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16. Abstract

Over the last several years, there has been a substantial increase in traffic in cities along the Texas-Mexico border. Laredo, Texas is located on IH 35 -- the only north/south interstate freeway in the state that connects directly to Mexico. The increased traffic has also resulted in increased development along IH 35. Specifically, a circumferential road designated as Loop 20 is being constructed to intersect IH 35 at Milo Road (FM 3464) in northern Laredo. The section of Loop 20 which intersects I-35 will ultimately be developed into a freeway facility. The diamond interchange that exists at the IH 35/Milo Road intersection currently operates poorly during the morning and evening peak periods. The additional demand from Loop 20 will cause added delay and will require capacity improvements. This report documents the analysis and recommendations associated with a long-range improvement strategy for the Milo Road Interchange.

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IH 35/Milo Road (Loop 20) Interchange Analysis Laredo, Texas

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Sponsored by the
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IMPLEMENTATION STATEMENT

This research report documents the analysis of existing operations at the IH 35/Milo Road (Loop 20) Interchange in Laredo, Texas and the evaluation of alternative geometric improvements. The interchange currently operates poorly during the morning and evening peak periods. The addition of a Loop 20 connection to the interchange, increased truck traffic resulting from a fourth bridge connecting directly to Milo Road, and proposed developments in the area will only increase the congestion. The results from this study can be used in the development of design drawings for an improved IH 35/Milo Road Interchange.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. This report was prepared by Kirk E. Barnes (Texas certification number 66755) and Russell H. Henk (Texas certification number 74460).

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SUMMARY

This study addresses the interim and long-range capacity needs for the Milo Interchange in Laredo, Texas. Analyses conducted as a part of this study indicate that the existing interchange (with the Loop 20 connection complete) currently operates with a moderate level of congestion (Table S-1). Within the next ten years, however, the operations at the interchange will significantly deteriorate (to level-of-service F).

Table S-1. Summary of Milo Interchange Operational Analysis

Condition	Interchange Stopped Delay (veh-hrs/hr)	Average Stopped Delay (sec/veh)	Level-of-Service (LOS)[1]
Existing Configuration, (With Loop 20 Connection), 1993 Volumes, P.M. Peak[2]	14	22	C
Existing Configuration, (With Loop 20 Connection), 2003 Volumes, P.M. Peak[2]	2,083	1,148	F
2-Level Split Diamond Interchange, 2003 Volumes, P.M. Peak[2]	11	14	B
2-Level Split Diamond Interchange, 2013 Volumes, P.M. Peak[2]	38	30	D
2-Level Split Diamond Interchange, (With Two Direct Connection Ramps), 2013, P.M. Peak[2,3]	11	12	B

[1]Level-of-service is based on average stopped delay (seconds per vehicle)
[2]Does not include grade-separated Loop 20 mainlanes
[3]The two direct connector ramps are the eastbound FM 3464 to northbound IH 35 and southbound IH 35 to westbound FM 3464

As is noted in Table S-1, improving the Milo Interchange to a two-level split diamond design with two direct connector ramps will not only provide significant decreases in delay for the year 2003, but will also provide acceptable levels-of-service (LOS) in the year 2013. Construction of the direct connector ramps for the southbound IH 35 to westbound FM 3464 movements (and vice versa) would improve operations in the year 2013 from LOS D to LOS B. The costs associated with this design would be approximately $24 million and would meet the apparent long-term needs at the interchange.

It is, therefore, recommended that efforts be initiated to improve the Milo Interchange to a two-level split diamond design with two direct connector ramps. It is further suggested that operations at the Milo Interchange and its immediate vicinity be monitored. Many variables (e.g., changes in adjacent land use, changes in U.S. and/or Mexican transportation policies, devaluation of the peso, NAFTA, etc.) still exist with regard to this interchange which, at present, are impossible to accurately predict and/or quantify. Changes in these variables will have a direct significant impact on the travel patterns at the interchange and will subsequently require re-examination of appropriate improvements.

I. INTRODUCTION

In order to improve the movement of goods and people in a quickly developing area north of Laredo, the Laredo District of the Texas Department of Transportation (TxDOT) has requested that the Texas Transportation Institute (TTI) develop a future improvement strategy for the IH 35/FM 3464 (Milo Road) Interchange. The area shown in Figure 1 is approximately 11.9 km (7.4 miles) north and 4.2 km (2.6 miles) west of the Texas-Mexico border.

PROBLEM STATEMENT

The Milo Road Interchange experiences periods of congestion due to the limited existing capacity at the interchange and the high volume of trucks which utilize the facility. The location's close proximity to the Mexican border, its position on a major north/south interstate highway, and the recent North American Free Trade Agreement (NAFTA) provide considerable traffic growth potential. Two of the most prominent future developments in the area that will have a significant impact on traffic at the Milo Road Interchange are the current construction of Loop 20 (that will intersect IH 35 at FM 3464 on the east side of the interchange) and the planned development of a fourth border crossing that will connect directly to FM 3464 from the west.

STUDY OBJECTIVE

The objective of this study is to develop and evaluate alternative geometric design improvements that will provide acceptable levels of operation at the Milo Road Interchange, both now and in the future.

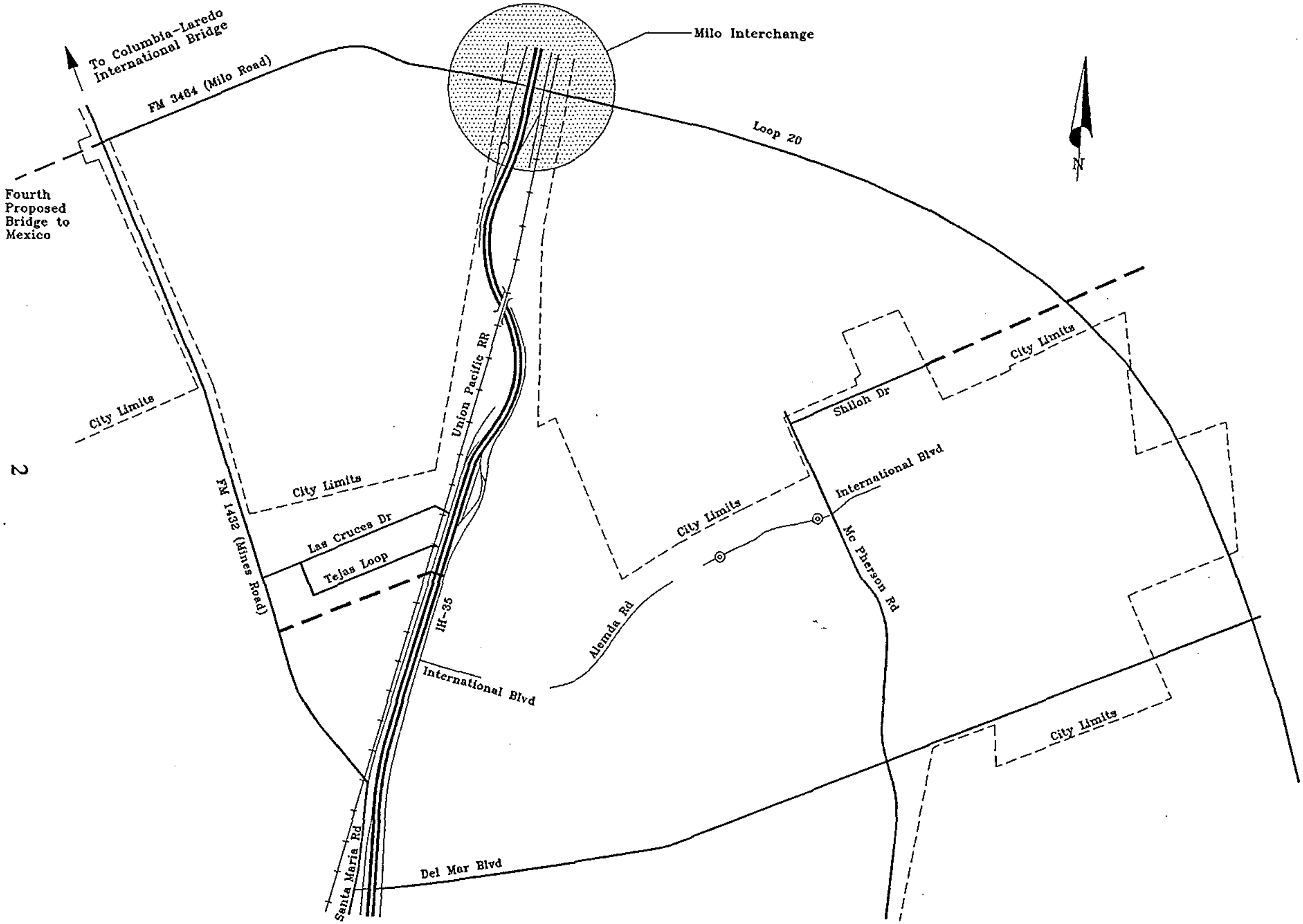


Figure 1. Milo Interchange Vicinity Map

II. DESIGN CONSIDERATIONS

The existing Milo Road Interchange needs considerable capacity improvements to minimize the current congestion. Additional demand from future corridors will only amplify the effects of the bottleneck that currently exists at the interchange. Aspects of the site that were considered to be design factors are discussed subsequently.

LOOP 20

A "circumferential" roadway is currently under construction that will ultimately connect U.S. 59 with IH 35 in the northeastern section of the city of Laredo. The section of Loop 20 which intersects I-35 (i.e., the northern portion of the inner loop) is being constructed on a 400-foot right-of-way (ROW). Loop 20 is ultimately planned to be a freeway-class facility, consisting of mainlanes and frontage roads with restricted control of access. The initial construction has entailed a two-lane two-way roadway with at-grade intersections that connect Loop 20 with IH 35 at FM 3464 to the north and Del Mar Boulevard to the south. In order to allow the new two-lane roadway to serve as the north-side frontage road in the future and provide room for the future development of a freeway cross-section, the initial construction is taking place on the northern/eastern side of the ROW.

UNION PACIFIC RAILROAD

The Union Pacific Railroad (UPRR) runs parallel and to the west of IH 35 through Laredo to just south of the existing Milo Road Interchange. At this point, the railroad crosses over IH 35 and continues northward on the east side of IH 35 (Figure 1). At the Milo Road Interchange, the UPRR lies approximately 300 feet east of the northbound IH 35 mainlanes. The bridge structure, which provides a grade-separation between the UPRR and IH 35 (just south of the Milo Road Interchange), was constructed in such a way that the frontage roads are not provided north of the Texas Tourist Information Bureau. However, the frontage road system begins again just north of the UPRR bridge structure. The only manner in which continuous one-way frontage roads could be provided north of the proposed Shiloh Interchange would be to improve the existing UPRR bridge structure to accommodate more traffic lanes beneath the structure. Future transportation facility improvements in the area are required to be grade-separated from the railroad. This design constraint limits design alternatives, but is necessary for both safety and capacity reasons. All future mainlanes, frontage roads, or ramps must either be constructed over or underneath the existing UPRR.

