

Los Alamos County

North Mesa Transportation and Utilities Study

Final Report – August 26, 2025

WILSON
& COMPANY

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North Mesa Transportation and Utilities Study

Project No. 23-100-035-11

FINAL REPORT | AUGUST 26, 2025

FOR THE:
COUNTY OF LOS ALAMOS
1000 CENTRAL AVE
LOS ALAMOS, NM 87544

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Table of Contents

Table of Contents.....	iv	V. Crash & Safety Analysis.....	18
List of Tables.....	v	a. Crash Data.....	18
List of Figures.....	v	VI. Implementation 10-Year No-Build Performance.....	31
Acronyms and Abbreviations.....	vi	a. No-Build Future Traffic Volumes.....	31
EXECUTIVE SUMMARY.....	viii	b. Intersection Capacity Operations.....	31
I. Study Overview.....	viii	VII. Proposed Conditions.....	35
II. Conclusions and Recommendations.....	viii	a. Description of Proposed Improvements.....	35
a. Transportation.....	viii	b. Implementation of Future Traffic Volumes.....	41
b. Wastewater.....	viii	VIII. Implementation Year Traffic Performance (Deterministic).....	41
c. Water.....	viii	a. Intersection Capacity Operations.....	41
III. Supplementary Documents for North Mesa Site.....	ix	b. Pedestrian & Bicycle Usage.....	42
INTRODUCTION.....	1	IX. Implementation 10-Year Build Traffic Performance.....	45
I. Overview.....	1	a. Intersection Capacity Operations.....	45
II. Study Areas & Vicinity.....	1	X. Transit Facilities.....	48
III. Systems Analyzed.....	3	XI. Traffic and Safety Conclusions and Recommendations.....	48
a. Transportation.....	3	a. Pedestrian & Bicycle Facilities.....	48
b. Wastewater.....	3	B. WASTEWATER DESIGN ANALYSIS.....	50
c. Water.....	3	I. Background.....	51
IV. Proposed Developments.....	3	II. Existing System.....	51
A. TRANSPORTATION ANALYSIS.....	5	a. Field Inspection.....	54
I. Introduction.....	6	b. Existing Wastewater System Capacity.....	55
a. Project Purpose and Need.....	6	III. Improvement Areas.....	57
b. Project Limits.....	6	a. Area A Description.....	57
II. Study Area Description.....	6	b. Area B Description.....	57
a. Existing Conditions (Summary).....	6	IV. Design Analysis.....	57
III. Traffic Analysis.....	10	a. Area A.....	57
a. Traffic Data.....	10	b. Area B.....	59
b. Traffic Operational Analysis Definitions & Methodologies.....	11	V. Conclusion and Recommendations.....	61
IV. Existing Traffic Performance (Deterministic).....	12	C. WATER DESIGN ANALYSIS.....	62
a. Intersection Capacity Operations.....	12	I. Background.....	63
b. Pedestrian & Bicycle Usage.....	16	II. Existing System.....	63
		a. Water.....	63
		III. Improvement Areas.....	68

a.	Area A Description.....	68
b.	Area B Description.....	68
IV.	Design Analysis.....	68
a.	Area A.....	68
b.	Area B.....	72
V.	Conclusion and Recommendations.....	73

Appendix A – Environmental Site Assessment (ESA) for North Mesa Site

Appendix B – Property Survey for North Mesa Site

Appendix C – Site Plan for Arbolada Subdivision

Appendix D – Turning Movement Counts

Appendix E – Synchro Model Traffic Operations Results

Appendix F – Crash Data Results

Appendix G – Wastewater Design Flow Calculations

Appendix H – SewerCAD Model Results

Appendix I – North Mesa Housing Types Table

Appendix J – Altitude Control Valve Specifications

Appendix K – Water Calculations

Appendix L - Fire Flow & Pressure Results

List of Tables

Table A-1 – Street/Road Criteria.....	8
Table A-2 – Intersections Identification Number.....	8
Table A-3 – Roadway AADT Historical Counts.....	10
Table A-4 – Total Pedestrian and Bicyclist Counts.....	10
Table A-5 – LOS Criteria for Signalized Intersections.....	11
Table A-6 – LOS Criteria for Two-Way Stop-Controlled Intersections.....	12
Table A-7 – Minimum Acceptable Level of Service Standards.....	12
Table A-8 – 2025 Existing Unsignalized Traffic Operations Summary.....	12
Table A-9 – 2025 Existing Roundabout Traffic Operations Summary.....	13
Table A-10 – 2025 Existing Signalized Traffic Operations Summary.....	13
Table A-11 – Status of Bicycles Facilities.....	17
Table A-12 – Crash Summary.....	18

Table A-13 – Summary of Crash Characteristics – Crashes near Project Site, 2019-2023.....	19
Table A-14 – 2045 Horizon No-Build Unsignalized Traffic Operations Summary.....	31
Table A-15 – 2045 Horizon No-Build Roundabout Traffic Operations Summary.....	31
Table A-16 – 2045 Horizon No-Build Signalized Traffic Operations Summary.....	32
Table A-17 – 2035 Implementation Build Unsignalized Traffic Operations Summary.....	41
Table A-18 – 2035 Implementation Build Roundabout Traffic Operations Summary.....	41
Table A-19 – 2035 Implementation Build Signalized Traffic Operations Summary.....	41
Table A-20 – 2045 Horizon Build Unsignalized Traffic Operations Summary.....	45
Table A-21 – 2045 Horizon Build Roundabout Traffic Operations Summary.....	45
Table A-22 – 2045 Horizon Build Signalized Traffic Operations Summary.....	45
Table A-23 – Recommended Intersection Improvements (Diamond Drive) from Los Alamos County Pedestrian Master Plan.....	49
Table A-24 – Recommended Intersection Improvements (San Ildefonso Road near North Mesa Site) from Los Alamos County Pedestrian Master Plan.....	49
Table B-1 – Sewer Drop B Pipe Replacement Cost Estimate.....	54
Table B-2 – Existing Wastewater Production.....	55
Table B-3 – Existing System Pipe Capacity.....	55
Table B-4 – Design Criteria.....	57
Table B-5 – 360 Build-Out Pipe Capacity.....	59
Table B-6 – 497 Build-Out Pipe Capacity.....	59
Table B-7 – Area A Cost Estimate.....	59
Table B-8 – Area B Future Wastewater Production.....	61
Table B-9 – Area B Pipe Capacity.....	61
Table B-10 – Area B Cost Estimate.....	61
Table C-1 – PRV Elevation.....	63
Table C-2 – Monthly Water Demand, North Mesa Area.....	66
Table C-3 – Area A Cost Estimate.....	72
Table C-4 – Area B Cost Estimate.....	73

List of Figures

Figure 1 – Areas of Study and Vicinity.....	2
Figure 2 – Housing Concept for North Mesa Site (Area A), from North Mesa Housing Study.....	4
Figure A-1 – Typical Section - Diamond Drive Between West Road and Sycamore Street.....	6
Figure A-2 - Typical Section - Diamond Drive Between Sycamore Street and 35th Street.....	6
Figure A-3 – Typical Section - Diamond Drive Between 35th Street and San Ildefonso Road/North Mesa Road ...	6
Figure A-4 – Typical Section - North Mesa Road Between San Ildefonso Road and Deer Trail.....	7
Figure A-5 – Typical Section - San Ildefonso Road Between Camino Durasnilla and North Mesa Road.....	7
Figure A-6 – Existing Conditions and Lane Configuration.....	9
Figure A-7 – Miovision Traffic Data Collection Methodology.....	10
Figure A-8 – Existing Intersection Turning Movements.....	14
Figure A-9 – Existing Conditions LOS Results.....	15
Figure A-10 – Los Alamos Townsite Pedestrian Barriers, from the Los Alamos County Pedestrian Master Plan (2025).....	16

Figure A-11 – Priority Routes for Bicycle Facilities.....	17
Figure A-12 – Reported Crashes on Diamond Drive (NM 501), 2019-2023	18
Figure A-13 – Diamond Drive Roadway Segment LOSS - Total.....	22
Figure A-14 – Diamond Drive Roadway Segment LOSS - Severe.....	22
Figure A-15 – Diamond Drive & West Road – Intersection LOSS – Total.....	23
Figure A-16 – Diamond Drive & West Road – Intersection LOSS – Severe	23
Figure A-17 – Diamond Drive & Trinity Drive – Intersection LOSS – Total	23
Figure A-18 – Diamond Drive & Trinity Drive – Intersection LOSS – Severe.....	23
Figure A-19 – Diamond Drive & Canyon Road – Intersection LOSS – Total.....	24
Figure A-20 – Diamond Drive & Canyon Road – Intersection LOSS – Severe	24
Figure A-21 – Diamond Drive & Sandia Drive – Intersection LOSS – Total.....	24
Figure A-22 – Diamond Drive & Sandia Drive – Intersection LOSS – Severe	24
Figure A-23 – Diamond Drive & Urban Street – Intersection LOSS – Total.....	25
Figure A-24 – Diamond Drive & Urban Street – Intersection LOSS – Severe	25
Figure A-25 – Diamond Drive & Arkansas Avenue – Intersection LOSS – Total	25
Figure A-26 – Diamond Drive & Arkansas Avenue – Intersection LOSS – Severe.....	25
Figure A-27 – Diamond Drive & 36 th Street – Intersection LOSS – Total.....	26
Figure A-28 – Diamond Drive & 36 th Street– Intersection LOSS – Severe.....	26
Figure A-29 – Crash Density - Crashes 2019-2023 (Diamond Drive Primary Street).....	27
Figure A-30 – Crash Density - Crashes 2019-2023 (Diamond Drive Secondary Street).....	28
Figure A-31 – Crash Locations - Crashes Severity 2019-2023 (Diamond Drive Primary Street)	29
Figure A-32 – Crash Locations - Crashes Severity 2019-2023 (Diamond Drive Secondary Street).....	30
Figure A-33 – Horizon Year No-Build Turning Movements.....	33
Figure A-34 – Horizon Year No Build LOS Result.....	34
Figure A-35 - Estimated Trip Generation and Distribution - North Mesa Site.....	35
Figure A-36 – North Mesa Housing Development Turning Movements	36
Figure A-37 – Site Generated Traffic - Arbolada Subdivision, from TRAFFIC IMPACT ANALYSIS - ARBOLADA SUBDIVISION	37
Figure A-38 – Arbolada Turning Movements	38
Figure A-39 – Site Generated Traffic, from TRAFFIC DATA FOR PONDEROSA ESTATES SUBDIVISION PHASE III (TIA)	39
Figure A-40 – Ponderosa Turning Movements	40
Figure A-41 – Implementation Year Build Turning Movements	43
Figure A-42 – Implementation Year Build LOS Results.....	44
Figure A-43 – Horizon Year Build Turning Movements	46
Figure A-44 – Horizon Year Build LOS Results	47
Figure A-45 – Route 6 Map – Atomic City Transit.....	48
Figure A-46 – Atomic City Transit Route 7 and Route 9 Maps.....	48
Figure B-1 – North Mesa Area Existing Sewer System.....	52
Figure B-2 – Reduced North Mesa Area Existing Sewer System.....	53
Figure B-3 – Sewer Drop A Interior.....	54
Figure B-4 – Sewer Drop B Interior Holes	54
Figure B-5 – Limits of Existing System Model.....	56
Figure B-6 – Full Build-Out Areas.....	57
Figure B-7 – Area A Proposed Sewer Syst.....	58

Figure B-8 – Area B Proposed Sewer System	60
Figure C-1 – Los Alamos County Existing Water System.....	64
Figure C-2 –Existing Water System.....	65
Figure C-3 – Existing System Pipe Capacity.....	66
Figure C-4 – Low Pressure and High Velocity Areas within North Mesa and Barranca	67
Figure C-5 – Proposed Waterline Improvement Areas.....	69
Figure C-6 – Upgraded System with Areas of Low Fire Flow.....	70
Figure C-7 – New Proposed Waterline System for Areas A and B.....	71

Acronyms and Abbreviations

AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ACT	Atomic City Transit
ALTA	American Land Title Association
AV	altitude valve
CBD	central business district
CTWLF	center two-way left-turn lane
DI	ductile iron
DPU	Los Alamos County Department of Public Utilities
EBLT	eastbound left turn
EPDO	equivalent property damage only, a crash severity index
ESA	Environmental Site Assessment
FHWA	Federal Highway Administration
ft/s	feet per second
GIS	geographic information system
gpm, gpd	gallons per minute, gallons per day
HCM	<i>Highway Capacity Manual</i>
ID	identification number for intersections analyzed in this study
KABCO	injury classification scale for crashes
LAC	Los Alamos County
LANL	Los Alamos National Laboratory
LAPS	Los Alamos Public Schools
LF	linear foot or linear feet
LOS	level of service

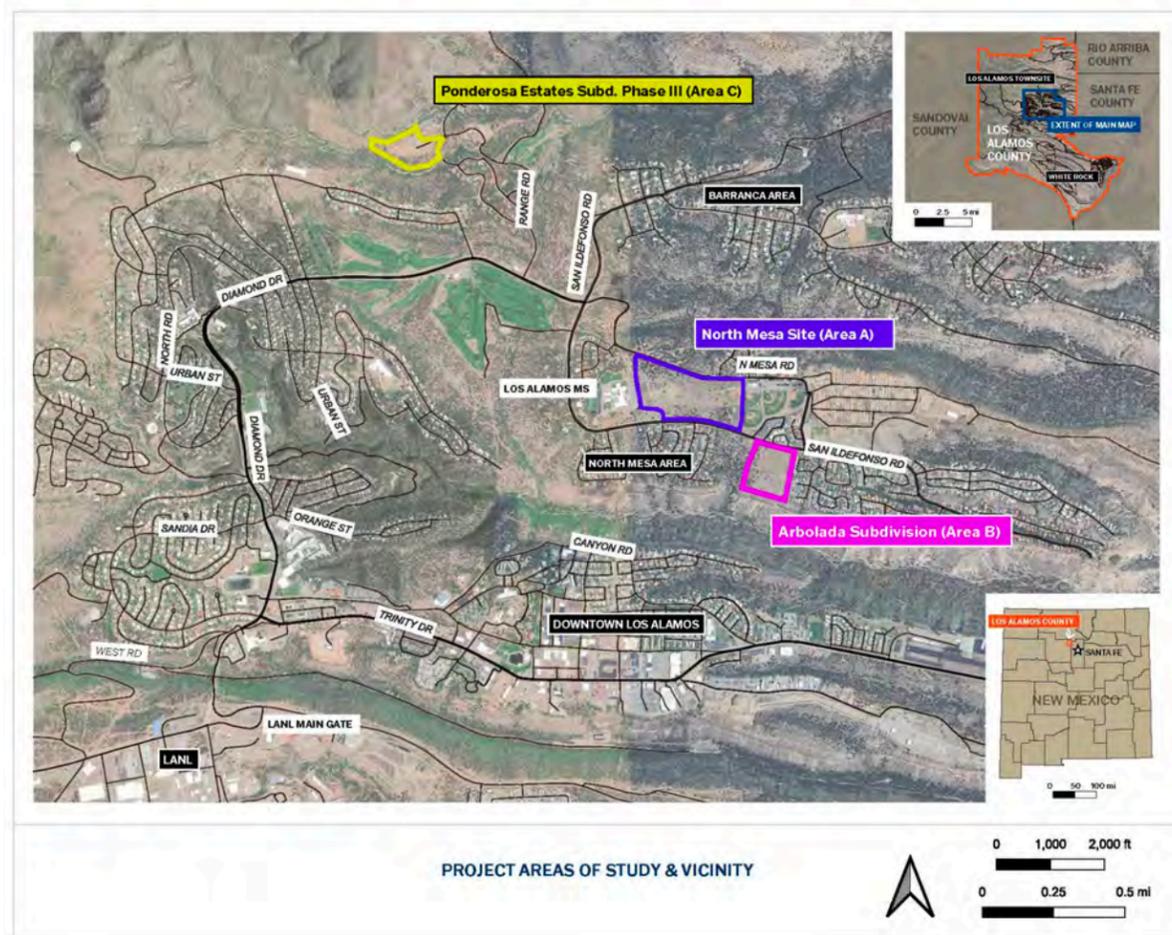
LOSS	level of service of safety
MID	midday
NFPA	National Fire Protection Association
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMTank	North Mesa tank
PDO	property damage only, a type of crash
PRV	pressure reducing valve
psi	pounds per square inch
PVC	polyvinyl chloride
RCOL	rural collector
RINT	rural interstate highway
RMA	rural minor arterial
RPA	rural principal arterial
RTM	regression to the mean
RTOR	right-turn on red, a type of intersection turning movement
SAMM	<i>State Access Management Manual</i>
SBLT	southbound left turn
SPF	Safety Performance Function
subd.	subdivision
TIA	traffic impact analysis
TMC	turning movement count
UCOL	urban collector
UINT	urban interstate highway
UMA	urban minor arterial
UPA	urban principal arterial
v/c	volume-to-capacity

EXECUTIVE SUMMARY

I. Study Overview

This study evaluates infrastructure capacity and needs related to proposed residential development projects in the North Mesa area of Los Alamos County, New Mexico.

The study is a follow-up to the *North Mesa Housing Study* (“*Housing Study*”). The *Housing Study*, completed in 2020, recommended a concept for a housing development on an undeveloped, 30-acre site (the “North Mesa Site”) directly east of Los Alamos Middle School owned by Los Alamos Public Schools (LAPS). The site was studied for its potential to help address the County’s housing shortage and to provide housing for LAPS staff. At the density recommended by the *Housing Study*, 210-360 housing units could be constructed on the site.



The *North Mesa Transportation and Utilities Study* also incorporates details about two proposed residential subdivisions in the vicinity of the North Mesa Site: Arbolada Subdivision (137 single-family and multifamily residences) and Ponderosa Estates Subdivision Phase III (49 detached, single-family dwelling units). Together with the development on the North Mesa Site, these projects may potentially impact traffic volumes and utility demand in the area. (Ponderosa Estates Phase III is not included in the water or wastewater analyses.)

This study evaluates the existing capacity of Los Alamos County’s transportation, wastewater (sewer), and water infrastructure systems in the North Mesa area and assesses the additional demand that the residential development projects described above may put on these systems. Where demand would exceed current capacity, infrastructure improvements are recommended and associated cost estimates are provided.

II. Conclusions and Recommendations

a. Transportation

The assessment of intersection turning movements found that the proposed developments being constructed will not impact traffic operations and that the intersections will operate at acceptable levels of service (LOS) under all scenarios. A number of improvements to pedestrian and bicycle infrastructure improvements are recommended to enhance the experience of pedestrians and bicyclists traveling to, from, and near the future development sites.

b. Wastewater

To support the housing growth expected in Los Alamos County, expanding the sewer infrastructure in the North Mesa area is essential. The evaluation of the existing sewer infrastructure was based on a field investigation and wastewater system analysis. The wastewater system is generally in good condition and operating well. While the existing infrastructure is adequate for the County’s current needs, it requires significant expansion to support the proposed housing developments.

To support the housing growth, the study analyzes three options: 1) Area A 360 Build-Out; 2) Area A 776 Build-Out; and 3) Area B. Options 1 and 3 are recommended, as the existing system would have ample capacity to accommodate the flows. Option 2 is not recommended as several sewer segments would closely approach the design capacity limit. The options provide the County with the flexibility to develop the North Mesa area in a phased approach depending on funding resources. Conceptual cost estimates were prepared for Options 1 and 3.

c. Water

The existing water system needs upgrades before the North Mesa Site (Area A) residential development and the Arbolada Subdivision (Area B) can be built. The study identifies several improvements that would maintain the water system within reasonable standards.

Impacts from the proposed development projects on the North Mesa Site (Area A) and the Arbolada property (Area B) on the existing water system were observed and analyzed. One noticeable impact was the stress from high velocity onto the existing 8-in. waterline wrapping around proposed Area A. Along with this observation, were areas with low flow entering communities on the west side of the North Mesa area.

Three performance tests were done to evaluate the existing system: fire flow needs, velocity of the pipes, and residual pressures. Wilson & Company then increased a total of 2,589 LF of 6-in. pipe to an 8-in. pipe; 8,441 LF of 8-in. to 10-in. pipe; and 632 LF of 8-in. to 12in. pipe to address the concerns of high velocity within the existing system. A fire flow analysis was performed after verifying the velocity of the water was within a reasonable range of 3-5 ft/second. After upsizing the necessary pipes, the system’s flow did increase.

The proposed North Mesa Site development project has a build-out of 360 new homes across a range of building densities (low, medium, and high). For the water design analysis, the following densities were assumed: 50

customer meters for low, 106 customer meters for medium, and 204 customer meters for high. To help support this growth, a new water system consisting of 2,751 LF of 6-in. pipe was modeled, which would be sufficient for the entire North Mesa Site build-out. The Arbolada Subdivision (Area B) would bring development of 23 single-family lots, 3 duplex lots, and 39 triplex lots. The existing system can handle another 137 houses from Area B. A system of 3,600 LF of 6-in. pipe is recommended to serve the new development in Area B.

III. Supplementary Documents for North Mesa Site

Los Alamos County also contracted Wilson & Company to complete two documents to support the due diligence process for future development of the North Mesa Site.

These documents are 1) an environmental site assessment (ESA) and 2) a property survey. Both are standard documents typically required before key steps of real estate transactions or land development can occur. The documents are provided in their entirety as appendices to this study report. (See Appendix A for the ESA and Appendix B for the property survey.)

The property survey was completed to standards that make it ALTA (American Land Title Association) survey worthy. However, without a specific buyer identified at this time, a title company cannot yet provide a certified title commitment, and therefore, the survey is not an ALTA survey.

INTRODUCTION

I. Overview

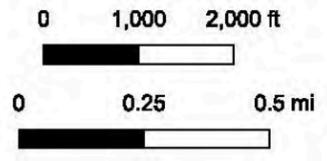
The study is a follow-up to the *North Mesa Housing Study* (“*Housing Study*”). The *Housing Study*, completed in 2020, studied options for housing development on an undeveloped, 30-acre site (the “North Mesa Site”) located directly east of Los Alamos Middle School and owned by Los Alamos Public Schools (LAPS). The site was studied for its potential to help address the County’s housing shortage and to provide housing for LAPS staff. At the density recommended by the *Housing Study*, 210-360 housing units could be constructed on the site.

The *North Mesa Transportation and Utilities Study* also incorporates details about two proposed residential subdivisions in the vicinity of the North Mesa Site: Arbolada Subdivision (137 single-family and multifamily dwelling units) and Ponderosa Estates Subdivision Phase III (49 detached, single-family dwelling units). Additional information about these proposed developments is provided in “Proposed Developments” (**section IV**) below.

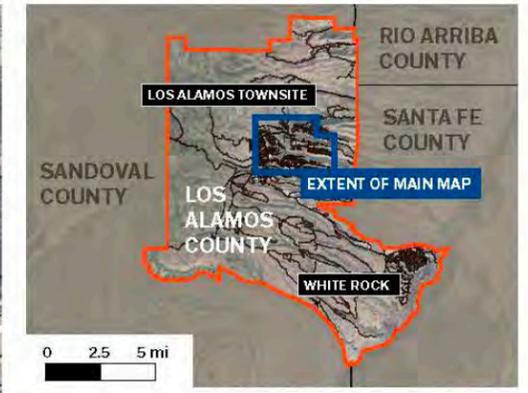
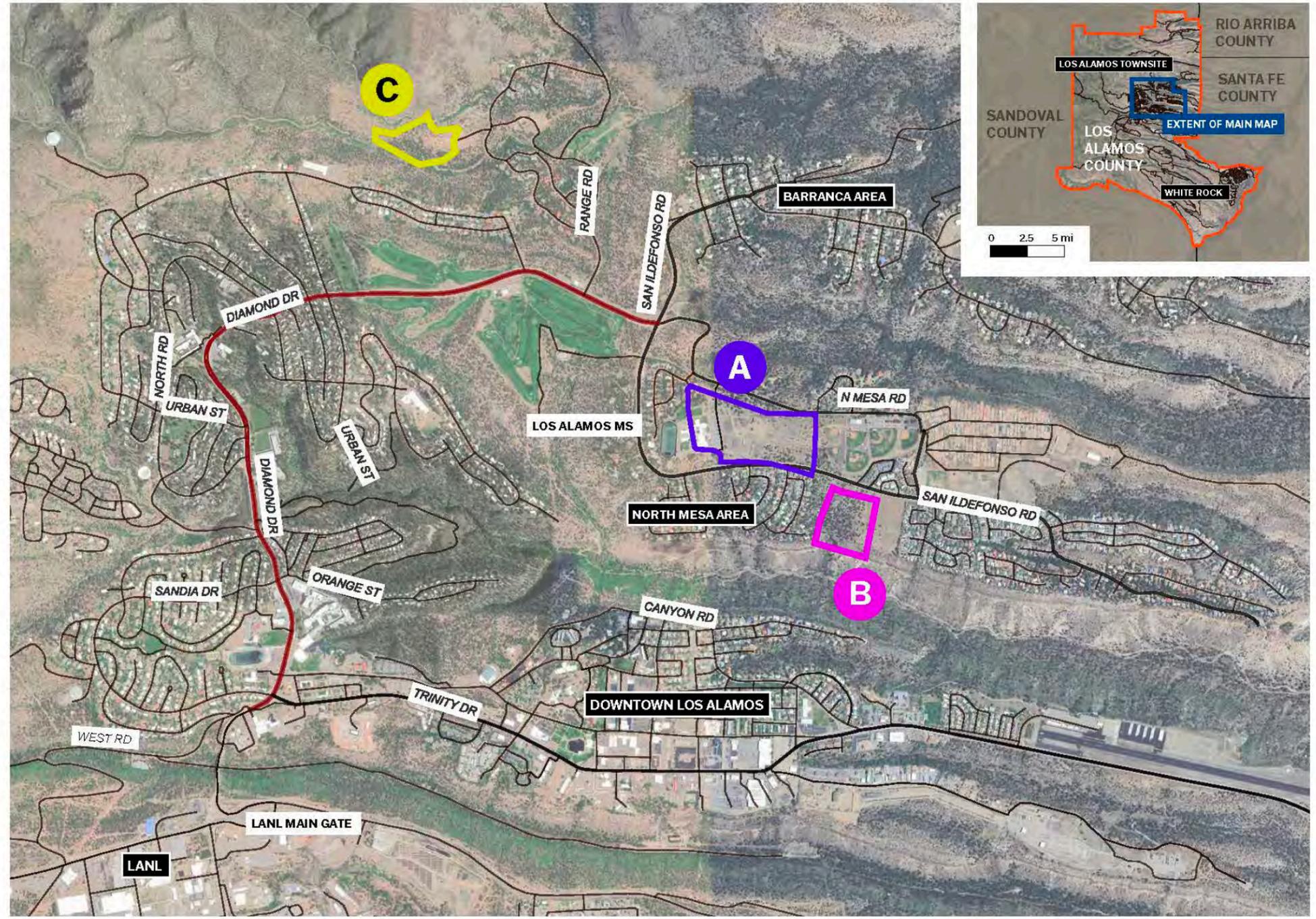
These projects would represent a significant amount of new development in the North Mesa area and, consequently, would increase demand on infrastructure systems in the area. This study was commissioned to understand the impact of this new development on three County-maintained infrastructure systems: transportation, wastewater, and water.

II. Study Areas & Vicinity

Los Alamos County is located in the north-central part of New Mexico, about 35 miles northwest of Santa Fe. The infrastructure systems analyzed by this study are located among the areas of study shown in **Figure 1**, in the North Mesa area of Los Alamos County. These areas of study correspond to residential development projects described under “Proposed Developments” below.



- LEGEND**
- A North Mesa Site (Area A)
 - B Arbolada Subd. (Area B)
 - C Ponderosa Estates Subd. III (Area C)
 - Diamond Dr
 - Other roads



AREAS OF STUDY & VICINITY

Figure 1 - Areas of Study and Vicinity

III. Systems Analyzed

a. Transportation

Impacts to transportation operations and safety were studied. The project area is connected to the core of Los Alamos Townsite by just one road: Diamond Drive. The main impacts from area developments are anticipated to be on Diamond Drive. Existing automobile, pedestrian, and bicycle traffic volumes and intersection turning movements along Diamond Drive were provided by the County. Anticipated trip generation, provided directly from the traffic impact studies, by the three residential development projects were added to existing background traffic volumes to evaluate the impact of these developments on the intersections of the Diamond Drive corridor.

Traffic analysis was conducted following the methodologies from the *Highway Capacity Manual, 7th Edition* (HCM7) and using Synchro software. This analysis identified characteristics of traffic in an “implementation” year (the year when proposed development projects are completed, assumed to be 2035) and a “horizon” year (10 years after completion of the projects, assumed to be 2045). Analysis was also completed for a “horizon no-build” scenario, which assumes that the developments projects are not implemented.

A deterministic operational analysis was completed. This evaluation examines performance measures, such as “level of service” (LOS) results, for each intersection and road segment along Diamond Drive. LOS is a term used to qualitatively describe roadway and intersection traffic operations. LOS is expressed as a value from a scale that resembles a grading system. Values range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst. Per the NMDOT *State Access Management Manual*, LOS C for rural conditions and LOS D for urban conditions are acceptable measures. LOS scores E or F are considered unacceptable levels of delay and should be addressed with improvements to roadway infrastructure.

A safety analysis of reported crashes along Diamond Drive from 2019-2023 was also conducted. This analysis seeks to identify the type, severity, and location of crashes along a roadway. This evaluation also informs what type of infrastructure improvements should be made along a corridor. Locations with high concentrations of crashes (especially of severe crashes) might be in need of infrastructure improvements.

The existing pedestrian and bicycle networks were evaluated for potential improvements related to the North Mesa Site and nearby development projects.

The transportation analysis is provided in **section A** of this report.

b. Wastewater

Impacts to the existing sanitary sewer system were analyzed. The main impacts from the North Mesa area developments are projected to be on the sewer systems leading to two of the existing sewer drops. Existing and projected flows were calculated using data from *Wastewater Engineering Treatment and Reuse, 4th ed.* (Metcalf and Eddy, 2014).

Sewer modeling was conducted using Bentley SewerCAD. The analysis applied design criteria that included a minimum slope of 0.004 ft/ft to maintain adequate velocity and drainage and a maximum pipe capacity of 2/3 full to prevent surcharge and ensure system reliability under peak flows.

A field inspection of the sewer drops was also conducted. This inspection aims to identify the conditions and any potential issues of the existing sewer drops.

The wastewater analysis is provided in **section B** of this report. Ponderosa Estates Subdivision Phase III was not included in the wastewater analysis.

c. Water

Impacts from the proposed development projects at the North Mesa Site (Area A) and the Arbolada property (Area B) on the existing water system were analyzed. Three performance tests were done to evaluate the existing system: Fire flow needs, velocity of the pipes, and residual pressures. Bentley WaterCAD was used to observe these impacts and then to analyze how to address them.

The water analysis is provided in **section C** of this report. Ponderosa Estates Subdivision Phase III was not included in the water analysis.

IV. Proposed Developments

The analyses in this study are informed by data about three proposed residential development projects in the North Mesa area of Los Alamos Townsite. The locations of these projects are shown in **Figure 1**. The development projects are summarized below.

i) North Mesa Site (Area A)

The *North Mesa Housing Study* proposes housing and open space for the 30-acre parcel located between Los Alamos Middle School and Los Alamos County-owned baseball field complex. (The North Mesa Site is also referred to as Area A in this study.) The *Housing Study* recommends a range of housing types, including apartments, townhouses, and cottages. This variety is intended to facilitate different building densities to interface with existing surrounding development. The diversity of housing types would also provide different price-points for future occupants. A portion of the housing units could be reserved for LAPS staff.

The density of the development would range from 7-12 units per acre. At this density, 210-360 housing units could be constructed on the site. Access to the development would be provided by two access points from Mesa Road and a third access point from San Ildefonso Road. Mature vegetation in the northwest and southeast corners of the parcel would be preserved as open space. A shared-use path would follow the perimeter of the site. A neighborhood-scale park is recommended for the center of the parcel.

A map of the housing concept plan and densities proposed by the *North Mesa Housing Study* is shown in **Figure 2**.

INTRODUCTION

North Mesa Transportation and Utilities Study | Los Alamos County, NM



Figure 2 – Housing Concept for North Mesa Site (Area A), from North Mesa Housing Study

ii) Arbolada Subdivision (Area B)

This Arbolada Subdivision is a proposed residential development on an undeveloped 17.07-acre lot located just southeast of the North Mesa Site. (The subdivision is also referred to as Area B in this study.) The location of the subdivision is shown in **Figure 1**, and a layout of the development is shown in Appendix C. The developer has proposed an 85-lot subdivision, encompassing 137 single-family and multifamily dwelling units. As currently proposed, the subdivision would be constructed in a single phase.

A traffic impact analysis (TIA) for the development was completed in November 2022. The TIA assumed an implementation year of 2025 and a horizon year of 2035. The TIA evaluated traffic operations at the following intersections associated with Area B:

- Diamond Drive / San Ildefonso Road / North Mesa Road roundabout
- San Ildefonso Road / Hawk Drive
- San Ildefonso Road / Mountain Vista Apartments driveway (apartment complex to the north of the proposed subdivision)
- San Ildefonso Road / North Mesa Road
- North Mesa Road / Hawk Drive

The TIA found that all intersections will operate satisfactorily with an LOS C or better under the no-build scenario and in the implementation and horizon years. Although some criteria were met for a right-turn lane (deceleration

lane) to be added to San Ildefonso Road for vehicles turning into the subdivision, addition of such a lane would create possible conflicts with pedestrians. Constructing such a lane was, therefore, not recommended. No other deficiencies or improvements were identified by the TIA.

iii) Ponderosa Estates Subdivision Phase III (Area C)

This development is the third phase of the four-phase, master-planned Ponderosa Estates development. It will consist of 49 detached, single-family dwelling units on an 11.62-acre site. Ponderosa Estates Subdivision Phase III is referred to as Area C in this document. It is not included in the wastewater and water analyses of this study.

A traffic study evaluating the development's impact on the key intersection of Diamond Drive (NM 501) and Range Road was completed in 2020. (County staff determined that a full traffic impact analysis was not required for this project.) The key approaches at the intersection are expected to operate satisfactorily at LOS C or better under no-build and build scenarios. The implementation year of the entire phase was assumed to be 2025; a horizon-year scenario was not evaluated.

The Ponderosa Estates Subdivision Phase III site is located approximately one mile from the North Mesa Site, as the crow flies. Although the two sites are some distance apart, the Ponderosa Estates traffic data is analyzed in this study because both projects will affect traffic patterns on Diamond Drive.

A. TRANSPORTATION ANALYSIS

I. Introduction

a. Project Purpose and Need

The northeast portion of Los Alamos Townsite is expected to see significant land development, with several housing development projects planned, as described in the previous section. The County requested the preparation of this study, in part, to determine the overall traffic impacts of the proposed developments.

b. Project Limits

The limits for the transportation element of this study are Diamond Drive from the intersection with West Road to the intersection with San Ildefonso Road. San Ildefonso Road and North Mesa Road in the vicinity of the areas of study (Areas A, B & C) are also evaluated.

II. Study Area Description

a. Existing Conditions (Summary)

i) General Alignment/Corridor Descriptions

The corridor that received the most-detailed evaluation is Diamond Drive, as depicted in **Figure 1** in this report's introduction. Diamond Drive is the primary street linking the North Mesa Site to the core of Los Alamos Townsite and is likely where many of the traffic impacts of the North Mesa area development projects would occur. Other streets evaluated are the roads that bound the North Mesa Site, North Mesa Road, San Ildefonso Road, and streets intersecting Diamond Drive.

