EAST ANAMOSA

STREET EXTENSION STUDY

REVISED FINAL REPORT

May 24, 2000

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EAST ANAMOSA

STREET EXTENSION STUDY

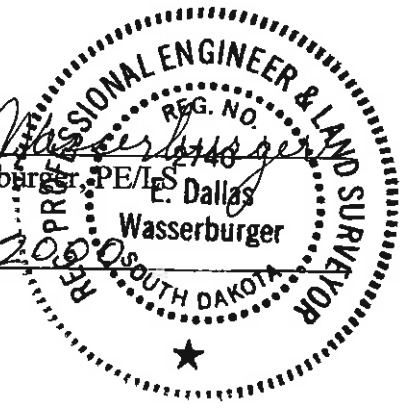
OWNER	Rapid City Metropolitan Planning Organization 300 Sixth Street Rapid City, South Dakota
PROJECT NO.	98-660
DATE	February 15, 2000
ENGINEER	ALLIANCE OF ARCHITECTS AND ENGINEERS Rapid City, South Dakota
CERTIFICATION	I hereby certify that the Street Extension Study together with the accompanying documents were prepared by me under my direct supervision and that I am duly registered under the laws of the State of South Dakota.

E. Dallas Wasserburger per verbal per

E. Dallas Wasserburger, PE/LS

2-15-2000

Date



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CHAPTER ONE

INTRODUCTION

GENERAL

The recent development between East North Street and Elk Vale Road, including the Menards Subdivision and the Rushmore Business Park Expansion, has increased the need for an additional east/west transportation corridor to service the entire area. In addition, the area between the present terminus of East Anamosa Street and East North Street is experiencing growth and is not presently served by an adequate street or utility system.

The Alliance of Architects and Engineers (AAE), in association with HDR Engineering (HDR), has been retained by the Rapid City Area Metropolitan Planning Organization (MPO) to prepare a corridor analysis and an infrastructure expansion study for the area surrounding the proposed extension of East Anamosa Street. This proposed extension would commence at the intersection of La Crosse Street, and continue to the intersection of Elk Vale Road (approximately three miles in length).

The primary purpose of this study is to evaluate alternative east/west corridors between La Crosse Street and Elk Vale Road. Current development, which includes Menards, Western Dakota Technical Institute, the Rushmore Business Park Expansion and the proposed "Heartland Express" roadway designation, a major thoroughfare that will link Rapid City to Denver, will create a demand for a more efficient and effective means of accessing the area. At the present time, the majority of the land adjacent to the proposed East Anamosa Street Extension remains undeveloped. However, once the corridor is established and constructed, development will most likely occur within a relatively short period of time.

The existing portion of Anamosa Street primarily serves east/west traffic between Interstate 190 (I-190) and La Crosse Street and is presently classified as an urban collector street. It is proposed that the classification of East Anamosa, from La Crosse Street to Elk Vale Road, be designated as an urban principal arterial street. While this extension will provide a means of handling traffic and future growth as described above, it could ultimately be expanded to serve as an additional major east/west corridor through the city.

This report entitled the *East Anamosa Street Extension Study* will analyze several alternatives for this corridor and will identify the best alternative using a matrix system to evaluate pertinent criteria.

PROJECT LOCATION

The location of the project area is shown on Figure 1. East Anamosa Street lies in the northeast quadrant of Rapid City. Interstate 90 (I-90) passes through the northern portion of Rapid City in an east/west direction with Exits 59, 60 and 61 presently providing the primary access to the northeast quadrant of the city, and to the area that will be served by the East Anamosa Street Extension.

The study area for the project has been established as shown on Figure 2. This area is bounded by I-90 on the north, La Crosse Street on the west, Elk Vale Road on the east and South Dakota Highway 44 on the south.

PROJECT NEED AND PURPOSE

In June 1998, the MPO, in conjunction with the City of Rapid City and the South Dakota Department of Transportation, selected the AAE/HDR team to prepare the *East Anamosa Street Extension Study*. The goal of the study is to identify and evaluate alternative alignments, review environmental and drainage issues for the preferred alignment, prepare a conceptual level infrastructure layout, and ultimately establish the proposed centerline for the roadway extension.

The East Anamosa Street Extension will provide a vital transportation corridor from the northern part of Rapid City, through the study area, to Elk Vale Road. The selected route will handle future traffic and the anticipated growth along the entire length of the corridor. This extension will also provide an additional access point to the future Heartland Express, and become a major contributor to the development of the street network system throughout the area.

PREVIOUS STUDIES

The first task of the *East Anamosa Street Extension Study* was to compile and review previous documents relevant and necessary for completing the analysis of the East Anamosa Street Extension. A number of reports and planning documents, obtained from the MPO, were reviewed and their conclusions incorporated into this corridor analysis. The documents include the following:

- *SDDOT's Heartland Express Traffic Forecast Study Summary*, April 1997.
- *SDDOT's Signalized Intersection Summary*, April 1997.
- *Rapid City's Major Street Plan*, Latest Update February 1998.
- *Rapid City's Street Design Criteria Manual*, Latest Update June 1996.
- *Draft Elk Vale Neighborhood Future Land Use Plan Map*, December 1997.
- *Draft Elk Vale Neighborhood Traffic Analysis, June 1999.*
- *Pennington County-Rapid City Planning Department's Land Use Data by Traffic Analysis Zones*, September 1998.
- *Rapid City's and MPO's 1997 Traffic Counts and Factors*, June 1998.
- *SDDOT Access Plan for Elk Vale Road*, June 1997.
- *Wastewater Facilities Plan for Rapid City, SD, Addendum No. 1*, 1990.
- *Unnamed Tributary Drainage Basin Design Plan.*
- *Racetrack Draw Drainage Basin Design Plan.*
- *Preliminary Section of Perrine Drainage Basin Design Plan.*
- *Preliminary Engineering Study for Northeast Sanitary Sewer Interceptor*, February 1996.
- *Study and Report of Municipal Water System*, December 1985.
- *Sanitary Sewer Layout Map for Visitor Information Center*, January 1997.
- *Water Main Extension Layout Map for Visitor Information Center*, October 1996.
- *Rushmore Business Park's Expansion Layout Plat*, April 1998.
- *Menard's Development and Grading Plan and Overall Site Map*, April 1997.
- *Menard's Subdivision Layout Plat*, April 1998.

RESULTS OF PREVIOUS STUDIES

The draft version of the *Elk Vale Neighborhood Future Land Use Map* was prepared to address future land uses throughout an area bounded by Cambell Street on the west; East North Street and I-90 on the north, to approximately one-quarter mile east of Exit 61; approximately one-quarter mile east of East 53rd Street on the east and SD Highway 44 on the south. The land use along the East Anamosa Street Extension corridor consists

of a mixture of light industrial, public, general commercial, office commercial, neighborhood commercial, medium density residential with planned residential development and mobile home park. Other land use in the vicinity includes business park, heavy industrial, low density residential, and several different densities of planned residential development.

In addition, land use in the area between La Crosse Street, I-90 and East North Street, as shown on Figure 4A, is a combination of general commercial, light industrial, mobile home park and medium density residential. The DM&E Railroad divides this area approximately in half (north/south). The area north of the railroad is designated as medium density residential with a strip of land adjacent to La Crosse Street identified as general commercial. The south half of the area is a combination of all four previously mentioned land uses.

The *Rapid City Major Street Plan* not only addressed existing major streets throughout Rapid City, but also indicated the proposed location for future major traffic routes. The East Anamosa Street Extension will add about three miles of principal arterial to the existing street system. The plan also identifies a future extension of East Anamosa Street to the west that would connect I-190 to Deadwood Avenue. This street may ultimately continue westward to Sturgis Road. East Anamosa Street is also shown to extend eastward and connect to East 53rd Street (Reservoir Road). In addition, a potential connection could be made to the future Airport Crossover Road, which would extend from Exit 67/I-90 to the Rapid City Regional Airport. The Rapid City Area MPO updated the major street plan using their GIS system in February 1998. Copies of the Major Street Plan and Future Land Use Map are included as Figure 3 and 4 respectively.

The *Rapid City Major Street Plan,* in conjunction with the *Elk Vale Neighborhood Future Land Use Map,* also depicts several proposed traffic routes within the study area. In addition to East Anamosa Street, two other east/west corridors are shown. The southern roadway, designated the "East-West Road", would connect Valley Drive to Elk Vale Road south of East Anamosa Street. The plan shows an unnamed road north of East Anamosa Street that would connect East North Street to Elk Vale Road.

Several north/south collectors are also shown on the Major Street Plan and/or the Future Land Use Map. Mickelson Drive connects SD Highway 44 to East Anamosa Street. East Philadelphia is shown continuing eastward and northward to the unnamed road. Valley Drive is shown connecting SD Highway 44 to the unnamed road. Concourse Drive is shown extending from its present terminus north of Elk Vale Road to Eglin Street.

In 1997, the Rapid City Traffic Engineering and Operations Division compiled traffic count data for the majority of the streets within the City of Rapid City. The data is presented as peak season average daily traffic (PSADT) values. The major streets surrounding the study area and their associated PSADT values are as follows:

STREET	PSADT
Elk Vale Road from I-90 to Jolly Lane	8,500
Elk Vale Road from Jolly Lane to East St. Patrick Street	11,000
East Omaha Street from East St. Patrick Street to Sedivy Lane	15,300
East Omaha Street from Sedivy Lane to Cambell Street	17,400
East North Street from I-90 to East Anamosa Street	8,900
East North Street from East Anamosa Street to Cambell Street	No Data
East North Street from Cambell Street to La Crosse Street	20,500

STREET	PSADT
La Crosse Street from I-90 to East Anamosa Street	18,200
La Crosse Street from East Anamosa Street to East Van Buren Street	20,800
La Crosse Street from East Van Buren to East North Street	19,500
I-90 from Elk Vale Road to East North Street	25,600
I-90 from East North Street to La Crosse Street	22,700
Eglin Street from Beale Street to East Anamosa Street	3,900

In addition to the 1997 traffic count information, the Rapid City Area MPO has prepared a table and map, identified as the "Future Land Use Totals by Traffic Analysis Zones," for the entire East Anamosa Street Extension Study area. The future land use traffic analysis zones provides a breakdown of dwelling units and square footages for each of the eleven land use categories. The Future Land Use Totals by Traffic Analysis Zones, the Traffic Analysis Zones Map and the Land Use Category Descriptions are included in Appendix A.

The *SDDOT Heartland Express Traffic Forecast Study* was developed to determine future traffic impacts on Elk Vale Road resulting from proposed land use changes, the development of a street network system in the area and the locations of future access points onto Elk Vale Road. However, because of recent changes in the area surrounding Elk Vale Road, the MPO decided to update the previous traffic analysis of the proposed street network. This change was necessitated by the completion of the *Elk Vale Neighborhood Future Land Use Map* and by the submittal of major development plans for property near the intersection of East Anamosa Street and Elk Vale Road, including the Rushmore Business Park Expansion.

The updated traffic data for present and future years were developed by Felsburg Holt & Ullevig (FHU) in two reports which are entitled the *Elk Vale Neighborhood Traffic Analysis* and the *East Anamosa Traffic Analysis* (See Appendices B and C respectively). The FHU studies indicated that approximately 20,000 vehicles per day (vpd) or more utilize the four-lane major roadways surrounding the perimeter of the study area. The study also indicated that the two-lane area roads, especially the southern portion of Elk Vale Road, accommodate a maximum of approximately 11,000 vpd.

According to the FHU study, volumes of through traffic were estimated based on present day traffic flow and land use patterns with some adjustments made for the proposed Southeast Connector.

EXISTING CONDITIONS

Roadway System

The existing focus area roadway system surrounding the study area is shown on Figure 2. A brief description of the major street network highlights key features of each roadway.

Interstate 90 (I-90) is a four-lane interstate highway, with three interchanges serving the study area. These interchanges are located at Exit 59, 60 and 61. The interchanges at La Crosse Street (Exit 59) and Elk Vale Road (Exit 61) were designed as diamond-shaped configurations which provides full-access for all entering and exiting traffic. The third interchange located at East North Street is a partial-diamond configuration which provides for eastbound and westbound I-90 exiting traffic, but only eastbound entering traffic.

Elk Vale Road is classified as an urban principal arterial that connects I-90 with SD Highway 44. At present, Elk Vale Road is a two-lane road with a center lane used for passing and left turn movements. This portion of Elk Vale Road will eventually become a part of the Heartland Express, a major thoroughfare that will link Rapid City to Denver, Colorado. A new interchange will be constructed at the intersection of Elk Vale Road and SD Highway 44 as a part of the Heartland Express. The SDDOT has limited the number of access points onto Elk Vale Road in anticipation of its proposed status. At present, the only access points approved are at Concourse Drive, Turbine Drive, Jolly Lane, "East-West Road", East Anamosa Street and a future service road left and right at I-90.

SD Highway 44 is classified as an urban principal arterial. Beginning on the west side of Rapid City, the arterial is four lanes with curb, gutter and left turn lanes until the intersection of Longview Drive where it narrows to a two lane rural section. From that point it continues eastward to the Badlands. SD Highway 44 is one of the few major east/west thoroughfares in the city and transports a large volume of traffic.

Cambell Street is a four lane urban principal arterial with curb, gutter and left turn lanes from the south city limits to the intersection of East North Street. Because this is the main truck access from the south, which ultimately connects with I-90, it is an important link in the Rapid City transportation network. Truck traffic from US 16 generally diverts to Cambell Street rather than entering downtown Rapid City via Mount Rushmore Road.

East North Street is also classified as an urban principal arterial that carries traffic from portions of the downtown area to I-90. East North Street is four lanes with curb, gutter and left turn lanes from East St. Joseph Street to I-90. Because of existing commercial establishments and new development along the recently finished segment of East Anamosa, East North Street has increased in importance as a major traffic artery.

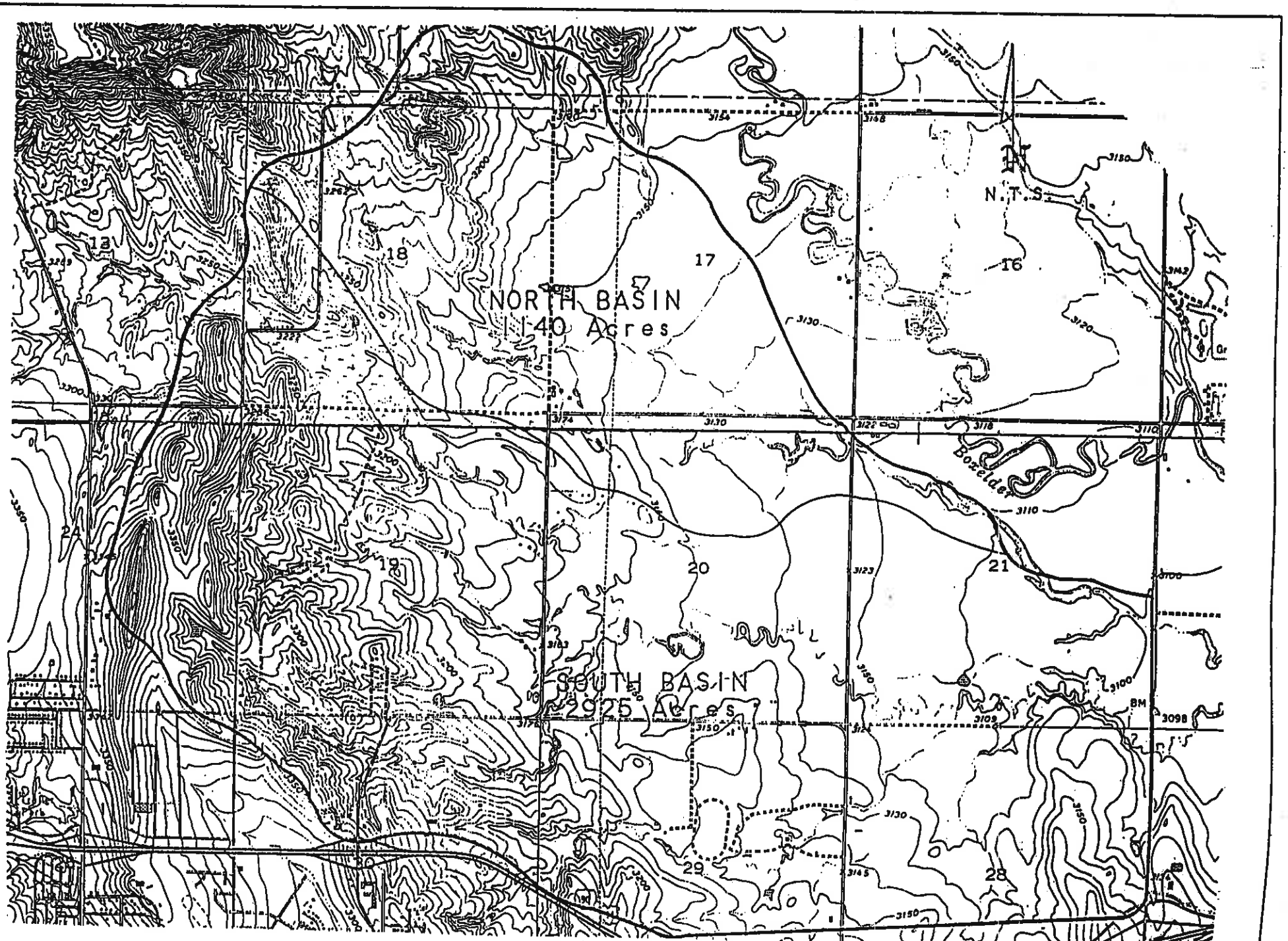
La Crosse Street is an Urban Minor Arterial that provides access from SD Highway 44 to East North Street to Exit 59/I-90. La Crosse Street is four lanes with curb, gutter and left turn lanes which serves as the westbound access point to I-90 from Cambell Street via East North Street. In addition, La Crosse Street traverses through a large commercial traffic generating area south of I-90.

Utilities and Drainage

The *Northeast Sanitary Sewer Interceptor Study* addressed sewer service to approximately 4,100 acres north of I-90 (See Figure 5). This area is bounded by Haines Avenue, the Meade/Pennington County Line, the Box Elder Creek Flood Plain, Elk Vale Road and I-90. The wastewater from this entire area would flow by gravity to the lift station north of the Visitor Information Center, which is located in the northwest quadrant of Exit 61/I-90. This proposed sewer system would also be available in the future to service the majority of the study area between La Crosse Street and East North Street. However, for the immediate future an alternate method of servicing this area would be required.

The remainder of the study area between East North Street and Elk Vale Road would connect to either Rapid City's wastewater collection system, or to the Rapid Valley Sanitary District's collection system. Wastewater treatment for the entire study area would be provided at Rapid City's Water Reclamation Plant.

Due to the varied topography of Rapid City, multiple pressure zones have been developed for the water distribution system. The *Municipal Water System Study and Report,* dated December 1985, indicated that the Low Level Pressure Zone would generally serve the East Anamosa Street Extension Study Area. This zone provides water service below a United States Geologic Survey (U.S.G.S.) elevation of 3,320 feet above sea level. However, in order to provide adequate pressure to the area, the City has lowered the pressure zone



NE SANITARY SEWER INTERCEPTOR STUDY - STUDY AREA BOUNDARY

FIGURE 5

elevation to 3,300 feet. Figure 6 depicts the boundaries of the various pressure zones indicated in the above mentioned study. The central portion of the study area between East North Street and Elk Vale Road has a maximum elevation of 3,413 feet above sea level. Before development can occur above the 3,300 elevation level, a water booster station with elevated reservoir or an extension from the North Rapid High Level Zone would be required. The high level zone is at an elevation of 3,544 feet. Therefore, by connecting to the high level zone at the intersection of La Crosse and East Anamosa Streets, service could be provided to the highest elevations in the study area by installing a water line along the East Anamosa Street Extension. The 1985 report also addressed existing and future major water supply lines and included estimated year 2005 flows, pressures and potential reservoir locations (See Figure 7).

Three drainage basins transect the study area between East North Street and Elk Vale Road. Two of these basins, the *Unnamed Tributary Drainage Basin,* and the *Racetrack Draw Drainage Basin* have completed basin design plans. The *Perrine Drainage Basin Design* was in the process of being developed at the time of this writing. Several detention facilities are either in place or are planned to reduce the rate of discharge from these basins. These three basins ultimately drain into Rapid Creek.

The area between La Crosse Street and East North Street generally drains to the northeast into the Box Elder Drainage Basin. A basin design plan is not available at the present time for this area.

FUTURE CONDITIONS

The year 2025 has been selected as the design year for the East Anamosa Street Extension. The growth of Rapid City is dependent upon tourism, expansion of the service businesses, the increase in light industry and manufacturing and the level of activity of Ellsworth Air Force Base (EAFB). A significant percentage of Rapid City's work force is either employed in the service area or at EAFB.

Traffic Forecasts

Through traffic for year 2025 was estimated using a 50 percent growth factor between current volumes and the year 2025. This approximates the two percent average annual increase in traffic volumes experienced on roadways throughout Rapid City over the last three years. One additional adjustment was made to the year 2025 estimate to allow for diverting traffic to the planned Southeast Connector once that portion of the system is completed.

CHAPTER TWO

PROJECT DESCRIPTION

GENERAL

The East Anamosa Street Extension is designated as an urban principal arterial that will be between 2.6 and 3.1 miles (depending on the alignment selected) in length traversing the northeastern portion of Rapid City. This project will provide an alternative east/west corridor between Lacrosse Street and Elk Vale Road and enhance the potential for development in the area.

Current development at strategic points, most notably Wal-Mart, Menards and the Rushmore Business Park Expansion, has intensified the need for a transportation system to connect these points and allow for future development.

TYPICAL GRADING/SURFACING SECTIONS

The typical sections for the East Anamosa Street Extension are shown in Figures 8, 9 and 10. The ultimate typical grading/surfacing section will consist of six twelve-foot driving lanes with exterior curb and gutter; a central sixteen-foot grassed, continuous depressed median with curb and gutter; and a buffer zone behind each outside curb line. A detached five-foot sidewalk on the north side and a ten-foot bike path on the south side are both adjacent to the buffer zone. The surfacing section will probably consist of portland cement concrete pavement with an aggregate base course overlaying a compacted subgrade. The maximum vertical grade proposed for the arterial is six percent. The maximum allowable superelevation (cross-slope) proposed on a curve is four percent. A right-of-way width of at least 117 feet will be required for the proposed grading section. Three options for maintaining the right-of-way width to the current 113 feet would include: 1) reducing the distance behind the sidewalk and bike path to ½ foot each, 2) reducing the bike path width to 8 feet, or 3) reducing the sidewalk width to 4 feet. The purchase of additional right-of-way will be necessary in some areas because of the anticipated embankment fills. Temporary construction easements in cut areas will be utilized instead of purchasing permanent slope easement rights-of-way. This will minimize the investment necessary to acquire the land for construction of the arterial. The design speed is anticipated to be 50 miles per hour (mph) with a maximum posted speed of 45 mph.

The interim typical grading section will be the same as the ultimate grading section, except for the median, which will be graded to a width of twenty-eight feet. The interim section would consist of outside curb and gutter, surfacing the two outside driving lanes and adding a six foot gravel shoulder to the inside lane on each side of the roadway (See Figure 8). The depressed median would remain grass with median drains to control drainage. Because the grading would be completed on the interim section, converting this section to the ultimate section would only require adding an additional lane each side with inside curb and gutter. The ultimate and interim typical sections are depicted on Figure 8.

Figure 9 indicates the ultimate and interim typical left turn sections. The ultimate section adds a ten-foot left turn lane by reducing the median to six feet and providing a patterned concrete median surface instead of grass. The interim section adds a twelve-foot turn lane, which reduces the grassed surface to sixteen feet.

The typical collector section is shown on Figure 10. This section consists of two fourteen-foot driving lanes with curb and gutter, twelve-foot left turn lane, and a buffer zone behind each outside curb line. A detached five-foot sidewalk on the left side and an eight-foot bike path on the right side are both adjacent to the buffer

zone. The right-of-way width for the typical collector section is 76 feet. The design speed for the collector is 35 miles per hour.

The East Anamosa Street Extension will intersect two principal arterials (East North Street and Elk Vale Road) and one minor arterial (La Crosse Street) with at-grade signalized intersections. Right hand turn lanes will likely be provided at these intersections.

The intersection of East Anamosa with the Dakota, Minnesota & Eastern (DM&E) Railroad will be accomplished with a grade separation structure. Based on the final alignment, existing railroad cuts will be used to the maximum extent possible to reduce the amount of fill required for grade separation.

CHAPTER THREE

SYSTEM ANALYSIS

EXISTING ROADWAY NETWORK

Figure 2 shows the existing roadway network that surrounds the study area. This graphic depicts Interstate 90 and SD Highway 44 as the primary east/west highways and La Crosse Street and Elk Vale Road as the major north/south routes.

Interstate 90 is a four-lane controlled-access freeway that borders the north side of the study area for approximately 2.6 miles. The majority of I-90 in this area was designed and constructed in the early 1960's. The freeway is in good condition with maintenance being provided by the SDDOT. The posted speed limit on this section of the freeway is 65 mph.

Highway 44 consists of approximately 2.1 miles of four-lane highway along the south side of the study area. This roadway runs generally east and west, nearly paralleling I-90. The roadway is in good condition and is maintained by the SDDOT. This road is classified as Principal Arterial with a posted speed limit of 45 mph.

Elk Vale Road is the eastern boundary of the study area. This road consists of a two-lane and three-lane highway and is classified as a Principal Arterial. This section of the roadway is approximately 2.6 miles in length and at present serves as the main connection between St. Patrick Street and I-90. In the future, this road will be connected to SD Highway 79 (via the Southeast Connector) a portion of the planned "Heartland Express". Elk Vale Road is in good condition, but will be upgraded as part of the Southeast Connector project. The posted speed is 55 mph until just south of the service road at I-90, where the speed is reduced to 35 mph.

La Crosse Street is the western boundary of the study area and is presently classified as a Minor Arterial. However, this street will be upgraded to a Principal Arterial in the near future. La Crosse Street is approximately 1.6 miles in length and provides access from Highway 44 to Exit 59/I-90. The street is presently a four-lane plus turn-lane road with curb and gutter and is in excellent condition. The posted speed is 35 mph.

TOPOGRAPHY

The topography of the study area consists of rolling hills with classic dendritic drainage patterns. Three major natural drainage basins, varying in size and extent, transect the area. The alignments considered for the study have a maximum elevation change of 110 feet. The majority of the study area adjacent to the corridor is currently undeveloped land primarily used for agriculture. However, commercial development exists near the La Crosse Street and the East North Street intersections with East Anamosa. In addition, a business park is being developed at the intersection of East Anamosa and Elk Vale Road.

EXISTING ZONING

The area is mostly undeveloped and a large portion of it is presently zoned either General or Limited Agriculture. That portion of the study area adjacent to La Crosse and East North Streets and Elk Vale Road is presently zoned general commercial. An area west of and adjacent to Century Road is zoned light industrial, as is an area south and west of Elk Vale Road. Several areas are zoned medium density residential, including an area east of La Crosse Street adjacent to the DM&E Railroad and a separate area north and west of Elk Vale Road. A small tract of land southeast of East North Street is zoned low density residential.

ACCIDENT HISTORY

Accident history is unavailable for this proposed roadway since it is a new alignment. In addition, the existing intersections at La Crosse Street and East North Street have recently been reconstructed and are signalized to control traffic and improve safety. The field access at Elk Vale Road will be rebuilt as part of the "Heartland Express". Therefore, historical accident data for these intersections, prior to their reconstruction, is of little value in analyzing the corridor. The proposed roadway and intersections along East Anamosa Street will be designed in accordance with current safety standards.

CHAPTER FOUR

ESTABLISH PROPOSED ALTERNATES

The purpose of this study is to evaluate several alternative corridors for the East Anamosa Street Extension between La Crosse Street and Elk Vale Road. The main focus of the corridor analysis will be to determine the most feasible route for the street extension.

This study used information contained in *the Elk Vale Neighborhood Traffic Analysis* and the *East Anamosa Traffic Forecasts* prepared by Felsburg Holt & Ullevig, dated June 1999. Because of the volume of daily traffic that will use this roadway, it has been designated as an urban principal arterial. Table 1 outlines the main characteristics for the major classes of streets applicable to the area. The year 2025 design year volume is estimated to be 34,000 vehicles per day (vpd). At build-out, this volume increases to 43,000 vpd. The ultimate typical section (at build-out) is a six-lane arterial with a depressed median and a ten-foot left turn lane. However, the interim typical section for design year 2025 is a four-lane section with a twelve-foot left turn lane (See Figure 8).

The proposed East Anamosa Street Extension will commence at La Crosse Street on the west and extend east and south through the East North Street intersection to Elk Vale Road. The street extension, including both the west and east segments will be between 2.8 and 3.4 miles in length, depending on the alternative selected. The primary purpose of the new route is to provide an alternate east/west route across the city. A secondary, but equally important objective, is to provide access to this undeveloped area and to the Rushmore Business Park, which is presently being expanded.

The study area is divided into two segments. The west segment is the area between La Crosse Street and East North Street. Alternate alignments in this segment are referred to 1, 2 and 3 respectively. The east segment is the area between East North Street and Elk Vale Road. Alternative alignments in this segment are referred to as A, B and C respectively. Ultimately, in determining the overall preferred alignment, a combination of the two designations is used. Figure 11 shows the proposed alignments of the three west alternates that will be analyzed during the course of this study. Figure 12 depicts the alignments of the three east alternates. The six alternate roadway alignments are identified in Table 2 and are described in the following section.

TABLE 1

CHARACTERISTICS OF STREET CLASSES[1]

EAST ANAMOSA STREET EXTENSION
LA CROSSE STREET TO ELK VALE ROAD

Rapid City, South Dakota

Function	Street Classification				
	Freeway	Major Arterial	Minor Arterial	Collector	Local
1. Average Trip Length	Over 3 Miles	Over 1 Mile	Over 1 Mile	Under 1 Mile	Under 1/2 Mile
2. Average Travel Speed	50 MPH	30 - 45 MPH	30 - 45 MPH	25 - 35 MPH	20 - 25 MPH
3. Access Control	Full	Partial	Partial	Partial	Minimum
4. Number of Through Lanes	4 - 8	4 - 6	2 - 4	2 - 4	2
5. Entrance/Exit Spacing	1 - 4 Miles	1/2 - 1 Miles	1/4 - 1/2 Mile	500 - 1200 Feet	300 - 500 Feet
6. ROW Widths (minimum)	Over 210 Feet	100 Feet	100 Feet	76 Feet w/ Parking	52 Feet w/Parking
7. Traffic Volume (ADT)	Over 50000	20,000 to 50,000	5,000 to 20,000	2,000 to 5000	100 to 2,000
8. Traffic Control	Free Flow	Stop Signs or Signals on Cross Streets	Stop Signs or Signals on Cross Streets	Stop Signs On Cross Streets	Stop or Yield
9. Percentage of VMT	0 - 40%	40 - 70%	40 -70%	10 - 20%	5 - 10%
10. Examples in Rapid City	I-90	Omaha Street East North Street Cambell Street	La Crosse Street St. Patrick Street Fairmont Boulevard	West Boulevard Eglin Street Creek Drive	New York Street College Avenue Jet Drive

ADT - Average Daily Traffic
VMT - Vehicle Miles of Travel

[1] Design of Urban Streets, U.S. Department of Transportation and criteria set forth in the Rapid City Street Design Criteria Manual.

TABLE 2

ALTERNATE HIGHWAY NETWORKS

EAST ANAMOSA STREET EXTENSION
LA CROSSE STREET TO ELK VALE ROAD

Rapid City, South Dakota

ALTERNATE	DESCRIPTION
0.	No Build
1.	East from La Crosse Street along the north line of Section 31 to approximately the east 1/16 line, then southeast across Sections 31 (approximately 600 feet south of the Northeast Corner of Section 31) and 32 through three circular curves to align with the existing portion of East Anamosa Street at East North Street.
2.	East from La Crosse Street along the north line of Section 31 to approximately the east 1/16 line, then southeast across Sections 31 (approximately 300 feet south of the Northeast Corner of Section 31) and 32 through two circular curves to align with the existing portion of East Anamosa Street at East North Street.
3.	East from La Crosse Street approximately 900 feet along the north line of Section 31 and then northeast into Section 30 (approximately 850 feet north of the Northeast Corner of Section 31), 29 and 32 through three circular curves to align with the existing portion of East Anamosa Street at East North Street.
A.	Southeast from East North Street along the existing portion of East Anamosa Street and then south and east through two circular curves in the Southeast Quarter of Section 33 and the Northeast Quarter of Section 5 to a point on the east section line of Section 5 approximately 900 feet south of the Northeast Corner of Section 5. From that point the alignment continues east and northeast to the north section line of Section 4 and then east along the section line to the business park where it curves southeast to the intersection of Elk Vale Road approximately 300 feet south of the Northeast Corner of Section 4.
B.	Southeast from East North Street along the existing portion of East Anamosa Street and then south and east through two circular curves in the Southeast Quarter of Section 33 and the Northeast Quarter of Section 5 to a point on the east section line of Section 5 approximately 65 feet south of the Northeast Corner of Section 5. From that point the alignment continues east paralleling the north section line of Section 4 and then curves southeast adjacent to the north side of the business park to the intersection of Elk Vale Road, approximately 300 feet south of the Northeast Corner of Section 4.
C.	Southeast from East North Street along the existing portion of East Anamosa Street and then southeast through two circular curves in the Southeast Quarter of Section 33 to a point on the east section line of Section 33 approximately 600 feet north of the Southeast Corner of Section 33. From that point the alignment continues southeast to the north section line of Section 4 and then curves southeast adjacent to the north side of the business park to the intersection of Elk Vale Road, approximately 300 feet south of the Northeast Corner of Section 4.

NO BUILD ALTERNATE

The "No-Build" option was considered as the beginning point for the development of alternates. With this option, a new roadway would not be constructed between La Crosse Street and Elk Vale Road. This option does not provide the necessary east/west collector required to move traffic from the easternmost portion of Rapid City to the developed commercial centers along La Crosse Street and East North Street. In addition, the no-build option does not provide ready access to the newly developed Rushmore Business Park adjacent to Elk Vale Road, or to the future Southeast Collector. Because another major east/west route is necessary to handle future traffic as forecasted by the Felsburg Holt and Ullevig traffic studies, this option is not desirable.

ALTERNATE 1

Alternate 1 is approximately 0.9 mile in length. This alternate crosses the DM&E Railroad in a cut section, which will minimize the height of fill required for the grade separation structure. This alignment crosses a drainage basin upstream of an existing detention facility and therefore, will not interfere with the existing detention structure. Connecting roads will intersect the arterial at a minimum interval of approximately 1,200 feet to 1,500 feet to provide for ultimate build-out access and future traffic signal progression. The vertical alignment will have a maximum vertical grade of less than five percent as it proceeds east from La Crosse Street. This route will follow the terrain as closely as possible to minimize the amount of earthwork and the need for additional right-of-way. Right-of-way will be required to protect the fill sections of the roadway. Because this location generally follows the existing terrain, except in the railroad and drainage areas, the resulting flat grades with improved parcel access via intersecting network streets will provide an excellent opportunity for commercial development to occur adjacent to the arterial.

ALTERNATE 2

This alternate has a length of about 1.0 mile with a maximum vertical grade of less than five percent as it proceeds east from La Crosse Street. The spacing of connecting road will be similar to that discussed in Alternate 1. Because this alignment crosses the DM&E Railroad farther to the east, it will require considerably more embankment than Alternate 1. In addition, the roadway fill section will eliminate approximately one-half of the existing detention facility that would require mitigation and increased costs. Except for the major fill area across the railroad and drainage area, the alignment will basically follow the existing terrain and the resulting flat grades with improved parcel access via intersecting network streets will provide a good opportunity for commercial development to occur adjacent to the arterial. However, the property adjacent to the west side of Century Road will be cut in half by the arterial which may be a hindrance for a large developer. Right-of-way will be similar to that required for Alternate 1, except for additional right-of-way to protect the wider fill sections.

ALTERNATE 3

The length of this alternate is about 1.2 miles with a maximum vertical grade of six percent as it leaves the section line and proceeds northeast. The spacing of connecting road will be similar to that discussed in Alternate 1. This alignment crosses the DM&E Railroad in a cut section with the crossing being almost perpendicular to the tracks. Because this alignment is north of the railroad when it crosses the drainage, it does provide an opportunity for an additional detention facility. The terrain is rolling and easily erodible and therefore, much of the property is unavailable for commercial development without major earthwork grading. More right-of-way will be required to protect the large fill slopes, which in some cases are in excess of forty feet. In addition, once the alignment enters into Section 32 on the east side of Century Road, it will interfere with two major transmission power lines, both of which will probably need to be relocated.

ALTERNATE A

Alternate A is approximately 2.2 miles in length. Connecting roads will intersect the arterial at an interval of about 1,200 feet to 1,500 feet to provide for ultimate build-out access and future traffic signal progression. The vertical alignment will have a maximum grade of less than six percent as it proceeds south from Menards. This route will experience cuts and fills in the range of about forty feet due to the rolling terrain between East North Street and Elk Vale Road. Additional right-of-way will be required to protect the fill sections of the roadway. Because this location traverses numerous areas that have grades less than three percent, opportunities exist for improving individual parcel access via intersecting network streets and providing for commercial development adjacent to the arterial. The easternmost portion of the arterial will be adjacent to the north side of the Rushmore Business Park and will match the two existing intersecting street grades in the park.

ALTERNATE B

Alternate B is approximately 2.0 miles in length. Connecting roads will intersect the arterial with spacing similar to that discussed in Alternate A. The vertical alignment will have a maximum grade of five percent just east of the intersection with Valley Drive. This road location will experience cuts and fills in the range of about thirty feet due to the rolling terrain between East North Street and Elk Vale Road. Additional right-of-way will be required to protect the fill sections of the roadway. The ease of development along this alternate will be similar to that discussed for Alternate A. The alignment along the north side of the Rushmore Business Park will follow that established for Alternate A.

ALTERNATE C

Alternate C is approximately 1.9 miles in length. Connecting roads will intersect the arterial with spacing similar to that discussed in Alternate A. The vertical alignment will have a maximum grade of five percent as it proceeds south from Menards. This route will experience long sections of cuts and fills with a depth in the range of about thirty feet due to the rolling terrain between East North Street and Elk Vale Road. Additional right-of-way will be required to protect the fill sections of the roadway. Commercial development along this alignment will be more difficult due to the longer cut and fill sections and will require major earthwork grading. In addition, because the location of the arterial is along the top of the ridge, utilities adjacent to the road could not practically serve the lower elevations.

Before evaluating and comparing the alternate routes for the proposed East Anamosa Street Extension Project, certain assumptions must be made concerning the functional classification of the roadway to address capacity to handle projected traffic. These assumptions are summarized in Table 4. It is anticipated there will be induced growth for commercial development along this roadway because it will serve the Rushmore Business Park and enhance growth adjacent to the existing commercial development on East North and La Crosse Streets. Based on these use and function considerations, the roadway will be classified as a Principal Arterial.

Table 3, Preliminary Construction Features, briefly summarizes Alternates 1, 2, 3, A, B and C in terms of their length, grades, earthwork quantities, maximum cuts and fills, drainage structures, and relative construction costs.

TABLE 3
PRELIMINARY CONSTRUCTION FEATURES
AND ESTIMATE OF PROBABLE COST

EAST ANAMOSA STREET EXTENSION
LA CROSSE STREET TO ELK VALE ROAD

ALTERNATE 0 - No Build

West Segment: La Crosse Street to East North Street

ALTERNATE 1

1)	Project Length	- 5000 Feet
2)	Earthwork	276,500 Cubic Yards
3)	Right-Of-Way	- 117 to 300 Feet
4)	Maximum Grade and Length	- 5%
5)	Maximum Cut at Centerline	- 4 Feet
6)	Maximum Fill at Centerline	- 38 Feet
7)	Drainage Structures (Pipe Diameter, Inches)	- 18, 24, 30, 36, 42, 54
8)	Grade Separation Structure	- 160 Feet
9)	Construction Cost Estimate	- $5.5 Million

ALTERNATE 2

1)	Project Length	- 5100 Feet
2)	Earthwork	- 600,000 Cubic Yards
3)	Right-Of-Way	- 117 to 500 Feet
4)	Maximum Grade and Length	- 5%
5)	Maximum Cut at Centerline	- 5 Feet
6)	Maximum Fill at Centerline	- 39 Feet
7)	Drainage Structures (Pipe Diameter, Inches)	- 18, 24, 30, 36, 42, 54
8)	Grade Separation Structure	- 180 Feet
9)	Construction Cost Estimate	- $6.4 Million

ALTERNATE 3

1)	Project Length	- 6500 Feet
2)	Earthwork	- 510,000 Cubic Yards
3)	Right-Of-Way	- 117 to 400 Feet
4)	Maximum Grade and Length	- 6%
5)	Maximum Cut at Centerline	- 8 Feet
6)	Maximum Fill at Centerline	- 41 Feet
7)	Drainage Structures (Pipe Diameter, Inches)	- 18, 24, 30, 36, 42, 48, 54
8)	Grade Separation Structure	- 140 Feet
9)	Construction Cost Estimate	- $6.7 Million

WATER AND SEWER UTILITIES: WEST SEGMENT

1)	Water	- $710,000
2)	Sewer	- $820,000

TABLE 3 CONTINUED
PRELIMINARY CONSTRUCTION FEATURES
AND ESTIMATE OF PROBABLE COST

EAST ANAMOSA STREET EXTENSION
LA CROSSE STREET TO ELK VALE ROAD

East Segment: East North Street to Elk Vale Road

ALTERNATE A

1)	Project Length	- 11,700
2)	Earthwork	- 343,400 Cubic Yards
3)	Right-Of-Way	- 117 to 430 Feet
4)	Maximum Grade and Length	- 6%
5)	Maximum Cut at Centerline	- 29 Feet
6)	Maximum Fill at Centerline	- 41 Feet
7)	Drainage Structures (Pipe Diameter, Inches)	- 18, 24, 30, 36, 42, 48, 54
8)	Grade Separation Structure	- None
9)	Construction Cost Estimate	- $7.6 Million

ALTERNATE B

1)	Project Length	- 10,600 Feet
2)	Earthwork	- 392,700 Cubic Yards
3)	Right-Of-Way	- 117 to 275 Feet
4)	Maximum Grade and Length	- 4%
5)	Maximum Cut at Centerline	- 29 Feet
6)	Maximum Fill at Centerline	- 25 Feet
7)	Drainage Structures (Pipe Diameter, Inches)	- 18, 24, 30, 36, 42, 48, 54
8)	Grade Separation Structure	- None
9)	Construction Cost Estimate	- $7.1 Million

ALTERNATE C

1)	Project Length	- 10,000 Feet
2)	Earthwork	- 431,200 Cubic Yards
3)	Right-Of-Way	- 117 to 330 Feet
4)	Maximum Grade	- 5%
5)	Maximum Cut at Centerline	- 32 Feet
6)	Maximum Fill at Centerline	- 24 Feet
7)	Drainage Structures (Pipe Diameter, Inches)	- 18, 24, 30, 36, 42, 48, 54
8)	Grade Separation Structure	- None
9)	Construction Cost Estimate	- $6.8 Million

WATER AND SEWER UTILITIES: EAST SEGMENT

1)	Water	- $4,710,000
2)	Sewer	- $1,700,000

TABLE 4

PRELIMINARY
DESIGN STANDARDS [1, 2]

EAST ANAMOSA STREET EXTENSION
LA CROSSE STREET TO ELK VALE ROAD

Rapid City, South Dakota

ITEM	DESCRIPTION	STANDARD
1.	Arterial Classification [1]	
	a. Functional Category	Urban Principal Arterial
	b. Design Category	Typical Suburban Design
	c. Arterial Class	I
2.	Roadway Section	Six 12-Foot Through Lanes and 12-Foot Center Turn Lane and Median
3.	Design Speed [1]	50 Miles Per Hour
4.	Operating Speed	45 Miles Per Hour
5.	Average Daily Traffic (ADT 2025) [2] (Two Way Projected Design)	West 35,000: East 22,000 ADT
6.	Right-of-Way Width	Minimum 117 Feet
7.	Maximum Grade [1]	6 Percent
8.	Minimum Length of Vertical Curve [1]	400 Feet
9.	Minimum Horizontal Curve Radius [1]	1,000 Feet (305 m)
10.	Maximum Superelevation [1]	4 Percent
11.	Minimum Stopping Sight Distance [1]	400 Feet
12.	Maximum Side Slopes [1]	Cut 5:1 and 4:1 adjacent to power line Fill 4:1for 20 Feet and then 3:1
13.	Access Control	Limited to Street Intersections

1 A Policy on Geometric Design of Highway and Streets, AASHTO 1995.
2 FHWA Highway Capacity Manual, 1994.

COMPARISON OF ALTERNATES

Preliminary Design Standards shown in Table 4, define the design parameters to be used to further develop alternative alignments. Each alternate will have the same posted speed limit, similar maximum grades, but differing horizontal alignment geometry. The roadway is to function as an urban principal arterial by providing traffic access in both directions between La Crosse Street and Elk Vale Road. Since there will ultimately be six lanes of traffic between these two points, emergency vehicle access to and through the study area will be greatly enhanced, especially as development moves into the eastern portion of the study area. Limited commercial and residential access to the arterial will also preserve efficient emergency vehicle access. Regularly spaced access points along the arterial will serve adjacent, future developments.

Several categories were used to make a broad comparison between 1, 2 and 3 and A, B and C alternates:

- Convenience to users
- Future collector connections to East Anamosa Street between La Crosse Street and Elk Vale Road
- Future utilities construction
- Capital Construction Cost

User convenience is a subjective evaluation, but measurable as a function of travel time. Figures 11 and 12 illustrate that the distances from the intersection of each alternate at La Crosse Street to their terminus at East North Street are within three tenths of a mile of each other. The distances between East North Street and Elk Vale Road alternates also vary by only three tenths of a mile. This slight difference in distance amounts to about 28 seconds of driving time based on an 85th percentile speed of 38 miles per hour. Alternate 1 is the shortest route of Alternates 1 through 3 and Alternate C is the shortest of Alternates A through C. Alternate 1 has the best horizontal and vertical alignment and the least amount of earthwork for the west layout plan. Alternate 2 is approximately one-tenth of a mile longer, but may not be as convenient as Alternate 1 because it has a very long horizontal curve. The length of Alternate 3 is the longest with the most horizontal curvature and the steepest grades.