ACCESS TO ADJACENT LAND

When continuous frontage roads are maintained along a controlled access roadway, access to the adjacent property can easily be provided. However, discontinuous frontage roads and the nearby UPRR (with its grade separation requirements), limit the range of geometric alternatives. If elevated, the frontage roads will not provide access to the adjacent land. If the provision of good access is desired, the frontage roads must, therefore, be at ground level.

FM 1472

FM 1472 (Mines Road) is a major north/south roadway that provides access to IH 35 (at the Del Mar Interchange and from FM 3464) from the major shipping/warehouse area of northwest Laredo (Figure 1). Mines Road has recently been upgraded to a five-lane arterial, with two lanes in each direction and a continuous left-turn lane from the Del Mar Interchange area to north of the FM 3464 intersection. Mines Road (along with Milo Road) also provides direct access to the Laredo Solidarity Bridge.

TRUCK TRAFFIC

The proximity of the site to the Mexican border and the increased emphasis on free trade has produced an extraordinarily large percentage of trucks within the traffic mix at the Milo

Road Interchange. Trucks at the interchange currently account for up to 50 percent of the approach volumes. The design and operations of an interchange at this location should include considerations for such a large truck population. Turning radii, lane widths, stopping distances, and storage bays should be designed for the WB-50 vehicle class as a minimum.

INTERCHANGE SPACING

Diamond interchanges currently exist at Del Mar Boulevard and Milo Road with approximately three miles separating them. A previous study by TTI has indicated the need for another interchange (Shiloh Interchange) near the existing Texas Tourist Information Bureau. An interchange at Shiloh would produce desirable interchange spacings of approximately 2.4 km (1.5 miles) between Del Mar Boulevard and Milo Road. The addition of a new Shiloh Interchange would also allow the conversion of the eastside frontage road north of Del Mar to one-way operation. This conversion would allow the removal of one signal phase from the Del Mar Interchange, thereby significantly improving operations at that interchange. The adjacent interchange north of Milo Road is located approximately 10 km (6 miles) away.

RAMP CONFIGURATIONS

The current ramp configurations that prevail in Laredo produce interchanges commonly known as "diamond" interchanges. The basic design characteristics of a diamond interchange include exit ramps upstream of the cross street and entrance ramps downstream from the cross street. An alternative interchange design for the Milo Road Interchange should maintain the same ramp configurations in order to preserve driver expectancy. Since the intersection of IH 35 and Loop 20 is planned to become a freeway-to-freeway interchange that is grade-separated from the UPRR, configurations such as a three-level diamond or fully directional interchange are logical design candidates.

FUTURE BORDER CROSSING (FOURTH BRIDGE)

Milo Road currently forms a "T" intersection with Mines Road west of IH 35. A Presidential Permit has been received by the City of Laredo for a fourth bridge crossing which will intersect Mines Road at Milo Road (Figure 1). Since 1990 and the opening of the Laredo Solidarity Bridge, traffic on Milo Road has tripled. The advent of a fourth border crossing will undoubtedly produce additional increases in demand on Milo Road and its connection to IH 35. Local officials are also considering the prohibition of truck traffic across the IH 35 bridge into Mexico. All truck traffic would be re-routed to either the Laredo Solidarity Bridge or the new Fourth (Milo Road) Bridge.

III. STUDY DESIGN

The study involved the following four major tasks:

- The collection of data associated with existing conditions - geometrics, traffic control, traffic demand, visual observation of visual operations;
- The analysis of existing and projected operations;
- The development and analysis of alternative designs; and
- The production of a report documenting the study findings and recommendations.

EXISTING CONDITIONS

The Milo Road Interchange is currently a diamond configuration with signal control on the two-way frontage road intersections that experiences considerable congestion during the peak periods (i.e., 7:00 to 8:00 a.m. and 4:00 to 5:00 p.m.). The queue for the northbound exit to Milo Road often extends back onto the exit ramp from the IH 35 mainlanes. A considerable queue also forms on the eastbound Milo Road approach to the westside frontage road to turn right (southbound). Figure 2 shows a schematic of the existing lane assignments for the frontage roads and Milo Road. Changes associated with the Loop 20 connection on the east side of the interchange are, however, currently being initiated which will improve operations considerably.

Traffic data were collected in October 1993 and included 24-hour directional machine counts for all ramps, frontage roads, mainlanes, and Milo Road. The machine counts were used to count axles, while manual counts were used to derive a factor of 3.5 axles/vehicle for this interchange. The average daily traffic (ADT) and peak hour volumes derived from the machines counts are shown in Figure 3. The manual counts were conducted using a video camera at each side of the interchange. The morning and evening peak-hour volumes are shown in Figures 4 and 5. At the time of the data collection process, no construction had begun on Loop 20.