Descriptions of these streets follow. Key characteristics for the streets (NMDOT functional class, posted speed limit, and lane configuration) are summarized in **Table A-1**.

ii) Diamond Drive (NM 501)

Diamond Drive (NM 501) facilitates travel between the northern part of Los Alamos Townsite, the central part of the community that includes the central business district (CBD) of Los Alamos, and the main gate of Los Alamos National Laboratory. It also connects to Trinity Drive (NM 502), which serves Los Alamos CBD, and which is the main facility that provides public entry to and egress from Los Alamos Townsite. Diamond Drive (NM 501) is functionally classified as a minor arterial and is maintained by Los Alamos County. Diamond Drive extends approximately three miles between the main gate of Los Alamos National Laboratory and the roundabout at San Ildefonso Road/North Mesa Road. This study looks at most of the road's length, the 2.6 miles from West Road to San Ildefonso Road/North Mesa Road.

Typical cross sections for Diamond Drive are shown in **Figure A-1**, **Figure A-2**, and **Figure A-3**. The street is four lanes wide, with a center two-way left-turn lane. Bike lanes are present on both sides of the street, and curb and gutter lines the road west of Range Road. From West Road to the western edge of Los Alamos County Golf Course, there is sidewalk on both sides of Diamond Drive; for the remaining segment to the east, a sidewalk or shared-use trail is present along the north side of the street.

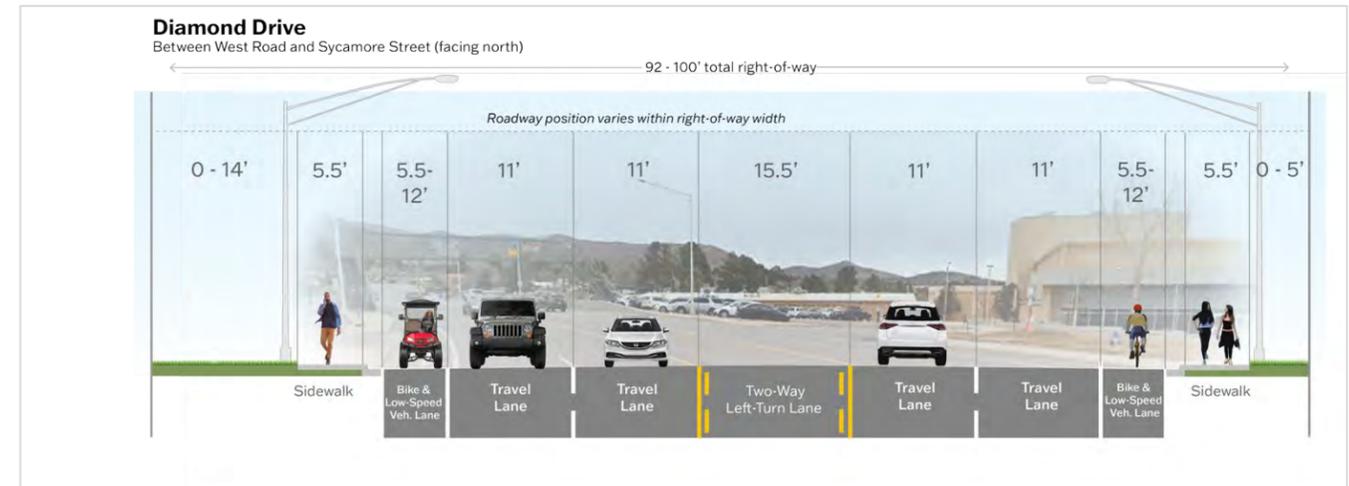


Figure A-1 – Typical Section - Diamond Drive Between West Road and Sycamore Street

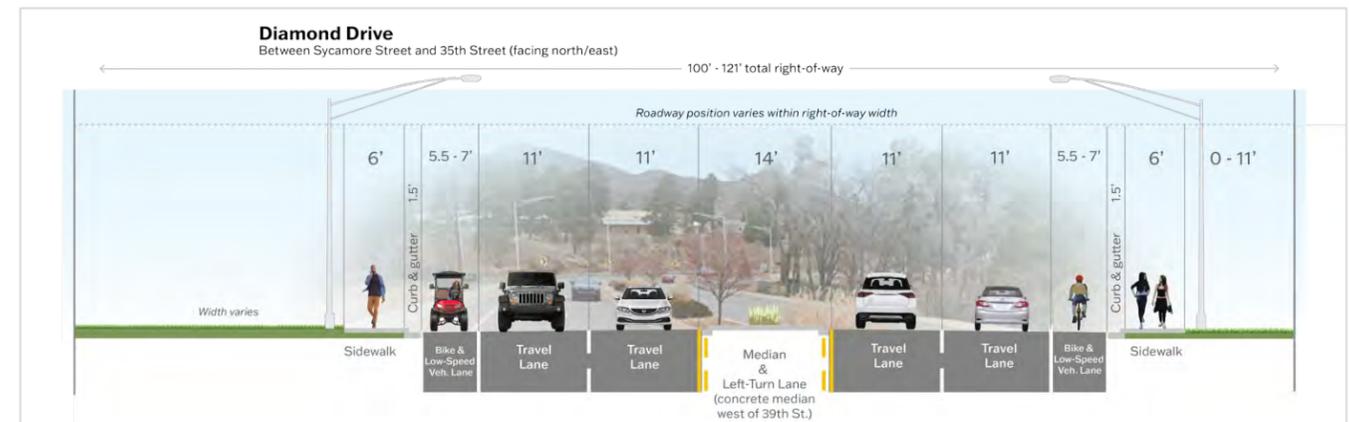


Figure A-2 - Typical Section - Diamond Drive Between Sycamore Street and 35th Street

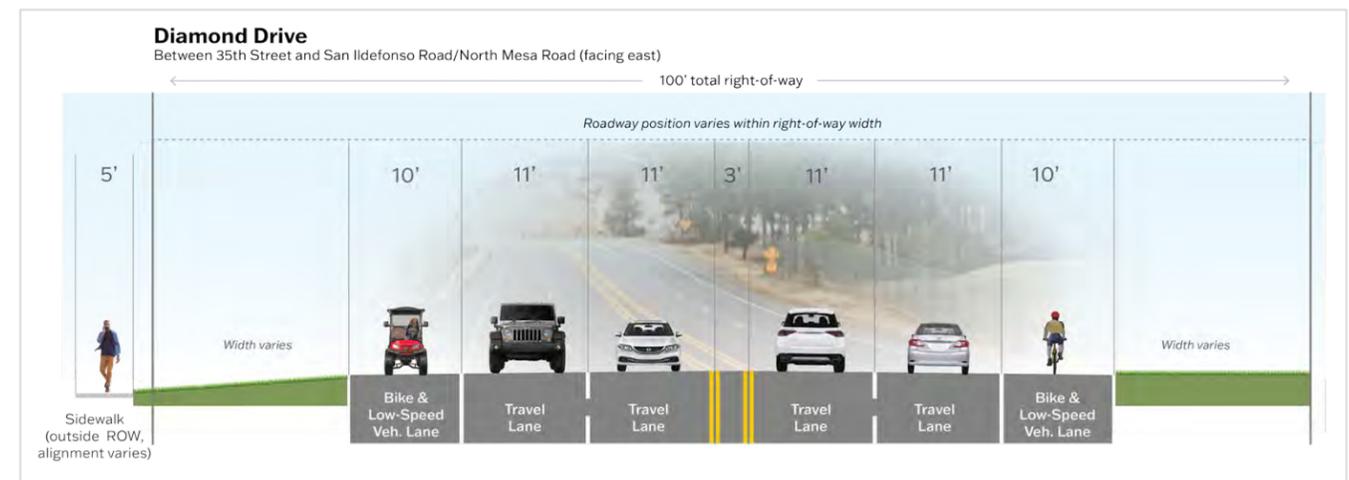


Figure A-3 – Typical Section - Diamond Drive Between 35th Street and San Ildefonso Road/North Mesa Road

iii) North Mesa Road

This street runs directly along the north side of the North Mesa Site. The street extends 1.25 miles between the Diamond Drive/San Ildefonso Road roundabout to the west and San Ildefonso Road in the east. It is functionally classified as a minor collector. The facility is owned and maintained by Los Alamos County.

A typical cross section is shown in **Figure A-4**. North Mesa Road is two lanes wide with no curb and gutter. A four-foot-wide shared-use trail is present along the street. The shared-use trail runs along the north side of the street from the roundabout to Terry Lane, opposite the baseball field complex. At Terry Lane, the shared-use trail switches to the south side of North Mesa Road. From there, it runs through the baseball field complex and then continues along the west side of North Mesa Road until San Ildefonso Road.



Figure A-4 – Typical Section - North Mesa Road Between San Ildefonso Road and Deer Trail

iv) San Ildefonso Road

San Ildefonso Road extends directly along the south side of the North Mesa Site. The street is approximately three miles long. It has a generally north-south alignment for one mile between Barranca Road and Los Alamos Middle School. Near the school, the street turns to run east to west. It terminates in a cul-de-sac approximately two miles to the east. San Ildefonso Road is owned and maintained by Los Alamos County. San Ildefonso Road north of the intersection with Diamond Drive is classified as minor collector. The portion of the street south of the intersection is not included in the NMDOT Functional Classification System and so is deemed a local road.

A typical cross section is shown in **Figure A-5**. The road is two lanes wide. South of the Diamond Drive roundabout, San Ildefonso Road has a sidewalk on the east side of the street. Along this same segment, 5-foot bike lanes and curb and gutter are present on both sides of the street. A sidewalk is also present on the south side of the San Ildefonso Road to the east of Camino Redondo.

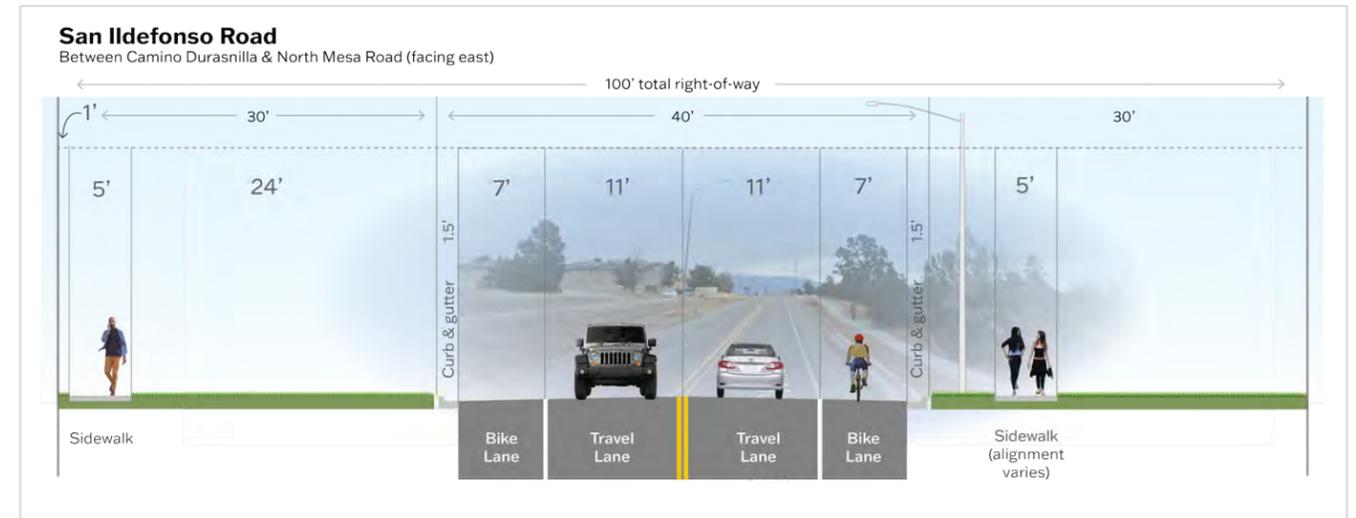


Figure A-5 – Typical Section - San Ildefonso Road Between Camino Durasnilla and North Mesa Road

v) Other Side Streets and Intersecting Roads

Other streets and roads that intersect with Diamond Drive (NM 501) were evaluated as part of this study. These facilities are located farther from the North Mesa Site than the roads described above; however, they were analyzed for their potential to impact or be impacted by traffic associated with the North Mesa Site, particularly where they intersect with Diamond Drive.

Among these other roads, that with the highest functional classification is Trinity Drive (NM 502), with a functional classification of principal arterial. It is owned and maintained by NMDOT. Trinity Drive is the main roadway serving the core of Los Alamos County and is one of the primary routes into Los Alamos County. It originates in a residential area a few blocks west of Diamond Drive (NM 501) and extends 18 miles east to US Highway 285 in Santa Fe County. (It is only known as “Trinity Drive” within the Los Alamos Townsite.)

Canyon Road parallels Trinity Drive (NM 502) a short distance to the north. This road provides another link from Diamond Drive into Downtown Los Alamos. Canyon Road originates at Diamond Drive to west. After 0.6 miles, it connects to Central Avenue, the “main street” of Downtown Los Alamos. Although the 2016 Los Alamos County *Comprehensive Plan* classifies Canyon Road as an arterial road, it is classified as a minor collector as of 2018 in the NMDOT Functional Classification online webmap. Canyon Road and Central Avenue are owned and maintained by Los Alamos County.

The Diamond Drive intersections analyzed for this study include North Street, Urban Street, Sandia Drive/Orange Street, and Arkansas Avenue/38th Street, which are classified as minor collectors. West Road, 36th Street, Club Road, and Range Road are local roads. These streets are owned and maintained by Los Alamos County.

Table A-1 – Street/Road Criteria			
Facility Name	NMDOT Functional Class	Posted Speed	Lane Configuration
North Mesa Road	Minor Collector	35 mph	Two lanes
Diamond Drive	Major Arterial	35 mph/40 mph*	Four lanes
West Road	Local Road	25 mph	Two lanes
Trinity Drive (NM 502)	Principal Arterial	35 mph	West-Two lanes East-Three lanes with CTWLF
Canyon Road	Minor Collector	25 mph	Two lanes
Sandia Drive/ Orange Street	Minor Collector	25 mph	Two lanes
North Road	Minor Collector	25 mph	Two lanes
Urban Street	Minor Collector	25 mph	Two lanes
Arkansas Avenue/ 38 th Street	Minor Collector	25 mph	Two lanes
36 th Street	Local Road	25 mph	Two lanes
Club Road	Local Road	25 mph	Two lanes
Range Road	Local Road	25 mph	Two lanes
San Ildefonso Road	Minor Collector	35 mph	Two lanes

* Note: Diamond Drive posted speed limit changes to 40 mph along golf course and goes back to 35 mph near San Ildefonso Rd

vi) Intersections

For this study a total of 11 intersections were analyzed. They are listed below in **Table A-2**. The locations of these intersections are shown **Figure A-6**.

Table A-2 – Intersections Identification Number		
Intersection	ID	Control
Diamond Drive & West Road	1	Signalized
Diamond Drive & Trinity Drive	2	Signalized
Diamond Drive & Canyon Road	3	Signalized
Diamond Drive & Sandia Drive/Orange Street	4	Signalized
Diamond Drive & North Road	5	Unsignalized
Diamond Drive & Urban Street	6	Unsignalized
Diamond Drive & Arkansas Avenue/38 th Street	7	Signalized
Diamond Drive & 36 th Street	8	Unsignalized
Diamond Drive & Club Road	9	Unsignalized
Diamond Drive & Range Road	10	Unsignalized
Diamond Drive/Mesa Road & Ildefonso Road	11	Roundabout

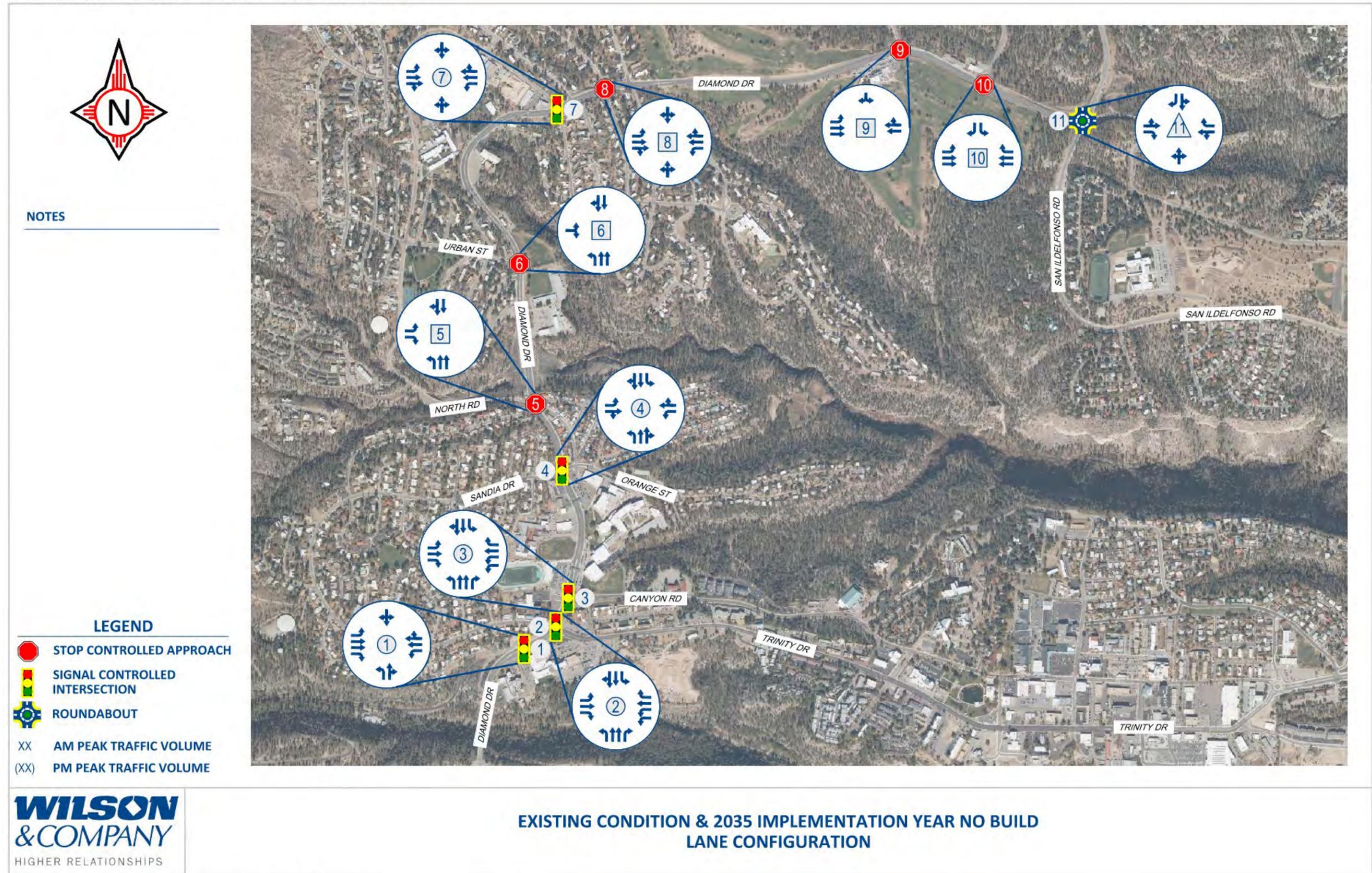


Figure A-6 – Existing Conditions and Lane Configuration

III. Traffic Analysis

a. Traffic Data

i) Annual Average Daily Traffic (AADT) Volume Counts

Information related to annual average daily traffic was obtained from the New Mexico Department of Transportation (NMDOT) Traffic Count Database, a web-based system that allows users to download historical traffic counts including both continuous and short-term counts across the state of New Mexico. **Table A-3** shows the information collected.

Road Name	NMDOT Functional Class	Posted Speed	Lane Configuration	NMDOT 2024 AADT
Diamond Drive – north of the intersection with Trinity Drive	Major Arterial	35 mph	Four lanes	18,818
Diamond Drive - from Ridgeway Drive to San Ildefonso Road	Major Arterial	35 mph/40 mph*	Four lanes	10,025
Sandia Drive - from S. 48th Street to Diamond Drive	Minor Collector	25 mph	Two lanes	680
Orange Street - from Diamond Drive to 35th Street	Minor Collector	25 mph	Two lanes	484
Urban Street - from 47th Street to Diamond Drive	Minor Collector	25 mph	Two lanes	1,542
San Ildefonso Road - from Diamond Drive to Barranca Rd.	Minor Collector	35 mph	Two lanes	2,937

* Note: Diamond Drive posted speed limit changes to 40 mph along golf course and goes back to 35 mph near San Ildefonso Rd

ii) Intersection Turn Movement Counts (TMC)

Turning movement counts (TMCs) were provided by the County and collected by Miovision, a cloud-based software platform that collects traffic data. TMCs were collected on Wednesdays during the month of February 2025, except for a few collected on February 25, 2025 (Tuesday). Complete TMCs are provided in Appendix D.

TMCs were obtained at the following intersections:

1. Diamond Drive & West Road
2. Diamond Drive & Trinity Drive
3. Diamond Drive & Canyon Road
4. Diamond Drive & Sandia Drive/Orange Street
5. Diamond Drive & North Road
6. Diamond Drive & Urban Street
7. Diamond Drive & Arkansas Avenue/38th Street
8. Diamond Drive & 36th Street
9. Diamond Drive & Club Road

10. Diamond Drive & Range Road

11. Diamond Drive/Mesa Rad & Ildefonso Road

From the TMCs provided, three peak hours were identified for existing conditions: AM peak hour from 7:30am to 8:30am, Midday (MID) peak hour from 11:30am to 12:30pm, and PM peak hour from 5:00pm to 6:00pm.

iii) Vehicle Classification Data

From the TMCs provided, none of them included information related to vehicle classification or information related to heavy vehicle traffic counts. Therefore, a 2% adjustment was used for heavy vehicles in the calculations of traffic operations for all intersections being analyzed.

iv) Pedestrian and Bicycle Counts

Information related to pedestrians and bicyclist counts were obtained from the TMCs provided by the County. Miovision reports pedestrian and bicyclist counts based on movements on the crosswalks at each intersection, as shown in **Figure A-7**. **Table A-4** lists the total counts of pedestrians and bicyclists for the 14-hour period collected.

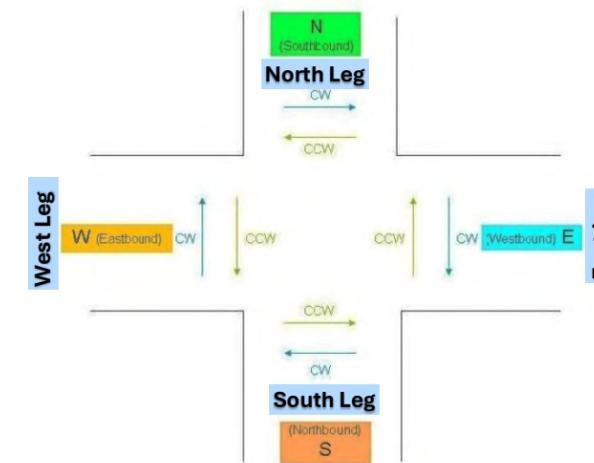


Figure A-7 – Miovision Traffic Data Collection Methodology

Intersection	14-hr Total (6:00am-8:00pm)			
	South Leg	North Leg	West Leg	East Leg
Diamond Drive & West Road	1 ped/0 cyclist	34 peds/4 cyclist	74 peds/76 cyclist	4 peds/1 cyclist
Diamond Drive & Trinity Drive	25 peds/1 cyclist	25 peds/1 cyclist	41 peds/7 cyclist	0 peds/0 cyclist
Diamond Drive & Canyon Road	19 peds/1 cyclist	81 peds/5 cyclist	22 peds/2 cyclist	17 peds/0 cyclist
Diamond Drive & Sandia Drive/Orange Street	0 peds/0 cyclist	20 peds/6 cyclist	100 peds/3 cyclist	32 peds/9 cyclist
Diamond Drive & North Road	0 peds/0 cyclist	3 peds/0 cyclist	125 peds/3 cyclist	N/A

Table A-4 – Total Pedestrian and Bicyclist Counts

Intersection	14-hr Total (6:00am-8:00pm)			
	South Leg	North Leg	West Leg	East Leg
Diamond Drive & Urban Street	0 peds/0 cyclist	0 peds/0 cyclist	30 peds/4 cyclist	N/A
Diamond Drive & Arkansas Avenue/38 th Street	26 peds/4 cyclist	16 peds/0 cyclist	61 peds/6 cyclist	36 peds/4 cyclist
Diamond Drive & 36 th Street	13 peds/0 cyclist	31 peds/7 cyclist	4 peds/0 cyclist	2 peds/0 cyclist
Diamond Drive & Club Road	N/A	58 peds/5 cyclist	0 peds/1 cyclist	0 peds/0 cyclist
Diamond Drive & Range Road	N/A	30 peds/0 cyclist	0 peds/0 cyclist	0 peds/0 cyclist
Diamond Drive/Mesa Road & Ildefonso Road	0 peds/0 cyclist	0 peds/0 cyclist	0 peds/0 cyclist	17 peds/10 cyclist
Diamond Drive & Golf Course Crossing	N/A	N/A	64 peds/2 cyclist	94 peds/4 cyclist

b. Traffic Operational Analysis Definitions & Methodologies

i) Traffic Operations Study Methodology – Intersections

The traffic operations analysis of intersections addresses unsignalized, signalized, and modern roundabout intersection operations using the procedures and methodologies contained in the *Highway Capacity Manual, Seventh Edition (HCM7)* for weekday AM and PM peak hour traffic operations. Study intersection operations were evaluated using level of service calculations as analyzed in the Synchro software version 12.

The operational performance of an intersection or a highway facility is based on LOS criteria. LOS is a term used to qualitatively describe roadway and intersection traffic operations. LOS is expressed as a value from a scale similar to a grading system, with values ranging from LOS A (indicating free flow traffic conditions with little or no delay) to LOS F (representing oversaturated conditions where traffic flows exceed design capacity, resulting in long queues and delays). Per the NMDOT *State Access Management Manual*, LOS C for rural conditions and LOS D for urban conditions are acceptable measures. LOS scores E or F are considered unacceptable levels of delay and should be addressed with improvements to roadway infrastructure.

ii) Signalized Intersections

Traffic conditions at signalized intersections were evaluated. The operational analysis uses various intersection characteristics (such as traffic volumes, lane geometry, and signal phasing) to estimate the intersection’s volume-to-capacity (v/c) ratio. For signalized intersections, the HCM7 defines the LOS as the average delay per vehicle for the overall intersection. **Table A-5** summarizes the relationship between delay and LOS for signalized intersections.

Unless posted otherwise, New Mexico law permits a right-turn movement by a vehicle facing a circular red light or a red arrow indication after stopping and yielding to pedestrians and any conflicting vehicles. To appropriately evaluate traffic control operations at the signalized intersections, Right Turn On Red (RTOR) volumes were input into the Synchro models. The typical range of RTOR at signalized intersections is approximately between 30% to

80% of the total right-turning volumes. For this study, it was assumed 50% of right-turning traffic at the intersections analyzed would turn on red.

Table A-5 – LOS Criteria for Signalized Intersections

Level of Service	Interpretation	Control Delay (sec/vehicle)
A	Progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may contribute to low delay.	≤10
B	Good progression, short cycle lengths, or both. More vehicles stop than with LOS A.	>10 and ≤20
C	Fair progression longer cycle lengths, or both. The number of vehicles stopping is significant, though many still pass through without stopping.	>20 and ≤35
D	Longer delays result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop.	>35 and ≤55
E	High delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.	>55 and ≤80
F	This level often occurs with oversaturation when arrival flow rates exceed the capacity of the intersection. Poor progression and long cycle lengths may be major contributing factors to such delays.	>80

iii) Roundabouts

At roundabout intersections, screening-level traffic conditions were evaluated using procedures and methodologies contained in the HCM7. The operational analysis uses various intersection characteristics (such as traffic volumes and lane geometry) to estimate the roundabout’s v/c ratio. The HCM7 defines the LOS at roundabouts as the average delay per vehicle for the overall intersection. Approach delay detail is also generated.

iv) Unsignalized Intersections

For unsignalized (all-way stop-controlled and side-street stop-controlled) intersections, the HCM7 was utilized. With this methodology, operations are defined by the average control delay per vehicle (measured in seconds) for each stop-controlled movement. The method incorporates delay associated with deceleration, acceleration, stopping, and moving up in the queue. For all-way stop-controlled intersections, the HCM7 defines the LOS as the average delay per vehicle for the overall intersection. For side-street stop-controlled intersections, LOS is reported for the approach with the highest average delay/vehicle. **Table A-6** summarizes the relationship between delay and LOS for unsignalized intersections.

Table A-6 – LOS Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Interpretation	Control Delay (sec/vehicle)
a	Little or no delay	0 ≤ 10
b	Short traffic delays	>10 ≤ 15
c	Average traffic delays	>15 ≤ 25
d	Long traffic delays	>25 ≤ 35
e	Very long traffic delays	>35 ≤ 50
f	When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing that may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrants improving the intersection.	>50

v) Significance Criteria

The New Mexico Department of Transportation (NMDOT) *State Access Management Manual* (SAMM) provides guidelines that generally requires that signalized intersections should operate at an overall LOS D or better and that unsignalized intersections should maintain an overall LOS D or better and for urban conditions, as shown in **Table A-7**.

Table A-7 – Minimum Acceptable Level of Service Standards

Facility Type ¹	Access Categories (see Sub-Section 10.D)							
	UNIT	UPA	UMA	UCOL	RINT	RPA	RMA	RCOL
Freeway Sections	D	-	-	-	C	-	-	-
Ramp Junctions	D	- ²	- ²	- ²	C	- ²	- ²	- ²
Weaving Areas	D	- ²	- ²	- ²	C	- ²	- ²	- ²
Multi-lane Highways	-	D	D	C	-	C	C	B
Two-lane Highways	-	D	D	C	-	C	C	B
Signalized Intersections	-	D	D	D	-	C	C	C
Unsignalized Intersections	-	D	D	D	-	D	D	C

Note: 1. The Facility Types are per the Highway Capacity Manual.
2. Evaluate safety and operational concerns using the best available technique.

For Signalized Intersections:

Impact thresholds consider relative contributions to degradation of LOS. For example, this threshold is met when the added project traffic causes an intersection to exceed the LOS standard. The threshold may also be met when the background traffic conditions (without project traffic) exceeds the established LOS standards and the project traffic causes more than a 20 percent increase in the intersection delay.

For Unsignalized Intersections:

For unsignalized intersections, queuing is an important factor in addition to delay. In this case, impact may result when the queuing of traffic to adjacent intersections creates impeded traffic flows or when excessive delays are determined to create potential safety problems. It is typical for an unsignalized intersection to notice delay higher than 35 seconds (LOS e) for a single approach without meeting signal warrants (criteria for justifying a traffic signal). Therefore, LOS E or worse for a single movement at an unsignalized intersection may be tolerated.

IV. Existing Traffic Performance (Deterministic)

a. Intersection Capacity Operations

i) Daily and Peak-Hour Traffic Volumes

As previously discussed in **section A.III**, turning movement counts (TMCs) for Diamond Drive were provided by the County. They are displayed in **Figure A-8**. The existing peak hour factors were used for the 2025 traffic analysis.

ii) Unsignalized

This section provides information related to the traffic operations of the unsignalized intersections being analyzed.

Existing Unsignalized LOS Summaries

Traffic operations results for unsignalized intersections are shown in **Table A-8**. All unsignalized intersections are operating at an acceptable LOS D or better. Full Synchro analysis reports for 2025 existing conditions are included in Appendix E.

Table A-8 – 2025 Existing Unsignalized Traffic Operations Summary

Control	ID	Intersection	LOS/Delay [In seconds/vehicle] (Critical Movement)		
			AM Peak Hour	MID Peak Hour	PM Peak Hour
Unsig.	5	Diamond Drive & North Road	D / 32.8 (EBLT)	B / 12.8 (EBLT)	C / 22.4 (EBLT)
Unsig.	6	Diamond Drive & Urban Street	C / 19.9 (EB)	A / 9.8 (EB)	B / 11.1 (EB)
Unsig.	8	Diamond Drive & 36 th Street	B / 15.0 (NB)	B / 11.4 (NB)	C / 15.7 (NB)
Unsig.	9	Diamond Drive & Club Road	C / 15.4 (SB)	A / 9.6 (SB)	B / 10.6 (SB)
Unsig.	10	Diamond Drive & Range Road	C / 19.3 (SBLT)	B / 11.0 (SBLT)	B / 14.4 (SBLT)

Existing Operational & Auxiliary Lane Deficiencies

A critical movement (the movement requiring the most time to pass through the intersection) with LOS D is found at the intersection of Diamond Drive and North Road, specifically for the eastbound left-turn; however, for the eastbound movement there are auxiliary lanes available for each movement (i.e., left-turn and right-turn). For the

northbound approach, there is a north to west left-turn lane. The high delay for vehicles making a left-turn is due to the high number of opposing vehicles during the AM Peak.

iii) Roundabout

This section provides information related to the traffic operation of the roundabout within the study area.

Existing Roundabout LOS Summary

The roundabout intersection of Diamond Drive & Mesa Drive and San Ildefonso Road operates at LOS B or better during all three peak hours, see **Table A-9**. Full Synchro analysis reports for 2025 existing conditions are included in Appendix E.

Table A-9 – 2025 Existing Roundabout Traffic Operations Summary					
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)		
			AM Peak Hour	MID Peak Hour	PM Peak Hour
Round.	11	Diamond Drive/Mesa Road & Ildefonso Road	B / 10.6	A / 3.8	A / 6.6

Existing Operational Deficiencies

No operational deficiencies were found for existing conditions.

iv) Signalized

This section provides information related to the traffic operations of the signalized intersections being analyzed.

Existing Signalized LOS Summaries

Signalized intersections along Diamond Drive operate at LOS C or better during all three peak hour periods. Existing (2025) overall signalized intersection LOS and delay results are summarized in **Table A-10**. Full Synchro analysis reports for 2025 existing conditions are included in Appendix E.

Table A-10 – 2025 Existing Signalized Traffic Operations Summary					
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)		
			AM Peak Hour	MID Peak Hour	PM Peak Hour
Signal	1	Diamond Drive & West Road	A / 4.4	B / 14.3	C / 21.1
Signal	2	Diamond Drive & Trinity Drive/NM 502	B / 15.4	C / 23.1	B / 16.1
Signal	3	Diamond Drive & Canyon Road	C / 25.0	B / 16.2	C / 30.3
Signal	4	Diamond Drive & Sandia Drive/Orange Street	B / 17.4	B / 14.6	B / 17.4
Signal	7	Diamond Drive & Arkansas Avenue/38 th Street	C / 25.4	A / 8.6	B / 11.6

Existing Operational Deficiencies

No operational deficiencies were found for existing conditions.

