future, regardless of whether the WDC is built. This local interchange would serve both the proposed WDC and the planned Shepard Lane projects.

***Why Eliminated:*** I-15 is a freeway facility, and the WDC is planned to be a freeway facility. Connecting two freeways with a local interchange is not considered acceptable, since the interchange would likely fail. UDOT has determined that system connections are a requirement for any interchange concept.

### *Reconfigure the US 89 interchange with I-15 and Legacy Parkway so that US 89 traffic to and from I-15 is routed on Legacy Parkway for a distance south of the existing interchange. Traffic to and from I-15 would require the addition of "jumpover" ramps between I-15 and Legacy Parkway at a point farther south on Legacy Parkway. (This is the same idea as the "SC" concepts except that US 89 traffic makes the jumpover movement as opposed to WDC-associated traffic.)*

***Why Considered:*** It could be very beneficial to the northbound WDC interchange to locate the exit from I-15 to a place south of the existing US 89 and Legacy Parkway structures. This could add considerable weaving distance within the CD road under all applicable concepts.

Also, the location of the entrance would be in a good location, since it would not be downstream of a curve and several large structures.

***Why Eliminated:*** There are about 3,000 vehicles in the peak hour making the move to or from US 89 and I-15. Adding this much capacity to the section of Legacy Parkway and the associated structures would be very expensive and would have substantial impacts. If a northbound CD system to the WDC were added, exiting where US 89 is currently, then this would require rebuilding several large structures. This would be very expensive. Also, routing US 89 traffic on what is now Legacy Parkway would require a major diverge interchange to the south. This would also be very expensive and would have substantial impacts.

# Appendix B: Explanation of Concept Comparison Categories

*Note:* A few of the evaluation categories apply to only one direction (northbound or southbound), so the tables are not identical with respect to the categories listed below. Evaluation categories are not presented in any particular order (that is, categories listed first are not considered more important).

The abbreviation *MOI* refers to the UDOT *Roadway Design Manual of Instruction* (August 2011 update). The abbreviation *GB* refers to the 2011 version of the AASHTO publication *A Policy on Geometric Design of Highways and Streets*, or "Green Book." The Green Book is considered the industry standard for roadway design and has been adopted by UDOT as its official standard.

## Part 1: Traffic Performance

***Average Network Speed.*** The average speed of all vehicles traveling through the analysis area in the peak hour. Higher speeds reflect better operation.

***Travel Time on I-15 through the Area.*** Travel time from a common point on I-15 south of the interchange to a common point on I-15 north of the interchange. This is a comparison of how well traffic flows along the I-15 mainline and whether trouble spots are encountered through the interchange area.

***Travel Time (to/from) WDC.*** Travel time from/to a common point on I-15 (south of the interchange) to/from to a common point on the WDC (west of the interchange). This compares of how well traffic flows to/from the WDC and whether trouble spots are encountered in making this maneuver.

***Travel Time I-15 to Legacy Parkway (Southbound Concepts Only).*** Travel time from a common point on I-15 north of the interchange to a common point on Legacy Parkway south of the interchange. This is a comparison of how well traffic flows from southbound I-15 to Legacy Parkway.

***Total Network Delay.*** This is the total delay of all vehicles in the peak hour in the WDC study area. Less delay reflects better operation.

***Total Travel Time.*** This measures all travel time for all maneuvers from common points through the interchange in the peak hour. This is useful to compare overall traffic operation of the concepts. It is possible for a concept to have a greater amount of total travel time but still have a smaller amount of total network delay. This is because not all facilities in a system have the same speed limit.

## Part 2: Operations and Design

***Maximizes Merge Approach Lengths.*** This covers lengths for parallel exit lanes, entrance lane acceleration, gap acceptance, parallel exit lane length, etc. These are not considered weaves, since vehicles are going in only one lateral direction (either exiting or entering the lane). The lengths are important in relation to both traffic operation and UDOT/AASHTO standards (*GB* pp. 10-109 to 10-116).

***Driver Expectancy.*** This refers to how well the design fits with normal, prevailing driver expectations of roadway features and required maneuvers. For example, most drivers expect that most exit ramps will be to the right (*GB* pp. 2-41 to 2-42).

***Maximize Design Speed.*** A higher design speed for all parts of the interchange is desirable (*GB* p. 10-81, p. 10-89).

***Roadway Geometry and/or Features.*** This involves general geometry and features that exceed minimum standards or that might meet values that are recommended but not required (for example, overlap barriers where possible at areas with multiple gore points). This category uses UDOT/AASHTO standards and engineering judgment to determine a ranking (UDOT *MOI* p. 51 and *GB* pp. 3-111 to 3-112, 3-163 to 3-166).

***Signs.*** This evaluates whether guidance signing can be placed in compliance with the Manual on Uniform Traffic Control Devices to ensure safe and efficient traffic operations.

***Decision Sight Distance.*** When difficult or unexpected maneuvers are required, a clear sight distance is recommended, especially when there are other elements such as merging, weaving, etc. (*GB* pp. 3-6 to 3-7).

***Ramp Metering.*** This category is based on how readily an on ramp could be converted to a metered ramp if desired. A ramp with extra length (or room to add in the future) will be ranked better than a ramp that is constrained in length.

***Lane Density.*** This can be a predictor of how readily weaving can occur. *Weaving* refers to a condition in which some vehicles are moving into a lane and other vehicles are moving out of the same lane. (For example, some on ramps enter the freeway and become an “exit-only” lane for an upcoming interchange. Vehicles entering the freeway often want to leave this lane, while other vehicles preparing to exit the freeway will enter this lane.) Traffic modeling predicts how many vehicles will be using each lane of the facility. Lanes with more traffic make weaving more difficult, while lanes with less traffic allow easier weaving movements.

***Length Available for Lane Change Moves.*** Greater lengths available for lane changes will allow easier operation for vehicles, especially in heavy traffic. It is considered a disadvantage if lane changes, especially multiple lane changes, are required in short distances.

***Total Lane Changes.*** This category reflects all lane changes by all vehicles in the modeled interchange area. This number is determined by computer models of the interchange area. This includes lane changes made by vehicles that are required to make lane changes to reach their desired destinations, and also vehicles that are not required to change lanes but do so to make room for other vehicles entering the traffic stream. Lower numbers of lane changes are expected to reflect more desirable operating conditions.

***System Movement Lane Assignments.*** Lane assignments are considered the particular lanes that vehicles enter when in a multi-lane roadway section. It is considered an advantage when a vehicle entering a roadway section is already in the lane needed for the desired destination.

***Separate Weaving Section.*** If weaving is to occur within an interchange, it is considered an advantage to separate the weaving from the main facility and provide minimal number of exits (*GB* pp.10-80 to 10-81).

***Two-Exit vs. Single Exit.*** It is preferable that interchanges have only a single exit as opposed to two different exit points. This can help simplify the driver's decision process and maneuvering requirements (*GB* pp. 10-81 to 10-82).

***System Connection for All Moves.*** It is considered an advantage if all potential moves can be completed with a system connection; that is, vehicles do not have to traverse through a local road or a traffic signal (*GB* pp. 10-53 to 10-54).

***Situational Complexity.*** It is an advantage to drivers to have well-spaced, sequential decision points and traffic movements. Movement decisions, heavy traffic, and multiple lane changes (especially weaving movements), combined with high speeds, can increase the risk of accidents, poor driver performance, and frustration. It is advantageous if a design avoids the condition of "a lot going on at once" (*GB* p. 2-44, p. 10-127).

## Part 3: Impacts, Costs, and Miscellaneous Factors

***Minimize Size and Number of Structures.*** It is advantageous to minimize structures due to ongoing maintenance costs, safety issues such as increased tendency to form ice, and visual impacts. The initial cost of structures is compared separately within the Estimated Cost category.

***Minimizes Impact to Developable Land.*** The open land in the vicinity of the interchange is considered developable property, and options that have the least impact to this land are considered advantageous. Impacts are considered as total footprint, splitting up large areas, and creating oddly shaped parcels of land.

***Avoids I-15 Shifts.*** The northbound concepts are currently evaluated as if there is no shift to I-15, but concepts that requires shifting I-15 to the east or west will likely increase impacts to that side of I-15. This also could require redesigning and/or re-evaluating northbound concepts. Therefore, it is considered advantageous if a freeway shift is not part of the concept.