Alternate B has the best combination of horizontal and vertical alignments of the east layout plan alternatives. Alternate A has the poorest horizontal alignment and Alternate C has the poorest vertical alignment of the three east layout plan options.

Another significant factor in terms of convenience is the location of adjacent commercial development. For the west layout plan, Alternates 1 and 2 are positioned such that they cross a large portion of flat terrain. Businesses could locate adjacent to the arterial and be served from connecting roads with adequate land available for parking. In comparison, Alternate 3 has a limited amount of land available for commercial usage adjoining the roadway. Because of the terrain, these businesses may be forced to locate on collector streets that will be perpendicular to the central arterial. However, in most cases these businesses will be forced to locate on side slopes that approach eight percent. This slope will require major earthwork grading to accommodate future development.

The east layout plan is best served from Alternate B because this is a central alignment that is primarily located at the southern toe of the sloping land to the north and provides good access for development on both sides of the arterial. Alternate A bisects a future platted trailer court near Mickelson Drive and eliminates the largest area of developable land within that particular property. Alternate C is located on the crest of the hill and provides very little access to the property on the south.

Based on the above considerations, convenience to the motorists will play an important part in the selection process. As previously indicated, the primary purpose of the East Anamosa Street Extension is to move traffic in an east/west direction through the northeastern part of Rapid City. It is also important to select a route that will coincide with development that will occur along this corridor. In order for this development to be successful, it must also be located so future customers can conveniently find their way to these businesses.

The City of Rapid City is planning for the future by anticipating increased population growth and expansion along the roadway network to serve the northeastern part of the City. Much of this portion of Rapid City is currently undeveloped, but can be expected to grow once the arterial is constructed. With this in mind, future collectors on both sides of the arterial should be considered when evaluating the alternatives. The main collectors in the west study area will be Cambell Street, Century Road, and a street extending north along the east property line of Wal-Mart to Farnwood Avenue to serve the property between the DM&E Railroad and I-90. Farnwood Avenue will ~~continue eastward to~~ connect with an extension of Cambell Street north of the DM&E Railroad and then extend to the trailer park located at the intersection of I-90 and East North Street. In the east study area collectors will be located at East Philadelphia, Mickelson Drive, North Valley Drive, Concourse Drive and Turbine Drive. In addition, other collectors may be constructed in both study areas as they develop.

All of the collector roads will access the future arterial with at-grade intersections. The location of the selected alternate is partially linked to future development of the roadway network in the area. Because of its location, Alternate 1 will provide good access to all the intersecting collectors. Based on an initial evaluation, the collector grades entering Alternate 1 will be relatively flat and will meet the arterial in areas where superelevation on the arterial will be minimal. In the same manner, Alternate B appears to have the best collector access from both the north and south with intersecting grades less than six percent. Mickelson Drive is the only access point entering the arterial in a curve with superelevation.

In comparison, roads connecting to Alternate 2 will be similar to Alternate 1, except the road along the east property boundary of Wal-Mart, which will require considerably more fill. Alternate 3 presents more challenges in terms of fitting the horizontal alignment of collector roads with the new arterial. Due to the location of Alternate 3, connecting future collectors will be through a series of horizontal curves, which can limit development and compromise safety. In addition, grades tying into the arterial may exceed maximum grades. Depending upon the final location of future collectors, superelevation of the arterial may create access problems for Alternates 2 and 3 because of the length of the horizontal curves, which are at a maximum superelevation of four percent. Therefore, because of the superelevation of the arterial, it makes collector intersections less desirable to travel. Alternate A and B have similar intersecting grades and intersect the arterial at less than six percent. Alternate C has the poorest collector access with grades in excess of seven percent and fill sections twelve feet in depth.

INFRASTRUCTURE – WATER, SEWER AND STORM DRAINAGE ANALYSIS

Overview

As part of the East Anamosa Street Extension Infrastructure Assessment and Alignment Identification, the MPO required the development of a conceptual level analysis of infrastructure relating to water, sewer, and storm drainage.

Existing system information and reports were researched to develop a starting point for the study and are summarized as follows:

The *Northeast Sanitary Sewer Interceptor Study* addressed sewer service for approximately 4,100 acres north of I-90. Haines Avenue, the Meade/Pennington County Line, the Box Elder Creek Flood Plain, Elk Vale Road and I-90 bound this area. The wastewater from this entire area would flow by gravity to the lift station north of the Visitor Information Center, which is located in the northeast quadrant of Exit 61/I-90. This proposed sewer system would also be available in the future to service the majority of the study area between La Crosse Street and East North Street. Additionally this area is now under study as part of the *Northeast Area Analysis Future Land Use Neighborhood Area Map, Road Network Analysis and Utilities Plan, and Infrastructure Feasibility Analysis*. However, for the immediate future an alternate method of servicing this area would be required.

The remainder of the study area between East North Street and Elk Vale Road would connect to either Rapid City's wastewater collection system, or to the Rapid Valley Sanitary District's collection system. Wastewater treatment for the entire study area would be provided at Rapid City's Water Reclamation Plant.

Due to the varied topography of Rapid City, multiple pressure zones have been developed for the water distribution system. The *Municipal Water System Study and Report,* dated December 1985, indicated that the East Anamosa Street Extension Study Area would generally be served by the Low Level Pressure Zone which provides water service below a U.S.G.S elevation of 3,320 feet above sea level. However, in order to provide adequate pressure to the area, the city has lowered the pressure zone elevation to 3,300 feet. The central portion of the study area between East North Street and Elk Vale Road has a maximum elevation of 3,413 feet above sea level. Before development can occur above the 3,300 level, either a water booster station with an elevated reservoir or an extension from the North Rapid High Level Zone would be required. The high level zone is at an elevation of 3,544 feet. Therefore, by connecting to the high level zone at the intersection of La Crosse and East Anamosa Streets, service could be provided to the highest elevations in the study area by installing a water line along the East Anamosa Street Extension. The 1985 report also addressed existing and future major water supply lines and included estimated year 2005 flows, pressures and potential reservoir locations.

Three drainage basins transect the study area between East North Street and Elk Vale Road. Two of these basins, the *Unnamed Tributary Drainage Basin,* and the *Racetrack Draw Drainage Basin* have completed basin design plans. The *Perrine Drainage Basin Design Basin* was in the process of being developed and only preliminary information was available at the time of this writing. Several detention facilities are either in place or are planned to reduce the rate of discharge from these basins. These three basins ultimately drain into Rapid Creek.

The area between La Crosse Street and East North Street generally drains to the northeast into the Box Elder Drainage Basin. A basin design plan is not available at the present time for this area.

Water

The alignments for primary waterlines shown in Figure 13 and Figure 14 were selected to follow planned major collectors and arterials. This will allow for a reduction in construction costs and needed easements. The following is a description of the proposed major alignments for the high level system:

A 12-inch water main will connect to the east end of the existing 10-inch water main on East Anamosa and will parallel the proposed East Anamosa Street alignment to the proposed intersection of East Anamosa and E. Philadelphia Street that will be placed on E. Philadelphia Street. The 12-inch main will transition into a 14-inch main and parallel E. Philadelphia Street to the east, through the study area to the intersection of the proposed Turbine Drive. At this intersection the 14-inch main will transition to a 20-inch main and continue east across Elk Vale Road to a proposed future high-level reservoir. Approximately one-quarter mile to the east

of the proposed intersection of E. Philadelphia Street and East Anamosa the 14-inch main will be infused with water from the proposed low-level system in combination with a booster pump to achieve the desired pressure. Two other 14-inch water mains will service the high level system. Both will tee off of the main line described above. One of the water mains will begin at the proposed intersection of E. Philadelphia Street and the Turbine Drive; the other will begin at the intersection of E. Philadelphia Street and Concourse Drive. Both will parallel their respective proposed road alignments, Turbine Drive and Concourse Drive, southward until the 3,300 level is encountered.

The following is a description of the proposed major alignments for the low-level system:

A 20-inch main will provide the primary flow carrying capacity from the proposed two million-gallon reservoir to the proposed intersection of East Anamosa and E. Philadelphia Street. From this intersection, the 20-inch main will continue west paralleling East Philadelphia and connect into the existing 16-inch main at the intersection of East Philadelphia and Cambell Street. At the proposed intersection of East Philadelphia and Mickelson Drive a 12-inch main will tee off the 20-inch trunkline and parallel Mickelson Drive southwards to an existing 8-inch main. From the proposed intersection of E. Philadelphia Street and East Anamosa, a 16-inch main will tee off in both the northwesterly and southeasterly directions. The water main that heads to the northwest along East Anamosa will connect into an existing 12-inch water main near Menards and then transition back into a 16-inch main that will be the primary supply line for the northwest section of the study area. A 16-inch main connects to the proposed trunkline at the proposed intersection of East Anamosa and E. Philadelphia Street, and follows East Anamosa alignment southeasterly until it reaches Elk Vale Road. At the proposed intersection of Elk Vale Road and East Anamosa, the water main transitions to a 12-inch main and follows Elk Vale Road southward to tie into an existing 12-inch water main near the business park. From their respective intersections, three mains will tee south off of East Anamosa Street along Valley Drive, Concourse Drive and Turbine Drive to existing water mains. The proposed water main along Valley Drive will be a 16-inch, while the other two water mains will be 12-inch. The proposed 12-inch main that parallels "East-West Road" will start at the proposed Valley Drive main and end at the proposed "East-West Road" main. One other proposed 16-inch main will start at the proposed intersection of East Anamosa and Turbine Drive, and parallel Turbine Drive to the North until intersecting with the proposed Eglin Street alignment. Then, the main will run west until it connects into the existing 16-inch main along Eglin Street.

Sizing And Fire Flow Pressures

The water line sizing was developed on a conceptual level and no precise calculations or models were performed. Based on discussions with City staff, the recommended fire flow for this study was established at

3,000 gallons per minute. Conceptual sizes were reviewed and confirmed, and a 12-inch line was calculated to be the minimum pipe diameter to carry the fire flow.

Pressure Zones

Two pressure zone systems were designated by this study, the E. Philadelphia High Level System and the East Anamosa Low Level System. The E. Philadelphia High Level System would serve all water needs from 3,300 feet above sea level to 3,450 feet above sea level in the study area. The E. Philadelphia High Level system will connect to the North Rapid High Level System at the east end of the existing East Anamosa with a 14-inch water main. The high level system will be served by the proposed low level reservoir/booster pump combination and the future high level reservoir to be located east of Elk Vale Road. This system would also help serve the East Anamosa Low Level System via the use of pressure reducing stations.

The East Anamosa Low Level will serve all water needs up to a maximum of 3,300 feet above sea level. It will be supplied by the low-level reservoir, connections to other low level systems and the high level system via use of pressure reducing stations.

Storage

The *Municipal Water System Study and Report,* dated 1985, proposed storage that would consist of a two million gallon low-level reservoir located approximately one-quarter mile northeast of the proposed intersection of East Anamosa and E. Philadelphia Street. This would serve the low-level system and the high level system with the aid of a booster pump station. Additionally a high-level reservoir is planned just to the east of Elk Vale Road.

Integration with existing utilities.

The proposed water mains were designed to connect into existing water mains whenever possible to provide sufficient system looping.

Phasing Plans

Phasing for the water system in the study area will primarily follow development. The most logical order of progression would be the industrial park area, the northwest section of the project, the area around Menards, areas in the immediate vicinity of newly built sections of East Anamosa, and lastly the E. Philadelphia High Level System.

Opinions of Probable Cost

Costs are included in Table 3.

Potential Funding Sources

There are several funding sources available for the water improvements proposed in this study. These sources include the State Revolving Fund (SRF), Community Development Block Grants, revenue bonds, assessment programs and cash reserves from the Water Enterprise Fund.

Sewer

Alignments

In the northwest area of the study, proposed sewer mains S-1 through S-8 flow to the north and ultimately will cross under Interstate 90 and connect to the future northeast area system. All of these proposed sewer mains are 8-inch except S-8 and S-10 that are proposed as 10-inch sewer mains. Sewer main S-9 flows to this same intersection, where the accumulation of flows from sewer main S-1 through S-8 join to enter S-10 under Interstate 90. If the northwest area developed before the northeast area sewer system was complete, Alternate 1 shows flows S-1 through S-8 joining S-9 and pumped back to a crossing on East North Street via a 10-inch sewer main.

To the west of the E. Philadelphia Street extension area, proposed sewer mains S-12 and S-13 both enter the existing sewer mains near Menards. The sewer mains that flow all the way down to Grimm Drive may need to be upgraded depending on actual flows once this area is entirely developed.

On the north of the E. Philadelphia Street extension area, proposed pipes S-14 through S-20, all 8-inch sewer mains, flow north into proposed collector lines S-21 through S-25. S-26, an 8-inch sewer line, flows into the Junction of S-25 and S-27. S-22 is proposed as a 10-inch sewer main along Beal Street that will provide service for the existing commercial property and the South Dakota Department of Transportation facility between Beal Street and Eglin Street. This flow is routed into proposed sewer main S-27 which then flows north under the interstate to the lift station near the Visitor Information Center. For cost estimates the length of sewer main S-25 was only calculated to Interstate 90 which is the study boundary.

To the South of the E. Philadelphia Street extension area, sewer mains S-31 through S-36 all enter existing sewer mains. Sewer mains S-31 through S-36 are all proposed as 8-inch diameter pipe.

Sizing

The wastewater flows for this study were estimated for peak conditions at buildout for each basin based upon proposed future land use. The *Wastewater Facilities Plan for Rapid City – 1979 to 1990* estimated future peak design flow factors dependent on land use and acreage. Utility Engineering Corporation derived factors based upon actual wastewater flow measurements and studies of land uses in Rapid City. The factors estimated by that study are 2 gallon per minute per acre (gpm/acre) for all residential areas and 5 gpm/acre for commercial and industrial areas. The same factors were utilized in this study.

The wastewater flows were estimated by multiplying the design flow factors (gpm/acre) by the actual number of acres of each land use type in each basin. The pipe diameter was calculated using Manning's equation with $n = 0.010$ for PVC sewer pipe (ASTM D-3034). The average slope over each proposed wastewater main was used in calculating the diameter of pipe. The diameter sizing of each line was calculated at a maximum of 65% full at peak flow. This allows the sizing to be slightly on the conservative side, since this study was only performed on a conceptual level. The minimum pipe size used in this study was an 8-inch diameter. The design flows and sizes are shown in both Figure 15 and Figure 16.

Lift Stations

The only proposed lift station would be in the northwest study area at the junction of S-8 and S-9 as shown on Figure 15 for Alternate 1. This alternative should be considered only in the case that the proposed northeast area sewer system is not complete at the time the northwest area needs to be served by sewer. This lift station would take the flows to the east study area via a 10-inch line under East North Street and ultimately connect to a collector on Beal Street.

Integration with Existing Utilities

All the proposed sewer main alignments will utilize existing facilities. The northwest section has two options: 1) the wastewater will flow northward and then be pumped to the south at the intersection of East Anamosa and East North Street, or 2) flow north under Interstate 90 and into a proposed sewer line to the lift station north of the Visitor Information Center. Option 1 may require increasing the size of some existing lines from the intersection of East North Street and East Anamosa to Grimm Drive, depending on actual flows once the northwest area is entirely developed. Option 2 will require one less lift station, but will require boring underneath Interstate 90, and will require a primary sewer main in place to the lift station north of the Visitor Information Center.

The sewer mains that flow off the north of the E. Philadelphia Street extension area will all gravity flow to the north and be collected into sewer main S-25. The proposed alignment for sewer main S-25 will require boring underneath Interstate 90, and will ultimately enter a future sewer to the lift station north of the Visitor Information Center.

Both Option 2 for the northwest section, and the proposed alignments north of the E. Philadelphia Street extension area, would require building a primary sewer line to the lift station north of the Visitor Information Center. Also, they would most likely require an increase in the size of the force main that delivers the flows from the lift station, north of the Visitor Information Center, to the point along Elk Vale Road where the flows can gravity flow into the existing system.

All the proposed sewer alignments to the south of the E. Philadelphia Street extension area connect into existing sewer mains. Some of these existing sewer mains will require enlargement because of the increased flow from the East Anamosa Study Area.

Plans for phasing

Phasing for the sanitary sewer system in the study area will primarily follow development. The most logical order of progression would be the business park area, the northwest section of the project, the area around Menards, areas in the immediate vicinity of newly built sections of East Anamosa, and lastly to the north of the E. Philadelphia Street extension area.

Opinions of Probable Cost

Costs are included in Table 3. This cost would include Option 1 for the northwest section of the study area. Option 2 for the northwest section was not analyzed because the development of this option will be determined by the course of expansion in the area north of Interstate 90.

Potential Funding Sources

There are several funding sources available for the water improvements proposed in this study. These sources include the State Revolving Fund (SRF), Community Development Block Grants, revenue bonds, assessment programs and cash reserves.

Drainage and Storm Sewer

Three drainage basin studies have been completed, or are being developed for drainage areas that transect the proposed study area. Two of these basins, the Unnamed Tributary drainage basin and the Racetrack Draw drainage basin have completed design plans. The Perrine drainage basin design plan was 95% complete at the time of this study. Several existing detention facilities are currently in place in the immediate vicinity of the East Anamosa alignment as shown in Figure 17 and Figure 18. All three of these basins ultimately drain to Rapid Creek.

There are two basins in the northwest section of the project, between East North Street and La Crosse Street, and both drain to the northeast into the Box Elder Creek drainage basin. Basin design plans have not been developed for these basins at the present time.

Two other basins exist on the north of the E. Philadelphia Street extension area in the central section of the study area. They both drain north into the Box Elder Creek drainage basin. Basin design plans have not been developed for these basins at the present time.

Existing Drainage Detention Sites

There are four existing detention facilities in close proximity to the proposed East Anamosa alignment as shown in Figure 17 and Figure 18.

The location of three proposed detention facilities proposed by the Perrine Drainage Basin design plan are shown in Figure 18 and labeled as DDF-310, DDF-311 and DDF-320. These numbers correspond to the element numbers used in the basin design plan. The following summarizes the proposed construction and improvements for these three facilities. Detention Facility DDF-310 is proposed as a new detention pond with roadway embankment and a 24-inch RCP outlet pipe. Detention Facility DDF-311 is proposed as a new detention pond with roadway embankment and an 18-inch RCP outlet pipe reduced to a 12-inch orifice. Detention Facility DDF-320 is proposed as a new detention pond with roadway embankment and a 30-inch RCP outlet pipe with standpipe.

Proposed Drainage Detention Sites

The proposed locations for two culverts, PC-3 and PC-4 , in the unnamed tributary are shown in Figure 18. Culvert PC-3 is estimated to be 54 inches in diameter and 410 feet in length. Culvert PC-4 is estimated to be 48 inches in diameter and 250 feet in length.

The Racetrack Draw drainage basin is currently being developed in the vicinity of the proposed East Anamosa alignment. It is assumed that the developer and the Pennington County Drainage Commission have addressed all drainage considerations in this area.

The most northwest basin in the northwest section of the study area, between La Crosse Street and East Anamosa, ultimately drains into Box Elder Creek. For the purposes of this study this basin will be called the Box Elder Sub-Drainage Basin. There are two proposed culverts for this drainage basin, PC-1 and PC-2, as shown in Figure 17. Culvert PC-1 is estimated to be 18 inches in diameter and 360 feet in length. Culvert PC-2 is estimated to be 42 inches in diameter and 390 feet in length.

Storm Sewer

Storm sewer will be needed all along the East Anamosa alignment. As shown in Figure 8, the storm sewer will parallel the proposed East Anamosa alignment on the left side. Type E inlets are proposed at 400 feet apart in locations where there will be only street runoff, and at 200 feet apart where offsite drainage enters the roadway. Drainage plans are to be held to historical flow conditions.

An estimated flow of 10 cubic feet per second (cfs) per inlet was used to calculate pipe diameters.

Opinions of Probable Cost

Costs are included in Table 3.

Potential Funding Sources

There are several funding sources available for the improvements proposed in this study. These sources include the State Revolving Fund (SRF), Community Development Block Grants, revenue bonds, drainage fees, assessment programs and cash reserves.

SUMMARY

The estimated construction cost for each of the three alternates is summarized in Table 3. The cost of each alternate is arranged by major construction components. Contingencies include items such as signing, striping, landscaping, lighting, etc. Earthwork costs are based on computed earthwork quantities from conceptual-level evaluations. The interim typical section for each alternate is comprised of four 12-foot lanes with a 28-foot median and 12-foot center turning lanes at the intersections. Costs are based on 9 inches of portland cement concrete pavement with 6 inches of aggregate base course for comparisons only. Actual pavement design may vary.

In the west study area, between La Crosse Street and E. North Street, Alternate 1 is the least expensive due to its shorter length, less right-of-way requirements and smallest amount of earthwork. Alternate 2 is in the median cost range since its project length is between Alternates 1 and 2. However, Alternate 2 has the greatest amount of earthwork. Alternate 3 is the longest route and the most expensive.

In the east study area, between E. North Street and Elk Vale Road, Alternate A is the longest alternate, requires the most right-of-way and is the most expensive. Alternate B is in the median cost range and is slightly shorter than Alternate A, but requires the most earthwork. Alternate C is the shortest and least expensive, but is not well suited to future development.

Because soils in the area may be expansive, all six of these areas may require over-excavation and the use of imported non-expansive backfill material in order to obtain roadway stability. Insitu-stabilization with lime is another consideration, but often not cost effective. Depending upon the extent of the problem areas, these preventative measures can greatly increase the cost of these alternatives.

CHAPTER FIVE

TRAFFIC VOLUMES

TRAFFIC ANALYSIS

The expected land use development along East Anamosa Street will result in additional demand for municipal transportation services. As new houses, apartments and businesses are constructed, new residents will be attracted to the area, new business will be generated and drivers will expect an expanded street system.

Felsburg, Holt & Ullevig (FHU) were retained to evaluate the level of traffic demand posed by new development surrounding the East Anamosa Street corridor. Their analysis, contained in *The Elk Vale Neighborhood Traffic Analysis*, and *East Anamosa Traffic Forecasts*, provides future volumes and looks at the traffic operations of the major intersections in the study corridor. FHU's analysis provided the basis for evaluation of alternatives for East Anamosa Street improvements and subsequent recommendations provided in this study.

TRAFFIC FORECASTING

Traffic forecasts for the East Anamosa study area were generated using methods commonly applied by traffic engineers to analyze the effects of new land use developments. The following sequential steps describe the traffic forecasting procedure:

1. *Forecast through-traffic volumes* – Existing traffic volumes were provided by the City of Rapid City and the South Dakota Department of Transportation, as collected in 1997 and 1998. The level of through traffic was estimated from the counts based on existing traffic flow and land use patterns. Future year (2025) through traffic levels were then determined by applying an estimated 50% growth factor, representing a continuation of the approximate 2% average annual increase in traffic volumes found on roadways throughout Rapid City over the last three years. Flow patterns were also adjusted to reflect expected changes resulting from the addition of new arterial routes.
2. *Planned land use* – The Rapid City Future Land Use Committee provided data on the expected total development within the study area. The data was expressed as the number of dwelling units and square feet of industrial and commercial space in 24 analysis zones. The City also provided reduction factors reflecting the amount of development expected in 2025. The expected development represents a significant increase in the Rapid City land use base.
3. *Trip generation* – The number of auto trips generated by the expected land uses within each analysis zone were estimated using rates published in *Trip Generation, 6th Edition, Institute of Transportation Engineers*. That publication provides average vehicle trip generation rates for a wide range of land uses based on extensive national survey data. Trip generation figures were refined to show the number of trip demands satisfied within each analysis zone without reaching the major street system. The total number of trips generated by new development is expected to add over 200,000 trips per day to the Rapid City street system demand.
4. *Trip distribution* – The zonal trips calculated in the trip generation step were distributed to the study area street system based on anticipated traffic and development patterns, with input from the study Traffic Advisory Committee. The distribution showed the majority of the new trips using East Anamosa Street and other existing streets to travel west to the rest of Rapid City.
5. *Traffic forecasts* – The forecast through-traffic and distributed new trips were then added together to derive the total long-range traffic forecasts for each street section in the study area network. Traffic forecasts were prepared for full build-out of the study area and for development expected by the year 2025.

The results of the traffic forecasting procedure are shown in Figure 8, Long Range Through Lane Requirements, Elk Vale Build-Out, *Elk Vale Neighborhood Traffic Analysis* and Figure 6, Total Daily Traffic Forecasts, *East Anamosa Traffic Forecasts*, reproduced herein. They show significant growth along the east-west study area streets and along Elk Vale Road and its extension to the south.

TRAFFIC OPERATIONS ANALYSIS

The number of traffic lanes required by the forecast traffic on the study area street system was determined based on the general planning-level capacities of typical street sections. The amount of traffic that can be carried by typical street sections has been determined by study of the traffic characteristics of existing streets. Formal procedures for operational analysis are contained in the *Highway Capacity Manual*, published by the Transportation Research Board.

The number of lanes expected for year 2025 on study streets is displayed in Figure 8 of the *Elk Vale Neighborhood Traffic Analysis* and Figure 6 of the *East Anamosa Traffic Forecasts.* The forecast lane demand, particularly for the extension of Anamosa Street, was used to evaluate Anamosa Street alternatives and provide the recommended preliminary design found in this study.

More detailed operational analysis was conducted on selected intersections within the study area. Required intersection lane configurations were determined using intersection capacity analysis techniques from the *Highway Capacity Manual.*

The capacity of a roadway reflects its ability to carry a certain traffic volume and is directly related to the number of lanes, the amount of turning volume, the total volume and the speed at which vehicles are allowed to travel. The Level of Service (LOS) is a measure of the quality of traffic flow. In other words, capacity can easily be quantified, but LOS is determined by less tangible factors such as ease of weaving and perceived delay. The range of LOS goes from "A", which represents free-flow operation at or above the speed limit, to "F", which describes complete breakdown in vehicle flow. The design concepts for each intersection achieve at least Level of Service "C".

ANAMOSA STREET LANE RECOMMENDATIONS

Anamosa Street will require six through-lanes to carry the traffic expected at build-out of the study area. Design and policy requirements further direct that the ultimate street cross-section include a raised median separating travel directions. Intersection capacity analyses show that left and right turn lanes will be needed at all major intersections. In addition double left turn-lanes will probably be needed in the future at the intersections of East Anamosa Street and La Crosse Street and East Anamosa Street and East North Street.

Build-out of the study area, however, is not expected until considerably later than the year 2025 planning horizon. The level of development expected by year 2025 may be carried on an interim four-lane street section, based on study estimates. The four lane cross-section should include two through lanes in each direction. Turning lanes will be required at major intersections and access points.

REFERENCES

The complete text of the FHU reports is contained in the Appendix.

CHAPTER SIX

ALTERNATE ANALYSES

All the alternates were screened in more detail to determine the most feasible route. This final screening addressed land use compatibility, traffic, aesthetics, right-of-way impacts, comparative construction costs, constructibility and environmental issues. In order to evaluate these alternates, conceptual plans and profiles were prepared based on the interim typical section and preliminary design standards previously identified. Appendix D includes Figures 25 through 49 which indicate the horizontal and vertical alignments of Alternates 1, 2 and 3 and A, B and C. The plan view is at a scale of 1 inch equals 600 feet horizontal and the profile scale is 1 inch equals 200 feet horizontal and 1 inch equals 20 feet vertical. The screening factors, and their effect on each alternate, are discussed in the following paragraphs.

LAND USE COMPATIBILITY

Items considered during the evaluation of land use compatibility included developable areas adjacent to the arterial, drainage areas and infrastructure ties to the existing utilities and the development of a collector road system.

West Layout Plan

Because the alignment of Alternate 1 is along the west and south sides of two large parcels of developable land, and is the most direct route through these properties, it has the most developable land adjacent to the arterial. One of these parcels lies west of Century Road and the other adjacent to the eastside of the road. Therefore, the location is ideally suited for future commercial development. No part of this alternate lies within a designated flood plain. A single drainage crosses the arterial and it will be conveyed through the road embankment by a reinforced concrete culvert. A possible detention facility could be constructed using the upstream face of the embankment as the drainage structure. City water and sewer mains are available around the perimeter of the study area, and could be readily extended to serve the entire development. This arterial will become a major east/west thoroughfare that will serve the northeast portion of the city, and provide a shortcut from I-90 to the Rushmore Business Park and the Rapid City Regional Airport. All collector roads, including the extension of Cambell Street, will have good access to the arterial. Figure 19 indicates the proposed collectors for Alternate 1.

Alternate 2 traverses terrain that is similar to Alternate 1, but is located farther to the east and crosses through the center of the developable property west of Century Road. This location reduces the effectiveness of the property for large-scale development. No part of this alternate lies within a designated flood plain. As in the case of Alternate 1, only a single drainage crosses the arterial and it will be conveyed through the road embankment by a reinforced concrete culvert. However, this location has a significant negative impact on an existing detention/retention pond adjacent to the DM&E Railroad. City water and sewer mains are available as indicated for Alternate 1. This alternate would also serve as a major east/west thoroughfare for the city. Collector roads would meet this alternate in a manner similar to that discussed for Alternate 1 and are not shown.

Alternate 3 has only a limited amount of land available for development adjacent to the south side of the arterial. In addition, there is no access to the large parcel of property west of Century Road. Due to terrain constraints, the amount of earthwork required to develop the adjacent property will be greatly increased. In addition, this route will require the relocation of two major power transmission lines. The arterial crosses the

same drainage discussed in Alternate 1, but at a location approximately 1,500 feet north. The drainage will be conveyed through the road embankment by a reinforced concrete culvert. A possible detention facility could be constructed using the upstream face of the embankment as the drainage structure. City water and sewer mains are available within the study area and could be readily extended to serve development along the entire arterial, but at a considerable increase in the length of the utilities. This alternate could serve as an east/west thoroughfare, but it may discourage through traffic because it is a longer and more circuitous route. In general, collector access is more difficult, especially the future extension of Cambell Street. Collector roads for Alternate 3 are not shown, but they would be similar to an extension of those shown in Figure 19.

East Layout Plan

Alternate A is the southern most alignment and is the longest of the three Alternates. Because the arterial traverses farther south than the other two alternates, it bisects a future platted trailer court near Mickelson Drive and eliminates the largest area of developable land within this property. Therefore, a large portion of that property is not well suited for future commercial development. No part of this alternate lies within a designated flood plain. Several drainages cross the arterial and they will be conveyed through the road embankment by a reinforced concrete culvert. In addition, several possible detention facilities could be constructed using the upstream face of the embankment as the drainage structure. City water and sewer mains are available along East North Street, sewer is available on Elk Vale Road and water is available in the Rushmore Business Park. These services would be extended to serve the entire development. This arterial will become the eastern portion of the major east/west thoroughfare discussed in Alternate 1. All collector roads will have good access to this arterial. Collector roads are shown for Alternate B only (See Figure 20) because Alternate A and C are similar.

Alternate B is the central alignment of the three alternates, is in the mid-range of the three for length, and offers the best opportunity for commercial development adjacent to the arterial because it is primarily located at the toe of the sloping land to the north. This alignment does not interfere with the planned trailer court located just south of the arterial. No part of this alternate lies within a designated flood plain. Several drainages cross the arterial and they will be conveyed through the road embankment by a reinforced concrete culvert. In addition, several possible detention facilities could be constructed similar to the discussion in Alternate A. City water and sewer mains are available as previously discussed in Alternate A. These services would be extended to serve the entire development. Access is available for either southern or northern collector roadway alignment ties.

Alternate C is the shortest, northern-most alignment of the three and primarily located on the crest of the ridge. Commercial development would be available along the north side of the arterial, but would be problematic for the property to the south. This alignment completely avoids the planned trailer court to the south since it is not adjacent to the property. No part of this alignment lies within in a designated floodplain. Drainage will be conveyed through the road embankment using reinforced concrete pipe. The opportunity for constructing detention facilities is greatly diminished. Only two minor drainage ways cross the alignment, both near the headwaters of the drainage basin. City water and sewer is available as previously discussed in Alternate A and would be extended to serve the area. Collector access is available from the north, but is poor from the south without major earthwork grading.

TRAFFIC

Traffic considerations relate to items such as route continuity, safety, spacing of intersection roads and signalization.

West Layout Plan

Alternate 1 provides for better route continuity in the Cambell Street area than either Alternate 2 or 3. This is extremely important because this intersection will become a major route connection to East Anamosa Street, since it is an extension of South Dakota Highway 79. Alternates 2 and 3 both intersect Cambell Street on a circular curve with superelevation, whereas the intersection with Alternate 1 is on a tangent section. In addition, Century Road would also intersect Alternate 3 on a circular curve.

Safety considerations are similar for the three alternates. However, Alternates 2 and 3 have long circular curves with superelevation, which could present more serious winter driving hazards especially during icy periods. In addition, Alternate 3 has the steepest grade at six percent. All the alternates would have controlled access with a minimum of 1,000 feet separating the intersections, except near Wal-Mart and from Cambell Street to East North where the intersections may be about 600 feet apart. Local traffic from commercial businesses will be required to gain access to the arterial from an intersecting road, not directly from the business. Traffic signals will be installed if they are warranted, on major intersections to provide adequate traffic control, but not impede vehicular movement or reduce the level of service. As traffic increases, other intersections may require the installation of traffic signals.

East Layout Plan

Alternates A and B provide for better route continuity than Alternate C. However, the North Valley Drive connection to Alternate B is better than for the other two alternates. Connecting East Philadelphia Street and Mickelson Drive to Alternate C will be a problem due to the steeper intersecting grades and intersecting skew angle. In addition, Alternate A may be in competition with the proposed "East-West Road" in the North Valley Drive area, which could compromise the function of the principal arterial route.

Safety considerations are similar for the three alternates. However, Alternate A has more circular curves with superelevation, which could present more serious winter driving hazards, especially during icy periods. In addition, Alternates A and C have the steepest grades, at or exceeding five percent. All the alternates would have controlled access with a minimum of 1,000 feet separating the intersections, except between Turbine Drive and Elk Vale Road which would be approximately 800 feet. Local traffic from commercial businesses will be required to gain access to the arterial from an intersecting road, not directly from the business. Traffic signals will be installed if they are warranted, on major intersections to provide adequate traffic control, but not impede vehicular movement or reduce the level of service. As traffic increases, other intersections may require the installation of traffic signals.

AESTHETICS

Since the arterial will be the main east/west thoroughfare for the northeast portion of Rapid City, aesthetics is very important. The roadway needs to impart a sense of belonging to the community as well as a pleasing avenue to everyone traveling the roadway. Landscaping along the arterial tends to heighten this sense of place and enhances the beauty of the area. In addition, well designed median landscaping, using xeriscaping and trees suitable for our climate, can reduce maintenance costs by requiring less watering and mowing and providing areas for snow storage in the winter. Due to the location of either Alternates 1 and 2 in the West Layout Plan or Alternates B and C in the East Layout Plan, the alternate would provide an excellent vista of the arterial and the surrounding countryside. With proper landscaping these routes would enhance the aesthetics of the area as the community develops. Alternates 3 and A would not be as aesthetically pleasing because their location and elevation is much lower than the other alternates.

RIGHT-OF-WAY IMPACTS

Because the amount of right-of-way (ROW) to be acquired would be minimal for all six alternates, the ROW costs would have less than a three percent impact on any of the overall project costs. Alternate 1 would require 18 acres of additional ROW, not including the existing section line highway. Alternate 2 would need 21 acres and Alternate 3 would require 23 acres of ROW. Alternate A would require 34 acres, Alternate B 27 acres and Alternate C 29 acres of ROW.

Two key issues that must be considered regarding the need for ROW are first, the number of affected land owners and second, any remainder tracts that may be isolated by the location of the arterial. Figure 21 indicates the Property Ownership Map for the west area and Figure 22 is the Property Ownership Map for the east area.

Alternate 1 crosses property owned by four landowners. Alternate 2 affects six owners and Alternate 3 encompass properties owned by five landowners. Alternates 1 and 2 both cross three power lines located east of Century Road. Alternate 3 would require the relocation of one and possibly two major transmission lines. Alternate A crosses property owned by ten landowners, Alternate B has eight property owners and Alternate C has the least with only six property owners. Alternates A, B and C all cross and then parallel an existing West River Electric Association power line along the south line of Section 32.

Alternates 1 and 2 would each have one small remaining parcel that may be undevelopable, whereas Alternate 3 would probably isolate three parcels. Alternate A would isolate four small to medium sized parcels, with Alternate B two parcels would be isolated and Alternate C would isolate three medium sized tracts. In discussions with several key property owners there appears to be a feeling that the proposed arterial would be of great benefit to the area in general and to each of them in particular.

COMPARATIVE CONSTRUCTION COSTS

Conceptual level estimates of probable construction costs were prepared for each alternate. These costs included earthwork, surfacing and other roadway elements, drainage and storm sewers, fencing, erosion control, lighting and signalization, traffic control during construction, mobilization, incidentals, excise tax, bonding and profit. Also included is an estimate of the construction costs for water and sewer utilities to serve the areas. In addition, an allowance was made for contingencies, design and construction engineering. The quantities used and the costs ~~prepared are~~ based on the conceptual drawings included in Appendix D of this report.

Alternate 1 is the least expensive with a relative cost of $5.5 million due to its shorter length. Alternate 2 is the mid-range with a cost of $6.4 million and Alternate 3 is the most expensive with a conceptual level cost of $6.7 million. Alternate A is the most expensive with a relative cost of $7.6 million due to its longer length. Alternate B is the mid-range with a cost of $7.1 million and Alternate C is the least expensive with a cost of $6.8 million. The above costs are for the roadway only and do not include water and sewer utilities. Water and sewer utility costs are estimated to be $7.9 million. Based on the types of soil in the area, any of the alternates could contain highly expansive clay soils. The existence of these types of soils may require extensive excavation and imported backfill to maintain roadway stability, which could increase the cost of construction.

The South Dakota Department of Transportation had previously listed maintenance costs for an urban four-lane highway at approximately $10,000 per mile. This number, which was a three-year average, was inflated at four percent per year since 1991. In addition the cost was increased to account for the extra width to six lanes. This amount was also increased approximately $2,000 per mile to account for the intermittent left turn lanes. Therefore, the annual projected maintenance costs for Alternates 1, 2 and 3 would be $20,800, $21,300 and

$27,100 respectively; and for Alternates A, B and C the maintenance costs would be $48,800, $44,200 and $41,700 respectively.

CONSTRUCTIBILITY

Constructibility would be similar for all three alternates in terms of traffic during construction, major utility reroutes and haul roads. Because this would be entirely new construction, there would not be an existing road to maintain or traffic to handle throughout the project during construction. However, Alternate 2 may be more difficult to construct because the existing retention pond south of the DM&E Railroad and Alternate 3 because of the terrain. Alternates A, B and C would be all be similar to construct, except for the steepness of the terrain along Alternate C and the depth of cuts and/or fills for Alternates A and C. The likelihood of encountering highly expansive clay soils along any of the alternates exists. If over-excavation were required, a disposal site would need to be obtained for the waste material. In addition, suitable material would need to be imported to backfill the over-excavated areas. This would increase the contractors work if the area of over-excavation were extensive.

During the conceptual level evaluation, earthwork quantities for Alternates 1, 2 and 3 require large amounts of borrow to construct the embankments. However, Alternates A, B and C were more nearly balanced with reasonable short haul distances between balance points

ENVIRONMENTAL ISSUES

An environmental assessment is not a part of this study. However, a preliminary review of known environmental issues is included.

There are only two potential wetland areas in the study area. These are both located in the West Layout Plan vicinity, one adjacent to Alternate 2 and the other near Alternate 3. The U. S. Army Corps of Engineers would need to be contacted in order to receive their environmental clearance for these alternates.

A cultural resources inventory survey has not been undertaken for this project at this time.

No long-term air quality impacts are expected from any of the alternates. During construction the contractor will be required to comply with the provisions of the Local Ordinance for Fugitive Dust and obtain the necessary permits to ensure compliance.

No threatened or endangered species are presently known or anticipated in the vicinity. However, if an environmental assessment becomes necessary, the U. S. Fish and Wildlife Service would need to be contacted for their assessment.

Native vegetation exists throughout much of the study areas, except in those areas where development has already occurred. The land is presently used for pasture. None of the land to be used for right-of-way has been developed for recreational purposes, wildlife refuges, parks or as historic areas.

In addition to the roadway costs, the utility costs for sewer and water were only calculated for the preferred alternates.

CHAPTER SEVEN

ALTERNATE RANKING

In the preceding section, the relative merits of the alternates were fully discussed and evaluated. A decision-making matrix that comprehensively rated each alternate based on the various factors discussed was used to determine a single preferred alternate. Three broad categories and seven specific screening factors were used to analyze each of the three alternates. Detailed evaluation matrices for Alternates 1, 2 and 3 and for Alternates A, B and C are shown on Table 5 and 6 respectively. Alternates were rated within each screening factor according to the level of impact each would have on the project or the level of compatibility with future plans for the area. These factors were then used in assigning a score to each alternate. The actual score was determined on a numerical basis with 1 being the most favorable, and 5 the least favorable score.

In addition to assigning a numerical score to each of the screening factors, each factor was weighted by the advisory committee in terms of its relative importance to the project. A total of 100 points was assigned to the seven screening factors as shown on Tables 5 and 6. The score was then multiplied by the relative weight of each criterion to determine the total weighted score. These values were then summed for all seven criteria and the alternate with the lowest total score was selected as the preferred alternate. This process resulted in Alternate 1 being selected as the most feasible alternate for the section from La Crosse Street to East North Street and Alternate B for the section from East North Street to Elk Vale Road.

PROPOSED ZONING

Based on the selection of Alternates 1 and B, proposed zoning maps were prepared for the study area. These maps are shown on Figure 23 and 24. The corridor adjacent to the section of the arterial from La Crosse Street to East North Street would be either General Commercial, General Commercial with Planned Commercial Development, Light Industrial, Medium Density Residential or Medium Density Residential with Planned Residential Development. The section from East North Street to Elk Vale Road would be a combination of General Commercial, Office Commercial, Mobile Home Residential, Medium Density Residential with Planned Residential Development, Neighborhood Commercial, Light Industrial or a Planned Residential Development.

INFRASTRUCTURE

The utility costs for sewer and water were only calculated for the preferred Alternates 1 and B, and are shown on Figures 13, 14, 15 and 16. The total combined area cost for water improvements for both alternates is estimated to be $5.4 million. This estimate includes the cost of a two million gallon ground reservoir southeast of Menards at an elevation of approximately 3,406 feet. The area sewer cost estimate is $2.5 million. This includes a lift station to pump the sewage from the area north of East North Street to an existing sewer main near Menards. In addition the entire area between East North Street and Elk Vale Road will be serviced by a sanitary sewer that will transport the wastewater to Rapid City's main interceptor line and ultimately to the water reclamation plant.

TABLE 5

ALTERNATE EVALUATION MATRIX

EAST ANAMOSA STREET EXTENSION – WEST LAYOUT
LA CROSSE STREET TO EAST NORTH STREET

Rapid City, South Dakota

CRITERIA	RELATIVE WEIGHT	ALTERNATES					
		1		2		3	
		Score*	Weighted Score	Score*	Weighted Score	Score*	Weighted Score
Land Use Compatibility	25	2	50	3	75	5	125
Traffic (Level of Service)	20	1	20	2	40	4	80
Infrastructure	15	3	45	3	45	4	60
Aesthetics	5	2	10	3	15	3	15
Rights-of-Way Impacts	15	2	30	1	15	4	60
Comparative Construction Costs	10	2	20	4	40	4	40
Constructibility	5	1	5	5	25	3	15
Environmental Issues	5	4	20	4	20	3	15
TOTAL	100		200		275		410

* NOTE: '1' is the most favorable score and '5' is the least favorable score. Therefore, the lowest total score represents the most feasible project.

TABLE 6

ALTERNATE EVALUATION MATRIX

EAST ANAMOSA STREET EXTENSION – EAST LAYOUT
EAST NORTH STREET TO ELK VALE ROAD

Rapid City, South Dakota

CRITERIA	RELATIVE WEIGHT	ALTERNATES					
		A		B		C	
		Score*	Weighted Score	Score*	Weighted Score	Score*	Weighted Score
Land Use Compatibility	25	4	100	2	50	5	125
Traffic (Level of Service)	20	2	40	1	20	3	60
Infrastructure	15	2	30	2	30	3	45
Aesthetics	5	3	15	2	10	1	5
Rights-of-Way Impacts	15	4	60	2	30	3	45
Comparative Construction Costs	10	5	50	3	30	2	20
Constructibility	5	2	10	2	10	3	15
Environmental Issues	5	1	5	1	5	1	5
TOTAL	100		310		185		320

* NOTE: '1' is the most favorable score and '5' is the least favorable score. Therefore, the lowest total score represents the most feasible project.

CHAPTER EIGHT

RECOMMENDED ALTERNATE

Based on the data gathered, compiled and analyzed during the course of this study, it is recommended that Alternates 1 and B are the preferred alignments for the East Anamosa Street Extension Arterial. These alternates are recommended for the following reasons:

1. Combined Alternates 1 and B have nearly the lowest initial construction cost and are the alternates most compatible with the future land use in the area. This compatibility enhances the development of a new core business area and provides access for future residential growth beyond the commercial core.

2. Traffic would be better served by the combination of Alternates 1 and B because of location and length of travel. In addition, the relatively flat grades of the intersecting major streets will provide the continuity needed to extend collector roads beyond the arterial. Also because of flatter grades and fewer curves, this location will provide for a much safer means of transportation with a higher level of service.

3. Finally because of the location, the development of Alternates 1 and B would improve the aesthetics of the area and provide a good view of the surrounding community. This attractiveness will be paramount in enticing residents and businesses to relocate in this area.