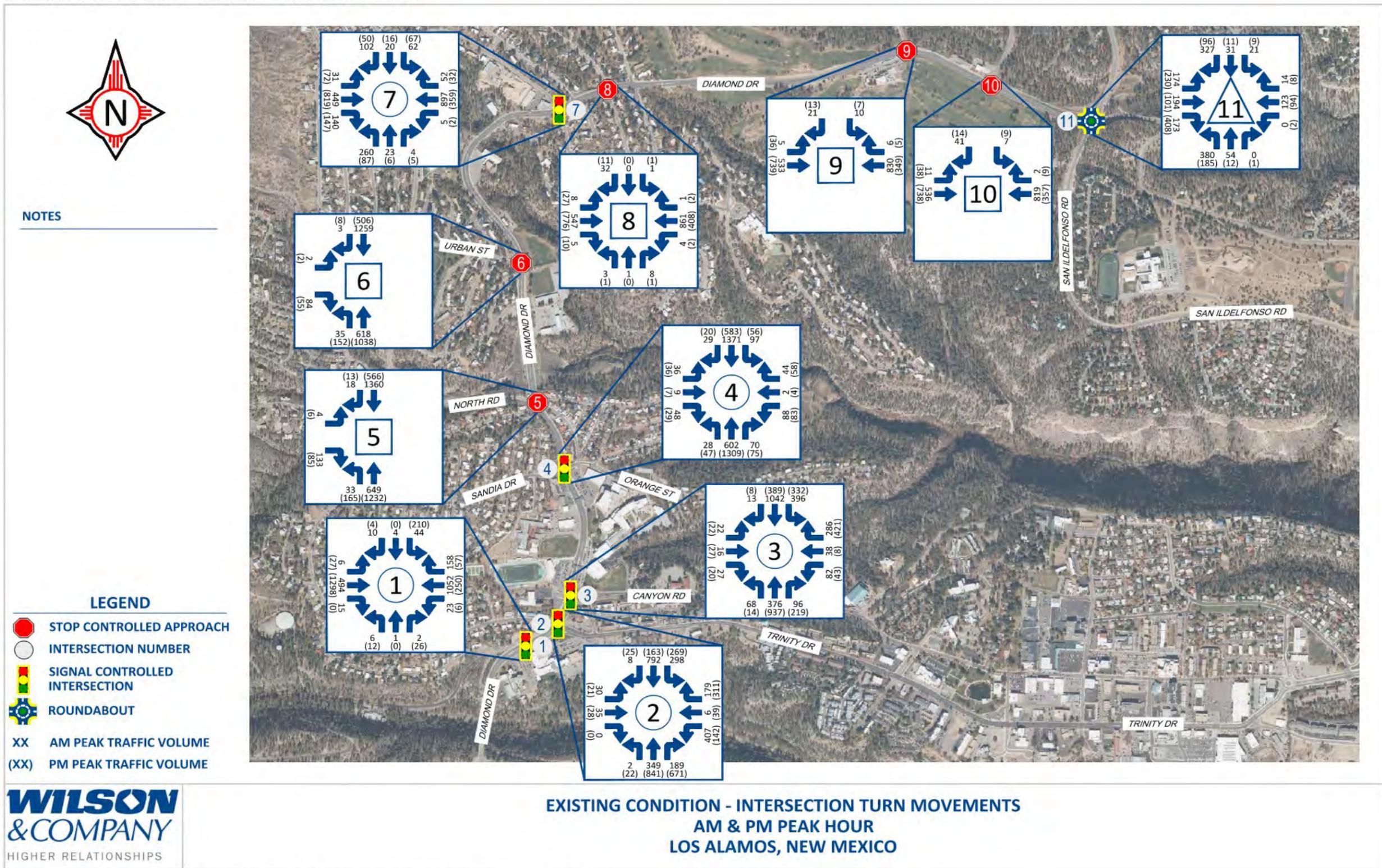


Figure A-8 - Existing Intersection Turning Movements

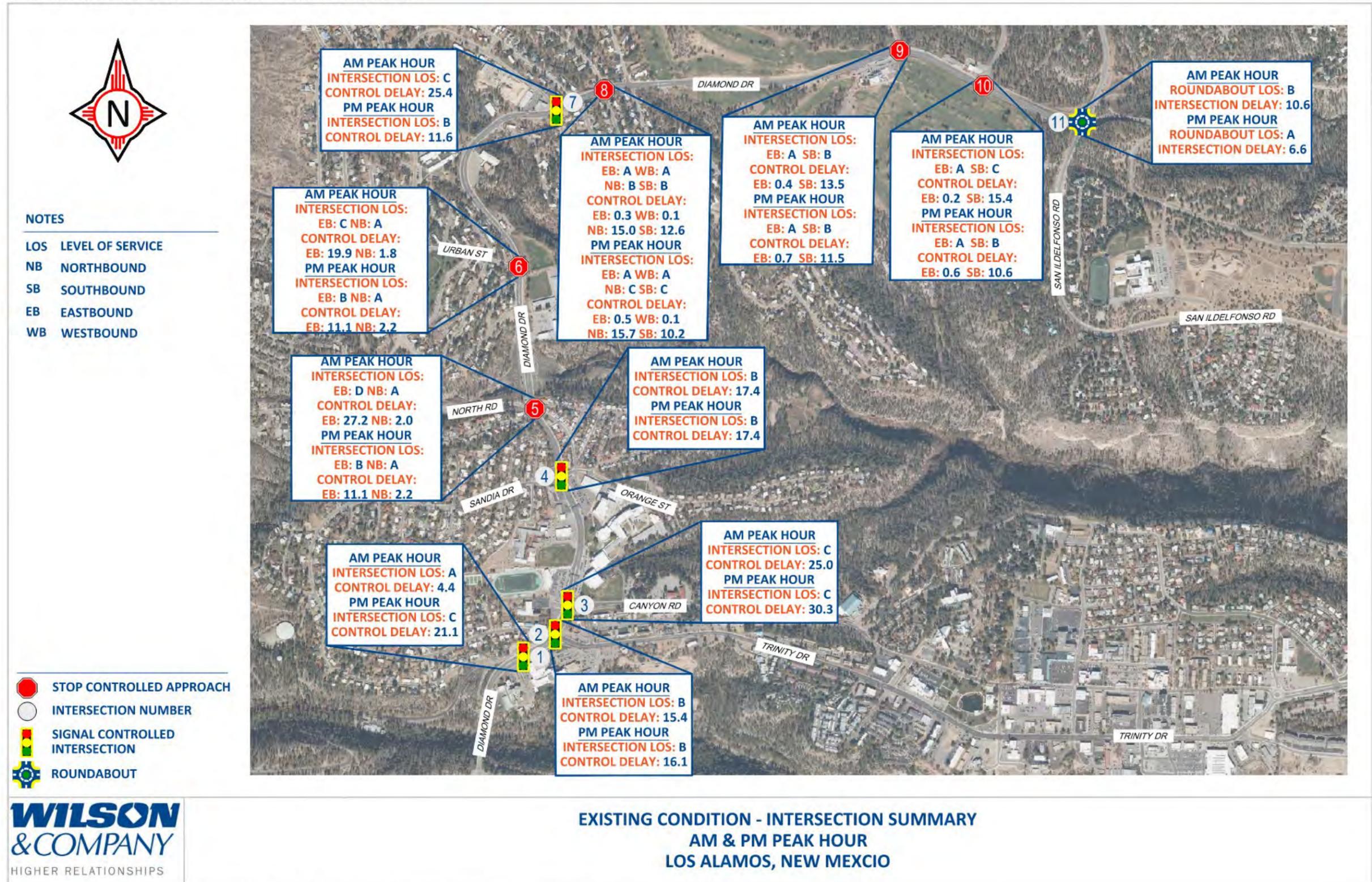


Figure A-9 – Existing Conditions LOS Results

b. Pedestrian & Bicycle Usage

The following section describes several possible areas of improvement for bicycle and pedestrian infrastructure along the corridors evaluated by this study. Specific projects that address these issues are described later in **section A.XI.a.**

i) Existing Pedestrian and Bike Facilities Deficiencies

Pedestrian

The *Los Alamos County Pedestrian Master Plan (2025)* identified pedestrian “barriers” (pedestrian crashes, vehicles crashes, and non-ADA compliant curb ramps) in Los Alamos Townsite, including along the Diamond Drive corridor and along North Mesa Road and San Ildefonso Road. These issues are shown in **Figure A-10.**

Bicycle

Diamond Drive

Along Diamond Drive, bicycle travel is provided for with an on-street bicycle lane. This lane is not buffered from travel lanes and is at points very narrow. Only experienced bicyclists likely feel comfortable using the facility. Although there is a shared-use trail between San Ildefonso Road and just east of 35th Street, west of there, the trail transitions to a sidewalk, which is generally too narrow for shared pedestrian-bicycle use.

North Mesa Road

Except for experienced riders, bicycle travel along North Mesa Road, especially west of the North Mesa Site, is likely challenging and infeasible. West of the North Mesa Site, the road features narrow travel lanes, significant grade, and a blind corner. There is no dedicated on-street bicycle facility on the road. The existing trail along North Mesa Road is insufficient for shared use by pedestrians, bicyclists, and users of other non-motorized modes. Although it is wider along other segments, to the west of Loma Linda Drive, the trail narrows to only 4- or 5-foot wide. Pedestrians, bicyclists, and others may not be able to comfortably share a facility of this width where space to yield for and pass each other is limited. Guidelines published by the American Association of State Highway and Transportation Officials (AASHTO) recommend a width of at least eight feet for trails that will accommodate shared use.

The sidewalk underpass under San Ildefonso Road (north of the roundabout where San Ildefonso Road and Diamond Drive intersect) is narrow, poor lit, and uninviting for users.

San Ildefonso Road

Although there are on-street bike lanes along San Ildefonso Road, the lanes are unbuffered from traffic, and many bicycle users may not feel comfortable using the lanes and traveling next to moving automobiles. Like along North Mesa Road, the existing sidewalk on the north and east side of the San Ildefonso Road is insufficient for accommodating shared pedestrian and bicycle use.

There is some evidence of a “desire path” on the south and west side of San Ildefonso Road west of Camino Redondo, possibly as far north as Diamond Drive. If pedestrians are using this route, they may be, at different points, encroaching on adjacent private property, traversing uneven terrain, or walking in the roadway.

Range Road

Range Road, which links Diamond Drive to the Ponderosa Estates Subdivision Phase III site, lacks facilities for bicycle or other non-motorized modes.

Other projects

Several plans propose strategies for upgrading the County’s bicycle transportation system without pinpointing specific issues.

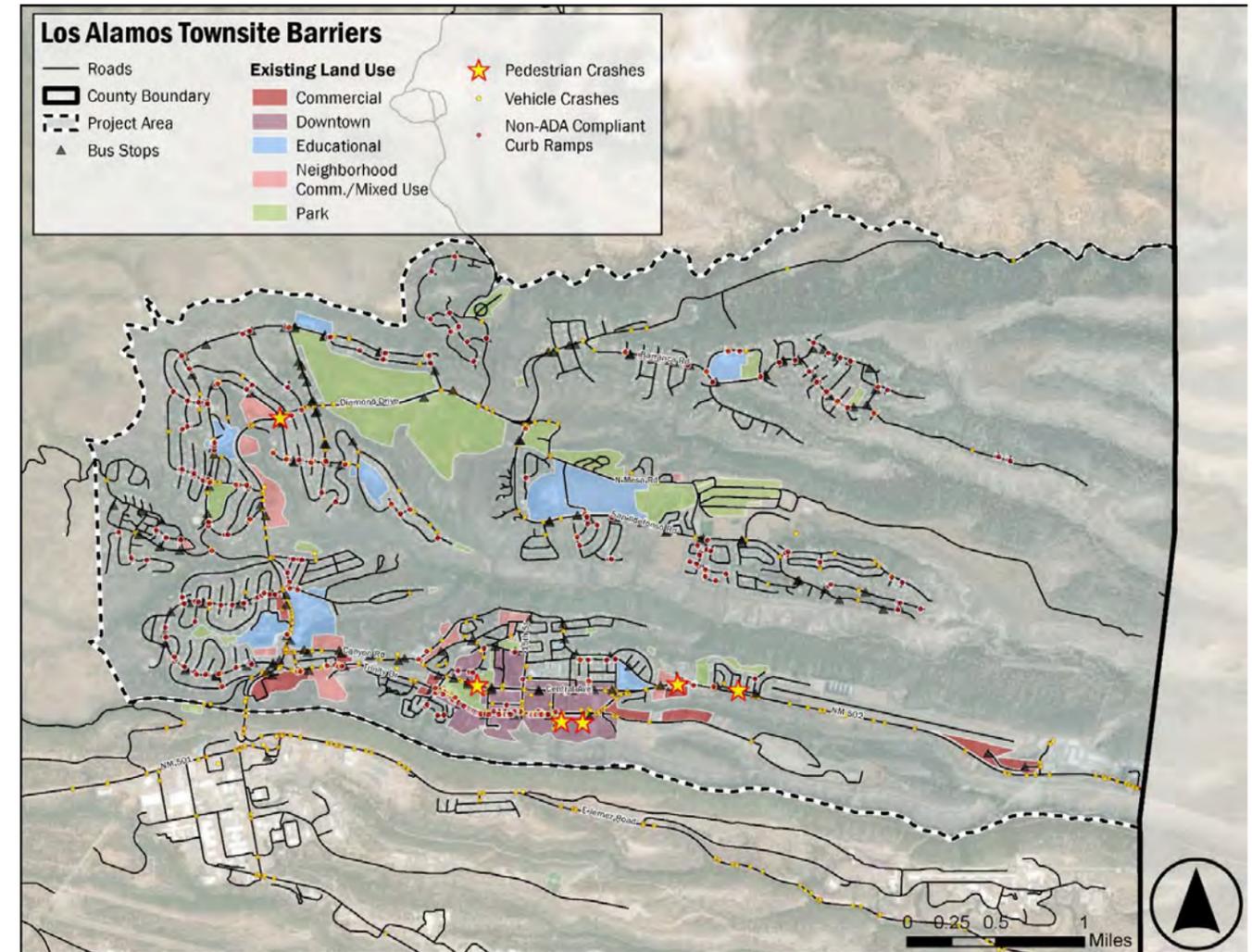


Figure A-10 – Los Alamos Townsite Pedestrian Barriers, from the *Los Alamos County Pedestrian Master Plan (2025)*

The *New Mexico Prioritized Statewide Bicycle Network Plan* was adopted by NMDOT in 2018. It classifies state-owned roadways across the state based on their potential to support bicycling. The plan identifies three tiers for roads:

- Tier 1 – High benefit for bicycling
- Tier 2 – Moderate benefit for bicycling
- Tier 3 – Minimal benefit for bicycling

Per the plan, higher-tier roads should be prioritized for bicycle-focused infrastructure projects.

Where Diamond Drive is known as NM 501, between NM 502 and Los Alamos National Lab (LANL), the road is classified as Tier 1, with a high potential benefit for bicycling road users (about 0.36 miles). It is labeled as a Tier 2 facility, with a moderate benefit for bicycling, between NM 4 and NM 502 (approximately 5.15 miles).

Los Alamos County has its own prioritized bicycle route network. **Figure A-11** shows the priority routes identified and adopted in the 2005 Bicycle Transportation System. The County's tier system reflects the functional classification of the road:

- Priority 1 – Arterials
- Priority 2 – Major Collectors
- Priority 3 – Minor Collectors



Figure A-11 – Priority Routes for Bicycle Facilities

The status of these bicycle route is provided in the 2017 Los Alamos County *Bicycle Transportation Plan*, as shown below in **Table A-11**. Priority routes are intended to connect residential communities and destinations through Los Alamos, particularly through collector and arterial roads. Priority routes also provide connectivity via state and Los Alamos National Lab roads. Several of the facilities that form part of the County's bicycle transportation system (as shown in **Figure A-11**) are the roads being analyzed for this study.

The *Bicycle Transportation Plan* notes that the public voiced support during the planning process for a “[d]irect route from northern residential areas to the business district.”

Table A-11 – Status of Bicycles Facilities

Priority 1 - Arterials	
Diamond Drive (Omega Bridge to San Ildefonso Road)	Bike Lanes
Central Avenue (NM 502 to Rose Street) 9th Street to Oppenheimer Oppenheimer to Canyon Road	Sharrows Installed Bike Lanes Installed
Canyon Road (Rose Street to Diamond Drive)	Bike Lanes Installed
Trinity Drive - East Road (Diamond Dr. to Airport Rd.) Diamond Drive to 4th Street 4th Street to Tewa Loop Tewa Loop to Airport Road	* Bike Lanes Installed *
Priority 2 – Major Collectors	
Arkansas Avenue and North Road	*
Grand Canyon Drive	*
Rover Boulevard and Meadow Lane	*
San Ildefonso North (Diamond Drive to beginning of Barranca Road) Diamond Drive to Chamisa Street Chamisa Street to Barranca Road	Bike Lanes *
San Ildefonso Road South (Diamond Drive to Sioux Street)	Bike Lanes
38th Street	Bike Lanes
Villa Street	Shoulders
Priority 3 – Minor Collectors	
Bryce Avenue	*
Canyon Road (NM 502 to Central Avenue) NM 502 to 15th Street 15th Street to Central Avenue	* Shoulders
North Mesa Road	*
Sherwood Boulevard NM 4 to Aztec Road Aztec Road to Piedra Loop Canada Way to Piedra Loop	Sharrows Installed Sharrows Installed Single Striped Bike Lane
Western Area Loop: Trinity Drive from Diamond Drive to 48th Street, 48th Street to Sandia Drive, and Sandia Drive to Diamond Drive	*
Urban Street (Diamond Drive to North Road)	*

* No Separate Bicycle Facilities/Shared Use

V. Crash & Safety Analysis

a. Crash Data

Crash data was collected for the entire length of Diamond Drive for 2019 through 2023. Crash data was collected for crashes for which Diamond Drive was reported as the primary street and for which it was reported as secondary street. Crash data collected and analyzed by Wilson & Company is provided Appendix F. A total of 94 crashes were reported along the road during this period. Information for each crash is summarized in **Table A-13**.

i) Crash Severity

Federal Highway Administration (FHWA) provides an injury classification scale for crashes, where acronyms are used to represent each severity type to divide them into different classes. The different classes are shown below:

- Class K – Killed (Fatal)
- Class A – Incapacitated (Carried from scene)
- Class B – Visible injury
- Class C – Complaint of injury, but not visible
- Class O – No apparent injury (Property damage only)

Severity of crashes in the vicinity of the North Mesa Site is presented in **Table A-12** and in **Figure A-31** and **Figure A-32**.

Crash Severity	Years					Years Total
	2019	2020	2021	2022	2023	
K	0	1	1	0	0	2
A	2	0	1	1	0	4
B	3	2	1	0	3	9
C	2	2	6	3	7	20
O	10	9	12	14	14	59
Total per Year	17	14	21	18	24	94

ii) Crash Summary

The lowest number of crashes (14) occurred in 2020 – this low figure is likely the result of the strictest stage of public health restrictions associated with the Covid-19 pandemic. The highest number of crashes (24) was in 2023. The number of crashes by year are shown in **Table A-12** and density of crashes is shown in **Figure A-29** and **Figure A-30**.

By far, most crashes occurred near the southern end of Diamond Drive. The intersection of Diamond Drive and Canyon Road had the highest number of crashes at 14. The intersections of Diamond Drive with University Drive (entrance to UNM-Los Alamos), Trinity Drive, West Drive each had eight crashes, the second-highest total for an intersection. The intersection of Diamond Drive and 38th Street had seven crashes. No other Diamond Drive intersection had more than four reported crashes over the assessed period.

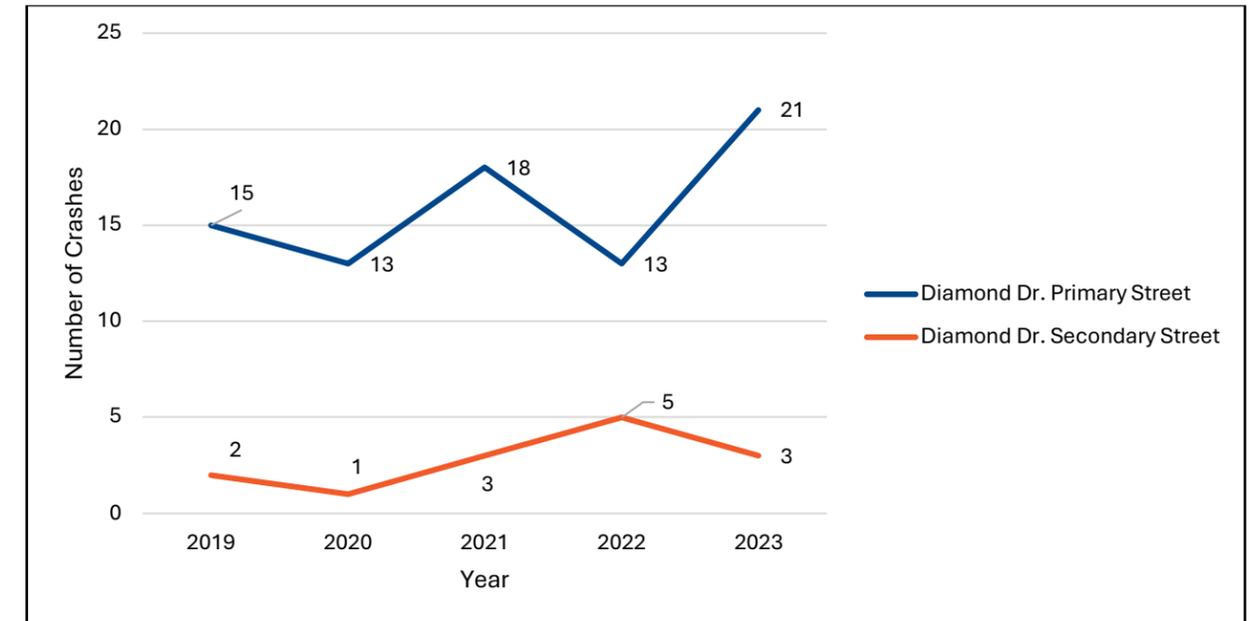


Figure A-12 – Reported Crashes on Diamond Drive (NM 501), 2019-2023

Near the North Mesa Site, four crashes were reported at or near the intersection of Diamond Drive/San Ildefonso Road/North Mesa Road. One of these crashes was fatal, which was a collision with a fixed object and involved alcohol.

The three other crashes resulted in property damage only. One of these crashes occurred at the intersection, while the two others occurred away from the intersection. Two of the crashes involved a motor vehicle impacting a fixed object, one was a rear-end crash between vehicles and one was a sideswipe crash between vehicles. One of the crashes involved alcohol.

Table A-13 – Summary of Crash Characteristics – Crashes near Project Site, 2019-2023

Date/ Time	Primary St.	Secondary St.	First Harmful Event		Lighting	Max. Veh. Damage	Intersection?	Alcohol Inv.?	KABCO Class
			Event	Manner of Crash					
3/11/2019 8:30	Diamond Dr	Eniwetok Dr	Collision with Motor Vehicle	Not Available	Daylight	Disabling	Not Available	No	(C) Possible Injury
9/27/2019 15:15	Diamond Dr	39Th St	Collision with Animal	Not Available	Daylight	Functional	Not Available	No	(B) Suspected Minor Injury
3/8/2019 11:14	Diamond Dr	Urban St	Collision with Motor Vehicle	Not Available	Daylight	Disabling	Not Available	No	(O) Property-Damage Only
1/7/2019 12:53	Diamond Dr	38Th St	Collision with Motor Vehicle	Not Available	Daylight	Disabling	Not Available	No	(O) Property-Damage Only
1/31/2019 7:45	Diamond Dr	Not Applicable	Collision with Animal	Not Available	Daylight	Appearance	Not Available	No	(B) Suspected Minor Injury
7/26/2019 8:50	Diamond Dr	Nm 501	Collision with Motor Vehicle	Not Available	Daylight	Appearance	Not Available	No	(O) Property-Damage Only
4/24/2019 7:14	Diamond Dr	Orange Ave	Collision with Motor Vehicle	Not Available	Daylight	Appearance	Not Available	No	(A) Suspected Serious Injury
8/22/2019 11:47	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Not Available	Daylight	Appearance	Not Available	No	(O) Property-Damage Only
8/29/2019 20:48	Diamond Dr	Trinity Dr	Collision with Motor Vehicle	Not Available	Dark-Lighted	Disabling	Not Available	No	(O) Property-Damage Only
12/27/2019 18:09	Diamond Dr	Urban St	Collision with Motor Vehicle	Not Available	Dark-Lighted	Appearance	Not Available	No	(O) Property-Damage Only
2/15/2019 12:45	Diamond Dr	Trinity	Collision with Motor Vehicle	Not Available	Daylight	Functional	Not Available	No	(O) Property-Damage Only
9/3/2019 9:39	Diamond Dr	North Dr	Collision with Motor Vehicle	Not Available	Daylight	Appearance	Not Available	No	(O) Property-Damage Only
9/5/2019 15:14	Diamond Dr	36Th St	Collision with Motor Vehicle	Not Available	Daylight	Functional	Not Available	No	(O) Property-Damage Only
11/12/2019 18:25	Diamond Dr	Trinity Dr	Collision with Motor Vehicle	Not Available	Dark-Lighted	Disabling	Not Available	No	(A) Suspected Serious Injury
6/19/2019 21:08	Diamond Dr	38Th St	Collision with Motor Vehicle	Not Available	Dark-Lighted	Functional	Not Available	No	(O) Property-Damage Only
8/5/2019 19:45	Canyon Rd	Diamond Dr	Collision with Motor Vehicle	Not Available	Daylight	Appearance	Not Available	No	(C) Possible Injury
1/18/2019 7:14	Canyon Rd	Diamond Dr	Collision with Motor Vehicle	Not Available	Daylight	Appearance	Not Available	No	(B) Suspected Minor Injury
3/9/2020 17:20	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Same Direction	Daylight	Appearance	Not Applicable	No	(O) Property-Damage Only
9/13/2020 10:06	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	From Same Direction	Daylight	Not Available	Four-Way	No	(O) Property-Damage Only
11/9/2020 12:45	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	From Same Direction	Daylight	Not Available	Four-Way	No	(O) Property-Damage Only
10/30/2020 17:58	Diamond Dr	University	Collision with Motor Vehicle	From Opposite Direction	Dawn	Disabling	Not an Intersection	No	(B) Suspected Minor Injury
10/30/2020 17:58	Diamond Dr	University Dr	Collision with Motor Vehicle	From Opposite Direction	Daylight	Disabling	L-Intersection	No	(K) Fatal Injury
1/16/2020 16:45	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Same Direction	Daylight	Appearance	Not Applicable	No	(O) Property-Damage Only
8/3/2020 16:37	Diamond Dr	Sycamore Ave	Collision with Animal	Not Available	Daylight	Disabling	Not an Intersection	No	(O) Property-Damage Only
1/14/2020 18:37	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Same Direction	Dark-Not Lighted	Functional	Not Applicable	No	(C) Possible Injury
1/13/2020 21:08	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Same Direction	Dark-Lighted	Disabling	Not Applicable	No	(B) Suspected Minor Injury
12/8/2020 18:07	Diamond Dr	Not Applicable	Collision with Animal	Not Available	Dark-Lighted	Functional	Not an Intersection	No	(O) Property-Damage Only
12/21/2020 9:56	Diamond Dr	West Rd	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(C) Possible Injury
6/15/2020 20:33	Diamond Dr	38Th St	Collision with Motor Vehicle	Not Available	Dark-Lighted	Disabling	Four-Way	No	(O) Property-Damage Only
2/18/2020 10:30	Diamond Dr	40Th St	Collision with Fixed Object	Not Available	Daylight	Disabling	T-Intersection	Yes	(O) Property-Damage Only
1/14/2020 17:59	West Jemez Rd Nm 501	Diamond Dr	Collision with Motor Vehicle	From Same Direction	Dark-Lighted	Disabling	0	No	(O) Property-Damage Only
9/28/2021 16:46	Diamond Dr	West Rd	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(C) Possible Injury
11/1/2021 18:13	Diamond Dr	Not Applicable	Collision with Fixed Object	Not Available	Dusk	Disabling	Roundabout	Yes	(K) Fatal Injury
11/22/2021 18:28	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	Intersecting Path (T-bone)	Dark-Lighted	Functional	Four-Way	No	(O) Property-Damage Only
5/24/2021 15:17	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	From Opposite Direction	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
4/22/2021 14:44	Diamond Dr	Canyon Dr	Collision with Motor Vehicle	From Same Direction	Daylight	Disabling	Not an Intersection	No	(O) Property-Damage Only

Table A-21– Summary of Crash Characteristics – Crashes near Project Site, 2019-2023 (cont.)

Date/ Time	Primary St.	Secondary St.	First Harmful Event		Lighting	Max. Veh. Damage	Intersection?	Alcohol Inv.?	KABCO Class
			Event	Manner of Crash					
6/23/2021 12:43	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Not Applicable	No	(O) Property-Damage Only
8/13/2021 14:49	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Not an Intersection	No	(O) Property-Damage Only
10/18/2021 7:50	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Opposite Direction	Daylight	Not Available	Not an Intersection	No	(O) Property-Damage Only
5/10/2021 14:48	Diamond Dr	Not Applicable	Collision with Fixed Object	Not Available	Daylight	Disabling	Not an Intersection	No	(B) Suspected Minor Injury
10/19/2021 9:37	Diamond Dr	San Ildefonso Rd	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Roundabout	No	(O) Property-Damage Only
6/8/2021 6:03	Diamond Dr	36Th St	Collision with Animal	Not Available	Dawn	Functional	T-Intersection	No	(O) Property-Damage Only
6/5/2021 17:56	Diamond Dr	38Th St	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(C) Possible Injury
6/14/2021 7:33	Diamond Dr	West Rd	Collision with Motor Vehicle	From Opposite Direction	Daylight	Disabling	Four-Way	No	(C) Possible Injury
3/5/2021 19:30	Diamond Dr	Not Applicable	Collision with Fixed Object	Not Available	Dark-Lighted	Disabling	Not an Intersection	No	(O) Property-Damage Only
8/31/2021 6:22	Diamond Dr	Orange St	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Disabling	Four-Way	No	(O) Property-Damage Only
11/23/2021 11:22	Diamond Dr	Not Applicable	Collision with Fixed Object	Not Available	Daylight	Disabling	Not an Intersection	No	(O) Property-Damage Only
12/15/2021 12:33	Diamond Dr	West Rd	Collision with Motor Vehicle	From Same Direction	Daylight	Disabling	Four-Way	No	(C) Possible Injury
12/13/2021 20:18	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Same Direction	Dark-Lighted	Disabling	Not an Intersection	No	(C) Possible Injury
12/21/2021 20:03	Trinity Dr	Diamond Dr	Collision with Person	Intersecting Path (T-bone)	Dark-Lighted	Functional	Four-Way	No	(C) Possible Injury
3/10/2021 13:37	35Th St	Diamond Dr	Collision with Person	From Same Direction	Daylight	Disabling	L-Intersection	No	(A) Suspected Serious Injury
4/6/2021 11:00	West Rd	Diamond Dr	Collision with Fixed Object	Not Available	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
5/20/2022 14:32	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	Not Available	Daylight	Not Available	Four-Way	No	(O) Property-Damage Only
8/29/2022 12:34	Diamond Dr	West Rd	Collision with Motor Vehicle	Not Available	Daylight	Not Available	Four-Way	No	(O) Property-Damage Only
9/1/2022 11:27	Diamond Dr	University Dr	Collision with Motor Vehicle	Not Available	Daylight	Not Available	L-Intersection	No	(C) Possible Injury
1/5/2022 2:00	Diamond Dr	Urban St	Collision with Fixed Object	Not Available	Dark-Lighted	Disabling	T-Intersection	No	(O) Property-Damage Only
2/4/2022 12:45	Diamond Dr	Not Applicable	Collision with Fixed Object	Not Available	Daylight	Disabling	Not an Intersection	No	(O) Property-Damage Only
1/10/2022 7:34	Diamond Dr	Canyon Dr	Collision with Motor Vehicle	Not Available	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
3/8/2022 7:29	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	Not Available	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
12/15/2022 17:45	Diamond Dr	Not Applicable	Collision with Animal	Not Available	Dark-Not Lighted	Functional	Not an Intersection	No	(O) Property-Damage Only
4/6/2022 20:10	Diamond Dr	Not Applicable	Collision with Animal	Not Available	Dark-Not Lighted	Functional	Not an Intersection	No	(O) Property-Damage Only
1/5/2022 15:05	Diamond Dr	Trinity Dr	Collision with Motor Vehicle	Not Available	Daylight	Not Available	Four-Way	No	(O) Property-Damage Only
2/17/2022 9:44	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Not Available	Daylight	Disabling	Not an Intersection	No	(A) Suspected Serious Injury
9/10/2022 17:30	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Not Available	Daylight	Not Available	T-Intersection	No	(O) Property-Damage Only
7/23/2022 12:12	Diamond Dr	Sandia Dr	Collision with Motor Vehicle	Not Available	Daylight	Disabling	Four-Way	No	(C) Possible Injury
10/25/2022 7:18	San Ildefonso Rd	Diamond Dr	Collision with Fixed Object	Not Available	Daylight	Disabling	Not an Intersection	No	(O) Property-Damage Only
8/16/2022 7:35	38Th St	Diamond Dr	Collision with Motor Vehicle	Not Available	Daylight	Disabling	Four-Way	No	(O) Property-Damage Only
1/1/2022 2:42	36Th St	Diamond Dr	Collision with Fixed Object	Not Available	Dark-Lighted	Disabling	Four-Way	No	(O) Property-Damage Only
9/8/2022 11:30	West Rd	Diamond Dr	Collision with Motor Vehicle	Not Available	Daylight	No Damage	Not an Intersection	No	(O) Property-Damage Only
11/16/2022 17:03	West Rd	Diamond Dr	Collision with Motor Vehicle	Not Available	Daylight	Disabling	Four-Way	No	(C) Possible Injury
7/8/2023 19:12	Diamond Dr	Orange St	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Disabling	Four-Way	No	(O) Property-Damage Only
4/17/2023 6:53	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Opposite Direction	Daylight	Disabling	Not an Intersection	No	(B) Suspected Minor Injury

Table A-21- Summary of Crash Characteristics – Crashes near Project Site, 2019-2023 (cont.)

Date/ Time	Primary St.	Secondary St.	First Harmful Event		Lighting	Max. Veh. Damage	Intersection?	Alcohol Inv.?	KABCO Class
			Event	Manner of Crash					
7/13/2023 16:55	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Disabling	Four-Way	No	(C) Possible Injury
2/3/2023 11:50	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Same Direction	Daylight	Not Available	Y-Intersection	No	(O) Property-Damage Only
8/15/2023 14:55	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(C) Possible Injury
3/3/2023 7:32	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
2/14/2023 6:56	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(C) Possible Injury
6/7/2023 16:15	Diamond Dr	Diamond Dr N	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
5/4/2023 16:00	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	From Opposite Direction	Daylight	Disabling	Four-Way	No	(C) Possible Injury
3/14/2023 14:59	Diamond Dr	Orange Dr	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Disabling	Four-Way	No	(O) Property-Damage Only
4/12/2023 14:43	Diamond Dr	Canyon St	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
8/18/2023 10:41	Diamond Dr	Canyon Ct Ne	Collision with Motor Vehicle	From Opposite Direction	Daylight	Disabling	Four-Way	No	(B) Suspected Minor Injury
7/25/2023 10:16	Diamond Dr	Trinity Dr	Collision with Motor Vehicle	From Same Direction	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
11/1/2023 18:49	Diamond Dr	Arkansas Ave	Collision with Motor Vehicle	Intersecting Path (T-bone)	Dark-Lighted	Not Available	Four-Way	No	(O) Property-Damage Only
12/14/2023 10:15	Diamond Dr	36Th St	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(C) Possible Injury
11/13/2023 16:35	Diamond Dr	Arkansas Ave	Collision with Motor Vehicle	From Same Direction	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
9/26/2023 7:41	Diamond Dr	Not Applicable	Collision with Motor Vehicle	From Same Direction	Daylight	Disabling	Not an Intersection	No	(O) Property-Damage Only
12/9/2023 17:09	Diamond Dr	35Th St	Collision with Motor Vehicle	From Same Direction	Dusk	Disabling	Not an Intersection	No	(C) Possible Injury
9/22/2023 12:15	Diamond Dr	Not Applicable	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Functional	Four-Way	No	(O) Property-Damage Only
10/16/2023 11:55	Diamond Dr	Canyon Rd	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Disabling	Four-Way	No	(C) Possible Injury
12/16/2023 0:49	Diamond Dr	Ridgeway Dr	Collision with Fixed Object	Not Available	Dark-Not Lighted	Disabling	Not an Intersection	Yes	(B) Suspected Minor Injury
9/13/2023 16:15	Trinity Dr	Diamond Dr	Collision with Motor Vehicle	Intersecting Path (T-bone)	Daylight	Disabling	Four-Way	No	(O) Property-Damage Only
3/4/2023 9:18	San Ildefonso Rd	Diamond Dr	Collision with Motor Vehicle	From Same Direction	Daylight	Disabling	Not an Intersection	No	(O) Property-Damage Only
11/18/2023 12:34	Sycamore St	Diamond Dr	Collision with Fixed Object	Not Available	Daylight	Disabling	T-Intersection	No	(O) Property-Damage Only

iii) Crash Rate Analysis, Network Screening & EPDO

Safety Evaluation

Intersection and roadway segment safety was evaluated by means of the Safety Performance Function (SPF). The SPF models provide an estimate of the normal crash frequency and severity for a range of average annual daily traffic (AADT) at intersections and roadway segments with similar characteristics (e.g., traffic control, number of lanes, rural vs. urban) across New Mexico. The analysis assesses the magnitude of the safety performance at an intersection or roadway segment in reference to its expected frequency and severity of crashes as predicted by its SPF. It corrects for Regression to the Mean (RTM) using the Empirical Bayes method and uses the Level of Service of Safety (LOSS) concept to quantitatively assess and qualitatively describe the safety performance of the selected intersection. Intersections and roadway segments are categorized into one of four LOSS levels, as defined below:

- LOSS I - Low potential for crash reduction
- LOSS II - Low to moderate potential for crash reduction
- LOSS III - Moderate to high potential for crash reduction
- LOSS IV - High potential for crash reduction

The LOSS categories are determined by using a cumulative probability threshold of 20% denoting the boundary between LOSS I and LOSS II, and 80% denoting the boundary between LOSS III and LOSS IV. Two different SPFs are used to evaluate an intersection's or roadway segment's safety performance. There is an SPF based on the total number of crashes and another SPF based on crashes involving an injury or fatality (severity).