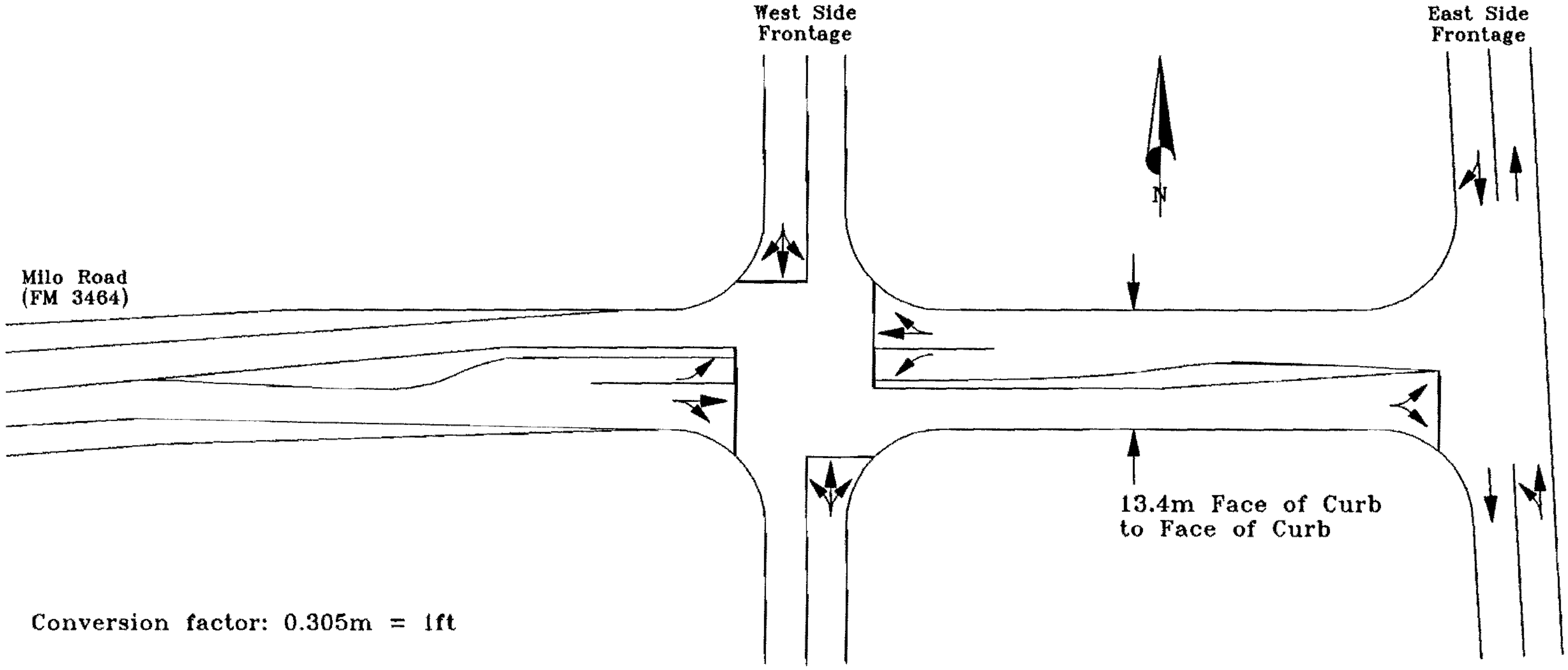


Figure 2. Existing Lane Assignments, Milo Road Interchange

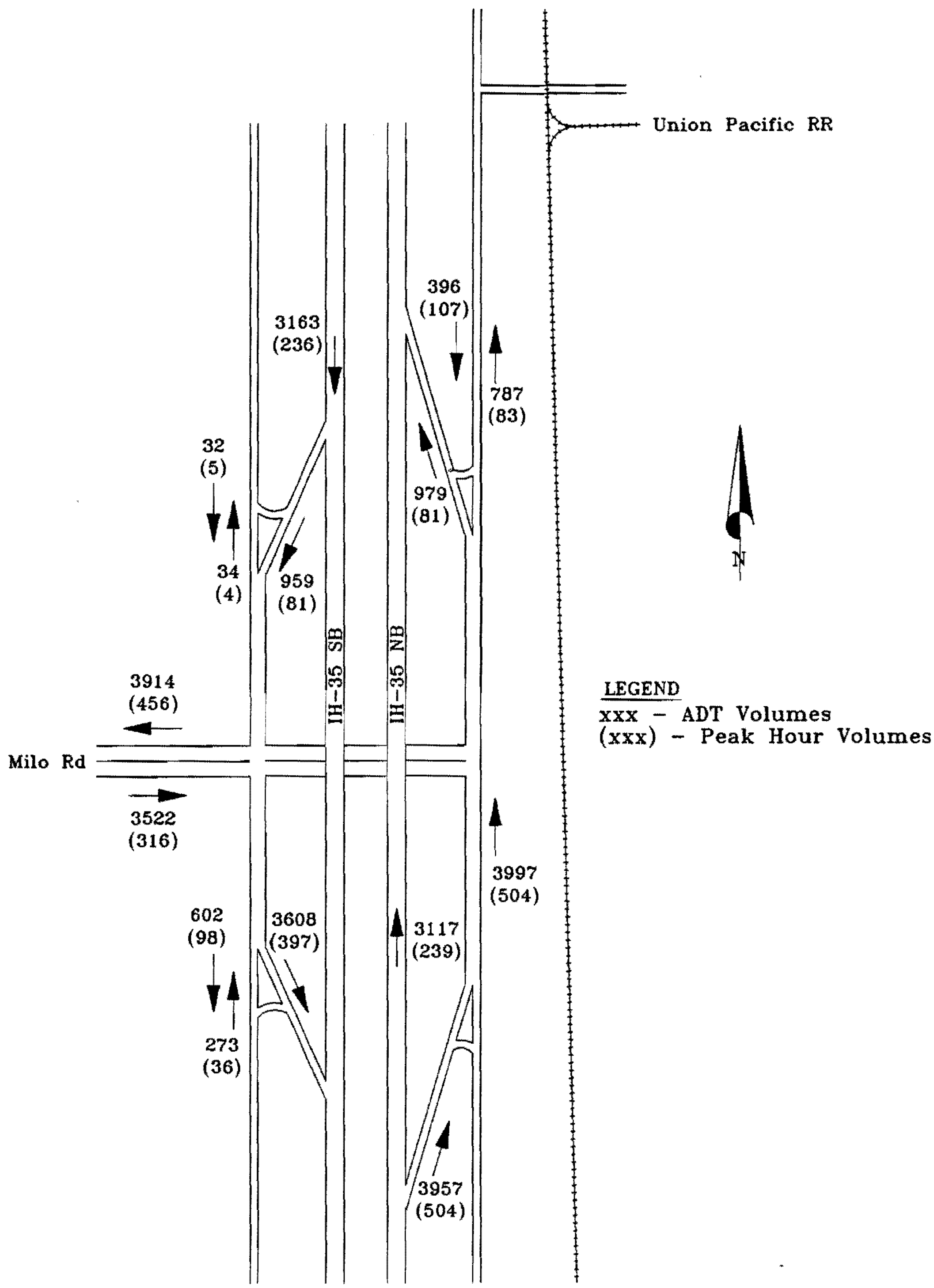


Figure 3. Milo Road Interchange ADT and Peak Hour Volumes

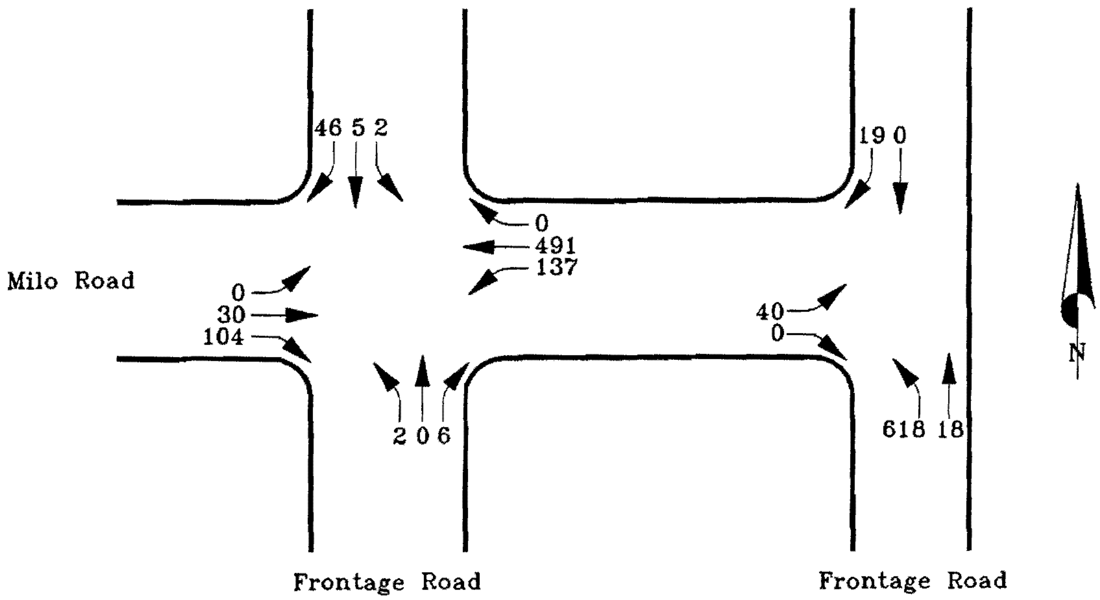


Figure 4. Morning Peak Hour Volumes at IH 35/Milo Road Interchange

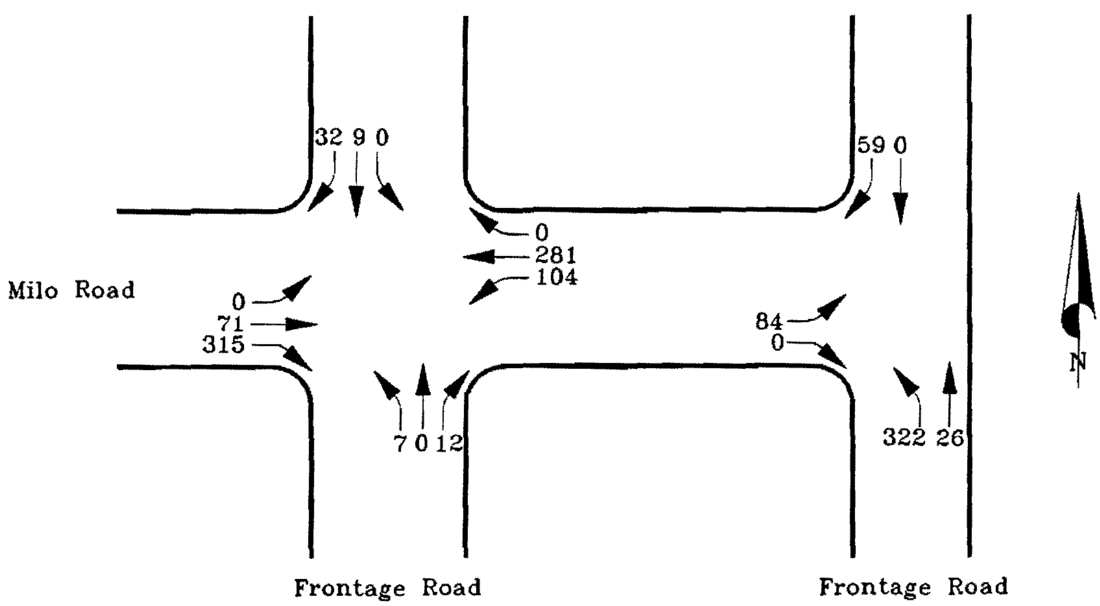


Figure 5. Evening Peak Hour Volumes at IH 35/Milo Road Interchange

ANALYSIS OF EXISTING OPERATIONS

Analysis of the existing interchange was accomplished using TRANSYT-7F to optimize and simulate the operating conditions. PASSER III was not used for this scenario since it is not able to simulate two-way frontage roads. During the TRANSYT analysis, each truck was equated to two passenger car equivalents, and a vehicle mix of 50% trucks was used. The results indicated that the interchange currently operates with 34 vehicle-hours of stopped delay, with an average delay of 94 seconds per vehicle (level-of-service F) during the morning peak hour (7:00 to 8:00 a.m.). The analysis for the evening peak hour indicated a stopped delay of four vehicle-hours and an average delay of 12 seconds per vehicle (LOS B). The level-of-service was derived from the 1985 Highway Capacity Manual (HCM) average delay/vehicle guidelines. As alluded to previously, improvements to the east side of the interchange (in association with the Loop 20 connection) will improve current operations to LOS C.

INTERIM OPERATIONS WITH LOOP 20

The construction of the first phase of Loop 20 (IH 35 to Del Mar Boulevard) is complete. The eastside intersection of the Milo Road Interchange has been reconfigured during the Loop 20 addition. Figure 6 shows a schematic of the lane assignments for the interchange upon its completion (connection with Loop 20) in the fall of 1994. Projected traffic volumes for Loop 20 were obtained from the Laredo District office of the Texas Department of Transportation (TxDOT). The 1993 projected morning and evening peak hour interchange volumes with a Loop 20 connection are shown in Figures 7 and 8 respectively. TRANSYT was used to analyze the operations of the interchange with the volumes and lane assignments that are projected after the opening of Loop 20. The analysis indicated that the morning peak hour would produce a total interchange stopped delay of 13 vehicle-hours with an average stopped delay of 21 seconds per vehicle. The evening peak hour would produce a total interchange stopped delay of 14 vehicle-hours with an average stopped delay of 22 seconds per vehicle. Consequently, the operations of the Milo Road Interchange will operate with an improvement to a LOS C when Loop 20 is made operational. The reason for the improved operations of the interchange after the opening