APPENDIX A

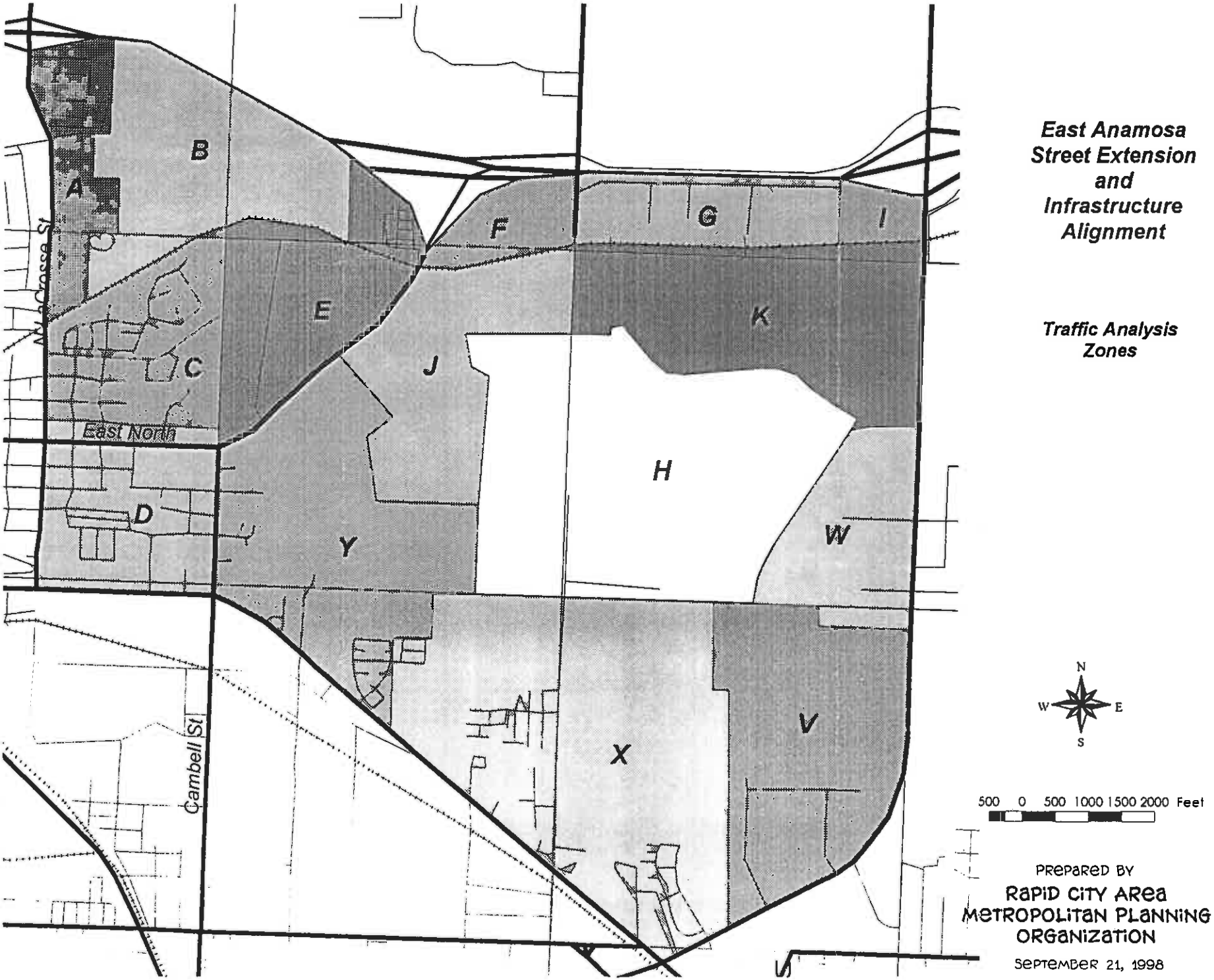
LAND USE TOTALS BY TRAFFIC ANALYSIS ZONES

East Anamosa Corridor Analysis
Land Use Totals by Traffic Analysis Zones
South of I90, North of Omaha/Hwy 44, East of LaCrosse St, and West of Elk Vale Rd

Projected Development at Anticipated Densities[1]

TAZ	LDR	PRD	MDR	MHP	NC	OC	BP	GC	LI	HI	PUBLIC
	Units measured in Dwelling Units				Units measured in Square Footage						
A								589,050			
B			2,211					82,810			
C			80	320				28,691	61,062		
D			16	157				532,377	313,615		26,375
E								817,714	202,290		
F								131,532			20,700
G								1,870	170,142	37,284	
H		543					487,060				
I								87,716			
J			474			50,130		1,051,508			
K								347,410	718,956	288	
V					48,828			296,156	748,257		49,050
W						65,070		818,202			
X	292	147	1,667	27				214,701			72,350
Y				435				1,377,265	54,414		
Totals	292	690	4,448	939	48,828	115,200	487,060	6,377,002	2,268,736	37,572	168,475

[1] The Future Land Use Committee has recommended "Anticipated Densities" for various uses throughout the Future Land Use Study area that are lower than the maximum densities currently allowed based on actual development that has occurred in the community.


East Anamosa
Street Extension
and
Infrastructure
Alignment
Traffic Analysis
Zones
A
B
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K
H
W
Y
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V
East North
Campbell St
N
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500 0 500 1000 1500 2000 Feet
PREPARED BY
RAPID CITY AREA
METROPOLITAN PLANNING
ORGANIZATION
SEPTEMBER 21, 1998

LAND USE CATEGORY DESCRIPTION

Low Density Residential (LDR)

All units are single family residences.

Planned Residential Development (PRD)

Planned Residential Developments identify single family residential uses where development concerns may exist, i.e., physical constraints, access concerns, minimizing site impacts, and/or compatibility issues with abutting land uses. All units identified are single family residences.

Medium Density Residential (MDR)

Multi-family housing includes townhomes and apartment buildings. The total units include the number of individual housing units available.

Mobile Home Park (MHP)

Mobile Home Parks allow for a concentration of mobile homes within a specified area. All units identify the number of mobile homes located within the various traffic zones.

Neighborhood Commercial (NC)

Neighborhood commercial uses include those shopping facilities geared to meet the needs of the local residents rather than the community as a whole.

Office Commercial (OC)

Office commercial uses typically include professional offices such as those for doctors, lawyers, real estate firms, etc. where no retail trade is conducted. Financial institutions such as banks and credit unions fall into this category.

Business Park (BP)

A business park is for the integration of the functional elements of a business or group of businesses which for purposes of security, efficiency and flexibility are located in close proximity or on the same developmental lot. This district provides for the integration of office, assembly and warehousing functions but does not provide for general retail, fabrication or processing.

General Commercial (GC)

This commercial use is for personal and business services and general retail businesses.

Light Industrial (LI)

This industrial district is to provide areas in which the principal use of land is for light manufacturing and assembly plants, processing, storage, warehousing, wholesaling and distribution, in which operations are conducted so that noise, odor, dust and glare are completely confined within an enclosed building.

Heavy Industrial (HI)

This industrial district is established to provide areas in which the principal use of land is for manufacturing, assembling, fabricating, and for warehousing. These uses do not depend primarily on frequent person visits of customers or clients, but usually require good accessibility to major rail or street transportation routes.

Public

This provides for facilities which serve the general public that are operated by the United States of America, the state of south Dakota or any political subdivision which qualifies for exemption from peroperty taxes, or nonprofit organizations. Facilities identifies as public use are generally not involved in commerce and frequently are sited with public safety and government efficiency in mind.

APPENDIX B

ELK VALE NEIGHBORHOOD TRAFFIC ANALYSIS

DRAFT

ELK VALE NEIGHBORHOOD
TRAFFIC ANALYSIS

FELSBURG
HOLT &
ULLEVIG

engineering paths to transportation solutions

ELK VALE NEIGHBORHOOD
TRAFFIC ANALYSIS

Prepared for:

The City of Rapid City
300 Sixth Street
Rapid City, SD 57701

Prepared by:

Felsburg Holt & Ullevig
7951 East Maplewood Avenue, Suite 200
Englewood, CO 80111
303/721-1440

Project Principal: Robert W. Felsburg, P.E.
Project Manager: Elliot Sulsky, P.E., AICP
Project Engineer: Debbie Zermuehlen

FHU Reference No. 98-183
June, 1999

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I. INTRODUCTION

The Elk Vale neighborhood, shown on Figure 1, is an approximately six square-mile area to the east of Rapid City. The neighborhood is now only partially developed, with residential development primarily concentrated in the southeastern portion, industrial development along Eglin Street in the northern part of the area and along Elk Vale Road in the central part, and retail/commercial development in the western portion of the neighborhood. However, the area is beginning to experience significant growth. The City has recently prepared an Elk Vale Neighborhood Future Land Use Plan and anticipates rapid mixed use growth in the area.

Two regionally significant roadway construction projects are also being planned for the area. The South Dakota Department of Transportation (SDDOT) is planning to construct an extension of the existing Elk Vale Road corridor to the southwest of SD Highway 44 as a bypass route to be part of the proposed interstate Heartland Expressway route. Also, Rapid City is conducting a design process for the extension of East Anamosa Street as an east-west arterial roadway through the center of the Elk Vale area.

The existing and anticipated growth pressures in the Elk Vale neighborhood, combined with planning for major roadway projects in and around the area, have created a need to develop a roadway plan for the area. The purpose of this report is to assess the travel demands associated with anticipated area development and to prepare a conceptual roadway plan to accommodate those demands. Two particular focus areas for conceptual roadway analysis include the need for and configuration of an east-west road south of East Anamosa Street and access control on Elk Vale Road.

This plan has been developed in coordination with the Elk Vale Neighborhood Traffic Advisory Committee, consisting of City staff, a City Council representative, and two land owner representatives.

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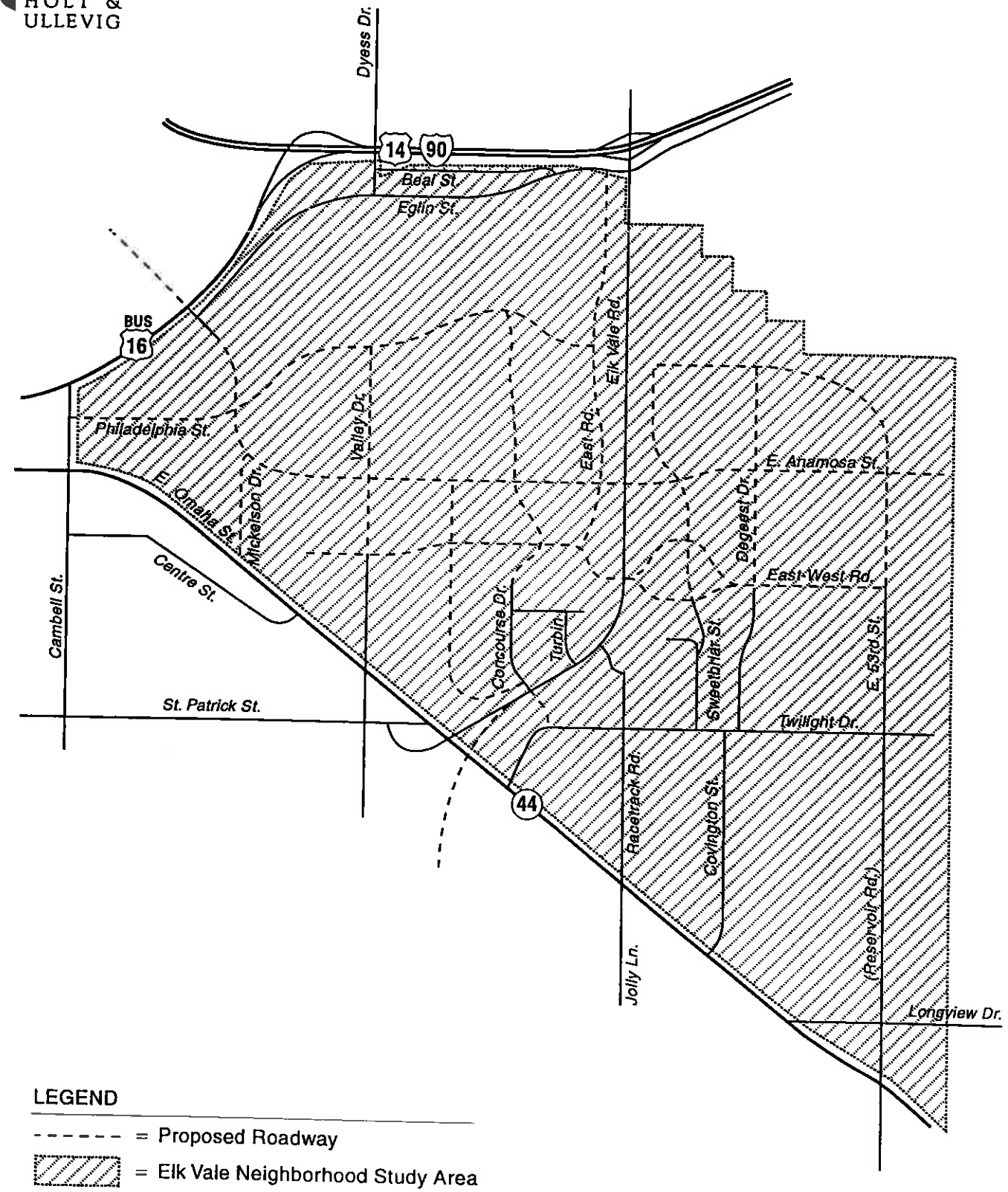

LEGEND

- - - - - - = Proposed Roadway

= Elk Vale Neighborhood Study Area

North

Figure 1

Study Area

II. TRAVEL DEMAND FORECASTS

Travel demand on Elk Vale roads was forecast by forecasting two demand elements. First, through-traffic volumes (traffic that passes through the area without a destination in Elk Vale), was forecast for a Year 2025 time frame. Next, traffic generation anticipated to and from Elk Vale neighborhood land uses was forecast. These two traffic components were then added together to develop total travel demand forecasts for the Elk Vale roadway system.

A. Through Traffic Forecasts

The existing Elk Vale major roadway network is depicted on Figure 2, along with numbers of through lanes and daily traffic volumes. Traffic volumes are based on 1997 and 1998 traffic data collected by Rapid City and the SDDOT.

Traffic volumes of approximately 20,000 vehicles per day (vpd) or more are found on the four-lane major roadways on the perimeter of the study area, including Interstate 90 (I-90) to the north, State Highway 44 (East Omaha Street) on the south, Business 16 (East North Street) on the northwest, and Cambell Street on the west.

Interior study area roads are all currently two-lane roads, with the exception of three-lane segments of Elk Vale Road, which have passing lanes in uphill directions. The highest traffic volumes on interior streets are found in southern segments of Elk Vale Road, with approximately 11,000 vpd.

Existing volumes of through-traffic were estimated based on existing traffic flow and land use patterns. Figure 3 shows that significant through movements are currently seen on the primary perimeter roadways, including I-90, Business 16, SH 44, and Cambell Street, as well as on Elk Vale Road.

Through traffic for the Year 2025 time frame was forecast, first using an estimated 50% growth factor between current volumes and the Year 2025. This growth rate represents a continuation of the approximate 2% average annual increase in traffic volumes found on roadways throughout Rapid City over the last three years.

One additional adjustment was made to derive the forecasted through-traffic volumes shown on Figure 3. A 5,000 vpd adjustment was made, diverting trips from Business 16/Cambell Street to Elk Vale Road, reflecting the planned southwest extension of Elk Vale Road as a primary route between I-90 on the north and Business 16 and SH 79 on the south.

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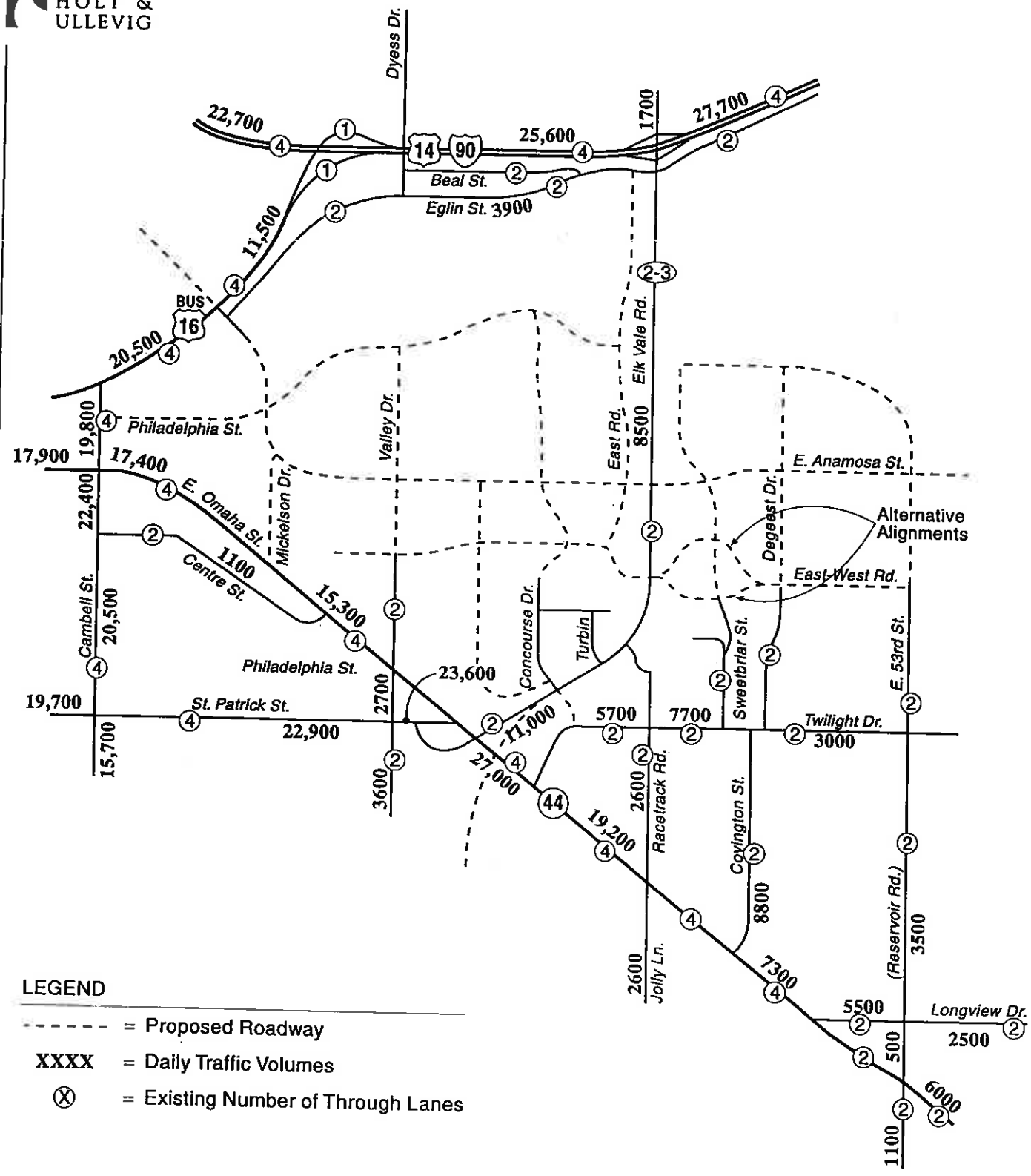

LEGEND

- - - - - - = Proposed Roadway

XXXX = Daily Traffic Volumes

Ⓧ = Existing Number of Through Lanes

SOURCES: 1997 and 1998 Rapid City, MPO and SDOT Counts

North

Figure 2

Existing Laneage and Daily Traffic Volumes

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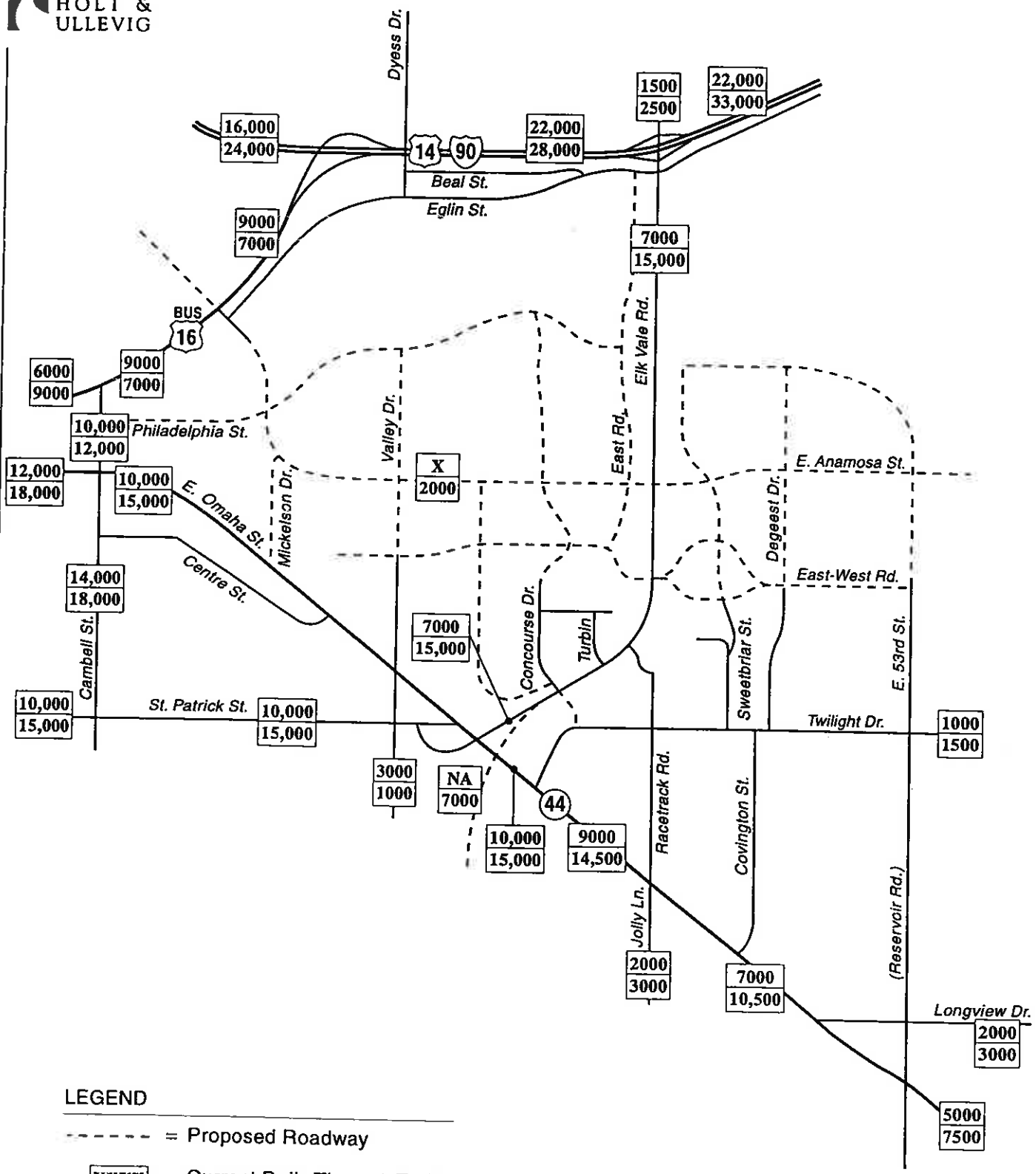

LEGEND

- - - - - - = Proposed Roadway

XXXX = Current Daily Through Traffic
XXXX = Future Daily Through Traffic

North

Figure 3

Through Traffic Estimates and Forecasts

B. Elk Vale Land Use Plan

Figure 4 shows the Elk Vale Neighborhood Future Land Use Plan that was developed this year by the Future Land Use Committee formed by Rapid City. Industrial and commercial development is planned to continue along the I-90/Eglin Street/Business 16 corridor, the Elk Vale corridor, and the SH 44 corridor. Predominantly residential uses, with a mix of densities, are planned in other parts of the neighborhood.

The Future Land Use Committee subdivided the area into 20 analysis zones, labeled F through Y on Figure 5. The Committee then quantified the anticipated development densities at area build-out for each zone. These anticipated densities yielded a total of nearly 10,000 dwelling units and nearly 10 million square feet of industrial and commercial development. It should be noted that these build-out estimates, while they are reduced considerably from the potential development levels allowed by zoning, represent aggressive growth forecasts for the area. For perspective, it can be noted that build-out of Elk Vale residential development would represent on the order of 50% of existing Rapid City population.

Based on discussions with land use committee members, dwelling unit and building area forecasts that were developed in broad zoning categories were classified in more specific land use categories. Table 1 shows the resulting land use forecasts by analysis zone.

C. Elk Vale Trip Generation

Vehicle trip generation associated with Elk Vale build-out was estimated using rates published in Trip Generation, 6th Edition, Institute of Transportation Engineers. That publication provides average vehicle trip generation rates for a wide range of land uses based on extensive national survey data. Rapid City has collected local trip generation rate data which show some higher residential rates; however, national Trip Generation rates were used in Elk Vale analysis since they represent a more extensive database collected over a wider range of development types and neighborhood configurations.

By applying these trip generation rates to the land use forecasts, a total of 302,000 daily vehicle trips were estimated to be generated by the Elk Vale neighborhood at build-out.

In a large mixed use area such as Elk Vale at build-out, many of the trips that are generated by individual developments will not create vehicle trips on the major roadway system. Rather, many of these trips will be captured by pedestrian or bicycle modes, or by short vehicle trips on local streets. Land use within each individual zone, as well as those between adjacent zones within super zones shown in Figure 5, was examined to determine which zones will have a sufficient mix of uses to capture a significant portion of trips internally. A compilation of these internal trip estimates led to a total of approximately 25% of trips being captured within individual zones or adjacent zones (see Table 2). These trips were not included in the trip distribution forecasts on the major street system. This level of internal trip capture is viewed as being a relatively conservative level based on the magnitude of Elk Vale build-out forecasts and on experience from other studies.

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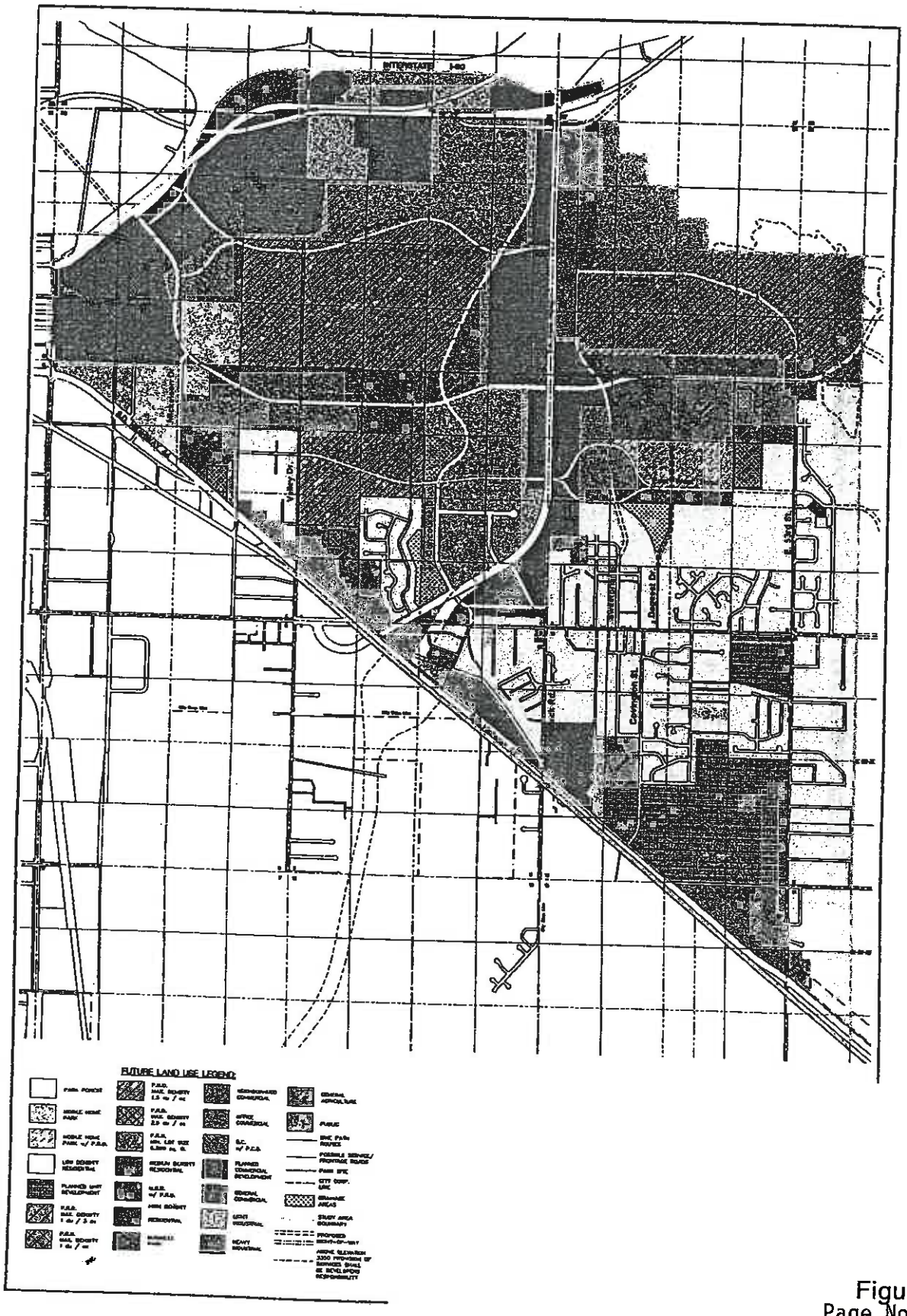

Figure 4
Page No. B-11
Future Land Use

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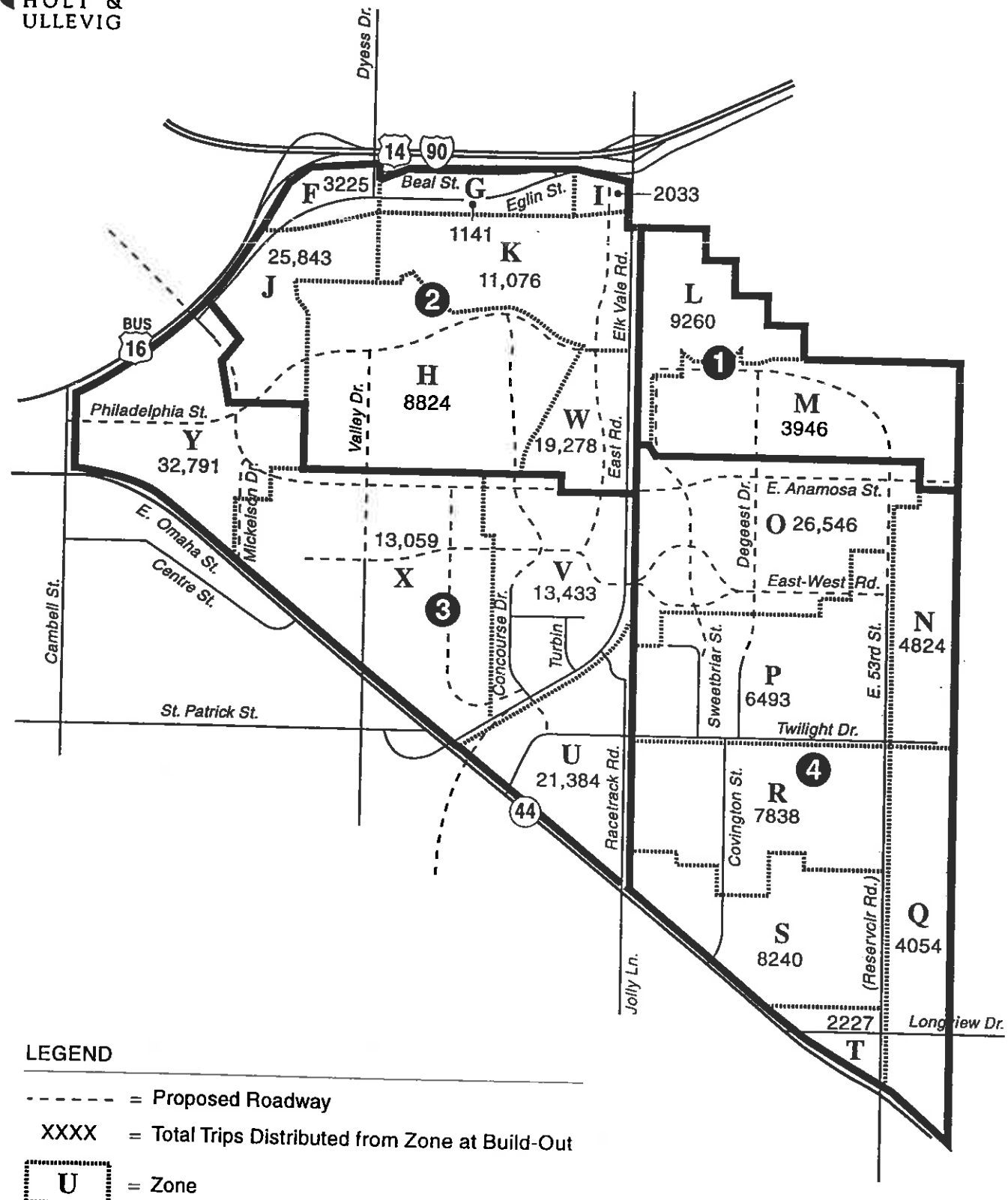


LEGEND

- - - - - - = Proposed Roadway

XXXX = Total Trips Distributed from Zone at Build-Out

U = Zone

3 = Super Zone

North

Figure 5

Traffic Analysis Zones

Table 1
Elk Vale Neighborhood
Land Use and Trip Generation Forecasts by Traffic Analysis Zone

TAZ	Projected Build-out at Anticipated Densities									Vehicle Trip Generation				
	Dwelling Units			Commercial/Institutional Development (In 1000 Sq. FU)						Daily (2-way)	AM Peak		PM Peak	
	Single Family	Mobile Home	Multi-Family	Light Industrial	Heavy Industrial	Office	Retail (shop ctr)	Business Park	Public*		In	Out	In	Out
F				28		25	79		21	4,007	124	42	154	227
G				172	37					1,254	156	21	23	170
H	543							487		11,411	687	417	495	681
I				18		17	53			2,587	71	26	102	140
J			474	221		250	631			34,518	957	528	1,419	1,824
K				792		66	209			15,217	863	184	485	1,171
L				458		214	169			12,802	771	159	411	988
M	453									4,335	85	255	293	165
N	554									5,302	104	312	358	201
O		300	1,592	137		306	433		340	39,231	1,233	1,061	1,676	2,021
P	729		24							7,136	139	420	481	270
Q	399		96						11	4,455	92	267	299	174
R	766	27	108			23	7			8,730	191	493	568	348
S	758	61		6		240	43		46	12,631	546	514	655	714
T			335	1		67	12			3,481	128	161	178	176
U	148	14		199		169	534		21	27,903	775	358	1,128	1,494
V	439			810		56	227		49	20,206	997	443	806	1,411
W				172		220	491			24,695	750	257	957	1,375
X		27	1,667	45		41	129		77	18,898	374	796	958	754
Y		435		343		262	826			42,820	1,193	556	1,741	2,319
Total	4,789	864	4,296	3,402	37	1,956	3,843	487	565	301,619	10,234	7,269	13,189	16,624

*Public uses include: F-DOT facility; O-High School, Middle School, Elem. School; Q-Fire Station; S-Elem. School; U-Elem. School; V-Fire Station; and X-Technical College

Table 2
Elk Vale Neighborhood
Trip Generation and Internal Trip Forecasts

TAZ	Daily Trip Generation by Land Use Type - Build-Out						Total Daily Trip Distribution		
	Residential	Industrial	Office/ Bus. Park	Retail	Public*	Total Trips	Internal Trips Within Zones & Adjacent Zones	Trips Between Elk Vale Zones	External Trips
1									
L	0	3,192	2,356	7,253	0	12,802	3,542	926	8,334
M	4,335	0	0	0	0	4,335	390	395	3,551
2									
F	0	195	275	3,391	146	4,007	783	323	2,902
G	0	1,254	0	0	0	1,254	113	114	1,027
H	5,197	0	6,214	0	0	11,411	2,586	882	7,942
I	0	125	187	2,275	0	2,587	554	203	1,830
J	3,143	1,540	2,753	27,083	0	34,518	8,674	2,584	23,259
K	0	5,520	727	8,970	0	15,217	4,141	1,108	9,968
W	0	1,199	2,422	21,074	0	24,695	5,417	1,928	17,350
3									
V	4,201	5,646	617	9,743	0	20,206	6,773	1,343	12,090
X	11,182	314	451	5,537	1,414	18,898	5,839	1,306	11,753
Y	2,092	2,391	2,885	35,452	0	42,820	10,028	3,279	29,512
4									
N	5,302	0	0	0	0	5,302	477	482	4,342
O	11,998	955	3,369	18,584	4,325	39,231	12,686	2,655	23,891
P	7,136	0	0	0	0	7,136	642	649	5,844
Q	4,455	0	0	0	0	4,455	401	405	3,649
R	8,177	0	253	300	0	8,730	892	784	7,054
S	7,547	42	2,642	1,846	553	12,631	4,391	824	7,416
T	2,221	7	738	515	0	3,481	1,254	223	2,004
U	1,484	1,387	1,861	22,919	253	27,903	6,519	2,138	19,246
Total	78,469	23,767	27,750	164,942	6,691	301,619	76,101	22,552	202,966

* Public uses include: F:DOT facility; O-High,Middle & Elem. School; Q-Fire Station; S-Elem. School; V-Fire Station; and X-Tech. College

East Anamosa Traffic Forecasts
FHU Reference No. 99-055

06/14/99

The remaining 75% of trips, approximately 225,000 trips per day, were accounted for in developing traffic forecasts on the major roadway system. These trips are shown on Figure 5 in their zone of origin or destination. Approximately 10% of those trips are estimated to travel between zones across Elk Vale, while the remaining trips are estimated to enter or leave the Elk Vale neighborhood.

D. Elk Vale Trip Distribution

The directional distribution of traffic to and from the Elk Vale area was estimated by Felsburg Holt & Ullevig and the Traffic Advisory Committee based on anticipated traffic and development patterns. Figure 6 shows that the anticipated trip distribution patterns are heavily weighted to the west, toward the heart of Rapid City. More than 60% of all traffic entering or leaving Elk Vale is anticipated to use routes on the west, including I-90, the planned extension of East Anamosa Street, Business 16, SH 44, and St. Patrick Street. An estimated 15% of traffic is expected to be oriented toward the south, primarily using the southwest Elk Vale Road extension. Less than 25% of traffic is anticipated to be oriented toward the east and north.

Daily, AM peak hour, and PM peak hour Elk Vale-generated traffic forecasts were assigned to the anticipated roadway network, with the assistance of the IMPAX traffic distribution computer program.

E. Build-Out Traffic Forecasts

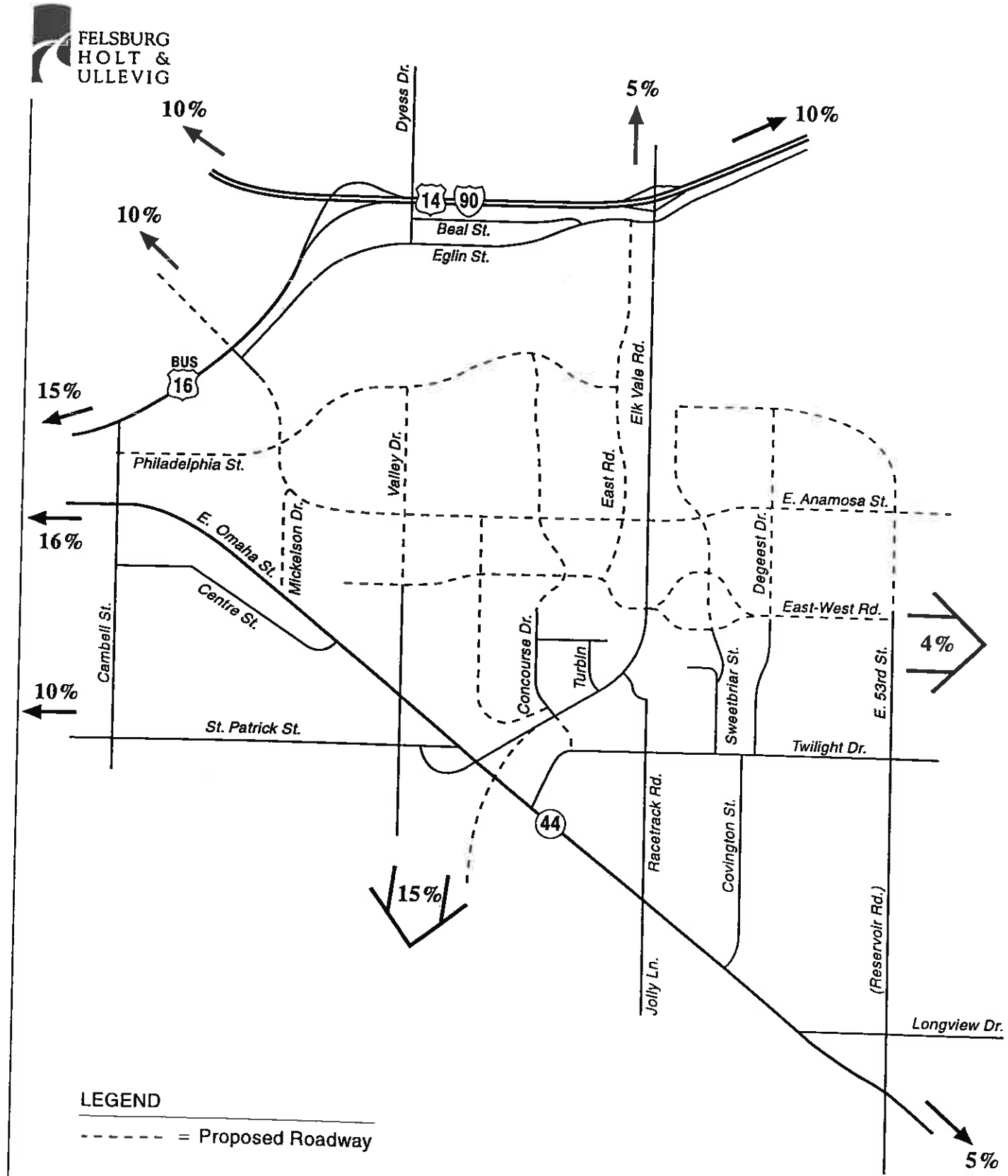
Forecasted Year 2025 through-traffic and traffic generated by Elk Vale build-out were added together to derive total long-range traffic forecasts for the "base case" Elk Vale roadway system, which was developed based upon Elk Vale land use planning and Traffic Advisory Committee input.

These daily traffic volume forecasts are shown on Figure 7. The following key observations can be made with regard to these long-range traffic forecasts:

a. Traffic growth that is significant but less than a doubling of existing traffic is anticipated on I-90 and Business 16 through the study area. Potential travel demand on these roads will be mitigated somewhat by improvement and extension of the Elk Vale Road corridor southwest of the study area.

b. Elk Vale Road traffic volumes will increase to as much as five times current levels. Although through traffic will comprise a significant proportion of Elk Vale Road traffic, a large majority of its traffic will be generated by the Elk Vale neighborhood.

c. The distribution of a majority of Elk Vale neighborhood traffic toward the center of Rapid City will cause traffic volumes on major east-west roadways, including SH 44, Anamosa Street, and the two unnamed future east-west roads, to generally increase moving toward the west.



North

Figure 6

External Trip Distribution

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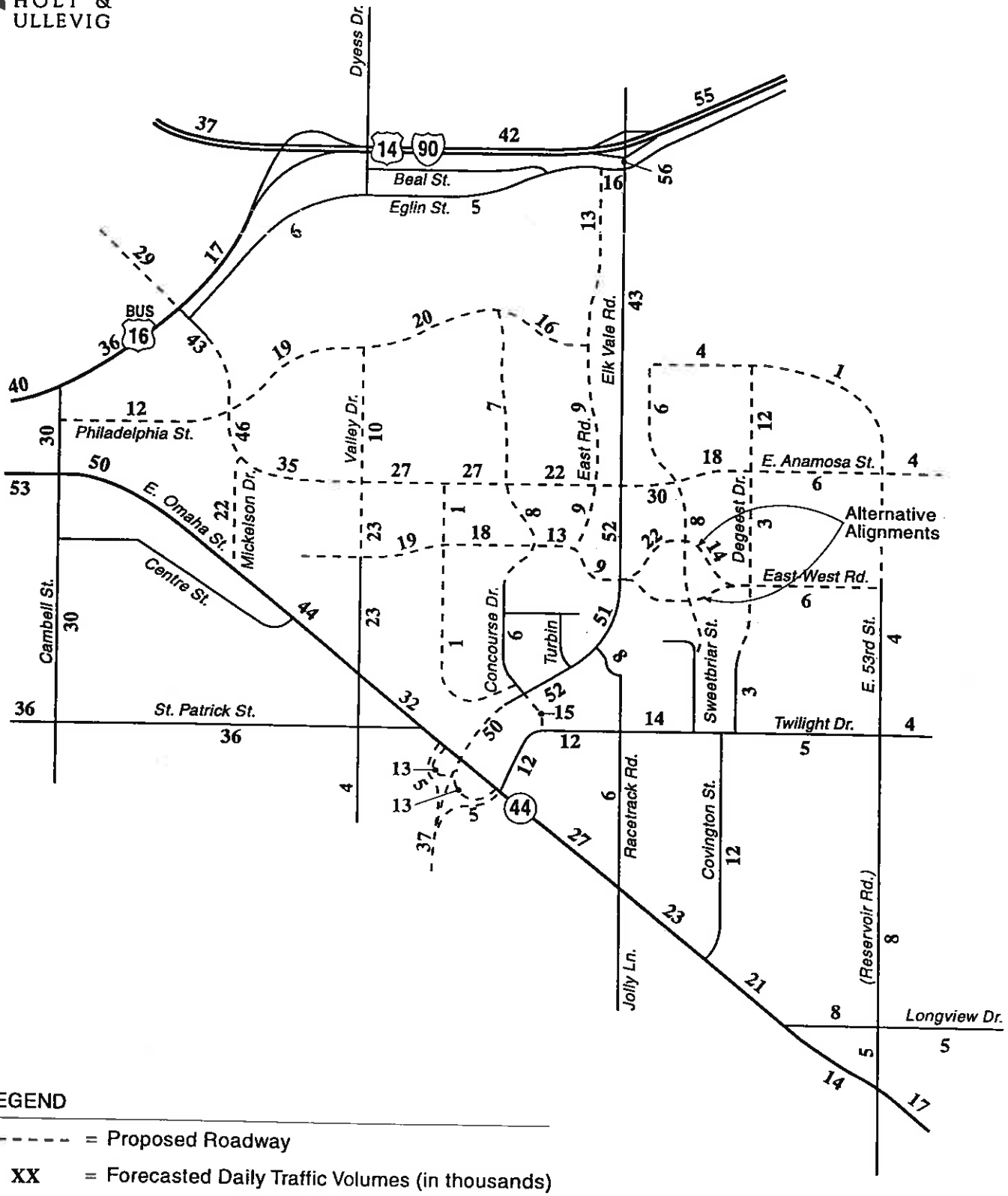

LEGEND

- - - - - - = Proposed Roadway

XX = Forecasted Daily Traffic Volumes (in thousands)

Figure 7

Long Range Traffic Forecasts

Elk Vale Build-Out

North

III. ROADWAY NETWORK EVALUATION

A. Planning-Level Capacity Analysis

General through lane requirements to accommodate long-range traffic forecasts were determined. Capacities of particular roadways vary according to such factors as peak hourly traffic patterns; spacing, cross-street volumes and traffic control at intersections; topography; and vehicle types. However, approximate traffic volume thresholds can be established to perform planning level analyses of laneage requirements. Following are descriptions of four major roadway classifications and capacity thresholds for each road type that were used for preliminary identification of future through lane requirements.