***Provides Flexibility for Design of Connector from WDC–Shepard Lane.*** There are many possible concepts that could connect the WDC to Shepard Lane and the vicinity. Allowing many possible options here increases the ability of the final project design to provide the best option for local neighborhoods, travelers, and municipalities. If a concept allows many possible WDC–to–Shepard Lane connections, it is considered an advantage.

***Avoids Direct Wetland Impacts.*** Options that first avoid and then minimize wetland impacts are considered more advantageous.

***Avoids Direct Home Impacts.*** Direct home impacts are considered as requiring a residential relocation. Avoiding or minimizing these impacts is considered an advantage.

***Avoids Indirect Home Impacts.*** Indirect home impacts are considered those impacts that do not require relocations but still might affect homes due to the proximity of a highway facility. Avoiding or minimizing these impacts is considered advantageous.

***Avoids Other NEPA Impacts [Farmland, Historical, Section 4(f), etc.].*** Many other potential impacts are evaluated as part of the NEPA process. Minimizing these impacts is considered advantageous.

***Provides a Direct Off Ramp from I-15 to Shepard/Park Lane.*** Although driver expectancy and operations are covered in a separate category, this is considered separately due to the possible economic advantages of a direct off ramp as opposed to an indirect one. A driver might consider "convenience of access" when making a choice regarding whether to exit the freeway for commercial purposes (that is, not a trip to work or home). Direct off ramps from I-15 to Shepard Lane and Park Lane are considered advantageous.

***Provides Emergency Bypass Route Independent of I-15/Legacy Parkway.*** In the event of a shutdown or catastrophe affecting I-15 or Legacy Parkway, independent access will still allow traffic to function with the other facility to/from the WDC. Vehicles (including emergency response vehicles) will have a way to bypass the affected route. This is explained in more detail below.

- *Northbound:* It is considered an advantage if traffic has independent access from I-15 and Legacy Parkway to the WDC. If a vehicle traveling to the WDC from Legacy Parkway can do so without ever having to enter I-15, this is considered an advantage. It is also an advantage if a vehicle traveling from I-15 to the WDC can do so without ever having to enter Legacy Parkway.
- *Southbound:* It is considered an advantage if traffic has independent access from the WDC to I-15 and Legacy Parkway. If a vehicle traveling from the WDC to Legacy Parkway can do so without ever having to enter I-15, this is considered an advantage. It is also an advantage if a vehicle traveling from the WDC to I-15 can do so without ever having to enter Legacy Parkway.

***Separation of CD Roads and/or Ramps from I-15 and Railroad Tracks.*** Greater physical separation of CD roads and ramps from I-15 and railroad tracks is considered an advantage. Concepts with features in close proximity to railroad right-of-way increase the risk of added cost, ongoing maintenance, inconvenience, etc. Wide spacing of ramps and CD roads from the main line is also preferable (*GB* pp. 10-81 to 10-82), since it helps with ease of maintenance and provides a less stressful driving task. It also reduces the likelihood of accidents that affect both routes, either directly or by drivers slowing down to look.

***Reduces Risk of Impact to Existing Roadway Structures.*** Concepts that minimize the risk of impacts to existing roadway structures are considered more advantageous.

***Allows Potential Future Expansion of I-15.*** Because I-15 is a nationally significant facility, it is desirable to preserve the ability to expand the facility if needed. Concepts that more easily allow for expansion of I-15 are considered advantageous.

***Estimated Cost.*** Preliminary cost estimates have been developed. Concepts with estimated costs that are disproportionately lower or higher than other concepts are considered an advantage or disadvantage, respectively.

# Appendix C: Figures

Figure NB-1 – Auxiliary Lanes

Figure NB-2 – NB CD Road

Figure NB-3 – Northbound Split CD Road

Figure NB-4 – Northbound CD Ramps

Figure NB-5 – Northbound Braided Ramps

Figure NB-3 SC – Northbound Split CD Road with Southern Connection

Figure NB-4 SC – Northbound CD Ramps with Southern Connection

Figure NB-SC – Northbound Southern Connection (Accompanies both NB-3 SC and NB-4 SC)