Crash data within the study area was also obtained using Vision Zero Suite software. The period of the crash data selected for the evaluation was from 2019 through 2023.

Roadway Segment Crashes

Within the study area, thirty-eight (38) roadway segment crashes occurred along Diamond Drive in the 2019-2023 period. **Figure A-13** and **Figure A-14** show that the segment of Diamond Drive within the study area (as a urban two-lane undivided highway) is at LOSS III for total crashes (just above the mean), indicating a moderate to high potential for crash reduction, and within the range of LOSS III for severe crashes, indicating a moderate to high potential for crash reduction.

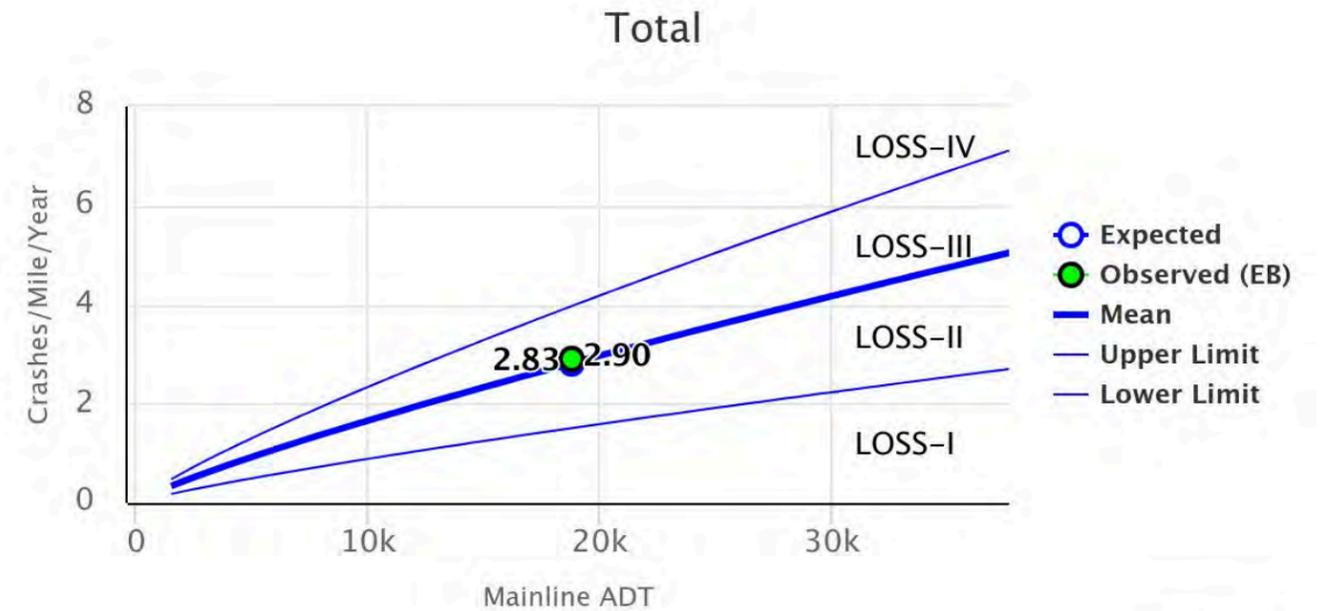


Figure A-13 – Diamond Drive Roadway Segment LOSS - Total

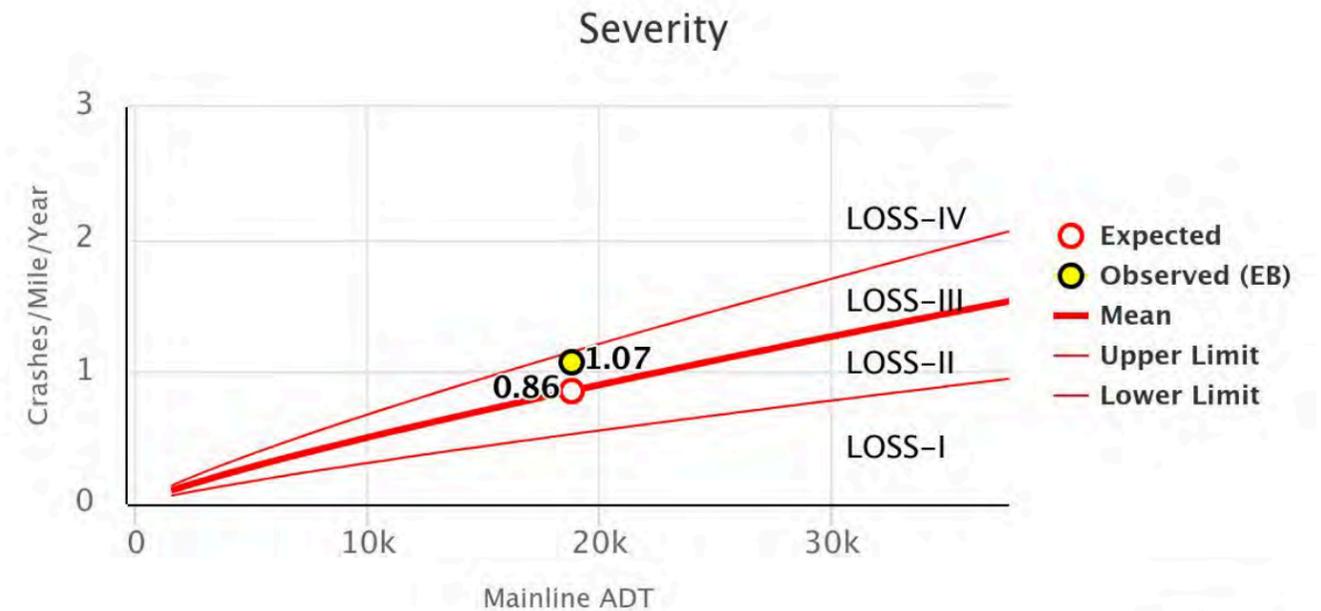


Figure A-14 – Diamond Drive Roadway Segment LOSS - Severe

Roadway Intersection Crashes

Diamond Drive & West Road

Diamond Drive & West Road is a signalized intersection. There was a total of nine crashes within the crash period of 2019-2023. Six crashes were property-damage only (PDO), and three crashes resulted in injuries. Regarding the manner of impact, four crashes related to broadside impacts, two were rear-ends, two were sideswipes from same direction, and one was due to an approach turn.

The safety performance of the intersection was analyzed based on New Mexico – Urban 4-Lane Divided Signalized Intersection SPF. As shown in the following figures, the intersection operates at a LOSS I for total and severe crashes, indicating there is a low potential for crash reduction.

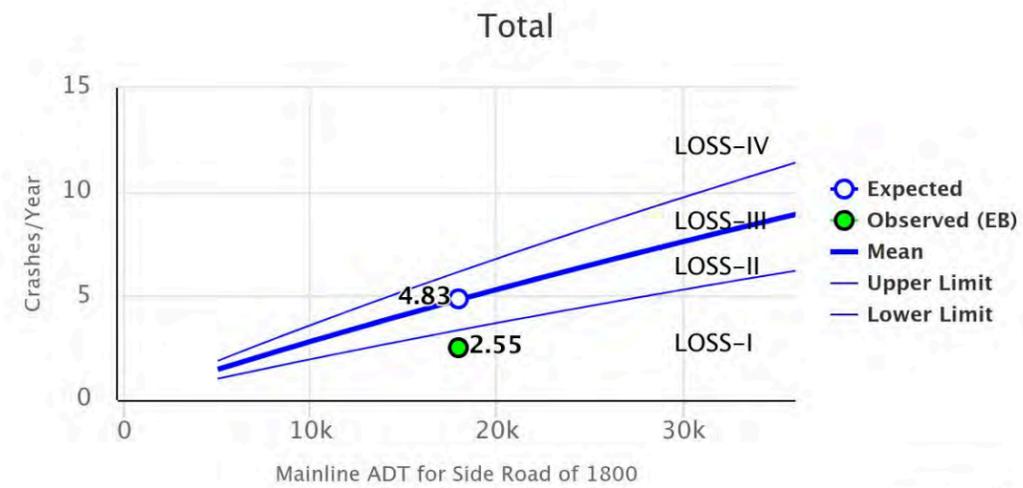


Figure A-15 – Diamond Drive & West Road – Intersection LOSS – Total



Figure A-16 – Diamond Drive & West Road – Intersection LOSS – Severe

Diamond Drive & Trinity Drive

Diamond Drive & Trinity Drive is a signalized intersection. There was a total of 10 crashes within the crash period of 2019-2023. Eight of these crashes were property damage only (PDO), and two crashes resulted in injuries. Regarding manner of impact, three crashes related to broadside impacts, three were rear-ends, and four were due to approach turns.

The safety performance of the intersection was analyzed based on New Mexico – Urban 4-Lane Divided Signalized Intersection SPF. As shown in the following figures, the intersection operates at a LOSS II for total and LOS I severe crashes, indicating there is a low potential for total crash reduction and a low to moderate potential for severe crash reduction.



Figure A-17 – Diamond Drive & Trinity Drive – Intersection LOSS – Total

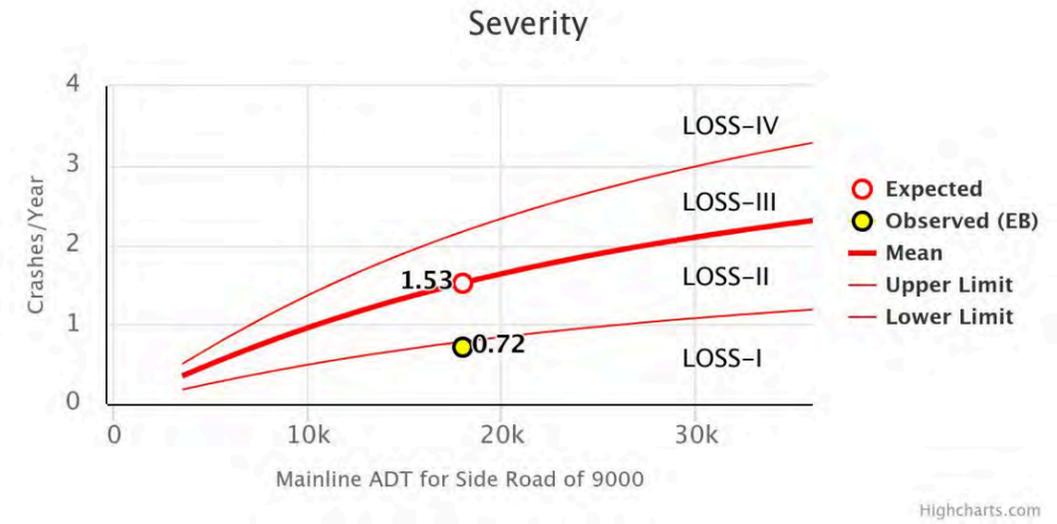


Figure A-18 – Diamond Drive & Trinity Drive – Intersection LOSS – Severe

Diamond Drive & Canyon Road

Diamond Drive & Canyon Road is a signalized intersection. Of the intersections evaluated, it was the one with the highest crash frequency. There was a total of 19 crashes within the crash period of 2019-2023. Twelve crashes were property damage only (PDO), and seven crashes resulted in injuries. Regarding manner of impact, five crashes resulted from broadside impact, six were rear-ends, six were due to approach turns, one related to an overtaking turn, and one was a collision with a parked vehicle.

The safety performance of the intersection was analyzed based on New Mexico – Urban 4-Lane Divided Signalized Intersection SPF. As shown in the following figures, the intersection operates at a LOSS III for total and severe crashes, indicating there is a moderate to high potential for crash reduction.



Figure A-19 – Diamond Drive & Canyon Road – Intersection LOSS – Total



Figure A-20 – Diamond Drive & Canyon Road – Intersection LOSS – Severe

Diamond Drive & Sandia Drive

Diamond Drive & Sandia Drive/Orange Street is a signalized intersection. The intersection did not have any reported crashes during the period of 2019-2023.

Diamond Drive & North Road

Diamond Drive & North Road is a one-way stop-controlled intersection. There was a total of three crashes within the crash period of 2019-2023. Two crashes were property damage only (PDO), and one crash resulted in injuries. Regarding manner of impact, there were two rear-ends and one collision with a fixed object.

The safety performance of the intersection was analyzed based on New Mexico – Urban 4-Lane Divided Unsignalized Intersection SPF. As shown in the following figures, the intersection operates at a LOSS II for total and severe crashes, indicating there is a low to moderate potential for crash reduction.

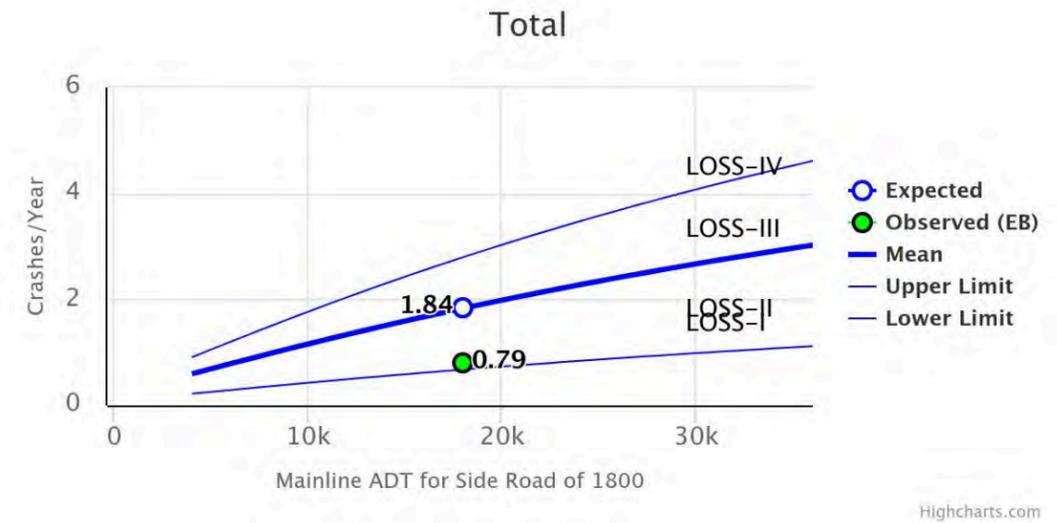


Figure A-21 – Diamond Drive & Sandia Drive – Intersection LOSS – Total



Figure A-22 – Diamond Drive & Sandia Drive – Intersection LOSS – Severe

Diamond Drive & Urban Street

Diamond Drive & Urban Street is a one-way stop-controlled intersection. There was a total of two crashes within the crash period of 2019-2023, both of which were property damage only (PDO). Regarding manner of impact, one related to broadside impact, and one was a rear-end.

The safety performance of the intersection was analyzed based on New Mexico – Urban 4-Lane Divided Unsignalized Intersection SPF. As shown in the following figures, the intersection operates at a LOSS I for total and severe crashes, indicating there is a low potential for crash reduction.



Figure A-23 – Diamond Drive & Urban Street – Intersection LOSS – Total

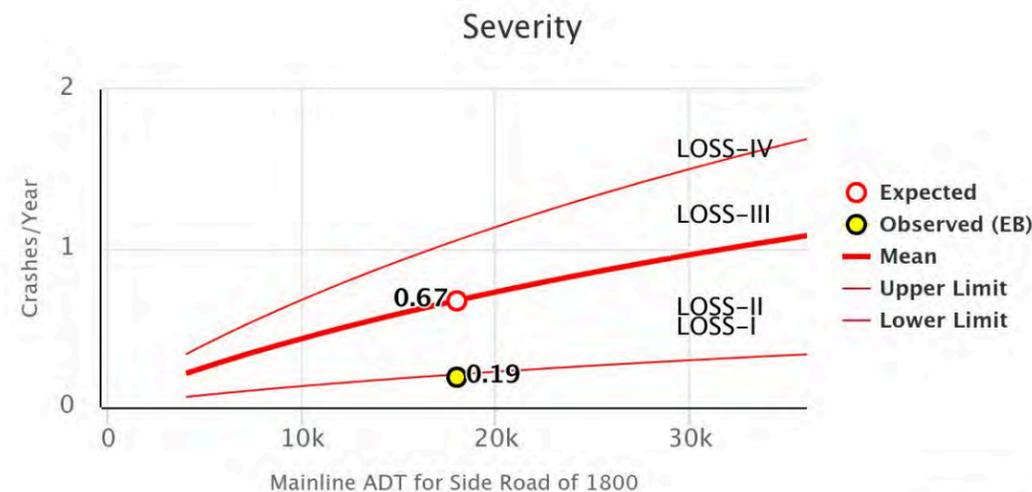


Figure A-24 – Diamond Drive & Urban Street – Intersection LOSS – Severe

Diamond Drive & Arkansas Avenue

Diamond Drive & Arkansas Avenue/38th Street is a signalized intersection. There was a total of 10 crashes within the crash period of 2019-2023, all of which were property damage only (PDO). Regarding manner of impact,

three resulted from broadside impact, one was a head-on crash, four were rear-ends, and two were due to approach turns.

The safety performance of the intersection was analyzed based on New Mexico – Urban 4-Lane Divided Signalized Intersection SPF. As shown in the following figures, the intersection operates at a LOSS I for total and severe crashes, indicating there is a low potential for crash reduction.



Figure A-25 – Diamond Drive & Arkansas Avenue – Intersection LOSS – Total



Figure A-26 – Diamond Drive & Arkansas Avenue – Intersection LOSS – Severe

Diamond Drive & 36th Street

Diamond Drive & 36th Street is a two-way stop-controlled intersection. There was a total of three crashes within the crash period of 2019-2023. Two crashes were property-damage only (PDO), and one crash resulted in injuries. Regarding manner of impact, one crash resulted from broadside impact, one was a rear-end, and one was a sideswipe crash from the same direction.

The safety performance of the intersection was analyzed based on New Mexico – Urban 4-Lane Divided Unsignalized Intersection SPF. As shown in the following figures, the intersection operates at a LOSS I for total and severe crashes, indicating there is a low potential for crash reduction.



Figure A-27 – Diamond Drive & 36th Street – Intersection LOSS – Total



Figure A-28 – Diamond Drive & 36th Street – Intersection LOSS – Severe

Diamond Drive & Club Road

Diamond Drive & Club Road is a one-way stop-controlled intersection. The intersection did not have any reported crashes during the period of 2019-2023.

Diamond Drive & Range Road

Diamond Drive & Range Road is a one-way stop-controlled intersection. The intersection did not have any reported crashes during the period of 2019-2023.

Diamond Drive & San Ildefonso Road

Diamond Drive & San Ildefonso Road is a roundabout intersection. There was a total of one crash within the crash period of 2019-2023. The crash was property damage only (PDO). The crash resulted from a broadside impact.

iv) Crash Mitigation Improvements

Intersections

Retroreflective backplates are a the FHWA Proven Safety Countermeasure known to reduce total crashes at intersections by up to 15%. At the signalized intersections of Diamond Drive with West Road, Trinity Drive, Canyon Road, and Arkansas Avenue, adding a retroreflective border to the existing traffic signal head backplates is recommended. This will improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background making the signal heads more visible and conspicuous in both daytime and nighttime conditions.

v) Crash Summary Heat Maps & Crash Locations

The following figures provide maps of crashes separated by whether Diamond Drive was indicated as the primary or secondary street of crash. **Figure A-29** and **Figure A-30** are heat maps showing crash density. **Figure A-31** and **Figure A-32** show crash locations by severity type.

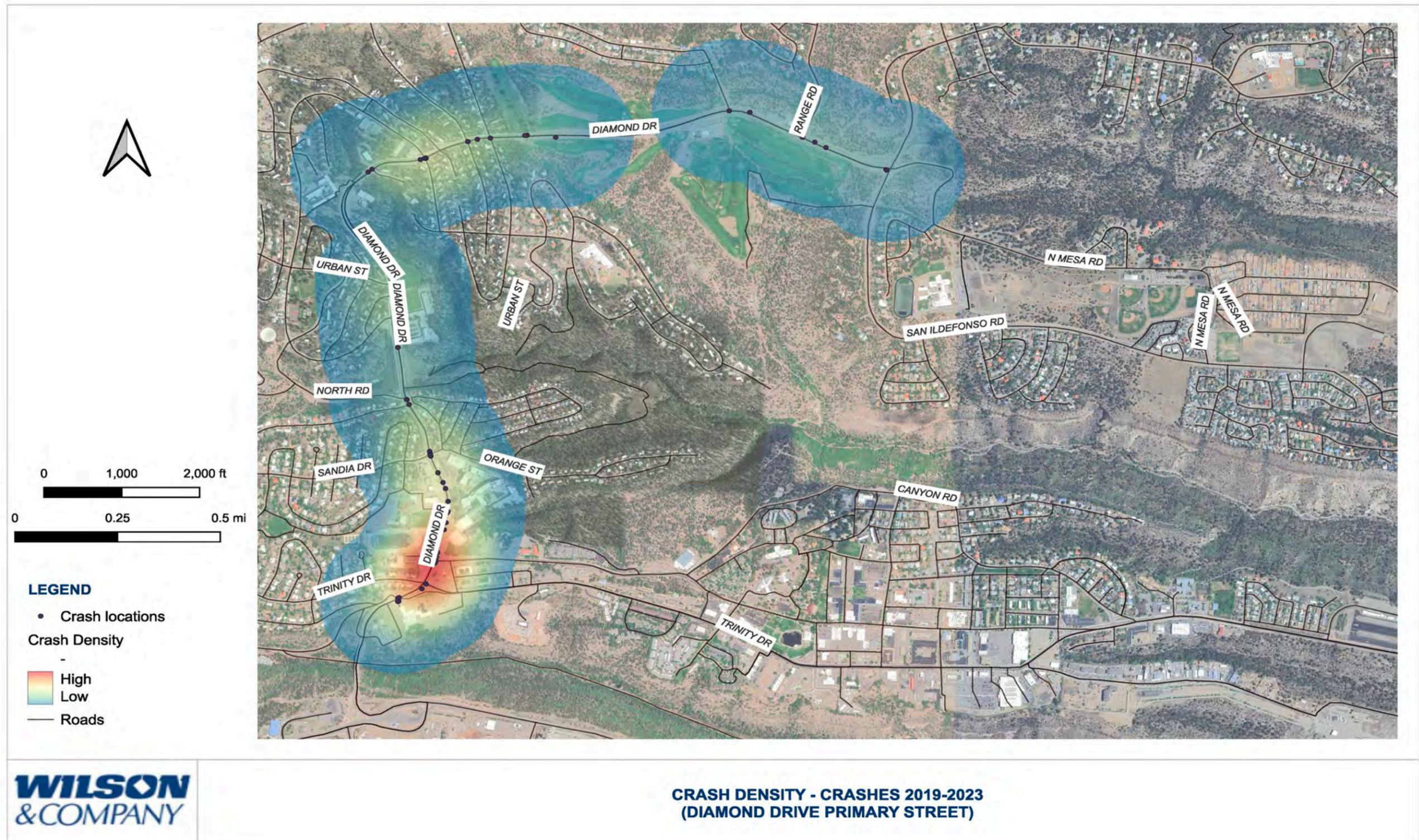


Figure A-29 – Crash Density - Crashes 2019-2023 (Diamond Drive Primary Street)

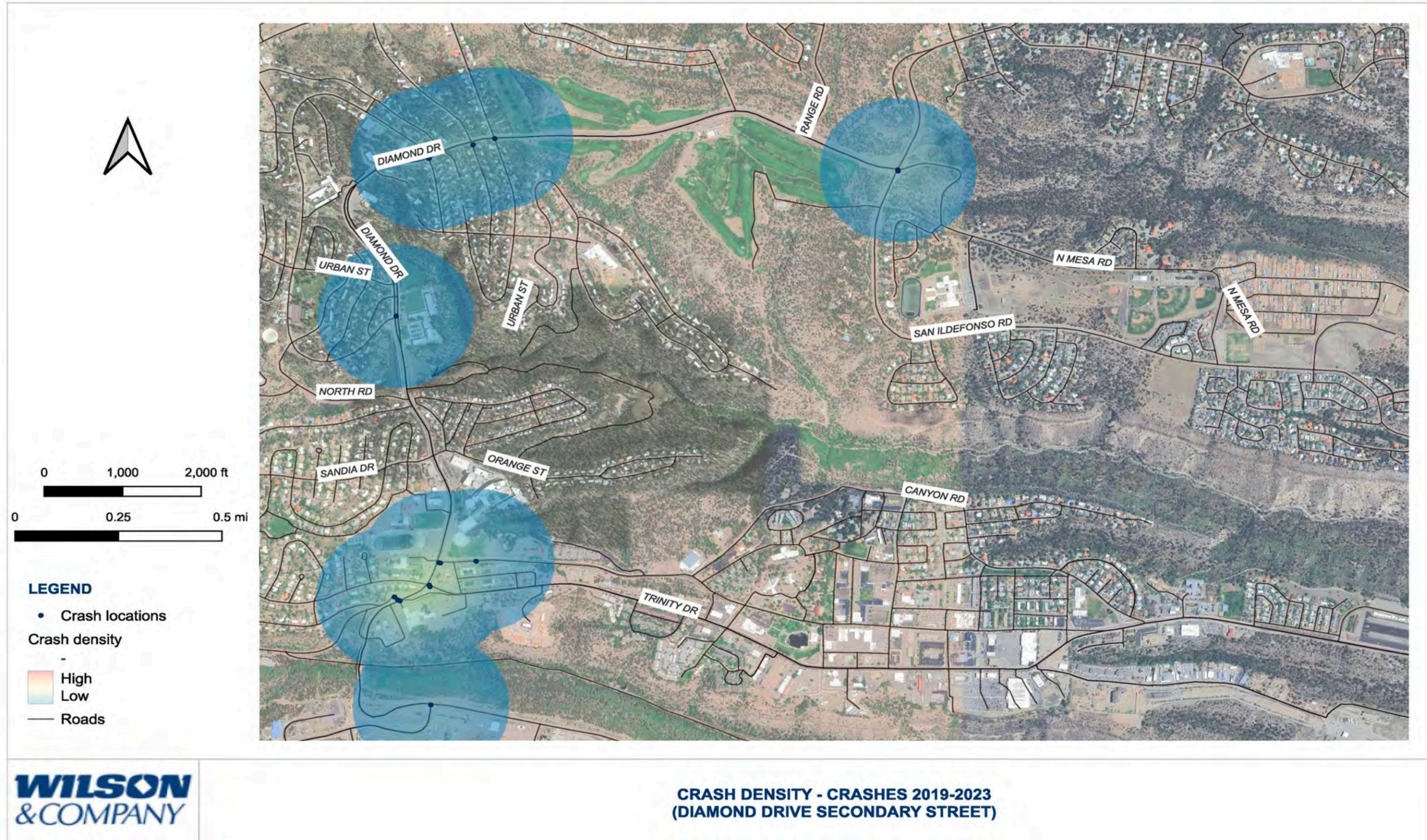


Figure A-30 – Crash Density - Crashes 2019-2023 (Diamond Drive Secondary Street)

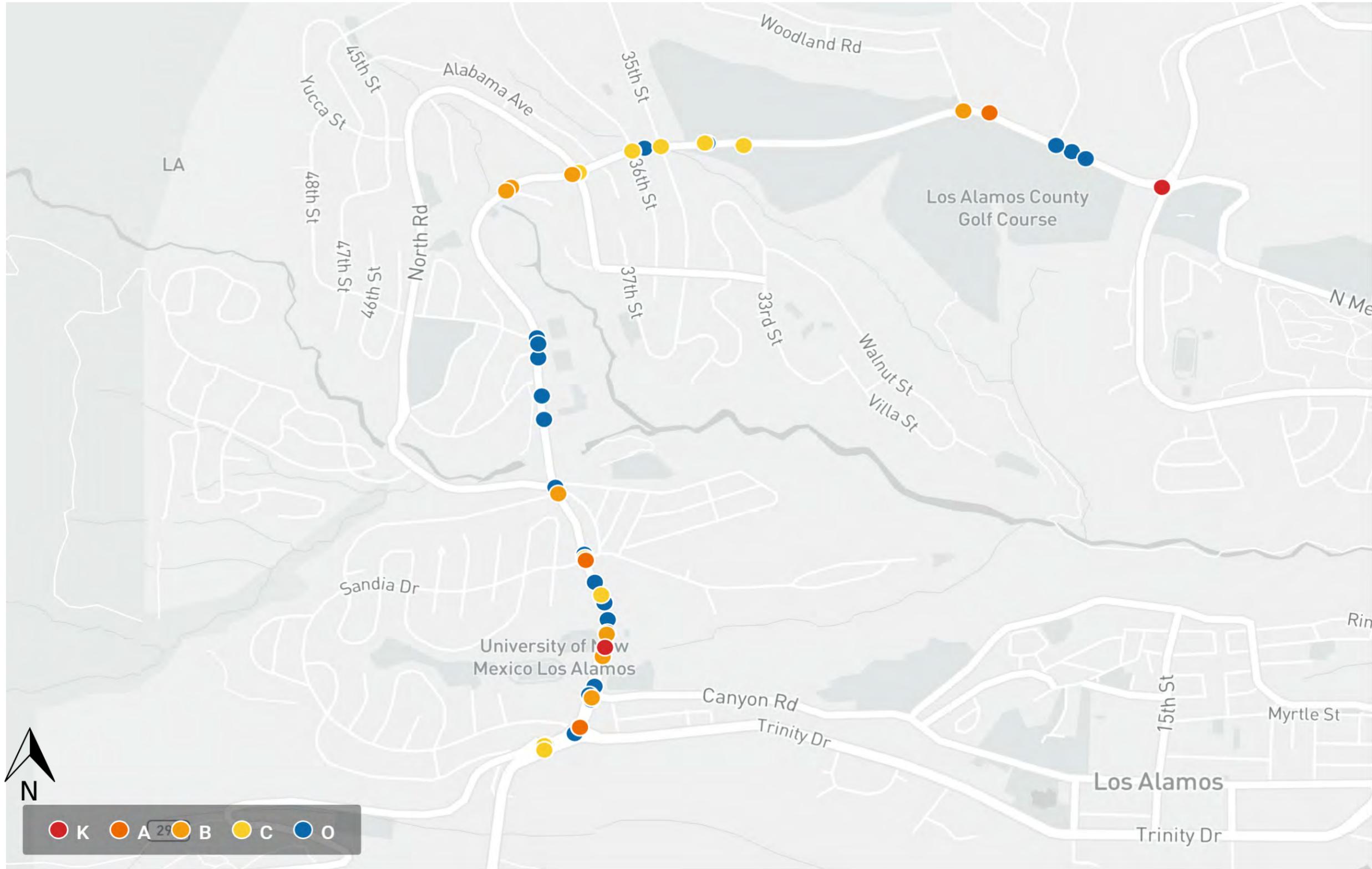


Figure A-31 - Crash Locations - Crashes Severity 2019-2023 (Diamond Drive Primary Street)

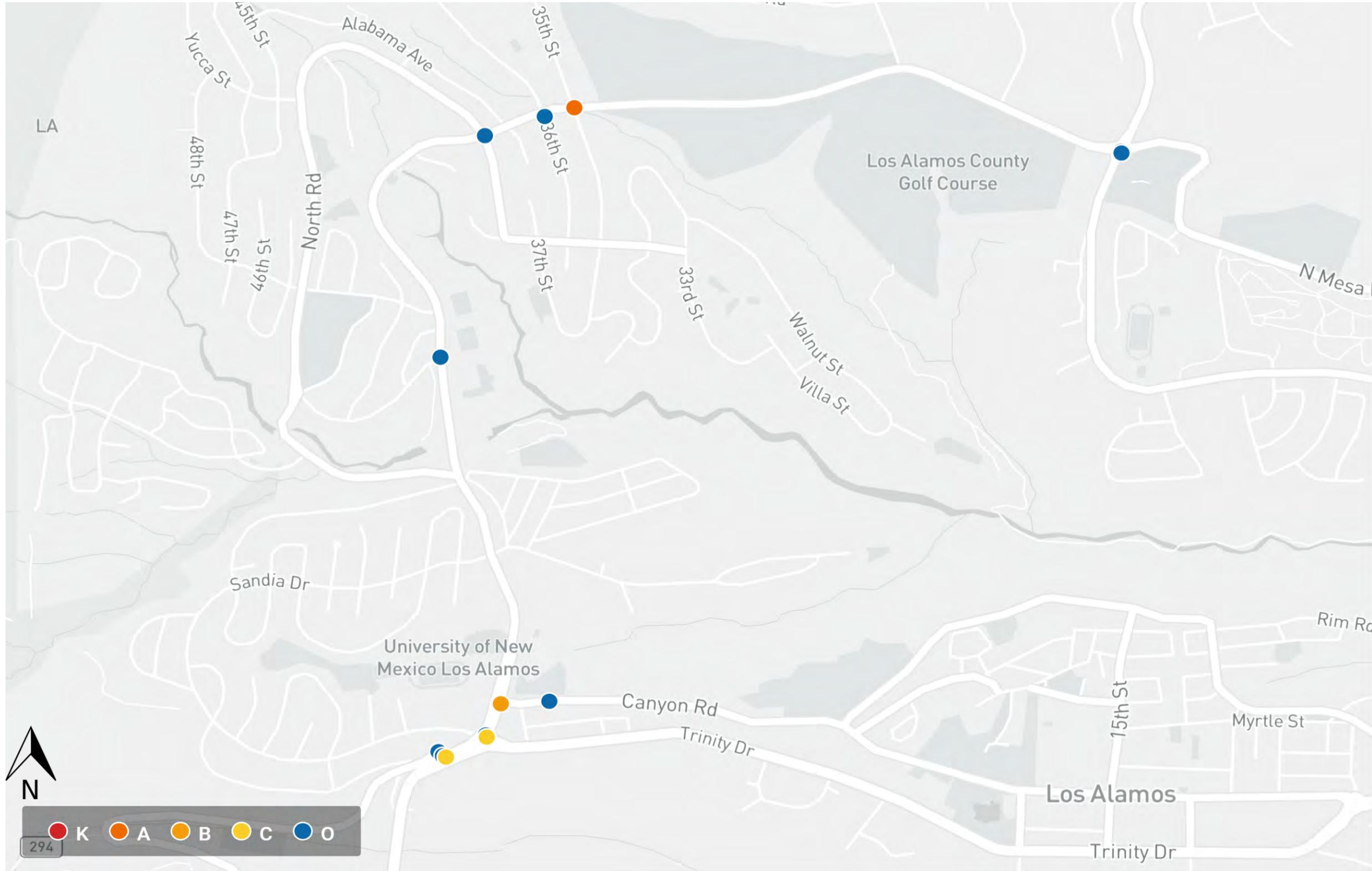


Figure A-32 – Crash Locations - Crashes Severity 2019-2023 (Diamond Drive Secondary Street)

VI. Implementation 10-Year No-Build Performance

a. No-Build Future Traffic Volumes

i) Growth Factors & Projection

As discussed with Los Alamos County during the initial scoping meeting, a growth rate of 0.5% per year was agreed and used for the Implementation 10-Year No-Build (2045 Horizon No-Build) model to remain conservative. The following growth factor formula was used:

$$\text{Growth Factor} = (1 + \text{Growth Rate})^n$$

Where n=year difference

The growth factor for Horizon Year (2045) is shown below:

$$\text{Horizon Growth Factor} = (1 + 0.5\%)^{20}$$

$$\text{Horizon Growth Factor} = 1.10$$

ii) Horizon No-Build Background Traffic

The Horizon No-Build Condition is analyzed as a base condition to compare to the Build Condition.

b. Intersection Capacity Operations

i) Horizon No-Build Projected Daily and Peak-Hour Traffic Volumes

The volumes reflect the traffic that the intersections should experience without the proposed developments. The 2045 Horizon Year No-Build volumes are shown in **Figure A-33**. The 2045 Horizon Year No-Build volumes are the existing Peak Hour volumes with a growth factor of 1.10. A value of 0.92 based on HCM urban standard peak hour factor was used for the 2045 horizon traffic analysis.

ii) Unsignalized

Horizon No-Build LOS Summaries

Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Unsig.	5	Diamond Drive & North Road	D / 33.2 (EBLT)	D / 33.2 (EBLT)
Unsig.	6	Diamond Drive & Urban Street	C / 20.3 (EB)	B / 12.5 (EB)
Unsig.	8	Diamond Drive & 36 th Street	C / 15.7 (NB)	C / 17.1 (NB)

Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Unsig.	9	Diamond Drive & Club Road	B / 14.6 (SB)	B / 11.1 (SB)
Unsig.	10	Diamond Drive & Range Road	C / 19.7 (SBLT)	B / 15.0 (SBLT)

Horizon No-Build Operational & Auxiliary Lane Deficiencies

Four of the unsignalized intersections are expected to operate at a LOS C or better for both peak hour periods. As in the existing conditions assessment, the intersection of Diamond Drive and North Road is expected to have a critical movement for the eastbound left-turn with a LOS D; however, the eastbound approach does provide an auxiliary lane for this movement. Traffic operations results for the unsignalized intersection are shown in **Table A-14**. Full Synchro analysis reports for 2045 horizon no-build conditions are included in Appendix E.

iii) Roundabouts

Horizon No-Build LOS Summaries

Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Round.	11	Diamond Drive/Mesa Road & Ildefonso Road	A / 9.1	A / 6.4

Horizon No-Build Operational Deficiencies

The roundabout intersection is expected to operate at a LOS A or better during both peak hours, shown in **Table A-15**. No operational deficiencies were found during horizon no-build conditions. Full Synchro analysis reports for 2045 horizon no-build conditions are included in Appendix E.

iv) Signalized

Horizon No-Build LOS Summaries

<i>Table A-16 – 2045 Horizon No-Build Signalized Traffic Operations Summary</i>				
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Signal	1	Diamond Drive & West Road	A / 3.8	B / 18.0
Signal	2	Diamond Drive & Trinity Drive/NM 502	B / 15.2	B / 13.6
Signal	3	Diamond Drive & Canyon Road	C / 22.7	C / 32.9
Signal	4	Diamond Drive & Sandia Drive/Orange Street	B / 16.7	B / 16.8
Signal	7	Diamond Drive & Arkansas Avenue/38 th Street	C / 20.9	B / 10.2

Horizon No-Build Operational & Auxiliary Lane Deficiencies

All signalized intersections are expected to operate at LOS C or better in both the AM and the PM peak hour, shown **Table A-16**. No operational deficiencies were found during horizon no-build conditions. Full Synchro analysis reports for 2045 horizon no-build conditions are included in Appendix E.