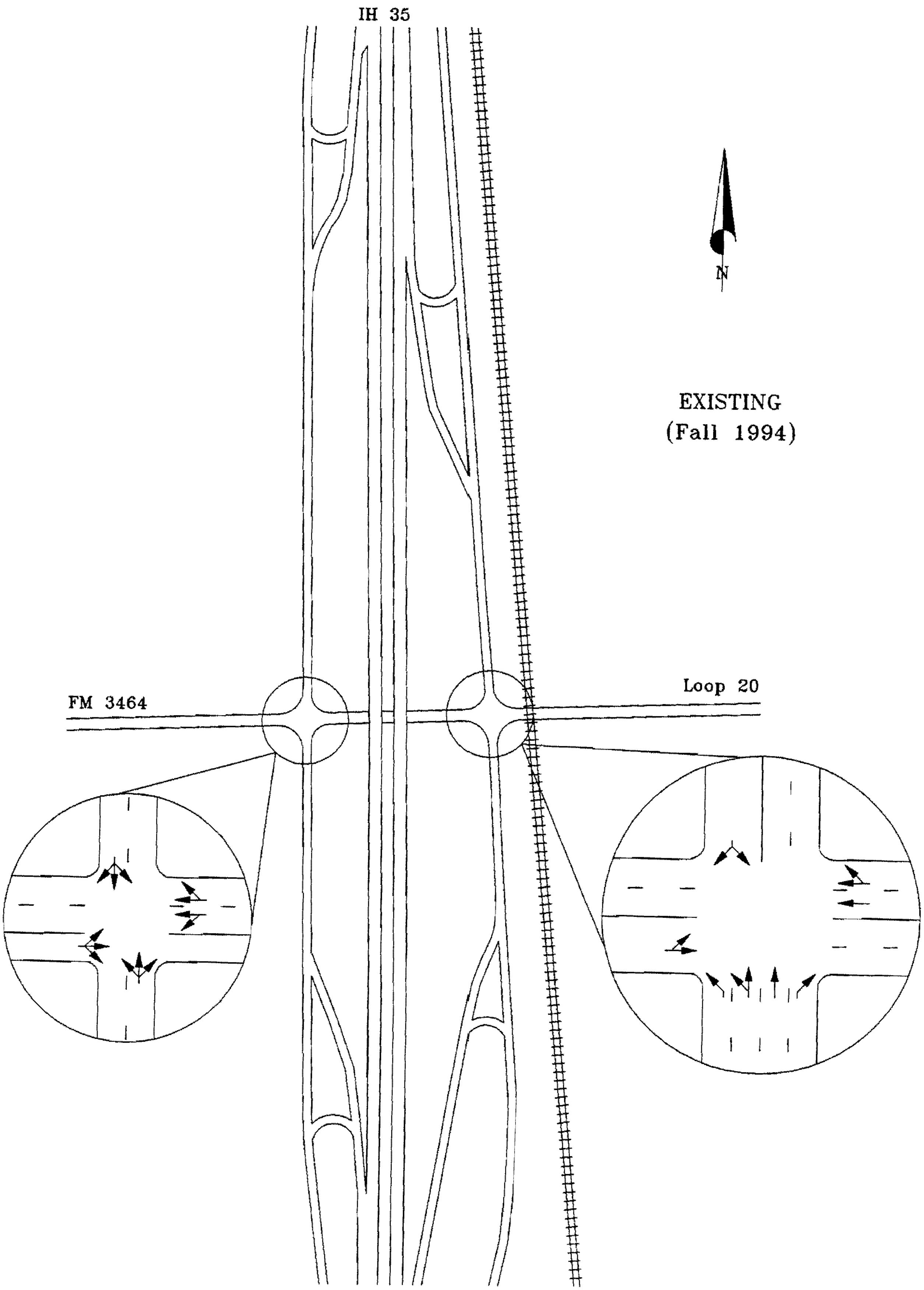


Figure 6. Milo Road Interchange Lane Assignments with Loop 20 Connection

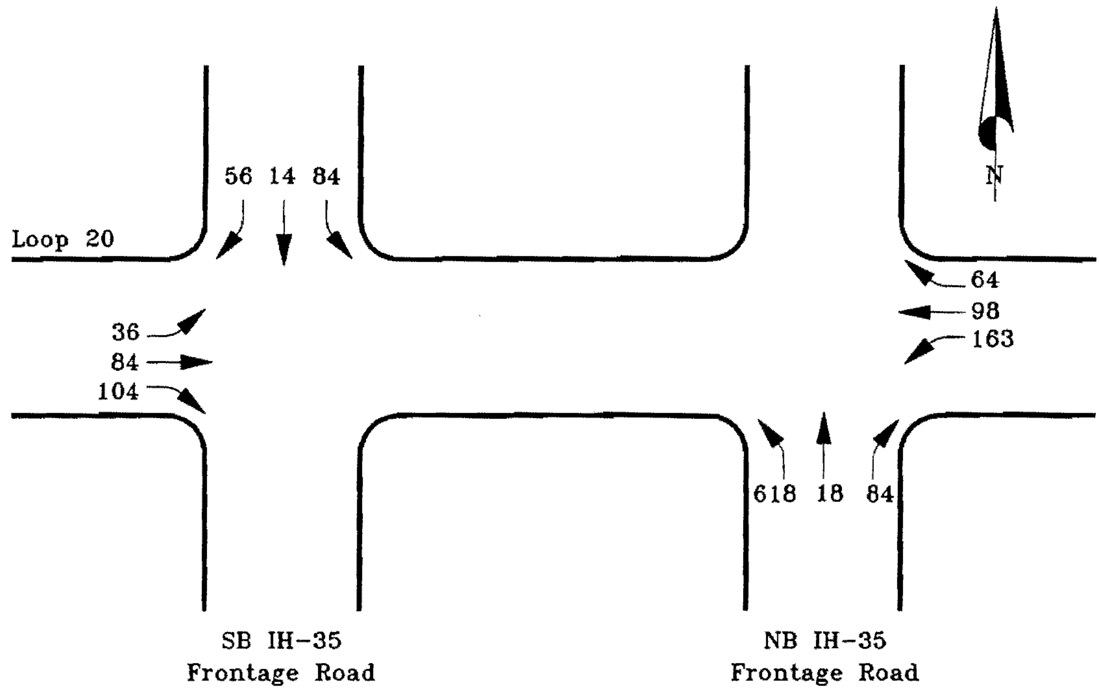


Figure 7. Morning Peak Hour Volumes (1993) at IH 35/Milo Road Interchange with Loop 20 Connection

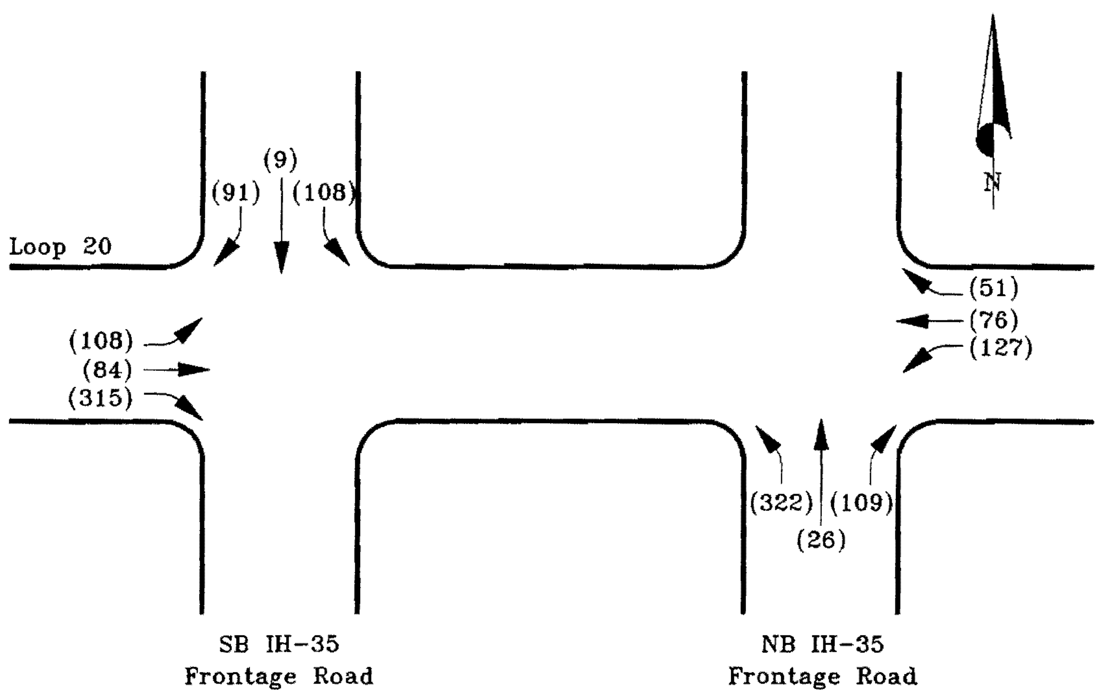


Figure 8. Evening Peak Hour Volumes (1993) at IH 35/Milo Road Interchange with Loop 20 Connection

of Loop 20 is the capacity improvements (additional lanes on the external approaches) that will be made on the eastern intersection.

FUTURE OPERATIONS

The operations at the Milo Road Interchange are expected to deteriorate over time due to a significant growth in demand. An automatic traffic recorder (ATR) station located on IH 35 approximately 1.1 km (0.7 miles) north of Mines Road was used to determine that the average annual traffic growth rate since 1988 (i.e., over the last five years) has been 19 percent. To conservatively estimate the traffic demand for 10- and 20-year projections, a progressively decreasing growth rate was utilized. The growth rate used for future years one through five was 15 percent, for years six through ten, a rate of 8 percent was used, and for years 10 through 20, a rate of 5 percent was used. TRANSYT was used to analyze the 10- and 20-year (2003 and 2013) traffic operations for the Milo Road Interchange. The analysis indicated that the existing interchange will produce LOS F operations for both the a.m. and p.m. peak hours, with (or without) the addition of Loop 20. The TRANSYT analyses for existing and year 2003 conditions for the existing (no Loop 20) and the Loop 20 connection configurations are summarized in Table 1.

Table 1. Summary of Peak Hour TRANSYT Simulations for Existing and Future Traffic

Condition	Interchange Stopped Delay (veh-hrs/hr)	Average Stopped Delay (sec/veh)	Level-of-Service (LOS)[1]
Existing Configuration, 1993 Volumes, A.M. Peak Hour[2]	34	94	F
Existing Configuration, 1993 Volumes, P.M. Peak Hour[2]	4	12	B
Loop 20 Connection with Associated Improvements, 1993 Volumes, A.M. Peak Hour[3]	13	21	C
Loop 20 Connection with Associated Improvements, 1993 Volumes, P.M. Peak Hour[3]	14	22	C
Existing Configuration, 2003 Volumes, A.M. Peak Hour[2]	1,418	930	F
Existing Configuration, 2003 Volumes, P.M. Peak Hour[2]	762	751	F
Loop 20 Connection with Associated Improvements, 2003 Volumes, A.M. Peak Hour[3]	2,083	1,148	F
Loop 20 Connection with Associated Improvements, 2003 Volumes, P.M. Peak Hour[3]	1,633	876	F

[1]Level-of-service is based on average stopped delay (seconds per vehicle)

[2]Interchange configuration as in Figure 2

[3]Interchange configuration as in Figure 6

IV. ALTERNATIVE DESIGN DEVELOPMENT

All of the design considerations listed previously were used in the development of an alternative design for the Milo Road Interchange. The ultimate plan for Loop 20 is to be an access-controlled, grade-separated freeway facility. Thus, the early stage(s) of development for the interchange had to be conducive to an eventual freeway-to-freeway interchange. All movements had to be grade-separated from the nearby UPRR. In addition, the roadway system had to provide access to the adjacent land for development. The system of roadways that connected the interchange to the surrounding network had to have adequate capacity for future demands. The design had to comply with driver expectancy and maintain design consistency. One of the major considerations was to design for an unusually high percentage of truck traffic. Above all else, the interchange had to be able to be constructed without causing undue delay to the existing traffic.

ALTERNATIVE GEOMETRICS

Several geometric configurations were considered for the Milo Road Interchange. However, only a three-level diamond, a fully directional interchange, or a combination of both designs met all design requirements.

The grade separation of all roadways from the UPRR on the east side of IH 35 proved to be one of the most demanding design considerations. As mentioned previously, Loop 20 is currently being constructed as a two-lane, two-way roadway on an alignment that will ultimately become the westbound frontage road. A schematic of the Milo Road Interchange with the connection to Loop 20 is shown in Figure 6. If the Loop 20 frontage roads were elevated over the UPRR, then they would not provide access to the adjacent land and would require lowering the IH 35 mainlanes (i.e., an extremely expensive construction sequence). It was, therefore, decided that the Loop 20 frontage roads should pass underneath the UPRR. This configuration would provide a UPRR grade separation, access for land development and comply with all other design considerations. A maximum grade of four percent could be used under the railroad crossing. The existing and future sequences for the construction of a three-level diamond at the Milo Road Interchange are illustrated in Figures 9 through 12. Step 2 in Figure 10 (i.e., the construction of the grade-separated one-way Loop 20 frontage roads crossing underneath the UPRR and IH 35) will produce two levels of a traditional three-level diamond interchange. This configuration (Step 2) is the minimum recommended configuration that will accommodate projected 10-year demands. All Loop 20 movements would be required to pass through at least one signal. A schematic of the four signalized intersections for the Step 2, two-level diamond interchange is shown in Figure 13.

As future demand dictates, the Loop 20 mainlanes could be constructed between the two frontage roads and routed over the top of the IH 35 mainlanes (Step 3). If turning movement volumes reach a critical point (i.e., the level-of-service begins to significantly deteriorate), then it may become necessary to construct direct connectors. It is expected that the eastbound Milo Road to northbound IH 35 and southbound IH 35 to westbound Milo Road will be the predominant turning movements that might require direct connector ramps (Figure 12). These heavy movements are predicated on the construction of the Fourth Bridge, which will tie directly to Milo Road west of the interchange.

Other improvements in the area that are recommended to compliment the proposed interchange configuration are the following.

- Eventual conversion of all frontage roads to one-way traffic. The existing low volumes that would be affected and the development of the Shiloh Interchange to the south support such a change.The frontage roads north of Milo Road Interchange should ultimately be converted to one-way to minimize the number of signal phases at the interchange, thereby reducing delay. Circulation problems associated with the Intermodal Center may require the conversion of frontage roads to one-way operation in the northeast quadrant of the interchange to be delayed for the time being.