Figure SB-1 – SB Direct Ramps

Figure SB-2 – SB CD Road

Figure SB-3 – SB Split CD Road

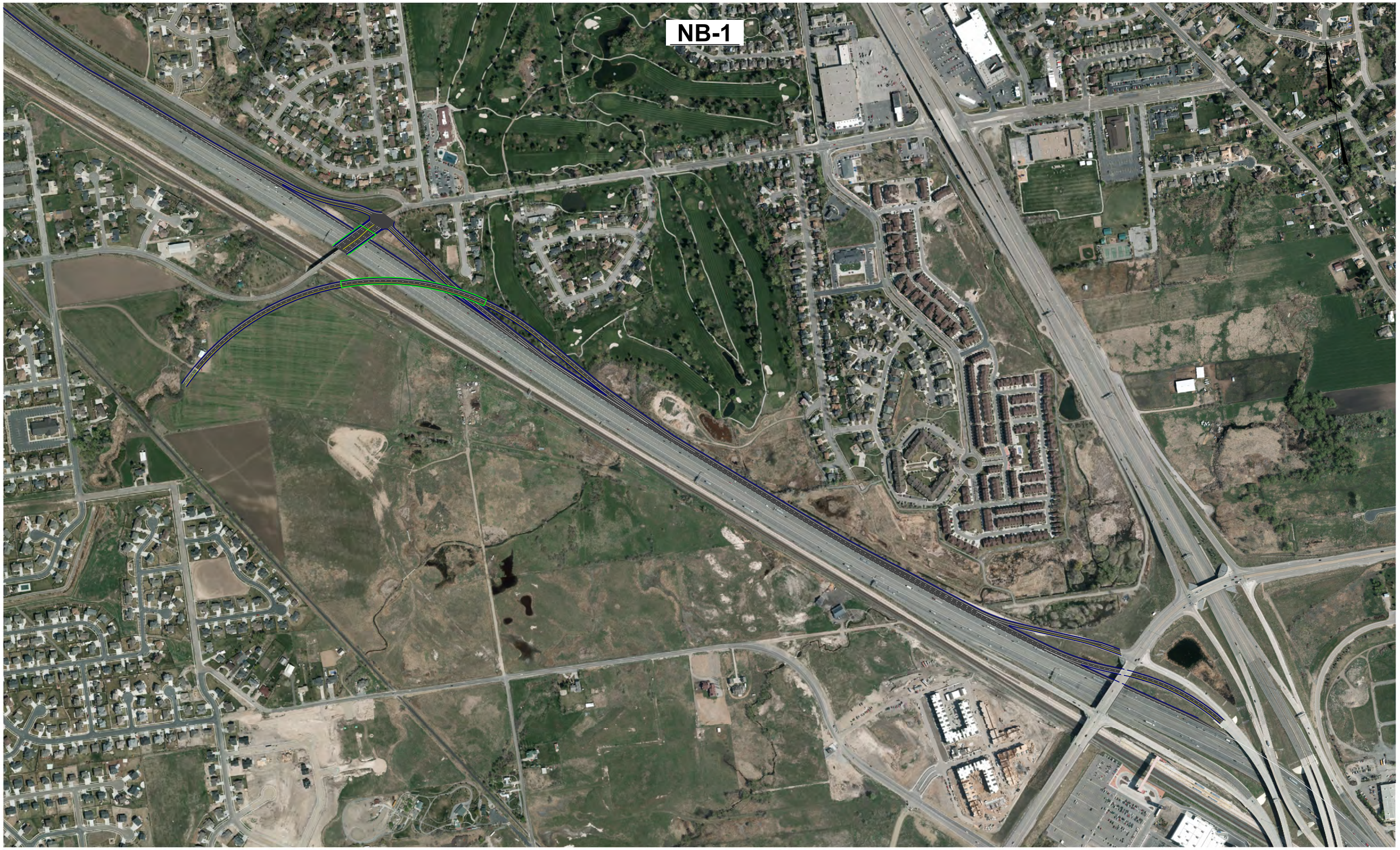
Figure SB-4 – SB CD Ramps

Figure SB-2-SC – SB CD Road with Southern Connection

Figure SB-3-SC – SB Split CD Road with Southern Connection

Figure SB-4-SC – SB CD Ramps with Southern Connection