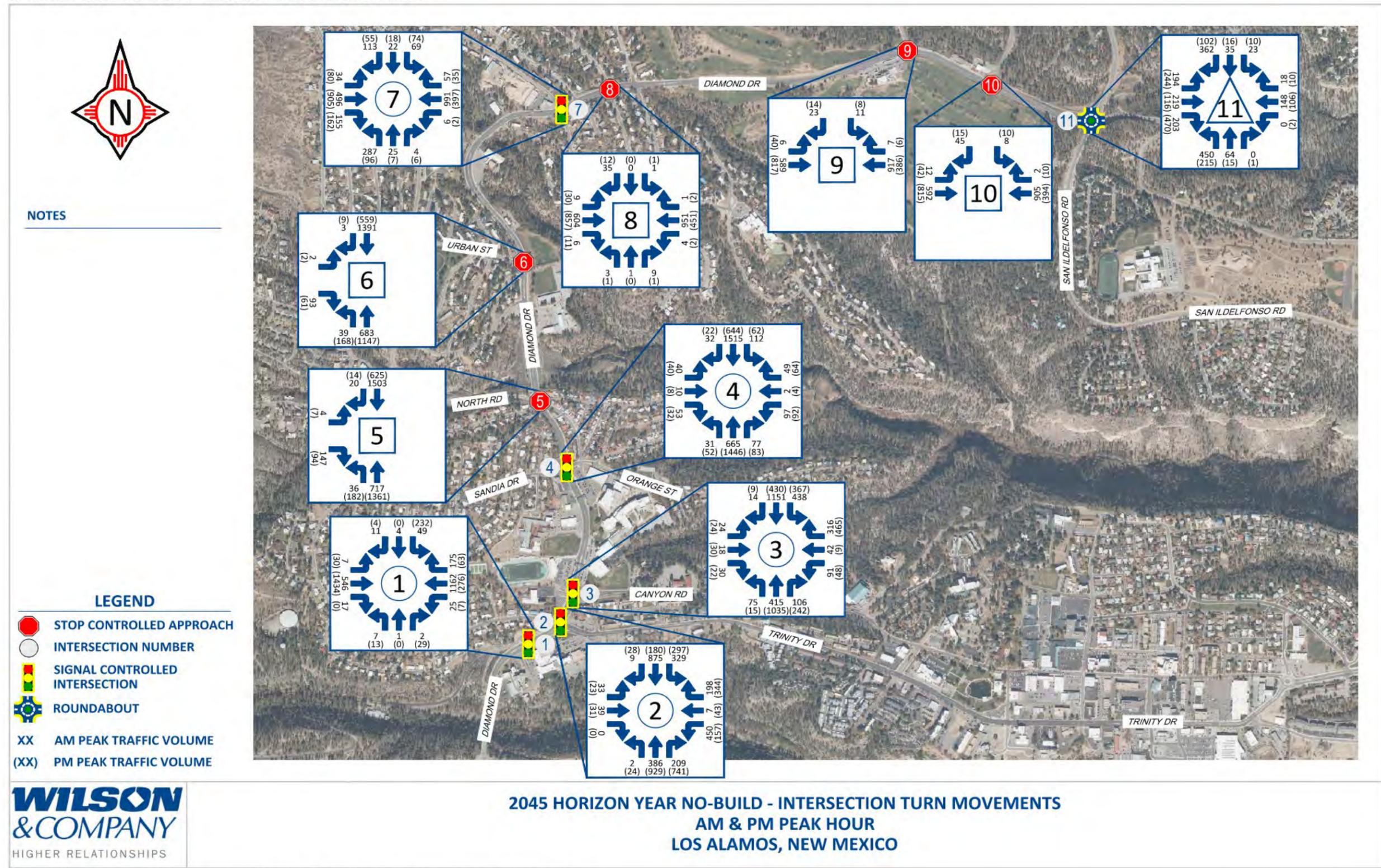


Figure A-33 – Horizon Year No-Build Turning Movements



Figure A-34 – Horizon Year No Build LOS Result

VII. Proposed Conditions

a. Description of Proposed Improvements

i) North Mesa Housing

The *North Mesa Housing Study* proposes housing and open space for the 30-acre parcel located between Los Alamos Middle School and Los Alamos County (LAC) -owned baseball field complex. The density of the development would range from 7-12 units per acre. At this density, 210-360 housing units could be constructed on the site. Access to the development would be provided by two access points from Mesa Road and a third access point from San Ildefonso Road.

Site-generated traffic, shown **Figure A-35**, was assigned to the roadway network between each of the intersections being analyzed. **Figure A-36** provides the distribution of the estimated trip assignments from the North Mesa Site proposed development.

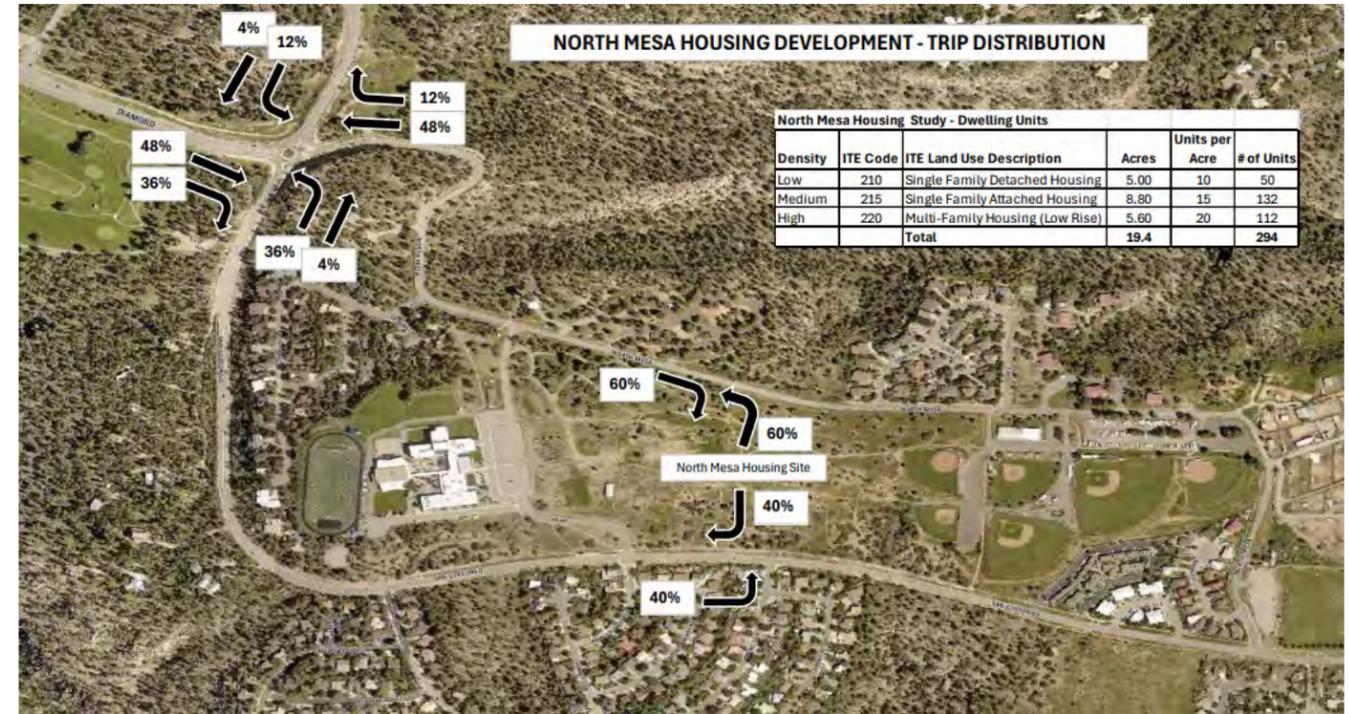


Figure A-35 - Estimated Trip Generation and Distribution - North Mesa Site

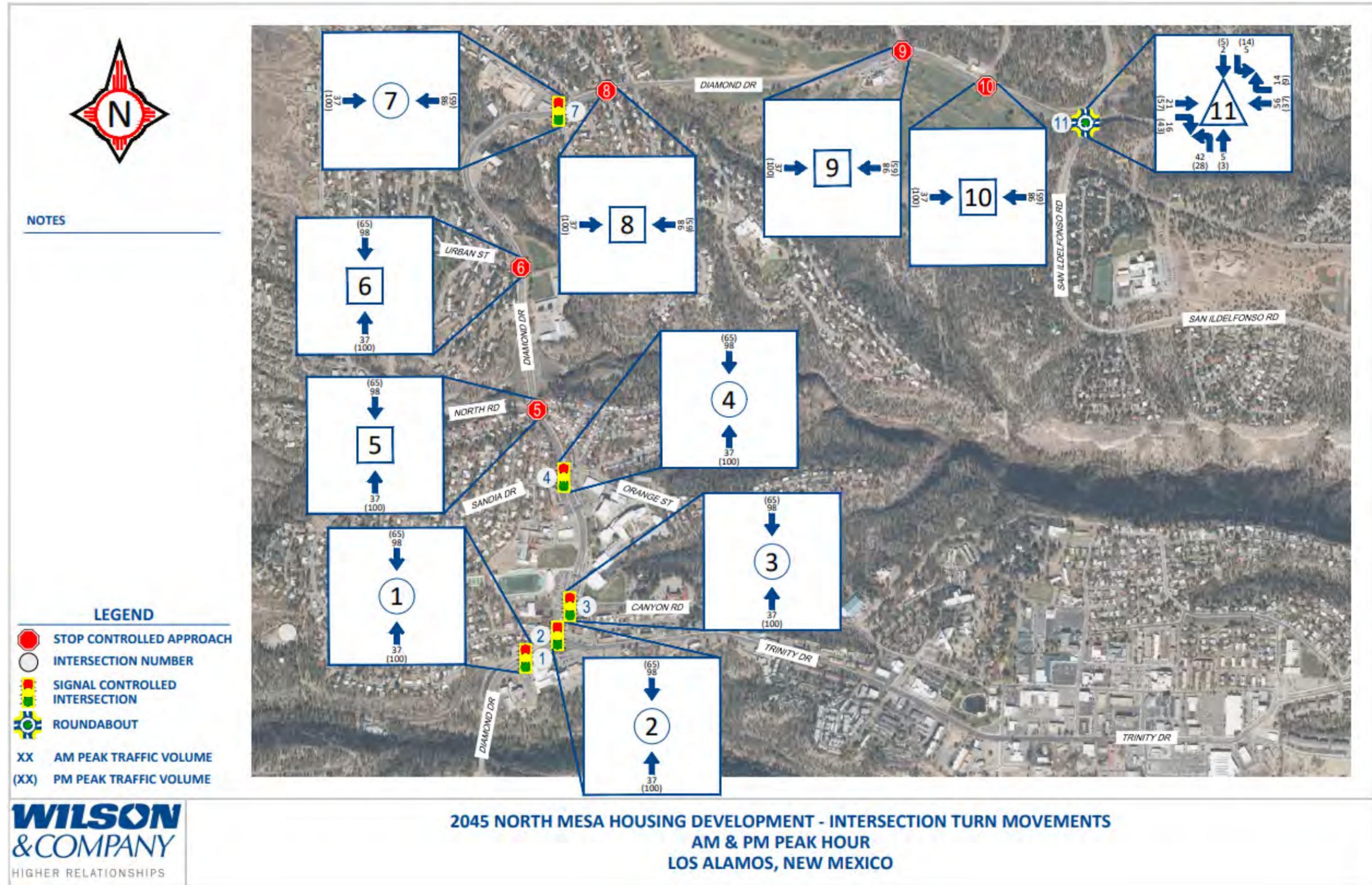


Figure A-36 - North Mesa Housing Development Turning Movements

ii) Arbolada Subdivision

The Arbolada Subdivision is a proposed residential development on an undeveloped 17.07-acre lot located just southeast of the North Mesa Site. (See **Figure 1**) The developer has proposed an 85-lot subdivision, encompassing 137 single-family and multifamily dwelling units. As currently proposed, the subdivision would be constructed in a single phase.

Site-generated traffic, shown in **Figure A-37**, was assigned to the roadway network between each of the intersections being analyzed. **Figure A-38** provides the distribution of the estimated trip assignments from the Arbolada proposed development.

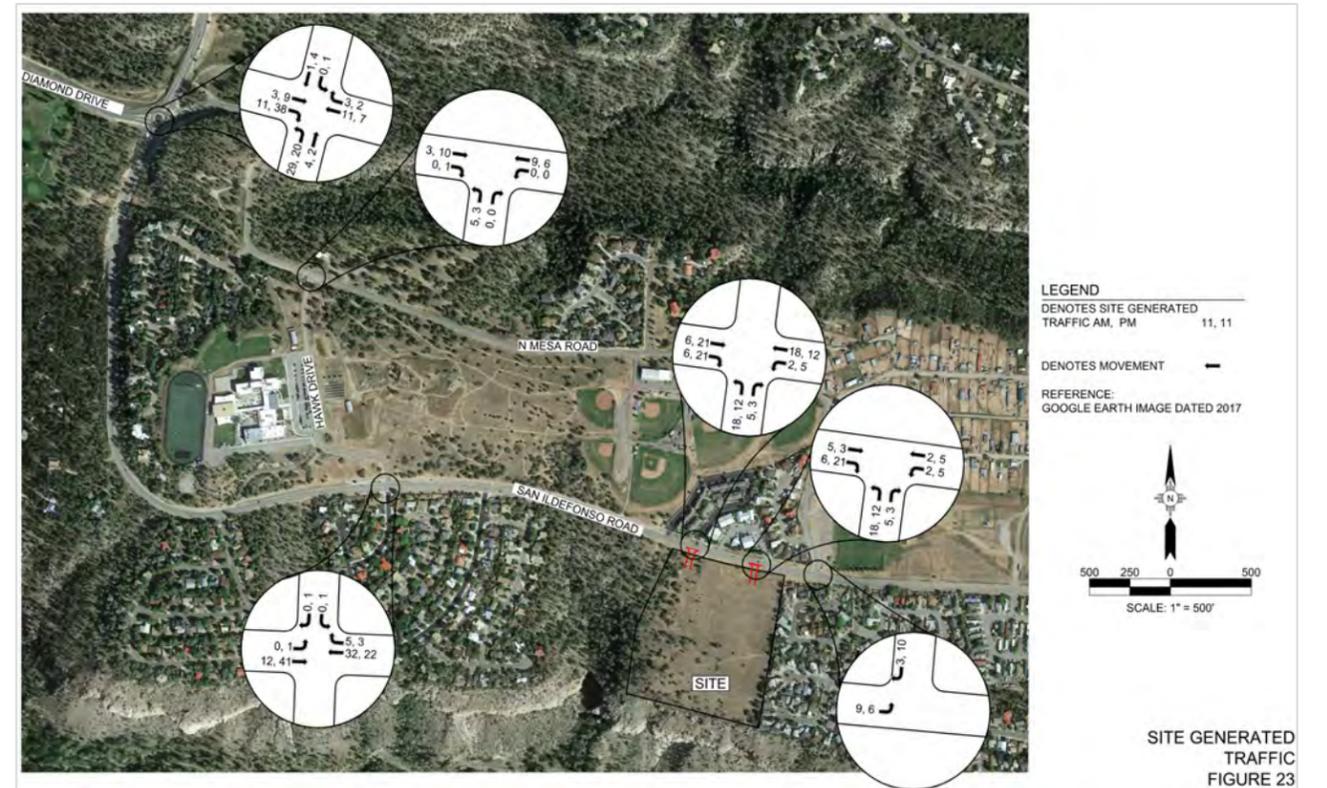


Figure A-37 – Site Generated Traffic - Arbolada Subdivision, from TRAFFIC IMPACT ANALYSIS - ARBOLADA SUBDIVISION

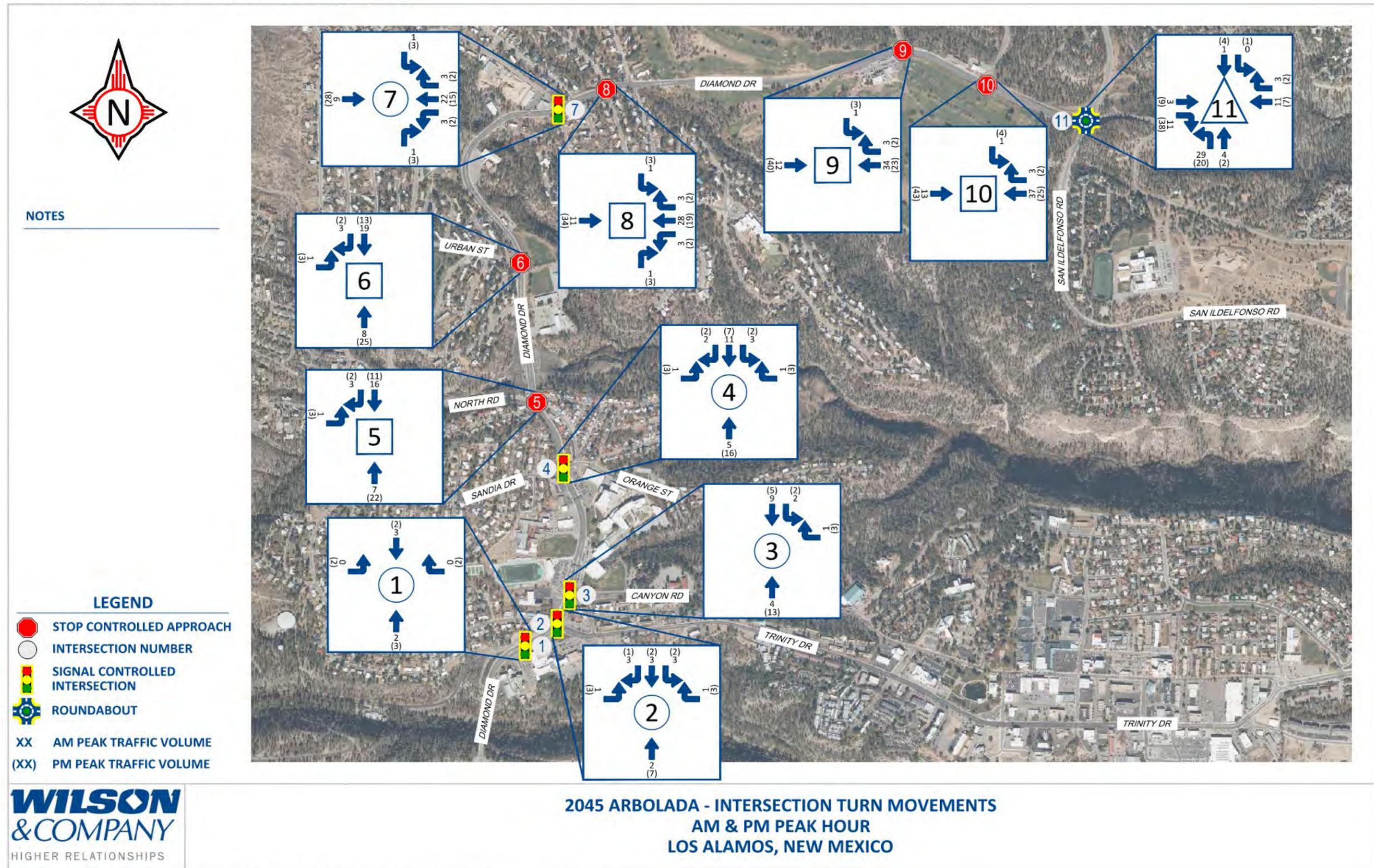


Figure A-38 - Arbolada Turning Movements

iii) Ponderosa Estates Subdivision Phase III

This development is the third phase of the four-phase, master-planned Ponderosa Estates development. It will consist of 49 detached, single-family dwelling units on an 11.62-acre site.

Site-generated traffic, determined by the traffic impact analysis for the subdivision as shown in **Figure A-39**, was assigned to the roadway network between each of the intersections being analyzed. **Figure A-40** provides the distribution of the estimated trip assignments from the Ponderosa proposed development.



Figure A-39 – Site Generated Traffic, from TRAFFIC DATA FOR PONDEROSA ESTATES SUBDIVISION PHASE III (TIA)

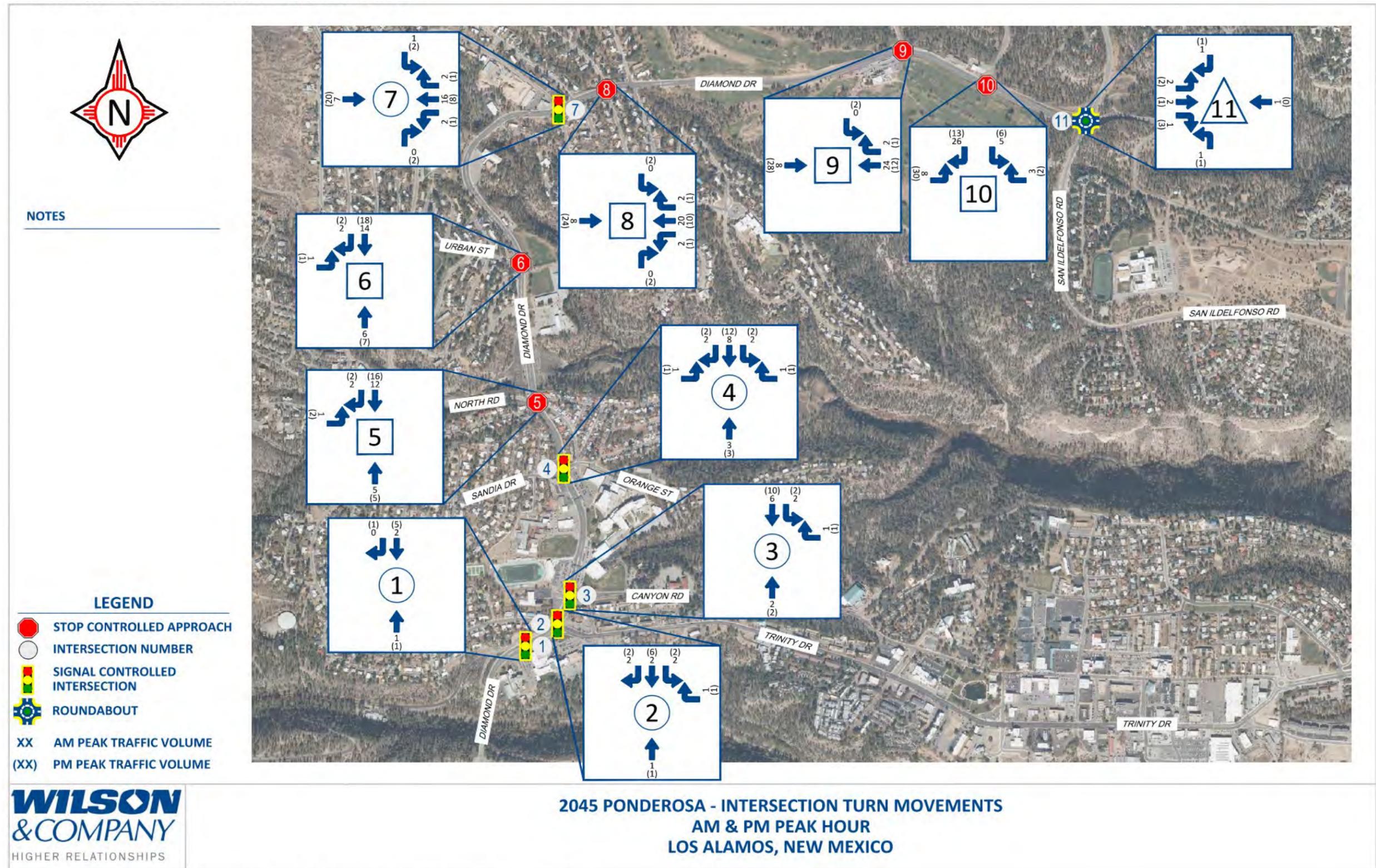


Figure A-40 – Ponderosa Turning Movements

b. Implementation of Future Traffic Volumes

- i) Build plus Future Background Traffic

Background traffic was multiplied by the growth factors identified above for each scenario. Expected site-generated traffic was then added to future background traffic.

VIII. Implementation Year Traffic Performance (Deterministic)

a. Intersection Capacity Operations

- i) Implementation Build Projected Daily and Peak-Hour Traffic Volumes

The volumes reflect the traffic that the intersections should experience with the proposed developments. The 2035 Implementation Year Build volumes are shown in **Figure A-41**. The 2035 Implementation Year Build volumes are the existing peak-hour volumes with a growth factor of 1.05 plus the site-generated volumes from the proposed developments. A value of 0.92 based on HCM urban standard peak hour factor was used for the 2035 implementation traffic analysis.

Implementation Year Build LOS for each intersection is shown in **Figure A-42**.

- ii) Unsignalized

Implementation Year LOS Summaries

Table A-17 – 2035 Implementation Build Unsignalized Traffic Operations Summary				
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Unsig.	5	Diamond Drive & North Road	E / 39.4 (EBLT)	C / 24.1 (EBLT)
Unsig.	6	Diamond Drive & Urban Street	C / 22.4 (EB)	B / 12.9 (EB)
Unsig.	8	Diamond Drive & 36 th Street	C / 21.6 (NB)	C / 17.8 (SB)
Unsig.	9	Diamond Drive & Club Road	C / 17.2 (SB)	B / 13.1 (SB)
Unsig.	10	Diamond Drive & Range Road	C / 22.6 (SBLT)	C / 17.4 (SBLT)

Implementation Year Operational & Auxiliary Lane Deficiencies

Almost all of the unsignalized intersections are expected to operate at LOS C or better in both the AM and the PM peak hour, as shown in **Table A-17**. At the intersection of Diamond Drive and North Road, the critical movement (eastbound left-turn) has an LOS E; however, for the eastbound movement there are auxiliary lanes available for

each movement (i.e., left-turn and right-turn). For the northbound approach, there is a north-to-west left-turn lane. The increasing delay of vehicles making a left-turn is due to the high number of opposing vehicles during the AM Peak. No operational deficiencies were found during implementation build conditions. Full Synchro analysis reports for 2035 implementation build conditions are included in Appendix E.

- iii) Roundabouts

Implementation Year LOS Summaries

Table A-18 – 2035 Implementation Build Roundabout Traffic Operations Summary				
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Round.	11	Diamond Drive/Mesa Road & Ildefonso Road	B / 10.8	A / 7.9

Implementation Year Operational Deficiencies

The roundabout intersection is expected to operate at a LOS B or better during both peak hours, as shown in **Table A-18**. No operational deficiencies were found during implementation build conditions. Full Synchro analysis reports for 2035 implementation build conditions are included in Appendix E.

- iv) Signalized

Implementation Year LOS Summaries

Table A-19 – 2035 Implementation Build Signalized Traffic Operations Summary				
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Signal	1	Diamond Drive & West Road	A / 3.6	B / 16.5
Signal	2	Diamond Drive & Trinity Drive/NM 502	B / 14.2	B / 12.6
Signal	3	Diamond Drive & Canyon Road	C / 22.5	C / 32.2
Signal	4	Diamond Drive & Sandia Drive/Orange Street	B / 16.7	B / 17.0
Signal	7	Diamond Drive & Arkansas Avenue/38 th Street	C / 21.0	B / 10.5

Implementation Year Operational & Auxiliary Lane Deficiencies

All signalized intersections are expected to operate at LOS C or better in both the AM and the PM peak hour, as shown in **Table A-19**. No operational deficiencies were found during implementation build conditions. Full Synchro analysis reports for 2035 implementation build conditions are included in Appendix E.

b. Pedestrian & Bicycle Usage

Projects to support future pedestrian and bicycle travel are discussed in **section XI.a**.

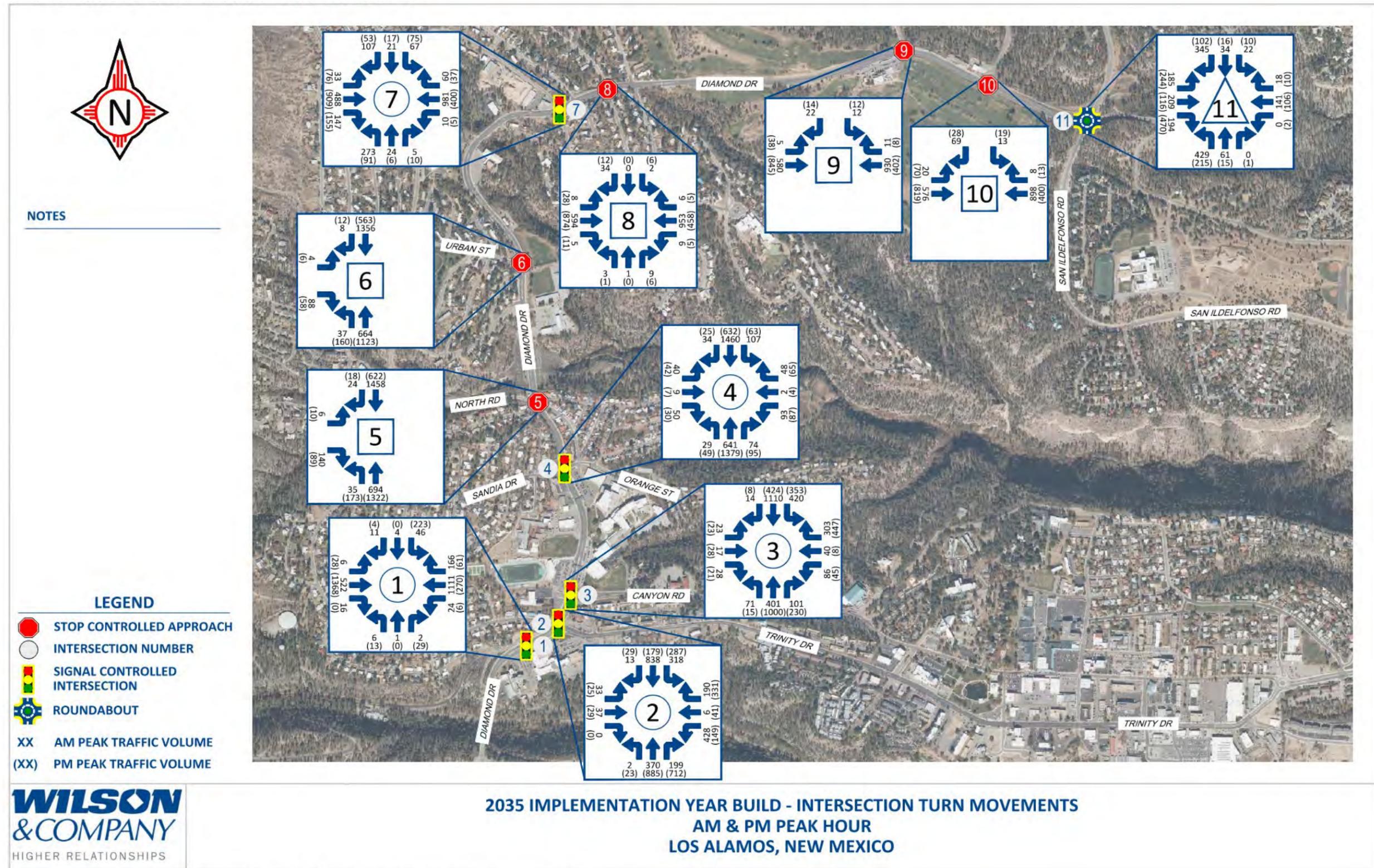


Figure A-41 - Implementation Year Build Turning Movements

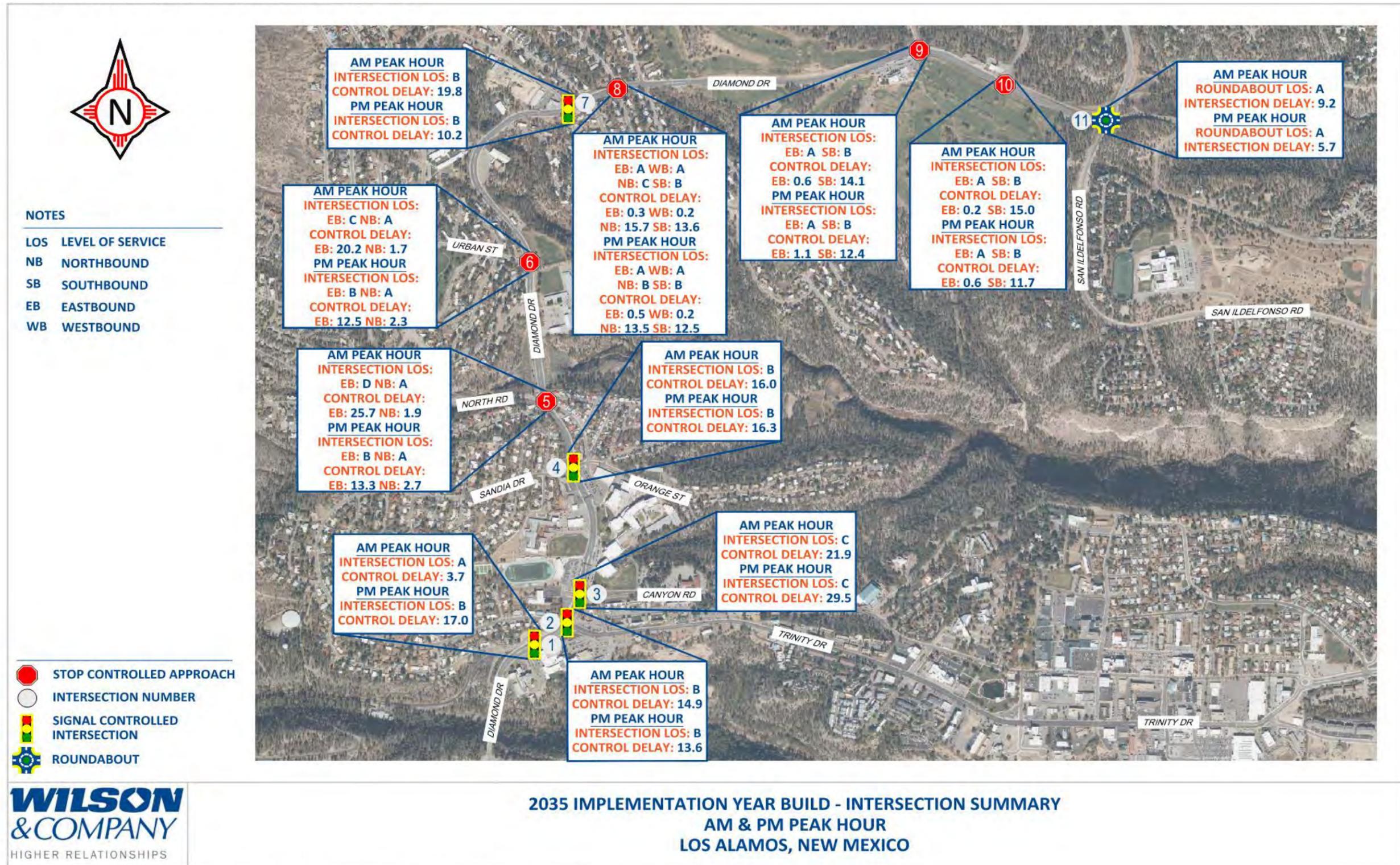


Figure A-42 – Implementation Year Build LOS Results

IX. Implementation 10-Year Build Traffic Performance

a. Intersection Capacity Operations

i) Implementation Build Projected Daily and Peak-Hour Traffic Volumes

The volumes reflect the traffic that the intersections should experience with the proposed developments. The 2045 Horizon Year Build volumes are shown in **Figure A-43**. 2045 Horizon Year Build volumes are the existing peak-hour volumes with a growth factor of 1.10 plus the site generated volumes from the proposed developments. A value of 0.92 based on HCM urban standard peak hour factor was used for the 2045 horizon traffic analysis.