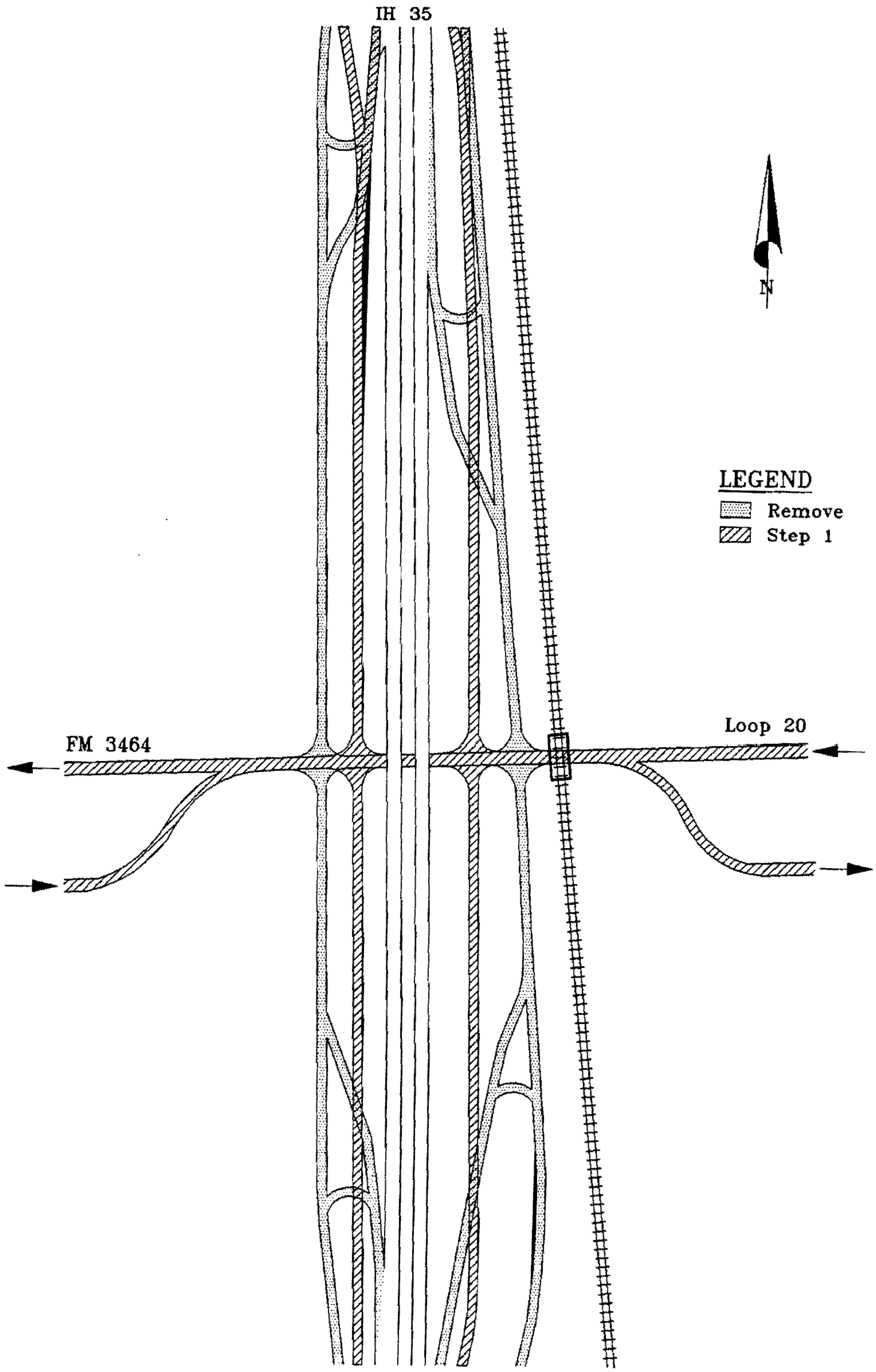


Figure 9. Step 1 Construction of Proposed Milo Road Interchange

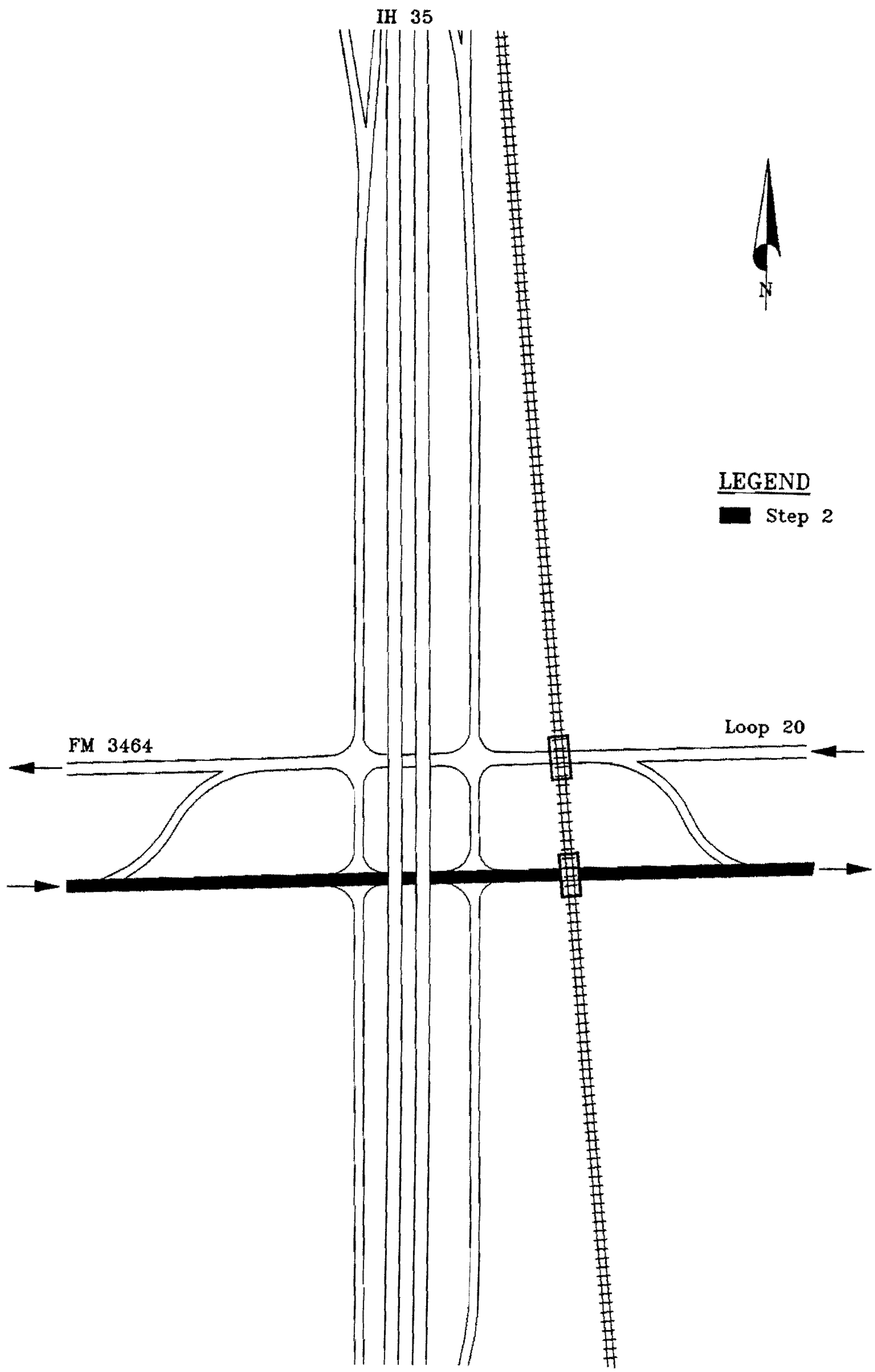


Figure 10. Step 2 Construction of Proposed Milo Road Interchange

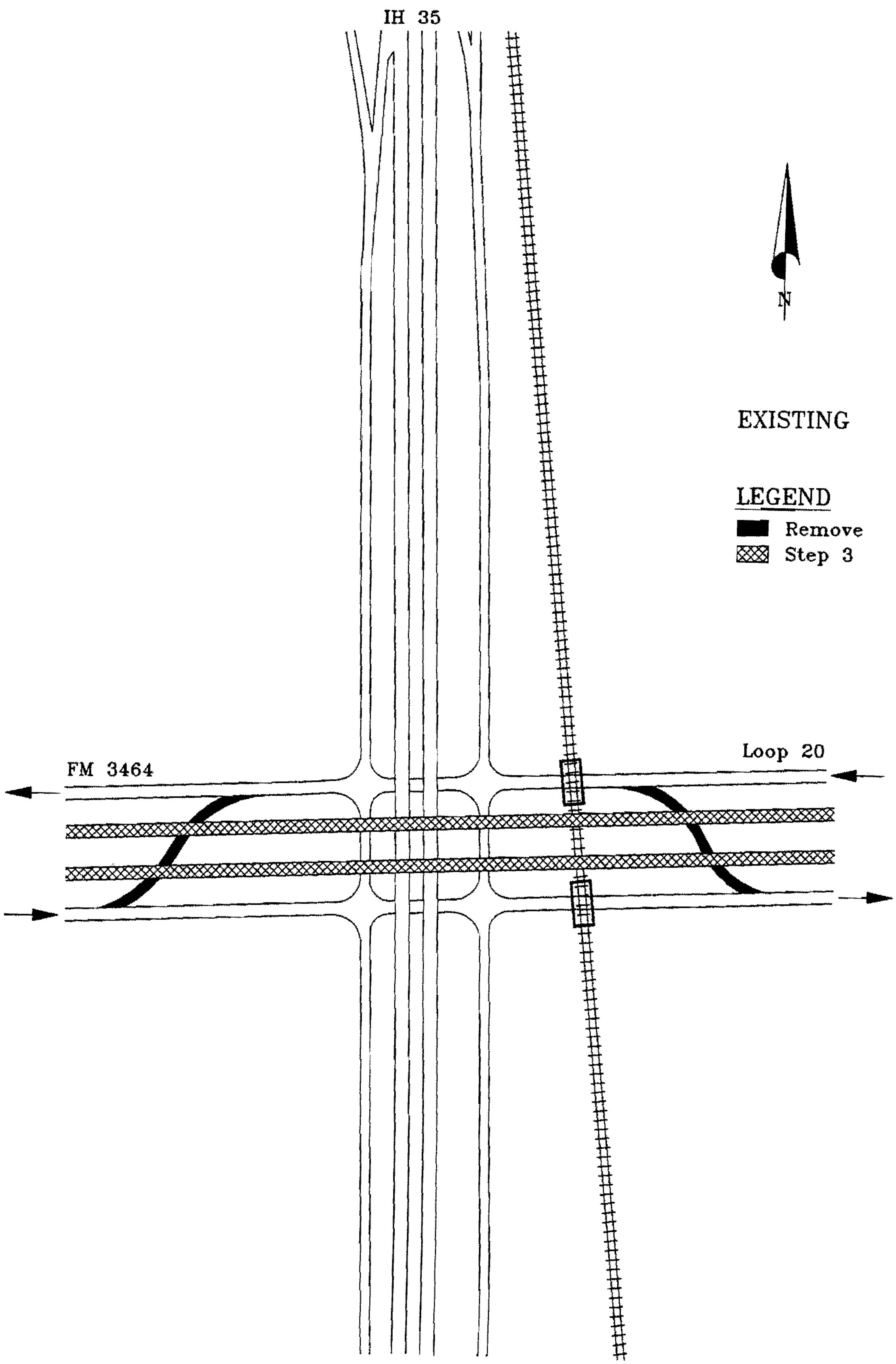


Figure 11. Step 3 Construction of Proposed Milo Road Interchange

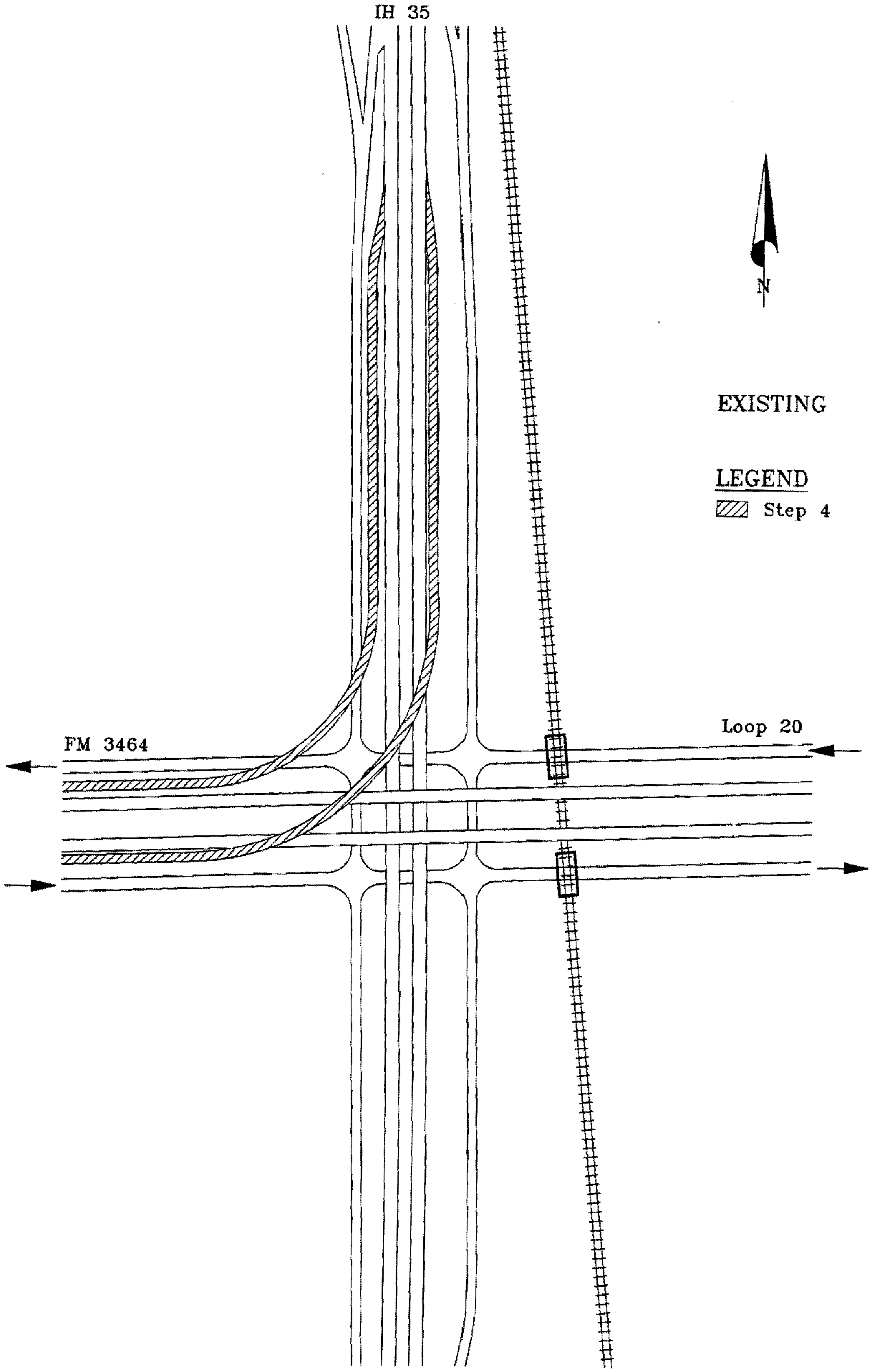


Figure 12. Step 4 Construction of Proposed Milo Road Interchange

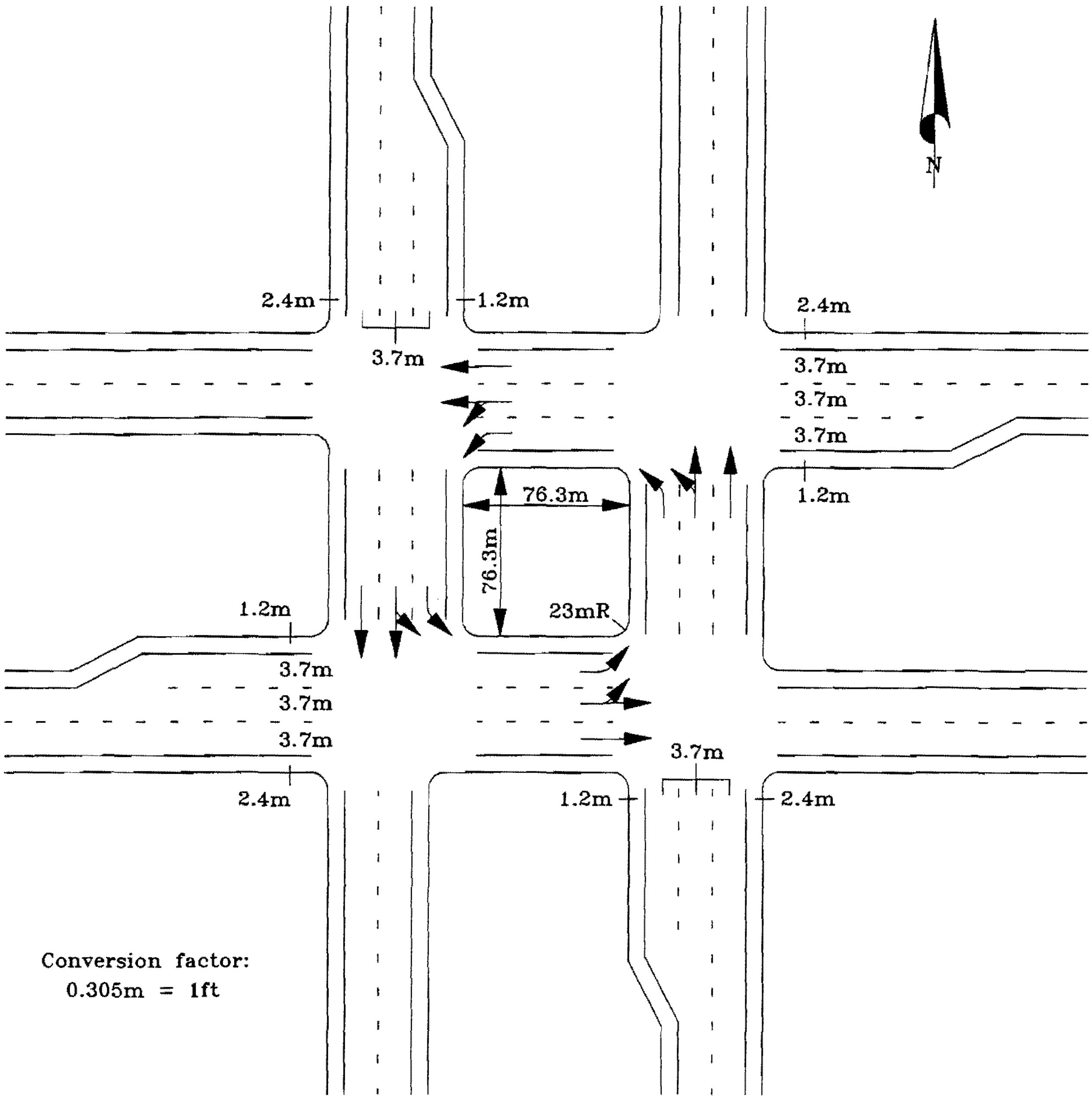


Figure 13. Lane Configuration of Frontage Road (Level 2) Intersections for Proposed Milo Road Interchange

- An additional IH 35 mainlane northbound between the Texas Tourist Bureau entrance and the exit to Loop 20/Milo Road. The positioning of the current UPRR bridge structures prohibit additional mainlane capacity. A new UPRR structure would be necessary to provide this additional lane. The additional lane will serve as an auxiliary lane between the entrance from the Tourist Bureau, the exit to Loop 20/FM 3464, and can even serve as the continuation of the northbound frontage road. An additional IH 35 mainlane is also recommended southbound between the Milo Road entrance and the exit to the Tourist Bureau. A schematic of this configuration is shown in Figure 14. The construction of a structure which spans I-35 would allow for widening to either the outside (as shown) or the inside. Placement of the new bridge columns in the position shown would allow for expansion of I-35 (beyond the widening shown), should the need arise in the future.