Figure SB-SC – Southbound Southern Connection (Accompanies SB-2-SC, SB-3-SC, and SB-4-SC)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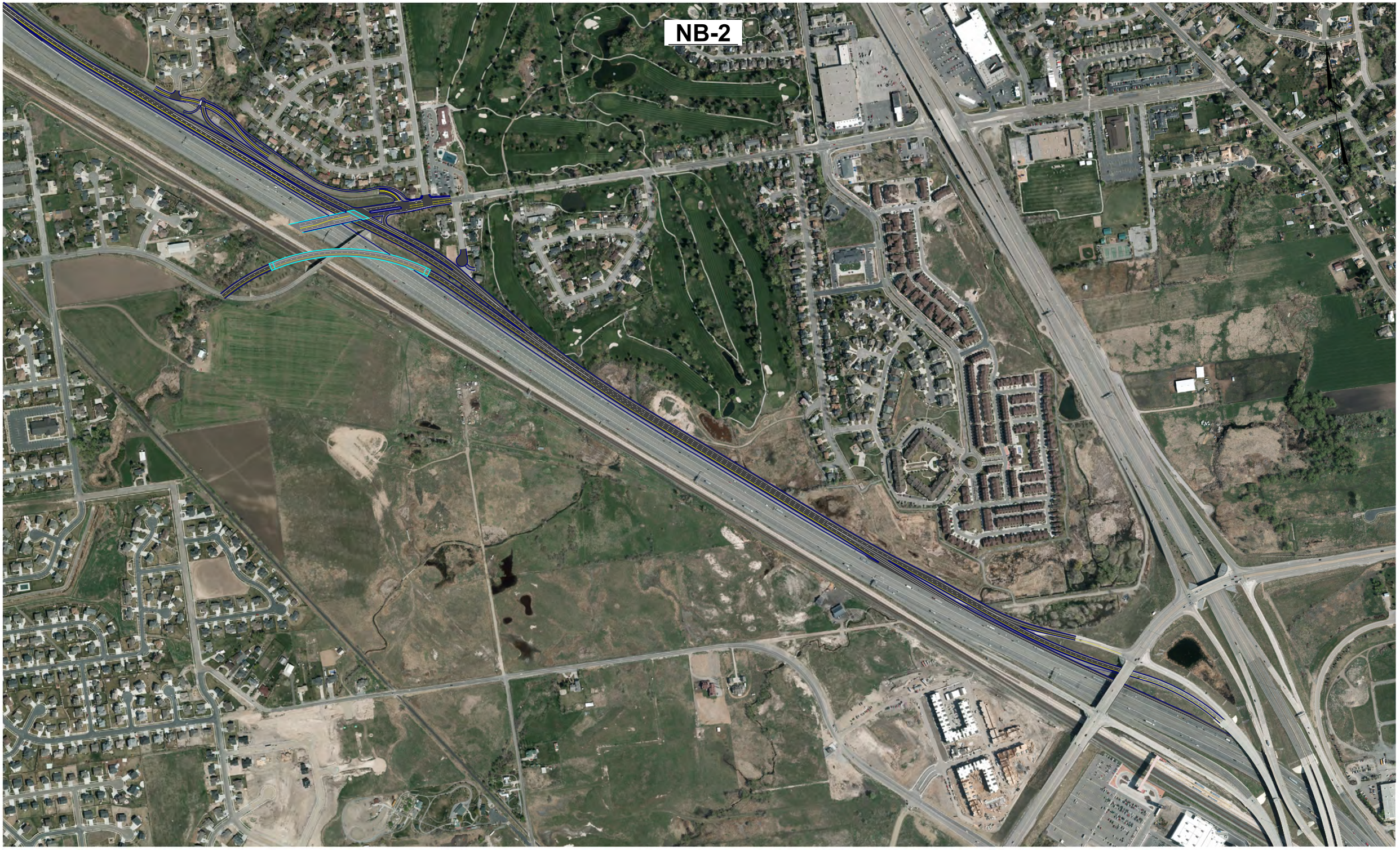
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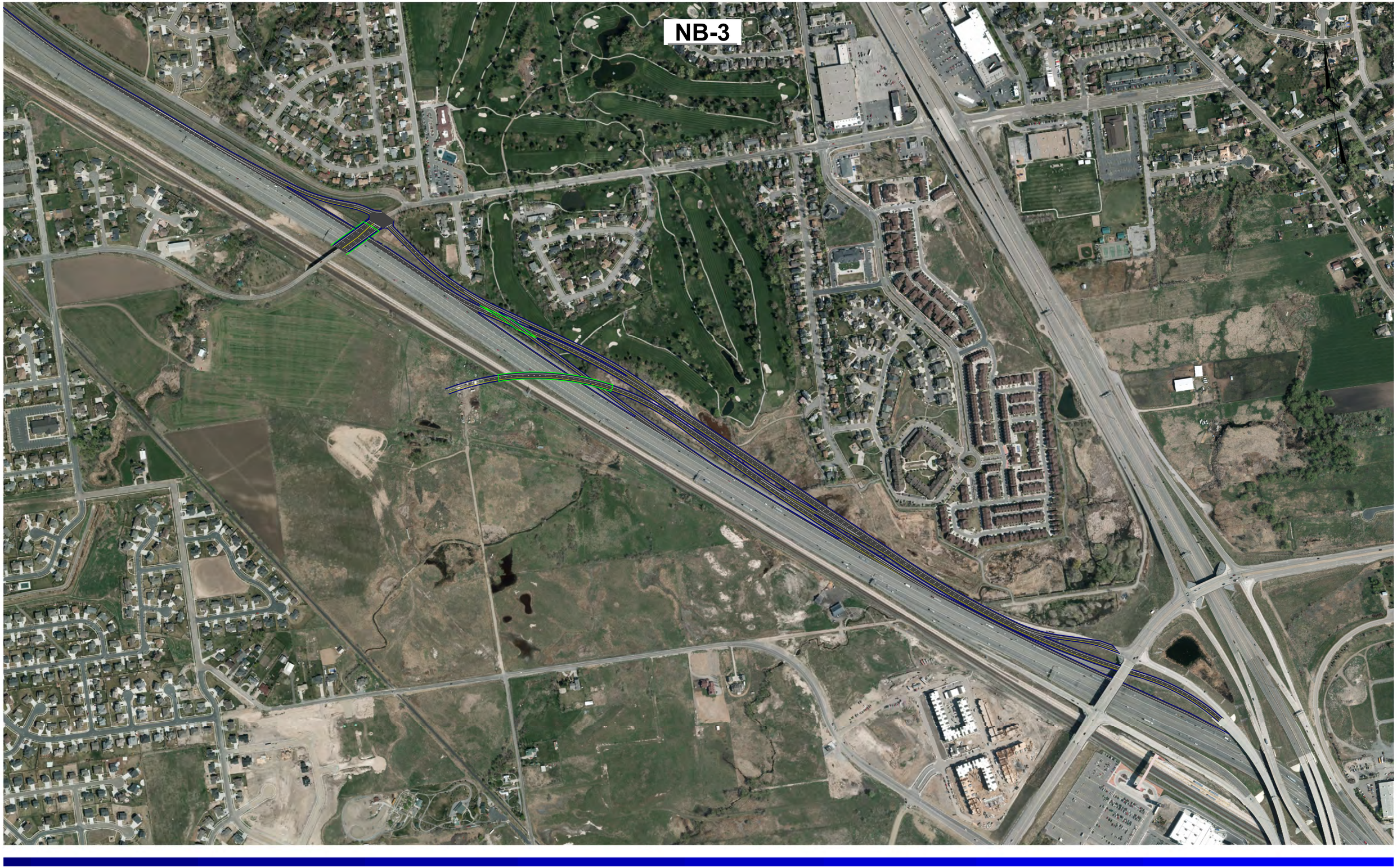