2045 Horizon Year Build LOS for each intersection is shown in **Figure A-44**.

ii) Unsignalized

Horizon 10-Year Build LOS Summaries

Table A-20 – 2045 Horizon Build Unsignalized Traffic Operations Summary				
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Unsig.	5	Diamond Drive & North Road	E / 43.8 (EBLT)	D / 25.8 (EBLT)
Unsig.	6	Diamond Drive & Urban Street	C / 24.5 (EB)	B / 13.2 (EB)
Unsig.	8	Diamond Drive & 36 th Street	C / 22.5 (NB)	C / 18.8 (SB)
Unsig.	9	Diamond Drive & Club Road	C / 17.8 (SB)	B / 13.6 (SB)
Unsig.	10	Diamond Drive & Range Road	C / 23.8 (SBLT)	C / 18.1 (SBLT)

Horizon 10-Year Build Operational & Auxiliary Lane Deficiencies

Four of the unsignalized intersections are expected to operate at LOS C or better for both peak hour periods, see **Table A-20**. As in the existing conditions assessment, the intersection of Diamond Drive and North Road is expected to have a critical movement for the eastbound left-turn with LOS E; however, the eastbound approach does provide an auxiliary lane for this movement. Full Synchro analysis reports for 2045 horizon build conditions are included in Appendix E.

iii) Roundabouts

Horizon 10-Year Build LOS Summaries

Table A-21 – 2045 Horizon Build Roundabout Traffic Operations Summary				
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Round.	11	Diamond Drive/Mesa Road & Ildefonso Road	B / 12.0	A / 8.3

Horizon 10-Year Build Operational Deficiencies

The roundabout intersection is expected to operate at LOS B or better during both peak hours, shown in **Table A-21**. No operational deficiencies were found during horizon build conditions. Full Synchro analysis reports for 2045 horizon build conditions are included in **Appendix B**.

iv) Signalized

Horizon 10-Year Build LOS Summaries

Table A-22 – 2045 Horizon Build Signalized Traffic Operations Summary				
Control	ID	Intersection	LOS/Delay [in seconds/vehicle] (Critical Movement)	
			AM Peak Hour	PM Peak Hour
Signal	1	Diamond Drive & West Road	A / 3.8	B / 17.8
Signal	2	Diamond Drive & Trinity Drive/NM 502	B / 14.5	B / 12.7
Signal	3	Diamond Drive & Canyon Road	C / 23.7	C / 31.8
Signal	4	Diamond Drive & Sandia Drive/Orange Street	B / 17.8	B / 18.1
Signal	7	Diamond Drive & Arkansas Avenue/38 th Street	C / 23.3	B / 10.9

Horizon 10-Year Build Operational & Auxiliary Lane Deficiencies

All signalized intersections are expected to operate at LOS C or better in both the AM and the PM peak hour, shown in **Table A-22**. No operational deficiencies were found during implementation build conditions. Full Synchro analysis reports for 2035 horizon build conditions are included in Appendix E.

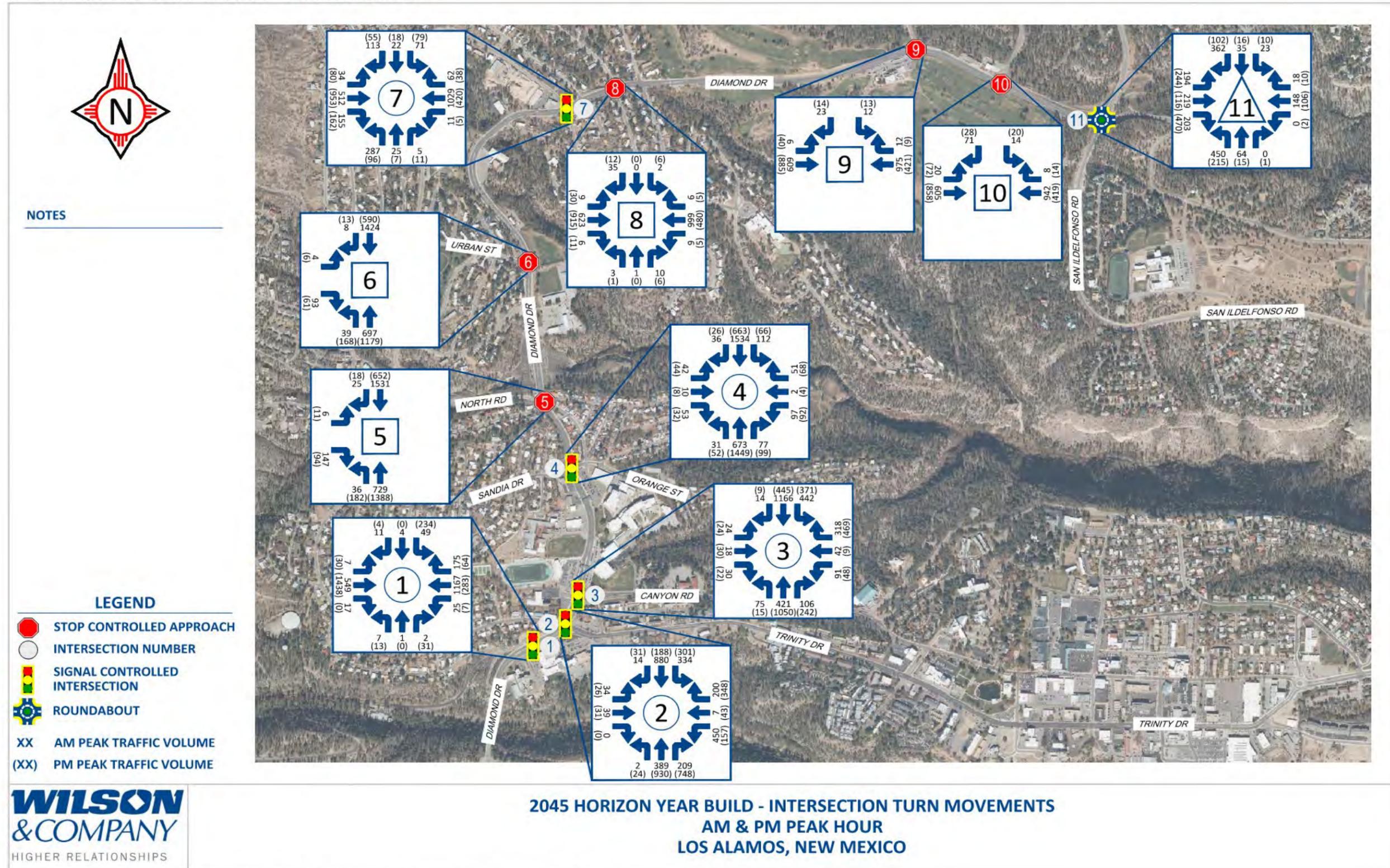
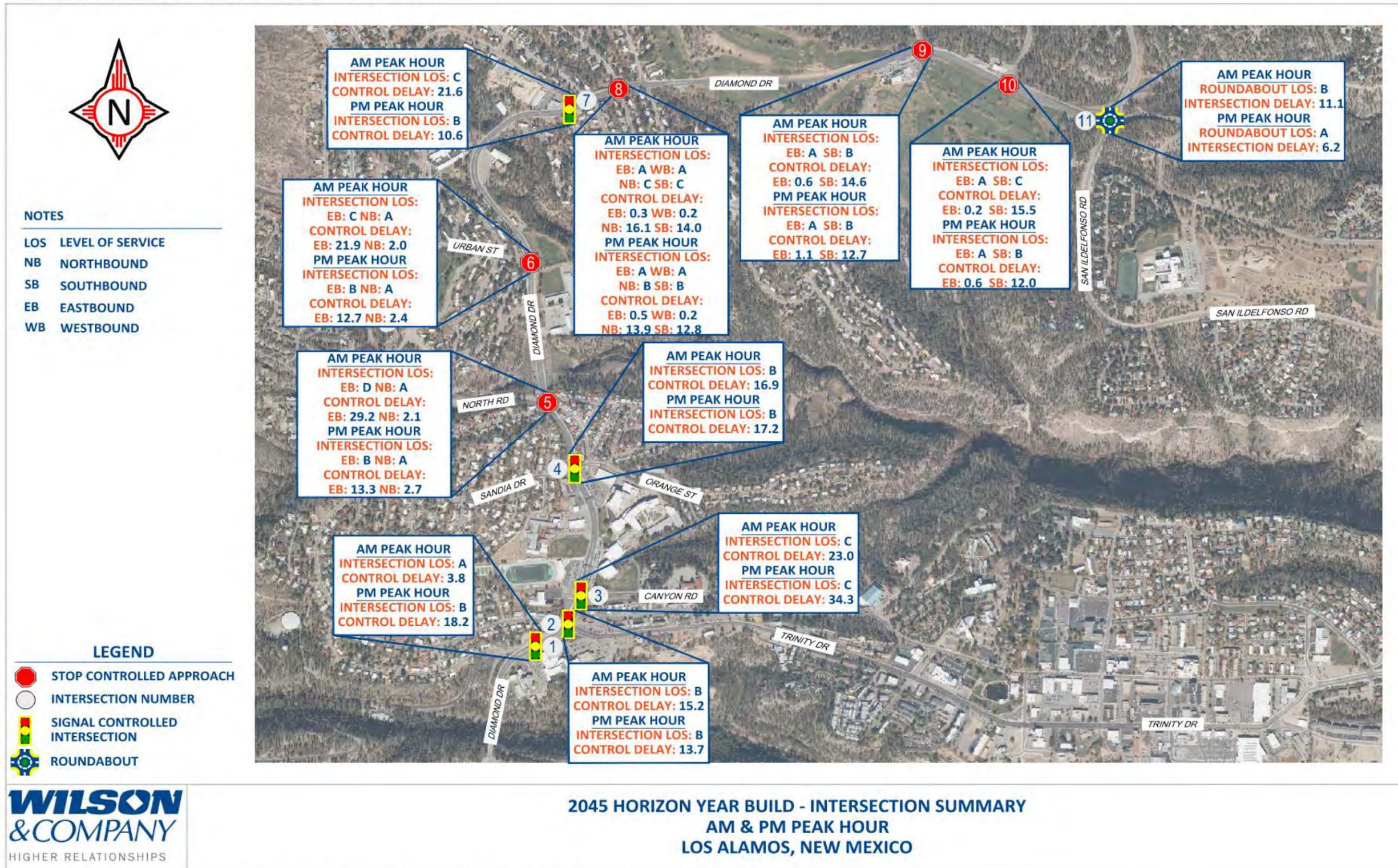


Figure A-43 – Horizon Year Build Turning Movements



2045 HORIZON YEAR BUILD - INTERSECTION SUMMARY
 AM & PM PEAK HOUR
 LOS ALAMOS, NEW MEXICO

Figure A-44 – Horizon Year Build LOS Results

X. Transit Facilities

The Figure A-37 site is served by Route 6 – North Mesa of Atomic City Transit (ACT), the County’s public bus service. Route 6 runs between the Los Alamos Transit Center and the eastern end of San Ildefonso Road via Diamond Drive and San Ildefonso Road. The route has 22 outbound runs and 19 inbound runs on weekdays between approximately 6:00 a.m. to 7:00 p.m. Headways are every 20-30 minutes during peak hours (until 9:30 a.m. and 3 p.m. to 6:30 p.m.) and hourly during non-peak hours. (Route 6 morning peak service is currently not provided.) The alignments of Route 6 and other ACT fixed routes are shown in **Figure A-45**.

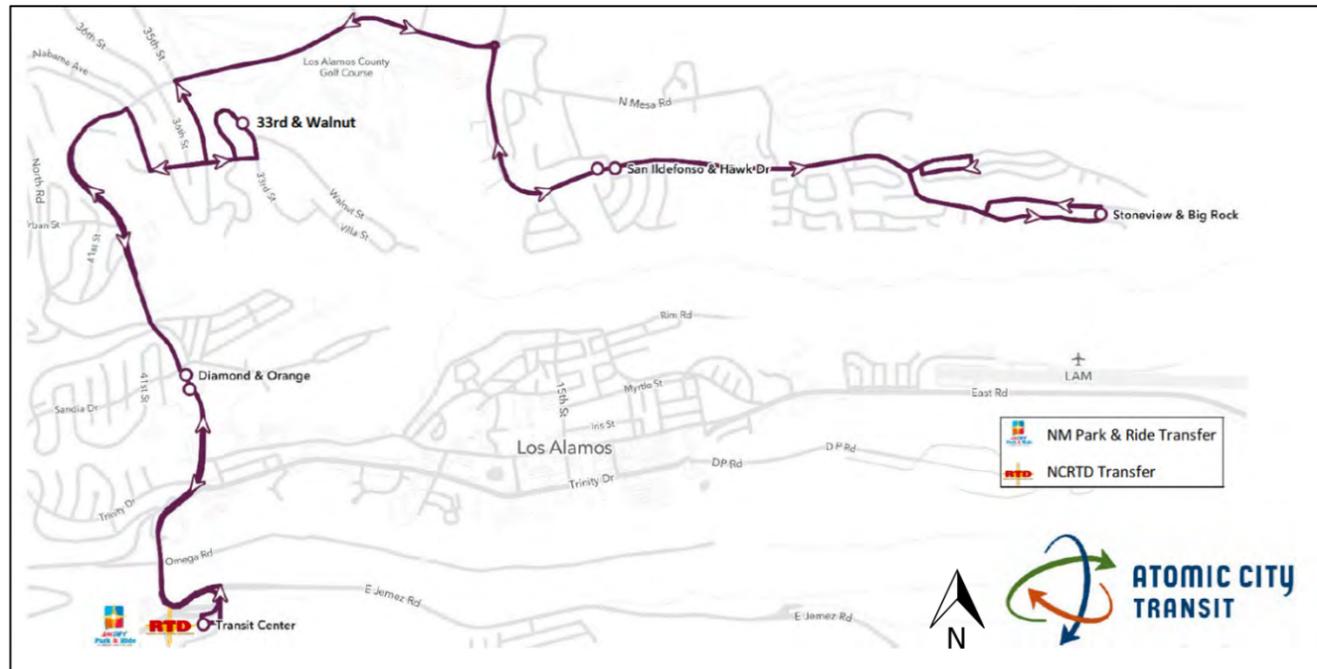


Figure A-45 – Route 6 Map – Atomic City Transit

The North Mesa Site is also served by two ACT express routes, Route 7 North Mesa Express and Route 9 Aspen Area Express. ACT provides express route service on school-day afternoons. Route 7 and Route 9 each provide one inbound run between the North Mesa area and Downtown Los Alamos. The routes depart the stop on the north side of San Ildefonso Drive at Hawk Drive, adjacent to Los Alamos Middle School, at 3:35 p.m. and 2:59 p.m., respectively. The alignments of Route 7 and Route 9 are shown in **Figure A-46**.

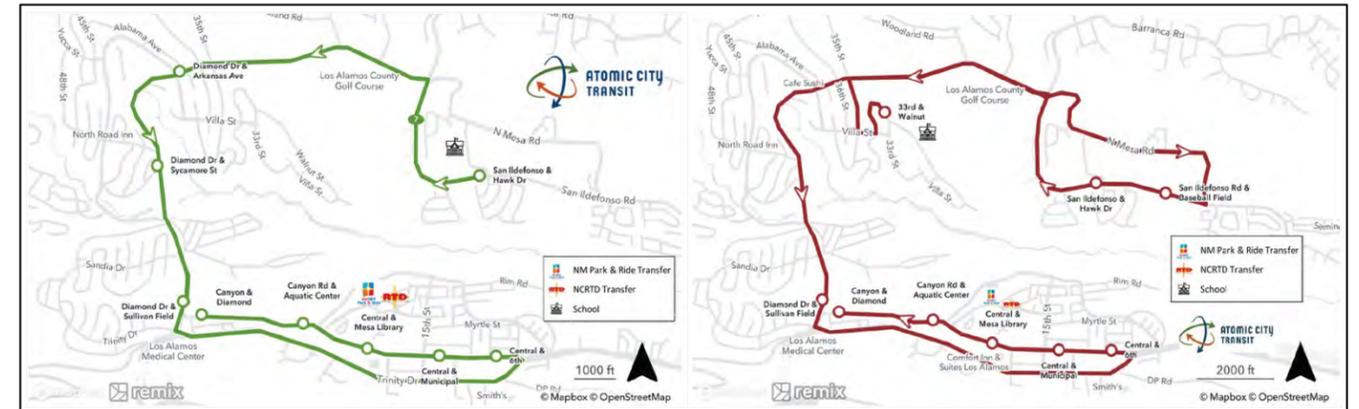


Figure A-46 – Atomic City Transit Route 7 and Route 9 Maps

XI. Traffic and Safety Conclusions and Recommendations

The assessment of the intersections and turning movements found that the proposed developments being constructed will not impact on traffic operations and that the intersections will operate at acceptable levels of service (LOS) under all scenarios.

a. Pedestrian & Bicycle Facilities

Although pedestrian and bicycle facilities exist in the vicinity of the North Mesa Site, construction of new facilities and upgrades to existing ones would likely improve the safety and comfort of those traveling without an automobile. The following improvements should be considered for study. As possible alternatives are studied, the County should carefully weigh the needs of vulnerable travelers (such as children and older residents) and the distinct needs of those using the facilities for transportation compared to those using them for leisure.

i) Diamond Drive

The County should study the feasibility of a separated bicycle facility between the western end of the shared-use trail near 35th Street and West Road. Although a bike lane is present, it is not buffered from traffic lanes. A separated facility could enhance bicyclists' safety and comfort. Such a facility would support bicycle travel between northern residential areas of Los Alamos Townsite and Downtown Los Alamos until such time as a direct route between these areas (called for in the County's 2017 *Bicycle Transportation Plan*) can be developed.

The Los Alamos County *Pedestrian Master Plan* recommends several pedestrian-oriented intersection improvements along Diamond Drive. These recommendations are listed in **Table A-23**. The County should continue to implement these recommendations. (See **section A.IV.b.i**) for information about what issues the plan identified.)

Table A-23 – Recommended Intersection Improvements (Diamond Drive) from Los Alamos County Pedestrian Master Plan

Improvement # from Plan	Improvement Recommendation	Location	Construction Cost Estimate	Estimate	Additional Requirements
IMP 2	Repaint crossing striping	Southbound approach at Diamond Drive and Arkansas Avenue	\$770/each standard crosswalk	Short-Term	
IMP 3	Enhance landscaping on median and add curb extensions	East of 35th Street and Diamond Drive	\$13,000/each curb extension \$15 - \$25/sq ft of landscaping	Mid-Term	Engineering Study
IMP 4	Install high visibility crosswalk and RRFB	Sycamore Street and Diamond Drive	\$5,710/each high vis. crosswalk \$14,160/each RRFB	Mid-Term	Engineering Study
IMP 5	Insert marked crosswalk at northbound approach and Pedestrian Push Buttons	Sandia Drive / Orange Street and Diamond Drive	\$770/each standard crosswalk \$1,200/each push button installation	Short-Term	
IMP 6	Repaint pedestrian crossing striping and add Leading pedestrian interval	Eastbound approach at Canyon Road and Diamond Drive	\$770/each standard crosswalk \$1,500/ped signal retiming	Short-Term	Engineering Operational Study
IMP 20	Install crosswalk striping and RRFBs	Southeast corner of Trinity Drive and Diamond Drive	\$770/each standard crosswalk \$14,160/each RRFB	Mid-Term	
IMP 21	Leading pedestrian interval	Diamond Drive and Trinity Drive	\$1,500/ped signal retiming	Short-Term	Engineering Operational Study

ii) North Mesa Road

The County should study the feasibility of constructing a new shared-use trail along the south and west side of North Mesa Road, along the edge of Loma Linda Park. This facility should be built to a sufficient width to

accommodate shared use. It could better serve transportation-oriented users than the existing sidewalk, while the existing sidewalk could remain to serve those seeking a recreational experience.

Separately or in addition to the above improvements, the underpass under San Ildefonso Road could be improved by widening and through addition of lighting. These changes would improve the experience of people using the passage, which is currently narrow, dark, and uninviting. The sidewalk approaching the underpass from the east, which has a significant slope, could be enhanced by widening and through addition of railing to serve mobility-limited users.

iii) San Ildefonso Road

The County should work in the short term to understand the pedestrian activity along the possible “desire path” on the south and west side of the road west of Camino Redondo. If preliminary evaluation shows it is warranted, the County should conduct a formal study in future to explore design alternatives for a pedestrian facility along this part of the roadway. It is not clear that right-of-way for such a facility is currently available, and there are some notable grade changes that may require significant engineering design to overcome in order to build a walkway.

The Los Alamos County *Pedestrian Master Plan* recommends several pedestrian-oriented intersection improvements along San Ildefonso Road near the North Mesa Site. These recommendations are listed in **Table A-24**. The County should continue to implement these recommendations. (See section **A.IV.b.i**) for information about what issues the plan identified.)

Table A-24 – Recommended Intersection Improvements (San Ildefonso Road near North Mesa Site) from Los Alamos County Pedestrian Master Plan

Improvement # from Plan	Improvement Recommendation	Location	Construction Cost Estimate	Estimate	Additional Requirements
IMP 13	Install stop signs at eastbound and westbound approaches and upgrade curb ramps to meet ADA standards. Hawk Drive and San Ildefonso Road (school zone) \$300/each sign \$700-\$3,500/each curb ramp reconstruction (depends on level of reconstruction.) Long-Term Engineering All-Way Stop Control (AWSC) Study	Hawk Drive and San Ildefonso Road (school zone)	\$300/each sign \$700-\$3,500/each curb ramp reconstruction (depends on level of reconstruction.)	Long-Term	Engineering All-Way Stop Control (AWSC) Study
IMP 22	Leading pedestrian interval	Diamond Drive and Trinity Drive	\$1,500/ped signal retiming	Short-Term	Engineering Operational Study

iv) Range Road

A bicycle facility along Range Road is recommended. The facility would connect to Diamond Drive and provide connectivity to the wider County bicycle network.

B. WASTEWATER DESIGN ANALYSIS

I. Background

This section presents an analysis of the sewer system in the North Mesa area and of its capability to accommodate the increased demands from the growth areas. This analysis is focused on evaluation of the sewer collection system.

II. Existing System

The North Mesa area wastewater system consists of a combination of gravity sewer collection system and lift station with forcemain that convey wastewater to four pipes off the south edge of North Mesa to the canyon floor below. The drop pipes are exposed steel pipes that are anchored to the canyon wall and extend approximately 800 feet before returning to subgrade piping and connecting to the 18-inch trunk sewer at the bottom of the canyon. The drop pipe configuration consists of single pipes at the easternmost and westernmost locations and two pipes at the central location, as shown on **Figure B-1**. Sewer Drop A and Sewer Drop C are individual parallel lines running adjacent to each other.

Early coordination with Los Alamos County Department of Public Utilities (DPU) determined that information such as manhole elevations were not available for the entire North Mesa system to complete a comprehensive system model. However, DPU was able to provide information on existing manholes downstream from where the new sewer system would connect to the vertical drops. Using this information, Wilson & Company was able to model a reduced section of the existing system with estimated existing flows, as well as simulate future conditions by incorporating projected flows from anticipated growth areas.

For this report, only the systems that convey flows to Sewer Drop A and Sewer Drop B, shown on **Figure B-2**, were analyzed and modeled.

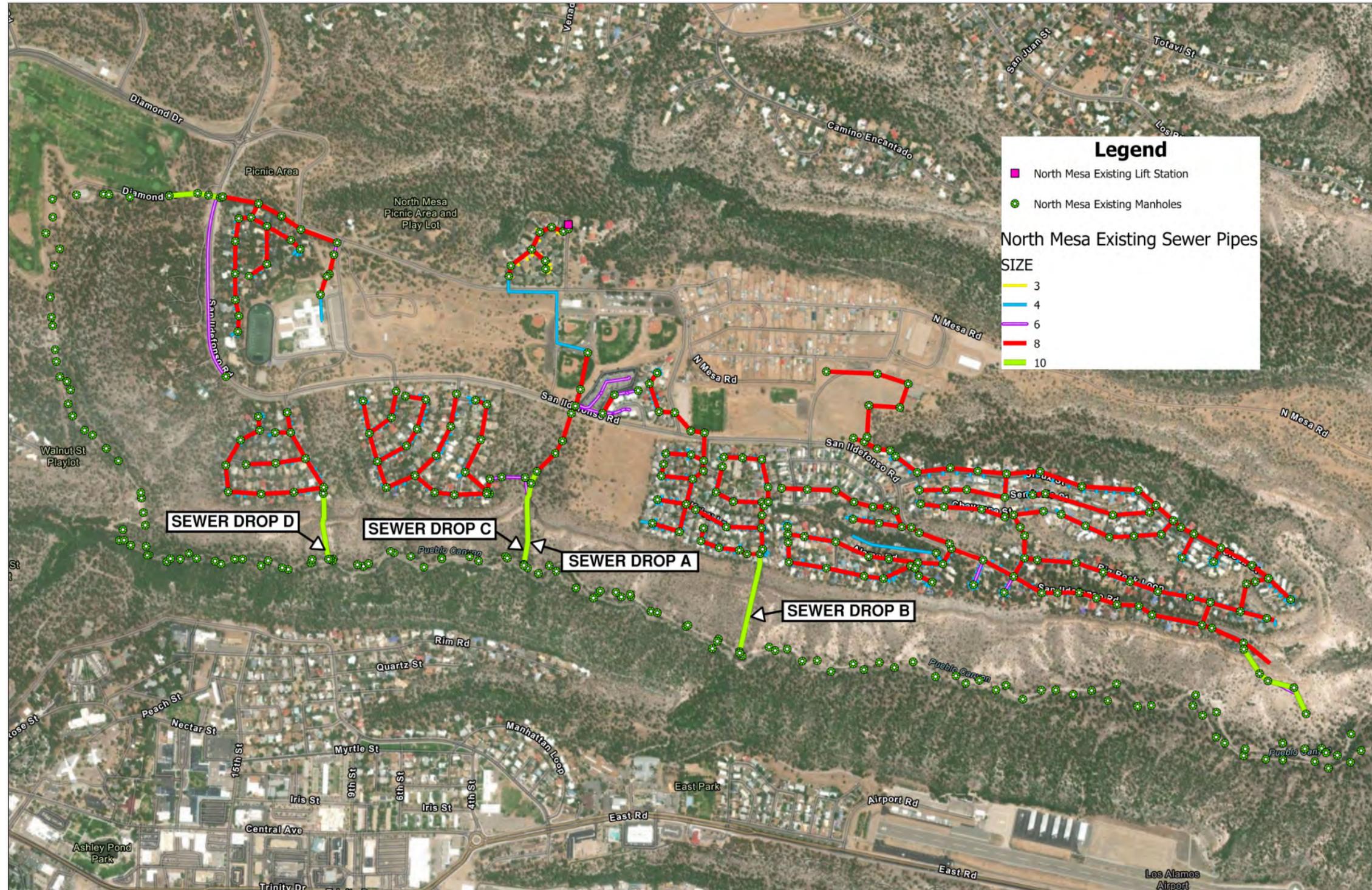


Figure B-1 – North Mesa Area Existing Sewer System

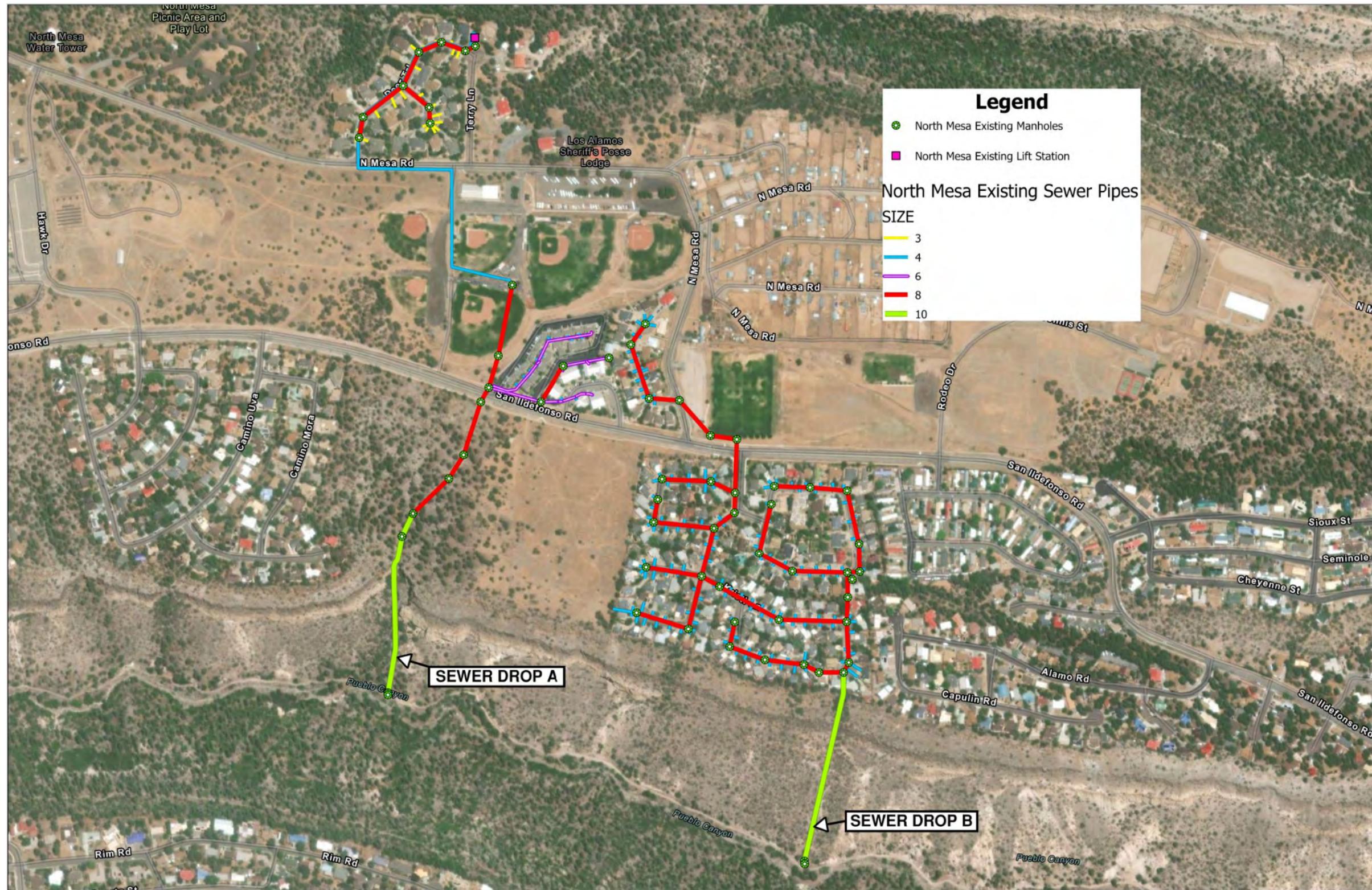


Figure B-2 – Reduced North Mesa Area Existing Sewer System

a. Field Inspection

Assessing the condition of the pipes was a critical step in the evaluation process. A field inspection was performed by Pro Pipe, which consisted of internal video footage of the drop pipes. The footage showed the interior of Sewer Drop A, as shown in **Figure B-3**. The inspection also revealed that Sewer Drop B, located at Cooper Place, has multiple holes in the pipe that expose the interior of the pipe, as shown in **Figure B-4**.