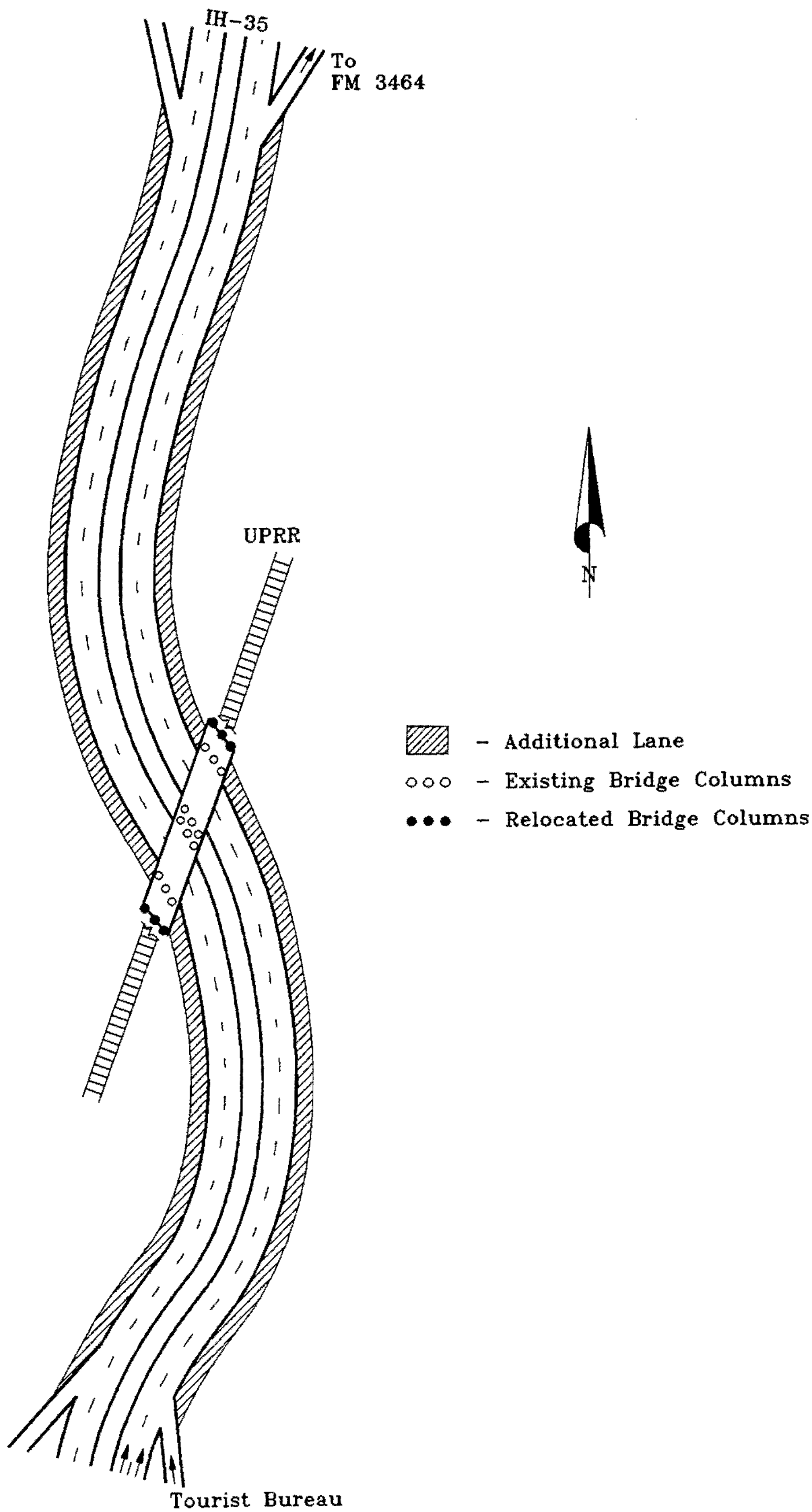


Figure 14. Proposed Additional IH 35 Mainlanes South of Milo Road Interchange

ALTERNATIVE OPERATIONS

The analysis of a three-level diamond interchange with various stages of completion was conducted using TRANSYT. The projected traffic volumes that were used in the analysis (10- and 20-year projections) are shown in Figures 15 and 16. The projected traffic volumes were based on the following assumptions.

- Prohibition of thru trucks (i.e., destined for the border) south of the Milo Interchange along I-35;

- The annual growth rates outlined previously:
  - 15% for years one through five;
  - 8% for years six through 10,
  - 5% for years 11 through 20.

Table 2 summarizes the results of the TRANSYT simulations for the proposed alternatives. The interchange referred to as Step 2 construction, shown in Figure 17, (containing the 4 intersections of Loop 20 frontage roads, IH 35 frontage roads and the IH 35 mainlanes) will operate at LOS B for the morning and evening peak hours with the 10-year projected volumes. The 20-year projected volumes using the Step 2 alternative will operate with a LOS C during the morning peak hour and LOS D during the evening peak hour. If the Step 2 configuration was improved by adding direct connector ramps from eastbound Milo Road to northbound IH 35 and from southbound IH 35 to westbound Milo Road (Figure 18), the operations for the 20-year projected volumes would be at LOS B for both the morning and 4-evening peak hours.

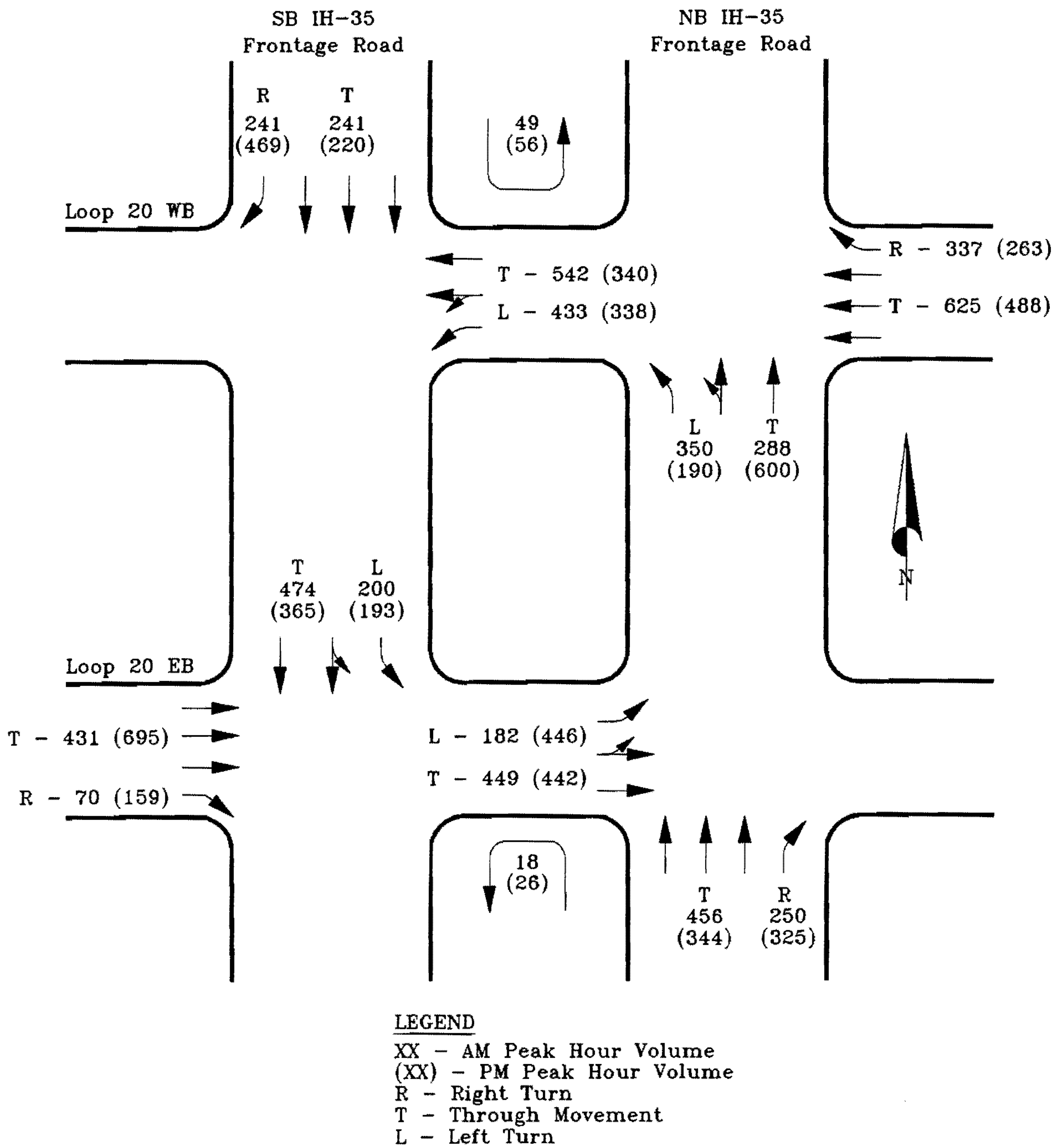
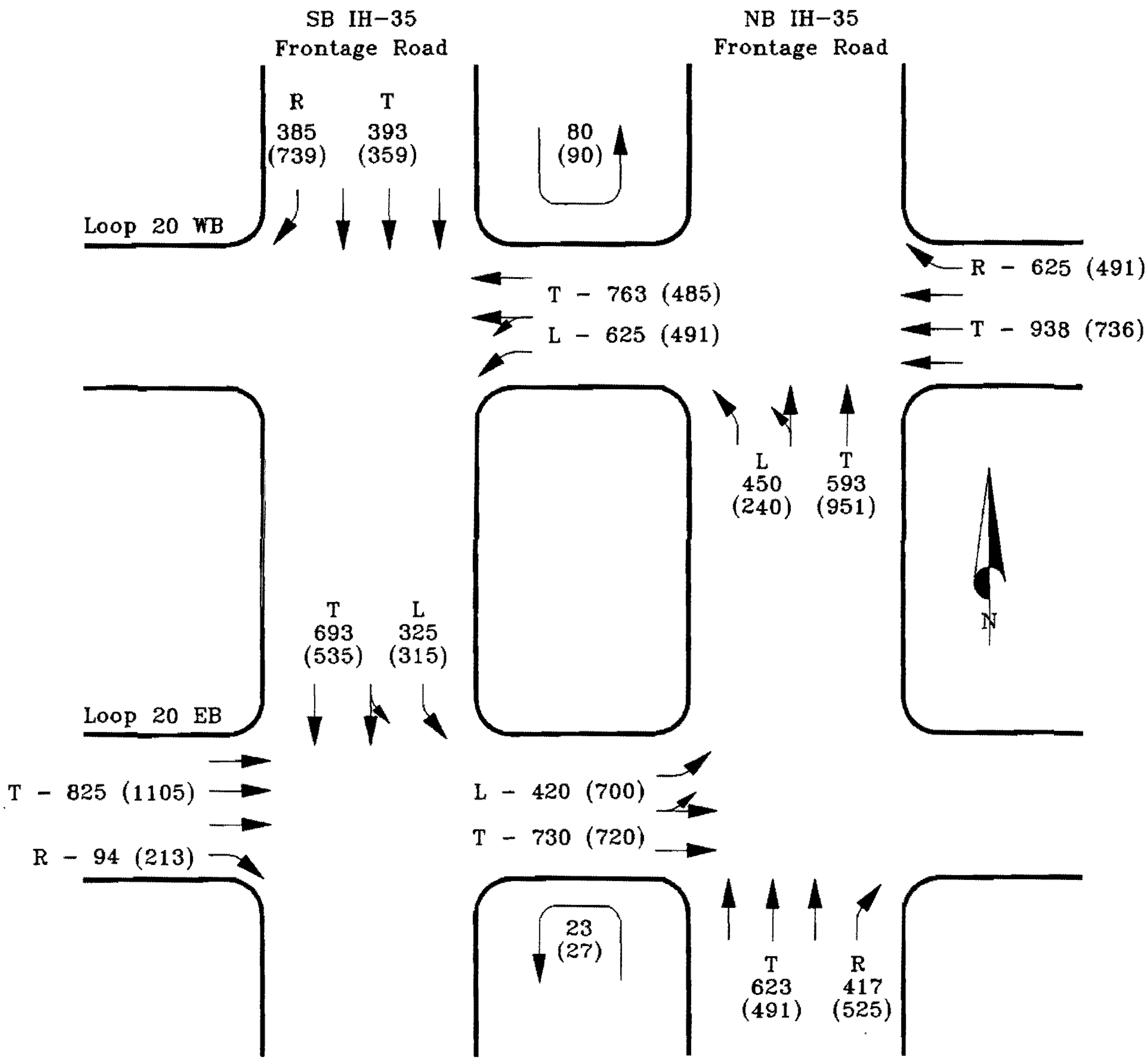


Figure 15. Projected 2003 Volumes for the Proposed IH 35/Milo Road Interchange



LEGEND
XX - AM Peak Hour Volume
(XX) - PM Peak Hour Volume
R - Right Turn
T - Through Movement
L - Left Turn