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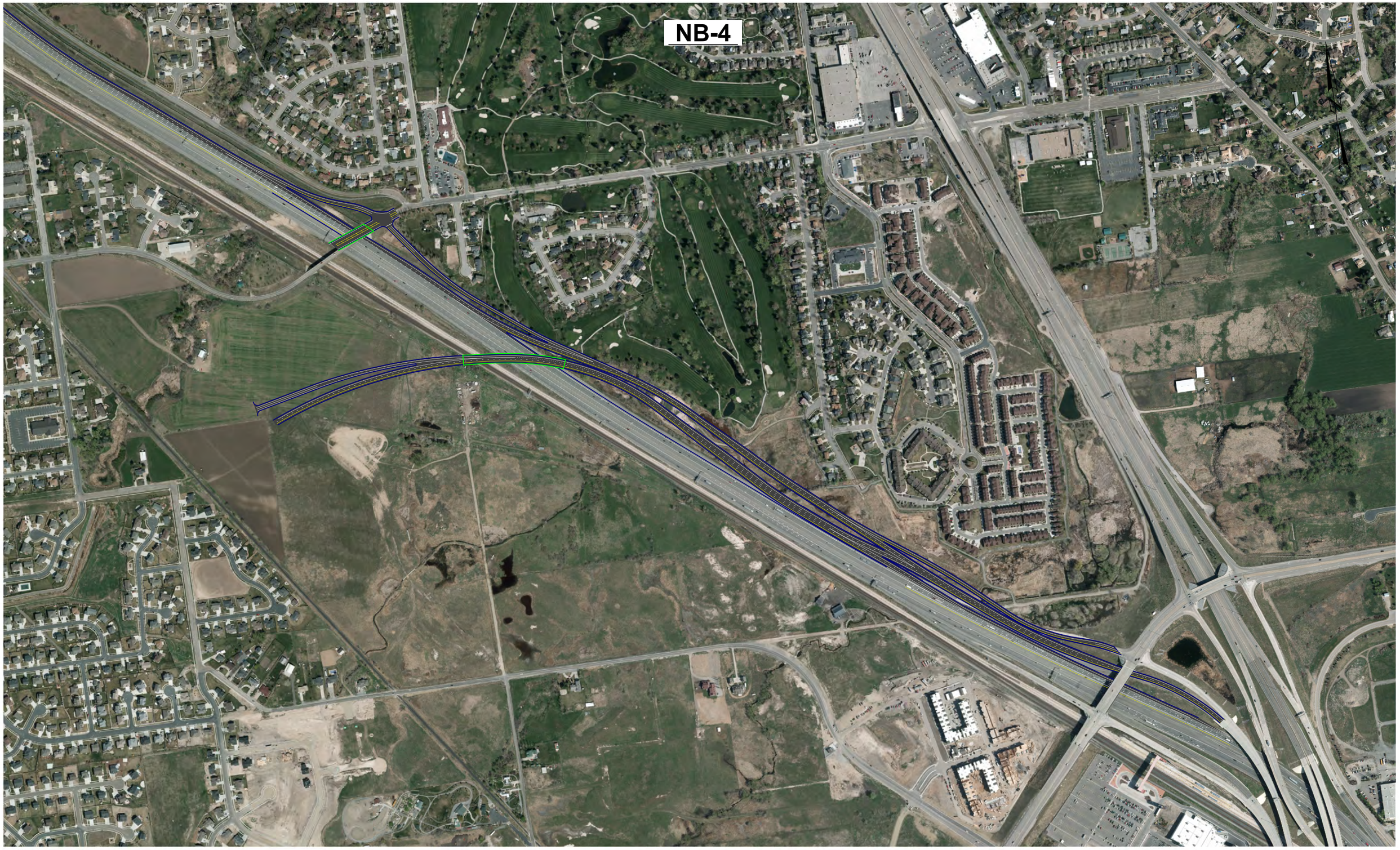
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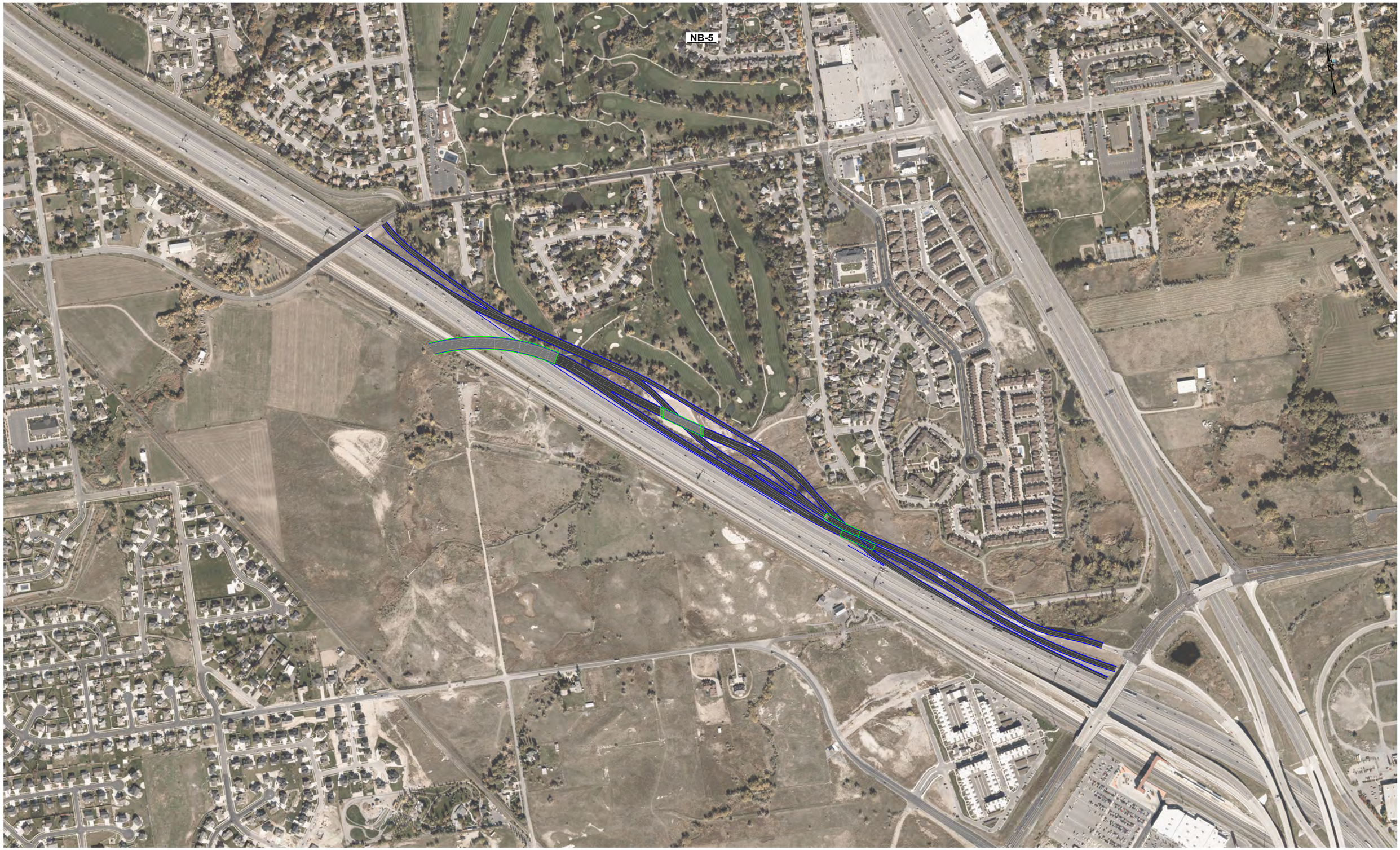
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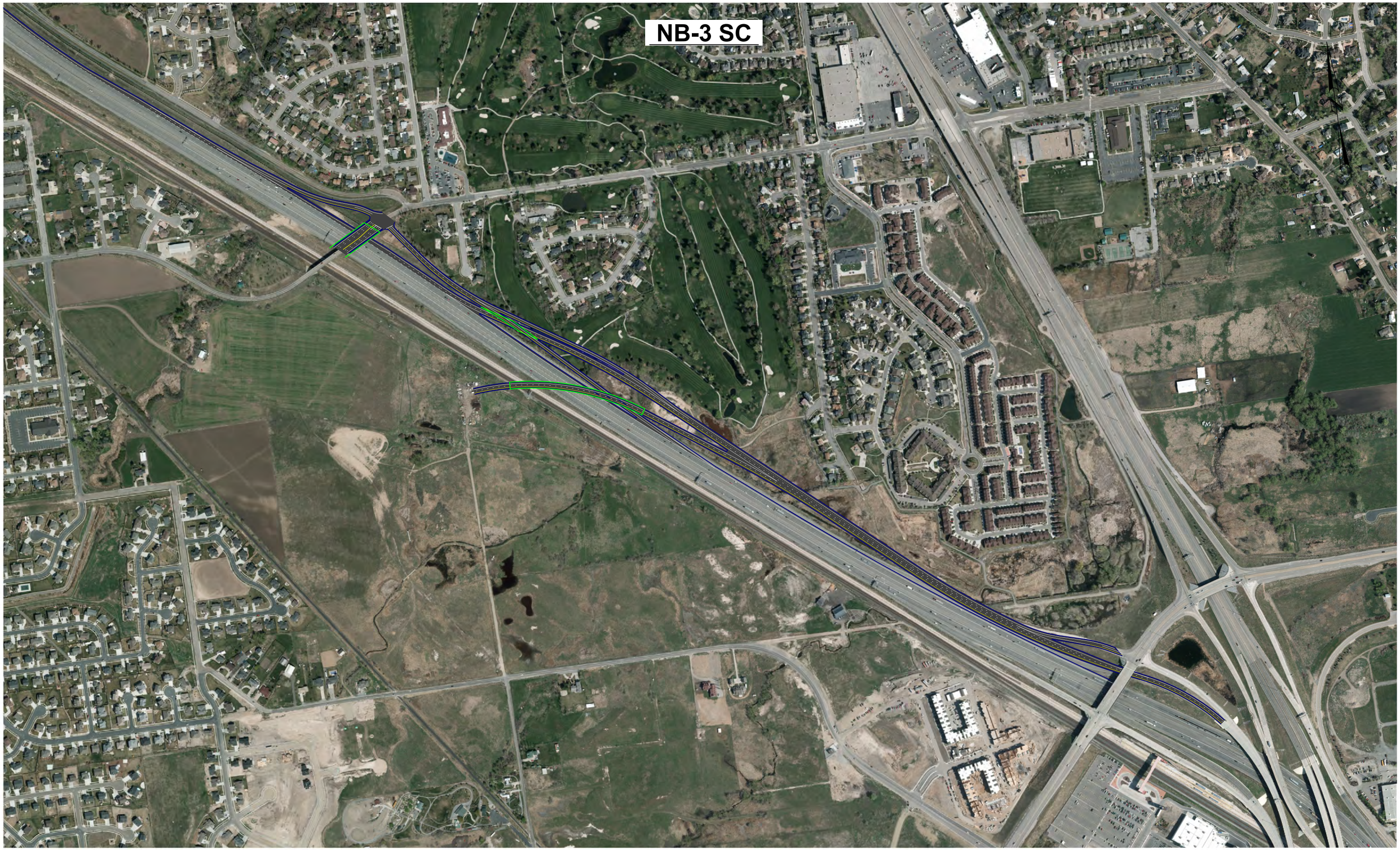
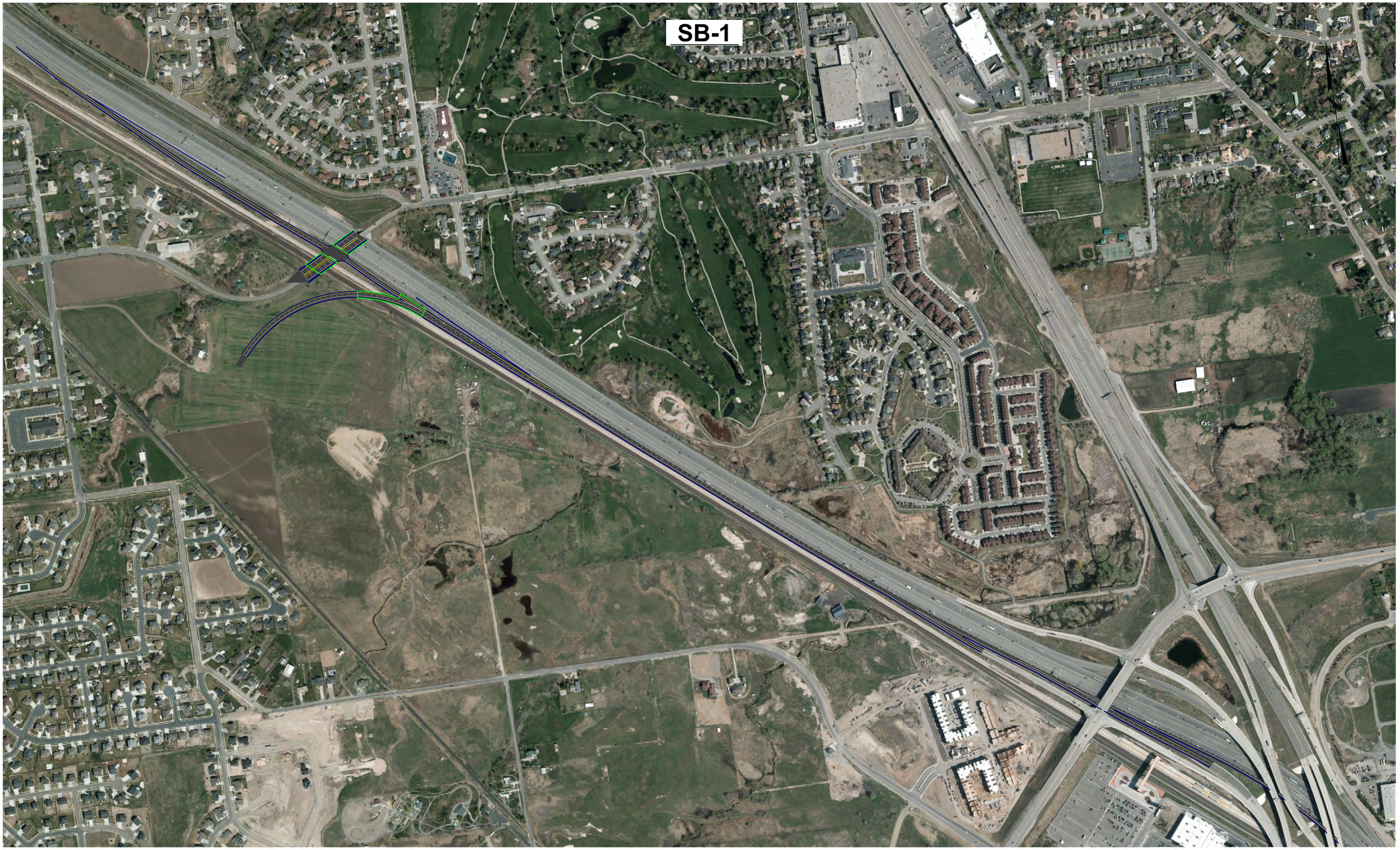