Freeways are high speed roadways designed to accommodate long distance trips and to carry high traffic volumes. Access is limited to grade-separated intersections. A typical planning-level capacity for freeways is 20,000 vehicles per day (vpd) per lane.

Principal Arterials are roadways designed for moderate to high traffic volumes. Principal arterials generally have regional continuity and are designed to accommodate longer distance traffic movements. Access is typically provided by signalized intersections which are spaced to allow for efficient traffic movements. Typical planning-level capacities for principal arterials range from 8,000 to 10,000 vpd per lane depending upon such factors as cross-traffic and access control.

Minor Arterials are roadways which are designed for somewhat reduced traffic volumes compared with principal arterials, and typically have significant, but not regional, continuity. Access is typically provided by both signalized and Stop sign controlled intersections. Typical planning-level capacities for minor arterials are in the range of 6,000 to 7,000 vpd per lane.

Collectors are roads that are intended to carry traffic between the local street system and the arterial street system. Collector streets are designed for significant access functions for adjacent land uses in addition to their traffic-carrying functions. Traffic control is typically unsignalized except for arterial street intersections. A typical planning-level capacity for collector streets is 6,000 vpd per lane.

Functional classification recommendations were developed after additional roadway analysis; however, previous Rapid City planning assumptions were used as a starting point to classify roads according to these capacity thresholds. Preliminary classifications included I-90 as a freeway; Elk Vale Road, SH 44, Business 16, Cambell Street and St. Patrick's Street as principal arterials; and all other roadways as minor arterials or collectors.

The resulting through lane requirements to accommodate long-range traffic forecasts are shown on Figure 8 and discussed in the following sections.

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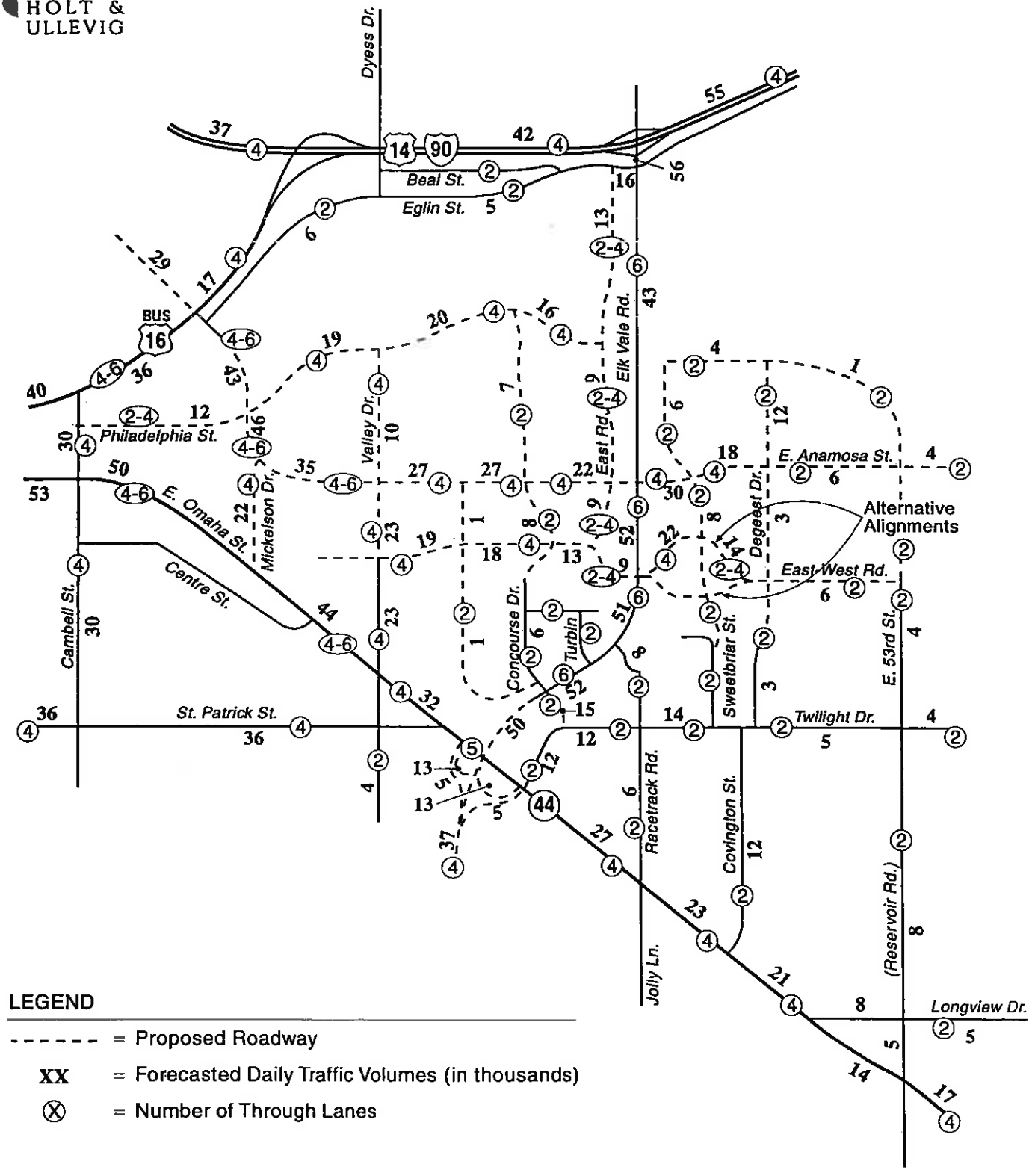

Figure 8

Long Range Through-Lane Requirements

Elk Vale Build-Out

B. The East-West Road

The East-West Road that has been proposed between Cambell Street (connecting with the Philadelphia Street alignment at Cambell Street) and East 53rd Street has been evaluated in greater detail in order to develop a recommended configuration west of Elk Vale Road. Figure 9 shows four conceptual configurations for the East-West Road that provide potential alternatives to the direct east-west alignment shown in the base case network. Base case build-out traffic forecasts were adjusted and forecasts associated with each alternative configuration are also shown on Figure 9.

Alternative 1 provides the minimal east-west connection, with the East-West Road hooking north just west of Elk Vale Road and connecting with East Anamosa Street. This configuration is not recommended for several reasons. First, the lack of a continuous East-West Road would place additional demands on the busy East Anamosa Street corridor and on the segment of Concourse Drive south of the East-West Road alignment. Second, it would induce many east-west trips from the East-West Road east of Elk Vale Road to use segments of Elk Vale Road, adding short trips and intersection turning movements to Elk Vale Road intersections. Finally, without a significant East-West Road segment west of Elk Vale Road, the need for the East-West Road east of Elk Vale Road may be questioned. Without this road east of Elk Vale Road, demands on East Anamosa Street and on Twilight Drive would be significantly increased.

Alternative 2 is not recommended for similar reasons as those discussed above. Also, a discontinuous and confusing roadway network would be created, requiring multiple turns in order to complete direct east-west movements through the area.

Alternatives 3 and 4 are similar to one another in terms of alignment. These alternatives differ in that Alternative 4 makes the east-west movement on the East-West Road the continuous movement, while Alternative 3 makes the north-south movement continuous on the north-south road west of Elk Vale Road, requiring turning movements to complete east-west trips. Alternative 4 is favored over Alternative 3 since east-west travel demand is forecast to be greater than north-south demand, and since Alternative 4 would create a more understandable roadway network.

The direct east-west alignment shown in the base case network is undesirable to the developing Rushmore Business Park along the west side of Elk Vale Road, since it would interfere with the desired parcel development plans and would significantly impact the drainage plan for the development. A comparison of Alternative 4 with the base case alignment shows that the same basic roadway functions would be provided by Alternative 4. Therefore, Alternative 4 is the recommended East-West Road alignment.

Two potential alignments exist for the East-West Road east of Elk Vale Road, where a deviation from a direct alignment is required by two existing radio towers. Alternatively, the radio towers could be relocated to allow for a more direct alignment of the East-West Road. These alternative alignments would function similarly, so the best alignment should be selected when this road is designed.

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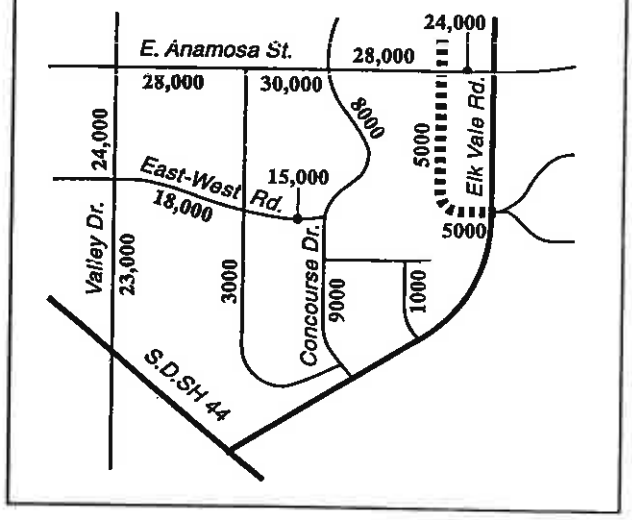
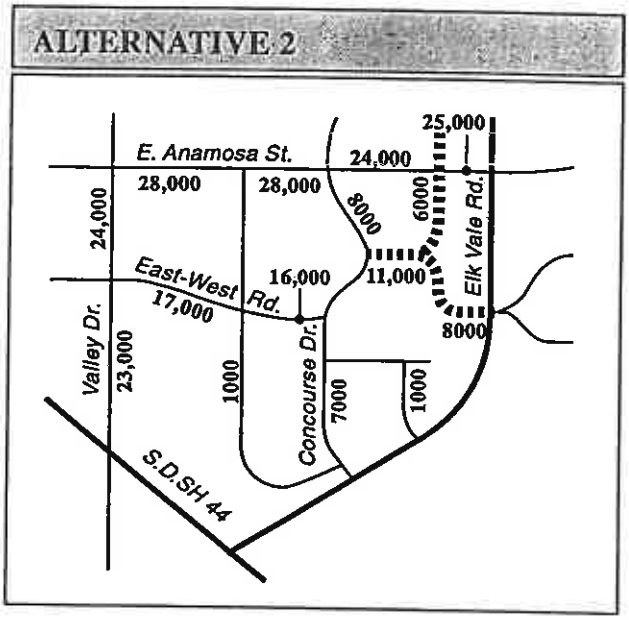
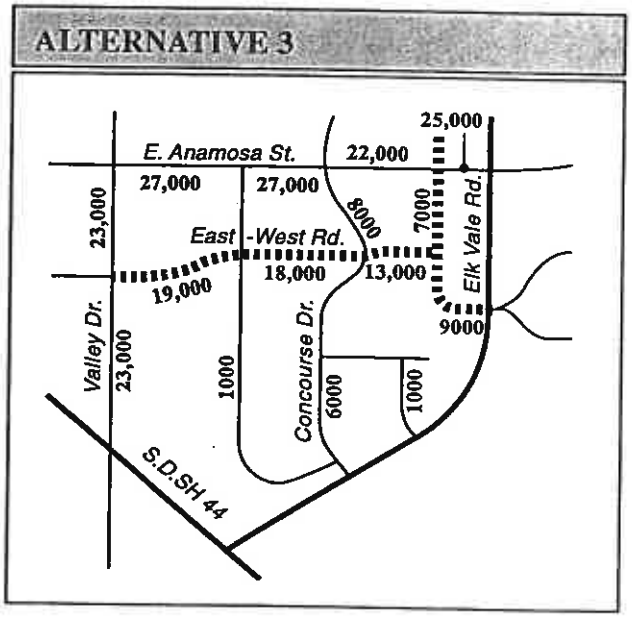
ALTERNATIVE 1



ALTERNATIVE 2



ALTERNATIVE 3



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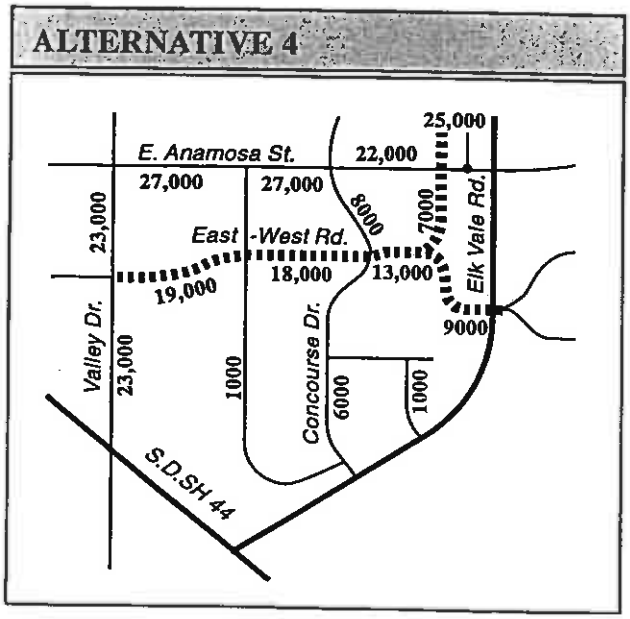

LEGEND

XXXX = Daily Traffic Volume Forecasts at Build-Out

North

Figure 9

East-West Roadway Alternatives

Once this East-West Road alternative west of Elk Vale Road was established as the preferred one, traffic forecasts were refined and peak hour turning movement forecasts were developed under build-out conditions for selected intersections. Turning movement forecasts at key intersections along Elk Vale Road, the East-West Road, East Anamosa Street, and SH 44 are shown on Figures 10 and 11. Analyses based on these peak hour turning movement forecasts were used, along with daily volume forecasts and capacity thresholds, to evaluate the roadway needs described below.

C. Corridor Analysis

Levels of service (LOS) were evaluated at selected key intersections using signalized and unsignalized intersection analysis techniques described in the 1994 Highway Capacity Manual, published by the Transportation Research Board. LOS is a national standard measure of congestion on roadways and at intersections. LOS is measured on a scale from A to F, with LOS A referring to conditions with essentially no congestion and delay and LOS F referring to high levels of congestion and delay. LOS D is typically considered to be an acceptable level of congestion during peak hours in urban and suburban jurisdictions. Figure 12 shows the proposed lane geometry and resulting peak hour LOS at intersections that were evaluated.

Those of the selected key intersections that are not currently signalized were also evaluated to determine if traffic signals are likely to be warranted in the long-range future. A series of traffic signal warrants are presented in the Manual of Uniform Traffic Control Devices. Signal warrants are thresholds for traffic volumes or other intersection conditions that must be met before jurisdictions should allow installation of traffic signals. Long-range peak hour traffic volumes were measured against the Peak Hour Volume warrant to determine where traffic signals are likely to be warranted.

1. SH 44

SH 44 will require a five-lane cross-section, with two through lanes in each direction and a center left-turn lane. This cross-section will require major widening of the existing two-lane segment east of Longview Drive and minor widening of the existing four-lane segment east of Racetrack Road. Build-out volumes suggest the need to consider additional widening to create six through lanes in western segments of SH 44 in the long-range future. In addition, a third eastbound through lane is recommended beginning at St. Patrick Street, continuing through the Elk Vale Road interchange.

Peak hour turning movement forecasts with full build-out of the Elk Vale neighborhood were developed for SH 44 intersections with Mickelson Drive, Valley Drive, St. Patrick Street, The Elk Vale interchange ramp termini, Racetrack Road, Covington Street, Longview Drive, and Reservoir Road.

At the currently signalized Racetrack Road intersection, a good LOS can be maintained without major intersection improvements.

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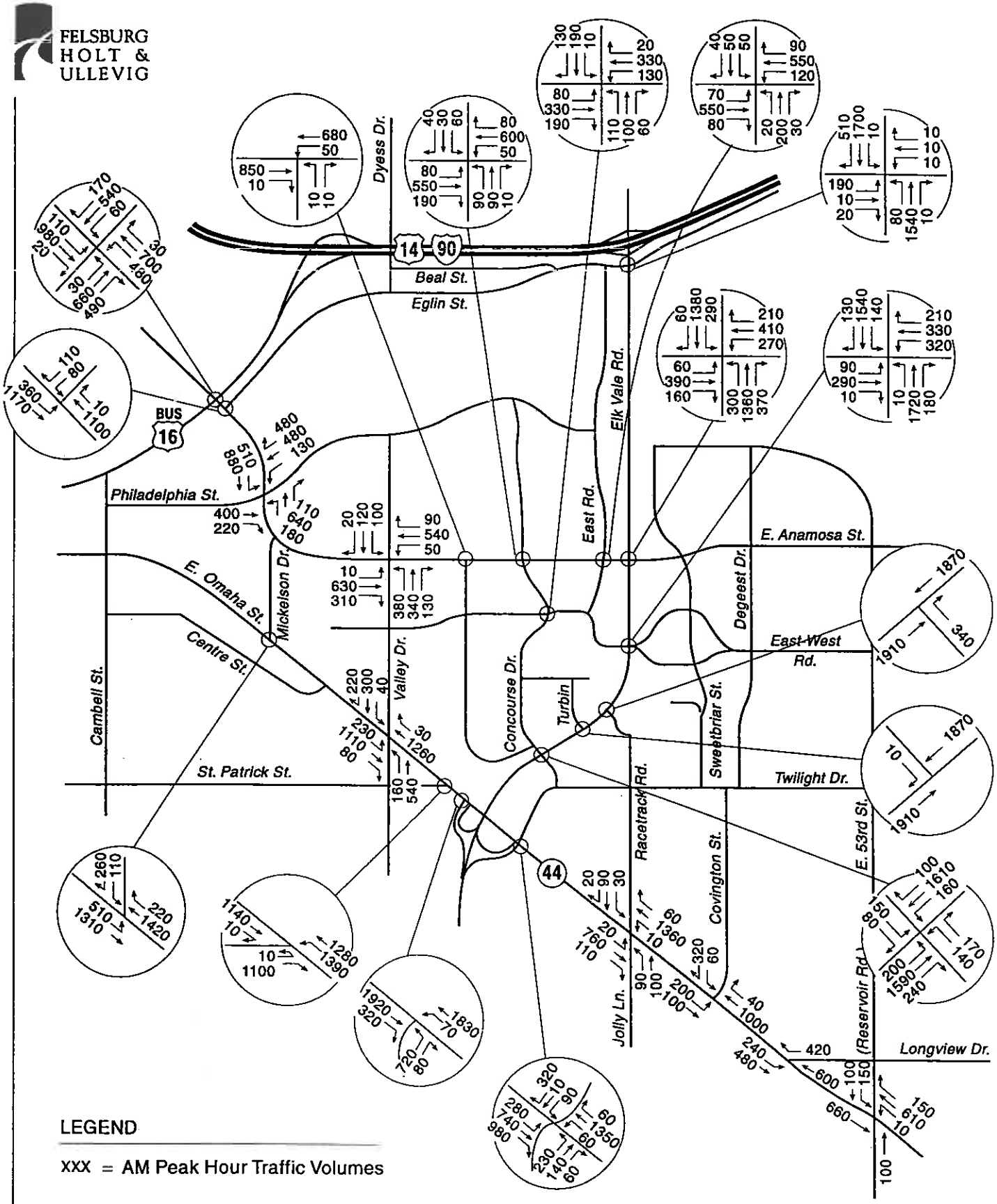

Figure 10

AM Peak Hour Total Traffic Volumes

Elk Vale Build-Out

North

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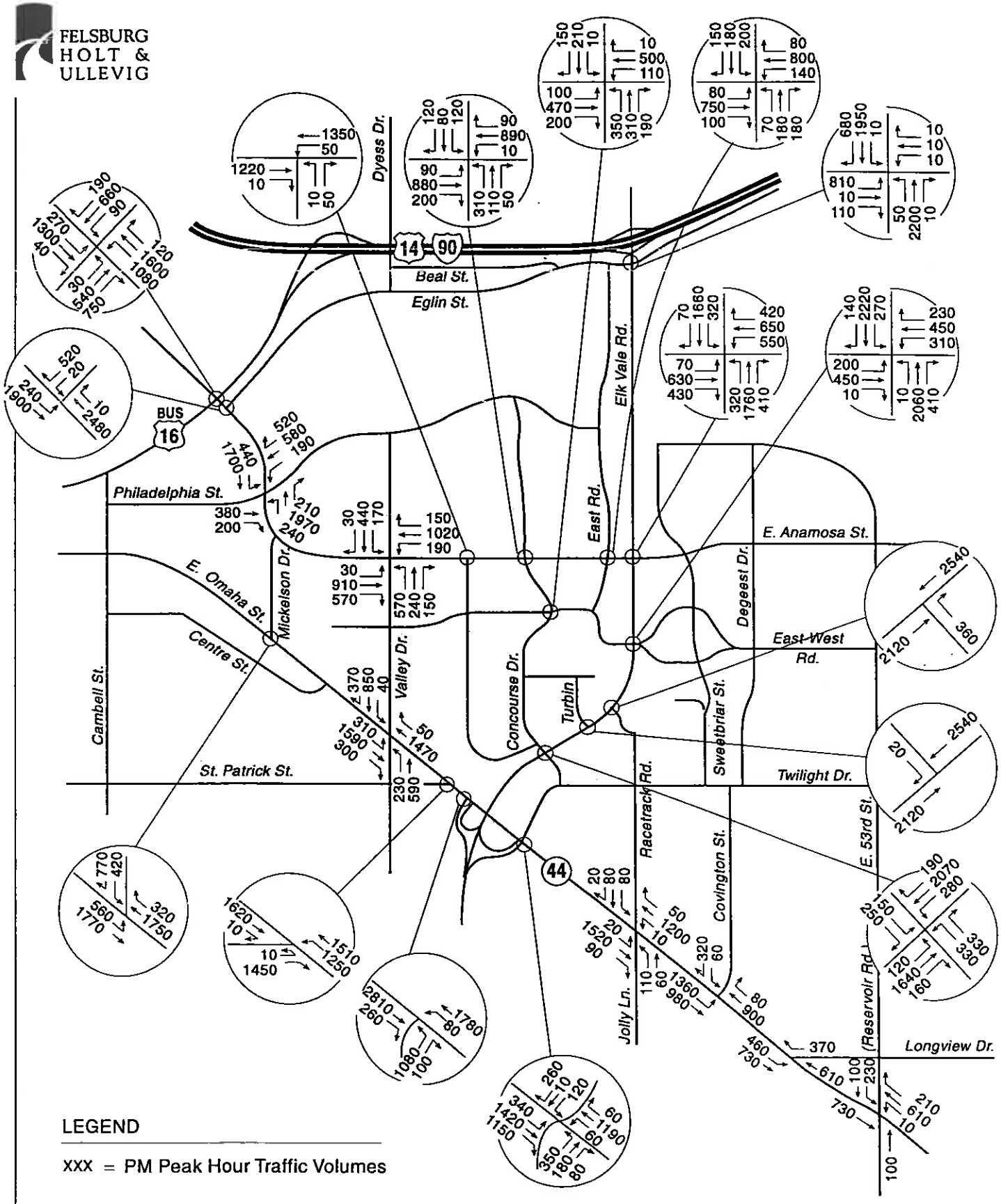

Figure 11

PM Peak Hour Total Traffic Volumes

Elk Vale Build-Out

North

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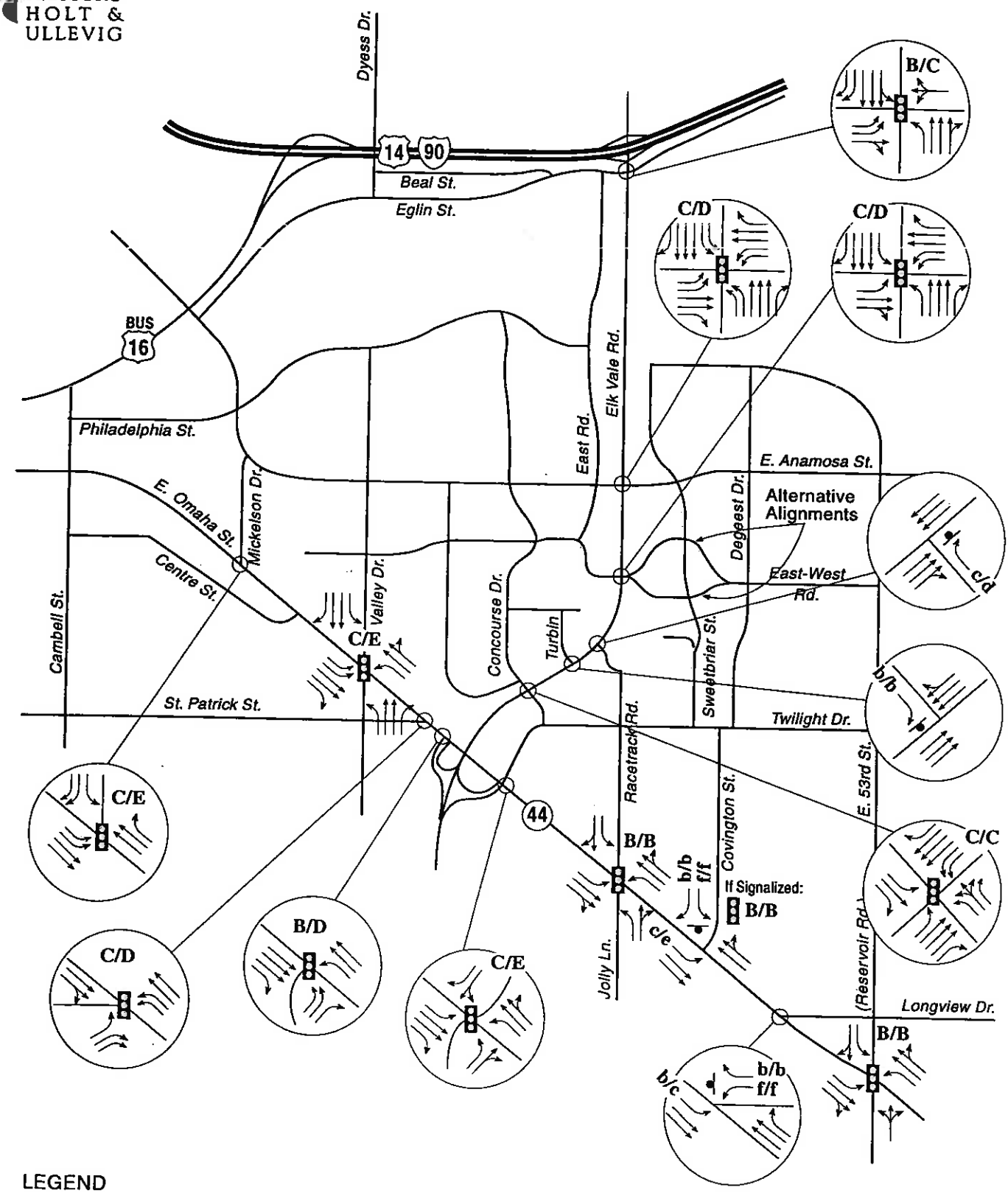

LEGEND

X/X = AM/PM Peak Hour Signalized Intersection Level of Service

x/x = AM/PM Peak Hour Unsignalized Intersection Level of Service

= Stop Sign

= Traffic Signal

North

Figure 12

Intersection Geometry and Peak Hour Level of Service

Elk Vale Build-Out

The Elk Vale interchange ramp terminal intersections will warrant traffic signals. They are projected to operate with PM peak hour LOS D and E in the long-range future with signals in place. Figure 12 shows that a third eastbound through lane is recommended beginning from St. Patrick Street and ending at the eastbound-to-northbound loop ramp to Elk Vale Road.

The intersections at Mickelson Drive, Valley Drive, St. Patrick Street, Reservoir Road, and East 53rd Street are anticipated to meet signal warrants with long-range traffic forecasts. With signalized operation and intersection geometrics shown in Figure 12, peak hour LOS is anticipated to be LOS E at Mickelson Drive and Valley Drive intersections in the western part of the study corridor. These LOS E findings reinforce the conclusion that improvements beyond the four through-lane level may need to be considered on the western segment of SH 44 if these full build-out traffic forecasts are realized.

Traffic volumes at the Covington Street intersection are expected to be close to meeting peak hour signal warrant levels. If this intersection is not signalized, poor LOS can be expected for southbound left-turns onto SH 44. If a traffic signal were to be installed at this location, the intersection would operate at good LOS.

The low volume left-turning movement from westbound Longview Drive to southwest-bound SH 44 is expected to operate at poor LOS. Since this acute turning movement has small demand and the movement can be made using East 53rd Street instead, it is recommended that the turn be prohibited at Longview Drive/SH 44.

SH 44 corridor signal progression was evaluated using the computerized Passer-2 signal progression analysis program. A 45 miles per hour travel speed along SH 44 and 90 second signal cycles were assumed for this analysis, in a corridor extending from Mickelson Road to Reservoir Road. Quality of signal progression can be measured by the calculated green-band through the corridor. Green-band is the amount of time during each signal cycle during which a vehicle can travel through the corridor without encountering a red traffic signal. This analysis resulted in AM and PM peak hour green-bands ranging from 15 seconds to 23 seconds. These green-bands are characterized by the Passer-2 program as being indicative of "fair progression".

2. *Business 16*

Build-out volume forecasts on Business 16 are near capacity thresholds for four-lane principal arterials, although the southwest extension of Elk Vale Road will relieve this road of some of its through demand. Continued intersection improvements and access control on this corridor are expected to allow for acceptable operations with four through lanes until forecasts very close to Elk Vale build-out levels occur. At build-out forecast levels, additional through capacity may be considered west of Anamosa Street.

3. *Elk Vale Road*

Elk Vale Road is projected to have traffic volume levels of 43,000 to 56,000 vehicles per day in the long-range future, with its southwest extension and Elk Vale neighborhood build-out. Six through-lanes will be required to accommodate these long-range volume levels. Approximately 60% of volume growth associated with full build-out can be accommodated in a four through-lane section, suggesting construction of an initial four through-lane roadway improvement, with right-of-way preserved for a future six-lane expansion.

Elk Vale Road intersections were evaluated assuming that the access control plan tentatively agreed to by SDDOT and Rapid City would be in place. This plan calls for full movement intersections at Concourse Drive, the East-West Road, East Anamosa Street, and Eglin Street. Each of these intersections is expected to meet signal warrants when substantial adjacent development is in place.

Figure 12 shows that peak hour LOS with depicted configurations would be LOS D at the East Anamosa and East-West Road intersections or better at Concourse Drive, the East-West Road, and Eglin Street with the maximum reasonable laneage shown on Figure 12. This finding reinforces the importance of the East-West Road as an alternative east-west connection to reduce pressure on East Anamosa Street. It also suggests that if traffic volume levels approach forecasted build-out levels, additional improvements may be considered. One such potential improvement could be a grade-separated connection of the unnamed east-west road in the northern part of the study area across Elk Vale Road. If warranted by development in the northern parts of the study area and by Anamosa Street congestion, this could provide a useful alternative east-west route for vehicular traffic, as well as bicycle and pedestrian movements.

Elk Vale corridor signal progression was evaluated, again using the computerized Passer-2 signal progression analysis program. A 45 miles per hour travel speed along Elk Vale Road and 100 second signal cycles were assumed for this analysis, in a corridor extending from Eglin Street to Concourse Drive. This analysis resulted in AM peak hour green-bands of 24 and 26 seconds and PM peak hour green-bands of 23 and 22 seconds. These green-bands are characterized by the Passer-2 program as "fair progression" in the AM peak and "good progression" in the PM peak.

To further evaluate the recommendation for an East-West Road with a signalized intersection with Elk Vale Road, signal progression along Elk Vale Road was evaluated without an East-West Road intersection. Signal progression was determined to be similar without the East-West Road intersection. This finding further supports the recommended East-West Road connection.

Other intersections with Elk Vale Road, including Turbin Street and Racetrack Road, are planned for right-turn access only. Evaluation of the right turning movement from Racetrack Road to northbound Elk Vale Road suggests the need for an acceleration lane for this movement on Elk Vale Road. To help preserve traffic flow on Elk Vale Road, no additional access points on Elk Vale Road are recommended.

4. I-90

Forecasted traffic volumes on I-90 can be accommodated with the existing four-lane configuration.

5. East Anamosa Street

Volume forecasts on East Anamosa suggest that four through-lanes will generally provide adequate capacity to accommodate anticipated traffic volumes between Business 16 and Elk Vale Road, although build-out forecasts on the far western segments suggest that right-of-way should be preserved for potential long-range widening to six lanes.

East of Elk Vale Road, a four-lane cross-section will be needed on a segment preliminarily defined to the extension of Degeest Drive. However, the appropriate transition between four and two through lanes will need to be defined as development occurs.

Alignment issues and intersection geometrics along East Anamosa Street are currently being addressed in the East Anamosa Street design process.

6. Cambell Street and St. Patrick Street

Cambell Street and St. Patrick Street in the vicinity of the study area are both forecast to have traffic volumes near their four-lane capacity thresholds in the long-range future.

7. *Minor Arterial and Collector Streets*

Other Elk Vale neighborhood roads are forecast to carry traffic volumes of less than 20,000 vpd with area build-out. General requirements for these streets are briefly discussed below; however, specific lane configurations, traffic control and other roadway characteristics for these streets will need to be defined in concert with adjacent development.

Unnamed Road is a planned east-west road extending from Concourse Drive to I-90. Traffic forecasts suggest the need to plan for four through lanes in the long-range future, although an initial two through lane section may be implemented. Potential long-range grade-separated crossing of Elk Vale Road was discussed earlier, and may be considered if warranted by development in the northeastern part of the study area and by congestion on East Anamosa Street. Such a connection would be estimated to carry roughly in the range of 5,000 to 8,000 vpd at Elk Vale neighborhood build-out, providing a direct access role and also relieving East Anamosa Street and, to a lesser degree, the East-West Road.

Twilight Drive is projected to see increased traffic levels with continuing development, a connection at with the northbound Elk Vale extension off-ramp at SH 44, and a proposed right-turn connection at Elk Vale Road. Long-range build-out forecasts would necessitate consideration of widening western parts of Twilight Drive to include additional intersection turn lanes.

Longview Drive will operate efficiently with a two-lane cross-section. As discussed earlier, prohibition of the acute left-turn from westbound Longview Drive to SH 44 is recommended when SH 44 is improved to a four through-lane section.

Mickelson Drive is expected to require a four-lane section between East Anamosa Street and SH 44 with long-range build-out volumes.

Valley Drive will become a significant north-south spine through the major residential development area planned for the western parts of the Elk Vale neighborhood. Four through lanes will be needed when this area is substantially developed.

Concourse Drive will serve as an important access route for existing and planned industrial and commercial development west of Elk Vale Road. A minor arterial street with two through lanes is anticipated to generally accommodate demand, although adjacent development may necessitate wider segments.

East 53rd Street will have continuity from north of East Anamosa Street to south of SH 44. Traffic volumes are forecast to remain relatively moderate. East 53rd Street will operate efficiently with two through lanes, but development of a center left-turn lane is recommended to reduce conflicts between through traffic and turning vehicles.

East Road is a planned north-south street, extending from the East-West Road on the south to Eglin Street on the north. It will provide an important access and mobility function, particularly due to limited access to the parallel Elk Vale Road. Four-lane segments of the East Road may be required by adjacent development and area travel demand, so preservation of right-of-way to accommodate future four lane sections is recommended.

Other Streets are expected to have relatively moderate volumes and can function effectively as two-lane minor collectors or local streets, with turn lanes as required to accommodate adjacent development.

IV. RECOMMENDED ROADWAY PLAN

A. Functional Classification

Figure 13 shows the recommended roadway plan for the Elk Vale neighborhood. The recommended functional classification is shown. Also depicted are recommended numbers of through lanes under a long-range scenario.

B. Phasing of Improvements

In several cases, the recommended roadway plan shows a range of numbers of through lanes. These are cases where substantial proportions of full build-out forecasts can be accommodated with one laneage, but long-range forecasts are near the borderline of levels requiring additional lanes. In all cases, particularly those where forecasts are near lane threshold levels, future roadway needs will need to be monitored and adjusted as development occurs over time. It is recommended that right-of-way be preserved to allow for the potential expansion to the maximum widths that are shown. The City can apply discretion in determining roadway cross-sections that are required to coincide with particular developments.

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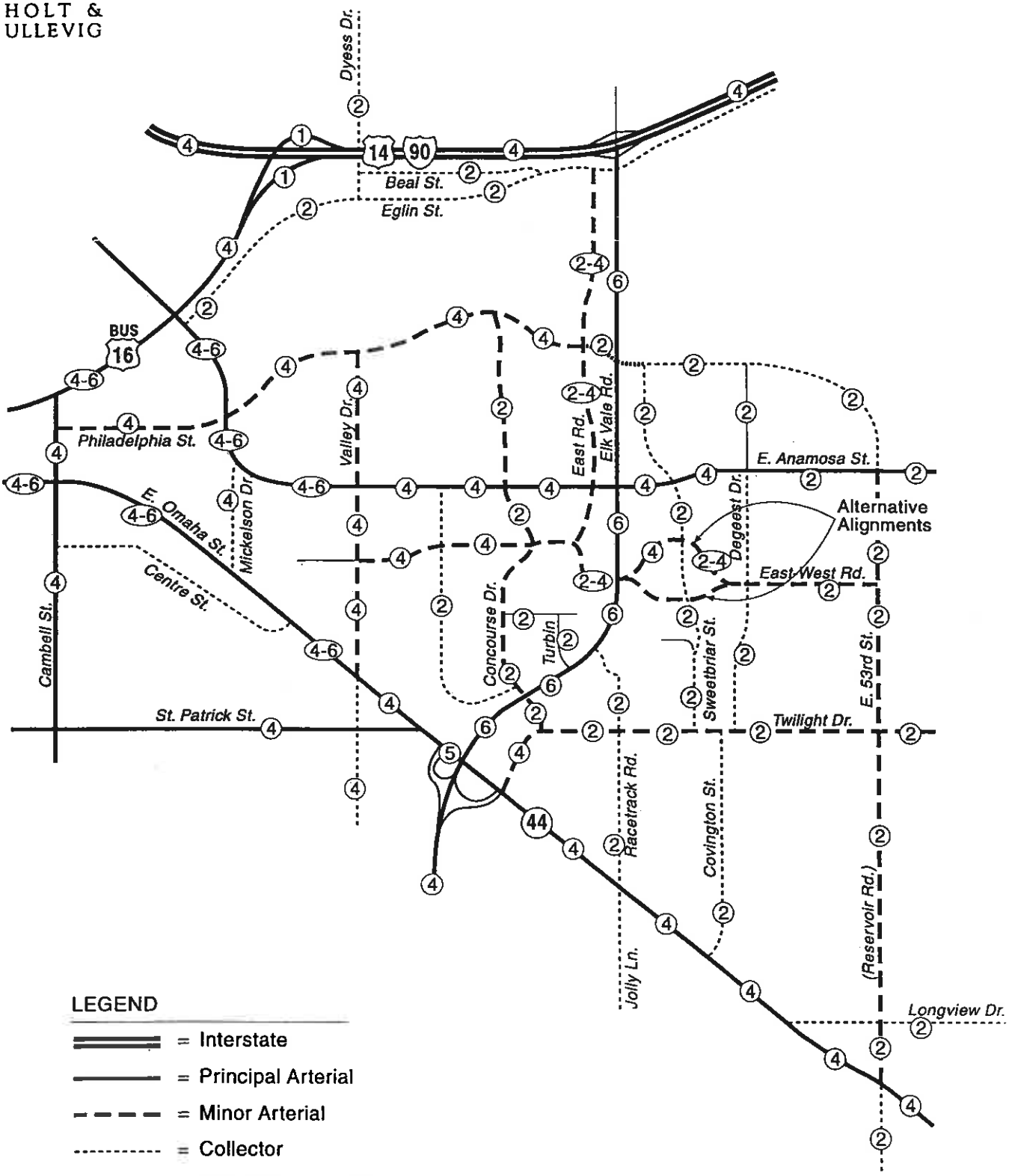

Figure 13

Roadway Plan

North

TECHNICAL ADDENDUM - YEAR 2025 FORECASTS

TECHNICAL ADDENDUM
YEAR 2025 FORECASTS

INTRODUCTION

The analysis presented in the body of this report represents conditions associated with the forecasted build-out of the Elk Vale neighborhood. The build-out scenario for the area provides a basis for the ultimate roadway system that should be planned and for which rights-of-way should be preserved.

Rapid City and its Future Land Use Committee have also prepared a set of development forecasts for the Year 2025 in the Elk Vale neighborhood. This Technical Addendum provides 2025 land use and traffic forecasts. These forecasts will be useful in evaluating phased roadway improvement needs towards the development of the full ultimate roadway system that would be needed at full build-out.

YEAR 2025 ABSORPTION FORECASTS

Table A-1 provides a comparison of dwelling unit and building area forecasts for the Year 2025 and build-out of the Elk Vale neighborhood. This comparison shows that absorption of total build-out land use in the Year 2025 is forecast to be 38% of dwelling units and 29% of commercial/industrial/public building area. This proportion of build-out land use would generate approximately one third of build-out vehicle trip generation.

Table A-1
Year 2025 and Build-Out Elk Vale Neighborhood Land Use Forecasts

Year	Dwelling Units			Commercial/Industrial/Public Bldg Area (1000 Sq. Ft.)					Daily Vehicle Trips
	Single Family	Multi-Family	Total	Retail	Office	Industrial	Public	Total	
2025	3,058	709	3,767	1,226	299	1,272	214	3,011	101,600
Build-Out	5,653	4,296	9,949	3,843	2,443	3,439	565	10,290	301,600
2025 % of Build-Out	54%	17%	38%	32%	12%	37%	38%	29%	34%

YEAR 2025 TRAFFIC FORECASTS

Traffic volumes for the Year 2025 were forecast using the assumption that the one-third of build-out development would be spread proportionally throughout the Elk Vale neighborhood. Thus, one third of all neighborhood-generated traffic volumes was assumed. This neighborhood-generated traffic was added to long-range background traffic forecasts to develop total Year 2025 forecasts.

Figure A-1 shows resulting daily traffic volume forecasts for the Year 2025. A comparison of Year 2025 forecasts with build-out forecasts shows that Year 2025 forecasts are more than half of build-out levels on perimeter roads with major regional movements, including SH 44, Business 16, Elk Vale Road, and I-90. Roads that are expected to carry primarily neighborhood-generated traffic show approximately one third of build-out traffic levels, corresponding with the proportion of build-out land development assumed.

Through laneage needed to accommodate 2025 forecasts is shown on Figure A-1, based on similar planning level thresholds as those presented for buildout conditions. These forecasts show that arterial roadway sections that would warrant six through-lanes to accommodate build-out demand would only require four through-lanes in the Year 2025 scenario, with one third of build-out development. Included are segments of Elk Vale Road, East Anamosa Street, SH 44, and Business 16.

Similarly, the Year 2025 scenario would not necessitate four-through lanes on all of the minor arterials for which four lanes are recommended in the long-range. However, construction of four-lane road segments may be required initially at some locations, depending upon development patterns and phasing in particular parts of the Elk Vale area.

Figures A-2 and A-3 show Year 2025 AM and PM peak hour turning morning forecasts for East Anamosa Street intersections.