Figure 16. Projected 2013 Volumes for the Proposed IH 35/Milo Road Interchange

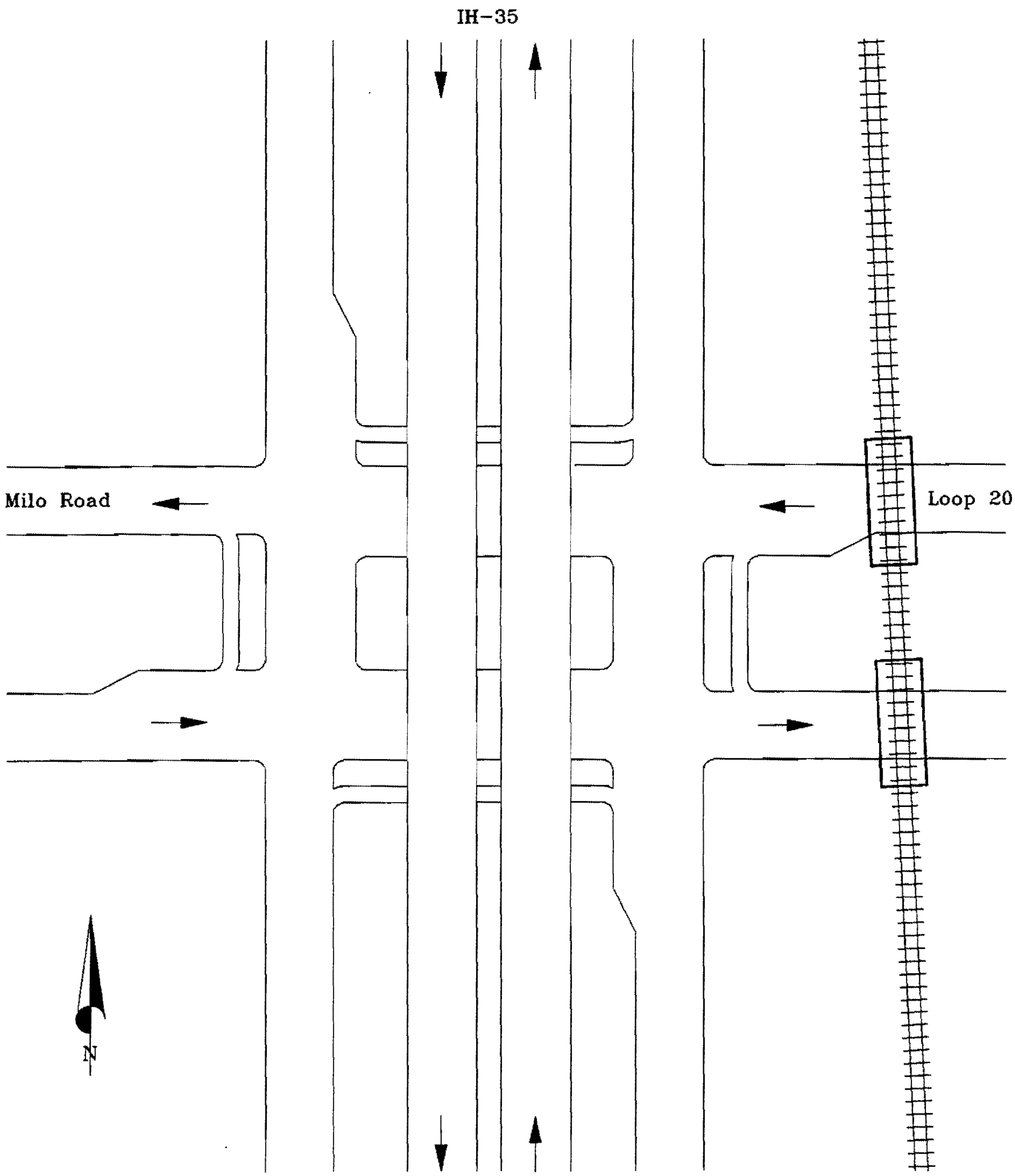


Figure 17. Proposed 2-Level (Step 2) Milo Road Interchange Configuration

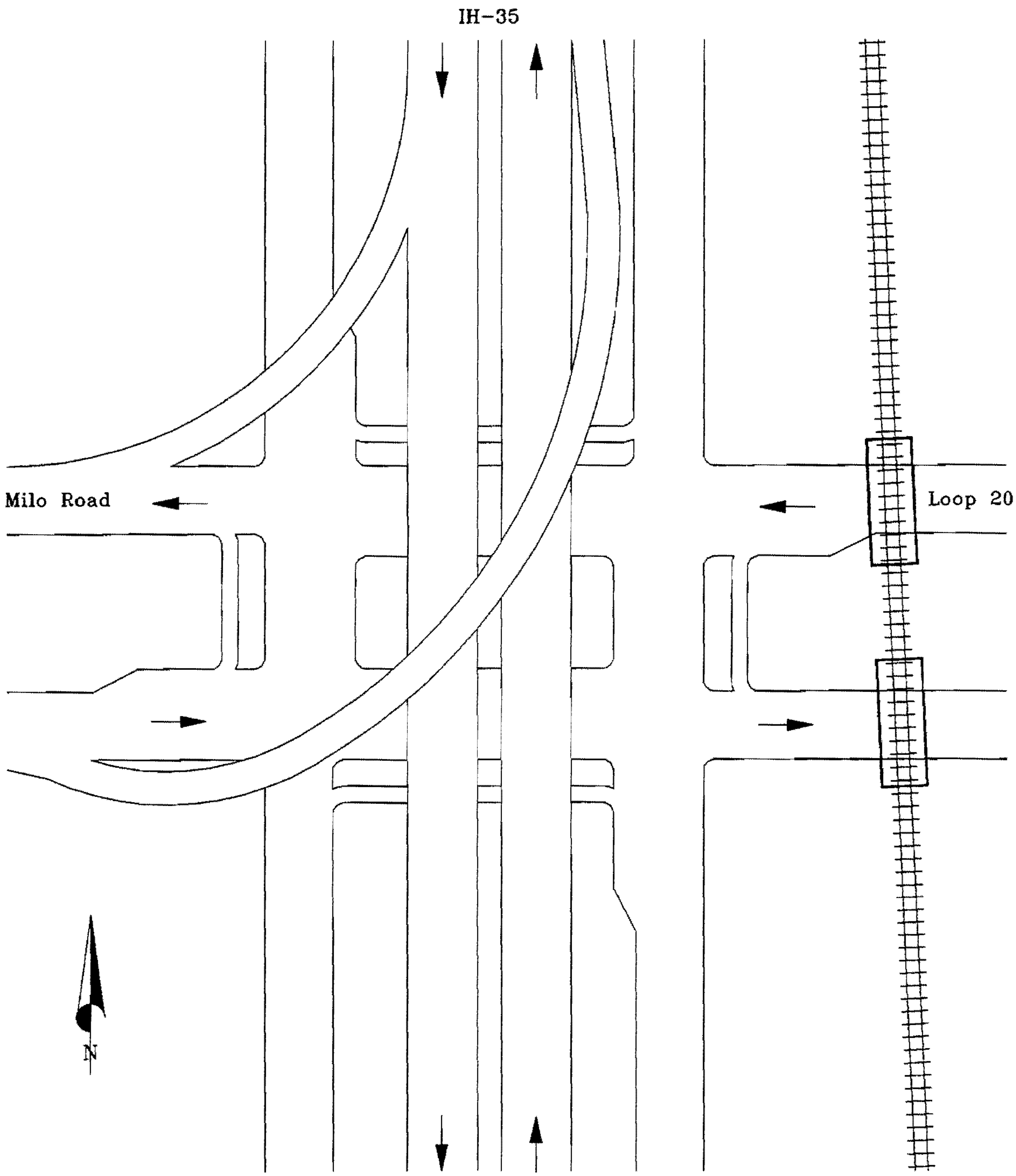


Figure 18. Proposed 2-Level Milo Road Interchange Configuration with Possible Direct Connector Ramps

Table 2. Summary of TRANSYT Simulations for Proposed Alternative

Condition	Interchange Stopped Delay (veh-hrs/hr)	Average Stopped Delay (sec/veh)	Level-of-Service (LOS)[1]
2-Level Split-Diamond Interchange 2003 Volumes A.M. Peak Hour[2]	9	13	B
2-Level Split-Diamond Interchange 2003 Volumes P.M. Peak Hour[2]	11	14	B
2-Level Split-Diamond Interchange 2013 Volumes A.M. Peak Hour[2]	20	17	C
2-Level Split-Diamond Interchange 2013 Volumes P.M. Peak Hour[2]	38	30	D
2-Level Split-Diamond Interchange with two Direct-Connect Ramps, 2003 Volumes A.M. Peak Hour[2,3]	7	11	B
2-Level Split-Diamond Interchange with two Direct-Connect Ramps, 2003 Volumes P.M. Peak Hour[2,3]	6	11	B
2-Level Split-Diamond Interchange with two Direct-Connect Ramps, 2013 Volumes A.M. Peak Hour[2,3]	13	13	B
2-Level Split-Diamond Interchange with two Direct-Connect Ramps, 2013 Volumes P.M. Peak Hour[2,3]	11	12	B

[1]Level-of-service is based on average stopped delay (seconds per vehicle)
[2]Does not include grade-separated Loop 20 mainlanes (Step 2 configuration, Figure 17)
[3]The two direct connector ramps are the eastbound FM 3464 to northbound IH 35 and southbound IH 35 to westbound FM 3464 (Figure 18)

V. COST ESTIMATES

Cost estimates were developed for the various alternatives that were considered. The assumptions that were used for the construction cost were as follows.

Elevated Roadway - $590/m^2$ ($55/ft^2)

Roadway on Embankment - $375/m^2$ ($35/ft^2)

At-Grade Roadway - $270/m^2$ ($25/ft^2)

The cost for the construction of a two-level split-diamond Milo Road Interchange without grade separated Loop 20 mainlanes (as in Figure 17) is approximately $16.4 million. The cost of the same interchange with two direct connect ramps (westbound Milo Road to northbound IH 35 and southbound IH 35 to eastbound Milo Road as Figure 18) is approximately $24 million. The construction of a complete three-level diamond with grade separated Loop 20 mainlanes and no direct connectors is approximately $20.7 million. The cost of a complete three-level diamond Milo Road Interchange with grade-separated Loop 20 mainlanes and all direct connector ramps (8 ramps total) is approximately $55 million.

VI. CONCLUSIONS AND RECOMMENDATIONS

The analyses conducted in this study indicate that the existing Milo Interchange configuration (Fall 1994) will not adequately handle demand beyond the year 2000. In fact, the expected growth in travel demand at the Milo Interchange over the next five years appears to warrant consideration of immediate initiatives to provide capacity improvements. This anticipated high growth in demand is primarily attributed to currently proposed land development adjacent to the interchange (and along Loop 20) and the proposed fourth bridge crossing which will tie directly into Milo Road.

It is recommended that the Milo Interchange be improved to a two-level diamond design with direct connector ramps for the EB Milo Road to NB I-35 movement and vice versa. Such an improvement would (by current traffic demand estimates) provide an acceptable level-of-service for the next 20 years. Provision for the Loop 20 mainlanes to go over I-35 should be built into this design. It is further recommended that the UPRR structure be improved such that three lanes can be provided for each direction of I-35 just south of the Milo Interchange. Expansion of the UPRR structure will be necessary, should direct connector ramps (i.e., additional capacity improvements to the Milo Interchange) be desired/necessary in the future.

Many variables (e.g., changes in land use, changes in U.S. and/or Mexican transportation policies, NAFTA, devaluation of the peso, etc.) still exist with regard to this interchange which, at present, are impossible to accurately predict and/or quantify. Continued monitoring of operations in the vicinity of the Milo Interchange is, therefore, suggested.