Figure B-3 – Sewer Drop A Interior

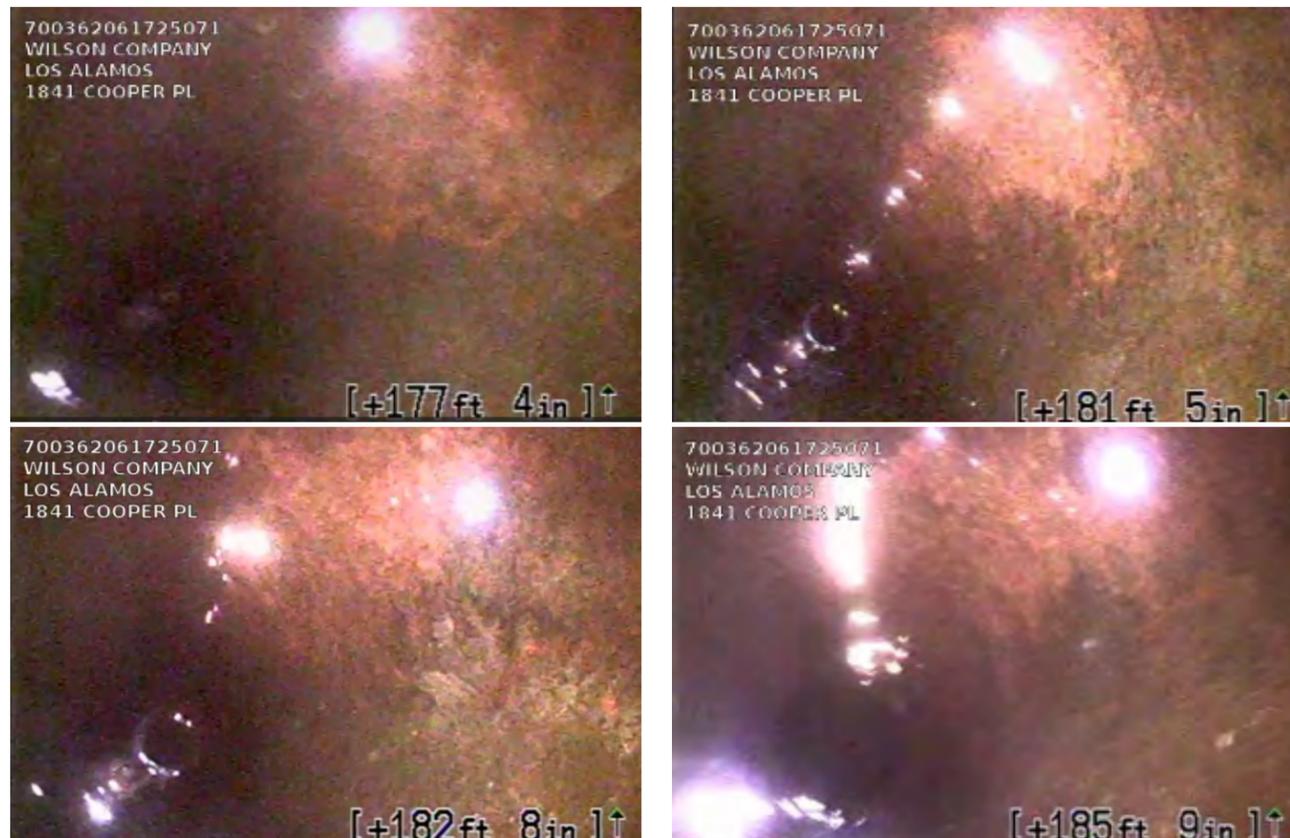


Figure B-4 – Sewer Drop B Interior Holes

i) Sewer Drop A

The Sewer Drop A pipe appears to be lined and in adequate condition. Therefore, the sewer drop does not require modifications or replacement.

ii) Sewer Drop B Pipe Replacement

Given the severity of the deterioration, rehabilitation or continued use of Sewer Drop B is not recommended, as either could lead to further damage. Instead, full reconstruction is necessary.

Based on Los Alamos County’s history with horizontal directional drilling (HDD) and its demonstrated comfort with this installation method, it is recommended that Sewer Drop B be replaced using HDD. This approach would allow the new proposed pipe to be installed beneath the existing sewer drop, minimizing surface disturbance by maintaining its alignment within the existing utility right-of-way. Additionally, the pipe would be better protected because of its being placed deep underground and would be less susceptible to damage from external conditions. Furthermore, this method enables the existing system to remain operational during construction, as installation would not interfere with current infrastructure.

The new proposed pipe would connect to the existing manholes at the top and bottom of the cliff that the current Sewer Drop B connect to. A cost estimate was prepared for the replacement of Sewer Drop B, as shown in **Table B-1**. Unit costs from previous similar projects in Los Alamos were used as a basis of the cost estimate and adjusted to present-day costs.

Table B-1 – Sewer Drop B Pipe Replacement Cost Estimate

SEWER DROP B REPLACEMENT - HDD					
ITEM NO.	MATERIAL DESCRIPTION:	UNITS	QTY	UNIT COST	ITEM COST
GENERAL ITEMS					
1	Mobilization/Demobilization	LS	1	\$ 36,944.25	\$ 36,944.25
2	Construction Staking and Survey	LS	1	\$ 14,777.70	\$ 14,777.70
3	Traffic Control Plan and Management	LS	1	\$ 22,166.55	\$ 22,166.55
4	Material Testing Allowance	ALLOW	1	\$ 8,000.00	\$ 8,000.00
5	Subsurface Utility Locating Allowance	ALLOW	1	\$ 6,000.00	\$ 6,000.00
SANITARY SEWER SYSTEM					
6	Horizontal Directional Drilling for Installation of New 10" Steel Sewer Drop	LF	1041	\$ 430.00	\$ 447,630.00
7	Connect New Sewerline to Existing Manhole, CIP.	EA	2	\$ 22,000.00	\$ 44,000.00
8	New Manhole, 4' dia., Type "C" or "E", 10' to 14' deep, CIP.	EA	2	\$ 12,000.00	\$ 24,000.00
9	Cut, Cap, and Abandon Existing Sewer Drop	EA	1	\$ 150,000.00	\$ 150,000.00
10	Rock Trench Excavation	CY	533	\$ 95.00	\$ 50,635.00
11	Existing Pavement Removal/Replacement	SY	90	\$ 55.00	\$ 4,950.00
12	4" Aggregate Base-Course for Pavement Bedding	SY	90	\$ 45.00	\$ 4,050.00
AREA B CONSTRUCTION COST SUBTOTAL:					\$ 826,773.50
CONTINGENCY (20%):					\$ 165,354.70
LOS ALAMOS COUNTY GRT @ 7.0625%:					\$ 70,069.05
SEWER DROP B TOTAL CONSTRUCTION COST:					\$ 1,062,197.25
NON-CONSTRUCTION COSTS					
13	Pre-Engineering - Survey	LS	1	\$ 33,070.94	\$ 33,070.94
14	Engineering Design Services	LS	1	\$ 82,677.35	\$ 82,677.35
15	Engineering - Bid Phase	LS	1	\$ 37,204.81	\$ 37,204.81
16	Engineering - Construction Phase	LS	1	\$ 49,606.41	\$ 49,606.41
17	Legal Services	LS	1	\$ 24,803.21	\$ 24,803.21
AREA B NON-CONSTRUCTION COST SUBTOTAL:					\$ 227,362.71
CONTINGENCY (20%):					\$ 45,472.54
LOS ALAMOS COUNTY GRT @ 7.0625%:					\$ 19,268.99
SEWER DROP B TOTAL NON-CONSTRUCTION COST:					\$ 292,104.24
SEWER DROP B TOTAL PROJECT COST:					\$ 1,354,301.50

b. Existing Wastewater System Capacity

Wastewater design flow calculations are presented in Appendix G. The unit average daily flow was assumed to be 103 gal/capita/day for homes, based upon Table 3-2 of *Wastewater Engineering Treatment and Reuse*, 4th ed. (Metcalf and Eddy, 2014). According to the U.S Census Bureau, the average persons per household in Los Alamos County is 2.37. Therefore, the calculated average daily flow per housing unit is 244.11 gallons per day (gpd). For design purposes, a peaking factor of 3 was applied to the average daily flow. **Table B-2** below breaks down the calculated wastewater production for each existing building.

Building	Wastewater Production (gpd)
Homes	46,625
Mountain Vista Apartments	12,720
Mesa Del Norte Apartments	9,120
Flint Field Bathrooms	2,420
Total Average (gpd)	73,305
Total Peak (gpd)	219,915

To evaluate the current system performance, Bentley Connect Edition SewerCAD Version 10.04.00.158 was utilized to model both average and peak scenarios. The existing model focused only on the existing infrastructure that collects and conveys flows to Sewer Drop A and Sewer Drop B. Areas outside of these contributing regions, including upstream flow and any flow directed to the additional drop pipes were not analyzed as part of this effort. **Figure B-5** shows the limits of the modeled system.

The results confirmed that the current system is efficiently running and pipes have ample capacity, as shown in Appendix G. **Table B-3** summarizes the existing system capacity with average and peak flows.

Scenario	Wastewater Production (gpd)	% of Pipe Full
Existing Demand Average	73,305	17.3%
Existing Demand Peak	219,915	30.1%

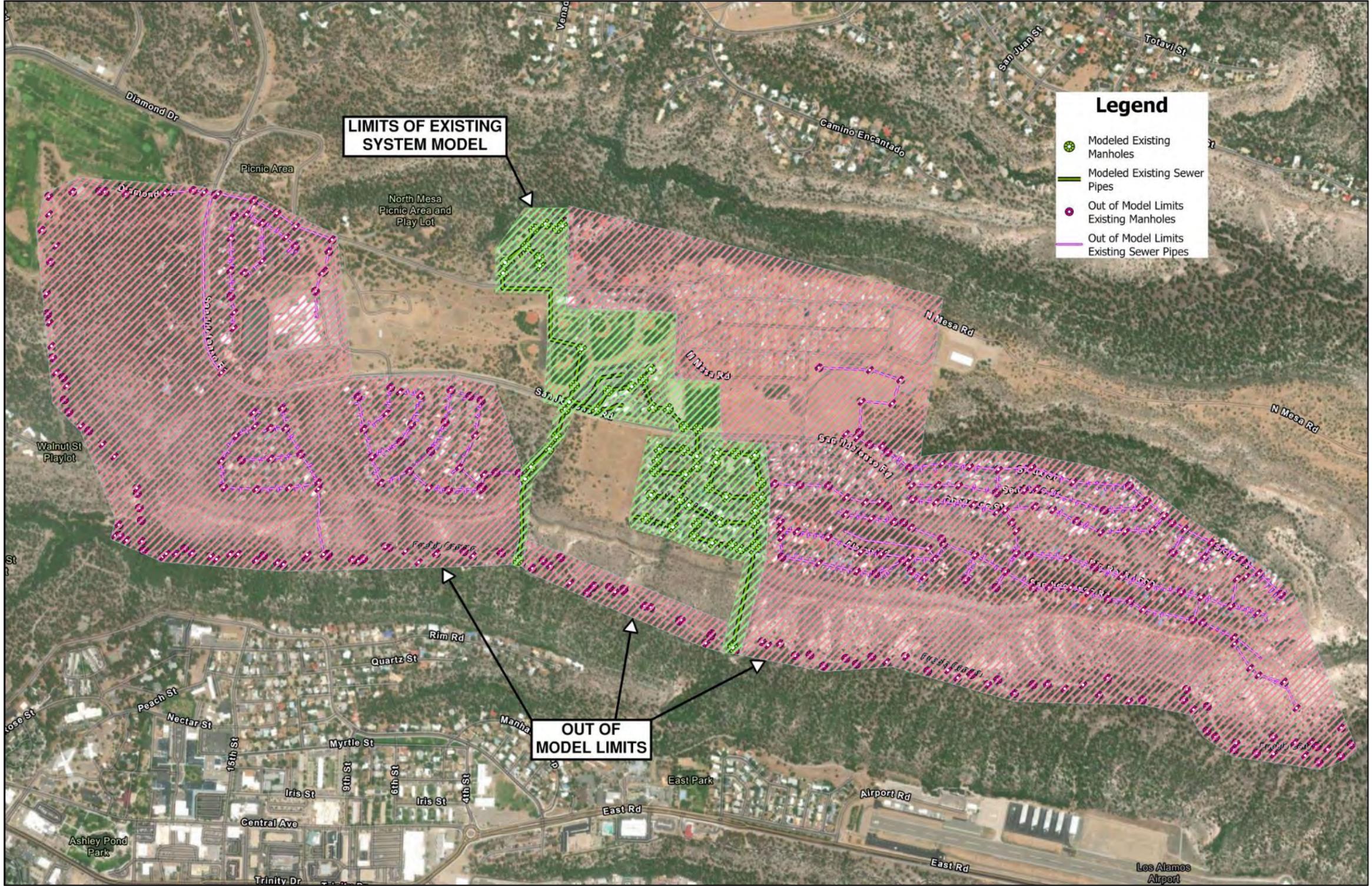


Figure B-5 – Limits of Existing System Model

III. Improvement Areas

The project involves expanding the existing sanitary system to accommodate the county's future growth. It focuses on two key areas, Area A and Area B, as shown in **Figure B-6**, for which the County has provided documentation for upcoming residential developments.

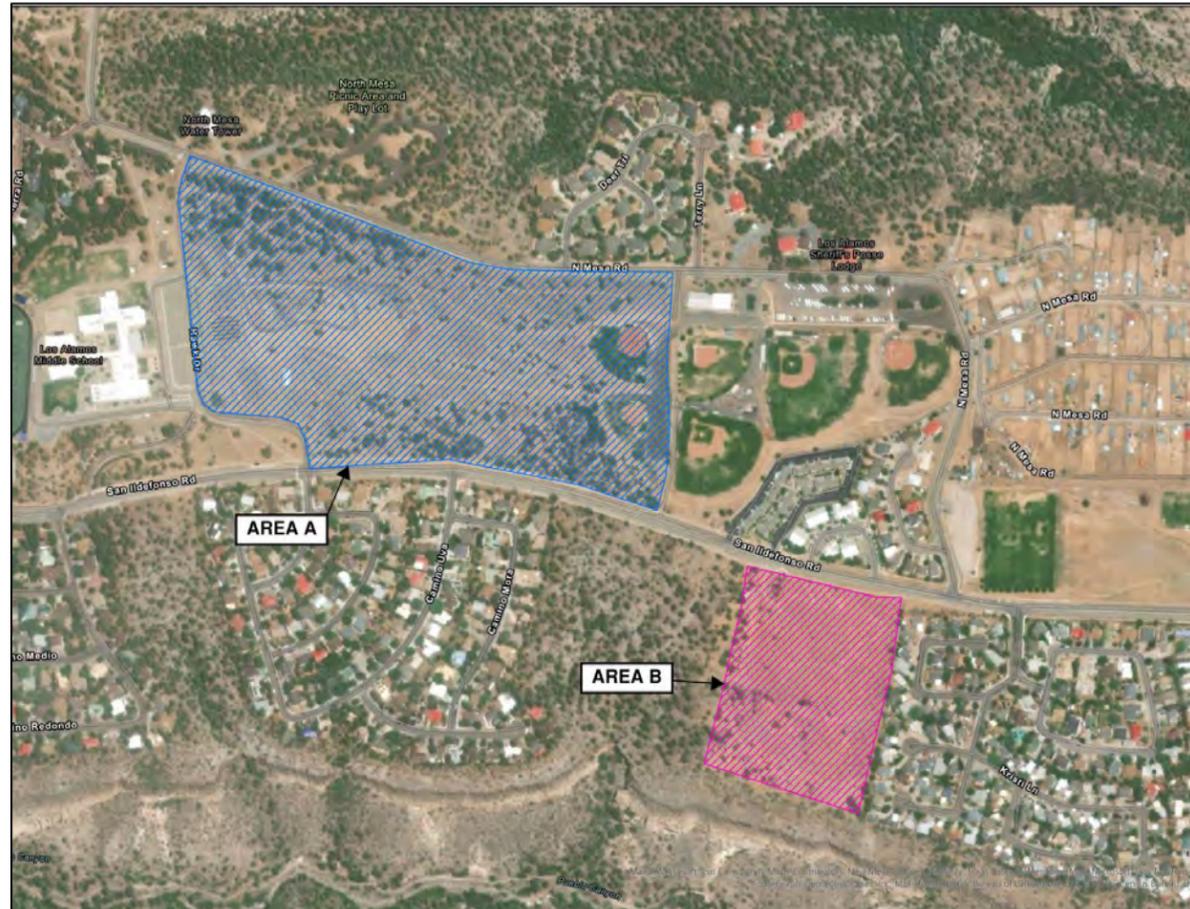


Figure B-6 – Full Build-Out Areas

a. Area A Description

For Area A, the proposed development is outlined in the *North Mesa Housing Study*, as shown in **Figure 2**. The plan includes approximately five acres of low-density housing, 8.8 acres of medium-density housing, and 5.6 acres of high-density housing. This translates to an estimated 7-12 housing units per acre, resulting in approximately 210 to 360 new homes at full build-out. The housing types proposed in the *Housing Study* are shown in Appendix I.

b. Area B Description

For Area B, the County provided a proposed development plan, shown in **Appendix C**. The plan includes 23 single-family lots, three duplex lots, and 36 triplex lots, totaling 137 housing units. Additionally, the development features a clubhouse with a leasing office and a swimming pool.

IV. Design Analysis

The design criteria for the expansion of sanitary systems involves a comprehensive evaluation of the project area. This process included an in-depth investigation utilizing geographic information system (GIS) data and existing utility record drawings provided by Los Alamos County.

The system extension is meant to consolidate wastewater flows from future residents and connect to the existing system. **Table B-4** presents the project design criteria:

Design Criteria	NMED Recommended Standards
Minimum Size	8 inches
Minimum Slope	0.40 feet/100 feet
Manning's Coefficient	.010
Maximum Manhole Spacing	400 feet
Minimum Manhole Diameter	48 inches
Minimum Size	8 inches

a. Area A

i) Design Criteria

A potential sewer system was modeled on SewerCAD, shown on **Figure B-7**. It consists of approximately 6,546 linear feet (LF) of 8-inch (in.) PVC sewer pipe and 30 manholes. The proposed system would need to connect to the existing manhole at Mendius Lane. An easement would be required, as the sewer line would run between two homes.

The Thiessen Polygon analysis feature in SewerCAD was used to create polygon areas at each manhole, and the LoadBuilder tool in SewerCAD was then used to distribute the total wastewater production at Lot A to each manhole to approximate realistic accumulation of flow. The results from the potential sewer model are provided in Appendix H.

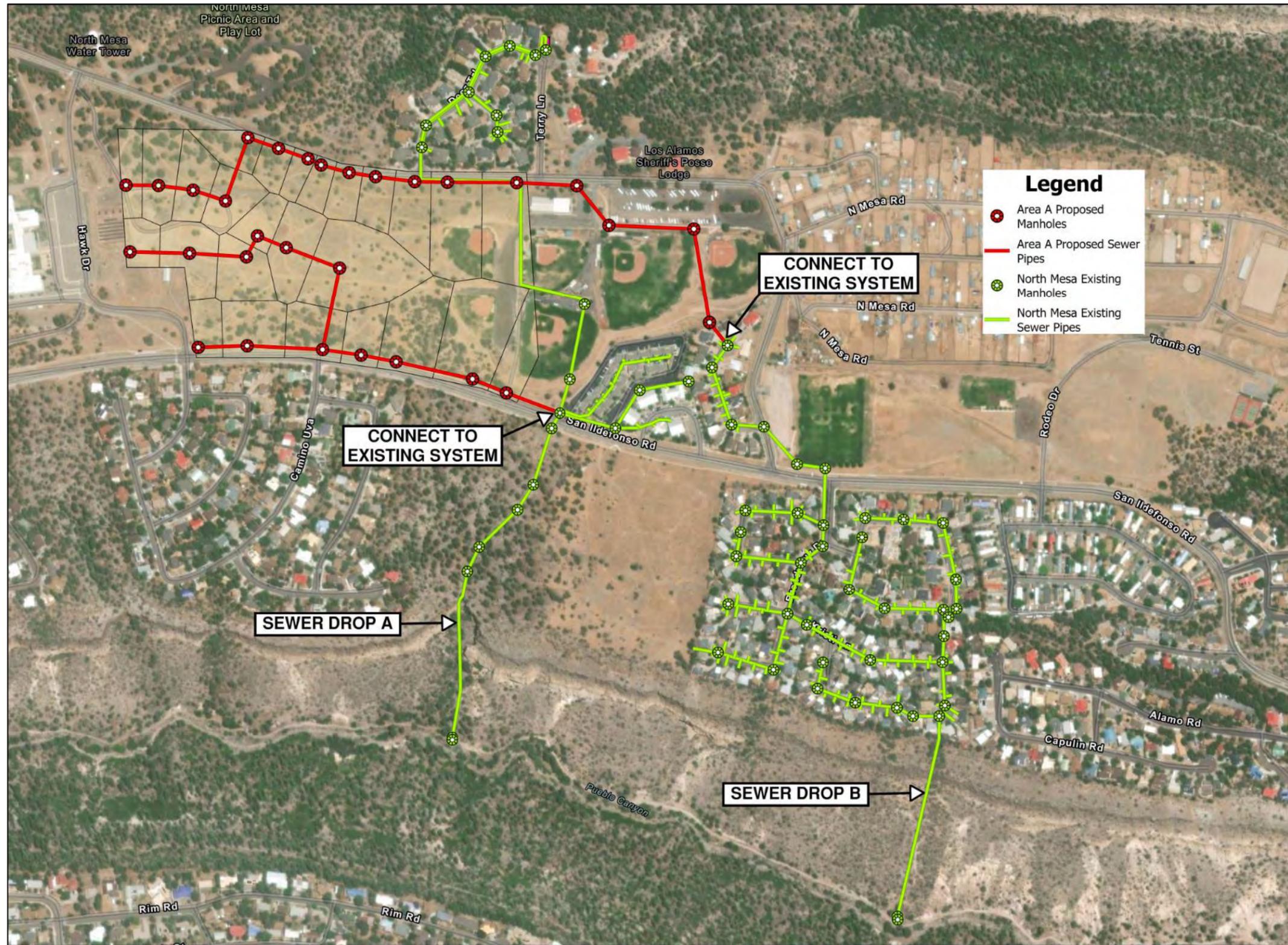


Figure B-7 – Area A Proposed Sewer Syst

360 Full Build-Out

As previously noted, the North Mesa Housing Study identifies a maximum of 360 housing units in its final concept plan. Based on this scenario, wastewater demand was calculated using the methodology outlined in the previous section, resulting in an estimated average increase of 87,880 gpd and peak increase of 263,640 gpd.

SewerCAD was employed to model and analyze both the average and peak flow conditions. After the LoadBuilder tool is applied, approximately half of the future demand, 45,404 gpd, is conveyed to the south trunk in Area A, which directs the flow to Sewer Drop A. The remaining future wastewater demand, 42,475 gpd, is conveyed to the north trunk, which directs flows to Sewer Drop B. The current system was confirmed to have the capacity to accommodate the additional flow at both average and peak, as shown below. Table B-5 summarizes the overall pipe capacity based on average and peak flows for the scenario.

Scenario	Wastewater Production Sewer Drop A (gpd)	Wastewater Production Sewer Drop B (gpd)	% of Pipe Full Sewer Drop A*	% of Pipe Full Sewer Drop B*
360 Full Build-Out Demand Average	76,500	84,685	27.2%	24.0%
360 Full Build-Out Demand Peak	229,500	254,055	48.1%	42.4%

*Including existing and future wastewater production from Area A

497 Full Build-Out

Based on the maximum 360 housing units planned in Area A and the proposed 137 housing units in Area B, a full build-out scenario of 497 housing units, accounting for both areas simultaneously, was considered. Wastewater demand calculations were performed using the methodology previously outlined, resulting in an average demand increase of 122,223 gpd.

SewerCAD was employed to model and analyze both the average and peak flow conditions. After the LoadBuilder tool is applied, future demand for Area A is approximately split in half, with 45,404 gpd directed to Sewer Drop A and 42,475 to Sewer Drop B. Additionally, 34,344 gpd of future wastewater from Area B is directed to Sewer Drop B. The current system was confirmed to have the capacity to accommodate the additional flow at both average and peak, as shown below. Table B-6 summarizes the overall pipe capacity based on average and peak flows for the scenario.

Scenario	Wastewater Production Sewer Drop A (gpd)	Wastewater Production Sewer Drop B (gpd)	% of Pipe Full Sewer Drop A*	% of Pipe Full Sewer Drop B*
497 Full Build-Out Demand Average	76,500	119,030	27.2%	28.9%
497 Full Build-Out Demand Peak	229,500	357,085	48.1%	51.1%

*Including existing and future wastewater production from Area A and Area B

ii) Cost Estimate

A cost estimate for Area A was prepared based on the final concept plan, which includes 360 housing units, as shown in Table B-7.

Table B-7 – Area A Cost Estimate

ITEM NO.	MATERIAL DESCRIPTION:	UNITS	QTY	UNIT COST	ITEM COST
GENERAL ITEMS					
1	Mobilization/Demobilization	LS	1	\$ 130,474.00	\$ 130,474.00
2	Construction Staking and Survey	LS	1	\$ 52,189.60	\$ 52,189.60
3	Traffic Control Plan and Management	LS	1	\$ 78,284.40	\$ 78,284.40
4	Material Testing Allowance	ALLOW	1	\$ 8,000.00	\$ 8,000.00
5	Subsurface Utility Locating Allowance	ALLOW	1	\$ 6,000.00	\$ 6,000.00
SANITARY SEWER SYSTEM					
6	8" Sewer Pipe, SDR-35 PVC, incl. Trace Wire, Trench Compacted Backfill, 0 to 12' Bury Depth, CIP	LF	6546	\$ 130.00	\$ 850,980.00
7	Furnish, Install, and Connect Sewer Service Lines	EA	360	\$ 3,500.00	\$ 1,260,000.00
8	CIP.	EA	2	\$ 13,000.00	\$ 26,000.00
9	Manhole, 4' dia., Standard Manhole, 6' to 10' deep, CIP.	EA	25	\$ 16,500.00	\$ 412,500.00
10	Manhole, 4' dia., Standard Manhole, 10' to 14' deep, CIP.	EA	3	\$ 20,000.00	\$ 60,000.00
				AREA A CONSTRUCTION COST SUBTOTAL:	\$ 2,884,428.00
				CONTINGENCY (20%):	\$ 576,885.60
				LOS ALAMOS COUNTY GRT @ 7.0625%:	\$ 244,455.27
				AREA A TOTAL CONSTRUCTION COST:	\$ 3,705,768.87
NON-CONSTRUCTION COSTS					
10	Pre-Engineering - Survey	LS	1	\$ 115,377.12	\$ 115,377.12
11	Engineering Design Services	LS	1	\$ 288,442.80	\$ 288,442.80
12	Engineering - Bid Phase	LS	1	\$ 129,799.26	\$ 129,799.26
13	Engineering - Construction Phase	LS	1	\$ 173,065.68	\$ 173,065.68
14	Legal Services	LS	1	\$ 86,532.84	\$ 86,532.84
				AREA A NON-CONSTRUCTION COST SUBTOTAL:	\$ 793,217.70
				CONTINGENCY (20%):	\$ 158,643.54
				LOS ALAMOS COUNTY GRT @ 7.0625%:	\$ 67,225.20
				AREA A TOTAL NON-CONSTRUCTION COST:	\$ 1,019,086.44
				AREA A TOTAL PROJECT COST:	\$ 4,724,855.31

b. Area B

For Area B, a potential sewer system was modeled as shown on Figure B-8. Property connections were placed at all proposed housing units per site plans provided by the County, resulting in a system consisting of approximately 4,182 LF of 8-in. PVC pipe, 31 manholes, and 138 property connections.

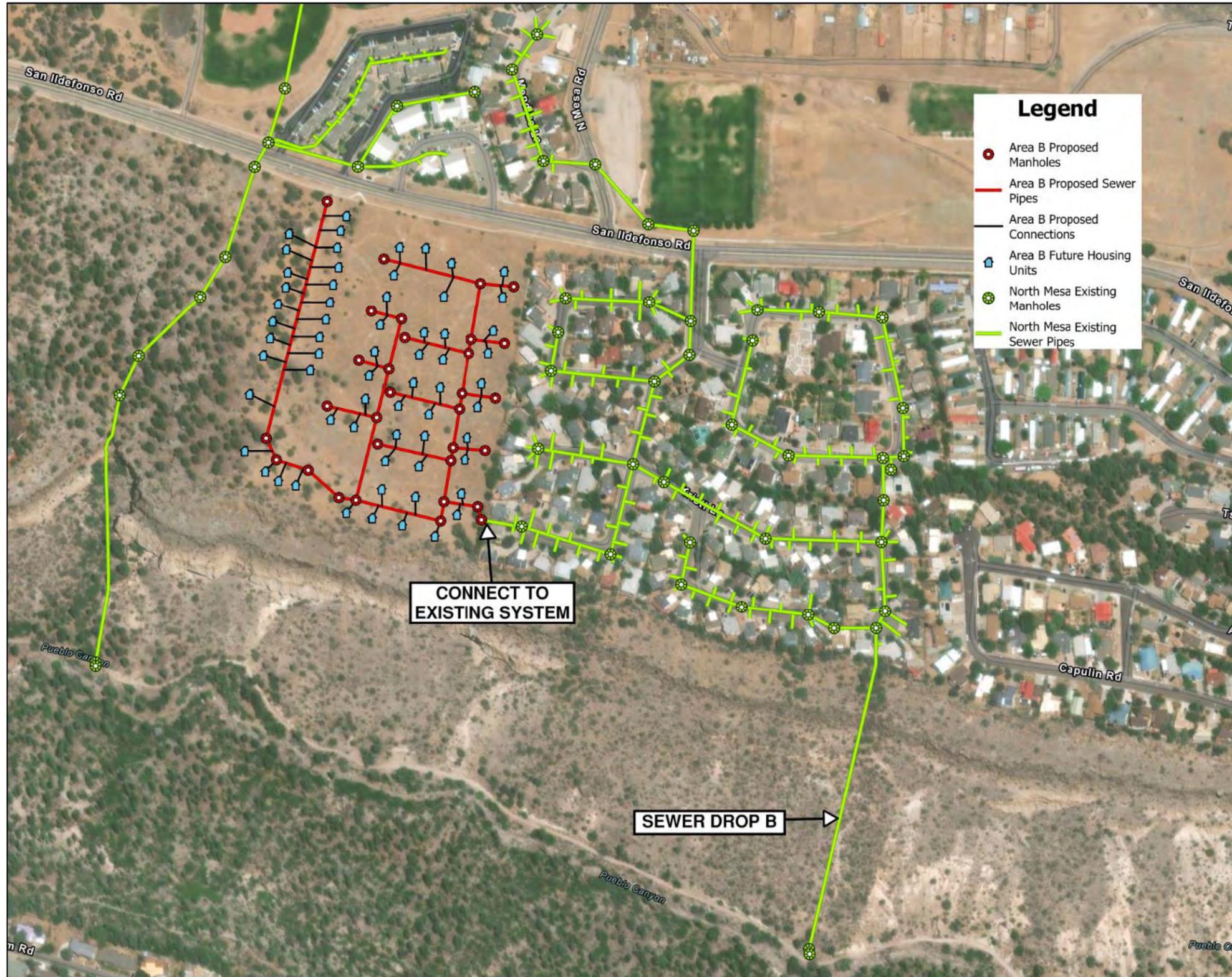


Figure B-8 – Area B Proposed Sewer System

i) Design Criteria

Wastewater demand calculations were performed using the methodology previously outlined, resulting in an average demand increase of 34,344 gpd and peak of 103,032 gpd, as shown in **Table B-8**.

Lots	Wastewater Production (gpd)
23 Single Family Homes	5,615
3 Duplex	1,465
36 Triplex	26,364
Clubhouse	900
Total Average (gpd)	34,344
Total Peak (gpd)	103,032

SewerCAD was employed to model and analyze both the average and peak flow conditions. The current system was confirmed to have the capacity to accommodate the additional flow, as shown in **Table B-9**. Detailed SewerCAD results are provided in Appendix H.

Scenario	Wastewater Production (gpd)	% of Pipe Full*
Area B Demand Average	76,553	22.7%
Area B Demand Peak	229,659	40.1%

*Including existing and future wastewater production from Area B

ii) Cost Estimate

The project cost estimate for Area B is shown in **Table B-10**.

Table B-10 – Area B Cost Estimate

ITEM NO.	MATERIAL DESCRIPTION:	UNITS	QTY	UNIT COST	ITEM COST
GENERAL ITEMS					
1	Mobilization/Demobilization	LS	1	\$ 76,908.00	\$ 76,908.00
2	Construction Staking and Survey	LS	1	\$ 30,763.20	\$ 30,763.20
3	Traffic Control Plan and Management	LS	1	\$ 46,144.80	\$ 46,144.80
4	Material Testing Allowance	ALLOW	1	\$ 8,000.00	\$ 8,000.00
5	Subsurface Utility Locating Allowance	ALLOW	1	\$ 6,000.00	\$ 6,000.00
SANITARY SEWER SYSTEM					
6	8" Sewer Pipe, SDR-35 PVC, incl. Trace Wire, Trench Compacted Backfill, 0 to 12' Bury Depth, CIP	LF	4182	\$ 130.00	\$ 543,660.00
7	Furnish, Install, and Connect Sewer Service Lines	EA	138	\$ 3,500.00	\$ 483,000.00
8	Manhole, 4' dia., Standard Manhole, 6' to 10' deep, CIP.	EA	31	\$ 16,500.00	\$ 511,500.00
AREA B CONSTRUCTION COST SUBTOTAL:					\$ 1,705,976.00
CONTINGENCY (20%):					\$ 341,195.20
LOS ALAMOS COUNTY GRT @ 7.0625%:					\$ 144,581.47
AREA B TOTAL CONSTRUCTION COST:					\$ 2,191,752.67
NON-CONSTRUCTION COSTS					
9	Pre-Engineering - Survey	LS	1	\$ 68,239.04	\$ 68,239.04
10	Engineering Design Services	LS	1	\$ 170,597.60	\$ 170,597.60
11	Engineering - Bid Phase	LS	1	\$ 76,768.92	\$ 76,768.92
12	Engineering - Construction Phase	LS	1	\$ 102,358.56	\$ 102,358.56
13	Legal Services	LS	1	\$ 51,179.28	\$ 51,179.28
AREA B NON-CONSTRUCTION COST SUBTOTAL:					\$ 469,143.40
CONTINGENCY (20%):					\$ 93,828.68
LOS ALAMOS COUNTY GRT @ 7.6250%:					\$ 39,759.90
AREA B TOTAL NON-CONSTRUCTION COST:					\$ 602,731.98
AREA B TOTAL PROJECT COST:					\$ 2,794,484.65

V. Conclusion and Recommendations

Expanding the sewer infrastructure in the North Mesa area is essential to support the housing growth needed in Los Alamos County. Based on the findings of this design analysis, a build-out of 360 housing units in Area A and 137 housing units in Area B can be supported by the existing sewer system from a capacity standpoint. However, several sewer segments would operate at approximately 50% of their capacity, which still falls within the acceptable design capacity of the existing pipes but would leave limited capacity for future flows outside these planned areas; Upgrades to these pipes should be considered for future planning.

Additionally, while the sewer system has sufficient capacity to accommodate additional flow, the condition of the sewer drop at Cooper Place, Sewer Drop B, is poor. The pipe has visible holes and is not recommended for continued use. Replacement of the sewer drop should be considered for future planning.

C. WATER DESIGN ANALYSIS

I. Background

This analysis evaluated the existing County water infrastructure system to determine its capacity to accommodate the increase in water demand and water pressure associated with planned future housing in the North Mesa area.

II. Existing System

a. Water

A water model of the entire Los Alamos County area, shown in **Figure C-1**, was provided by the County to Wilson & Company. The County has nine tanks in their system which all vary in sizes, with the smallest having a capacity of 6,700 gallons, and the largest, a capacity of 0.78 million gallons of water. Every community in the County has at least one tank to provide enough water to its respective residents.

The existing model was updated with recent changes near the golf course at the intersection of Diamond Drive and Range Road. A major addition to the system is an 8-inch (in.) waterline starting at the golf course's booster station, running up Gold Road, and connecting into the Arizona Avenue and Woodland Road community. The County also informed us of a 14-in. waterline bridging the water system from the North Mesa area to the Barranca Tank. An analysis of the entire water system's pressure network was done after the inclusion of Pressure Reducing Valves (PRVs) and an Altitude Valve (AV). This AV was modeled with reference to a specification from Models 106-A-Type 2/206-A-Type 2 one-way flow to graph a head loss curve. The exact specification can be seen in Appendix J. A recent upgrade in the North Mesa area is the replacement of approximately 3,979 LF of pipe to 12-in. PVC along San Ildefonso Road, as shown in **Figure C-1**.