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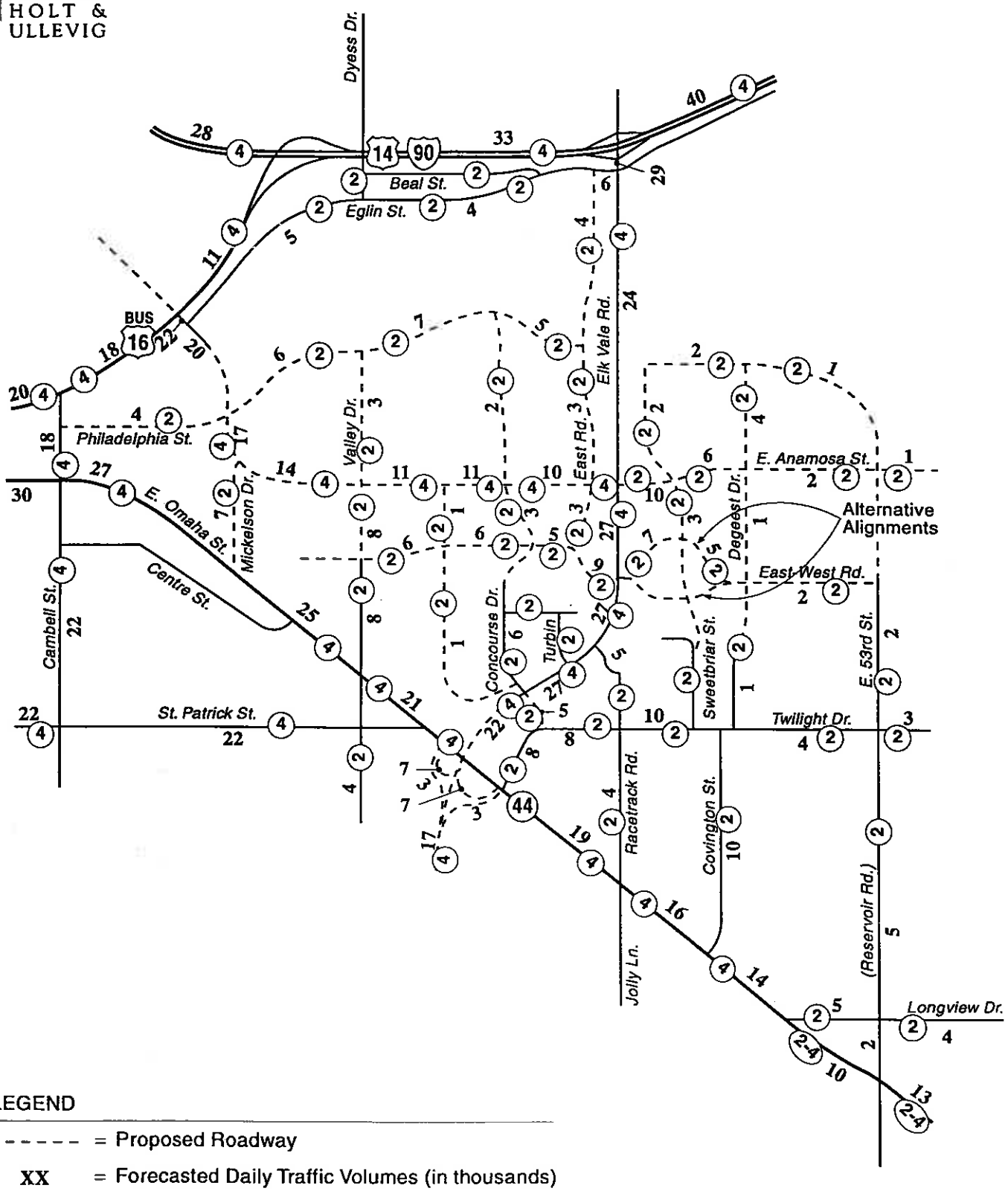

Figure A-1

Year 2025 Traffic Forecasts and Through-Lane Requirements

North

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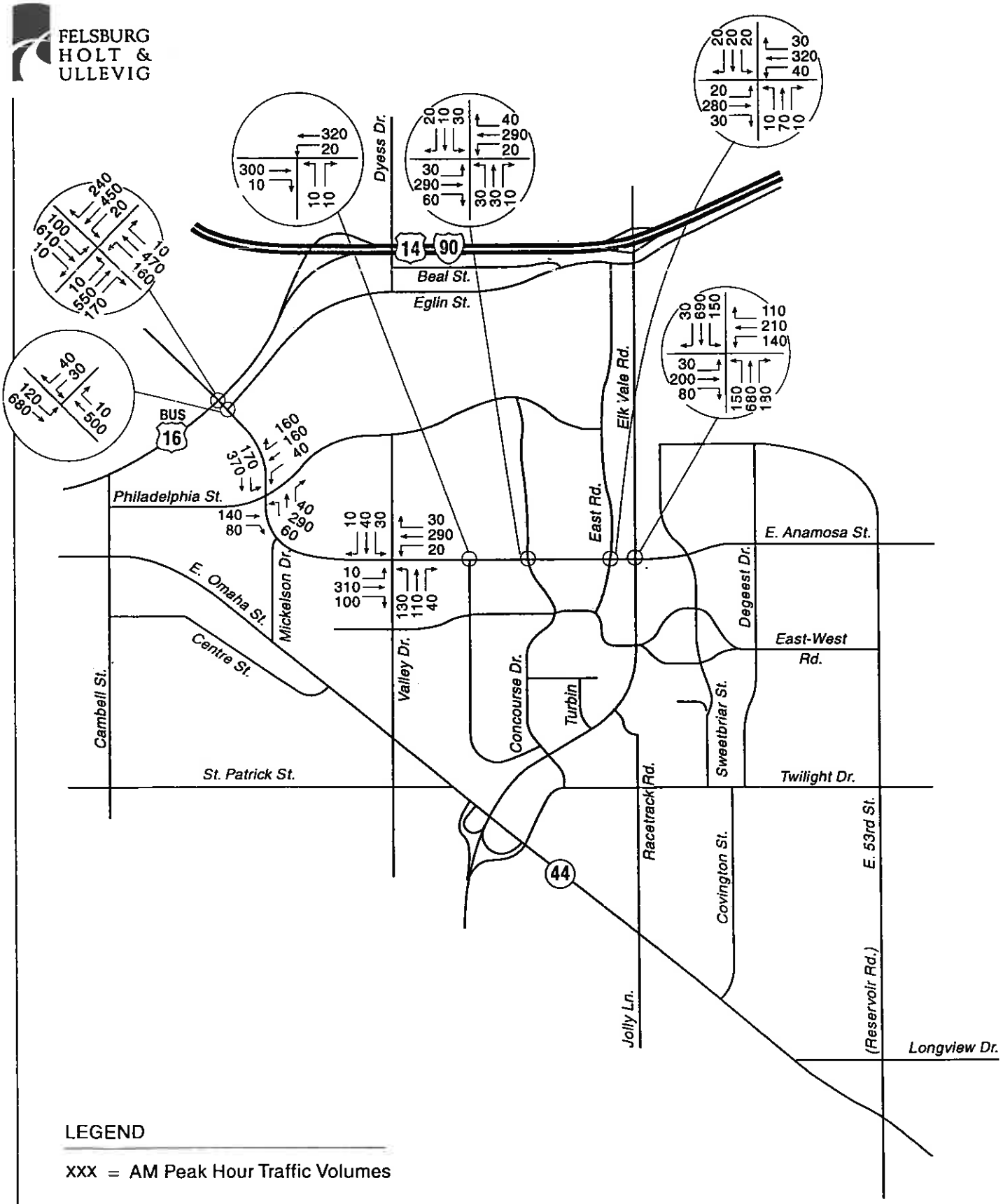

LEGEND

XXX = AM Peak Hour Traffic Volumes

Figure A-2

Year 2025 AM Peak Hour Total Traffic Volumes

East Anamosa Street Intersections

North

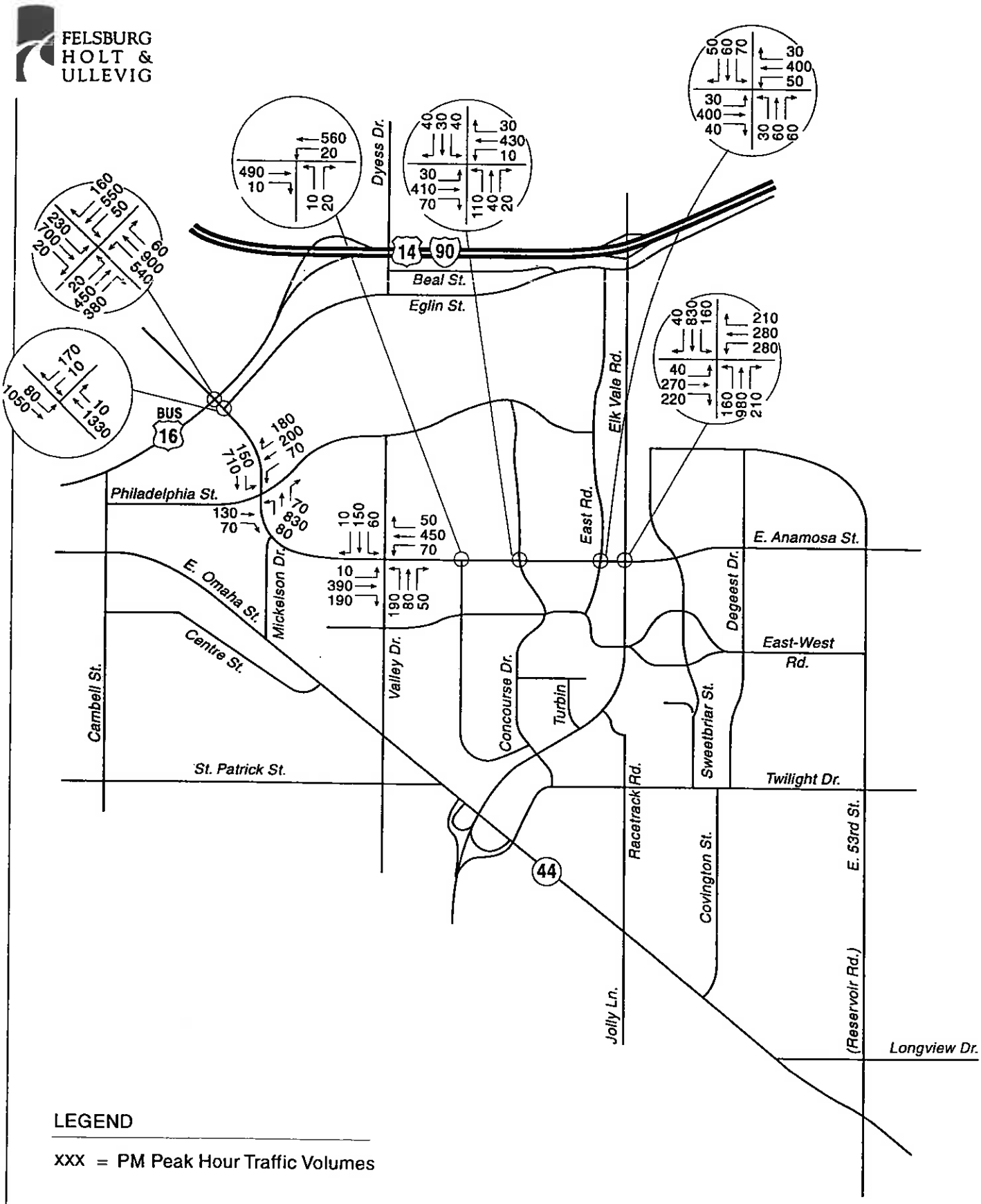

Figure A-3

Year 2025 PM Peak Hour Total Traffic Volumes

East Anamosa Street Intersections

North

APPENDIX C

EAST ANAMOSA TRAFFIC FORECASTS

DRAFT

East Anamosa Traffic Forecasts

East Anamosa Traffic Forecasts

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Prepared by:

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303/721-1440

June 1999
FHU Reference No. 99-055

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INTRODUCTION

The purpose of this report is to present traffic forecasts for the segment of the planned East Anamosa Street extension between LaCrosse Street and East North Street (Business 16). Felsburg Holt & Ullevig is currently completing traffic forecasting and roadway planning for the Elk Vale neighborhood east of East North Street. As part of that project, traffic forecasts have been prepared for the segment of the East Anamosa Street extension east of East North Street.

Forecasting for the west segment involved analysis of two traffic components. First, traffic generation associated with forecasted year 2025 land use for a study area surrounding the East Anamosa Street extension was estimated. Second, through traffic that is forecasts to travel on or cross the study corridor in the Year 2025 was estimated. These two components were added together to form year 2025 traffic forecasts. Daily traffic volume forecasts are presented for major roadways in the study area and peak hour turning movement forecasts are presented for the three major East Anamosa Street intersections, including LaCrosse Street, Cambell Street extended, and East North Street.

STUDY AREA TRIP GENERATION

The Pennington County - Rapid City Planning Department and Future Land Use Committee provided build-out forecasts of land uses in the study corridor by traffic analysis zones. A study area surrounding the subject segment of East Anamosa Street was defined, bounded by LaCrosse Street on the west, I-90 on the north, and East North Street on the south and east.

Figure 1 shows the four traffic analysis zones that comprise the study area. Table 1 shows the build-out development forecasts by zone and land use type. A total of 1183 dwelling units and nearly 2.7 million square feet of retail, industrial, and office space are anticipated at build-out. An estimated 85% of this build-out land use level is forecasted to be developed in the year 2025, yielding approximately 1,000 dwelling units and 2.3 million square feet of non-residential development.

The vehicle trip generation that would be associated with year 2025 land use was estimated using trip generation rates provided in Trip Generation, sixth edition, Institute of Transportation Engineers. Since this area is planned as a large, mixed use area, it is anticipated that a significant proportion of trip making would be internal to the area, by pedestrian, bicycle or short automobile trips between adjacent land uses. Total trip generation for each individual development was reduced by 15% to reflect this anticipated internal trip making.

Table 1 shows that the resulting year 2025 trip generation estimates are approximately 58,000 daily vehicle trips, with nearly 5,500 trips in the PM peak hour.

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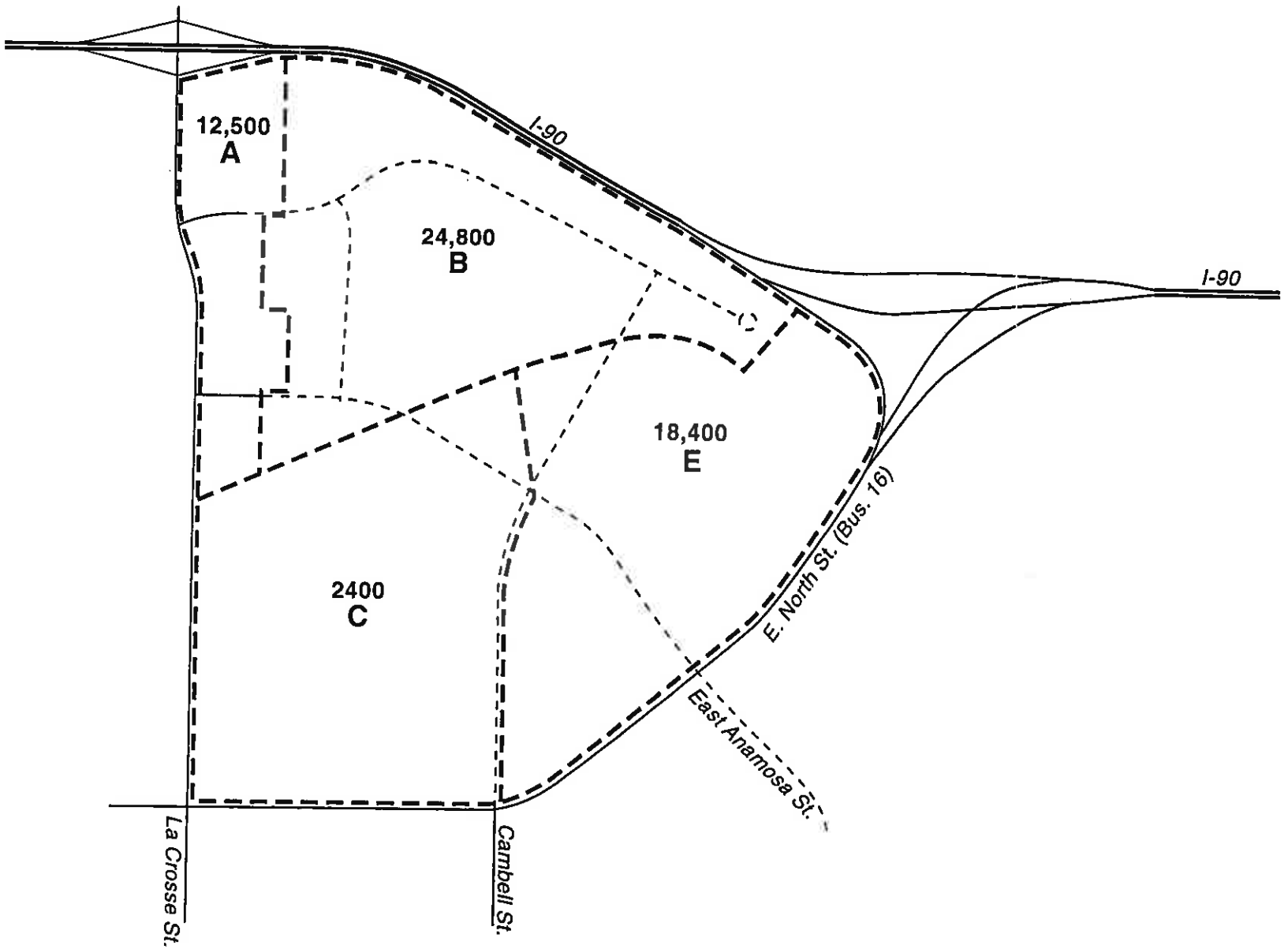

Figure 1
Traffic Analysis Zones
and Year 2025 Daily Vehicle Trips

North

Table 1
West Part of East Anamosa Corridor
Land Use and Trip Generation Forecasts by Traffic Analysis Zone

TAZ	Land Use Forecasts						External Vehicle Trip Generation				
	Dwelling Units			Commercial/Industrial Development (In 1000 SF)			Daily	AM Peak		PM Peak	
	Single Family	Mobile Home	Multi-Family	Light Industrial	Office	Retail (shop/ctr)	(2-way)	In	Out	In	Out
Build-out Forecasts											
A				124	112	353	14,661	405	150	575	792
B			783	209	189	596	29,163	737	538	1,248	1,473
C		320	80	67	5	17	2,823	89	128	156	154
E				374	155	491	21,579	700	227	820	1,249
Total	0	320	863	774	461	1,457	68,226	1,931	1,044	2,799	3,668
Year 2025 Forecasts (85% of Build-out)											
A				105	95	300	12,462	344	127	489	673
B			666	178	161	507	24,788	626	458	1,060	1,252
C		272	68	57	4	14	2,400	76	109	133	131
E				318	132	417	18,342	595	193	697	1,061
Total	0	272	734	658	392	1,238	57,992	1,642	887	2,379	3,118

* Includes a 15% reduction from total trip generation to reflect internal traffic

TRIP DISTRIBUTION

The directional distribution of trips to and from the study area was estimated based on planned land use patterns, the planned major roadway network, existing traffic patterns, and Elk Vale neighborhood traffic analysis. This distribution is shown on Figure 2. Approximately 25% of study area traffic is anticipated to be oriented toward the I-90 and LaCrosse Street interchange to the northwest, 20% is anticipated to be oriented toward the Elk Vale neighborhood and other areas to the east, and 55% is anticipated to be oriented toward the center of Rapid City on the west and south. Specifically, only 5% of study area traffic is expected to use the existing part of East Anamosa Street west of LaCrosse Street, since this segment of Anamosa Street is a residential collector street which lacks continuity to the city's major roadway network.

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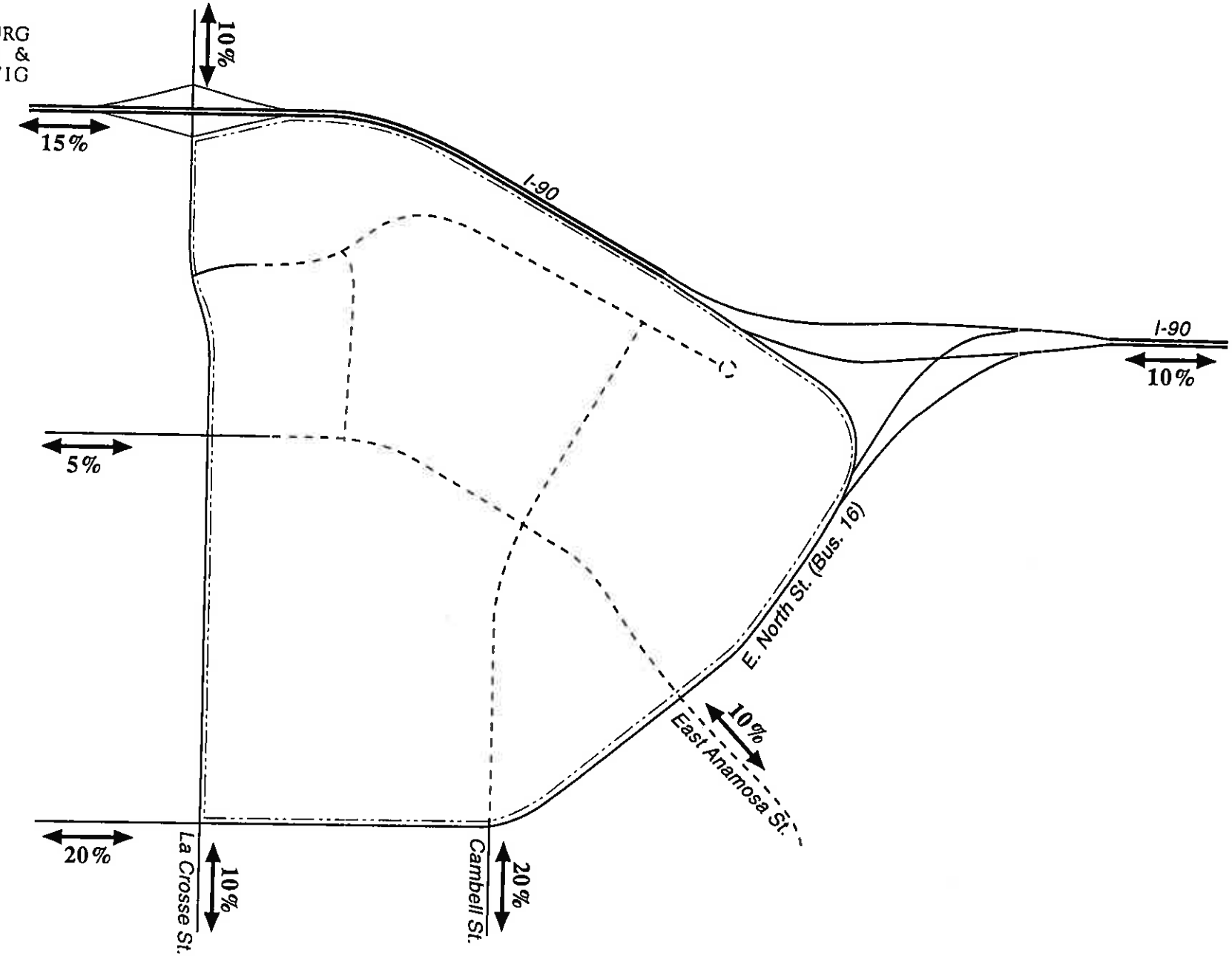

North

Figure 2
Trip Distribution

STUDY AREA-GENERATED TRAFFIC

Figure 3 shows the major roadway network anticipated for the study area. In addition to the extension of East Anamosa Street, the extension of Cambell Street from the south, to intersect with an east-west frontage road south of I-90, is assumed. Figure 3 shows the daily traffic volumes that would be generated by the study area at build-out. Traffic volumes generated by study area volumes on the study segment of East Anamosa Street are forecast to be in 14,000 to 25,000 vehicles per day range.

Figure 4 shows forecast AM and PM peak hour turning movements created by study area development at the three major East Anamosa Street intersections.

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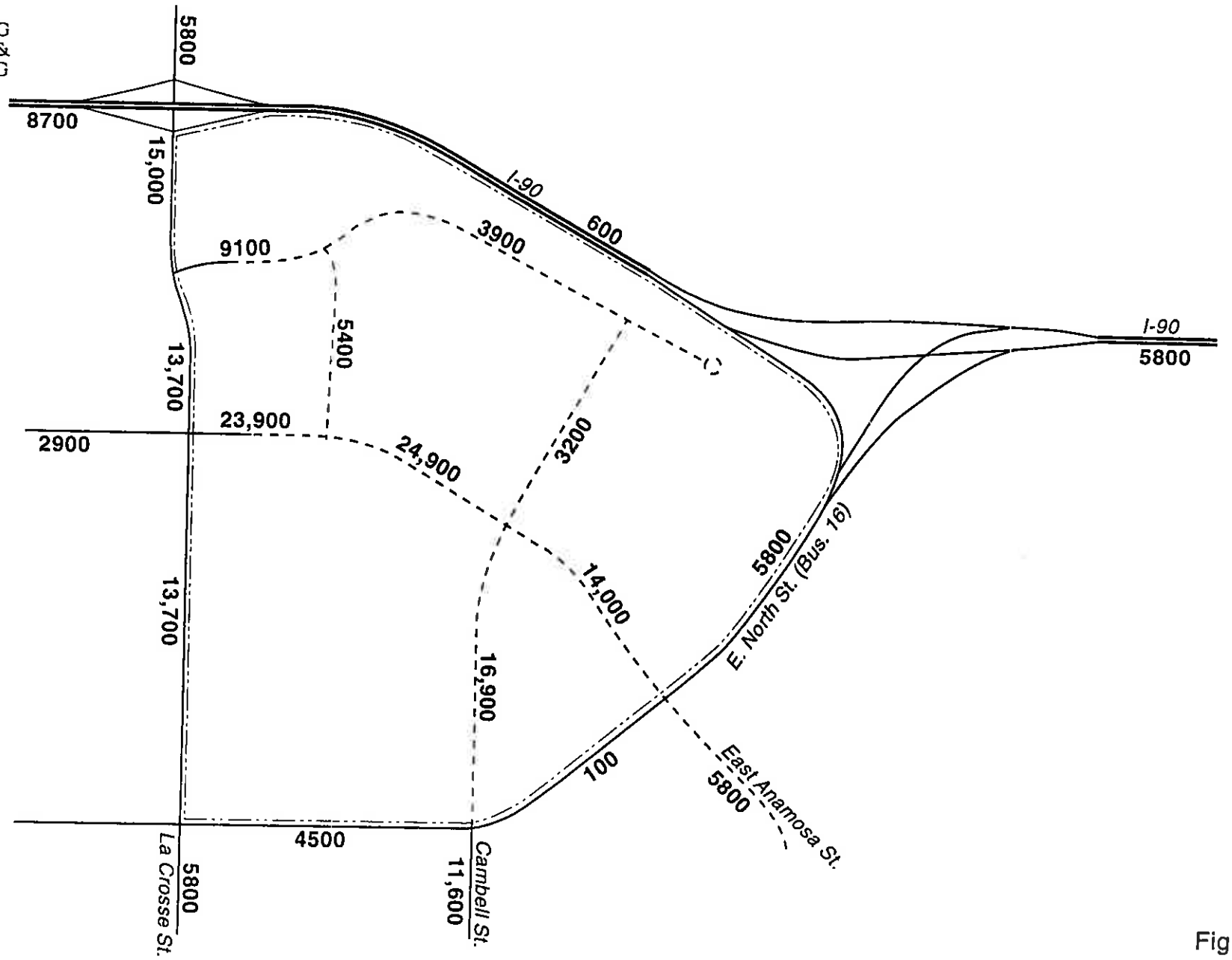

Figure 3

Daily Study Area Generated Traffic

Year 2025

North

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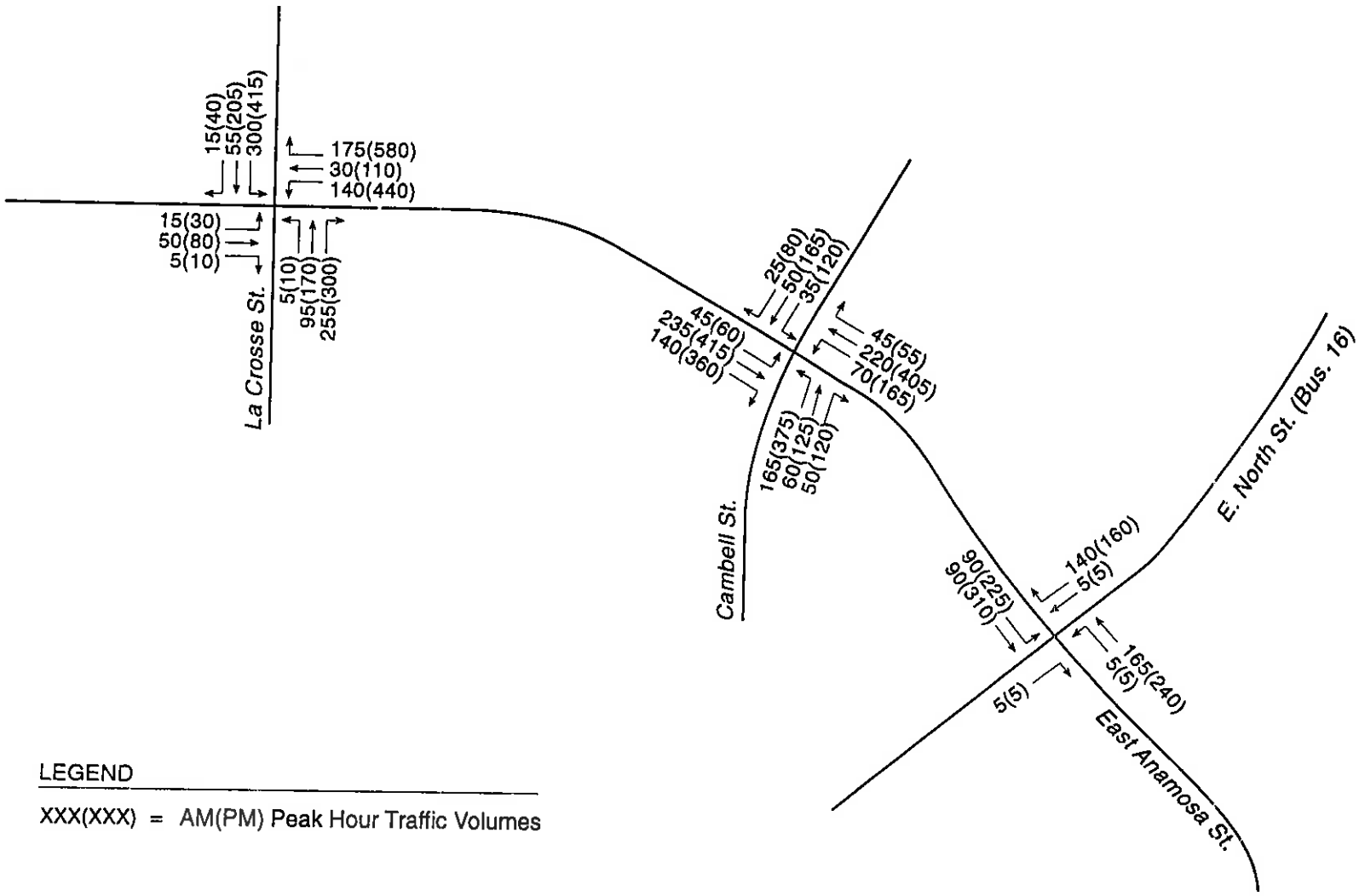

LEGEND

XXX(XXX) = AM(PM) Peak Hour Traffic Volumes

Figure 4

Study Area Generated Traffic

Year 2025

North

THROUGH-TRAFFIC

Figure 5 shows Year 2025 forecasts of major traffic movements on the study segment of East Anamosa Street that do not have an origin or destination within the study area. These estimates are based on existing traffic counts at Lacrosse Street and Anamosa Street, Elk Vale neighborhood traffic forecasts, and other estimated traffic flows resulting from the extension of East Anamosa Street. The same 50% traffic growth assumption by the Year 2025 that was used for Elk Vale Neighborhood traffic analysis was applied for this analysis to existing LaCrosse Street volumes. Traffic forecasts from the Elk Vale Neighborhood analysis are based on anticipated year 2025 development of that area.

The most significant through movement on the study segment of East Anamosa Street is the estimated 6,000 vehicle per day volume forecast to travel between East Anamosa Street in the Elk Vale neighborhood and the I-90/LaCrosse Street interchange.

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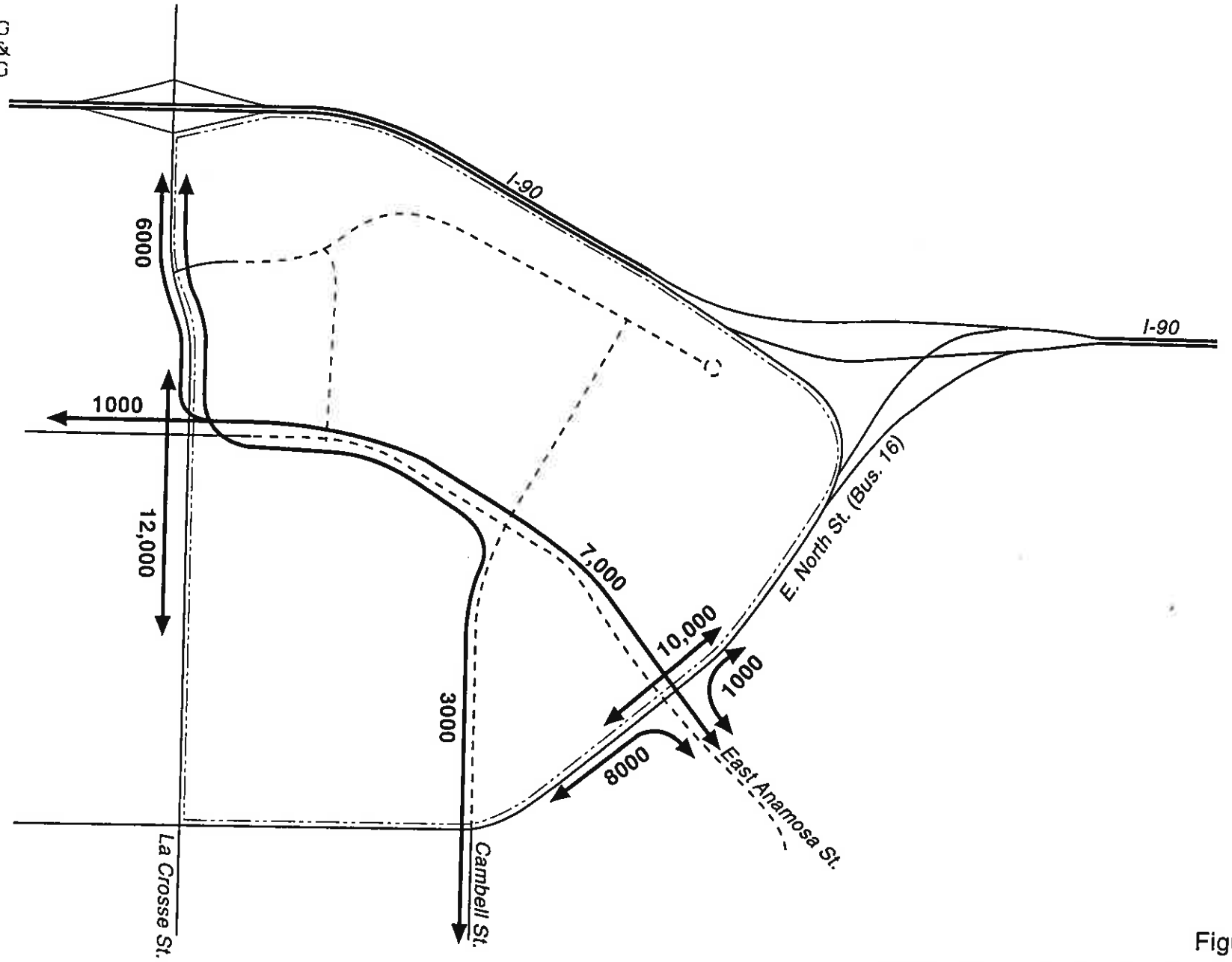


Figure 5
Daily Through Traffic Forecasts
Year 2025

North

TOTAL LONG-RANGE TRAFFIC FORECASTS

Figure 6 shows total long-range daily traffic forecasts on major study area roadways. These forecasts represent the addition of traffic generated by the study area and through-traffic forecasts, both in the year 2025. Traffic forecasts on the study segment of East Anamosa Street are forecast to be in the 20,000 to 35,000 vehicles per day range with area build-out.

Figure 6 also shows through-lane requirements based on the same typical planning-level capacity thresholds used in Elk Vale neighborhood analysis. The threshold for principal arterials such as East Anamosa Street is in the 8,000 to 10,000 vehicles per day per lane range. Based on these ranges, the western part of the East Anamosa Street study segment and the northern part of LaCrosse Street would be near the four to six lane threshold in the year 2025.

Figure 7 shows total forecasted peak hour turning movements at the three major East Anamosa Street intersection. These forecasts represent the addition of study area-generated peak hour turning movements and estimated peak hour movements associated with through-traffic forecasts.

FELSBURG HOLT & ULLEVIG

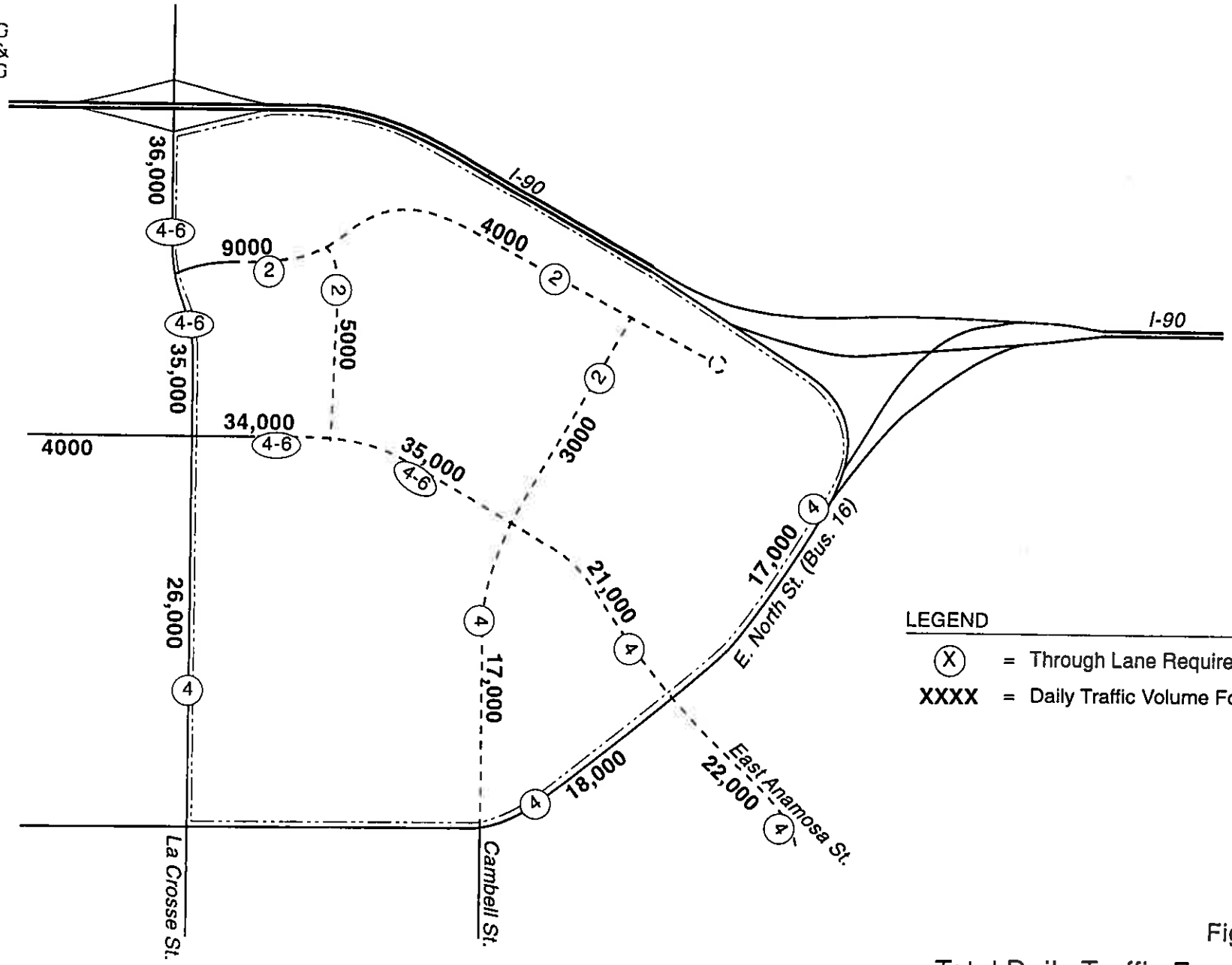
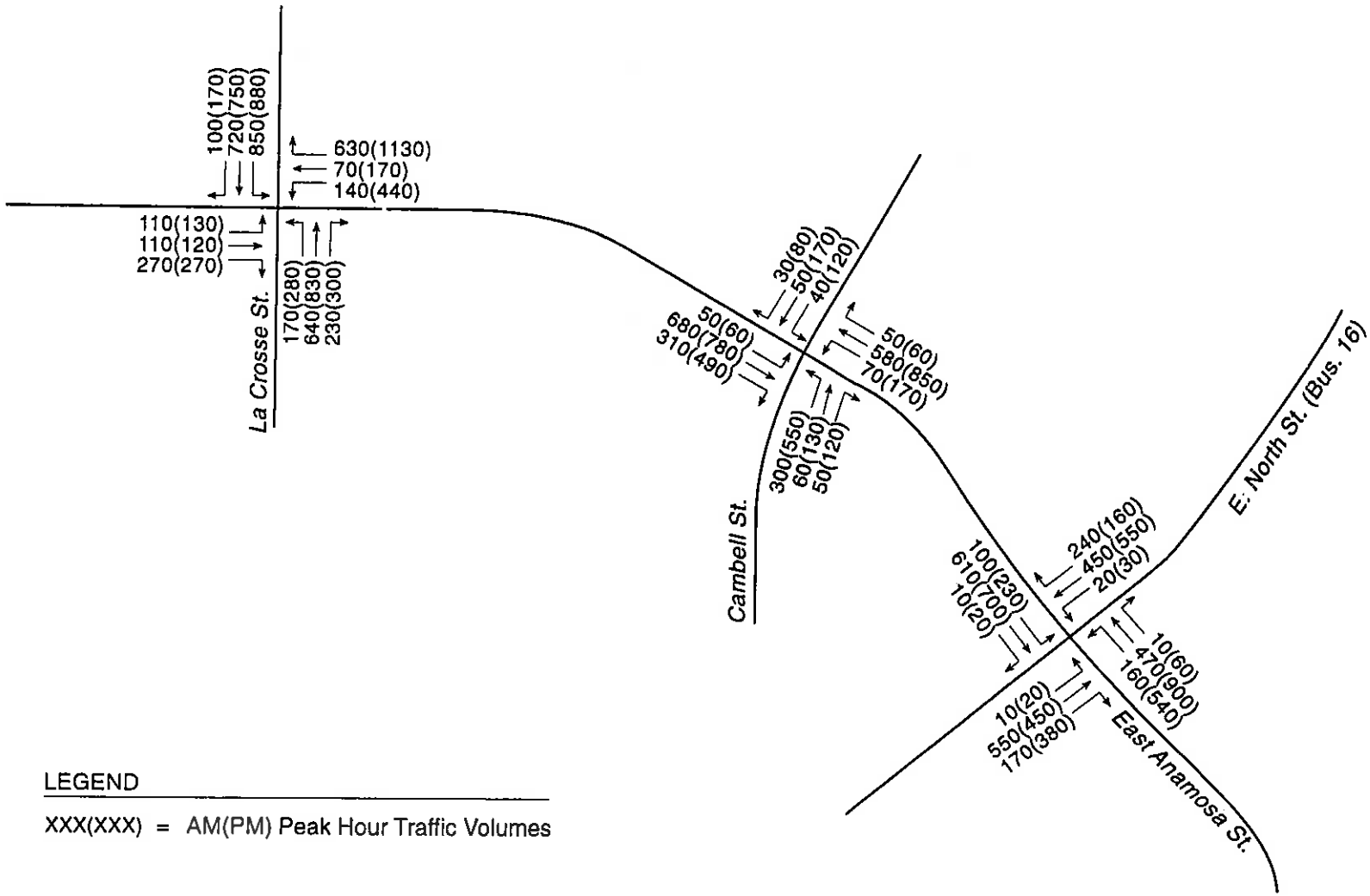


Figure 6.
Total Daily Traffic Forecasts
Year 2025

North

FELSBURG HOLT & ULLEVIG



LEGEND

XXX(XXX) = AM(PM) Peak Hour Traffic Volumes

Figure 7

Total Forecasted Turning Movements

Year 2025

North

APPENDIX D

HORIZONTAL AND VERTICAL ALIGNMENTS OF ALL ALTERNATES

DRAWN BY: SAM, RJD DATE: 11/19/99

RAPID CITY

ELLSWORTH AIRFORCE BASE

I-90

BOX ELDER

EXIT 60

EXIT 61

EXIT 59

LOOP

PROJECT LOCATION

RAPID CITY REGIONAL AIRPORT

DM&E RAILROAD

CAPUTA

90 14 90 79 190 90 90 44 16 79 44 16B 44

VICINITY MAP

EAST ANIMOSA STREET EXTENSION STUDY

98-660/660GES01.DGN

HDR ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 1
PAGE NO. 2

DRAWN BY: SAM, RJD DATE: 11/19/99

EAST ANAMOSA STREET EXTENSION STUDY

STUDY AREA MAP

98-660/660GES02.DGN

FIGURE NO. 2
PAGE NO. 3

MAJOR STREET PLAN

City of Rapid City

Rapid City Area Transportation Planning Process

Layers

City Limits
Principal Arterial
Proposed Principal Arterial
Minor Arterial
Proposed Minor Arterial
Collector Street
Proposed Collector Street
Interstate
Airports
Section Lines

N
W E
S

Miles
0 1 2

I do hereby certify that this Major Street Plan was adopted by the Rapid City Common Council on February 16, 1998. I further certify that original minutes of the Rapid City Common Council meeting on February 16, 1998, are on file in the Finance Office.