NB-3 SC


NB-4 SC


NB SC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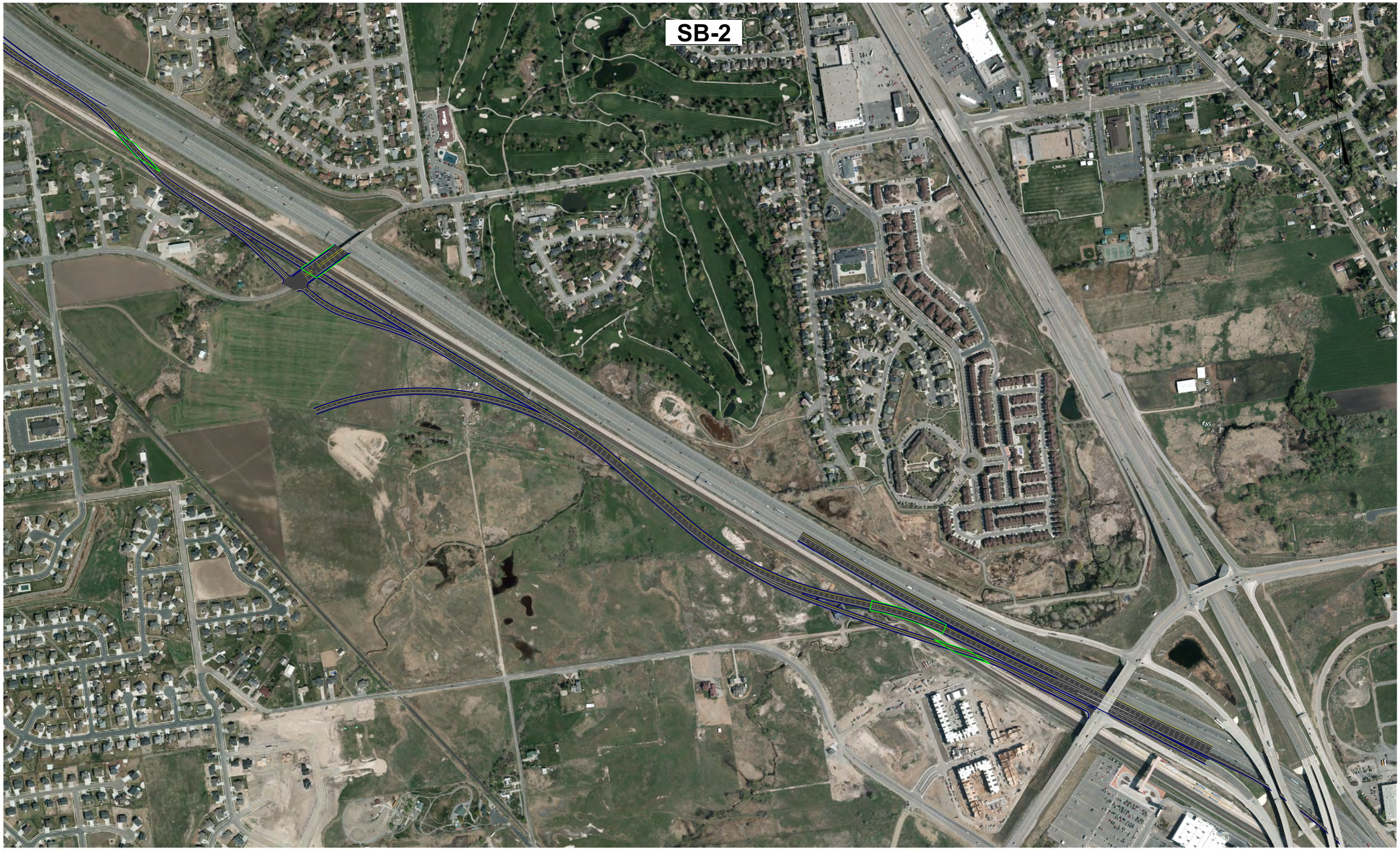
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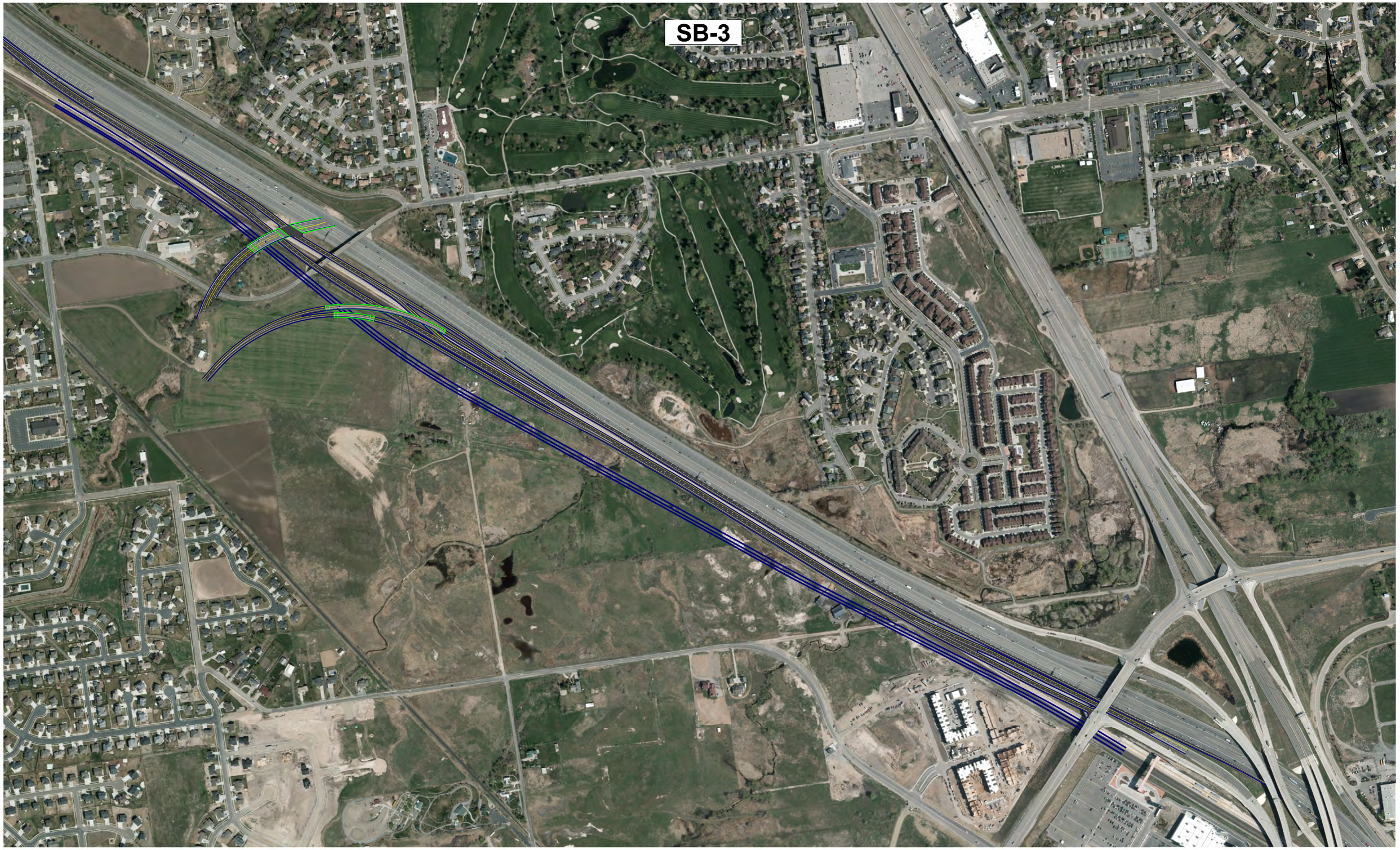