The North Mesa community water system consists of a 0.16-million-gallon water tank found in the northwestern corner of the area. A distribution system running along North Mesa Road and San Ildefonso Road continues towards the houses in the southeast corner of the area. This report analyzed the entire North Mesa area water distribution system, isolating the communal water system starting from the south end of the roundabout from the rest of the Los Alamos County water distribution system. **Figure C-2** is a visual representation of the water system of North Mesa.

The County informed Wilson & Company of the removal of the 8-in. PRV near the golf course, which affects the pressure leading into the North Mesa and Barranca areas. To combat the higher pressure, the County advised to include an 8-in. PRV on the 8-in. PVC line connecting into the northern portion of the Loma Linda subdivision and a 14-in. PRV on the 14-in. water fill line from the roundabout area to the Barranca Tank. These PRVs are listed in **Table C-1** and can be seen in **Figure C-1**. Another change to the model was the addition of an altitude valve. Elevations in Table C-2 were checked with the survey provided by the County.

Table C-1 – PRV Elevation

Name	Elevation, (FT)	Condition
PRV 13	7,296.01	Existing 8-inch and removed
North Mesa Tank	7341.71	Existing
PRV-2	7,357.05	Proposed 8-inch
PRV-4	7,372.71	Proposed 14-inch
PRV-5	7,288.79	Proposed 8-INCH
Altitude Valve	7,342.87	Proposed 14"

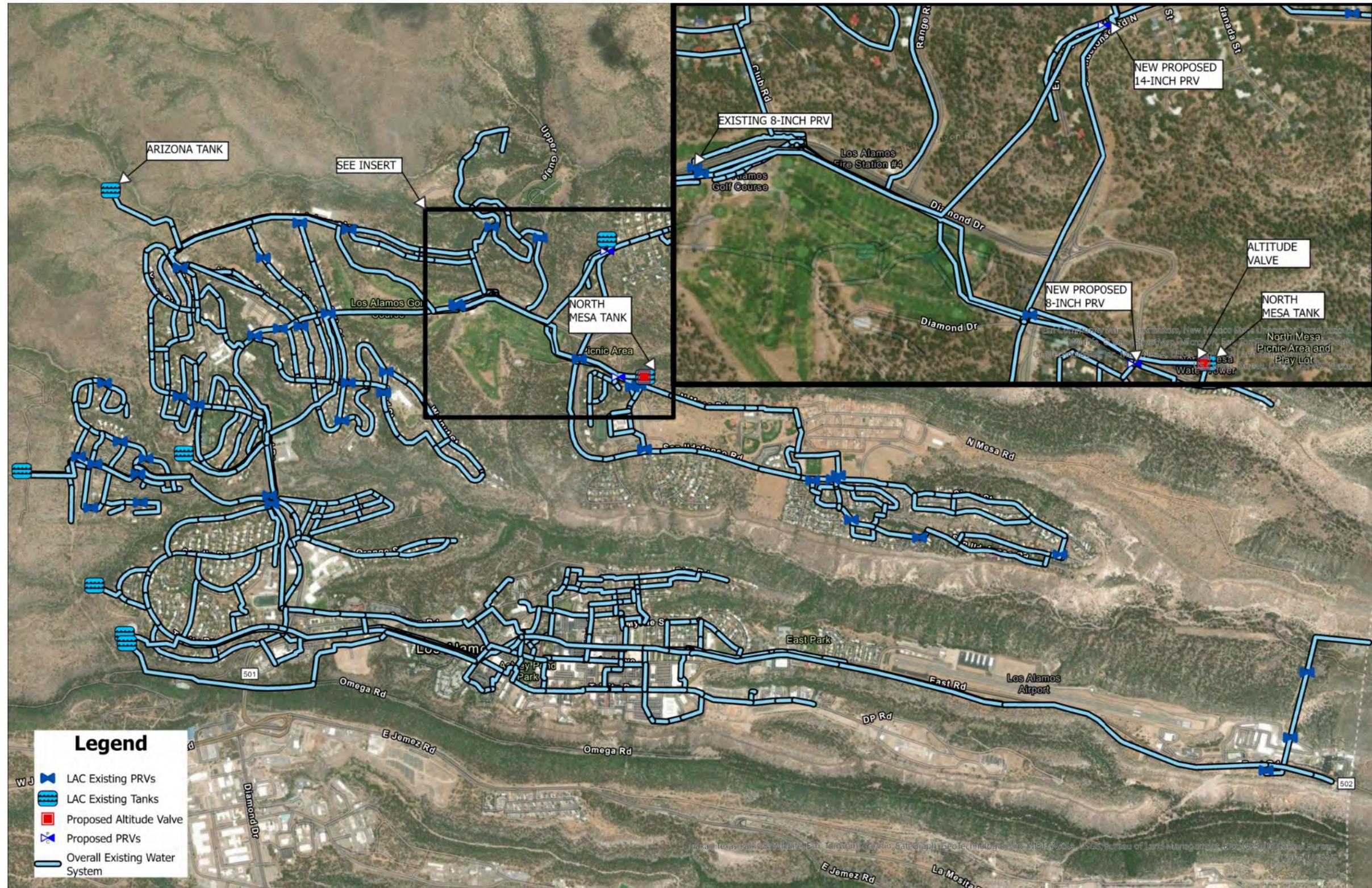


Figure C-1 – Los Alamos County Existing Water System

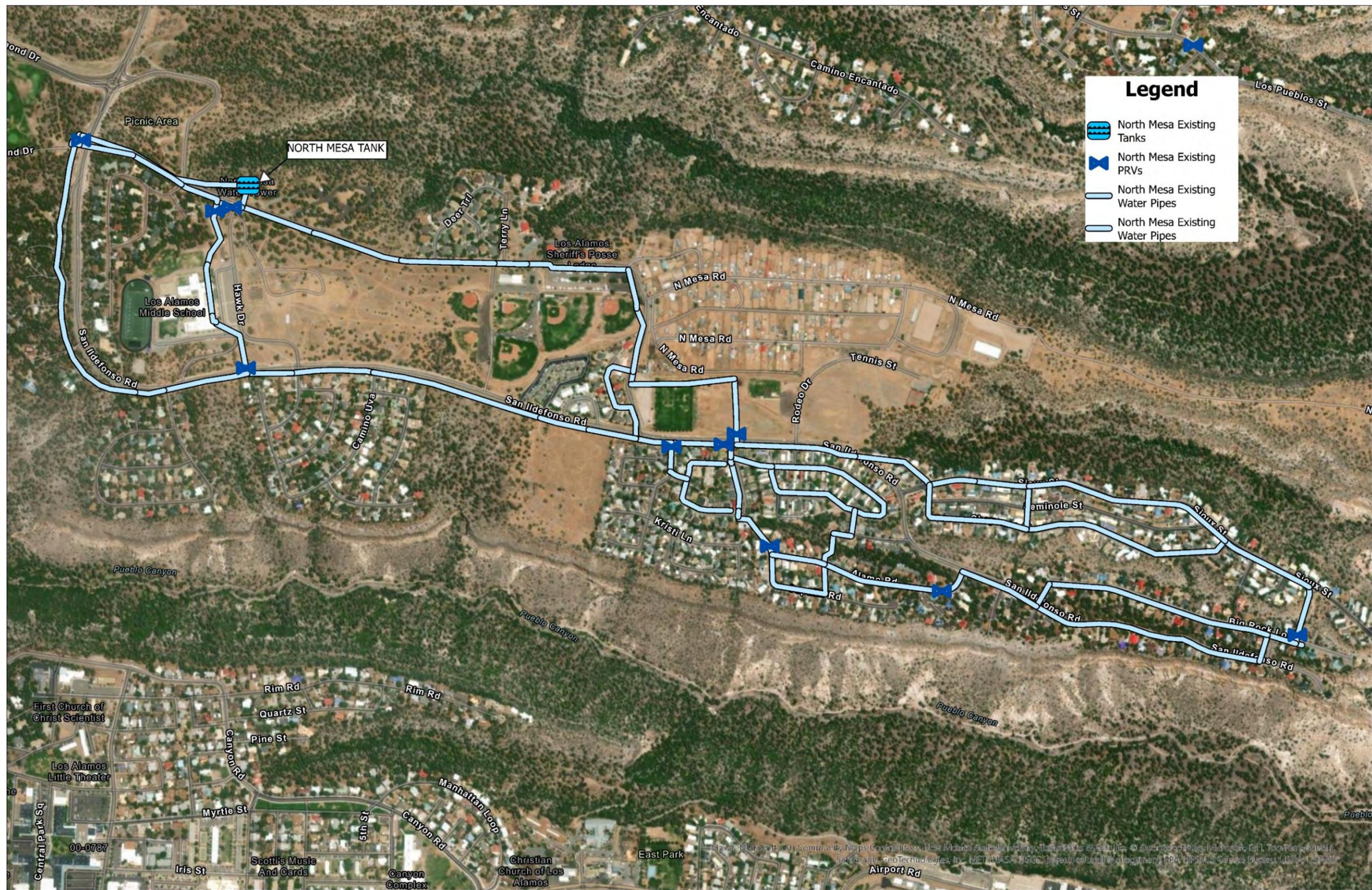


Figure C-2 - Existing Water System

i) Existing Water System Capacity

A full evaluation of the existing water system’s velocity, flows, and pressure conditions was done to assess the system’s current state. Water calculations are presented in Appendix K. The County provided the team with water meter data from 2019 to 2024 for the North Mesa area. The data was presented as monthly usage of each resident in the respective year. Table 1 was created by averaging the usage of every month for each year. A graph of Table 1 was created to find a trendline that would assist in finding a minimum and maximum demand for the community. Once a minimum and maximum demand value was found, the 90th percentile was found for the value for that month. The values presented in **Table C-2** show the demand used for the proposed houses.

Table C-2 – Monthly Water Demand, North Mesa Area						
Monthly Water Demand, gpm	2024	2023	2022	2021	2020	2019
Jan	0.09	0.09	0.10	0.09	0.01	0.01
Feb	0.09	0.09	0.09	0.11	0.11	0.13
Mar	0.09	0.09	0.09	0.10	0.09	0.11
Apr	0.09	0.08	0.09	0.10	0.10	0.11
May	0.13	0.12	0.15	0.15	0.17	0.12
Jun	0.27	0.20	0.29	0.24	0.29	0.15
Jul	0.27	0.23	0.27	0.27	0.28	0.24
Aug	0.21	0.31	0.21	0.24	0.30	0.25
Sep	0.22	0.25	0.16	0.23	0.28	0.25
Oct	0.20	0.22	0.13	0.24	0.23	0.20
Nov	0.16	0.18	0.13	0.16	0.22	0.15
Dec	0.08	0.10	0.09	0.11	0.10	0.09

The minimum and maximum values were used to model a diurnal curve over the course of a year. A regression line was modeled to help identify a reasonable value to represent the water demand for the service meters. A water demand of 0.28 gallons per minutes (gpm) was chosen from the 90th percentile from **Figure C-3**.

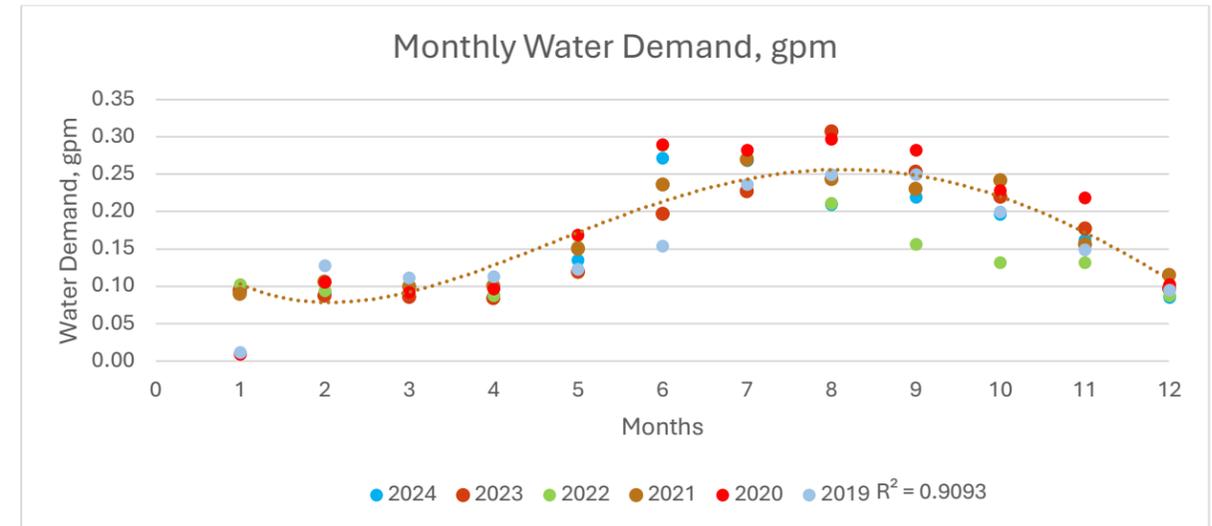


Figure C-3 – Existing System Pipe Capacity

Performance tests of the County’s existing water model were conducted with the software Bentley Connect Edition WaterCAD Version 10.04.00.158 to verify the existing conditions of the model. After validating the model through these performance test, a key criterion was applied: The velocity of the water shall not exceed 7-feet per second (ft/s).

A color-coded performance test of the system’s velocity was completed, where red represents segments with a velocity range of 5ft/s to 6ft/s, approaching the design limit. The analysis showed that certain pipe segments in the North Mesa and Barranca areas fall within this range. In North Mesa, the outlet pipes from the North Mesa Tank (NMTank) running east along North Mesa Road and then turning south consist of an 8-in. PVC pipe approximately 3,942 linear feet (LF) in length. In the Barranca area, a 6-in. ductile iron (DI) pipe extends from the Barranca Tank along San Ildefonso Road and crosses into Barranca Road.

Figure C-4 highlights existing pipes with velocity currently at risk of exceeding 7 ft/s velocity. The new development projects were modeled with the existing system to see how the system would behave. Red segments in **Figure C-4** show the pipe segments which exceed the velocity parameter when new development is considered, causing the system to fail as a result of stress. Specifically, within the North Mesa area, an 8-in. pipe exceeded the 7-ft/s parameter, while another line in Barranca did show an increase of around 0.5-ft/s.

In addition to a velocity check, a fire flow analysis was performed to assess the pressures and flow outputs within the existing system. Pipe segments shown in pink in **Figure C-4** represent the areas of concern and in need of an upgrade to meet a minimum pressure of 20 pounds per square inch (psi). This analysis was done before connecting the proposed development projects into the existing system. A scenario was analyzed with the new development connected to the system, which caused the pressures to range from 5 psi to 19 psi within the pink segments of the pipes. With respect to the existing system’s output flow, there are only two segments of pipes which seem to deliver less than 1,500 gpm to their areas. **Figure C-4** highlights these areas in yellow. Their size will need to increase to accommodate existing infrastructure and future development.



Figure C-4 – Low Pressure and High Velocity Areas within North Mesa and Barranca

III. Improvement Areas

The water design analysis evaluated the existing system with some modifications to expand the distribution system for future development. The analysis focuses on two areas of interest, Area A and Area B, shown in **Figure 1**, which are the locations of proposed residential developments projects. Other minor improvements include additional Pressure Reducing Valves (PRVs) in the Barranca and North Mesa areas. The first PRV is placed on the 14-in. line, located just south of the Barranca Tank, that connects the North Mesa area to the Barranca area. The second PRV will be placed on the 8-in. line connecting into the northwest portion of North Mesa. Along with a PRV, the North Mesa area will have a 16-in. altitude valve on the fill line modeled to assist with the water level of the NMTank.

a. Area A Description

Area A is the North Mesa Site for which the County has proposed a residential development project (see “Proposed Developments” in the Introduction). The final concept of the proposed project proposes up to 360 residential housing units with a mix of three different densities (low, medium, and high) across the site. For this analysis, densities were assumed to be 50 customer meters for low, 106 customer meters for medium, 204 customer meters for high. The project was modeled in WaterCAD using these densities.

b. Area B Description

Area B is the proposed Arbolada Subdivision (see “Proposed Developments” in the Introduction). A layout of the development is shown in Appendix C. The proposed development consists of 23 single family lots, 3 duplex lots, and 39 triplex lots, for a total of 137 housing units. A clubhouse consisting of a leasing office and swimming pool would also be constructed as part of the project.

IV. Design Analysis

The design criteria for the expansion of water systems involved a comprehensive evaluation of the capacity of the existing system. The system expansion is meant to consolidate water flows from future residents and connect to the existing system. The following specifications were used to evaluate the system:

1. The velocity of pipes does not exceed 7 feet per second (ft/s)
2. The fire flow standard within the system has minimum flow of 1,500 gallons per minute (gpm)
3. Residual pressures are 20 pounds per square inch (psi)

High velocity in pipes leads to the possibility of water hammer occurring in the water system, which can damage the infrastructure. Another issue with water having high velocity is the increase in the chances of corrosion occurring in the system. The National Fire Protection Association (NFPA) 101 Life Safety Code is used by the State Fire Marshall and Los Alamos as standards for their fire protection system and design. A minimum flow of 1,500 gpm is recommended for design for fire hydrants within a 500-ft. radius. The code also recommends the minimum residual pressure for hydrants to be 20 psi.

a. Area A

i) Design Criteria

The *North Mesa Housing Study*'s final concept proposes a mix of dwelling-unit (low, medium, and high), resulting in approximately 210-360 proposed housing units. Water demand calculations were performed using the methodology previously outlined, resulting in a demand increase of 0.28 gpm. WaterCAD was employed to model and analyze the average flow and fire flow conditions. Some existing lines in the current system need to be replaced to support the expansion. The first segment to be replaced would be in the Barranca area. There, it is recommended to upgrade the existing system of 2,589-LF of 6-in. pipe to an 8-in. pipe. This upgrade would help reduce the velocity from over 5ft/s to below 5ft/s. Additionally, the flow in this length of pipe would increase to meet the 1,500-gpm standard. The residual pressure in this area had previously met the minimum requirements and still did after the increase in pipe size. An analysis of this area after including the future developments showed the improvements were not impacted.

In the North Mesa area, the first improvement would be increasing 2,817-LF of existing pipeline size from 8-in. to a 10-in. pipe, 2,342-LF of existing 8-in. to a 12-in. pipe, and 2,747 of existing 8-in. to 14-in. pipe shown as the orange, purple, and pink color, respectively, in **Figure C-7**. These pipe segments showed signs of stress after looking at the velocity check. The pipe segment on North Mesa Road showed the velocity to be in a concerning range of 5-7 ft/s. With an increase in the size of the pipe, the velocity decreased, with the highest speed approaching 5-ft/s. The next requirement checked for the existing system was the fire flow analysis consisting of the minimum residual pressure of 20 psi and a minimum flow of 1,500 gpm.

North Mesa has two other areas that showed signs of failure under future conditions. One area is near the northwest corner of the North Mesa Site, where the residual pressure is 20 psi today but falls below 20 psi after the inclusion of the proposed development projects. With an increase in the pipe size in this area, a residual pressure of close to 40 psi resulted. **Figure C-6** shows this area as pink.

A new proposed system was developed to simulate an additional water system connected to the existing system after improvements were modeled. The proposed system has a total length of 3,198 LF of 10-in. PVC pipe connected to the proposed 10-in. pipe along North Mesa Road, in **Figure C-5** and **Figure C-7**. The inclusion of the new water system did alleviate the surrounding pipes' velocity, lowering it further from the 5-7ft/s range. The fire flow and pressure results can be found in Appendix L, showing the system still met requirements.

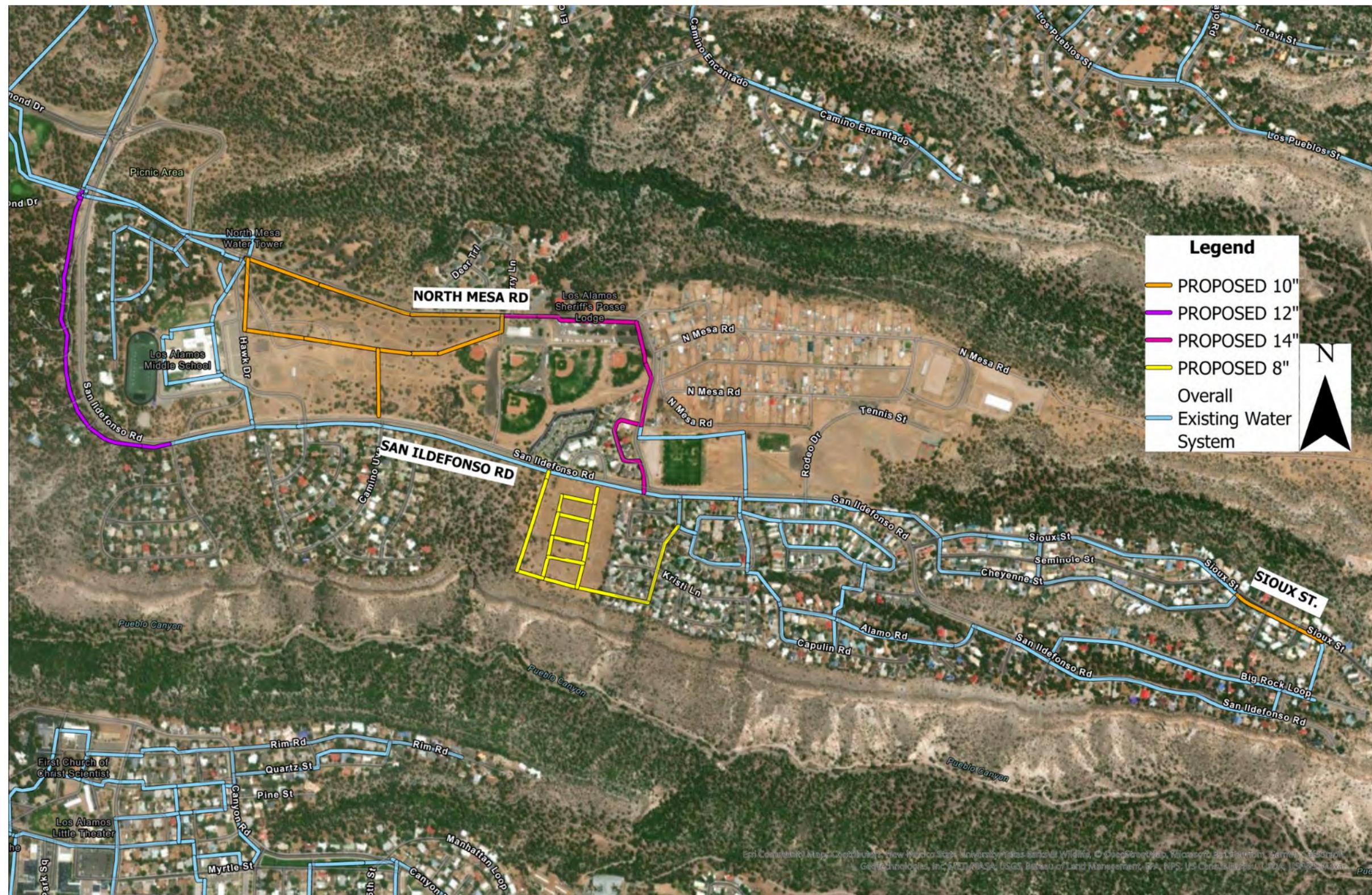


Figure C-5 – Proposed Waterline Improvement Areas



Figure C-6 – Upgraded System with Areas of Low Fire Flow

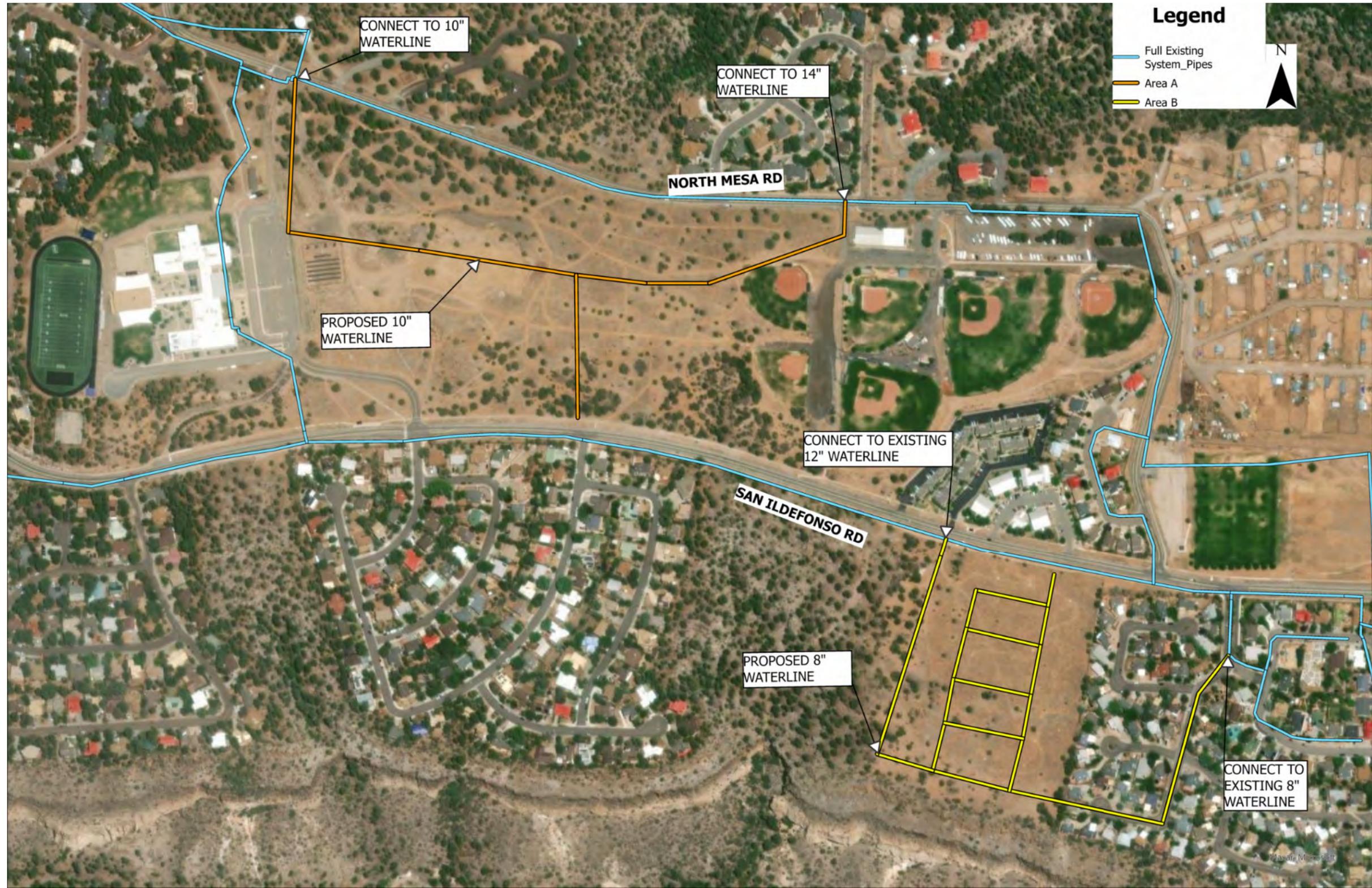


Figure C-7 – New Proposed Waterline System for Areas A and B

ii) Cost Estimate

Table C-3 provides the cost estimate for the proposed water system for Area A along with the improvements to the existing system. The total amount of pipe upgraded to a 10-in. is 2,817 LF. To account for the 360 customer meters, an approximate total of 3,198 LF is needed for the connections. Along with the pipes, improvements will include eight gate valves to isolate all segments of the new developments. The new system will connect into the existing system from a 10-in. line to 10-in. pipe for the residential area.

Table C-3 – Area A Cost Estimate

ITEM NO.	MATERIAL DESCRIPTION:	UNITS	QTY	UNIT COST	ITEM COST
GENERAL ITEMS					
1	Mobilization/Demobilization	LS	1	\$ 65,432.50	\$ 65,432.50
2	Construction Staking and Survey	LS	1	\$ 26,173.00	\$ 26,173.00
3	Traffic Control Plan and Management	LS	1	\$ 39,259.50	\$ 39,259.50
4	Material Testing Allowance	ALLOW	1	\$ 8,000.00	\$ 8,000.00
5	Subsurface Utility Locating Allowance	ALLOW	1	\$ 6,000.00	\$ 6,000.00
WATER SYSTEM					
6	Furnish and Install 10-inch PVC DR-18 Waterline by Open Trenching, CIP	LF	6,020	\$ 67.00	\$ 403,340.00
7	Furnish and Install 12-inch PVC DR-18 Waterline by Open Trenching, CIP	LF	2,310	\$ 68.00	\$ 157,080.00
8	Furnish and Install 14-inch PVC DR-18 Waterline by Open Trenching, CIP	LF	2,760	\$ 93.00	\$ 256,680.00
9	Locate and Connect to Existing Waterline, CIP	EA	6	\$ 12,000.00	\$ 72,000.00
10	Furnish and Install 3/4-in Water Service Lines by Open Trenching, CIP	EA	158	\$ 2,150.00	\$ 339,700.00
11	Furnish and Install 10-inch Gate Valve in Cast Iron Valve Box, CIP	EA	8	\$ 3,000.00	\$ 24,000.00
12	Furnish and Install a 14-inch PRV, CIP	LS	1	\$ 8,500.00	\$ 8,500.00
13	Furnish and Install a 8-inch PRV, CIP	LS	1	\$ 6,500.00	\$ 6,500.00
13	Furnish and Install 14-inch Altitude Valve in Cast Iron Valve Box, CIP	EA	1	\$ 40,850.00	\$ 40,850.00
AREA A CONSTRUCTION COST SUBTOTAL:					\$ 1,453,515.00
CONTINGENCY (20%):					\$ 290,703.00
LOS ALAMOS COUNTY GRT @ 7.0625%:					\$ 123,185.40
AREA A TOTAL CONSTRUCTION COST:					\$ 1,867,403.40
NON-CONSTRUCTION COSTS					
10	Pre-Engineering - Survey	LS	1	\$ 58,140.60	\$ 58,140.60
11	Engineering Design Services	LS	1	\$ 145,351.50	\$ 145,351.50
12	Engineering - Bid Phase	LS	1	\$ 72,675.75	\$ 72,675.75
13	Engineering - Construction Phase	LS	1	\$ 87,210.90	\$ 87,210.90
14	Legal Services	LS	1	\$ 43,605.45	\$ 43,605.45
AREA A NON-CONSTRUCTION COST SUBTOTAL:					\$ 406,984.20
CONTINGENCY (20%):					\$ 81,396.84
ALBUQUERQUE GRT @ 7.6250%:					\$ 37,239.05
AREA A TOTAL NON-CONSTRUCTION COST:					\$ 525,620.09
AREA A TOTAL PROJECT COST:					\$ 2,393,023.49

b. Area B

i) Design Criteria

In the plans provided by the County, the additional housing units were modeled using the methodology previously outlined, resulting in a demand increase of 0.28 gpm, as shown in Table 1. WaterCAD was employed to model the average flow and fire flow conditions. Modeling shows that replacement of some existing lines will be required to support development in Area B. These are the same segments described for Area A – their replacement would also accommodate anticipated new demand from Area B. The improvement of upsizing a portion of the 8-in. line on San Ildefonso in front of Area B did not drastically change existing conditions within the water system, as like with Area A, the pipes within the surrounding areas showed a decrease in the velocity.

ii) Cost Estimate

Table C-4 provides the cost estimate for the proposed water system for Area B. To account for the 180 customer meters, an approximate total amount of 1,220 LF of 8-in. pipe is needed for the new subdivision. Along with the pipes, improvements will include 15 gate valves to isolate all segments of the new developments and a new 8-in. PRV to help reduce pressure in the new subdivision. The new system will connect into the existing system from a 12-in. line to 8-in. pipe for the residential area.

Table C-4 – Area B Cost Estimate

ITEM NO.	MATERIAL DESCRIPTION:	UNITS	QTY	UNIT COST	ITEM COST
GENERAL ITEMS					
1	Mobilization/Demobilization	LS	1	\$ 26,627.50	\$ 26,627.50
2	Construction Staking and Survey	LS	1	\$ 10,651.00	\$ 10,651.00
3	Traffic Control Plan and Management	LS	1	\$ 15,976.50	\$ 15,976.50
4	Material Testing Allowance	ALLOW	1	\$ 8,000.00	\$ 8,000.00
5	Subsurface Utility Locating Allowance	ALLOW	1	\$ 6,000.00	\$ 6,000.00
WATER SYSTEM					
6	Furnish and Install 8-inch PVC DR-18 Waterline by Open Trenching, CIP	LF	5,470	\$ 65.00	\$ 355,550.00
7	Locate and Connect to Existing Waterline, CIP	EA	2	\$ 12,000.00	\$ 24,000.00
8	Furnish and Install 3/4-in Water Service Lines by Open Trenching, CIP	EA	50	\$ 2,150.00	\$ 107,500.00
9	Furnish and Install 8-inch Gate Valve in Cast Iron Valve Box, CIP	EA	15	\$ 2,600.00	\$ 39,000.00
10	Furnish and Install a 8-inch PRV, CIP	LS	1	\$ 6,500.00	\$ 6,500.00
AREA B CONSTRUCTION COST SUBTOTAL:					\$ 599,805.00
CONTINGENCY (20%):					\$ 119,961.00
LOS ALAMOS COUNTY GRT @ 7.0625%:					\$ 50,833.47
AREA B TOTAL CONSTRUCTION COST:					\$ 770,599.47
NON-CONSTRUCTION COSTS					
9	Pre-Engineering - Survey	LS	1	\$ 23,992.20	\$ 23,992.20
10	Engineering Design Services	LS	1	\$ 59,980.50	\$ 59,980.50
11	Engineering - Bid Phase	LS	1	\$ 29,990.25	\$ 29,990.25
12	Engineering - Construction Phase	LS	1	\$ 35,988.30	\$ 35,988.30
13	Legal Services	LS	1	\$ 17,994.15	\$ 17,994.15
AREA B NON-CONSTRUCTION COST SUBTOTAL:					\$ 167,945.40
CONTINGENCY (20%):					\$ 33,589.08
ALBUQUERQUE GRT @ 7.6250%:					\$ 15,367.00
AREA B TOTAL NON-CONSTRUCTION COST:					\$ 216,901.48
AREA B TOTAL PROJECT COST:					\$ 987,500.96

V. Conclusion and Recommendations

The water model showed areas of high velocity in the North Mesa area water system after new demand from planned development projects was incorporated. High velocity can cause deterioration of the infrastructure. To address this issue, the following upgrades are recommended: Increasing a total of 2,589 LF of 6-in. pipe to 8-in. pipe; 8,441 LF of 8-in. to 10-in. pipe; and 632 LF of 8-in. to 12-in. pipe.

A fire flow analysis was performed after verifying the velocity of the water was within a reasonable range of 3-5ft/s. Results from the fire flow analysis showed the existing system had areas of with low pressure and flow not meeting the minimum requirements of 1,500 gpm and 20 psi, respectively. These requirements are defined by the NFPA 101 Life Safety Code for housing greater than single to double style family housing. After upsizing the necessary pipes in the model, the system's flow did increase.

After evaluating the area for residual pressures, it is recommended to keep the PRV on the 8-in. line connecting into the northwest part of the North Mesa Site inactive, as the release of pressure results in the area not meeting a minimum 20 psi.

The Area A residential development has a planned build-out of 360 homes. To support this growth, a new water system consisting of 2,751 LF of 10-in. pipe was modeled.

The new residential subdivision in Area B will include a total of 137 units. The existing system can handle this new housing. A proposed system consisting of 3,600 LF of 6-in. pipe was modeled to connect the existing system to new users in the subdivision.

A total cost for the upgrades to the existing system and installation of the new lines to support development in Area A and Area B would be \$3,213,123.19