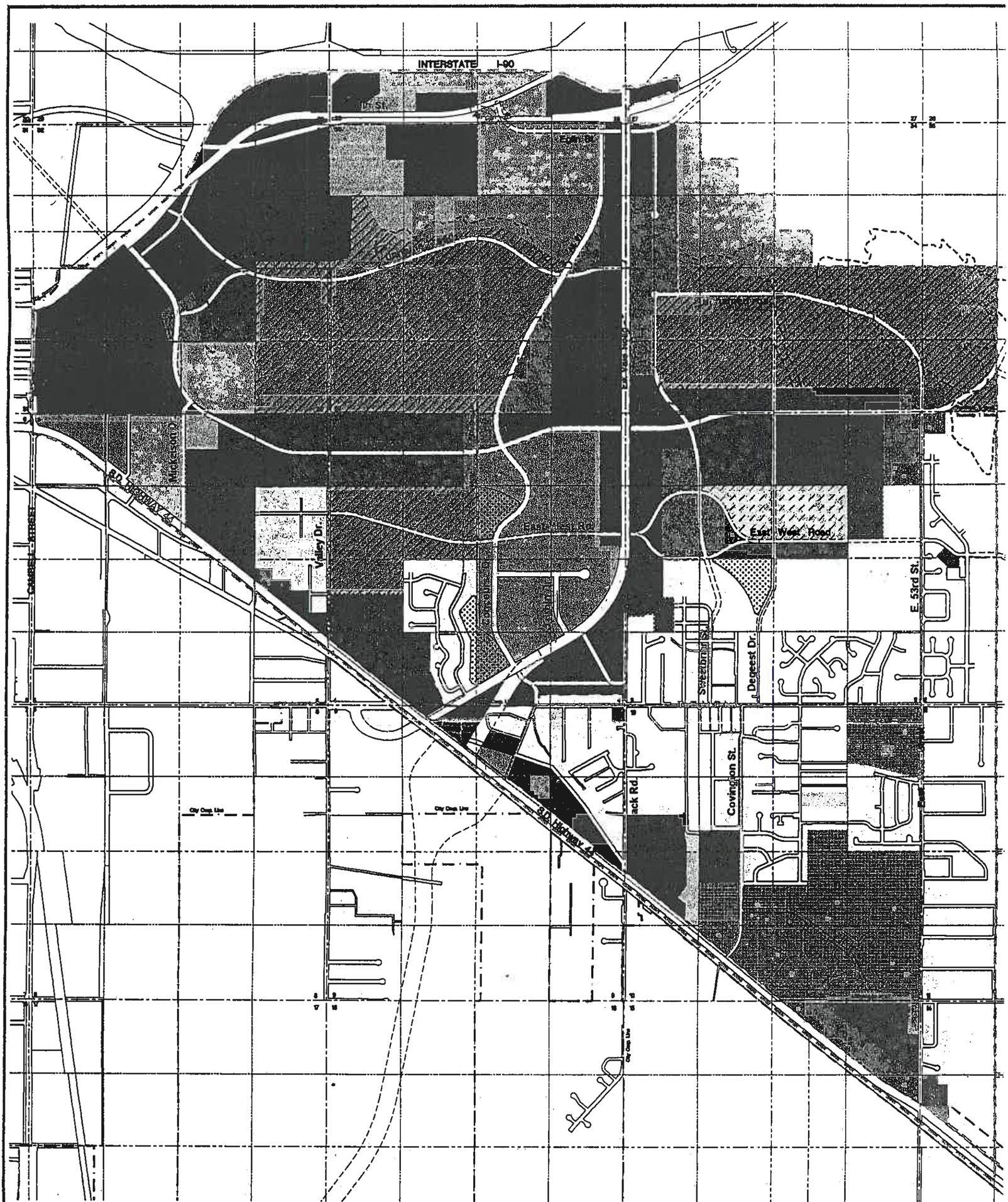
Dated this 16 day of February, 1998.

Jim Shaw, Mayor

James F. Preston, Finance Officer

(SEAL)

Figure No. 3
Page No. 6



FUTURE LAND USE LEGEND:

- PARK FOREST
- MOBILE HOME PARK
- MOBILE HOME PARK w/ P.R.D.
- LOW DENSITY RESIDENTIAL
- PLANNED UNIT DEVELOPMENT
- P.R.D. MAX. DENSITY 1 du / 3 ac
- P.R.D. MAX. DENSITY 1 du / ac
- P.R.D. MAX. DENSITY 1.5 du / ac
- P.R.D. MAX. DENSITY 2.5 du / ac
- P.R.D. MIN. LOT SIZE 6,500 sq. ft.
- MEDIUM DENSITY RESIDENTIAL
- M.D.R. w/ P.R.D.
- HIGH DENSITY RESIDENTIAL
- BUSINESS PARK
- NEIGHBORHOOD COMMERCIAL
- OFFICE COMMERCIAL
- O.C. w/ P.C.D.
- PLANNED COMMERCIAL DEVELOPMENT
- GENERAL COMMERCIAL
- LIGHT INDUSTRIAL
- HEAVY INDUSTRIAL
- GENERAL AGRICULTURE
- PUBLIC
- BIKE PATH ROUTES
- POSSIBLE SERVICE/ FRONTAGE ROADS
- PARK SITE
- CITY CORP. LINE
- DRAINAGE AREAS
- STUDY AREA BOUNDARY
- PROPOSED RIGHT-OF-WAY
- ABOVE ELEVATION 3350 PROVISION OF SERVICES SHALL BE DEVELOPERS RESPONSIBILITY

ELK VALE NEIGHBORHOOD FUTURE LAND USE MAP

SCALE: 1"=1700'

NORTH

DRAFT

12-11-97

GALYARDT ASSOCIATES INC.
ARCHITECTS ENGINEERS PLANNERS
RAPID CITY, SOUTH DAKOTA

PENNINGTON COUNTY-RAPID CI
PLANNING DEPARTMENT

DRAWINGS PREPARED BY:
GALYARDT ASSOCIATES, INC.

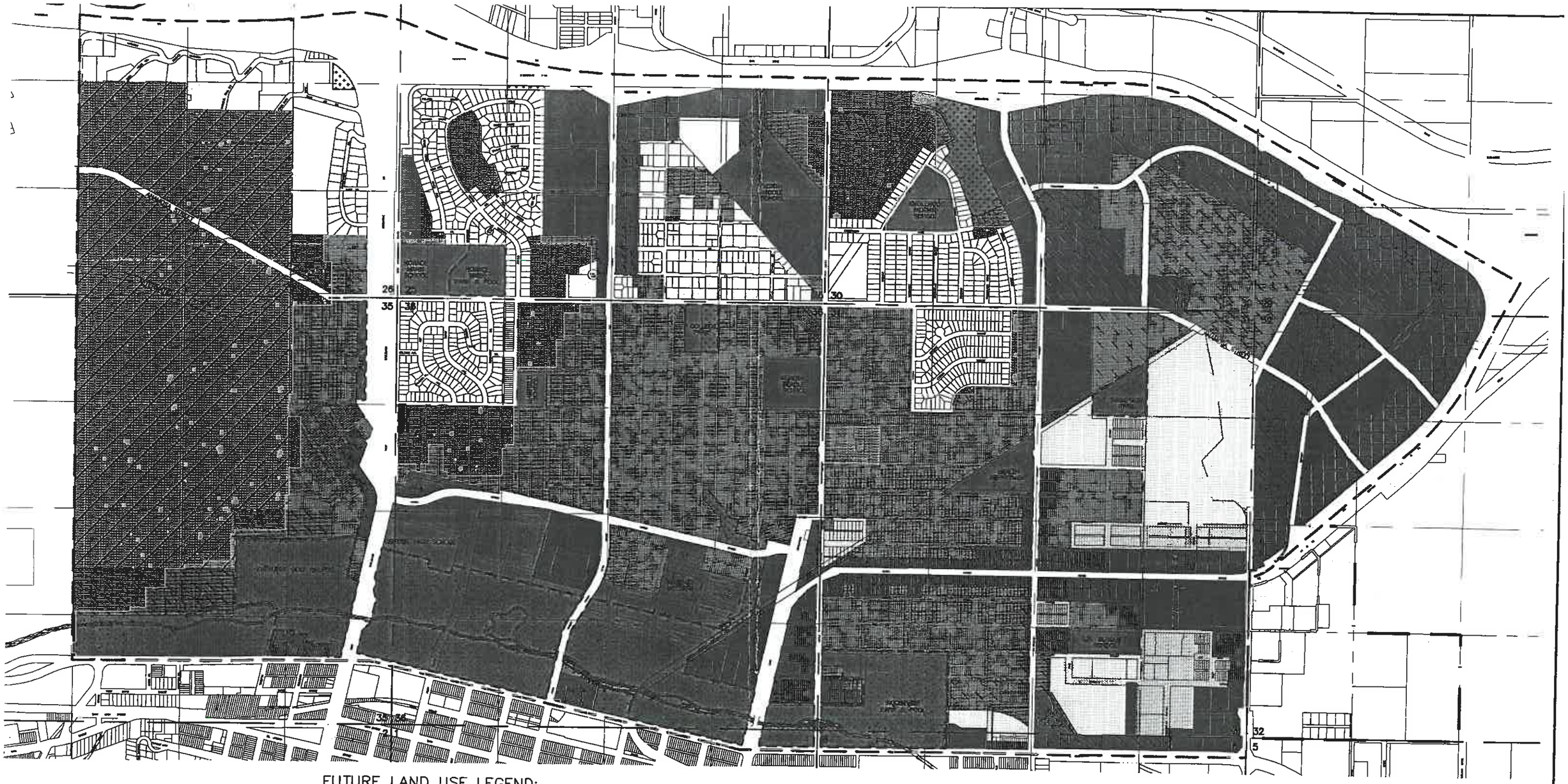
PROPERTY & RIGHT-OF-WAY INFORMATION PROVIDED BY:
HORIZON'S INC.

ELK VALE NEIGHBORHOOD
FUTURE LAND USE MAP

DESIGNED:		DATE: DEC. 1997	APPROVED:
DRAWN: RJF		SCALE: AS SHOWN	
CHECKED:		FILE:	DATE:
REVISIONS:			DATE:

1

FIGURE 4



FUTURE LAND USE LEGEND:

- GENERAL COMMERCIAL
- GENERAL COMMERCIAL w/ P.C.D.
- GENERAL COMMERCIAL w/LANDSCAPE BUFFER ZONE
- O.C. w/ P.C.D.
- P.R.D.
- P.R.D. MAX. DENSITY 1 du / 3 ac
- LIGHT INDUSTRIAL
- NEIGHBORHOOD COMMERCIAL
- M.D.R.
- M.D.R. w/ P.R.D.
- HIGH DENSITY RESIDENTIAL
- MOBILE HOME PARK
- PUBLIC
- PUBLIC FLOOD/HAZARD
- LOW DENSITY RESIDENTIAL
- HOTEL/MOTEL
- BUSINESS PARK w/ P.C.D.
- DRAINAGE AREAS
- PARK SITE
- PROPOSED
- RIGHT-OF-WAY
- CITY CORPORATION BOUNDARY
- STUDY AREA BOUNDARY

NORTH RAPID NEIGHBORHOOD
FUTURE LAND USE MAP

SCALE = 1"=1200'

NORTH

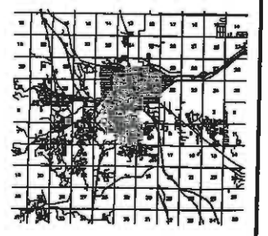
I do hereby certify that this North Rapid Neighborhood Area Future Land Use Plan, as an amendment to the Comprehensive Plan, was adopted by the Rapid City Council on December 6, 1999. I further certify that original minutes of the Rapid City Council meeting on December 6, 1999, are on file in the Finance Office.

Dated this 6th day of December, 1999

Jim Shaw, Mayor

James F. Preston, Finance Officer.

(SEAL)



KEY MAP
NO SCALE
NORTH

PENNINGTON COUNTY-RAPID CITY
PLANNING DEPARTMENT

BANNER

SHEET

Figure No. 4A
Page No. 7A.

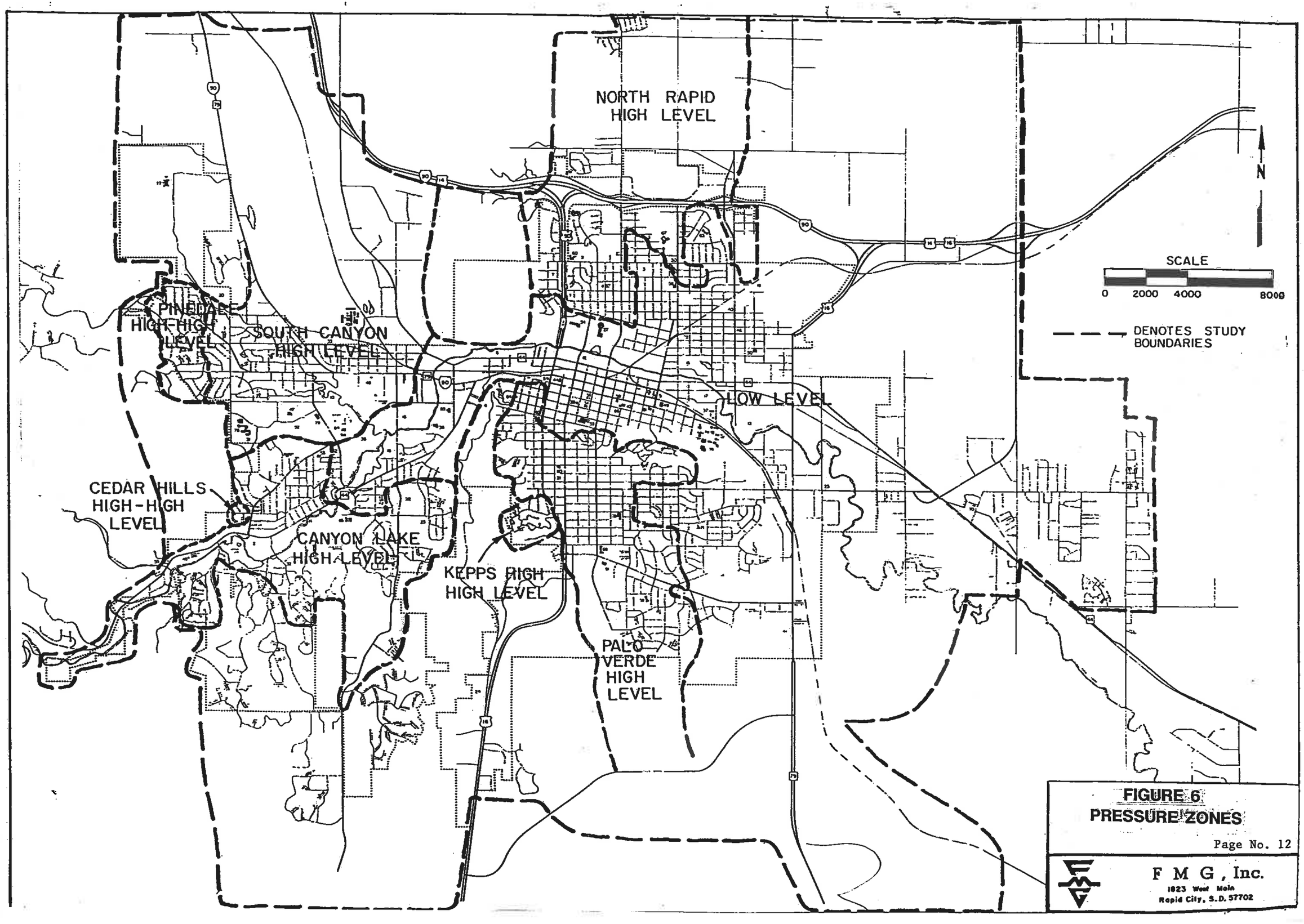


FIGURE 6
PRESSURE ZONES

F M G, Inc.
1823 West Main
Rapid City, S.D. 57702

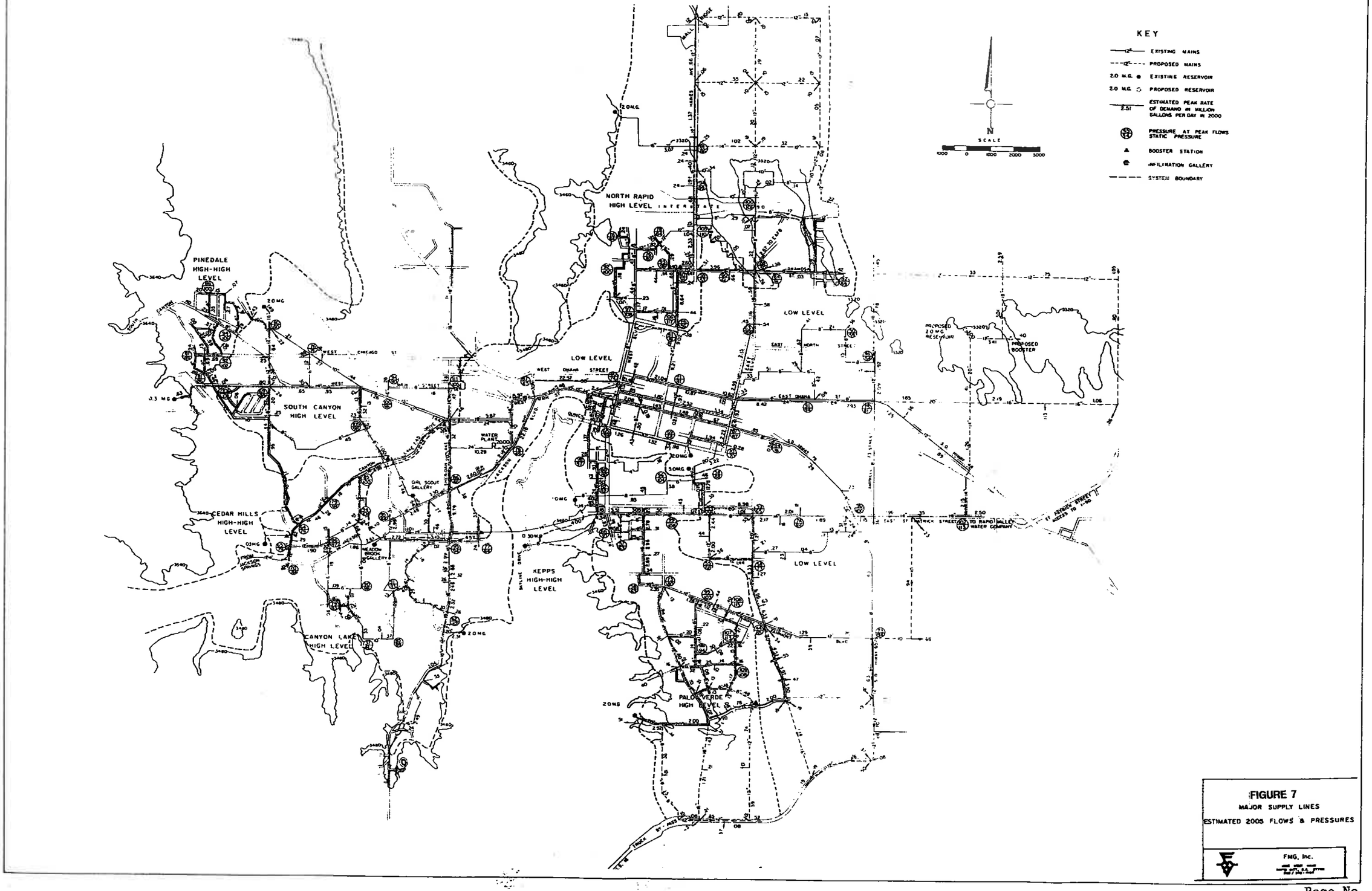


FIGURE 7

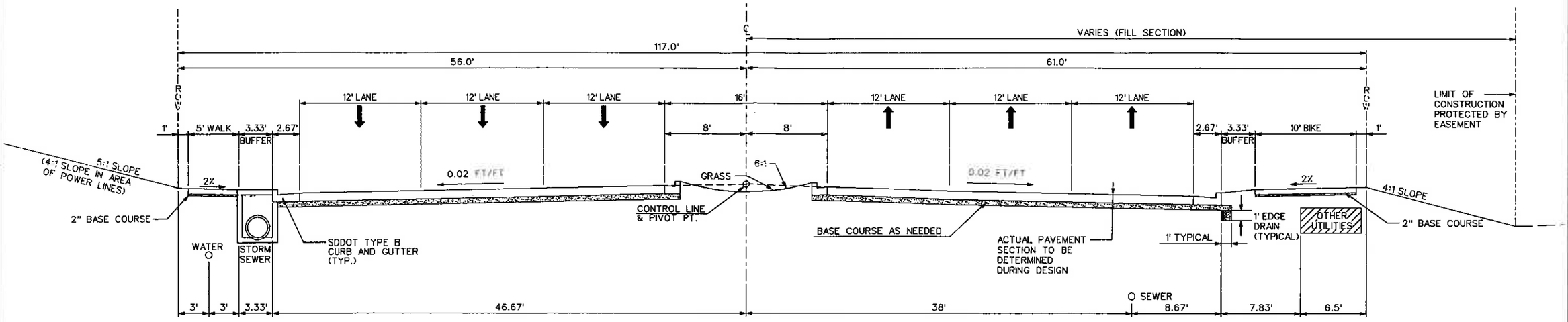
MAJOR SUPPLY LINES

ESTIMATED 2005 FLOWS & PRESSURES

FMG, Inc.

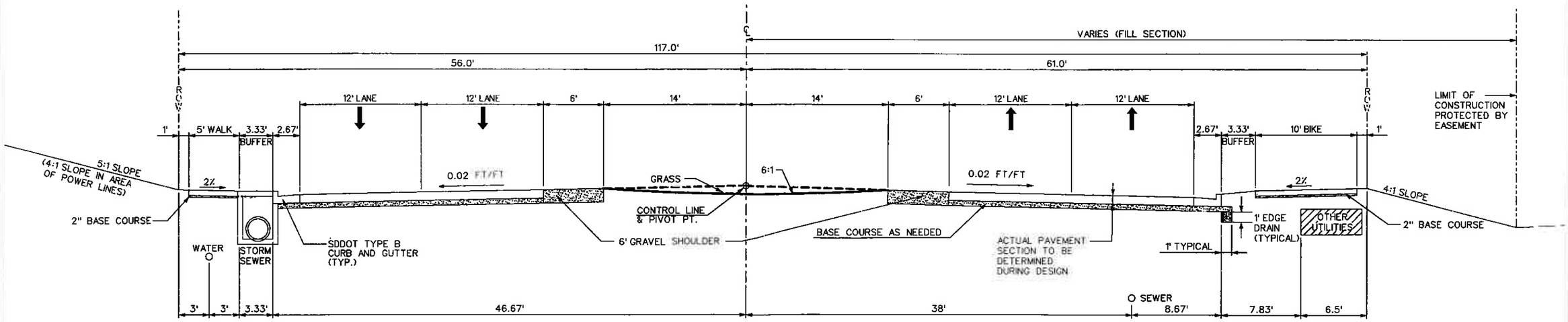
DRAWN BY: SAM, RJD, AP DATE: 05/15/2000

EAST ANAMOSA STREET EXTENSION



*NOTE: WATER LINES SHALL BE PLACED ON THE NORTH AND EAST SIDE.

ULTIMATE TYPICAL SECTION ARTERIAL



*NOTE: WATER LINES SHALL BE PLACED ON THE NORTH AND EAST SIDE.

INTERIM TYPICAL SECTION ARTERIAL

TYPICAL GRADING AND SURFACING
N.T.S.

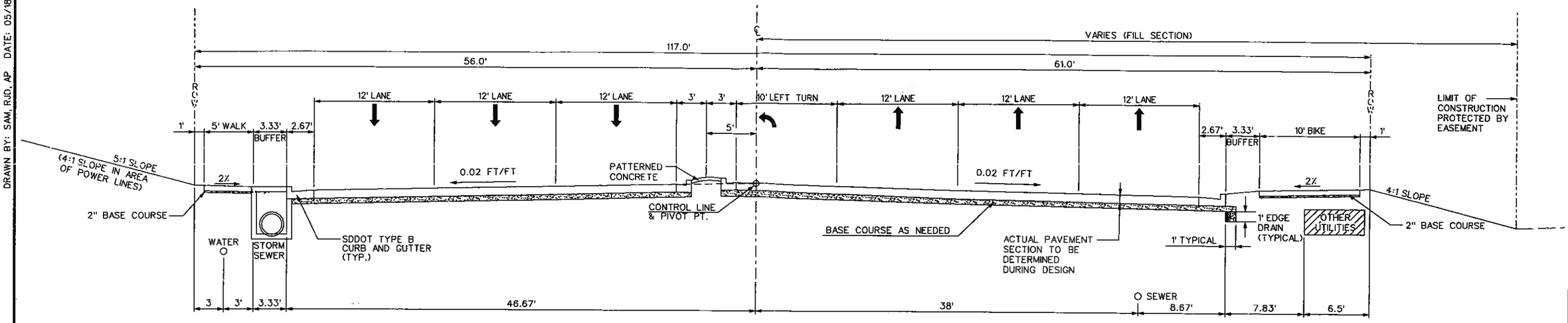
EAST ANAMOSA STREET EXTENSION STUDY

98-660/660RDT06.DGN

FIGURE NO. 8
PAGE NO. 15

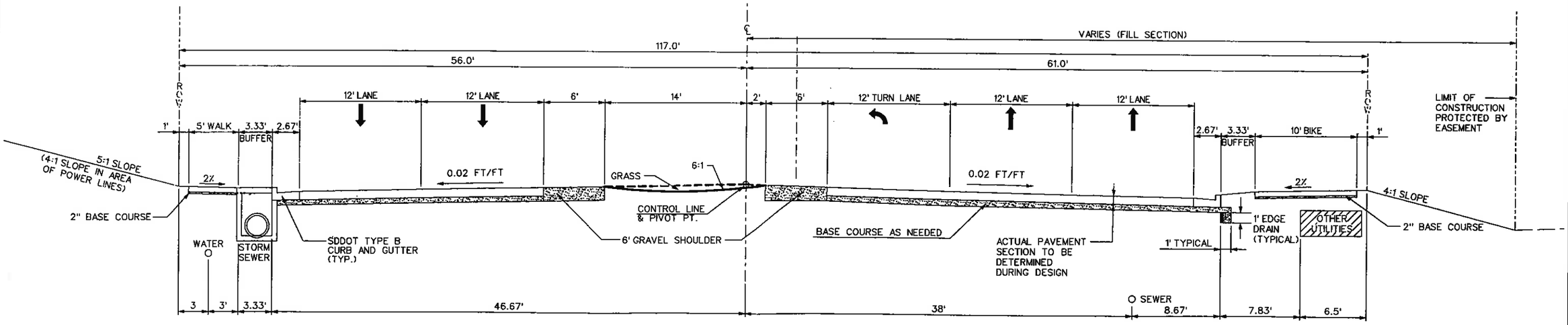
DRAWN BY: SAM, RJD, AP DATE: 05/18/2000

EAST ANAMOSA STREET EXTENSION



*NOTE: WATER LINES SHALL BE PLACED ON THE NORTH AND EAST SIDE.

ULTIMATE TYPICAL LEFT TURN SECTION ARTERIAL



*NOTE: WATER LINES SHALL BE PLACED ON THE NORTH AND EAST SIDE.

INTERIM TYPICAL LEFT TURN SECTION ARTERIAL

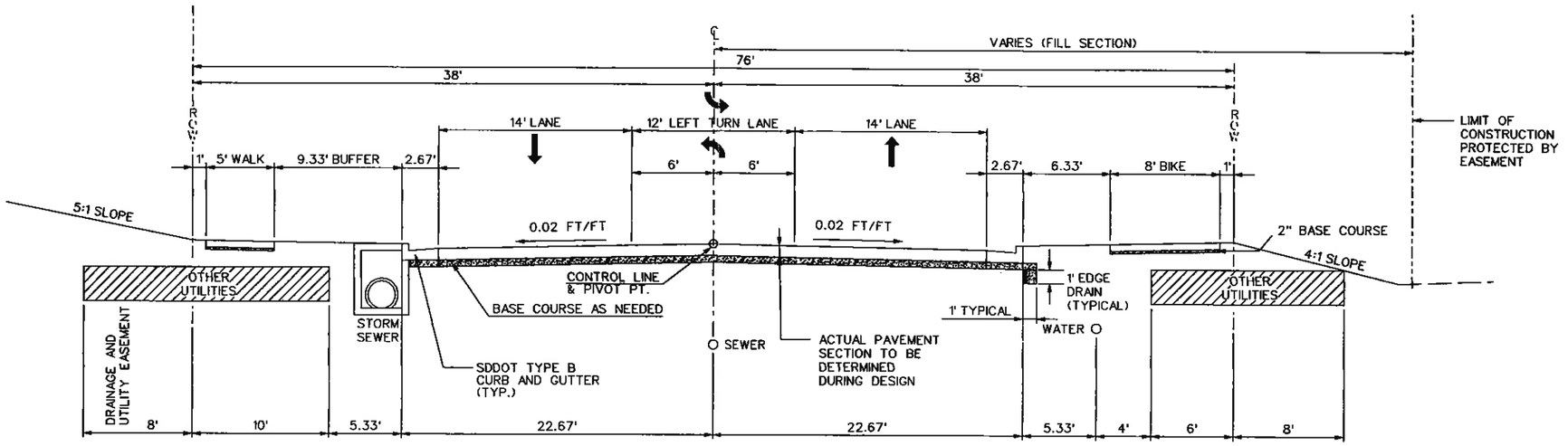
TYPICAL GRADING AND SURFACING
N.T.S.

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660RDT07.DGN

HDR ALLIANCE ARCHITECTS and ENGINEERS

DRAWN BY: HAE/JB/SAM/RJD DATE: 11/19/99



*NOTE: WATER SHALL BE PLACED ON THE NORTH AND EAST SIDE.

TYPICAL SECTION COLLECTOR

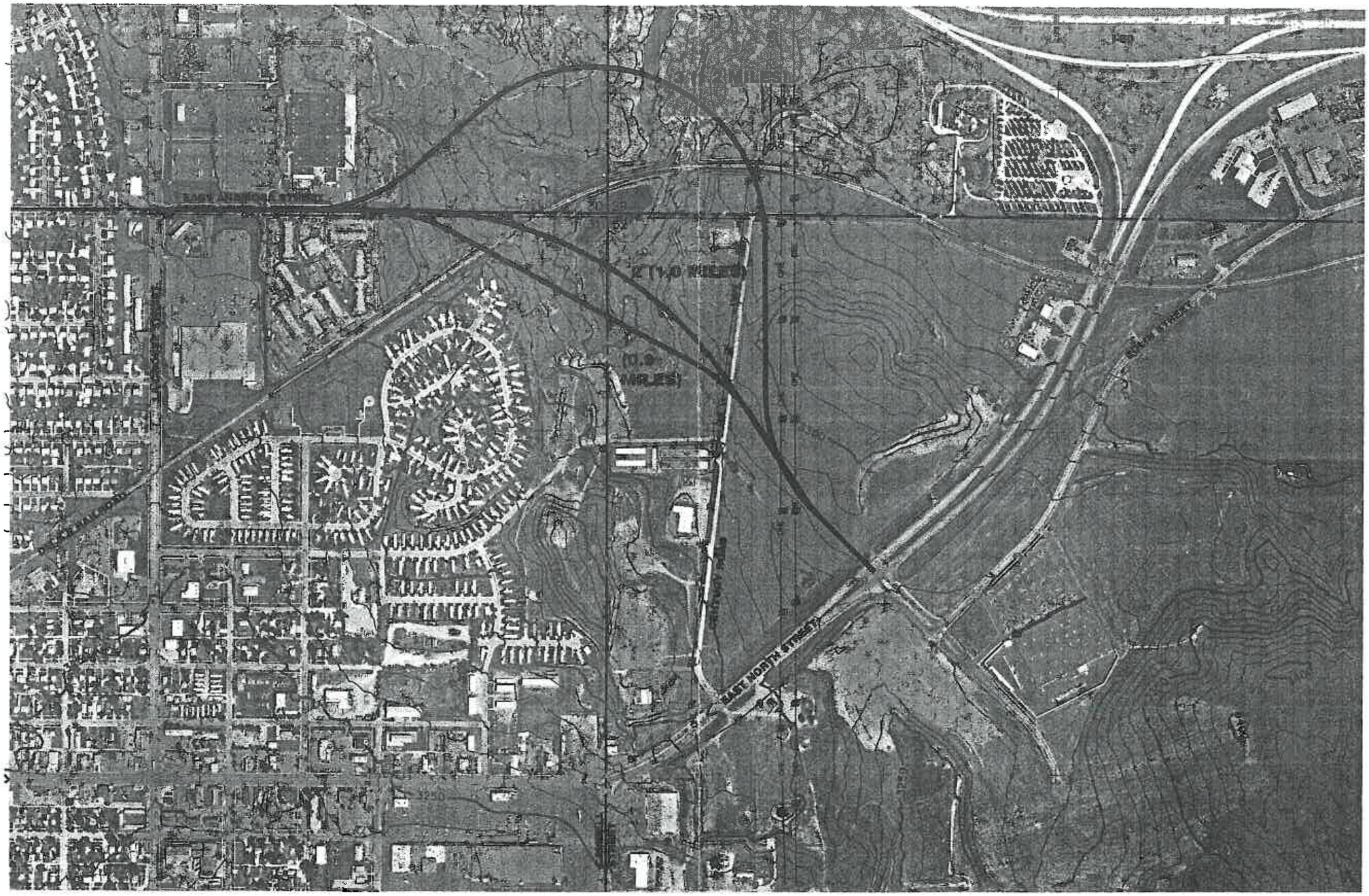
TYPICAL GRADING AND SURFACING
N.T.S.

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660RDT02.DGN

FIGURE NO. 10
PAGE NO. 17

DRAWN BY: RJD DATE: 11/19/99



PROPOSED ALTERNATIVES

600 300 0 600

SCALE: 1" = 600
CONTOUR INTERVAL 10'

WEST LAYOUT PLAN

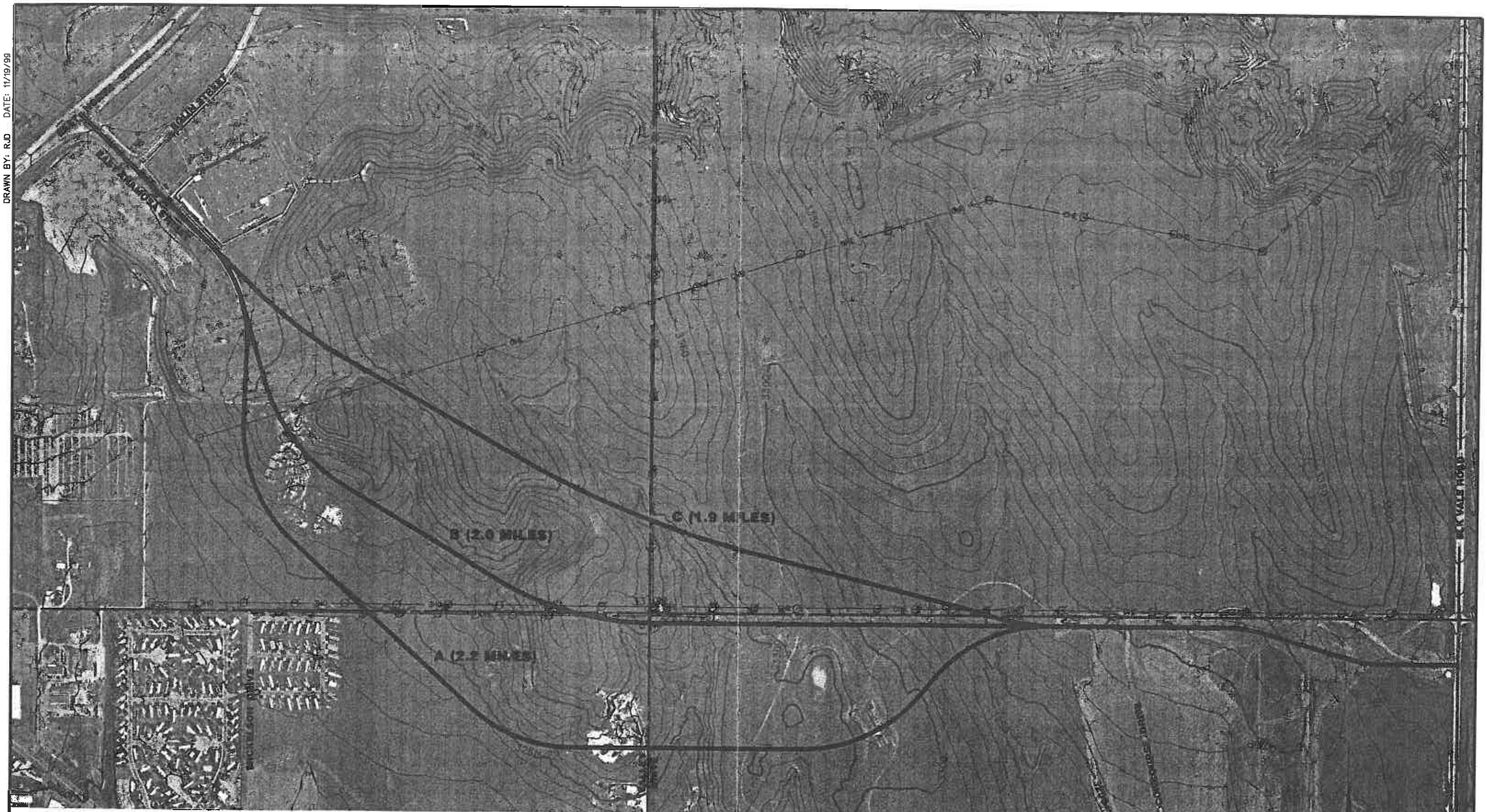
EAST ANAMOSA STREET EXTENSION STUDY

98-660/660RDL1.DGN

HDR ALLIANCE

FIGURE NO. 11
PAGE NO. 24

DRAWN BY: RJD DATE: 11/19/99



PROPOSED ALTERNATIVES

600 300 0 600

SCALE: 1" = 600
CONTOUR INTERVAL 10'

EAST ANAMOSA STREET EXTENSION STUDY

EAST LAYOUT PLAN

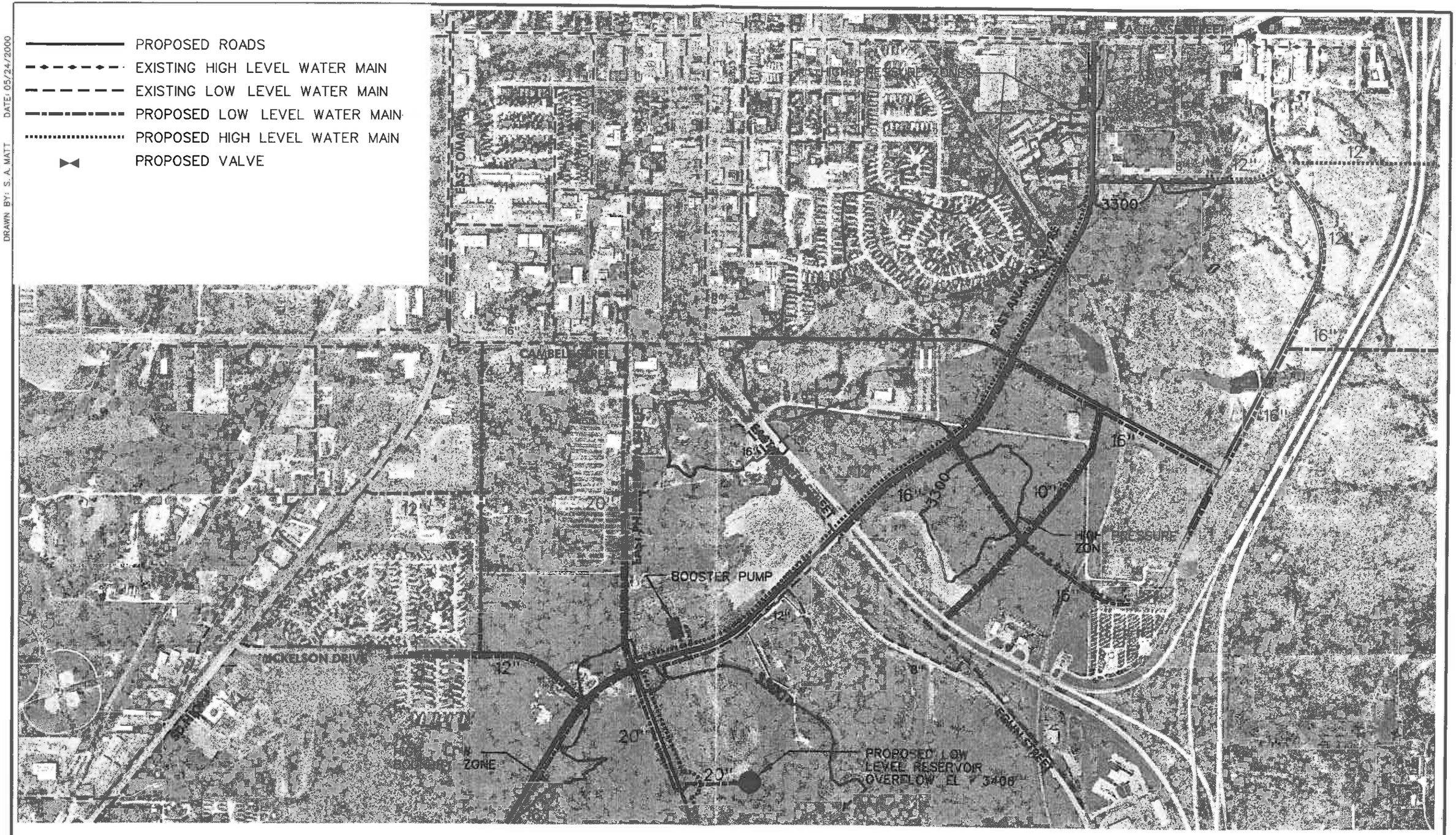
98-660/660RDL2.DGN

HDR ALLIANCE

FIGURE NO. 12
PAGE NO. 25

DRAWN BY: S. A. MATT DATE: 05/24/2000

PROPOSED ROADS
EXISTING HIGH LEVEL WATER MAIN
EXISTING LOW LEVEL WATER MAIN
PROPOSED LOW LEVEL WATER MAIN
PROPOSED HIGH LEVEL WATER MAIN
PROPOSED VALVE



800 400 0 800 1600

SCALE: 1"= 800'

WATER UTILITY EXISTING AND CONCEPTUAL LAYOUT WEST

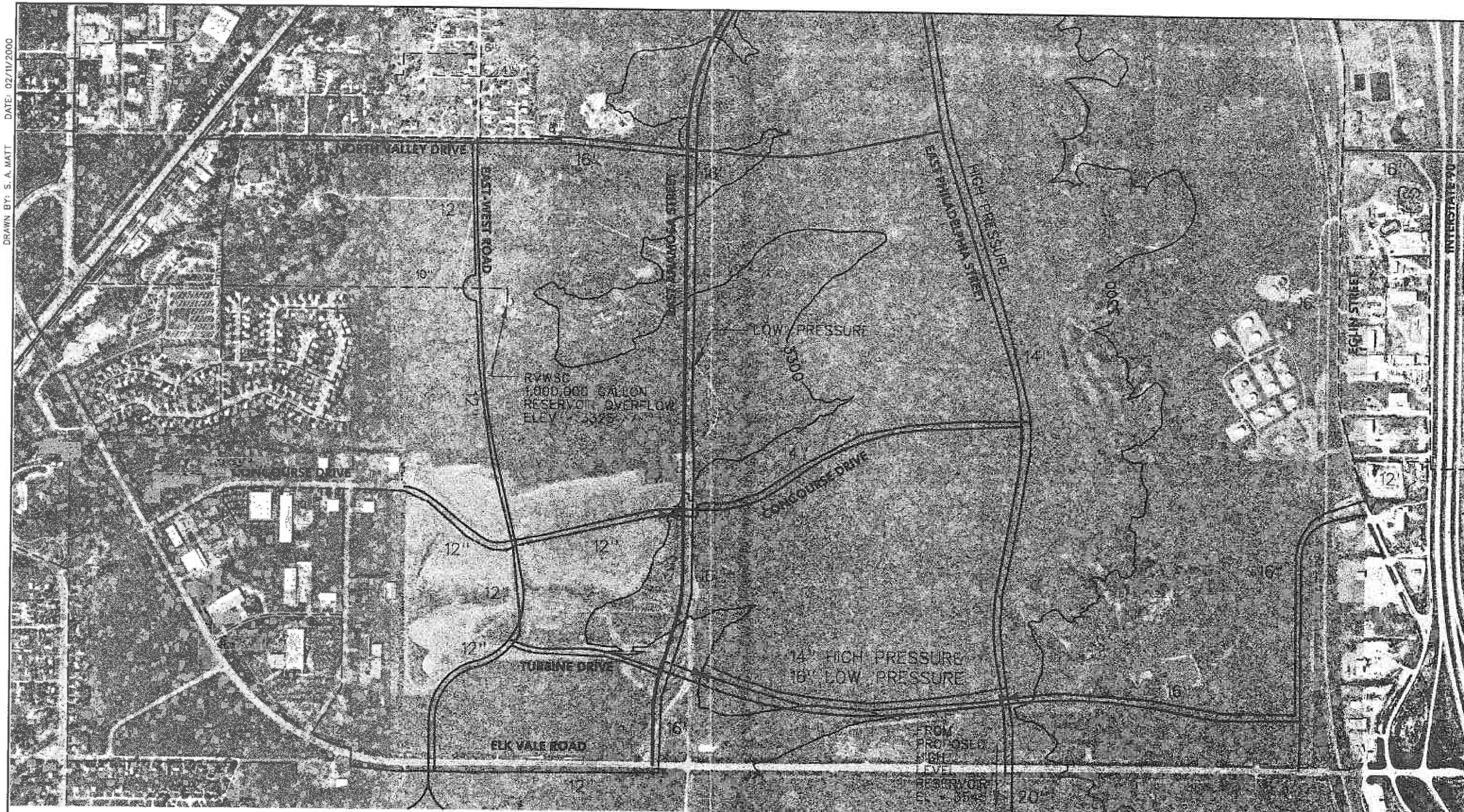
EAST ANAMOSA STREET EXTENSION STUDY

98-660/660UTL01.DGN

HDR ALLIANCE

FIGURE NO. 13
PAGE NO. 34

DRAWN BY: S. A. MATT   DATE: 02/11/2000



800 400 0 800 1600

SCALE: 1"= 800'