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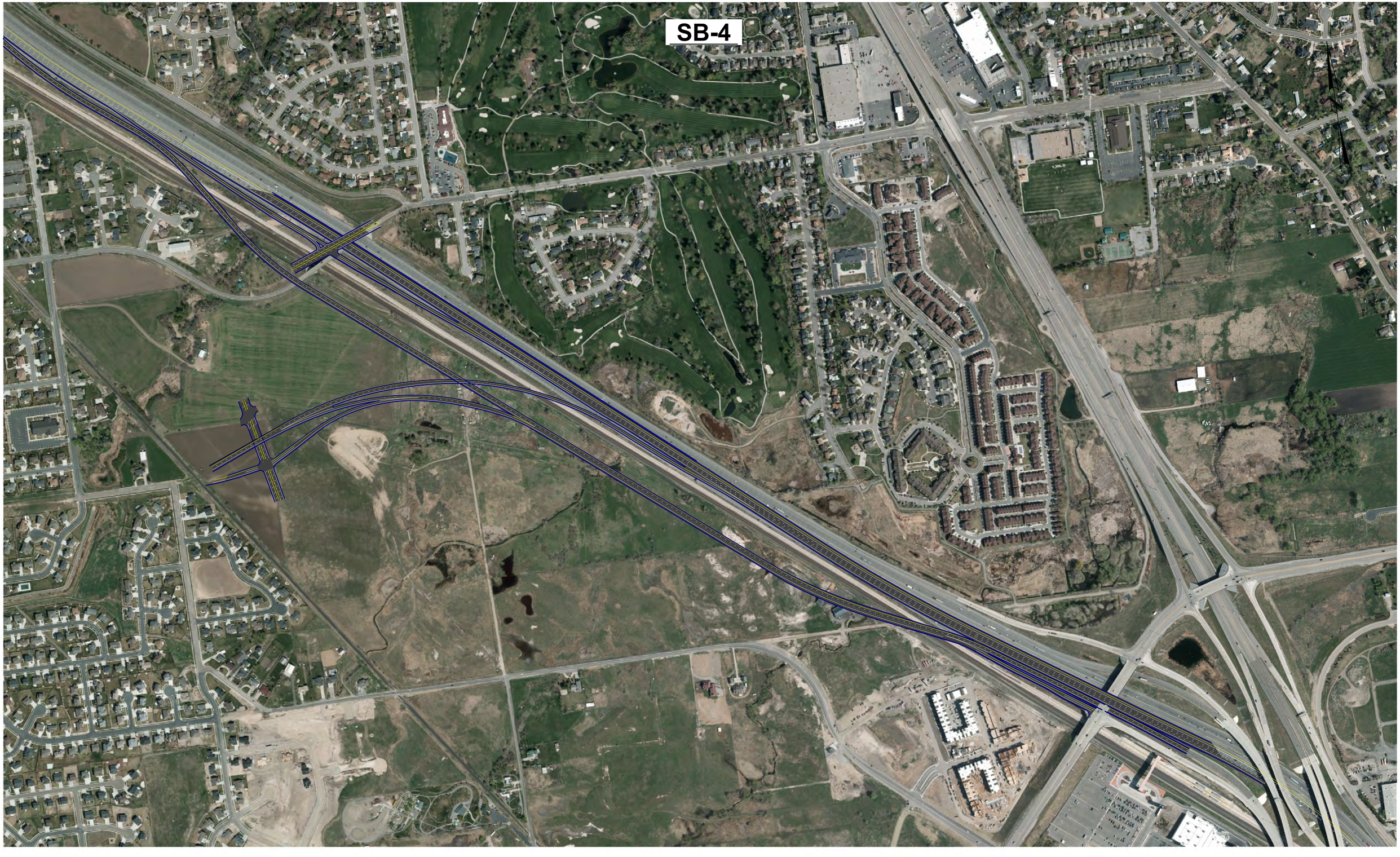
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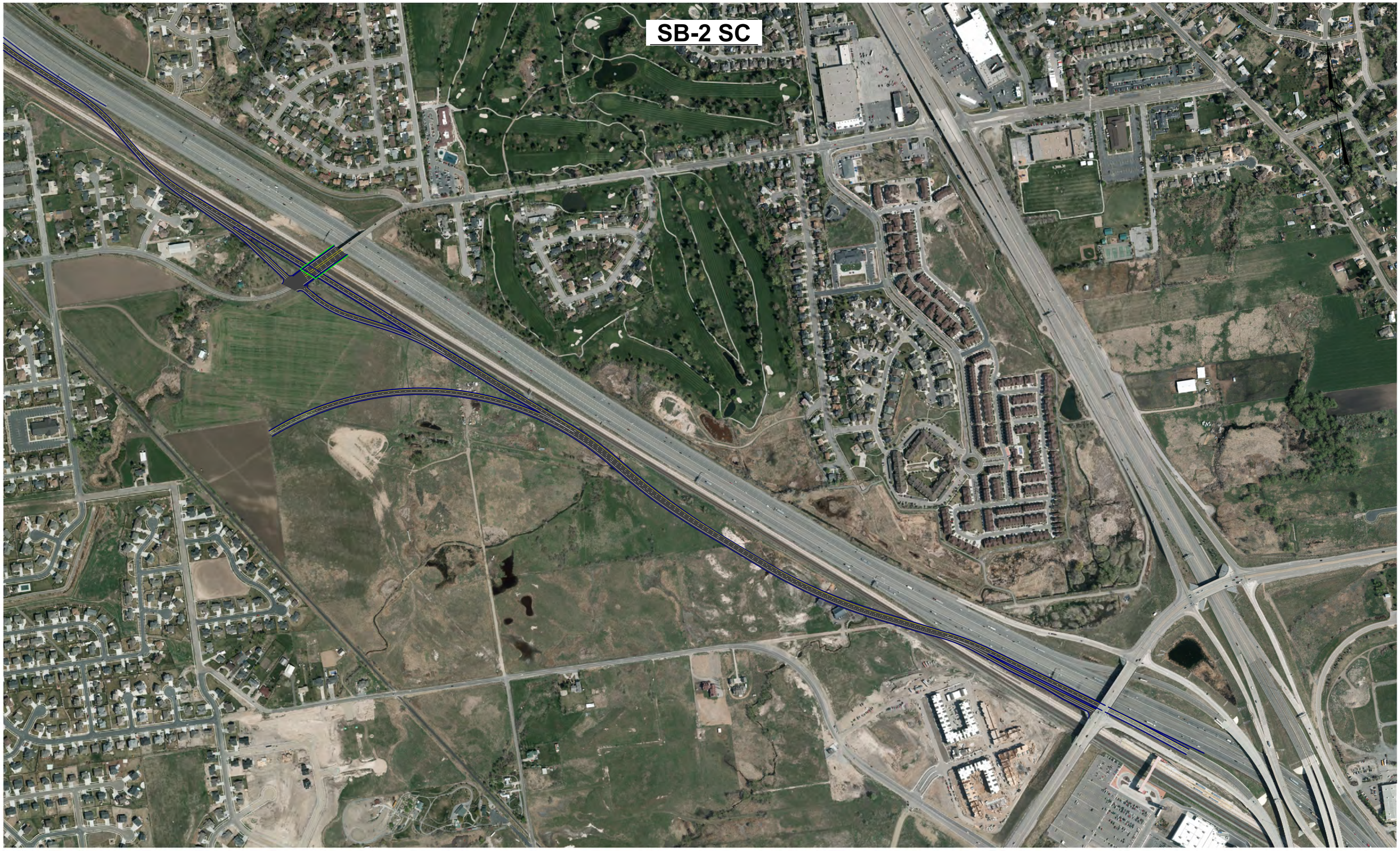
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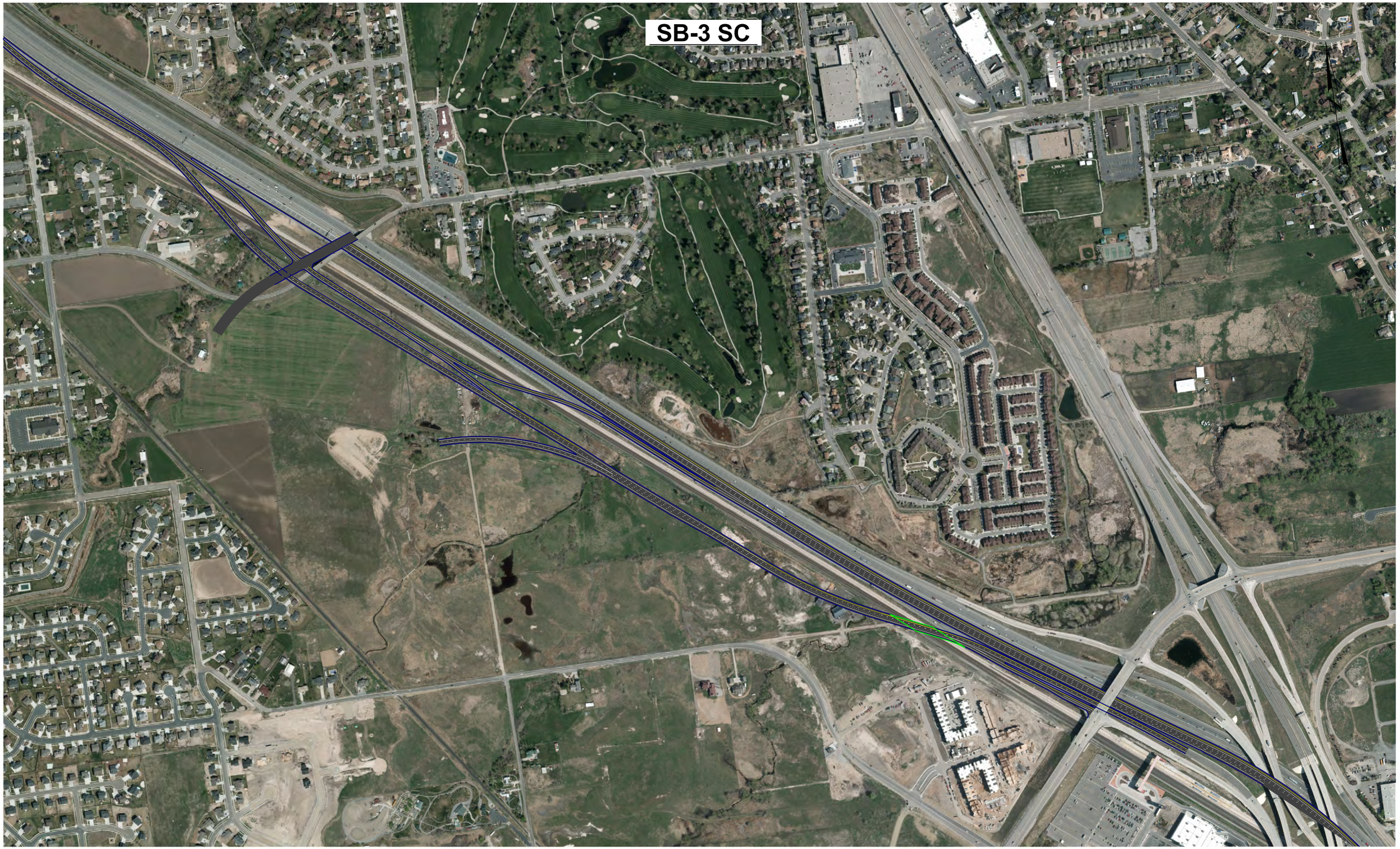