EAST ANAMOSA STREET EXTENSION STUDY

WATER UTILITY EXISTING AND CONCEPTUAL LAYOUT EAST

98-660/660UTL02.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 14

DRAWN BY: S. A. MATT DATE: 05/24/2000

PROPOSED ROADS

EXISTING SANITARY SEWER MAIN

PROPOSED SANITARY SEWER FORCE MAIN

PROPOSED SEWER MAIN

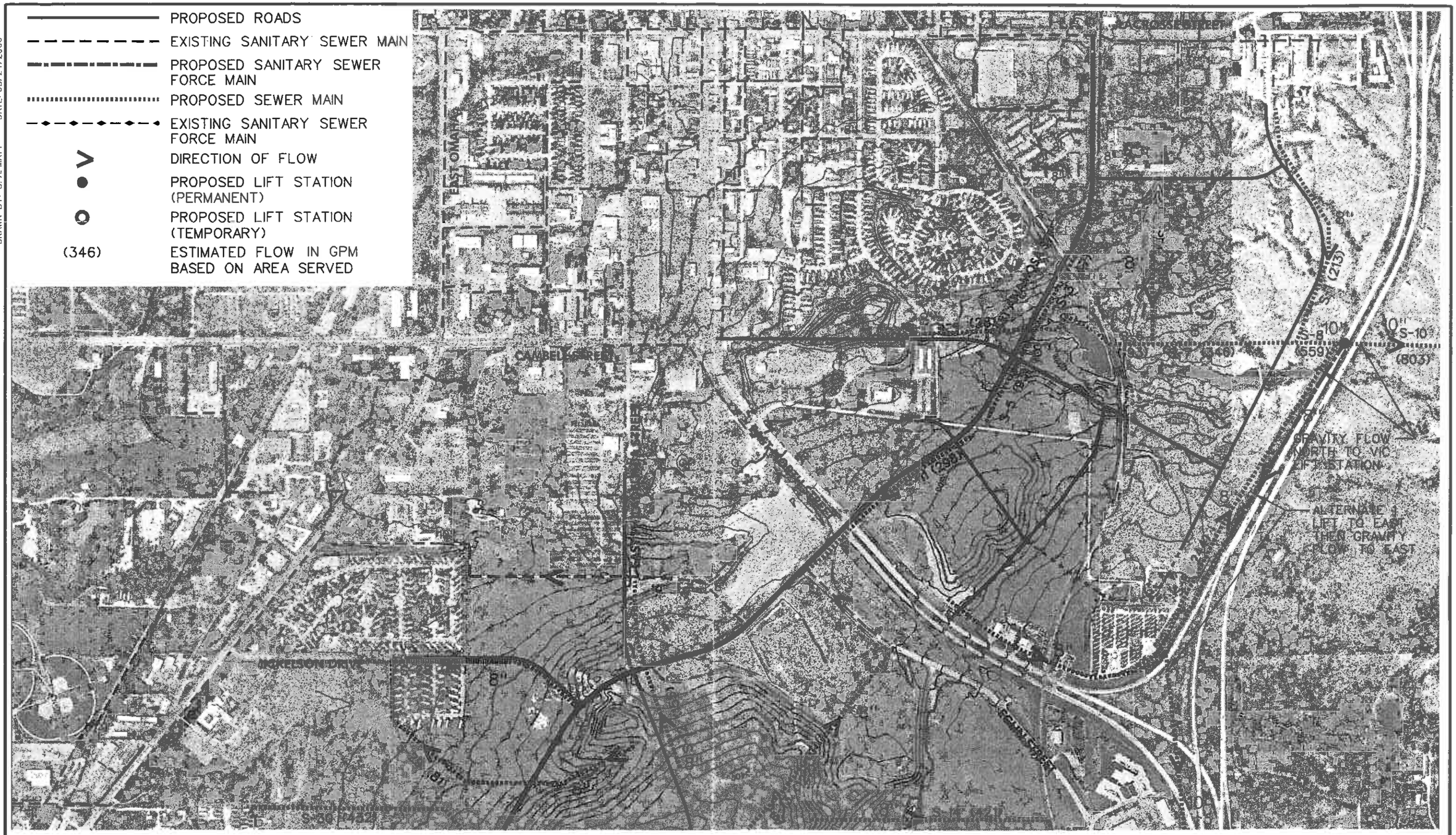
EXISTING SANITARY SEWER FORCE MAIN

DIRECTION OF FLOW

PROPOSED LIFT STATION (PERMANENT)

PROPOSED LIFT STATION (TEMPORARY)

(346) ESTIMATED FLOW IN GPM BASED ON AREA SERVED



800 400 0 800 1600

SCALE: 1"= 800'

EAST ANAMOSA STREET EXTENSION STUDY

SANITARY SEWER UTILITY EXISTING AND CONCEPTUAL LAYOUT WEST

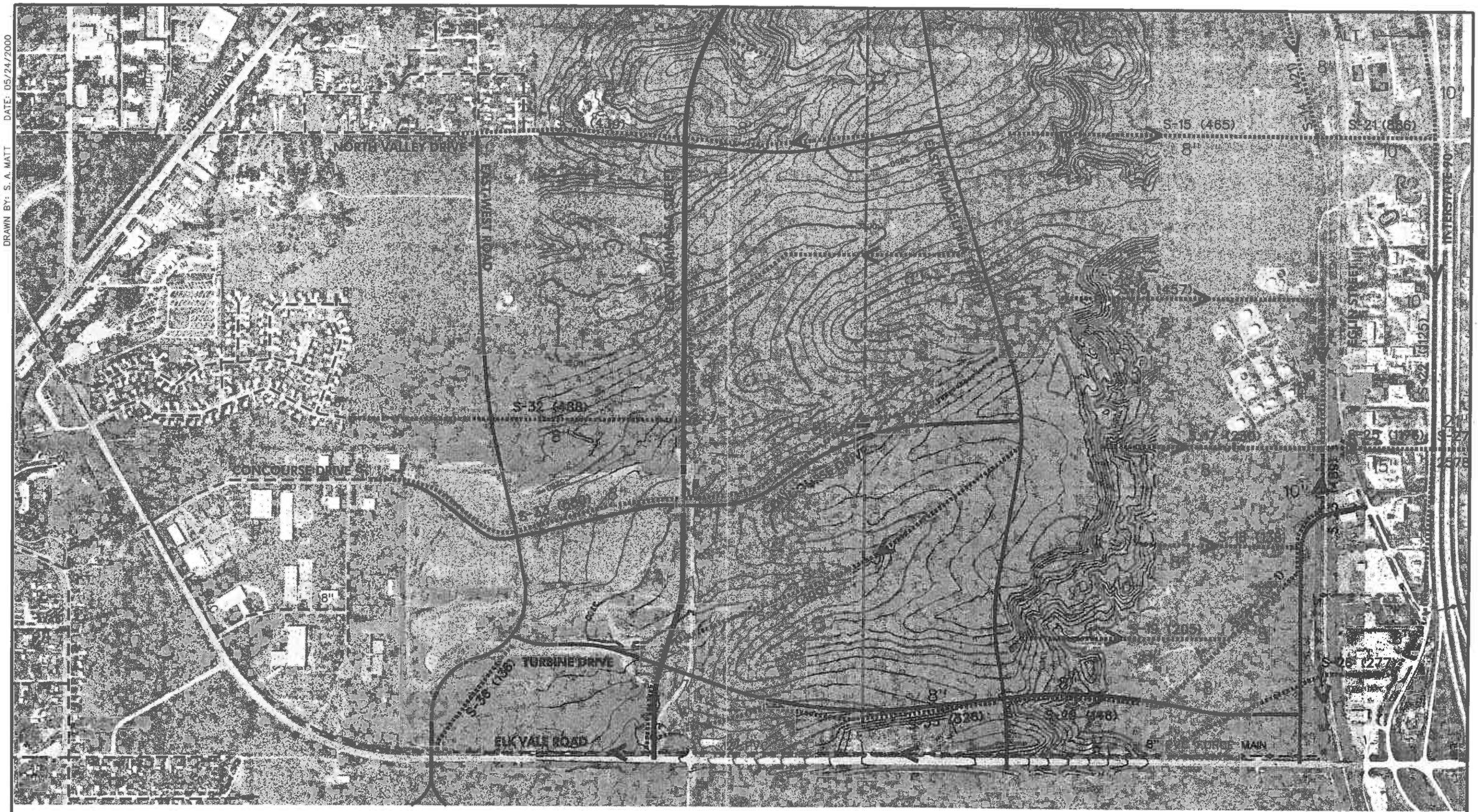
HDR

ALLIANCE ARCHITECTS and ENGINEERS

98-660/660UTL03.DGN

FIGURE NO. 15
PAGE NO. 39

DRAWN BY: S. A. MATT DATE: 05/24/2000



800 400 0 800 1600

SCALE: 1"= 800'

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660UTL04.DGN

SANITARY SEWER UTILITY EXISTING AND CONCEPTUAL LAYOUT EAST

HDR ALLIANCE

FIGURE NO. 16
PAGE NO. 40

DRAWN BY: S. A. MATT DATE: 02/12/2000

EXISTING DETENTION FACILITY

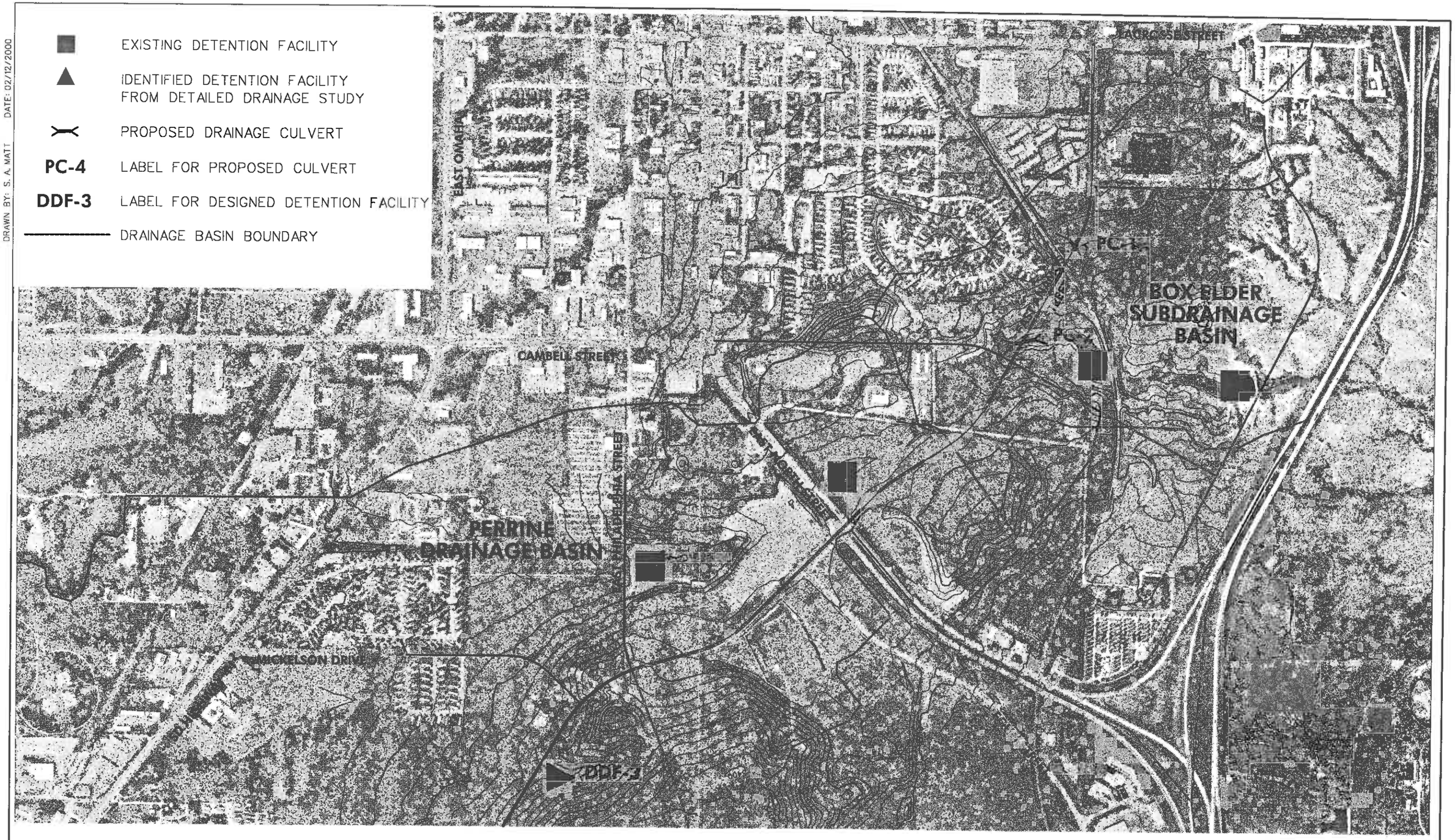
IDENTIFIED DETENTION FACILITY FROM DETAILED DRAINAGE STUDY

PROPOSED DRAINAGE CULVERT

PC-4 LABEL FOR PROPOSED CULVERT

DDF-3 LABEL FOR DESIGNED DETENTION FACILITY

DRAINAGE BASIN BOUNDARY



800 400 0 800 1600

SCALE: 1"= 800'

EAST ANAMOSA STREET EXTENSION STUDY

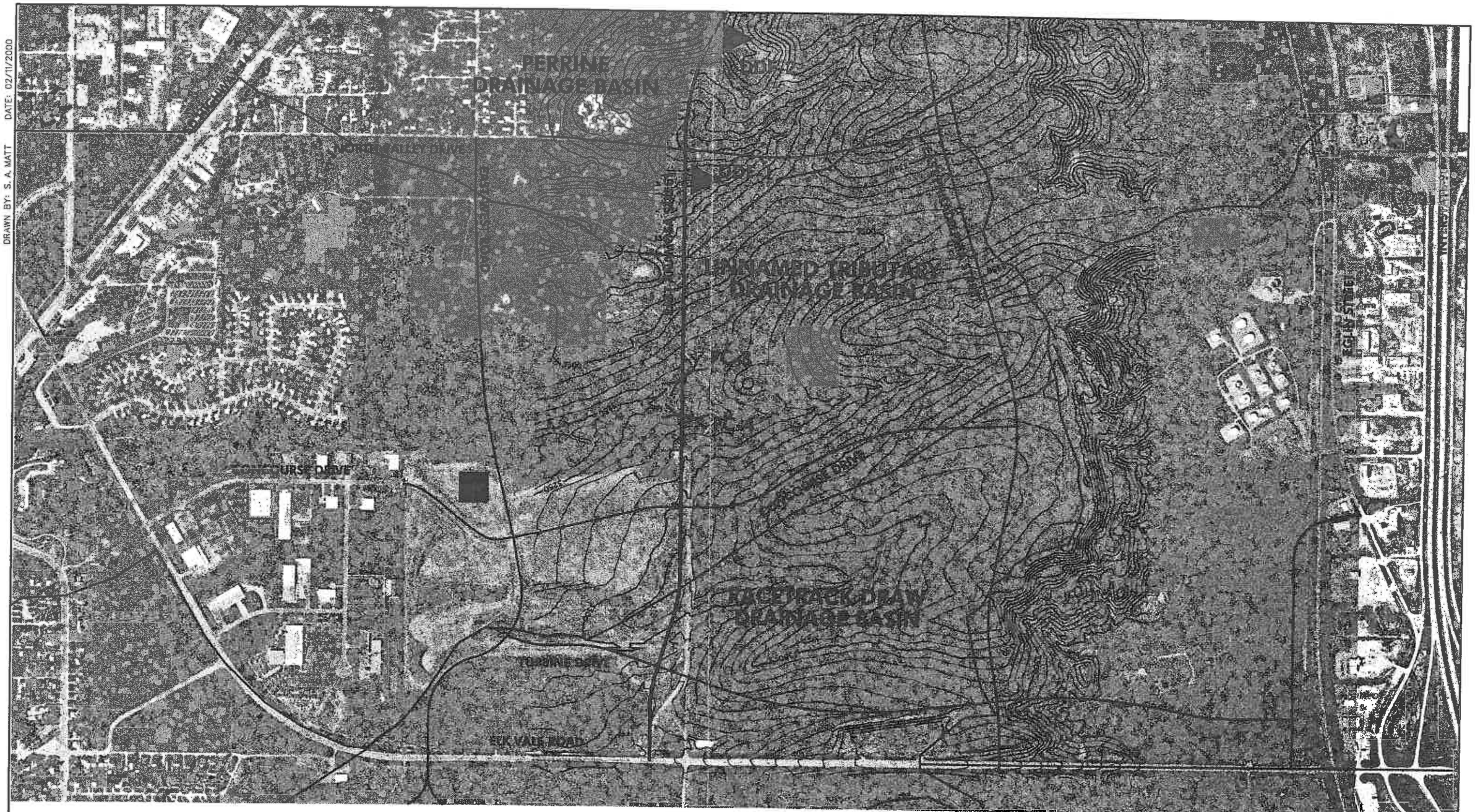
DRAINAGE: EXISTING AND CONCEPTUAL LAYOUT WEST

HDR ALLIANCE ARCHITECTS and ENGINEERS

98-660/660UTL05.DGN

FIGURE NO. 17
PAGE NO. 43

DRAWN BY: S. A. MATT DATE: 02/11/2000



800 400 0 800 1600

SCALE: 1"= 800'

DRAINAGE: EXISTING AND CONCEPTUAL LAYOUT EAST

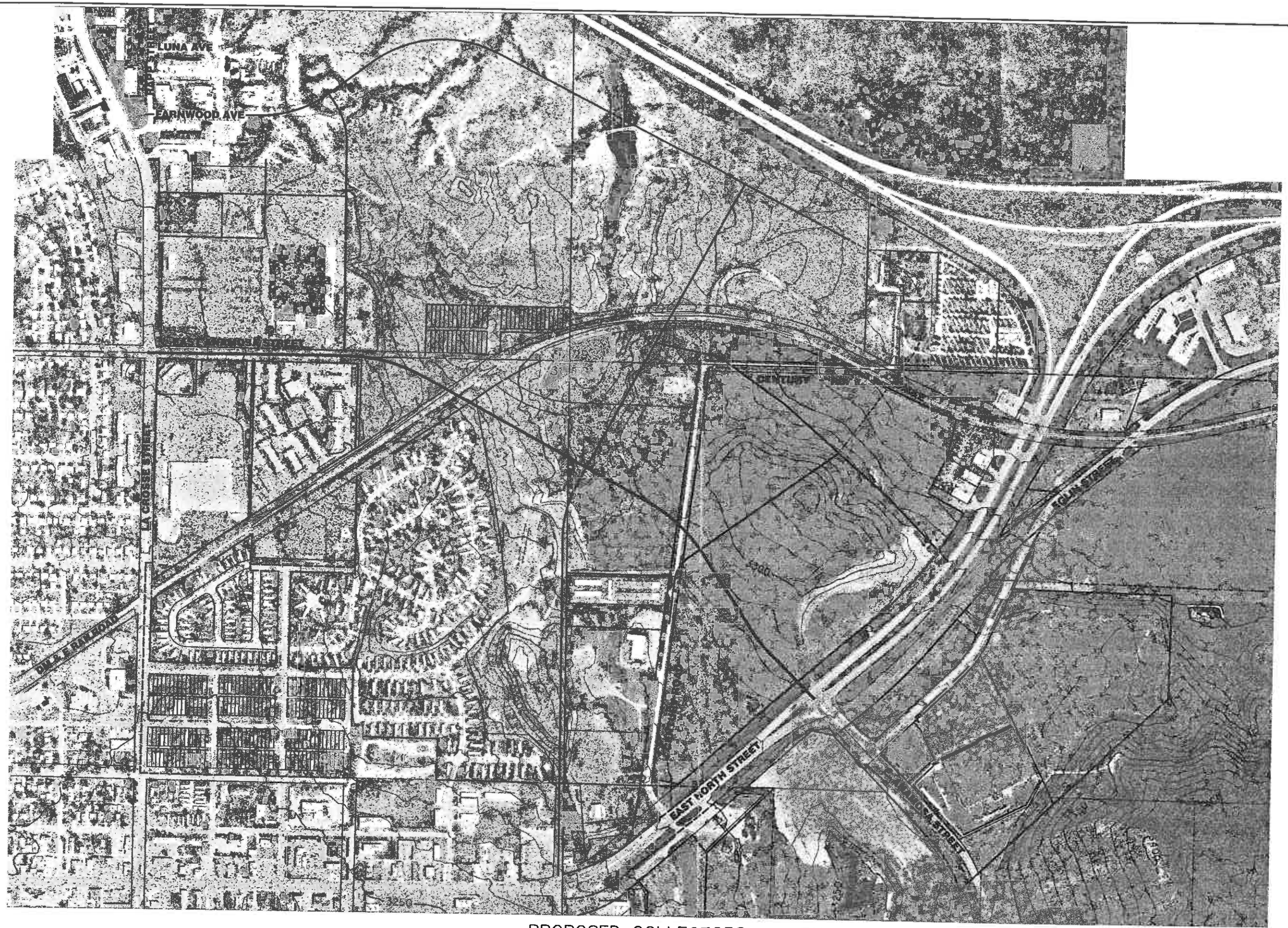
EAST ANAMOSA STREET EXTENSION STUDY

98-660/660UTL06.DGN

HDR ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 18
PAGE NO. 44

DRAWN BY: RJD DATE: 02/12/2000



PROPOSED COLLECTORS ALTERNATE 1

CONTOUR INTERVAL 10'

600 300 0 600

SCALE: 1" = 600

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660WRDS.DGN

HDR ALLIANCE ARCHITECTS and ENGINEERS

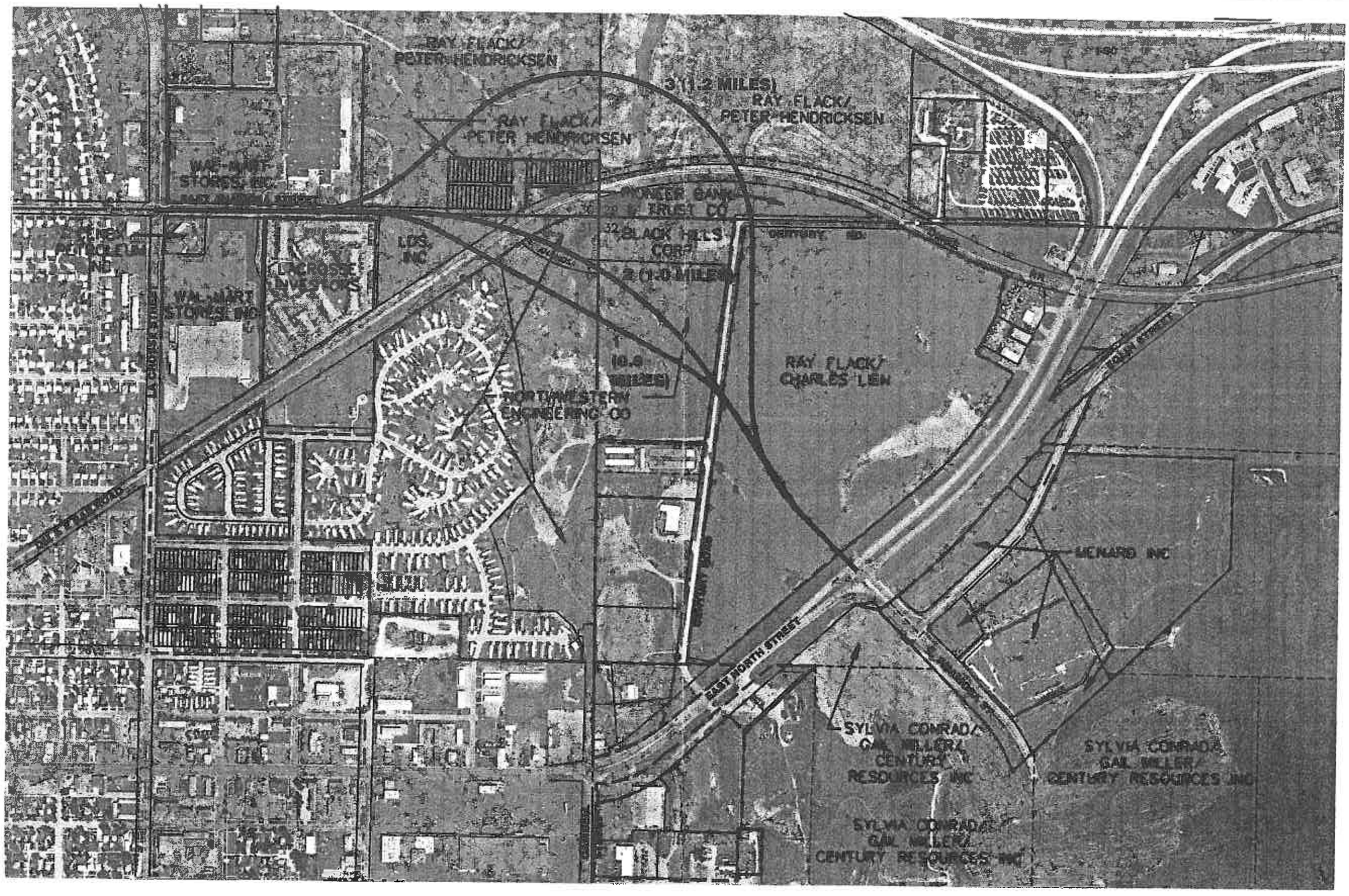
PROPOSED COLLECTORS ALTERNATE B

CONTOUR INTERVAL 10'

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660ERDS.DGN

DRAWN BY: RJD DATE: 11/19/99



PROPERTY OWNERSHIP

600 300 0 600

SCALE: 1" = 600

WEST LAYOUT PLAN

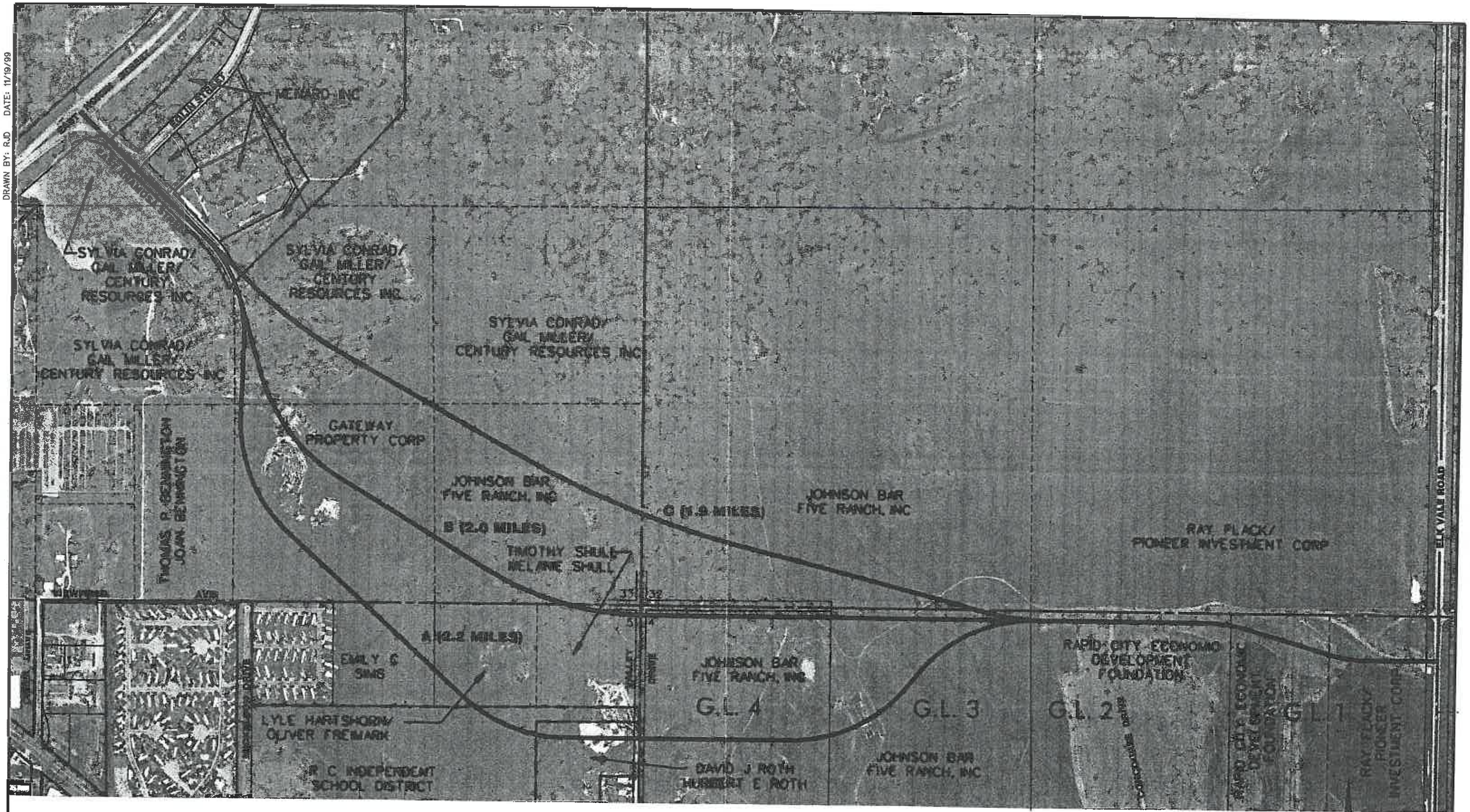
EAST ANAMOSA STREET EXTENSION STUDY

98-660/6600WN01.DGN

HDR ALLIANCE

FIGURE NO. 21
PAGE NO. 54

DRAWN BY: RJD DATE: 11/19/99



PROPERTY OWNERSHIP

600 300 0 600

SCALE: 1" = 600

EAST ANAMOSA STREET EXTENSION STUDY

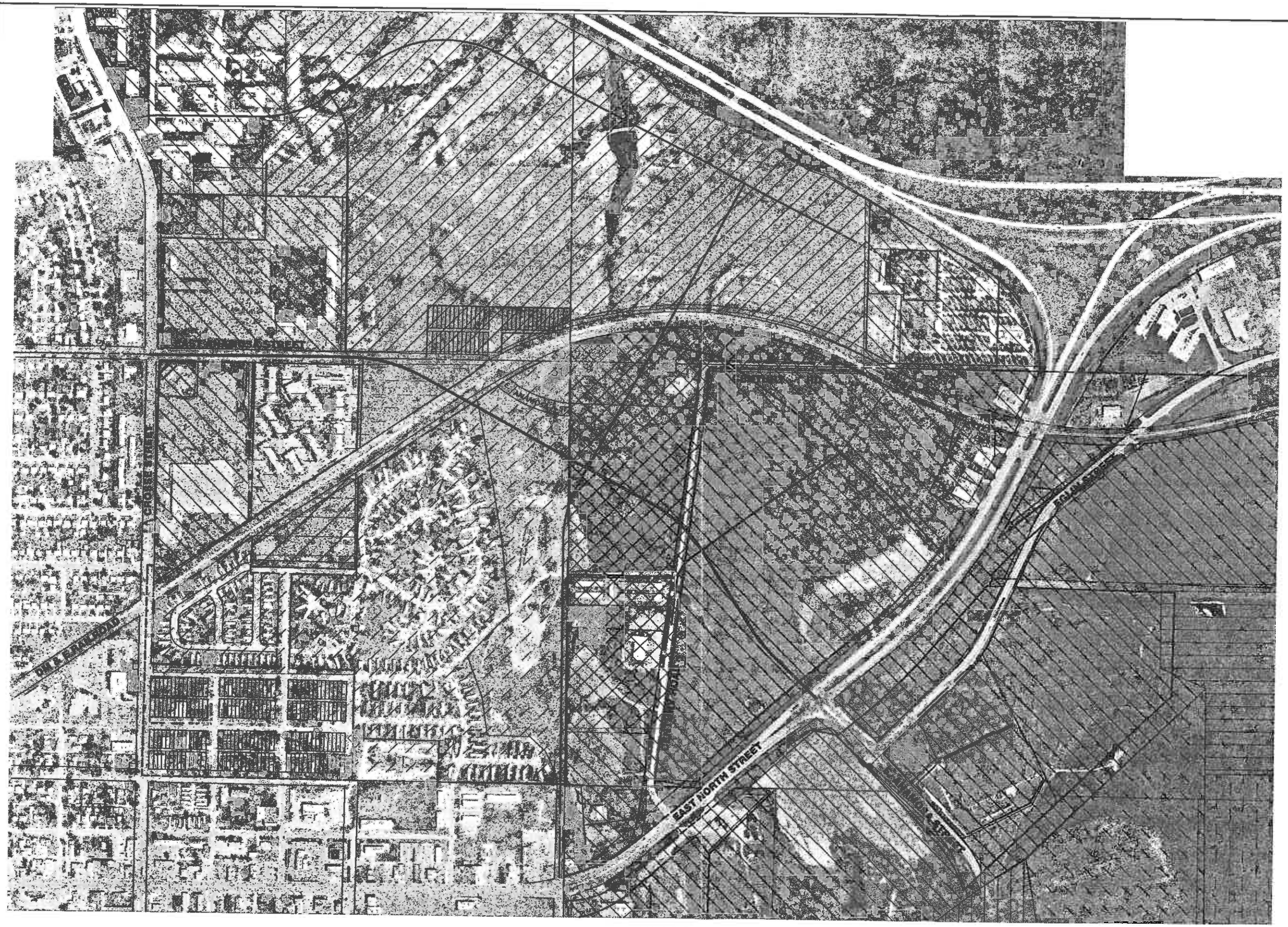
EAST LAYOUT PLAN

98-660/6600WN02.DGN

HDR ALLIANCE

FIGURE NO. 22
PAGE NO. 55

DRAWN BY: RJD DATE: 02/12/2000



EAST ANAMOSA STREET EXTENSION STUDY

PROPOSED ZONING
WEST LAYOUT PLAN

98-660/660LUM01.DGN

HDR ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 23
PAGE NO. 60

DRAWN BY: RJD DATE: 02/14/2000

EAST NORTH STREET
EGLIN STREET
EAST ANAMOSA STREET
RAPID CITY CORP. LINE
CORP LINE
VIEWFIELD AVE.
CREEK DRIVE
MICHELSON DRIVE
VALLEY DRIVE
ELK VALE ROAD
G.L. 4
G.L. 3
G.L. 2
G.L. 1

SEE FIGURE NO. 23 FOR LEDGEND

PROPOSED ZONING

600 300 0 600

SCALE: 1" = 600

EAST ANAMOSA STREET EXTENSION STUDY

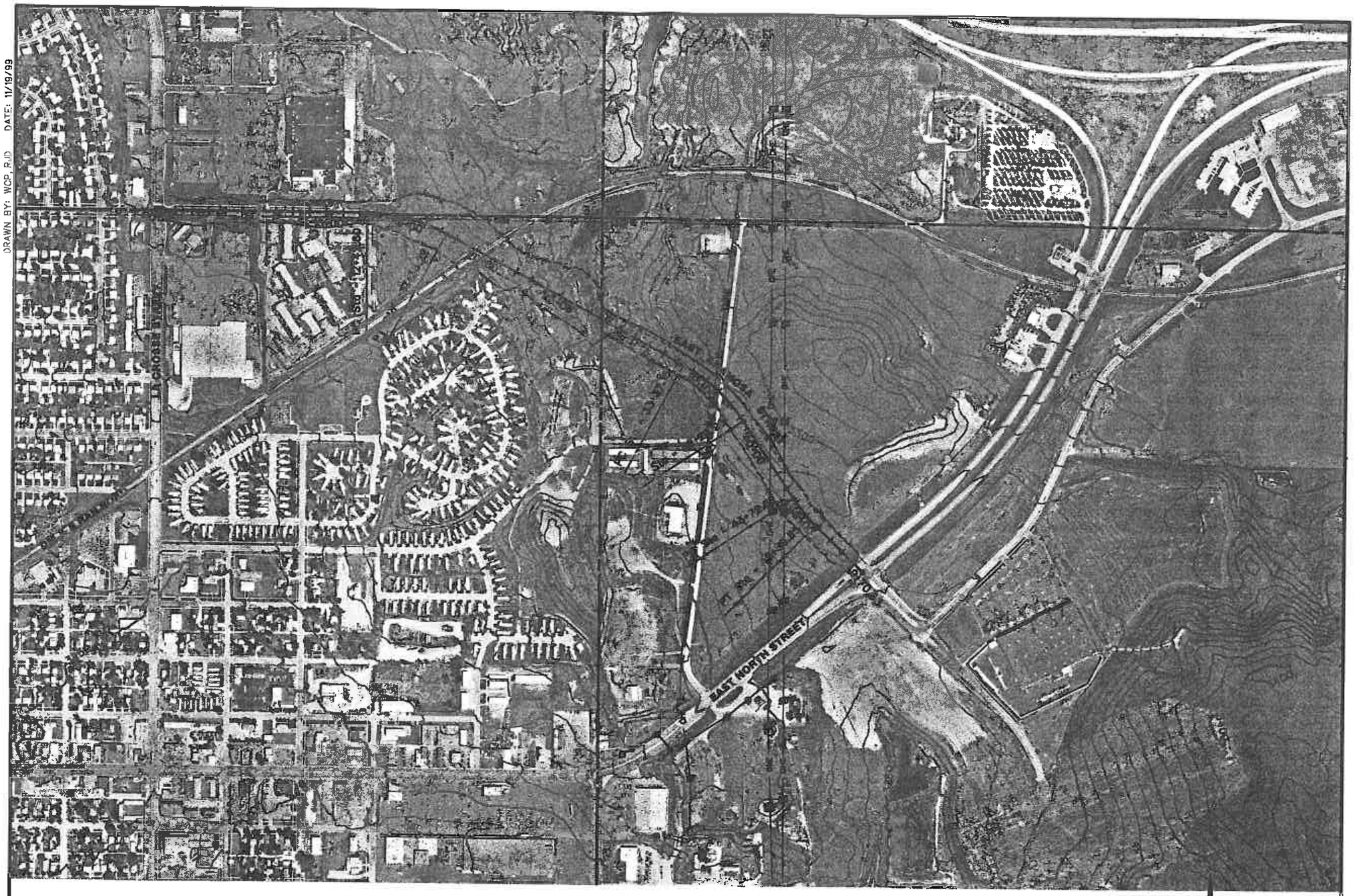
EAST LAYOUT PLAN

98-660/660LUM02.DGN

HDR ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 24

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

600 300 0 600

SCALE: 1" - 600
CONTOUR INTERVAL 10'

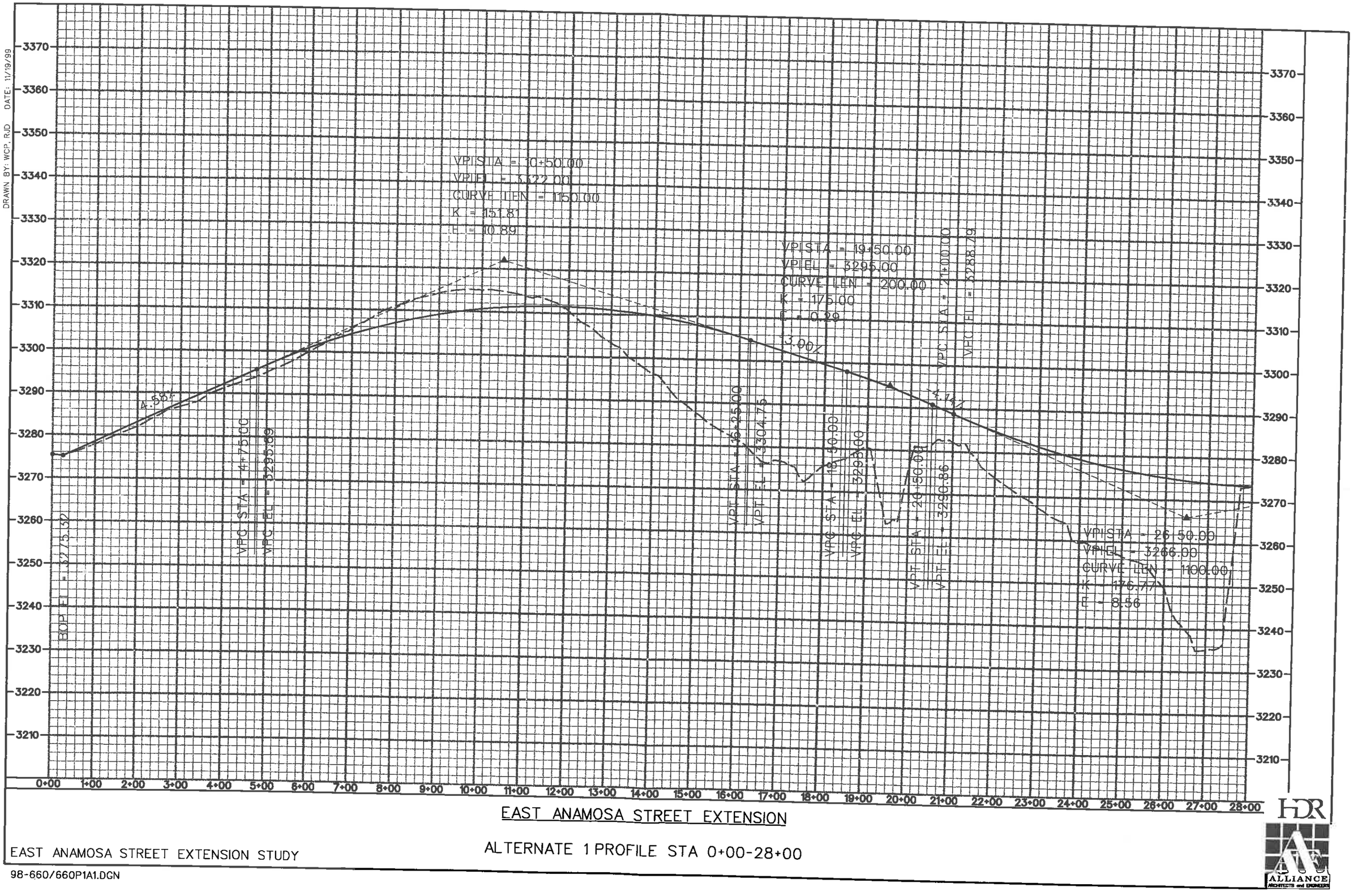
ALTERNATE 1 PLAN

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660ALGN1.DGN

FIGURE NO. 25
PAGE NO. D-1

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE 1 PROFILE STA 0+00-28+00

98-660/660P1A1.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 26
PAGE NO. D-2

DRAWN BY: RJD DATE: 11/19/99

VPI STA = 32+00.00
VPI EL = 3277.44

VPC STA = 35+00.00
VPC EL = 3283.68

VPI STA = 39+00.00
VPI EL = 3292.00
CURVE LEN = 1800.00
K = 256.05
F = 3.12

VPI STA = 43+00.00
VPI EL = 3287.82

VPI STA = 48+00.00
VPI EL = 3282.60

EOP STA = 49+70.63
EOP EL = 3281.44

2.08%

-1.04%

-0.68%

3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220 3210 3200 3190

28+00 29+00 30+00 31+00 32+00 33+00 34+00 35+00 36+00 37+00 38+00 39+00 40+00 41+00 42+00 43+00 44+00 45+00 46+00 47+00 48+00 49+00 50+00

EAST ANAMOSA STREET EXTENSION

ALTERNATE 1 PROFILE STA 28+00-50+00

EAST ANAMOSA STREET EXTENSION STUDY

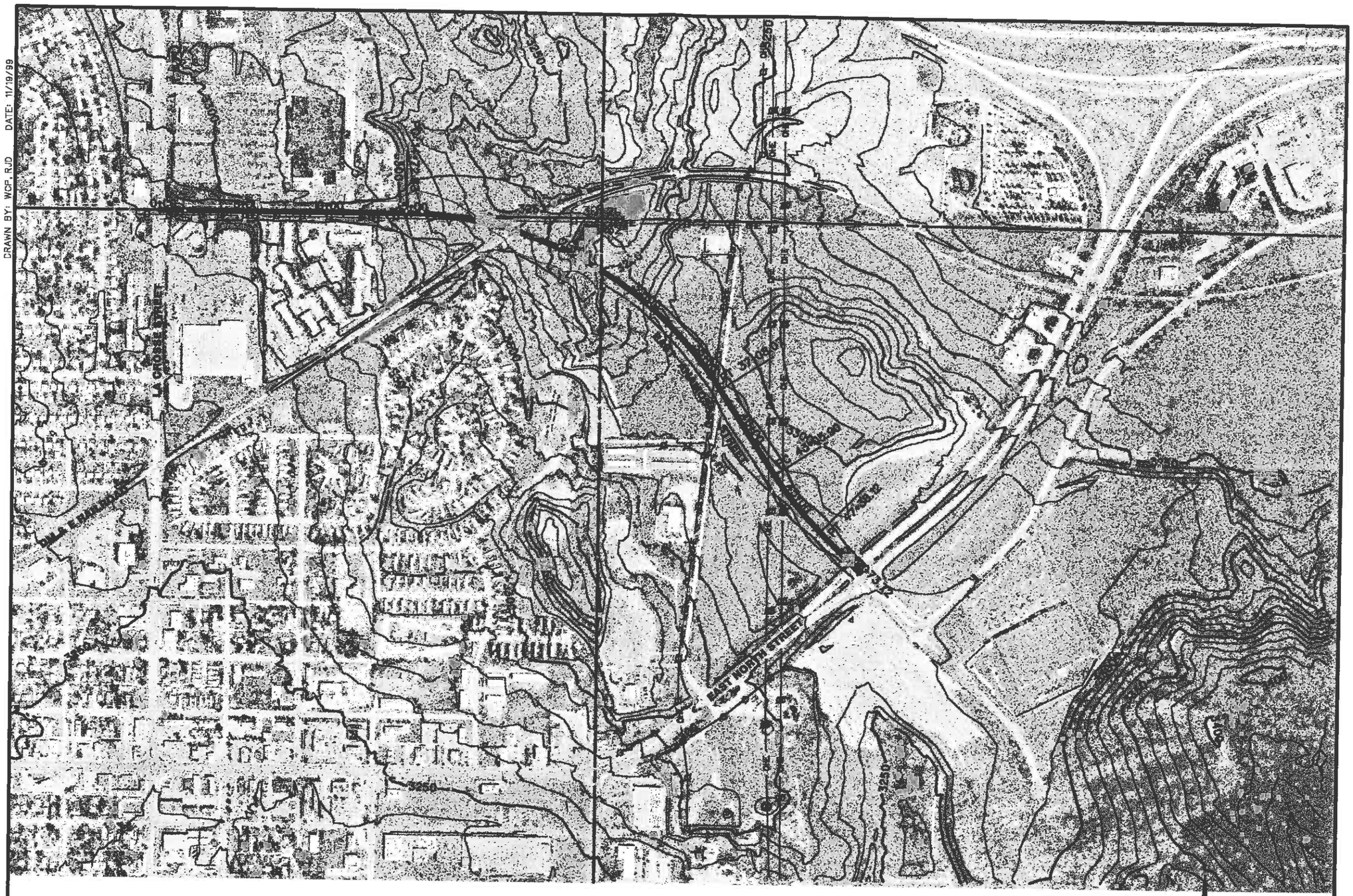
98-660/660P1A2.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 27
PAGE NO. D-3

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

600 300 0 600

SCALE: 1" = 600
CONTOUR INTERVAL 10'