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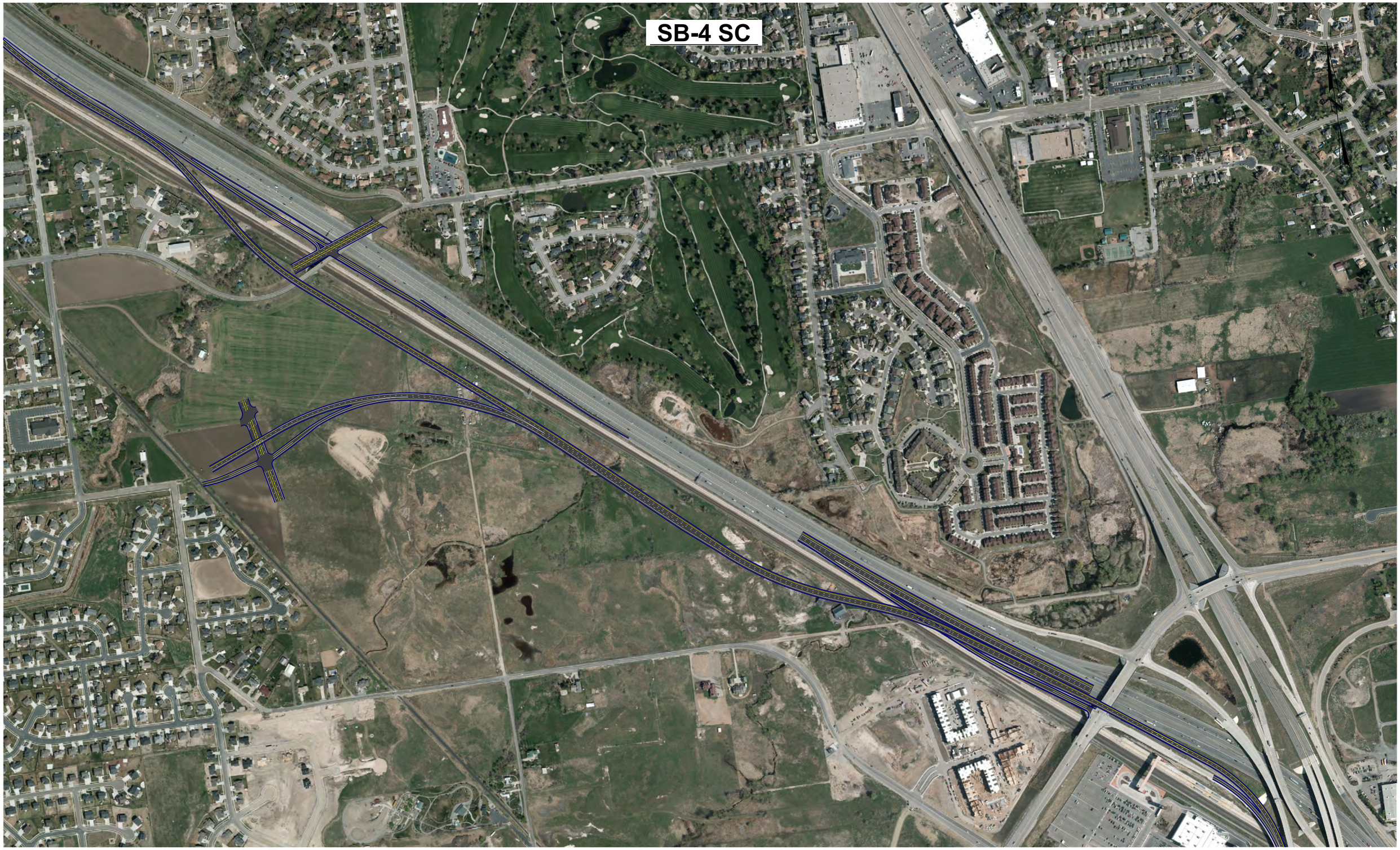
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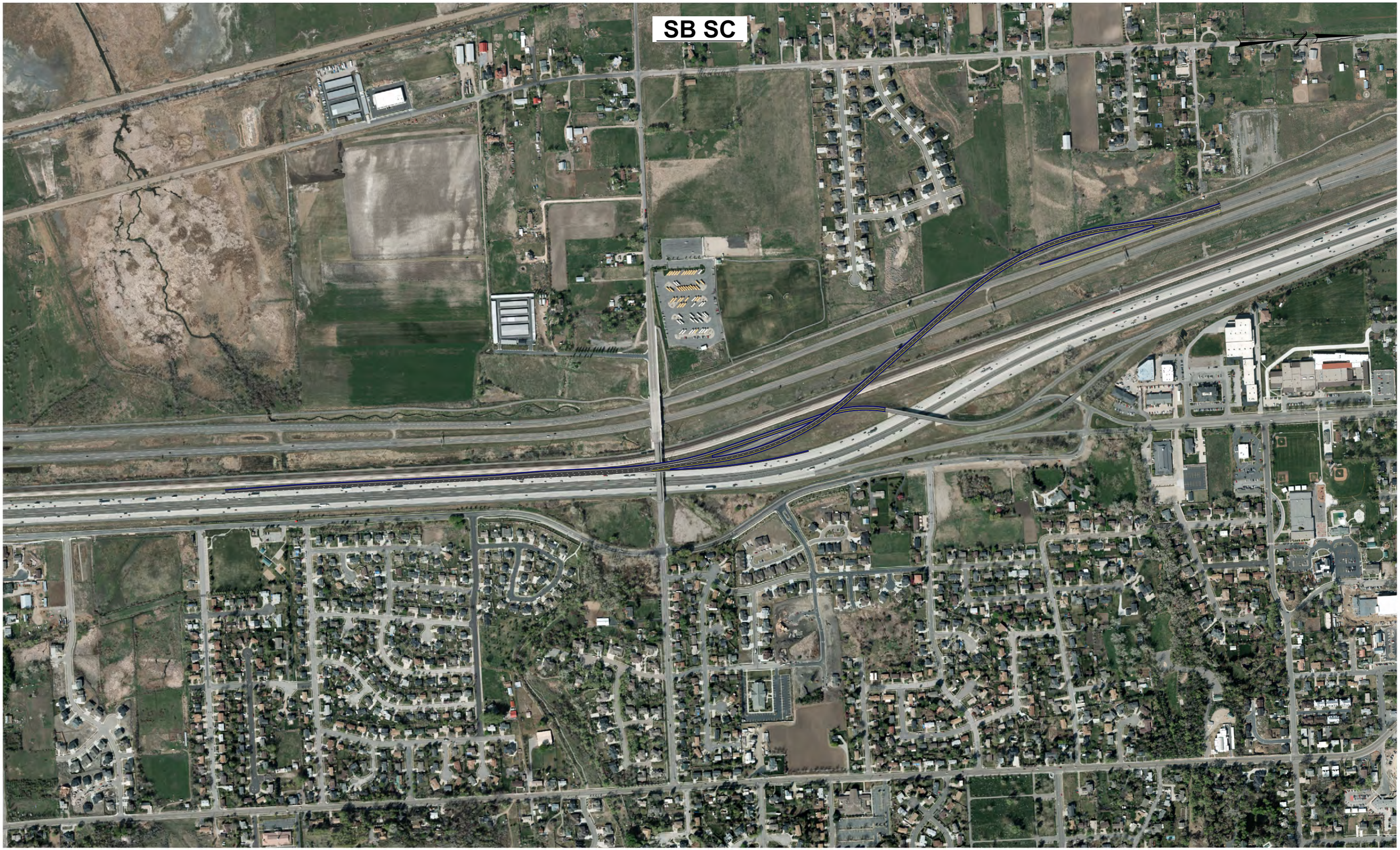
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