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE 2 PLAN

98-660/660ALGN2.DGN

FIGURE NO. 28
PAGE NO. D-4

DRAWN BY: WCP, RJD DATE: 11/19/99

VPI STA = 12+13.23
VPI EL = 3330.00
CURVE LEN = 200.00
K = 36.29
E = 3.31

VPC STA = 6+13.23
VPC EL = 3302.28

VPC EL = 3278.32

VPT STA = 18+13.23
VPT EL = 3304.50

VPC STA = 22+50.00
VPC EL = 3285.94

VPI STA = 28+50.00
VPI EL = 3276.25

VPI STA = 20+50.00
VPI EL = 3273.19
CURVE LEN = 600.00
K = 113.82
E = 3.95

-4.25%

1.02%

3380 3370 3360 3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00

EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE 2 PROFILE STA 0+00-30+00

98-660/660P2A1.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 29
PAGE NO. D-5

DRAWN BY: WCP, RJD DATE: 11/19/99

VPI STA = 40+00.00
VPI EL = 3288.00
CURVE LEN = 300.00
K = 157.02
E = 0.72

1.02%

VPC STA = 38+50.00
VPC EL = 3286.47

VPT STA = 41+50.00
VPT EL = 3286.67

0.89%

VPC STA = 48+00.00
VPC EL = 3280.88

VPT STA = 50+00.00
VPT EL = 3280.83

0.83%

VPI STA = 49+00.00
VPI EL = 3280.00
CURVE LEN = 300.00
K = 116.45
E = 0.43

VPC STA = 50+73.72
VPC EL = 3281.44

3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220 3210 3200 3190

31+00 32+00 33+00 34+00 35+00 36+00 37+00 38+00 39+00 40+00 41+00 42+00 43+00 44+00 45+00 46+00 47+00 48+00 49+00 50+00 51+00

EAST ANAMOSA STREET EXTENSION

ALTERNATE 2 PROFILE STA 30+00-51+00

EAST ANAMOSA STREET EXTENSION STUDY

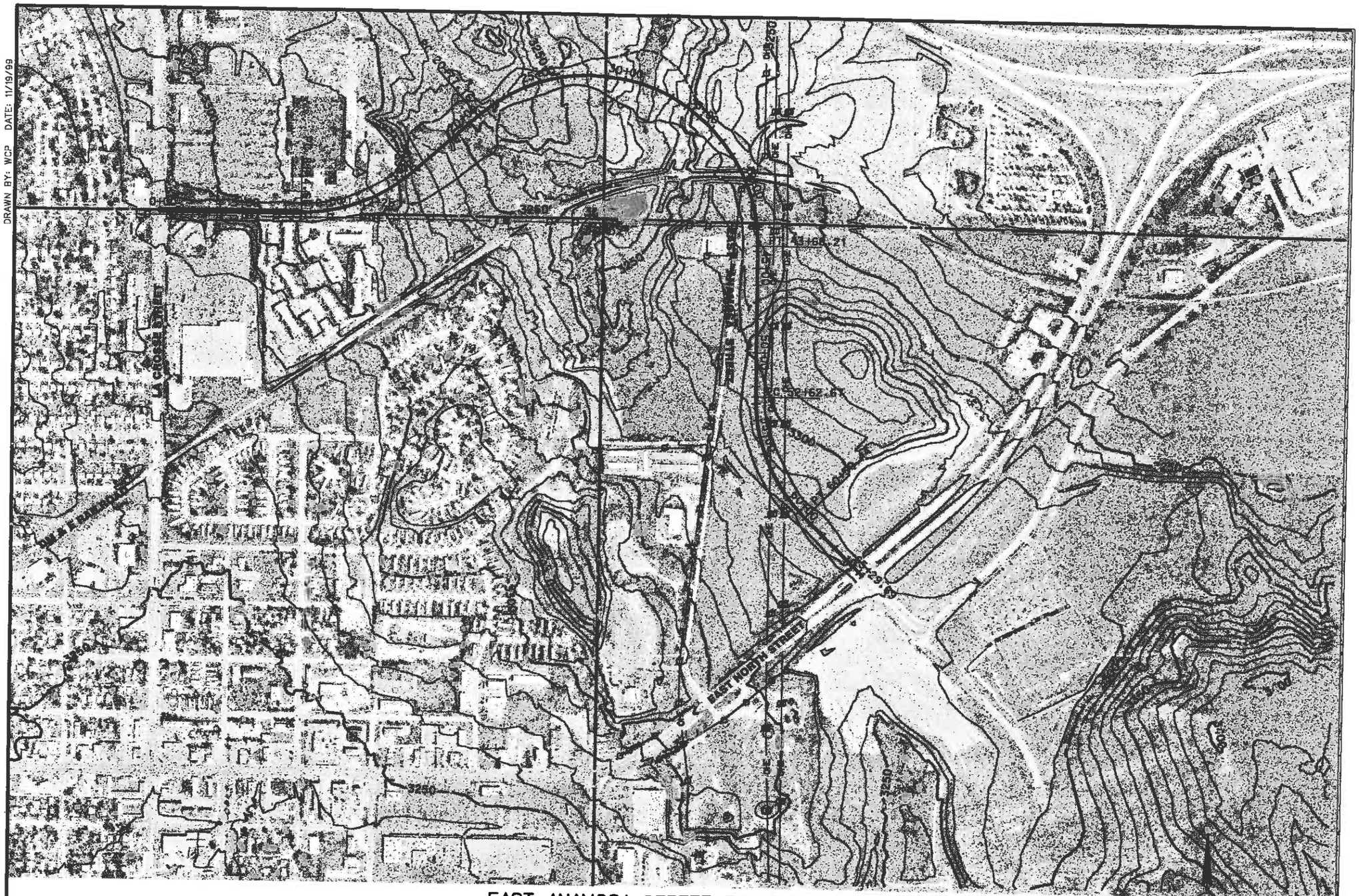
98-660/660P2A2.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 30
PAGE NO. D-6

DRAWN BY: WCP DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

ALTERNATE 3 PLAN

600 300 0 600

SCALE: 1" - 600
CONTOUR INTERVAL 10'

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660ALGN3.DGN

FIGURE NO. 31
PAGE NO. D-7

DRAWN BY: WCP, RJD DATE: 11/19/99

VPI STA = 12+00.00
VPI EL = 3330.00
CURVE LEN = 1200.00
K = 111.73
E = 16.11

VPI STA = 2+79.01
VPI EL = 3266.00
CURVE LEN = 0.00

VPC STA = 6+00.00
VPC EL = 3301.56

VPT STA = 18+00.00
VPT EL = 3291.00

VPC STA = 23+50.00
VPC EL = 3261.00

VPI STA = 29+00.00
VPI EL = 3228.00
CURVE LEN = 100.00
K = 100.10
E = 15.11

VPC STA = 0+25.13
VPC EL = 3273.12

4.17%

-8.00%

3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220 3210 3200 3190

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00

EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

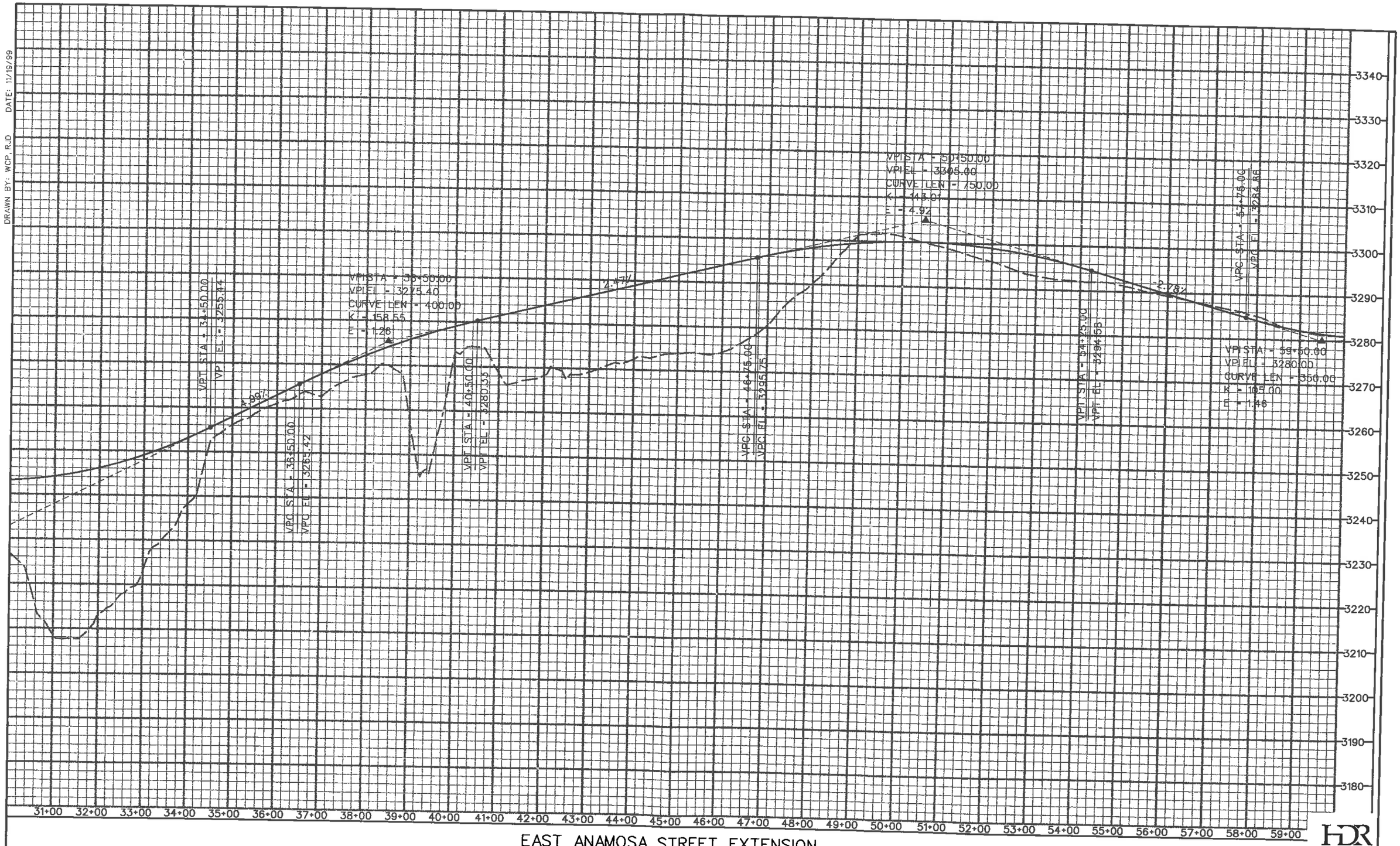
ALTERNATE 3 PROFILE STA 0+00-30+00

98-660/660P3A1.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

ALTERNATE 3 PROFILE STA 30+00-60+00

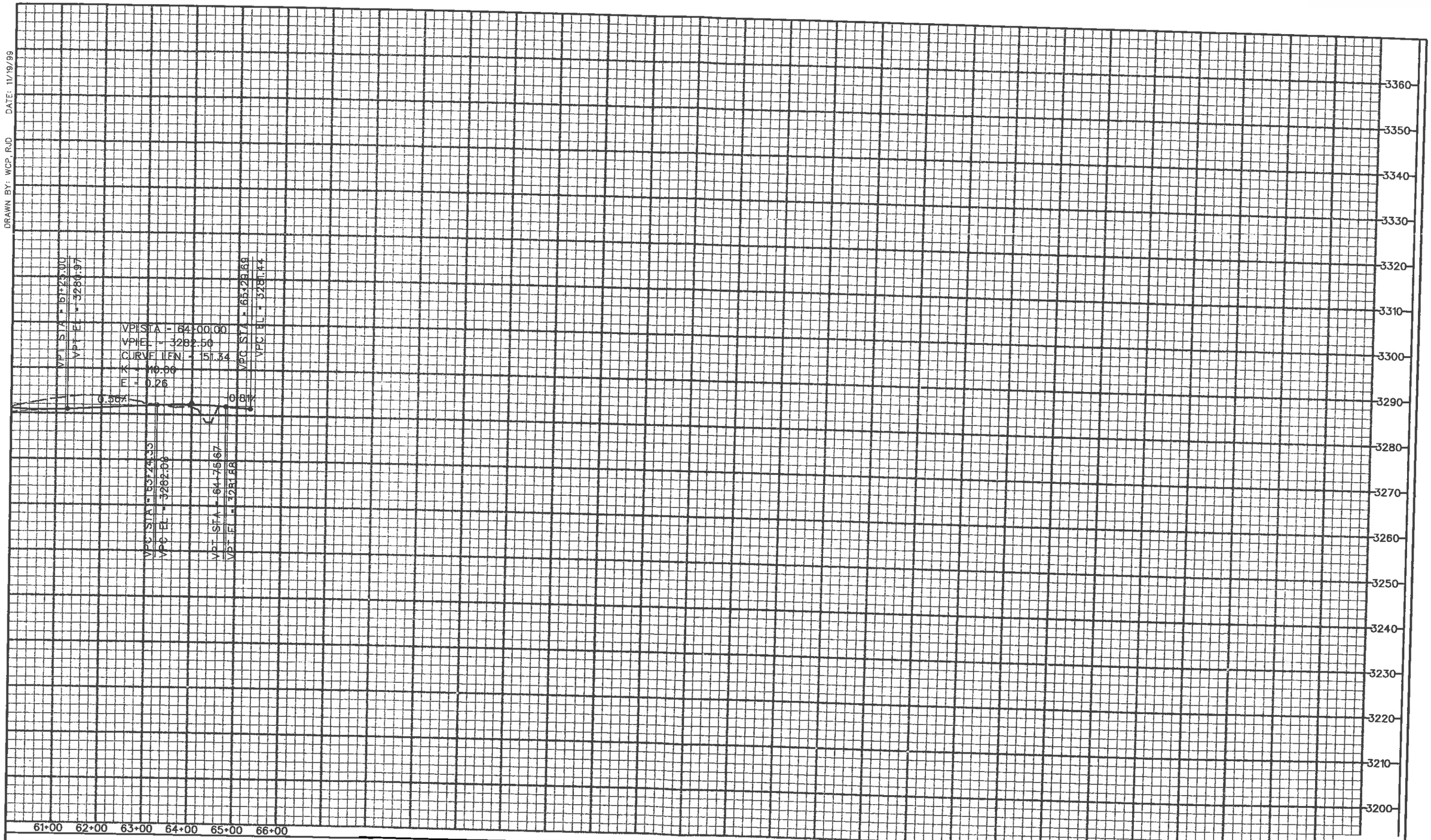
EAST ANAMOSA STREET EXTENSION STUDY

98-660/660P3A2.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE 3 PROFILE STA 60+00-66+00

98-660/660P3A3.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

DRAWN BY: WCP, RJD DATE: 11/19/99

EAST ANAMOSA STREET EXTENSION

600 300 0 600

SCALE: 1" = 600
CONTOUR INTERVAL 10'

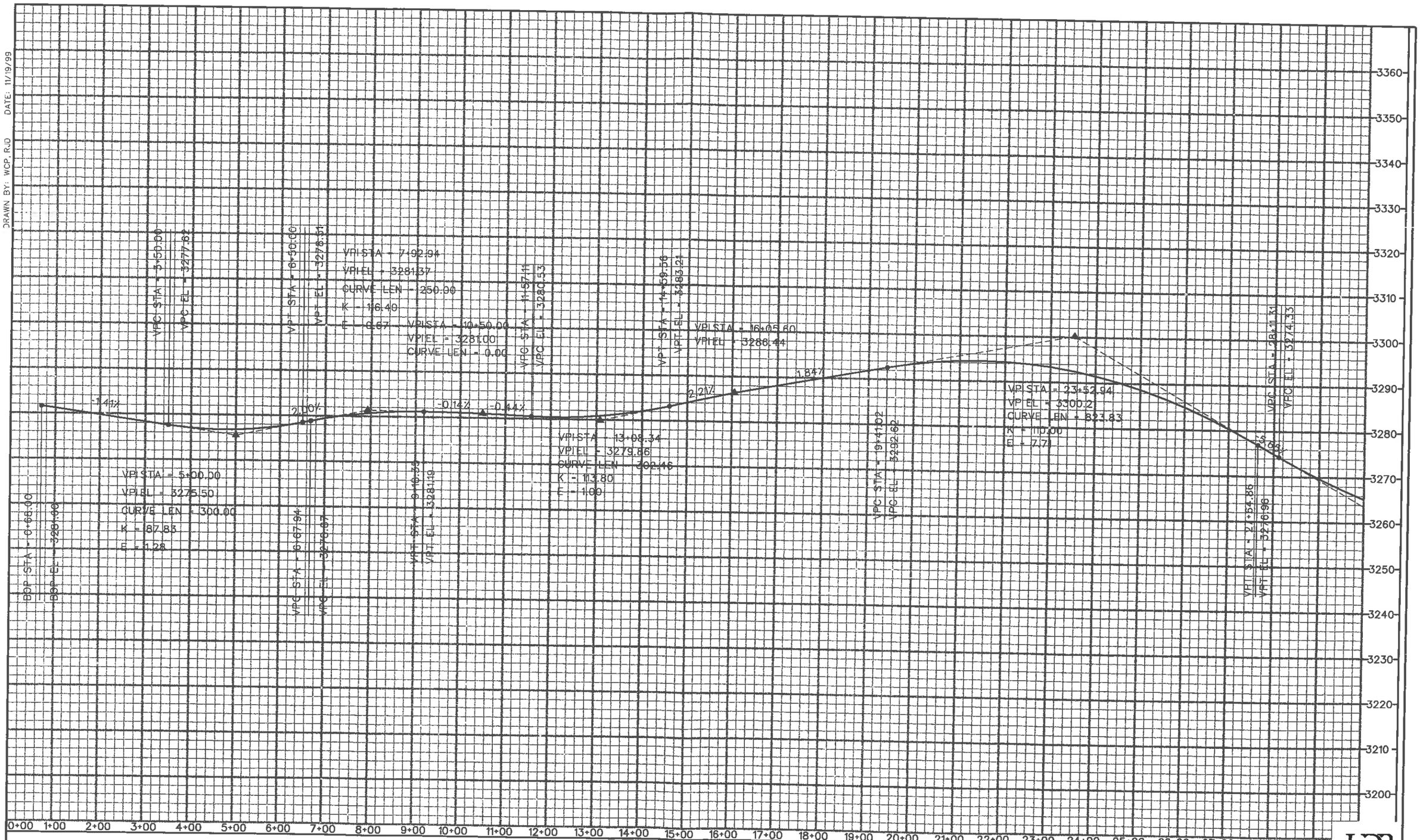
EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE A PLAN

98-660/660ALGNA.DGN

FIGURE NO. 35
PAGE NO. D-11

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

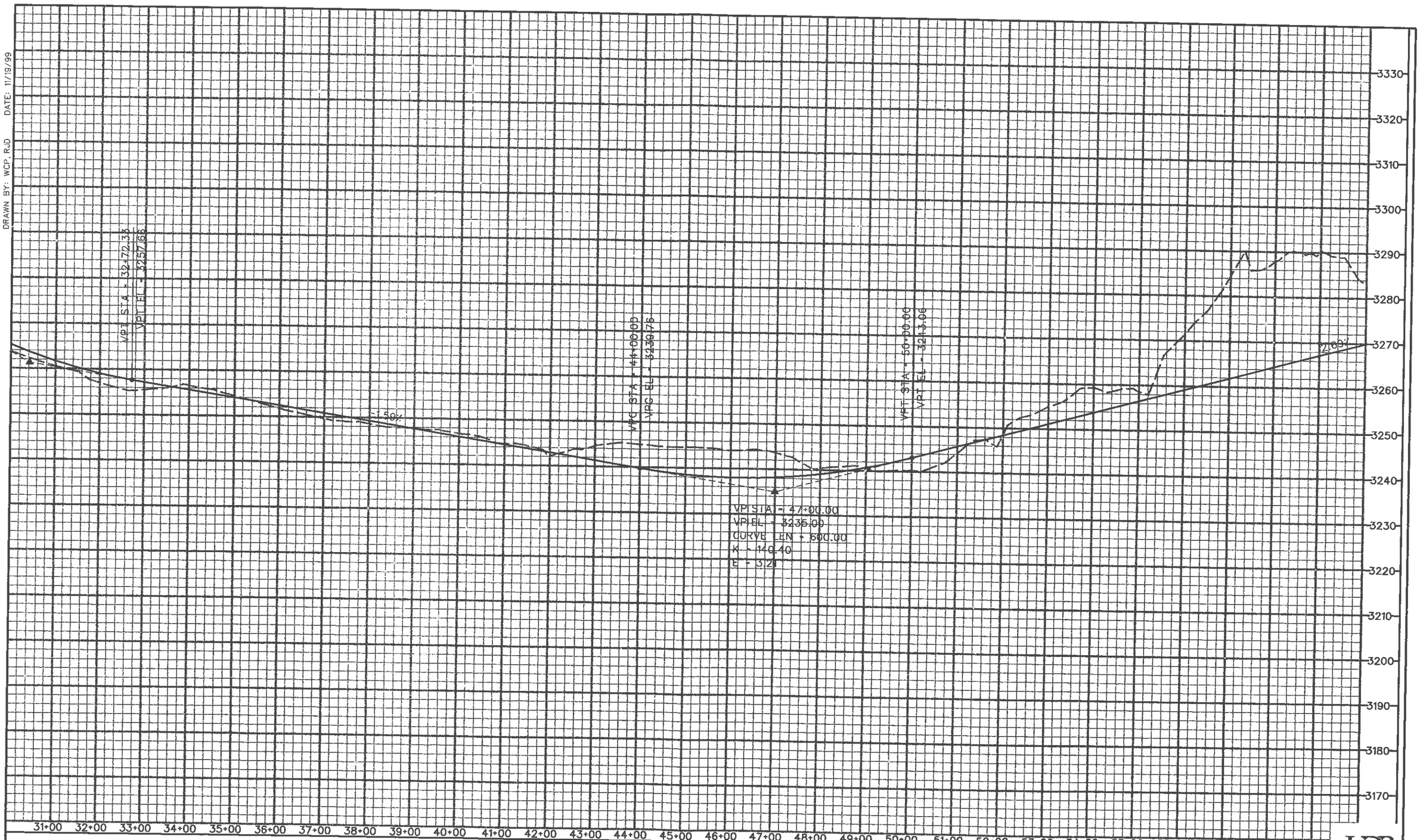
ALTERNATE A PROFILE STA 0+00-30+00

98-660/660PAA1.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

ALTERNATE A PROFILE STA 30+00-60+00

EAST ANAMOSA STREET EXTENSION STUDY

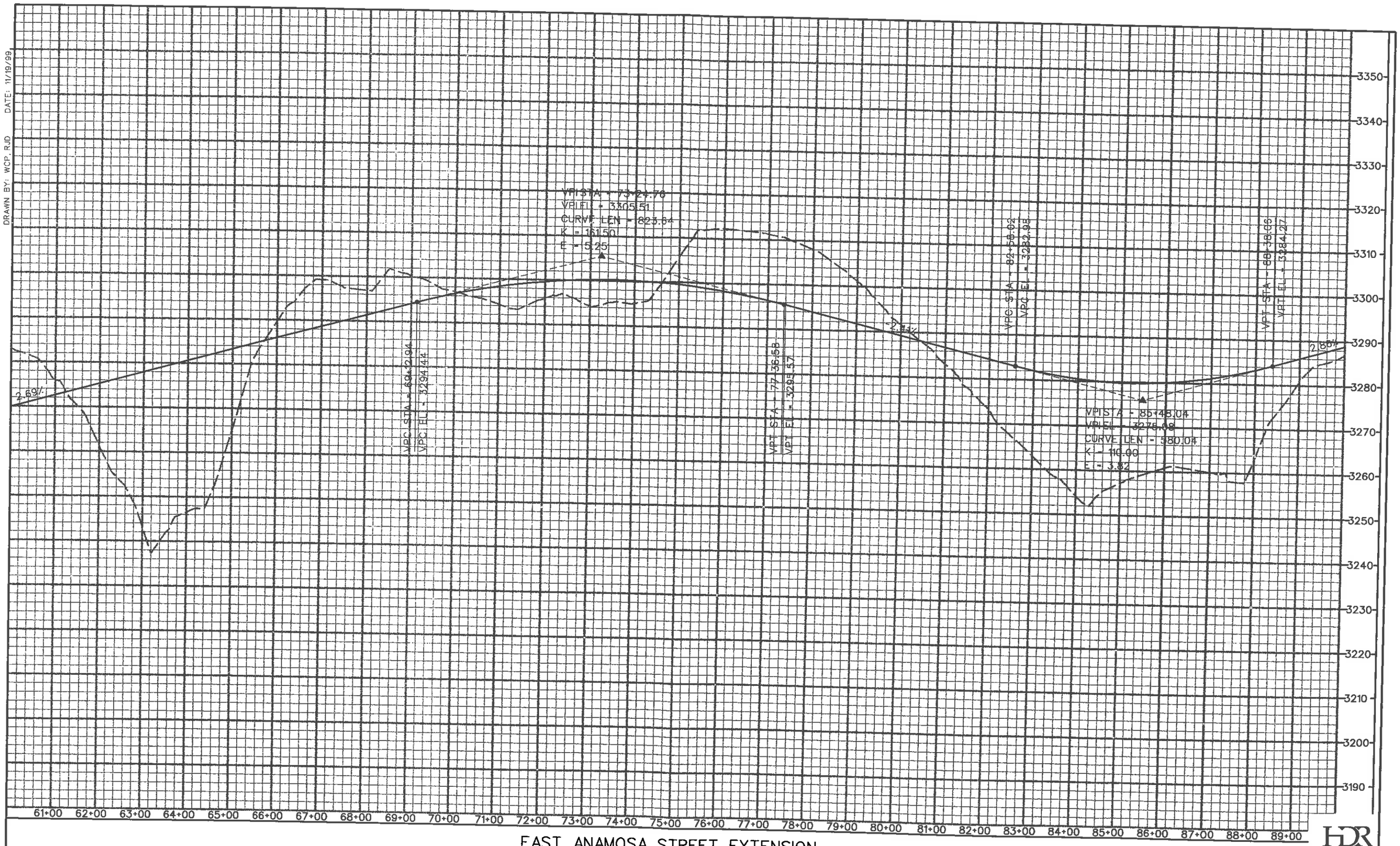
98-660/660PAA2.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 37

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE A PROFILE STA 60+00-90+00

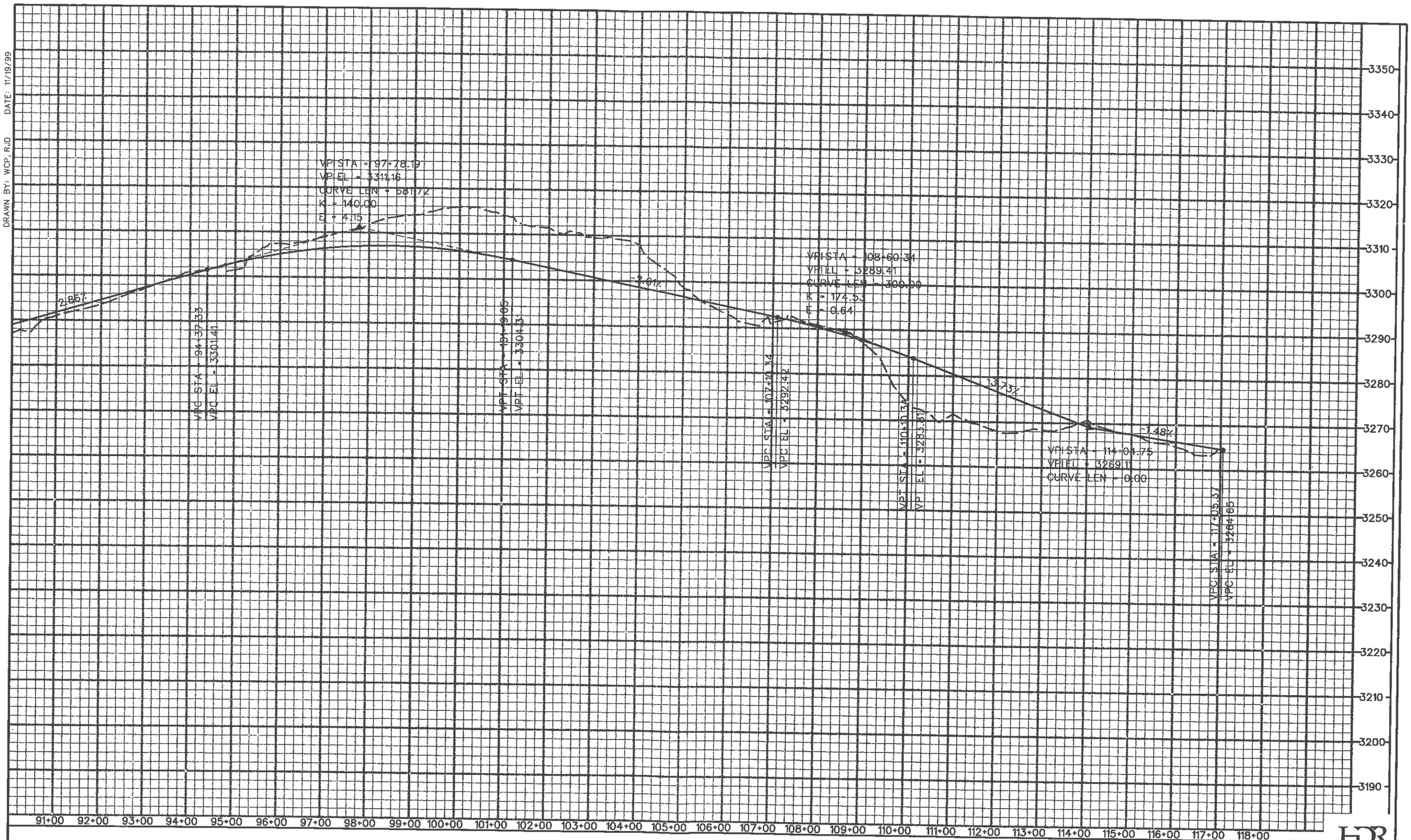
98-660/660PAA3.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 38
PAGE NO. D-14

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

ALTERNATE A PROFILE STA 90+00-118+00

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660PAA4.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 39

DRAWN BY: WCP, RJD DATE: 11/19/99

EAST ANAMOSA STREET EXTENSION

600 300 0 600

SCALE: 1" = 600
CONTOUR INTERVAL 10'

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE B PLAN

98-660/660ALGNB.DGN

FIGURE NO. 40

DRAWN BY: RJD DATE: 11/19/99

VPISTA = 7+92.94
VPIEL = 3281.37
CURVE LEN = 250.00
K = 116.40
E = 0.67

VPISTA = 5+00.00
VPIEL = 3275.50
CURVE LEN = 300.00
K = 87.83
E = 1.28

VPISTA = 10+50.00
VPIEL = 3281.00

VPISTA = 13+08.34
VPIEL = 3279.85
CURVE LEN = 300.00
K = 113.29
E = 0.99

VPISTA = 24+50.00
VPIEL = 3305.00
CURVE LEN = 800.00
K = 174.52
E = 4.58

1.41%
2.00%
0.14%
0.45%
2.20%

VPC STA = 3+50.00
VPC EL = 3277.62
VPT STA = 6+50.00
VPT EL = 3278.31
VPC STA = 11+58.34
VPC EL = 3280.52
VPT STA = 14+58.34
VPT EL = 3283.15
BCR STA = 0+68.00
BCR EL = 3276.60
VPC STA = 6+67.94
VPC EL = 3278.87
VPT STA = 9+17.94
VPT EL = 3281.19
VPC STA = 20+50.00
VPC EL = 3296.19

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00 25+00 26+00 27+00 28+00

3360 3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220 3210 3200

EAST ANAMOSA STREET EXTENSION

ALTERNATE B PROFILE STA 0+00-28+00

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660PBA1.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

DRAWN BY: RJD DATE: 11/19/99

VPI STA = 47+00.00
VPI EL = 3330.00
CURVE LEN = 1400.00
K = 174.43
= 14.29

VPC STA = 31+50.00
VPC EL = 3288.33

VPT STA = 38+50.00
VPT EL = 3294.58

4.38%

VPC STA = 28+50.00
VPC EL = 3295.48

VPT STA = 28+50.00
VPT EL = 3295.48

VPI STA = 35+00.00
VPI EL = 3280.00
CURVE LEN = 700.00
K = 106.91
= 5.73

VPC STA = 40+00.00
VPC EL = 3300.85

VPC STA = 54+00.00
VPC EL = 3302.00

VPI STA = 54+00.00
VPI EL = 3307.00

4.00%

3370 3360 3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220 3210

28+00 29+00 30+00 31+00 32+00 33+00 34+00 35+00 36+00 37+00 38+00 39+00 40+00 41+00 42+00 43+00 44+00 45+00 46+00 47+00 48+00 49+00 50+00 51+00 52+00 53+00 54+00 55+00 56+00

EAST ANAMOSA STREET EXTENSION

ALTERNATE B PROFILE STA 28+00-56+00

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660PBA1.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

DRAWN BY: WCP, RJD DATE: 11/19/99

VPI STA = 60+00.00
VPI EL = 3293.75
VPC STA = 57+00.00
VPC EL = 3295.36
VPI STA = 65+00.00
VPI EL = 3300.00
CURVE LEN = 750.00
K = 176.47
E = 3.98
VPI STA = 57+00.00
VPI EL = 3290.00
CURVE LEN = 600.00
K = 114.29
E = 3.94
1.25%
VPC STA = 71+50.00
VPC EL = 3280.59
VPT STA = 68+75.00
VPT EL = 3288.75
3.00%
VPI STA = 75+00.00
VPI EL = 3270.00
CURVE LEN = 700.00
K = 109.81
E = 5.58
VPT STA = 78+50.00
VPT EL = 3281.81
3.37%
VPC STA = 83+00.00
VPC EL = 3294.00

3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220 3210 3200 3190

56+00 57+00 58+00 59+00 60+00 61+00 62+00 63+00 64+00 65+00 66+00 67+00 68+00 69+00 70+00 71+00 72+00 73+00 74+00 75+00 76+00 77+00 78+00 79+00 80+00 81+00 82+00 83+00 84+00

EAST ANAMOSA STREET EXTENSION

ALTERNATE B PROFILE STA 56+00-84+00

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660PBA3.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

DRAWN BY: WCP, RJD DATE: 11/19/99

VPI STA = 88+00.00
VPI EL = 3313.87
CURVE LEN = 1000.00
K = 171.48
E = 7.29

3.3%

VPI STA = 96+00.00
VPI EL = 3301.59

2.26%

VPC STA = 96+87.50
VPC EL = 3292.06

VPI STA = 98+00.00
VPI EL = 3289.30
CURVE LEN = 225.00
K = 160.37
E = 0.39

VPC STA = 99+12.50
VPC EL = 3284.99

2.86%

VPI STA = 102+00.00
VPC EL = 3273.86

VPI STA = 104+00.00
VPI EL = 1268.01

.96%

VPC STA = 105+25.00
VPC EL = 3265.59

VPI STA = 105+75.00
VPI EL = 3264.82

VPI STA = 103+00.00
VPI EL = 3270.00
CURVE LEN = 200.00
K = 105.26
E = 0.47

VPI STA = 105+50.00
VPI EL = 3265.10
CURVE LEN = 50.00
K = 60.11
E = 0.05

EOP STA = 105+96.09
EOP EL = 3264.58

3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220 3210 3200 3190

84+00 85+00 86+00 87+00 88+00 89+00 90+00 91+00 92+00 93+00 94+00 95+00 96+00 97+00 98+00 99+00 100+00 101+00 102+00 103+00 104+00 105+00 106+00

EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE B PROFILE STA 84+00-106+00

98-660/660PBA4.DGN

HDR ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 44
PAGE NO. D-20

DRAWN BY: WCP, RJD DATE: 11/19/99

EAST ANAMOSA STREET

EAST ANAMOSA STREET EXTENSION

600 300 0 600

SCALE: 1" - 600
CONTOUR INTERVAL 10'

EAST ANAMOSA STREET EXTENSION STUDY

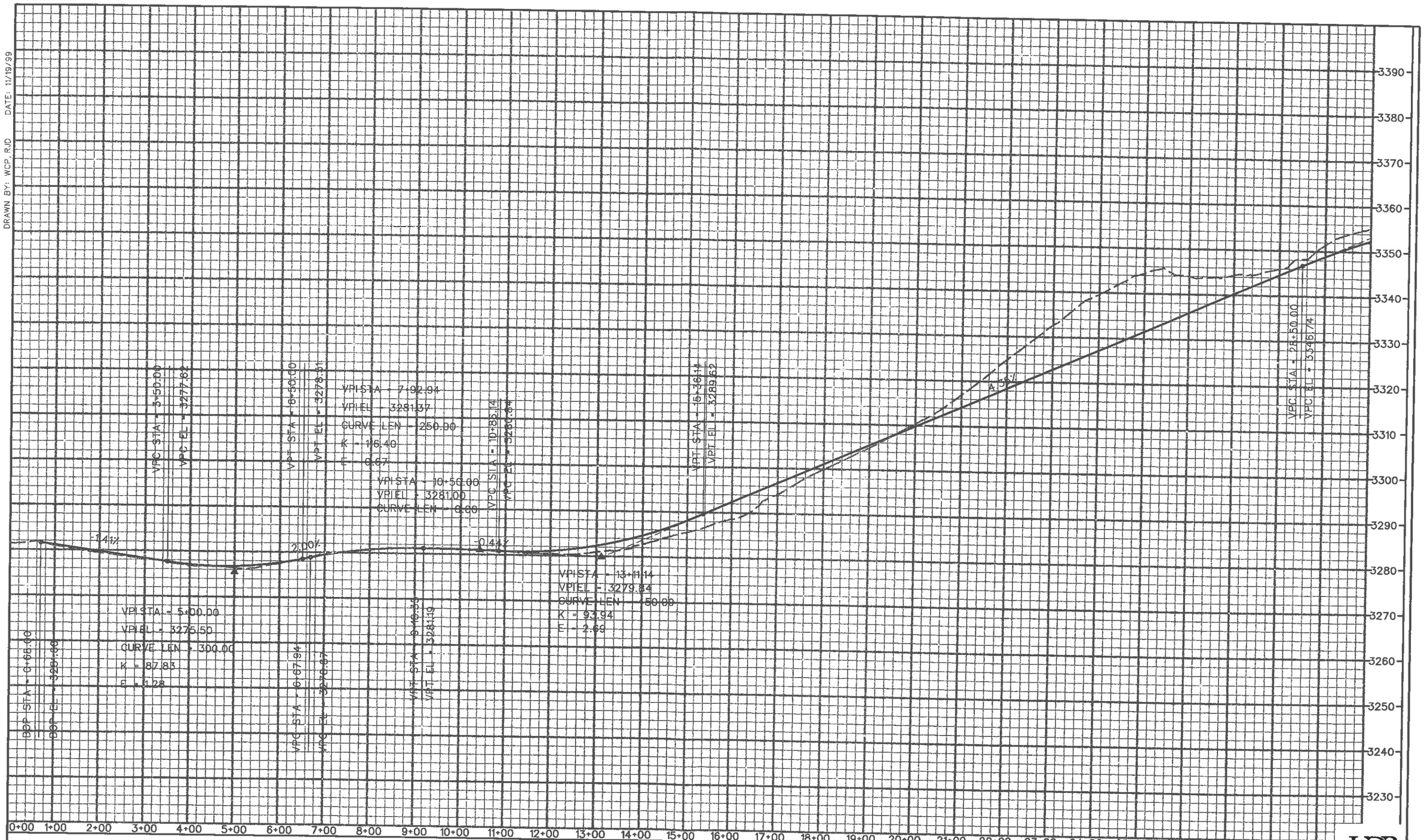
ALTERNATE C PLAN

98-660/66ALGNC.DGN

HDR ALLIANCE

FIGURE NO. 45
PAGE NO. D-21

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE C PROFILE STA 0+00-30+00

98-660/660PAC1.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 46
PAGE NO. D-22

DRAWN BY: WCP, RJD DATE: 11/19/99

VPI STA = 35+00.00
VPI EL = 3375.00
CURVE LEN = 1300.00
K = 139.08
F = 15.19

-2.35%

VPT STA = 41+50.00
VPT EL = 3342.50

-5.00%

VPC STA = 46+50.00
VPC EL = 3317.50

VPT STA = 51+50.00
VPT EL = 3300.29

VPI STA = 49+00.00
VPI EL = 3305.00
CURVE LEN = 500.00
K = 80.56
F = 1.95

-1.39%

3390 3380 3370 3360 3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230

31+00 32+00 33+00 34+00 35+00 36+00 37+00 38+00 39+00 40+00 41+00 42+00 43+00 44+00 45+00 46+00 47+00 48+00 49+00 50+00 51+00 52+00 53+00 54+00 55+00 56+00 57+00 58+00 59+00

EAST ANAMOSA STREET EXTENSION

HDR

ALLIANCE ARCHITECTS and ENGINEERS

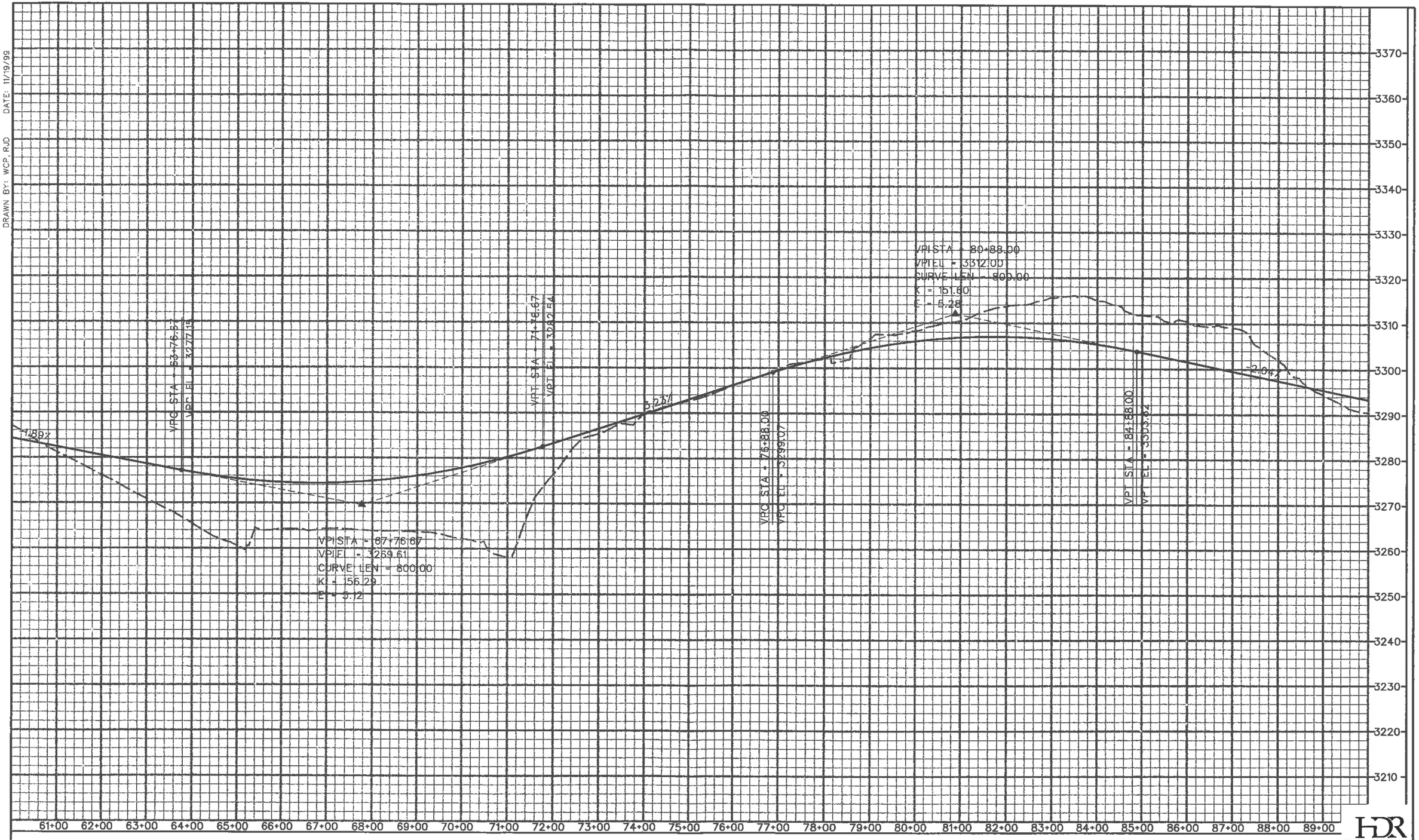
EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE C PROFILE STA 30+00-60+00

98-660/660PAC2.DGN

FIGURE NO. 47

DRAWN BY: WCP, RJD DATE: 11/19/99



EAST ANAMOSA STREET EXTENSION

ALTERNATE C PROFILE STA 60+00-90+00

EAST ANAMOSA STREET EXTENSION STUDY

98-660/660PAC3.DGN

FIGURE NO. 48
PAGE NO. D-24

DRAWN BY: WCP, RJD DATE: 11/19/99

VPI STA = 91+93.19
VPI EL = 3289.48
CURVE LEN = 300.00
K = 176.08
E = 0.63
3.04%

VPC STA = 90+43.19
VPC EL = 3292.47

VPT STA = 93+45.19
VPT EL = 3283.81

VPC STA = 96+14.07
VPC EL = 3273.71

VPT STA = 98+61.14
VPT EL = 3267.29

1.48%

VPI STA = 97+37.61
VPI EL = 3269.11
CURVE LEN = 247.07
K = 110.00
E = 0.69

VPC STA = 100+38.22
VPC EL = 3264.65

3350 3340 3330 3320 3310 3300 3290 3280 3270 3260 3250 3240 3230 3220 3210 3200 3190

91+00 92+00 93+00 94+00 95+00 96+00 97+00 98+00 99+00 100+00 101+00

EAST ANAMOSA STREET EXTENSION

EAST ANAMOSA STREET EXTENSION STUDY

ALTERNATE C PROFILE STA 90+00-101+00

98-660/660PAC4.DGN

HDR

ALLIANCE ARCHITECTS and ENGINEERS

FIGURE NO. 49